

4.6 Pacific Islands Region

The NMFS Pacific Islands Region consists of the EEZs of American Samoa, Guam, Hawaii, the Northern Mariana Islands, and the Pacific Remote Island Areas, forming the largest regional EEZ in the U.S. (two million square miles). One LME has been designated in the region, the Insular-Pacific Hawaiian LME.¹ The WPFMC, in conjunction with NMFS, is responsible for managing Federal fisheries in the Pacific Islands Region. Much of the Pacific Island culture reflects the island inhabitants' dependency on the sea. The relationship between land and sea remains close today, with fish consumption much higher than the national average, broad participation in artisanal fisheries, and several large fleets targeting HMS in the open ocean.

4.6.1 Fisheries Overview

A total of 31 domestic commercial fisheries are included in this report for the Pacific Islands Region (Table 4.6.1). Hawaii landings from these fisheries were valued at approximately \$71 million dollars in 2005.² Fisheries in this region are diverse, falling into three general categories: fisheries for deep-water bottomfish (snapper, grouper, and jack species); fisheries targeting tuna and swordfish (*Xiphias gladius*); and fisheries for crustaceans, coral reef fishes, and corals. Island-based fisheries operate in American Samoa, the Marianas, and Hawaiian archipelagos, and catches are landed almost exclusively within each local area. Not evaluated in this edition of the U.S. National Bycatch Report are the very large-scale purse seine fisheries for skipjack (*Katsuwonus pelamis*) and yellowfin tuna (*Thunnus albacares*), or the distant-water troll fishery for albacore (*Thunnus alalunga*). These fisheries are discussed in the Southwest Regional section but are not evaluated, as they operate almost entirely outside the U.S. EEZ and are managed under international agreements.

Fifty-five percent of Pacific Islands Region fisheries are federally managed (Figure 4.6.1). A few fisheries have shared Federal–state management (e.g., Hawaii bottomfish) or a state counterpart, such as the Hawaii Federal and state fisheries for precious corals.

The staff of NMFS Pacific Islands Regional Office (PIRO), Pacific Islands Fisheries Science Center (PIFSC), and the WPFMC work closely with state partner agencies the American Samoa Department of Marine and Wildlife Resources, the CNMI Department of Fish and Wildlife, the Hawaii Department of Aquatic Resources, and the Guam Division of Aquatic and Wildlife Resources to regulate and monitor the

marine species of the Pacific Islands. In 2005, the WPFMC had five FMPs in place to manage Federal fisheries.³

The Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region FMP, developed in 1986, covers a diverse group of species and fisheries that occur throughout the western Pacific region. Commercial bottomfish stocks are divided into two groups: seamount groundfish and deep-slope bottomfish. The seamount fishery includes alfonsin (*Beryx splendens*) and armorhead (*Pseudopentaceros* spp.). This fishery was never fished domestically and the only area in the U.S. EEZ where this fishery occurred (a portion of Hancock Seamount) has been closed to fishing since 1986 due to heavy overfishing of armorhead stocks by foreign trawl fleets. Deep-slope bottomfish fisheries targeting snappers, groupers, and emperors occur throughout the western Pacific, although the largest occur in the Hawaiian Archipelago. The fishery in the main Hawaiian Islands is managed through an annual total allowable catch limit to prevent overfishing. The limited-access fishery in the Northwestern Hawaiian Islands (NWHI), although exploiting a satisfactory level of biomass, was closed in 2010. The bottomfish fisheries in the other parts of the region exploit a broader depth range (including shallower areas) and a more diverse assemblage of fishes, including deepwater reef species, than in Hawaii.

Under the Crustacean Fisheries of the Western Pacific Region FMP (1981), red spiny (*Panulirus marginatus*) and slipper (*Scyllarides squammosus*) lobsters in the NWHI were harvested until 2000, when the fishery was closed due to protracted uncertainty over the status of the stocks. While smaller-scale lobster fisheries take place throughout the U.S. Pacific, the NWHI lobster fishery was of particular importance, as it was the region's most valuable demersal fishery. Although a comprehensive research program was initiated to better understand NWHI stock dynamics, all fishing in that area ended in 2001, and lobster fishing has not resumed in the interim. The fishery continues in the eight main Hawaiian Islands under state regulations. Other crustacean fisheries in the region are very small.

The Precious Coral Fisheries of the Western Pacific Region FMP, implemented in 1983, treats each coral bed as a separate management unit. The life history of corals makes them particularly susceptible to over-harvesting, and the high demand for coral jewelry and other coral products encouraged high levels of harvest prior to effective regulation. Collected species once included black, gold, and pink coral, but currently there are no active permits anywhere in the region to harvest species other than black coral. Black coral, which can be reached at depths accessible by scuba gear, is harvested by hand. A state fishery for black coral also exists in the Hawaiian Islands. The most serious conservation

¹ <http://www.lme.noaa.gov/>.

² Ex-vessel landings value, Fisheries Economics of the U.S., 2006. Available online at http://www.st.nmfs.noaa.gov/st5/publication/fisheries_economics_2006.html.

³ These FMPs were replaced by five fishery ecosystem plans (FEPs) (75 FR 2198, 14 January 2010).

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Table 4.6.1

Pacific Islands Region fisheries included in the U.S. National Bycatch Report. Fisheries are listed alphabetically, first by management authority and then by fishery name. Shaded rows indicate those fisheries for which bycatch estimates are currently available.

Fishery^a	Management Authority	Federal Fishery Management Plan (FMP)^b	Gear Type	Target Species (Common Name)	Data Sources^c
American Samoa Bottomfish	Federal	Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region	Hand Line	Deep snappers (pink, red, gray/jobfish), other snappers/jobfishes, emperors, and groupers	Creel survey data
American Samoa Lobster	Federal	Crustacean Fisheries of the Western Pacific Region	By Hand, Diving Gear	Green spiny lobster, slipper lobster	
American Samoa Pelagic Longline Fishery	Federal	Pelagic Fisheries of the Western Pacific Region	Longline	Albacore and other tunas (bigeye, yellowfin), wahoo	Logbooks, observer data
American Samoa Troll	Federal	Pelagic Fisheries of the Western Pacific Region	Troll Lines	Tunas (skipjack and yellowfin), blue marlin, dolphinfish, wahoo	Creel survey data
Commonwealth of the Northern Mariana Islands Bottomfish	Federal	Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region	Hook and Line, Electric	Shallow-water emperors, snappers, groupers, and, deepwater snappers (red, pink, gray/jobfish)	Creel survey data
Commonwealth of the Northern Mariana Islands Lobster	Federal	Crustacean Fisheries of the Western Pacific Region	Pots and Traps, Spiny Lobster	Spiny lobsters (green, long-legged, painted)	
Commonwealth of the Northern Mariana Islands Tuna Troll	Federal	Pelagic Fisheries of the Western Pacific Region	Troll Lines	Tunas (skipjack, yellowfin, kawakawa), wahoo dolphinfish, Indo-Pacific blue marlin	Creel survey data
Guam Bottomfish Handline	Federal	Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region	Hook and Line, Electric	Deepwater snappers and Hawaiian groupers	Creel survey data
Guam Longline	Federal	Pelagic Fisheries of the Western Pacific Region	Longlines	Bigeye tuna, yellowfin tuna	Creel survey data, logbooks
Guam Troll	Federal	Pelagic Fisheries of the Western Pacific Region	Troll Lines	Tunas (skipjack, yellowfin), dolphinfish, wahoo, Indo-Pacific blue marlin	Creel survey data
Hawaii Shrimp Trap	Federal	Crustacean Fisheries of the Western Pacific Region	Pots and Traps, Shrimp	Deepwater Caridean shrimp	State commercial catch report data, state dealer data
Hawaii-Based Deep-Set Pelagic Longline Fishery for Tuna	Federal	Pelagic Fisheries of the Western Pacific Region	Longline	Bigeye tuna, yellowfin tuna, albacore	Logbook data, observer data, state dealer data
Hawaii-Based Shallow-Set Pelagic Longline Fishery for Swordfish	Federal	Pelagic Fisheries of the Western Pacific Region	Longline	Swordfish, bigeye tuna	Logbook data, observer data with 100% coverage, state dealer data
Hawaii Non-Longline Commercial Pelagic Fishery	Federal	Pelagic Fisheries of the Western Pacific Region	Combined Gears	Tunas (yellowfin, skipjack, bigeye, albacore), blue marlin, dolphinfish, wahoo	State commercial catch report data, state dealer data

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Table 4.6.1 (continued)

Fishery ^a	Management Authority	Federal Fishery Management Plan (FMP) ^b	Gear Type	Target Species (Common Name)	Data Sources ^c
Northwestern Hawaiian Islands Bottomfish	Federal	Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region	Combined Gears	Deepwater snappers (gray/jobfish, red, pink), Hawaiian grouper, and thick-lipped trevally	Logbook data, observer data, state commercial catch report data, state dealer data
Precious Coral (Federal Waters)	Federal	Precious Coral Fisheries of the Western Pacific Region	By Hand, Diving Gear	Black coral	
Western Pacific Squid Jig	Federal	Pelagic Fisheries of the Western Pacific Region	Hand Lines, Auto Jig	Neon flying squid	State commercial catch report data, State dealer data
Hawaii Bottomfish	Federal, State	Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region	Combined Gears	Deepwater snappers (pink, red, gray/jobfish, and Hawaiian grouper)	State commercial catch report data, State dealer data
Hawaii Crab Trap	State		Pots and Traps	Kona crab, Samoan crab	
Hawaii Fish Pond	State		Unspecified Gear	Mullet, milkfish, Pacific threadfin, bonefish, coral reef fishes	
Hawaii Fish Trap	State		Pots and Traps, Fish	Coral reef fishes (surgeonfishes, jacks, squirrelfishes, parrotfishes, goatfishes, etc.)	
Hawaii Inshore Handline	State		Hand Line	Mackerel scad, bigeye scad, coral reef fishes	
Hawaii Lay Net	State		Gillnets, Other	Coral reef fishes (surgeonfishes, jacks, squirrelfishes, parrotfishes, goatfishes, etc.)	
Hawaii Lobster Diving	State		By Hand, Diving Gear	Spiny lobsters (green and red), slipper lobsters	
Hawaii Lobster Trap	State		Pots and Traps, Lobster	Spiny lobsters (green and red), slipper lobsters	
Hawaii Octopus, Spear	State		Spears	Octopus, coral reef fishes	
Hawaii Opelu/Akule Net	State		Nets, Other	Mackerel scad, bigeye scad	
Hawaii Pelagic Handline	State		Handline	Tunas (yellowfin, bigeye)	
Hawaii Throw Net, Cast Net	State		Cast Nets	Convict tang, Āholehole (flagtail), Hawaiian threadfin, other coral reef fishes	
Hawaii Trolling, Rod and Reel	State		Troll Lines	Tunas (yellowfin, skipjack), Indo-Pacific blue marlin, dolphinfish, wahoo	
Precious Coral (State Waters)	State		By Hand, Diving Gear	Black coral, pink coral	

^a Aquaculture fisheries are listed for consistency with the MMPA List of Fisheries when they occur, but were not analyzed for the U.S. National Bycatch Report. Recreational fisheries are not included in this report.

^b FMPs as of 2005. Note that non-Federal FMPs were not identified through this process.

^c Data sources were evaluated only for Federal fisheries and for non-Federal fisheries with Federal data-collection programs.

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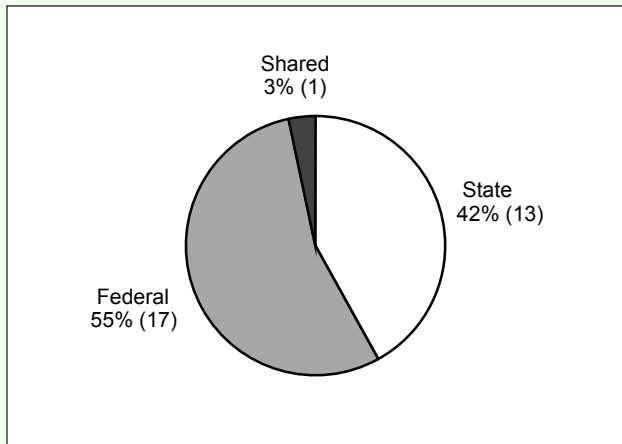


Figure 4.6.1.

Management jurisdiction for Pacific Islands Region fisheries (percentages are based on numbers of fisheries, not volume or revenue; $n = 31$). "Shared" indicates that international, Federal, and state authorities share management jurisdiction for the fishery.

concern over black coral is the spread of an exotic coral species (the octocoral *Carijoa riisei*) that overgrows black coral.

