

Pacific Islands Region Bycatch Reduction Implementation Plan FY04-FY05

[NOTE: This is a public, working document that will be revised in the future as additional bycatch minimization opportunities occur.]

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Introduction

Bycatch, or the catch of non-target species, is a growing concern to the fishing industry, managers and the general public in the region. Bycatch can be simply described as unwanted animals caught while fishing. The Magnuson-Stevens Fishery Conservation and Management Act (MSA) defines bycatch as fish which are caught but are not sold or kept for personal use. This includes fish which are discarded for economic or regulatory reasons. When considering these reasons with fishing effort, reducing bycatch becomes quite complicated.

As the environments affected by fisheries are looked at from an ecosystem-wide perspective, bycatch becomes increasingly important. Determining the amount of bycatch is important for completing the classic fisheries management equation, $F + M = Z$. Fishing (F) + Natural Mortality (M) = Total Mortality (Z). The equation seems simple, but quantifying each of the variables is not. In addition, identifying and reducing the effects of fishing on the recovery of protected species is another very important facet to the bycatch issue. The incidental bycatch of protected species; sea turtles, seabirds and marine mammals; has maintained a high public profile and a primary concern to fishery managers of the region.

Since 1990, protected species bycatch issues have had an increasingly important effect on managing large sectors of the fishing activity within the region, the nation and the world. The incidental catch of seabirds and sea turtles are a global concern in longline fisheries. Protected species bycatch is a concern for fishery managers in the pelagic longline, bottomfish and pelagic handline fisheries. There are no reports of seabird and/or sea turtle incidental catch in lobster, coral reef, or precious coral fisheries in the region.

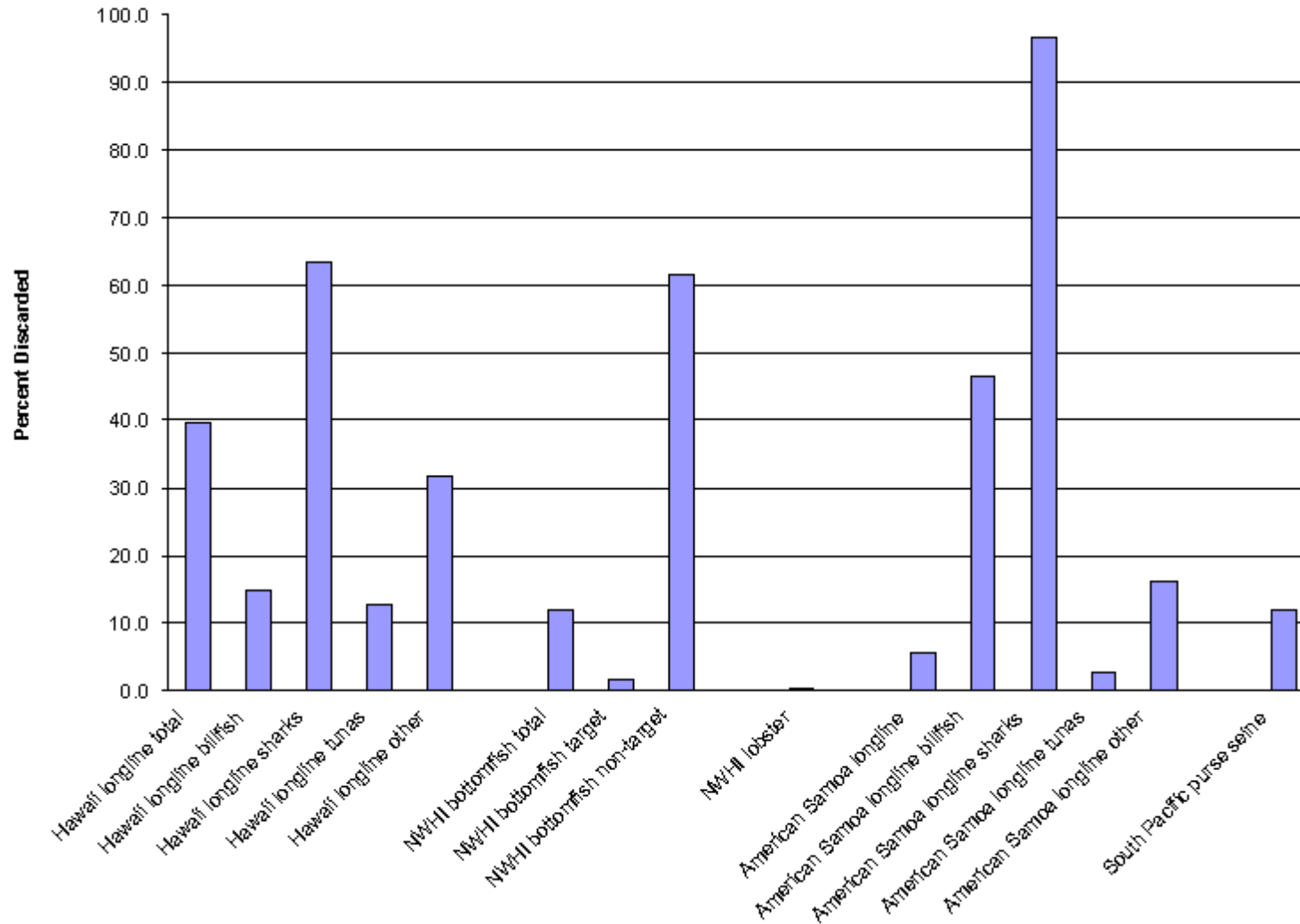
Seabird bycatch is addressed in the U.S. Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries (NPOA), which was jointly developed by NOAA Fisheries, the U.S. Fish & Wildlife Service (USFWS) and the U.S. Department of State and published by NOAA Fisheries in February 2001. The US NPOA was developed in response to the United Nations' Food & Agriculture Organization's International Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries (IPOA) that was adopted in 1999. The IPOA calls on United Nations Food and Agricultural Organization member states to conduct assessments of their longline fisheries to determine if a seabird bycatch problem exists.

