CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

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4.1 INTRODUCTION

This Chapter is organized by potentially affected component of the human environment (Sections 4.2 through 4.10), in correspondence with Chapter 3. Within each section the respective direct and indirect environmental consequences of adoption of each of the alternatives described in Chapter 2 are analyzed and compared. A summary of the ten alternatives and the management measures contained in each is presented in Table 4.1-1. Several of the sections in this chapter use the analytical results of the model prepared by Kobayashi and Polovina (2000) (Appendix C).

Section 4.11 discusses the potential cumulative effects of implementation of the respective alternatives. The Council on Environmental Quality's (CEQ) regulations (40 CFR §§ 1500-1508) implementing the procedural provisions of the National Environmental Policy Act (NEPA) define cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." In the case of the pelagic fisheries of the western Pacific, variability of the natural environment itself may have profound effects on many of the resources discussed in this Environmental Impact Statement (EIS). Climatological and oceanographic cycles operating on the scale of decades and longer affect oceanic productivity and the carrying capacity of the environment for biological resources throughout the oceanic food web. Natural fluctuations of population sizes and productivity in some cases may be large enough to obscure the effects of human actions on biological resources. Consequently, the discussion of cumulative effects in Section 4.11 evaluates past, present and future human actions, in the context of natural environmental variability.

Table 4.1-1: 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 EIS 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 EIS 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

4.2 ESSENTIAL FISH HABITAT AND MARINE ENVIRONMENT

4.2.1 Oceanic Influences

Pelagic species are immersed in the oceanic physical and chemical environment. Suitable physical environment for these species depends on gradients in temperature, oxygen or salinity, all of which are influenced by oceanic conditions on various scales. In the pelagic environment, physical conditions such as isotherm (temperature) and isohaline (salinity) boundaries often determine whether or not the surrounding water mass is suitable for a given species, and many of the species are associated with specific isothermic regions. Additionally, areas of high trophic transfer as found in fronts and eddies, are important habitats for foraging, migration, and reproduction for many species. Thus, any factors or actions that change oceanic conditions over large scales will influence the habitat for these species. Perhaps the most important factor in distribution and productivity of these species, and for the ecosystem as a whole, is cyclical oceanic events which affect productivity over large areas. These events, which may occur on decadal or longer time scales (such as the *El Niño*-Southern Oscillation), can change the spatial pattern of isothermal boundaries, frontal systems, associated areas of enhanced productivity, and/or the movement patterns of pelagic species. These low frequency changes, termed regime shifts, can impact the entire ocean basin. Recent regime shifts in the North Pacific have occurred in 1976 and 1989, with both physical and biological (including fishery) impacts (Polovina, 1996; Polovina *et al.*, 1995).

4.2.2 Fishery Effects

The habitat of pelagic species is the open-ocean water column, and managed fisheries employ variants of mid-water seine nets and hook and line gear which have a low incidence of gear loss. As a result, there is little impact to essential fish habitat (EFH) from fisheries managed under the Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Region (Pelagics FMP). Although certain amounts of gear loss may be a hazard to some species due to entanglement, there is a negligible direct effect on pelagic habitat.

The day-to-day operation of a fishing vessel can produce a number of waste products, including oil, sewage, garbage, and lost gear which may have a negative effect on the marine environment. Impacts of these types directly related to fishery operations conducted under the Pelagics FMP are likely to be small. A much more adverse impact on the marine environment has been identified with remote fisheries outside the area covered by the Pelagics FMP. Most of the marine debris identified in areas near the main pelagic fishing grounds (e.g., the Northwestern Hawaiian islands) has been identified as trawl webbing, thought to be transported by ocean currents from distant fisheries around the rim of the North Pacific Ocean (Marine Mammal Commission, 2000).

The accidental grounding of fishing vessels can adversely affect marine habitat and coral reefs. The impact of a vessel striking the bottom can physically destroy marine substrate, and the possible subsequent break-up of the vessel can release fuel and oil which can result in

pollution of the marine environment and mortality of marine life. Groundings of vessels operating under the Pelagics FMP are rare. Two vessels operating under the Pelagics FMP have run aground in the past 15 years. One vessel ran aground in the Northwestern Hawaiian islands (NWHI), and one vessel ran aground in the main Hawaiian islands (MHI). In both cases there was some localized damage to the marine substrate, but no reported effects on the surrounding marine environment.

4.2.3 Effects of Alternatives

A large amount of information exists on the effects of environmental fluctuations on the productivity and distribution of pelagic species. At the present time, these environmental influences are thought to be the major factor affecting the essential habitat for pelagic species. No data currently exist which indicate that the pelagic fisheries managed under the Pelagics FMP have a discernable effect on the pelagic environment, or the essential habitat for pelagic species, that would be detectable against the background of cyclical large-scale oceanographic events which drive the pelagic ecosystem.

The alternatives in this EIS present options for mitigating mortalities of protected species, reducing incidental take of seabirds and sharks, and minimizing conflicts associated with catch interactions. They consist of various combinations of training, fishery operation modification, and time and area dosures. Although the alternatives represent some re-distribution and/or reduction of localized fishing effort, the affected vessels are likely to continue operating in pelagic fisheries in the Pacific Ocean. Because there would likely be no net loss of fishing activity for the basin as a whole, and the habitat for the managed pelagic species includes the entire Pacific Ocean Basin, the impact to the marine environment from any of the alternatives would be similar to that of the no-action alternative.

4.3 IMPACTS ON PELAGIC MANAGEMENT UNIT SPECIES (PMUS)

None of the management scenarios described in this EIS (singly or cumulatively) would have a deleterious impact on the status of any of the PMUS falling under the Western Pacific Regional Management Council (Council)'s jurisdiction (listed in Table 3.3-1, page 3-8 of this document). This is because:

1. The pelagic fisheries under the Council's jurisdiction exploit PMUS stocks that are pan-Pacific in distribution.

2. At current levels of exploitation, these pan-Pacific stocks are able to sustain the combined fishing effort of the various gears used by the entire United States and international fleets.

3. Hawai'i-based fisheries (longline, troll, handline) and other fisheries under the Council's jurisdiction account for a very small percentage of the total catch of PMUS

taken in the Pacific. Any changes in catch due to changes in fisheries regimes under the Council's jurisdiction will be obscured by natural variation and catches made by the much larger sectors of the Pacific fleet.

As described in Section 3.4, various assessments of the status of stocks of the various PMUS indicate that on a Pacific-wide basis, none of these stocks are overfished and, with the possible exception of bigeye tuna, these stocks are currently being exploited at sustainable levels. The condition of the blue marlin and bigeye tuna stocks need to be carefully monitored (SCTB, 2000). Although current fishing mortality of bigeye tuna may exceed maximum sustainable yield (MSY), the underlying stock is still well above that required for MSY (Boggs *et al.*, 2000). In no case would fishing effort by Hawai'i's relatively small fleet (even complete closure - Alternative 8) measurably affect the abundance of any PMUS stock (Boggs *et al.*, 2000; Boggs and Ito, 1993).

Although the precise values change from year to year, the Hawai'i based fishery accounts for a very small fraction of the overall harvest of pelagic species in the Pacific. In 1990, the Hawai'i-based fisheries accounted for less than eight percent of the Pacific-wide catch of pelagic species. For that period, estimates ranged from 14 percent for swordfish to 2.7 percent for the Pacific-wide blue marlin catch and 0.4 percent for yellowfin tuna (Skillman *et al.*, 1993). More recent analyses show similar results. For example, Council fisheries were estimated to take 1.5 percent of the 1994 Pacific bigeye catch, 3.7 percent of the 1997 blue marlin catch and 23 percent of the 1997 swordfish catch. However, even this 23 percent of the total Pacific catch represents only ten percent of the estimated MSY (Boggs *et al.*, 2000).

With the possible exception of swordfish, the small percentage of the total pelagic species harvest taken by Hawai'i-based fleets means that any putative changes in harvest levels that might accrue from the various alternative management schemes would probably not measurably impact PMUS stocks (Boggs *et al.*, 2000; Boggs and Ito, 1993). The Preferred Alternative (Alternative 10) would eliminate 23 percent of the swordfish catch taken by the Hawai'i fleet, although it is possible that some or all of this catch would be taken by foreign fleets. This interpretation is reinforced for all management alternatives and PMUS by the fact that no Council-imposed restrictions would apply to foreign pelagic fishing fleets which could increase their presence in areas vacated by the Hawai'i-based fleet and/or experience marginally increased catch-per-unit-effort (CPUE) in response to decreased harvests by the Hawai'i-based fleet. For all these PMUS, meaningful management can only be obtained through a Pacific-wide management structure. Unilateral reduction in catches by the Council fleet would be ineffectual and would run counter to the intent of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) (Boggs *et al.*, 2000).

Blue sharks have the most overlap of distribution with the areas exploited by the swordfish sector of the longline fleet and swordfish sets catch more sharks than tuna sets (Ito and Machado, 1999). Consequently, the catch rate of blue sharks is significantly reduced in the scenarios generated by Kobayashi and Polovina (2000) to assess the impacts of various longline fleet management alternatives. In the 'non-switching' analysis of Preferred

Alternative 10 blue shark harvest is reduced by 87 percent and in the 'switching' analysis it is reduced by 78 percent. Under Alternative 8 (permanent longline closure), a complete elimination of blue shark mortality (by the Hawai'i-based fishery) would occur. Based on the 1999 catch, this would be a reduction of around 80,000 animals. This catch was a moderate increase from the 1991 catch but a decrease from recent years. While sharks (particularly blue sharks) constitute the bulk of the Hawai'i-based longline fishery catch, the total shark catch within U.S. jurisdiction is small. Estimates of total Pacific shark catches for 1994 (Stevens, 1996) and catch data for all U.S. Pacific insular fisheries for 1998 (Ito and Machado, 1999) would indicate that U.S. catches account for less than two percent of the total shark catch within the Pacific. Thus, even total elimination of shark catch by the Hawai'i fleet may not have a measurable impact on the blue shark population. This interpretation is reinforced by the fact that current fishing mortality on blue sharks is well below the levels of MSY (P. Kleiber, pers. comm.). For similar reasons, reductions in blue shark harvest due to shark finning prohibitions (whether state or federal) are unlikely to produce changes in the status of the blue shark population that would be measurable with current techniques and sources of data.

Several studies have shown that for targeted species, the Hawai'i-based fisheries are dependent on the status of the broad, Pacific-wide condition of the PMUS stocks rather than on the status of the stock in the EEZ around Hawai'i or the immediately adjacent areas fished by the Hawai'i fleet. That is, the Hawai'i fleet depends on the overall status of the Pacific stocks and influx of recruits from outside the Hawai'i area (Wetherall and Yong, 1983; Skillman and Kramer, 1992; Boggs and Ito, 1993; He and Boggs, 1997). This has been most firmly demonstrated for yellowfin and bigeye tuna and for blue marlin. In those cases, the source of Hawai'i's fish is probably to the south and southwest of the Hawaiian archipelago. These and other studies also indicate that, under current levels and geographic distribution of effort, the Hawai'i fleet (handline, troll, longline) does not significantly impact the abundance of fish in the Hawai'i fishery. That is, local catches do not affect local abundance (Boggs, 1994; He and Boggs, 1996).

The role of the Hawai'i-based longline fleet in the nearshore abundance of Pacific blue marlin is frequently discussed. This is of particular concern to the sport fishing and trolling community. However, it is the status of the Pacific-wide stock (and probably oceanographic variability) that determines the availability of blue marlin in Hawaiian waters (Wetherall and Yong, 1983; Skillman and Kramer, 1992; Skillman *et al.*, 1993). Further, data from 1991-1998 indicated that blue marlin only represented two percent of the average catch composition (numbers of fish) of the Hawai'i-based longline fishery (WPRFMC, 1999). Thus, the putative changes in blue marlin catch that might occur under the various management alternatives (including Alternative 8) are unlikely to have a significant positive effect either on the overall status of the blue marlin stock or on the availability of blue marlin in nearshore waters.

The 'switching' analysis of Preferred Alternative 10 estimates a 32 percent increase in the number of striped marlin harvested by the longline fleet even though striped marlin longline

CPUE has been declining in recent years (WPRFMC,1999). Although the impact of the Hawai'i-based harvest is small compared to total pan-Pacific levels, management options that potentially increase the harvest of striped marlin should be accompanied by the recognition that close attention be paid to future trends in the catch of this species.

4.3.1 Local Catch and Gear Competition

There is some evidence that, at very local scales, there is the possibility that competition may arise within and between gear types targeting PMUS. In practical terms, these restricted areas would be nearshore locations or 'hot spots' such as seamounts. That is, increasing fishing effort applied in the immediate vicinity of the Hawaiian (or other) islands will compete on a local scale for a finite (but variable) number of animals recruiting into the area. This could result in local depletion and reduced CPUE on a local level (Skillman *et al.*, 1993; He and Boggs, 1996; Hampton *et al.*,1996). One scenario in which this might happen is if there was a major realignment of longline fishing effort into areas close to the main Hawaiian islands. However, there already exist rules which exclude longliners from nearshore Hawaiian waters (longlining is prohibited from February to September within 50 nm on the north side of the main islands and from October to January, within 25 nm. To the south, the closed area around the main islands is 75 nm year round. There are also closures around the Northwestern Hawaiian Islands that were established to reduce interactions with the endangered monk seal. These closures prohibit longline fishing within 50 nm of the center of the NWHI). Although it is possible that some of the proposed area closures might increase fishing effort within the EEZ around Hawai'i (where marlin catch is higher than in the more northern sectors of the swordfish grounds), there is no indication in any of the proposed alternatives that longline effort would be significantly reshaped in a way that would increase local competition or interaction with nearshore handline or trolling gears.

However, under scenarios where time/area closures would completely prohibit any longline fishing in any area under the Council's jurisdiction (Alternatives 3, 6, 7 and 8), there could be a redistribution of fishing effort in order to fill the demand for tuna created by the absence of longline fishing. Although it is not possible to completely predict the responses of fishers to imposed regulations, this redistribution of effort may result in increased handline fishing, trolling and possibly pole-and-line fishing. The latter, however, might not be feasible due to the waning number of baitboats available in Hawai'i.

Under these Alternatives (3, 6, 7 and 8), there could be a significant increase in fishing effort applied around publicly funded nearshore FADs, offshore NOAA weather buoys and seamounts. This would result in a concomitant increase in the harvest of sub-adult bigeye and yellowfin tuna and raises the possibility of catch competition and gear conflicts occurring at those locations. There would also probably be more wear and tear on the buoys and FADs.

One probable site of increased handline activity would be the Cross seamount which is located approximately 150 nm south of Honolulu. For the past decade, this seamount has

supported a very active handline and jig fishery which produces between 227 mt (WPRFMC, 1999) and 500 mt of sub-adult bigeye and yellowfin tuna per year (Itano and Holland, 2000). There have already been cases of gear competition and conflicts between fishers at the Cross seamount and concerns have been raised about the viability of the tuna aggregations associated with this feature (Holland *et al.*, 1999).

Although originally described as a yellowfin fishery, the catch is actually about 2:1 bigeye tuna (Holland *et al.*, 1999). Tag-and-release experiments have demonstrated that individuals of both species (bigeye and yellowfin tuna) spend only a few weeks associated with the seamount. This quite rapid 'through-put' reduces the risk of localized overfishing at current levels of effort (Holland *et al.*, 1999). However, a significant increase in fishing effort targeted at this seamount could change this situation. Although the exchange of fish from the seamount to inshore fishery areas appears to be small fraction of the biomass associated with the seamount (Sibert *et al.*, 2000), tuna do move from the Cross seamount into nearshore fisheries (Itano and Holland, 2000). Consequently, the larger the seamount population, the greater the contribution to nearshore handline and troll fisheries. The importance of the seamount aggregations to the Hawai'i-based longline fleet is still under investigation.

Although the harvest of sub-adult bigeye from the Cross seamount may be small in comparison with the amount taken from drifting FADs in the eastern Pacific, it was concern over the heavy exploitation of sub-adult bigeye that prompted the IATTC to place seasonal prohibitions on log sets in the eastern Pacific (IATTC, 1999). Time closures of the type included in Alternatives 3, 6, 7 and 8 might significantly increase the number of sub-adult tuna taken from Hawaiian waters. While the limited duration closures of Alternatives 3, 6 and 7 may only increase gear competition during the closures, the permanent longline closure of Alternative 8 could cause ongoing gear competition and local depletion although there would be no discernable impact on the underlying Pacific-wide stocks.

4.3.2 Handline and Troll Fisheries

Just as the total PMUS catch of the entire fleet fishing under the Pelagics FMP represents a very small fraction of the overall Pacific harvest, so the handline and troll fleets represent a small fraction of the catch under this FMP (WPRFMC, 1999). There exists the possibility of an increase in handline fishing, 'vertical longlining' and trolling for tuna if management measures are imposed that restrict longline fishing for tuna. This increase in effort would result in an increased harvest of sub-adult yellowfin and bigeye tuna and may possibly cause the gear competition and local depletions described above. Other than these possible local impacts, there are no management alternatives for the handline and troll fisheries under the Council's jurisdiction that would have a significant impact on the status of any PMUS stocks.

4.3.3 Summary of Impacts of Alternatives on PMUS Stocks

Given the various circumstances described above (status of the stocks, low catch percentage of the Hawai'i-based fleet, uncertainties regarding response of foreign and domestic fleets, etc.) the impact of the various alternatives can be summarized as follows:

Alternative 1: No measurable impact on stock status of PMUS or local availability.

Alternative 2: No measurable impact on stock status of PMUS or local availability.

Alternative 3: No measurable impact on stock status of PMUS. Possible local gear and catch competition between trollers and handline fishers at buoys, FADs and seamounts during periods of longline closure.

Alternative 4: No measurable impact on stock status of PMUS or local availability.

Alternative 5: No measurable impact on stock status of PMUS or local availability.

Alternative 6: No measurable impact on stock status of PMUS. Possible local gear and catch competition between trollers and handline fishers at buoys, FADs and seamounts during periods of longline closure.

Alternative 7: No measurable impact on stock status of PMUS. Possible local gear and catch competition between trollers and handline fishers at buoys, FADs and seamounts during periods of longline closure.

Alternative 8: No measurable impact on stock status of PMUS. Year-round closure of longline fishing could cause catch and gear competition between trollers and handline fishers at buoys, FADs and seamounts with possible significant annual increase in capture of sub-adult yellowfin and bigeye tuna. Possibility of some localized depletion of tuna species.

Alternative 9: No measurable impact on stock status of PMUS or local availability.

Alternative 10: ***(Preferred)***
No switching/No reallocation. No negative impact on any PMUS stock. Possible increase in size of swordfish and blue shark populations although these changes may not be of sufficient magnitude to be measurable with existing sources of data and analysis techniques.

Switching/Complete Reallocation. No measurable impact on any PMUS stock. Possible increase in swordfish and blue shark

populations but these changes may not be of sufficient magnitude to be measurable with existing techniques and sources of data. Striped marlin CPUE should be monitored for possible continued or accelerated negative trends.

4.4 OTHER SPECIES, INCLUDING NON-TARGET, ASSOCIATED, OR DEPENDENT PELAGIC SPECIES (NADS)

Several non-target and associated species are caught in the pelagic fisheries of the region. In the Hawai'i-based longline fishery, the highest discards are of sharks (blue, mako, thresher) and oilfish. In the U.S. purse seine fishery in the region, non-PMUS discards include triggerfish, mackerel, sharks, rainbow runner, and barracuda (Section 3.5).

Current reporting methods for bycatch include information collected from National Marine Fisheries Service (NMFS) observer programs and various catch reporting systems that are compiled by the Western Pacific Fishery Information Network (WPacFIN). These data are sufficient to provide estimates of the amount and type of bycatch in fisheries managed under the FMP. The prevalent gear types used by these fisheries tend to be fairly selective, and without gear modification it would be difficult to reduce bycatch mortality. The impact on the NADS is relatively slight. Non-PMUS that are caught by the longline fleet represent about six percent of the total number of fish caught, and for the U.S.-based purse seine fishery amount to less than 0.5 percent of the total volume of the catch (Section 3.5).

Currently there are insufficient data for most of these species to provide estimates of stock-recruitment relationships or biological reference points, but none of these species are believed to be seriously depleted as a result of fishing practices managed under the Pelagics FMP. Most of these species have high fecundity rates and extensive spawning seasons and areas. The most important factors which determine their abundance and productivity are thought to be environmental fluctuations, and cyclic changes in productivity occurring in response to ecosystem dynamics.

A growing body of information exists on the effects of environmental fluctuations on the productivity and distribution of pelagic species. At the present time, these environmental influences are thought to be the major factor affecting the productivity and abundance of pelagic species. No data currently exist which indicate that the pelagic fisheries managed under the Pelagics FMP have a discernable impact on the NADS. It is highly unlikely that any fishery-induced changes in abundance of these species would be detectable against the background of cyclical large-scale oceanographic events which drive the pelagic ecosystem.

The alternatives presented in this EIS provide a range of options for mitigating mortalities of protected species, and are comprised of various combinations of training, gear modification, and time and area closures. The alternatives that include actions that reduce the take of sharks (Alternatives 2, 4-7 and 10), or displace domestic longline fishing in

Hawai'i (Alternatives 3, 4, 6 and 10) or throughout the Western Pacific Region (Alternative 8) would have a minimal effect on the total NADS populations. None of these species are thought to be depleted by fisheries operating under the Pelagics FMP. Additionally, the impact on NADS from domestic pelagic fisheries is slight in comparison to the diverse array of international fisheries. For example, in 1998 the Hawai'i-based longline fleet caught approximately three percent of the total weight of blue sharks landed by all high-seas fishing in the Pacific. Although several of the alternatives would results in some redistribution and/or reduction of localized fishing effort, the affected vessels are likely to continue operating in pelagic fisheries in the Pacific Ocean. Because there would be no net loss of fishing activity for the basin as a whole, and the habitat for the non-target and associated pelagic species includes the entire Pacific Ocean basin, the impact to non-PMUS from any of the alternatives would be similar to that of the no-action alternative.

4.5 SEA TURTLES

4.5.1 Background

To evaluate the effects of various management alternatives on sea turtle populations requires an accurate appraisal of population size and structure as well as rigorous data on the interaction levels between the fishery and the turtles. It has to be acknowledged that much of this information is unavailable, so that the analysis must represent a qualitative appraisal based on the available scientific evidence. As noted earlier, there is a reasonably accurate appraisal of sea turtle population status in the Pacific based on the number of nesting female turtles (for discussion of sea turtle populations see Section 3.6), but it is lacking in basic life history information on population structure, including sex ratios, juvenile to adult ratios and structure, life-stage based survival rates, and in some cases age at first reproduction. These variables are critical in the development of quantitative population models without which the ability to assess the impact of removing turtles from a population is severely hampered. Further rudimentary information is missing on turtle distributions, habitat preferences and migrations. Based, however, on a number of assessments (e.g., Endangered Species Recovery Plans, 5-Year Status Reviews, recent publications and reports noted elsewhere) it can be concluded that most sea turtle populations in the Pacific are declining and are in danger of extinction; that sea turtles are caught and in some cases killed incidental to pelagic and coastal fishing operations (including longline fishing); and that pelagic longline fishing represents a threat to the recovery of sea turtle populations in the Pacific. For this document, however, the purpose is to evaluate how various NMFS-proposed management actions affecting U.S. domestic fisheries operating in the western Pacific will impact sea turtle populations. In particular it is a purpose of this document to describe how those actions might reduce sea turtle take levels by these western Pacific fisheries.

The basis used herein for assessing how the various alternatives will impact sea turtle interaction and mortality rates is an analysis by Kobayashi and Polovina (2000). In this analysis they utilize a general additive model (GAM) to estimate sea turtle take per longline set based

on data from a NMFS-sponsored observer program on the Hawai'i-based longline vessels between 1994-1998. The use of this model was reviewed by Crowder (1999), Hampton (1999) and Sissenwine (1999) at the request of Judge Ezra. All agreed that the model is technically accurate and a valuable tool, however they also acknowledge that data used in the model are far too limited. Crowder summarizes the limitations most succinctly when he notes that the "spatio-temporal distribution model for leatherbacks [is] based on only 37 sightings over 5 years!" It is generally acknowledged that at least for leatherback turtles, this sample size is too small for the model to be a quantitatively accurate predictor of sea turtle takes. When it is considered that the leatherback take estimates and subsequent determination of the effects of the alternative fishing management scenarios are based on this unsatisfactory data set, the accuracy of the model's output must be viewed critically. Sea turtle take levels could be much higher or much lower, and the model would be unable to anticipate the inaccuracy. According to Crowder (1999) a review of the model's confidence intervals, suggests that a 50 percent target reduction in leatherback takes, could actually be as low as 18 percent or as high as 75 percent. While this error estimate is described in Kobayashi and Polovina (2000) only for leatherbacks, similar error is applicable for other species (J. Polovina, pers. comm., November 2000). Given the uncertainty inherent in this analysis, a conservative approach is to describe the Kobayashi and Polovina results plus or minus an estimated error based on the 95 percent confidence interval as described in their paper for leatherback take rates. This allows us to illustrate the imprecision inherent in the model but still use its results to compare various alternatives. The model is the best tool available and is based on the best available science so must be utilized, but we need to be sensitive to its limitations.

When trying to balance the need to reduce sea turtle take against the need to reduce the take of other non-target species, and against the needs of fishing industries, it is important to determine how many turtles the population can afford to lose, before the take jeopardizes the stability (or in the case of ESA listed species, the recovery) of the population. Such an analysis is the responsibility of a Section 7 consultation Biological Opinion (BO). Recently completed, the Biological Opinion for Authorization of Pelagic Fisheries under the Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Region (Pelagics BO) determined that the current longline fishery based in Hawai'i jeopardizes the survival of leatherback, loggerhead and green turtle populations, and does not jeopardize olive ridley populations. A BO for the California/Oregon Drift Gillnet Fishery (CA/OR BO) was also completed recently. This Opinion addressed the impact of the gillnet fishery on the same stocks of Pacific sea turtles, and NMFS determined that the anticipated take of 13 leatherbacks annually with an estimated mortality of eight cannot be sustained by the population, and therefore issued a jeopardy finding. The CA/OR BO proposes mitigation (RPAs) to reduce this take by approximately 78 percent, plus enhancement activities to increase hatchling production on the nesting beaches. A recent paper (Spotila *et al.*, 2000) calculates that the total allowed anthropogenic mortality from all sources for leatherbacks in the Pacific should be less than 17 adult females and 13 subadult females if population stability is to be maintained.

For loggerhead turtles the CA/OR BO determined that there was not enough information on the status of the species to determine whether an anticipated take of 66 loggerheads with a mortality of 22 over three years will be sustainable. The CA/OR BO took a conservative approach to this uncertainty and recommended time/area closures as a method to limit loggerhead take. Because the CA/OR BO did not anticipate the take of the western Pacific stocks of green turtles, nor hawkbills and olive ridleys, there is no estimate of allowable take for these species in the CA/OR Biological Opinion.

4.5.2 Evaluation of the Alternatives Proposed by NMFS

4.5.2.1 Alternative 1: Existing FMP (No Action)

Take levels associated with this alternative will remain as they were prior to the current injunction (Table XI). Because hawksbills have little or no known interaction with this fishery, neither this nor any other alternative will have any effect on those two species.

Table 4.5-1: Turtle Takes and Mortalities Under Alternative 1. Source: Appendix M.

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	418	87	0
Leatherback	112	9	0
Olive Ridley	146	49	0
Green	40	5	0

4.5.2.2 Alternative 2: Pending Council Actions

Alternative 2 represents a return to the FMP mandated management regime, with the inclusion of mandatory training of fishing crews on sea turtle handling and a few other adjustments. It is unlikely that take rates will change significantly for any species under this alternative. There may be some incremental improvement in post-release mortality due to improved handling by fisherman after the training course, but this is speciulative at present. Loggerheads and olive ridleys should benefit because these species have far higher rates of internal hooking (harsh handling of hooked turtles by pulling the turtle out of the water by the line has been speculated to cause increased mortality). However, there are no good data on the effect of handling and post-release mortality to quantify this improvement. Also part of this alternative is the addition of a prohibited zone for large vessels fishing in the waters of American Samoa. This particular change may have some benefit to turtles by keeping the number of hooks in American Samoan waters low. However, if the larger Hawai'i-based longline vessels move (from Hawai'i) to fish outside proposed the restricted zone (50 nm) surrounding American Samoa there may be increased sea turtle take within the 200 mile EEZ. Unfortunately, it is not possible to evaluate this with current information. While there

are no data available on the rate of incidental capture of sea turtles in these waters, Swains Atoll is an important nesting colony of the green turtle (NMFS and FWS, 1998b), and the only 42 cm juvenile leatherback ever encountered was killed by an experimental longline fishing vessel in these waters (Grant, 1994). Further, American Samoa supports nesting and foraging by hawksbill sea turtles, and increased longline fishing efforts may impact this highly endangered species.

Table 4.5-2 presents the modeled results of turtle takes and kills for Alternative 2. Because it is unknown how effective the training sessions will be, it is not possible to estimate quantitatively the reduction in mortalities that might result. The results for Alternative 2 are therefore identical to those for Alternative 1.

Table 4.5-2: Turtle Takes and Mortalities Under Alternative 2. Source: Appendix M.

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	418	87	0
Leatherback	112	9	0
Olive Ridley	146	49	0
Green	40	5	0

4.5.2.3 Alternative 3: Court-Ordered Action (Current Status Quo)

Under this alternative, as defined by the Court, a portion of the central Pacific is divided into three areas (A, B, and C) (see Figure 1-2). Area A is closed all year to fishing, Area B is limited to a total of 154 sets during the period August 10 - December 31, 2000; 77 sets from January 1 - March 14, 2001; all vessels in Area B must carry fishery observers; the area is closed from March 15, 2001, or until the EIS is complete. Finally, in Area C, swordfish may not be targeted, lightsticks may not be onboard the vessels, depth of the mainline between floats must exceed 100 m at its deepest point; 30 percent of proceeds from the sale of swordfish must be donated to charity; ten percent of the vessels must have observers by September 21, 2000, 20 percent of the vessels must have observers by November 7, 2000, and the area will be closed from March 15 to May 31, 2001, or until the EIS is complete.

The Kobayashi and Polovina model results for Alternative 3 are summarized in Table 4.5-3. Results are shown for both switching (redirection of swordfish effort into tuna fishing) and non-switching (elimination of the swordfish fishing segment of the Hawai'i-based longline fleet). Assuming that the actual result will be somewhere between total switching and no switching, mean values of these two extreme scenarios are also presented. In a relative sense, this alternative, as is the case for most of the alternatives modeled, is most effective at reducing loggerhead interactions. It is also quite effective at reducing leatherback interactions. It is less effective for green turtles, and least effect for olive ridley turtles.

Table 4.5-3: Turtle Takes and Mortalities Under Alternative 3. Source: Appendix M.

(a) with switching

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	94	97	-77.5
Leatherback	47	4	-58.2
Olive Ridley	143	48	-2.3
Green	27	3	-32.3

(b) without switching

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	86	18	-79.5
Leatherback	34	3	-69.3
Olive Ridley	98	33	-32.7
Green	20	3	-51.1

(c) Mean (recalculated from raw data)

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	90	19	-78.5
Leatherback	41	3	-63.7
Olive Ridley	121	40	-17.5
Green	23	3	-41.7

4.5.2.4 Alternative 4: Seasonal Area Longline Fishery Closures

Under Alternative 4, fishing areas north of 29° N. would be closed from July-January. According to Kobayashi and Polovina, there would be a 19 percent reduction in the take of leatherbacks, a 48 percent reduction in loggerhead take and a seven percent reduction in the take of greens. The olive ridley take level would increase six percent.

Table 4.5-4: Turtle Takes and Mortalities Under Alternative 4. Source: Appendix M.

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	218	45	-47.9
Leatherback	91	8	-19.1
Olive Ridley	156	52	6.5
Green	38	5	-6.1

4.5.2.5 Alternative 5: Increase Fishing Gear Deployment Depth

This alternative intends to reduce sea turtle takes by setting lines more deeply and/or setting the lines to depth more quickly. Data to support this particular strategy are that take rates for sea turtles (primarily leatherbacks) are higher in sets targeting swordfish, which fish at shallow depths, at night with lightsticks, than those fishing for tuna, which are set deep, in daylight and without lightsticks. By requiring the depth of the branch line between floats to be in excess of 100 m or the vessel to deploy the line using a line-shooter it is hoped that the line will be set deeper than turtles typically venture, and in a manner that submerges it below typical sea turtle dive depths quickly enough to avoid sea turtle interactions. Due to a general lack of data on how deeply sea turtles dive within this area, quantifying the effectiveness of this alternative is difficult. The Kobayashi - Polovina model (Table 4.5-5) anticipates a 61 percent reduction in leatherback take; a 100 percent reduction in loggerhead take; a 51 percent reduction in olive ridley take and a 56 percent reduction in green turtle take for the mean of the switching and non-switching scenarios..

Table 4.5-5: Turtle Takes and Mortalities Under Alternative 5. Source: Appendix M.

(a) with switching

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	0	0	-100.0
Leatherback	56	5	-50.4
Olive Ridley	90	30	-38.7
Green	23	3	-42.8

(b) without switching

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	0	0	-100.0
Leatherback	31	3	-72.0
Olive Ridley	53	18	-63.6
Green	13	2	-68.4

(c) Mean (recalculated from raw data)

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	0	0	-100.0
Leatherback	43	4	-61.2
Olive Ridley	72	24	-51.1
Green	18	2	-55.6

4.5.2.6 Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas

Alternative 6 would prohibit longline fishing north of 29° N. at all times, and would establish a closed season from April-May in all waters. It is estimated (by the Kobayashi-Polovina model) that this alternative would result in a 78 percent reduction in leatherback take, a 63 percent take reduction in loggerheads; 20 percent reduction in olive ridley take and a 36 percent reduction in green turtle take (Table 4.5-6).

Table 4.5-6: Turtle Takes and Mortalities Under Alternative 6. Source: Appendix M.

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	154	32	-63.0
Leatherback	25	2	-77.2
Olive Ridley	118	39	-19.5
Green	25	3	-36.3

4.5.2.7 Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas

In this alternative a combination of time and area closure and gear modification would be required. All fishing would be closed in April and May, while depth restrictions identical to those of Alternative 5 would be required. For the mean of the switching and non-switching scenarios, turtle take reductions would be 78 percent for leatherbacks, 100 percent for loggerheads, 55 percent for olive ridleys, and 83 percent for green turtles.

Table 4.5-7: Turtle Takes and Mortalities Under Alternative 7. Source: Appendix M.

(a) with switching

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	0	0	-100.0
Leatherback	27	2	-76.3
Olive Ridley	85	28	-42.2
Green	6	1	-85.4

(b) without switching

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	0	0	-100.0
Leatherback	23	2	-79.6
Olive Ridley	47	16	-67.9
Green	8	1	-79.6

(c) Mean (recalculated from raw data)

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	0	0	-100.0
Leatherback	25	2	-77.9
Olive Ridley	66	22	-55.1
Green	7	1	-82.5

4.5.2.8 Alternative 8: Regional Longline Closure

This alternative would eliminate sea turtle mortality by Hawai'i-based longline vessels (Table 4.5-8), though it may have little net gain in reducing Pacific-wide sea turtle mortality. It is likely that displaced vessels would either leave Hawai'i and operate out of other ports, or resort to unloading at international ports. In addition, import substitution could lead to higher turtle takes in foreign fisheries.

Table 4.5-8: Turtle Takes and Mortalities Under Alternative 8. Source: Appendix M.

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	0	0	-100.0
Leatherback	0	0	-100.0
Olive Ridley	0	0	-100.0
Green	0	0	-100.0

4.5.2.9 Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries

This alternative suggests two action paths: (a) to analyze limited effort alternatives for American Samoa's longline fishery; and (b) to prepare and implement a comprehensive research plan to evaluate the potential for interactions between Pelagics FMP-managed fisheries that could affect the catch rates in these fisheries. The act of (a) analyzing fishery dynamics and regulation or (b) developing a research plan to evaluate the dynamics of fishing effort between species is difficult to evaluate in terms of sea turtle take reduction. While such actions can reveal information on sea turtle interaction with American Samoan longline fisheries, reducing sea turtle takes will depend entirely on how the results of the analysis are addressed in management policy.

4.5.2.10 Alternative 10: *(Preferred)* Increase Gear Deployment Depth, Seasonal Area Closure

Alternative 10 seeks to reduce the incidental take of sea turtles through a combination of gear / fishing method prohibitions and time / area closures. This alternative will result in a very high reduction in sea turtle take within the Hawai'i-based longline fishery for all species. There are two possible scenarios in which take data are evaluated for this fishery. One in which the swordfish fishery switches to tuna style fishing and one in which it does not. These estimates are summarized in Table 4.5-9. Mean values for the two modeled scenarios show reductions of loggerheads of 100 percent, leatherbacks of 84 percent, olive ridleys of 61 percent, and greens of 88 percent.

This alternative performs as well as or better than any other alternative (except Alternative 8) in reducing interactions with all four species.

Table 4.5-9: Turtle Takes and Mortalities Under Preferred Alternative 10. Source: Appendix M.

(a) with switching

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	0	0	-100.0
Leatherback	20	2	-81.8
Olive Ridley	70	23	-52.2
Green	6	1	-85.0

(b) without switching

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	0	0	-100.0
Leatherback	16	1	-85.5
Olive Ridley	45	15	-69.1
Green	4	0	-91.1

(c) Mean (recalculated from raw data)

Species	Take	Mortality	Percent Change from Alternative 1
Loggerhead	0	0	-100.0
Leatherback	18	2	-83.6
Olive Ridley	58	19	-60.6
Green	5	1	-88.0

4.5.2.11 Option A: Fishing Experiment

Option A, which is described in detail in Chapter 2 - provides the commercial fishing fleet and management agencies with an opportunity to experiment with sea turtle reduction methods. In order to implement the research fishery, a permit must be applied for under Section 10 of the ESA, which may require some modification to the design detailed in this EIS. Sea turtle takes under a fishing experiment, however, should lead to fewer mortalities than in a regular commercial fishing operation due to the greater than average expertise of the turtle handling. In itself, Option A will not reduce sea turtle take and in fact it may increase take because it may reduce the effectiveness of the alternatives it is assigned to (i.e., it lifts some of the fishing restrictions assigned under each alternative). The objective is to continue swordfish fishing under experimental conditions such that data on the use of alternate gear and deployment adjustments may provide insight into turtle saving techniques.

The value in Option A is that it allows experimentation in turtle take reduction methods under fishery conditions, and it is potentially more cost-effective as the experiment is conducted ancillary to ongoing commercial operations. Further it has the potential benefit of developing take reduction methods that can benefit turtles both domestically and internationally (if those methods can be exported to other longline fishing fleets).

However, it must also be acknowledged that the development of sea turtle take reduction methods and their subsequent promotion internationally need not necessarily be conducted as part of Option A, which is limited only to the Hawai'i-based longline fishery. An experiment by the Hawai'i-based fleet is hampered by the low number of turtle interactions and the low density of turtles in this fishing area. It may take a number of years to validate experimental take reduction methods if tested by this fishery alone. However the need to develop turtle take reduction methods for all fleets is very great. By all accounts the killing of sea turtles in the Hawai'i-based longline fishery is minor when compared to the global mortality sustained by these species in international longline fisheries.

4.6 SEABIRDS

4.6.1 Background

Evaluation and analysis of the predicted consequences and impacts of the various alternatives on populations of seabirds is confounded by three fundamental data deficiencies. The first is the absence of any data on the level of bycatch of seabirds by foreign fleets fishing in the North Pacific outside the U.S. EEZ. The relative significance of the Hawai'i-based longline fishery seabird bycatch is impossible to determine without an estimate of its magnitude in relation to the total of foreign fleet bycatch. If the foreign fleet take is as high as some of the estimates suggested in other sections of this EIS, either the Hawai'i-based longline take or elimination of the Hawai'i-based longline fisheries could have population level effects that are so insignificant that they could not be measured. On the other hand, if foreign fleet bycatch is minor, the significance of the Hawai'i-based longline bycatch could be profound, especially for black-footed albatross and short-tailed albatross.

[It should be noted that this discussion of consequences and impacts on seabirds is limited to Hawai'i-based longline fisheries, as none of the other fishing methods or geographic fishing areas within U.S. EEZs considered in this EIS are believed or known to have other than minor or non-existent seabird impacts.]

The second data-related complicating factor is the nature of the seabird bycatch information collected by observers on Hawai'i-based longline vessels. The minimal temporal and spatial data collected by observers requires complex statistical analysis and modeling to provide estimates of actual take. The confidence intervals produced by the various analytical techniques are so wide that the estimates could, again, vary from insignificant to profound, particularly for black-footed albatross.

The third data deficiency is long-term, accurate breeding population estimates and demographic information for Laysan and black-footed albatross nesting in the NWHI. Of the three data deficiencies mentioned here, however, the NWHI albatross breeding data are likely the most complete and reliable, although they still leave much to be desired. These NWHI breeding albatross data, in some cases, show apparently dramatic declines in some albatross populations in the last several years. Still, the data can also be interpreted to suggest either slight long-term population increases or declines. There is no way to discern whether or not these apparent population changes are "normal" fluctuations or are declines demonstrably linked with Hawai'i-based (or foreign) longline fisheries.

Thus, these three data deficiencies are compounded when any necessary assumptions are made in order to model the total population or Hawai'i-based longline-level impacts of the various alternatives, and obfuscated to an even greater degree when extrapolating estimates of relative consequence and impact of the various alternatives.

Nevertheless, there are general observations that can be made about the Hawai'i-based longline fishery, and regarding the differences between the estimated impacts among the alternatives. Albatross are caught and killed incidental to longline fishing operations; therefore longline fishing poses a threat on some level to seabird populations in the Pacific.

The alternatives and basis for arriving at overall estimated consequences and impacts of the alternatives are discussed in detail elsewhere in this EIS. The point estimates generated from the Kobayashi-Polovina model for Laysan and black-footed albatross takes and kills are summarized in Appendix M. The following discussion is limited to the relative estimated impacts on seabirds among the alternatives.

4.6.2 Evaluation of the Alternatives Proposed by NMFS

Alternative 1: Existing FMP (No Action)

Seabird (albatross) bycatch levels associated with this alternative will remain the same. As discussed above, it is impossible to predict with a high degree of certainty the impact of this alternative on albatross populations as a whole. However, it should be kept in mind that current Hawai'i-based longline bycatch levels *could* be having a negative impact, especially on black-footed albatross.

Alternative 2: Existing FMP Plus Pending Council and NMFS Actions

Alternative 2 represents a return to the FMP mandated management regime, with the inclusion of mandatory training of Hawai'i-based vessel operators on seabird identification, population concerns, and avoidance measures, and would also require implementation of three seabird deterrents when fishing in prescribed areas. Seabird interactions with fishing gear would also be required to be recorded. This alternative is predicted to result in a significant reduction in albatross mortality.

Based on the requirements of this alternative and the statistical model, this alternative will likely reduce seabird bycatch within the EEZ around Hawai'i, by as much as an order of magnitude. Any reduction of albatross bycatch offers some benefit to the overall species' population, but given the overall quality of available data, the actual significance of this reduction is unpredictable.

Alternative 3: Court-ordered Action (Status Quo).

Under this alternative, as defined by the Court, a portion of the central Pacific is divided into three Areas (A, B, and C) (see Figure 1-2). Area A is closed all year to fishing, Area B is limited to a total of 154 sets during the period 10 August-31 December 2000; 77 sets from 1 January-14 March 2001; all vessels must carry fishery observers; the area is closed from 15 March, 2001, or until the EIS is complete. Finally, in Area C, lightsticks may not be onboard the vessels, depth of the mainline between floats must exceed 100 m at its deepest point; 10 percent of the vessels must have observers by 21 September 2000, and 20 percent of the vessels will have observers by 7 November 2000, and the area will be closed from 15 March to 31 May 2001, unless the EIS is complete. Certain seabird avoidance/deterrence measures could be selected or prescribed in some areas.

According to the model, Alternative 3 will result in significant reductions in interactions with black-footed and Laysan albatross (see Appendix M). Based on the requirements of this alternative and the statistical model, this alternative will reduce seabird bycatch within the EEZ around Hawai'i, perhaps dramatically. Requirements for on-board observers will increase data quantity and reliability.

Any reduction of albatross bycatch offers some benefit to the overall species' population, but given the overall quality of available data, the actual significance of this reduction is unpredictable.

Alternative 4: Seasonal Area Longline Fishery Closures

Under Alternative 4, fishing areas north of 29° N would be closed from July-January, and use of three seabird interaction deterrents would be required. According to NMFS, there would be a low reduction in the take of turtles, and a significant reduction in seabird take (Appendix M). If these figures are accurate, this bycatch reduction could have significant benefits to seabirds.

Alternative 5: Increase Fishing Gear Deployment Depth

This alternative intends to reduce sea turtle takes by setting lines more deeply and/or setting the lines to depth more quickly. Three seabird deterrent measures would be required when fishing north of 23 N. A consequence of this alternative would likely be a dramatic reduction in seabird bycatch. If the gear deployment prescription under this alternative was combined

with other seabird avoidance/deterrent practices, the reduction of seabird bycatch (compared with the no action alternative) could be significant.

Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas

Alternative 6 would prohibit longline fishing north of 29° N at all times, and would establish a closed season from April-May in all waters. This alternative, especially in combination with other seabird avoidance/deterrence practices, would likely reduce seabird bycatch, but the actual extent of the reduction and its consequences would be unknown. Any reduction of albatross bycatch offers *some* benefit to the overall species' population, but the actual significance of the estimated bycatch reduction of this alternative is unpredictable.

Alternative 7: Increase Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas

In this alternative a combination of time and area closure and gear use modification would be required. All fishing would be closed in April and May, while depth restrictions identical to Alternative 5 would also be required. It is estimated that this alternative, especially in combination with three other required seabird avoidance/deterrence practices, would significantly reduce seabird bycatch.

Alternative 8: Regional Longline Closure

This alternative would eliminate seabird mortality caused by Hawai'i-based longline vessels, if those vessels did not offload catches at non-U.S. ports, and thereby avoid the restriction. This alternative, based on all estimates and models, would result in the greatest reduction of seabird bycatch in the EEZ around Hawai'i. Although elimination of the longline fishery could have significant benefits for seabirds, it is unknown to what degree this alternative reduces mortality compared to methods prescribed in other alternatives, especially Alternatives 2-7. Given the inherent uncertainty resulting from the broad lack of reliable data as explained in the background introduction for this section, the same unpredictability of consequence and impact remains. Any reduction of albatross bycatch offers some benefit to the overall species' population, and on a relative basis, this alternative offers the greatest reduction.

Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries

The establishment of a large vessel closure area for American Samoa and evaluation of potential gear conflicts and catch interaction conflicts would have a potentially beneficial effect on sea birds by limiting fishing effort. This would reduce the risk of incidental take, depending on the management measures recommended. However, it is unlikely to have a significant impact on albatross mortality in the near future.

Alternative 10: ***(Preferred)*** **Increase Gear Deployment Depth, Seasonal Area Closure**

This alternative would require area closures (April - May , between 15°N and the equator, bounded by 145 °W and 180°), stringent observer requirements, and use of three seabird deterrent methods north of 23°N. This alternative would result in a significant reduction in black-footed and Laysan albatross bycatch, to essentially insignificant levels.

Option A: Fishing experiment

Option A allows for the collection of much-needed data on seabird/Hawai'i-based longline fishery interactions and the effectiveness of a variety of avoidance/deterrent methods. The value of this option depends on the details of how the fishery and research would be conducted. It also depends in the long run on the simultaneous collection of albatross data at breeding colonies in the NWHI. This alternative appears to offer a needed opportunity to study, manage, and reduce seabird bycatch if longline fishing in the EEZ around Hawai'i continues.

4.7 MARINE MAMMALS

4.7.1 Alternative 1: Existing FMP (No action)

During the baseline management regime (i.e., the regime that existed prior to December 27, 1999, the date on which emergency rules for the Hawai'i-based longline fishery were implemented) the Hawai'i-based longline fishery was the only pelagic fishery in the Western Pacific Region for which information on interactions with marine mammals and other protected species was routinely collected and compiled by NMFS.[1] Information on interactions between the longline fishery and marine mammals and other protected species was collected, and continues to be collected, through mandatory logbook and observer programs administered by NMFS. The NMFS Western Pacific Region Daily Longline Fishing Log requires longline vessels to record the number of protected species released alive, injured or dead. Suspected under-reporting of interactions with protected species (sea turtles in particular) was the major factor that led to the establishment of a NMFS observer program for the Hawai'i-based longline fishery in 1994 (Ito and Machado, 1999). From 1994 -1999, the observer coverage was 5.7, 4.3, 4.9, 3.6, 4.1 and 3.3 percent, respectively, for an annual average observer coverage of approximately 4.3 percent (NMFS, 2001a). The selection of trips to observe is based on a sampling design to monitor sea turtle interactions.

[1] U.S. purse seine vessels operating in the western and central Pacific are also required to report interactions with marine mammals under the reporting requirements of an international treaty. Observers deployed aboard these vessels also record marine mammal interactions. To date, however, NMFS has not compiled data on marine mammal interactions in the western and central Pacific purse seine fishery because of the infrequency with which these interactions occur.

Documented instances of interactions between the Hawai'i-based longline fishery and endangered cetaceans were infrequent under the baseline management regime. In 1991, one humpback whale was observed entangled in longline gear in the EEZ off the NWHI and released alive (Dollar, 1991). Because humpback whales prefer shallower waters and the 1991 interaction occurred inside the 50 nautical mile area now closed to longline fishing, NMFS considers the likelihood of another interaction low and does not expect the Hawai'i-based longline fishery to interact with humpback whales (NMFS, 2001a). In 1999, one sperm whale was reported hooked and entangled and released alive from a longline (NMFS, 2001a). At this time, there are insufficient data to suggest that a sperm whale interaction with longline gear is anything more than a one-time random, event (NMFS, 2001a). Without additional information to support the frequency of entanglements, NMFS does not anticipate that there will be another sperm whale interaction in the foreseeable future by the Hawai'i-based longline fishery (NMFS, 2001a).

During the baseline management regime there were no reported incidences of blue whales, fin whales or sei whales interacting with the Hawai'i-based longline fishery.

Evidence of interactions between Hawaiian monk seals and the Hawai'i-based longline fishery began to accumulate in 1990, and included three hooked seals and thirteen unusual wounds thought to have resulted from longline interactions. To eliminate interactions between monk seals and the longline fishery, NMFS and the WPRFMC created a Protected Species Zone in 1991 which extends 50 nautical miles around the NWHI and includes the designated corridors between islands (56 FR 52214, October 14, 1991). Longline fishing is prohibited in this area. Since the establishment of the Protected Species Zone there have been no observed interactions between the Hawai'i-based longline fishery and monk seals (Fourney *et al.*, 2000; Marine Mammal Commission, 2000). Troll and handline fisheries regulated under the Pelagics FMP fish in critical habitat areas of the Hawaiian monk seal (i.e., ocean waters out to 20 fathoms depth around ten areas of the NWHI), although they do not adversely affect physical features identified as critical habitat. In addition, these fisheries do not target or incidentally catch prey species of monk seals (NMFS, 2001a).

Documented interactions between non-endangered marine mammals and the Hawai'i-based longline fishery were also infrequent under the baseline management regime. From 1994 through 1999, six interactions with Risso's dolphins and two interactions with bottlenose dolphins were observed in the fishery (NMFS observer program, unpub. data). In 1997, one interaction with a spinner dolphin was observed in the fishery (NMFS observer program, unpub. data). Two false killer whales were taken by the Hawai'i-based longline fishery, one in 1997 and one in 1998 (NMFS observer program, unpub. data). In 1997, one short-finned pilot whale was taken by the longline fishery (NMFS observer program, unpub. data). From 1994 through 1999, five interactions with unidentified cetaceans were observed in the Hawai'i-based longline fishery (NMFS observer program, unpub. data). Observer descriptions and photographs suggest that at least two of these unidentified cetaceans may have been Blainsville's beaked whales or Cuvier's beaked whales (Fourney *et al.*, 2000).

False killer whales have been reported to occasionally strip bait from longline hooks (Nitta and Henderson, 1993). To avoid this type of interaction, many Hawai'i-based longline vessels that encounter false killer whales delay setting their lines until a sufficient distance has been achieved between the vessel and the whale school. In 1990, a solitary killer whale was reported to have removed hooked fish from the longline of a Hawai'i-based vessel (Dollar, 1991).

During the baseline management regime there were no reported interactions between the Hawai'i-based longline fishery and Pacific white-sided dolphins, rough-toothed dolphins, striped dolphins, melon-headed whales, Bryde's whales, pygmy killer whales, pygmy sperm whales or dwarf sperm whales. Although the northern elephant seal and northern fur seal are found within the Western Pacific Region and could potentially interact with the Hawai'i-based longline fishery, there have been no reported or observed incidental takes of these species in the longline fishery since the fishery was first observed by NMFS in 1994.

NMFS has calculated rates of interactions between marine mammals and the Hawai'i-based longline fishery based on extrapolations of observer data (Table 4.7-1). However, these estimates may be imprecise and biased because observer coverage was low and non-random across the longline fleet. Even taking into account the uncertainty, however, the bounds of the confidence intervals imply a very low interaction level.

Table 4.7-1: Estimated Annual Interaction Rate for Marine Mammals in the Hawai'i-based Longline Fishery Based on Extrapolated Observer Data. Confidence intervals are in parentheses. Source: Forney *et al.*, 2000.

Species	Annual Interaction Rate
Risso's Dolphin	18 (5.5 - 43)
Bottlenose Dolphin	4.6 (0.2 - 22)
Spinner Dolphin	4.6 (0.2 - 22)
False Killer Whale	9 (1.3 - 29)
Short-finned Pilot Whale	4.6 (0.2 - 22)
Blainville's Beaked Whale or Cuvier's Beaked Whale	9 (1.3 - 29)

At present, the Hawai'i-based longline fishery and other pelagic fisheries in the Western Pacific Region are classified as Category III fisheries under Section 118 of the Marine Mammal Protection Act. Category III fisheries are those that have been determined to have a remote likelihood or no known incidental takings of marine mammals. In early 2001, however, NMFS proposed to elevate the Hawai'i-based longline fishery to Category II because of the diversity of marine mammal species that have been documented to interact with the fishery, including false killer whales, Risso's dolphin, bottlenose dolphin, spinner dolphin and short-finned pilot whales (66 FR 6545-6565, January 22, 2001). Category II fisheries are those that cause occasional mortality or serious injury to marine mammals.

In conclusion, the frequency of observed interactions between marine mammals and the Hawai'i-based longline fishery was low under the baseline management regime. However, NMFS observer data may not provide an accurate estimate of the actual number of fishery interactions. Moreover, there is substantial uncertainty about the stock identification, abundance and distribution of cetaceans occurring in the Western Pacific Region. Given the lack of information on the number of interactions and condition of cetacean stocks, the effects of the baseline management regime on cetaceans cannot be determined with certainty at this time.

4.7.2 Alternative 2: Pending Council Actions

The mandatory protected species workshops organized by NMFS under this alternative could have a positive effect on marine mammals. To the extent that workshops educate longline permit holders and vessel operators on the importance of reducing the incidental mortality and serious injury of marine mammals in the longline fishery, there would be an expected reduction in the risk of hooking, entanglement in fishing gear or behavioral disturbance by longline fishing activities.

Implementation of the measure to reduce the incidental catch of seabirds in the Hawai'i-based longline fishery would likely result in the same interaction rate for marine mammals that occurred under the baseline management regime (Alternative 1). The use of line-setting machines and weighted branch lines, strategic discharge of offal and night setting were common practices in the Hawai'i-based longline fishery during the baseline management regime. As noted for Alternative 1, observed interactions between the Hawai'i-based longline fishery and marine mammals were infrequent under that management regime. The increased use of towed deterrents that could result if the measure to reduce the incidental catch of seabirds is implemented is unlikely to affect marine mammals, as marine mammals can easily detect and avoid these devices. The increase in the use of blue-dyed bait is also not expected to affect the marine mammal interaction rate in the Hawai'i-based longline fishery. It is likely that toothed whales and dolphins would continue to be attracted to bait after it has been dyed. Although these marine mammals are generally adept at removing bait from hooks without being snagged, some animals have been hooked in the fishery as noted in Alternative 1.

An action to prohibit shark finning would likely have no effect on most species of marine mammals. However, a ban on finning could result in an increase in the populations of tiger sharks, Galapagos sharks and other sharks that prey on the Hawaiian monk seal. Consequently, a finning ban could increase shark predation of monk seals, particularly monk seal pups.

4.7.3 Alternative 3: Court Ordered Action (Status Quo)

If the fishing vessels displaced by the emergency control measures are totally removed from longline fisheries, there would be a reduction in the risk of hooking, entanglement in fishing

gear or behavioral disturbance by longline fishing activities. However, it is probable that displaced vessels will shift to longline fisheries based in other areas. The most likely destination for displaced vessels would appear to be California, as in the past some Hawai'i-based longline vessels have found it desirable to fish out of California for part of each year. In fact, since December, 1999, 40 longline boats that originated in Hawai'i have unloaded their catch in California ports (NMFS, 2000c). As a result of this increased effort off California, interactions between marine mammals and the California longline fishery may increase. Because there is no NMFS observer program for the California longline fishery, and skippers in that fishery typically do not report every marine mammal they take, the nature and extent of interactions with marine mammals in the California longline fishery can not be reliably assessed (NMFS, 2000c). It is not possible, therefore, to determine the effects on marine mammals if Hawai'i-based longline vessels shift their fishing effort into the California fishery.

4.7.4 Alternative 4: Seasonal Area Longline Fishery Closures

Measures to reduce the incidental catch of sea turtles proposed under Alternative 4 would have the same uncertain effects on marine mammals as the measures proposed under Alternative 3. It is probable that vessels displaced from the Hawai'i-based longline fishery will shift to longline fisheries in other areas, the most likely destination being California. Currently, there is little information available on the effects of the California longline fishery on marine mammals.

The measures to reduce seabird interactions, restrict shark finning and mitigate potential interactions among American Samoa's pelagic fisheries proposed under this alternative are identical to the measures proposed under Alternative 2, and the impacts on marine mammals would be the same.

4.7.5 Alternative 5: Increase Fishing Gear Deployment Depth

The impacts of this alternative on marine mammals would be the same as the impacts described for Alternative 4.

4.7.6 Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas

The impacts of this alternative on marine mammals would be the same as the impacts described for Alternative 4.

4.7.7 Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas

The impacts of this alternative on marine mammals would be the same as the impacts described for Alternative 4.

4.7.8 Alternative 8: Regional Longline Closure

A prohibition on the landing of fish caught with longline gear would have a positive effect on marine mammals by reducing fishery interactions. Although a few displaced fishers may be able to relocate and participate in longline fisheries outside the Western Pacific Region, it is likely that most will be forced to either switch to other fisheries in Hawai'i or terminate their fishing ventures. The resulting overall reduction in longline fishing effort would decrease the risk of hooking, entanglement in fishing gear or behavioral disturbance by longline fishing activities. It may have little net gain in reducing Pacific-wide sea turtle mortality. It is likely that displaced vessels would either leave Hawai'i and operate out of other ports, or resort to unloading at international ports. In addition, import substitution could lead to higher turtle takes in foreign fisheries.

4.7.9 Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries

The establishment of a limited access system for the American Samoa longline fishery would have a positive effect on marine mammals by limiting fishing effort which, in turn, would reduce the low-level risk of accidental hooking, entanglement in fishing gear or behavioral disturbance by longline fishing activities.

Research to evaluate catch interactions between pelagic fisheries would in itself have no effect on marine mammals. The implementation of measures to mitigate those interactions could have an effect, but until those measures are identified, a discussion of impacts on marine mammals would be speculative.

4.7.10 Alternative 10: *(Preferred)* Increase Gear Deployment Depth, Seasonal Area Closure

The impacts of this alternative on marine mammals would be the same as the impacts described for Alternative 4.

4.7.11 Option A: Fishing Experiment

Given that many of the details of the experimental design have not yet been finalized, it is uncertain what effects, if any, this option would have on marine mammals. To the extent that the fishing effort of an fishing experiment in combination with the fishing effort under Alternatives 2-8 and 10 is lower than the fishing effort of the base case (Alternative 1), the

overall number of marine mammal interactions in the Hawai'i-based longline fishery would also be expected to be lower. In addition, a fishing experiment would provide data that can be used to more accurately estimate the level of marine mammal interactions in the Hawai'i-based longline fishery.

4.8 ECONOMIC IMPACTS OF THE ALTERNATIVES

4.8.1 Introduction

The economic portion of the alternatives analysis assesses potential economic impacts of management alternatives being considered for implementation in the western Pacific pelagic fisheries. The analysis combines information presented in Section 3.10 of this EIS with ongoing modeling efforts of scientists at NMFS SWFSC Honolulu Laboratory and with information from previously published environmental assessments on albatross and turtles, and studies of American Samoa. Together, the use of these studies and the application of a set of analytical constructs and conventions yield a comprehensive assessment of potential economic impacts. This section briefly describes the analysis and is followed by a section that describes methodology. That section describes the methods used, their limitations, and the reasons that these methods were chosen. A summary of the economic impacts of the alternatives follows, which lays out the most salient results of the analysis. This is followed by the analysis of each alternative, describing the economic impacts of each alternative in detail, comparing the results to the baseline case of Alternative 1. Alternative 10 is the preferred alternative.

In general, only the Hawai'i-based longline fleet is projected to experience significant direct effects from the alternatives. Other fleets may experience insignificant direct or indirect effects that are difficult to project. For this reason most of the analytical effort in this section focuses on the effects of the alternatives on these Hawai'i-based longline vessels. Alternative 8, however, has a substantial and measurable direct effect on the American Samoa longline fleet which is quantified in the analysis. Otherwise, the few direct effects on the Hawai'i-based pelagic troll, handline, and pole-and-line fisheries as well as the activities of vessels operating out of American Samoa, Guam, and the CNMI, are discussed, but these fleets are assumed to operate as they have in recent years. The existing conditions and recent activities of the Hawai'i-based pelagic troll, handline, and pole-and-line fisheries as well as the conditions and activities of the Hawai'i-based longline fleet, and vessels operating out of American Samoa, Guam, and the CNMI are discussed thoroughly in Section 3.10.

Economic impacts were estimated and quantified for Alternatives 1-8 and 10. Economic impacts of Option A[2] and Alternative 9,[3] both of which could be applied as an add-on to any of the other alternatives, are not quantifiable, and therefore the assessment of the effects of these options does not follow the same pattern as for the other alternatives. The indicators listed below were used to quantify projected outcomes under Alternatives 1-8, and 10.

- Break-even Vessels (No. of Vessels)
- Crew on Break-even Vessels (No. of Persons)
- Effort (No. of Sets)
- Effort (No. of Trips)
- Tuna Gross Revenue ($Millions)
- Swordfish Gross Revenue ($Millions)
- Shark Gross Revenue ($Millions)
- Other PMUS Gross Revenue ($Millions)
- Total Gross Revenue ($Millions)
- Average Gross Revenue per Break-even Vessel ($)
- Direct Payments to Labor ($Millions)
- Direct Purchases from Local Input Suppliers ($Millions)
- Hawai'i Total Economic Impact – Direct, Indirect, and Induced ($Millions)
- Fleetwide Direct Albatross and Turtle Compliance Cost ($ annualized over five years)
- Total Turtle Mortality (No. of Turtles)
- Total Albatross Mortality (No. of Birds)
- Total Blue Shark Mortality (Thousands of Pounds)

Alternatives 2-8 and 10 include a measure that requires permitting and reporting by vessels participating in the troll and handline fisheries in EEZ waters around the PRIAs. In addition to the indicators that are quantified, the economic assessment discusses price effects, indirect effects on non-longline pelagic vessels, consumer surplus, community participation, and environmental justice for each alternative.