The first ecosystem-based FMP in the U.S., the WPFMC Coral Reef Ecosystem of the Western Pacific Region FMP (2001), was implemented to conserve and protect coral reefs and their associated biota and fisheries in the Pacific Islands Region through a system of MPAs and fishery regulations. This FMP is distinct from the FMP for precious corals. Precious corals are mostly found below the photic zone where reef-building corals live. The Coral Reef Ecosystem of the Western Pacific Region FMP addresses an enormous diversity of fishes and other biota not covered in any other FMP. Fishery regulations for coral reef ecosystem resources, including the creation of several MPAs in the Pacific Remote Island Areas were implemented in 2004 (69 FR 8336, 24 February 2004). In addition, this FMP encourages coordination with local governments to conserve coral reef ecosystems through such actions as prohibitions on taking of live corals.

Implemented in 1987, the Pelagic Fisheries of the Western Pacific Region FMP regulates fisheries for HMS species in the Pacific Islands Region. While the FMP was initially developed to regulate foreign fisheries within the U.S. EEZ, the requirement for foreign operators to obtain licenses and carry observers was a deterrent. No foreign fisheries currently operate within the U.S. EEZ, though international fisheries on the high seas and in EEZs of other nations dominate pelagic harvests in the region. Current FMP management focuses primarily on regulating large limited-

access domestic longline fisheries in Hawaii and American Samoa, which are by far the most developed fisheries in the U.S. Pacific Islands EEZ. These U.S.-based longliners also fish outside of the U.S. EEZ and are managed both inside and outside the zone by the FMP, as well as by U.S. participation in RFMOs. These organizations include the IATTC, which regulates pelagic fishing east of longitude 150°W, and the Western and Central Pacific Fishery Commission (WCPFC), which regulates pelagic fishing to the west of 150°W. The RFMOs also manage the very large-scale tropical tuna purse seine fishery and albacore troll fishery in the region.

This section of the Bycatch Report focuses on two Pacific Islands fisheries regulated under the Pelagic FMP for which adequate bycatch data and estimation methods are currently available: the Hawaii-based deep-set pelagic longline fishery targeting tuna, and the Hawaii-based shallow-set pelagic longline fishery targeting swordfish. Future editions of this report will include bycatch estimates for other Federal fisheries that have observer programs in place, such as the American Samoa pelagic longline fishery, and fisheries where data become available to develop such estimates.

4.6.2 Addressing Regional Bycatch Concerns

The staff members of PIFSC and PIRO have worked with WPFMC to implement a variety of operational and management measures to minimize bycatch and bycatch mortality in Pacific Islands Federal fisheries.

Bottomfish

The management of Hawaiian Archipelago bottomfish is conducted on an area-specific basis with Federal management measures in the NWHI and shared Federal–state measures in the eight main islands. This is the largest bottomfish fishery in the region, although it is shrinking under regulation. Bycatch of non-target fish, sharks, and two protected species, Hawaiian monk seals (*Monachus schauinslandi*) and Pacific bottlenose dolphins (*Tursiops truncatus*), are known to have occurred. In 2002, NMFS completed an ESA Section 7 BiOp on the bottomfish fishery's interactions with endangered Hawaiian monk seals. The BiOp ruled that bottomfish fisheries of the western Pacific did not jeopardize the continued existence of Hawaiian monk seals. Due to concern over the fishery's interactions with protected species, however, a mandatory observer program was implemented from 2003 through 2005. Funding for this program was diverted in 2005 in order to meet the 100% court-ordered coverage requirement for the Hawaii-based shallow-set pelagic longline fishery for swordfish.

In 2006, the NWHI were designated as the Papahānaumokuākea Marine National Monument, an area that encompasses 137,797 square miles of land and sea in the Pacific Ocean.

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Photo: Dwayne Meadows, NMFS

A school of sergeant major fish swim at a shipwreck at Pearl and Hermes Reef in Hawaiian waters.

All commercial fishing activities ceased in 2010 in order to promote recovery of the ecosystem to an unexploited state. Previous bycatch data from the NWHI observer program do not indicate any recent direct interactions with marine mammals, and the data for fish bycatch for that fishery have not been evaluated since the fishery is closed.

For the other bottomfish fisheries (American Samoa, CNMI, Guam, and the main Hawaiian Islands), reliable bycatch data are currently unavailable. Attempts have been made to estimate bycatch as the difference between fishers' self-reported catch and self-reported sales (from State Commercial catch report data in Hawaii) and from creel survey interviews in the other island areas (see the Bottomfish and Seamount Groundfish Resources of the Western Pacific Region 2005 annual report (WPFMC 2006)). These estimates indicate an extremely low amount of fish bycatch; however, fishers' self-reporting and creel survey interview comments have not been validated.

Unobserved mortality as a result of hook escapement, barotrauma, and depredation may also be a significant source of mortality in all bottomfish fisheries. Studies indicate that perhaps as many as 23 to 27 fish are lost for every 100 brought aboard in the NWHI fishery. Much of this loss is attributed to depredation by sharks, although bycatch of sharks in the fishery is believed to be low overall. Fish mortality may also occur due to barotrauma (expansion of fish gas bladders as fish are pulled up from depth). A program encouraging fishermen to employ special bycatch release methods including venting and weighted return to depth has been developed and is being promoted for voluntary use in the region (Pacific Islands Fisheries Group n.d.).

Post-hooking survival rates for several bycatch species (jacks and sharks) are believed to be high, as these species do not suffer from the effects of barotrauma. Long-standing FMP regulations such as prohibitions on the use of bottom trawls, bottom gillnets, explosives, poisons, and other gear restrictions are presumed to have been effective in limiting bycatch in the bottomfish fishery.

Crustaceans

Prior to its closure, a number of management measures had been instituted to reduce discards in the NWHI lobster fishery, including size limits, trap vents, and full retention of the target species. Size limits remain in place in the state-managed fishery, where the great majority of the catch is hand-collected by divers. Tag-and-release research in the NWHI using underwater video indicated that if lobsters were kept wet during sorting and quickly returned to depth in traps that were then remotely opened, very little predation was observed, even in the presence of very high observed predator density. This method could be applied in other fisheries.

Highly migratory species

Only the longline fisheries are described in this section, as they represent the predominance of effort in Federal waters. Sharks, especially blue sharks (*Prionace glauca*), form the largest component of bycatch for Hawaii longline fisheries. Prior to regulations initiated in 2001–04 to prevent shark-finning and reduce sea turtle bycatch, under-utilized shark catch (finned and carcasses dumped) and especially the rate of shark catch (per unit of fishing effort) by the shallow-set longline fishery was much greater than in more recent times. Blue sharks were less frequent in the deep-set longline fishery, which remained opened while the shallow-set fishery was closed over turtle concerns in 2001–04. Although many shark species can have very high post-release survival rates (Moyes et al. 2006), prior to 2001, shark mortality was high as sharks were often finned. Prohibitions on shark finning, implemented under the Shark Finning Prohibition Act of 2000, appear to have been largely effective in eliminating the dumping of finned shark carcasses. Today, most of the shark catch is now categorized as discards, which was not the case when fins were harvested. Discards have therefore increased, but discards with long-term survival remain classified as bycatch in commercial fisheries. Since 2004, over 90% of the total shark catch has been released alive (WPFMC 2007). Required use of circle hooks with fish bait in the reopened (2004–present) shallow-set fishery appears also to have benefited sharks.

A 2001 BiOp under ESA Section 7 on the combined deep-set tuna and shallow-set swordfish fisheries concluded that the Hawaii-based longline fisheries jeopardized the continued existence of three sea turtle species: loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*), and

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green (*Chelonia mydas*), but did not jeopardize the continued existence of the olive ridley sea turtle (*Lepidochelys olivacea*) or any ESA-listed marine mammals. This BiOp was overturned in litigation, but not before extensive changes were effected to dramatically reduce turtle bycatch and mortality, including a three-year closure of the swordfish fishery, a regulatory definition of gear and turtle take limits for the continued deep-set tuna fishery, measures for handling and release of protected species, and certified training for vessel operators. A 2004 BiOp on the region's pelagic fisheries, a 2005 BiOp on the deep-set fishery, and a 2008 BiOp on the shallow-set fishery concluded that neither fishery was likely to jeopardize the continued existence of a listed species. Litigation continues on the operation of this fishery, with challenges to NMFS policy by both industry associations and environmental groups.

Limits on incidental take of sea turtles were established by the 2004 and 2008 BiOps, mandating immediate closure of the Hawaii-based shallow-set pelagic longline fishery for swordfish when limits are reached in a calendar year. Take limits that trigger reconsultation but not closure were also established for green and olive ridley sea turtles in the swordfish fishery (one-year limits), and for all four turtle species in the Hawaii-based deep-set pelagic longline fishery for tuna (three-year limits). Currently, there is also a cap on effort (number of sets) that applies only in the shallow-set swordfish fishery, which has 100% mandatory observer coverage to monitor sea-turtle interactions (the deep-set longline fishery is known to have significantly lower bycatch of marine turtles). When the swordfish fishery bycatch of loggerhead or leatherback sea turtles reaches the take limit, the fishery is closed for the remainder of the year, which occurred in 2006 but not in 2004, 2005, or 2007–2009. Sea turtle bycatch in the deep-set longline fishery stayed under the take limit through 2011.

The changes in fishing gear that were required to reduce sea turtle bycatch in the swordfish fishery were the result of a success story that began in the Atlantic and continued to the Pacific. Watson et al. (2005) conducted experiments in the Atlantic Ocean which showed that replacing "J" hooks with large (size 18) circle hooks and replacing squid bait with fish bait could greatly reduce both loggerhead and leatherback sea turtle bycatch in swordfish longline fishing. Both measures were required in the reopened Hawaii swordfish fishery in 2004 and were as effective as expected in reducing turtle bycatch. In addition, the average rate of shark catch in the reopened swordfish fishery was much lower than before the gear was changed, perhaps due to the elimination of the previously used type of bait, squid, which is a preferred food of blue shark (Gilman et al. 2006). The fishery has also been much more concentrated in the early part of the calendar year than it was before effort was capped in 2004. This may also have reduced blue shark catch rates, which tended to be higher later in the year. Although not required to do so, the American Samoa longline

fishery has always used circle hooks of varying size, and the Hawaii deep-set longline fishery, which used tuna hooks almost exclusively prior to 2004, has greatly increased its use of circle hooks.

Other Pacific longline fisheries may have high levels of sea turtle bycatch, although the shallow-set type of fishing for swordfish, which has the highest turtle bycatch rates, has not yet been used in American Samoa or Guam. In fiscal year 2006, an observer program was implemented for the deep-set American Samoa longline fishery for albacore. Annual observer reports indicate that this fishery interacts with a large number of green sea turtles, false killer whales, and possibly other protected species. However, observer coverage has been inadequate for any statistically meaningful determinations to be made. As discussed previously, this fishery voluntarily uses circle hooks, which may have an ameliorating effect on bycatch.

In the Hawaii-based deep-set longline fishery (and less so in the shallow-set fishery), false killer whales become hooked or entangled in fishing gear and, as a result, may become seriously injured or killed. In 2010, NMFS convened a TRT to draft recommendations for a TRP for reducing serious injuries and mortalities of false killer whales that occur incidental to commercial fishing activities. NMFS will monitor its progress and ensure the TRP meets the MMPA goal of reducing false killer whale mortalities and serious injuries in the fisheries to appropriate levels. If not, NMFS will reconvene the TRT to develop additional consensus recommendations for reducing mortalities and serious injuries and amending the TRP.

The Hawaii longline fishery is treated as two separate fisheries (deep-set and shallow-set) under the MMPA, without substantially altering the management strategy for either sector. The shallow-set sector is classified as a Category II fishery, and the deep-set sector is classified as a Category I fishery. There are no fish bycatch limits or fish bycatch management measures in the fishery, although there is a regulatory limit on the number of swordfish that may be retained per trip in the Hawaii tuna longline fishery, designed to discourage shallow fishing outside of the effort limits for the shallow-set swordfish fishery. The regulatory bycatch of non-retained swordfish under this rule is quite small compared with the retained catch in the swordfish fishery. Information on bycatch in small-scale island fisheries is available only from creel survey data in American Samoa, CNMI, and Guam. Fishermen interviewed indicate that they discard very little because few species and sizes are unwanted, and because when fish are discarded they are often in viable condition. These self-reported data are not used in the U.S. National Bycatch Report. No data on unobserved mortality in these fisheries are available.