Methods to address sea turtle bycatch issues have proven more difficult; however, techniques have been identified. Measures showing promise of reducing sea turtle bycatch include the use of circle hooks in combination with mackerel type bait and removal of longline gear from the upper 40 m of the water column (*i.e.*, employment of deep sets rather than shallow sets). There is a growing interest in expanding at-sea data collection programs which could provide a better understanding of sea turtle bycatch throughout the region. The closure of the Hawaii-based swordfish fishery is an example of efforts to mitigate sea turtle bycatch. Currently, agencies throughout the region are actively engaged in identifying, addressing, mitigating and alleviating pelagic longline impacts to sea turtle species.

In the central and western Pacific region, the level of bycatch of each fishery varies substantially in terms of overall quantity and the causes. Identified causes include regulatory, economic, and protected status of certain species groups. These causes were extensively documented in the Western Pacific Regional Fishery Management Council's Sustainable Fisheries Act (SFA) bycatch amendments.¹ It is important to keep in mind that changes in regulations have led to increases, in some cases significant increases, in the numbers of reported bycatch. While the number actual number of animals caught has not increased, the changes have affected the manner in which the animals are counted for reporting purposes.

¹ WPRFMC. 1998. Magnuson-Stevens Act Definitions and Required Provisions. Amendment 6 to the Bottomfish and Seamount Groundfish Fisheries Management Plan; Amendment 8 to the Pelagic Fisheries Management Plan; Amendment 10 to the Crustaceans Fisheries Management Plan; Amendment 4 to the Precious Corals Fisheries Management Plan. Western Pacific Regional Fishery Management Council, Honolulu Hawaii.

Western Pacific Bycatch (as % of total catch)



This report considers several aspects of the bycatch issues in the region's fisheries which include, enhancement of bycatch reporting methodologies (and standardization of data elements), identification of priority research needs, identification of potential new mitigation measures, and enhancement of outreach and education measures.

Standardization of data elements and reporting is important and valuable to address the many issues of managing fisheries. In order to understand what to modify, a good picture of what is being used is necessary. A standardized set of descriptive elements has already been developed and incorporated into the larger data collection efforts of the Western Pacific Fisheries Information Network creel surveys and commercial fishery observer programs in the region.

Modification of fishing practices has been an active pursuit, primarily in the longline fishery as exhibited by experiments for reducing bycatch of sea birds and sea turtles.

One of the more important outreach programs in the Pacific Islands Regional Office (PIRO) are the Protected Species Workshops. These workshops will be maintained and updated where they already exist. The basic program for the pelagic longline fishery will be modified as necessary to include other fisheries. New release and handling techniques such as using the ARC De-hooker© will be incorporated into outreach and education programs for the region's fishers. This will be an on going process throughout FY04 and FY05. Web-based Protected Species Training to allow greater access & flexibility will be investigated. Certificates could be printed from the web or mailed from the PIRO. Bycatch issues involving protected species also offer opportunities for continued cooperation with other resource management agencies like the USFWS, Inter-American Tropical Tuna Commission (IATTC), Secretariat of the Pacific Community (SPC) and the Forum Fisheries Agency (FFA).

Several nations with significant fishing interest in the Pacific have seen an increase in the levels of cooperation and contact between their data collection programs (*i.e.* observer programs, scientific data collection programs and research programs). In late 2002, a representative from the PIRO Hawaii Longline Observer Program in the 5th SPC-FFA Data Form meeting in Brisbane, Australia. Also in 2002, the NMFS PIRO began assisting the Korean National Fisheries Research and Development Institute (NFRDI) with the development of the Korean National Fishery Observer Program. Cooperation between NMFS and the NFRDI continue through 2004 and beyond. Representatives from the government of Taiwan have also expressed interest in learning more about PIRO observer programs. Staff and observers from the PIRO Longline Observer Programs will participate in the 4th International Fisheries Observer Conference in Sydney, Australia.

This bycatch initiative is a joint report between the NOAA Fisheries Pacific Islands Regional Office and the Western Pacific Regional Fisheries Management Council. Further elaboration concerning NOAA Fisheries' Bycatch Initiatives can be found in "Managing the Nation's Bycatch" (NMFS 1998) and "Evaluating Bycatch: a National Approach to Standardized Bycatch Monitoring Programs" (NMFS 2003).

PELAGIC FISHERIES

The pelagic fisheries are by far the largest of the commercial and recreational fisheries of this region. Each of the pelagic fisheries in this region are variations of hook-and-line gear, except for the fleet of about 30-50 purse seine vessels that fish across the Western and Central Pacific. The purse seine fleet is managed under the South Pacific Tuna Treaty, a treaty between the US and the independent Pacific Island nations.