- For Alternative 1 (the base case), the indicators listed above are defined, quantified, and discussed.

- For Alternatives 2-8, and 10 the indicators are quantified, discussed, and compared to outcomes under Alternative 1. Comparisons are made in absolute terms and on a percentage basis.

- Two sets of outcomes are provided for Alternatives 3, 5, 7, and 10 based on the assumptions that vessels either are able to shift between swordfish and tuna fishing

[2]Option A would establish a protocol that would allow NMFS-supervised experimental fishing by longliners, with a goal to study and modify fishing methods to reduce interactions with turtles and seabirds.

[3]Alternative 9 would create a limited entry program in American Samoa, and would establish a research plan with a goal of more complete documentation of the activities of all vessels operating under the jurisdiction of the NMFS. While the research plan could impose data collection costs on vessels, it is not expected that the implementation of the research plan would have the scope of economic effects that might be expected under the Alternative.

modes without cost, or are not able to shift at all between those modes. Switching and non-switching scenarios are not provided for other alternatives because projections of outcomes do not depend on effort switching behaviors. These scenarios present the boundaries of vessel opportunities. The expected outcome will be between these two bounds since it will be market based and determined by individual fisher decision making.

- For Alternative 9, a strictly qualitative analysis is provided. The analysis indicates the effects that can be anticipated when limited entry programs are established and provides a qualitative discussion of the benefits and costs that could be expected with a research program designed to gather more information about the pelagic fisheries that are under the jurisdiction of the FMP.

- For Option A, which could be applied in combination with Alternative 4-8 and 10 the analysis shows the effects of a 3,500 set research program involving shallow set longline gear. The projected effects of Option A would subsume the projected effects on swordfish vessels in Alternatives 5, 6, 7, 8, and 10. The research program would not have a significant quantifiable impact on the outcomes projected for Alternative 4 because the number of sets in the research program is less than the number of sets that would be projected to occur under the alternative.

Method of Analysis

The analysis is based on projected changes in gross revenue that result from projected changes in the distribution and amount of effort that is expended in the Hawai'i-based longline fishery under the different alternatives. Gross revenues are the preferred unit of analysis because most economic indicators focus on changes in gross revenues. For example, payments to labor, input purchases, sales of outputs, and contributions to gross domestic product are all generally determined by gross revenues. Net revenues, on the other hand, remove all costs and expenses, thereby obscuring changes in economic indicators.[4] Changes in the distribution and amount of effort are projected in the Kobayashi-Polovina model,[5] which was developed to assess effects of time and area closures, but does not include additional restrictions on shark-finning or likely measures to reduce albatross interactions. Therefore, the output from the Kobayashi-Polovina model, catch by species (including turtles and albatross) and gross revenue, were modified to meet the requirements of additional restrictions. The following bulleted text describes the modifications made to Kobayashi-Polovina model outputs under the various alternatives.

[4] Net revenues would be appropriate for other uses such as a cost-benefit analysis, which could not be conducted for this EIS because of the lack of available data.

[5] A complete description of the Kobayashi-Polovina model is contained in Appendix C.

- Alternative 1: No modifications to the outputs of the Kobayashi-Polovina model. The results are the baseline outcomes generated by the model, which are based on catch and effort from 1994-1999.

- Alternative 2: Baseline outputs of the Kobayashi-Polovina model were modified to reflect changes in catch per unit effort (CPUE) of pelagic species and changes in albatross interaction rates that are projected from the use of the various albatross measures in WPRFMC, 2001a. Changes in CPUEs and interaction rates were applied to the proportion of effort that is estimated to have occurred north of 23° N. latitude. In addition, the Kobayashi-Polovina model results were adjusted to reflect the prohibition on shark-finning, by assuming that all blue sharks would be released, but all other sharks would be retained.

- Alternative 3: No modifications to the outputs of the Kobayashi-Polovina model.

- Alternatives 4-8 and 10: The post-Kobayashi-Polovina modifications assume that fishers release all blue sharks that are caught, retaining none on board, and that the albatross measures are used and reduce albatross interactions, but have no incremental effect on catch of pelagic species. The convention that the albatross interaction measures would not have an incremental effect on catches of pelagic species was used because the alternatives themselves produce significant changes to the amount of effort north of 23° N. latitude, and the model results do not indicate the amount of effort that would remain in areas that would be affected by the albatross measures.

One of the more significant assumptions of the Kobayashi-Polovina model is that swordfish and mixed-target effort in the baseline case can be redeployed or switched to targeting tuna. This switched effort is assumed to achieve a CPUE equal to the existing tuna effort. While it is likely that some swordfish and mixed-target effort may switch to effort targeting tuna, it is unlikely that the new tuna effort will be as productive as the current tuna effort. The new entrants are likely to experience a significant "learning curve" when they switch effort types. In addition, their vessels are not ideal tuna vessels in either configuration or size. For example, most swordfish vessels would need to purchase a line-shooter, which typically costs $12,000. Configuration and crew inexperience are likely to reduce the efficiency of these vessels when targeting tuna. It is uncertain whether these vessels could bear the out-of-pocket costs and the period of reduced productivity necessary for the transition to targeting tuna. Unfortunately, there are no data available that would allow the model to reliably reduce the productivity of "switched" effort. Therefore, to bracket the projected results, two model runs were made for Alternatives 3, 5, 7, and 10. (Alternatives 3, 5, 7, and 10 all create the possibility of significant amounts of effort switching, which is not a factor in the projected results under the other alternatives).

Another important feature of the economic assessment is the use of a "breakeven analysis." In the existing fleets, the total number of available licenses exceeds the number of active

vessels. This condition suggests that entering the longline fleet would not be profitable under current conditions; otherwise, additional vessels would enter the fleet. In other words, the average vessel is currently breaking even. Using this assumption and the current gross revenues of the fleets in the baseline case (Alternative 1), a vessel that targets swordfish and mixed species requires $414,000 to break even, while vessels that target tuna require $298,000 to break even. The break-even gross revenue estimates are similar to estimates of fixed and operating costs shown in Section 3.10. Under alternatives in which effort switches from swordfish and mixed targets to effort targeting tuna, it is assumed the break-even gross revenue for vessels that originally targeted swordfish or mixed species remains at $414,000 even after the vessels switch to targeting tuna. This assumption is made because swordfish vessels are generally larger than tuna vessels, with higher levels of capitalization and greater operating expenses, as reflected in information from industry sources (J. Cook, pers. comm.; M. Dang, pers. comm., October 2000) and from cost-earning surveys (Hamilton and Huffman, 1997). Although some change in costs may occur with switching of targets, information from which to determine that change is unavailable.

The break-even analysis avoids potential miscalculations and misleading conclusions that could be generated by the use of cost-earnings estimates, which have not been rigorously updated and reflect operations in 1993. For example, the cost-earnings estimates from the 1993 longline fishery in Hamilton and Huffman (1997) together with the current fleet activities suggest that tuna vessels on average lose $713 per trip, while swordfish vessels generate $693 in net revenues per trip and mixed-target vessels generate $4,087 in net revenues per trip. If these numbers were used in the analysis, it could be easily concluded that, from an economic perspective, all effort targeting tuna should be eliminated.[6] On the other hand, if it is assumed that on average existing vessels are just breaking even,[7] then the focus of the analysis shifts from net revenues to gross revenues and the overall effects of the alternatives can be seen more readily.

The ideal economic assessment of the effects of alternatives would include a cost-benefit analysis, under which each alternative's benefits are compared to its costs. Unfortunately, the assessment developed in this section cannot quantify the cost and benefits of the alternatives. A cost-benefit analysis should examine both gross revenues and fixed and operating costs of the affected vessels, costs and benefits incurred by consumers,[8] and

[6] To maintain consistency, the break-even analysis does not include reductions in gross revenues for the cost of compliance with regulations under the alternatives. Although this convention may lead to a very slight overestimation of fleet size, the omitting compliance costs maintains the focus on gross revenues.

[7] This assumption is likely to be true, given the fact that vessels have been participating in the fishery in relative stable numbers since 1994.

[8] Consumer surplus and the markets for tuna and swordfish are discussed in some depth in Section 3.10. In that section it was concluded that consumers in Hawai'i would likely experience a loss in consumer surplus if there are significant reductions in the harvest of tuna by the Hawai'i-based longline fleet. A reliable quantitative estimate of changes in consumer surplus was not available.

changes in non-market values[9] realized by reductions in mortality of turtles, albatross, and sharks. Updated estimates of fixed and operating costs of affected vessels are not available; nor are reliable quantitative estimates of changes for consumers or changes in non-market values of relevant species. Because of these shortcomings, the analysis of alternatives is not an attempt to provide a thorough cost-benefit analysis. Instead, the analysis focuses on available information that is both reliable and measurable and can be used to provide reasonably accurate projections of the relative differences in gross revenues among the alternatives. Vessels are expected to leave the fishery under several of the alternatives. Some of these may leave immediately, some may switch from targeting swordfish to targeting tuna and subsequently leave the longline fishery, and some may leave after a period of time due to financial stress.

Several variables are used for the comparison of alternatives. The mortality estimates for turtles and albatross are critical to determining whether an alternative achieves its objectives. Gross revenue, break-even fleet size, and payments to crew members provide an indication of the impact of the alternatives on the affected fisheries. The constructed variable that estimates average loss of gross revenue to the fleet per turtle and albatross saved is a useful comparison tool. The measure provides a simple estimate of the burden imposed on fishers by the alternative in achieving its goal. Used in the context of the other variables, reduction in gross fleet revenue can be used to compare the relative cost of achieving mortality reductions under the different alternatives. However, these measures as reported in this analysis are not equivalent to estimates of the value of turtles or of albatross and should not be used as such. Furthermore, this constructed variable should not be construed as an estimate of damages to the longline fleet.[10]

Although the analysis makes projections of blue shark mortality for each alternative, the gross revenues realized from the sale of blue sharks and blue shark fins are not included in the results. One of the measures contained in Alternatives 2, 4-8, and 10 would prohibit finning of sharks without retaining the carcass. This option would likely eliminate retention of blue sharks, which are valued almost exclusively for their fins. The flesh of blue sharks is very undesirable and is believed to negatively affects the quality of other fish in the holds. Therefore it is assumed that no blue sharks will be retained under Alternatives 2, 4-8, and 10. Retention of other shark species is not expected to be affected by the prohibition. Revenues from finning typically went to crew members as a supplement to their crew share. Although these revenues are not be fully represented in the model projections, they are worthy of consideration in evaluating the alternatives.

[9] The valuation of environmental goods is treated thoroughly in Section 3.10. In that section it was concluded that reliably accurate estimates of the value of turtles and seabirds are not currently available and are not possible to generate within the court-imposed time constraints of the analysis.

[10] A possible assessment of damages to the longline fleet would compensate fleet vessel owners and crew members in an amount that would provide them the same level of income that they realized in the absence of the regulations.

Economic Impact Summary

This section provides an overview of economic indicator outcomes for all alternatives. Detailed discussions of potential effects of each alternative are in separate sections that follow, along with descriptions of analytical constructs and assumptions used to generate estimates.

Table 4.8-1 shows primary indicator outcomes under each alternative for Hawai'i-based longline vessels.[11] Below the table, each of the various indicators used in the summary of the results is discussed in some detail. Two sets of outcomes are provided for Alternatives 3, 5, and 7, where 3A, 5A, 7A, and 10A assume that vessels are able to switch fishing modes, and 3B, 5B, 7B, and 10B assume that vessels are not able to switch. The table shows the range of outcomes that were considered within the scope of the EIS.

- Alternative 2, based on the existing measures already approved by the NMFS and Council, and revised to incorporate the Biological Opinion of FWS for the Effects of the Hawai'i-based Domestic Longline Fleet on the Short-Tailed Albatross (*Phoebastria albatrus*) (STAL BO), and would generate slightly higher overall gross revenues than would occur under the base case in Alternative 1.[12]

- Alternative 3, the Court-ordered alternative, would generate the lowest total fishery gross revenues for any alternative, with the exception of the total longline closure under Alternative 8.

- Alternative 10 (*Preferred*), reflects the latest RPAs of the Pelagics BO and is expected to result in the lowest levels of turtle (with the exception of the total longline closure under Alternative 8) and very low levels of albatross mortality. Alternative 10 is expected to completely eliminate the Hawai'i-based swordfish fishery because of the prohibition of the use of swallow-set gear in the Northern Hemisphere. The effects on the Tuna fleet appear to be relatively minor. It is expected that some vessels which currently focus on swordfish may be remain financial viable by switching to deep-set gear. The permits restrictions included in the preferred alternative mean that vessels with Hawai'i Longline Permits will not be able to fish with shallow sets even, if the operate out of California, or ports. If the vessel chooses to decouple its Hawai'i Permit, so that it can engage in shallow set fisheries, it will be allowed to recouple the permit to the vessel only during the month of October. This effectively eliminates the possibility that vessels move back and forth between fishing with deep-set gear in Hawai'i and shallow-set gear out of other locations.

[11] Appendix M contains a set of tables showing projected outcomes under the Alternatives for all of the variables assessed. These additional variables including pounds harvested and gross revenue by species, effort by sets and trips, and takings and mortality of turtles and seabirds by individual species.

[12] This increase in gross revenues results from the compulsory use of night sets under Alternative 2, which the model projects to have a higher CPUE.

Table 4.8-1: Summary of Economic Impacts of Alternatives on Hawai'i-based Longline Vessels.

Indicator	Alt. 1	Alt. 2	Alt. 3		Alt. 4	Alt. 5		Alt. 6	Alt. 7		Alt. 8	Alt. 10	
			A	B		A	B		A	B		A	B
Break-even Vessel (No. of Vessels)	119	118	88	65	115	110	78	86	98	72	0	108	77
Break-even Crew members (persons)	610	605	480	354	591	605	429	445	539	396	0	594	424
Total Fishery Gross Revenue ($Millions)	40.7	40.9	28.2	20.0	39.6	37.4	23.8	29.1	32.1	21.5	0.0	36.4	23.5
Direct Payments to Labor ($Millions)	19.7	19.8	13.7	9.7	19.2	18.1	11.5	14.1	15.6	10.4	0.0	17.6	11.4
Direct Purchases from Local Input Suppliers ($Millions)	14.3	14.4	9.9	7.0	13.9	13.1	8.4	10.2	11.3	7.6	0.0	12.8	8.3
Hawai'i Total Economic Impact – Direct, Indirect, and Induced ($Millions)	48.3	48.5	33.5	23.7	47.1	44.3	28.3	34.5	38.2	25.6	0.0	43.2	28.0
Total Turtle Mortality (No. of Turtles)	150	150	75	56	110	37	22	77	31	19	0	26	17
Total Albatross Mortality (No. of Albatross)	2,235	291	433	379	221	22	14	221	20	12	0	26	15
Total Blue Shark Mortality (Thousands of pounds)	5,469	665	1,440	1,214	597	170	112	378	161	105	0	176	112

Notes: 1. Alternative 9 is not anticipated to have directed quantifiable effects on the longline fleet and is therefore not included in this summary table. Similarly, because Option A is not fully specified, the additional economic impacts that could be generated are not included in the table.
2. Details describing analytical constructs and conventions and a more complete discussion of results are in separate sections for each alternative.
3. "NA" indicates that the calculation of costs are not applicable – Alternative 1 is the base case against which costs are measured, and Alternative 2 does not result in gross revenue reductions.

A primary indicator used in this section of the EIS is the estimated number of vessels that could generate enough gross revenue to break-even (total gross revenue equals total cost) under the alternatives. As total gross revenue in the fishery decreases (as occurs under most of the alternatives), the number of vessels the fishery can support also decreases. While currently active vessels will not drop out immediately if gross revenues drop, the estimated number of break-even vessels provides an estimate of potential long-term effects of the alternatives, since vessels covering at least variable costs would be expected to remain in the fishery, at least temporarily.

To analyze the economic impacts of the various alternatives, the vessels were separated into two groups. Those with line-shooters, which can more effectively target tuna, are

considered tuna vessels. Tuna vessels tend to have lower operating costs and are able to fish closer to port. More recently, tuna fishing activity by this fleet is increasing in more distant areas such as Kingman Reef and Palmyra Atoll. (R. Ito, NMFS, pers. comm., January 25, 2001) Longline vessels not equipped with line-shooters (which are therefore restricted to targeting swordfish or a mixture of swordfish and tuna) are treated as a single group, swordfish vessels. The significantly different gross revenue and cost patterns support the separation of the two longline vessel types (tuna and swordfish). It is estimated that the average gross revenue for boats currently operating is $298,000 for the tuna vessels and $414,000 for the swordfish vessels. The analytical convention that these boats, on average, are breaking even is backed by empirical studies (Hamilton and Huffman, 1997) that show stable numbers of both types of vessels in the longline fishery over the last several years.

Figure 4.8-1 shows the estimated number of break-even vessels by vessel type for each alternative. Three vertical bars are shown for each alternative – the break-even number of total vessels (back), tuna vessels (middle) and swordfish vessels (front). High (a) and low (b) estimates are provided for Alternatives 3, 5, 7, and 10. High estimates are based on the assumption that vessels switch effort from targeting swordfish to targeting tuna.

- Under Alternative 8 the fishery is eliminated, so no longline vessels would operate in the fishery.

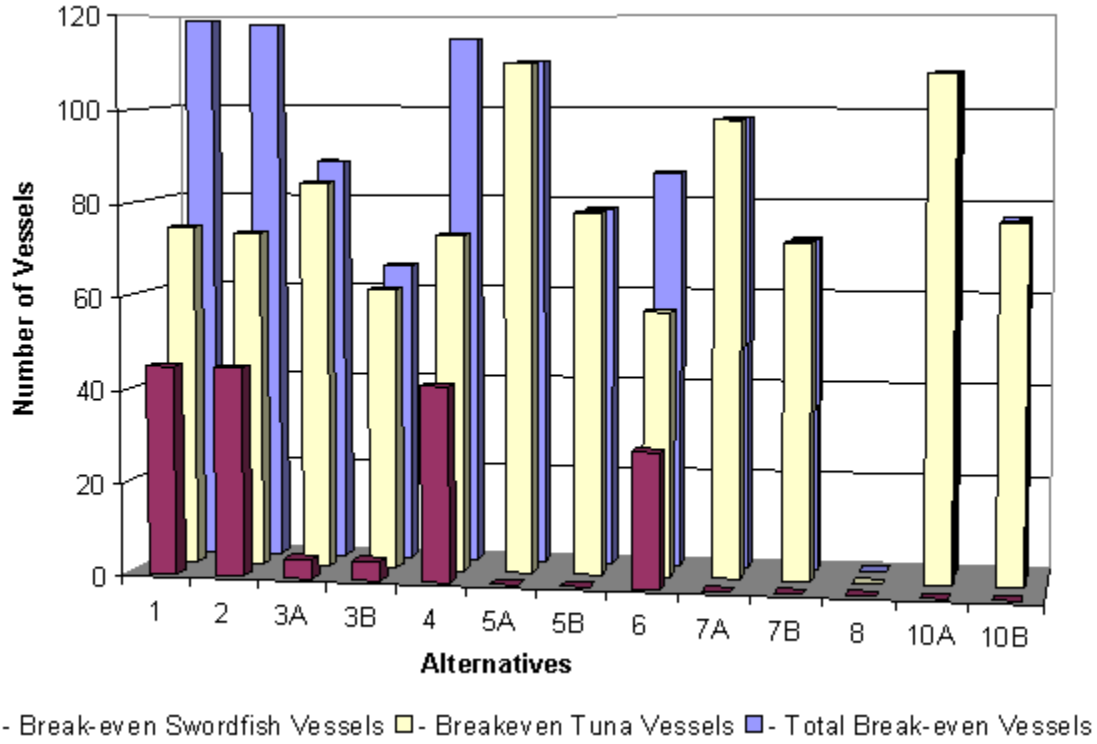
- Under Alternative 2, the total fishery gross revenue is estimated to increase slightly because of higher CPUEs.[13]

- Under Alternatives 4 and 6, a number of swordfish vessels would be able to operate at break-even gross revenues and remain in the fleet.

- Under Alternatives 5, 7, and 10 directed fishing for swordfish would be eliminated. It is possible that some of these vessels may be able to switch to tuna, as depicted in Scenarios 5A, 7A, and 10A.

[13] Under Alternative 2 the mandatory use of night fishing is projected to increase the CPUE.

Figure 4.8-1: Estimated Number of Break-even Hawai'i-based Longline Vessels by Type for Each Alternative.



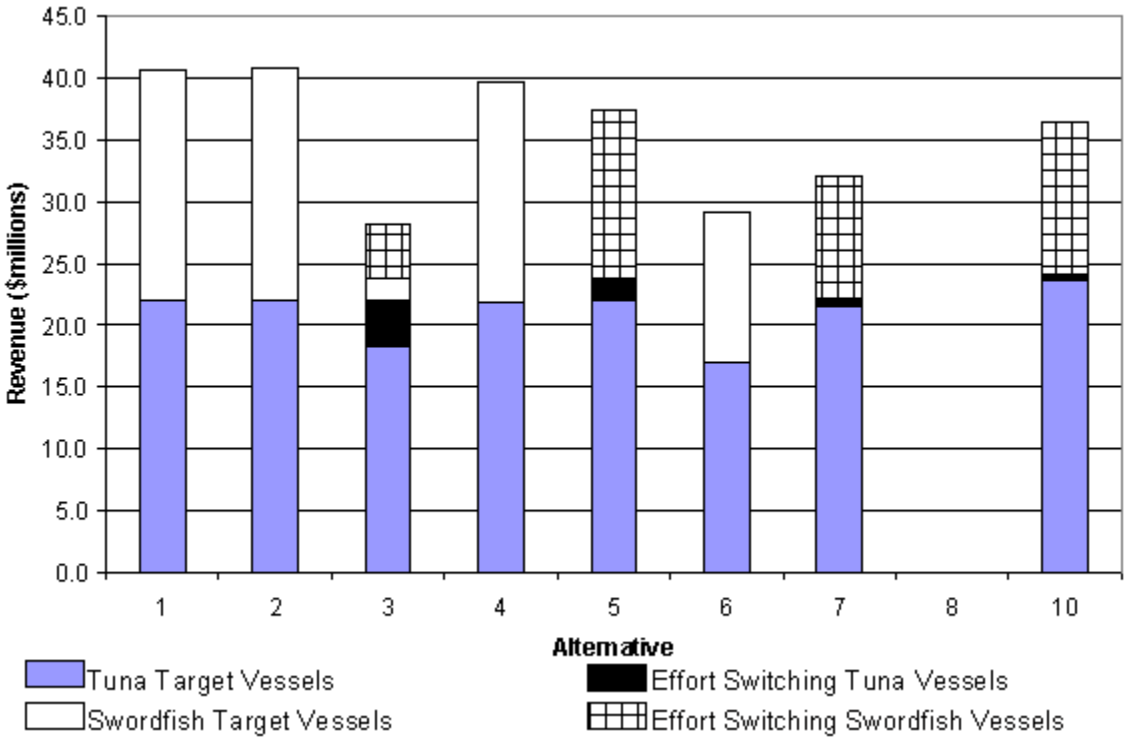
Estimates of gross revenue in the longline fishery vary by alternative in a pattern similar to the pattern for estimates of break-even vessels. This similarity results from the fact that the estimate of break-even vessels was calculated by dividing total gross revenue by the estimate of gross revenue that would be needed for the average vessel in each fleet to break even. Nonetheless, tracking gross revenue by source of effort, as shown in Figure 4.8-2, demonstrates an important analytical construct that was used in the impact assessment – the assumption that swordfish vessels can switch their effort to target tuna. The figure shows gross revenue from tuna vessels that are estimated to remain tuna target vessels, and gross revenue from swordfish vessels that are estimated to remain swordfish target vessels. Additional categories showing vessels that are estimated to switch types of effort are provided.

While swordfish vessels can, in theory, switch to targeting tuna without incurring excessive direct expenses (estimated expenses are approximately $12,000), the fact that most swordfish vessels have not made this investment indicates that the economics of tuna fishing are such that the generally larger and faster swordfish vessels are too expensive to operate in the lower-gross-revenue tuna fishery. The estimated gross revenue for effort switching swordfish vessels is for vessels that target swordfish under the base case, but switch to tuna fishing under the alternative. Effort switching tuna vessels are defined similarly – vessels with installed tuna gear that switch from mixed-target fishing into more focused tuna fishing.

Under each alternative in which vessels switch targets, the direct cost of equipment is annualized over five years in the analysis.

In general, estimates of gross revenue from effort switching are more uncertain than estimates for other gross revenue sources. Thus, the gross revenue estimates for Alternatives 3, 5, and 7, all of which incorporate significant amounts of effort switching, are more uncertain than gross revenue estimates under the other alternatives.

Figure 4.8-2: Total Hawai'i-based Longline Gross Revenue by Effort Type Under Each Alternative.



One other aspect of the model is worthy of discussion. The catch estimates (from which gross revenues are estimated) were determined based on effort levels and CPUEs in the existing fisheries. In determining catch (and gross revenues) all vessels were assumed to continue to fish to the extent permitted by the regulations. Under the model, any vessels prohibited from fishing in the location where they fish under Alternative 1 are assumed to move to other areas. In these new areas the relocated vessels are assumed to have a CPUE equal to the average for vessels in that area.

The analysis then determined the number of vessels in the fleet, based on the total fleet gross revenues. Consequently, the model may overestimate the fleet gross revenues since some vessels that may have dropped out of the fishery were assumed active for the purpose of determining the catch. The number of vessels may also be overestimated since the gross

revenues were calculated based on the catch of the entire existing fleet. This shortcoming is of greatest concern in the alternatives that utilize seasonal closures. Vessels that are unable to survive with a shortened season will be removed from the fleet by these closures.

Several classes of vessels other than longline vessels participate in Hawai'i-based pelagic fisheries. All of these other vessels would be directly affected by the research program envisioned under Alternative 9. With the exception of vessels in American Samoa, however, these vessels are not directly affected by management changes that would be imposed under Alternatives 2-8 and 10. All vessels in American Samoa would be affected by the creation of nearshore area closures under Alternative 2 and under the limited entry program in Alternative 9. Additionally, all longliners in American Samoa would be included in the longline closure under Alternative 8.

Table 4.8-2 shows the gross revenues, labor income, input purchases, employment, and total (direct, indirect, and induced) output of each vessel type in the Hawai'i-based pelagic fishery from 1998 – because these non-longline vessels are not quantitatively affected by the alternatives the analysis assumes that they will continue to operate as they have in the recent past.[14] More detailed discussions of the current activities of the non-longline pelagic fishing vessels in Hawai'i are provided in Section 3.10. Gross revenues for the pelagic fisheries outside of Hawai'i but within the management area are also included in the table.

Recreational and charter vessels both had gross revenues of more than $15 million, handline vessels have gross revenues more than $9 million, troll vessel gross revenues were approximately $6.5 million, and pole-and-line gross revenues were less than $1 million. The American Samoa, Guam, and CNMI fleets generated slightly more than $2 million in gross revenues. The total gross revenue of these fleets combined is considerably less than the current gross revenue of the Hawai'i-based longline fleet.

[14]Price changes discussed below could have implications for gross revenues of all fleets.

Table 4.8-2: Estimated Economic Contributions by Pelagic Fishing Sectors, 1998. Source: Estimated from Table 3.10.2-1 and adapted from WPRFMC 1998 Annual Report and Our Living Oceans 1999 Report *in* NMFS, 2000j.

Fishing Sector	Industry Output ($Millions)	Industry Labor Income ($Millions)	Industry Inputs ($Millions)	Industry Jobs	Total Output ($Millions)
Hawai'i-based Fleet					
Longline	40.7	19.7	14.3	610	48.3
Handline	9.35[a]	3.70	4.51	188	12.69
Pole-and-Line	0.93[b]	.37	0.45	25	1.26
Troll	6.50[c]	2.57	3.13	305	8.82
Recreational /Expense	18.87[d]	NA	14.84	NA	42.39
Charter	15.27[e]	5.92	8.24	389	39.29
Total	91.62	32.26	45.47	1517	152.75
Other Pelagic Fleets					
American Samoa Longline	0.97	-	-	-	-
American Samoa Troll/Charter	0.03	-	-	-	-
Guam Troll/Charter	0.71	-	-	-	-
CNMI Troll/Charter	0.40	-	-	-	-

[a] Representative total gross revenue as estimated in Hamilton and Huffman (1997)
[b] Inflation-adjusted gross revenue for 1998
[c] The representative sales estimate for the commercial troll sector is from Hamilton and Huffman (1997) This estimate excludes sales by charter and recreational/expense boats that typically are included in current-year gross revenue estimates from agency sources.
[d] Fish sales and expenses for recreational/expense boats as estimated in Hamilton (1998) are combined for use in the I/O model.
[e] Fish sales and charter gross revenue, as estimated in Hamilton (1998), are combined for use in the I/O model.

The analysis does not attempt to measure any price changes that may result from regulation of the pelagic fisheries. Evidence from the Hawai'i market for pelagic fish, however, suggests that declines in the harvests of fish are likely to trigger changes in prices. In the current market (particularly the market for tuna) seasonal variations in harvests typically are accompanied by price changes (Bartram, 1997). The likely result of the curtailment of harvests by the alternatives is an increase in prices.[15]

Harvest declines (and corresponding price rises) in tuna are likely to be of greatest harm to Hawai'i consumers. Although not estimated numerically, the price fluctuations in the local market suggest that price rises in tuna could cause losses to consumers that are significant. Consumers realize a benefit known as "consumer surplus" when prices are below the

[15] Economists typically refer to the change in demand for a good that results from a change in price as the "price elasticity of demand" of a good. Inelastic goods are goods for which the quantity demanded changes little with a change in price. The large seasonal price changes for fish in Hawai'i suggest that fish is very price-inelastic. When local supply declines, the price rises and imports of foreign supplies to Hawai'i increase, keeping the total amount of fish sold relatively constant.

maximum consumers are willing to pay. Since the amount of fish demanded in the Hawai'i market is quite high in all seasons, including those when prices are high, consumer surplus is significant when prices are low. If those prices are driven up by declines in harvests, consumer surplus will be lost.

Prices of fish purchased in Hawai'i are likely to rise if the supply longline caught fish is reduced. Hawaiian fishers, however, will not be the greatest beneficiary of the price rise. Importers who ship fish into the state will realize the most gain because the price rise will make it feasible for them to enter the market. Hawai'i's tuna fishers may realize some gain since they will receive a higher price for their production. However, this benefit may be offset by the reductions in harvests by the local fleet and loss of market share to import suppliers.[16]

Harvest declines in the swordfish market will have a very different effect on the Hawai'i economy. Most of Hawai'i's swordfish catch is shipped to the continental U.S. market. Since Hawai'i's catch is a minor component of that large market, prices are likely to be less influenced by the changes in Hawai'i harvests. The absence of a price change would have a negative impact on fishers because little, if any, of their loss from harvest declines will be compensated for by a price rise. Harvest declines in swordfish, however, are less likely to have a substantial impact on Hawai'i's consumers since the price is less likely to change and local consumption of swordfish is small. As a consequence, swordfish harvest declines are likely to harm Hawai'i fishers and leave Hawai'i consumers largely unaffected.

The quantified results generally show estimated impacts on the longline fishing fleet for alternatives that are designed to reduce the number of interactions of fishing vessels with turtles and albatross – particularly Laysan and black-footed albatross. Thus, an important component of the assessment is the estimation of albatross and turtle mortality. Figure 4.8-3 shows estimated albatross and turtle mortality under the alternatives. These estimates were derived by economists using model results provided by NMFS scientists and may vary slightly from estimates in other sections of this EIS. The estimates indicate that:

- While Alternative 2 would provide a significant reduction in albatross mortality, quantifiable differences in turtle mortality are not readily apparent, but may in fact occur.

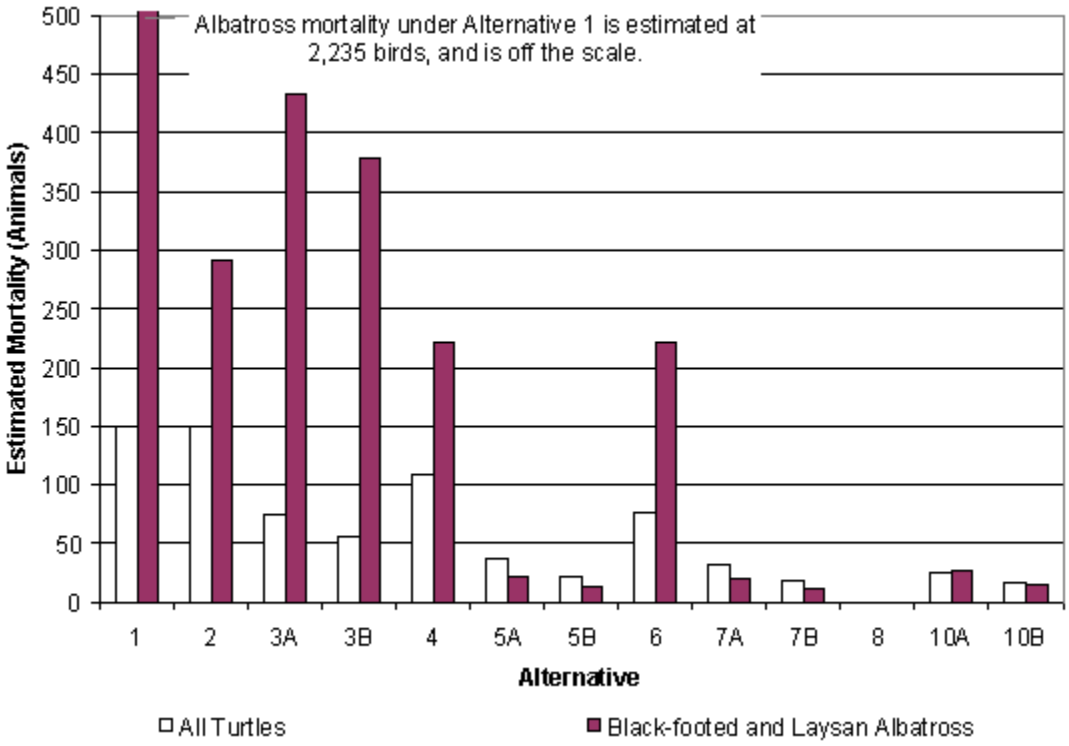
- Alternatives 3-8, and 10 would enhance albatross protection and reduce turtle mortality from interactions with the Hawai'i-based longline fleet.

- Alternative 8 would provide the ultimate protection from interaction with longliners. by eliminating the Hawai'i-based longline fishery completely.

[16] It is possible that individual fishers (namely, longline fishers not restricted by the regulations or non-longline fishers) may realize a net gain through price increases.

- Alternatives 5, 7, and 10, both with and without assumptions for effort switching,[17] provide the lowest estimates of albatross and turtle mortality for the alternatives analyzed, while still allowing the longline fishery to take place. The additional permit restrictions in Preferred Alternative 10 that effectively prevent vessels with Hawai'i longline permits from fishing part of the year in Hawai'i and part of the year in California will provide additional but unquantified protections for albatross and turtles.

Figure 4.8-3: Estimated Turtle and Albatross Mortality Under the Alternatives.



The EIS is intended to provide decisionmakers with comprehensive information to allow them to compare and contrast outcomes under differing circumstances. Decisionmakers often face conflicting goals and objectives. Two such conflicting objectives in fisheries management are:

- Manage the fisheries to provide stability and income to fishers and fishing communities.
- Manage the fisheries to minimize negative impacts on protected resources.

[17] Scenarios denoted with the letter "A" assume effort switching, while scenarios denoted with the letter "B" assume that effort switching does not occur.

Figure 4.8-1 and Figure 4.8-2 show fleet and gross revenue changes to longline fishers that would result from implementation of the alternatives, while Figure 4.8-3 shows estimated mortality of turtles and albatross. One useful comparison between alternatives is the relationship between gross fishery revenues foregone for each turtle or albatross saved. This compares the change in estimated turtle or albatross mortality under the alternative (as compared to the baseline case in Alternative 1) divided by the change in total gross revenue of the longline fleet under the alternative (as compared to the baseline case in Alternative 1). Such a comparison is not useable as a proxy for the value of a turtle or albatross. The most favored alternatives based solely on this comparison would be those under which the mortality of both turtles and albatross is low (more animals are saved by the alternative) and the reduction in gross revenues of the longline fleet per animal saved are low.[18]

Under Alternative 10, the preferred alternative, with the assumption that swordfish vessels can switch into the tuna fishery (Scenario 10A), estimated overall turtle mortality is quite low while the estimated declines in gross revenue are relatively low compared to other alternatives. Only Scenario A under Alternative 5 provides comparable results. In other words, the gross revenue foregone per animal saved is lower for these two scenarios than with other alternatives. Under Scenario 10A foregone revenue per turtle saved is projected to be $35,000. (Under 5A foregone revenue per turtle saved is projected to be $30,000.) Both of these scenarios assume that vessels can switch efficiently from swordfish fishing to tuna fishing. This may not be the case in actuality since swordfish vessels are substantially larger and more expensive to operate than tuna vessels and have crews that are less experienced in targeting tuna. If vessels are unable to switch, estimated foregone revenue for each turtle saved under for Preferred Alternative 10 (Scenario 10B) is $128,000, while for Scenario 5B under Alternative 5, the estimate is $132,000. It is likely that the actual outcomes under Preferred Alternative 10 and Alternative 5 would fall somewhere between the switching and non-switching projections at approximately $81,000 per turtle saved for both alternatives.

4.8.2 Economic Impacts of Alternative 1

Alternative 1 is considered the baseline case against which all other alternatives are compared. In general, the description of Alternative 1 is a projection of the Hawai'i-based longline fisheries based on fishing activities for 1994-1999.[19] The baseline case assumes that factors that are exogenous to the alternative, such as pelagic fish stocks, prices, and markets,

[18] The gross revenue reduction comparison should not be interpreted as valuing either turtles or albatross, but is merely a tool for comparing the forgone gross revenues to the fleet of reducing mortality of these animals under the different alternatives. The use of gross revenues for this analysis is particularly revealing since payments to labor, input purchases, and employment will all parallel gross revenues.

[19] As indicated in Section 4.8.1 other Hawai'i-based pelagic fisheries are directly affected only by the reporting requirements of Alternatives 4-8 of this EIS. Activity in these other fisheries is therefore not expected to change significantly from the current status as described in Section 3.10. Indirect effects on these other fisheries, however, are discussed in the summary of economic impacts.

have remained unchanged from averages for that period. Other factors such as the regulatory regime and fishing practices are considered unchanged from 1999.

Much of the information used for the analysis of all of the alternatives is delineated in Section 3.10, which describes the fisheries managed under the Western Pacific Pelagic. In addition, the analysis relies heavily on a model developed this year by Donald Kobayashi and Jeffrey Polovina of the NMFS Southwest Fisheries Science Center, Honolulu Laboratory. That model is described fully in Appendix C. Additional details on the model and its assumptions for Alternative 1 are provided later in this section.

Table 4.8-3 summarizes the projected economic impacts to the Hawai'i-based longline fleet under Alternative 1 for a one-year period. The 119 vessels in the fleet generate about $40.7 million in total gross revenue.[20] The fleet is estimated to employ 610 persons, who receive total payments for labor of $19.7 million. In addition to payments to labor, the longline fishery is estimated to purchase $14.3 million in inputs from local suppliers. Overall, the estimated total economic impact of the Hawai'i-based longline fleet is more than $48 million. It is estimated that in generating these economic impacts, the fleet would kill 150 turtles of all species and 2,235 black-footed and Laysan albatross.

[20] These revenue figures and all others reported in this section do not include revenues from shark finning because those revenues are not reported and reliable data are unavailable.

Table 4.8-3: Annual Economic Impacts of the Hawai'i-based Longline Fleet Under Alternative 1.

Economic Indicators	Target Effort Type		
	Tuna	Swordfish	Total
Break-even Vessels (No. of Vessels)	74	45	119
Crew on Break-even Vessels (No. of Persons)	407	203	610
Effort (No. of Sets)	7,128	4,751	11,879
Effort (No. of Trips)	714	433	1,148
No. of Trips per Break-even Vessel	9.7	9.6	9.6
Tuna Revenue ($Millions)	19.5	5.2	24.7
Swordfish Revenue ($Millions)	0.5	11.3	11.8
Shark Revenue ($Millions)	0.4	1.2	1.6
Other PMUS Revenue ($Millions)	1.7	1.0	2.6
Total Revenue ($Millions)	22.1	18.6	40.7
Average Revenue per Break-even Vessel ($Millions)	0.298	0.414	0.342
Direct Payments to Labor ($Millions)	10.7	9.0	19.7
Direct Purchases from Local Input Suppliers ($Millions)	7.7	6.5	14.3
Hawai'i Total Economic Impact – Direct, Indirect, and Induced ($Millions)	26.2	22.1	48.3
Total Turtle Mortality (No. of Turtles)	46.8	103.3	150.1
Total Albatross Mortality (No. of Albatross)	159	2,077	2,235
Total Blue Shark Mortality (Thousands of Pounds)	566	4,903	5,469

Description of the Analytical Model and Constructs

The projected outcomes of Alternative 1 are based primarily on the output of the Kobayashi-Polovina model. For most of the alternatives, the model defines three types of longline effort based on targets: sets targeting tuna, swordfish, and both swordfish and tuna (mixed). In general, vessels targeting swordfish or mixed species use gear that fishes at shallower depths than are fished with sets configured for tuna. (Shallow gear is used primarily by swordfish vessels.) Because mixed-target and swordfish target efforts generally use shallow gear, Table 4.8-3 (as well as similar tables and figures for other alternatives) groups these two effort types under the single heading of swordfish effort. Tuna sets are also differentiated from the other effort types by use of a line-shooter, which deploys line at a rate faster than the vessel's speed, allowing the line to sink to greater depths.

In addition to defining effort by target type the Kobayashi-Polovina model can produce differentiated outputs for shallow-set gear and deep-set gear. This distinction was used to generate results for Alternatives 5 and 7. As shown in Table 4.8-4, the correlation between

shallow sets for swordfish and mixed targets and deep sets for tuna is considerable, but not complete – the results imply that some mixed-target sets were made with deep gear sets.

Table 4.8-4: Projected Annual Effort by Target and Gear Type Under Alternative 1.

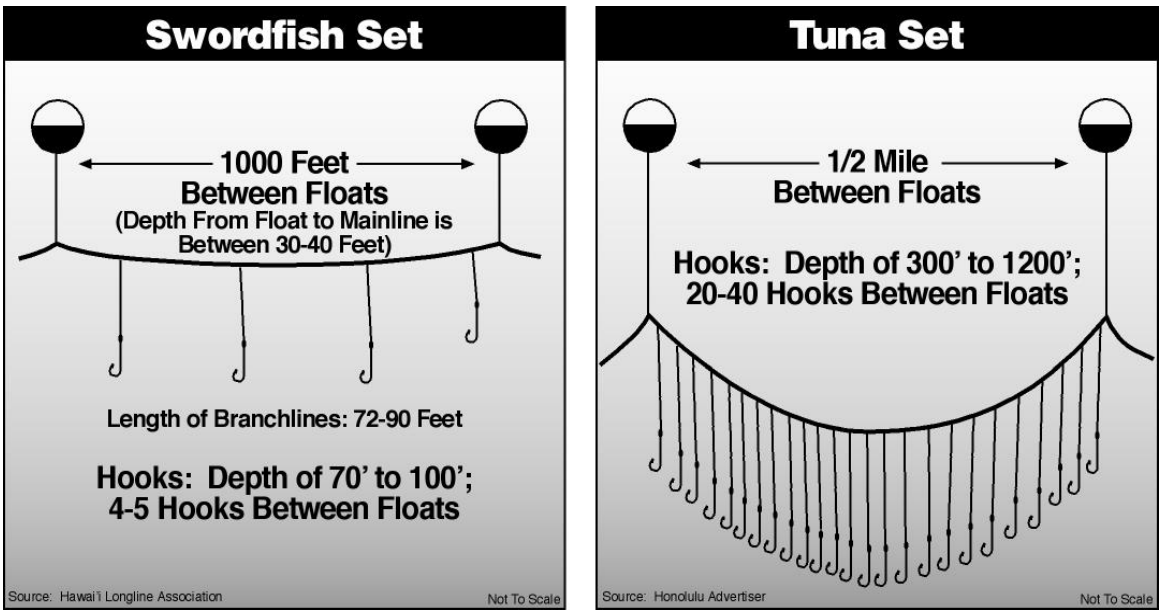
Effort by Target	Number of Sets	Effort by Gear Type	Number of Sets
Swordfish	1,703	Shallow	4,239
Mixed	3,048	Deep	7,640
Tuna	7,128		
All Targets	**11,879**	**All Gear**	**11,879**

Note: The model output indicates that in the base case depicted by Alternative 1 there are 512 more deep sets than sets that targeted tuna – the analysts presume that these 512 sets are sets defined as mixed-target sets. The remainder of the mixed-targeted sets are defined as shallow sets by the model outputs.

Figure 4.8-4, which is reproduced from Section 3.10, shows the two types of gear configurations. The gear configurations in the diagram should be view as representative of the differences between the two gear types, and should not be viewed as definitive in terms of FMP regulations. In the figure, as in the assessment of alternatives, shallow sets are defined as swordfish sets and deep sets are defined as tuna sets. Mixed-target sets are generally used on vessels that also target swordfish, and therefore, the analysis assigns all mixed-target sets to swordfish vessels.[21]

[21] The Kobayashi-Polovina model does not include vessel indicators – assignment of effort to specific types of vessels was done by the analysts for this EIS.

Figure 4.8-4: Effort Types by Target, as Used in the Analysis of Alternatives.



The primary output of the Kobayashi-Polovina model indicates the number of animals (fish, turtles, and albatross) taken by each effort type. The model also generates an estimate of total gross revenue, based on fish weights and prices specific to gears, areas, and months of harvest. Total weight by species and total gross revenue by species are not included as primary outputs. Table 4.8-5 shows the model output for Alternative 1.

Using the primary outputs from the model, the total weight for each fish species taken was calculated by multiplying the number of fish caught by their average weight for 1994-1998. Estimated catch weights by species were then transformed to estimate gross revenues for each species, based on the average price per pound for each species for the base period. Gross revenues estimated for each species, based on average prices and fish weights for the base period, were then adjusted proportionally so that the sum of the estimated gross revenue for each individual species equals the total estimated gross revenue that was a primary output of the model. Table 4.8-6 shows the average fish weights and prices by gear type that were used to estimate individual species gross revenue and catch weights.

Conversion of estimated turtle and albatross takes (outputs of the model) to turtle and albatross mortality was accomplished by using estimates provided to Kobayashi and Polovina from NMFS observer reports.[22] Table 4.8-7 shows the estimated kill-to-take ratios used in the model.

[22] Estimates of the ratio of take to kill for turtles and albatross were provided by Marti McCracken, NMFS-SWFSC-Honolulu Laboratory.

Table 4.8-5: Primary Output of the Kobayashi-Polovina Model for One Year Under Alternative 1.

Target Effort Type	Tuna	Swordfish	Mixed	Total
		Effort by Target Type (No. of Sets)		
Sets	7,127.8	1,703.0	3,048.2	11,879
		Catch by Target Effort Type (No. of Animals)		
Loggerhead Turtle	23.1	199.3	195.1	417.5
Leatherback Turtles	38.7	32.0	41.4	112.1
Olive Ridley Turtles	109.2	8.4	28.8	146.4
Green Turtles	18.8	10.1	11.1	40.0
Black-footed Albatross	127.6	642.8	656.4	1,426.8
Laysan Albatross	54.0	543.6	567.7	1,165.3
Swordfish	1,623.3	16,825.7	19,698.7	38,147.7
Bigeye Tuna	57,203.8	2,318.0	10,438.0	69,959.8
Albacore Tuna	40,435.8	3,349.2	4,188.2	47,973.2
Yellowfin Tuna	13,682.2	1,055.0	5,142.9	19,880.1
Blue Shark	5,657.8	26,062.8	22,966.8	54,687.4
Mako Shark	502.8	153.4	324.3	980.5
Thresher Shark	1,584.8	30.0	163.2	1,778.0
Blue Marlin	3,761.0	437.7	2,243.7	6,442.4
Striped Marlin	11,742.5	726.2	2,700.8	15,169.5
		Revenue by Target Type ($)		
Total Revenue	22,060,916.8	7,046,003.9	11,590,929.0	40,697,849.7

Note: Effort defined as targeting mixed species (3,048 longline sets) is treated as effort by swordfish vessels in the analysis. However, approximately 500 of the mixed-target sets were made with gear configured to fish deep, with more hooks and longer leaders than would be used to catch swordfish, and are therefore more likely to have been associated with tuna vessels.

Table 4.8-6: Baseline Average Weight per Fish and Average Price per Pound by Effort Type for One Year.

Species	Tuna Effort		Swordfish Effort		Mixed Effort	
	Average Weight (lb per fish)	**Average Price** ($ per lb)	**Average Weight** (lb per fish)	**Average Price** ($ per lb)	**Average Weight** (lb per fish)	**Average Price** ($ per lb)
Swordfish	130.48	1.78	175.34	1.66	153.42	1.67
Bigeye Tuna	71.28	3.02	96.20	3.16	81.98	2.66
Albacore Tuna	52.90	1.27	42.12	1.20	50.68	1.14
Yellowfin Tuna	73.50	2.36	105.36	3.38	115.86	2.53
Blue Shark	100.00	0.23	100.00	0.23	100.00	0.23
Mako Shark	174.34	0.65	137.84	0.64	169.72	0.44
Thresher Shark	171.90	0.58	195.80	0.19	154.70	0.41
Blue Marlin	146.30	1.29	169.88	1.22	170.10	1.06
Striped Marlin	57.64	1.19	90.30	1.99	69.04	1.18

Note: Average weights and prices were estimated for 1994-1998 and provided as part of the model output.

Table 4.8-7: Estimated Animals Killed for Every Animal Interaction in the Hawai'i-based Longline Fishery. Source: McCracken, 2000, *in* Kobayashi and Polovina Model Documentation.

Turtle Species				Albatross Species	
Loggerhead	**Leatherback**	**Olive Ridley**	**Green**	**Black-footed**	**Laysan**
Estimated No. of Animals Killed for Every Turtle Interaction in the Hawai'i-based Longline Fishery					
0.2082	0.0832	0.3326	0.1292	0.8994	0.8172

The number of vessels, employment, payments to labor, input purchases, and total economic impacts of the alternative were estimated. The estimates were calculated based on total gross revenue generated by the model and on information in the input-output model discussion in Section 3.10.2.2. Payments to labor were estimated as 48 percent of total gross revenue, while input purchases were estimated as 35 percent of total gross revenue. Finally, total economic impact, which includes direct, indirect, and induced effects, was estimated as 118 percent of total gross revenue.

The number of vessels under Alternative 1 is set at 119; the number of vessels that participated in the Hawai'i-based longline fishery in 1999. Information from the Hawai'i Longline Association (HLA) (M. Dang, HLA, pers. comm., October 2000; J. Cook, Pacific Ocean Processors, pers. comm., October 2000), indicated that 45 vessels targeted swordfish primarily or had mixed-target trips, and that the remaining 74 vessels targeted tuna primarily. For Alternative 1 the analysis assumes that all revenue generated by swordfish or mixed-target trips came from landings by the 45 swordfish vessels, and that all

revenue generated by tuna target trips came from landings by the 74 tuna vessels.[23] Furthermore, the analysis assumes that the 45 swordfish vessels generated just enough gross revenue to cover their expenses, including payments to crew members and skippers and a normal return on investment for vessel owners. The analysis makes a similar assumption regarding gross revenues and costs for the 74 tuna vessels. Based on fleet data from Alternative 1, it is estimated that the average vessel in the tuna fishery had gross revenues of $298,000 and the average vessel in the swordfish fishery had gross revenues of $414,000.

Estimates of costs for the two types of longline vessels (tuna and swordfish) for 1993 as developed by Hamilton (Hamilton and Huffman, 1997) are presented in Section 3.10.3.1. Updated cost estimates have been developed by NMFS. The updates are based on the same basic information used in Hamilton *et al.* (1997) and therefore do not fully reflect the significantly different cost patterns that have developed since the original survey of vessel owners was conducted in 1993.

As shown in Figure 4.8-5, the Hawai'i-based longline fishery, as currently operated, sustains 119 vessels. Tuna vessels make up approximately 62 percent of the fleet, with swordfish vessels comprising the other 38 percent. The current regulatory system includes a limitation on the number of vessels and protects certain species with area and seasonal closures. The entry limitation, however, is 164 vessels, more than the 119 participating. Since licenses are available, the economic analysis of the alternatives assumes that no additional profits could be generated by more vessels entering the fishery.

Both the original and the updated cost-earnings estimates indicate that the average vessel in both the tuna and swordfish fleets is approximately breaking even.[24] The analytical construct that under the base case as estimated in Alternative 1 all vessels on average are just breaking even is further justified because the number of vessels in the Hawai'i-based longline fleet has been relatively stable since 1994, and because, while the fishery has a limited number of permits, not all of the permits are currently active. In addition, there is no indication that overall CPUE is significantly affected by the number of vessels in the fishery.

Adherence to the assumption that the number of active vessels changes such that on average all vessels break even enables estimation of effects on fleet size and employment from changes in total gross revenue under the alternatives. Additional details on the methodology used to adjust fleet size are presented in the discussion of Alternatives 2 through 7.

[23] These assumptions were necessary because the number of vessels by vessel type were not included in the data used to generate output in the Kobayashi-Polovina model.

[24] The 1993 study indicated that the average tuna vessel was not covering all of its costs, and the updated estimates indicated that the average swordfish vessel was not covering all of its costs. While it is possible that vessels have years in which they do cover all costs, it is unlikely that vessels remain in the fishery if they are not at least breaking even over time.

Figure 4.8-5: Estimated Number of Break-even Vessels by Effort Type Under Alternative 1.

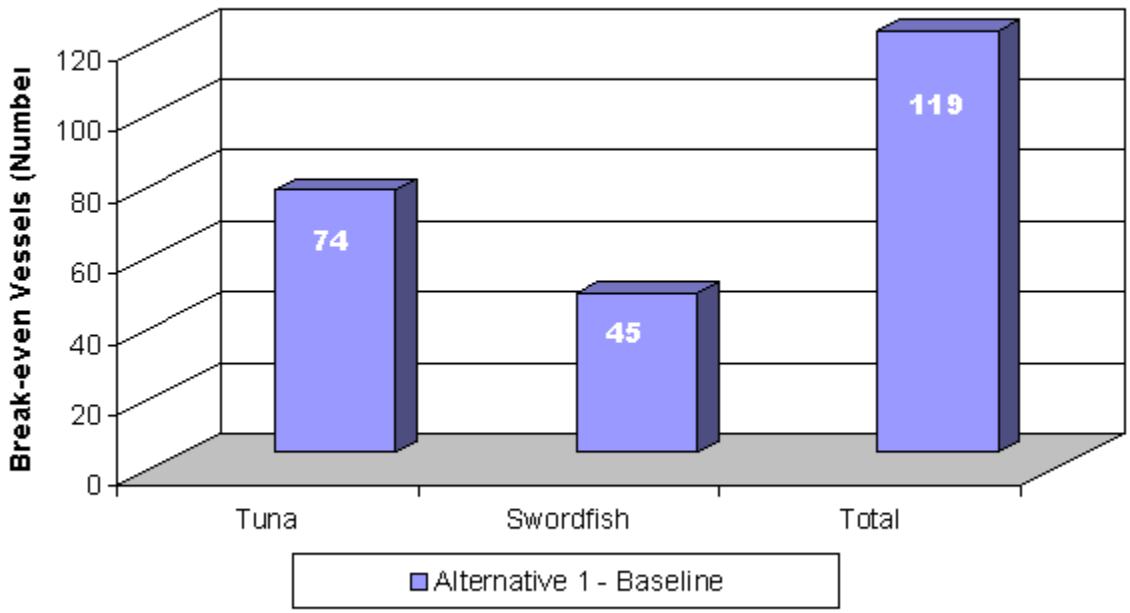
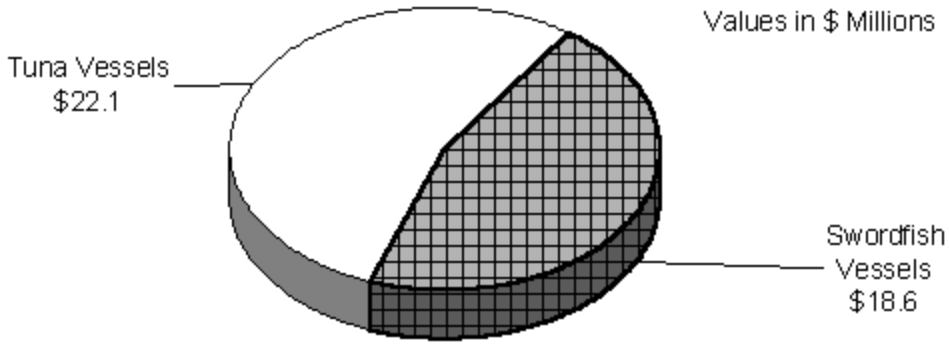


Figure 4.8-6 shows estimated gross revenues of the longline fleet under Alternative 1 as $40.7 million. Tuna vessels have gross revenues of $22.1 million (approximately 54 percent of total longline gross revenues). Swordfish vessels have gross revenues of approximately $18.6 million (46 percent of total longline gross revenues). The average swordfish vessel has $414,000 in gross revenues, and the average tuna vessel has $298,000. Swordfish vessels tend to be slightly larger than tuna vessels and are more expensive to operate. This cost difference is compensated for by the higher relative gross revenues. The average gross revenue figures for tuna and swordfish vessels were relied on as break-even values for operation of vessels and were used throughout the analysis for determining the number of vessels active in the two fleets.

Figure 4.8-6: Estimated Total Longline Gross Revenues by Effort Type Under Alternative 1.



Note: Alternative 1 is the base line case with a collective fleet-wide gross revenue of $40.7 million.

Other Fisheries Managed Under the Western Pacific Pelagics

In addition to the longline fleet, several other, smaller fleets participate in the Hawai'i-based pelagic fishery and in fisheries in the EEZs of U.S. territories in the western Pacific. These fisheries are not directly affected under Alternative 1 and are assumed to operate at current levels described in Section 3.10.

Currently, 1,824 handline and troll vessels, six pole-and-line vessels, and 199 charter vessels participate in the Hawai'i-based pelagic fishery. A substantial number of recreational vessels also participate. In addition, 25 longline vessels and 24 troll and charter vessels based in American Samoa, 438 troll and charter vessels based in Guam, and 89 troll and charter vessels based in the CNMI participate under the jurisdiction of the western Pacific Pelagics FMP. Table 4.8-2 shows the estimated economic indicators for these fisheries.

4.8.3 Economic Impacts of Alternative 2

Alternative 2 integrates several management actions approved by NMFS and the Council since 1999 with the effort, catch, and gross revenue projections of Alternative 1 set out in Table 4.8-8. As of March 2001, these management actions had not been fully implemented in the fisheries. A detailed description of the additional management measures under Alternative 2 is provided in Section 4.1. In general terms, Alternative 2 adds the following management changes to Alternative 1:

- The preferred alternatives to reduce the incidental catch of albatross in the Hawai'i-based longline fishery as described in the STAL BO (FWS, 2000).

- The Prohibition on Shark-finning adopted by the U.S. Congress in December 2000.
- Requirements to use line clippers and dip nets and comply with sea turtle handling regulations, as described in NMFS (2000k).
- Permitting and reporting requirements for handline and troll fisheries in Pacific Remote Island Areas.

Table 4.8-8: Alternative 2: Current and Pending Council and NMFS Actions.

Objective of Measure	Measure
Reduce Turtle Mortalities	Requirements to use line clippers and dip nets and comply with sea turtle handling regulations
Reduce Albatross Interactions	Use of albatross deterrents in specific areas
Reduce Blue Shark Interactions	Shark finning would be banned as mandated in the Magnuson-Stevens Act
Reduce American Samoa Fishery Interactions	Large vessel area closure plus control date for possible limited entry in American Samoa
Increase Understanding of the Fishery	Permitting and reporting requirements for handline and troll fisheries in Pacific remote island areas

In addition to direct effects on the Hawai'i-based longline fishery, Alternative 2 imposes area restrictions in the EEZ around American Samoa on all vessels that are greater than 50 feet in length. The effects of the prohibition on fishing for PMUS within closed areas around the islands of American Samoa by vessels more than 50 feet in length are described in detail in WPRFMC (2000f). However, direct economic impacts of this change are not quantified in this analysis due to the lack of data showing area-specific effort for longline vessels in American Samoa. Qualitative effects and a figure showing the American Samoa closure areas are presented later in this section.

Alternative 2 also includes a requirement that handline and troll fishing vessels landing PMUS in EEZ waters of the Remote Pacific Island Areas obtain permits. The permit requirement will not create a limited entry fishery, but is to aid in creating better records for activity in the fishery. The alternative also establishes reporting requirements for these fishers. The reporting requirements would include information concerning catch, effort, incidental catch and discards, and interactions with protected species.

The institution of reporting requirements will impose some minor costs on fishers, primarily time costs of reporting data. The benefits of this program, however, extend to many aspects of the fishery, including the fishers. Reporting requirements will provide data to fisheries managers that will assure that future regulations are well crafted to preserve the fishery and will impose the least restrictive regulations on the activities of fishers. A more complete discussion of some possible specific reporting requirements appears in the discussion of Alternative 9B.

The projected economic impacts of Alternative 2 are shown in Table 4.8-9. Overall, it is estimated that the total gross revenue in the Hawai'i-based longline fishery would increase by 0.4 percent under Alternative 2 compared to Alternative 1, while longline interactions with Laysan and black-footed albatross would decrease by 87 percent. Tuna vessels are expected to see a slight decrease in total revenue while swordfish vessels are expected to experience a slight increase.[25] The economic effects of Alternative 2 were estimated by adjusting the Kobayashi-Polovina model results for Alternative 1 to be consistent with projected changes in CPUE and albatross interaction rates resulting from the changes in fishing practices described in WPRFMC (2001a), and by adjusting blue shark mortality under the assumption of no retention.

The changes to CPUE as modeled have the effect of increasing total catch and gross revenue under Alternative 2, particularly for swordfish vessels. This change is primarily a result of a projected increased catch resulting from an increase in night sets under this alternative. The projected changes in catches should be regarded as somewhat tentative, because it is likely that if increased CPUEs and revenues were attainable with changes in fishing practices, fishers would have adopted the changes already.

The prohibition on shark finning is assumed to make it un-economic for fishers to retain any blue sharks because of the undesirable qualities of their flesh after mortality. The analysis assumes all blue shark will be unhooked and returned to the water. It is assumed that there is a 15 percent hooking mortality for blue sharks. In other words, all sharks will be returned to the sea, but 15 percent of those will not survive. It is also assumed that all other sharks will be retained.

