Programmatic Environmental Assessment
Research to Support Reduction of Sea Turtle Bycatch in Domestic and International Fisheries
Pacific Islands Fisheries Science Center, Bycatch Reduction Program
Honolulu, Hawaii

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Pacific Islands Fisheries Science Center
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Executive Summary

The Pacific Islands Science Research Center (PIFSC) Fish Biology and Stock Assessment Division (FBSAD) has, as one of its goals, to identify and test the effectiveness of strategies and techniques for reducing bycatch in commercial fisheries. This analysis, conducted in compliance with the National Environmental Policy Act (NEPA), evaluates the Division's fishery bycatch research program to reduce incidental bycatch of sea turtles in domestic and foreign longline fisheries while preserving the catch rates of target fish species by using modified fishing gear and/or operations. National Marine Fisheries Service (NMFS) has assumed a leadership role in sea turtle conservation worldwide and has dedicated significant resources to research programs intended to find ways to reduce takes of sea turtles in U.S. and foreign fisheries and transfer of effective technologies to foreign fleets.

Typical tests of modified gear and operations involve hook size and/or shape, type of bait or lure, branch line position, line materials, depth of set, daily time of set and/or other operational and gear parameters as they become available, and may be conducted anywhere in the oceans in participating fleets where sea turtles and pelagic longline fisheries interact.

All field-based research, both domestic and foreign, would involve testing gear or methods that have been indicated to be effective or shown promise for reducing bycatch or injury and that have no known mechanism for causing additional harm to turtles or to the environment, but have not been proven to reduce sea turtle bycatch in pelagic longline fishing in a particular region with different fisheries. Since domestic and foreign field studies are coincidental to normal fishing operations, no additional bycatch of sea turtles compared to that experienced using standard gear and operations is anticipated. Effective gear and methodologies would be transferred to cooperating foreign countries and fleets to sea turtle reduce bycatch.

No adverse impacts of the proposed program are anticipated from the existing and proposed actions on the listed species of marine mammals or species protected by the MMPA. Use of hooks baited with fish rather than squid in research conducted in domestic and foreign longline fleets and transferring this technology to foreign fleets to reduce sea turtle bycatch should decrease the incidental take of sharks as well, especially blue sharks, while maintaining the catch rate of target species. No other resources are anticipated to be adversely impacted by the existing and proposed research program.

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Abbreviations and Acronyms

BPUE	Bycatch per Unit Effort
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CPUE	Catch Per Unit Effort
CWPO	Central and Western Pacific Ocean
DOC	U.S. Department of Commerce
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EFP	Exempted Fishing Permits
EIS	Environmental Impact Statement
EPO	Eastern Pacific Ocean
ESA	Endangered Species Act
ETPO	Eastern Tropical Pacific Ocean
FAO	Food and Agriculture Organization of the United Nations
FIGIS	Fisheries Global Information System (FAO)
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FR	Federal Register
FTE	Full-time Equivalent
GMRR	Galapagos Marine Resources Reserve
HAPC	Habitat Area of Particular Concern
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
ISC	Interim Scientific Committee for Tuna and Tuna-like Species in the North Pacific
IUCN	International Union for Conservation of Nature and Natural Resources
IWC	International Whaling Commission
MBTA	Migratory Bird Treaty Act
MHI	Main Hawaiian Islands
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Act
NED	Northeast Distant Statistical Area
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuary Act
NMSP	National Marine Sanctuary Program
NOAA	National Oceanographic and Atmospheric Administration
NPALW	North Pacific Albacore Workshop
NPOA	National Plan of Action to Reduce the Incidental Catch of Seabirds in U.S. Fisheries
NWHI	Northwestern Hawaiian Islands
PFRP	Pelagic Fisheries Research Program
PIFSC	Pacific Islands Fisheries Science Center (NMFS)

PIRO	Pacific Islands Regional Office (NMFS)
PMUS	Pelagic Management Unit Species
PRIA	Pacific Remote Islands Area
SCRS	Standing Committee on Research and Statistics (ICATT)
SCTB	Standing Committee on Tuna and Billfish
SFD	Sustainable Fisheries Division (NMFS)
SPC	Secretariat of the Pacific Community (formerly South Pacific Commission)
UNESCO	United Nations Educational, Scientific and Cultural Organization
USFWS	U.S. Fish and Wildlife Service
WCPO	Western and Central Pacific Ocean
WPRFMC	Western Pacific Regional Fishery Management Council
WWF	World Wildlife Fund

1 Purpose and Need

1.1 Summary of the Proposed Action

The Pacific Islands Science Research Center (PIFSC) Fish Biology and Stock Assessment Division (FBSAD) has, as one of its goals, to identify and test the effectiveness of strategies and techniques for reducing bycatch in commercial fisheries. This analysis, conducted in compliance with the National Environmental Policy Act (NEPA), evaluates the Division's fishery bycatch research program to reduce incidental bycatch of sea turtles in domestic and foreign longline fisheries. This research program focuses on evaluating strategies to reduce the incidental capture of sea turtles in commercial fishing gear while preserving the catch rates of target fish species by using modified fishing gear and/or operations. Per the Magnuson-Stevens Act National Standard 9, the National Standard regulating bycatch in fisheries (50 CFR 600.350), the first priority for reducing bycatch should be to avoid catching bycatch species where possible. To the extent that bycatch cannot be avoided, reducing bycatch is mandatory to the extent practicable while mortality of bycatch should be minimized. NMFS, rather than the Fishery Management Councils, has the responsibility to implement bycatch reduction management measures.

Development and testing of gear, bait, and operational methods to reduce incidental bycatch of sea turtles in pelagic longline fisheries targeting primarily swordfish, dolphinfish (mahi mahi) and tuna has taken place in all major oceans where sea turtle bycatch has been recorded. Countries involved in pelagic longline fishing with recorded sea turtle bycatch include Australia, Canada, European fleets in the Mediterranean Sea, the United States in the Atlantic Ocean and Gulf of Mexico, and the Pacific Ocean (Hawaii-based longline fleet), Japan in the Atlantic, Pacific, and South China Sea, coastal countries in Central and South American and other fleets, including distant water fishing nations in the western and central Pacific Ocean. Of the 40 nations engaged in pelagic longline fishing, only a small proportion have observer programs that document sea turtle bycatch incidental to the swordfish and tuna longline fisheries, which results in substantial uncertainties in levels of bycatch and primary causes and locations of such bycatch (Beverly and Chapman 2007). .

The National Oceanographic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) PIFSC FSBAD has been involved with testing modified gear, bait, methods, and other factors in Atlantic and Pacific fisheries in compliance with the Magnuson-Stevens Act (MSA) and, as a researcher, governmental cooperator and/or a member of various international organizations, in foreign fisheries for many years to reduce sea turtle bycatch. In recent years, NMFS has assumed a leadership role in sea turtle conservation worldwide and has dedicated significant resources to research programs intended to find ways to reduce takes of sea turtles in U.S. and foreign fisheries and transfer of effective technologies to foreign fleets (Section 2.1.2).

Research conducted by NMFS has included laboratory-based turtle physiological and behavioral responses in relation to longline gear, bait, and methodologies (NMFS 2007) and field research and studies in both domestic and foreign pelagic longline fisheries (Section 2.1.2). Effectiveness of methodologies and gear is defined in terms of substantial reductions in bycatch of sea turtles with little to no corresponding decrease in catch of target species and associated revenues. If

catch of target species decreases to the point where revenues are affected, the fishers will not incorporate the modifications into their operations (Gilman et al. 2006, Beverly and Chapman 2007).

PIFSC research originally focused on modification of fishing gear and identifying areas with high potential for fishing interactions with sea turtles. The program expanded over time to conduct research of effective modified gear and operations in additional domestic and foreign fleets and transfer of effective modifications to foreign fisheries. Results of the research conducted to date indicate that significant reductions in bycatch of sea turtles can be achieved using large circle hooks instead of traditional J hooks and using mackerel bait rather than squid bait (Largacha et al. 2005), especially in the shallow-set fisheries targeting swordfish at night when both sea turtles and swordfish are foraging in near-surface waters (Read 2007, Gilman et al. 2007). Many effective sea turtle bycatch reduction measures have been implemented by regulation in the Hawaii-based longline fishery in 2004, resulting in substantial reductions in sea turtle bycatch, while, generally, maintaining catch per unit effort (CPUE) of target species. Interactions of U.S. longline vessels with sea turtles represent only a small fraction of the total fishing effort by all fleets. Typical tests of modified gear and operations involve hook size and/or shape, type of bait or lure, branch line position, line materials, depth of set, daily time of set and/or other operational and gear parameters as they become available, and may be conducted anywhere in the oceans in participating fleets where sea turtles and pelagic longline fisheries interact.

All field-based research, both domestic and foreign, would typically use modified gear and/or operations that have been indicated to be effective at reducing bycatch in comparison with standard gear, deployed using unbiased protocols. However, experiments could involve testing gear or methods that have shown promise for reducing bycatch or injury and that have no known mechanism for causing additional harm to turtles or to the environment, but have not been proven to reduce sea turtle bycatch in pelagic longline fishing in a particular region with different fisheries. Since domestic and foreign field studies are coincidental to normal fishing operations, no additional bycatch of sea turtles compared to that experienced using standard gear and operations is anticipated.

This research is intended to evaluate the effectiveness of modified gear on the catchability of target species while reducing the bycatch per unit effort (BPUE) of sea turtles; it is not intended to directly catch or take sea turtles. While conducting this research, any interactions with turtles by contracted Hawaii-based longline vessels in the shallow-set fishery will count against the hard cap authorized in the Incidental Take Statements of the Biological Opinion pursuant to the Endangered Species Act – Section 7 Consultation (NMFS 2008a).

1.2 Need for Action

1.2.1 Introduction to Longline Gear and Fishing Methodologies

Vessels fishing with longline gear generally target bigeye tuna (Thunnus obesus), yellowfin tuna (T. albacares), albacore tuna (T. alalunga), or broadbill swordfish (Xiphias gladius). Fleets participating in PIFSC research also target bluefin tuna (T. thynnus) and mahimahi (dolphinfish, Coryphaena hippurus, C. equiselis). Pelagic longline gear, however, also catch a variety of other

species such as sharks, some marketed and some not, and some longline fisheries may target species considered bycatch in other fisheries, again, such as sharks.

Pelagic longline fishing generally occurs in open ocean areas beginning several miles from shore (at least outside the 6.6 km limit of state waters (3 nmi) and can often extend well offshore into international waters outside the Exclusive Economic Zone (EEZ) of any nation (200 nmi).

Pelagic longline fleets range in size from small-scale traditional domestic artisanal fisheries, to small domestic commercial fleets, to modern mechanized industrialized fleets from nations distant from the fishing grounds. Longline fishing involves suspending a mainline from floats at the sea-surface to which is attached branch lines with terminal hooks. The configuration of the gear, including the length of the mainline, the number of branch lines between floats, the maximum depth of branch lines, the size of hooks, the bait, and other characteristics vary with the specific target fishery. At the extreme, a longline may be nearly 100 km (60 miles) in length with up to 2,400 hooks. Depending on their target species, longline fisheries may deploy hooks at depths ranging from near the surface to 400 m (1,312 feet) in depth (Beverly and Chapman 2007, NMFS 2008a (Figure 1). Mainlines are typically 33 km (18 nmi) to over 100 km (60 nmi) long.

Depending on the fishery and the size and type of vessel, the main line of pelagic longline gear generally drifts freely near the surface in the high seas for approximately 12 hours between the time they are set and the time they are hauled back out (soaking time). The Hawaii-based pelagic longline fishing can be roughly divided into two categories, (recognizing that other fisheries also are conducted, such as that for mahi mahi in South America; Figure 1):

- Shallow-set gear, where the hooks are typically within 100 m (300 feet) of the surface and are generally set at night, deploying between 700 and 1,000 hooks, targeting either broadbill swordfish or night-swimming bigeye tuna;

- deep-set gear, where the majority of the hooks are set much deeper (140 m to 370 m; 450 to 1200 feet below the surface) during the day, typically deploying between 1200 to 1900 hooks, targeting albacore and bigeye tuna (because the underwater lines typically form a "U-shape" between the floats, hooks nearer the floats may actually be in the same water layer as shallow-sets).

Pelagic longline sets of both types are often deployed where target fish are expected to be found near temperature breaks (thermal fronts) or eddies that can be identified by available sea surface temperature and height charts or color charts showing phytoplankton concentrations that are readily available to fishers worldwide. Sea turtles, especially loggerhead (Caretta caretta) turtles are highly vulnerable to pelagic longline fishing because they typically forage within 60 m (<180 feet) of the surface and occupy the same fronts and eddies as targeted fish, due to the abundance of prey inthese nutrient-rish waters. Therefore, most sea turtle encounters in pelagic longline fisheries involving either hooking or entangling turtles happen on shallow sets for swordfish that are set at night using squid baits near thermal fronts or eddies. In addition, in deep sets, up to 30% of the hooks may be set within the upper 100 m (300 feet) of the water column near the

floats, resulting in near-surface sea turtle takes even in the deep-set tuna fisheries (Beverly and Chapman 2007, Beverly et al. in press; Figure 1).