The largest component of the bycatch in the Hawaii-based longline fishery is sharks, particularly the Blue shark (*Prionace glauca*). Sharks and other finfish bycatch species are discarded primarily for two reasons; economic and regulatory. According to observer data, during 1994-2001, about 40%, by number, of the total catch in the Hawaii-based longline fishery was discarded. The percentage discard rates were approximately 13% for tunas, 15% for billfish, 63% for sharks, 32% for other Management Unit Species (MUS), and 97% for non-MUS. In the past, many sharks were finned. Finning is defined as retained the fins while returning the rest of the carcass to the sea. The finning rate peaked in 1999, when about 65% of all captured sharks were finned. The majority of fins came from Blue sharks, representing 95% of all finned sharks. Two important regulatory changes in 2000 and 2001 substantially altered bycatch rates and bycatch mortality rates. State and federal prohibitions on shark finning resulted in three important effects on shark bycatch. First, the percent of blue shark that were discarded increased. Second, a decrease in the absolute bycatch mortality rate of Blue sharks. Because Blue sharks have relatively high post-hooking survival rates. Three, a slight increase of the retention rate of whole Blue sharks. The closure in 2000 of the swordfish-directed fishery also greatly decreased the catch of Blue sharks, thereby decreasing the bycatch rate overall. Vessel logbooks indicate that in 2001, 96% of the approximately 45,000 sharks caught in the Hawaii-based longline fishery were discarded and the balance retained whole.

Bycatch of sea turtles and sea birds is also an issue in longline fisheries and to a lesser extent in the handline (*palu ahi* and *ika shibi*) fisheries. Protected species listed under the ESA that occur throughout the region include seven species of marine mammals, five species of sea turtles, and one species of seabird. All other species of marine mammals and seabirds occurring in the region are protected under the Marine Mammal Protection Act (MMPA) or the U. S. Migratory Bird Treaty Act (MBTA). Interaction rates of ESA listed sea turtle and seabird species with the managed fisheries within the US western Pacific region are generally low.

In the early 1990s longline operations were suspected of adversely affecting the Hawaiian monk seals. There were a few instances of animals seen with hooks imbedded in their bodies and injuries that could not be attributed to known natural causes. The sources of the gear or injuries could not be conclusively associated with commercial fishing operations. Amendment 3 to the Pelagic Fisheries Management Plan (FMP), implemented in 1991 established a 50nmi longline exclusion zone around the Northwestern Hawaiian Islands. Similarly, Amendment 5 to the Pelagic FMP established a 50-70nmi longline exclusion zone around the Main Hawaiian Islands (MHI). The exclusion zone around the MHI is reduced to 25nmi on the windward (north and east sides) sides of the islands in winter (October 1 – January 31). Since 1993 there have been no reported interactions between Hawaii-based longline vessels and Hawaiian monk seals.

Interactions have occurred between longliners and sea turtles; but mitigation measures have been demonstrated to dramatically reduce the number of sea turtles caught incidentally. Experiments testing the efficacy of different mitigation measures have shown promise.

To date, there have only been three observed interactions with Endangered Species Act (ESA) listed whale species and pelagic longline fisheries. Two incidents involving a Humpback whale (*Megaptera novaengliae*) and one involving a Sperm whale (*Physeter macrocephalus*). Recent Biological Opinions have concluded that the region's pelagic fisheries are not likely to have an adverse affect the populations of the seven ESA listed whale species in the region.

In pelagic fisheries managed under an FMP, there are documented interactions with several non-ESA listed marine mammals. Observer data from the Hawaii-based longline fishery show that interactions with non-ESA listed marine mammals are infrequent. At present, the Hawaii-based pelagic fisheries; longline, troll, *palu-ahi*, and *ika-shibi*, are classified as Category III fisheries under Section 118 of the MMPA; which defines them to have a remote likelihood or no known incidental take of marine mammals. The NMFS re-examines the classification of these fisheries annually.

The seabird species most often documented as bycatch in the Western Pacific Region are the Black-footed albatross (*Phoebastria nigripes*) and the Laysan albatross (*P. immutabilis*). Both species are not listed as endangered under the ESA. The primary nesting grounds for these species is in the Northwestern Hawaiian Island (NWHI). The proximity of the nesting grounds to some of the longline fishing grounds is thought to be a contributing factor to their incidental capture in that fishery. Incidental seabird bycatch in the Hawaii-based longline fishery occurs as seabirds follow longline vessels and dive on baited hooks being deployed or retrieved. In addition to the prohibition of targeting swordfish by the Hawaii-based longline fishery; other required mitigation measures such as line setting devices (known as line shooters) and blue-dyed bait, have dramatically reduced the bycatch rates of Black-footed and Laysan albatross.

The Short-tailed albatross (*P. albatrus*) is the only seabird that occurs in the Western Pacific Region that is listed under the ESA. There have been no reports of interactions between the Short-tailed albatross and the Hawaii-based longline fishery.

In American Samoa, the amount of bycatch in that longline fishery is measured through creel surveys and a Federal logbook program. The American Samoa Department of Marine & Wildlife Resources' Longline Observer Program will provide data for further assessment of the magnitude of bycatch in the fishery. From logbook estimates, the largest component of the American Samoa longline fishery bycatch are tunas, comprising 44.5% of the catch. Sharks are 25.5% of the catch, and billfish comprise 12% of the catch. Sharks are a much smaller component of the catch total than in the Hawaii-based longline fishery; although most of the sharks (96.7%) are discarded. Tuna discards range from a low of 0.32% for albacore to 59.0% for bluefin, although averaged over all species, 3% of the total tuna catch is discarded.