Interactions with seabirds are also of concern for longline fisheries in the Pacific Islands. In 2000 and 2004, the U.S.

Fish and Wildlife Service issued BiOps for the deep-set and shallow-set components of the Hawaii longline fishery. Of primary concern were potential interactions with the short-tailed albatross (*Phoebastria albatrus*), an ESA-listed species. Bycatch of black-footed albatross (*Phoebastria nigripes*), Laysan albatross (*Phoebastria immutabilis*), and other seabirds is also known to occur. Under the BiOps, reasonable and prudent measures (RPMs) for reducing seabird bycatch were identified, including testing of “side-setting” (setting longline gear off the side of the boat versus the stern) and other seabird deterrents (dyed bait, weighted branch lines, and streamers) that had been shown by research fishing experiments to be highly effective in reducing interactions (Boggs 2001). Also mandated were safe-release and handling workshops for vessel operators, who are provided with handling guidelines and seabird identification cards. In 2006, side-setting was demonstrated by directed research, observer data, and other sources to be more effective at reducing seabird bycatch than several other seabird avoidance methods. The 2006 regulatory Amendment 5 to the WPFMC Pelagic FMP included side-setting as one of the seabird avoidance techniques that fishermen may adopt to meet FMP requirements.

The NMFS monitors seabird bycatch in the deep-set and shallow-set fisheries. The black-footed albatross is used as a proxy species to anticipate likely impacts to the much rarer endangered short-tailed albatross. To date, with 100% observer coverage in the shallow-set longline fishery (the fishery historically most susceptible to seabird bycatch) and approximately 20% coverage in the deep-set fishery, there has been no observed bycatch of a short-tailed albatross. Recent analyses have shown reductions in both numbers and catch rates for albatrosses in Hawaii longline fisheries. Overall, interaction numbers have been reduced by 95 to 99%, and interaction rates have been reduced in both sectors of the fishery by at least 83%.

Precious Corals

Restriction under the FMP of harvesting methods to those that require species identification and measurement of coral before it is removed from the bottom prevented the type of widespread bycatch and bed destruction that characterizes such fisheries when corals are harvested by dredges or tangle nets.

4.6.3 Data Sources

Table 4.6.1 lists bycatch data sources available for federally managed Pacific Islands Region fisheries and those state fisheries with relevant Federal data-collection programs.

4.6.3.1 Observer Programs

Currently, there are two observer programs in place for the Pacific Islands Region (Table 4.6.2). The Hawaii longline program, which provides coverage of both the deep-set and the shallow-set longline fisheries, monitored 10,393 days in 2005 (7,099 and 3,294, respectively). The American Samoa longline observer program, which was initiated in 2006, monitored a total of 381 fishing days in its first year.

American Samoa Longline

A mandatory observer program for the American Samoa longline fishery was initiated in 2006 as a result of a Federal limited-entry permit system instituted at the end of 2005. The observer coverage levels are based on the total number of trip departures by permitted vessels (at least 20% observer coverage has been recommended but has not been achieved and is not currently targeted). Since the opening of the American Samoa Observer Program, 16% of the permitted fleet remains inactive. When an observer is ready for deployment, longline vessels are chosen using a random sampling scheme to select a vessel from the pool of candidates. All sets within a sampled trip are observed. Contract observers for the program are chosen from experienced observers who have previously worked in the Hawaii longline fisheries. Upon arrival, observers receive additional training in collection, identification, safety, and cultural awareness that is specific to this fishery. Observers are directed to collect data on fishing effort (gear configuration, deployment and retrieval, environmental conditions, etc.); biological data (target and bycatch composition, physical condition at capture and/or release, morphometrics, and sex identification); interactions with protected species; and samples for various research projects.

A fragment of this fishery utilizes open-deck, motorized catamarans called “alias” that are too small (less than 40 feet in length) to safely accommodate an observer. The active permitted alia fleet is currently comprised of one vessel. While the inability to observe this vessel may create a bias in observer coverage, this vessel does self-report catch and bycatch through a mandatory Federal logbook program. Alias once dominated the fishery, but alia participation greatly diminished as larger vessels moved into the fishery, so this issue may become much less important. Among the larger vessels there could be a sampling bias arising from the two differing patterns of trip length. Some vessels stay out for two months or more and others stay for three to four weeks. Because sampling is performed on a trip-by-trip basis, long trips may result in over-estimation of the average trip estimates, while short-trips may produce under estimation. Accounting for effort differences may address this bias but also complicates the quantification of statistical confidence and coverage. Alternative coverage

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Table 4.6.2

Current Pacific Islands Region Federal observer programs and fisheries observed. Programs and observed fisheries are listed alphabetically. Observer programs that ended over 10 years ago are not listed here.

Observer Program	U.S. National Bycatch Report Fisheries	Authority to Place Observers	Program Duration	Coverage Level
American Samoa Pelagic Longline	American Samoa Pelagic Longline Fishery	MSFCMA (50 CFR 665)	2006–present	2005: 0% 2006: 7.4% 2007: 7% 2008: 12%
Hawaii Bottomfish	Northwestern Hawaiian Islands Bottomfish	MSFCMA (50 CFR 665)	2003–06	2005: 21% 2006: 9.30% 2007–08: NA
Hawaii Pelagic Longline	Hawaii-Based Deep-Set Pelagic Longline Fishery (Tuna)	MSFCMA (50 CFR 665)	1994 ^a –present	2005: 26.1% deep-set, 100% shallow-set
	Hawaii-Based Shallow-Set Pelagic Longline Fishery (Swordfish)			2006: 21% deep-set, 100% shallow-set
				2007–08: 20% deep-set, 100% shallow-set

^a Coverage levels were approximately 5% prior to 1994.

methods, such as comparing fleet hook and set effort to observed effort, are being evaluated during the program's pilot stage.

Hawaii Bottomfish

The Hawaii Bottomfish observer program became redundant with the closure of the fishery in 2010. Analyzing the fishery bycatch data would be useful in providing information on other unobserved bottomfish fisheries, although results would likely have some unknown bias due to dissimilar gear, habitat, and other factors in other fisheries.

Hawaii Longline

Mandatory sampling programs have been in place for Hawaii pelagic longline fisheries since 1994. In the Hawaii deep-set longline fishery, a probability sampling design for selecting trips has been used since 2002. Prior to 2002 there was low coverage, around 5%, and various sampling protocols were used for selecting trips. Current coverage levels are around 20%. Trips are selected randomly for sampling, and all sets within a selected trip are observed.

Since its re-opening in late 2004, 100% coverage of the Hawaii shallow-set longline fishery has been maintained. From 2002 to 2004 the fishery was closed, and prior to that the observer coverage was low, around 5%, with various sampling protocols used for selecting trips. All sampled hauls are watched in their entirety, with every fish recorded and biological information collected on selected species. Measurements are taken on a subset of fish. Scanning seabird abundance during setting may help explain the frequency of hooking during haulback, so observers are required to make two scan counts of seabird abundance during each set as well as at the beginning, during every other hour, and at the end of the hauling operation. Every haul is watched in its entirety with all marine mammal, sea turtle, and seabird bycatch being recorded, as well as biological information when feasible. Additionally, any seabird mitigation measures undertaken are recorded.

Sampling bias is not a concern for either fishery. All trips are observed in the shallow-set longline fishery. In the deep-set longline fishery, all vessels are subject to being randomly sampled, and it is mandatory that they take an observer if selected. After completing the trip the observer returns to port for debriefing and data entry. The data then go through several quality control checks before the trip is identified as an approved trip.

4.6.3.2 Logbooks

A mandatory logbook program is currently in place for the Hawaii, American Samoa, and western Pacific general longline fisheries. The first complete year of Hawaii longline logbook reporting was 1991, and since then logbook data have been consistently collected. American Samoa logbook data have been collected since 1996, but submission of the General Fisheries Logbook (Guam) has been very infrequent. In addition, poor logbook reporting by some sectors of the fishery has created a bias in logbook catch estimates, which have been corrected using data from a creel survey. Effort data are collected on the number of hooks, location, and time of set and haul. Catch of pelagic species is recorded by species as numbers kept and released. All discards of all pelagic species are recorded, as well as bycatch of protected species. Records of non-target species are considered less reliable, especially concerning bycatch of seabirds and protected species. All hard-copy data are checked for quality, and then the data are entered and verified by NMFS staff.

4.6.3.3 State Dealer Data

A mandatory state dealer data-collection program is also in place for the Hawaii longline fishery and all other fisheries selling fish landed in the State of Hawaii. Data from 2000 through the present are available in electronic format. The program tracks species of fish brought to the market, price, and weight (when practical). No data on bycatch are collected.

4.6.3.4 Commercial Catch Reports

A mandatory commercial catch report is required of all commercial fishermen landing catch in the State of Hawaii, except for longliners. Data from 1948 through the present are available in electronic format, although not all data files are available for the early decades. The report includes information on catch by species, gear type, and area fished, and until the state sealer data system took over that function, the report also included weight of catch, pounds sold, and value. The difference between catch and pounds sold from these reports has sometimes been used as an estimate of bycatch.⁴ This method was not used in this report because this difference is thought to represent only retained catch that is not sold at first attempt, and which may be sold later or otherwise utilized. This would exclude it from the definition of bycatch used in this report.

⁴ <http://www.wpcouncil.org/bottomfish/BSAW2004/Documents/PanelReport.pdf>.

4.6.4 Pacific Islands Region Bycatch Estimation Methods

Bycatch data and estimation methods were available for two Pacific Island Region fisheries: the Hawaii deep-set longline for tuna and the Hawaii shallow-set longline for swordfish. Estimation methods are currently being developed for other fisheries and will be included in future editions of this report.

Bycatch estimates for the 2005 Hawaii longline deep-set fishery were based on a random sample of longline trips on which scientific observers were deployed. Observed trips were selected using two sampling schemes. The primary scheme was a systematic sample. Before departing on a fishing trip, longline vessels were required to call the NMFS PIRO observer program contractor at least 72 hours prior to their intended departure date. To enable sample selection, the PIRO contractor numbered calls sequentially in the order in which they were received (referred to as the "call number"). Prior to the beginning of a quarter, a systematic sample of call numbers was drawn by PIFSC and supplied to the contractor. The trips associated with these selected call numbers were designated to be sampled.

Because the number of observers was limited, it was impractical to achieve the full targeted coverage under the systematic design. The sample selected under the systematic design was slightly less than the targeted coverage rate, typically 5% less. The additional trips needed to reach the targeted level were then selected using a secondary sampling scheme when all trips selected by the systematic sample were already covered, and additional observers were available. In this instance, a trip was randomly selected from recently received call numbers that had not already been selected.

Because the systematic sample was selected quarterly, point estimates of bycatch (counts) were computed on a quarterly basis and then summed for the total annual estimate. All observed bycatch on a trip was assigned to the quarter when the vessel returned to port after completing the trip. The approximate sampling probabilities during the periods when additional (secondary) samples were drawn were computed by enumerating the number of call-ins during consecutive periods of comparable coverage. It was then assumed that the additional trips were selected with equal probability from those trips that had not been selected as part of the systematic sample. When coverage was below that of the anticipated systematic sample, the sampling probabilities were computed by enumerating all call-ins during this period and assuming that the trips sampled were selected with equal probability. Because the coverage level changed with fluctuations in observer availability and fishing activity, trips were not selected with equal probability. Therefore, the Horvitz-Thompson estimator (Thompson 1992) was used to estimate total bycatch (counts), as

it takes into account unequal sampling probabilities. This estimator was used for fish, marine mammals, sea turtles, and seabirds.

Approximate 95% confidence intervals (in units of counted bycaught individuals) for estimated total bycatch were computed on a quarterly basis for animals rarely caught, and on a quarterly and yearly basis for animals more frequently caught. For animals frequently caught, the confidence intervals were computed based on a normal approximation of the distribution of estimated total bycatch. Measures of uncertainty were not available for the bycatch estimates of fish in units of weight (as presented in this report) as a statistical estimator has not been developed. For rarely caught animals such as marine mammals, sea turtles, and seabirds, confidence intervals were computed on a quarterly basis, under the assumption that counts are Poisson variants.

During the third and fourth quarter of 2005, several vessels participated in an experiment that involved alternating, within a set, between circle hooks and the hook type the vessel normally used. All trips involved in this experiment had an observer onboard. These trips were considered to be part of the Hawaii longline deep-set fishery, as the protocol for this experiment fell under current legal practices for this fishery. Because these trips had 100% coverage they were not part of the random sampling scheme. To estimate the total bycatch for all deep-set longline fishing activity, the total observed bycatch from these experimental trips was added to the total estimated bycatch for trips subject to the random sampling scheme (i.e., all trips not participating in the experiment).