In addition to changes in CPUEs, the measures to reduce albatross interactions impose direct costs on swordfish and tuna vessels. These compliance costs, as shown in Table 4.8-9, are estimated to total more than $115,000 annually, 60 percent of which is projected to be borne by swordfish vessels.[26] Specific details on the albatross interaction measures, compliance costs, and changes in CPUEs are provided later in this section.

[25] The slight decrease in the gross revenue results in a one-vessel decrease in the break-even tuna fleet. The reduction in vessels reflect the integer nature of the break-even analysis, which requires at least $298,000 per tuna vessel.

[26] These compliance costs are not used in the breakeven analysis to maintain the emphasis on gross revenues.

Table 4.8-9: Projections of Economic Impacts Under Alternative 2.

	Alternative 2			Change from Alternative 1			Percentage Change from Alternative 1		
	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total
Break-even Vessels (Number)	73	45	118	-1	0	-1	-1.4	0.0	-0.8
Persons on Break-even Vessels	402	203	605	-5	0	-5	-1.2	0.0	-0.8
Effort (Sets)	7,128	4,751	11,879	0	0	0	0.0	0.0	0.0
Effort (Trips)	714	433	1,148	0	0	0	0.0	0.0	0.0
Trips per Break-even Vessel	9.8	9.6	9.7	0.1	0.0	0.1	1.4	0.0	0.8
Tuna Revenue ($Millions)	19.7	7.4	27.0	0.2	2.2	2.4	0.8	43.0	9.6
Swordfish Revenue ($Millions)	0.4	10.6	11.0	-0.1	-0.7	-0.8	-18.0	-6.5	-7.0
Shark Revenue ($Millions)	0.3	0.1	0.3	-0.1	-1.1	-1.3	-36.7	-94.8	-80.3
Other PMUS Revenue ($Millions)	1.7	0.8	2.5	0.0	-0.1	-0.1	2.8	-15.2	-3.8
Total Gross Revenue ($Millions)	22.0	18.8	40.9	-0.0	0.2	0.2	-0.1	1.1	0.4
Fleet-wide Direct Albatross & Turtle Compliance Cost ($ Annualized over 5 Years)	52,346	63,034	115,379	52,346	63,034	115,379	Not applicable – fleet-wide compliance costs are zero in Alternative 1		
Average Gross Revenue per Break-even Vessel ($Thousands)	301.0	417.0	345.0	3.0	3,000	3,000	1.0	0.7	0.9
Direct Payments to Labor ($Millions)	10.7	9.1	19.8	-0.0	0.1	0.1	-0.1	1.1	0.4
Direct Purchases from Local Input Suppliers ($Millions)	7.7	6.6	14.4	-0.0	0.1	0.1	-0.1	1.1	0.4
Hawai'i Total Economic Impact – Direct, Indirect, and Induced ($Millions)	26.2	22.4	48.5	-0.0	0.2	0.2	-0.1	1.1	0.4
Total Turtle Mortality	47	103	150	0	0	0	0.0	0.0	0.0
Total Albatross Mortality	15	276	291	-144	-1,800	-1,944	-90.6	-86.7	-87.0
Total Blue Shark Mortality (Thousands of Pounds)	81.9	582.9	664.8	-483.9	-4,320.1	-4,804.0	-85.5	-88.1	-87.8

Alternative 2 is not expected to have a direct effect on Hawai'i-based vessels that are currently participating in the pelagic fisheries with gear other than longline. The analysis assumes that these vessels will continue to operate in the manner described in Section 3.10.

Estimates of the primary economic indicators of these non-longline vessels are shown in Table 4.8-2.

Description of Specific Analytical Assumptions and Results

Alternative 2 requires the use of albatross deterrent measures when fishing in areas north of 23° N. latitude. All vessels fishing north of 23° N. latitude must make night sets when targeting swordfish or mixed targets, and must use a line-shooter when making sets targeting tuna. In addition, the alternative requires the use of blue-dyed and thawed baits, and requires that at least one other albatross avoidance measure be taken, depending on fishing effort type.

Data in WPRFMC (2001a) indicated that only 13 percent of the 59 vessels (six vessels) that made tuna target sets in the restricted area would need to add line-shooters. The fact that CPUEs with the line-shooters in use were projected to increase led the analysts to assume that these six vessels would install line-shooters, the estimated one-time cost of $12,000 for installation notwithstanding (J. Cook, pers. comm., October 2000).

Finally, data in WPRFMC (2001a) indicated that the use of blue-dyed and thawed bait would impose relatively low costs ($12 per affected set) and would result in relatively high reductions in albatross interactions.

Estimated changes in CPUEs with the use of night sets and line-shooters in areas north of 23° N, based on data provided in WPRFMC (2001a),are shown in Table 4.8-10. The table also shows the estimated number of affected sets and vessels and provides estimates of compliance costs, including costs of turtle mortality avoidance measures.[27]

[27] Effort switching from targeting swordfish to targeting tuna is not considered under this alternative because swordfish grounds remain open for all vessels affected by the area closure.

Table 4.8-10: Assumptions Used to Estimate Effects of Alternative 2. Source: Estimates were adapted for use in the analysis from information developed in WPRFMC, 2001a.

Affected Area	**All Sets in Areas North of 23 N. Latitude**		
Affected Effort Types	Tuna Sets	Mixed Sets	Swordfish Sets
Regulatory Requirement	Use Line-shooter	Make Night Sets	
Number of Affected Sets	831	2,304	7,764
Number of Affected Vessels	6	45	
Change in CPUE [a]	**Percentage Change in CPUE from Baseline (Fish per Set)**		
Swordfish	-89	-17	6
Bigeye	85	-32	105
Yellowfin	-67	-19	21
Albacore	343	75	28
Blue Shark [b]	-25	23	-39
Mako Shark	0	0	0
Thresher Shark	0	0	0
Blue Marlin	289	-24	-56
Striped Marlin	110	-49	-25
Compliance Cost for Albatross and Turtle Mortality Avoidance Measures			
Line-shooter for 6 Affected Vessels	$18,993 [c]	NA	NA
Blue Dyed-thawed Bait (Fleetwide)	$9,972	$48,816	
Seabird and Turtle Mortality Avoidance Training Costs (Fleetwide)	$23,380	$14,218	
Total Cost (Fleetwide)	$52,346	$6,0334	

[a] CPUE change estimates were available only for the area north of 25° N. latitude. It was assumed that CPUEs between 23° N. latitude and 25° N. latitude were change in a similar manner.
[b] Mortality of hooked blue sharks is assumed to be 15 percent.
[c] Assumes a $12,000 installation cost per vessel (WPRFMC, 1999d) that is financed with a ten percent loan over a five-year period.

The procedure for projecting outcomes under Alternative 2 used the following steps:

1. Multiply the number of affected sets by the nominal change in CPUE for each species and gear type (tuna, mixed, swordfish) to derive an estimated change in number of fish by species for all affected sets.

2. Add the result from Step 1 to the projected number of fish by species and gear from the Kobayashi-Polovina model for the base case (Alternative 1).

3. Multiply the new estimate (from Step 2) of the number of fish by species by the average weight per fish to estimate pounds caught under the alternative for each species.

4. Multiply the estimate of pounds (from Step 3) by the adjusted average price per pound for each species[28] to estimate total gross revenue.

5. Estimate total compliance costs as shown in Table 4.8-10.

6. Adjust total gross revenue by vessel type (from Step 4) by the estimated cost (from Step 5) and use the result to estimate the number of break-even vessels for each vessel type.

7. Estimate the number of break-even swordfish vessels under Alternative 2 by dividing the total gross revenue for swordfish vessels from Step 6 by the break-even gross revenue estimate under the baseline case ($414,000).

8. Estimate the number of break-even tuna vessels under Alternative 2 by using the same procedure as in Step 7, but dividing by $298,000 – the estimated break-even gross revenue for each vessel under Alternative 1.

Figure 4.8-7 shows the projected number of break-even vessels by effort type for Alternative 2. Because gross revenue projected for tuna vessels is slightly less than under the base case in Alternative 1 ($29,000 less in total), the number of break-even vessels decreases by one. The alternative is projected to have a minimal effect on the number of break-even tuna vessels active in the Hawai'i-based longline fishery.

Figure 4.8-8 shows that under this alternative, tuna vessel gross revenues are basically unchanged from Alternative 1. Swordfish revenues, however, are projected to rise by $0.2 million to $18.8 million. This change is minor (and is more likely a result of imprecision in the model than the actual effects of the regulation). Under this alternative, however, the longline fishery is largely unchanged. As shown in Table 4.8-9, industry labor income, input purchases, employment and total output (including direct, indirect, and induced output), all of which are determined directly by gross revenue, will increase by approximately three percent.

[28] The price per pound for each species was first adjusted so that the sum of revenue by species equal the estimates of total revenue generated directly by the model output as in the assessment of Alternative 1.

Figure 4.8-7: Estimated Number of Break-even Vessels by Effort Type Under Alternative 2.

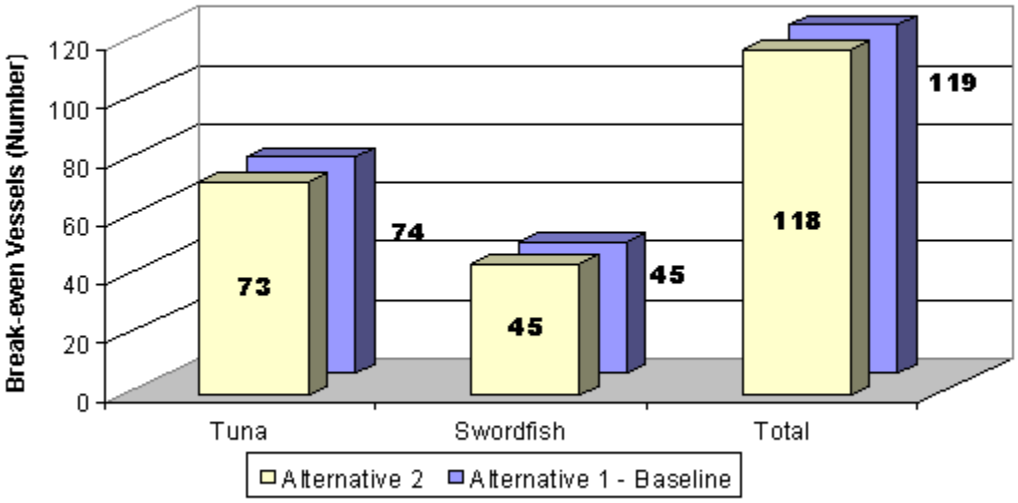
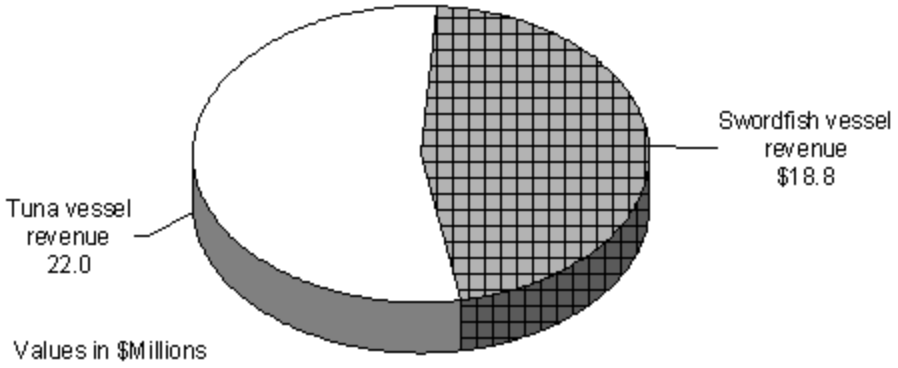


Figure 4.8-8: Projected Gross Revenue By Vessels Type under Alternative 2.



Note: Vessels targeting swordfish under Alternative 1 will receive a collective increase in gross revenues of $0.2 million under Alternative 2. Total revenues for tuna vessels are basically unchanged ($29,000 less overall).

Assessment of Effects of Alternative 2 on the Pelagic Fisheries in American Samoa.

Alternative 2 includes a measure that would implement area closures in the EEZ around American Samoa. The measures address the concerns raised by the potential entry of large vessels (vessels more than 50 feet in length) into the EEZ around American Samoa. The entry of these large vessels may create gear conflicts, reduce profitable fishing operations, and negatively affect traditional fishing practices and recreational fishing activities (WPRFMC, 2000f). The alternative will close off fishing grounds to these large vessels in a radius of 50 nautical miles around Swain's Island and 50 nm surrounding the Manu'a Group, Tutuila, and Rose Atoll, as shown in Figure 4.8-9. The figure shows the existing conditions under the alternative. The existing condition portion of the figure illustrates the ranges and areas of the fishing vessels that operate around American Samoa. A few of the large domestic longline vessels, in addition to working the fishing grounds shown in the figure, range throughout the EEZ and into international waters. An analytical summary of the biological/ecological, economic, and social impacts of this preferred alternative follows (taken directly from WPRFMC, 2000f):

Biological/Ecological Impacts

- No stockwide impact.
- Maintains potential for localized densities and catch rates of pelagic fish by controlling vessel size, thereby limiting per-vessel fishing power and fish mortality in the fishing range of small-boat fleet.
- Reduces potential for bycatch, especially from *payao* sets by purse seiners.
- Redirects fishing effort away from heavily exploited inshore marine resources.
- Establishes buffer zone around Rose Atoll that reduces risk of large U.S. pelagic vessel grounding.

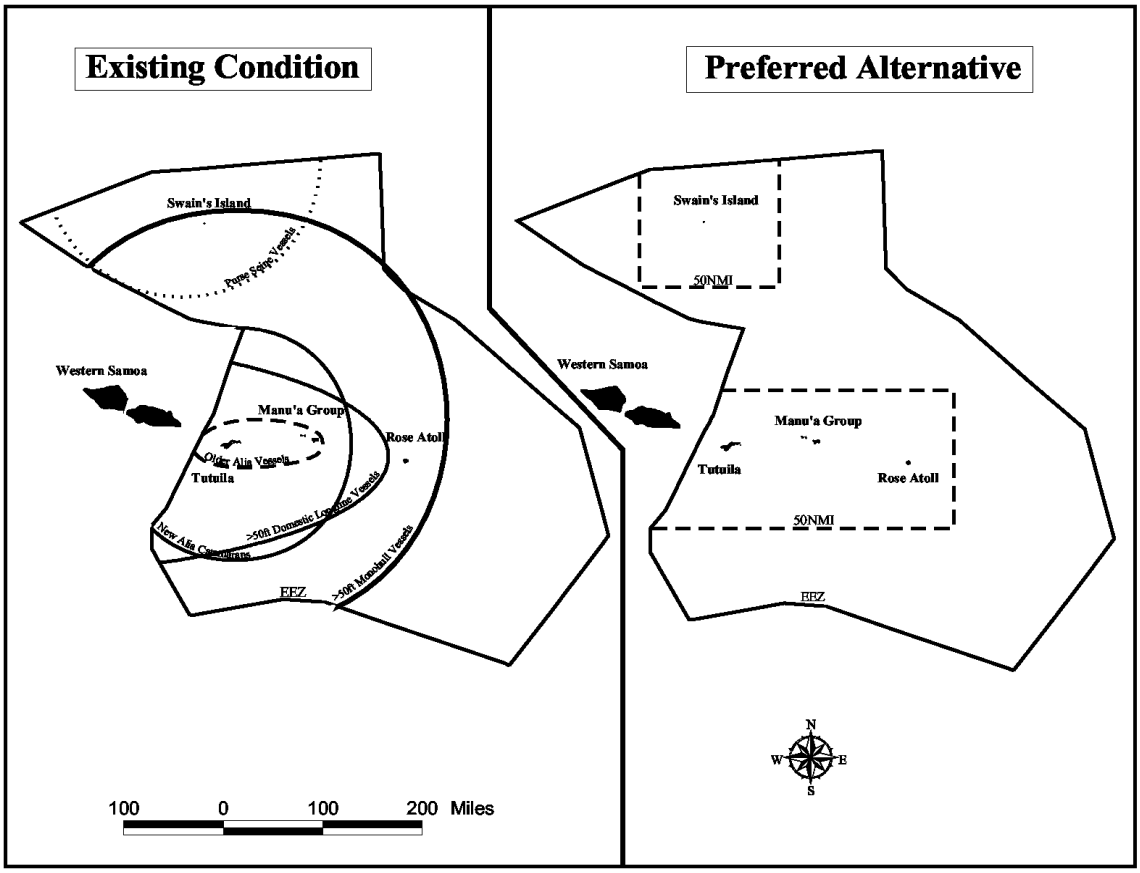
Economic Impacts

- Reduces catch competition from large-scale harvesters, thereby maintaining the potential for economically viable catch rates within fishing range of small-scale pelagic fleet.
- Reduces risk of "boom and bust" development of local pelagic fishery.
- Encourages expansion of fishery and support industries at a managed pace.
- Marginally increases fishing costs for non-exempted large-scale U.S. pelagic

Social Impacts

- Maintains availability of pelagic fish within fishing range of small-scale fleet to sustain community participation in fishery and meet subsistence and cultural needs.

Figure 4.8-9: American Samoa, Existing Condition: Fishing Grounds by Gear Type; Preferred Alternative: Fishing Areas to be Closed to Large Vessels. Source: Adapted from WPRFMC, 2000f.



4.8.4 Economic Impacts of Alternative 3

Alternative 3 examines the effects of the court-mandated management measures, which are currently in effect and described in Table 4.8-11.

Table 4.8-11: Alternative 3: Court-Ordered Action (Status Quo).

Objective of Measure	Measure
Reduce Turtle Interactions	Current Court-ordered time/area longline closures to reduce incidental take of sea turtles
Reduce Albatross Interactions	Actions reducing turtle interactions also reduce albatross interactions
Reduce Blue Shark Interactions	Effects on incidental shark take resulting from Court-ordered closures
Reduce American Samoa Fishery Interactions	As per Alternative 1 - The order does not affect American Samoa

This alternative will reduce fishing effort and redirect it to deep-set longlines. In summary, these management measures would consist of the following actions:

- Close an area between 28° N. and 40° N. latitude, and between 168° W. and 150° W. longitude, (Area A) to fishing and transshipping all year.
- Establish Area B, consisting of the area east and west of Area A from 173° E. to 168° W. longitude and from 150° W. to 137° W. longitude, and institute the following measures in that area:
    - Hawai'i-based longliners cannot make more than 216 sets during the period 1 June to 31 December.
    - Hawai'i-based longliners cannot make more than 74 sets from 1 January to 14 March.
    - All longline vessels must carry fishery observers when fishing in Area B at all times.
    - Area B is closed to all fishing from 15 March to 31 May.
- Establish Area C, consisting of the area south of Areas A and B from 28° N. latitude to the Equator and institute the following measures in that area:
    - Lightsticks may not be possessed onboard longline vessels.
    - Mainlines must be set so that the deepest point between any two floats is greater than 100 meters.

- Thirty percent of gross revenues derived from the sale of swordfish caught in the area must be donated to charity.

- Twenty percent of the vessels must carry fishery observers and have a NMFS fishery waiver form onboard if fishing without an observer.

- Area C is closed to fishing from 15 March to 31 May.

Projections of the outcomes under Alternative 3 were made using the Kobayashi-Polovina model. This model is described in detail in Appendix C. The same model was used to estimate the outcome under the base case described in Alternative 1. The projected outcomes under Alternative 3 use the same data as were used in the base case, but redistribute effort on a time-and-area basis. In general, the redistribution of efforts is made with the assumption that swordfish sets in closed areas shift to swordfish sets in open areas within the same time period. Similarly, effort in mixed-target and tuna target sets in closed areas shifts to effort on similar targets in open areas. Analytical difficulty arises when all effort on a target in a particular period is closed under the alternative. In such cases one of two scenarios can occur: (1) effort for that target will switch to effort for another target; or (2) effort for that target will leave the longline fishery completely. In other words, if all effort on swordfish targets is closed for a period of time under the alternative, swordfish vessels will either (1) switch their effort to mixed or tuna targets; or (2) leave the Hawai'i-based longline fishery completely.

While it is reasonable to assume that swordfish vessels would easily switch from effort targeting swordfish to mixed-target effort, it is more difficult to accept the premise that swordfish vessels will be able to easily switch to effort targeting tuna – the gear configurations and the vessel economics differ greatly for tuna fishing and swordfish fishing. It is likely that the outcome will fall somewhere between these two scenarios.

The results of the analysis that assumes that swordfish vessels will switch to targeting tuna, if profitable, are presented in Table 4.8-12. The results of the analysis that assumes no switching of targets are presented in Table 4.8-13. Projections for both scenarios were made using the model and are presented in this section.

Under the switching analysis, enough effort from swordfish and mixed-target sets switches to tuna target sets that the total gross revenue generated will accommodate an additional ten swordfish vessels switching to targeting tuna, assuming that each swordfish vessel needs $414,000 to break even. Thus, in Table 4.8-12 the number of tuna vessels is shown to increase to 84 from the base case in Alternative 1. However, total gross revenue for swordfish vessels that do not switch is only enough to accommodate three vessels, assuming that each needs at least $414,000 to break even. The overall impact is a reduction in fleet gross revenue of about $12.5 million or 31 percent.

Albatross mortality is projected to decline by approximately 81 percent from the base case under this alternative. Turtle mortality is projected to decline by approximately 50 percent or 75 animals. Alternative 3 results in the second highest tradeoff in terms of gross revenues foregone per protected turtle and albatross saved. Only Alternative 8, a total closure of the Hawai'i-based longline fishery, results in higher economic tradeoffs to the fleet. The two scenarios in this alternative are fairly similar in their effect under this comparison. Also, in each case, the more animals saved the larger the gross revenues foregone to the fleet. The fleet is projected to have foregone gross revenues of $165,000 per turtle saved and $7,000 per albatross saved. The lower revenue reduction per albatross reflects higher albatross mortality. Under Alternative 3 with no switching, blue shark mortality is projected to decline by approximately 78 percent from the level under Alternative 1.

A few aspects of the model are worth discussing here. For purposes of this analysis, each participating vessel is assumed to be at a break-even gross revenue position in the base case. This means that total gross revenues are just sufficient to cover total fixed and operating costs, $298,000 in the case of tuna vessels, and $414,000 in the case of swordfish vessels. As alternatives are analyzed, the number of vessels drops or increases, depending on whether available gross revenues can support more vessels. Vessels switching between target types are assumed to require the same gross revenues as required under the base case in Alternative 1. This assumption may underestimate the total fleet size if swordfish vessels are able to target tuna at less cost than they target swordfish, reducing the break even gross revenue from $414,000 used in the estimation. Complete and accurate vessel cost and opportunity information is not available to estimate anticipated actual vessel behaviors.

Other aspects of the model, however, likely overestimate gross revenues and the number of vessels in the fleet. The analysis is an aggregate analysis, rather than a vessel-level analysis. Consequently, gross revenues were calculated based on the total effort remaining in the fishery after the restriction was imposed, assuming that all vessels continue to operate to the extent permitted by the regulation. A more precise estimation would first determine which vessels would remain economically viable under the restrictions imposed by the alternative. All effort from vessels not economically viable would be removed from the fishery. Only effort from vessels able to remain in the fishery under the regulation would be used to determine catches, gross revenues, and other effects of the alternative. Information on vessel-specific productivity levels needed for a vessel-level analysis are unavailable. Therefore, the method of estimation used may overestimate gross revenues and the number of vessels in the fishery under the alternative.

The model may also overestimate the number of vessels in the fishery in cases of seasonal closures. This alternative closes all fisheries for two and a half months from mid-March to the end of May. Under a vessel-level analysis, each vessel's productivity would depend solely on its fishing effort for the portion of the year that it is able to fish (with no vessels having any revenues during the two-month closure). The loss of revenues from a seasonal closure is highly detrimental to fishers, who require a significant portion of their yearly revenues to

cover fixed costs. Fixed costs include costs such as vessel payments, which must be paid whether the fisher is able to fish or not. For vessel owners with large vessel payments, seasonal closures could drive them out of a fishery or out of business altogether. Seasonal closures can have the effect of eliminating all returns to the vessel owner. Seasonal closures are less severe for vessel owners with low fixed costs, such as vessel owners who own their vessels outright, who must cover only variable costs (such as payments to crew members and input purchases). Because the break-even analysis ignores the issue of fixed costs, the number of vessels likely to fall under the break-even gross revenue using a vessel level-analysis (and in reality) is likely to be less than estimated by the aggregate analysis used here.

This effect may be countered if vessels are able to supplement their income by operating in other fisheries during closures. Under the currentCourt-orderd management regime a portion of the swordfish fleet has relocated to California during the closures. The amount of revenue that these vessels will need from the Hawai'i-based fishery to reach break-even gross revenues and still remain active would be less than the amount required by vessels that do not relocate to California. The option of relocating to California, however, should not be viewed as a long-term solution for these fishers because it is probable that California fisheries will adopt similar closures in the near future. Clearly, the model is not without shortcomings. The model, however, is the best available with existing data. Its economic estimates should be considered generally accurate and should be considered in the context of its limitations.

Effects of a seasonal closures on fishing vessels may also be mitigated to some extent by changing the timing of annual vessel maintenance and repairs and by shifting the timing of non-fishing periods. If fishers in the past have typically taken time off from fishing during the winter period for boat repair or vacations, they may shift that time off to the closure period and thereby maximizing potential fishing time during open periods.

Seasonal closures are likely to create opportunities for other commercial fishing sectors. It is likely that handline and troll fishers will seek to increase landings during the closure period to take advantage of the supply shortfalls and the potentially higher prices that may follow. Data and models to produce quantitative estimates of the ability of other commercial sectors to fill the supply void are not available, but as discussed in Section 3.10.3 quality issues may limit the ability of other sectors to completely satisfy demand.

The closures are likely to have effects on fishery trade and distribution sectors and on input suppliers. Fishery closures will force fishery trade and distribution sectors to look for other sources of product. Businesses that are primarily involved in exports may see a shift to importing. Businesses that are currently importing fish will likely experience revenues gains Businesses that deal primarily with local supplies may also need to develop import markets. While it is likely that the overall demand for fishery products in Hawai'i will continue at a relatively high level, seasonal closures of the tuna fishery will mean that some of this demand will be met through increased imports or from increasing purchases from other types of

Hawai'i-based fishing vessels. It is also likely that some of the demand for fish will change to demand for chicken, pork, or beef.

While it is clear that the seasonal closures will cause disruptions in the existing structure of the economy, it is unlikely that markets and market channels for fishery products and supplies will be completely eliminated. Many, if not most, of the fisheries in the United States operate under seasonal restrictions. The Bering Sea pollock fishery off Alaska,[29] which is one of the largest single species fisheries in the world, has successfully operated over the last decade with open seasons from the end of January through the beginning of March and the beginning of September through October. The market for pollock remains strong in spite of its seasonal nature, and the industry is able to purchase gear and supplies to meet its needs. Similarly, the Alaska salmon and halibut fisheries both with participating vessels numbering in the thousands, are completely inactive during the winter months, but manage to remain viable in spite of their seasonal natures.

Table 4.8-12 shows the estimated economic impacts of Alternative 3 with the assumption that swordfish vessels will be able to switch to tuna fishing. Under this somewhat optimistic scenario, the Alternative is expected to reduce of revenue from longline fishing by $12.5 million. The scenario under Alternative 3 in which effort switching does not occur, is shown in Table 4.8-13. This less optimistic scenario projects that revenue from the longline fishery will decline by $20.7 million, a reduction of 51 percent. Under the non-switching assumption, total gross revenue in tuna target fisheries are reduced to the point that 13 fewer tuna vessels would be able to meet break-even gross revenue requirements. In addition, revenue for swordfish vessels drops to levels that support no more than four vessels, assuming that each needs to generate $414,000 to remain in the fishery.

The effects of Alternative 3 will not be limited to fishing vessel owners, operators and crewmembers, but will also be felt by sectors of the economy that supply inputs and services to the fishing vessels, by sectors of the economy that purchase the products of the longline fleet, and indirectly by all other sectors as the reductions in income and sales ripple through the economy. As shown in Tables 4.8-12 and 4.8-13, Alternative 3 is expected to reduce input purchases by $4.4 million to $7.9 million depending on the ability of swordfish fishers to switch to targeting tuna. These reductions represent up to 51 percent of the total input purchases made by the longline fleet and, based on 1998 estimates represent between 15 and 20 percent of all purchases of inputs by Hawai'i-based fishing vessels (see Table 3.10.2-7).

An estimated 77 fewer turtle mortalities are projected to occur under Alternative 3 assuming the effort switching scenario (Table 4.8-12) – a decline of over 50 percent from the baseline, while albatross mortalities are expected to fall by nearly 81 percent. Under the non-switching scenario for Alternative 3, it is projected that 94 fewer turtles and 1,857

[29]The Alaska pollock fishery is a highly industrialized fishery with most of its product sold frozen and highly processed. In this regard it is different than the Hawai'i longline fisheries with its predominantly fresh markets.

fewer albatrosses are killed as a result of interactions with longline gear. The average gross revenue foregone by the fleet under this alternative is approximately $220,000 per turtle saved and $11,000 per albatross saved.

Table 4.8-12: Projections of Economic Impacts Under Alternative 3 Assuming Effort Switching.

Indicator	Alternative 3 With Switching			Change from Alternative 1			Percentage Change from Alternative 1		
	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total
Break-even Vessels (Number)	84	4	88	10	-41	-31	13.5	-91.1	-26.1
Persons on Break-even Vessels	462	18	480	55	-185	-130	13.5	-91.1	-21.3
Effort (Sets)	9,088	420	9,508	1,960	-4,331	-2,371	27.5	-91.2	-20.0
Effort (Trips)	911	35	946	196	-398	-202	27.5	-91.8	-17.6
Trips per Break-even Vessel	10.8	8.9	10.7	1.2	-0.8	1.1	12.3	-8.1	11.5
Tuna Revenue ($Millions)	23.5	0.3	23.8	4.0	-4.9	-0.9	20.5	-94.9	-3.6
Swordfish Revenue ($Millions)	0.5	1.3	1.8	0.0	-10.0	-10.0	0.6	-88.6	-85.1
Shark Revenue ($Millions)	0.4	0.2	0.6	0.0	-1.0	-1.0	10.2	-86.3	-62.2
Other PMUS Revenue ($Millions)	2.0	0.0	2.1	0.4	-0.9	-0.6	21.3	-96.8	-22.0
Total Gross Revenue ($Millions)	26.5	1.7	28.2	4.4	-16.9	-12.5	19.9	-90.6	-30.7
Fleet-wide Direct Albatross & Turtle Compliance Cost ($ Annualized over 5 years)	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
Average Gross Revenue per Break-even Vessel ($Millions)	0.315	0.437	0.320	0.017	0.023	-0.022	5.7	5.6	-6.4
Direct Payments to Labor ($Millions)	12.8	0.8	13.7	2.1	-8.2	-6.0	19.9	-90.6	-30.7
Direct Purchases from Local Input Suppliers ($Millions)	9.3	0.6	9.9	1.5	-5.9	-4.4	19.9	-90.6	-30.7
Hawai'i Total Economic Impact--Direct, Indirect, and Induced ($Millions)	31.4	2.1	33.5	5.2	-20.1	-14.8	19.9	-90.6	-30.7
Total Turtle Mortality	58.4	16.1	74.5	11.6	-87.2	-75.6	24.8	-84.4	-50.4
Total Albatross Mortality	171	261	433	12	-1,815	-1,803	7.8	-87.4	-80.6
Total Blue Shark Mortality (thousands of pounds)	714	726	1,440	148	-4,177	-4,029	26.1	-85.2	-73.7

Table 4.8-13: Projections of Economic Impacts Under Alternative 3 with No Effort Switching.

Indicator	Alternative 3 Without Switching			Change from Alternative 1			Percentage Change from Alternative 1		
	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total
Break-even Vessels (Number)	61	4	65	-13	-41	-54	-17.6	-91.1	-45.4
Persons on Break-even Vessels	336	18	354	-71	-185	-256	-17.4	-91.1	-42.0
Effort (Sets)	6,224	420	6,644	-904	-4,331	-5,235	-12.7	-91.2	-44.1
Effort (Trips)	624	35	659	-91	-398	-488	-12.7	-91.8	-42.6
Trips per Break-even Vessel	10.2	8.9	10.1	0.6	-0.8	0.5	5.9	-8.1	5.1
Tuna Revenue ($Millions)	16.2	0.3	16.5	-3.3	-4.9	-8.2	-16.9	-94.9	-33.2
Swordfish Revenue ($Millions)	0.3	1.3	1.6	-0.2	-10.0	-10.2	-33.7	-88.6	-86.4
Shark Revenue ($Millions)	0.3	0.2	0.5	-0.1	-1.0	-1.1	-26.3	-86.3	-71.3
Other PMUS Revenue ($Millions)	1.4	0.0	1.4	-0.3	-0.9	-1.2	-16.8	-96.8	-46.1
Total Gross Revenue ($Millions)	18.2	1.7	20.0	-3.8	-16.9	-20.7	-17.4	-90.6	-50.9
Fleet-wide Direct Albatross & Turtle Compliance Cost ($ Annualized over 5 years)	0	0	0	0	0	0	0.0	0.0	0.0
Average Gross Revenue per Break-even Vessel ($Millions)	0.299	0.437	0.307	0.1	0.023	-0.035	0.3	5.6	-10.2
Direct Payments to Labor ($Millions)	8.8	0.8	9.7	-1.9	-8.2	-10.0	-17.4	-90.6	-50.9
Direct Purchases from Local Input Suppliers ($Millions)	6.4	0.6	7.0	-1.3	-5.9	-7.3	-17.4	-90.6	-50.9
Hawai'i Total Economic Impact – Direct, Indirect, and Induced ($Millions)	21.6	2.1	23.7	-4.6	-20.1	-24.6	-17.4	-90.6	-50.9
Total Turtle Mortality	39.9	16.1	56.0	-6.9	-87.2	-94.1	-14.8	-84.4	-62.7
Total Albatross Mortality	117	261	379	-42	-1,815	-1,857	-26.2	-87.4	-83.1
Total Blue Shark Mortality (thousands of pounds)	488	726	1,214	-78	-4,177	-4,255	-13.8	-85.2	-77.8

As shown in Figure 4.8-10, Alternative 3 is projected to have a dramatic effect on the longline fishery. Assuming that vessels do not switch effort to fisheries that are unaffected

by the regulations (Scenario B), this alternative is projected to reduce the number of tuna vessels to 61 (a decline of almost 20 percent) and the number of swordfish vessels to four (a reduction of more than 90 percent). The total fleet is projected to decline by almost 50 percent. Under Scenario A, in which swordfish vessels switch effort to target tuna, the decline in vessels is moderated slightly by increased activity in the tuna fishery. The number of swordfish vessels is still projected to decline to four, because the swordfish fishery is largely eliminated from the Hawai'i-based pelagic fishery. The number of tuna vessels, however, is projected to increase by ten to 84 – in other words, with effort switching the models project an increase in overall effort targeting tuna. This increase is somewhat speculative because the vessels used to target swordfish are larger and more costly to operate than those used to target tuna. The swordfish vessels would, therefore, need to realize greater revenues targeting tuna than the average vessel that currently targets tuna. Although this is accounted for in the break-even analysis, the number of swordfish vessels that could successfully make this transition is questionable.

Figure 4.8-10: Estimated Number of Break-even Vessels by Effort Type Under Alternative 3.

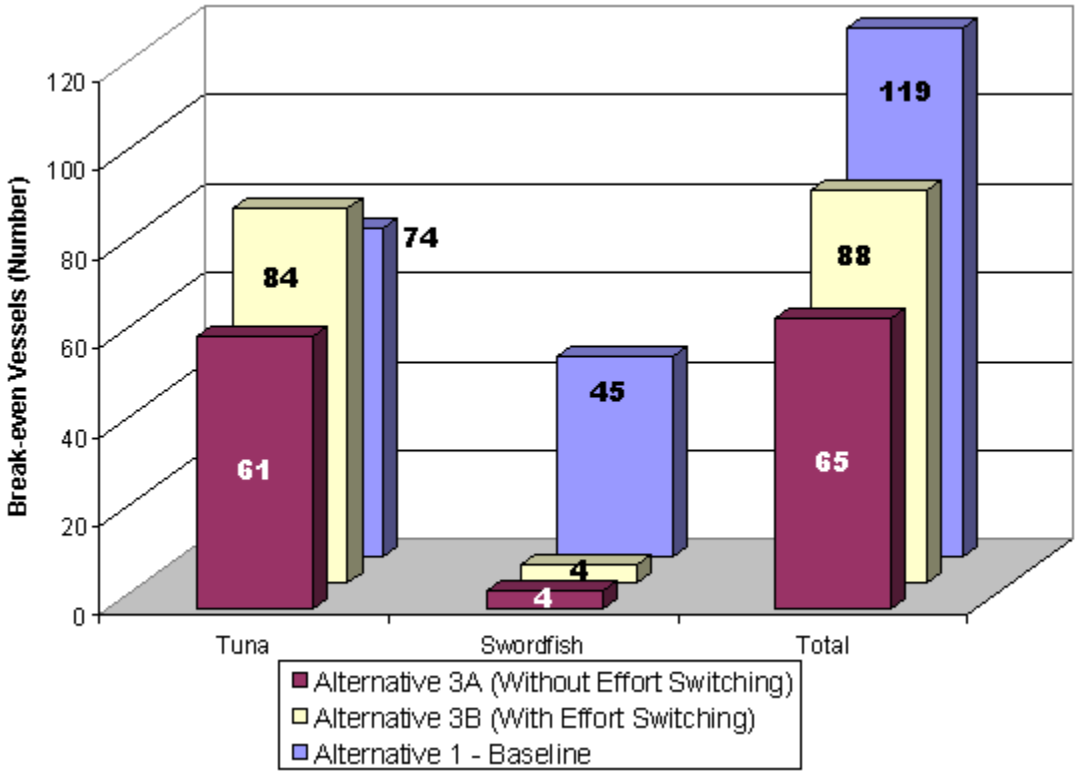
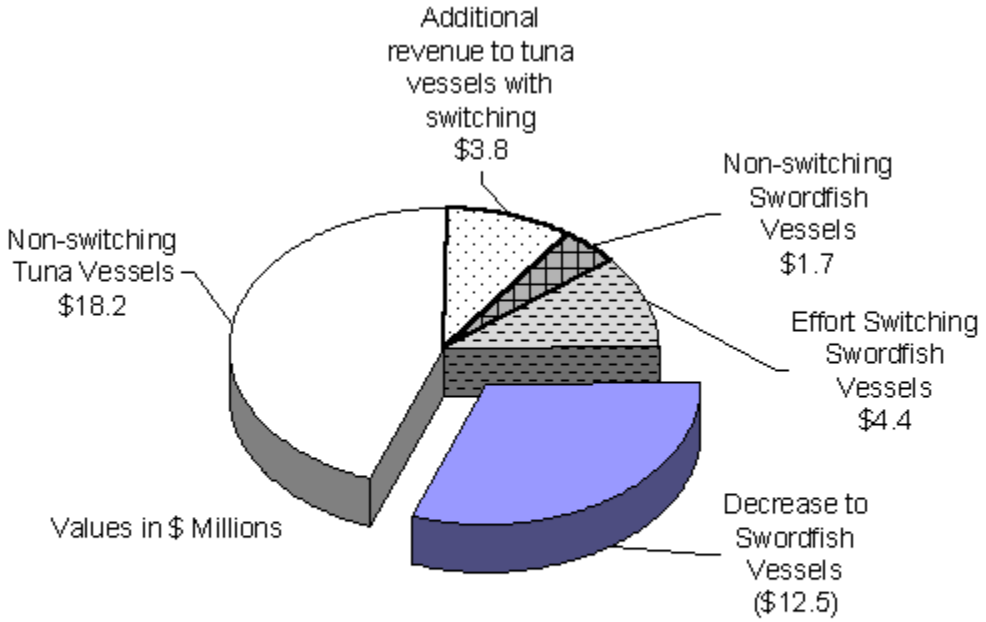


Figure 4.8-11 shows the projected gross revenues under Alternative 3. Under the scenario without effort switching, swordfish fleet gross revenues are projected to decrease by more than 90 percent to $1.7 million. Tuna fleet gross revenues are also projected to decline by approximately 17 percent in the scenario without effort switching. The decline in tuna gross

revenues, however, is projected to be recovered if effort switching is successful – however it should be noted that this recovery is not expected to go to traditional tuna vessels but will instead accrue to swordfish vessel owners who successfully switch into fishing for tuna. An additional $4.4 million in gross revenues is projected to be realized by swordfish vessels, if they are successful in entering the tuna fishery. As noted above, switching of effort may be unsuccessful because the swordfish vessels are less suitable for the tuna fishery. The result of this model (assuming that all vessels are successful in switching effort) is a decline in gross revenues of approximately $12.5 million (or more than 30 percent).

Figure 4.8-11: Total Longline Gross Revenues by Effort Type Under Alternative 3.



Notes:
1. Vessels targeting swordfish under Alternative 1 will suffer a collective reduction in gross revenues of $12.5 million under Alternative 3.
2. Scenario B assumes vessels will not switch effort, therefore the fleet will suffer an additional collective loss of $8.2 million ($20.7 million total).

4.8.5 Economic Impacts of Alternative 4

Alternative 4 institutes a management measure that is different from those mandated by the Court-ordered regime and is described in Table 4.8-14. The measure will both reduce and redirect fishing effort by using a combined temporal and spatial closure. The alternative would consist of a closure of the area north of 29° N. latitude to longline fishing by the Hawai'i-based fleet from July through January.

Table 4.8-14: Alternative 4: Seasonal Area Longline Fishery Closures.

Objective of Measure	Measure
Reduce Turtle Interactions and Mortalities	Seasonal closure of areas north of 29° N. latitude to longline fishing from July through January. Fisher education and training to reduce incidental take of sea turtles
Reduce Albatross Interactions	Use of albatross deterrents in specific areas based on the STAL BO Actions reducing turtle interactions also reduce albatross interactions
Reduce Blue Shark Mortalities	Shark finning would be banned as mandated in the Magnuson-Stevens Act
Reduce American Samoa Fishery Interactions	Large vessel area closure plus control date for possible limited entry in American Samoa
Increase Understanding of the Fishery	Permitting and reporting requirements for handline and troll fisheries in Pacific remote island areas

In addition, Alternative 4 includes a prohibition on the finning of sharks without retention of the carcass, and Alternative 4 implements a suite of measures that would reduce interactions with albatross. The albatross measures are the same as those analyzed in Alternative 2. All vessels fishing north of 23° N. latitude must make night sets when targeting swordfish or mixed targets, and must use a line-shooter when making sets targeting tuna. In addition, the alternative requires the use of blue-dyed and thawed baits, and requires that at least one other albatross avoidance measure be taken, depending on fishing effort type.

Alternative 4 includes a measure that will close off fishing grounds around American Samoa to vessels more than 50 feet in length. The area closure would include waters in two areas, with straight-line boundaries, that encompass a radius of 50 nautical miles around Swain's Island and 50 nautical miles surrounding the Manu'a Group, Tutuila, and Rose Atoll, as shown in Figure 4.8-9. The closure is intended to reduce gear conflicts, increase profitable fishing operations, and preserve traditional fishing practices and recreational fishing activities that are thought to suffer with the entry of large vessels to the fishery (WPRFMC, 2000f). The closure might be expected to affect few large vessels under this alternative, because few vessels are displaced from the Hawai'i-based fisheries under this alternative's regulations.

Alternative 4 includes a requirement that handline and troll fishing vessels landing PMUS in EEZ waters of the PRIAs obtain permits. The permit requirement will not create a limited entry fishery but is to aid in creating better records for activity in the fishery. The alternative also establishes reporting requirements for these fishers. The reporting requirements would include information concerning catch, effort, incidental catch and discards, and interactions with protected species.

The institution of reporting requirements will impose some minor costs on fishers, primarily time costs of reporting data. The benefits of this program, however, extend to many aspects of the fishery, including the fishers. Reporting requirements will provide data to fisheries managers that will assure that future regulations are well crafted to preserve the fishery and will impose the least restrictive regulations on the activities of fishers. A more complete

discussion of some possible specific reporting requirements appears in the discussion of Alternative 9B.

As for all alternatives, projections of outcomes under Alternative 4 are based on the Kobayashi-Polovina model. The primary outcomes of the model estimating the effects of the closures to reduce turtle interactions were adjusted by adding the effects of the albatross measures and the restrictions on shark-finning.

- The effects of the prohibition on shark-finning were generated based on the assumptions that no blue sharks would be retained and that there is a 15 percent mortality rate for all blue sharks that are caught.
- The effects of the albatross measures are shown in the reduction in the incidental albatross catch rates estimated in WPRFMC, 1999c.

Because the Hawai'i-based longline fleet is restricted from primary swordfish grounds during part of the year, total gross ex-vessel revenue to the fleet is projected to decline. This decline in revenue is expected to result in several vessels leaving the fleet and concurrent reductions in catch.

The economic analysis of Alternative 4 is presented in Table 4.8-15. Under Alternative 4, three swordfish vessels and one tuna vessel (or three percent of the fleet total) are anticipated to leave the fishery. The overall effect is a reduction in total gross revenue by about $1.1 million or three percent.[27] The alternative also reduces input purchases by $0.4 million.

Albatross and turtle mortalities are projected to decrease from the projections under Alternative 1 by 90 percent and 27 percent, respectively. Foregone gross revenues are projected to be approximately $26,000 per turtle and $1,000 per albatross saved under this alternative. This is the lowest foregone gross revenue per turtle and albatross under any of the alternatives. Blue shark mortality is projected to decline by approximately 89 percent from Alternative 1 levels.

The alternative is expected to reduce gross revenue from the sale of swordfish by $1.8 million. The reduced catch of swordfish is expected to be partially offset by a $1.6 million increase in sales of tuna as swordfish fishers move into waters that are more productive for tuna, but less productive for swordfish. The negative consequences of the alternative will not be limited swordfish vessels – businesses that export swordfish out of Hawai'i will see declines, as will businesses that sell supplies to swordfish vessels. Under the alternative, input purchases are expected to decline by $0.3 million.

The results reported in Table 4.8-15 assume that the prohibition on shark finning without retaining the carcass is followed. The Kobayashi-Polovina model projects that 39,800 blue

[27]No vessels will switch targets under this alternative because swordfish fisheries remain open to the fleet.

sharks would be caught. Because the flesh of blue sharks is very undesirable, it is assumed that all blue sharks will be released with an expected hooking mortality of 15 percent. This translates to a projected blue shark mortality of 598,700 pounds.[28]

[28]Reliable estimates of the revenues derived from the finning of sharks are unavailable. It is believed that shark-fin revenue retained by crew members was a significant portion of crew member revenue.

Table 4.8-15: Projections of Economic Impacts Under Alternative 4.

Indicator	Alternative 4			Change from Alternative 1			Percentage Change from Alternative 1		
	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total
Break-even Vessels (Number)	73	42	115	-1	-3	-4	-1.4	-6.7	-3.4
Persons on Break-even Vessels	402	189	591	-5	-14	-19	-1.2	-6.9	-3.1
Effort (Sets)	7128	4,751	11,879	0	0	0	0.0	0	0
Effort (Trips)	714	433	1,148	0	0	0	0.0	0	0
Trips per Break-even Vessel	9.8	10.3	10.0	0.1	0.7	0.3	1.4	7.1	3.5
Tuna Revenue ($Millions)	19.5	6.7	26.3	0.0	1.6	1.6	0.1	30.6	6.5
Swordfish Revenue ($Millions)	0.4	9.5	10.0	0.0	-1.8	-1.8	-7.4	-15.8	-15.5
Shark Revenue ($Millions)	0.3	0.1	0.3	-0.1	-1.1	-1.3	-36.5	-94.6	-80.1
Other PMUS Revenue ($Millions)	1.7	1.4	3.1	0.0	0.4	0.4	0.1	46	16.9
Total Gross Revenue ($Millions)	21.9	17.7	39.6	-0.2	-0.9	-1.1	-0.7	-4.8	-2.6
Fleet-wide Direct Albatross and Turtle Compliance ($ Annualized over 5 years)	38,163	74,716	112,878	38,163	74,716	112,878	Not applicable–fleet-wide compliance costs are zero in Alternative 1		
Average Gross Revenue per Break-even Vessel ($)	300,000	421,000	344,000	2,000	7,000	2,000	0.7	1.7	0.6
Direct Payments to Labor ($Millions)	10.6	8.6	19.2	-0.1	-0.4	-0.5	-0.7	-4.8	-2.6
Direct Purchases from Local Input Suppliers ($Millions)	7.7	6.2	13.9	-0.1	-0.3	-0.4	-0.7	-4.8	-2.6
Hawai'i Total Economic Impact--Direct, Indirect, and Induced ($Millions)	26.0	21.1	47.1	-0.2	-1.1	-1.2	-0.7	-4.8	-2.6
Total Turtle Mortality	46.1	63.4	109.5	-0.6	-39.9	-40.5	-1.4	-38.6	-27
Total Albatross Mortality	10.7	210.4	221.2	-148.1	-1,866.2	-2,014.3	-93.2	-89.9	-90.1
Total Blue Shark Mortality (Thousands of Pounds)	82	515	597	-484	-4388	-4872	-85.5	-89.5	-89.1

Figure 4.8-12 shows the projected change in the number of longline vessels under Alternative 4. Both tuna and swordfish fleets are projected to experience slight declines. The tuna fleet is projected to decline by a single vessel, while the swordfish fleet is projected to decline by three vessels (or slightly less than seven percent). The total projected decline is four vessels (or approximately three percent).

Figure 4.8-12: Estimated Number of Break-even Vessels by Effort Type Under Alternative 4.

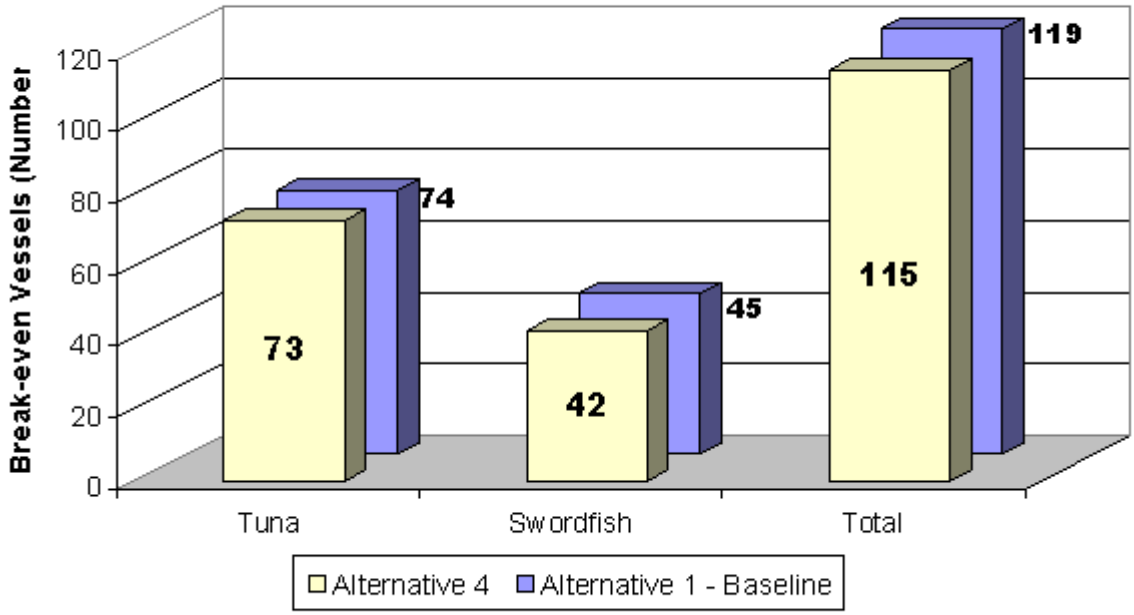
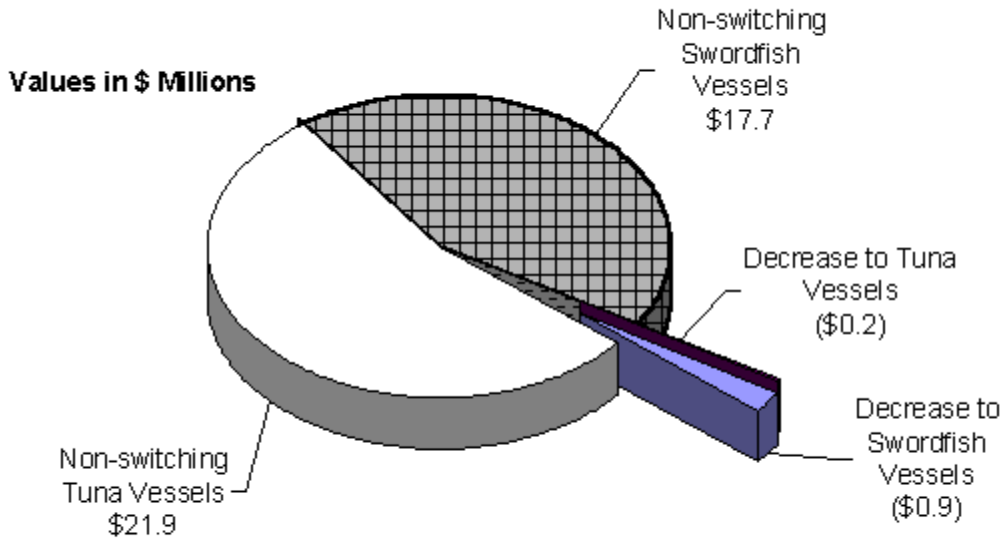


Figure 4.8-13 shows the changes in fleet gross revenue under Alternative 4. The total decline in the longline fleet's gross revenues is slightly more than $1 million (or approximately three percent). Under this alternative, gross revenues of swordfish vessels are expected to decline by approximately $0.9 million (or almost five percent of the swordfish longline fleet gross revenue), and gross revenues of tuna vessels are expected to decline by approximately $0.2 million (or less than one percent of the tuna longline fleet gross revenue). Declines of about three percent are projected for labor income, input purchases, employment, and total output (including direct, indirect, and induced output), all of which appear in Table 4.8-15.

Figure 4.8-13: Estimated Total Longline Gross Revenues by Effort Type Under Alternative 4.



Note: Vessels targeting swordfish under Alternative 1 will suffer a collective reduction in gross revenues of $0.9 million and those targeting tuna a collective reduction of $0.2 million, for a total fleet-wide reduction of $1.1 million, under Alternative 4.

4.8.6 Economic Impacts of Alternative 5

Alternative 5 institutes a management measure that is different than those mandated by the court and is described in Table 4.8-16. This measure will reduce fishing effort by redirecting effort to deep-set longline. In summary, this alternative would require the use of line-shooters or weighted branch lines on all Hawai'i-based longliners.

Table 4.8-16: Alternative 5: Increase Fishing Gear Deployment Depth.

Objective of Measure	Measure
Reduce Turtle Interactions and Mortalities	Require methods to increase water depth of fishing gear deployment Fisher education and training to reduce incidental take of sea turtles
Reduce Albatross Interactions	Use of albatross deterrents in specific areas based on the STAL BO Actions reducing turtle interactions also reduce albatross interactions
Reduce Blue Shark Mortalities	Shark finning would be banned as mandated in the Manson-Stevens Act
Reduce American Samoa Fishery Interactions	Large vessel area closure plus control date for possible limited entry in American Samoa
Increase Understanding of the Fishery	Permitting and reporting requirements for handline and troll fisheries in Pacific remote island areas

Alternative 5 includes a requirement that handline and troll fishing vessels landing PMUS in EEZ waters of the Pacific remote island areas obtain permits. The permit requirement will not create a limited entry fishery but is to aid in creating better records for activity in the fishery. The alternative also establishes reporting requirements for these fishers. The reporting requirements would include information concerning catch, effort, incidental catch and discards, and interactions with protected species.

The institution of reporting requirements will impose some minor costs on fishers, primarily time costs of reporting data. The benefits of this program, however, extend to many aspects of the fishery, including the fishers. Reporting requirements will provide data to fisheries managers that will assure that future regulations are well crafted to preserve the fishery and impose the least restrictive regulations on the activities of fishers. A more complete discussion of some possible specific reporting requirements appears in the discussion of Alternative 9B.

Alternative 5 includes an area closure that would prohibit vessels more than 50 feet in length from entering certain fishing grounds around American Samoa. The area closure would include waters in a radius of 50 nm around Swain's Island and 50 nautical miles surrounding the Manu'a Group, Tattily, and Rose Atoll, as shown in Figure 4.8-9. The objective of the closure is to reduce gear conflicts, increase profitable fishing operations, and preserve traditional fishing practices and recreational fishing activities that are thought to suffer with the entry of large vessels to the fishery (WPRFMC, 2000f). Because other limitations of this alternative effectively close the swordfish fishery off Hawai'i, the closure in American Samoa could affect several of the displaced swordfish vessels. The closure might prevent these vessels from pursuing opportunities in the area of American Samoa. In addition, Alternative 5 would implement the same suite of albatross and shark measures implemented under Alternative 4.

Alternative 5 has the effect of eliminating the use of shallow gear–the primary gear used by swordfish vessels. For swordfish vessels to remain in the fishery, they will have to adapt their

gear to fish deep. According to industry sources (J. Cook, Pacific Ocean Processors, pers. comm., October 2000; M. Dang, HLA, pers. comm., October 2000) the most efficient way to deploy deep-set gear is with the use of a line-shooter, which spins mainline off the reel at a rate that is faster than the vessel is traveling. Line-shooters puts sufficient slack in the line to allow it to sink, before being pulled taut by the vessel. Therefore, the analysis assumes that for a swordfish vessel to remain in the fishery, the vessel's owner must purchase and install a line-shooter – estimated to cost $12,000. The analysis also assumes that the line-shooters will be purchased with a ten percent interest loan over five years, and therefore the annualized cost of the line-shooters is estimated at $3,600 per vessel.

The analysis of this alternative was undertaken using two scenarios as in Alternative 3. Alternative 3, Scenario A, assumes that shallow sets that were made in the baseline case (Alternative 1) are converted to deep sets. This scenario of conversion to deep sets is designated as Alternative 5, Scenario A. Alternative 5, Scenario B assumes that full conversion to tuna target fishing with deep-setting gear is not economically viable for swordfish vessels and that instead all swordfish vessels leave the fishery. The non-switching assumption in Scenario B is based on statements by industry sources that indicate that the swordfish vessels are too heavily capitalized to be cost-effective as tuna fishing vessels. In reality, it is likely that some swordfish vessels will be able to convert and some will be forced to leave the fishery in which case the outcome is likely to fall somewhere between Scenario A and Scenario B.

As in previous alternatives, the Kobayashi-Polovina model was used to project the outcomes under this alternative. However, because the alternative focuses on effort defined by the depth of the set rather than on effort defined by the target of the set, outcomes under Alternative 5 are not directly comparable to outcomes under other alternatives except for Alternative 7 which has the same deep set requirements. The mismatch arises because 512 of the sets that were defined as mixed-target sets under Alternative 1 (and therefore assigned to swordfish vessels) meet the specifications that define effort as "deep" under Alternative 5. Therefore, the amount of effort assigned to tuna vessels under Alternative 5, Scenario B, in which no switching occurs, is greater than the amount of effort assigned to tuna under Alternative 1. The 512 sets that were redefined from mixed-target sets to tuna sets add a total of $1.8 million in gross revenue to vessels that are designated as tuna vessels under Alternative 5, Scenario B. To be consistent to the extent possible with analytical constructs used for all other alternatives, the assessment of Alternative 5 retains the assumption that all sets made for mixed targets, regardless of the depth of the set, were made on swordfish vessels. Therefore, in estimating the number of break-even vessels in Alternative 5, Scenario B (without switching), it is assumed that the original 74 vessels that target tuna require $298,000 to break even, and that the additional vessels that are re-categorized from targeting swordfish to targeting tuna require $414,000 to break even.[29]

[29] The analysis of the alternatives is based on a simplified model of reality. All models by definition make simplifying assumptions and the assumption that all mixed-target sets are made by swordfish vessels is one of those simplifying assumptions.

The projected outcomes under Alternative 5, Scenario A (with effort switching) are presented in Table 4.8-17. The projected outcomes under Alternative 5, Scenario B (without effort switching) are presented in Table 4.8-18. Under the switching analysis, all 45 swordfish vessels are anticipated to leave the swordfish fishery. Nine vessels or eight percent of the fleet are projected to leave the Hawai'i-based pelagic fishery, while 36 vessels are projected to switch to targeting tuna. The overall impact is a reduction in fleet gross revenue by about $3.3 million or eight percent. The fleet is estimated to spend approximately $172,000 annually purchasing equipment to comply with the regulation.[30]

In Scenario B, without effort switching, no vessels target swordfish and all but four of the vessels currently categorized as swordfish vessels drop out of the pelagic fishery altogether. The effort that appears to switch to tuna targeting is actually current deep sets that target tuna and are made by the present swordfish fleet. Instead of removing these deep sets from the fishery effort, the model structure assigns them all to four swordfish boats, which are projected to remain in the fishery after the regulation is put into effect.

All of the results reported in this section assume that shark finning without retaining the carcass is prohibited. The prohibition is expected to eliminate any retention of blue sharks because of the undesirable qualities of its flesh after mortality. The prohibition is not expected to have a significant impact on the retention of other shark species. The estimated mortality of blue sharks is expected to drop to approximately 1,700 animals under Scenario A (with switching) and 1,100 animals under Scenario B. The prohibition on shark finning is expected to have a significant but unknown impact on the income of longline crewmembers.[31]

Alternative 5 is expected to reduce annual purchases of inputs by longline vessels of $1.2 million if it is assumed the vessels using shallow gear can successfully switch to deep gear (Scenario A). Input purchase reductions increase to $5.9 million under Scenario B, or between 10 and 15 percent of total input purchase made by pelagic fishing vessels in Hawai'i in 1998 (see Table 3.10.2-7. Fishery trade and distribution sectors are also expected to be affected by the alternative, particularly business that rely on swordfish exports – swordfish sales are expected to fall by $11.3 million under either scenario. The effect of the alternative on the market for tuna will depend on the ability of vessels to migrate to deep-set gear. Under Scenario A, with effort switching, sales of tuna are projected to increase by $8.0 million assuming that prices remain constant. On the other hand, if swordfish fishers are unable to adapt to deep-set gear, then ex-vessel tuna sales under Alternative 5 are expected to decline by $3.8 million.

[30] This figure is based on estimates from WPRFMC, 1999c and M. Dang, HLA, pers. comm., October 2000.

[31] Reliable estimates of income derived from the practice of finning blue shark are unavailable, but crew members are thought to have received the majority of the revenues from shark finning.

Under Alternative 5A with effort switching, albatross mortality declines by 99 percent from the level projected in Alternative 1. Turtle mortality declines by 75 percent to approximately 37 animals. Under this alternative, foregone gross revenues are projected to approximate $2,000 per albatross saved and $30,000 per turtle saved. Blue shark mortality also declines by 79 percent from the Alternative 1 levels. Under Alternative 5B without effort switching turtle mortality is projected to decrease by an additional 15 turtles (or ten percent) from Alternative 5A. Albatross mortality is 22 under the scenario with effort switching and 14 under the scenario without effort switching. In Alternative 5B, the longline fleet, and in particular the swordfish vessel owners, are projected to forego $132,000 in gross revenues for every turtle saved. In terms of albatross saved, the gross revenues foregone to the longline fleet is $8,000 for every bird saved under Alternative 5B.