The data from the American Samoa longline fishery's logbooks, for the time period 1992-1999 indicate a range of interactions with sea turtles. The reported interactions include both hooking and entanglements. During that time period, there were six reported interactions with sea turtles. Four involved unspecified species of hardshell sea turtles (*i.e.* non-Leatherback species). Three of the turtles were reported as released alive, the fourth was reported as released dead. There was one reported incident involving a Leatherback sea turtle and one of an

unidentified sea turtle. Due to the lack of supporting documentation, such as observer data, the identity of the sea turtle species were could not be confirmed.

Reliable estimates of bycatch and bycatch mortality rates in the small-boat troll and handline fisheries of all the island areas are just now being achieved through modification of creel survey programs but the rates are believed to be negligible, < 1.0% of the total catch. Bycatch mortality rates are believed to be relatively small because few species and sizes are unwanted and because when fish are discarded they are often in viable condition.

In the region, there are reported interactions with sea turtles in these pelagic fisheries in; the Hawaii-based longline fishery, the American Samoa-based longline fishery, and the Central and Western Pacific U.S. purse seine fishery. It is possible that small boat hook & line fisheries interact with sea turtles. Due to the relatively low levels of fishing effort and the relatively high selectivity of the gear, incidental takes and mortalities of sea turtles are likely to be minimal.

Future priorities: Bycatch reporting

Measures to improve bycatch reporting in the Pacific Islands region include the following proposals.

- **Assessment of the amount and type of bycatch in the small boat recreational, charter, commercial, and mixed-motivation fisheries in all the island groups.**

The reporting of bycatch data for small boat troll and handline fisheries is relatively new and are either self-reported on logbooks or volunteered during creel survey interviews. Data collected from American Samoa, Guam and Hawaii trollers suggest that fin-fish bycatch for trolling is extremely low, generally less than 1% of the total catch. Further data collection is needed for commercial trollers in Hawaii and Northern Mariana Island-based troll vessels, and for pelagic handline fisheries in Hawaii. New catch reporting forms in Hawaii have been modified to report bycatch in all fisheries, but the level of reporting by fishermen and the data quality need to be evaluated. Bycatch information is also being collected by the Hawaii Marine Recreational Statistical Survey, which also needs to be further evaluated of its potential to generate bycatch information.

- **Deployment of observers on troll and handline fishing vessels**

To complement the reporting of bycatch by small scale fishermen and creel surveys, observers should be deployed opportunistically on troll and handline vessels. Observer deployment policies for small and medium scale vessels may present a set of problems not encountered on larger vessels. Issues such as vessel size & crew compliment may preclude observer deployment on particular vessels. Selective deployment of observers on specific vessels may be the most feasible means to capture information from these vessels. Selective deployment strategies for observers should be explored. Observer coverage on troll and handline vessels could be used to explore any differences in bycatch between commercial and recreational fishers in these fisheries.

- **Evaluation of American Samoa fisherman/observer project**

A current University of Hawaii Pelagic Fisheries Research Program project is exploring the use of fishermen as observers. The effectiveness of this approach needs to be properly evaluated for use elsewhere with small vessels. Issues such as reporting of sensitive bycatch such as turtles, seabirds and marine mammals, or under-reporting of fin-fish bycatch need to be addressed.

- **Evaluation and testing of electronic and video monitoring technology for all sizes of pelagic fishing vessels**

Observers programs are the best sources of bycatch data, but they are expensive to maintain, particularly if high observer coverage rates are required, such as in the Hawaii longline fishery. Moreover, placing observers on small fishing vessels may not always be feasible, requiring innovative solutions for bycatch reporting. Video monitoring and digital imaging software may offer an opportunity to remotely collect catch data from longline fisheries without observers. Further, digital video monitoring may offer a long term solution for small vessels where observer deployment is difficult.

- **Validation of self reported discard data for all fisheries**

The NMFS PIFSC has developed modeling techniques to calibrate the volume of discards from Hawaii longline fishery logbooks by comparing logbook and observer records from the same sets. This enables fleet wide estimates of discards to be reliably computed from the logbook data. Similar approaches should be explored with other self reporting logbooks and catch report forms, if observers can be deployed on fishing vessels. Observer programs on small vessels, where observer placement will be opportunistic could be structured around acquiring sufficient data for this type of modeling.

- **Routine analysis, synthesis, and interpretation of bycatch data.**

The current SAFE reports produced by the Council contain limited bycatch data. To date this has only included information on Guam and American Samoa troll fisheries, and the American Samoa longline fishery. The Pelagic Annual Report will be revised to include bycatch information from the Hawaii longline fishery and discard information for Hawaii recreational fishing

- **Observer data management system**

The newly implemented data management system will continue to be supported, expanded and improved. In early FY04, additions and improvements to the system for updating and revising collection protocols will be instituted. Observer program staff from the NMFS Southwest Region West Coast Longline Observer Program has adopted the system.

Bycatch minimization and other research priorities

Experimentation and implementation of new seabird techniques such as side setting continues in Hawaii. In order to test the efficacy of side setting, the observer program has been collecting data on use of this technique along with other mitigation measures used in the Hawaii based longline fishery. On-going through FY05: Research on the effects of sea surface temperature (SST) on the catch rates of turtles. Produce guidelines for further reducing the incidental takes of sea turtles using SST guidelines. Development and implementation of new data elements for the logbooks to capture the long term effects of modified fishing practices is on-going.