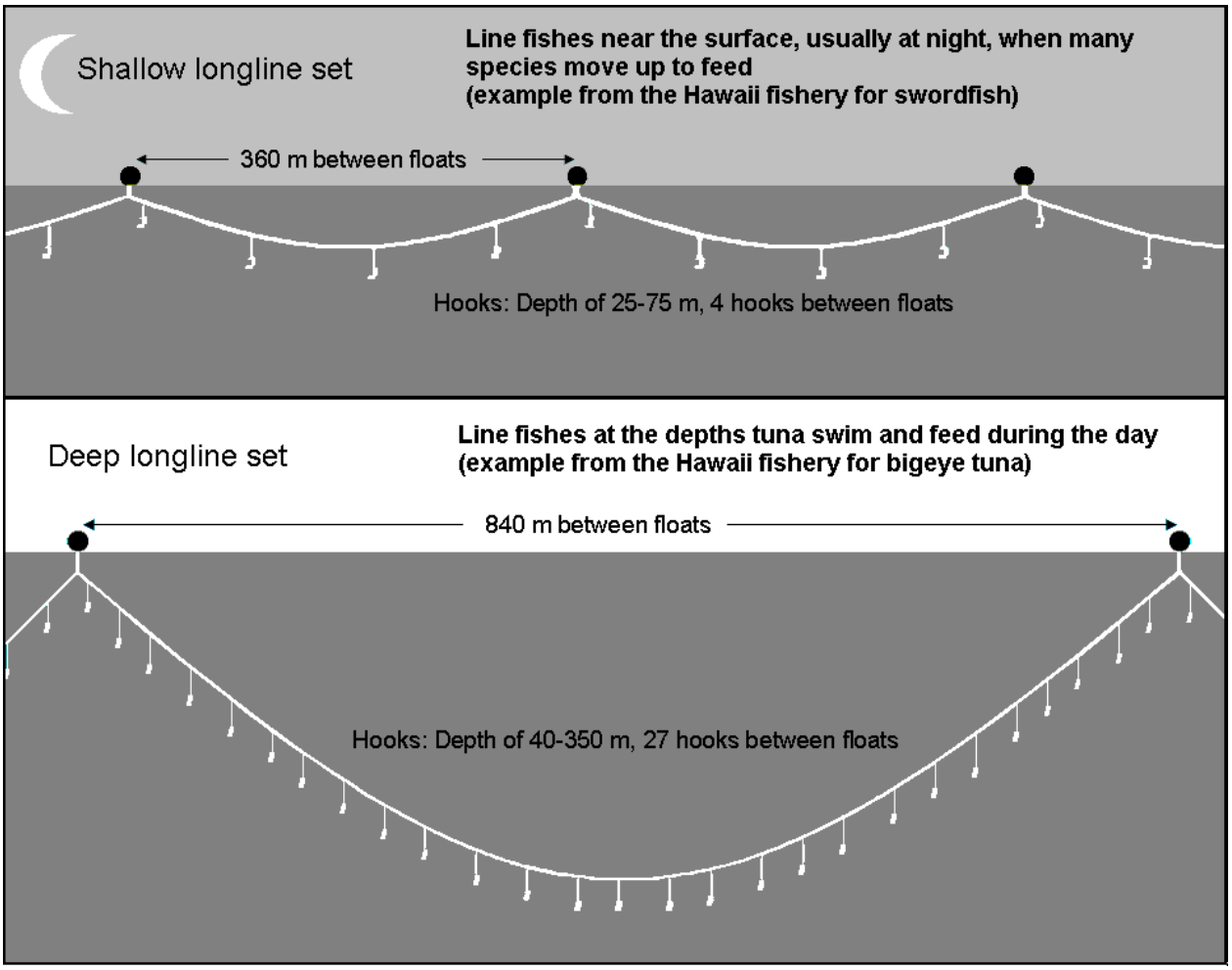

Figure 1. Pacific Longline with Gangions[1]
[1] Depth varies based on target species (WPRFMC 1995)

1.2.2 Status of Sea Turtles

All populations of sea turtles are in decline, except for some olive ridley and green turtle subpopulations, which appear to be increasing (Spotila et al. 2000, Kamezaki et al. 2003, Limpus and Limpus 2003, Chaloupka and Balazs 2007). In the last two decades in the Pacific Ocean, for example, numbers of nesting leatherbacks and loggerheads have declined by 95% and 80%, respectively (Spotila et al. 1996, Spotila et al. 2000, Kamezaki et al. 2003, Limpus and Limpus 2003). Estimated trends of Pacific leatherback populations in Costa Rica and Malaysia suggest that these turtles could become functionally extinct by 2010 (Spotila et al. 2000).

Impacts to sea turtles throughout the world are due to the cumulative effect of primarily human activities, including the legal harvest and illegal poaching of adults, juveniles, and eggs;

incidental capture in various kinds of fisheries (coastal and high-seas); loss and degradation of nesting and foraging habitat; and predation on nesting beaches by feral and domestic animals (especially dogs and pigs). Increased environmental contaminants and hazards, such as marine debris, and sewage and industrial discharges, adversely impact nearshore sea grass and coral reef ecosystems on which some species of sea turtles depend for food and shelter. Anchoring beaches with walls, which prevent sea turtles from reaching the nesting beaches, and lights associated with human activity inland which cause hatchlings to move toward land rather than the ocean upon hatching, also reduce nesting success. In addition to direct and indirect human activities that affect the survival and recovery of sea turtle populations, other factors also contribute to declining populations, such as coastal erosion, seasonal storms, predators, temperature variations, rising sea and temperature levels from climate change, diseases such as fibropapillomatosis and spirochidiasis, and phenomena such as El Niño (Kaplan 2005, Beverly and Chapman 2007, Gilman et al. 2007, NMFS 2008a, Hermsmeyer 2008).

At present, all species of sea turtles are categorized by the International Union for Conservation of Nature and Natural Resources (IUCN 2004) as "critically endangered" (hawksbill [Eretmochelys imbricata], Kemp's ridley [Lepidochelys kempii] and leatherback), "endangered" (loggerhead, olive ridley, and green), or "vulnerable" (Australia's flatback turtle [Natator depressa]). Under the U.S. Endangered Species Act (ESA), leatherback, hawksbill, Kemp's ridley, the populations of olive ridley turtles nesting in Mexico, and the populations of green turtles in Florida and the Pacific coast of Mexico are listed as endangered; loggerhead, other Pacific populations of olive ridley turtles, and the Hawaii subpopulation of green turtles are listed as threatened. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) identifies all sea turtle species excluding the flatback as threatened with extinction, and prohibits the international trade in sea turtles and sea turtle products.

The shallow-set fisheries in the north Pacific and Atlantic Oceans interact primarily with juvenile loggerhead turtles and adult leatherback turtles, primarily during their migratory stage (Watson et al. 2005). Due to their deep-diving behavior, the deep-set fishery interacts primarily with olive ridley turtles (Polovina et al. 2003, NMFS 2008a).

Most sea turtle species are highly migratory, traveling over broad expanses of open ocean between land-based nesting areas and pelagic foraging areas. In order to comprehensively address population decreases, the harvesting of adults and eggs for food, habitat degradation from pollution, and loss of nesting beaches and habitat are issues that must be addressed concurrently with attempts at reducing bycatch in ocean marine fisheries. Sea turtle conservation, therefore, cannot be implemented by a single nation, but rather requires international cooperation in alleviating all of the primary threats to their recovery. Therefore, a holistic integrated management approach appears to have the highest chance of success in solving the problem of declining sea turtle populations (Lewison et al. 2004, Kaplan 2005, Gilman et al. 2006, Beverly and Chapman 2007, Gilman et al. 2007). Kaplan (2005) calculated that, for leatherback turtles, land-based mortality may have a stronger effect on mortality than longline fishing and, therefore, addressing losses on nesting beaches may provide a more substantial contribution to species recovery. However, with most sea turtle populations in an increased rate of decline, all contributing factors to mortality must be addressed, including interactions with domestic and foreign longline fisheries.

1.2.3 Worldwide Interactions of Longline Sets and Sea Turtles

The extent of international longline fisheries grew rapidly worldwide since the 1950s, then leveled off at relatively high levels during the last 50 years. Longline fishing increased four-fold from 113 million hooks to 680 million hooks annually between 1952 and 2002 in the western central Pacific Ocean (Molony 2004, in: Beverly and Chapman 2007). The combined catch of bigeye and yellowfin tuna doubled from 100,000 metric tonnes to 200,000 metric tonnes in the same time span. Since the 1980s, 50% of the fleet fishing in the western and central Pacific Ocean has been Japanese, Taiwanese, and Korean flagged. Other fleets have grown since the 1980s, including the U.S. fleet, the mainland Chinese fleet, and smaller fleets in several Pacific Island countries and territories. The growth in global catch since 1952 is striking in that the combined fleets fishing in the western central Pacific Ocean and Indian Ocean (the only fleets operating at that time) caught a total of 68,000 metric tonnes of albacore, bigeye, and yellowfin tuna. By 2002, the combined global fleets fishing in the western central Pacific Ocean, Indian Ocean, eastern Pacific Ocean and the Atlantic Ocean caught 643,000 metric tonnes of the same three species (WCPFC 2006, in: Beverly and Chapman 2007).

Longline vessels are known to fish throughout the Pacific Basin from 50oN to 50oS latitude, as well as in the Atlantic Ocean, Indian Ocean, and Mediterranean Sea (Carocci and Majkowski 1996). Many sea turtle species also exhibit broad distribution north and south of the equator, with apparent affinity for certain oceanographic conditions indicative of available food and favorable currents for migrations. Relevant conditions for sea turtles include converging oceanic fronts, suitable salinity, sea temperature, and surface chlorophyll levels, all of which interact to create highly productive foraging areas for both sea turtles and the larger fish targeted in the longline fleets, such as swordfish and tuna (Polovina et al. 2000, Polovina et al. 2004, Beverly and Chapman 2007). This increases the potential for sea turtle bycatch in the pelagic longline fisheries worldwide.

Sea turtle tracking studies indicate that loggerhead turtles spend a majority of their time at depths less than a maximum of 40 m (130 feet), with much of their time spent at shallower depths (Polovina et al. 2003, Polovina et al. 2004). Even when hooks are intended to fish at depth, they must pass through the near surface waters frequented by sea turtles, and hooks near the floats also tend to be in the near-surface waters. Observer data from the Hawaii-based longline fleet (Kleiber and Boggs 2000) and from experiments in the Atlantic Ocean (Watson et al. 2004a) show that a higher-than-expected proportion of leatherback turtles are taken on the shallower branch lines closest to floats than on other deeper branch lines. Despite even the deepest hooks briefly passing through near-surface waters during set and haul operations, deep-set pelagic longline fisheries have been shown to have lower turtle interaction rates than shallow-set fisheries in the U.S., Japan, Spain, Costa Rica, and the western tropical Pacific (WPRFMC 1993, SPC 2001, NMFS 2001, NMFS 2002, Gilman et al. 2006).

Turtles may become hooked by biting the bait, by being snagged by the hook in passing, or by becoming entangled in the line. Leatherbacks cannot back up, so they are especially vulnerable to becoming entangled. If the branch line is not long enough to allow the hooked or entangled turtle to reach the surface to breathe, it will drown. Sea turtles feeding on hooked bait may swallow the hook as well as the bait, with the hook becoming snagged in the esophagus or stomach. Turtles tend to bite pieces off of fish used as bait until the fish is completely removed

from the hook, often avoiding the hook. However, when squid is used as bait, they line up the squid with their flippers and gulp it down whole, along with the hook. Even turtles hooked or entangled but released alive may subsequently die due to internal injuries and/or secondary infections. The risk of mortality for sea turtles captured in pelagic longline fisheries is affected by the level of hook ingestion, with fully ingested hooks believed to cause mortality and handling while removing turtles from the line either in the water or after being brought on board increasing the risk (Watson et al. 2003, Watson et al. 2004a, Gilman et al. 2007, Read 2007).

Although adult leatherback and juvenile loggerhead turtles are the species most at risk worldwide for interaction with shallow-set longline gear in mid-ocean because they spend more of their lives in pelagic habitats than other sea turtles, other species are caught as well (Polovina et al. 2003, Gilman et al. 2006, NMFS 2008a). In temperate waters such as around the Hawaiian Islands, olive ridley turtles are often the species of turtle most frequently caught by deep-set longline gear targeting tuna. In the tropics, olive ridley capture rates are especially high in many artisanal fisheries off the Pacific coast of Latin America (Arauz et al. 2000, Largacha et al. 2005, Swimmer et al. 2005, Swimmer et al. 2006). Approximately 75% of the olive ridley turtles taken in the Hawaii deep-set longline fishery originate in the eastern Pacific Ocean (NMFS 2005, 2008b).

Beverly and Chapman (2007) compiled the results of various studies to identify the following Bycatch per Unit Effort (BPUE; catch of sea turtles per 1,000 hooks). A selection from this table (eliminating those with missing data and/or selecting studies with the highest number of hooks) indicates that BPUE in the Mediterranean Sea is comparatively high, BPUE in an artisanal fleet (smaller boats fishing along the coastline of Costa Rica) is also high, and BPUE in the U.S. fleets in both the Atlantic and Pacific Oceans prior to 2004 (before regulations requiring large circle hooks baited with fish were implemented) was also relatively high (Table 1). The summary of sea turtle bycatch studies compiled by Beverly and Chapman (2007) found that the Hawaii-based longline fishery bycatch (measured in terms of bycatch per unit effort; BPUE) of all sea turtle species was 0.06 compared to foreign longline fishery fleets, which had much higher BPUE, varying from 0.3 to almost 20 turtles per 1,000 hooks. The major finding of a study conducted by Bartram and Kaneko (2004) was that Hawaii's longline fishery has a lower CPUE/BPUE ratio of finfish to sea turtles compared to most competing pelagic longline fisheries.