Table 4.8-17: Projections of Economic Impacts Under Alternative 5 Assuming Effort Switching.

Indicator	Alternative 5 With Switching			Change from Alternative 1			Percentage Change from Alternative 1		
	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total
Break-even Vessels (Number)	110	0	110	36	-45	-9	48.6	-100.0	-7.6
Persons on Break-even Vessels	605	0	605	198	-203	-5	48.6	-100.0	-0.8
Effort (Sets)	11879	0	11,879	4,751	-4751	0	66.7	-100.0	0
Effort (Trips)	1,190	0	1,190	476	-433	43	66.7	-100.0	3.7
Trips per Break-even Vessel	10.8	0.0	10.8	1.2	-9.6	1.2	12.1	-100.0	12.2
Tuna Revenue ($millions)	32.7	0.0	32.7	13.2	-5.2	8.0	67.5	-100.0	32.5
Swordfish Revenue ($millions)	1.1	0.0	1.1	0.7	-11.3	-10.7	142.0	-100.0	-90.4
Shark Revenue ($Millions)	0.5	0.0	0.5	0.1	-1.2	-1.1	15.7	-100.0	-71.2
Other PMUS Revenue ($Millions)	3.1	0.0	3.1	1.4	-1.0	0.4	83.3	-100.0	16.2
Total Gross Revenue ($Millions)	37.4	0.0	37.4	15.3	-18.6	-3.3	69.3	-100.0	-8.2
Fleet-wide Direct Albatross & Turtle Compliance Cost ($ Annualized over 5 yrs)	172,366	0	172,366	172,366	0	172,366	Not applicable–fleet-wide compliance costs are zero in Alternative 1		
Average Gross Revenue per Break-even Vessel ($)	338000	0	338,000	40,000	-414,000	-4,000	13.4	-100.0	-1.2
Direct Payments to Labor ($Millions)	18.1	0.0	18.1	7.4	-9.0	-1.6	69.3	-100.0	-8.2
Direct Purchases from Local Input Suppliers ($Millions)	13.1	0.0	13.1	5.4	-6.5	-1.2	69.3	-100.0	-8.2
Hawai'i Total Economic Impact--Direct, Indirect, and Induced ($Millions)	44.3	0.0	44.3	18.2	-22.1	-4.0	69.3	-100.0	-8.2
Total Turtle Mortality	37.4	0.0	37.4	-9.4	-103.3	-112.7	-20.0	-100.0	-75.1
Total Albatross Mortality	22	0	22	-136	-2,077	-2,213	-85.9	-100.0	-99.0
Total Blue Shark Mortality (Thousands of Pounds)	170	0	170	-395	-4903	-5,298	-69.9	-100.0	-96.9

Table 4.8-18: Projections of Economic Impacts Under Alternative 5 with no Effort Switching.

Indicator	Alternative 5 Without Switching			Change from Alternative 1			Percentage Change from Alternative 1		
	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total
Break-even Vessels (Number)	78	0	78	4	-45	-41	5.4	-100.0	-34.5
Persons on Break-even Vessels	429	0	429	22	-203	-181	5.4	-100.0	-29.7
Effort (Sets)	7,640	0	7,640	512	-4,751	-4,239	7.2	-100.0	-35.7
Effort (Trips)	766	0	766	51	-433	-382	7.2	-100.0	-33.3
Trips per Break-even Vessel	9.8	0.0	9.8	0.2	-9.6	0.2	1.7	-100.0	1.8
Tuna Revenue ($Millions)	20.9	0.0	20.9	1.4	-5.2	-3.8	7.0	-100.0	-15.3
Swordfish Revenue ($Millions)	0.7	0.0	0.7	0.2	-11.3	-11.1	45.3	-100.0	-94.2
Shark Revenue ($Millions)	0.3	0.0	0.3	-0.1	-1.2	-1.3	-31.5	-100.0	-82.9
Other PMUS Revenue ($Millions)	2.0	0.0	2.0	0.3	-1.0	-0.7	17.8	-100.0	-25.4
Total Gross Revenue ($Millions)	23.8	0.0	23.8	1.8	-18.6	-16.9	8.0	-100.0	-41.5
Fleet-wide Direct Albatross & Turtle Compliance Cost ($ Annualized over 5 years)	56,086	0	56,086	56,086	0	56,086	Not applicable–fleet-wide compliance costs are zero in Alternative 1		
Average Gross Revenue per Break-even Vessel ($)	305,000	0	305,000	7,000	-414,000	-37,000	2.3	-100.0	-10.8
Direct Payments to Labor ($Millions)	11.5	0.0	11.5	0.8	-9.0	-8.2	8.0	-100.0	-41.5
Direct Purchases from Local Input Suppliers ($Millions)	8.4	0.0	8.4	0.6	-6.5	-5.9	8.0	-100.0	-41.5
Hawai'i Total Economic Impact--Direct, Indirect, and Induced ($Millions)	28.3	0.0	28.3	2.1	-22.1	-20.0	8.0	-100.0	-41.5
Total Turtle Mortality	22	0	22	-25	-103	-128	-53.1	-100.0	-85.4
Total Albatross Mortality	14	0	14	-145	-2,077	-2,222	-91.4	-100.0	-99.4
Total Blue Shark Mortality (Millions of Pounds)	112	0	112	-454	-4,903	-5,357	-80.3	-100.0	-98

Figure 4.8-14 shows that under Alternative 5, targeting of swordfish is eliminated from the Hawai'i-based longline fleet. Consequently, no vessels target swordfish under this

alternative. In the scenario without switching, the number of tuna vessels increases by four. The scenario with effort switching includes an additional 32 vessels that switch to targeting tuna from targeting swordfish (or a total increase of 36 tuna vessels over the base case). Under the effort-switching scenario, additional deep tuna sets are made by the swordfish vessels that switch effort to target tuna.

Figure 4.8-14: Number of Break-even Vessels by Effort Type, Alternative 5.

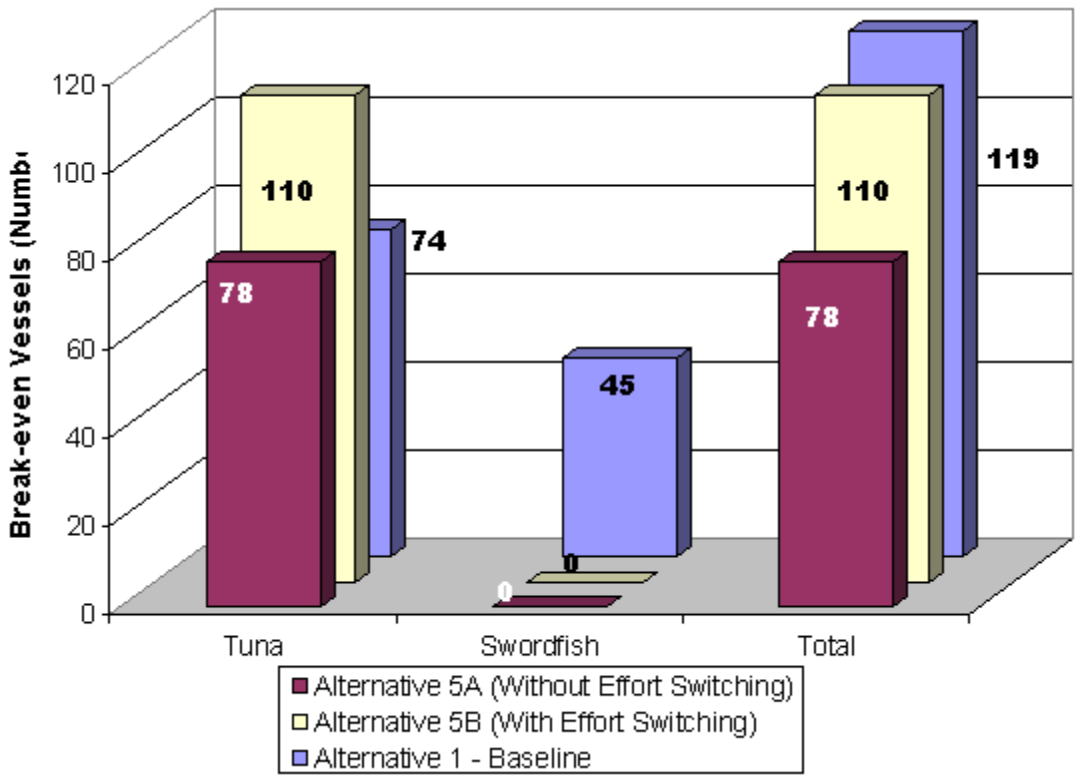
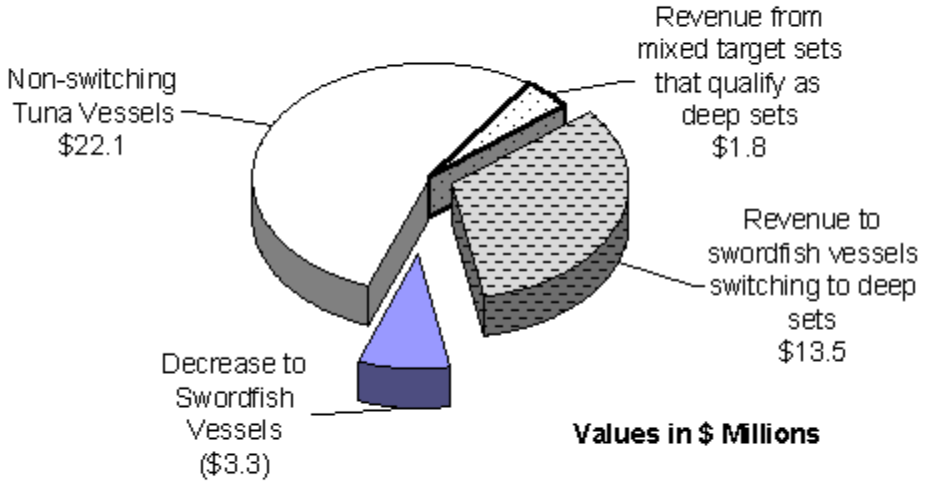


Figure 4.8-15 shows that under this alternative, with switching, longline gross revenues are projected to decline by $3.3 million (or eight percent). All of this loss is incurred by the swordfish vessels that do not switch effort to tuna. Swordfish vessels are projected to realize $15.3 million in gross revenues from switching effort to the tuna fishery. As with Alternative 3, a shift of this magnitude is speculative. The model does not consider the ability of these larger swordfish vessels to enter a new fishery with less experienced crews and higher operating costs. Although some of these vessels are known to use deep sets, deep sets that target tuna are made to complement earnings on swordfish. Tuna is not the primary target of these vessels. This periodic use of deep sets should not be interpreted as suggesting that these are vessels fully prepared to target tuna exclusively. The results are particularly questionable since a large part of the fleet that targets swordfish is projected to switch effort to tuna. Industry labor income, input purchases, employment, and total output are projected to decline by eight percent, as shown in Table 4.8-17.

Figure 4.8-15: Estimated Total Longline Gross Revenues by Effort Type Under Alternative 5.



Notes:
1) There were 512 mixed target sets that qualified as deep sets, regardless of whether the model allows switching. Revenue from these set was $1.8 million.
2) Vessels designated as swordfish vessels under Alternative 1 will suffer a collective reduction in gross revenues of $3.3 million under Alternative 5.

4.8.7 Economic Impacts of Alternative 6

Alternative 6 institutes management closures that are different from those mandated by the Court-orderd regime and is described in Table 4.8-19.

Table 4.8-19: Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas.

Objective of Measure	Measure
Reduce Turtle Interactions and Mortalities	Permanent closure of areas north of 29°N. latitude, seasonal closures of all other areas to longline fishing Fisher education and training to reduce incidental take of sea turtles
Reduce Albatross Interactions	Use of albatross deterrents in specific areas based on the STAL BO Actions reducing turtle interactions also reduce albatross interactions
Reduce Blue Shark Mortalities	Shark finning would be banned as mandated in the Manson-Stevens Act
Reduce American Samoa Fishery Interactions	Large vessel area closure plus control date for possible limited entry in American Samoa
Increase Understanding of the Fishery	Permit reporting requirements for handline and troll fisheries in Pacific remote island areas

These measures will both reduce and redirect fishing effort by utilizing both temporal and spatial closures. In summary, the additional management measures would:

- Close all areas for the Hawai'i-based longline fleet during the months of April through July.
- Close the area north of 29° N. latitude to longline fishing by the Hawai'i-based longline fleet year-round.
- Implement the same suite of albatross and shark measures as are implemented under Alternative 4.

Alternative 6 includes a requirement that handline and troll fishing vessels landing PMUS in EEZ waters of the Remote Pacific Island Areas obtain permits. The permit requirement will not create a limited entry fishery but is to aid in creating better records for activity in the fishery. The alternative also establishes reporting requirements for these fishers. The reporting requirements would include information concerning catch, effort, incidental catch and discards, and interactions with protected species.

The institution of reporting requirements will impose some minor costs on fishers, primarily time costs of reporting data. The benefits of this program, however, extend to many aspects of the fishery, including the fishers. Reporting requirements will provide data to fisheries managers that will assure that future regulations are well crafted to preserve the fishery and impose the least restrictive regulations on the activities of fishers. A more complete discussion of some possible specific reporting requirements appears in the discussion of Alternative 9B.

Alternative 6 includes an American Samoa area closure that would prohibit vessels more than 50 feet in length from entering waters in a radius of 50 nautical miles around Swain's Island and 50 nautical miles surrounding Manu'a Group, Tattily, and Rose Atoll, as shown in Figure 4.8-9. The closure is intended to reduce gear conflicts, increase profitable fishing operations, and preserve traditional fishing practices and recreational fishing activities that are thought to suffer with the entry of large vessels to the fishery (WPRFMC, 2000f). This closure could affect a few of the vessels displaced under this alternative that might pursue opportunities in the area of American Samoa once forced from the area where they routinely fish around Hawai'i. Because the fleet is restricted from primary swordfish grounds during the entire year and from all of the grounds during part of the year, total gross ex-vessel revenue to the fleet drop under this alternative. This decline will result in some vessels leaving the fleet and concurrent reductions in catch of targeted species and incidental catch.[32]

[32] This alternative includes no switching because swordfish vessels will be able to relocate to swordfish fisheries during all open seasons.

The analysis for Alternative 6 is presented in Table 4.8-20. Under this alternative, 33 vessels or 28 percent of the fleet are anticipated to leave the fishery. The longline fleet gross revenues are projected to be about $11.6 million (or 29 percent of the baseline gross revenues) under this alternative. The economic effects of Alternative 6 were estimated by adjusting the Kobayashi-Polovina model results for Alternative 1 to be consistent with projected changes in albatross interaction rates described in WPRFMC (1999c).

Turtle mortality under this alternative is projected at approximately 77 animals, approximately 49 percent less than the level of the base case, Alternative 1. Albatross mortality is projected to decline by 90 percent. The foregone gross revenues from reducing albatross mortality under this alternative are on average $6,000 per bird. Turtle mortality reductions, however, are estimated to result in foregone gross revenues of approximately $158,000 per animal.

The prohibition on shark finning is expected to eliminate any retention of blue sharks because of the undesirable qualities of its flesh after mortality, but is not expected to have a significant impact on the retention of other shark species. The estimated mortality of blue sharks is expected to drop to approximately 3,800 animals under Alternative 6. The prohibition on shark finning is expected to have a significant but unknown impact on the income of longline crewmembers.[33]

Alternative 6 is expected to have negative impacts on input suppliers and on Hawai'i's fishery trade and distribution sectors. Input supply purchases are projected to fall by $4.1 million, a decline that in 1998 would have represented nearly nine percent of all input purchase Hawai'i-based pelagic fishing vessels (see Table 3.10.2-7). The $6.8 million reduction in swordfish catch is likely to translate to losses for swordfish exporters that are unlikely to be made up with substitutes, at least for local participants. The Alternative also reduces tuna catches by $3.1 million. Some of these reductions are likely to be made up with increased purchases of tuna from other Hawai'i-based pelagic fisheries. It is also likely that tuna imports will increase to meet local demand.

[33] Reliable estimates of income derived from the practice of finning blue shark are unavailable., but crew members are thought to have received the majority of the revenues from shark finning.

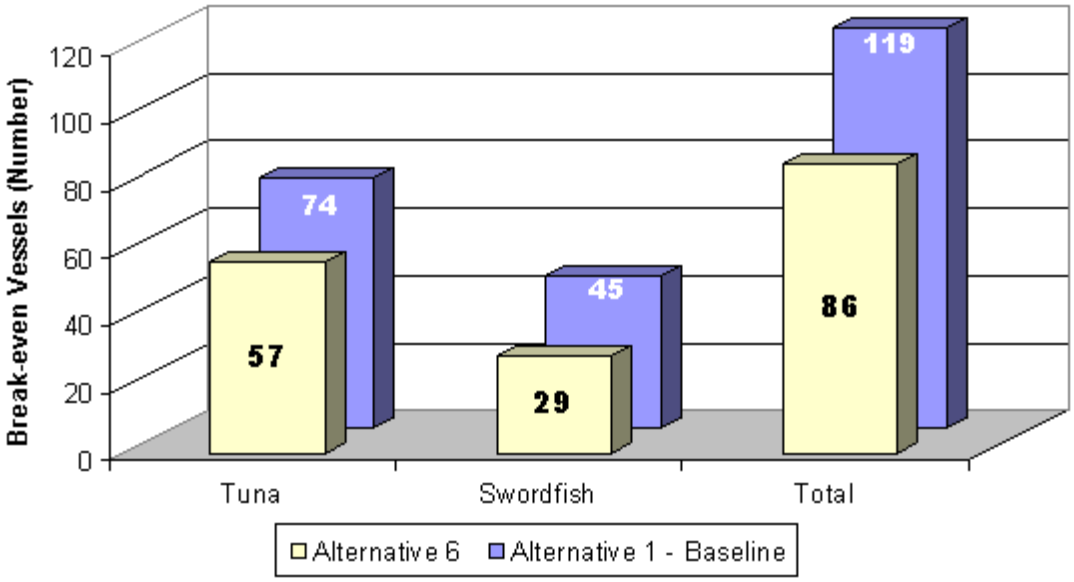
Table 4.8-20: Projections of Economic Impacts Under Alternative 6.

	Alternative 6			Change from Alternative 1			Percentage Change from Alternative 1		
	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total
Break-even Vessels (Number)	57	29	86	-17	-16	-33	-23.0	-35.6	-27.7
Persons on Break-even Vessels	314	131	445	-93	-72	-165	-22.9	-35.5	-27.0
Effort (Sets)	5,533	3,150	8,682	-1,595	-1,601	-3,197	-22.4	-33.7	-26.9
Effort (Trips)	554	286	840	-160	-147	-307	-22.4	-34.0	-26.8
Trips per Break-even Vessel	9.7	9.9	9.8	0.1	0.2	0.1	0.8	2.4	1.3
Tuna Revenue ($Millions)	15.4	6.2	21.6	-4.1	1.0	-3.1	-21.0	19.9	-12.5
Swordfish Revenue ($Millions)	0.2	4.8	5.0	-0.2	-6.6	-6.8	-52.6	-58.0	-57.8
Shark Revenue ($Millions)	0.2	0.0	0.2	-0.2	-1.2	-1.4	-59.2	-96.9	-87.5
Other PMUS Revenue ($Millions)	1.3	1.0	2.3	-0.4	0.1	-0.3	-24.5	8.0	-12.6
Total Gross Revenue ($Millions)	17.1	12.0	29.1	-5.0	-6.6	-11.6	-22.7	-35.5	-28.6
Fleet-wide Direct Albatross & Turtle Compliance Cost ($ Annualized over 5 years)	24,866	50,020	74,886	24,866	50,020	74,886	Not applicable–fleet-wide compliance costs are zero in Alternative 1		
Average Gross Revenue per Break-even Vessel ($)	299,000	413,000	337,000	1,000	-1,000	-5,000	0.3	-0.2	-1.5
Direct Payments to Labor ($Millions)	8.3	5.8	14.1	-2.4	-3.2	-5.6	-22.7	-35.5	-28.6
Direct Purchases from Local Input Suppliers ($Millions)	6.0	4.2	10.2	-1.8	-2.3	-4.1	-22.7	-35.5	-28.6
Hawai'i Total Economic Impact--Direct, Indirect, and Induced ($Millions)	20.3	14.3	34.5	-5.9	-7.9	-13.8	-22.7	-35.5	-28.6
Total Turtle Mortality	35	42	77	-12	-62	-73	-25.3	-59.6	-48.9
Total Albatross Mortality	11	210	221	-148	-1,866	-2,014	-93.2	-89.9	-90.1
Total Blue Shark Mortality (Thousands of Pounds)	63	315	378	-502	-4,588	-5,091	-88.8	-93.6	-93.1

Under Alternative 6, both the tuna fleet and the swordfish fleet are projected to decline (see Figure 4.8-16). The tuna fleet is projected to decline by 17 vessels (or 23 percent), while the

swordfish fleet is projected to decline by 16 vessels (or 36 percent). The model likely overestimates the number of vessels able to remain in the fleet since this alternative closes the entire pelagic fishery for two months. The aggregate analysis undertaken by the model does not consider that each vessel will lose several days of fishing during the closure. The model instead redistributes the total number of sets across the maximum number of vessels that those sets can sustain. While vessels can reduce the effect of this closure by using the time for shore-based activities such as repairs, and for traveling to and from favored fishing grounds, some fishing time will be lost by all vessels in the fleet. Some vessels will be unlikely to sustain operations because of these lost gross revenues. The number of vessels unable to continue to operate profitably is uncertain, but is likely to be less than the number estimated by the model.

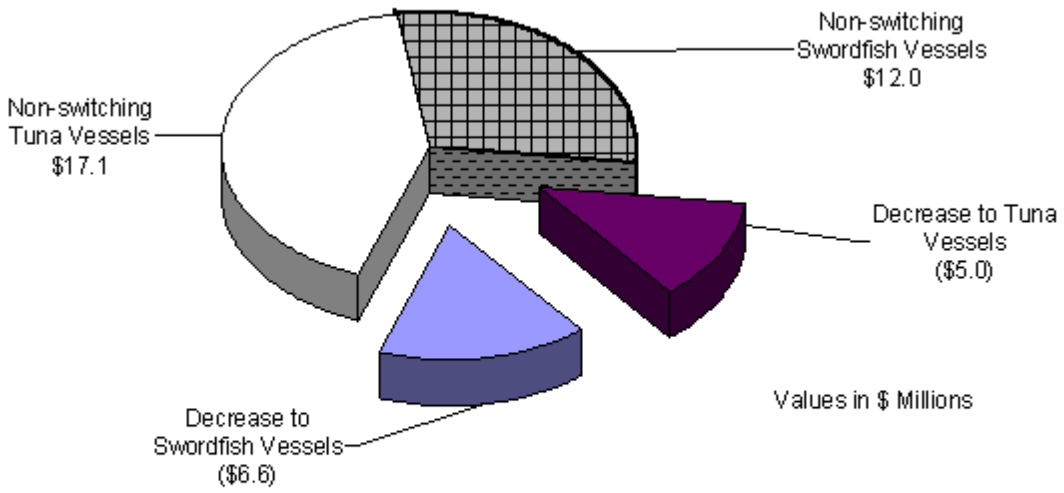
Figure 4.8-16: Estimated Number of Break-even Vessels by Effort Type Under Alternative 6.



As shown in Figure 4.8-17, tuna vessels are projected to suffer a decline in gross revenues of approximately $5 million (or 23 percent) under Alternative 6. Gross revenues of swordfish vessels are projected to decline by approximately $6.6 million (or 35 percent). The decline in gross revenues is likely underestimated by the model since the fishery will be entirely closed for two months. Since the model uses an aggregate approach that estimates gross revenues using the current fishing effort prior to estimating the number of vessels, the model likely overestimates both the number of vessels in the fleet and the gross revenues of the fleet. Consequently, the estimate of approximately $29 million (or 71 percent of the

current fleet gross revenues) likely overestimates the gross revenue that will be realized by the longline fleet if this alternative is adopted. The decline of approximately 29 percent in labor income, input purchases, employment, and total output (including direct, indirect and induced output) projected under this alternative is shown in Table 4.8-20.

Figure 4.8-17: Total Longline Gross Revenues by Effort Type Under Alternative 6.



Note: Vessels targeting swordfish under Alternative 1 will suffer a collective reduction in gross revenues of $6.6 million and those targeting tuna a collective reduction of $5.0 million, for a total fleet-wide reduction of $11.6 million, under Alternative 6.

4.8.8 Economic Impacts of Alternative 7

Alternative 7 institutes management closures that are different from those mandated by theCourt-orderd regime and is described in Table 4.8-21.

Table 4.8-21: Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas.

Objective of Measure	Measure
Reduce Turtle Interactions and Mortalities	Require methods to increase water depth of fishing gear deployment Seasonal closures of all other areas to longline fishing Fisher education and training to reduce incidental take of sea turtles
Reduce Albatross Interactions	Use of albatross deterrents in specific areas based on the STAL BO Actions reducing turtle interactions also reduce albatross interactions
Reduce Blue Shark Mortalities	Shark finning would be banned as mandated in the Manson-Stevens Act
Reduce American Samoa Fishery Interactions	Large vessel area closure plus control date for possible limited entry in American Samoa
Increase Understanding of the Fishery	Permitting and reporting requirements for handline and troll fisheries in Pacific remote island areas

The alternative is composed of the following two measures:

- Closure of all areas for the Hawai'i-based longline fleet during the months of April and May.
- Requiring use of line-shooters or weighted branch lines on all Hawai'i-based longliners.

In addition, Alternative 7 would implement the same suite of albatross and shark measures as are implemented under Alternative 4.

Alternative 7 includes a requirement that handline and troll fishing vessels landing PMUS in EEZ waters of the Pacific Remote Island Areas obtain permits. The permit requirement will not create a limited entry fishery but is to aid in creating better records for activity in the fishery. The alternative also establishes reporting requirements for these fishers. The reporting requirements would include information concerning catch, effort, incidental catch and discards, and interactions with protected species.

The institution of reporting requirements will impose some minor costs on fishers, primarily time costs of reporting data. The benefits of this program, however, extend to many aspects of the fishery, including the fishers. Reporting requirements will provide data to fisheries managers that will assure that future regulations are well crafted to preserve the fishery and impose the least restrictive regulations on the activities of fishers. A more complete

discussion of some possible specific reporting requirements appears in the discussion of Alternative 9B.

Alternative 7 includes area closures in the EEZ of American Samoa. The measures would close fishing grounds in a radius of 50 nautical miles around Swain's Island and 50 nautical miles surrounding the Manu'a Group, Tattily, and Rose Atoll fishing grounds to vessels more than 50 feet in length, as shown in Figure 4.8-9. The entry of these large vessels is thought to create gear conflicts, reduce profitability of fishing operations, and negatively affect traditional fishing practices and recreational fishing activities (WPRFMC, 2000f). The closure might be expected to have a relatively larger impact under this alternative since most of the swordfish vessels are displaced from targeting swordfish in the waters off Hawai'i. Whether these vessels would attempt to relocate to American Samoa, however, is entirely speculative.

Requiring the mainline to be set deeper than 100 m by requiring the use of a line-shooter or weights will effectively force the vessels targeting swordfish to switch to targeting tuna or to leave the Hawai'i-based longline fishery altogether. This choice was evaluated assuming two scenarios – that swordfish vessels would switch to tuna, if profitable, or that they would not switch but would leave the fishery. This is the same assumption of depth of line set used for Alternatives 5A and 5B. The actual behavior of the displaced swordfish vessels will likely fall between these extremes.

Table 4.8-22 presents the results of the analysis under the assumption that swordfish vessels will switch to targeting tuna if doing so is profitable. Table 4.8-23 presents the results under the assumption that no switching is undertaken. Under this alternative all 45 vessels currently classified as swordfish vessels are projected to change from targeting swordfish. In the scenario under which vessels switch effort, 21 vessels (or 46 percent of the fleet presently targeting swordfish) are projected to leave Hawai'i-based pelagic fisheries. Under the scenario with no effort switching, all swordfish vessels and two tuna vessels exit the fishery. Under the switching scenario, the fleet gross revenue is projected to decrease by about $8.6 million (or 21 percent of fleet gross revenues under Alternative 1). Under the scenario without switching, gross revenues are projected to decline by $19.2 million (or approximately 47 percent).

Alternative 7 is similar to Alternative 5 in that both require the use of a line-shooter or weighted mainline to eliminate shallow fishing. This effect is manifested in both alternatives by all vessels that now target swordfish switching to targeting tuna or leaving the fishery. In terms of the effectiveness of the alternatives in reducing turtle and albatross mortality, the projections under Alternatives 5 and 7 are very similar. The Alternative 7 scenario without effort switching is projected to reduce turtle mortality by seven more animals than the Alternative 5 scenario without effort switching. Alternative 7 with effort switching, however, is projected to reduce gross revenues by approximately $5 million more than the projected decline under Alternative 5, Scenario B (without effort switching). The fleet is projected to

bear an additional $129,000 in compliance costs under this alternative for the purchase of line-shooters.[34]

Albatross and turtle mortalities are projected to decrease under Alternative 7 slightly more than under Alternative 5. Turtle mortalities are projected to decline 79 percent from the baseline alternative in the scenario with switching and 88 percent in the scenario without switching. Albatross mortality is projected to decrease 99 percent from the baseline alternative under both scenarios. Foregone gross revenues per turtles saved is projected at $72,000 with switching and $146,000 without switching. For albatross this foregone gross revenue is estimated at $4,000 per bird with switching and $9,000 per bird without. While Alternative 5 may actually have slightly lower comparative foregone gross revenues per animal saved, it appears that Alternative 7 saves more animals.

The prohibition on shark finning is expected to eliminate any retention of blue sharks, but is not expected to have a significant impact on the retention of other shark species. The estimated mortality of blue sharks is expected to drop to approximately 1,200 animals under Scenario A and 1,000 animals under Scenario B (with no switching). The prohibition on shark finning is expected to have a significant but unknown impact on the income of longline crewmembers.[35]

[34] This estimate is based on M. Dang, HLA, pers. comm., October 2000.

[35] Reliable estimates of income derived from the practice of finning blue shark are unavailable, but crew members are thought to have received the majority of the revenues from shark finning.

Table 4.8-22: Projections of Economic Impacts Under Alternative 7 Assuming Effort Switching.

	Alternative 7 With Switching			Change from Alternative 1			Percentage Change from Alternative 1		
	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total
Break-even Vessels (Number)	98	0	98	24	-45	-21	32.4	-100.0	-17.6
Persons on Break-even Vessels	539	0	539	132	-203	-71	32.4	-100.0	-11.6
Effort (Sets)	10,692	0	10,692	3,564	-4,751	-1,187	50.0	-100.0	-10
Effort (Trips)	1,071	0	1,071	357	-433	-76	50.0	-100.0	-6.6
Trips per Break-even Vessel	10.9	0.0	10.9	1.3	-9.6	1.3	13.3	-100.0	13.4
Tuna Revenue ($Millions)	28.2	0.0	28.2	8.7	-5.2	3.5	44.5	-100.0	14.3
Swordfish Revenue ($Millions)	1.0	0.0	1.0	0.5	-11.3	-10.8	106.7	-100.0	-91.8
Shark Revenue ($Millions)	0.3	0.0	0.3	0.0	-1.2	-1.2	-12.3	-100.0	-78.2
Other PMUS Revenue ($Millions)	2.6	0.0	2.6	0.9	-1.0	0.0	56.2	-100.0	-1.0
Total Gross Revenue ($Millions)	32.1	0.0	32.1	10.1	-18.6	-8.6	45.7	-100.0	-21
Fleet-wide Direct Albatross & Turtle Compliance Cost ($ Annualized over 5 years)	129,110	0	129,110	129,110	0	129,110	Not applicable–fleet-wide compliance costs are zero in Alternative 1		
Average Gross Revenue per Break-even Vessel ($)	327,000	0	327,000	29,000	-414,000	-15,000	9.7	-100.0	-4.4
Direct Payments to Labor ($Millions)	15.6	0.0	15.6	4.9	-9.0	-4.1	45.7	-100.0	-21
Direct Purchases from Local Input Suppliers ($Millions)	11.3	0.0	11.3	3.5	-6.5	-3.0	45.7	-100.0	-21.0
Hawai'i Total Economic Impact--Direct, Indirect, and Induced ($Millions)	38.2	0.0	38.2	12.0	-22.1	-10.2	45.7	-100.0	-21
Total Turtle Mortality	31	0	31	-16	-103	-119	-33.5	-100.0	-79.3
Total Albatross Mortality	20	0	20	-139	-2,077	-2,216	-87.6	-100.0	-99.1
Total Blue Shark Mortality (Thousands of pounds)	161	0	161	-405	-4,903	-5,308	71.6	-100.0	-97.1

Table 4.8-23: Projections of Economic Impacts Under Alternative 7 with No Effort Switching.

	Alternative 7 Without Switching			Change from Alternative 1			Percentage Change from Alternative 1		
	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total
Break-even Vessels (Number)	72	0	72	-2	-45	-47	-2.7	-100.0	-39.5
Persons on Break-even Vessels	396	0	396	-11	-203	-214	-2.7	-100.0	-35.1
Effort (Sets)	7,015	0	7,015	-113	-4,751	-4,864	-1.6	-100.0	-40.9
Effort (Trips)	703	0	703	-11	-433	-445	-1.6	-100.0	-38.7
Trips per Break-even Vessel	9.8	0.0	9.8	0.1	-9.6	0.1	1.2	-100.0	1.2
Tuna Revenue ($Millions)	18.9	0.0	18.9	-0.6	-5.2	-5.8	-3.1	-100.0	-23.3
Swordfish Revenue ($Millions)	0.6	0.0	0.6	0.1	-11.3	-11.2	26.6	-100.0	-95.0
Shark Revenue ($Millions)	0.2	0.0	0.2	-0.2	-1.2	-1.4	-42.5	-100.0	-85.7
Other PMUS Revenue ($Millions)	1.8	0.0	1.8	0.1	-1.0	-0.9	6.6	-100.0	-32.5
Total Gross Revenue ($Millions)	21.5	0.0	21.5	-0.5	-18.6	-19.2	-2.4	-100.0	-47.1
Fleet-wide Direct Albatross & Turtle Compliance Cost ($ Annualized over 5 years)	34,485	0	34,485	34,485	0	34,485	Not applicable–fleet-wide compliance costs are zero in Alternative 1		
Average Gross Revenue per Break-even Vessel ($)	298,000	0	298,000	0	-414,000	-44,000	0.0	-100.0	-12.9
Direct Payments to Labor ($Millions)	10.4	0.0	10.4	-0.3	-9.0	-9.3	-2.4	-100.0	-47.1
Direct Purchases from Local Input Suppliers ($Millions)	7.6	0.0	7.6	-0.2	-6.5	-6.7	-2.4	-100.0	-47.1
Hawai'i Total Economic Impact--Direct, Indirect, and Induced ($Millions)	25.6	0.0	25.6	-0.6	-22.1	-22.8	-2.4	-100.0	-47.1
Total Turtle Mortality	19	0	19	-28	-103	-132	-60.3	-100.0	-87.6
Total Albatross Mortality	12	0	12	-147	-2,077	-2,223	-92.3	-100.0	-99.5
Total Blue Shark Mortality (Thousands of pounds)	105	0	105	-461	-4,903	-5,364	81.4	-100.0	-98.1

Table 4.8-24 isolates the effect of the two month closure on the tuna fleet. The estimates are derived by comparing the non-switching scenarios of Alternative 5 and Alternative 7, in

which the swordfish vessels are assumed to exit the fishery. It should be noted that the only difference between Alternative 5 and Alternative 7 is the two- month closure. Table 4.8-24 shows the outcomes for the tuna vessels under Scenario 5B and Scenario 7B, and in the right-most column the difference between the two non-switching, which is a quantitative estimate of the effect of the two-month closure.

The tuna fleet of 78 vessels from Scenario 5B is expected to lose gross revenues of $2.3 million or approximately ten percent of their gross total due to the seasonal closure imposed in Alternative 7. This is the equivalent of six full-time vessels. Direct payments to labor are expected to drop by $1.1 million and direct input purchases are expected to decline by $1.8 million. Turtle mortalities are projected to decrease by three and albatross mortalities are projected to decrease by two. The foregone revenues per turtle saved is projected at $131,773 and at $7,598 per albatross saved.

Table 4.8-24: Projections of Economic Impacts of the Seasonal Closure Alone Under Alternative 7 with No Effort Switching.

	Effect on Tuna Vessels Due to Two Month Closure		
	Alternative 5b	Alternative 7b	Change from Alternative 5b to 7b
Break-even Vessels (Number)	78	72	-6
Persons on Break-even Vessels	429	396	-33
Effort (Sets)	7,640	7,015	-625
Effort (Trips)	766	703	-63
Trips per Break-even Vessel	9.8	9.8	0
Tuna Revenue ($Millions)	20.9	18.9	-2.0
Swordfish Revenue ($Millions)	0.7	0.6	-0.1
Shark Revenue ($Millions)	0.3	0.2	-0.1
Other PMUS Revenue ($Millions)	2.0	1.8	-0.2
Total Gross Revenue ($Millions)	23.8	21.5	-2.3
Fleet-wide Direct Albatross & Turtle Compliance Cost ($ Annualized over 5 years)	56,086	34,485	-21,601
Average Gross Revenue per Break-even Vessel ($)	305,000	298,000	-7,000
Direct Payments to Labor $Millions)	11.5	10.4	-1.1
Direct Purchases from Local Input Suppliers ($Millions)	8.4	7.6	-1.8
Hawai'i Total Economic Impact--Direct, Indirect, and Induced ($Millions)	28.3	25.6	-2.7
Total Turtle Mortality	22	19	-3
Total Albatross Mortality	14	12	-2
Total Blue Shark Mortality (Thousands of pounds)	112	105	-7

The tuna vessels displaced by the two month closure are expected to adopt several strategies tom reduce the hardship of the closure. As stated previously in the description of the Kobayashi-Polovina model under Alternative 3, it is assumed that, on average, vessels will be able to make up one month of a seasonal closure by scheduling non-fishing time during the closure. It is likely that boat yard work would shift from when it is now to the closed period. Some vessels may be put to other commercial uses. These vessels, in turn, are expected to switch fishing effort to other times of the year that are now considered less productive. Some risk exists that fishers will delay vessel maintenance or fish in poor weather to schedule vessel maintenance only during the closure. This risk, however, exists in any fishery, because fishers may delay maintenance or fish in poor weather at times when harvests are high. It is also possible that some vessels may not be able to financially survive the closure.

Other parts of the fishing industry will also respond to the two month closure. The closure encompasses about half of Lent and some school graduations. Fishers will work to fill this market void to the extent they can. The result will be increased effort, expenditures and gross revenues for these other fisheries. A steep reduction in tuna exports during the period and an increase in tuna imports to Hawai'i are expected. Local retail outlets for fish including restaurants, hotels and fish markets will likely increase the use of imported fish. Some of these imported products may be of lower quality. An increase in demand for meat and other food products may occur.

Figure 4.8-18 shows the changes in number of vessels in the pelagic fisheries under Alternative 7. Assuming that no vessels switch effort, Alternative 7 is projected to decrease the tuna fleet by two vessels (or approximately three percent). Swordfish targeting, however, is eliminated by this alternative, removing all 45 vessels from the fleet, in the absence of effort switching. If effort switching does take place, the tuna fleet is projected to grow by approximately 24 vessels (or 32 percent) to a total of 98 vessels. The model projections for this alternative, however, suffer from two shortcomings previously mentioned. First, the switching of effort of vessels that currently target swordfish to targeting tuna is unlikely to be as successful as predicted by the model. Second, because the entire fishery is closed during the months of April and May under this alternative the model likely underestimates the number of vessels that would be eliminated from the fleet, since some vessels are unlikely to be successful in a ten-month season.

Figure 4.8-18: Number of Break-even Vessels by Effort Type Under Alternative 7.

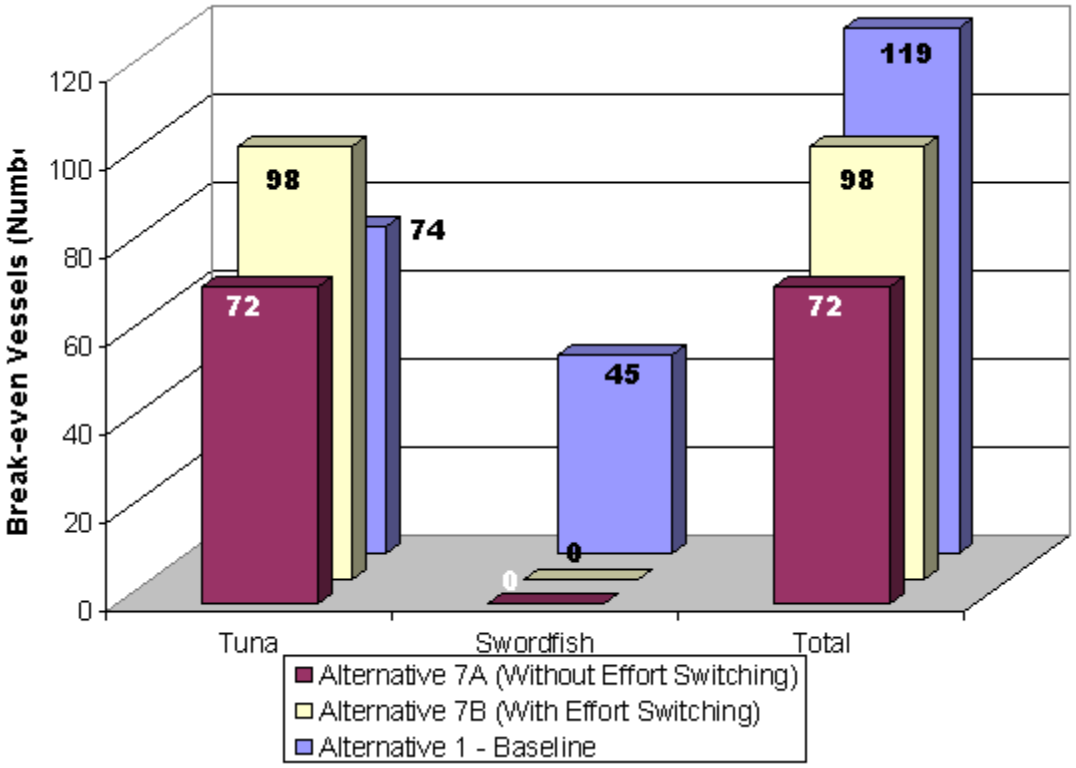
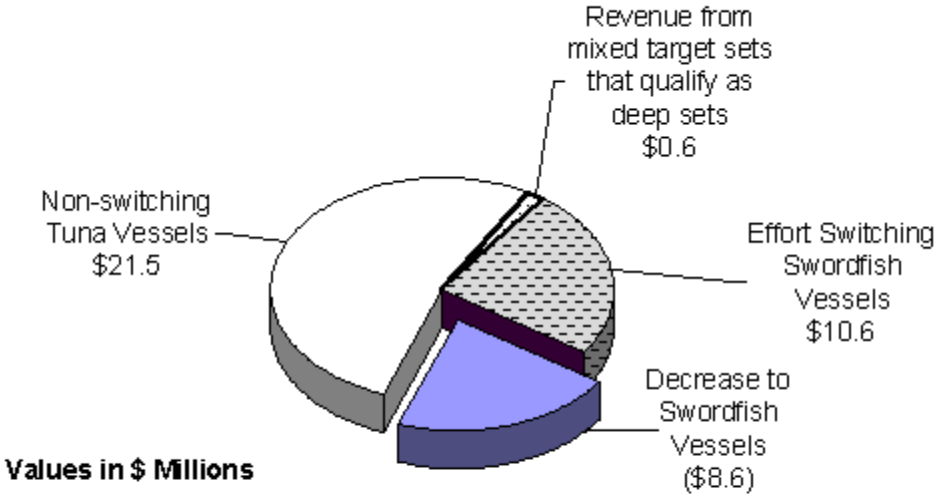


Figure 4.8-19 shows that under this alternative, gross revenues of tuna vessels are projected to decline by less than $1 million, even without vessels switching effort. This entire decline is recouped in the event the tuna vessels suffering this loss of gross revenue switch effort. In the absence of effort switching, swordfish vessels, however, are projected to lose their entire gross revenue, approximately $18.6 million. Gross revenues of the longline fleet are projected to be $21.5 (or 53 percent of the baseline alternative gross revenues) under the scenario without effort switching. If effort switching is undertaken, approximately $10.1 million (or 54 percent) of these gross revenues are projected to be recouped. Labor income, input purchases, employment, and total output (including direct, indirect, and induced outputs) would decline proportionally with gross revenues as shown in Table 4.8-22. Under the switching scenario estimated longline fleet gross revenue is $32.1 million (or 79 percent of the baseline fleet gross revenue). However, the model is likely to overestimate the gross revenues of the fleet because of its assumption concerning effort switching and failure to account for the loss of gross revenues from the season closure at the vessel level.

Figure 4.8-19: Estimated Total Longline Gross Revenues by Effort Type Under Alternative 7.



Note: Vessels targeting swordfish under Alternative 1 will suffer a collective reduction in gross revenues of $8.6 million under Alternative 7.

4.8.9 Economic Impacts of Alternative 8

Alternative 8 prohibits the domestic landing of longline-caught pelagic fish at all ports in the Western Pacific Region and is described in Table 4.8-25.

Table 4.8-25: Alternative 8: Regional Longline Closure.

Objective of Measure	Measure
Eliminate Interactions and Mortalities of All Protected Species	The EEZ of all areas managed by the WPRFMC 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.)

This alternative would close the Hawai'i-based longline fishery as well as the longline fishery in American Samoa. The result would be the complete displacement of the entire longline fleet in both fisheries. Displaced vessels and fishers may or may not move to fisheries not subject to the regulation.

Alternative 8 also includes a requirement that all commercial fishers landing PMUS, including troll fishers and handline fishers, obtain permits. The permit requirement will not create a limited entry fishery but is to aid in creating better records for activity in the fishery. The

alternative also establishes reporting requirements for these fishers. The reporting requirements are not specified but are expected to include information concerning catch and effort in the fishery.

The reporting requirements under this alternative will impose some minor costs (primarily time costs of submitting data) on fishers. The benefits of this program, however, are that fisheries managers will have better data with which to regulate the fishery. Well crafted regulations will help fishers by preserving the fishery and limiting the restrictiveness of regulations on their activities. A more complete discussion of some possible specific reporting requirements appears in the discussion of Alternative 9B.

All participation, effort, landings, revenues, and economic output from longline fisheries are reduced by 100 percent from the baseline case by this alternative. Approximately $40.1 million in gross revenues are projected to be lost by the Hawai'i-based fleet. In addition, slightly less than $1 million is projected to be lost by the American Samoa longline fleet. The projections for the Hawai'i-based longline fleet under this alternative are presented in Table 4.8-26. Projections for the American Samoa-based longline fleet are presented in Table 4.8-27.

In addition to direct effects on the longline vessels, the closure of the longline fishery will result in significant impacts on businesses to supply goods and services to the longline vessels and on businesses that rely fishery trade and distribution. In 1998, input purchases from longline vessels represented nearly 35 percent of all purchases from Hawai'i-based pelagic fisheries (see Table 3.10.2-7) and 31 percent of all inputs purchased by commercial fishing vessels in Hawai'i (Sharma *et al.*, 1999). It is likely that business that are dependent on sales to commercial fishing vessels will face significant hardships. The importance of the longline fishery to input supplier in American Samoa is unknown, but it is likely that they will be negatively impacted.

The economic and financial impacts of total longline closure will be far reaching throughout the Hawaiian economy. Since longlining supplies most of the fish to Hawai'i, stopping that flow will result in the probable closure of numerous local fish markets and suppliers of inputs to the fishery. The lack of supply to the local market will create a demand void which will be filled to one extent or another with imports. Some of the local import/export firms will replace lost export business with imports and others probably will not. Since there is a net export of fish from Hawai'i at this time there will be a significant decrease in the import/export sector and related local economic activity will not be as large as it is now. It is expected that handline, troll and expense/recreational fishermen will work to fill this market void to the extent they can. The result will mean increased effort, expenditures and gross revenues for this group. Local retail outlets for fish including restaurants, hotels and fish markets will likely use more imported fish than is the case now and some consumers will substitute other food products. Consumers, use to enjoying fresh, locally caught fish are expected to suffer a large decrease in consumer surplus.

Table 4.8-26: Projections of Economic Impacts on the Hawai'i-based Fleet Under Alternative 8.

Indicator	Alternative 8			Change from Alternative 1			Percentage Change from Alternative 1		
	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total
Break-even Vessels (Number)	0	0	0	-74	-45	-119	-100.0	-100.0	-100.0
Persons on Break-even Vessels	0	0	0	-407	-203	-610	-100.0	-100.0	-100.0
Effort (Sets)	0	0	0	-7,128	-4,751	-11,879	-100.0	-100.0	-100.0
Effort (Trips)	0	0	0	-714	-433	-1,148	-100.0	-100.0	-100.0
Trips per Break-even Vessel	0.0	0.0	0.0	-9.7	-9.6	-9.6	-100.0	-100.0	-100.0
Tuna Revenue ($Millions)	0.0	0.0	0.0	-19.5	-5.2	-24.7	-100.0	-100.0	-100.0
Swordfish Revenue ($Millions)	0.0	0.0	0.0	-0.5	-11.3	-11.8	-100.0	-100.0	-100.0
Shark Revenue ($Millions)	0.0	0.0	0.0	-0.4	-1.2	-1.6	-100.0	-100.0	-100.0
Other PMUS Revenue ($Millions)	0.0	0.0	0.0	-1.7	-1.0	-2.6	-100.0	-100.0	-100.0
Total Gross Revenue ($Millions)	0.0	0.0	0.0	-22.1	-18.6	-40.7	-100.0	-100.0	-100.0
Fleet-wide Direct Albatross & Turtle Compliance Cost ($ Annualized over 5 years)	0	0	0	0	0	0	0.0	0.0	0.0
Average Gross Revenue per Break-even Vessel ($)	0	0	0	-298,000	-414,000	-342,000	-100.0	-100.0	-100.0
Direct Payments to Labor ($Millions)	0.0	0.0	0.0	-10.7	-9.0	-19.7	-100.0	-100.0	-100.0
Direct Purchases from Local Input Suppliers ($Millions)	0.0	0.0	0.0	-7.7	-6.5	-14.3	-100.0	-100.0	-100.0
Hawai'i Total Economic Impact--Direct, Indirect, and Induced ($Millions)	0.0	0.0	0.0	-26.2	-22.1	-48.3	-100.0	-100.0	-100.0
Total Turtle Mortality	0	0	0	-47	-103	-150	-100.0	-100.0	-100.0
Total Albatross Mortality	0	0	0	-159	-2,077	-2,235	-100.0	-100.0	-100.0
Total Blue Shark Mortality (Millions of Pounds)	0.0	0.0	0.0	-0.6	-4.9	-5.5	-100.0	-100.0	-100

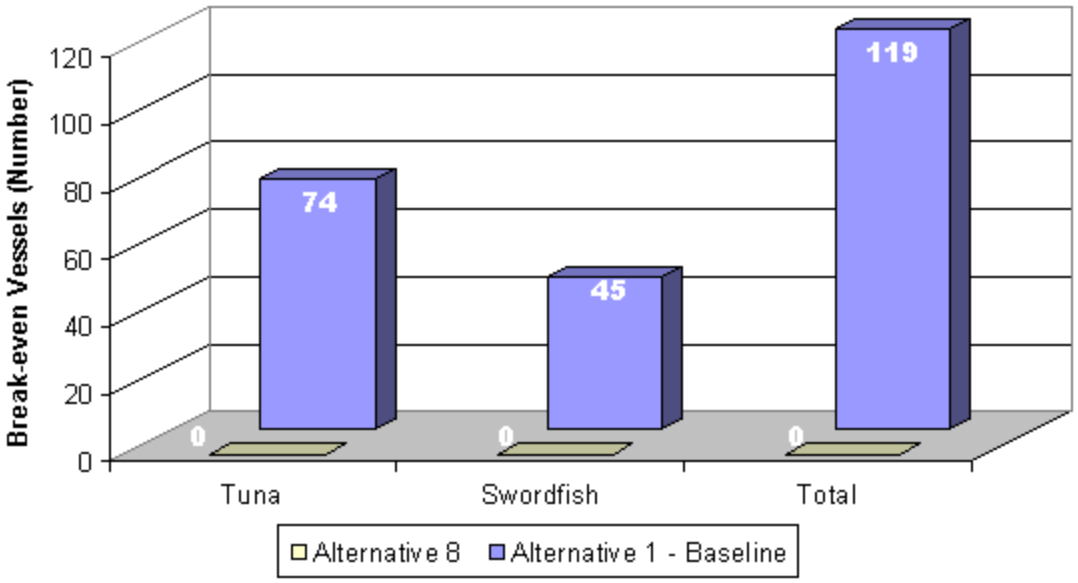
Table 4.8-27: Projections of Economic Impacts on the American Samoa Fleet Under Alternative 8.

American Samoa Longline Fishery	Alternative 8	Change from Alternative 1	Percentage Change from Alternative 1
Active Vessels	26	-26	-100.0
Total Landings (Pounds)	884,000	-884,000	-100.0
Total Trips	2,359	-2,359	-100.0
Total Ex-vessel Value ($)	976,913	-976,913	-100.0

Alternative 8 closes the Hawai'i-based longline fishery. As shown in Figure 4.8-20, all 74 active tuna vessels and 45 active swordfish vessels are eliminated. Unlike the other alternatives, this alternative also closes all fisheries in the areas of Guam, American Samoa, and the CNMI. These closures would eliminate some of the other alternative fishing grounds and bases that would be open to the Hawai'i-based pelagic fleet in their absence. In addition, these closures would remove all longline vessels from American Samoa, Guam, and the CNMI. American Samoa had 26 active longline vessels.[36] Several foreign based longline vessels are active in these fisheries. These vessels are unaffected by the restrictions.

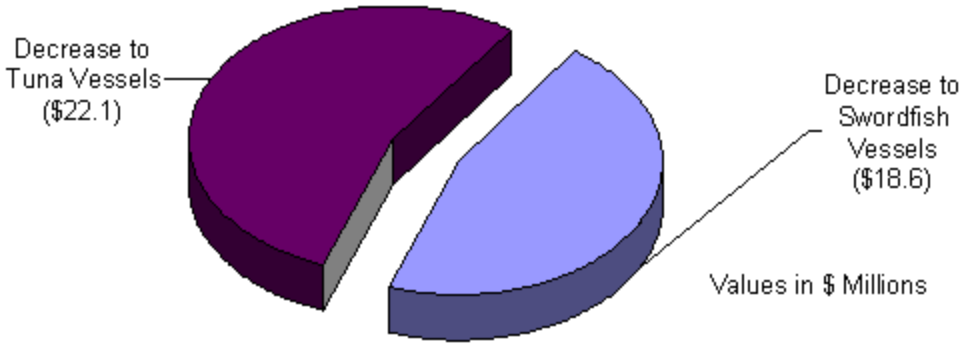
[36] Guam issued three longline licenses and the CNMI issued one longline license in 1998; however, none of those vessels were active in the longline fishery. American Samoa issued 48 longline licenses in 1998, but only 26 vessels were active in the fishery.

Figure 4.8-20: Estimated Number of Break-even Vessels by Effort Type Under Alternative 8.



This alternative will eliminate all gross revenues from the longline fisheries. As shown in Figure 4.8-21, tuna longline fishers will lose $22.1 million in gross revenues, while swordfish longline fishers will lose $18.6 million in gross revenues. Under this alternative, all labor income, input purchases, and employment of the longline fleet (shown in Table 4.8-26) would be lost. The American Samoa longline fleet will lose an additional $1 million in gross revenues. Despite these reductions in harvests by the American Samoa longline fleet, significant harvests will continue in these waters by foreign vessels.

Figure 4.8-21: Total Longline Gross Revenues by Effort Type, Alternative 8.



Note: Vessels targeting swordfish under Alternative 1 will suffer a collective reduction in gross revenues of $18.6 million and those targeting tuna a collective reduction of $22.1 million, for a total fleet-wide reduction of $40.7 million, under Alternative 8.

4.8.10 Estimated Economic Impacts of Alternative 9

Alternative 9 addresses potential gear conflicts and localized overfishing that may be developing in fisheries other than the Hawai'i-based longline fishery. Alternative 9 can be viewed as a supplement to any of the other alternatives. Alternative 9 is described in Table 4.8-28.

Table 4.8-28: Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries.

Objective of Measure	Measure
Reduce Gear Conflicts and Reduce Localized Overfishing	Large vessel area closure plus control date for possible limited entry in American Samoa 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

Alternative 9 is divided into two sub-alternatives as follows:

- Alternative 9A addresses potential localized overfishing of local albacore stocks within the EEZ around American Samoa by instituting a program to limit effort in American Samoa's longline fishery.

- Alternative 9B prepares and implements a comprehensive research plan that will eventually allow the evaluation of potential interactions among the several fisheries managed under the alternative.

4.8.10.1 Assessment of Alternative 9A

In anticipation of a limited access system possibly being created in American Samoa, a control date of July 15, 2000, was established for this alternative. Vessels entering the longline fishery in American Samoa after that date would not be guaranteed continued access to the pelagic fisheries in the EEZ around American Samoa if a limited access program is approved by the Council and NMFS.

According to industry sources (P. Bartram, pers. comm., October 2000) it is estimated that approximately 70 vessels would meet the criteria established in the control date, including apparently all of the 50 currently licensed longline vessels[37] in American Samoa.

Given that the details for a limited entry program for longline vessels have not been established, the assessment of Alternative 9A is based on the analytical assumptions listed in the bulleted items below. It should be emphasized that the analytical assumptions are posited only as a means to demonstrate the potential economic impact of the effort limitation system and do not presume to define the system that would eventually be established.

- The total number of transferable licenses issued in the future would be equal to the number of vessels that meet the criteria established as of the control date.

- All 50 of the longline vessels that are currently licensed in American Samoa would qualify under the future limited access system. Approximately 20 additional vessels, which are not currently active in the American Samoa longline fleet, also appear to qualify for licenses.

- The licenses would have the same types of restrictions that currently apply to Hawai'i-based longline limited entry permits, including a length limitation of 101 feet and requirements that all landings of licensed vessels that occur in American Samoa be made within the regulations.

- Marginal increases in effort as measured by total catch do not appear to have a significant effect on CPUE. (K. Holland, pers. comm., November 2000.)

Using the analytical assumptions listed above, the effort limitation program does not appear to impose any significant costs on the existing fleet in American Samoa. In other words, no currently active vessels are excluded from the fishery; nor are their efforts restricted from their current level. In addition, the approximately 20 additional vessels eligible for entry create slack in the effort limitation program, allowing for growth in the fleet even after the program is initiated. The eligibility of these additional vessels to enter the longline fleet is consistent with development plans that are currently underway in American Samoa to

[37] As indicated in Section 3.10 there are currently 50 licensed longline vessels in American Samoa with annual catch of approximately equal to 900,000 lb.

encourage locally owned fishing enterprises and to improve the safety of currently operating vessels (WPRFMC, 2000e).

It is less clear, however, whether the effort limitation program as described above would entirely protect the currently operating vessels from the potential effects of localized reductions in CPUE that could occur if there were significant increases in total effort. For example, because the licenses are presumed to be transferable, it is plausible that some of the licenses would be purchased by vessel owners who could be displaced from the Hawai'i-based longline fishery under Alternatives 3-8. Whether this growth would harm the existing fleet is also speculative. With no evidence of current local depletion, the level of growth in the fleet that would deplete local catch is not known. In addition, fleet growth may help support the development of improved infrastructure that could assist the existing fleet. To demonstrate how such increases in effort could occur, a hypothetical scenario is developed in the bulleted items below.

- In 1998 the vessels fishing with longline techniques in the currently operating fleet averaged 18,000 pounds of catch and annual gross revenues of $20,000. (See Section 3.10.)

- Owners of 20 of the 50 currently operating longline vessels choose to upgrade their older, relatively unsafe vessels (*alias*) with newer, safer *alias,* as described in WPRFMC (2000f). Their original licenses are transferred to the new vessels. The newer, safer *alias* are assumed (in this example) to allow each vessel owner to increase total annual catch and gross revenue by 20 percent to 22,000 pounds and $24,000, respectively. The total catch by the 50 fishers that are currently operating would increase to 980,000 pounds and total gross revenue would increase to $1,080,000 under these assumptions.

- Ten of the 20 licenses that are not associated with currently active longliners in American Samoa are assumed in this hypothetical example to be used by local fishers who enter the fishery with newer, safer *alias*. Because these newer vessels' owners are less experienced, it is assumed that they are only able to generate catches and revenues equal to those for the average vessel in the current fleet. In total, these ten new vessels catch 180,000 lb and generate total gross revenues of $200,000.

- The ten remaining licenses are assumed to be sold to swordfish vessel owners who have been displaced from the Hawai'i-based longline fleet. These vessels tend to be larger and more efficient than the vessels in the current American Samoa based longline fleet. These ten vessels are assumed to now operate full-time out of American Samoa but are only able to generate 90 percent of the catch they had when operating out of Hawai'i. These ten vessels would have a total catch of 2,777,000 lb and generate $3.1 million in gross revenue annually.

- Total annual catch by licensed American Samoa-based longliners under this scenario would be 3.9 million pounds and total gross annual revenue would exceed $4.3 million.

The hypothetical scenario described above demonstrates the plausibility of significant increases of effort, even under an effort limitation program that does not strictly control the types of vessels upon which license could be used.

Even if the effort limitation program does not provide licenses to the 20 vessels that are not currently participating in the fishery, it is likely that significant increases in effort could occur. For example, it is probable that the least productive of the currently operating fleet would be hard-pressed to refuse license purchase offers from displaced swordfish longline vessels from Hawai'i. Because of the differences in catch and earning potential, displaced swordfish longline vessel owners from Hawai'i would, in theory, be willing to pay significantly more for an American Samoa license than the most American Samoa vessel owners could earn over several years of fishing.[38]

It is possible to impose additional restrictions on licenses that could prevent the use of American Samoa licenses by displaced vessels from Hawai'i. One such restriction would limit the length of the vessel to which the license could be associated. The restriction could be based on the length of the vessel with which the license was originally issued. In the Alaska Groundfish License Limitation Program licenses can be used only on a vessel that is less than or equal to 120 percent of the length of the vessel to which the license was originally issued. Since most of the currently operating vessels in American Samoa are less than 50 feet in length, such a restriction would prohibit vessels longer than 60 feet in length from using the license, and would effectively eliminate the possibility that displaced swordfish vessels from Hawai'i, which are generally longer than 60 feet, would acquire and use the licenses.

In summary, it is possible that an effort limitation program could be implemented in American Samoa that would maintain the current level of effort in the longline fishery in American Samoa. With careful crafting, the effort limitation program could allow for controlled expansion of the locally owned fleet, while prohibiting entry of the generally larger vessels that may be displaced from the longline fleets in Hawai'i. It is probable that without a fairly restrictive effort limitation program, effort in American Samoa could increase dramatically over current levels.

4.8.10.2 Assessment of Alternative 9B

Alternative 9B, which is considered a supplement that can be attached to any of the other alternatives in the EIS, prepares and implements a comprehensive research plan that will eventually allow the evaluation of potential interactions among the several fisheries managed under the Pelagics FMP. The plan would include all fisheries managed under the alternative.