Projects identified include:

- **Minimization of shark bycatch and mortality in the Hawaii longline fishery**

Recent regulatory measures have substantially increased the amounts of fish classified as bycatch in this region. The primary influence was the passage of the national prohibition on shark finning in 2001. Because the region's most abundant and commonly caught shark species, blue shark, is high in urea, processing the carcass is labor intensive and the returns on sales marginal. Further the blue shark carcasses may contaminate the flesh of high value fish that come into contact with it. The prohibition on shark finning resulted in a steep declining in the retention of these sharks by longline fishermen, but they continue to be caught incidentally and released as bycatch. Moreover, the return of swordfish fishing in 2004 in the Pacific Islands region will likely increase blue shark catches, as in the past blue sharks comprised about 50% of the total catch in this fishery. Some progress has been made in other areas of the US with development of baits that may catch fish but repel sharks. The use of de-hooking devices to release sharks should be encouraged. This and other techniques to minimize shark catch should be explored.

- **Exemption for catch and release of recreational or charter vessel catches**

Some recreational and charter vessel fishermen in Hawaii practice catch and release for billfish, particularly marlins. In Guam charter vessel operators catching reef fish also encourage patrons to catch and release fish. Currently, any caught and intentionally released fishes are considered as bycatch, even though the promotion of a catch & release ethic has a conservation motive. Some Atlantic fisheries have a Secretarial exemption from being considered as bycatch under the MSA. The granting of a similar exemption should be explored for recreational and charter boat fishermen who practice catch and release in the Pacific Islands region.

- **Stock assessment and biology of bycatch species, especially, non-blue pelagic sharks and lancet fish**

The NMFS PIFSC has conducted a stock assessment of the blue shark, the main bycatch species in the Hawaii longline fishery. Stock assessments of other commonly encountered bycatch species are needed to place bycatch discards and mortalities in perspective.

- **Assessment of mortality of discarded finfish in the pelagic fisheries.**

Relatively large numbers of finfish are discarded in the Hawaii and American Samoa longline fishery. Many fish are released alive but there is little to no information on post-release mortality. Future management measures may explore the use of mandatory catch and release policies for longline fisheries in the Western Pacific (*esp.* billfish). In order to develop effective catch and release policies, information on the survival rates for different species from longline fishing would be necessary. Similar information is also required to examine similar catch and release policies (*e.g.* billfish) that may be implemented in the region's troll and handline vessels.

- **Assessment of unobserved mortality in the longline fisheries.**

Besides observed catches, fishing gear may also have a bycatch component that is unobserved. This includes fish that are caught and may fall off the hook, or fishes caught and bitten by sharks or other predators, such as toothed whales. Some work has already been conducted by the NMFS PIFSC on bottomfish unobserved fishing mortality. Similar work needs to be conducted on pelagic longline fisheries to quantify the volume of unobserved fishing mortality, in relation to the total observed catch.

- **Assessment of bycatch in the American Samoa longline fishery.**

Observers will be deployed on the American Samoa longline fishery to provide accurate information on protected species interactions and to calibrate logbook discard records, so that fleet wide estimates of bycatch can be generated through modeling.

- **Assess bycatch of new fishing gear requirements & novel deployment techniques**

The advent in 2004 of a re-established shallow set swordfish fishery may have different bycatch and protected species (other than turtles) interaction profiles, compared to squid and J-hook gear. A description of the bycatch performance of this fishery should be a priority following its re-establishment in 2004. Experiments with 18/0 offset circle hooks with mackerel bait have shown promise as effective mitigation measures. The large circle hook is difficult for the turtles to bite and with the hook point covered, the turtles may be less likely to become snagged. The new gear may also have an influence on post-release mortalities for protected species and non-target species (*e.g.* the incidental longline catch of marlins) of fish, which should also be considered in

bycatch investigations. The use of de-hooking devices can mitigate the effects of bycatch by increasing the post-capture survival rate of released animals.

- **New fisheries, e.g. squid**

A new seasonal squid jig fishery has been established to the north of Hawaii. This fishery employs light attraction and squid jigs using artificial lures. At this time, self reporting from vessel logbooks is the only source of data on this fishery. Bycatch in this fishery should be investigated.

- **Enhance market opportunities for American Samoa fishery.**

The identification of accessible markets for frozen product may help reduce bycatch in the American Samoa longline fishery by promoting greater utilization of fish currently discarded. The American Samoa longline fishery is based almost entirely on albacore catches for the local canneries in Pago Pago. The small resident population in Tutuila, means that the domestic market is limited, as are the opportunities for airfreighting fresh fish to lucrative markets in Japan, Hawaii or mainland USA through limits on air freight. There may, however, be opportunities for shipping frozen fish to markets in mainland USA and Japan, and these should be explored and evaluated.

- **Develop opportunities for NMFS/fishing industry partnerships for bycatch reduction.**

Most protected species bycatch mitigation measures employed in the region's pelagic fisheries evolved from ideas developed by longline fishermen. These include such devices and techniques as *tori* lines (bird scaring lines), dyeing the bait blue, underwater setting chutes and side setting (deploying longline gear from the side instead of the stern). The NMFS should engage in partnership research with pelagic fishers to further develop bycatch minimization measures. Once developed, the techniques can be exported to other fishers and fishing interests through outreach & education programs. The PIRO protected species workshops have proven to be an effective venue to spread awareness of mitigation techniques.

CRUSTACEANS FISHERIES

The NWHI lobster fishery is the only significant commercial lobster fishery in the region. No significant recreational lobster fishing occurs in the economic exclusive zone (EEZ) around the MHI or in the EEZ's around American Samoa, Guam, the Northern Mariana Islands, and the Pacific Remote Island Areas (PRIAs). In the near-shore waters lobsters are collected by two methods, spears and by hand. These methods are highly selective methods, and bycatch is likely to be negligible.