Bycatch estimates for the 2005 Hawaii longline shallow-set fishery were based on a census of longline trips on which scientific observers were deployed. Because the total bycatch (counts) of all animals was recorded for all trips in the shallow set fishery, the total bycatch was known.

Estimates of bycatch weights were computed from the estimated counts using observer information on discarded fish size and available weight-length regressions. Longline fishery observers make two kinds of observations of fish size: actual measurements of decked fish length (in centimeters) and visual estimation of fish length (in feet) for fish released without being brought aboard. The protocol for size data collection has changed over time from measuring all fish of only certain species (tunas, billfishes, and sharks) to measuring every third fish of any species that comes aboard the vessel. This change in protocol occurred during 2005, and it was only after the change that substantial numbers of measurements became available for species that are predominantly discarded. To obtain larger sample sizes of discarded fish, all size data from 2004 to 2006 were used.

The numbers of discarded fish size observations in the 2004–06 data sets varied from thousands of observations

on discards of target species to zero for the more infrequent bycatch species. The first priority for estimating the size of a species was to use actual measurements. Separate fish-size estimates were compiled for the two longline fishery sectors (swordfish and tuna). Often, there were very few or no actual measurements. A size estimate was calculated as the mean of the actual measurements if there were at least five observations. Otherwise a five-point weighted average was used to include data from other sources, such as visually estimated fish lengths. For example, if there were less than five measurements (e.g., only two) the remaining point weight (three) for the weighted average was provided from the average of the visually estimated weights. If at least three visual observations were not available, the remaining point weight was provided from data on the same species from the other fishery sector. Still, there were sometimes fewer than five observations available to estimate discarded fish size (e.g., black marlin, *Makaira indica*). Estimates of the variance for such estimates were not possible.

Weight-length regressions available for most species from the literature or on the web (e.g., from Fishbase; see <http://www.fishbase.org>) were used to convert length estimates to weight estimates. Where a regression was not available, one was sometimes used for a closely related species with similar allometry. For groupings of taxa, regression-based weight estimates for one or more of the predominant taxa in the grouping were averaged.

4.6.5 Tier Classification of Pacific Islands Region Fisheries

The quality of bycatch data and estimation methods were analyzed for 18 Pacific Islands Region fisheries with Federal management authority, relevant Federal data-collection programs, or shared Federal–state management. Only Federal data sources were evaluated for this report. Other data may be available for state and international fisheries; however, these programs were beyond the scope of this initial report. The remaining 13 fisheries are not federally managed and have no relevant Federal data-collection programs, or are recreational or aquaculture fisheries, and were therefore excluded from the analysis in this report. Catches in unscored fisheries amounted to only about 300,000 pounds of primarily reef fish species in 2005, a very small fraction of regional landings.

Tier classifications were assigned to each fishery using the tier scoring procedures outlined in Section 3 for fish, marine mammals, and other protected species (Table 4.6.3). Regional fisheries were evaluated based on the quality of Fish, Marine Mammals, and Other Protected Species bycatch data and estimation methods.

The majority of fisheries were classified as Tier 1 for fish (66%, Figure 4.6.2A). Eleven percent of fisheries were clas-

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Table 4.6.3

The 2005 fishery tier classifications for the Pacific Islands region (listed alphabetically, first by management authority and then by fishery). Shaded fisheries were evaluated for this report. Only Federal data sources were evaluated for this report.

Fishery	Management Authority	Fish Tier	Marine Mammals Tier	Other Protected Species Tier
American Samoa Bottomfish	Federal	1	0	0
American Samoa Lobster	Federal	0	0	0
American Samoa Pelagic Longline Fishery	Federal	1	0	0
American Samoa Troll	Federal	1	0	0
Commonwealth of the Northern Mariana Islands Bottomfish	Federal	1	0	0
Commonwealth of the Northern Mariana Islands Lobster	Federal	0	0	0
Commonwealth of the Northern Mariana Islands Tuna Troll	Federal	1	0	0
Guam Bottomfish Handline	Federal	1	0	0
Guam Longline	Federal	1	0	0
Guam Troll	Federal	1	0	0
Hawaii Shrimp Trap	Federal	1	0	0
Hawaii-Based Deep-Set Pelagic Longline Fishery for Tuna	Federal	2	3	3
Hawaii-Based Shallow-Set Pelagic Longline Fishery for Swordfish	Federal	3	4	4
Non-Longline Commercial Pelagic Fishery	Federal	1	0	0
Northwestern Hawaiian Islands Bottomfish	Federal	2	3	3
Precious Coral (Federal Waters)	Federal	1	0	0
Western Pacific Squid Jig	Federal	1	0	0
Hawaii Bottomfish	Federal, State	0	0	0
Hawaii Crab Trap	State			
Hawaii Fish Pond	State			
Hawaii Fish Trap	State			
Hawaii Inshore Handline	State			
Hawaii Lay Net	State			
Hawaii Lobster Diving	State			
Hawaii Lobster Trap	State			
Hawaii Octopus, Spear	State			
Hawaii Opelu/Akule Net	State			
Hawaii Pelagic Handline	State			
Hawaii Throw Net, Cast Net	State			
Hawaii Trolling, Rod and Reel	State			
Precious Coral (State Waters)	State			

sified as Tier 2 for fish, 6% as Tier 3, and the remainder as Tier 0 (three fisheries, or 17%). No fisheries were classified as Tier 4 for fish bycatch data collection and estimation. Of the fisheries evaluated, one fishery (the Hawaii-based shallow-set pelagic longline fishery for swordfish) was classified as Tier 4 for both marine mammals and other protected species. Two evaluated Pacific Islands fisheries were classified as Tier 3 for both marine mammals and other protected species (Figure 4.6.2B and C). The remaining fisheries were classified as tier 0 for marine mammals and other protected species.

4.6.6 Pacific Islands Region Key Stocks

Twenty-one key stocks were identified in the Pacific Islands Region (Table 4.6.4). As in other regions, not all species listed as key stocks had available bycatch estimates. For example, all 14 ESA-listed species found in the Pacific Islands Region were prioritized for inclusion in the list of key stocks, regardless of whether bycatch was reported. The 21 key stocks were split fairly evenly between fish (15%), marine mammals (32%), sea turtles (24%), and seabirds (29%) (Figure 4.6.3). In some cases, species identified for analysis were subsequently shown not to merit further consideration.⁵

All ESA-listed marine mammal populations found in the Pacific Islands (five cetaceans and one pinniped) were included in the list of key stocks. Additionally, the false killer whale (*Pseudorca crassidens*) was identified as a key stock through the quantitative evaluation process. It is considered a strategic stock under the MMPA.

All species of sea turtles found in the Pacific Islands were designated as key stocks, as all sea turtle species are listed under the ESA and are therefore prioritized as key stocks. The leatherback and the Mexican breeding populations of olive ridley and green turtles are endangered, while the log-

⁵ Great barracuda (*Sphyraena barracuda*) was initially identified as a key stock through the quantitative process due to unknown FSSI status as part of the Coral Reef Complex (both overfished and overfishing status were listed as unknown). After evaluating the biological and economic conditions, the Pacific Islands Regional team concluded that the (approximately) four tons of discarded barracuda, potentially worth only about \$8,000, was negligible compared with the reported 366 tons harvested in the same Food and Agriculture Organization of the United Nations area (FAO area 77) by fisheries of all nations in 2005 (FAO 2007). Additionally, in the adjacent Western Pacific (FAO Area 71), the reported barracuda harvest by all nations was about 20,000 tons. Although the harvests were from separate stocks, they provide an indication that the productivity of regional great barracuda stocks should easily support small amounts of discards. For these reasons, the regional team elected to remove great barracuda from the list of key stocks. Through the qualitative process, the Pacific Islands team added to the list of key stocks one FSSI stock, the blue shark, and two non-FSSI fish stocks, the longnose lancetfish (*Alepisaurus ferox*) and the big-eye thresher shark (*Alopias superciliosus*). These three species are the most numerous discarded fish species in the longline fishery, and are also those with the greatest discarded weight.

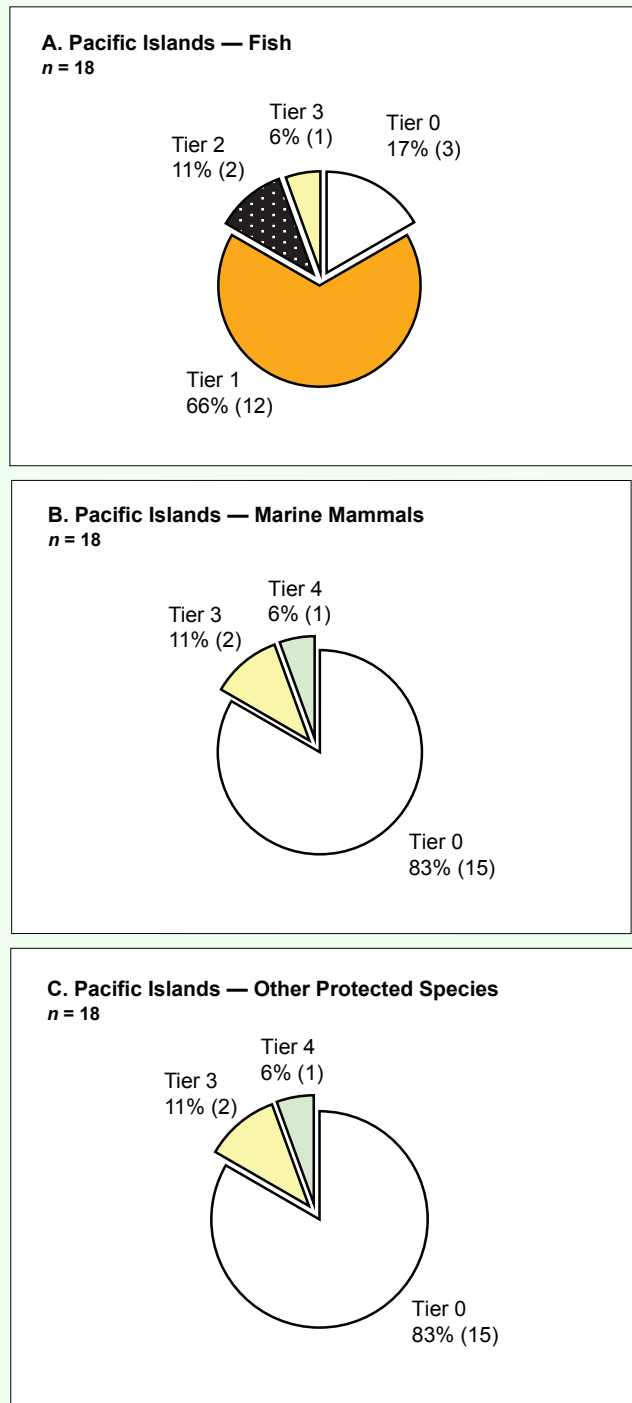


Figure 4.6.2
Pacific Islands Region fishery tier classifications, by number and percentage, for fisheries with Federal management or relevant Federal data-collection programs for A) fish, B) marine mammals, and C) other protected species. Tier scores are for the year 2005.