[38] Experience in the license limitation programs in Alaska indicates that limited entry licenses often sell for two or more times the annual gross revenue that could be expected with the license.

Of all of the alternatives under consideration, only Alternative 9B is likely to have a direct effect on non-longline vessels in Hawai'i and vessels operating in Guam and the CNMI.

Because the actual specifications of the comprehensive research plan have not been formalized, quantifying impacts of the program is not feasible. However, it is likely that such a program will have significant direct costs, particularly for management agencies that would be charged with collection, storage, and analysis of the information. The information collection program would also impose time costs on fishers required to report information under the program. The comprehensive research plan would also generate significant benefits because higher-quality information will be available for determining management actions. Better information can lead to better management decisions that are more likely to be accepted by both fishers and the non-fishing public.

The text that follows discusses some of the gaps in and shortcomings of the currently available information. It also describes some of the potential means by which that information could be gathered and used within a comprehensive research plan as proposed by Alternative 9B.

Comprehensive and Uniform Catch Reporting

Currently various fishing fleets are subject to very different catch reporting requirements. Data collection programs in Hawai'i are different from programs in American Samoa, Guam, and the CNMI. Even within Hawai'i reporting requirements vary between longline vessels and non-longline vessels.

Because of the different data collection programs for the various fisheries, it is very difficult to combine information for use in comprehensive decision making. Cross-fishery catch and effort comparisons are difficult. Even reliable total catch and effort estimates are very difficult to make, as completeness and accuracy of the data vary across the different fisheries.

A comprehensive and uniform catch reporting system will ease aggregation of catch and effort information across fisheries and could greatly enhance the regulatory ability of fishery managers.

Uniform Vessel Identifiers

Currently it is difficult or impossible to track the efforts of fishing vessels that fish in multiple fisheries. Implementation of a uniform system of vessels identifiers that would be attached to all catch reports will greatly enhance the ability of managers to monitor interactions between fisheries.

Uniform and Comprehensive Effort Reporting

With currently available data, it is very difficult to compare effort across fisheries. A comprehensive research plan could collect effort information in ways that allow a comparison among fisheries, and also provide better data within each fishery. For example, cross-fishery effort comparisons require running time and fishing time for each trip, neither of which are reported in all of the fisheries subject to the management plan. In addition, if fishery-specific effort reporting were also required, managers would be better able to project impacts of regulatory actions. Examples of fishery-specific effort reporting might include the number of rods fished for charter and pole-and-line fisheries, and the number of lines fished for handline fisheries.

Uniform and Comprehensive Fishing Location Reporting

Concerns about localized depletions could be addressed more easily if there were a uniform and comprehensive system to report the locations of fishing effort. While fishing location information is generally very sensitive, it is a critical component of any analysis of cross-fishery interactions. In order for fishers to be comfortable reporting this information, they would need assurances from fishery managers that the information would be treated in a strictly confidential manner.

Uniform and Comprehensive Reporting of Bycatch

Catch reporting systems that are currently in place focus primarily on landed catch and do not require the reporting of bycatch – catches of fish that are discarded at sea. Without a uniform and comprehensive bycatch reporting system it is impossible for fishery managers to know the true extent of fishing mortality.

Uniform and Comprehensive Reporting of Turtle and Albatross Interactions

Information on turtle and albatross interactions from the Hawai'i-based longline fleet is considered reliable. Catch reporting systems that are currently in place in other fleets may not require the reporting of interaction with turtles, albatross or other species of concern. The lack of reporting leads to uncertainty as to the extent of interactions by these fleets and the threat that they pose to turtles, albatross, and other species.

Uniform and Comprehensive Reporting of Crew Sizes

The assessment of economic impacts of various fisheries would be significantly improved by a uniform and comprehensive system of reporting of the number of persons in fishing crews. Unlike other industries, fishing crews are not included in the regular reports of wage and salary labor generated by state and federal labor agencies – fishing crew members are paid on a share basis and therefore are not included as wage earners.

Regular and Uniform Reporting of Fishing Vessel Economic Indicators

Increasingly, regulation and management of fisheries requires quantification of the economic impacts of proposed actions. If regular and uniform data showing economic indicators of individual fishing vessels were available, it is more likely that fishery managers could more accurately document the economic effects of proposed actions. Reliable and comprehensive reports of economic impacts of proposed actions can improve the likelihood that management actions are sound and that they meet management objectives as required under federal and state legislation.

4.8.11 Economic Impacts of Alternative 10 *(Preferred)*

Alternative 10, the preferred alternative, institutes the RPA of the Pelagics BO and is described in Table 4.8-29. The measure will both reduce and restrict fishing effort using a combination of temporal and spatial closures and restrictions on permissible methods. The alternative would consist of an April-May area closure effective south of 15° N. latitude, bounded by 145° W. and 180°. The alternative also includes a prohibition on the deployment of shallow-set gear to reduce sea turtle interactions, as well as fisher education and training on methods to reduced interactions and release methods that reduce mortality. The prohibition on shallow sets will essentially require that all fishers have line-shooters, which can be purchased for approximately $12,000. Since swordfish cannot be effectively targeted with deep sets, the requirements of this alternative will result in all vessels currently targeting swordfish to either switch to targeting tuna or to exit the fishery.

To prevent fishers relocating from the Hawai'i-based fishery for a portion of the year to avoid the area closures and other restrictions, this alternative will include a provision that requires any vessel owner who dregisters a Hawai'i Longline Permit from a vessel to surrender the license for the remainder of the calendar year. In addition, the restriction would permit re-registering of vessels to permits only during the month of October.[39] Currently, approximately 30 vessels from the Hawai'i-based fleet have moved to California for the peak swordfish season in that area, which begins in October. Some, but not all of these vessels have de-registered their permits. By processing of permit applications exclusively in October, fishers that choose to fish the peak swordfish season with shallow gear in California[40] will be prevented from reentering the Hawai'i fishery for a full year. The reentry restriction is thought to increase the effectiveness of the management measures by limiting the ability of fishers to move between the Hawai'i-based fishery and other less regulated areas, where they would otherwise be allowed to use shallow-set gear.

[39] New entrants to the fishery would be accepted at any time of the year.

[40] This would be legal only if the Hawai'i Permit is de-registered from the vessel during the period it is fishing with shallow-set gear.

Table 4.8-29: Alternative 10: *(Preferred)* Increase Gear Deployment Depth, Seasonal Area Closure

Objective of Measure	Measure
Reduce Turtle Interactions and Mortalities	Prohibition on the deployment of shallow-set gear in the northern hemisphere. Closure of areas south of 15° N. latitude, bounded by 145° W. and 180° longitude from April 1 through May 31 to longline fishing Restrict the ability to de-register vessels and Hawai'i Longline Permits. Fisher education, training to reduce incidental take of sea turtles and careful release requirements to reduce turtle mortality
Reduce Albatross Interactions	Use of albatross deterrents in specific areas based on the STAL BO Actions reducing turtle interactions also reduce albatross interactions
Reduce Blue Shark Mortalities	Shark finning would be banned as mandated in the Magnuson-Stevens Act
Reduce American Samoa Fishery Interactions	Large vessel area closure plus control date for possible limited entry in American Samoa
Increase Understanding of the Fishery	Reporting requirements for handline and troll fisheries under the Pelagics FMP Permit and reporting requirements for handline and troll fisheries in Pacific remote island areas

The provisions intended to reduce turtle interactions will also reduce interactions with albatross. In addition, north of 23° N. latitude fishers will be required to use the preferred alternatives as specified in the STAL BO to reduce the incidental catch of seabirds (FWS, 2000).

The preferred alternative is analyzed under two scenarios. Under Scenario A – the more optimistic of the two scenarios – fishers using shallow sets (for targeting swordfish) switch to deep sets (to target tuna). Scenario B – depicting a more pessimistic outcome – assumes that swordfish vessels are too heavily capitalized to effectively switch to targeting tuna (as is believed by some industry sources) and instead exit the fishery.

The Kobayashi-Polovina model is used to assess the outcomes under both scenarios of Preferred Alternative 10. Two aspects of the scenario without effort switching are worthy of explanation. First, under the scenario without switching of effort, tuna vessels that are currently active in the area that is subject to the closure are assumed to fish in areas not subject to the closure. Second, as under Alternative 5, the assignment of the mixed target sets to vessels has potential to create some confusion. In Alternative 1, all mixed target sets are assigned to swordfish vessels. Under this alternative, approximately 512 of those mixed target sets qualify as "deep" sets and are defined as targeting tuna (even though these sets are made by swordfish vessels). Under the scenario without switching, revenues from these mixed sets are sufficient for two swordfish vessels to break even by targeting exclusively tuna. Consequently, the number of tuna vessels increases by three under the scenario without switching.

The projected outcomes under Preferred Alternative 10, Scenario A (with effort switching) are presented in Table 4.8-30. The projected outcomes under Preferred Alternative 10, Scenario B (without effort switching) are presented in Table 4.8-31. Under both scenarios, all swordfish targeting is eliminated, removing all swordfish vessels from the fishery. Under the scenario with effort switching 34 swordfish vessels are projected to switch from swordfish to target tuna, increasing the number of tuna targeting vessels by almost 46 percent. Total gross revenues in the Hawai'i-based longline fishery are projected to decline by approximately $4.3 million or 10.5 percent.

Under Scenario B, the scenario without effort switching, only two of the swordfish vessels are able to realize revenues from mixed sets sufficient to break even, resulting in an increase of three (or four percent) in the number of tuna targeting vessels. Since swordfish fishing is prohibited and swordfish vessels are unable to switch targets, total gross revenues are projected to decline by approximately $17.6 million or 43 percent.

Under the Preferred Alternative 10 scenario with effort switching, albatross mortality declines approximately 99 percent from the base case of Alternative 1. Sea turtle mortality is projected to decline by approximately 124 animals (or 83 percent). Under the scenario with effort switching, seabird mortality declines are projected to result in approximately $2,000 in foregone revenues per bird saved. Foregone gross revenues of approximately $35,000 are projected for each turtle saved. Under Preferred Alternative 10 without effort switching, albatross mortality is projected to decline by over 99 percent. Turtle mortality is projected to decline by 133 animals (or approximately 89 percent). Under the scenario without effort switching, approximately $8,000 in gross revenues are projected to be foregone for each seabird saved. Declines in turtle mortality under the scenario without switching are projected to result in approximately $128,000 in foregone revenues for each turtle saved.

All of the results reported in this section assume that shark finning without retaining the carcass is prohibited. The prohibition is expected to eliminate any retention of blue sharks because of the undesirable qualities of its flesh after mortality. The prohibition is not expected to have a significant impact on the retention of other shark species. Estimated catches of blue sharks are expected to range from 11,707 animals with effort switching to 7,225 animals without effort switching, but with the prohibition on shark finning, the analysis assumes that all blue sharks will be released. The estimated mortality of released blue sharks is expected to be 15 percent of total catch or approximately 1,756 animals under Scenario A (with switching) and 1,142 animals under Scenario B. The prohibition on shark finning is expected to have a significant but unknown impact on the income of longline crewmembers.[41]

[41] Reliable estimates of income derived from the practice of finning blue shark are unavailable., but crew members are thought to have received the majority of the revenues from shark finning.

Table 4.8-30: Projections of Economic Impacts Under Alternative 10 *(Preferred)* with Effort Switching.

	Alternative 10 With Switching			Change from Alternative 1			Percentage Change from Alternative 1		
	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total
Break-even Vessels (Number)	108	0	108	34	-45	-11	45.9	-100.0	-9.2
Persons on Break-even Vessels	594	0	594	187	-203	-16	45.9	-100.0	-2.6
Effort (Sets)	11,879	0	11,879	4,751	-4,751	0	66.7	-100.0	0.0
Effort (Trips)	1,190	0	1,190	476	-433	43	66.7	-100.0	3.7
Trips per Break-even Vessel	11.0	0.0	11.0	1.4	-9.6	1.4	14.2	-100.0	14.3
Tuna Revenue ($Millions)	31.5	0.0	31.5	12.0	-5.2	6.9	61.6	-100.0	27.9
Swordfish Revenue ($Millions)	1.3	0.0	1.3	0.8	-11.3	-10.5	173.3	-100.0	-89.2
Shark Revenue ($Millions)	0.4	0.0	0.4	-0.0	-1.2	-1.2	-9.5	-100.0	-77.5
Other PMUS Revenue ($Millions)	3.2	0.0	3.2	1.6	-1.0	0.6	93.4	-100.0	22.5
Total Gross Revenue ($Millions)	36.4	0.0	36.4	14.4	-18.6	-4.3	65.1	-100.0	-10.5
Direct Albatross & Turtle Compliance Cost ($1,000 Annualized over 5 years)	165.2	0	165.2	165.2	0	165.2	Not applicable–fleet-wide compliance costs are zero in Alternative 1		
Average Gross Revenue per Break-even Vessel ($Thousands)	336,000	0	336,000	38,000	-414,000	-6,000	12.8	-100.0	-1.8
Direct Payments to Labor ($Millions)	17.6	0.0	17.6	7.0	-9.0	-2.1	65.1	-100.0	-10.5
Direct Purchases from Local Input Suppliers ($Millions)	12.8	0.0	12.8	5.0	-6.5	-1.5	65.1	-100.0	-10.5
Hawai'i Total Economic Impact--Direct, Indirect, and Induced ($Millions)	43.2	0.0	43.2	17.1	-22.1	-5.1	65.1	-100.0	-10.5
Total Turtle Mortality	26	0	26	-21	-103	-124	-45.0	-100.0	-82.8
Total Albatross Mortality	26	0	26	-133	-2,077	-2,209	-83.5	-100.0	-98.8
Total Blue Shark Mortality (Thousands of pounds)	176	0	176	-390	-4,903	-5,293	-69.0	-100.0	-96.8

Table 4.8-31: Projections of Economic Impacts Under Alternative 10 *(Preferred)* with No Effort Switching.

	Alternative 10 Without Switching			Change from Alternative 1			Percentage Change from Alternative 1		
	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total	Tuna	Sword-fish	Total
Break-even Vessels (Number)	77	0	77	3	-45	-42	4.1	-100.0	-35.3
Persons on Break-even Vessels	424	0	424	17	-203	-186	4.2	-100.0	-30.5
Effort (Sets)	7,640	0	7,640	512	-4,751	-4,239	7.2	-100.0	-35.7
Effort (Trips)	766	0	766	51	-433	-382	7.2	-100.0	-33.3
Trips per Break-even Vessel	9.9	0.0	9.9	0.3	-9.6	0.3	3.0	-100.0	3.1
Tuna Revenue ($Millions)	20.5	0.0	20.5	1.0	-5.2	-4.1	5.2	-100.0	-16.8
Swordfish Revenue ($Millions)	0.7	0.0	0.7	0.3	-11.3	-11.1	57.0	-100.0	-93.8
Shark Revenue ($Millions)	0.2	0.0	0.2	-0.2	-1.2	-1.4	-41.7	-100.0	-85.5
Other PMUS Revenue ($Millions)	2.0	0.0	2.0	0.4	-1.0	-0.6	22.0	-100.0	-22.7
Total Gross Revenue ($Millions)	23.5	0.0	23.5	1.5	-18.6	-17.1	6.7	-100.0	-42.1
Direct Albatross & Turtle Compliance Cost ($1,000 Annualized over 5 years)	52.6	0	52.6	52.6	0	52.6	Not applicable–fleet-wide compliance costs are zero in Alternative 1		
Average Gross Revenue per Break-even Vessel ($Thousands)	305,000	0	305,000	7,000	-414,000	-37,000	2.3	-100.0	-10.8
Direct Payments to Labor ($Millions)	11.4	0.0	11.4	0.7	-9.0	-8.3	6.7	-100.0	-42.1
Direct Purchases from Local Input Suppliers ($Millions)	8.3	0.0	8.3	0.5	-6.5	-6.0	6.7	-100.0	-42.1
Hawai'i Total Economic Impact--Direct, Indirect, and Induced ($Millions)	28.0	0.0	28.0	1.8	-22.1	-20.4	6.7	-100.0	-42.1
Total Turtle Mortality	17	0	17	-30	-103	-133	-64.0	-100.0	-88.8
Total Albatross Mortality	15	0	15	-144	-2,077	-2,221	-90.6	-100.0	-99.3
Total Blue Shark Mortality (Thousands of pounds)	112	0	112	-453	-4,903	-5,356	-80.1	-100.0	-97.9

Figure 4.8-22 shows that under Preferred Alternative 10 the targeting of swordfish is eliminated. Under the scenario that assumes effort switching, 34 of the vessels that currently target swordfish are projected to successfully break even after switching effort to targeting tuna. Under the scenario without effort switching, three vessels currently targeting

swordfish are projected to break even using the "deep" mixed target sets currently attributed to the swordfish fleet. Using these projections, this alternative is projected to result in the decline of the total Hawai'i-based longline fleet from its current level of 119 vessels to 108 vessels under the alternative with effort switching and to 77 vessels under the scenario without effort switching.

Figure 4.8-23 shows that under Preferred Alternative 10 scenario with effort switching, swordfish vessels unable to shift effort and break even suffer a loss of approximately $4.3 million. Swordfish vessels able to effectively target tuna are projected to have $12.3 million in gross revenues under the switching scenario. Under both scenarios approximately $0.6 million is projected to be realized by swordfish vessels that use existing "deep" mixed sets currently allocated to swordfish vessels.

Figure 4.8-22: Number of Break-even Vessels by Effort Type Under Preferred Alternative 10.

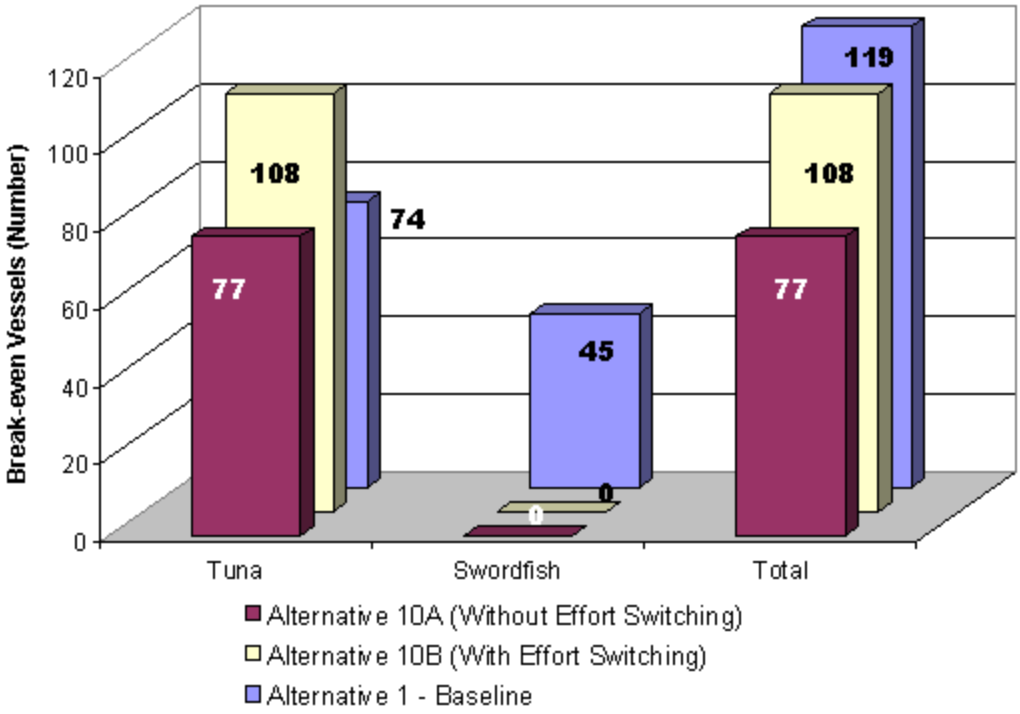
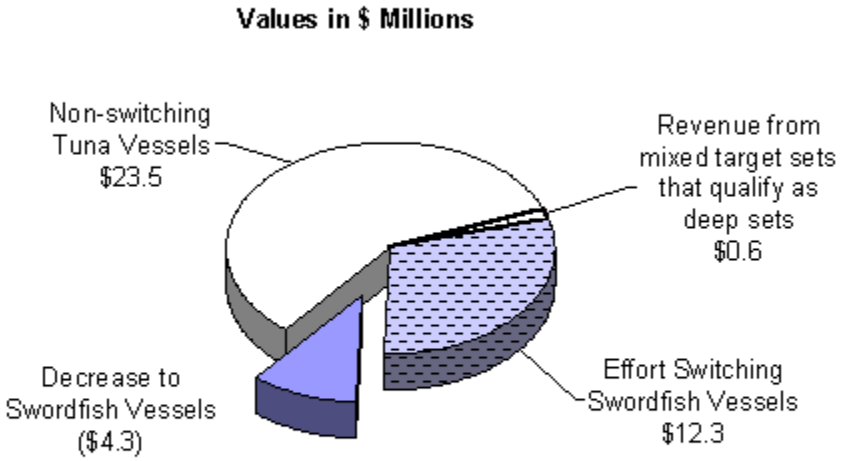


Figure 4.8-23: Estimated Total Longline Gross Revenues by Effort Type Under Preferred Alternative 10.



Note: Vessels targeting swordfish under Alternative 1 will suffer a collective reduction in gross revenues of $4.3 million under Alternative 10 if they are fully able to switch effort to tuna.

Effects of Seasonal Closed Area under Preferred Alternative 10

The preferred alternative prohibits fishing by vessels with Hawai'i limited access longline permits between the equator and 15° N. latitude, bounded by 145° W. and 180° longitude from April 1 through May 31. The closure is projected to result in a shifting of Hawai'i-based effort northward from the closed area. If effort of the Hawai'i-based fleet shifts northward as expected, the overall economic effects in terms of gross revenue are projected to be minimal, because CPUEs in areas north of the closed area are not significantly different than CPUEs within the closed area in the months of the closure.

Table 4.8-32 shows the projected effects of the closure on deep-set effort (new-effort from effort switching swordfish vessels is not shown in the table).[42] The numbers in column 2 show the projected total deep-set effort that is unaffected by the closure–total revenues of $22.53 million are projected. Column 3 shows the amount of effort and revenue that is directly affected by the closure–an estimated 413 sets were made in the closed area in an average year between April 1 and May 31 generating total revenues of $1.49 million. Column 4 shows the impacts of reallocating that effort to areas north of the closure. Because average revenue per unit of effort is less with the reallocated effort, projected total

[42]The estimates are approximations derived from previous Kobayashi-Polovina Model runs, in particular a preliminary model run showing the effects of a 5-month closure without the assumption that affected deep-set effort would relocate. Primary data allowing more precise estimates of the effects of the area closure were not provided.

revenue of these sets drops to $1.01 million. The total projected outcome under Preferred Alternative 10-Scenario B (without effort switching by swordfish vessels) is shown in column 5, and is equal to the sum of column 2 and column 4. Subtracting column 5 from the sum of column 2 and column 3 results in estimates of the net effect of the area closure (shown in column 5). It should be noted that the sum of column 2 and column 3 is actually equal to the results of Alternative 5B, and the projected net effect on deep-set effort of the closure is in fact the difference between results projected for the non-switching scenarios (Scenario B) under Alternative 5 and Preferred Alternative 10.[43]

In terms of projected revenue foregone to save additional turtles, the time-area closure under the preferred alternative appears to be relatively effective. Imposing the time-area closure results in an average foregone revenue of $81,553 per turtle.

Table 4.8-32: Projected Economic Impact the Seasonal Closure Under Alternative 10 *(Preferred)* with No Effort Switching.

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
	Total Deep-set Effort Excluding Effort Affected by the Closure	**Deep-set Effort in Closed Area – Alternative 1**	**Deep-set Effort Re-allocated – Alternative 10 Scenario B**	**Totals Under Alternative 10 Scenario B**	**Net Effect of Effort Reallocation**
Effort (sets)	7,227	413	642	7,640	0
Revenue from Tuna Sales ($Millions)	19.27	1.36	1.64	20.54	-0.54
Revenue from Swordfish Sales	0.67	0.02	0.11	0.73	0.05
Revenue from Shark Sales ($Millions)	0.22	0.05	0.02	0.23	-0.04
Revenue from Other PMUS Sales ($Millions)	1.93	0.06	0.11	2.05	0.05
Total Revenue	22.53	1.49	1.01	23.55	-0.48
Turtle Mortality	13	7	1	14	-7

Note: The sum of column 2 and column 3 is equal to the results projected for the non-switching scenario under Alternative 5 which prohibits shallow set gear, but does not impose area closures.

Effects on Other Hawai'i-Based Pelagic Fisheries

The preferred alternative is not expected to have significant direct impacts on Hawai'i-based catch and effort of commercial troll and handline vessels, nor is it expected that Preferred Alternative 10 will have significant direct effects on catch and effort of charter and recreational vessels in the pelagic fisheries. These vessels will be affected by the permit and reporting requirements that can be expected to improve the available data regarding these

[43]Data were not available to project the effects of the area closure on effort that might switch from swordfish vessels into deep-set effort.

fleets. It is likely that these vessels may also indirectly benefit from the preferred alternative if swordfish vessels owners find they are not able to successfully switch into deep-set fishing. In this case the amount of Hawai'i-based longline caught tuna is expected to decline which could result in a price increase for all sources of tuna. Higher prices will mean higher gross revenues for non-longline pelagic fishers, even if their own landings remain constant.

4.8.12 Option A: Research Fishery for Swordfish to Investigate Techniques to Reduce Turtle Interactions

This option would implement a research fishery that would be designed to obtain statistically reliable estimates of the effectiveness of different methods of reducing turtle interactions with longline gear deployed to catch swordfish. In the first year of the research program three research methods are proposed: (1) use of blue-dyed bait; (2) use of sets configured without branch lines near floats; and (3) changing location after a turtle interaction has occurred. In addition to the three tested methods, the experiment would include a control fishery that would deploy gear using methods that are currently the norm. The option could be used in conjunction with Alternatives 2, 4-8 or 10 and would be allowed to continue subject to an overall limit in turtle takes. In subsequent years the research program would be adjusted to align results from the previous year.

The objective of the research program is to continue swordfish fishing under experimental conditions such that data on the use of alternative gear and gear deployment may provide insights into turtle saving techniques. Because it is likely that the research fishery will have turtle interactions, a Section 10 permit would have to be obtained, before the research fishery could take place.

In order that the research program generate statistically reliable results the number of sets under the experiment fishery would need to be relatively high. Therefore it has been proposed that the experiment would consist of 3,500 sets in total with 50 percent (1,750 sets) deployed as a control and the remaining 50 percent distributed equally across the three other methods – 16.67 percent (583 sets) would used blue dye bait, 16.67 percent (583 sets) would be deployed without branch lines near floats, and 16.67 percent (584 sets) would be normally deployed but the vessel would be required move to a different location after a turtle interaction. All of the vessels participating in the research program would carry observers, with observer costs paid by NMFS.

Participation in the program would be on a volunteer basis, although there is a possibility that charter fees would be paid by NMFS. A permit under Section 10 of the ESA would be required for conduct of a research fishery for swordfish, and modifications to the program design could occur during the permit process. Under Alternatives 5, 7, 8 and 10, no fishing with shallow sets would be allowed except as a part of the experiment and therefore sufficient numbers of volunteers for the research fishery would likely be available. Alternatives 2, 4 and 6 would allow effort in the swordfish fishery to continue regardless of

the research fishery, and therefore combining the experiment with either of these alternatives could result in less than expected participation in the research program.

Economic Effects of the Research Fishery

The 3,500 set research fishery proposed under this option, while very large compared to other research fisheries, represents approximately 26 percent less effort than the 4,751 swordfish or mixed targets sets projected by the Kobayashi-Polovina model in the baseline case depicted under Alternative 1. Thus it is anticipated that, while the research fishery would improve gross revenues to swordfish vessels over alternatives that eliminate the swordfish fishery completely, and would serve as a mitigating measure of the preferred alternative, fewer swordfish vessels would be sustained by the research fishery than the base case shown under in the baseline case depicted by Alternative 1.

The projected economic outcomes of the first year of the research fishery are presented in Table 4.8-32. The results are projected based on the shallow-set gear baseline in the Kobayashi-Polovina model. The model has been adjusted from the baseline to account for the reduced number of sets allowed, and to account for an expected five percent reduction in CPUEs for commercial fish species. The reduced CPUEs are expected to occur in that portion of the research program that requires moving after a turtle interaction (C. Boggs, pers. comm., March 2001).

As shown in Table 4.8-32, the research fishery is projected to support 31 swordfish vessels, a decline of 14 (or 31.1 percent) from the base case of Alternative 1.Gross revenues of participating swordfish vessels are projected to be approximately $13.0 million, a decline of approximately 5.7 percent from the gross revenues of swordfish vessels under the baseline depicted in Alternative 1. Approximately $4 million in gross revenues are projected from tuna harvests and approximately $8.2 million in gross revenues are projected from swordfish harvests. The results of the research fishery for the first year would bring substantial benefits to the swordfish vessels, particularly if coupled with an alternative that restricts swordfish targeted effort. The continuation of the fishery after the first year, however, would depend on the results of the first year research and the prospects of continuing swordfish targeting effort with acceptable mortality to protected animals.

Table 4.8-32: Projections of Economic Impacts Under Option A – the Swordfish Research Fishery.

Swordfish Vessels in the First Year of the Research Program			
Indicator	**Research Program Total**	**Change from Alternative 1**	**Percentage Change from Alternative 1**
Break-even Vessels (number)	31	-14	-31.1
Persons on Break-even Vessels	140	-63	-31.0
Effort (sets)	3,500	-1,251	-26.3
Effort (trips)	319	-114	-26.3
Trips per Break-even Vessel	10.3	0.7	6.9
Tuna Revenue ($Millions)	4.0	-1.1	-21.5
Swordfish Revenue ($Millions)	8.2	-3.1	-27.4
Shark Revenue ($Millions)	0.0	-1.2	-97.2
Other PMUS Revenue ($Millions)	0.7	-0.3	-31.3
Total Revenue ($Millions)	13.0	-5.7	-30.5
Average Revenue per Break-even Vessel ($)	418,000	4,000	1.0
Direct Payments to Labor ($Millions)	6.3	-2.7	-30.5
Direct Purchases from Local Input Suppliers ($Millions)	4.6	-2.0	-30.5
Hawai'i Total Economic Impact – Direct, Indirect, and Induced ($Millions)	15.4	-6.7	-30.5
Total Blue Shark Mortality (Thousands of Pounds)	556	-4,347	-88.7

4.9 SOCIAL IMPACTS

This analysis examines the following three types of potential social impacts for each alternative:

- **Sustained participation of fishing communities**. An analysis of these impacts is consistent with the MSA and National Standard 8. The detailed economic analysis presented in Section 4.8 will not be repeated here. Rather, the focus is on those socioeconomic impacts that follow from the links between fishing sectors and sub-regions or communities.

- **Group and cultural issues**. This portion of the analysis is intended to identify specific social groups and cultural factors with the potential to be adversely impacted

in ways that may be substantially different from those seen at the level of the community as a whole, or are not captured in an analysis of sustained community participation. This information is provided to adequately disclose and examine sociocultural issues identified during the review of existing information and/or the public scoping process.

- **Environmental justice issues**. An analysis of these issues is consistent with Executive Order 12898. The objective is to identify potential disproportionately high and adverse impacts to minority populations or low income populations.

These social impacts are examined for each of the measures addressing interactions with sea turtles and seabirds, shark finning and American Samoa fisheries interactions included in each alternative. The impacts for the five sub-regions (Hawai'i, American Samoa, Guam, CNMI, and U.S. Pacific remote island areas) are discussed separately or in combination, as appropriate to the individual alternative. Finally, in addition to describing the separate effects of the various measures under each alternative, this analysis examines the combined effects of measures on communities and social groups.

4.9.1 Alternative 1: Existing FMP (No action)

4.9.1.1 Sustained Participation of Fishing Communities

4.9.1.1.1 Hawai'i

Seabird and Sea Turtle Interactions and Shark Finning

Under the no action alternative the pelagic fisheries would continue to benefit Hawai'i fishing communities as described in Section 3.11. The sustained participation of these communities in the pelagic fisheries would be unaffected.

4.9.1.1.2 American Samoa, Guam, CNMI and U.S. Pacific Remote Island Areas

Seabird and Sea Turtle Interactions and Shark Finning

As there are no restrictions in response to these issues under this alternative, the pelagic fisheries would continue to benefit fishing communities in these sub-regions as described in Section 3.11, and the sustained participation of these communities in the pelagic fisheries would be unaffected.

American Samoa Fisheries Interactions

Under the no action alternative, highly capitalized vessels with high levels of fishing power could fish on grounds that have traditionally been the most important to small boats participating in American Samoa's pelagic fisheries, leading to possible gear conflicts and catch competition between the large and small vessels. A reduction in the availability of pelagic fish within the fishing range of the small-boat fleet would have a particularly adverse effect on the emerging small-scale longline fishery and the developing shore-side support services that support this fishery. However, the large tuna processing sector that occupies an important place American Samoa's economy would not be affected by this alternative, as the vessels that supply the canneries with fish generally operate outside the U.S. EEZs. Given the enormous difference in scale between the relative economic contributions of the tuna canning industry and the local small-boat fishery, this alternative would not significantly affect the economic participation of American Samoa's fishing communities in pelagic fisheries. However, this alternative could have a significant negative effect on the ability of local artisanal and subsistence fishers to harvest pelagic fishery resources in the EEZ to meet social and smaller scale economic needs.

4.9.1.2 Group and Cultural Issues

4.9.1.2.1 Seabird and Sea Turtle Interactions and Shark Finning

One group that would be negatively affected by the no-action alternative would be those members of the general public who are concerned about protected species issues and shark finning and potential shark overfishing issues. In recent years, shark finning, in particular, has been subject to considerable organized opposition by various environmental associations. Moreover, it is likely that some members of the public ascribe the same high value to preserving the leatherback turtle and short-tailed albatross that they assign to the preservation of other endangered "charismatic megafauna." In the absence of public surveys, however, it is difficult to determine how widespread such concerns are in American society. The level of these concerns could vary across different age, ethnic and income groups as well as other demographic groupings.

Public concerns over seabird and sea turtle interactions in the pelagic fisheries of the Western Pacific Region have focused on the Hawai'i-based longline fishery. Similar concerns have not been expressed for pelagic fisheries occurring in other sub-regions because of the relatively low level of recorded interactions in those fisheries. However, public concerns related to shark finning and potential shark overfishing may apply across the region.

4.9.1.2.2 American Samoa Fisheries Interactions

Also potentially negatively affected by this alternative would be the small-boat fishing fleet participating in American Samoa's pelagic fisheries and the shore-side businesses that support this fleet. New profitable opportunities for artisanal fishers to harvest pelagic species may be precluded. In addition, this alternative could hinder subsistence fishing activities that continue to contribute to the integrity of Samoan culture.

4.9.1.2.3 Combined Group and Cultural Impacts

The impacts of this alternative are additive to the extent that continued inaction to address seabird and sea turtle interactions and shark finning issues in the Hawai'i-based longline fishery may heighten public concerns and reduce or compromise the existence and ethically motivated values associated with the protection of these species.

4.9.1.3 Environmental Justice

4.9.1.3.1 Populations in Hawai'i

The no action alternative has no environmental justice implications for minority populations or low-income populations in Hawai'i.

4.9.1.3.2 Populations in American Samoa

This alternative does not address potential environmental justice issues affecting American Samoans. A reduction in the level of participation of the small-boat fleet in the pelagic fisheries could result unless there are measures to protect the fishery resources available to this fleet. Such a reduction would have a disproportionately high and adverse effect on both minority populations and low-income populations, as it is mainly Samoans who captain and crew the small-scale fishing vessels and who own or are employed in the shoreside businesses that support these vessels.

4.9.1.3.3 Populations in Guam, CNMI and U.S. Pacific Remote Island Areas

The no action alternative has no environmental justice implications for minority populations or low-income populations in Guam, CNMI, or the U.S. Pacific remote island areas.

4.9.2 Alternative 2: Pending Council Actions

4.9.2.1 Sustained Participation of Fishing Communities

4.9.2.1.1 Hawai'i

Sea Turtle Interactions

As there are no measures addressing sea turtle interactions under this alternative, no negative impacts to fishing communities would result from this component of this alternative.

Seabird Interactions and Shark Finning

The impacts of measures to reduce seabird interactions and prohibit shark finning, either taken separately or in combination, would not be significant in terms of affecting the participation of fishing communities in the pelagic fisheries. While individual fishing-related enterprises and particular groups of fishers may experience adverse impacts, these impacts would not be significant from the community level of analysis. Economic modeling indicates that this alternative could lead to an increase in direct payments to labor, direct purchases from local input suppliers, and total (direct, indirect and induced) output in the Hawai'i-based longline fishery (Section 4.8). The predicted increase is minor, however, and is most likely a result of imprecision in the model. It is probable that this alternative would have no significant economic effect on the longline fishery as a whole

4.9.2.1.2 American Samoa, Guam, CNMI and U.S. Pacific Remote Island Areas

Seabird and Sea Turtle Interactions

As there are no measures to protect seabirds and sea turtles that apply to these sub-regions under this alternative, the pelagic fisheries would continue to benefit fishing communities as described in Section 3.11.

Shark Finning

Although sharks are caught by small-boat fishing fleets in American Samoa, Guam and the CNMI, sharks comprise a small portion of landings. In addition, sharks are usually landed whole rather than finned. Thus, the ban on shark finning proposed under this alternative would have no impact on the sustained participation of American Samoa, Guam or CNMI fishing communities in the pelagic fisheries.

American Samoa Fisheries Interactions

The area closures imposed on large fishing vessels proposed under this alternative would reduce the potential for gear conflicts and catch competition between highly capitalized vessels and small boats participating in American Samoa's pelagic fisheries. Reducing catch competition from large-scale harvesters would help maintain catch rates on fishing grounds that have traditionally been among the most important to artisanal and subsistence fishers. Pelagic fish landings by the small-scale fleet are important in American Samoa as a source of food for local consumption, for local income and employment and as a means of preserving and perpetuating Samoan cultural values. Moreover, small-scale fishing ventures represent an important path to sustainable development and economic self-reliance for American Samoa.

In anticipation of possibly creating a limited access system for American Samoa's longline fishery, the Council and NMFS established a control date of July 15, 2000, after which any vessel of any size entering the fishery will not be assured of being allowed to use longline gear to fish for pelagic management unit species in the EEZ around American Samoa (65 FR 62692 [2000]). In other words, the control date placed the owners of new longline vessels of any size on notice that they might be excluded if they entered the fishery after the control date. Since this specific action established a control date, but not a limited access system itself, there are no impacts associated with the action, except to the unknown extent that a control date may have encouraged some individuals to acquire permits prior to the control date to ensure access to the fishery and discouraged other individuals from acquiring permits after the control date. Any analysis of the social impacts of this action would be speculative.

Permitting and Reporting Requirement in Troll and Handline Fisheries of U.S. Pacific Remote Island Areas

As this measure would involve only a small number of vessels and compliance costs would be minimal, there would be no social impacts.

4.9.2.2 Group and Cultural Issues

4.9.2.2.1 Seabird Interactions

By taking action to reduce the number of seabird interactions in the Hawai'i-based longline fishery, this alternative addresses public concerns regarding the incidental mortality of seabirds in the fishery. However, the degree to which these public concerns are allayed will be contingent on the effectiveness of the mitigation measures.

As noted in Section 3.11, the Hawai'i-based longline fishery can be broken down into two components based on differences in fishing area, gear and technique, as well as target

species group. In 1999, the total number of vessels participating in the fishery was 119. Of these, 45 were not equipped with line shooters and therefore were restricted to targeting swordfish or a mixture of swordfish and tuna. For the purposes of analyzing the social impacts of this and other alternatives, these vessels are referred to as swordfish vessels and are treated as a single group separate from vessels equipped with line-shooters and targeting mainly tuna, consistent with the methodology utilized in the analysis of economic impacts.

The impact of the measure to reduce seabird interactions proposed under this alternative will be concentrated among swordfish vessels, as these vessels account for most of the total longline fishing effort (sets) above 23° N., the fishing area in which the use of mitigation measures would be required (WPRFMC, 1999c). Swordfish vessels, in turn, are closely associated with a single ethnic or sociocultural group - Vietnamese Americans. As indicated in Section 3.11, nearly all of the owners, captains and deckhands of swordfish vessels belong to this ethnic group. With respect to the community base of swordfish vessels, all of these vessels are moored in the Honolulu area. Therefore, virtually all of the social impacts associated with the proposed seabird interaction reduction measure would be experienced by one group within one community, at least in terms of impacts on the harvest portion of the fishery. However, the compliance costs of this measure are likely to be minimal. The required use of strategic offal discharge, blue dyed bait and thawed bait would have a negligible impact on catch rates, and the direct cost of employing these mitigation methods is relatively low. Further, it is likely that swordfish vessels would adopt night setting as their additional mitigation method, as these vessels already routinely set at night.

4.9.2.2.2 Shark Finning

This alternative and Alternatives 4-8 and 10 take into account the Shark Finning Prohibition Act passed by the U.S. Congress in 2000. Consequently, this alternative directly addresses public concerns related to shark finning by prohibiting the practice.

The economic impacts of this measure will be concentrated among tuna vessels, as these vessels account for 58 percent of the sharks finned based on 1998 data provided by NMFS. Although the shark catch rate for swordfish vessels is higher than that of vessels targeting tuna, the crews of the latter engage more frequently in shark finning. The lower rate of finning on swordfish boats may be related to the fact that the on-board processing time for swordfish is greater than that for tuna. Consequently, crew members on swordfish vessels have less time to fin sharks without interfering with the harvest and handling of target species.

A ban on finning would eliminate an income supplement equal to approximately ten percent of an average crew member's annual earnings of $25,000 (WPRFMC, 2000b). Although there would be no direct impact on longline owners or captains, the lost supplement to crew income may increase the difficulty of hiring crew. As indicated earlier, however, the landing

of shark fins by Hawai'i-based longline vessels has already decreased substantially as the result of a state statute enacted in mid-2000.

A shark finning ban could also have a negative impact on crew members of purse seine vessels based in American Samoa. Generally, it is the lowest paid crew members on seiners that engage in shark finning (McCoy and Ishihara, 1999). These individuals are typically citizens of the Philippines or a Pacific Island nation. However, the importance of the income from finning may have already declined for these individuals as a result of the voluntary ban on shark finning adopted by the U.S. purse seine fleet as an industry standard.

Also impacted by a shark finning ban would be local traders who buy shark products from the Hawai'i-based longline fleet. There are one or two Hawai'i-based shark fin traders who process and sell these fins. It is estimated that in 1998 between $332,000 and $399,000 was generated by local shark product traders dealing with the Hawai'i-based domestic longline fleet. Under this alternative this group would see no change in shark meat revenue but would realize a decline of 17 percent in shark fin revenue (WPRFMC, 2000b).

Shark fin dealers in Hawai'i indicate that some of the fins landed by Hawai'i-based longline vessels are shipped to the U.S. mainland for further processing. At least a portion of the processed fins are sold in the U.S. market. There is a significant and apparently growing domestic consumption of shark fins, particularly in urban areas with large populations of ethnic Chinese, such as New York, San Francisco and Los Angeles. It is doubtful, however, that a prohibition on shark finning would affect the availability or prices of shark fins for American consumers. Most of the processed shark fins sold in the United States are imported from Hong Kong which receives shark fins from multiple sources around the world.

Finally, a ban on shark finning would eliminate the delivery of shark fins from foreign longliners to transshipment operations in Hawai'i, as these deliveries are conducted by U.S.-flag vessels contracted for that purpose. Based on these contract costs and local in-port costs (agency fees, storage, wharfage, etc.), it estimated that $235,000 in annual local expenditures related to the transshipment of shark fins would be foregone under this alternative (WPRFMC, 2000b).

4.9.2.2.3 American Samoa Fisheries Interactions

The large-vessel area closures in American Samoa proposed under this alternative would have a beneficial effect on participants in American Samoa's small-boat fisheries and the shoreside businesses that support these fisheries.

This alternative would have a negative effect on residents of American Samoa who have invested in large vessels if they are excluded from productive fishing grounds within 50 miles

of the shoreline. Currently, there are four domestic longline vessels based in American Samoa that are greater than 50 ft in length. However, two of these boats would be permitted to fish within the proposed closed areas, as they would qualify for the exemption to be granted to vessels that held NMFS general longline permits and made qualifying landings prior to the control date. In addition, it is likely that another of the large vessels would qualify for an experimental fishing permit that would allow it to fish within the area closure. This vessel is being used to train Samoans as commercial fishers under a grant provided by the Administration for Native Americans. Consequently, it is likely that only one of the domestic longline vessels currently based in American Samoa would be affected by the area closure.

Negative effects could also be realized by owners of large domestic longline vessels based outside of American Samoa who are seeking new productive fishing grounds. This alternative would eliminate a possible fishing area for these boat owners by closing off a part of the U.S. EEZ to fishing by large vessels.

It is possible that the establishment of area closures in the waters around American Samoa could have an indirect negative effect on U.S. purse seine fishing activities in the western and central Pacific. Specifically, the closure of areas to fishing by large vessels could set a precedent that would be followed by Pacific island nations that are parties to the SPTT (Section 3.13). This treaty sets forth the terms and conditions that U.S. purse seine vessels must adhere to in order to fish in the region. Among the principal issues of the treaty are closed and limited areas. It is important to note, however, that a number of Pacific island nations, such as Kiribati, Tuvalu and the Federated States of Micronesia, depend upon foreign fishing access fees for a significant portion of their government revenue. The access fees paid by the United States under the SPTT are the highest of any licensing arrangement in the region (ten percent of the value of fish harvested). This economic incentive for Pacific island nations to accommodate foreign fishing vessels, particularly U.S. purse seiners, is likely to continue. On the other hand, one way in which Pacific island countries may encourage the development of local tuna industries is to reserve a portion of their EEZ waters for exclusive use by their own fishing fleets. Some islands have already created such closures, and this trend is likely to continue whether or not an area closure is established in American Samoa.

4.9.2.3 Environmental Justice

4.9.2.3.1 Populations in Hawai‘i

This alternative has no environmental justice implications for minority populations or low-income populations in Hawai‘i. Although the impacts of the measure to reduce seabird interactions proposed under this alternative would be concentrated among fishing vessels owned and operated by Vietnamese Americans, these impacts would not be significant.

4.9.2.3.2 Populations in American Samoa

This alternative would avoid or mitigate potential environmental justice impacts that could result from the reduced participation of local minority populations or low-income populations in the pelagic fisheries. It would particularly benefit Samoans, as they constitute the majority of owners, captains and crew members of the small boats participating in American Samoa's pelagic fisheries and have the highest level of dependence on these fisheries to meet economic and cultural needs.

4.9.2.3.3 Populations in Guam, CNMI and U.S. Pacific Remote Island Areas

This alternative has no environmental justice implications for minority populations or low-income populations in Guam, CNMI, or the U.S. Pacific remote island areas.

4.9.3 Alternative 3: Court Ordered Action (Status Quo)

4.9.3.1 Sustained Participation of Fishing Communities

4.9.3.1.1 Hawai'i

Sea Turtle Interactions

Only the Hawai'i-based longline fishery would be affected by the measure to reduce sea turtle interactions that would continue to be implemented under this alternative. This fishery is by far the most economically important of Hawai'i's commercial fisheries, accounting for 73 percent of the total gross revenue generated in 1999 by all commercial fisheries in the state. Economic modeling indicates that this alternative would decrease direct payments to labor, direct purchases from local input suppliers, and total (direct, indirect and induced) output in the Hawai'i-based longline fishery by 31 to 51 percent (Section 4.8). These decreases, however, would have a negligible impact on the structure and integrity of the economy of Honolulu, the urban community where the Hawai'i-based longline fleet is concentrated. As detailed below, this measure would result in significant impacts on some fishing-related enterprises based in Honolulu. However, the economic dependence of Honolulu on the harvest or processing of fishery resources is negligible in comparison to its dependence on other economic activities, such as tourism.

Seabird Interactions and Shark Finning

As there are no fishing restrictions in response to these issues under this alternative, the pelagic fisheries would continue to benefit fishing communities as described in Section 3.11.

4.9.3.1.2 American Samoa, Guam, CNMI and U.S. Pacific Remote Island Areas

Seabird and Sea Turtle Interactions and Shark Finning

As there are no fishing restrictions in response to these issues that apply to these sub-regions under this alternative, the pelagic fisheries would continue to benefit fishing communities as described in Section 3.11.

American Samoa Fisheries Interactions

Because there are no fishing restrictions in response to this issue under this alternative, the impacts on the sustained participation of American Samoa's fishing communities in the pelagic fisheries would be the same as those under Alternative 1. As noted in that alternative, possible gear conflicts and catch competition between large and small vessels could significantly affect the ability of local artisanal and subsistence fishers to harvest pelagic fishery resources in the EEZ to meet economic and social needs.

4.9.3.2 Group and Cultural Issues

4.9.3.2.1 Seabird and Sea Turtle Interactions and Shark Finning

By taking action to reduce the number of sea turtle interactions in the Hawai'i-based longline fishery, this alternative addresses public concerns over the incidental mortality of sea turtles in the fishery. However, the degree to which these public concerns are allayed is contingent on the effectiveness of the mitigation measures.

This alternative does not address public concerns over seabird interactions with the Hawai'i-based longline fishery nor does it address public concerns related to shark finning and potential shark overfishing.

The time, area, effort and gear restrictions implemented under this alternative mainly affect swordfish vessels. As noted in Alternative 2, swordfish vessels are predominately owned, captained and crewed by Vietnamese Americans and the shoreside activities of these vessels are concentrated in the Honolulu area. The preceding economic analysis examined two sets of impacts based on two different assumptions: (1) all swordfish vessels are able to switch gear types to become tuna vessels without cost; and (2) all swordfish vessels are unable to switch because they are too heavily capitalized to be cost-effective as tuna fishing vessels (Section 4.8).

Even if it is assumed that all swordfish vessels are able to convert to tuna longline fishing economic modeling indicates that the number of these vessels that would continue operating

at break-even in the Hawai'i-based longline fishery would decline by 69 percent from the baseline (Alternative 1), based on the net difference of 'tuna vessels added' and 'swordfish vessels subtracted' from the overall longline fleet. Based on the differential number of crew positions on the vessels lost and gained, the number of persons employed on these vessels would drop by 64 percent. The total gross revenue of these vessels would drop by 67 percent.

If it is assumed that none of the current swordfish vessels managed to switch gear types to become tuna vessels economic modeling indicates that the number of these vessels that would continue operating at break-even, the number of persons employed on these vessels and their total gross revenue would drop by 91 percent from the baseline. Direct payments to labor and direct purchases from local input suppliers would decrease by a similar percent.

The most likely scenario is that some swordfish vessels will be unable to switch and forced to leave the Hawai'i-based longline fishery, while others will successfully convert to tuna fishing. It is uncertain if those most likely to find switching a viable option would be the owners of the less successful swordfish vessels (e.g., owners of small, less-capitalized vessels) or the more successful swordfish vessels (e.g., owners of large vessels who have the financial resources to make the switch or simply have superior fishing skills). It is important to note that swordfish vessels that switch to tuna fishing would have the option of periodically switching back to targeting swordfish as long as their swordfish fishing operations were outside the jurisdiction of the Pelagics FMP. For several years prior to the court ordered action, for example, some Hawai'i-based swordfish vessels routinely fished outside the EEZ off California and made landings in that state during part of each year, typically from October through February. Apparently, swordfish catch rates in the eastern Pacific are higher than those in the central Pacific during these months, possibly because of a seasonal eastward migration of the fish stock. This periodic movement of vessels to swordfish fishing grounds outside the jurisdiction of the Pelagics FMP could continue under this alternative.

Those swordfish vessels permanently displaced from the Hawai'i-based longline fishery by this alternative could recover some of their losses if they were able to redirect their effort to other swordfish fishing grounds. The most likely destination for displaced vessels would appear to be California. As noted above, some swordfish vessels already find it desirable to fish out of California for part of each year. In fact, since December 1999, 40 longline boats that originated in Hawai'i have unloaded their catch in California ports (NMFS, 2000c).[44] The quantity of swordfish landed at San Pedro/Terminal Island, California increased from 1.5 million pounds in 1999 to 2.6 million pounds in 2000 (NMFS, 2001a). However, the California fishery has generally been a seasonal (October-February) fishery for the Hawai'i-based longline vessels that participated in the fishery, and it is uncertain what alternative fisheries would be available for these vessels once the season ends. Some fishers may opt

[44] In comparison, only about twenty swordfish vessels regularly shifted to California during the fall and winter months prior to the Court-orderd actions modifying the FMP management regime. An industry representative indicated that all but five swordfish vessels shifted after the Court-orderd actions (Minh Dang, pers. comm., November 6, 2000, Honolulu, 96827). The five boats that stayed in Hawai'i were too small to make the crossing to the U.S. mainland.

to shift to Atlantic or Gulf of Mexico fisheries, but acquiring access to these fisheries may be difficult due to license limitation programs.

The reduced earnings or job losses that result from this alternative occur at a time when opportunities for shore-based jobs within fishing related fields (e.g., at marinas or dry dock facilities) as well as in other segments of Hawai'i's labor market where fishers and their family members are likely to seek employment have been constricting. Furthermore, jobs in unskilled sectors of the state economy are increasingly staffed by temporary, casual and immigrant workers who keep wages at minimum levels. Although Hawai'i is recovering from its tourism recession, employment opportunities remain limited and the cost of living in Hawai'i remains higher than all states except Alaska.

Deckhands would arguably be the most severely impacted by reductions in the economic viability of swordfish fishing operations caused by this alternative. They are likely to have the greatest difficulty in finding suitable alternative jobs because of their relatively low level of job skills and formal education.

A recent study of workers that were laid off following the shut down of the sugar industry on the island of Hawai'i found that more than a year after the loss of their jobs 35 percent of the interviewees were still unemployed and seeking work (DeBaryshe *et al.*, undated). Moreover, anecdotal evidence suggests that many of those who had found employment were in temporary or seasonal jobs. Although three-quarters of the plantation workers who were laid off made use of state-sponsored job training services, use of these services did not increase the chance of finding a new job. DeBaryshe *et al.* report that demographic characteristics such as age, former plantation job grade and education were also largely unrelated to the likelihood of re-employment. It is likely that individuals who lose their jobs in the fishing industry as a result of this measure would encounter similar difficulties in finding suitable alternative employment.

Those who become unemployed would face the social and psychological costs of job loss. Individuals who lose their jobs typically experience heightened feelings of anxiety, depression, emotional distress and hopelessness about the future, increases in somatic symptoms and physical illness, lowered self-esteem and self-confidence and increased hostility and dissatisfaction with interpersonal relationships (DeBaryshe *et al.*, undated). In addition, both spouses and children of such individuals are at risk of similar negative effects. A study of workers displaced from Hawai'i's sugar industry found many families reported difficulty in paying bills and in affording transportation, health care and even food and clothing (DeBaryshe *et al.*, undated). The results of this financial strain were high levels of psychological distress among some family members as well as an increase in physical health problems. It is probable that a similar level of stress would be experienced by individuals who lose their jobs in the fishing industry as a result of this measure.

This alternative would also have a negative impact on businesses involved in the sale of fishery inputs or purchase of fishery outputs. The capability of these entities to weather this alternative would be a function of their degree of dependence on the longline fishery. Those businesses that sell goods and services to swordfish vessels or purchase the catches of these vessels would be especially adversely affected.

The effects of the alternative on U.S. consumers of fresh swordfish are expected to be minimal. A decrease in Hawai'i swordfish production may result in a short-term increase in the price of fresh swordfish, but over the long term the demand on the U.S. mainland for this product will be met by increased production in countries currently exporting swordfish to the United States, such as Brazil, Chile and Uruguay.

4.9.3.2.2 American Samoa Fisheries Interactions

Because there are no fishing restrictions in response to this issue under this alternative, the impacts on the American Samoa's small-boat fishing fleet and the shoreside businesses that support that fleet would be the same as those under Alternative 1. As noted in that alternative, opportunities for artisanal and subsistence fishers to harvest pelagic species may be reduced.

4.9.3.3 Environmental Justice

4.9.3.3.1 Populations in Hawai'i

The minority population in Hawai'i that would experience disproportionate high and adverse impacts under this alternative are Vietnamese American fishers. Available data do not allow a determination of whether or not the population disproportionately impacted by this alternative is also a low-income population.[45]

The negative effects of this alternative on Vietnamese American owners of swordfish vessels would be immediate and substantial. Although these individuals may have the skills to rebound in the long run, many would face foreclosure and loss of the cumulative investments that went into their fishing enterprises.

This alternative would also likely impose a severe economic hardship on deckhands of Vietnamese descent. These crew members as a group are probably among the least occupationally flexible population in Hawai'i. The majority have limited education and poor English skills. It is likely that there are few jobs available for them in the local community outside of minimum wage opportunities, and for many the income losses may be long-term.

[45] Income statistics for Vietnamese American fishers in Hawai'i are unavailable. However, data from the 1990 U.S. Census indicated that the poverty rate of Vietnamese Americans nationwide was 34 percent, more than three times the rate of the total U.S. population.

This alternative would have a negative impact on those businesses owned by Vietnamese Americans involved in the sale of inputs to the longline fleet. There are two such businesses in Honolulu, both of which cater primarily to swordfish vessels.

In summary, Vietnamese American vessel owners, skippers, and deckhands, along with the owners and employees of some associated fishing supply firms, are likely to experience disproportionate high and adverse impacts under this alternative. The negative effects of this alternative on Vietnamese American longline vessels owners could be mitigated by a permit or vessel "buy-back" program. Some holders of a Hawai'i longline limited access permit might be willing to sell their permit or vessel to the federal government or a third party for the sole purpose of retiring the permit or vessel. Subject to the availability of funds for this purpose, the government might be willing to buy these permits or vessels to enable and encourage fishers who wish to pursue alternatives to fishing for swordfish in the Western Pacific Region. Any such "buy-out" would require, at a minimum, a cooperative seller, a willing buyer and available funds. Close involvement of fishery participants is advisable to ensure that such mitigation measures are appropriate.

4.9.3.3.2 Populations in American Samoa

As discussed in Alternative 1, a reduction in the level of participation of the small-boat fleet in the pelagic fisheries could result in a disproportionately high and adverse effect on both minority populations and low-income populations.

4.9.3.3.3 Populations in Guam, CNMI and U.S. Pacific Remote Island Areas

This alternative has no environmental justice implications for minority populations or low-income populations in Guam, CNMI, and the U.S. Pacific remote island areas.

4.9.4 Alternative 4: Seasonal Area Longline Fishery Closures

4.9.4.1 Sustained Participation of Fishing Communities

4.9.4.1.1 Hawai'i

The impacts of measures to reduce sea turtle and seabird interactions and prohibit shark finning, either taken separately or in combination, would not be significant in terms of affecting the participation of fishing communities in the pelagic fisheries. While individual fishing-related enterprises and particular groups of fishers may experience adverse impacts, these impacts would not be significant from the community level of analysis. Economic modeling indicates that this alternative would decrease direct payments to labor, direct purchases from local input suppliers, and total (direct, indirect and induced) output in the Hawai'i-based longline fishery by less than three percent from the baseline (Section 4.8). As

noted in Alternative 3, any change in the economic performance of the Hawai'i-based longline fleet would have a negligible impact on the structure or integrity of Honolulu's economy.

4.9.4.1.2 American Samoa, Guam, CNMI and U.S. Pacific Remote Island Areas

The impacts of measures to reduce sea turtle and seabird interactions, restrict shark finning and mitigate potential fisheries interactions in American Samoa implemented under this alternative would be similar to those described for Alternative 2.

As indicated in Alternative 2, there would be no social impacts associated with establishing a permitting and reporting requirement for troll and handline fisheries in the U.S. Pacific remote island areas.

4.9.4.2 Group and Cultural Issues

4.9.4.2.1 Seabird and Sea Turtle Interactions

By taking action to reduce the number of sea turtle and seabird interactions in the Hawai'i-based longline fishery, this alternative addresses public concerns over the incidental mortality of these animals in the fishery. However, the degree to which these public concerns are allayed would be contingent on the effectiveness of the mitigation measures.

As in Alternative 3, the impacts of measures to reduce sea turtle interactions are concentrated among swordfish vessels, virtually all of which are owned, captained and crewed by Vietnamese Americans. Economic modeling indicates that the number of swordfish break-even vessels, and the number of persons employed on swordfish vessels, would drop by seven percent from the baseline; swordfish revenue on these vessels would drop by 16 percent; and direct payments to labor and direct purchases from local input suppliers would drop by five percent.

Swordfish vessels could recover some of these losses if they switched to tuna longline fishing during the seasonal closure. However, as discussed in Alternative 3, many of these vessels may be too heavily capitalized to be used to target tuna exclusively. Some swordfish vessels may tie up in Hawai'i during the closure or relocate to areas where they can access alternative swordfish fishing grounds, either temporarily or permanently. It is also unclear how many vessels in the swordfish fleet would be able to withstand a 16 percent drop in swordfish revenue over the long term. It is likely that the effects of this revenue loss would be unevenly distributed over the fleet according to vessel size, operating characteristics, and financing structure. The need for many of the owners of swordfish vessels to repay large bank loans acquired to purchase their vessels may force some to relocate during the months that the area closure is in effect (July-January). As noted in Alternative 3, the most likely

destination for displaced vessels would appear to be California, given that some swordfish vessels already find it desirable to fish out of California during the fall and winter months (October-February).

The social impacts of the reduced earnings or job losses among participants in the Hawai'i-based longline fishery that result from this alternative would be similar to those described in the group and cultural issues for Alternative 3.

The measures to reduce seabird interactions, restrict shark finning and mitigate potential interactions among American Samoa's pelagic fisheries proposed under this alternative are identical to the measures proposed under Alternative 2, and the impacts on social groups and cultural factors would be the same.

4.9.4.2.2 Combined Group and Cultural Impacts

The impacts of the measures implemented under this alternative are additive in that the impacts of the sea turtle and seabird interaction reduction measures would be concentrated among swordfish vessels. Swordfish vessels would also be negatively affected by a ban on shark finning, although the effects of this measure would be concentrated among tuna vessels.

Restrictions on fishing by large vessels in a portion of the EEZ around American Samoa could have a negative effect on Hawai'i-based swordfish and tuna vessels displaced by regulations by eliminating a possible alternative fishing ground. However, it is uncertain if the swordfish resources in the waters around the territory could support a directed swordfish fishery even in the absence of an area closure. Furthermore, vessels harvesting tuna or swordfish for the fresh fish market would have to overcome logistical obstacles in American Samoa such as limited shoreside ice and cold storage facilities and infrequent and expensive air transportation links.

4.9.4.3 Environmental Justice

4.9.4.3.1 Populations in Hawai'i

The minority population in Hawai'i that would experience disproportionate adverse impacts under this alternative are Vietnamese American fishers, but from the available data it is not clear whether or not these impacts are either 'high and adverse' or significant. In addition, available data do not allow a determination of whether or not the population disproportionately impacted by this alternative is also a low-income population.

4.9.4.3.2 Populations in American Samoa

As discussed in Alternative 2, reserving a portion of the EEZ around American Samoa for use by small boats would avoid or mitigate potential environmental justice impacts that could result from resource competition and gear conflicts between industrial-scale fishing vessels and boats owned by mainly ethnic Samoan artisanal and subsistence fishers.