Studies by NMFS report that unintentional loss of lobster traps have occasionally occurred in the NWHI, however, ghost fishing by lost traps was determined to be negligible. While lobsters may enter these traps, they were also able to exit, and there were no observed mortalities associated with ghost fishing. NMFS concluded that lobsters utilized the traps as shelter.

Data gathered by NMFS experiment traps from 1984-1996 indicate that the non-target species taken in traps are principally other small crustaceans-such as hermit crabs-and molluscs and reef fish. However, unlike the traps used in the commercial fishery, research traps do not contain escape vents. Thus, the amount of bycatch in the research traps is probably higher than the bycatch in commercial traps. Similar results were recorded by observers deployed on fishing vessels to record the number of lobsters discarded during the 1997 NWHI lobster season.

The NWHI lobster fishery rarely interacted with any protected species. In 1983, precautionary measures were taken to redesign the entrance cone lobster traps to ensure that Hawaiian monk seals could not get caught inside lobster traps. In 1986, a Hawaiian monk seal was reported to drown from entanglement in the bridle rope of a lobster trap. Since 1999, the lobster fishery in the NWHI (where most Hawaiian monk seals occur) has been closed.

Future Priorities: Bycatch reporting

- **An accurate description of bycatch using commercial lobster fishing traps based on observers and video technology.**

Bycatch minimization and other research priorities

- **Explore opportunities for industry collaboration on bycatch mitigation. Examine existing data for changes in bycatch due to changes in mesh size.**

PRECIOUS CORALS FISHERIES

This fishery is currently inactive although selective harvest has occurred in the past several years primarily in the MHI. The fishery management plan for Precious Corals Fisheries, implemented in 1979, defines selective gear as any gear used for harvesting corals that can discriminate between type, size, quality, or characteristics of living or dead corals. Non-selective gear is defined as any gear that cannot make this discrimination or differentiation. At this time, only selective gear may be used to harvest precious corals in the Pacific Islands region. Selective harvesting of precious coral has been done with submersibles, remotely operated vehicles (ROVs) and divers. Under current regulations, the amount of bycatch from selective harvest operations is minimal.

There has been no observed bycatch of marine mammals from precious coral fisheries managed under an FMP in the region.

Future Priorities: Bycatch reporting

Video tracking of precious coral harvesting can provide data on many aspects of the fishery. A video record would allow managers and scientists to evaluate the harvest selection criteria, better assess the status of precious coral stocks, and supply information about the basic biology and ecology of the precious coral beds in the region.

Bycatch minimization and other research priorities

Maintain, and promote where feasible, proven selective harvesting techniques.

BOTTOMFISH FISHERIES

The bottomfish fisheries of Hawaii are relatively small compared to the pelagic fisheries, but bottomfish (snappers, groupers, and jacks) are critical to the seafood markets in Hawaii (and increasingly in Guam and the Northern Mariana Islands) and are historically important. The basic design of the handline gear used in Pacific Island bottomfish fisheries has remained essentially unchanged from gear used by early indigenous Pacific islanders (Haight et al. 1993b)². Today, domestic bottomfish vessels catch deepwater snappers, groupers and jacks primarily on powered (hydraulic or electric) handline gear. Throughout their range, deepwater snappers are typically distributed along the 100 fathom depth curve..

Bycatch rates are low in the bottomfish fisheries, but poor correspondence among observer, logbook, and experimental fishing data indicate a level of uncertainty associated with bycatch estimates for the NWHI fishery, and reliable estimates are not yet available for the bottomfish fisheries of the other island areas (the fleets of which are mostly comprised of small boats). Only hook-and-line gears are used in the bottomfish fisheries, and these gears strongly select for carnivores, particularly aggressive predators. These species, with the exception of sharks, are favored in markets, thus they tend to be target species. In Hawaii, important exceptions include some Carangidae, like *kahala* (*Seriola spp.*) and *butaguchi* (*Pseudocaranx dentex*), which are often discarded, often for economic reasons. Shark meat is difficult to market in the region. The prohibition on shark finning has greatly reduced or nearly eliminated the marketing of fins in Hawaii and large parts of the region.

There are no finfish or invertebrate species captured in the bottomfish fisheries whose capture or retention is prohibited by law. There are, however, State of Hawaii, size limits but these are most likely to affect the near-shore fisheries in the main Hawaiian Islands.

²Haight, W.R., Parrish, J.D., Hayes, T.A. 1993 Feeding Ecology of Deepwater Lutjanadae Snappers at Penguin Bank, Hawaii; Transactions of the American Fisheries Society Vol. 122 pg. 328-347.

Unobserved fishing mortality can be substantial with prohibited gears such as poisons, explosives, and nets (from which fish drop out before harvest either injured or dead and which, when lost, can continue to capture and kill fish). In contrast, hook-and-line gears can be expected to result in comparatively little unobserved mortality, since few fish drop off once hooked and fish taken by predators such as sharks are not completely consumed, with the head often remaining on the hook. Potential sources of unobserved mortality in the bottomfish fisheries include: 1) fish that are hooked, but escape before being brought to the vessel; and, 2) hooked fish that are taken from the line by predators, such as sharks and marine mammals.