Some attempts to conserve Pacific sea turtles have focused on unilaterally closing commercial fisheries or areas to commercial fishing. However, with transboundary species such as turtles migrating across many nations' EEZs and the high seas, fish formerly caught in Hawaii-based fisheries with high levels of regulation and low levels of bycatch are likely to be caught by other nations with higher levels of bycatch and imported back into the nation with the closed fishery (market transfer effect). If U.S. demand for swordfish remains high and fewer fish are caught by the Hawaii-based fishery because of closures, reliance on imports from nations having higher bycatch rates would most likely increase. The main sources of imports during the 2001 to 2004 closure of the Hawaii-based shallow-set longline fishery were Mexico, Panama, Uruguay, Brazil, Costa Rica, New Zealand/Cook Islands, Viet Nam, and South Africa, all of which have higher sea turtle bycatch (in terms of BPUE). A study of the market transfer effect during the closure of the Hawaii-based shallow-set longline fishery resulted in an estimated transfer of 1,602 mt of

swordfish catch to non-U.S. fisheries, which led to an estimated additional 2,882 sea turtle interactions (Rausser et al. 2008, in: Hermsmeyer 2008, WPRFMC 2008).

Table 1. Sea Turtle Bycatch Recorded in Domestic and International Fisheries[1]

Location	Year	Approx. no. of hooks	No. of Turtles	BPUE	Reference
Atlantic Ocean, Japan	1978-1981	3.7 million	126	0.0073	Witzell et al. 1984
Gulf of Mexico	1978-1981	1.7 million	204	0.018	Witzell et al. 1984
Gulf of Mexico	1979, 1980	0.3-0.5 million	8-12	0.027	Ogren 1994
Azores	1998	No data	60	0.3-0.4	Bjorndal and Bolten 1999
Azores	No data	No data	27	0.753 (July)	Prieto et al. 2000
US Atlantic Fleet	1992-1993	15.8 million	841	0.053	Witzell and Cramer 1995
US Atlantic Fleet	1992-1995	17.8 million	2601	0.146	Witzell 1999
US Atlantic Fleet	2000	7.5 million	769	0.1	Yeung 2001
US Atlantic Fleet	2004	7.2 million	2096	0.3	Garrison 2005
Canada	2001	0.3 million	227	0.8	Javiteck 2002
Mediterranean Sea - Spain	1991-1992	0.3 million	1100	3.2	Aguilar et al. 1995
Mediterranean Sea - Spain	2000	1.6 million	1858	1.15	Caminas 2004, Laurent et al. 2001
Mediterranean Sea – Italy	2000	0.2 million	174	0.93	Caminas 2004, Laurent et al. 2001
Mediterranean Sea – Greece	2000	9.8 million	6159	0.63	Caminas 2004, Laurent et al. 2001
Pacific Ocean – Australia	1993	0.5 million	1	0.02	Miller 1994
Pacific Ocean – Australia	1997-2001	68 million	272	0.004	Robins et al. 2002
Costa Rica	1991	0.003 million	84	3.0	Segura and Arauz 1995
Costa Rica	1997	0.002 million	34	19.42	Arauz et al. 1999
Costa Rica	1999, 2000	0.04 million	262	6.7	Arauz 2001
West Pacific/S. China Sea	1988-1989	No data	21,200	0.1	Nishemura and Nakahigashi 1990
Pacific Ocean – Hawaii	1994-1995	11.8 million	752	0.06	Skillman and Kleiber 1998
Pacific Ocean –	2000	0.8 million	46	0.6	Ito and Machado 2001

Hawaii					

[1]Table adapted from Beverly and Chapman (2007). Only information that is relatively complete is included.

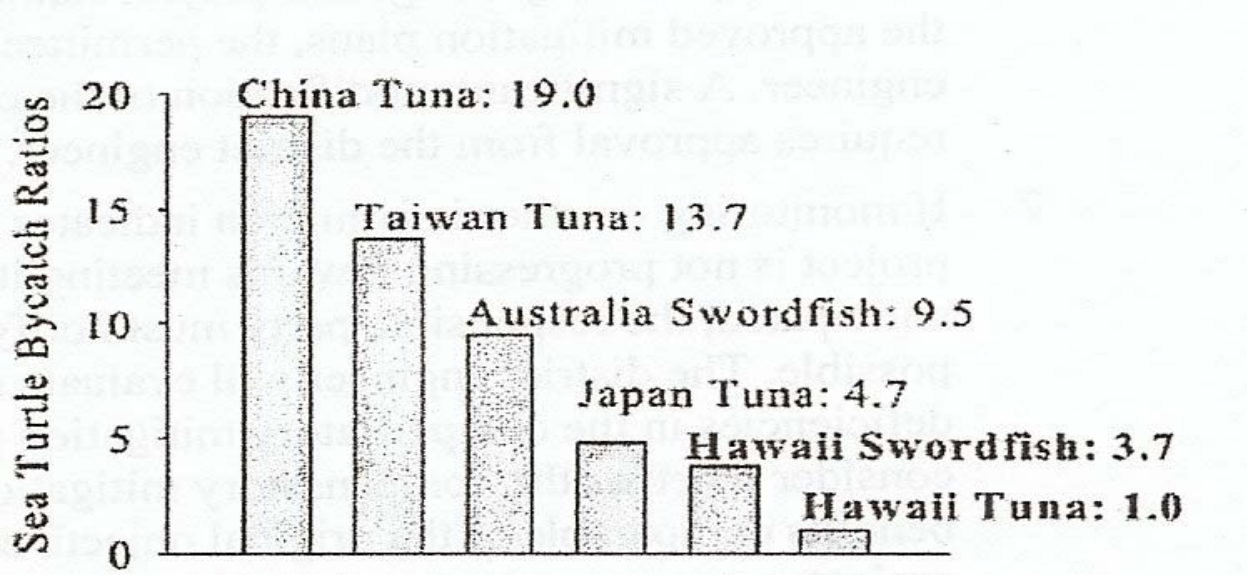

Figure 2. Sea turtle bycatch to target catch ratios (per 190,000 kg of fish) of the Hawaii-based longline fisheries for swordfish (shallow-set) and tuna (deep-set) with other longline fisheries operation in the central and western Pacific (Kaneko and Bartram 2008).

The shallow-set component of the Hawaii-based longline fishery traditionally interacted with far more turtles than the deep-set component, although mortality of turtles in shallow-set gear is typically lower than in deep-set gear because turtles are more likely to be able to reach the surface to breathe in shallow sets (NMFS 2008a). The Hawaii-based shallow-set longline fishery fleet experienced almost 90% reduction in sea turtle bycatch from the period before turtle regulations were implemented and after such implementation (Gilman and Kobayashi 2007, Gilman et al. 2007, Kaneko and Bertram 2008, Figure 3). After the regulations were implemented, the 2007 shallow-set component of the Hawaii-based longline fishery had 5 interactions with a leatherback turtle, 15 with a loggerhead turtle, and 1 with an olive ridley turtle, down from an estimated annual bycatch of 7 green turtles, 34 leatherback turtles, 21 loggerhead turtles, and 42 olive ridley turtles before the regulations were instituted (NOAA Southwest Region Report 2008).

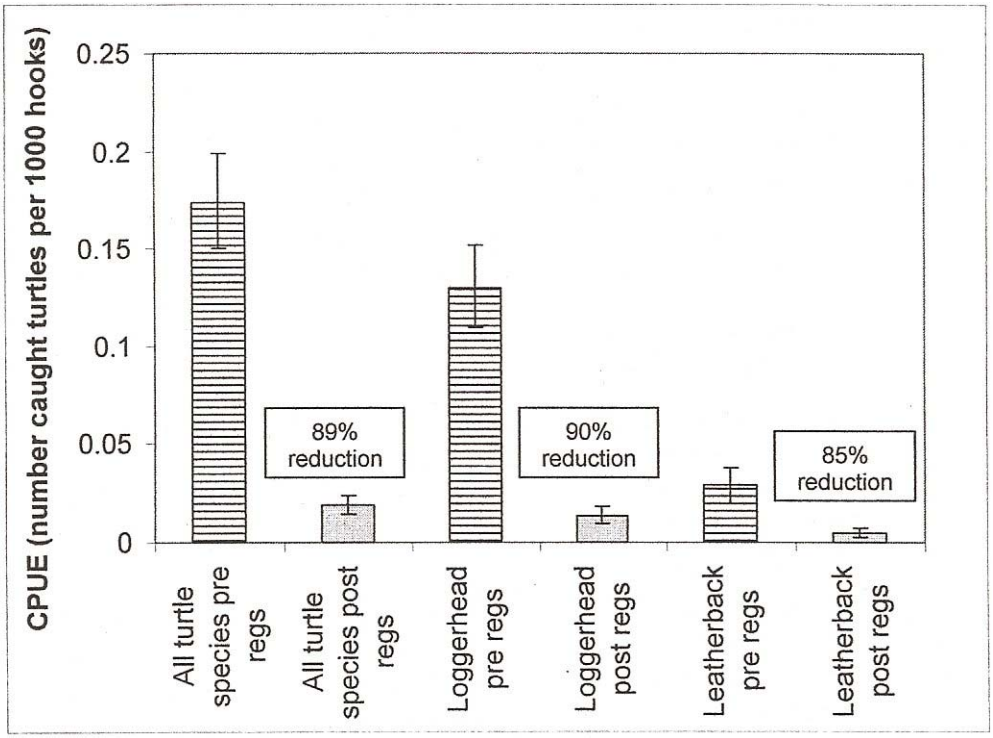

Figure 3. Change in sea turtle capture after implementation of bycatch regulations in Hawaii swordfish longline fishery

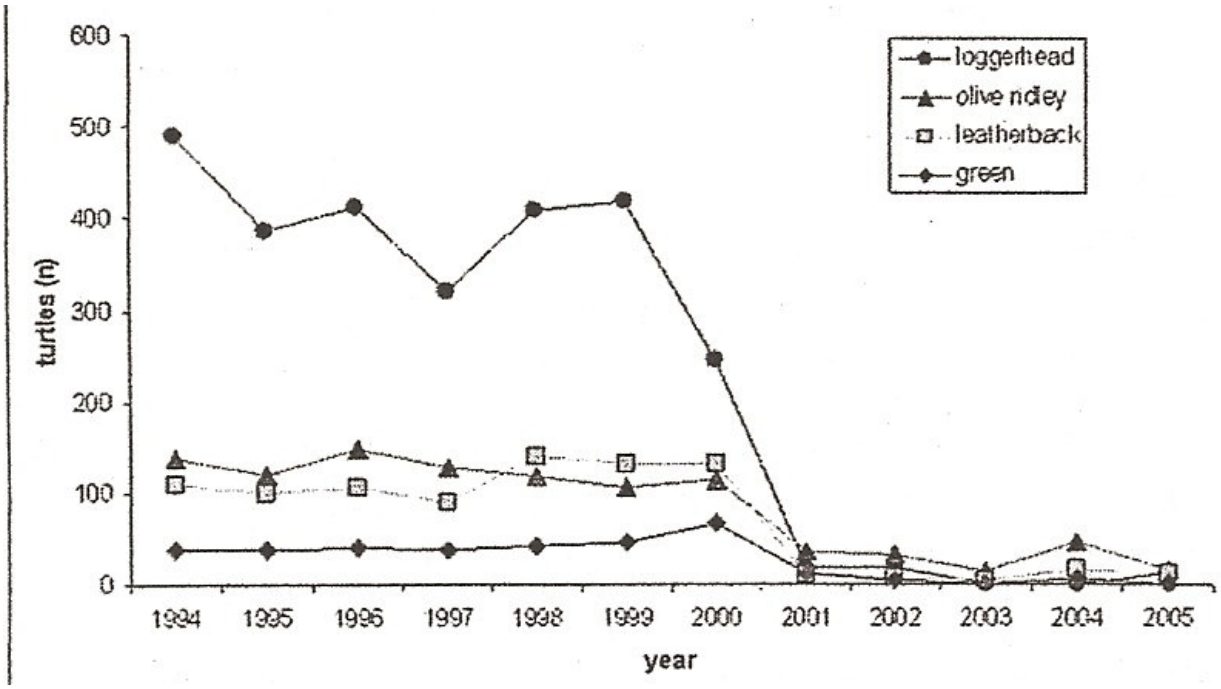

Figure 4. Estimated annual turtle interactions in the Hawaii-based longline fishery (deep-set and shallow-set combined), 1994-2005. (WPRFMC 2008).

Summaries of records of turtle bycatch in shallow-set longline fisheries compiled by Beverly and Chapman (2007) document that most sea turtles hauled in alive are released alive. However, turtles that swallow the hook have a higher risk of dying after release. Modified gear, including large diameter circle hooks with fish bait, used on boats with dehooking equipment by a trained crew such as is required in the Hawaii-based longline fishery, substantially reduced sea turtle bycatch and mortality of bycaught turtles (Boggs and Swimmer 2007, Read 2007, Gilman et al. 2007, Figure 3, Figure 4). In addition to substantially decreasing sea turtle bycatch, changing bait from squid to fish also decreased shark bycatch substantially (Boggs and Swimmer 2007, Gilman et al. 2007). More sea turtles were lightly hooked than deeply hooked after the Hawaii-based regulations requiring circle hooks and fish bait were implemented (Gilman and Kobayashi 2007, Figure 5, Figure 6), resulting in an apparent decrease in post-release mortality, although mortality rates are difficult to determine long-term (Ryder et al. 2006, Beverly and Chapman 2007). These general trends were also found in studies conducted in Italy, Brazil, Uruguay, and Indonesia (Boggs and Swimmer 2007).