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Table 4.6.4

Key fish and marine mammal stocks and key sea turtle and seabird populations for the Pacific Islands Region. Overfishing/overfished status based on 2008 Quarter 1 FSSI report

Key Fish Stocks Listed by FSSI			
Species/stock name		Overfishing	Overfished
Common name	Scientific name		
Blue shark	<i>Prionace glauca</i>	No	No
Key Fish Stocks Listed by ESA			
Species/stock name		Stock status	
Common name	Scientific name		
None			
Key Fish Stocks Not Listed by FSSI or ESA			
Species/stock name		Stock status	
Common name	Scientific name		
Bigeye thresher shark	<i>Alopias superciliosus</i>	Not applicable	
Longnose lancetfish	<i>Alepisaurus ferax</i>		
Key Marine Mammal Stocks Listed by ESA			
Species/stock name		Stock status	
Common name	Scientific name		
Blue whale	<i>Balaenoptera musculus</i>	Endangered	
Fin whale	<i>Balaenoptera physalus</i>	Endangered	
Hawaiian monk seal	<i>Monachus schauinslandi</i>	Endangered	
Humpback whale	<i>Megaptera novaeangliae</i>	Endangered	
Sei whale	<i>Balaenoptera borealis</i>	Endangered	
Sperm whale	<i>Physeter macrocephalus</i>	Endangered	
Key Marine Mammal Stocks Not Listed by ESA			
Species/stock name		ZMRG	Stock status ^a
Common name	Scientific name		
False killer whale	<i>Pseudorca crassidens</i>	0.24	Unknown
Key Sea Turtle Populations			
Species/stock name		Population status	
Common name	Scientific name		
Green sea turtle	<i>Chelonia mydas</i>	Threatened (except in Florida and the Pacific coast of Mexico, where the breeding populations are endangered)	
Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Threatened	
Leatherback sea turtle	<i>Dermochelys coriacea</i>	Endangered	
Loggerhead sea turtle	<i>Caretta caretta</i>	Threatened	
Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Endangered (except the Pacific coast of Mexico breeding populations, which are endangered)	

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Table 4.6.4 (continued)

Key Seabird Populations Listed by ESA			
Species/stock name		Population status	
Common name	Scientific name		
Hawaiian dark-rumped petrel	<i>Pterodroma phaeopygia sandwichensis</i>	Endangered	
Newell's Townsend's shearwater	<i>Puffinus auricularis newelli</i>	Threatened	
Short-tailed albatross	<i>Phoebastria albatrus</i>	Endangered	
Key Seabird Populations Not Listed by ESA			
Species/stock name		Bycatch concern	Population status
Common name	Scientific name		
Black-footed albatross	<i>Phoebastria nigripes</i>	Yes	Increasing/Decreasing/ Stable ^b
Brown booby	<i>Sula leucogaster</i>	Unknown	Unknown
Laysan albatross	<i>Phoebastria immutabilis</i>	Yes	Increasing/Decreasing/ Stable ^c

^a Stock status based on NMFS Marine Mammal Stock Assessments (Caretta, Forney, Lowry, et al. 2007).

^b Different colonies have different population trends (see Naughton et al. 2008a).

^c Different colonies have different population trends (see Naughton et al. 2008b).

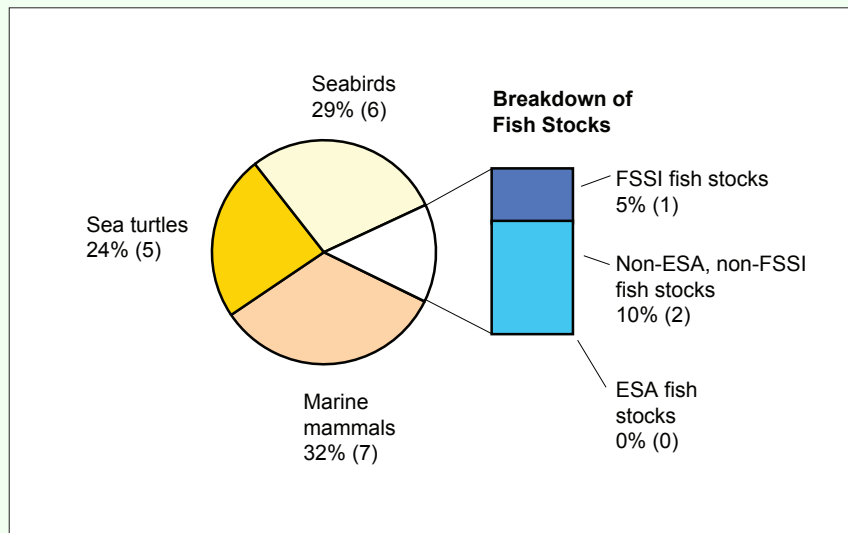


Figure 4.6.3
Numbers and percentages of key stocks for the Pacific Islands Region by resource type ($n = 21$).

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gerhead, hawksbill, and other breeding populations of olive ridley and green turtles are threatened.

Due to unknown bycatch status and listing as a bird of conservation concern, the brown booby (*Sula leucogaster*) was listed as a key stock during the quantitative evaluation process. Two albatross species were also added to the Pacific Islands list of key stocks, one through the quantitative process (black-footed) and one through the qualitative process (Laysan). The black-footed and Laysan albatross are also on the USFWS List of Birds of Conservation Concern. Under the BiOp for the Hawaii longline fishery, the black-footed albatross is used as a proxy for the short-tailed albatross, an ESA-listed species. In addition to the short-tailed albatross, two other species were included as regional key stocks due to their ESA status: the Hawaiian dark-rumped petrel (*Pterodroma phaeopygia sandwichensis*) and Newell's Townsend's shearwater (*Puffinus auricularis newelli*).

4.6.7 Pacific Islands Region Bycatch Estimates

Appendix 4.6, Tables 4.6.A–F list available bycatch estimates by fishery, based on 2005 data (for fish, turtles, and

seabirds) or the average from the years 2002–06 (marine mammals). Bycatch estimates were available for only two fisheries (Hawaii deep-set and Hawaii shallow-set longline) for inclusion in this report. Bycatch estimates were computed for all species observed caught in recent years. Bycatch estimates were provided for 88 fish stocks and stock groups, 15 marine mammal stocks, 4 sea turtle populations, and 4 seabird populations. Disposition of one of the most numerous bycatch species (blue sharks) has been discussed previously in this section. Over the last decade, populations of some high-bycatch species, such as longnose lancetfish, appear to be increasing; while others, such as escolar, are experiencing increased marketability (escolar is marketed as Hawaiian butterfish).

Landings information was available for 19 bycatch fish stocks. Bycatch reported for stock groups could not be compared with landings data, as the individual stocks making up the bycatch were unknown (e.g., reported as “billfish” or “unidentified bony fish”). In other cases, landings data may be confidential or unavailable, or the stock may not be landed. Where landings data were available, they are presented in Table 4.6.5. The timeframe of data used to calculate bycatch is included in Tables 4.6A–F.

Table 4.6.5

Summary of Pacific Islands Region recommendations and estimated requirements for implementation in terms of full-time staff and observer DAS. All requirements are annual unless otherwise indicated; ** denotes no additional annual cost. For further discussion of recommendations, see Section 5.8.

Recommendation ^a	Additional DAS ^b	Feasibility
Develop statistical estimator for discarded fish weight in the Hawaii deep-set and shallow-set longline fisheries.	NA	High
Maintain current observer program coverage levels for the Hawaii deep- and shallow-set pelagic longline fisheries.	**	High
Increase observer program coverage levels for the American Samoa pelagic longline fishery to 40% (4 observers, based on 2006 data).	855	High
Develop statistical estimator for discarded fish weight in the American Samoa Longline fishery.	NA	High
Number of new full-time staff needed to implement all data-quality and estimation method improvements recommended by the Pacific Islands Region:	6	
Total requirement for all DAS recommendations: ^c	855	

^a Some recommendations may require additional resource expenditures, such as equipment, which are not itemized.

^b One observer DAS includes the cost for the observer deployment as well as costs for associated equipment and program administrative functions (staffing).

^c This amount is in addition to the annual requirements of Pacific Islands Region observer programs.

4.6.8 Bycatch Estimate Improvement Plans for Pacific Islands Region Fisheries

An improvement plan was developed for the two Pacific Islands Region fisheries where bycatch data and estimation methods are currently available. The improvement plan for Hawaii longline fisheries covers both sectors (deep-set and shallow-set longline) and focuses on improving the quality of length–weight conversions for bycatch species. The Pacific Islands Regional team also recommends maintaining observer coverage for the fishery at current levels.

4.6.8.1 Improvement Plans

American Samoa Longline Fishery

Tier Classes: Fish = 1; Marine Mammals = 0; Other Protected Species = 0

Bycatch and data-collection concerns:

- Observer coverage of this fishery is too low (7% in 2007) to reliably detect rare species of management concern that may interact with this fishery.
- Sample size of fish bycatch estimates is at baseline levels.
- Vessel sampling bias exists as a result of vessel safety compliance issues.

Recommendations

- It was recommended to increase observer coverage to 40% to increase the likelihood of documenting rare interactions, and increase bycatch sample size.
- Increased measurement of discards, improvement in length–weight relationships, and the development of a statistical method to better estimate total fish discard weight and provide confidence limits were recommended.
- It was also recommended to minimize vessel sampling bias by increasing the number of observers available to ensure compliance.

Hawaii Longline Fisheries

Tier Classes:

Deep-set: Fish = 2; Marine Mammals = 3; Other Protected Species = 3

Shallow-set: Fish = 3; Marine Mammals = 4; Other Protected Species = 4

Bycatch and data-collection concerns:

- Sufficient measurements of bycatch fish lengths and adequate length–weight regressions to produce good estimates of fish bycatch weight are not yet available for most species. For the key fish stocks there are length–weight regressions available, along with dozens (bigeye thresher shark), hundreds (blue shark), or thousands (lancetfish) of length measurements.
- More measurements and better length–weight regressions are needed. (Currently 55 measurements are available for bigeye thresher shark and 11 for lancetfish.)
- A method of estimating the statistical properties of the estimated fish bycatch weights is lacking.

Recommendations:

- Increased measurement of discards, improvement in length–weight relationships, and development of a statistical method to better estimate total fish discard weight and provide confidence limits were recommended.
- In 2006, observers started measuring a subsample of fish on each haul, which will eventually provide sufficient data for improved estimates, but to adequately characterize all species a total census of lengths was recommended to provide more accurate estimates.
- The development of a statistical estimator for discarded fish weight that takes into account the variability in recorded lengths and the uncertainty in the weight–length relationships used to convert these lengths into weights was also recommended.
- The estimated resources needed to implement improvements were three full-time staff for two years, with only two full-time staff members needed for maintenance following the initial two-year period.

4.6.8.2 Summary of Cost and Feasibility of Pacific Islands Region Recommendations

Table 4.6.5 outlines bycatch data-collection and estimation improvements recommended by the Pacific Islands Region. The feasibility of implementing these recommendations was evaluated by the Pacific Islands Regional team based on overall resource requirements, currently available resources, and external factors. A total of four recommendations were made, involving new resources of six full-time staff members and 855 observer DAS. These improvements

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would raise the fish tier classifications one level in three fisheries, and the marine mammal and other protected species tier classifications by at least one level in one fishery. Costs for enhancing existing programs or implementing new observer programs are recommended in addition to current program operating costs. Observer program costs for the Pacific Islands Region were \$5.7M in FY 2008. The

American Samoa longline fishery has only preliminary by-catch estimates for protected species (from annual reports starting in 2006), and is not listed in Appendix 4.6. Fish by-catch estimates have not yet been made, and the existing pilot observer program has inadequate coverage and funding to provide such estimates. This fishery would have the highest priority for future work.

Photo: NMFS, PIRO



Bigeye tuna.



Photo: NMFS, PIRO

Yellowfin tuna.



Photo: NMFS, PIRO

Observer measures a tuna.

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Appendix 4.6 Pacific Islands Region Bycatch Estimates

Table 4.6.A

Subtables showing estimates of annual fish bycatch in Pacific Islands Region fisheries, in live pounds. Estimates reflect the average of the years identified. Key stocks are shaded. * following the names of stock groups indicates fisheries for which bycatch estimates were available only for the generalized stock group. Fishery bycatch ratios = bycatch / (bycatch + landings).