No estimates have been made of unobserved mortality in the bottomfish fisheries in the MHI, Guam, Northern Mariana Islands, or American Samoa. It is not known to what degree the predation rates estimated for the NWHI fishery are indicative of those in the other island areas. Observations of likely predation events were recorded in the NWHI bottomfish fishery observer program, resulting in a rough estimate of 27 fish lost to predation for every 100 fish boated. It is not known to what degree these estimates reflect predation rates in the bottomfish fisheries in the other island areas. The mortality rates due to hooked fish escaping and subsequently mortality as a result of being hooked are presently unknown.

Although Hawksbill, Leatherback, Loggerhead, and Olive ridley sea turtles are found in areas where bottomfish fisheries occur, there have been no reported or observed interactions between these species. Data from the 1990-1993 NWHI Bottomfish Observer Program collected data on interactions between bottomfish vessels in the NWHI and Hawaiian monk seals and dolphins.

There are also reports of fishermen discarding fish with little or no market value (*e.g.* kahala) to distract monk seals from the gear and higher value target species.

There have been no reports of sightings or interactions between the Short-tailed albatross and the NWHI bottomfish fishery. There are reports of interactions between Laysan and Black-footed albatross and the NWHI bottomfish fishery. Both Laysan and Black-footed albatross have been observed stealing bait from bottomfish gear. The NWHI Bottomfish observer program reported a moderate level of interactions with other seabird species during the period from 1990 - 1993. The interactions were noted to have a negative impact on the fishing operations manifest as lost fishing time. Seabirds are reported as easy to scare away from the gear. Simply waving a pole or gaff has proven effective in many situations. There are no reports of injuries or mortalities to seabirds during bottomfishing operations, though the possibility of unintentionally hooking a seabird has been identified. Circle hooks are the predominant type of hook used in the bottomfish fishery. They are less likely to snag than other types of hooks. One interaction involving a Laysan albatross occurred while a bottomfish fishing vessel was trolling for pelagic fish species. The bird became hooked but was subsequently released alive. Fishermen have reported that other species of birds, particularly juvenile boobies (*Sula* spp.) Often dive on trolling lures. The level of fishery interaction with seabirds is expected to have no effect on seabird distribution, survival, or population structure. In late 2003, the PIRO re-initiated the NWHI Bottomfish Observer Program.

The State of Hawaii has submitted an application for an Incidental Take Permit under Sec. 10 of the ESA for Hawaiian Monk Seals and Green sea turtles. The fishery of concern in

the Main Hawaiian Islands targets large *ulua* (*Caranx spp.*). There are known interactions with Hawaiian monk seals and Green sea turtles in this fishery. There is only one report, however, of a hooking of a monk seal on gear being actively fished. Most evidence comes from observations of monk seals with hooks embedded in their mouths. When the hooks are removed, they can often be attributed to shore-based fisheries. The fishery takes place within waters under state jurisdiction. It is referenced in this report because the review process is a federal action.

Future priorities: Bycatch reporting

The Northwestern Hawaiian Islands bottomfish fishery observer program was re-initiated in 2003. Observer collected data will be incorporated into the data management system developed by the PIFSC and PIRO in FY04. The following represent new or expanded data reporting efforts in the region's bottomfish fisheries.

- **Assessment of the amount and type of bycatch in the small boat recreational, charter, commercial, and mixed-motivation fisheries in all island groups.**
- **Routine analysis, synthesis, and interpretation of bycatch data.**

Data collected through each of the reporting components in the region are synthesized and interpreted in the annual bottomfish SAFE report. The design details of each of these components (e.g., the frequency and coverage of observer programs) vary by area and gear type and may be occasionally adjusted over time in order to meet information targets in the most cost-effective manner. These information targets, such as the scope, accuracy, precision, and resolution of collected data, may also be occasionally adjusted as needed.

- **Evaluation and testing of electronic and video monitoring technology for all sizes of bottomfish fishing vessels**

NWHI bottomfish vessels range from 35 to 60 feet in length. Deploying observers on small vessels is difficult due the lack of space and physical constraints. The use of a video monitoring system in lieu of observers may mitigate some of the obstacles to deploying observers on board small vessels. The technology might be applied to other fisheries where observers may need to be placed on small vessels, such as the American Samoa *alia* longline fleet.

Bycatch minimization and other research priorities

- **Consider measures to minimize bycatch mortality, or assessing mortality**

Improvements in handling and release methods might also reduce the mortality of some species (*e.g.*, sharks, kahala) discarded in the larger-vessel commercial bottomfish fisheries – particularly in the NWHI. Reducing bycatch mortality through increasing the live releases could be encouraged through outreach programs directed towards charter crews. Promoting the distribution of informational material on methods of deflating swollen swim bladders is one method to increase participation by recreations fishers.

- **Explore ways to increase gear selectivity**

Enhancing the ability to selectively target certain bottomfish species will allow for the utilization of focused management measures for species of concern. This may also result in the reduction of economic discards. For example, hook sizes are selected to maximize the catch of desired fish sizes, thereby minimizing the catch of unwanted (*e.g.* small) sizes.

- **Enhance market opportunities**

There may be, as yet unidentified, opportunities to develop new markets for historically low-value species such as jacks and sharks.

CORAL REEF ECOSYSTEM FISHERIES

Coral reefs located within the US Pacific island cover an estimated area of 6,120sq. miles. Nearshore fisheries of the Pacific Islands region include a wide variety of species. Species associated with reefs and lagoons, as well as pelagic fishes found within lagoons or near reef margins. A variety of methods are employed in coral reef fisheries; hand harvesting (*i.e.* gleaning), hook-and-line, spears, nets and traps. The responsibility to monitor and regulate these fisheries rests with the island governments, although there are some 4,200sq. miles of lightly fished coral reef habitat that are under federal jurisdiction.