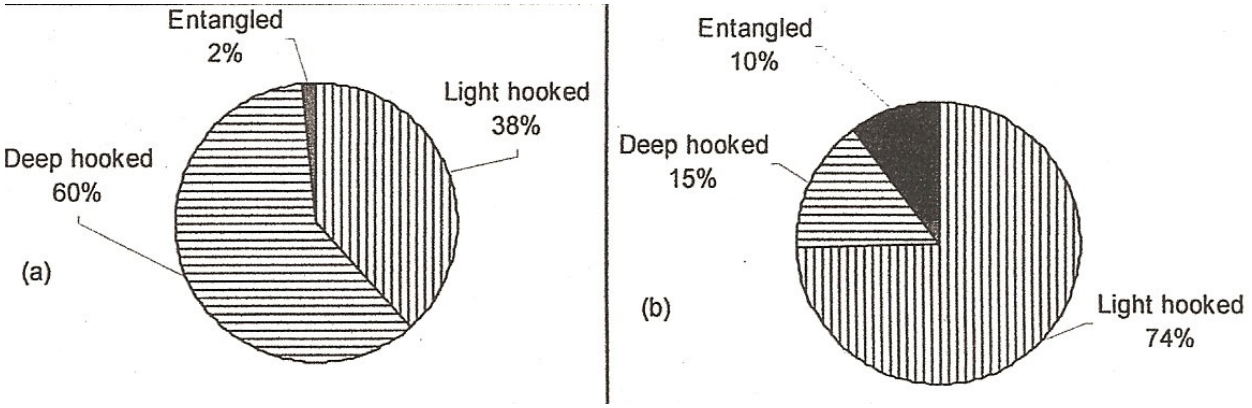

Figure 5. Severity of hooking of hardbacked sea turtles before and after implementation of sea turtle bycatch regulations in Hawaii longline fishery

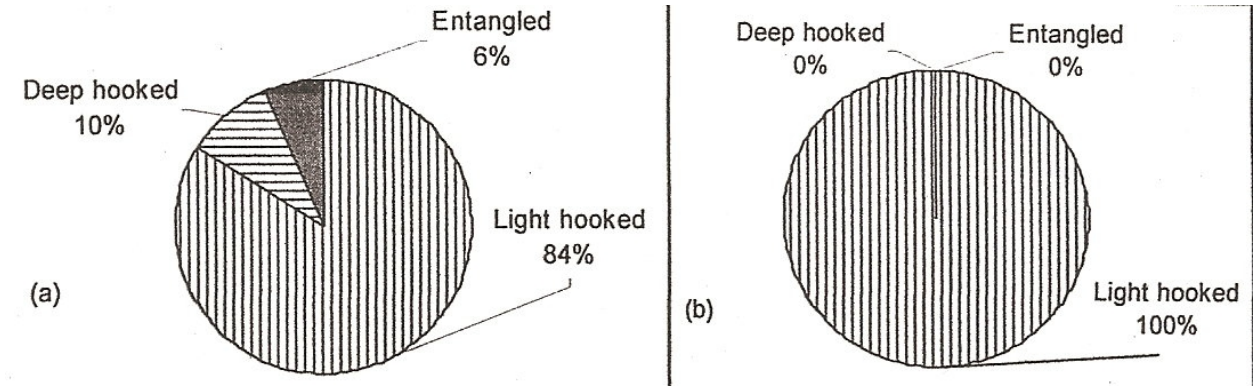

Figure 6. Severity of hooking of leatherback sea turtles before and after implementation of sea turtle bycatch regulations in Hawaii longline fishery

1.3 Regulatory Basis for Reducing Sea Turtle Bycatch in Domestic and International Longline Fisheries

Because Hawaii-based longline fishery vessels occasionally incidentally hook threatened and endangered species of sea turtles, they have been the subject of consultations required by Section 7 of the Endangered Species Act (ESA). These consultations have resulted in publications of Biological Opinions prepared by NMFS which contain discretionary and nondiscretionary measures for protection of listed sea turtles.

The original Biological Opinion for both the Hawaii-based shallow-set and deep-set longline fishery (as well as the American Samoa longline and regional non-longline pelagic fisheries combined) was prepared in 2004 (NMFS 2004). Formal consultation was re-initiated for the deep-set component of the longline fishery in 2005 when the limit for incidental take of olive ridley sea turtles identified in the Incidental Take Statement was exceeded in 2004 (NMFS 2005). The Biological Opinion for the Hawaii-based deep-set longline fishery, which primarily targets tuna in the Pacific Ocean, was prepared in 2005 (NMFS 2005).

The original 2004 Biological Opinion for the Hawaii-based shallow-set fishery evaluated the use of large diameter circle hooks baited with fish instead of squid. This Biological Opinion limited effort in this sector of the fleet to 2,120 sets annually (based on 50% of the average annual number of sets fished from 1994 through 1999), and set "hard caps" on the interactions with leatherbacks and loggerheads to 16 and 17, respectively, for the shallow-set fishery.. In 2008, the Western Pacific Regional Fishery Management Council evaluated and recommended an increase in the number of sets to be that of the maximum number of sets fished in the Hawaii-based fishery between 1994 and 1999 (5,550 sets, an increase from the current 2,120 sets), ultimately maintained the cap on annual interactions for leatherback sea turtles at 16 as a precautionary measure (down from the proposed cap of 19), and increased the annual cap for incidental interactions with loggerhead turtles from 17 to 46 annually (WPRFMC August 2008a, WPRFMC October 2008b). These recommended changes to the number of sets were evaluated in the Draft Supplemental Environmental Impact Statement (DSEIS) for Amendment 18 to the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region (WPRFMC 2008) and the caps were set as non-discretionary Reasonable and Prudent Measures No. 1 for loggerhead and leatherback sea turtles (NMFS 2008a).

In addition, the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (MSA) of 2006 (Public Law 109-479), which was signed into law in January 2007, amends the High Seas Driftnet Fishing Moratorium Protection Act (Moratorium Protection Act, Public Law 104-43) to require the United States to take actions to, among other things, address bycatch of protected living marine resources by vessels of foreign nations. Per the Magnuson-Stevens Act National Standard 9, the National Standard regulating bycatch in fisheries, (50 CFR 600.350), the first priority for reducing bycatch should be to avoid catching bycatch species where possible, and, to the extent that bycatch cannot be avoided, minimizing mortality of such bycatch; that reducing bycatch is mandatory to the extent practicable; and that NMFS, rather than the Fishery Management Councils, has the responsibility to implement bycatch reduction management measures. The existing program for the deep-set fishery (NMFS 2005) and the existing and proposed program for the shallow-set fishery are both consistent with National Standard 9 because they continue to use circle hooks and mackerel bait, which have been shown

to substantially reduce and mitigate sea turtle bycatch, and seabird mitigation such as night-setting. Internationally, the Moratorium Protection Act provides for assistance to nations in qualifying for certification, which includes transfer of effective technology. The Act requires establishment of procedures to certify whether identified nations are taking appropriate corrective actions to address bycatch.

The need for research on reducing sea turtle bycatch and transferring successful technologies to foreign fleets is further emphasized in the Recovery Plans for U.S. populations of Atlantic green turtle (NMFS and USFWS 1991a), Atlantic loggerhead turtle (NMFS and USFWS 1991b), Atlantic leatherback turtle (NMFS and USFWS 1992), Atlantic hawksbill turtle (NMFS and USFWS 1993), east Pacific green turtle (NMFS and USFWS 1998a), Pacific hawksbill turtle (NMFS and USFWS 1998b), Pacific leatherback turtle (NMFS and USFWS 1998c), Pacific loggerhead turtle (NMFS and USFWS 1998d), Pacific olive ridley turtle (NMFS and USFWS 1998e), and Pacific green turtle (NMFS and USFWS 1998f). A Priority #1 (highest priority) goal for east Pacific green, olive ridley, Pacific green, Pacific leatherback and Pacific loggerhead turtles is to monitor and reduce incidental mortality in commercial and recreational fisheries. It is a Priority #2 goal for the Pacific hawksbill, and a Priority #3 goal for Atlantic hawksbills. To monitor fisheries causing turtle mortality and to promulgate regulations to reduce fishery-related mortality are Priority #2 goals for Atlantic green, Atlantic leatherback and Atlantic loggerhead turtles.

Therefore, the proposed research in the domestic and foreign longline fleets and transfer of technology to foreign fleets would meet the requirements of the Endangered Species and Magnuson-Stevens Acts, as well as the recommended actions in sea turtle recovery plans regarding deep-set (targeting tuna) and shallow-set (targeting swordfish) pelagic longline fisheries. However, it is clear that only through cooperative international efforts can the total impacts to global sea turtle populations caused by longline fishing be reversed.

1.4 Scope of Analysis of this EA

1.4.1 Temporal Scope

This Programmatic Environmental Assessment (PEA) provides the detailed descriptions of ongoing and proposed NMFS PIFSC FSBAD research programs for continuing and expanding the program for reducing bycatch of sea turtles while maintaining or improving catch per unit effort (CPUE) of target swordfish and tuna fish species. It includes related FSBAD actions that are ongoing as well as expansion of those actions by PIFSC for meeting stated objectives.

This PEA has no termination date; it is intended to provide the basis for long-term continuation and potential expansion of existing research activities. As long as individual projects are conducted as described in Chapter 2 and the actual impacts associated with implementation remain within the range of impacts as identified in Chapter 3, this document remains current. Per NOAA policy, the Finding of No Significant Impact (FONSI) for this PEA will be reviewed for consistency and appropriateness at least every 5 years.

1.4.2 Permit Requirements

As no directed take of sea turtles protected under the Endangered Species Act is included in the proposed action, no permit will be required per ESA Section 10. Also, incidental take of sea turtles are counted against the hard cap on turtle takes authorized in the Incidental Take Statement of the Biological Opinion on the effects of the Hawaii-based commercial shallow-set longline fishery (NMFS 2008a) and will be in compliance with the Biological Opinion for the Hawaii-based deep-set longline fishery (NMFS 2005) (Section 1.3). There would be no net increase in potential turtle captures due to the proposed research. No work would be conducted within the Papahānaumokuākea Marine National Monument (formerly Northwestern Hawaiian Islands National Monument, hereafter referred to as the Monument), as longline fishing is prohibited there. No permits are required for the ongoing and proposed expansion of the research on and transfer of technology to foreign longline fishing fleets, which will continue to maintain or reduce sea turtle bycatch, depending on the activity (research or technology transfer). All FSBAD research will be conducted in compliance with all applicable Federal and state laws, as well as international agreements.

1.4.3 Spatial Scope of this PEA

Pelagic longline fisheries conducted in any ocean: All domestic or foreign fleets/vessels or domestic or foreign governments and entities located anywhere in which longline pelagic fishing is lawful (unless an Exempted Fishing Permit is issued) that choose to cooperate with NMFS PIFSC in conducting sea turtle bycatch studies related to pelagic longline fishing in the field and/or be involved in technology transfer are included within the scope of this PEA.

1.4.4 Scope of Decisions to be Made

The Responsible Program Manager (RPM; the Director of the PIFSC) will use this PEA to make the following decisions:

1. Might the current and proposed domestic and foreign research and technology transfer activities as described have significant impacts requiring analysis in an Environmental Impact Statement?
2. Should the PIFSC FSBAD continue to conduct existing research in domestic and foreign pelagic longline fleets and conduct technology transfer of sea turtle bycatch technology to foreign fleets on a programmed and consistent basis, focused on continuing to improve gear and operations to reduce bycatch of sea turtles in domestic and foreign longline fisheries?
3. Should the PIFSC expand the existing research programs and technology transfer for reducing sea turtle bycatch in domestic and foreign longline fisheries?

The analysis associated with issuing an Exempted Fishing Permit (EPF) for testing longline modified gear off the coast of California and Oregon is not included within the scope of decisions to be made. This proposed action is evaluated in the 2007 Final Environmental Assessment (SWFSC 2007) and the associated Biological Opinion (NMFS 2007). Therefore, this research is not included within the scope of this PEA.

Projects conducted by the WPRFMC for sea turtle conservation for conserving and protecting loggerhead and leatherback nesting sites in Papua Indonesia, Papua New Guinea, and Yakushima Japan (WPRFMC 2005) and reducing loggerhead mortality in coastal fisheries in Baja California Sur, Mexico (WPRFMC 2008) are evaluated in separate EAs and are therefore not included within the scope of this PEA.

1.4.5 Species caught as bycatch or targeted fisheries not included in scope of PEA decision with rationale

This PEA only evaluates and makes decisions regarding FSBAD research on sea turtles in pelagic longline fisheries. Other species are also caught as bycatch in pelagic longline research, but this PEA does not evaluate nor make decisions on research related to these other species for the following reasons:

Seabirds as bycatch in longline fisheries: Seabird mortality in longline fisheries is the most critical global threat to most albatross and large petrel species, including in the Hawaii-based longline fishery (Gilman and Kobayashi 2007). For Hawaii-based longline fisheries, regulations requiring seabird avoidance methods were first adopted in June 2001, decreasing total seabird captures from over 2,400 captures in 2000 to 88 in 2006. Subsequently, similar actions were also adopted by the Western and Central Pacific Fisheries Commission for implementation by all Commission members, cooperating non-members, and participating Territories (Western and Central Pacific Fisheries Commission 2007). Actions to decrease seabird bycatch are substantially different from those for decreasing sea turtle bycatch and do not include circle hooks and fish bait on hooks. In addition, seabird bycatch mostly occurs above 23oN and below 23oS latitude in areas where FSBAD sea turtle research does not and would not occur (Agreement on the Conservation of Albatrosses and Petrels 2007). Therefore, this PEA does not include any decisions regarding research on reducing seabird bycatch in pelagic longline fisheries.