4.9.4.3.3 Populations in Guam, CNMI and U.S. Pacific Remote Island Areas

This alternative has no environmental justice implications for minority populations or low-income populations in Guam, CNMI, and the U.S. Pacific remote island areas.

4.9.5 Alternative 5: Increase Fishing Gear Deployment Depth

4.9.5.1 Sustained Participation of Fishing Communities

4.9.5.1.1 Hawai'i

The impacts of measures to reduce sea turtle and seabird interactions and restrict shark finning implemented under this alternative would be similar to those described for Alternative 4. Economic modeling indicates that this alternative would decrease direct payments to labor, direct purchases from local input suppliers, and total (direct, indirect and induced) output in the Hawai'i-based longline fishery by between 8 and 41 percent from the baseline (Section 4.8). However, while these decreases would be significant to individual operations, they would not affect the sustained participation of fishing communities in the pelagic fisheries.

4.9.5.1.2 American Samoa, Guam, CNMI and U.S. Pacific Remote Island Areas

The impacts of measures to reduce sea turtle and seabird interactions, restrict shark finning and mitigate potential fisheries interactions in American Samoa implemented under this alternative would be similar to those described for Alternative 2.

As indicated in Alternative 2, there would be no social impacts associated with establishing a permitting and reporting requirement for troll and handline fisheries in the U.S. Pacific remote island areas.

4.9.5.2 Group and Cultural Issues

4.9.5.2.1 Seabird and Sea Turtle Interactions

By taking action to reduce the number of sea turtle and seabird interactions in the Hawai'i-based longline fishery, this alternative addresses public concerns over the incidental mortality of these animals in the fishery. However, the degree to which these public concerns are allayed would be contingent on the effectiveness of the mitigation measures.

As in Alternative 3, the impacts of measures to reduce sea turtle interactions are concentrated among swordfish vessels, virtually all of which are owned, captained and crewed by Vietnamese Americans. If swordfish vessels managed to switch gear types to become tuna vessels, economic modeling for this alternative indicates that the number of these vessels that would continue operating at break-even in the Hawai'i-based longline fishery would decline by 20 percent from the baseline, and the number of persons employed on these vessels would drop by two percent. The total gross revenue of these vessels would drop by 17 percent. If none of the current swordfish vessels managed to switch gear types, economic modeling indicates that the number of these vessels that would continue operating at break-even would drop by 100 percent from the baseline. In other words, none of the vessels currently operating as swordfish boats would remain in the Hawai'i-based longline fishery.

As noted in Alternative 3, this analysis of the alternatives is based on a simplified model of reality. While it is true that some swordfish vessels are too heavily capitalized to be cost-effective as tuna fishing vessels and would be forced to leave the fishery, it is likely that some swordfish vessels would be able to convert. The swordfish vessels displaced from the Hawai'i-based longline fishery by this alternative could recover some of their losses if they were able to redirect their effort to other swordfish fishing grounds. The social impacts of the reduced earnings or job losses among participants in the Hawai'i-based longline fishery that result from this alternative would be similar to those described in the group and cultural issues for Alternative 3.

The measures to reduce seabird interactions, restrict shark finning and mitigate potential interactions among American Samoa's pelagic fisheries proposed under this alternative are identical to the measures proposed under Alternative 2, and the impacts on social groups and cultural factors would be the same.

The combined group and cultural impacts of this alternative would be similar to those described for Alternative 4.

4.9.5.3 Environmental Justice

4.9.5.3.1 Populations in Hawai'i

This alternative would result in disproportionately high and adverse impacts on Vietnamese American fishers similar to those discussed in Alternative 3.

4.9.5.3.2 Populations in American Samoa

As discussed in Alternative 2, reserving a portion of the EEZ around American Samoa for use by small boats would avoid or mitigate potential environmental justice impacts that could result from resource competition and gear conflicts between industrial-scale fishing vessels and boats owned by mainly ethnic Samoan artisanal and subsistence fishers.

4.9.5.3.3 Populations in Guam, CNMI and U.S. Pacific Remote Island Areas

This alternative has no environmental justice implications for minority populations or low-income populations in Guam, CNMI, and the U.S. Pacific remote island areas.

4.9.6 Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas

4.9.6.1 Sustained Participation of Fishing Communities

4.9.6.1.1 Hawai'i

The impacts of the measures to reduce sea turtle and seabird interactions and restrict shark finning implemented under this alternative would be similar to those described for Alternative 4. Economic modeling indicates that this alternative would decrease direct payments to labor, direct purchases from local input suppliers, and total (direct, indirect and induced) output in the Hawai'i-based longline fishery by 29 percent from the baseline (Section 4.8). While this level of decrease would be significant for the enterprises involved, they would not affect the sustained participation of fishing communities in the pelagic fisheries.

4.9.6.1.2 American Samoa, Guam, CNMI and U.S. Pacific Remote Island Areas

The impacts of measures to reduce sea turtle and seabird interactions, restrict shark finning and mitigate potential fisheries interactions in American Samoa implemented under this alternative would be similar to those described for Alternative 2.

As indicated in Alternative 2, there would be no social impacts associated with establishing a permitting and reporting requirement for troll and handline fisheries in the U.S. Pacific remote island areas.

4.9.6.2 Group and Cultural Issues

4.9.6.2.1 Seabird and Sea Turtle Interactions

By taking action to reduce the number of sea turtle and seabird interactions in the Hawai'i-based longline fishery, this alternative addresses public concerns over the incidental mortality of these animals in the fishery. However, the degree to which these public concerns are allayed will be contingent on the proven effectiveness of the mitigation measures.

As in Alternative 3, the impacts of measures to reduce sea turtle interactions are significant among swordfish vessels, virtually all of which are owned, captained and crewed by Vietnamese Americans. Economic modeling for this alternative indicates that the number of these vessels that would continue operating at break-even in the Hawai'i-based longline fishery would decline by 36 percent from the baseline, and the number of persons employed on these vessels would drop by a similar percent. Swordfish revenue on these vessels would decrease by 58 percent, and direct payments to labor and direct purchases from local input suppliers would fall by 36 percent.

The sea turtle interaction reduction measures proposed under this alternative would also have a significant negative effect on vessels targeting tuna. The seasonal closure would result in a substantial reduction in the income of these vessels, as it would occur during periods when the demand for tuna is relatively high (e.g., Lent, Mother's Day, Father's Day, graduation and wedding celebrations). In addition, the seasonal closure could result in longer term adverse impacts on fishery participants. For example, to offset the loss of Hawai'i-produced pelagic fish during the seasonal closure, it is likely that fish dealers in the state will increase their purchases of imported fish. As imports establish a greater foothold in the Hawai'i market they may depress the prices that Hawai'i-based vessels receive for tuna during the open season (NMFS and WPRFMC, 2000d).

The financial situation of many tuna longline vessels is sufficiently marginal that the effects of a seasonal closure may drive some fishing enterprises into insolvency. Economic modeling indicates that the number of tuna break-even vessels and the number of persons employed on tuna vessels would drop by 23 percent from the baseline. The gross revenue of these vessels would also drop by 23 percent. It is uncertain if tuna vessels displaced from the Hawai'i-based longline fishery by this alternative would relocate to other areas or remain in Hawai'i. For vessels which choose to stay there appear to be few alternative fisheries. Some vessel operators may experiment with pelagic handlining, but it seems unlikely that they would be able to cover their operating costs with this fishing method (NMFS and WPRFMC,

2000d). Further, handline fishing for tuna may bring these vessels into conflict with current participants in the pelagic handline fishery by creating congestion on popular fishing grounds, such as the Cross Seamount and NOAA weather buoys, and/or flooding the Hawai'i market with juvenile tuna.

The social impacts of the reduced earnings or job losses among participants in the Hawai'i-based longline fishery that result from this alternative would be similar to those described in the group and cultural issues for Alternative 3.

The supply of locally-caught fresh fish in the Hawai'i market would decrease during the seasonal closure, and participants in the troll and pelagic handline fisheries could benefit from this market void. However, the small boats participating in these fisheries may not be capable of meeting the market demand for fresh fish. It is likely that over time Hawai'i wholesalers would increasingly rely on outside sources of fresh tuna to compensate for the absence of fish caught by local longline vessels during the seasonal closure. These sources would probably be foreign nations with established longline fisheries and reliable and affordable air transportation links to Hawai'i. Some of these imported products may be of lower quality than locally-caught fish. A decrease in the availability of high quality tuna products during culturally important events would cause a loss in well-being among Hawai'i seafood consumers.

The measures to reduce seabird interactions, restrict shark finning and mitigate potential interactions among American Samoa's pelagic fisheries proposed under this alternative are identical to the measures proposed under Alternative 2, and the impacts on social groups and cultural factors would be the same.

The combined group and cultural impacts of this alternative would be similar to those described for Alternative 4.

4.9.6.3 Environmental Justice

4.9.6.3.1 Populations in Hawai'i

This alternative would result in disproportionately high and adverse impacts on Vietnamese American fishers similar to those discussed in Alternative 3.

4.9.6.3.2 Populations in American Samoa

As discussed in Alternative 2, reserving a portion of the EEZ around American Samoa for use by small boats would avoid or mitigate potential environmental justice impacts that could result from resource competition and gear conflicts between industrial-scale fishing vessels and boats owned by mainly ethnic Samoan artisanal and subsistence fishers.

4.9.6.3.3 Populations in Guam, CNMI and U.S. Pacific Remote Island Areas

This alternative has no environmental justice implications for minority populations or low-income populations in Guam, CNMI, and the U.S. Pacific remote island areas.

4.9.7 Alternative 7: Increase Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas

4.9.7.1 Sustained Participation of Fishing Communities

4.9.7.1.1 Hawai'i

The impacts of the measures to reduce sea turtle and seabird interactions and restrict shark finning implemented under this alternative would be similar to those described for Alternative 4. Economic modeling indicates that this alternative would decrease direct payments to labor, direct purchases from local input suppliers, and total (direct, indirect and induced) output in the Hawai'i-based longline fishery by between 21 and 47 percent from the baseline (Section 4.8). While significant to the individual operations involved, these decreases would not affect the sustained participation of fishing communities in the pelagic fisheries.

4.9.7.1.2 American Samoa, Guam, CNMI and U.S. Pacific Remote Island Areas

The impacts of measures to reduce sea turtle and seabird interactions, restrict shark finning and mitigate potential fisheries interactions in American Samoa implemented under this alternative would be similar to those described for Alternative 2.

As indicated in Alternative 2, there would be no social impacts associated with establishing a permitting and reporting requirement for troll and handline fisheries in the U.S. Pacific remote island areas.

4.9.7.2 Group and Cultural Issues

4.9.7.2.1 Seabird and Sea Turtle Interactions

By taking action to reduce the number of sea turtle and seabird interactions in the Hawai'i-based longline fishery, this alternative addresses public concerns over the incidental mortality of these animals in the fishery. However, the degree to which these public concerns are allayed would be contingent on the effectiveness of the mitigation measures.

As in Alternative 3, the impacts of measures to reduce sea turtle interactions are concentrated among swordfish vessels, virtually all of which are owned, captained and crewed by Vietnamese Americans. If swordfish vessels managed to switch gear types to become tuna vessels, economic modeling for this alternative indicates that the number of these vessels that would continue operating at break-even in the Hawai'i-based longline fishery would decline by 47 percent from the baseline, and the number of persons employed on these vessels would drop by 35 percent. The total gross revenue of these vessels would drop by 46 percent. If none of the vessels currently operated as swordfish boats managed to switch gear types, the number of these vessels that would continue operating at break-even would drop by 100 percent.

As noted in Alternative 3, this analysis of the alternatives is based on a simplified model of reality. While it is true that some swordfish vessels are too heavily capitalized to be cost-effective as tuna fishing vessels and would be forced to leave the fishery, it is likely that some swordfish vessels would be able to convert. The swordfish vessels displaced from the Hawai'i-based longline fishery by this alternative could recover some of their losses if they were able to redirect their effort to other swordfish fishing grounds.

The sea turtle interaction reduction measures proposed under this alternative would also have a significant negative effect on vessels targeting tuna. The seasonal closure would result in a substantial reduction in the income of these vessels, as it would occur during or immediately preceding periods when the demand for tuna is relatively high (e.g., Lent, Mother's Day, Father's Day, graduation and wedding celebrations). According to some fishery participants, fishing during the months of April and May generates a disproportionately high percentage of their annual gross revenues. The opportunity to participate in the Hawai'i-based longline fishery during April and May, and the associated revenues, would be lost to fishery participants under this alternative. As noted in Alternative 6, a seasonal closure could also result in longer term negative impacts on fishery participants. For example, to offset the loss of Hawai'i-produced pelagic fish during the seasonal closure, it is likely fish dealers in the state will increase their purchases of imported fish. As imports establish a greater foothold in the Hawai'i market they may depress the prices that Hawai'i-based vessels receive for tuna during the open season (NMFS and WPRFMC, 2000d).

As noted in Alternative 6, the financial situation of many tuna longline vessels is sufficiently marginal that the effects of a seasonal closure may drive some fishing enterprises into insolvency. Economic modeling indicates that under Alternative 7 the number of tuna break-even vessels and the number of persons employed on tuna vessels would drop by eight percent from the baseline. The gross revenue of these vessels would drop by ten percent.

It is uncertain if tuna vessels would relocate to other areas or remain in Hawai'i during the seasonal closure. Some vessels which choose to stay may shift routine non-fishing activities (e.g., boat yard work) to the closed period and fish during periods previously used for these other activities. However, vessel owners likely consider alternate fishing periods to be less

desirable, or they would have already been fishing during those periods. Other tuna vessels may engage in alternative fisheries such as pelagic handlining, but as noted in Alternative 6, handline fishing for tuna may bring these vessels into conflict with current participants in the pelagic handline fishery.

The social impacts of the reduced earnings or job losses among participants in the Hawai'i-based longline fishery that result from this alternative would be similar to those described in the group and cultural issues for Alternative 3.

As indicated in Alternative 6, the supply of locally-caught fresh fish in the Hawai'i market would decrease during the seasonal closure. While participants in the troll and pelagic handline fisheries may benefit from this market void, it is likely that over time Hawai'i wholesalers would increasingly rely on outside sources of fresh tuna. Some of these imported products may be of lower quality than locally-caught fish. A decrease in the availability of high quality tuna products during culturally important events would cause a loss in well-being among Hawai'i seafood consumers.

The measures to reduce seabird interactions, restrict shark finning and mitigate potential interactions among American Samoa's pelagic fisheries proposed under this alternative are identical to the measures proposed under Alternative 2, and the impacts on social groups and cultural factors would be the same.

The combined group and cultural impacts of this alternative would be similar to those described for Alternative 4.

4.9.7.3 Environmental Justice

4.9.7.3.1 Populations in Hawai'i

This alternative would result in disproportionately high and adverse impacts on Vietnamese American fishers similar to those discussed in Alternative 3.

4.9.7.3.2 Populations in American Samoa

As discussed in Alternative 2, reserving a portion of the EEZ around American Samoa for use by small boats would avoid or mitigate potential environmental justice impacts that could result from resource competition and gear conflicts between industrial-scale fishing vessels and boats owned by mainly ethnic Samoan artisanal and subsistence fishers.

4.9.7.3.3 Populations in Guam, CNMI and U.S. Pacific Remote Island Areas

This alternative has no environmental justice implications for minority populations or low-income populations in Guam, CNMI, and the U.S. Pacific remote island areas.

4.9.8 Alternative 8: Regional Longline Closure

4.9.8.1 Sustained Participation of Fishing Communities

4.9.8.1.1 Hawai‘i

As noted above, the longline fishery is by far the most economically important fishery in Hawai‘i, representing 73 percent of the total gross revenue generated in 1999 by all commercial fisheries. In addition to accounting for virtually all swordfish landings in 1998, the longline fishery accounted for 75 percent of tuna landings and 69 percent of landings of other commercially important fish such as marlin, *mahimahi*, *ono*, and *opah*. Honolulu is the base of the longline and other industrial-scale fishing fleets in the state and the center of the state's fish marketing/distribution network. When examined from a community frame of reference, however, the contribution of the harvesting and processing of fishery resources to the total economic fabric of Honolulu is diluted by the relative scale of other economic activities in the metropolitan area. In other words, Honolulu is the center of a major portion of commercial fishing-related activities in the state but is not a community 'substantially dependent upon' or 'substantially engaged in' fisheries in comparison to its dependence upon and engagement in other economic sectors. Nevertheless, the loss of the longline fleet would mean that the Honolulu community would participate in local fisheries at a greatly reduced level.

4.9.8.1.2 American Samoa

This alternative would have no effect on the tuna canning industry, as very little of the fish supplied to the canneries is harvested by domestic longline vessels. However, this alternative would eliminate a newly emerging longline fishery dominated by small boats operated by American Samoans. Since it began in 1995, the longline fishery has become by far the most important fishery in the EEZ around the territory, accounting for 93 percent of the total landings by small-boat fishers in 1999.

4.9.8.1.3 Guam, CNMI and U.S. Pacific Remote Island Areas

At this time there are no active domestic longline fisheries in Guam or the CNMI. Under this alternative, therefore, the pelagic fisheries would continue to benefit fishing communities in these sub-regions as described in Section 3.11. However, this alternative would result in the closure of the fish transshipment operation on Palmyra Atoll.

4.9.8.2 Group and Cultural Issues

In Hawai'i the largest impacts of this alternative would fall on the owners, captains and deckhands of longline vessels. The termination of the longline fishery would force displaced fishers to shift to different fisheries or tie up their vessels. For displaced fishers that choose to switch to alternative fisheries, there appear to be almost no options within Hawai'i. The most likely destination would appear to be California, as some participants already find it desirable to fish out of California for part of each year. Some fishers may opt to shift to Atlantic or Gulf of Mexico fisheries, but acquiring access to these fisheries may be difficult due to license limitation programs.

Given that opportunities for displaced fishers to recover their lost income by switching to other fisheries are limited, it is likely that some displaced fishers would be forced to sell out or retire. It is uncertain how active the nation- or world-wide market is for the types of vessels, gear and other investment capital used in the Hawai'i-based longline fishery. Moreover, it is possible that the market for these assets could quickly be flooded. Closure of the Hawai'i-based longline fishery would likely depress the immediate resale market for longline fishing equipment and vessels as well as diminish the long-term investment value of the vessels owned by displaced fishers who opt to continue fishing. This could create an economic hardship for those fishers who are relying on money earned from selling their fishing assets to supplement their retirement funds. Closure of the longline fishery would also cause freely transferable limited access permits for the fishery to lose their market value. It is likely that some current permit holders paid a significant sum to acquire a permit. Although the price of transferred permits is not recorded by NMFS, dockside reports prior to theCourt-orderd area closures indicated that the price of a permit was $25,000 to $50,000.

This alternative would also have a negative economic impact on local businesses that directly or indirectly support and are supported by the fishery. Included are firms that process, distribute and sell fishery products and enterprises that provide goods and services to the fish harvesting sector in Hawai'i such as chandlers, gear manufacturers, boatyards, tackle shops, bait shops and insurance brokers. The longline fishery supports a substantial portion of the fishery supply sector as well as the Honolulu fish auction house and numerous fish wholesaling and retailing operations. Some of these businesses may be unable to recoup losses resulting from a fishery closure. In addition, Hawai'i's important tourist-oriented food service industry would likely suffer if higher operating costs are incurred in order for restaurants to continue to offer high-quality fresh fish. As discussed in Section 3.11, tuna and other pelagic species, such as albacore, marlin, spearfish, *mahimahi*, *ono*, moonfish and pomfret, that are harvested in the Hawai'i-based longline fishery are featured as signature dishes in local restaurants to promote a regional seafood cuisine.

This alternative would also have a negative effect on Hawai'i residents who consume fresh tuna and other pelagic species. The Hawai'i-based longline fleet is the principal producer of

the fresh tuna and other pelagic fish sold in the Hawai'i market. The elimination of longline-caught fish would cause an immediate and substantial increase in the price of fresh fish products in the state, especially tuna products (e.g., *poke*, *sashimi*). These products have a significant cultural importance to many ethnic groups in Hawai'i (Section 3.11), and a decrease in the availability or increase in price of these products would cause a loss in well-being among many local consumers, although a quantitative assessment of this loss is not possible with available data.

It is likely that effort in other pelagic fisheries in Hawai'i, such as the troll, pelagic handline and *aku* pole and line fisheries, would increase in response to the reduced supply of longline-caught fish and increased market prices. However, as noted in Alternative 6, it is unlikely that these fisheries would be able to satisfy the market demand for pelagic fresh fish products. The fresh tuna produced by the small troll and pelagic handline boats may not meet the standards achieved by the longline fleet. In addition, the operational range of the small boats is limited, especially during the winter when rough sea conditions prevail.

As indicated in Alternative 6, it is likely that over time Hawai'i wholesalers would increasingly rely on outside sources of fresh tuna. Some of these imported products may be of lower quality than locally caught fish. A decrease in the availability of high quality tuna products during culturally important events would cause a loss in well-being among Hawai'i seafood consumers.

Closure of the longline fishery would also likely have a negative impact on those who value the continued existence of Hawai'i's maritime tradition and culture. Hawai'i's commercial fishing industry dates back nearly 200 years, and fishers have engaged in commercial longline fishing in Hawai'i since the early part of the last century. The longline fishery is a historically important component of an industry that is deeply intertwined with Hawai'i's social and cultural resources. By reducing the diversity and economic viability of the commercial fishing life way in Hawai'i, closure of the longline fishery would diminish the influence of Hawai'i's maritime culture.

As noted above, this alternative could have a positive economic effect for commercial troll and pelagic handline vessels in Hawai'i. The absence of a supply of longline-caught fish for the Hawai'i market may create new market niches for these small vessels. The charter vessel fleet would also benefit to the extent that the absence of a longline fishery in the waters around Hawai'i enhances the perception of the state as a premier location for offshore sportfishing although, at present, there are no fisheries data that indicate the absence of Hawai'i-based longlining would increase catch rates of local charter boats.

In American Samoa this alternative would have a significant negative impact on nearly all small-boat fishers, as most of these fishers have converted existing vessels to longline fishing or purchased new vessels specifically designed for longline fishing. New profitable opportunities for artisanal fishers to harvest pelagic species would be eliminated. Also

negatively impacted would be new business opportunities such as local boat building, vessel support services, fish processing and export marketing. Investments have already been made in such enterprises. Finally, this alternative would curtail the economic viability of five locally-owned vessels larger than 50 ft that are also engaged in the longline fishery. Like the small-boat fleet, these vessels mainly sell their catch to the canneries in Pago Pago.

Although most of the longline catch is sold to the canneries, some of the catch is sold to stores, restaurants and local residents and donated for family functions. This alternative would eliminate this important source of fresh fish in American Samoa.

4.9.8.3 Environmental Justice

4.9.8.3.1 Populations in Hawai'i

This alternative is likely to have disproportionately high and adverse effects on minority populations in Hawai'i, given the ethnic composition of participants in the Hawai'i-based longline fishery. As noted in Section 3.11, a recent survey of 130 Hawai'i-based longline vessel owners and captains found that 65 percent of respondents identified themselves as being non-Caucasian. Also, as noted in Section 3.11, non-Caucasian vessel owners and captains tend to hire crews that are also non-Caucasian. Further, the crews of longline vessels owned by Caucasians are generally a mixture of Micronesians and established Hawai'i residents of various ethnicities. Therefore, the proportion of minorities in the total population experiencing direct, high, and adverse impacts as a result of this alternative is substantially greater than the proportion of minorities in the total U.S. population.

4.9.8.3.2 Populations in American Samoa

This alternative is likely to have disproportionately high and adverse effects on both minority and low-income populations, as it is mainly Samoans who captain and crew the small-scale fishing vessels and who operate many of the shoreside businesses that support these vessels.

4.9.8.3.3 Populations in Guam, CNMI and U.S. Pacific Remote Island Areas

This alternative has no environmental justice implications for minority populations or low-income populations in Guam, CNMI, and the U.S. Pacific remote island areas.

4.9.9 Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries

Under Alternative 9(a), American Samoa limited entry/effort, the WPRFMC would evaluate alternatives and develop a program limiting entry or effort in American Samoa's longline

fishery for Secretarial approval and implementation. As discussed under Alternative 2, a control date of July 15, 2000 has been established in anticipation of a possible future limited entry program. A discussion of the social impacts of a limited effort or entry program would be speculative until a program has actually been developed. Nevertheless, the following general points may be made:

- The MSA requires that the following factors be taken into account when establishing a limited access system for a fishery in order to achieve optimum yield: (1) present participation in the fishery; (2) historical fishing practices in, and dependence on, the fishery; (3) the economics of the fishery; (4) the capability of fishing vessels used in the fishery to engage in other fisheries; (5) the cultural and social framework relevant to the fishery and any affected fishing communities; and (6) any other relevant considerations (Sec. 303(b)(6)). The economic and social impacts of a program limiting entry or effort in American Samoa's longline fishery will be largely determined by the way in which the Council and NMFS incorporate these various factors in the initial eligibility criteria for entry or access to the fishery.

- If the above control date is used for eligibility to participate in American Samoa's longline fishery, some current holders of NMFS longline general permits would be excluded. Approximately 83 permits have been issued as of October 2000, of which about nine were issued after the control date.

- A limited program would exclude not only any new 'outsiders,' but also any new American Samoa residents (unless entry is gained through a transfer of an existing permit or it has been determined that pelagic stocks are able to support additional fishing effort). This may limit future development of the fishery.

- The passing on of knowledge, vessels, gear, and a fishing tradition within family units may be disrupted by a limited entry program. For example, more than one offspring of a current permit holder could not enter the fishery by utilizing the parent's established place in the fishery.

- Traditional fishing rights in American Samoa, as in other Pacific island areas, are intricately woven into the social fabric of society, and any attempt to exclude fishermen who have had traditional access to the resource may be considered by some to be tantamount to denying them part of their birth-right.

- If a limited entry program makes permits freely transferable, the permits would acquire a market value that is difficult to predict. Limited entry permits become a commodity, and the costs of obtaining a permit (and the benefits of selling a permit) become part of the process of participating in the fishery.

- The additional capital cost of a permit may make entry and exit in the pelagic fisheries less fluid. In addition, there may be an incentive for permit holders to retain and use their permit even if it is not economical to do so in the short term is order to maintain access to the fishery. The loss in flexibility resulting from a limited entry program may have an adverse effect on the economic viability of some fishing operations, especially smaller ones that depend on harvesting diverse fishery resources utilizing a variety of gear types.

- Many more permits have been issued than have been actually used to participate in the fishery. In 1999, about 28 vessels participated in the longline fishery. As noted above, however, about 74 permits were issued prior to the control date. This considerable latent effort could move into the fishery in the future if conditions changed. Depending on the design of the program and the limits of transferability of permits, there could be continued (over)capitalization in the fishery even if no new permits were issued.

Under Alternative 9(b), comprehensive research plan regarding interactions, a comprehensive research plan to more thoroughly evaluate interactions among FMP-managed pelagic fisheries would be prepared. The plan would facilitate the development of appropriate management actions to mitigate the adverse effects of such interactions, if any. The preparation of a research plan in itself would have no social impacts, except to the extent that adverse social impacts associated with fisheries interactions may be more quickly and efficiently mitigated than would otherwise be the case.

4.9.9.1 Sustained Participation of Fishing Communities

This alternative will have no impact on the sustained participation of fishing communities in the pelagic fisheries of the Western Pacific Region.

4.9.9.2 Group and Cultural Issues

There are no group and/or cultural issues associated with this alternative.

4.9.9.3 Environmental Justice

This alternative has no environmental justice implications for minority populations or low-income populations in Hawai‘i, American Samoa, Guam, CNMI, or the U.S. Pacific remote island areas.

4.9.10 Alternative 10: *(Preferred)* Increase Gear Deployment Depth, Seasonal Area Closure

4.9.10.1 Sustained Participation of Fishing Communities

4.9.10.1.1 Hawai'i

Seabird and Sea Turtle Interactions and Shark Finning

The impacts of measures to reduce sea turtle and seabird interactions and restrict shark finning implemented under this alternative would be similar to those described for Alternative 4. Economic modeling indicates that this alternative would decrease direct payments to labor, direct purchases from local input suppliers, and total (direct, indirect and induced) output in the Hawai'i-based longline fishery by between 11 and 42 percent from the baseline (Section 4.8). However, while these decreases would be significant to individual operations, they would not affect the sustained participation of fishing communities in the pelagic fisheries.

4.9.10.1.2 American Samoa, Guam, CNMI and U.S. Pacific Remote Island Areas

The impacts of measures to reduce sea turtle and seabird interactions, restrict shark finning and mitigate potential fisheries interactions in American Samoa implemented under this alternative would be similar to those described for Alternative 2.

As indicated in Alternative 2, there would be no social impacts associated with establishing a permitting and reporting requirement for troll and handline fisheries in the U.S. Pacific remote island areas.

4.9.10.2 Group and Cultural Issues

4.9.10.2.1 Seabird and Sea Turtle Interactions and Shark Finning

By taking action to reduce the number of sea turtle and seabird interactions in the Hawai'i-based longline fishery, this alternative addresses public concerns over the incidental mortality of these animals in the fishery. However, the degree to which these public concerns are allayed would be contingent on the effectiveness of the mitigation measures.

As in Alternative 3, the impacts of measures to reduce sea turtle interactions are concentrated among swordfish vessels, virtually all of which are owned, captained and crewed by Vietnamese Americans. If swordfish vessels managed to switch gear types to become tuna vessels, economic modeling for this alternative indicates that the number of these vessels that would continue operating at break-even in the Hawai'i-based longline fishery would decline by 24 percent from the baseline, and the number of persons employed on these vessels would drop by eight percent. The total gross revenue of these vessels

would drop by 24 percent. If none of the vessels currently operated as swordfish boats managed to switch gear types, the number of these vessels that would continue operating at break-even would drop by 100 percent.

As noted in Alternative 3, this analysis of the alternatives is based on a simplified model of reality. While it is true that some swordfish vessels are too heavily capitalized to be cost-effective as tuna fishing vessels and would be forced to leave the fishery, it is likely that some swordfish vessel would be able to convert. The swordfish vessels displaced from the Hawai'i-based longline fishery by this alternative could recover some of their losses if they were able to redirect their effort to other swordfish fishing grounds.

It is important to note that this alternative effectively precludes swordfish vessels that convert to tuna fishing from periodically switching back to swordfish fishing. In order for a vessel "coupled" with a Hawai'i longline limited access permit to fish for swordfish outside the EEZ off California (or anywhere else) the vessel would have to be "decoupled" from the permit because of the gear restriction implemented under this alternative. Further, this alternative stipulates that vessels can not be "recoupled" with a permit until the following October. By effectively prohibiting Hawai'i-based longline vessels from fishing for swordfish outside the jurisdiction of the Pelagics FMP during part of the year, an activity that some vessels consider profitable (see Alternative 3), these restrictions would make it that much more difficult for former swordfish fishing enterprises to remain economically viable if this alternative is implemented.

The social impacts of the reduced earnings or job losses among participants in the Hawai'i-based longline fishery that result from this alternative would be similar to those described in the group and cultural issues for Alternative 3.

Economic modeling indicates that the sea turtle interaction reduction measures proposed under this alternative would not have a significant negative effect on vessels targeting tuna (Section 4.8).

The measures to reduce seabird interactions, restrict shark finning and mitigate potential interactions among American Samoa's pelagic fisheries proposed under this alternative are identical to the measures proposed under Alternative 2, and the impacts on social groups and cultural factors would be the same.

The combined group and cultural impacts of this alternative would be similar to those described for Alternative 4.

4.9.10.3 Environmental Justice

4.9.10.3.1 Populations in Hawai'i

This alternative would result in disproportionately high and adverse impacts on Vietnamese American fishers similar to those discussed in Alternative 3.

4.9.10.3.2 Populations in American Samoa

As discussed in Alternative 2, reserving a portion of the EEZ around American Samoa for use by small boats would avoid or mitigate potential environmental justice impacts that could result from resource competition and gear conflicts between industrial-scale fishing vessels and boats owned by mainly ethnic Samoan artisanal and subsistence fishers.

4.9.10.3.3 Populations in Guam, CNMI and U.S. Pacific Remote Island Areas

This alternative has no environmental justice implications for minority populations or low-income populations in Guam, CNMI, and the U.S. Pacific remote island areas.

4.9.11 Social Impacts of Option A: Fishing Experiment

4.9.11.1 Sustained Participation of Fishing Communities

4.9.11.1.1 Hawai'i

Option A could be coupled with any of the other alternatives considered in the EIS. It would allow an experimental longline fishery to be conducted to develop fishing techniques that minimize interactions with sea turtles and seabirds. As noted in Section 4.8, the fishing experiment would improve gross revenues to swordfish vessels over alternatives that eliminate the swordfish fishery completely, but fewer swordfish vessels would be sustained by the fishing experiment in comparison to the baseline case depicted by Alternative 1. Some individual fishing operations and other fishing-related enterprises based in Honolulu would experience adverse effects. However, a decrease in the size of the swordfish fishing fleet would not affect the sustained participation of fishing communities in the pelagic fisheries.

4.9.11.1.2 American Samoa, Guam, CNMI and U.S. Pacific Remote Island Areas

No experimental fishing would occur in these sub-regions under this option. Consequently, the pelagic fisheries would continue to benefit fishing communities in these sub-regions as described in Section 3.11, and the sustained participation of these communities in the pelagic fisheries would be unaffected.

4.9.11.2 Group and Cultural Issues

As indicated in Section 4.8, the fishing experiment is projected to support 31 swordfish vessels, which represent 69 percent of the swordfish fishing fleet under the base case of Alternative 1. Consequently, a fishing experiment would substantially mitigate the economic and social impacts on the swordfish fishing fleet when coupled with an alternative that otherwise sharply restricts or even eliminates swordfish fishing effort (i.e., Alternatives 3, 5, 6, 7, 8 and 10). Moreover, by facilitating the development of fishing techniques that obviate the need for time/area closures, a fishing experiment may avert the economic and social impacts associated with such closures more quickly and efficiently than would otherwise be the case.

4.9.11.3 Environmental Justice

4.9.11.3.1 Populations in Hawai‘i

A fishing experiment would substantially mitigate the disproportionately high and adverse impacts on Vietnamese American fishers that result from those alternatives that otherwise sharply restrict or even eliminate swordfish fishing effort (i.e., Alternatives 3, 5, 6, 7, 8 and 10).

4.9.11.3.2 Populations in American Samoa, Guam, CNMI and U.S. Pacific Remote Island Areas

The fishing experiment has no environmental justice implications for minority populations or low-income populations in American Samoa, Guam, CNMI, and the U.S. Pacific remote island areas.

4.10 ENFORCEMENT AND ADMINISTRATION

4.10.1 Evaluation of the Alternatives Proposed by NMFS

4.10.1.1 Alternative 1: Existing FMP (No action)

This alternative would perpetuate the status quo for existing administrative and enforcement procedures (as described in Section 3.12) without adding or reducing costs or responsibility to management agencies.

4.10.1.2 Alternative 2: Pending Council Actions

The Council's recommended action to reduce the incidental catch of seabirds in the Hawai'i-based longline fishery would not result in additional enforcement or administrative costs. The current level of dockside inspections could determine whether longline vessels are carrying the necessary gear to employ towed deterrents, strategic offal discharge or blue-dyed bait. The on-board presence of weighted branch lines and line-setting machines can also be effectively monitored through dockside inspections. At-sea monitoring would be required to ensure that these mitigation measures are actually used by fishers as specified in the regulations. However, the effectiveness of aerial surveillance or surface patrols in detecting non-compliance may be limited. Night setting, on the other hand, could be effectively enforced by means of the existing mandatory satellite-based vessel monitoring system (VMS) for Hawai'i-based longline vessels. This system tracks vessel movements and patterns of fishing activity in "real-time."

The current dockside monitoring program could effectively monitor compliance with a ban on shark finning by determining if fins without carcasses are on board a vessel.

Implementation of the Council's recommended measure to mitigate conflicts between small and large vessels in pelagic fisheries in American Samoa could be effectively enforced using the existing VMS. The additional area coverage would have a neutral effect on the costs of administering the current VMS. At this time, however, the only vessels operating in the Western Pacific Region that are required to carry VMS units are U.S. purse seine vessels and Hawai'i-based longline vessels. It is possible that international agreements for managing fisheries in the central and western Pacific will require all vessels that harvest pelagic species in more than one EEZ or on the high seas to carry VMS units as part of a regional surveillance and monitoring program. If such a regional program is implemented, it is likely that most large (> 50 ft) domestic longline vessels currently based in American Samoa would also be equipped with a VMS unit, as these vessels typically fish in the EEZs of neighboring countries and on the high seas.

The organization of an annual protected species educational workshop for all longline permit holders and vessel operators would increase administrative costs. The estimated annual cost of the workshop is $40,000. On the other hand, the workshop would be expected to lead to greater compliance by increasing the information available to fishers on the extent of the problem of fishery interactions with protected species and the measures that can be taken to resolve the problem.

The Council's pending action to implement federal permit and reporting requirements for pelagic handline and troll fisheries in the EEZs around the Pacific remote island areas would result in a minimal increase in administrative costs. Some costs would be incurred during the development of a new reporting form, but the implementation costs would be low because of the few (less than five vessels) participants in the specified fisheries.

4.10.1.3 Alternative 3: Court Ordered Action (Status Quo)

Measures to reduce the incidental catch of sea turtles implemented under this alternative substantially increase the size of the area that the USCG must monitor to detect fishing violations. Additional air and sea patrol days are required as a result of this larger area. These additional air and sea patrols have not increased enforcement costs, but they have required the USCG to shift enforcement resources from other mission areas. The additional area coverage has had a neutral effect on the costs of administering the current mandatory satellite-based VMS. In addition, no additional dockside enforcement costs are expected, as the current dockside monitoring program can effectively monitor whether longline vessels are carrying the necessary gear (line-setting machines and/or weighted branch lines) to set the mainline at the required depth. Possession restrictions on light sticks are also enforceable dockside.

4.10.1.4 Alternative 4: Seasonal Area Longline Fishery Closures

Measures to reduce the incidental catch of sea turtles proposed under this alternative would have the same effects on administrative and enforcement procedures as the measures proposed under Alternative 3. Additional air and sea patrol days would be required due to the additional area coverage, but the costs of administering the existing VMS would not be affected.

The effects of this alternative on administrative and enforcement procedures would be the same as the effects of Alternative 2 with respect to measures to reduce the incidental catch of sea birds; restrict shark finning; mitigate conflicts between small and large vessels in pelagic fisheries in American Samoa; organize a protected species educational workshop; and implement federal permit and reporting requirements for pelagic handline and troll fisheries in the EEZs around the Pacific remote island areas.

4.10.1.5 Alternative 5: Increase Fishing Gear Deployment Depth

Measures to reduce the incidental catch of sea turtles implemented under this alternative would not result in additional enforcement or administrative costs. The current dockside monitoring program could effectively monitor whether longline vessels are carrying the necessary gear (line-setting machines and/or weighted branch lines) to set the mainline at the required depth.

The effects of this alternative on administrative and enforcement procedures would be the same as the effects of Alternative 2 with respect to measures to reduce the incidental catch of sea birds; restrict shark finning; mitigate conflicts between small and large vessels in pelagic fisheries in American Samoa; organize a protected species educational workshop; and

implement federal permit and reporting requirements for pelagic handline and troll fisheries in the EEZs around the Pacific remote island areas.

4.10.1.6 Alternative 6: Permanent and Seasonal Closure of All Longline Fishery Areas

Measures to reduce the incidental catch of sea turtles proposed under this alternative would have the same effects on administrative and enforcement procedures as the measures proposed under Alternative 3. Additional air and sea patrol days would be required due to the additional area coverage, but the costs of administering the existing VMS would not be affected.

The effects of this alternative on administrative and enforcement procedures would be the same as the effects of Alternative 2 with respect to measures to reduce the incidental catch of sea birds; restrict shark finning; mitigate conflicts between small and large vessels in pelagic fisheries in American Samoa; organize a protected species educational workshop; and implement federal permit and reporting requirements for pelagic handline and troll fisheries in the EEZs around the Pacific remote island areas.

4.10.1.7 Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishery Areas

Measures to reduce the incidental catch of sea turtles implemented under this alternative would result in additional enforcement costs, as the large area coverage associated with this alternative would require additional air and sea patrol days. However, the additional area coverage would have no effect on the costs of administering the existing VMS. In addition, no additional dockside enforcement costs are expected, as the current dockside monitoring program could effectively monitor whether longline vessels are carrying the necessary gear (line-setting machines and/or weighted branch lines) to set the mainline at the required depth.

The effects of this alternative on administrative and enforcement procedures would be the same as the effects of Alternative 2 with respect to measures to reduce the incidental catch of sea birds; restrict shark finning; mitigate conflicts between small and large vessels in pelagic fisheries in American Samoa; organize a protected species educational workshop; and implement federal permit and reporting requirements for pelagic handline and troll fisheries in the EEZs around the Pacific remote island areas.

4.10.1.8 Alternative 8: Regional Longline Closure

This alternative would significantly reduce overall enforcement and administration costs. The costs of administering the observer and limited access programs for the Hawai‘i-based

longline fishery and the permitting programs for this fishery and other longline fisheries in the Western Pacific Region would be eliminated. In addition, this alternative would eliminate the administrative costs associated with maintaining a current separate fisheries data collection system for longline fisheries in the region. Enforcement costs would be substantially reduced, as the existing VMS for the Hawai'i-based longline fishery would no longer be required.

The current dockside monitoring program could effectively monitor compliance with the measures proposed under this alternative by determining if a combination of longline gear and PMUS are on board a fishing vessel.

4.10.1.9 Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries

The establishment of a limited access system for the American Samoa longline fishery would increase administration costs, but the added costs would be minimal.

Research to evaluate catch interactions between pelagic fisheries would in itself have no effect on administrative and enforcement procedures. The implementation of measures to mitigate those interactions could have an effect, but until such measures are identified a discussion of impacts on administrative and enforcement procedures would be speculative.

4.10.1.10 Alternative 10: *(Preferred)* Increase Gear Deployment Depth, Seasonal Area Closure

Measures to reduce the incidental catch of sea turtles proposed under this alternative would have the same effects on administrative and enforcement procedures as the measures proposed under Alternative 7. Additional air and sea patrol days would be required due to the additional area coverage, but the costs of administering the existing VMS would not be affected. In addition, no additional dockside enforcement costs are expected, as the current dockside monitoring program could effectively monitor whether longline vessels are complying with fishing gear restrictions.

The effects of this alternative on administrative and enforcement procedures would be the same as the effects of Alternative 4 with respect to measures to reduce the incidental catch of sea birds; restrict shark finning; mitigate conflicts between small and large vessels in pelagic fisheries in American Samoa; organize a protected species educational workshop; and implement federal permit and reporting requirements for pelagic handline and troll fisheries in the EEZs around the Pacific remote island areas.

4.10.1.11 Option A: Fishing Experiment

Costs would be incurred in the design and implementation of structured experiments. Given that the mitigation measures to be tested and the experimental design have not yet been specified, the costs of this alternative are uncertain. Some costs to the federal government may be reduced or displaced by involvement of the fishing industry in the experiments.

4.10.2 Observer Issues

4.10.2.1 Observer Coverage Requirements Under the Court Order

The August 4, 2000, Order Further Amending Order Modifying Provisions of Order of Injunction, mandated changes to the sea areas where the Hawai'i-based longline fishing vessels are allowed to fish, and has changed the observer coverage requirements. The Order delineated the traditional Hawai'i-based pelagic longline fishing grounds into three areas, Areas A, B and C (Figure 1). All longline fishing activity is prohibited in Area A, and effective three days after entry of the Order, longline fishing was prohibited in adjacent Area B, except for a total of 370 pelagic longline sets on an annualized basis with the added restriction that all vessels fishing must carry a NMFS-approved observer. If 100 percent observer coverage is not achieved, all fishing in Area B will be suspended. Additionally, in Area B, only 154 longline sets are allowed for the period from the Order coming into effect until the end of 2000, and 77 longline sets are allowed from January 1, 2001, through March 14, 2001. Finally, fishing that targets swordfish is prohibited in Area C.

For the period September 21 to November 6, 2000, the court order required a minimum of ten percent of all vessels fishing in the southern longline tuna fishing grounds (i.e. Area C on Figure 1) to carry an observer. After November 6, 2000, the minimum observer coverage requirement for vessels operating in Area C increased to 20 percent. These requirements will remain in place until the updated comprehensive EIS is completed.

Prior to the court order, NMFS had approximately twelve Federal Hawai'i longline observers on staff. The expectation was that the mandated increase in observer coverage would require substantially more observers than available in the Federal program. NMFS estimated that approaching 6,000 observer days[46] might be required in the first year under the new regime, depending on the level of fishing effort. NMFS concluded that this increase in manpower requirements would be best accomplished through external contracting. In August 2000, NMFS issued a request for proposals for a cost-plus-fixed-fee (CPFF) type of contract for services to supply up to 5,820 observer days in the Hawai'i longline observer program. The services required induded recruitment, selection, supervision, outfitting and deployment of all sea-going personnel. NMFS would retain the responsibilities of training and

[46] An observer day is counted as each day an observer is aboard a fishing vessel at sea, whether or not the vessel is actively fishing.

debriefing all observers. The expectation was that the new contractor would be in a position to start supplying observers for the longline fishery towards the end of 2000. Pending this, NMFS made a temporary arrangement to bring in additional observers from an external contractor under an existing federal service contract in order to meet the coverage requirements that came into force as of September 21 (ten percent) and November 7 (20 percent), 2000.

To meet these coverage requirements, NMFS scheduled a two-week training session from September 4 through September 15, 2000, for which the temporary contractor supplied 20 new observer recruits. Upon successful completion of the training, these observers were deployed before September 21, 2000, and the ten percent coverage requirement was met. A second training session was held October 16 through October 31, 2000, for 20 individuals recruited by the new contractor, and their deployment began November 1, 2000. By November 7, 2000, observer coverage slightly exceeded the 20 percent requirement mandated by the Order.

The observer coverage required under the Court Order (100 percent coverage of vessel days for longliners operating in Area B and 20 percent coverage for tuna longliners operating in Area C) is greater than the five percent level specified by the Fish and Wildlife Service for the monitoring of endangered species interactions (e.g. short-tailed albatross). Whether this coverage will be adequate for the purposes of monitoring both seabird and sea turtle interactions will depend to some extent on the way in which the observers' workload is managed on board the vessels. From existing knowledge of the observers workload it is expected that the current coverage will be sufficient to meet the requirements of the FWS. This does not mean , however, that either the five percent level specified by the FWS or the 20 percent level specified in the Court Order are necessarily adequate for achieving the goals and objectives of the observer program.

4.10.2.2 Observer Program Costs

Regarding the costs of the observer program, these depend fundamentally on the number of observer days. On October 23, 2000, NMFS announced the award of a one-year contract to supply the requested number of observer days (5,820) in the amount of $2,032,845. This equates to just over $349 per observer day. In addition to this contract cost, the fixed observer program costs of the Pacific Islands Area Office (PIAO) prior to the recent changes were estimated to be in the region of $600,000. PIAO anticipates that these costs will remain the same over the first year under the new external contract due to reassignment of existing personnel to other duties such as training of observers recruited by the contractor and all debriefing and data checking. Therefore, the total cost of observer coverage, including agency costs, from December 2000 through December 2001 (13 months), is estimated to be in the region of $2,683,000. Note that other costs implied by the observer program, such as processing of collected samples by the Honolulu Laboratory

and any analysis of observer data that the Lab or other NMFS offices may conduct, are not included in this total.

In the solicitation for the observer program contract, NMFS acknowledged that the requested number of observer days was only an estimate. This estimate was based on the premise that the existing fishing fleets would continue to operate as they have done in the past, restricted only by the number of days they can fish under the Court Order (in the case of the swordfish fleet). There are, however, reasons why the actual number of observer days required may vary from the estimate. First it is not clear what will happen following the completion of the EIS. The findings of the EIS and the court's ruling at that time, may result in different levels of both allowed fishing effort and required observer coverage. Secondly, the court order on August 4, 2000, may result in unanticipated effects on the fishery, giving rise to changes in the number of observer days required.

As with any major change in a fishery regulation, the substantial increase in observer coverage requirements could affect fishing patterns. For example, vessels apparently have the opportunity to fish in Areas B and C yet avoid the observer coverage requirement if they do not operate from a Hawai'i port, nor fish under an Hawai'i limited entry permit, but do obtain a fishing permit from another state (i.e. California). A lack of a Hawai'i limited entry permit prohibits the fishing vessel from offloading fish directly in Hawai'i, although they could offload their catch in other ports, such as in California or in Palmyra, a U.S. Pacific Territory located approximately 1000 nautical miles south-southwest of the main Hawaiian Island chain. From Palmyra, fish can be loaded onto cargo vessels and transported to the Honolulu fish auction. Vessels would not be required to carry an observer if the vessel did not operate or offload from a Hawai'i port, however those vessels would still be required to submit logbook data to NMFS.

As a first approximation, the cost of the program can be calculated by multiplying the number of observer days (i.e., days spent at sea by observers) by the cost per day of the contract, plus the fixed costs of the agency. Bids for the observer program contract were made on the basis of a cost per observer day. However, a substantial management setup is required to supply and support this level of manpower, as in any observer program. The costs of this management setup are more or less fixed once the program is greater than a nominal size (say, for example, 1000 days per year), and are spread over the total number of days expected to be supplied. Hence, if the actual number of observer days supplied are fewer than estimated, the actual cost per day will be higher. Based on the scope and management requirements of the Hawai'i longline observer program, it is estimated that the cost per day would be in the region of five percent higher if the actual number of observer days fell to 5,000, 15 percent higher if it fell to 4,000 days and 30 percent higher if it fell to 3,000 days. NMFS indicated in the solicitation for the observer contract that in the event that the number of observer days realized under the contract differs from the number estimated in the solicitation, then some re-negotiation of the cost per observer day would be expected.

In terms of cost per trip, data from previous years suggest that trips on longliners average between 20 and 25 days. This would put the cost per trip of observer coverage under the new contract, plus the fixed NMFS costs, in the region of $9,220 to $11,525, depending on trip length. The cost per trip under the Federal program, which only averaged a coverage rate of 4-5 percent, was in the region of $12,000 (using the annual average of 50 trips and $600,000 budget). However, the estimate of $12,000 is slightly exaggerated. While not deployed, as Federal employees, these observers were sometimes made available to other PIAO staff to assist on other programmatic or administrative work or to the Honolulu Lab. It has been estimated that non-observer work comprised approximately two-five percent of their time.

While a contract has been awarded for the amount stated previously, it is not currently possible to determine how realistic the costs under the new contract are in practice. There have been suggestions from those in the observer supply business that the amount of $349 per observer day will be insufficient for a commercial company to recruit, manage and retain the required number of qualified observers to ensure successful contract performance. Therefore the costs outlined above, should be regarded at best as a minimum of the actual anticipated costs of the observer coverage mandated by the August 4, 2000 Court Order.

4.10.2.3 Options for Funding of the Observer Program

Prior to the court order, the observer program was fully federally-funded and staffed. After the court order, the contract awarded to a private observer contracting company was also fully-funded by NMFS. Elsewhere in the United States and particularly abroad, the policy of having observer programs partially paid for by the industry is becoming a common practice. For example the North Pacific Groundfish Observer Program (NPGOP), Alaska Department of Fish and Game (ADF&G) shellfish program and the British Columbia domestic groundfish program operate under a mixture of government and industry funding (see Table 4.10.1). In these cases it is commonly the actual costs of observers and their deployment that is covered by the industry, with the government covering their own costs associated with the program. Rarely, observer programs are wholly industry-funded, for example the Australian Fisheries Management Authority (AFMA) funds their program through a mixture of direct payments by the industry and cost recovery.

Aside from the question of who should pay for the program, there is the issue of how the fees should be collected. For example, the fee system proposed for the NPGOP required a mandate for the North Pacific Fishery Management Council (NPFMC) to collect the fees from the industry. In January 1990, when the NPGOP was established in its fully domestic format, NMFS lacked the authority to collect user fees from participants in the domestic fishery. Consequently, the NPFMC devised an interim third party "pay-as-you-go" system under which vessel and processing plant owners contracted directly with private observer companies certified by NMFS, and paid for observer services as needed.

From the outset, the NPFMC was committed to working with Congress on a Magnuson Act amendment which would authorize collection of fees to cover observer coverage costs. Under the fee-based program concept, NMFS would contract directly for observer services, thereby eliminating the potential for conflict of interest generated by the direct contractual arrangement between the industry and the observer providers, and establishing arrangements under which observer companies would be directly accountable to NMFS for data quality. In 1990, the Magnuson Act was amended to authorize the Council to prepare a North Pacific Conservation Research Plan. Section 313 (b)(2) established the system of fees. As originally passed, the fee rate was "not to exceed" one percent of the value of the fish and shellfish harvested under the jurisdiction of the Council, including the North Pacific halibut fishery. Two years later, Congress amended Section 313(b)(2)(E) of the Magnuson Act to change the observer fee rate from "not to exceed" one percent to "not to exceed" two percent.

To date, however, the industry funding of the NPGOP remains under the pay-as-you-go system. A recent independent review of this program (MRAG Americas, 2000) identified this situation as a major concern for the credibility of the program and the data it produces. The report strongly recommended a re-structuring of the Service Delivery Model to eliminate the direct payments between multiple industry clients and the observer contracting companies, and the development of direct contractual arrangements between the companies and NMFS.

The report went on to discuss ways in which fees could be levied. Besides fully federal funding, the NPFMC considered the following funding options (NPFMC, 1998):

- two percent of ex-vessel value with an absolute cap (as authorized under Magnuson-Stevens);
- two percent fee with a supplemental program for monitoring programs which require direct individual vessel benefits such as the MSCDQ, AFA, and similar programs;
- TAC set aside for cost recovery, as was used by ADF&G to help fund observer program expansion in the Alaska crab fisheries; and
- pay-as-you-go with an ancillary fee, surcharge, or voluntary industry contribution.

None of these options discussed by the NPFMC has yet been taken forward as a viable alternative for funding the NPGOP. Linking the observer funding to landed value, for example, has proved to be a highly complex issue. The recent independent review recommended further consideration of a process linking observer fees to fishing effort in the form of vessel days at sea (i.e., not just observed vessel days on which the current fee is based). The difference between this and the present pay-as-you-go system is that costs would be spread amongst all vessels in the groundfish fleet, on the basis of all the days they

spend at sea. Costs would not be bourne only by those vessels with observers actually deployed on board.

As a guiding principle, the following objectives are suggested for an adequate observer program funding policy. The funding policy should:

provide financial support for current and future observer coverage needs;
ensure adequate observer coverage and data quality;
ensure equity of payment to all industry sectors;
keep costs of observer coverage reasonable; and
ensure adequate compensation for fisheries observers.

Table 4.10.1: Examples of observer programs and funding mechanisms.

Observer Program Mandate and Authority	North Pacific & Bering Sea Groundfish, Trawl & Fixed Gear Fishery	Bering Sea King Crab and Tanner Crab Pot Fisheries	Pacific Drift Gillnet Fishery	British Columbia Domestic Trawl Groundfish Fishery	Australian Sub-antarctic Fisheries	Northwest Atlantic Groundfish Fisheries
Mission of the Program	Collect data on catch and bycatch quantity, composition, and biological characteristics, document fishery interactions with marine mammals and seabirds, monitor compliance with federal fisheries regulations.	Collecting essential biological and fishery management data including quantifying species composition, bycatch, harvests, biological and legal crab carapace size distributions, the reproductive status of female crabs, and monitor regulation compliance.	To document the incidental take of marine mammals, sea turtles, seabirds, target and non-target fish species. To collect selected biological specimens.	Observers are required to monitor compliance of the fishing vessel to area(s) or operations, gear restrictions and other fishery regulations. Observers provide independent estimates of retained and discarded catch for quota management purposes. Observers are also required to collect biological samples of target and bycatch species for the science objectives of the program.	To establish accurate and reliable fisheries catch and effort data for the management of Australia's fisheries, and high seas fisheries under international agreements.	The main objective of NAFO is to contribute to the optimum utilization, rational management and conservation of fishery resources in the Northwest Atlantic. The primary role of the observer is to monitor the compliance of EU flagged vessels with the NAFO Conservation and Enforcement Measures, reporting any violation of NAFO regulations to the EU Inspectors.
Fishery Management	U.S. Federal	Alaska State	U.S. Federal	Canadian Federal	Australian Federal	NAFO / European Commission / high seas
Authority to Place Observers	Magnuson-Stevens Fishery Conservation and Management Act (amendments to the Gulf of Alaska Groundfish and Bering Sea/Aleutian Islands Groundfish Fishery Management Plans); Marine Mammal Protection Act; Endangered Species Act.	Magnuson-Stevens Fishery Conservation and Management Act (Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crab); Alaska Statutes - 16.05.05 and 16.05.251; Alaska Board of Fisheries; Alaska Administrative Code - 5 AAC 39.141 and 5 AAC 39.645.	Marine Mammal Protection Act (MMPA), Endangered Species Act.	Section 46 Fishery (General) Regulations.	Commonwealth Fisheries Management Act, 1991; Commonwealth Fisheries Administration Act 1991.	European Commission, Council Regulation No. 3069/95, 21st December 1995
Voluntary or Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory
Funding Sources	Direct observer costs - industry funded; NMFS operational costs - govt.	Direct observer costs - industry funded; ADF&G operational costs - State	Government (NMFS) funded	Co-Funded by Industry and Government	Industry funded	European Commission funded

4.11 CUMULATIVE EFFECTS

Cumulative effects would occur when direct and indirect effects of the alternatives combine with effects of factors exogenous to Pelagics FMP-managed fisheries to produce a net effect different than the separate effects or the exogenous factors. These net effects can be beneficial or adverse. Principles of cumulative effects analysis identified by the Council on Environmental Quality include the following:

- Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions.
- Cumulative effects are the total effect, including both direct and indirect effects, on a given resource, ecosystem, and human community of all actions taken, no matter who (Federal, other governmenty, or private) has taken the actions.
- Cumulative effects must be analyzed in terms of the specific resource, ecosystem, and human community being affected.
- It is not practical to analyze the cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful. In addition, there must be a relationship or "nexus" between the direct and indirect effects of the alternatives being evaluated and external effects.
- Cumulative effects on a given resource, ecosystem, and human community are rarely aligned with political or administrative boundaries.
- Cumulative effects may result from the accumulation of similar effects or the synergistic interaction of different effects.
- Cumulative effects may last for many years beyond the life of the action that caused the effects.
- Each affected resource, ecosystem, and human community must be analyzed in terms of its capacity to accommodate additional effects, based on its own time and space parameters.

4.11.1 Methodology

Section 4.11 assesses the cumulative effects of the alternatives following a standard methodology:

1. The exogenous factor(s) that may directly effect each resource component are summarized. The list of exogenous factors and the overall conclusions for each factor remain constant across all of the alternatives. The potential impacts of fisheries not managed under the Pelagics FMP are considered as exogenous factors.

2. The potential direct effects of the alternatives analyzed in Sections 4.1-4.9 are summarized for each major resource component. Each alternative may have a different effect on a particular resource.

3. The potential indirect effects of the alternatives analyzed in Sections 4.1-4.9 are summarized for each major resource component. This procedural step only needs to be addressed if the indirect effects of alternatives effect exogenous factors. There may be no identifiable indirect effects.

4. Effects of exogenous factors (1) combined with potential direct effects of the alternatives, (2) as modified by any indirect effects (3), result in the potential cumulative effects.

5. Possible mitigation measures are discussed in Chapter 5 for the potential cumulative effects that are likely to be significant.

4.11.2 Exogenous Factors – Essential Fish Habitat and the Marine Environment

One of the most important exogenous factors influencing essential fish habitat and the marine environment in the North Pacific was the Asian high seas drift net fishery that operated during the 1980s. Five other major exogenous factors were identified as having the potential to contribute to cumulative effects on essential fish habitat and the marine environment:

- Fluctuations in the pelagic ocean environment
- Drifting fish aggregation devices (FADs) deployed by the purse seine fishery
- Vessel groundings, marine debris and waste disposal
- Deep ocean mining
- Current and future regulatory regimes

Ecosystem Effects of the Now-Defunct Asian High Seas Drift Net Fishery

The region of the central North Pacific with the greatest levels of longline fishery interactions with sea turtles and seabirds is a latitudinal band from 25° N. to 40° N. latitude from the dateline to about 150° W. longitude. This band, known as the North Pacific Transition Zone, is the location of a series of fronts formed where warmer, less dense water

from the Subtropical Gyre to the south converges with cooler, more dense water from the Subartic Gyre to the north (Polovina, 2000; Seki *et al.*, in prep.). Biologically, the convergent fronts represent zones of enhanced trophic transfer with high concentrations of phytoplankton, zooplankton, jellyfish and squid attracting higher level predators (Olson *et al.*, 1994), including swordfish, sea turtles and seabirds (WPRFMC, 2001a).

Asian high-seas driftnet fisheries operated on a large-scale in the temperate North Pacific Transition Zone during the 1980s until the end of 1992 and made incidental catches of non-target species in the tens of thousands for marine mammals, hundreds of thousands for seabirds and tens of millions for fish (Yatsu *et al.*, 1993). Concern about the adverse effects of this fishery on the North Pacific pelagic ecosystem prompted the United Nations to place a moratorium on the fishery at the end of 1992. The populations of some long-lived marine species, especially sea turtles, may never fully recover from the adverse effects of the driftnet fishery.

At its peak, the driftnet fishery targeting neon flying squid harvested 300,000 to 340,000 mt per year of this squid (Huppert and Mittleman, 1993), which is a key prey and predator species in the North Pacific pelagic ecosystem. When the fishery ended, large quantities of squid were retained in the ecosystem with immediately apparent effects. The squid population became so large that, during the mid-1990s, Hawai'i-based longline fishers reported losing considerable amounts of bait to squid predation (Di Nardo, 1999). Squid is a primary prey item for North Pacific albatross (Harrison *et al.*, 1983) and greater availability of this food could contribute positively to North Pacific albatross species.

Fluctuations in the Ocean Environment

Environmental fluctuations are characteristic of the pelagic ecosystem and affect the distribution, movements and habitats of pelagic fish and non-fish species, both in the vertical and horizontal dimensions. Significant sources of inter-annual physical and biological variation are *El Niño* and *La Niña* events (Lehodey *et al.*, 1997). Physical and biological oceanographic changes have also been observed on decadal time scales. These low-frequency changes, termed regime shifts, can impact the entire ocean basin and pelagic ecosystem. Regime shifts in the North Pacific have occurred in 1976 and 1989 with both physical and biological (including fishery) impacts (Polovina, 1996, Polovina *et al.*, 1995). Future ocean shifts will likely affect the abundance and distribution of sea turtles, albatross, sharks and other marine species in the North Pacific. This factor, therefore, contributes significantly to cumulative effects on essential fish habitat and the marine environment.

Drifting FADs Deployed by Purse Seine Fishery

An emerging issue with the potential for significant ecosystem effects is the increasing deployment of drifting FADS (or rafts known as *payao*) by the U.S. and Spanish purse seine

fleets in the central and western Pacific. Many large purse seiners deploy between 20-30 untethered FADs per vessel, with Spanish vessels sometimes using many more. With up to 200 purse seiners of several nations operating in the central and western Pacific, the total number of untethered FADS could be many thousands (SPC 13th Tuna and Billfish Technical Standing Committee report, 2000). There is a risk that the migratory behavior of tuna in the western Pacific could be affected. FADs might retain tuna in areas where they otherwise quickly pass through and are not enticed by concentrated forage to remain. The potential effects on the pelagic ecosystem are largely unknown and require research attention (Sakagawa, in press). It is possible that drifting FADS could contribute significantly to cumulative effects on essential fish habitat and marine environment.