All gears used to catch coral reef species are essentially artisanal in nature. When compared to other western Pacific fisheries, catch rates of coral reef species are minimal, usually only a few pounds per man-hour or other unit of effort. Larger catches often rely on methods employing many people, such as driven-in-net fishing, beach seines (*e.g. hukilau*) or other group-oriented fishing methods.

Future Priorities: Bycatch Reporting

Efforts to improve bycatch reporting in the Pacific Islands region includes the following identified measures:

- **Assessment of the amount and type of bycatch in the commercial, recreational, charter, and subsistence coral reef fisheries in the Hawaiian archipelago.**

Hawaii is one of the few coastal states that does not require a marine recreational fishing license. As a result, the reporting of non-commercial, recreational and subsistence fishing catch & effort data is limited. Bycatch information is being collected by the Hawaii Marine Recreational Statistical Survey, but needs to be further evaluated for its potential. Additionally, new commercial catch reporting forms in Hawaii have been modified to include bycatch in all fisheries. The level of reporting and quality of the data need to be evaluated.

- **Frequency and coverage of creel surveys throughout Pacific Islands region**

Shore-based and boat based creel surveys need to be conducted consistently throughout all areas of the western Pacific. For example, Guam is the only island area that conducts both shore-based and boat-based creel sampling. Both the Commonwealth of the Northern Mariana Islands (CNMI) and American Samoa collect data from boat-based creel surveys. The CNMI is attempting to re-establish inshore creel surveys.

- **Assessment of protected species bycatch in coral reef fisheries**

The bycatch rate and mortality rates of bycatch are largely unknown in the region's coral reef fisheries. The National Marine Fisheries Service is conducting an environmental impact statement for the issuance of an incidental take permit requested by the State of Hawaii that will assess some of the effects of coral reef fisheries on protected species, particularly green sea turtles. Similar studies should be conducted in all island areas.

Bycatch minimization and other research priorities

Virtually all coral reef fisheries in the western Pacific operate in waters under state jurisdiction.

- **Bycatch Reduction Incentives**

Incentives to reduce bycatch in the region's coral reef ecosystem fisheries have limiting factors; large numbers of participants, cultural practices and ciguatoxic fish. Coral reef fisheries are typically composed of a large number of small scale fishers. Invoking widespread compliance with regulations to eliminate bycatch can be difficult due to the number of small scale fishers. Increased market opportunities are expected to provide positive incentives to reduce bycatch by improving retention. It should be noted, however, that regulatory driven retention of certain species may be perceived as culturally insensitive. Where fish are suspected of being ciguatoxic, certain species are commonly discarded because they may be unsafe to eat. Test kits for ciguatera toxins exist, but they are relatively expensive. The kits are designed to test individual fish, limiting their effective use on even modest amounts of harvested fish.

- **Increase Regulation on Gear Types and Gear Deployment**

Focusing regulations and incentives on gear types that produce the most bycatch can be expected to provide the greatest bycatch reductions. Traps and nets may be regulated by varying mesh size or, in some cases requiring escape vents, to exclude undersize fish and non-target species. A degradable panel or fastening can be employed to open traps after a given amount of time to minimize ghost-fishing by lost traps. Limits on fishing through regulations that identify specific gear amounts or effort levels may also reduce bycatch.

EDUCATION AND AWARENESS PROGRAMS

Education and awareness programs are effective means to educate fishers about the different aspects of bycatch and what they can do to reduce the magnitude of the problem. Improving the post-capture survival rate of released fish by minimizing damage from handling or capture will reduce bycatch. Information on techniques to do this can be transferred to fishers through outreach programs and materials. While specific release and handling techniques vary amongst fisheries, improving the post-capture survival rate of fish reduces the impact of bycatch on all fisheries. This fits well with the cultural background of many peoples in the region. Historically, many Pacific island societies promoted an efficient use ethic of their fishery resources.

- **Pelagic Fisheries**

In longline fisheries, post-hooking survival rates may be increased by adopting new release techniques or gear styles, like de-hooking devices, circle hooks or different bait types. The PIRO has a training program for the ARC De-hooker© that will be conducted in conjunction with the

Protected Species Workshops for the longline fishery. The PIRO Observer Programs will integrate de-hooking training into the curriculum for observers. Circle hooks work by hooking in the corner of a fish's the mouth or jaw instead of the stomach, throat or gills. Fish hooked in the mouth or jaws have higher post-capture survival rates than fish hooked in the stomach, throat or gills.

- **Bottomfish fisheries**

Bottomfish often fish suffer as the result of being rapidly pulled to the surface from depth. Deflating their distended swim bladders before releasing them allows the fish to swim down to their accustomed depth and improves their chances of surviving the handline and release. Tag recaptures studies have shown that many bottomfish handled in this manner survive. The widespread use of circle hooks in this fishery also contributes to post-capture survival of released fish. Release practices and protocols for use in the presence of Hawaiian monk seals can help prevent the seals from associating fishing vessels with feeding opportunities.

- **Precious Coral fisheries**

No recommendations at this time.

- **Coral Reef Ecosystem fisheries**

Trap-caught reef fishes can also be returned to the sea in good condition, if handled appropriately, and rapidly removed from traps with minimal trauma. It may be more difficult to release fish from gillnets and other seines in good condition if they are gilled or tangled. It is difficult to reduce the trauma of speared fish although release has been successful in some reef fish tagging experiments. The selection by fishermen of which fish to harvest should minimize most bycatch.