Flatback sea turtle (Natator depressus): This species is geographically limited to the shallow waters and coral reefs of Australia, Indonesia and Papua New Guinea north of 15oS, which are outside the zones of the international longline fishery. Therefore, this species is not included within the current and proposed research program.

Kemp's ridley sea turtle (Lepidochelys kempii): Adults of this species nest along the Gulf coasts of Mexico and U.S. and the Atlantic coast of North America to Nova Scotia and Newfoundland. They forage in nearshore and inshore waters of the northern and southern Gulf of Mexico, often in salt marsh habitats, which are outside the zones of the domestic and international longline fishery. Therefore, this species is not included within the current and proposed research program for pelagic longline fisheries.

Marine mammals caught as bycatch in worldwide longline fisheries: The Hawaii deep-set commercial longline fishery is identified by NMFS as a Category I fishery per the Marine Mammal Protection Act and the shallow-set fishery is identified as a Category II fishery because these fisheries have frequent incidental mortality and serious injury of marine mammals (FR 73(231):73056, 12/01/08). This puts the Hawaiian-based longline fisheries as requiring compliance with the Marine Mammal Protection Act (MMPA), including requirements for vessel

registration, observer coverage, and take reduction plans. Analysis of studies of gear modifications for reducing bycatch of marine mammals is not included within this programmatic EA, as research on effective bycatch reduction methods for cetaceans is in preliminary stages by FSBAD and therefore the action is not ripe for decisionmaking. Analysis of potential impacts of research and gear modifications for minimizing bycatch of sea turtles on specific marine species is found in Section 3.2.

1.5 Issues Not Considered in Detail in this PEA with Rationale

This PEA evaluates impacts to potentially affected resources that might be caused by the existing and proposed FSBAD research program for reducing sea turtle bycatch in pelagic longline fisheries. The following issues are not analyzed in detail in relation with this specific sea turtle bycatch research in this PEA because there is no potential for adverse impacts caused by the research program:

Potential impacts to target tuna and billfish: The objective associated with all PIFSC research and technology transfer for reducing sea turtle bycatch in domestic and foreign longline fisheries is to maintain target CPUE; otherwise the modified gear/operations would not be implemented in foreign fisheries. Many measures intended to manage overfishing situations worldwide in international waters are identified and implemented through the Regional Fisheries Management Organization framework. Member nations are obligated to implement these measures in their national fisheries. Any contribution to an overfishing situation made by U.S. flagged vessels are managed by the appropriate Fishery Management Council(s) through regulatory actions. The FSBAD research and technology transfer programs are not expected to take higher numbers of target species than taken under current fishing levels. Therefore, no adverse impact to populations of target species is expected as the result of the research.

Environmental and economic impacts associated with transfer of bycatch reduction technologies: Widespread adoption of turtle bycatch avoidance measures will depend on the impact to fishery revenues, including costs of materials and supplies and their effectiveness at maintaining or improving CPUE of target species. Bycatch avoidance methods that maintain or increase fishing efficiency on target species and have operational benefits have the best chance of being voluntarily accepted by industry. However, the scope of this PEA is necessarily limited to assessment of the potential environmental effects of conducting focused turtle bycatch reduction experiments. It is not intended to and does not address the potential environmental effects of widespread adoption of gear or other operational strategies for reducing turtle bycatch.

Coastal zone under the jurisdiction of the State of Hawaii: All longline fishing conducted by NOAA Fisheries on contracted vessels within the Hawaii-based longline fishery would be conducted outside the 3-nautical mile zone under the jurisdiction of the State of Hawaii. Therefore the Coastal Zone Management Act would not apply.

Sea turtle critical habitat (Endangered Species Act): No critical habitat has been designated for the loggerhead, olive ridley or Kemp's ridley sea turtles. Critical habitat for leatherback (St. Croix, US Virgin Islands), green (Culebra Island, Puerto Rico), and hawksbill sea turtles (Puerto Rico) are all designated for protection of important nesting beaches and would not be within areas identified for longline fisheries. The decision whether to designate critical habitat for

Pacific leatherback sea turtles off the coast of California is currently under consideration. Any research conducted within critical habitat designated in the future will require appropriate compliance with the Endangered Species Act. Therefore, this issue will not be considered further in this PEA.

Mediterranean monk seal: The Mediterranean monk seal is listed as critically endangered by the IUCN and is listed on Appendix I of CITES. Only 250 to 300 individuals remain in the northeastern Mediterranean Sea, mainly at remote locations in the Ionian and Aegean Seas and the Cicilian Basin (two other small populations exist off Portugal and northwestern Africa). Based on a review of the literature, a questionnaires of professional fishers, and necropsies, only one Mediterranean monk seal was known to become entangled in longline gear, and that juvenile animal released itself. Entanglement in static gill nets is the highest source of fishing-related mortality (Karamanlidis et al. 2008). However, the FSBAD program using modified gear would reduce the risk of interacting with a Mediterranean monk seal further. Therefore, this issue will not be considered further.

Hawaiian monk seal: The Hawaiian monk seal is listed as endangered per the US Endangered Species Act. Most of the extant Hawaiian monk seals live in the NWHI, but numbers are increasing in the Main Hawaiian Islands. The number of sightings tends to decrease moving to the southeast along the MHI island chain toward the islands with higher levels of development and human densities and activities. On all islands, seals tend to frequent remote areas where human presence or access is limited, although individual seals may use public beaches or become habituated to human presence and even interaction in the MHI. In the MHI, monk seals are in the nearshore waters where pelagic longline fishing does not occur.

A total of 38 seals have been observed with embedded hooks in the MHI during 1982 through 2006 (National Marine Fisheries Service unpublished data). For most of the interactions, the hooks were not always recovered, and it was not possible to attribute each hooking event to a specific fishery. It is possible that some of the hookings occurred in recreational fisheries. Since the 50 nm buffer around the NWHI was established, prohibiting longline fishing within the buffer, no interactions with Hawaiian monk seals and longline fisheries have been recorded (B. Antonelis, PIFSC, per. comm. July 2008).

In recent years, under the current program, there have been few instances of monk seals observed interacting or having interacted with fishing gear. NMFS has been and continues to be increasingly successful in identifying and dehooking seals with embedded hooks around the MHI.

It is not expected that Hawaiian monk seals would be associated with any open ocean areas within which field trials or domestic or foreign longline fishing tests would be conducted using modified gear. Therefore, the existing and proposed actions would have no effect on the endangered Hawaiian monk seal. This was also determined by NMFS in the Biological Opinion for the proposed Amendment 18 (NMFS 2008a). This issue will not be considered in detail in this PEA.

Hawaiian monk seal protected areas and critical habitat: Amendment 3 to the WPRFMP Pelagic Fishery Management Plan (WPRFMP 1986), implemented by rules published at 56 FR 52214 (18 October 1991; which made permanent previous emergency actions published at 56 FR 15842, 18 April 1991 and 56 FR 33211, 19 July 1991), established a zone in the Northwest Hawaiian Islands (NWHI) in which pelagic longline fishing is prohibited to protect endangered Hawaiian monk seals. The zone extends 93 km (50 nmi) seaward from each of the islands in the NWHI, and includes certain 185 km wide (100-nm) monk seal migration corridors between islands where the exclusion areas are not contiguous. This area encompasses critical habitat designated in 1988 (53 FR 18990, May 26, 1988; 50 CFR 226.201). Therefore, no impact would occur on this designated critical habitat and this issue will not be considered further.

Other marine mammals: The dugong (Dugon dugon) is found in the western and southwest areas of the Pacific Ocean and the West Indian manatee (Trichechus manatus) is present in the western central Atlantic, but these are nearshore coastal species that would not be within areas where pelagic longline fisheries are conducted. The Stellar sea lion (Eumetopias jubatus) range is primarily the northern Pacific Ocean and generally does not range further south than central California, outside the area of pelagic longline fisheries in the Pacific Ocean. They find prey in nearshore areas and haul out on land. Therefore, the Stellar sea lion is not known to interact with longline fisheries (York et al. 1996). Therefore, these three species will not be considered further. Potential impacts to other marine mammals are evaluated in Section 3.2.

Other marine mammal critical habitats: Critical habitat for the northern right whale (Eubalaena japonica)is restricted to nearshore areas off of New England and the southeastern United States, with additional proposed areas for Alaska. No critical habitat has been designated for the listed sperm whale (Physeter macrocephalus), blue whale (Balaenoptera musculus), fin whale (B. physalus), and sei whale (B. borealis). Critical habitat has not been designated for humpback whales, but protections are provided by the Humpback Whale National Marine Sanctuary while humpbacks are on their winter grounds in Hawaii. Stellar sea lion critical habitat includes rookeries, haulouts, and associated areas in Alaska, California, and Oregon. As none of these areas involve pelagic longline fishing areas, this issue will not be considered further.

Seabirds as bycatch in longline fisheries: Mortality in longline fisheries is the most critical global threat to most albatross and large petrel species, including in the Hawaii-based longline fishery (Gilman and Kobayashi 2007, US Fish and Wildlife Service 2002, US Fish and Wildlife Service 2004). For Hawaii-based longline fisheries, regulations (NMFS 2008a) requiring seabird avoidance methods were first adopted in June 2001, decreasing total seabird captures from over 2,400 captures in 2000 to 88 in 2006. Seabirds were not identified as potentially impacted species in the 2008 Hawaii-based shallow-set longline fishery Biological Opinion (NMFS 2008a). The Supplemental Draft EIS for Amendment 18 to the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region (WPRFMC 2008) identified that a two-order of magnitude reduction in albatross interactions in the Hawaii-based fishery as a whole occurred after the fishery was re-opened in 2004 and following implementation of regulations designed to reduce seabird catch rates (decrease of over 83%). Therefore, no effects are expected to seabirds from FSBAD research on sea turtle bycatch reduction and this issue will not be considered further in this PEA.

Essential Fish Habitat (EFH)/Habitat Areas of Particular Concern (HAPC) in areas fished by foreign longline fleets: The MSA identifies EFH as those waters and substrates necessary to fish for spawning, breeding, feeding, and growth to maturity. HAPC is defined as areas where the ecological function of the habitat is important, habitat is sensitive to anthropogenic degradation, development activities are or will stress the habitat, or the habitat type is rare.

The following FMPs might be applicable to the research:

- Highly Migratory Species FMPs for the Pacific Ocean, the Coastal Pacific Ocean, and the Atlantic Ocean
- Pelagic Fisheries
- Bottomfish and Seamount Groundfish
- Precious Corals
- Crustaceans
- Coral Reef Ecosystems

As the gear used for fishing in the field or transferred to foreign vessels would be modified, and the number of sea turtles taken would be less than that caught as bycatch without the modified gear, no impacts to EFH or associated HAPC would occur. No adverse impacts to any aspect of the water column, nor to any benthic habitats, because all pelagic longline gear would be fished in the water column. EFH and HAPC have not been identified in areas fished by foreign participating fleets and therefore will not be considered in detail. All experiments are conducted within the laws and regulations of the participating nation, including regarding discharges from vessels. Therefore, no adverse impacts would occur to EFH and or associated HAPC and this issue will not be considered further.

Unique, historic, archaeological, and protected resources: The proposed action regarding reducing bycatch of sea turtles would have no effect on archaeological, social or cultural resources; scientific, historic or cultural sites; or public health or safety. It would not affect National Scenic or National Historic Trails, Wild and Scenic Rivers, National Marine Sanctuaries, or National Estuarine Research Reserves. It would not have a disproportionate environmental or health effect on low-income or minority populations, nor would it impinge on the religious freedom of any group. It would not contribute to the introduction or spread of nonindigenous species. Therefore, these issues will not be considered further.

Impact on economies of foreign nations: The intent of the controlled studies on the relative CPUE is to evaluate the effectiveness of the modified gear on catch level compared to the original gear. Foreign fleets would only use the modified gear if it did not affect their revenues. Additionally, gear that does not catch nontarget sea turtles would have more hooks available for catching the target fish. Therefore, no adverse impact is expected for the use of modified gear on the economies of foreign nations and this issue will not be considered further.

1.6 Anticipated Use of this PEA for Future Research Program Actions

Any individual research project implemented within the described program and documented as consistent with this PEA and its associated decision can be implemented without further compliance with the National Environmental Policy Act (NEPA). However, any site-specific and/or project-specific actions that would be added to the program long-term and not specifically covered under this PEA or other PIFSC PEAs and that would potentially have environmental adverse impacts not evaluated in this PEA will need additional appropriate NEPA analysis in a supplement to this PEA (40 CFR 1502.9) or a new NEPA analysis. Any supplement to this PEA or new NEPA documentation shall not affect the analysis or decisions in this original PEA nor any other proposed project consistent with this PEA or any other PIFSC PEAs unless specifically stated in the subsequent supplement or NEPA document.

Any site-specific or project-specific actions that are not covered in this PEA or another NEPA document and that would not have any additional environmental considerations that have not already been addressed in this PEA or a previous EA, or that are purely administrative, conducted entirely within a laboratory without the use of live subjects caught in the wild for the purpose of the research, or purely technical in nature can be addressed in the research project implementation plan and protocol for the specific project. Possible examples include computer modeling and data analysis or technical support and advice. For any short-term project not consistent with this PEA, a categorical exclusion memorandum can be prepared if in compliance with NOA216-6(a) or (d), and having no exceptions to the use of a categorical exclusion.