Vessel Groundings, Marine Debris, Waste Disposal

The accidental grounding of fishing or non-fishing vessels can adversely affect shoreline nesting habitats of green or hawksbill sea turtles in the U.S. Pacific islands. Groundings can also damage coral reefs and other types of bottom habitat both locally and more broadly, if the vessel breaks up and releases fuel and oil that result in pollution of habitat. A grounding can also lead to the introduction of alien species, such as rodents or insects, which can have an adverse impact on terrestrial native fauna and flora.

Derelict fishing gear and other marine debris generated by large-scale net fisheries in the North Pacific entangle sea turtles and seabirds in the Northwestern Hawaiian Islands and they have had significant adverse effects on coral reef and shoreline habitats (WPRFMC, 2000b). Some kinds of flotsam in the pelagic ecosystem can have a positive effect on local biological productivity, including the aggregation of commercially-valuable fish around drifting logs, "trash lines" and man-made drifting FADs (i.e., *payao*). Most drifting FADs are eventually lost and wherever they ground, they present the same risks as other kinds of derelict gear to seabirds, sea turtles and habitat.

This exogenous factor has greater potential to add to cumulative effects on essential fish habitat and the marine environment in coral reef ecosystems than in the pelagic ecosystem. A number of legal instruments are presently in force in the United States and internationally for the prevention and management of disposal and loss of fishing gear at sea (Koehler *et al.*, 2000).

Deep Ocean Mining

The mining of cobalt-rich manganese crust on off-axis seamounts located in and around the EEZ around Hawai'i has been proposed and such activity could have significant adverse effects on EFH. The potential impacts include the physical destruction of deep benthic habitat and associated biota, discharge of a cold water surface plume potentially lethal to pelagic larvae and eggs, alteration of phytoplankton species composition and of trophic

dynamics, increased turbidity in the surface layer that could change feeding behavior, changes in local ocean circulation patterns and dissolved oxygen concentrations in the surface layers near mining sites (WPRFMC, 1998). This factor could contribute significantly to cumulative effects on essential fish habitat and the marine environment.

Current and Future Regulatory Regimes (Exogenous to Pelagics FMP)

There is growing concern whether the species-directed fisheries management policies presently in existence at the national and international levels are effective in preventing undesirable changes in marine ecosystem structure and function (Hall, 1998). General principles for ecosystem-level management have been proposed for U.S. fisheries management (EPAP, 1999) but to what extent they can be practically implemented remains unclear. This factor has the potential to add to cumulative effects on essential fish habitat and the marine environment.

4.11.3 Cumulative Effects of the Alternatives – Essential Fish Habitat and the Marine Environment

The cumulative effects of each EIS alternative are analyzed by combining (a) the direct effects of each alternative and (b) the indirect effects of each alternative with (c) the effects of exogenous factors, as modified by (b). The (a) direct and (b) indirect effects of the EIS alternatives on essential fish habitat and the marine environment are summarized in Table 4.11-5 at the end of this chapter.

None of the exogenous factors which contribute to cumulative effects are expected to be modified by (b) indirect effects of any EIS alternative. Any indirect effects of the Hawai'i-based longline fishery on essential fish habitat and the marine environment would be transferred to other areas to the extent that fishing effort in Hawai'i is relocated under Alternatives 3, 4, 5, 6, 7, 8 or 10. Indirect effects under Alternatives 1, 2 and 9 would remain in Pelagics FMP-managed fisheries.

When the estimated direct and indirect effects are combined with the potential effects of exogenous factors, none of the alternatives considered in the EIS are likely to have effects that can be detected against fluctuations in pelagic habitats and the ecosystem driven by large-scale oceanographic processes. This predicted cumulative effect is summarized in Table 4.11-5 at the end of this chapter. No significant cumulative effects that need mitigation were identified for essential fish habitat and the marine environment.

4.11.4 Exogenous Factors – Pelagic Fish Resources

Six major exogenous factors were identified as having the potential to contribute to cumulative effects on pelagic fish resources:

- Fluctuations in the pelagic ocean environment
- Pacific-wide stock status
- Pacific-wide longline fishing effort
- Drifting FADs deployed by the purse seine fishery
- Expanding Samoa region-wide longline fishing for albacore tuna
- Current and future regulatory regimes

Fluctuations in the Ocean Environment

Catch rates of pelagic fish species fluctuate in a time and space in relation to environmental factors that influence the horizontal and vertical distribution and movement patterns of fish. Cyclical fluctuations in the pelagic environment affect pelagic habitats and prey availability at high frequency (e.g., seasonal latitudinal extension of warm ocean waters) and low-frequency (e.g., ENSO-related longitudinal extension of warm ocean waters). Low or high levels of recruitment of pelagic fish species are also strongly related to fluctuations in changes in the ocean environment.

The effects of such fluctuations on the catch rates of pelagic management unit species (PMUS) obscure the effects of the combined fishing effort from Pacific pelagic fisheries (Section 4.3.2). During an *El Niño*, for example, the purse seine fishery for skipjack tuna shifts over 1,000 km from the western to central equatorial Pacific in response to physical and biological impacts on the pelagic ecosystem (Lehodey *et al.*, 1997). Future ocean shifts are likely to cause changes in the abundance and distribution of pelagic fish resources. This factor could contribute significantly to cumulative effects on these resources.

Pacific-wide Stock Status

Pelagic species are not confined to any particular EEZ or country but have a wide geographical distribution in the central and western Pacific. As described in Section 3.4, assessments of the status of pelagic fish indicate that, on a Pacific-wide scale, pelagic management unit species (PMUS) are currently being exploited at sustainable levels, although the conditions of blue marlin and bigeye tuna stocks need to be carefully monitored (Section 4.3.2). Little is known about the level of fishing mortality versus natural mortality for most of the non-target PMUS and there are insufficient data to allow for stock assessments or to define MSY for most of these species.

Comparison of total Pacific shark catch estimates for 1994 (Stevens, 1996) and 1998 catch data for western Pacific pelagic fisheries managed under the Pelagics FMP indicate that the western Pacific domestic harvest accounts for less than two percent of the total shark harvest in the Pacific (Section 4.3.2). Further, a stock assessment of North Pacific blue sharks, which comprise most of the sharks caught by the Hawai'i-based longline fishery, indicates that the most conservative estimate of MSY is twice the current Hawai'i harvest level (Kleiber, 2000). Preliminary results of the modeling suggest that the blue shark population showed a significant decline during the 1980s, the decade of extensive small-mesh driftnet fishing in the North Pacific, with the population starting to recover and catchability by longline fleets improving during the latter half of the 1990s (Kleiber, 2000).

The Pacific-wide distribution and harvest of pelagic fish resources is a significant factor in evaluating the cumulative effects on pelagic fish resources.

Pacific-wide Longline Fishing Effort

Longline fishing is conducted in the North Pacific by Asian fleets, as well as by the Hawai'i-based longline fleet. The areas fished by the Asian distant-water tuna longline fleets overlap with those fished by the Hawai'i-based longline fleet. From 1991-1997, longline fishing effort by the other fleets accounted for 95.5 percent of the total hooks set in the North Pacific. From 1991-1997, the average annual longline fishing effort in areas also fished by the Hawai'i-based fleet was 84 million hooks, of which 13 million hooks, or 16 percent of the total, were set by Hawai'i-based longline vessels. The remaining 84 percent was predominantly composed of the Japanese longline fleet (54 percent), with smaller amounts by the Korean (26 percent) and Taiwanese (four percent) fleets. The Asian longline fleets have traditionally fished mostly with "deep-set" longline gear in the areas fished by the Hawai'i-based longline fleet (Section 3.14).

Fishing effort in the Japanese swordfish-directed longline fishery occurs in the northwest Pacific west of the dateline (Takahashi and Yokawa, 1999), where the Hawai'i-based longline fleet rarely fishes. The Japanese swordfish fleet deploys a significantly greater amount of effort than the Hawai'i-based swordfish and mixed target longline sectors. Annual effort in the Japanese swordfish fishery increased from five million hooks prior to 1982 to about 25 million hooks in the 1990s (Yokawa, 1999).

Pacific-wide longline fisheries conducted by Asian fleets are a significant factor in determining cumulative effects on pelagic fish resources.

Drifting FADs Deployed by the Purse Seine Fishery

Until recently, U.S. purse seine fishing effort in the western Pacific was divided about equally between sets on floating objects (logs and FADs) and on free-swimming schools. During

1999, however, 90 percent of the fishing effort was around untethered FADS (i.e., rafts known as *payao*) deployed by the purse seiners themselves (Sakagawa, in press). Many large purse seiners deploy between 20-30 untethered FADs per vessel, with Spanish vessels sometimes using many more. With up to 200 purse seiners of several nations operating in the central and western Pacific, the total number of untethered FADS could be many thousands (SPC 13th Tuna and Billfish Technical Standing Committee report, 2000).

FAD technology has gained wide acceptance in the U.S. purse seine fishery because it increases harvesting efficiency. FADs are easily deployed, tracked and located with radio beacon devices. Locating unassociated, free-swimming tuna schools is more difficult and requires long hours of searching and knowledge of the fishing grounds. The deployment of drifting FADS by the vessels themselves augments the supply of naturally occurring drifting objects that attract forage animals and tunas under them in the open ocean. FAD performance is thus similar to log performance. Both FAD and log sets are executed before day break and have a very high success rate (more than 90 percent) for catching tuna. This is nearly double the success rate of unassociated school sets, which are executed at all hours of the day (Sakagawa, in press).

With increasing deployment of *payao*, there is a risk that the migratory behavior of tuna in the western Pacific could be affected. FADs might retain tuna in areas where they otherwise quickly pass through and are not enticed by concentrated forage to remain. This could affect their population parameters (growth, maturity, survival) and population dynamics. The potential effects on the population biology of tuna are largely unknown and require research attention (Sakagawa, in press). There has been a rapid increase in the harvest of juvenile bigeye tuna by purse seiners of several nations around *payao* in the eastern tropical Pacific (Coan *et al.*, 1999).

It is possible that drifting FADS could contribute significantly to cumulative effects on pelagic fish resources.

Expanding Samoa Region-wide Longline Fishing for Albacore Tuna

The albacore catch by small-scale longline fisheries in American Samoa and neighboring independent Samoa totaled 6,800 mt in 1998, which represents 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 it may be one of the significant factors contributing to cumulative effects on pelagic fish resources in the Samoa region (WPRFMC, 2000c).

Current and Future Regulatory Regimes (Exogenous to Pelagics FMP)

At the time of EIS preparation, a fishery management plan was being prepared for U.S. fisheries for highly migratory species in the Pacific. The California-based longline fishery will be managed under this plan (NMFS, 2001a). California-based longline vessels are required to have High Seas Compliance Act permits from the National Marine Fisheries Service and to file logbooks based on those permits. Domestic longline vessels that fish in waters outside the EEZ around California but unload their catches and re-provision in California ports are required to have a license from the State of California and to file landing reports with the State.

The U.S. western Pacific purse seine fishery is conducted on the high seas and within the EEZs of sovereign South Pacific Forum nations in the central, western and south Pacific under a multi-lateral treaty between Pacific island states and the U.S. government. 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 three North Pacific and seven South Pacific countries who are parties 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.

A provision for negotiating Pacific Insular Area Fishery Agreements (PIAFA) was included in the Magnuson-Stevens Act to allow foreign vessels to fish in the EEZ around American Samoa, Guam, CNMI and remote U.S. Pacific island areas in return for a negotiated fee. The PIAFA provision is intended to provide Pacific Insular Areas with an additional opportunity to derive economic benefits from the fishery resources within the EEZ. Any payments received under a PIAFA for American Samoa, Guam or the CNMI would be deposited in the island government treasuries. A PIAFA may not be entered into if it is determined by the Governor of the applicable Pacific Insular Area that the agreement will adversely affect the fishing activities of the indigenous people of the Pacific Insular Area (WPRFMC, 2000c).

The independent country of Samoa, which neighbors American Samoa, is considering whether to limit longline fishing permits to control fishing effort. A target number of 185 longline fishing permits is being discussed in independent Samoa (C. Evans, American Samoa DMWR, pers. comm., January 3, 2001).

The Shark Finning Prohibition Act (P.L. 106-557), in addition to proposing a comprehensive ban on possession and landing of shark fins without corresponding carcasses by domestic

fisheries, emphasizes the need for international cooperation to reduce the harvest of shark fins. The federal government would collect information about the extent of the shark fin trade in foreign ports. The United States would urge foreign governments to collect biological and trade data on shark species and to submit national plans of action for the conservation and management of sharks. The United States would also seek bilateral and multi-lateral agreements calling for an international ban on shark finning. A U.S. National Plan of Action for the Conservation and Management of Sharks has been developed by NMFS (2000) to fulfill the national responsibility of the United States to the International Plan of Action for the Conservation and Management of Sharks that was adopted by the U.N. Food and Agriculture Organization in November 1999.

The described regulatory regimes that already exist or are in the process of being established have significant potential to influence cumulative effects on pelagic fish resources.

4.11.5 Cumulative Effects of the Alternatives – Pelagic Fish Resources

The cumulative effects of each EIS alternative are analyzed by combining (a) the direct and (b) the indirect effects of each alternative with (c) the effects of exogenous factors, as modified by (b). The (a) direct and (b) indirect effects of the EIS alternatives on pelagic fish resources are summarized in Table 4.11-5 at the end of this chapter. Alternatives 3, 4, 5, 6, 7, 8 or 10 would displace some or all of the existing Hawai'i-based longline fishing effort. The displaced effort would be relocated to other areas, where it would indirectly affect the same pelagic fish stocks that were harvested by Hawai'i-based fishing effort. Thus, any increase in central North Pacific swordfish sub-populations would likely be offset by increased harvest of other sub-populations comprising the same overall stock.

Alternatives 3, 6, 7, and 10 would close portions of longline fishing grounds that have been utilized by the Hawai'i-based tuna longline fleet. These alternatives would be anticipated to cause some redirection of tuna longline fishing effort to seamounts in areas of the EEZ around Hawai'i not closed to longline fishing, especially the Cross Seamount where handline fishing is concentrated. The majority of the handline tuna catch is comprised of juvenile bigeye tuna. Alternative 8 would close the Hawai'i-based longline fishery entirely and would be expected to stimulate additional harvesting of juvenile bigeye tuna by the handline fishery to substitute in the Hawai'i tuna market for the displacement of longline-caught tuna. Additional harvest of juvenile bigeye tuna would be expected as an indirect effect of Alternatives 3, 6, 7, 8, and 10. Greatly increased catches of small bigeye made by FAD-associated purse seine sets recently prompted the IATTC to consider a suspension of FAD-associating fishing in the eastern tropical Pacific (R. Deriso, comments at 75th SSC meeting, 2000).

When the estimated direct and indirect effects are combined with the potential effects of exogenous factors, Alternatives 1-7 would not be anticipated to change the cumulative stock-wide effects or local availability of PMUS. Alternative 8 would not significantly change

the status of most pelagic fish stocks, although it could magnify any tuna catch interactions that may be occurring near Hawai'i's offshore seamounts. Preferred Alternative 10 would not significantly change the status of any pelagic fish stocks but it might marginally increase North Pacific swordfish and blue shark populations sufficiently to be measurable with existing sources of data and analytical techniques.

The predicted cumulative effects are summarized in Table 4- 5 at the end of this chapter. No significant cumulative effects that require mitigation were identified for pelagic fish resources.

4.11.6 Exogenous Factors – Sea Turtles

Five major exogenous factors were identified as having the potential to contribute to cumulative effects on sea turtles:

- Fishery effects – pelagic
- Fishery effects – shore
- Impacts on nesting environment
- Impacts on marine environment
- Current and future regulatory regimes

Fishery Effects – Pelagic

The incidental mortality of all species of marine turtles in commercial fishing operations has long been recognized as a serious threat to the stability of those populations (NMFS and FWS, 1998a, 1998b, 1998c, 1998d, 1998e,1998f; National Research Council, 1990). Often the effect of fishery mortality has a higher impact on population stability than many other sources of mortality (e.g., extensive egg harvest, nesting habitat destruction) because fisheries impact larger size/age classes of sea turtles. The effect of mortality in this size/age class is particularly damaging, as these turtles have some of the highest value to the population in terms of reproductive potential (Crouse *et al.*, 1987; Crowder *et al.*, 1994). Larger turtles not yet mature have survived many years of selective pressures but have not yet begun to support the population by reproducing themselves. Thus, while anthropogenic mortality may occur at many size/age classes in marine turtle population, it has been demonstrated that a relatively small anthropogenic mortality at these larger size/age classes will drive a population to extinction - despite almost complete protection of eggs and nesting females on the nesting beaches (Crouse *et al.*, 1987).

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, 2000b). 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 which 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).

One of the hallmarks of a fishery-impacted population decline is that the rate of decline can be quite fast. An example of this is the eastern Pacific nesting populations of leatherback sea turtles. As noted earlier, these populations dropped more than 80 percent in 15 years (Sarti *et al.*, 1996; Spotila *et al.*, 2000), a decline that was caused primarily by incidental mortality by coastal and high seas gillnet fishing off S. America and in the N. Pacific (Eckert and Sarti, 1997). In contrast, the destruction of the leatherback population in Terengannu, Malaysia took more than 50 years for which over harvest of eggs was primarily credited with the decline (Chan and Liew, 1996).

Another issue which must be considered when evaluating the interaction of fisheries with sea turtles is that sea turtle distribution is not homogeneous. Sea turtle distribution is often patchy, both temporally and geographically. The factors which lead to such patchiness are not entirely defined, though as noted earlier in this volume there are a few characteristics that can be important in governing turtle distribution (e.g., temperature, food availability, available refugia, etc.). Thus it is often impossible to estimate total fishery interaction based on fishing effort alone or fleet distribution alone. As more information on sea turtle habitat preference becomes available it should be easier to anticipate fishery turtle interaction rates.

Because of the highly migratory nature of sea turtle populations, there is significant overlap of sea turtle stocks between the western and eastern Pacific. This is particularly true of loggerheads and leatherbacks, and, with respect to the Hawai‘i fishing area, also for olive ridleys. The recently released Biological Opinion for the California/Oregon Drift Gillnet Fishery (NMFS, 2000c) provides an excellent discussion of fishery-based sources of mortality for Pacific sea turtle populations. An excerpted summary can be found in Appendix N of this document.

An additional source of mortality for loggerhead and leatherback turtles, besides the various international sources considered in the CA/OR BO, is the Japanese swordfish-directed

longline fishery in the northwest Pacific. This fishery generates a higher incidental mortality of loggerhead and leatherback sea turtles than the Hawai'i-based longline fishery. This reasoning is based upon fishery characteristics, as the Japanese swordfish fleet deploys gear that is similar to that used by the Hawai'i-based swordfish fleet but that exerts roughly four times more effort in the North Pacific Transition Zone and adjacent subtropical frontal zone (Section 3.14). Additionally, interaction rates for loggerhead turtles may be even higher in the Japanese fishery because of the closer proximity to nesting grounds in Japan (Section 3.14). Using the assumptions of Cousins *et al.* (2000) that the "mixed" target sector of the Hawai'i-based longline fishery is most similar to the Japanese swordfish longline fishery in gear, first approximations of leatherback and loggerhead incidental take and mortality were estimated by applying the interaction rates for these species in Hawai'i's "mixed" longline sector to the 25 million hooks of annual fishing effort (Section 3.14) in the Japanese swordfish-directed longline fishery. This calculation produces crude estimates of 1,350 takes, with 115 mortalities, of leatherback turtles per year and 3,950 takes, with 688 mortalities, of loggerhead turtles in the Japanese swordfish fishery.

Impacts of Asian tuna-directed longline fisheries are more difficult to define. It is assumed that cumulative sea turtle takes are greater for the Asian fleets simply because they account for an estimated 95.5 percent of all longline fishing effort in the Pacific. Most of the tuna-directed effort by these fleets is conducted at tropical latitudes, so the interaction rates would probably be highest for olive ridley turtles, moderate for green turtles and low for hawksbill, leatherback and loggerhead turtles (Section 3.14).

Fishery Effects – Shore

The Hawai'i recreational shoreline fishery is a source of mortality specifically for green turtles. Of the 299 documented turtle strandings in the main Hawaiian Islands during 1999, 15 percent, or 43 animals, had recreational fishing hooks in them. The most serious aspect of green turtle interactions with recreational shore fishers is entanglement in monofilament fishing line. The line may get wrapped around the turtle's flipper and restrict its movements and ultimately may even sever the appendage. 20 of the 43 documented turtle strandings related to recreational fishing were dead when recovered. The remaining 23 turtles were entangled in monofilament line (NMFS, 2000a). Anecdotal information from recreational fishers suggests that the rate of interaction with shoreline fishing gear is much higher than the NMFS-documented strandings.

Impacts on Nesting and Marine Environments

The Recovery Plans for Pacific sea turtles (NMFS and FWS, 1998a, 1998b, 1998c, 1998d, 1998e, 1998f) describe over 26 non-fishery related impacts to sea turtles and evaluate their impact to each population by region. These impacts are separated into "nesting environment" and "marine environment." The following is a summary of those impacts:

Nesting environment

- Directed Take - directed take refers to the intentional killing of sea turtles or their eggs for food or other domestic or commercial purposes. For most regions of the Pacific and most species such directed take is illegal as the killing of reproductive females and their eggs is counterproductive to population stability. However, enforcement is often difficult. As a general rule, egg take is more prevalent in most regions than the killing of reproductive females.

- Increased Human Presence - refers to the increase presence of humans near or on nesting beaches. Problems include increased recreational use, construction of permanent or temporary structures on the beaches, litter or refuse, and general harassment of nesting turtles or their hatchlings.

- Coastal Construction - because of the value of coastal lands, and because such areas are often easiest to build on, sea turtle nesting beaches are frequent subjects of private and commercial construction. Construction results in the destruction of the nesting beach through direct impact (sand harvesting, etc.) or through collateral effects such as light pollution (sea turtles require dark beaches to nest), increased human harassment and increased egg or turtle harvesting.

- Nest predation - egg and hatchling loss due to non-human predation is a serious problem in some areas. Often such problems are exacerbated in areas of high human occupancy because feral animals (e.g., dogs, pigs, cats, rats) are frequently the culprits. In some cases increased natural predators (e.g. racoons, coati-mundis,) can be a problem, but usually this only occurs where introduced terrestrial ecosystems have displaced the beach ecosystem.

- Beach erosion - the effects of storms, sea level rise or seasonal changes can affect beaches, and thereby degrade nesting habitat.

- Artificial lighting - as noted under human presence, artificial lighting can be a problem at nesting beaches. Adult and hatchling sea turtles use the presence of a lighter horizon to find the sea when returning from a nesting beach. Artificial light can disorient turtles or prevent them from nesting.

- Beach Mining - refers to the extraction of sand from nesting beaches to be used in construction (in concrete). The effect of removing sand from beaches is often increased erosion leading to destruction of the beach.

- Vehicular Driving on Beaches - crushes turtle eggs and destroys nesting habitat by causing compaction and rutting; makes it difficult or impossible for hatchlings to negotiate their way to the water.

- Exotic Vegetation - non-native species of vegetation can interfere with nesting beaches by affecting incubation temperatures (which impacts hatch success as well as hatchling sex ratios, which are thermally regulated), as well as by creating thick root masses which foul nests or by interfering with sand flow dynamics (beaches often need annual erosion and replenishment to clean the beach and remove residual organics that are left after incubation).

- Beach Cleaning - a process common to resort areas where mechanical rakes are used to remove accumulated debris, often damages nests in the process.

- Beach Replenishment - the replacement of sand onto a beach after it has been eroded away is called beach replenishment. However, such action can bury nests already deposited, or more significantly the replacement sand can be of the incorrect quality and can result in poor hatch success or even interfere with the turtle's ability to dig a nest cavity.

Marine Environment

- Direct take - refers to the direct harvest of turtles for domestic or commercial purposes (e.g. food, jewelry, leather or other products)

- Natural Disasters - such as large storms, hurricanes etc. can kill sea turtle turtles, particularly those foraging in shallow coastal habitats. More long term natural phenomena such as *El Niño* can also impact turtle populations, particularly those which are already stressed by other problems.

- Disease and parasites - can impact turtle populations, particularly once turtle populations have been reduced so severely that such natural stresses have larger impacts than would normally be the case in healthy populations. Often turtles that have been compromised by other problems will secondarily exhibit high parasite loads that exacerbate the poor health conditions of the turtle. Finally disease epidemics can impact turtle populations. For example, the fibropapillomas epidemic has been severe on green turtles living around the islands of Hawai'i, and threatens their recovery.

- Algae, Seagrasses and Reef Degradation - is a form of marine habitat damage which clearly impact turtle populations by limiting food or refugia.

- Environmental Contaminants - such as oil or other chemical contaminants are particularly high in coastal areas with larger human populations and can harm turtles as well as their habitats. Less well known are chemical contaminants on the high seas but they are a source of mortality to sea turtles.

- Debris (Entanglement and Ingestion) - provide a potentially serious but impossible-to-quantify source of mortality in sea turtle populations. For example ghost fishing gear (abandoned or discarded) can kill turtles submerged for extended periods by entanglement. Particularly insidious is gear that may entangle turtles until the gear becomes so weighted that it sinks and once the turtles have decomposed it rises to surface waters to entangle turtles again. There are numerous reports of abandoned gear with large numbers of dead turtles and other species entangled in the gear. Equally unquantified and potentially serious is debris that turtles may consume and cause death. All pelagic sea turtles will eat jellyfish (and for leatherbacks this is all they eat), and they often confuse plastics with this prey. The effect can be to kill the turtle through intestinal blockage, or there may be physiological impacts as has been suggested for turtles who consume latex balloons (Lutz, 1989; Lutz and Alfaro-Schulman, 1991). Finally, many pelagic turtles (particularly hatchlings) are surface grazers who will consume anything found floating at the surface. This can include a large number of anthropogenic contaminants such as plastic beads used in plastic fabrication and oil or tar balls.

- Predation - is considered a natural source of mortality however it must be considered a threat when turtle populations become reduced. Pelagic turtles probably represent only an occasional food source for predators such as sharks and *Orca*, and thus predator population size may be decoupled (predator population size is not linked to prey population size as in the more familiar snowy owl / lemming model) from sea turtle population size. Thus, when turtle populations are reduced the effect of predation has a greater impact than would be seen when turtles are numerous.

- Boat Collisions - can be a threat to turtle populations primarily in coastal environments when boat traffic and turtle densities are high.

- Marina and Dock development - can act as an indirect threat to turtles through the destruction of habitat, elevated contaminant levels (caused by increased boat traffic) and increased risk of boat strikes.

- Dredging - represents a risk to sea turtle coastal habitats.

- Dynamite fishing - threatens primarily coastal turtle populations by incidental killing of turtles and habitat destruction.

- Oil Exploration and Development - is considered threatening to turtle populations because of possible contamination of habitats, increased boat traffic and pre-drilling seismic exploration. This latter activity can kill turtles or damage their hearing.

- Power Plant Entrapment - occurs in some coastal areas that use ocean water for cooling. Turtles swim into the sea water intakes and are sometimes drowned.

- Construction Blasting - can kill or injure turtles in the immediate area, as well as degrade important habitats.

Current and Future Regulatory Regimes

Sea turtle species which are accidentally caught in Pelagics FMP-managed fisheries are protected under the Endangered Species Act. NMFS' CA/OR BO (NMFS, 2000c) concludes that the CA/OR drift gillnet fishery is likely to jeopardize leatherback and loggerhead turtles and proposes to restrict the fishery to reduce the fishery's take of these species. NMFS' Pelagics BO (NMFS, 2001a) has found that the Hawai'i-based longline fishery jeopardizes the survival of loggerhead, leatherback and green sea turtles. The Pelagics BO prescribes a "Reasonable and Prudent Alternative" (RPA) for continuation of the Hawai'i-based longline fishery. The RPA has been incorporated in this EIS as the Preferred Alternative (Alternative 10). Hence, the Pelagics BO is not an "exogenous factor" to fisheries managed under the Pelagics FMP.

A fishery management plan is currently being prepared for U.S. fisheries for highly migratory species in the Pacific. The California-based longline fishery will be managed under this plan. As necessary, this plan may also include restrictions on fishing methods in order to reduce or avoid impacts to sea turtles (NMFS, 2001a).

When it enters into force, the Inter-American Convention for the Conservation and Protection of Sea Turtles is expected to promote conservation of sea turtles in the convention area (NMFS, 2001a).

The regulatory factor contributes significantly to cumulative effects estimated for sea turtles.

4.11.7 Cumulative Effects of the Alternatives – Sea Turtles

The cumulative effects of each EIS alternative are analyzed by combining (a) the direct effects of each alternative and (b) the indirect effects of each alternative with (c) the effects of exogenous factors, as modified by (b). The (a) direct and (b) effects of the EIS alternatives on pelagic fish resources are summarized in Table 4.11-5 at the end of this chapter.

Fishery impacts are not limited to the Hawai'i-based longline fishery alone. Historically a number of high seas and coastal fisheries as well as coastal management problems (including nesting beaches) have had direct bearing on the endangered status of Pacific sea turtles. Contemporarily, incidental take in the Hawai'i-based longline fishery is small when seen in terms of all fisheries and other sources of mortality in the Pacific, but is likely still large enough to impose a significant threat to the stability of at least leatherback and loggerhead turtles.

Alternatives 3, 4, 5, 6, 7, 8 or 10 would displace some or all of the existing Hawai'i-based swordfish longline fishing effort. Some or all of the displaced effort may relocate to the California and Mexico-based longline fishery. Both leatherback and loggerhead sea turtles are commonly found in the eastern Pacific. Take rates are expected to be high because leatherback turtles aggregate in Monterey Bay during the summer and begin to migrate offshore beyond the EEZ in September. The California-based longline fishery is not observed , the current level of incidental take of sea turtles is unknown but may increase as a result of increased effort. Shifting swordfish longline fishing effort to the eastern Pacific would not increase the likelihood of survival or recovery of the sea turtle species (NMFS, 2001a).

When the estimated direct and indirect effects are combined with the potential effects of exogenous factors (as described in 4.11.1), Alternatives 1-8 and 10 have the potential to add to already significant effects because of the importance of even small numbers of mortalities of the latter species. The same alternatives could have a significant positive impact on cumulative effects if sea turtle takes by Pacific-wide longline fisheries could be reduced throughout the range of the populations of the threatened or endangered species. This would require comprehensive conservation and management of other fisheries besides those managed under the Pelagics FMP. The predicted cumulative effects are summarized below direct and indirect effects in Table 4.11-5 at the end of this chapter.

4.11.8 Significant Cumulative Effects Requiring Mitigation – Sea Turtles

To reverse the trend of decline in leatherback and loggerhead sea turtles will take a multilateral approach in both fisheries and coastal resource management. Acting to remove Hawai'i-based longline fishery mortality alone will not reverse these species declines. This is recognized in the Pelagics BO (NMFS, 2001a) which includes in the reasonable and

prudent alternative a measure to restrict the movement of Hawai'i-based longline vessels to areas of the Pacific that are not managed under the Pelagics FMP.

4.11.9 Exogenous Factors – Seabirds

Two of the most important historical factors influencing albatross populations in the North Pacific were (a) severe declines caused by feather hunters and egg collecting in the late 19th and early 20th centuries (McDermond and Morgan, 1993); and (b) the Asian high seas drift net fishery. North Pacific populations of black-footed, Laysan and short-tailed albatross have not yet recovered from the directed harvests of a century ago. High seas driftnet fishing was widely practiced by Japanese, Korean and Taiwanese fleets through the 1980s until the end of 1992. Driftnet fisheries in the temperate North Pacific had major impacts on Laysan and black-footed albatross through entanglement of birds in fishing gear. Although these fisheries were responsible for the deaths of hundreds of thousands of seabirds (Johnson *et al.*, 1993), they also provided a food supplement to black-footed albatross and, to a lesser extent Laysan albatross, which scavenged considerable amounts of squid and fish directly from driftnets and offal discarded from vessels during processing of the catch (Gould *et al.*, 1998). At the end of 1992, large-scale pelagic high seas driftnet fisheries conducted by Asian fleets ceased in accord with the United Nations' moratorium on this fishing method.

Seven other major exogenous factors were identified as having the potential to contribute to cumulative effects on essential fish habitat and the marine environment:

- Fluctuations in the ocean environment
- Extermination for construction of infrastructure
- Loss of nesting habitat
- Marine debris and waste disposal
- Air strikes
- Incidental take in fisheries
- Current and future regulatory regimes

Fluctuations in the Ocean Environment

A climatic shift that occurred in the central North Pacific in the late 1980s produced an ecosystem shift in the NWHI to a lower carrying capacity, with a 30-50 percent decline in productivity. The recruitment and survival of several marine resources, including seabirds, was negatively affected (Polovina *et al.*, 1994). Future ocean climate shifts are likely to cause changes in seabird abundance and this factor contributes significantly to cumulative effects on seabirds

Extermination

Ten of thousands of albatross were exterminated from Midway Atoll to construct an aircraft runway for the Department of the Navy. It is possible that short-tailed albatross on the island could have been killed during this process. The U.S. government transferred Midway Atoll from the Navy to the Department of the Interior in 1996 and Midway Atoll is presently managed as a National Wildlife Refuge where seabird nesting habitat is protected (FWS, 2000). If large-scale extermination occurs in the future at other important nesting habitats in the Pacific-range of albatross, this factor could contribute significantly to cumulative effects on seabirds

Loss of Nesting Habitat

Loss of habitat now represents the greatest threat to short-tailed albatross (McDermond and Morgan, 1993) and, to a lesser extent, black-footed and Laysan albatross. Current population enhancement efforts in Japan are concentrated on attracting breeding short-tailed albatross to an alternate, well-vegetated colony site on Torishima, which is less likely to be affected by volcanic eruptions, mud slides, or erosion than other nesting colony sites in Japan (FWS, 2000). As long as habitat continues to limit albatross population recovery, it will be of great significance to cumulative effects on seabirds

Marine Debris and Waste Disposal

Drift and trawl nets accumulate in the Northwestern Hawaiian Islands and entangle protected species, including albatross. A multi-agency state and federal effort is underway to remove derelict nets from several locations in the NWHI. The ingestion of marine debris (primarily plastic) by albatross chicks may result in dehydration and starvation, intestinal blockage, internal injury or exposure to dangerous toxins (Cousins, 1998). As long as net fisheries lose gear in the North Pacific and marine debris accumulates near albatross nesting sites, however, the potential for entanglement will remain (FWS, 2000) and this factor will contribute significantly to cumulative effects on seabirds

Air Strikes

Since acquiring the airfield at Midway Atoll NWR from the Department of Defense in July 1997, FWS has implemented several precautions to reduce and document seabird collisions with airplanes, especially during the albatross nesting season from November through June. The FWS has documented that 135 seabirds, not including any short-tailed albatross, have collided with aircraft and died. A female short-tailed albatross has seasonally resided close to the end of the runway since 1989. The limited airplane service to Tern Islet, French Frigate Shoals in the Hawaiian Islands NWR injures and kills a small number of seabirds, but

never short-tailed albatross (FWS, 2000). Air strikes, therefore could be of potential significance to cumulative effects on seabirds

Incidental Seabird Take in Fisheries

Asian longline fleets operate in North Pacific areas that overlap the known range of the short-tailed albatross (FWS, 2000). Most Asian longline vessels fish primarily for tuna, so they probably have much lower albatross take rates than swordfish longline fisheries. Unfortunately, they do not report longline interactions with seabirds. Collectively, these 3,000+ vessels no doubt have a significant effect on North Pacific albatross. Cousins *et al.* (2000) made a rough first approximation of the potential numbers of albatross killed in North and Central Pacific pelagic longline fisheries, based on the ratio of swordfish and seabirds incidentally hooked in the Hawai'i-based longline fishery. Applying different average catch rates of Laysan and black-footed albatross from different sectors of the Hawai'i-based longline fishery to Japan's swordfish-directed longline fishery in the North Pacific and to North Pacific longline fishing by Japanese, Taiwanese and Korean vessels which target tuna, Cousins *et al.* (2000) speculate that Asian pelagic longline fisheries operating in the North Pacific may accidentally catch 30,000 birds per year.

Seabird interaction problems in the North and Central Pacific are mild compared with those in Alaska's demersal longline fishery and in pelagic longline fisheries in the South Pacific and Southern Ocean (Cousins *et al.*, 2000) where the species and sheer numbers of birds involved are much greater. Pelagic longline fisheries kill far fewer albatross than did driftnet fisheries although they do not provide as much supplemental food. North Pacific fisheries which target squid, the primary prey item of albatross, may affect food availability but how this affects seabird populations is unknown. The balance of positive and negative impacts of longline fisheries on black-footed and Laysan albatross populations is unknown, complex and probably in a continual state of flux (Gould *et al.*, 1998).

The U.S. Fish and Wildlife service has authorized a recreational rod and reel fishery at Midway Atoll National Wildlife Refuge. About eight Laysan albatross were entangled in lines and one bird was hooked by a lure in the recreational fishery at Midway. No mortality was associated with these interactions. No injuries were reported for black-footed albatross as a result of the recreational fishery. Short-tailed albatross have been most frequently observed at Midway between October and April, although none were observed at sea during 1999 and 2000. The recreational fishery occurs primarily between April and October, so there is some overlap between the presence of short-tailed albatross and recreational fishing activities at Midway (FWS, 2000). Based on the low allowable take of this species (2.2 birds/year) set for the Hawai'i-based longline fishery in the short-tailed albatross Biological Opinion (FWS, 2000), even a small number of short-tailed albatross takes in the recreational fishery at Midway would be of concern.

If the North Pacific-wide estimate of Asian longline interactions with albatross (Cousins *et al*., 2000) is anywhere close to actual encounter rates, all albatross species in the North Pacific will not be able to maintain stable population levels and will eventually demonstrate declining numbers of breeding pairs in the NWHI and elsewhere. Therefore, this factor has major significance for cumulative effects on seabirds .

Current and Future Regulatory Regimes

The United Nations Food and Agriculture Organization (FAO) has endorsed (July 1999) a non-binding International Plan of Action for reducing the incidental catch of seabirds in longline fisheries. The United States is a party to five international treaties that deal with the conservation and management of migratory birds. NMFS is currently developing a national plan of action that will be compatible with the FAO plan. Measures have already been adopted by the United States for reducing the incidental catch of albatross and other seabirds in the ground longline fishery and Pacific halibut fishery off Alaska (WPRFMC, 2001b).

Understanding the rate of incidental albatross takes in foreign longline fisheries that operate in the North Pacific is an integral part of assessing cumulative effects on albatross populations, especially the endangered short-tailed albatross, whose foraging range overlaps with the foreign longline fishing effort to a far greater extent than with the Hawai'i-based longline fishing effort.

Existing and future regulatory regimes have significance for cumulative effects on seabirds.

4.11.10 Cumulative Effects of the Alternatives – Seabirds

The cumulative effects of each EIS alternative are analyzed by combining (a) the direct effects of each alternative and (b) the indirect effects of each alternative with (c) the effects of exogenous factors, as modified by (b). The (a) direct and (b) indirect effects of the EIS alternatives on pelagic fish resources are summarized in Table 4.11-5 at the end of this chapter. Because of exogenous factors, significant adverse cumulative effects on seabirds would continue under Alternatives 1-8 and 10, although the actual significance for albatross population levels is unknown. This estimate of cumulative effects on seabirds is summarized in Table 4.11-5 at the end of the chapter.

4.11.11 Significant Cumulative Effects Requiring Mitigation – Seabirds

Foreign fishing nations are not known to report seabird bycatch and fishers may not be able to identify seabirds or may have significant disincentives to do so for fear of consequences to the future of the fishery (FWS, 2000). No actions have been taken to coordinate policies, research, monitoring or enforcement by national fishery managers and the majority of

central and North Pacific longline vessels continue to operate without employing seabird deterrent measures.

4.11.12 Exogenous Factors – Marine Mammals

Most stocks of large whales were severely depleted by modern whaling. Moratoriums on hunting by the International Whaling Commission have restricted this activity, but poaching of whales and other marine mammals still occurs. Four other major exogenous factors were identified as having the potential to contribute to cumulative effects on marine mammals:

- Fluctuations in the pelagic ocean environment
- Incidental take in fisheries
- Ship traffic and anthropogenic noise
- Marine debris and waste disposal

Fluctuations in the Ocean Environment

Ocean climate fluctuations that change the habitat quality or the prey availability of marine mammals have the potential to affect their short-term or long-term distribution and abundance. Changes in oceanographic conditions may also alter rates of incidental takes of marine mammals in commercial fisheries. For example, during strong coastal upwelling events marine mammals that feed on zooplankton and small fish may be attracted to areas where drift gillnet fisheries are concentrated, and the concurrence of fishing effort and foraging animals may cause more entanglements than normal (NMFS, 2000). The magnitude of potential effects are uncertain but this factor could contribute significantly to cumulative effects on marine mammals.

Incidental Take in Fisheries

Domestic and foreign fisheries outside the Western Pacific Region may adversely affect marine mammals through gear hooking, entanglement or ingestion or by removal of prey species. For example, the California/Oregon shark and swordfish drift gillnet fishery takes dolphins and whales (Forney *et al.*, 2000; Hill and DeMaster, 1999; NMFS, 2000). The Mexican swordfish driftnet fishery is currently making an effort to convert to a longline fishery, which would considerably reduce the incidental take of marine mammals (NMFS, 2000). This factor may contribute significantly to cumulative effects on marine mammals.

Ship Traffic and Anthropogenic Noise

Collisions with vessels and disturbance from low frequency noise are potential threats to the recovery of large cetaceans. Because many of the ship strikes occur far offshore and, thus,

are unreported, this impact on large whales is most likely underestimated (NMFS, 2000). The increasing levels of anthropogenic noise in the world's oceans may have an adverse effect on whales, particularly deep-diving whales that feed in the oceans' "sound channel" (Forney *et al.*, 2000). These effects are difficult to assess but they may be significant as part of cumulative effects on marine mammals.

Marine Debris and Waste Disposal

Activities that may have adverse effects on marine mammal habitat include the dispersal of marine debris, large oil spills and other types of marine pollution. Petroleum has the potential to be toxic to marine mammals if it is inhaled, ingested or absorbed through the skin, mucous membranes or eyes, or if it inhibits feeding by fouling the baleen plates of whales. Hydrocarbons can also bio-accumulate in zooplankton and fish eaten by marine mammals and other wildlife. Any detrimental effects of marine pollution on their prey species would also affect marine mammals. Aside from large, catastrophic spills, the long-term effects of low levels of petroleum exposure are unknown.

Marine debris can be toxic to marine mammals if ingested or it can entangle them, leading to decreased ability to breathe, feed, breed, swim or haul out. The animals affected may be more vulnerable to predators or disease, reducing their survival or ability to reproduce.

These factors can have significance in local areas, where they contribute to cumulative effects on marine mammals.

4.11.13 Cumulative Effects of the Alternatives – Marine Mammals

The cumulative effects of each EIS alternative are analyzed by combining (a) the direct effects of each alternative and (b) the indirect effects of each alternative with (c) the effects of exogenous factors, as modified by (b). The (a) direct and (b) indirect effects of the EIS alternatives on pelagic fish resources are summarized in Table 4.11-5 at the end of this chapter.

Given the lack of reliable information on the rate of interactions between marine mammals and pelagic fisheries in the Western Pacific Region and on the condition of marine mammal stocks, the effects of the baseline management regime (Alternative 1) on marine mammals cannot be determined at this time. Nor can the effects of Alternatives 3, 5, 6, 7, 8 or 10 be determined with any degree of confidence because vessels displaced from the Hawai'i-based longline fishery by the management measures proposed under these alternatives may shift to alternative fisheries in which the interaction rates with marine mammals are unknown. Because of the substantial uncertainty of the effects of these alternatives on marine mammals, the cumulative effects of these alternatives are equally uncertain.

The mandatory protected species workshops organized by NMFS under Alternatives 2, 3, 4, 5, 6, 7 and 10 could have a positive effect on marine mammals by educating fishers on the importance of reducing the incidental mortality and serious injury of marine mammals. Alternative 9 could also have a positive effect on marine mammals if fishing effort in the longline fishery in American Samoa is limited. It is uncertain, however, if the effects of these measures would be significant in relation to the potential impacts of other actions on marine mammals.

This assessment of cumulative effects on marine mammals is summarized in Table 4.11-5 at the end of the chapter.

4.11.14 Exogenous Factors – Economic Impacts

This section examines the economic effects of the alternatives from a cumulative perspective. Cumulative effects are defined as the summation of likely outcomes, taking into consideration not only the direct effects of the alternatives, but also the effects of exogenous factors that may contribute to the overall outcome. The analysis of cumulative economic effects first summarizes the principal endogenous factors[47] - factors directly affected by the alternatives, such as gross revenues, number of vessels, and seabird and turtle mortalities. (These endogenous factors are the focus of Section 4.8.)

The analysis also describes the primary exogenous factors that will influence overall outcomes – factors such as the world market for pelagic fish and suppliers that compete with the Hawai'i-based fleet. Exogenous factors generally have the same effect for all alternatives. The section will also describe the synthesis of interactions between the endogenous factors and the exogenous factors that creates what are defined as cumulative effects. Understanding the interplay of direct and indirect effects among endogenous factors and exogenous factors is necessary to fully understand the outcome of the alternatives.

[47] In general, the designation of a factor as either endogenous or exogenous is relatively straightforward. However, these designations are almost always imprecise – factors designated as endogenous because they are directly and significantly affected by the alternatives may also be influenced to varying degrees by exogenous factors. The converse does not generally hold true in that exogenous factors are by definition not affected significantly by the alternatives.

The endogenous factors listed below are the primary measures of the direct economic effects of the alternatives. These factors are described in Section 4.8 and are considered the principal indicators of the impacts of the alternatives.

- Gross revenue from tuna longline sales
- Gross revenue from swordfish longline sales
- Gross revenue of non-longline Hawai'i-based fishing vessels under the FMP
- Number of displaced vessels from the Hawai'i-based longline fleet
- Number of turtle interactions
- Number of albatross Interactions

The following exogenous factors are likely to influence the overall cumulative effects of the alternatives:

- The pelagic nature of the marine resources that are managed under the FMP
- Other fisheries targeting pelagic fish species that are not within jurisdiction of the FMP (global fisheries and other U.S. fisheries)
- Global awareness of turtle and seabird interactions in global pelagic fisheries
- The global market for tuna and swordfish
- The economy of the State of Hawai'i (including fishing gear suppliers)

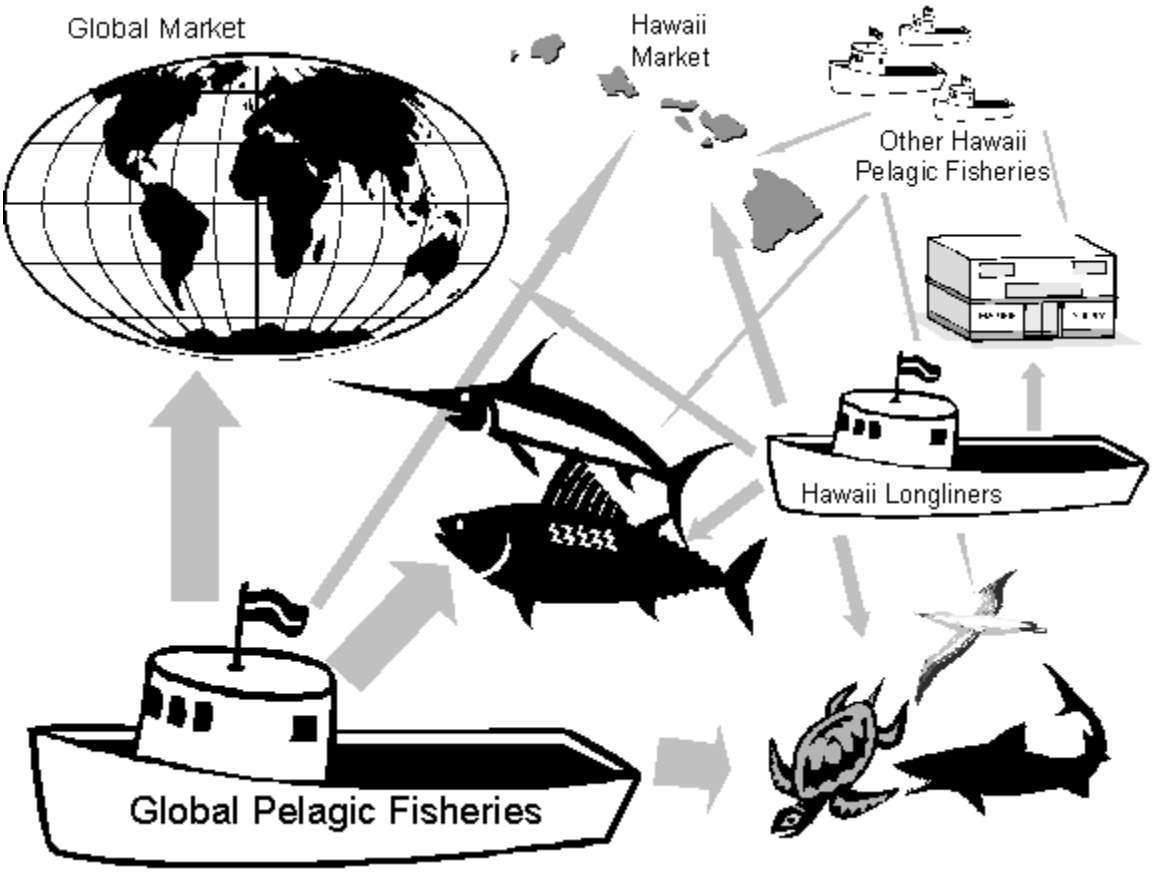
In addition to the factors listed above, one important factor cannot be precisely categorized as exogenous or endogenous, but is a combination of the two:

- The market in Hawai'i for pelagic species

Figure 4.11-1 provides an overview of the interrelationships of endogenous and exogenous factors. The figure shows that Hawai'i-based longliners are potentially creating impacts on the pelagic fish resources and on turtles, albatross, and sharks. At the same time, Hawai'i-based longliners are purchasing inputs from marine supply outlets and supplying fishery products to the Hawai'i and global markets. Similarly, non-longline fishers in Hawai'i are creating impacts on pelagic marine resources, input suppliers, and the local Hawai'i market, but on a smaller scale than Hawai'i-based longliners.

The global pelagic fisheries, including other U.S. pelagic fisheries, are collectively creating a significantly larger impact on pelagic fish resources and on turtles, albatross, and sharks. The global pelagic fisheries are also selling their products in Hawai'i and in the global market.

Figure 4.11-1: Interrelationships Influencing Cumulative Economic Effects of Alternatives on Hawai'i Pelagic Fisheries



4.11.15 Effects of the Alternatives on Endogenous Factors

In this section, endogenous factors are briefly described to discuss their interactions with exogenous variables.

Gross Revenue from Longline Tuna Sales

The gross revenues from tuna sales vary under the different alternatives. Under Alternative 1, baseline tuna sales are estimated to generate gross revenues of $24 million. The limitations of some of the more stringent alternatives may decrease tuna gross revenues substantially, particularly if vessels cannot effectively switch effort between fishing areas and targets. For example, Alternatives 3, 5, 7, and 10 could all decrease tuna gross revenues by greater than 18 percent if area and method switches are not effective. If switching of areas and targets is effective, the greatest projected decline in gross revenues from tuna sales is 12 percent under Alternative 6 (with the exception of the total closure in Alternative 8).

Switching of targets and areas is unlikely to be fully successful, suggesting that the greatest declines in gross revenues from tuna sales would occur under Alternatives 3, 5, 7 and 10.

One other area of concern is that the Kobayashi-Polovina model used in the analysis likely overestimates both harvests and gross revenues. The aggregate analysis used in the model likely overestimates the effort, since it shifts effort within the fishery before determining the number of vessels that can be sustained by the gross revenues generated by that effort. In addition, the CPUE is likely overestimated since vessels that change target species and fishing areas are assumed to have the average CPUE of vessels currently pursuing those targets and active in those fishing areas. Fishers that change targets and locations are not likely to be as successful as fishers that are more experienced in those methods and areas.

In any case, the primary influence of exogenous factors on the gross revenues from tuna sales will most likely be through price effects. The model estimations in Section 4.8 do not include price changes that might result from the decline of local supplies of fish under the alternatives. Those price effects and the influence of pelagic fishers based outside of Hawai'i on prices of tuna caught by Hawai'i-based vessels are discussed here.

The primary market for tuna caught by Hawai'i-based vessels is the Hawai'i market. The highest-quality tuna caught by Hawai'i's fishers is consumed in Hawai'i and in the Japanese markets. The remaining tuna is sold mainly in the local market and to the continental U.S. markets, where it competes with fish from both the Atlantic and Pacific fisheries. The Hawai'i-based fleet dominates only one market, the local Hawai'i market. Elsewhere, tuna caught by Hawai'i's fishers are a small part of the supply.

Typically, a decline in supply to a market is partially counteracted by an increase in price. Usually producers' revenues decline, but part of the decline is compensated for by a rise in prices. This convention generally applies in Hawai'i tuna markets, where prices rise substantially in the seasons when tuna supplies are low.

The local supply notwithstanding, significant imports of tuna are sold in Hawai'i's market. When local supplies are short, Hawai'i has proven to be a willing consumer of imports. With import channels already established, if regulations reduce local harvests it is likely that imports will rise to meet the shortfalls. The strong demand for tuna in Hawai'i during seasons when local catch is low and the current willingness to purchase imports suggest that part of the decline in supplies will be counteracted by an increase in imports. Prices in Hawai'i will likely increase to some degree, but probably will not reduce overall consumer purchases significantly. This influx of imports also dampens the price rise that occurs with a drop in local supply. Local tuna fishers, therefore, are likely to have a greater decrease in revenues than would occur in the absence of these imports.

Gross Revenue from Swordfish Longline Sales

Gross revenues from sales of swordfish harvests differ significantly across the alternatives. In the baseline alternative (Alternative 1) total annual swordfish revenues in Hawai'i are projected to be approximately $11.8 million. The more stringent alternatives that still allow longlining (Alternatives 3, 5, 7, 10) completely eliminate effort targeting swordfish, decreasing gross revenues from swordfish sales to very low levels. At the other extreme, swordfish gross revenues are projected to be only slightly less than the baseline under Alternatives 2 and 4.

As with tuna vessels, the primary effect on swordfish gross revenues from exogenous factors is expected to occur through price effects. These effects are most apparent in cases in which swordfish catches decline significantly but continue to be a significant part of the Hawai'i-based pelagic fishery. Exogenous factors are likely strong enough that prices are unlikely to increase for Hawai'i-based fishers in the event that local harvests are reduced by regulations – suggesting that revenues would decline noticeably.

Swordfish caught by Hawai'i-based vessels is sold primarily to the U.S. East coast market, where it competes with swordfish from around the world. Hawai'i's contribution is estimated to be less than 15 percent of this market. A reduction in the Hawai'i supply is likely to be quickly replaced with supplies from elsewhere. Since Hawai'i-based fishers have a minor role in the global swordfish market, declines in their contribution are unlikely to affect prices significantly. As a result, the loss of gross revenues to swordfish vessels from harvest decreases under the alternatives cannot be expected to be mitigated by a price rise.

Gross Revenue of Non-longline Hawai'i Fishing Vessels Under the FMP

Although gross revenues of the non-longline, Hawai'i-based U.S. fleet under the FMP are not directly restricted by the alternatives, they interact with both the longline fleet and exogenous fish supplies in much the same way as gross revenues of tuna vessels and swordfish vessels do. The direct effects on these vessels are not projected under the analysis of the alternatives. The indirect effects and the effects of exogenous factors on these vessels are discussed here.

Since the non-longline fleet is not directly restricted by the alternatives, their harvests will not be directly affected by the alternatives. Instead, these fleets will have an opportunity to fill some of the shortage in the local supply by the longline fleet. The non-longline vessels target primarily tuna, *mahimahi*, and *ono*, almost all of which is sold in the Hawai'i market. While tuna caught by the longline fleet tends to be of high quality, tuna from non-longline vessels tends to be of somewhat lower quality. The inability of these vessels to catch substantial quantities of high-quality tuna limits the ability of these fishers to fill the high-end tuna market, which is dominant in Hawai'i. Instead, imports should be expected to increase

in response to the decline in longline harvests, limiting the price effect that could induce greater revenues and greater activity in the non-longline fleet.

The non-longline fleets (trollers, handliners, and pole-and-line fishers) all currently target *mahimahi*, *ono* and other pelagic fisheries. The catch of these species by the non-longline fleet is generally preferred over the longline catch for its freshness. It is unlikely, however, that catch of these species by the non-longline fleet can be increased substantially to satisfy the demand that formerly was met by longline harvests. Imports also should be expected to increase in response to the decline in longline harvests, limiting the price effect that could induce greater activity in the non-longline fleet.

It is possible that a significant reduction in fresh fish entering the Hawai'i market as a result of closures in the longline fishery could have a significantly negative impact on local marketing chains and raise marketing costs, thereby reducing income to non-longline fishers through higher transaction costs.

Displaced Vessels from the Hawai'i-based Longline Fleet

The effects of the alternatives on the longline fleet differ primarily in the severity of restrictions on swordfish targeting. In the baseline alternative (Alternative 1) 119 vessels are projected to be active in the fleet, 74 tuna vessels and 45 swordfish vessels. The most restrictive alternatives (Alternatives 3, 5, 7, and 10) are projected to reduce the longline fleet to between 65 and 75 vessels, if vessels are not able to effectively switch target species. Less restrictive alternatives such as Alternatives 2 and 4 are projected to change the longline fleet size by less than ten vessels.

Vessels displaced from their Hawai'i base under the alternatives will be affected by several exogenous factors. Overly restrictive regulations in Hawai'i that severely constrain the ability of vessel owners to realize returns are likely to lead to these vessels relocating to less regulated areas. In response to the current regulations, some vessels active in Hawai'i have relocated to California during periods when the Hawai'i-based fisheries are closed. In 1999, when the current closure went into effect, the number of longline sets in California grew by more than 100 percent. The option to relocate to California is largely eliminated with the permit restrictions in the Preferred Alternative (Alternative 10), and it is likely that this option will be foreclosed if California adopts restrictions similar to those in Hawai'i, However, other relocations outside the United States and its territories are possible and may be undertaken either directly by vessel owners moving or indirectly by owners selling their vessels to fishers based elsewhere.

The nature of the Pacific pelagic fishery and pelagic fish themselves will contribute to the relocation of these vessels to less-regulated areas. Pelagic fish, by definition, migrate in the open ocean. The pelagic fish in waters fished by Hawai'i's fishers during one part of the year

could be in waters in the South Pacific off Asia or South America in another part of the year. These fish may or may not migrate back to Hawai'i's waters the following year. These yearly and seasonal migrations limit the effect of regulations that are applicable only to Hawai'i-based fishers since fishers from other areas will continue to have access to the same targets.

Migration related issues extend beyond the target species to the fishers themselves. Hawai'i-based fishers fish primarily in international waters, which are also fished by fishers of other nations. Fishers that are not based in Hawai'i, however, are not subject to the regulations of the FMP. Consequently, a strict regulation of Hawai'i-based fishers could result in their relocation to bases that are unregulated and therefore may not affect the level of effort in much of the area fished by Hawai'i-based fishers. Additional effort may come from a redistribution of effort throughout the Pacific fisheries, in which case new vessels could move into the waters fished by Hawai'i-based vessels prior to the regulation.

Numbers of Turtle Interactions

Reduction of turtle interactions is a primary objective of the alternatives. As with the other endogenous factors, the effectiveness of achieving this objective varies across the alternatives. Under Alternative 1, the baseline alternative, projected turtle mortality is 150 animals. The more effective alternatives in reducing turtle interactions, Alternatives 5, 7, and 10, reduce mortal interactions to approximately 11 to 37, depending on the number of vessels that are able switch target species and remain active. Other alternatives, such as Alternatives 2 and 4, have few measures to mitigate turtle interactions and consequently have a projected mortality of more than 100 animals.

The migratory nature of the turtles increases the influence of exogenous factors on the effects of the alternatives. Yearly and seasonal migrations of turtles throughout the Pacific complicate management and the ability of managers to achieve their objectives. To the extent that these species travel in and out of water fished by Hawai'i's fishers, regulations applicable only to those Hawai'i-based fishers may have limited effects. Turtles that are saved by limitations on Hawai'i-based fishers may migrate into waters outside the FMP where fishers from other jurisdictions are unregulated.

The nature of the pelagic fishery is likely to influence the impacts of the alternatives on turtle interactions. Swordfish vessels are known to travel particularly long distances to fish the best swordfish waters. Much of the Pacific, including the area fished by Hawai'i fishers, is open to fishers that are not subject to the regulations of the FMP. Consequently, turtle mortality in waters fished by Hawai'i's fishers could be unaffected by regulations if these fishers from elsewhere increase activity after regulations are put into effect. The inability to regulate all fishing effort in these waters raises questions as to the best manner in which to achieve objectives in regulating the Hawai'i fishery. The following discussion of the market served by Hawai'i-based fishers and other fishers that compete in those markets may clarify some of these issues.

The Hawai'i-based fleet is a small part of the total Pacific pelagic fleet and accounts for less than one percent of the total Pacific pelagic harvest (see Sections 3.12 and 3.13). Any shortfall in supplies of fish to the local Hawai'i market from the Hawai'i-based longline fleet is likely to be made up by an increase in imports through existing import channels. Exports of Hawai'i fish are a minor part of the total global market (including the swordfish supply to the U.S. East coast) and are likely to be quickly replaced by other supplies. Consequently, regulation of Hawai'i's fishers may not reduce total harvest of pelagic fish in the Pacific. The shortfall from Hawai'i's fishers failing to satisfy the local demand will likely be replaced by harvests from fishers based elsewhere. Some replacement supply may even be caught in the waters currently fished by the Hawai'i-based fleet. As fishers outside Hawai'i may not be well regulated, regulations designed to reduce turtle mortality could have the paradoxical effect of increasing turtle mortality.

Fishers that are not regulated may have no regard for turtles in their fishing methods. If Hawai'i-based fishers leave the market and are replaced by fishers who are from other areas and use techniques that do not minimize turtle mortality, the number of turtles killed could rise. This possibility does not suggest that the best alternative is to leave Hawai'i-based fishers unregulated. Minimizing turtle mortality in this case may be accomplished by maximizing the number of vessels subject to regulation. An effective regulation will increase the percentage of pelagic fish caught using turtle mortality reducing techniques, a more positive approach than simply adopting the strictest possible regulation to reduce turtle mortality by Hawai'i-based vessels to zero.

A related effect could arise through the reactions of vessels that are currently Hawai'i-based. In response to the current regulation, some of the vessels active in Hawai'i have relocated to California during periods when the Hawai'i-based fisheries are closed. Although Alternative 10 (the Preferred Alternative) effectively eliminates the possibility of operating in Hawai'i and in California during the same fishing year, Hawai'i-based swordfish vessels may still find suitable locations outside the U.S. or its territories from which to operate. This relocation could have the effect of maintaining the current level of turtle interactions. Even if vessel owners do not choose to relocate personally, it is possible that relocations will occur indirectly as owners sell their vessels to fishers based elsewhere. The current trend of vessel owners relocating to less regulated areas provides additional support for the conclusion that unilateral closures and severe regulations may be ineffective in reducing turtle interactions over large geographic areas.