Subtable 4.6.A.1		HAWAII-BASED DEEP-SET PELAGIC LONGLINE FISHERY (TUNA)			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE AMOUNT	UNIT	CV
Albacore	<i>Thunnus alalunga</i>	2005	8,027.02	Pounds	
Bigeye thresher shark	<i>Alopias superciliosus</i>	2005	426,336.03	Pounds	
Bigeye tuna	<i>Thunnus obesus</i>	2005	128,090.63	Pounds	
Bignose shark	<i>Carcharhinus altimus</i>	2005	66.14	Pounds	
Billfishes*	Istiophoridae	2005	24,738.04	Pounds	
Black mackerel	<i>Scombrobrax heterolepis</i>	2005	55.12	Pounds	
Black marlin	<i>Makaira indica</i>	2005	610.68	Pounds	
Blacktip shark	<i>Carcharhinus limbatus</i>	2005	0.00	Pounds	
Blue shark	<i>Prionace glauca</i>	2005	4,816,697.87	Pounds	
Bony fishes*	Osteichthyes	2005	119.05	Pounds	
Bony fishes (unidentified)*	Osteichthyes	2005	257.94	Pounds	
Brama pomfrets (unidentified)*	Bramidae	2005	1,168.45	Pounds	
Brilliant pomfret	<i>Eumegistus illustris</i>	2005	723.12	Pounds	
Cookie cutter shark	<i>Isistius brasiliensis</i>	2005	0.00	Pounds	
Cottonmouth jacks (unidentified)*	<i>Uraspis</i> spp.	2005	48.50	Pounds	
Crestfish	<i>Lophotus lacepede</i>	2005	2,998.28	Pounds	
Crocodile shark	<i>Pseudocarcharias kamoharai</i>	2005	6,417.65	Pounds	
Dolphinfish	<i>Coryphaena hippurus</i>	2005	37,405.79	Pounds	
Driftfishes	<i>Cubiceps</i> spp.	2005	41.89	Pounds	
Escolar	<i>Lepidocybium flavobrunneum</i>	2005	11,378.04	Pounds	
Galapagos shark	<i>Carcharhinus galapagensis</i>	2005	1,324.98	Pounds	
Great barracuda	<i>Sphyraena barracuda</i>	2005	8,489.99	Pounds	
Grey reef shark	<i>Carcharhinus amblyrhynchos</i>	2005	0.00	Pounds	
Hammerhead sharks*	<i>Sphyrna</i> spp.	2005	2,414.06	Pounds	
Indo-Pacific blue marlin	<i>Makaira mazara</i>	2005	27,352.72	Pounds	
Kawakawa	<i>Euthynnus affinis</i>	2005	0.00	Pounds	
King-of-salmon	<i>Trachipterus altivelis</i>	2005	0.00	Pounds	
Knifetail pomfret	<i>Taractes rubescens</i>	2005	12,932.30	Pounds	
Longfin mako shark	<i>Isurus paucus</i>	2005	2,504.45	Pounds	

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Table 4.6.A (continued)

(continuation of Subtable 4.6.A.1)		HAWAII-BASED DEEP-SET PELAGIC LONGLINE FISHERY (TUNA)			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE AMOUNT	UNIT	CV
Longnose lancetfish	<i>Alepisaurus ferox</i>	2005	922,036.02	Pounds	
Louvar	<i>Luvarus imperialis</i>	2005	0.00	Pounds	
Makos*	<i>Isurus</i> spp.	2005	2,475.79	Pounds	
Manta	<i>Manta birostris</i>	2005	617.29	Pounds	
Mantas, mobulas (unidentified)*	Mobulidae	2005	0.00	Pounds	
Mantas (unidentified)*	<i>Mobula</i> spp.	2005	1,388.91	Pounds	
Oarfish	<i>Regalecus glesne</i>	2005	0.00	Pounds	
Ocean sunfish	<i>Mola mola</i>	2005	37,967.97	Pounds	
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	2005	58,402.59	Pounds	
Oilfish	<i>Ruvettus pretiosus</i>	2005	5,158.81	Pounds	
Omosudid (hammerjaw)	<i>Omosudis lowei</i>	2005	268.96	Pounds	
Opah	<i>Lampris guttatus</i>	2005	36,563.62	Pounds	
Pacific (chub) mackerel	<i>Scomber japonicus</i>	2005	0.00	Pounds	
Pacific bluefin tuna	<i>Thunnus orientalis</i>	2005	0.00	Pounds	
Pacific bonito	<i>Sarda chiliensis</i>	2005	0.00	Pounds	
Pelagic puffer	<i>Lagocephalus lagocephalus</i>	2005	2,021.64	Pounds	
Pelagic stingray	<i>Dasyatis violacea</i>	2005	38,042.92	Pounds	
Pelagic thresher shark	<i>Alopias pelagicus</i>	2005	5,418.96	Pounds	
Pompano dolphin	<i>Coryphaena equiselis</i>	2005	401.24	Pounds	
Rainbow runner	<i>Elagatis bipinnulatus</i>	2005	154.32	Pounds	
Rays (other)*	Rajiformes	2005	0.00	Pounds	
Rays (unidentified)*	Rajiformes	2005	0.00	Pounds	
Razorback scabbardfish	<i>Assurger anzac</i>	2005	2,691.84	Pounds	
Roudi escolar	<i>Promethichthys prometheus</i>	2005	2,387.60	Pounds	
Rough pomfret	<i>Taractes asper</i>	2005	1,671.10	Pounds	
Rough triggerfish	<i>Canthidermis maculata</i>	2005	4.41	Pounds	
Sailfish	<i>Istiophorus platypterus</i>	2005	346.13	Pounds	
Salmon shark	<i>Lamna ditropis</i>	2005	599.66	Pounds	
Sandbar shark	<i>Carcharhinus plumbeus</i>	2005	3,225.36	Pounds	
Scalloped hammerhead shark	<i>Sphyrna lewini</i>	2005	773.82	Pounds	
Scalloped ribbonfish	<i>Zu cristatus</i>	2005	35.27	Pounds	
Shark (other)*	Chondrichthyes	2005	130.07	Pounds	
Sharks (unidentified)*	Chondrichthyes	2005	51,085.45	Pounds	
Sharptail mola	<i>Masturus lanceolatus</i>	2005	6,217.03	Pounds	
Shortbill spearfish	<i>Tetrapturus angustirostris</i>	2005	36,217.50	Pounds	
Shortfin mako shark	<i>Isurus oxyrinchus</i>	2005	156,618.41	Pounds	

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Table 4.6.A (continued)

(continuation of Subtable 4.6.A.1)		HAWAII-BASED DEEP-SET PELAGIC LONGLINE FISHERY (TUNA)			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE AMOUNT	UNIT	CV
Shortnose lancetfish	<i>Alepisaurus brevirostris</i>	2005	0.00	Pounds	
Sickle pomfret	<i>Taractichthys steindachneri</i>	2005	4,995.67	Pounds	
Silky shark	<i>Carcharhinus falciformis</i>	2005	36,034.51	Pounds	
Skipjack tuna	<i>Katsuwonus pelamis</i>	2005	81,196.15	Pounds	
Slender mola	<i>Ranzania laevis</i>	2005	34,557.42	Pounds	
Smooth hammerhead shark	<i>Sphyrna zygaena</i>	2005	2,453.74	Pounds	
Snake mackerel	<i>Gempylus serpens</i>	2005	156,338.42	Pounds	
Striped marlin	<i>Tetrapturus audax</i>	2005	27,277.76	Pounds	
Swordfish	<i>Xiphias gladius</i>	2005	23,734.94	Pounds	
Tapertail ribbonfish	<i>Trachipterus fukuzakii</i>	2005	2,546.34	Pounds	
Thresher shark	<i>Alopias vulpinus</i>	2005	0.00	Pounds	
Thresher sharks (unidentified)*	Alopiidae	2005	57,203.28	Pounds	
Tiger shark	<i>Galeocerdo cuvieri</i>	2005	4,310.03	Pounds	
Triggerfish (unidentified)*	Balistidae	2005	0.00	Pounds	
Tunas*	Scombridae	2005	20,719.02	Pounds	
Velvet dogfish	<i>Scymnodon squamulosus</i>	2005	844.37	Pounds	
Wahoo	<i>Acanthocybium solandri</i>	2005	13,287.24	Pounds	
White shark	<i>Carcharodon carcharias</i>	2005	92.59	Pounds	
Yellowfin tuna	<i>Thunnus albacares</i>	2005	86,273.39	Pounds	
Yellowtail jack	<i>Seriola lalandi</i>	2005	0.00	Pounds	
TOTAL FISHERY BYCATCH			7,436,959.28	Pounds	
TOTAL FISHERY LANDINGS			19,000,500.00	Pounds	
TOTAL CATCH (Bycatch + Landings)			26,936,959.28	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.28		

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Table 4.6.A (continued)

Subtable 4.6.A.2		HAWAII-BASED SHALLOW-SET PELAGIC LONGLINE FISHERY (SWORDFISH)			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE AMOUNT	UNIT	CV
Albacore	<i>Thunnus alalunga</i>	2005	15,928.38	Pounds	
Bigeye thresher shark	<i>Alopias superciliosus</i>	2005	6,538.90	Pounds	
Bigeye tuna	<i>Thunnus obesus</i>	2005	5,985.54	Pounds	
Bignose shark	<i>Carcharhinus altimus</i>	2005	66.14	Pounds	
Billfishes*	Istiophoridae	2005	4,720.09	Pounds	
Black marlin	<i>Makaira indica</i>	2005	152.12	Pounds	
Blue shark	<i>Prionace glauca</i>	2005	822,523.88	Pounds	
Bony fishes (other)*	Osteichthyes	2005	2.20	Pounds	
Bony fishes (unidentified)*	Osteichthyes	2005	94.80	Pounds	
Brama pomfrets (unidentified)*	Bramidae	2005	0.00	Pounds	
Brilliant pomfret	<i>Eumegistus illustris</i>	2005	4.41	Pounds	
Cartilaginous fishes*	Chondrichthyes	2005	6,968.80	Pounds	
Cookie cutter shark	<i>Isistius brasiliensis</i>	2005	2.20	Pounds	
Crocodile shark	<i>Pseudocarcharias kamoharai</i>	2005	50.71	Pounds	
Dolphinfish	<i>Coryphaena hippurus</i>	2005	19,418.29	Pounds	
Escolar	<i>Lepidocybium flavobrunneum</i>	2005	12,912.46	Pounds	
Galapagos shark	<i>Carcharhinus galapagensis</i>	2005	817.91	Pounds	
Great barracuda	<i>Sphyræna barracuda</i>	2005	22.05	Pounds	
Indo-Pacific blue marlin	<i>Makaira mazara</i>	2005	11,397.89	Pounds	
Knifetail pomfret	<i>Taractes rubescens</i>	2005	88.18	Pounds	
Longfin mako shark	<i>Isurus paucus</i>	2005	277.78	Pounds	
Longnose lancetfish	<i>Alepisaurus ferox</i>	2005	5,676.90	Pounds	
Louvar	<i>Luvarus imperialis</i>	2005	15.43	Pounds	
Mako sharks*	<i>Isurus</i> spp.	2005	3,331.18	Pounds	
Mantas (unidentified)*	<i>Mobula</i> spp.	2005	132.28	Pounds	
Ocean sunfish	<i>Mola mola</i>	2005	5,767.29	Pounds	
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	2005	38,640.37	Pounds	
Oilfish	<i>Ruvettus pretiosus</i>	2005	2,777.82	Pounds	
Opah	<i>Lampris guttatus</i>	2005	2,780.03	Pounds	
Pelagic puffer	<i>Lagocephalus lagocephalus</i>	2005	145.50	Pounds	
Pelagic stingray	<i>Dasyatis violacea</i>	2005	487.22	Pounds	
Pelagic thresher shark	<i>Alopias pelagicus</i>	2005	149.91	Pounds	
Salmon shark	<i>Lamna ditropis</i>	2005	628.32	Pounds	
Sandbar shark	<i>Carcharhinus plumbeus</i>	2005	1,082.47	Pounds	
Shortbill spearfish	<i>Tetrapturus angustirostris</i>	2005	3,168.04	Pounds	

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Table 4.6.A (continued)

(continuation of Subtable 4.6.A.2)		HAWAII-BASED SHALLOW-SET PELAGIC LONGLINE FISHERY (SWORDFISH)			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE AMOUNT	UNIT	CV
Shortfin mako shark	<i>Isurus oxyrinchus</i>	2005	31,521.66	Pounds	
Sickle pomfret	<i>Taractichthys steindachneri</i>	2005	167.55	Pounds	
Silky shark	<i>Carcharhinus falciformis</i>	2005	2,500.04	Pounds	
Skipjack tuna	<i>Katsuwonus pelamis</i>	2005	171.96	Pounds	
Slender mola	<i>Ranzania laevis</i>	2005	11.02	Pounds	
Smooth hammerhead shark	<i>Sphyrna zygaena</i>	2005	930.35	Pounds	
Snake mackerel	<i>Gempylus serpens</i>	2005	685.64	Pounds	
Striped marlin	<i>Tetrapturus audax</i>	2005	17,698.69	Pounds	
Swordfish	<i>Xiphias gladius</i>	2005	76,784.71	Pounds	
Thresher sharks*	Alopiidae	2005	1,029.56	Pounds	
Tiger shark	<i>Galeocerdo cuvieri</i>	2005	5,577.69	Pounds	
Tunas*	Scombridae	2005	776.03	Pounds	
Wahoo	<i>Acanthocybium solandri</i>	2005	72.75	Pounds	
Yellowfin tuna	<i>Thunnus albacares</i>	2005	628.32	Pounds	
TOTAL FISHERY BYCATCH			1,111,311.46	Pounds	
TOTAL FISHERY LANDINGS			3,500,000.00	Pounds	
TOTAL CATCH (Bycatch + Landings)			4,611,311.46	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.24		

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Table 4.6.B

Summary of Pacific Islands Region bycatch by species. All estimates are live weights. Key stocks are shaded. * following the names of stock groups indicates fisheries for which bycatch estimates were available only for the generalized stock group. Species bycatch ratio = the total regional bycatch of a species / (total regional landings of the species + total regional bycatch of the species).