2 Alternatives and Mitigation Measures

2.1 Alternatives Considered in Detail

2.1.1 No PIFSC research on reducing bycatch in domestic and international longline fisheries (No Action Alternative)

The No Action Alternative involves not conducting PIFSC-sponsored and/or funded efforts at reducing sea turtle bycatch in the domestic and international longline fisheries. Not conducting these activities would be contrary to the current Biological Opinions for the Hawaii-based longline fishery and the Moratorium Protection Act, as well as inconsistent with sea turtle recovery plans (Section 1.3).

2.1.2 PIFSC continues current programs but does not expand those programs (Current Program Alternative)

This alternative encompasses the current field research and technology transfer program conducted by FSBAD for reducing bycatch of sea turtles in domestic and foreign longline fisheries. FSBAD research efforts, including international studies conducted in collaboration with other governmental and nongovernmental entities, as well as in the Hawaii-based longline fleet that have been ongoing would continue. All current research involves no directed take of sea turtles, which would require a Section 10 permit per the Endangered Species Act, and no directed take is proposed for any expansion of the program under the Proposed Action.

The following actions are included in the current program evaluated in this PEA:

PIFSC research using contracted vessels in the Hawaii-based longline fishery: A number of vessels in the Hawaii-based longline fleet have been contracted (not chartered) to test modified longline gear under statistically-controlled conditions. To date, the controlled studies conducted on the contracted boats have involved the use of alternate gear and bait colors, alternate fishing depths and times, and specific types and sizes of circle hooks (Boggs 2004). Initial experiments in 2002 employed five vessels in several experiments to:

- Determine if modified fishing methods would remain commercially economically viable.
- Measure the time and duration of turtles being hooked on the line prior to being brought to the surface (using hook timers) to better understand and avoid the times of day when sea turtles are most vulnerable to hooking,

Results indicated that stealth gear using blue-colored gear and bait and low-spectrum yellow lightstick lures, deep fishing for swordfish during the day when they swim deep rather than at night when they swim shallow, and circle hooks significantly reduced swordfish catch rates in these experiments (Boggs 2004). No conclusions were reached (or expected) regarding turtle hooking rates from the few turtles caught. These experiments were authorized under an ESA Section 10 Permit for Scientific Research (#1303), which was subsequently withdrawn as a result of litigation. Other research indicated that blue-colored gear and bait was not sufficient camouflage for sea turtles (Swimmer et al. 2005).

Alternating circle and traditional tuna hooks (e.g., tuna or J hooks) on foreign vessels, with observers on board to determine differences in catch rates of target species: Current experiments involve furnishing foreign vessels with large circle hooks (18/0) alternated with traditional tuna hooks throughout each set to test catch rates of these hooks for target fish species when used during normal tuna longline fishing operations. Participating countries include Italy, Spain (coastal fishery), Ecuador, Peru, Brazil, Mexico (Gulf fishery), Costa Rica, Uruguay, and Guatemala. Some technical consulting has been exchanged with Japanese scientists conducting longline fishery testing of circle hooks using research vessels, mostly using methods like those used in the shallow-set fishery for swordfish and shark in the North West Pacific, but also using deep-set tuna fishery methods in the equatorial Pacific.

NMFS collaboration with the World Wildlife Fund (WWF) and other organizations involved in international turtle conservation efforts: This program involves providing hooks and dehooking devices for use in several Central American and Asian fisheries, including Indonesia, Papua New Guinea (PNG), Viet Nam, and the Philippines.

NMFS, Western Pacific Fishery Management Council, Inter-American Tropical Tuna Commission (IATTC) and the World Wildlife Fund (WWF) Cooperative Studies in Ecuador: NMFS, along with Western Pacific Fishery Management Council, Inter-American Tropical Tuna Commission (IATTC) and the WWF, is actively involved in testing modified hooks (such as relatively large circle hooks) and bait types (such as comparing fish and squid bait) throughout Central America. Preliminary results documented by Largacha et al. (2005) for the first year of the effort from March 2004 through March 2005 found dramatically reduced leatherback and

loggerhead sea turtle bycatch with circle hooks, especially larger hook sizes (16/0 and 18/0) (44% to 88% reduced interaction rates; 63% to 93% reduced mortality). Tuna catch rates were not affected, but catch rates of smaller hooks used in the mahimahi fishery (14/0 and 15/0) were reduced. Interaction rates in that fishery were reduced 16% to 37% (41% to 93% reduced mortality). More than 15,000 circle hooks were exchanged for J hooks on 115 participating vessels, and observers were placed aboard the vessels to document protected species interactions and catch rates of target species (Largacha et al. 2005).

PIFSC continued collaborative research efforts with foreign fleets and countries: The intention of this continued collaboration is to assist foreign fleets having frequent interactions with sea turtles to work toward conservation of sea turtles and to collect pertinent data about longline-sea turtle interactions. Many foreign fisheries have sea turtle catch rates are believed to be higher than in the highly regulated U.S. fisheries (Section 1.2.3, Table 1).

This work provides an opportunity to collect statistically powerful results regarding the efficacy of alternate gear in reducing turtle bycatch. At the same time, the opportunity to convert even a portion of the gear used in these fisheries to more turtle-friendly alternatives in experimental trials has some immediate benefit in reducing global fisheries' bycatch. The experiments are conducted in fisheries that would otherwise have continued to operate with traditional gear, and thus would not increase incidental takes of sea turtles. The effort involves providing funds to hire observers, circle hooks to use and test, and technical advice and support for modifying operations. Advice and support for turtle bycatch reduction efforts include a variety of activities that do not often involve financial assistance, but require the time of NOAA Fisheries personnel and collaborating researchers funded through grants, including suggesting designs for experiments, and providing guidelines and training in sea turtle handling and release, forms and instructions for the collection of data, advice and assistance in the statistical analysis of data, and help in interpreting results and deriving recommendations for the types of management measures that could be effective in reducing sea turtle bycatch in different fisheries. Currently, work has been conducted in foreign fleets from Japan, Brazil, Ecuador, Peru, Guatemala, Ecuador, Chile, El Salvador, Uruguay, Spain, Italy, Indonesia, Papua New Guinea, Vietnam, and the Philippines, and is currently working with Brazil to initiate a program.

Long-term research on sea turtle bycatch by PIFSC: The Honolulu Laboratory (now PIFSC) began monofilament longline research in 1989 after a decades-long hiatus in longline research. Since 1989, 30 longline research cruises have been conducted for a total of 686 sea-days. The NOAA vessel longline research is conducted for many purposes, but primarily to investigate the selectivity of longline gear for target species while reducing bycatch of nontarget species and to study fish catchability in relation to depth and other oceanographic variables. Research is also conducted on pelagic fish and sea turtle behavior and physiology to better understand gear selectivity and catchability. Future research would include testing gear modifications to reduce selectivity for epipelagic fish bycatch, which might have spin-off benefits for sea turtles.

PIFSC laboratory studies of sea turtle sensory and behavioral biology, effects of repellents, and deployment of satellite archival tags on free-swimming turtles: In 2007, PIFSC prepared an EA (Sea Turtle Bycatch Reduction Research Activities, PIFSC, Finding of No Significant Impact signed June 7, 2007) that focused on testing gear and researching various methods that have

shown promise in reducing sea turtle bycatch and bycatch injury, but had not been proven effective. Typical experiments involved the use of synthetic shark shapes as deterrents, variations in light sticks used to attract target fish that also attract sea turtles, visual sensitivity screening and behavioral assessments of turtles and hatchlings, turtle feeding behavior and biomechanics, tests of natural pheromone and mesh metal chemical repellents, tagging of live-swimming turtles incidentally captured in longline fishing gear to evaluate movements and the effectiveness of time-area fishing closures, and serological examinations of incidentally captured turtles. These studies are either ongoing or in the planning stage and will continue under the 2007 EA.

Studies on depth fishing in deep-set gear and associated catch of target and nontarget species: PIFSC, in cooperation with other Pacific Island countries, conducted research to evaluate whether setting deep-set gear with weights with no hooks near floats to ensure that all hooks fish at intended depth would decrease bycatch of sea turtles (and other nontarget species) while maximizing catch of deep-dwelling target species (Beverly et al. in press). This research indicated that elimination of shallow hooks in the upper 100 m (330 feet) of the water column using modified gear was achieved by using weighted vertical lines suspended by floats. Interactions with other species with preferences for waters less than 100 m deep were reduced. By logical extension, the researchers suggest that the experimental gear would also reduce interactions with sea turtles.

2.1.3 PIFSC continues to conduct research on modified longline gear and expands program for transfer of successful technology to foreign fleets (Proposed Action)

The existing programs as described above would continue and would be expanded as needed, and are therefore incorporated into this alternative. Proposed and possible expansions of the current program are described in the paragraphs below. All of these projects could be conducted on contracted vessels in the domestic longline fleet or on foreign longline vessels. Any incidental sea turtle take on contracted vessels in the Hawaiian longline fleet would count toward the cap on incidental takes set per the Endangered Species Act Biological Opinion for the shallow set longline fisheries (NMFS 2008a).

As the Hawaii-based fleet is better observed (100% observer-coverage required) and regulated than foreign fleets, the results can often be more rigorously evaluated and controlled. The frequency of turtle interactions will be relatively low and closed if turtle caps in the shallow-set fishery is reached (NMFS 2008a) , so projects will focus on testing or demonstrating the economic viability and efficacy of fishing modifications for reducing or eliminating sea turtle bycatch. However, some tests conducted in foreign fleets would require a scientific observer provided by NMFS or the contractor to ensure that the unbiased protocols developed by FSBAD are carefully followed to ensure reliable data.

No project would test any modification that is prohibited by fishery regulations.

In addition to the countries identified in the current program, other countries may be included, such as the Cook Islands.

Descriptions of Actions Included

1) Evaluate modifications to gear and/or operational factors on fishing boats in domestic and foreign fleets. Conduct operations using modified longline gear or modified timing or logistics of operations, along with instrumentation for gear monitoring and oceanographic sampling, to investigate variables which may alter the vulnerability of sea turtles and target fish species to being captured by the gear. In addition to sea turtles, particular interest would be in maintaining or increasing the CPUE of target tunas, sharks, marlins, other billfishes, dolphinfish (mahi mahi), and associated species.

The protocol for assisting foreign fishermen in conducting tests of fishing gear to reduce sea turtle bycatch under this action is to modify fishing effort that would have been conducted in any case. However, to consider the worst case where unforeseen circumstances might curtail fishing operations had these not been financially-assisted (contracted) by NOAA Fisheries, the magnitude of financially-assisted fishing effort is compared to background levels of fishing effort. Financially-assisted gear testing in foreign fisheries would never exceed a maximum of about 200,000 hooks in any year, throughout the world.

Methods for effectively reducing sea turtle bycatch while maintaining economic viability in particular circumstances appears to include a variety of alternatives (Boggs and Swimmer 2007):

1A) Modified gear could include different types of hooks, lines, weights, floats, lights, baits, lures, fishing depths, and deterrent devices such as galvanic metals, flavors, and odors. Specific examples of anticipated work include, but are not limited to, testing:

- Hooks without barbs for efficacy in catch retention and bycatch release
- Larger circle hooks
- Hooks with appendages
- Replacement of lightweight flexible polyfilament cord main line with less flexible monofilament line to reduce sea turtle entanglement
- Modifying baits
- Weighted lines
- Increasing gear depth to reduce epipelagic bycatch and increase target catch, such as fishing for swordfish at much deeper depths than currently practiced by commercial fisheries (for example, Figure 7)
- Altered frequencies, flickering rates, intensities, and directionality of light stick lures to determine their attractiveness to target species and sea turtles

1B) Modified timing or logistics of operations could include earlier or later setting, longer or shorter soaks, and targeting or avoiding specific localities.

1C) Utilization of oceanographic sampling could include observing the structure of the water column with respect to temperature, salinity, dissolved gases, nutrients, plankton, and nekton, to determine characteristics favoring the aggregation or sparsity of target catch and nontarget bycatch species, respectively. Specific examples of anticipated work include, but are not limited to finding:

- Localities and oceanographic conditions or regimes which favor the improved economic viability of fishing for target species
- Avoidance strategies for relocating fishing operations away from localities and oceanographic conditions characterized by unacceptable levels of sea turtle bycatch

2) Collect biological data on target and nontarget species. Sample the target and nontarget catch for biological measurements and characterization of life history (size, age, size and age frequency, growth, fecundity, reproductive and somatic condition, etc); population structure (genetics, micro-constituents, parasites, etc); and tropic relationships (stomach contents, isotopes, etc); and other biological or ecological aspects of the catch. This would include tagging and releasing sea turtles caught incidentally to longline fishing to observe the subsequent movement, behavior, habitat preferences, and post-release survival of the sea turtles.