Although turtle interactions by the Hawai'i-based fleet can easily be reduced, simply by eliminating the fishery, the actual reductions in turtle mortality may differ significantly from those under the model because of changes in the activities of other fleets in response to Hawai'i's regulations. For example, alternatives that substantially reduce harvests of Hawai'i-based vessels are likely to stimulate fishing by vessels based elsewhere that hope to take advantage of the decline in supply. The projected decline in gross revenues of Hawai'i-based

fishers under these alternatives is great, but actual turtle mortality may be largely unaffected, particularly if fishers from elsewhere take few steps to limit turtle mortality.

Compared to options that severely limit longline effort, alternatives that require the use of fishing methods that reduce turtle mortality may result in higher turtle mortality caused by Hawai'i-based longliners. These less restrictive alternatives, however, will leave more of Hawai'i's fishers active in the fishery and consequently stimulate less activity by fleets elsewhere that are not required to use fishing methods that reduce sea turtle mortality. Since more Hawai'i-based vessels are active in the fishery, the decline in gross revenues is likely to be less under these alternatives. Total turtle mortality may also be less since more of the fishing effort is conducted using turtle mortality reducing measures. Consequently, overall turtle mortality may be significantly lower under alternatives that attempt to alter fishing methods than under more restrictive measures that eliminate Hawai'i-based effort and therefore superficially appear more effective. Clearly, exogenous factors have large potential effects on both turtle interactions and mortality under the alternatives.

Numbers of Albatross Interactions

Albatross interactions are reduced substantially by all of the alternatives. The mortality under the baseline alternative, Alternative 1, is projected to be in excess of 2,000 birds. All of the alternatives reduce mortality to less than 500 birds. The most effective alternatives for reducing albatross mortality, Alternatives 5, 7, and 10, are projected to decrease mortality to less than 25 birds.

The influence of exogenous factors is largely the same for albatross interactions and turtle interactions. For purposes of this analysis, the most significant difference between seabirds and turtles is the relative abundance of seabirds. Seabird interactions are far more common than turtle interactions under all of the alternatives. As a result, the impact of exogenous factors that are likely to mute the effect of regulations to reduce turtle interactions will have a greater effect on seabird interactions. Consequently, regulations that increase catch by unregulated fishers (either through displaced vessels from Hawai'i relocating to other areas or simply through vessels from other areas taking advantage of a market opportunity) may have the unexpected effect of increasing albatross interactions.

4.11.16 Cumulative Effects of the Alternatives – Economic Impacts

The possible responses of both Hawai'i-based fishers and fishers in other areas suggest that care should be taken in setting regulations. The best path to minimizing turtle and seabird mortality may be to maximize the percent of total pelagic catch by well regulated vessels. Some reduction in catch may occur with increased regulation, but a goal of maintaining a well-regulated operating fleet in Hawai'i may minimize turtle and seabird mortality. In time, other areas may move to have similar regulations. For example, California is likely to follow

Hawai'i's lead, particularly if vessels from Hawai'i relocate to California to avoid regulation. A change in California's regulations, however, will not affect fleets based outside the U.S. that are likely to expand and increase catch in the face of a reduction in catch by U.S.-based vessels. Until other countries adopt regulations similar to those of the Hawai'i-based fleet, regulations that remove vessels from the fleet appear to be a relatively ineffective tool for limiting the global mortality of turtles and seabirds. The result will be simply to transfer the fish harvests (and consequently turtle and seabird interactions) to fisheries that are not required to use fishing methods that reduce sea turtle mortality.

Table 4.11-5 at the end of this chapter summarizes the direct and indirect effects and the cumulative effects on each endogenous variable under each of the alternatives. Direct and indirect effects do not include the effects of any exogenous variables. The cumulative effects on an endogenous variable are the final outcome of all effects on that variable under the alternative, including direct and indirect effects, as well as the effects of the exogenous variables. Outcomes that are projected to result in a change of the endogenous variable by more than 15 percent from the baseline case of Alternative 1 are considered significant. Outcomes that are projected to deviate from the baseline case by more than 50 percent are considered to be significant and "very" positive or negative, as the case may be. The comments beneath the reported change in each endogenous variable provide a brief explanation of the effects operating on that variable. In the cumulative effects line for each endogenous variable, the comments report the effects of exogenous variables on the endogenous variable.

4.11.17 Exogenous Factors – Social Impacts

Two major exogenous factors were identified as having the potential to contribute to cumulative social impacts.

- Fishermen's options for switching fisheries or relocating effort
- Economic climate

Options for Switching or Relocation

Increasingly restrictive regulatory environments and escalating compliance costs were major factors in the relocation of longline vessels from the Gulf of Mexico and Atlantic to Hawai'i in the late 1980s and early 1990s (Travis 1999). Since that time, longline operations in Hawai'i have become similarly constrained by the implementation of a limited access program, area closures and other regulations. New areas that these vessels could move to without encountering significant regulatory or economic obstacles are limited. Some swordfish vessels displaced from the Hawai'i fishery by the emergency closures have shifted to California. At this time, there is no federal management plan in place for the California longline fishery, but a FMP is currently being developed by the Pacific Council. Already state

regulations prohibit the use of longline gear in the EEZ off Washington and California for vessels respectively registered. Some fishers may opt to shift to Atlantic or Gulf of Mexico fisheries, but acquiring access to these fisheries may be difficult due to license limitation programs.

Relocating to other island areas in the Western Pacific Region is also an option for longline vessels displaced from the Hawai'i-based fishery, but these areas also have existing (or proposed) longline fishing regulations as well as logistical problems that could render the costs of longline fishing prohibitively high. In American Samoa, for example, longline vessels harvesting tuna or swordfish for the fresh fish market would have to overcome obstacles such as limited shoreside ice and cold storage facilities and infrequent and expensive air transportation links.

Regulatory changes in non-pelagic fisheries have also had a negative impact on some participants in the Hawai'i-based longline fishery. In 2000, for example, the establishment of the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve adversely affected the seven Hawai'i-based longline vessels that have permits for the NWHI lobster fishery. Commercial fishing within the Reserve is restricted. For commercial fishing activities other than bottomfish fishing the annual aggregate level of take allowed in the Reserve can not exceed the aggregate level under all permits in the year preceding December 4, 2000. This restriction effectively prohibits the commercial harvest of lobster in the Reserve, as the lobster fishery was not active anywhere in the NWHI during that period due to an emergency action taken by NMFS (65 FR 39314, June 26, 2000). All of the commercial lobster fishing in the NWHI has historically occurred in waters that are now within the Reserve. The impact of the loss of the NWHI lobster fishery on the annual fishing operations and income of the longline vessels that participated in the fishery is substantial. The lobster fishery occurred during a comparatively slow season for longline fishing activities (65 FR 39314, June 26, 2000). The importance of the lobster fishery to the longline vessels may have been roughly equal to 25 percent to 33 percent (three to four months) of their annual gross revenues (65 FR 39314, June 26, 2000).

The possibilities for switching fisheries or relocating fishing effort have major significance for cumulative social effects.

Economic Climate

The economies of the island areas in the Western Pacific Region could be seriously affected by numerous factors exogenous to pelagic fisheries, including changes in regional tourism patterns and government spending. With the exception of American Samoa, commercial fishing in general plays a minor economic role in these island areas. Tourism is the most important industry in Hawai'i, Guam, and the Commonwealth of the Northern Mariana Islands. This industry is stagnant in Guam and the CNMI. Hawai'i's tourist industry appears to be recovering after a sharp decline in Asian visitors during the 1990s. However, a listless

overall state economy continues to hamper the ability of Hawai'i fishers to adapt to regulatory changes by supplementing fishing incomes with shore-based employment. Labor market opportunities in construction and other economic sectors where Hawai'i fishers have found employment in the past have not yet recovered to pre-1990 levels. Changes in the level of government-related activities, such as federally-funded capital works projects or defense spending, also have a dramatic effect on economic conditions in the island areas. The economy of American Samoa is especially dependent on federal assistance.

The possibilities for switching fisheries or relocating fishing effort have major significance for cumulative social effects.

4.11.18 Cumulative Effects of the Alternatives – Social Impacts

The cumulative effects of each EIS alternative are analyzed by combining (a) the direct effects of each alternative and (b) the indirect effects of each alternative with (c) the effects of exogenous factors, as modified by (b). The (a) direct and (b) indirect effects of the EIS alternatives on pelagic fish resources are summarized in Table 4.11-5 at the end of this chapter.

Management regime changes in U.S. fisheries could either mitigate or magnify the effects of alternatives that close off large areas to longline fishing year round and/or require a significant change in fishing practices (Alternatives 3, 5, 6, 7 and 10) or that completely prohibit longline fishing in the Western Pacific Region (Alternative 8). It is likely that fishery management regimes will become more rather than less restrictive. Therefore, these regulatory changes will have a significant negative cumulative effect on participants in the Hawai'i longline fishery by further reducing their opportunities to shift to other fisheries.

The condition of island and regional economies could improve or worsen the effects of Alternatives 3-8 and 10. Should employment opportunities expand, displaced fishermen could possibly find new jobs. Should employment opportunities decrease, they will have more difficulty in finding new livelihoods. Therefore, the cumulative social effects associated with these economic variables may or may not be significant in a positive or negative direction.

Given the minimal direct social impacts of Alternatives 1, 2, 4, and 9, there would be no significant cumulative effects with these alternatives. This assessment of cumulative social effects is summarized in Table 4.11-5 at the end of the chapter.

4.11.19 Exogenous Factors – Seafood Markets and Consumers

Exogenous factors include:

- the market demand for fishery products
- currency exchange rates
- alternative sources of the same pelagic fish species
- seafood product substitution

Market Demand

The present and projected market demand for fresh high quality pelagic fishery products is an example of an exogenous factor. All pelagic fisheries under the Pelagics FMP in the western Pacific are focused primarily on the production of fresh, high quality and higher value seafood. There are currently no incentives to produce for the lower quality and lower value frozen seafood market with the exception of the small-boat longline fleet in American Samoa that produces albacore for the cannery market. Returns from frozen albacore sales to the canneries in American Samoa outweigh the incentives to ship fresh albacore by costly airfreight to distant markets. The Japanese market for fresh high quality tuna is believed to have peaked with little expectation for significant expansion. Meanwhile the fresh tuna market in the United States and to some extent, in Europe is expanding as consumers are offered increasing amounts of fresher higher quality tuna products from multiple international sources. The major market for fresh high quality swordfish is the U.S. seafood market. The price premium placed on fresh swordfish over frozen fish in the U.S. market persists as a strong incentive for domestic and international fleets to concentrate on producing fresh and not frozen swordfish.

The large and growing market for shark fins in Asia will continue to be supplied by diverse western Pacific fisheries in the short term without disruption. Increasing demand for shark fins during the early 1990s was correlated with rising incomes in Asia, particularly in the Peoples Republic of China (NMFS, 2000) and the market has strengthened with rebounding Asian economies. An International Plan of Action for the Conservation and Management of Sharks was adopted at the November 1999 FAO Conference. Implementation of this plan could restrict the global supply of shark fins to Asia. The principal markets for dried, unprocessed shark fins from primarily blue sharks caught in Hawai‘i are in Hong Kong and China where fins are further processed into the finished products. The processed shark fins available in the United States are imported from Hong Kong although the origin of the dried unprocessed fins may be multiple sources around the world including the Hawai‘i fishery.

Currency Exchange Rates

Currency exchange rates are another form of important exogenous factor affecting the market for pelagic fisheries products. In the foreseeable future, with the strong U.S. dollar

and Japanese yen, there will be added incentive to export fresh pelagic fish to Japan and the U.S. market. However, the weaker European Union Euro has not provided incentives to greatly increase shipments from U.S. ports to the European market since the currency was adopted.

Alternative Sources of Pelagic Fish Species

Alternative sources and product forms of pelagic fish species would be expected to fill part of the void in the supply created by reduced production of fresh Hawai'i pelagic fish resulting from management alternatives. The fresh swordfish supply available in the U.S. market is from domestic fisheries including the Hawai'i-based fisheries and imports from numerous countries fishing in the Pacific, Atlantic and Indian Oceans. The U.S. swordfish market is also supplied by numerous sources of frozen loins and steaks, however there is a price premium paid for fresh swordfish over frozen. Discriminating consumers that drive the market for fresh swordfish will continue to demand high quality fresh swordfish, independent of management actions in the Western Pacific Region. Should management actions result in a decrease in swordfish production from Hawai'i, imported fresh swordfish will likely replace any supply deficit.

Some of the fresh tuna supply deficit might be overcome with the increased importation and consumption of alternative product forms of frozen tuna treated with carbon monoxide. In recent years, processors in the Philippines, Taiwan and Indonesia have been processing raw tuna with carbon monoxide gas (and highly filtered wood smoke). This process is performed prior to freezing to impart an unnaturally bright cherry red color to the muscle similar but not identical to that of natural, high quality fresh tuna. The treated tuna products are being used in some markets in Hawai'i and the continental United States to substitute for genuine high quality fresh tuna. As Hawai'i's supply of fresh longline-caught tuna declines and the price of available supply increases, there will be increased incentive to substitute fresh tuna with frozen carbon monoxide or filtered smoke treated tuna. The primary active ingredient in filtered smoke is carbon monoxide. These treated frozen products are highly controversial in that carbon monoxide is not an approved food additive in the United States and treated products can be considered adulterated. Filtered smoke processing adds carbon monoxide to tuna, but these treated products are being imported into the U.S. market in increasing amounts.

Proponents of the filtered smoke process claim that the process should be considered safe simply because it is a component of wood smoke, a GRAS (generally regarded as safe) substance for treating tuna (HIS, 1999). The FDA has chosen not to challenge the company's claim that filtered smoke is GRAS at this time, but warns that tuna cannot be adulterated (color enhanced) or mislabeled (FDA, 2000). Consumers may be exposed to economic fraud if the products are misrepresented (mislabeled and/or color enhanced) as fresh tuna. Restaurants and retailers in Hawai'i and the U.S. mainland are known to neglect proper disclosure of the treated and frozen tuna products. There are also concerns regarding the

exposure of consumers to increased health risks because carbon monoxide treated tuna has an unnaturally red color that is unusually color stable (red color does not degrade at normal rate). This eliminates the effectiveness of practical indicators (off-color and off-odor) used by consumers to judge tuna product quality, decomposition (spoilage) and relative food safety (histamine poisoning and growing concerns about *Listeria monocytogenes*). Although the GRAS notification filed with FDA is limited to tuna treated with filtered smoke, frozen swordfish, *mahimahi* and tilapia fillets and steaks are also being treated and imported into the U.S. market.

Seafood Product Substitution

Seafood product substitution is another potential factor exogenous to the western Pacific fisheries under the management of the Pelagics FMP. This can be in the form of substituting alternative product sources or forms of the pelagic market species by other types of non-pelagic fishery products. For example, should the production of fresh domestic Hawai'i-caught swordfish decline significantly and the market price increase, consumers may switch from swordfish to farm raised Atlantic salmon or other fish such as halibut. Fresh swordfish and more recently fresh tuna have emerged as the premier steak fish in the U.S. market. This is because of the special product qualities (size of fish, large fillets without bones, meat-like qualities and consumer acceptance as steak fish for seafood grills). For these reasons, substitution of these premium steak fish with other fish will be incomplete and the market and discriminating consumer will go without Hawai'i-caught fish. Should management actions reduce the availability of fresh swordfish and tuna and the market price increase, consumers may also respond by switching back to eating beef products on the grill. As this occurs, consumers who have been encouraged to include seafood in their diet to reduce intake of saturated fat for health reasons, may be placed at increased risk of obesity and heart disease, both significantly impacting public health.

Shark fins used in shark fin soup are collected and processed from many different species of sharks. The majority of shark fins harvested in Hawai'i are from blue sharks. The shark fin market for dried unprocessed and fully processed fins is diversified by shark species and the size of the fin. The market is primarily in Hong Kong for the unprocessed and processed fins. Other species of shark fins produced by unregulated fleets could be substituted for blue shark fins with little impact on the consumer or market for the finished product. The Hawai'i market for dried unprocessed fins would not be able to substitute fins from blue sharks for any other species. However, the Hawai'i market and consumers of processed fins would be unaffected.

4.11.20 Cumulative Effects – Seafood Markets and Consumers.

The cumulative market effects of the EIS alternatives are complex. They are related primarily to the highly differentiated nature of the fisheries products, market niches and consumer uses of fresh tuna and swordfish on an international scale. Compounding the

cumulative effects are the availability of alternative sources of supply, the substitutability of these products and the marine resource effects of harvesting substitute products from alternative source areas. Some effects would be immediate (days to months), whereas others would be near-term (months to years) and long-term (years to decades).

Transferred effects are indirect effects that may occur outside of the managed area as a result of management actions within the managed area. Adverse transferred effects may occur as a result of management actions intended to reduce adverse impacts on protected or managed species in a discrete fishery, but actually promote and increase the adverse impacts on other populations of the integrated resource system. Transferred effects may affect the ultimate balance of environmental impacts, unintentionally driving the system in the opposite direction from the intent of the management measures when taken and evaluated in isolation. Beneficial transferred effects may also occur. For example, gear innovations and management approaches demonstrated to be effective in one fishery, might be transferred to another fishery and help to promote appropriate management of that resource.

Effects on the seafood market are divided into the (1) swordfish, (2) tuna and associated pelagic species and finally (3) shark fins.

4.11.20.1 Effects on Swordfish Markets and Consumers

Alternatives that significantly reduce swordfish landings by the Hawai'i-based longline fishery will have profound effects on the swordfish marketing system linking producers with wholesalers, retailers and ultimately the consumers. The majority of Hawai'i swordfish production is marketed on the U.S. mainland, so that these markets and consumers would be impacted. Locally, the Hawai'i auction, wholesaling, brokering and distribution system would be impacted. Hawai'i production of fresh swordfish is a significant portion of the domestic supply of high-end fresh swordfish in the U.S. market. The immediate impact on customers that pay a premium for fresh domestic swordfish is that their demand will not be met and the prices of available fresh swordfish caught by U.S. fisheries may increase.

In the near-term, fishing operations in other swordfish producing countries with reliable air links (ex. Uruguay, Brazil, Chile, Australia and other Pacific Islands) may increase fishing effort and exports of fresh swordfish to meet the U.S. demand. In the long-term, Taiwanese and Korean fleets may also adjust fishing operations to take advantage of the change in fresh swordfish supply and demand in the U.S. market. These fleets have proven to be highly adaptive and may respond to incentives to shift from producing frozen to fresh products that can be shipped from outside of the U.S. EEZ into U.S. ports by U.S. carriers. The trade deficit associated with swordfish estimated to be $82 million in 1998 could be increased by any reduction in the swordfish production in Hawai'i (NMFS, http://www.st.nmfs.gov/st1/trade/trade_balance_allcntrys.html).

Management alternatives that reduce the production of swordfish by the Hawai'i-based longline fishery will have adverse transferred market effects. These will result as the swordfish production and supply system adjusts to the reduction in Hawai'i swordfish landings. The U.S. mainland is the principal market for Hawai'i swordfish. The adverse transferred effects related to the restriction of Hawai'i swordfish production are a potential result of shifts of domestic fishing effort as vessels redirect effort to less restricted fishing grounds. Adverse transferred effects can also result as the market shifts from a declining domestic supply to an increased reliance on imported swordfish supplies from areas with unknown protected species monitoring and management efforts.

Beneficial transferred effects might occur should displaced Hawai'i-based longliners relocate to better managed fisheries with lower rates of anticipated adverse impacts on protected species. Beneficial transferred effects might occur should swordfish be imported to replace Hawai'i swordfish in the market from countries or fisheries that have lower adverse impacts. However, beneficial transferred effects are not likely.

The U.S. mainland market, particularly in the North Atlantic region, is a major consumer of fresh and frozen swordfish. Swordfish supplied to the higher-priced fresh sector of the market can come from several sources. Domestic suppliers include the North Atlantic and Hawai'i fisheries. Countries exporting fresh swordfish to the U.S. market are fishing North Atlantic, South Atlantic, South Pacific and Mediterranean swordfish stocks.

When North Atlantic swordfish management caused a reduction in the supply from the U.S. fishery, there was a supply response from swordfish producers outside of the management area (Thunberg and Seale, 1992). Part of the response in the late 1980s was a redirection of fishing effort to Hawai'i that resulted in the rapid expansion of the North Pacific domestic longline fishery for fresh swordfish. In this case, management action in the Atlantic fishery transferred adverse effects to Pacific sea turtle populations as the displaced fishing effort relocated to the western Pacific. Most of the swordfish production in Hawai'i was and continues to be shipped by air cargo to the North Atlantic states.

It is unlikely that reduced Hawai'i swordfish production will be replaced by domestic production. Management actions that restrict or eliminate access for Hawai'i swordfish vessels may drive some of the fleet to redirect effort on swordfish populations outside of the managed area. Some may relocate and fish in other domestic fisheries or move outside of the country to fisheries that do not share the same management requirements (limited entry, catch reporting, observer coverage, gear and area restrictions and concerns for adverse impacts on protected and non-targeted species) with the western Pacific fisheries managed under the Pelagics FMP.

Any void in domestic fresh swordfish supply is more likely to be filled by exporting countries. The U.S. imported fresh swordfish from many different countries with the top six countries

in 1999 being Brazil, Chile, South Africa, Australia, Mexico and Uruguay (NMFS, http://www.st.nmfs.gov/st1/trade/tradeprdctentry.html). A myriad of market-driven transferred effects occur on target, non-target and protected species. Comprehensive coverage of the full scope of transferred effects on protected species is hampered by the relative lack of accurate fisheries statistics, observer coverage and measures provided for protected species by international fleets. The Hawai'i pelagic fisheries managed under the Pelagics FMP are a notable exception in that the fishery has observer coverage and fishery statistics are available. However, it is important to attempt to gain an appreciation for the potential magnitude of market-driven adverse transferred effects where possible. Although fisheries data from some of the important exporting countries may be limited, what is available offers a glimpse of the potential significance of the transferred effects of product substitution. The following sections consider the possible impacts on sea turtles associated with replacing Hawai'i swordfish with fish from just a few of the leading fisheries exporting fresh swordfish to the U.S. market.

Uruguay

Based on observer records of 99 longline sets made between 1994 and 1995, the Uruguay swordfish longline fishery in the southern Atlantic may take 5.36 leatherbacks per 10,000 hooks and 10.72 loggerheads per 10,000 hooks (Weidner *et al.*, 1999). Mortality estimates are not available. Swordfish CPUE is estimated to be from 13.3 mt to 20.0 mt swordfish per 10,000 hooks. Using this information, there may be from 0.26 to 0.40 leatherbacks taken per mt of swordfish produced. There may be as many as 0.53 to 0.80 loggerhead turtles taken per mt of swordfish produced.

By comparison, the Hawai'i-based longline fishery is estimated to result in 0.10 leatherback takes per 10,000 hooks and 0.36 loggerhead takes per 10,000 hooks (NMFS, 2000). The CPUE during the 1999 directed swordfish fishery in Hawai'i was estimated to be 14.6 swordfish per 1,000 hooks with an average weight of swordfish of 57.2 kg (WPRFMC, 2000). This converts to an estimate of 8.3 mt of swordfish per 10,000 hooks. Using this information, each mt of Hawai'i-caught swordfish may be associated with 0.012 leatherback takes and 0.043 loggerhead takes.

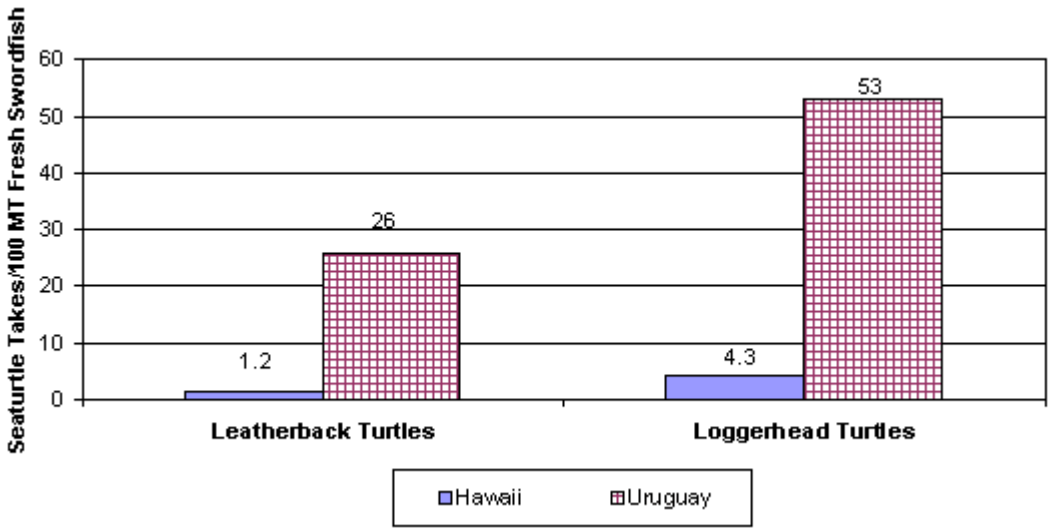
The potential difference in magnitude of the adverse transferred effects can be calculated by dividing the estimated number of sea turtle takes per mt of Uruguay swordfish with the number of estimated turtle takes per mt of Hawai'i swordfish (Table 4.11-1). The adverse transferred effect on sea turtles associated with each mt of Hawai'i swordfish replaced by swordfish from Uruguay might be expected to result in 21 to 33 times more leatherback takes per mt of swordfish. Each mt of Uruguay swordfish may be associated with 12 to 18 times more loggerhead turtle takes than predicted for swordfish from the Hawai'i-based longline fishery.

Table 4.11-1: Comparison of Adverse Impacts of the Uruguay and Hawai'i Swordfish Fisheries on Sea Turtles.

Fishery	Leatherback Turtles		Loggerhead Turtles	
	Takes per mt swordfish	mt swordfish per take	Takes per mt swordfish	mt swordfish per take
Uruguay	0.26-0.4 takes	3.85-2.5 mt	0.53-0.80 takes	1.89-1.25 mt
Hawai'i	0.012 takes	83.33 mt	0.043 takes	23.25 mt
Relative difference in rate	Uruguay 21.6x greater adverse impact per mt swordfish		Uruguay 12.3x greater adverse impact per mt swordfish	

To put this into perspective, each 100 mt of Hawai'i caught swordfish is predicted to result in the take of 1.2 leatherback takes. Substitution by imported swordfish from Uruguay would be expected to result in 26 leatherback takes (Figure 4.11-2). Similarly, for the same 100 mt of swordfish substituted into the market, Hawai'i swordfish would be associated with 4.3 loggerhead takes and be exchanged for 53 loggerhead takes caused in the production of Uruguay swordfish.

Figure 4.11-2: Potential Magnitude of Market Driven Transferred Effects on Sea Turtles Resulting from Substituting Swordfish Imported from Uruguay for Hawai'i-caught Swordfish in the U.S. Market.



Brazil

The best current evidence from Brazil's swordfish fishery in the southern Atlantic is based on extremely low numbers of observed trips. Observer data do not distinguish sea turtle

takes by species. However, the limited observer data available indicate that longliners operating in Brazil may take as many as 116 sea turtles resulting in 16 mortalities per 10,000 hooks (Weidner and Arocha, 1999). The CPUE for the Brazilian longline fishery is estimated to be five metric tonnes swordfish per 10,000 hooks (Weidner and Arocha, 1999). Using these values it is estimated that the Brazilian swordfish longline fishery may take as many as 23.2 sea turtles and result in 3.2 sea turtle mortalities per mt of swordfish produced.

By comparison, the Hawai'i-based longline fishery is estimated to result in 0.596 sea turtle takes and 0.028 sea turtle mortalities per 10,000 hooks based on observer data between 1994 and 1999 (NMFS, 2000). Using the CPUE of 8.3 mt swordfish per 10,000 hooks, it is estimated that the Hawai'i swordfish fishery may result in 0.071 sea turtle takes per mt of swordfish produced and 0.0033 sea turtle mortalities per mt of swordfish.

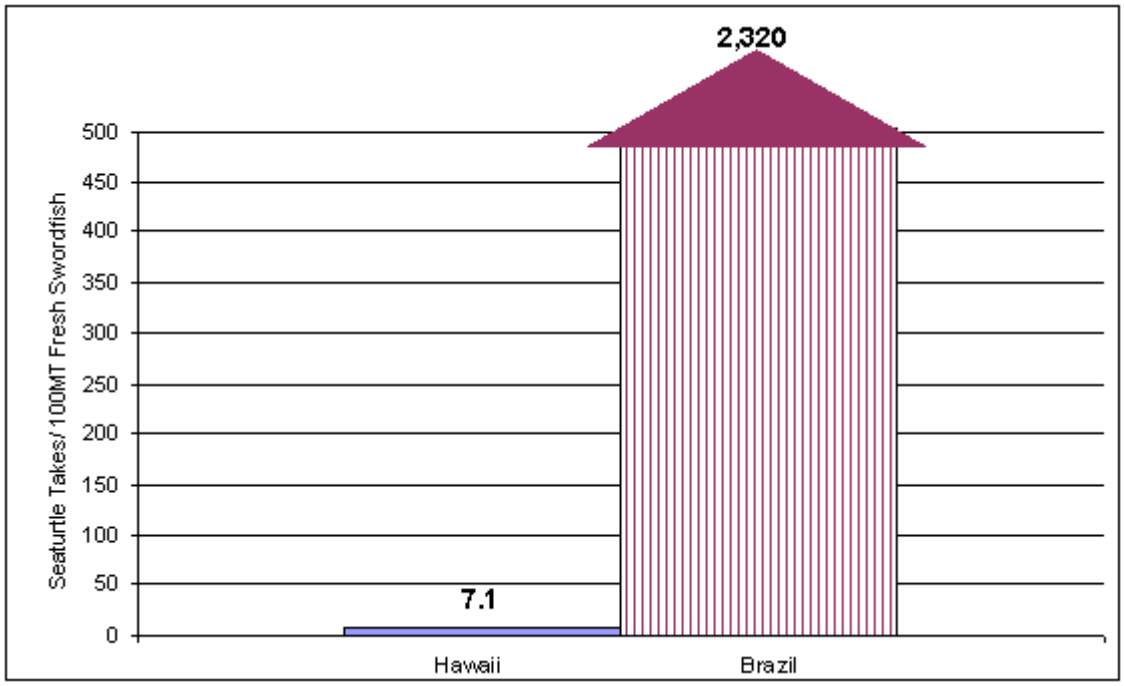
The magnitude of adverse transferred effects on sea turtles associated with each mt of Hawai'i swordfish displaced from the market that is substituted with fish from Brazil may be as high as 325 times more sea turtle takes and over 950 times more sea turtle mortalities per mt of swordfish (Table 4.11-2). Clearly, the substitution of each mt of Hawai'i-caught swordfish by swordfish from Brazil's fishery could represent an unintentional and yet significant adverse impact on sea turtles.

Table 4.11-2: Comparison of Adverse Impacts of the Brazil and Hawai'i Swordfish Fisheries on Sea Turtles.

Fishery	Sea Turtle Takes		Sea Turtle Mortalities	
	Takes per mt swordfish	mt swordfish per take	Mortalities per mt swordfish	mt swordfish per mortality
Brazil	23.2 takes	0.043 mt	3.2 mortalities	0.31 mt
Hawai'i	0.071takes	14.08 mt	0.0033 takes	303 mt
Relative difference in rate	Brazil 326x greater adverse impact per mt swordfish		Brazil 969x greater adverse impact per mt swordfish	

Each 100 mt of Hawai'i-caught swordfish is predicted to result in 7.1 sea turtle takes and if replaced with swordfish from Brazil, could increase the adverse impacts on sea turtles to 2,320 takes for the same amount of swordfish sold in the U.S. market (Figure 4.11-3).

Figure 4.11-3: Potential Magnitude of Market Driven Transferred Effects on Sea Turtles Resulting from Substituting Swordfish Imported from Brazil for Hawai'i-caught Swordfish in the U.S. Market.



Chile

The magnitude of the Chilean swordfish fishery in the eastern Pacific impacts on sea turtles in the eastern Pacific is unknown and fisheries data are limited. However, the potential significance of adverse impacts on sea turtles may be great as described in detail in Section 4.11.4, describing the cumulative impacts on sea turtles. With a large commercial and artisanal swordfish fishery in Chile using longline and driftnet gear, the adverse impacts on sea turtles may be significant. Evidence exists that links sea turtles (including leatherbacks and loggerheads) caught in Chile, with nesting populations of turtles in Mexico and Costa Rica. Although estimates of the numbers of sea turtle takes and mortalities per mt of swordfish produced could not be made with the limited data available, the potential for significant adverse transferred market effects exist and may result from substituting Hawai'i-caught swordfish with fish from Chile.

Mexico

The potential transferred market effects arising from the substitution of Hawai'i swordfish with fish caught in Mexico may also be significant. Fisheries data including information on

incidental takes and mortalities of sea turtles related to the swordfish fishery are not available. Mexico's swordfish fishery in the eastern Pacific by domestic or foreign vessels (potentially including displaced Hawai'i-based longliners) represents another significant source of adverse transferred effects on sea turtles. The swordfish fishery in Mexico deserves close scrutiny in that adverse transferred effects on sea turtles may occur as a result of management alternatives applied in the Western Pacific Region. Alternatives that result in the displacement or relocation of Hawai'i-based fishing vessels to fishing grounds in the eastern Pacific off Mexico may unintentionally compound adverse impacts on those sea turtle populations. The market substitution of swordfish caught by Mexican vessels for swordfish produced in the Hawai'i-based fishery may carry with it a significant adverse impact on sea turtles greatly exceeding the impacts of the Hawai'i fishery.

These are some of the market-driven transferred effects that could be the unintentional result of management efforts to mitigate the adverse effects of the Hawai'i-based longline fishery directed on swordfish. The transferred effects must be given consideration in determining the ultimate cumulative effect of management action. Although the adverse transferred effects may impact sea turtle populations distinct from those caught in the Western Pacific Region, they can be significant in the global effort to recover and sustain sea turtle populations. Each fishery has its own unique degree of impacts that can be used to compare different sources of the same species of fish on a ton for ton basis. Again, the Hawai'i-based fishery and the Western Pacific Region should not be viewed and managed in isolation. The interconnectedness and adaptive nature of the market and supply along with the mobility of the fishing effort are critical considerations. The ecosystem and precautionary management principles require that market-driven transferred effects be understood and anticipated.

4.11.10.2 Effects on Tuna Markets and Consumers

Alternatives that are likely to result in a significant reduction in the supply of fresh Hawai'i-based longline-caught tuna would cause immediate and potentially substantial increases in the price of all fresh fish products in the state, especially tuna products (*poke*, *sashimi*). The Hawai'i-based longline fleet is the principal producer of the fresh tuna and other pelagic fish to the Hawai'i market.

Any substantial reduction in the fresh fish supply would tend to drive prices higher as Hawai'i wholesalers, retailers, institutional buyers and others compete to fulfill contractual commitments and meet the market demand. Spot market demands in this situation might be partially unfulfilled. This situation could translate into continued purchasing by high-value product users (e.g., high-end *sashimi*), possibly via imports, but a potentially significant interruption in pelagic fish products for the middle and lower socio-economic strata of Hawai'i (NMFS SWFSC-HL, 2000a).

Some yellowfin tuna (from local troll and handline fishers) and small bigeye tuna (from local

handline fishers fishing offshore) would still be available from Hawai'i small boats. It is likely that effort by these vessels would increase in response to the reduced supply of longline-caught fish and the increased market prices. Nevertheless, landings by the small-boat fleet are unlikely to satisfy more than half of the normal market demand for pelagic fresh fish products, the portion for which spot market opportunities exist. Unfortunately the quality and shelf life of the fresh tuna (bigeye and yellowfin) produced by these small-boat fleets does not generally meet the standards achieved by the longline vessels. For this reason, the increase in fresh tuna production by the small-boat fleets would be able to replace some, but not the entire deficit of the longline-caught fish. Fresh tuna from the small boat fleets do not currently compete well with fish produced by the Hawai'i-based longline fleet in the Hawai'i market or the distant markets in the United States or Japan. This is especially true for the higher quality and higher priced grades of both yellowfin and bigeye tuna.

In contrast, troll-caught *mahimahi*, wahoo and marlins receive a price premium because they are routinely of higher quality than fish delivered by longliners. Unfortunately, the production capacity of the trolling fleet is limited by the size of the boats, in terms of vessel range and ability to operate safely in rough seas, especially in the winter season. It is unlikely that the Hawai'i trollers would be able to increase production to replace the volume of these important pelagic market fish lost by reduced production by the Hawai'i-based longline fishery. Prices for these fish would be expected to rise and increase the incentive for small boats to increase effort and take greater risks to take advantage of the market opportunity.

Resulting shortages of fresh fish would be especially acute during the holiday period (Christmas and New Year) when demand and prices for tuna and other fish species are at a seasonal high. During this time of year, the seasonal drop in tuna abundance nearshore causes a decline in catch rates of yellowfin tuna by the Hawai'i small-boat fleets. Rough ocean conditions experienced during the winter season in Hawai'i could hinder attempts by small-boat tuna fisheries to make a more substantial substitution for lost longline production (NMFS SWFSC-HL, 2000a). This would tend to stimulate further importing of fresh tuna from outside of Hawai'i.

A complete closure of the Hawai'i-based longline fishery would result in the immediate and complete cessation of fresh tuna exports (primarily bigeye tuna) to the high-end markets in Japan. Well-established, long-term marketing links between Hawai'i suppliers and Japan marketers are highly sensitive interpersonal and economic relationships. Any disruption in the supply to Japan, even for short periods could destroy the reputation of Hawai'i suppliers and the confidence of Japanese buyers. The Japanese market has many alternative sources for importing fresh tuna. Quick adjustments in the supply channels are anticipated at the expense of Hawai'i's export firms.

The availability of fresh tuna and associated species could become "feast or famine." Seafood marketers and consumers may enjoy lower tuna prices during times when the fishery is open and higher prices during the closed seasons.

Over time, Hawai'i wholesalers would locate alternate sources of fresh tuna to replace the loss of domestic longline supply. These would likely be foreign sources with reliable and affordable air transportation links to Hawai'i. There are a number of Pacific basin countries currently producing and exporting fresh tuna to Hawai'i's seafood market, including Indonesia, the Philippines, Fiji, Federated States of Micronesia, Samoa and Tahiti. Demand in Hawai'i for imported fresh tuna could be sufficient to create incentives in some producing areas to invest in additional harvesting capacity and expand longline fishing effort.

A reduction or elimination of the Hawai'i supply of fresh tuna and associated pelagic fish species to the U.S. mainland market would also create an opportunity for foreign suppliers. Fresh tuna imports (in particular yellowfin tuna) from the Philippines, Vietnam, Indonesia, Fiji, Trinidad and other countries could theoretically expand to fill increased demand. The Taiwanese fleet operating longline vessels in the vicinity of the Hawai'i-based longline fleet might be expected to shift to producing fresh tuna and expand efforts to transship to the U.S. market via air links or by ocean carriers. The $47 million U.S. trade deficit for fresh yellowfin tuna (NMFS, http://www.st.nmfs.gov/st1/trade/trade_balance_allcntrys.html) could grow as a result of alternatives that result in closure or reducing the effort of the Hawai'i-based longline fleet.

The reason for relative price stability in the Hawai'i-based longline fishery is the interconnection between the Hawai'i and Los Angeles markets for fresh tuna. When there is short-term oversupply in Hawai'i, Los Angeles marketers may need product and this maintains relative stability. If Hawai'i loses its reputation for a steady supply of fresh tuna, Los Angeles buyers will come to depend on other sources and the connection between the two markets will weaken. This will create greater instability in market prices in Hawai'i. As other sources increase their market share in Los Angeles and, depending on the perceptions of U.S. mainland tuna buyers of Hawai'i's reliability as a supplier, Hawai'i products could be largely displaced from mainland United States and other export markets.

Fresh skipjack tuna is a substitute for yellowfin and bigeye tuna in raw fish preparations consumed in Hawai'i. A reduction in the supply of longline-caught tuna would create an economic incentive to increase production in the local pole-and-line fishery for skipjack tuna. This fishery presently comprises only five vessels but at one time (1950s-1970s), pole-and-line skipjack (*aku*) boats supplied the vast majority of the local demand for fresh tuna.

A variety of pelagic species, such as albacore, marlins, spearfish, *mahimahi*, *ono*, moonfish, mako shark, thresher shark and pomfret, that are harvested incidentally in the Hawai'i-based longline fishery provide fresh fish for white tablecloth restaurants and some are featured in signature dishes created as part of efforts to promote Hawai'i regional seafood cuisine. Marlin is a particularly important product for island fish markets and fishmongers who supply raw fish for residents on the lower end of the economic spectrum. Such consumers may be especially affected by potentially significant price increases (NMFS, 2000a).

As with the swordfish supply and market, reduced production of tuna and associated species by the Hawai'i-based longline fishery can have adverse transferred effects that would occur in two ways. Hawai'i-based vessels could relocate to other areas to fish, or fish from those areas caught by other fleets could be imported to substitute for Hawai'i production decreases. Adverse transferred effects could offset the beneficial effects that were intended by displacing longline fishing effort from the Hawai'i fishery. The significance of the transferred effects is greatly dependent on where and how new longline fishing effort is conducted as well as the transferred effects associated with the source of the tuna replacing Hawai'i production.

There is a high probability that the existing Hawai'i-based longline fishing effort would be relocated to pelagic fishery resources outside of the Western Pacific Region management area, where markets have not developed for non-target species that are valuable in the Hawai'i market. This may result in increased amounts of economic discards by the displaced Hawai'i fleet that currently have a high level of retention because of the Hawai'i market demand for a wide range of pelagic species. Fish imported to replace reduced Hawai'i production would likely come from producing areas and fleets that currently discard all pelagic catches except tuna and billfish and may also have greater adverse impacts on protected species.

Longline fishing fleets operating in the western Pacific are a likely source of fresh tuna that may replace any reduction in supply of Hawai'i caught fresh tuna (bigeye, yellowfin, albacore) in the U.S. market. These would probably include Chinese, Taiwanese and Japanese vessels operating in Micronesia. These vessels deploy longline gear similar to the Hawai'i-based tuna fleet, though a sector of the Taiwanese and Chinese longline fleets make relatively shallow sets (five to ten hooks between floats) at night (SPC, 2000). A provisional estimate of sea turtle takes is 0.27 takes per 10,000 hooks from fleets operating from 10 N. to 10 S. (SPC, March 2001, unpub. data), which is similar to a rate of 0.20 takes per 10,000 hooks fleets operating in the Federated States of Micronesia (Bailey *et al.*, 1996). Both rates are aggregated over all gear configurations, and the shallow setting method suggests that the rate of sea turtle takes may actually be higher as evident in the Hawai'i-based longline fishery. While species identification in the western Pacific longline fisheries is not well documented, given the tropical area of the fishery the take rates would probably be highest for olive ridley and green turtles and lowest for hawksbill, leatherback and loggerhead turtles.

The tuna catch rate (bigeye, yellowfin, albacore) for these fleets is approximately 1.79 mt per 10,000 hooks (SPC, 2001, unpub. data). Using these estimates (Table 4.11-3), tuna caught by the fleets operating in the western Pacific would be expected to result in 0.15 sea turtle takes per mt of tuna. By comparison, the combined tuna catch rate in Hawai'i's tuna longline fishery is estimated at 2.58 mt tuna per 10,000 hooks. The Hawai'i tuna style longline trips are estimated to result in 0.0097 sea turtle takes/set (NMFS, 2001a). The average tuna set is 1,690 hooks. The Hawai'i tuna fishery is estimated to result in 0.057 sea turtle takes per 10,000 hooks. Using these estimates, the Hawai'i tuna longline fishery would

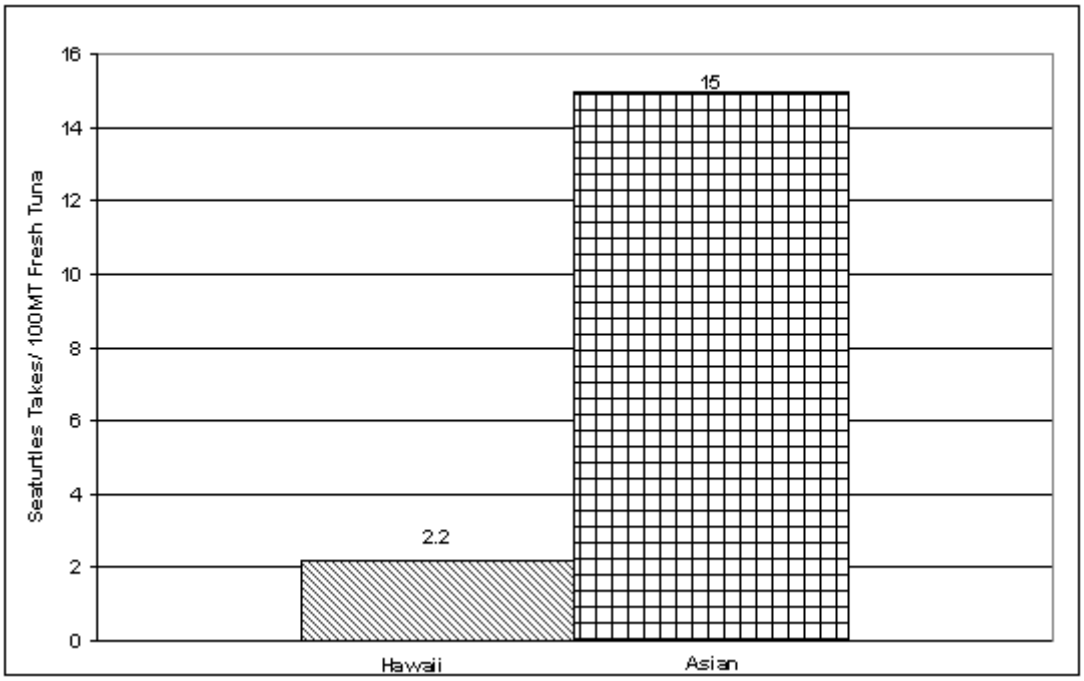
result in 0.0222 sea turtle takes per mt of tuna. Substitution of imported tuna caught by Taiwan, Chinese or Japanese vessels operating in Micronesia for Hawai'i tuna in the U.S. market would be expected to result in 6.75 times more sea turtle takes per mt.

Table 4.11-3: Comparison of Adverse Impacts of the Asian (Taiwan, China, Japan) and Hawai'i Tuna Fisheries on Sea Turtles.

Fishery	Sea Turtle Takes	
	Takes per mt tuna	mt tuna per take
Asian tuna longline fleets in western Pacific	0.150 takes	6.66 mt
Hawai'i	0.0222 takes	45.04 mt
Relative difference in rate	Asian fleets 6.75x greater adverse impact per mt tuna	

Hawai'i tuna-style longlining is predicted to result in 2.22 sea turtle takes for each 100 mt of tuna (Figure 4.11-4). By contrast, each 100 mt of tuna (bigeye, yellowfin and albacore) caught by Taiwan, China and Japan tuna longliners operating in the western Pacific is estimated to result in 15 sea turtle takes.

Figure 4.11-4: Potential Magnitude of Transferred Effects on Sea Turtles Resulting from Substituting Imported Tuna from Taiwanese, Chinese and Japanese Longline Fleets Operating in the Western Pacific for Hawai'i-caught Tuna in the U.S. Market.



Another example of an adverse transferred market effect would be if a reduced domestic supply of fresh tuna caused a shift in some consumer demand to bottomfish and reef fish species, most of which are fully or overexploited around the main Hawaiian Islands (NMFS SWFSC-HL, 2000a).

4.11.20.3 Effects on Shark Products Market and Consumers

This discussion on shark products addresses primarily shark fins from blue sharks. Mako and thresher sharks were described in the previous section.

Should the supply of dried, but unprocessed shark fins from Hawai'i be restricted or eliminated by regulation, the markets and consumers of shark fins in the form of shark fin soup might be subjected to rising prices, although the effect would likely be minor. The general consumer in Hawai'i and the United States will not be affected by a restriction on shark finning in Hawai'i, however niche markets and special consumers may (Chinese restaurants serving shark fin soup). The small number of buyers and exporters of dried unprocessed shark fins in Hawai'i would experience an immediate loss of income and business opportunity from the loss of a local supply. These buyers would most likely not have alternatives for sourcing dried unprocessed fins in distant ports and would lose this

business activity completely. Hawai'i-based longline fishing vessels that deliver shark fins would lose this portion of their revenues.

The State of Hawai'i recently adopted a law prohibiting the harvest of shark fins in state waters and the landing of shark fins in the state unless the fins were taken from a shark landed whole in the state. Although questions have been raised as to how this law will be applied to landings of shark fins taken by Hawai'i-based longline fishing in international waters outside state waters and the EEZ around Hawai'i, it is certain to contribute to a reduction in the supply of unprocessed shark fins entering the state. The law allows the continued importation of fins dried onboard foreign vessels fishing on the high seas in the general vicinity of the domestic vessels, which the law regulates. No state regulation on the importation of the processed shark fins from Hong Kong exists. No state regulation exists restricting the sale or consumption of shark fin soup in restaurants. State regulatory efforts to date appear to be directed at the Hawai'i-based longline fishery in isolation and without regard or understanding of the nature of the production, processing and marketing system for unprocessed and processed shark fins.

Requiring the landing of the sharks with fins attached will result in some finning onshore and discarding of the carcass on land rather than at sea. The value of the blue shark carcass is extremely low because of the poor market demand for this low quality fishery product. Requiring finning of sharks to occur only after landing will exacerbate the solid waste problem as efforts are made to reduce the wet waste stream to Hawai'i's limited landfill facilities. This would also result in higher waste disposal costs for fishers and wholesalers.

Proposals have been made for research and development of new processes and technologies to create new products from the presently unmarketable parts of the blue shark, especially its meat. In the near and long term, shark products made from cartilage, skin, liver and muscle might be developed to the point that the value of the blue shark carcass would elevate this fish species to a more significant commercially important species. For the immediate term, the vast majority of the value of the blue shark is in the fins alone.

If the market for shark fins continues to grow at a fast pace and the global supply of shark fins is restricted as a result of international pressure to ban the shark fin trade, it would not be surprising if some of the Asian longline fishing effort shifts from ultra-low frozen tuna products to a directed fishery to harvest and fin blue sharks in the North Pacific. Such a fishery could operate in and around some of the areas that could be closed to Hawai'i-based longline fishing under the EIS alternatives.

4.11.20.4 Summary of Cumulative Effects

The ten different management alternatives being considered have been analyzed for their impacts on the fishing effort and production of swordfish, bigeye, yellowfin and albacore

tuna, blue and striped marlin and mako, thresher and blue sharks as well as impacts on protected species. The predicted impacts of the nine alternatives on the production of these fish species range from production increases to no change to 100 percent reduction (elimination of the catch) at the extreme. The exogenous, direct and indirect factors described above that comprise the cumulative effects would be expected to occur in varying degrees depending on the extent by which the production of the various species is impacted. Some alternatives may increase the catch above the baseline and others may cause reductions.

The domestic shark fin trade that currently exists in Hawai'i is likely to decline sharply under all of the Alternatives (-73.7 to -100 percent), but the cumulative effects on the regional shark fin trade would not be significant. Even these broader actions would not change cumulative effects on the shark fin market, although the domestic supply for the Hong Kong processing market could be further reduced. Buyers would simply substitute shark fins processed onboard foreign fishing vessels for the reduced supply of fins from U.S. fisheries in the western Pacific. None of the alternatives would ban the landing (by cargo vessels) of imported fully processed shark fins in Hawai'i or other U.S. ports in the western Pacific, so access to imported shark fins would not be disrupted. Values given in the Table 4.11-4 for blue sharks merely indicate the predicted change in production of blue shark without the anticipated restrictions (quota or ban on finning).

Table 4.11-4: Impact of Management Alternatives on the Hawai'i-based Longline Fishery Production of Pelagic Fish Species, where zero percent = no change and -100 percent = elimination of the catch. Source: Kobayashi and Polovina, 2000.

Alts	Swordfish	Bigeye Tuna	Yellowfin Tuna	Albacore Tuna	Blue Marlin	Striped Marlin	Mako Shark	Thresher Shark	Blue Shark
Alt 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
Alt 2	-4%	0.9%	42.6%	-0.6%	-2.0%	-6.4%	0%	0%	-88%
Alt 3	-85.9%	-27.6%	-48.4%	-23.9%	-50.4%	-33.7%	-49.3%	-36.1%	-77.8%
Alt 4	-20.3%	5.7%	9.7%	-1.5%	24.5%	5.2%	-5.5%	4.9%	-89.1%
Alt 5	-95.1%	-17.5%	-34.7%	-12.3%	-31.2%	-22.8%	-40.3%	-6.7%	-98%
Alt 6	-61.9%	-6.0%	-18.1%	-37.8%	-5.7%	-22.3%	-37.5%	-34.6%	-93.1%
Alt 7	-95.6%	-22.6%	-40%	-22%	-36.1%	-28.6%	-45.5%	-21.6%	-98.01%
Alt 8	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
Alt 10	-94%	-18%	-29%	-7%	-26%	-14%	-40%	-29%	-86%

*assumes no switching

Alternative 1: Existing FMP (no action). This alternative represents the baseline. No change is anticipated. No adverse transferred effects would occur. Cumulative market effects

described above would not change.

Alternative 2: Pending Council Actions. The changes resulting from this alternative for swordfish would be a moderate reduction (-4 percent) while the reduction in bigeye tuna (-0.9 percent) and albacore (-0.6 percent) would be minor. Yellowfin tuna production would increase significantly (42.6 percent). Change in the production of the other market species would be minor. Catch of sharks would be decreased significantly (-88 percent). Transferred effects would not be significant. Cumulative market effects would not be significant.

Alternative 3: Court Ordered Action (status quo). This alternative would greatly reduce the production of swordfish (-85.9 percent). Bigeye tuna, yellowfin tuna, blue marlin, striped marlin, mako shark and thresher shark would be decreased substantially (-23.9 to -50.4 percent). Blue shark catch would decline significantly (-77.8 percent). Adverse transferred market effects could be severe depending on the source of swordfish and yellowfin tuna that replaces Hawai'i-caught fish in the U.S. market. Adverse transferred effects might also come about as Hawai'i vessels targeting swordfish are displaced and relocate to other fisheries where adverse impacts on sea turtles may be significant and potentially greater. Cumulative effects would likely be adverse and significant.

Alternative 4: Seasonal Area Longline Fishery Closure. This alternative would result in a significant reduction in swordfish catch (-20.3 percent). Bigeye tuna, yellowfin tuna, striped marlin and thresher shark catch would have moderate increases (4.9 to 9.7 percent). Albacore and mako shark would have minor to moderate decreases in production (-1.5 to -5.5 percent). Blue shark production would be decreased substantially (-89.1 percent). Adverse transferred effects on sea turtles associated with displaced swordfish are likely to be significant. Cumulative effects would also likely be adverse and significant.

Alternative 5: Increase Fishing Gear Deployment Depth. Swordfish production would be severely reduced (-95.1 percent). Bigeye tuna, yellowfin tuna, albacore, blue marlin, striped marlin, mako and thresher shark production would be greatly reduced (-6.7 to -40.3 percent). Blue shark catch would be substantially reduced (-98 percent). The adverse transferred effects on sea turtles associated with alternative sources of swordfish and tuna for the U.S. market would likely be substantial. Cumulative effects would likely be adverse and significant.

Alternative 6: Permanent and Seasonal Closure of All Longline Areas. Swordfish production would be severely restricted (-61.9 percent). Bigeye tuna (-6 percent) and yellowfin tuna (-18.1 percent) catch would be reduced significantly. Significant reductions in albacore, blue marlin, striped marlin, mako shark and thresher shark would be substantial (-5.7 to –37.8 percent). The catch of blue sharks would be substantially reduced (-93.1 percent). The adverse transferred effects on sea turtles associated with the reduction of swordfish, bigeye and yellowfin tuna production would likely be significant. The cumulative effects would likely be adverse and significant.

Alternative 7: Increase Fishing Gear Deployment Depth, Seasonal Closure of All Longline Fishing Areas. Swordfish production would be reduced substantially (-95.6 percent). Bigeye tuna (-22.6 percent) and yellowfin tuna (-40 percent) catch would be greatly reduced. The catch of the associated pelagic market fish would be decreased substantially (-21.6 to –45.5 percent). Blue shark catch would be greatly reduced (-98.1 percent). The adverse transferred market impacts on sea turtles associated with the reduction and replacement of swordfish and tuna would likely be significant. Cumulative effects would be adverse and significant.

Alternative 8: Regional Longline closure. The production of all pelagic species is eliminated by this alternative. The likely adverse transferred market effects associated with total closure of the Hawai'i-based longline fishery would result in the most significant adverse cumulative market effects of all the alternatives.

Alternative 9: Analyze Gear Conflicts and Catch Interactions Among Fisheries (American Samoa). Cumulative market effects would not apply to this alternative.

Alternative 10: Preferred Alternative. Swordfish production would be reduced substantially (-94 percent). Bigeye tuna (-18 percent) and yellowfin tuna (-29 percent) catch would be greatly reduced. The catch of the associated pelagic market fish species would be decreased substantially (-7 to -40 percent). Blue shark catch would be greatly reduced (-86 percent). The adverse transferred market impacts on sea turtles associated with the reduction and market replacement of swordfish and tuna would likely be significant. Cumulative effects would be adverse and significant.

Option A: Experimental Fishery. This consideration is valuable in that without efforts to identify appropriate fishing methods and strategies that can also mitigate adverse impacts on non-targeted and protected species, the only alternatives left for this and other fisheries may be increased restrictions and closures. Without an experimental fishery, viable mitigation methods may never be developed in the Hawai'i-based longline fishery, negating a unique opportunity to develop practical models for other fisheries to adopt. A strategic spread of appropriate fishery production and management approaches would be a form of positive transferred effect and has potential to promote protected species recovery and sustainability on a global scale. This is may be the only option with potentially significant beneficial cumulative effects.

4.11.20.5 Significant Cumulative Effects Requiring Mitigation - Domestic Seafood Markets and Consumers

Alternatives that significantly reduce swordfish production by the Hawai'i fishery are expected to result in significant adverse cumulative market impacts related in large part to transferred effects on sea turtles associated with swordfish replacing Hawai'i swordfish from other fisheries.

Alternatives that significantly reduce tuna and associated pelagic market species by the Hawai'i fishery even during seasonal closures may result in indirect adverse transferred effects in sea turtles as well as increase economic discards associated with fishery production that replaces Hawai'i-caught fish.

4.11.21 Exogenous Factors – Non-Use Resource Values

Non-use values, also referred to as passive-use or existence values, do not involve personal consumption of derived products nor *in situ* contact. (Bishop, 1987). Non-use values may, nevertheless, be the most important benefit derived from some endangered species, simply because such species are few in number that many people are unlikely to have seen them or to have had very much tangible experience regarding them. The most visible manifestation of existence values is the donation of funds to private organizations that support activities to preserve endangered species. However, whether people enjoy existence values of resources is not contingent upon whether they donate money to support a cause. Any impact of non-use values would be a hedonic (non-market) effect.

Particularly in the United States and western Europe, there are those who consider that certain marine species represent a special group of animals that should not be killed, deliberately or incidentally, under any circumstances. Certain marine animals are viewed symbolically as unique or majestic creatures – "charismatic megafauna" – similar to African big game. From this perspective, every incidental catch of such a species would be a severe problem.

The perceived need for conservation of such species may be independent of any impact caused by fishing or of its stock status. This perception may also influence the response of resource managers to bycatch management issues. For example, the case of three ice-entrapped gray whales in Alaska might be seen as an example of where the ecological impact is minimal but where public perception and political attractiveness may lead to disproportionate effort. Such views are strongly culture-dependent (Hall, 1998).

Numerous studies have been conducted on the value of endangered species (e.g., Loomis and White 1996) and several studies provide estimates of the value of protected species in Hawai'i, including the Hawaiian monk seal (WPRFMC, 2000e). Metrick and Weitzman

(1996) were unable to identify a satisfactory measure of charisma in the context of endangered species but they note that eye-size or eye-body ratio have been suggested. Another possible component of existence value is the degree to which a species is considered to be a higher form of life and possibly possess (anthropomorphic) capabilities for feeling, thought and pain (Metrick and Weitzman, 1996; Kellert, 1986). There may also be existence value for the contribution of particular species to biodiversity (Metrick and Weitzman, 1996). However, no valuation studies have been conducted specifically for sea turtles or seabirds in Hawai'i and for other species of interest in Pelagics FMP-managed fisheries. As a result, new research would be needed to understand the non-use value of these species and how such values would be affected by the alternatives (Section 3.10.2.4).

Based on the interest of conservation groups and the general public in protected marine species, it can be assumed that sea turtles, seabirds and probably pelagic sharks are embued with high existence values. Some species of sharks, as well as individual sharks, have spiritual importance in Hawaiian culture as *'aumakua*, or family guardians (McCoy and Ishihara, 1999). Whether the species in question are coastal or pelagic sharks is a matter of debate among Hawaiians (C. Ka'ai'ai, WPRFMC, pers. comm., 2000).

4.11.22 Cumulative Effects of the Alternatives – Non-Use Resource Values

All of the alternatives would have the potential for significant direct and indirect effects because they would impact individual turtles, seabirds and sharks, even if not affecting their overall population viability.

Alternatives 3, 5-8 and 10 would be expected to displace some or all Hawai'i-based swordfish longline fishing effort. The level of fishery interactions with protected species, including sea turtles, will depend on where fishing effort relocates. Proximity of longline fishing to nesting beaches in Mexico and Costa Rica could increase takes and mortalities for some sea turtle species. If the boats displaced from the Hawai'i-based longline fishery move from Mexico and Costa Rica to other fishing grounds, sea turtle takes and mortality would be expected to change again.

Until other countries adopt regulations similar to those of the Hawai'i-based fleet, regulations that remove vessels from the fleet appears to be a relatively ineffective tool for limiting the global mortality of turtles and seabirds. The result will be simply to transfer the fish harvests (and consequently turtle and seabird interactions) to unregulated fisheries (Section 4.11.7). Assuming that a sea turtle take or mortality in another fishery has the same non-use value as a sea turtle take or mortality in the Hawai'i-based longline fishery, then none of the alternatives would be expected to change the cumulative effects on non-use values for sea turtles because fishery takes and mortalities would be transferred to areas away from Hawai'i.

Many scientists argue that charismatic species cannot be separated from the management of other components of marine ecosystems (Hall, 1998). It is very difficult to conceive of a management strategy for Western Pacific pelagic fisheries management that would provide equal protection of all charismatic components of the pelagic ecosystem simultaneously.

4.11.23 Significant Cumulative Effects Requiring Mitigation – Non-Use Resource Values

It is likely to require global conservation efforts to prevent a significant cumulative loss of non-use value associated with sea turtles and other pelagic fish and non-fish species of interest.

Table 4.11-5: 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 4.11-5: 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 4.11-5: 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 4.11-5: 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 4.11-5: 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 4.11-5: 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 4.11-5: 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 4.11-5: 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 4.11-5: 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 4.11-5: 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 4.11-5: 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 4.11-5: 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