COMMON NAME	SCIENTIFIC NAME	TOTAL STOCK BYCATCH ^a		TOTAL SPECIES BYCATCH ^b		SPECIES LANDINGS ^c		SPECIES BYCATCH RATIO ^d
		AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Albacore	<i>Thunnus alalunga</i>			23,955.40	Pounds	1,008,007.00	Pounds	0.02
Bigeye thresher shark ^e	<i>Alopias superciliosus</i>			432,874.93	Pounds	see footnote		**
Bigeye tuna	<i>Thunnus obesus</i>			134,076.17	Pounds	10,934,544.00	Pounds	0.01
Bignose shark	<i>Carcharhinus altimus</i>			132.28	Pounds	^	–	**
Billfishes*	Istiophoridae			29,458.13	Pounds	–	–	**
Black mackerel	<i>Scombrolabrax heterolepis</i>			55.12	Pounds	^	–	**
Black marlin	<i>Makaira indica</i>			762.80	Pounds	2,461.00	Pounds	0.24
Blacktip shark	<i>Carcharhinus limbatus</i>			0.00	Pounds	^	–	**
Blue shark ^f	<i>Prionace glauca</i>			5,639,221.75	Pounds	see footnote		**
Bony fishes*	Osteichthyes			119.05	Pounds	–	–	**
Bony fishes (other)*	Osteichthyes			2.20	Pounds	–	–	**
Bony fishes (unidentified)*	Osteichthyes		See species column	352.74	Pounds	–	–	**
Brama pomfrets (unidentified) ^g	Bramidae			1,168.45	Pounds	see footnote	–	**
Brilliant pomfret ^g	<i>Eumegistus illustris</i>			727.53	Pounds	see footnote		**
Cartilaginous fishes*	Chondrichthyes			6,968.80	Pounds	–	–	**
Cookie cutter shark	<i>Isistius brasiliensis</i>			2.20	Pounds	^	–	**
Cottonmouth jacks (unidentified)*	<i>Uraspis</i> spp.			48.50	Pounds	–	–	**
Crestfish	<i>Lophotus lacepede</i>			2,998.28	Pounds	^	–	**
Crocodile shark	<i>Pseudocarcharias kamoharai</i>			6,468.36	Pounds	^	–	**
Dolphinfish	<i>Coryphaena hippurus</i>			56,824.08	Pounds	1,439,168.00	Pounds	0.04
Driftfishes	<i>Cubiceps</i> spp			41.89	Pounds	^	–	**
Escolar	<i>Lepidocybium flavobrunneum</i>			24,290.50	Pounds	3,436.00	Pounds	0.88

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Table 4.6.B (continued)

COMMON NAME	SCIENTIFIC NAME	TOTAL STOCK BYCATCH ^a		TOTAL SPECIES BYCATCH ^b		SPECIES LANDINGS ^c		SPECIES BYCATCH RATIO ^d
		AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Galapagos shark	<i>Carcharhinus galapagensis</i>	See species column		2,142.89	Pounds	^	–	**
Great barracuda	<i>Sphyrna barracuda</i>		8,512.04	Pounds	33,878.00	Pounds	0.20	
Grey reef shark	<i>Carcharhinus amblyrhynchos</i>		0.00	Pounds	^	–	**	
Hammerhead sharks*	<i>Sphyrna</i> spp.		2,414.06	Pounds	–	–	**	
Indo-Pacific blue marlin	<i>Makaira mazara</i>		38,750.61	Pounds	969,226.00	Pounds	0.04	
Kawakawa	<i>Euthynnus affinis</i>		0.00	Pounds	3,342.00	Pounds	0.00	
King-of-salmon	<i>Trachipterus altivelis</i>		0.00	Pounds	^	–	**	
Knifetail pomfret ^g	<i>Taractes rubescens</i>		13,020.48	Pounds	see footnote		**	
Longfin mako shark ^h	<i>Isurus paucus</i>		2,782.23	Pounds	see footnote		**	
Longnose lancetfish	<i>Alepisaurus ferox</i>		927,712.92	Pounds	^	–	**	
Louvar	<i>Luvarus imperialis</i>		15.43	Pounds	^	–	**	
Mako sharks ^h	<i>Isurus</i>		5806.97	Pounds	see footnote	–	**	
Manta	<i>Manta birostris</i>		617.29	Pounds	^	–	**	
Mantas, mobulas (unidentified)*	Mobulidae		0.00	Pounds	–	–	**	
Mantas (unidentified)*	<i>Mobula</i> spp.		1,521.19	Pounds	–	–	**	
Oarfish	<i>Regalecus glesne</i>		0.00	Pounds	^	–	**	
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>		97,042.96	Pounds	^	–	**	
Ocean sunfish	<i>Mola mola</i>		43,735.26	Pounds	123.00	Pounds	1.00	
Oilfish	<i>Ruvettus pretiosus</i>		7,936.63	Pounds	385,809.00	Pounds	0.02	
Omosudid (hammerjaw)	<i>Omosudis lowei</i>		268.96	Pounds	^	–	**	
Opah	<i>Lampris guttatus</i>		39,343.65	Pounds	1,086,076.00	Pounds	0.03	
Pacific (chub) mackerel	<i>Scomber japonicus</i>		0.00	Pounds	–	–	**	
Pacific bluefin tuna	<i>Thunnus orientalis</i>		0.00	Pounds	–	–	**	
Pacific bonito	<i>Sarda chiliensis</i>	0.00	Pounds	–	–	**		
Pelagic puffer	<i>Lagocephalus lagocephalus</i>	2,167.14	Pounds	^	–	**		
Pelagic stingray	<i>Dasyatis violacea</i>	38,530.14	Pounds	^	–	**		

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Table 4.6.B (continued)

COMMON NAME	SCIENTIFIC NAME	TOTAL STOCK BYCATCH ^a		TOTAL SPECIES BYCATCH ^b		SPECIES LANDINGS ^c		SPECIES BYCATCH RATIO ^d
		AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Pelagic thresher shark ^e	<i>Alopias pelagicus</i>	See species column		5,568.87	Pounds	^	–	**
Pompano dolphin	<i>Coryphaena equiselis</i>		401.24	Pounds	^	–	**	
Rainbow runner	<i>Elagatis bipinnulatus</i>		154.32	Pounds	4,265.00	Pounds	0.03	
Rays (other)*	Rajiformes		0.00	Pounds	–	–	**	
Rays (unidentified)*	Rajiformes		0.00	Pounds	–	–	**	
Razorback scabbardfish	<i>Assurger anzac</i>		2,691.84	Pounds	^	–	**	
Roudi escolar	<i>Promethichthys prometheus</i>		2,387.60	Pounds	^	–	**	
Rough pomfret ^g	<i>Taractes asper</i>		1,671.10	Pounds	see footnote		**	
Rough triggerfish	<i>Canthidermis maculata</i>		4.41	Pounds	^	–	**	
Sailfish	<i>Istiophorus platypterus</i>		346.13	Pounds	7,420.00	Pounds	0.04	
Salmon shark	<i>Lamna ditropis</i>		1,227.98	Pounds	^	–	**	
Sandbar shark	<i>Carcharhinus plumbeus</i>		4,307.83	Pounds	^	–	**	
Scalloped hammerhead shark	<i>Sphyrna lewini</i>		773.82	Pounds	^	–	**	
Scalloped ribbonfish	<i>Zu cristatus</i>		35.27	Pounds	^	–	**	
Shark (other)*	Elasmobranchii		130.07	Pounds	–	–	**	
Shark (unidentified)	Chondrichthyes		51,085.45	Pounds	^	–	**	
Sharptail mola	<i>Masturus lanceolatus</i>		6,217.03	Pounds	^	–	**	
Shortbill spearfish	<i>Tetrapturus angustirostris</i>		39,385.54	Pounds	467,748.00	Pounds	0.08	
Shortfin mako shark ^h	<i>Isurus oxyrinchus</i>		188,140.07	Pounds	see footnote		**	
Shortnose lancetfish	<i>Alepisaurus brevirostris</i>		0.00	Pounds	^	–	**	
Sickle pomfret ^g	<i>Taractichthys steindachneri</i>	5,163.22	Pounds	see footnote		**		
Silky shark	<i>Carcharhinus falciformis</i>	38,534.55	Pounds	^	–	**		
Skipjack tuna	<i>Katsuwonus pelamis</i>	81,368.11	Pounds	964,402.00	Pounds	0.08		
Slender mola	<i>Ranzania laevis</i>	34,568.44	Pounds	^	–	**		

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Table 4.6.B (continued)

COMMON NAME	SCIENTIFIC NAME	TOTAL STOCK BYCATCH ^a		TOTAL SPECIES BYCATCH ^b		SPECIES LANDINGS ^c		SPECIES BYCATCH RATIO ^d
		AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Smooth hammerhead shark	<i>Sphyrna zygaena</i>	See species column		3,384.09	Pounds	^	–	**
Snake mackerel	<i>Gempylus serpens</i>		157,024.06	Pounds	^	–	**	
Striped marlin	<i>Tetrapturus audax</i>		44,976.45	Pounds	1,218,030.00	Pounds	0.04	
Swordfish	<i>Xiphias gladius</i>		100,519.65	Pounds	3,445,598.00	Pounds	0.03	
Tapertail ribbonfish	<i>Trachipterus fukuzakii</i>		2,546.34	Pounds	^	–	**	
Thresher shark ^e	<i>Alopias vulpinus</i>		0.0	Pounds	see footnote	–	**	
Thresher sharks ^e	Alopiidae		1029.56	Pounds	see footnote	–	**	
Thresher sharks (unidentified) ^e	Alopiidae		57,203.28	Pounds	see footnote	–	**	
Tiger shark	<i>Galeocerdo cuvieri</i>		9,887.72	Pounds	^	–	**	
Triggerfish (unidentified)*	Balistidae		0.00	Pounds	–	–	**	
Tunas	Scombridae		21,495.05	Pounds			**	
Velvet dogfish	<i>Scymnodon squamulosus</i>		844.37	Pounds	^	–	**	
Wahoo	<i>Acanthocybium solandri</i>		13,359.99	Pounds	817,249.00	Pounds	0.02	
White shark	<i>Carcharodon carcharias</i>		92.59	Pounds	±	–	**	
Yellowfin tuna	<i>Thunnus albacares</i>		86,901.71	Pounds	3,208,468.00	Pounds	0.03	
Yellowtail jack	<i>Seriola lalandi</i>		0.00	Pounds			**	

^a Bycatch is listed in the species column, as there were no species with bycatch of more than one substock.

^b Landed weights are for catch sold only.

^c Species marked ^ were not landed or rarely landed; these may be kept and consumed. Species marked ± are federally prohibited to land.

^d A double asterisk (**) indicates that bycatch ratios could not be developed, where bycatch estimates were provided in both numbers of individuals and in pounds, or where landings were not available.

^e Pacific Region landings were not reported by thresher shark species, but were reported for thresher sharks in general. Landings for the year 2005 for the thresher shark family (Alopiidae) were 63,314 pounds, but could not be used to develop a bycatch ratio for thresher shark species, as the exact composition of the landings reported for Alopiidae is unknown.

^f Landings for all sharks (primarily blue sharks) for the year 2005 were 8,314 pounds, but could not be used to develop a bycatch ratio for shark species, as the exact composition of the landings reported for sharks in general is unknown. Blue sharks are the only other major landed shark species other than thresher and mako sharks, which are listed separately (below), and comprise the majority of the landings for sharks.

^g Pacific Region landings were not reported by pomfret species, but were reported for pomfret in general. Landings for the year 2005 for the pomfret family (Bramidae) were 646,000 pounds, but cannot be used to develop a bycatch ratio for pomfret species, as the exact composition of the landings reported for Bramidae is unknown.

^h Pacific Region landings were not reported by mako shark species, but were reported for mako sharks in general. Landings for the year 2005 for the mako shark genus (*Isurus*) were 203,827 pounds, but could not be used to develop a bycatch ratio for mako shark species, as the exact composition of the landings reported for *Isurus* spp. is unknown.

PACIFIC ISLAND REGION

Table 4.6.C

Subtables showing estimates of marine mammal incidental mortality and serious injury for Pacific Islands fisheries within the Hawaiian Islands EEZ. All bycatch estimates are in numbers of individuals and are an average for the years indicated. Key stocks/populations are shaded.