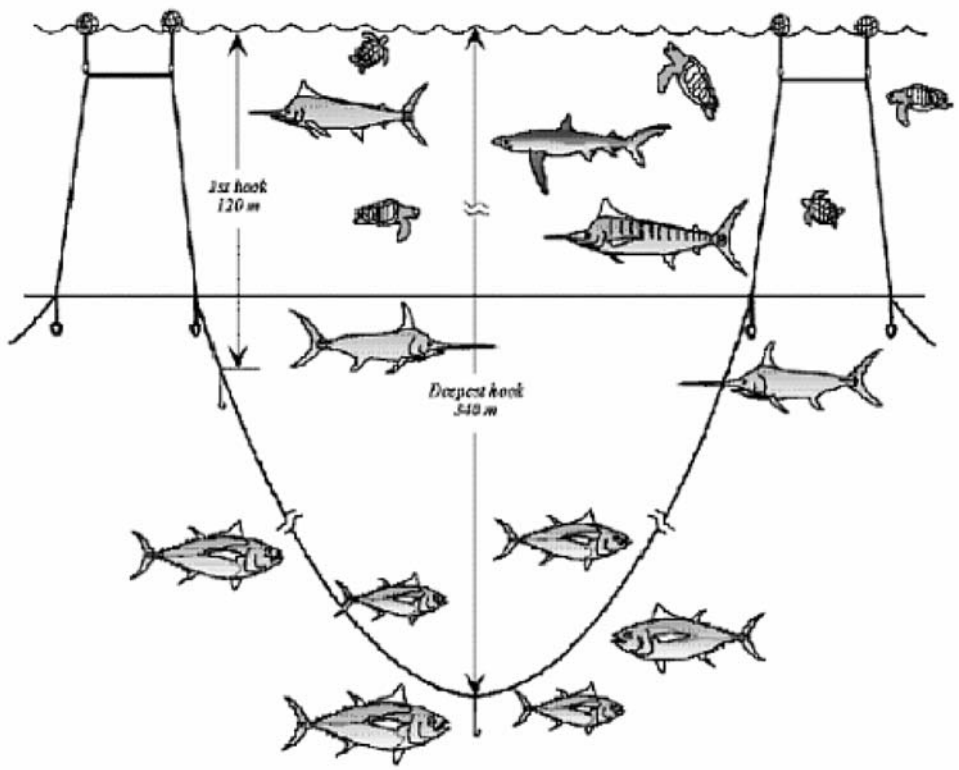

Figure 7. Deep-set longline technique for reducing the bycatch of sea turtles
(Source: http://www.smartgear.org/grand_prize2005.php)

Scale of the Proposed Action

The scale of the proposed action is bounded by the financial resources available for this work from year to year. For current experiments in foreign fisheries, contracted gear experiments (all contracts combined) are sufficiently funded to contract operations setting no more than 200,000 hooks per year, and generally substantially less. Funding could be provided directly by NOAA (for example, the Office of International Assistance) or be obtained from other entities and foreign governments. An individual deep-set longline deployment would typically include

between 800 and 1,900 hooks, and typical shallow-set deployment would include between 700 and 1,300 hooks. Funding available for providing hooks and dehooking equipment is also dependent on variable such as the price of fuel and equipment. Annual funding for technology transfer and research conducted on foreign vessels would be substantially less than the 2 to 10 vessels that can be contracted directly for gear testing each year. The hooks and equipment are provided by NOAA directly, or through other agencies, to vessels willing to use them in exchange for discontinuing use of their old hooks, or for experiments being supported by other agencies. Training is provided by NOAA.

Funds could also be provided to universities for grant support on this action for testing in either foreign or domestic fleets.

2.2 Conservation Actions Taken by Other Entities

For the past several years, the WPRFMC has worked with PIFSC, PIRO, and SWFSC to identify priorities for regional sea turtle conservation efforts, including collecting data to fill information gaps, measures to reduce direct harvest of turtles on beaches and protect nesting beach habitat, education and outreach, international management and networking, and fishery mitigation through research and transfer of effective gear technologies. Numerous workshops and meetings for planning and developing strategies for sea turtle conservation have been held. Six projects have been completed to date, including conservation efforts in Vanuatu, Mexico and Costa Rica. International agreements include the Bellagio Blueprint (2003), a multinational effort to save Pacific sea turtles; an MOU signed by Indonesia, Papua New Guinea, and the Solomon Islands to coordinate efforts to protect and save sea turtles; and the Indian Ocean and Southeast Asia MOU (SWFSC 2007).

2.3 Alternatives Not Considered in Detail

Testing gear modifications shown to increase sea turtle bycatch: NOAA Fisheries will not test gear modifications that have been shown to increase sea turtle bycatch. An example would be testing standard, unmodified J hooks or tuna hooks, except as these are used as controls for comparison of modified gear in ongoing fisheries that would not increase bycatch.

Testing gear or methods proven to greatly reduce CPUE of target species that is not offset by an increase in revenue due to substantially reduced sea turtle bycatch: The costs from sea turtle interactions can be due to depredation on hooked target species, the damage and loss of gear from catching sea turtles, reduced catch of target species because sea turtles are either hooked or have damaged the gear, safety risks to crew from handling sea turtles during gear retrieval, and reduced fishing efficiency due to time required to remove turtles from gear and repairing and replacing gear (Gilman et al. 2006). Therefore, some gear that reduces CPUE in favor of reducing bycatch may actually have increased economic benefits. Any gear that decreases CPUE to the point where revenue is not counterbalanced by decreases in bycatch would have virtually no chance of being adopted in domestic or foreign fleets. These gear modifications would only be used under controlled conditions in tests as a comparison for gear modifications to improve CPUE of target species.

2.4 ESA-Driven Measures for the Hawaii-Based Longline Fishery

The Hawaii-based longline fisheries (deep- and shallow-set) are among the most highly regulated and monitored fisheries in the world. Currently, these fisheries operate pursuant to Incidental Take Statements in two separate Biological Opinions (NMFS 2005, NMFS 2008a).

The Biological Opinion for the deep-set Hawaii-based longline fisheries (NMFS 2005) does not set incidental take caps for turtles and requires data collection, and 100% observer coverage.. Section 7 consultation must be re-initiated if incidental capture or mortality in any one year exceeds >50% of total take level specified or anticipated for multiple years for any species.

The Biological Opinion for the shallow-set fishery (NMFS 2008a), because of its higher interaction with sea turtles, set annual hard caps on take of leatherback sea turtles at 16 and on loggerhead sea turtles at 46 in the Incidental Take Statement. In addition, NMFS shall collect data on the capture, injury and mortality caused by the shallow-set fishery and basic life history information, if possible. All live sea turtles will be released alive, comatose turtles will be resuscitated if possible and dead turtles will be disposed at sea, unless needed for research.

2.5 Mitigation in Foreign Fleets

When FSBAD uses foreign vessels for research, the organization plays an active role in experimental design, funding, provision of modified gear, education and outreach materials and instruction and data management. Experimental protocols include methods for correctly handling captured sea turtles and using dehooking equipment, that are applied within the constraints of the fishery and in as close a manner to that described in NOAA guidelines for sea turtle handling and release. In addition, all participating foreign vessels would be required to comply with their current regulations for longline fishing as well as any permitting or licensing requirements, and would have scientific observers onboard. PIFSC would be responsible for ensuring compliance either directly or indirectly through their cooperating organizations such as the WWF or IATTC.

3 Environmental Consequences

3.1 No PIFSC research on reducing bycatch in domestic and international longline fisheries (No Action Alternative)

Because no field research associated with reducing sea turtle bycatch in domestic and international fisheries would be conducted under this alternative, there are no direct environmental impacts. However, indirect impacts would include continued high levels of sea turtle bycatch in domestic and international fisheries, resulting in continued declines in the population of endangered sea turtle species. This alternative would be contrary to the current Biological Opinions for the Hawaii-based longline fishery and the Moratorium Protection Act, as well as inconsistent with sea turtle recovery plans (Section 1.3).

3.2 Current and Expanded Programs: PIFSC research on reducing bycatch in domestic and international longline fisheries (Current Program Alternative and Proposed Action)

The proposed action is intended to further investigate ways to reduce the bycatch of sea turtles in pelagic longline fisheries in domestic and foreign fleets and continue to introduce effective modifications into fleets worldwide, including domestic fleets, as opportunities arise.

As the proposed action expands current research and technology transfer programs, and the impacts to appear to be similar between the two alternatives, the following impact analyses apply to both the Current Program alternative and the Proposed Action (expansion of current programs).

3.2.1 Potential Impacts to Sea Turtles

The proposed current and expanded program methods range from non-invasive behavioral, oceanographic, and gear modification studies to collecting biological data from sea turtle individuals. Impacts on sea turtles for various proposed techniques are listed in order of increasing level of human-turtle interaction. Standard operating procedures are specifically designed to minimize the impacts of these research techniques on turtles and the marine environment. It is anticipated that zero turtle mortalities would occur as a direct result of implementation of the current program alternative or proposed action. Because the proposed research is a global effort, potential impacts are evaluated by sea turtle populations as a whole rather than species-specific.

Potential impacts of research-related longline fishing gear modifications on sea turtle populations

As previously outlined in Section 1.2.3., the implementation of modified fishing gear, including large diameter circle hooks with fish bait, has already been shown to substantially reduce sea turtle bycatch and mortality of bycaught turtles, with general trends were also noted in studies conducted in Italy, Brazil, Uruguay, and Indonesia (Boggs and Swimmer 2007, Read 2007, Gilman et al. 2007). In general, proposed modifications to longline fishing gear are likely to reduce interactions with sea turtles, and as such, no direct negative impacts to sea turtle populations are expected to result from fishing gear modifications.

Potential impacts of handling live adult sea turtle individuals

Handling live sea turtles that have been stranded, captured incidental to longline fisheries, or held in captivity is one component to the proposed research methods. Uninjured sea turtles that are lightly entangled in fishing gear will be disentangled and released on site. Injured turtles that are captured by trained staff and collaborators may be transported to a facility for diagnosis and treatment by a licensed veterinarian. Whenever possible, turtles are rehabilitated and ultimately released back into their natural environment.

As with any marine research and monitoring program, there is a possibility that captured turtles could experience adverse impacts from capture, ranging from near drowning to drowning by

entanglement. Although these are not expected events, mitigation measures to minimize the potential for adverse impacts are in place, and include shortened handling time and attempted resuscitation of comatose animals. Turtles are only handled for the amount of time necessary to complete sampling, measuring, examination, and/or tagging. Data from 135 previously tagged and released turtles from 1982 through February 2006 showed that no tagged turtles found stranded were determined to have died from capture-related activities (NOAA and NMFS 2006). Therefore, no injury or mortality is predicted to occur from capturing, handling, tagging, or sampling during any of the proposed research activities, and measures are in place to minimize the risk to the animals.

While turtle mortalities are not expected as a direct result of any of the proposed research actions, an additional safety mitigation and experimental design evaluation measure is in place such that should up to two turtle mortalities occur while a research activity is being conducted, all operations involving that activity would be immediately suspended pending review of the methods and procedures. While rare, single animal mortality may occur coincidental to, but not directly resulting from, the research activity due to prior individual injury, disease, or other condition(s) unrelated to the research activity. However, in the unlikely event that a second mortality should occur during the course of the proposed research activity, the experimentation would be halted to verify that experimental design is not a contributing factor.

Importantly, these impacts would have been expected to occur in the baseline as a result of normal fishing activity. In the proposed action scenario, it is likely that fewer animals will need handling because fewer will be caught as bycatch as compared to normal (i.e., non-research scenario) fishing operations.

Potential impacts of invasive procedures such as blood sampling and tagging on sea turtle individuals

For a complete understanding of sea turtle population dynamics and life history, it is necessary to identify individuals and obtain biological samples for biochemical evaluation. Turtles are tagged with pop-up satellite archival tags (PSATs) using standard techniques (Swimmer et al. 2002, 2006); blood samples are taken using a medical grade needle and syringe (Bolten 1999, Owens 1999). All methods used are performed by trained personnel and have been peer-reviewed and used by sea turtle researchers worldwide. Blood sampling will not be taken from leatherbacks, as observers are not trained to do so. Unnecessary sampling on sick or injured animals will not be performed unless a veterinarian determines the animal is sufficiently healthy for samples to be taken. No mortality or adverse effects to turtles are expected from tagging or blood sampling.

The attachment of a radio transmitter (i.e. satellite tags) to the shell of a female sea turtle may appear to be obstructive to mating; however, this has been documented not to be the case. Females with satellite tags attached to their shell prior to the nesting season have been observed nesting, and examination of the nests after hatching indicated that successful mating/fertilization had occurred (NOAA and NMFS 2006). Additionally, transmitters continue to decrease in size as technology advances. The transmitters available for use today weigh approximately 0.1 – 0.2 kg and measure 6.5 cm x 3.5 cm x 2.5 cm. The small size of the transmitters reduces the likelihood that the animals' ability to mate or swim will be adversely affected. PSAT tags have

been shown to stay attached to the animal for up to one year without any adverse effects being observed (Swimmer et al. 2002 and 2006). A programmatic environmental assessment for the Marine Turtle Research Program at the PIFSC reaches the same conclusions, that satellite tagging poses no harm or threat to sea turtles (NOAA and NMFS 2006).

Potential cumulative impacts on sea turtle populations

Though difficult to accurately quantify, the incremental impact of the effects of the proposed sea turtle bycatch reduction research when added to other past, present, and reasonably foreseeable future actions is likely to be positive in nature. As detailed previously, the direct and indirect environmental consequences of the proposed research are expected to be minimal, as research design, methodologies, and standard operating procedures for working with endangered species in sensitive habitats are specifically formulated to minimize any negative impacts on the environment and sea turtles in particular.

The proposed current and expanded programs are likely to have net cumulative effects that are positive in that they: a) help to support current sea turtle monitoring programs in various parts of the world, b) contribute to foreign economies by purchasing supplies and hiring fisherman and observers in areas that are often economically depressed, c) establish community outreach programs and positive partnerships with foreign governmental agencies to encourage a sense of environmental stewardship, and d) are highly likely to develop into usable strategies to help reduce sea turtle interactions with fishing gear.

The proposed current and expanded programs support ESA mandates for the conservation and recovery of sea turtles. The role of the proposed research does not include making management decisions that may affect population recovery. Rather, the research and monitoring activities obtain scientific information in support of achieving the biological recovery and sound management of sea turtle populations worldwide.

The goal of reducing sea turtle bycatch is intertwined with unpredictable ongoing activities in the environment such as longline fishing, natural predation, and other forces that may influence affected ecosystems, all of which have unquantifiable influences and impacts on achieving such a goal. However, cooperation with U.S. and international regulatory agencies also aiming to reduce sea turtle bycatch and increase sea turtle stocks worldwide through fishing regulations, increased protection and awareness, anti-poaching laws, and more increases the likelihood that cumulative effects from these sources will be influential, as opposed to adverse, in the conservation of sea turtle species and habitats worldwide.

Conclusion regarding potential impacts on sea turtle populations from interaction with research-related longline fishing gear and other proposed research

Because the proposed current and expanded programs are aimed at reducing sea turtle interactions with longline fishing gear through implementation of research programs as mandated by NMFS, the potential impacts to sea turtle populations are expected to be minimal at the individual level, and cumulatively net positive at the population level.

3.2.2 Potential Impacts to Cetaceans

Potential impacts on cetaceans from interaction with research-related longline fishing gear

Interactions between marine mammals and fishing involve almost all existing fishing gear, including both hooking and entanglement of the marine mammal in the gear, as well as marine mammals removing hooked fish and bait from fishing gear (depredation), damaging gear, and eliminating potential to catch target species on hooks with captured bycatch. Cetaceans that damage gear, eat caught fish, and get caught on fishing gear can frustrate commercial fishers to the point that they have been known to kill the offending animal.

Interactions between marine mammals and longline fishing tend to be rare events and are difficult to predict. Most longline interactions are thought to be the result of toothed cetaceans, such as dolphins being attracted to the gear or boat because of the potential for food, homing in on the vessel or gear based on familiarity with its sounds. Less frequently, marine mammals, including baleen whales, are entangled in the longline gear probably as a result of their swimming paths accidentally encountering gear. Most depredation of catch or bait is believed to occur during hauling rather than setting of the gear (Gilman et al. 2006).

Many strategies have been proposed to reduce cetacean bycatch (hooking and/or entanglement) in fisheries, including changes in fishing gear and methods, regulatory constraints, and creating marine protected areas and implementing area and seasonal closures. Currently, the only known effective method to date to minimize marine mammal bycatch in fisheries involves real-time fleet communication and coordination to assist vessels in avoiding areas and periods with peak cetacean abundance (Gilman et al. 2006).

Between 1992 and 2004, a total of 200 interactions between marine mammals and U.S. Atlantic pelagic longline gear were observed. Of these, there were 10 observed mortalities and 94 observed serious injuries. One hundred of the observed interactions were with pilot whales, 64 were with Risso's dolphin, and all other species had six or fewer observed interactions (Garrison 2007).

Forney and Kobayashi (2007) reviewed marine mammal interactions in the Hawaii-based deep-set and shallow-set longline fishery and, of 24,542 sets, 67 marine mammal interactions were observed, with an average take of 2.7 cetaceans per 1,000 sets. Although sample sizes were small, cetacean deaths occurred at a similar rate in deep-set and shallow-set longline fisheries. Overall cetacean take rates appeared to be highest in shallow-set swordfish efforts (6.5 cetaceans per 1,000 sets) and lower during tuna or swordfish-style efforts (2.1 and 2.5 cetaceans per 1,000 sets, respectively). Apparent species-specific differences in take rates by set type and EEZ area are likely related to the distribution of the various species, with northern species such as Risso's dolphin taken primarily in higher-latitude swordfish-targeting sets and tropical species such as false killer whales and short-finned pilot whales taken primarily during lower latitude tuna or swordfish-style sets. These numbers may be an underestimate.

In the tropical Pacific, numerous observations of fishery interactions with false killer whales, pilot whales (Globicephala spp.), and killer whales (Orcinus orca), and at least eight species of

dolphin have been observed in the vicinity of longline gear. Sperm whales have also been observed taking fish from gear (Gilman et al. 2006).

The Hawaii deep-set commercial longline fishery is identified by NMFS as a Category I fishery per the MMPA and the shallow-set fishery is identified as a Category II fishery because these fisheries have frequent incidental mortality and serious injury of marine mammals (FR 73(231):73056, 12/01/08), including bottlenose dolphins, false killer whales, humpback whales, Risso's dolphins, short-finned pilot whales, spinner dolphins, pantropical spinner dolphins, and sperm whales. The Biological Opinion for proposed Amendment 18 determined that the endangered humpback whale would be likely to be adversely affected, but not the endangered blue whale (Balaenoptera musculus), the endangered fin whale (B. physalus), the endangered sei whale (B. borealis), the endangered sperm whale (Physeter macrocephalus), nor the endangered North Pacific right whale (Eubalaena japonica) (NMFS 2008a).

No takes of baleen whales, including sei, blue, humpback and fin whales, have been observed (12 years of observation data) in the Atlantic highly migratory species fishery (SWFSC 2007).

Intentional injury or mortality of depredating cetaceans may have important population-level effects in terms of numbers and/or distribution, especially for small isolated populations associated with oceanic islands. For example, there is concern over the ecological effects of longline interactions with genetically-distinct population of false killer whales around the Hawaiian Islands nearshore (insular) stock, Hawaiian Islands pelagic stock, and Palmyra Atoll stock, which are also genetically distinct from stocks elsewhere in the eastern Pacific Ocean. All three stocks associated with the Hawaiian Islands and Palmyra Atoll interact with foreign and domestic pelagic longline fisheries. The total annual estimated mortality and serious injury of the Hawaiian stock of the false killer whale exceeded the level allowable under the Marine Mammal Protection Act (MMPA), and this stock has been considered "strategic" under the MMPA since 2000 (Forney and Kobayashi 2007). Questions, however, have been raised regarding the assumption that insular stocks do not interact with pelagic longline fisheries and therefore whether this stock should be declassified from strategic (R, Baird, Cascadia Research Collective comments (10/08) on Pseudorca draft Stock Assessment Report, NMFS (05/08)).

Fishing experiments to test the effectiveness of sea turtle bycatch strategies conducted on domestic and foreign fishing fleet vessels would attempt to avoid areas with either reports of high cetacean presence or when the vessel has already caught a cetacean on gear, which increases the risk of catching additional cetaceans, as cetaceans often occur in groups. Known areas with cetaceans that have habituated to seeking out fishing vessels as a source of food would also be avoided. All vessels involved in field studies would have equipment for safely dehooking and disentangling any cetaceans caught in gear, with researchers experienced in its effective use. No field studies would be conducted in the Hawaiian Islands Humpback Whale Marine Sanctuary during the winter season when humpbacks are present.

Studies conducted in commercial fisheries would be expected to have cetacean bycatch no higher than that experienced by the commercial fisheries under typical conditions due to the PIFSC field studies conducted during normal fishing operations than what would occur on the domestic and foreign fishing vessels without the field study. It is highly possible the mortality would be

decreased on domestic and foreign vessels because of the availability of releasing equipment and the presence of trained research personnel to use it.

Potential direct and cumulative impacts on endangered humpback whale populations in the Pacific Ocean

While humpback whales are not typically at risk from drowning or immediate death from longline gear, they are at increased risk of starvation, infection, physical trauma, and ship strikes. Reports of entangled humpback whales found swimming, floating or stranded with fishing gear (not limited to longline gear) attached have increased in recent years in both Alaskan and Hawaiian waters. For example, reports of entanglement from Hawaii totaled 23 from 2001 through 2006; however, 16 of those were from 2005 and 2006. Many of the whales reported entangled in Hawaii waters most likely brought gear with them from higher latitude feeding grounds. Interactions between the Hawaii-based longline fisheries and humpback whales are rare and unpredictable, with only 5 observed interactions since 2001, 2 of which were with the shallow-set component. Available evidence from entangled northern right whales in the north Atlantic Ocean indicate that large whales may be able to extricate themselves, especially if the gear is not wrapped around their bodies (NMFS 2008a).

The effects of fishing gear interactions on adult humpback whales are not likely to be different between deep-set and shallow-set gear because the animals are large enough to pull themselves to the surface. NMFS determined that the proposed number of sets for the Hawaii-based longline fishery that has the potential to kill one humpback every one to two years would not result in a reduction in the numbers, distribution, or reproduction of the North Pacific population of humpback whales (NMFS 2008a). It is likely that this would also be the case for humpback whale populations elsewhere in the world.

NMFS-implemented regulations that prohibit approach to humpback whales within 100 yards when on the water and 1,000 feet in the air (50 CFR 224.103). The regulations also make it unlawful to disrupt the normal behavior or prior activity of the whales, including interruptions to feeding, nursing, or resting behaviors. National security and the ability of the Navy to conduct realistic training using SONAR was recently decided by the Supreme Court to override the potential for adverse impacts to marine mammals from the use of SONAR in the central and eastern Pacific ocean, which could set a precedent for other areas.

Conclusion regarding potential impacts on cetacean populations from interaction with research-related longline fishing gear

In summary, takes of most species of marine mammals are very rare in longline fishing (SWFSC 2007). Therefore, the existing and proposed actions would have no effect on the listed species of marine mammals or species protected by the MMPA. Other than the regulations regarding approach to humpback whales, NMFS has no control over the other potential sources of cumulative impacts to humpback whales.

3.2.3 Potential Impacts to Shark Populations

A significant bycatch issue in the Pacific Island Region as well as in many other regions of the world is the bycatch of sharks on longline and other fishing gear. In some fisheries, such as the Hawaii-based longline fisheries, shark species such as blue sharks (Prionace glauca) make up 33% of the total catch (Walsh et al. 2002), some of which are released alive, some of which are landed and sometimes finned, and some of which are discarded dead. Data suggest that blue sharks are being captured at levels close to or possibly exceeding maximum sustained yield (Clarke et al. 2006). Reports suggest that some shark populations such as scalloped hammerhead sharks (Sphyrna lewini), oceanic whitetip sharks (Carcharhinus longimanus), and tiger sharks (Galeocerdo cuvier) have decreased between 60% and 99% in certain areas (Baum et al. 2003, Baum et al. 2004). A lack of both fundamental biological information and fishery-dependent data for most shark species means that there is a high degree of uncertainty in the status of these species.

Use of circle hooks baited with squid resulted in a significant but small increase in capture of blue sharks, but when either circle hooks or J hooks are baited with fish, blue shark capture was significantly decreased (Read 2007). After the regulations requiring the use of circle hooks baited with fish were instituted in the Hawaii-based longline fishery, the CPUE of all sharks caught as bycatch declined significantly by 36%. Switching from squid to fish bait appeared to make the highest contribution to reducing the incidental catch of sharks on longline gear. Switching from squid to fish on circle hooks in the Hawaii-based longline fishery resulted in a significant and large reduction in shark capture rates without compromising target CPUE (Gilman et al. 2007).

Conclusion regarding potential impacts on shark populations from interaction with research-related longline fishing gear

Therefore, use of hooks baited with fish rather than squid in research conducted in domestic and foreign longline fleets and transferring this technology to foreign fleets to reduce sea turtle bycatch should decrease the incidental take of sharks as well, especially blue sharks, while maintaining the catch rate of target species. The use of circle hooks in the Hawaii-based shallow-set fisheries does not appear to appreciably reduce blue shark catch rates, but does appear to increase survivorship of those that are caught, based on observer records (in: SWFSC 2007). Therefore, no adverse impacts should occur to shark populations from the existing and proposed research activities, and it is expected that incidental take of sharks should decrease with the transfer of technology and use of fish bait in foreign fleets.

A cumulative impact analysis will not be conducted, as shark populations would not be impacted by the proposed action.

3.2.4 Summary of Cumulative Impacts and Climate Change Contributions

Although assessing the cumulative effects of field research projects is difficult, the past, present, and future research activities are not likely to have had or have any significant adverse effects on the environment, and have shown to be effective on reducing sea turtle bycatch without increasing bycatch of other nontarget species and while maintaining or improving CPUE of target fish. The current and proposed research and technology transfer programs are consistent

with both National Standard 9 of the MSA regarding bycatch and the ESA. Because the proposed program does not represent an increase to fishing activity and as such the impacts associated with these activities are negligible, the cumulative effect of this research and other reasonably foreseeable actions is insignificant.

Ocean climate fluctuations that change the habitat quality or the prey availability of ocean resources have the potential to affect their short- or long-term distribution and abundance. Changes in oceanographic conditions may alter rates of direct and incidental takes of ocean resources in commercial fisheries as well as research. The magnitude of potential effects is uncertain, but as applied to the smaller scale nature of the research considered here, is not likely to affect the analysis presented.

Potential cumulative contribution of climate change to humpback whale populations in the Pacific Ocean is evaluated in Section 3.2. Climate change would most likely affect sea turtles due to rising sea levels adversely impacting nesting beaches, as well as potentially on foraging habitats and prey availability, but no analyses of these impacts are available.

As indicated in Section 1.6, any changed circumstances that would have environmental relevance would require additional analysis and appropriate management changes that might be integrated into the FSBAD research program as appropriate. NMFS (2008a) has determined that cumulative effects on humpback whale and the five species of sea turtles are likely to occur as a result of worsening climate change, and any increase in fishing, ship traffic, and other actions. However, since the extent of climate change and the extent of increases in other contributory actions are unquantifiable, the corresponding effects are also unquantifiable.

Overall, the research and technology transfer programs conducted by PIFSC and in cooperation with other countries and entities as currently conducted or as expanded as proposed are not likely to have a cumulative adverse effect on populations of sea turtles, nor on sharks and marine mammals as evaluated in Chapter 3.

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