Subtable 4.6.C.1		HAWAII-BASED DEEP-SET PELAGIC LONGLINE FISHERY (TUNA)			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE AMOUNT	UNIT	CV
Beaked whale (unidentified)	<i>Ziphiidae</i>	2002–06	0	Individuals	
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	2002–06	0.41	Individuals	2.02
Bottlenose dolphin	<i>Tursiops truncatus</i>	2002–06	0.93	Individuals	
Bryde's whale	<i>Balaenoptera edeni</i>	2002–06	0	Individuals	
Cetacean (unidentified)	<i>Cetacea</i>	2002–06	1.21	Individuals	1.14
False killer whale	<i>Pseudorca crassidens</i>	2002–06	5.74	Individuals	0.64
False killer or short-finned pilot whale (unidentified)	<i>Delphinidae</i>	2002–06	3.47	Individuals	0.62
Humpback whale	<i>Megaptera novaeangliae</i>	2002–06	0	Individuals	
Risso's dolphin	<i>Grampus griseus</i>	2002–06	0	Individuals	
Short-beaked common dolphin (unidentified)	<i>Delphinus delphis</i>	2002–06	0	Individuals	
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	2002–06	0.94	Individuals	
Sperm whale	<i>Physeter macrocephalus</i>	2002–06	0	Individuals	
Spinner dolphin	<i>Stenella longirostris</i>	2002–06	0	Individuals	
Striped dolphin	<i>Stenella coeruleoalba</i>	2002–06	1.22	Individuals	
Pantropical spotted dolphin	<i>Stenella attenuata</i>	2002–06	0	Individuals	
TOTAL FISHERY BYCATCH			13.92	Individuals	

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Table 4.6.C (continued)

Subtable 4.6.C.2		HAWAII-BASED SHALLOW-SET PELAGIC LONGLINE FISHERY (SWORDFISH)			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE AMOUNT	UNIT	CV
Beaked whale (unidentified)	Ziphiidae	2002–06	0	Individuals	0
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	2002–06	0	Individuals	0
Bottlenose dolphin	<i>Tursiops truncatus</i>	2002–06	0	Individuals	0
Bryde's whale	<i>Balaenoptera edeni</i>	2002–06	0	Individuals	0
Cetacean (unidentified)	Cetacea	2002–06	0	Individuals	0
False killer whale	<i>Pseudorca crassidens</i>	2002–06	0	Individuals	0
False killer or short-finned Pilot whale (unidentified)	Delphinidae	2002–06	0	Individuals	0
Humpback whale	<i>Megaptera novaeangliae</i>	2002–06	0	Individuals	0
Risso's dolphin	<i>Grampus griseus</i>	2002–06	0	Individuals	0
Short-beaked common dolphin (unidentified)	<i>Delphinus delphis</i>	2002–06	0	Individuals	0
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	2002–06	0	Individuals	0
Sperm whale	<i>Physeter macrocephalus</i>	2002–06	0	Individuals	0
Spinner dolphin	<i>Stenella longirostris</i>	2002–06	0	Individuals	0
Striped dolphin	<i>Stenella coeruleoalba</i>	2002–06	0	Individuals	0
Pantropical spotted dolphin	<i>Stenella attenuata</i>	2002–06	0	Individuals	0
TOTAL FISHERY BYCATCH			0	Individuals	

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Table 4.6.C (continued)

Subtable 4.6.C.3 (SUMMARY)		TOTAL SPECIES BYCATCH	
COMMON NAME	SCIENTIFIC NAME	AVERAGE AMOUNT	UNIT
Beaked whale (unidentified)	Ziphiidae	0	Individuals
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	0.41	Individuals
Bottlenose dolphin	<i>Tursiops truncatus</i>	0.93	Individuals
Bryde's whale	<i>Balaenoptera edeni</i>	0	Individuals
Cetacean (unidentified)	Cetacea	1.21	Individuals
False killer whale	<i>Pseudorca crassidens</i>	5.74	Individuals
False killer or short-finned pilot whale (unidentified)	Delphinidae	3.47	Individuals
Humpback whale	<i>Megaptera novaeangliae</i>	0	Individuals
Risso's dolphin	<i>Grampus griseus</i>	0	Individuals
Short-beaked common dolphin (unidentified)	<i>Delphinus delphis</i>	0	Individuals
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	0.94	Individuals
Sperm whale	<i>Physeter macrocephalus</i>	0	Individuals
Spinner dolphin	<i>Stenella longirostris</i>	0	Individuals
Striped dolphin	<i>Stenella coeruleoalba</i>	1.22	Individuals
Pantropical spotted dolphin	<i>Stenella attenuata</i>	0	Individuals
TOTAL FISHERY BYCATCH		13.92	Individuals

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Table 4.6.D

Subtables showing estimates of marine mammal incidental mortality and serious injury for Pacific Islands fisheries outside the US EEZ. All bycatch estimates are in numbers of individuals and are an average for the years indicated. Key stocks/populations are shaded.

Subtable 4.6.D.1		HAWAII-BASED DEEP-SET PELAGIC LONGLINE FISHERY (TUNA)			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE AMOUNT	UNIT	CV
Beaked whale (unidentified)	Ziphiidae	2002–06	0.76	Individuals	1.09
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	2002–06	0.50	Individuals	1.06
Bottlenose dolphin	<i>Tursiops truncatus</i>	2002–06	0	Individuals	
Bryde's whale	<i>Balaenoptera edeni</i>	2002–06	0	Individuals	
Cetacean (unidentified)	Cetacea	2002–06	0	Individuals	
False killer whale	<i>Pseudorca crassidens</i>	2002–06	7.62	Individuals	0.43
False killer or short-finned pilot whale (unidentified)	Delphinidae	2002–06	0	Individuals	
Humpback whale	<i>Megaptera novaeangliae</i>	2002–06	0	Individuals	
Risso's dolphin	<i>Grampus griseus</i>	2002–06	1.13	Individuals	0.74
Short-beaked common dolphin (unidentified)	<i>Delphinus delphis</i>	2002–06	0	Individuals	
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	2002–06	1.30	Individuals	
Sperm whale	<i>Physeter macrocephalus</i>	2002–06	0	Individuals	
Spinner dolphin	<i>Stenella longirostris</i>	2002–06	0	Individuals	
Striped dolphin	<i>Stenella coeruleoalba</i>	2002–06	0	Individuals	
Pantropical spotted dolphin	<i>Stenella attenuata</i>	2002–06	0	Individuals	
TOTAL FISHERY BYCATCH			11.31	Individuals	

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Table 4.6.D (continued)

Subtable 4.6.D.2		HAWAII-BASED SHALLOW-SET PELAGIC LONGLINE FISHERY (SWORDFISH)			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE AMOUNT	UNIT	CV
Beaked whale (unidentified)	Ziphiidae	2002–06	0	Individuals	
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	2002–06	0	Individuals	
Bottlenose dolphin	<i>Tursiops truncatus</i>	2002–06	0.2	Individuals	
Bryde's whale	<i>Balaenoptera edeni</i>	2002–06	0	Individuals	
Cetacean (unidentified)	Cetacea	2002–06	0	Individuals	
False killer whale	<i>Pseudorca crassidens</i>	2002–06	0	Individuals	
False killer or short-finned pilot whale (unidentified)	Delphinidae	2002–06	0	Individuals	
Humpback whale	<i>Megaptera novaeangliae</i>	2002–06	0.2	Individuals	
Risso's dolphin	<i>Grampus griseus</i>	2002–06	0.6	Individuals	
Short-beaked common dolphin (unidentified)	<i>Delphinus delphis</i>	2002–06	0	Individuals	
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	2002–06	0	Individuals	
Sperm whale	<i>Physeter macrocephalus</i>	2002–06	0	Individuals	
Spinner dolphin	<i>Stenella longirostris</i>	2002–06	0	Individuals	
Striped dolphin	<i>Stenella coeruleoalba</i>	2002–06	0	Individuals	
Pantropical spotted dolphin	<i>Stenella attenuata</i>	2002–06	0	Individuals	
TOTAL FISHERY BYCATCH			1.0	Individuals	

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Table 4.6.D (continued)

Subtable 4.6.D.3 (SUMMARY)		TOTAL SPECIES BYCATCH	
COMMON NAME	SCIENTIFIC NAME	AVERAGE AMOUNT	UNIT
Beaked whale (unidentified)	Ziphiidae	0.76	Individuals
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	0.50	Individuals
Bottlenose dolphin	<i>Tursiops truncatus</i>	0.20	Individuals
Bryde's whale	<i>Balaenoptera edeni</i>	0	Individuals
Cetacean (unidentified)	Cetacea	0	Individuals
False killer whale	<i>Pseudorca crassidens</i>	7.62	Individuals
False killer or short-finned pilot whale (unidentified)	Delphinidae	0	Individuals
Humpback whale	<i>Megaptera novaeangliae</i>	0.20	Individuals
Risso's dolphin	<i>Grampus griseus</i>	1.73	Individuals
Short-beaked common dolphin (unidentified)	<i>Delphinus delphis</i>	0	Individuals
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	1.3	Individuals
Sperm whale	<i>Physeter macrocephalus</i>	0	Individuals
Spinner dolphin	<i>Stenella longirostris</i>	0	Individuals
Striped dolphin	<i>Stenella coeruleoalba</i>	0	Individuals
Pantropical spotted dolphin	<i>Stenella attenuata</i>	0	Individuals
TOTAL FISHERY BYCATCH		12.31	Individuals

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Table 4.6.E

Subtables showing estimates of sea turtle bycatch (mortalities and individuals released alive) in Pacific Islands Region fisheries, in numbers of individuals. Key populations are shaded.

Subtable 4.6.E.1		HAWAII-BASED DEEP-SET PELAGIC LONGLINE FISHERY (TUNA)				HAWAII-BASED SHALLOW-SET PELAGIC LONGLINE FISHERY (SWORDFISH)			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE AMOUNT	UNIT	CV	DATA SOURCE	AVERAGE AMOUNT	UNIT	CV
Green sea turtle	<i>Chelonia mydas</i>	2005	0	Individuals		2005	0	Individuals	
Leatherback sea turtle	<i>Dermochelys coriacea</i>	2005	4	Individuals		2005	8	Individuals	
Loggerhead sea turtle	<i>Caretta caretta</i>	2005	0	Individuals		2005	10	Individuals	
Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	2005	16	Individuals		2005	0	Individuals	
TOTAL BYCATCH			20	Individuals			18	Individuals	

Subtable 4.6.E.2 (SUMMARY)		TOTAL SPECIES BYCATCH	
COMMON NAME	SCIENTIFIC NAME	AVERAGE AMOUNT	UNIT
Green sea turtle	<i>Chelonia mydas</i>	0	Individuals
Leatherback sea turtle	<i>Dermochelys coriacea</i>	12	Individuals
Loggerhead sea turtle	<i>Caretta caretta</i>	10	Individuals
Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	16	Individuals
TOTAL BYCATCH		38	Individuals

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Table 4.6.F

Subtables showing estimates of seabird bycatch in Pacific Islands Region fisheries, in numbers of individuals. Bycatch estimates reflect the average of the years identified. Key populations are highlighted.

Subtable 4.6.F.1		HAWAII-BASED DEEP-SET PELAGIC LONGLINE FISHERY (TUNA)				HAWAII-BASED SHALLOW-SET PELAGIC LONGLINE FISHERY (SWORDFISH)			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AMOUNT	UNIT	CV	DATA SOURCE	AMOUNT	UNIT	CV
Black-footed albatross	<i>Phoebastria nigripes</i>	2005	82	Individuals		2005	7	Individuals	0
Brown booby	<i>Sula leucogaster</i>	2005	3	Individuals		2005	0	Individuals	0
Laysan albatross	<i>Phoebastria immutabilis</i>	2005	43	Individuals		2005	62	Individuals	0
Short-tailed albatross	<i>Phoebastria albatrus</i>	2005	0	Individuals		2005	0	Individuals	0
TOTAL BYCATCH			128	Individuals			69	Individuals	

Subtable 4.6.F.2 (SUMMARY)		TOTAL SPECIES BYCATCH	
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT
Black-footed albatross	<i>Phoebastria nigripes</i>	89	Individuals
Brown booby	<i>Sula leucogaster</i>	3	Individuals
Laysan albatross	<i>Phoebastria immutabilis</i>	105	Individuals
Short-tailed albatross	<i>Phoebastria albatrus</i>	0	Individuals
TOTAL BYCATCH		197	Individuals