Application for an Individual Incidental Take Permit Pursuant to the Endangered Species Act of 1973 for Listed Sea Turtles in Inshore Marine Fisheries in the Main Hawaiian Islands Managed by the State of Hawaii

State of Hawaii
Department of Land and Natural Resources
Division of Aquatic Resources
1151 Punchbowl St., Rm. 330
Honolulu, HI 96813

March 2002

1. Introduction and Background

The Division of Aquatic Resources (DAR), Department of Land and Natural Resources (DLNR) is applying for an Incidental Take Permit as authorized by Section 10(a)(1)(B) of the Endangered Species Act (ESA) of 1973. The permit would apply to all fisheries occurring in state waters (shoreline to the extent of state jurisdiction), which are under the State's management authority (except for pelagic and bottomfish fisheries managed by the Western Pacific Regional Fishery Management Council[1]). These fisheries are referred to as "inshore fisheries" in this application. This includes both recreational fishing and commercial fishing. While commercial fishing requires a license issued by the State of Hawaii, there is no requirement for a marine recreational fishing license.

The ESA defines take "to harass, harm, pursue, hunt, shoot, would, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Federal regulations (50 CFR 17.3) also interpret harm to include "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering." Incidental take is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity." This definition thus applies to any interaction between a turtle and inshore fishermen or their gear, and any habitat modification resulting from inshore fishing significant enough to meet the definition of harm.

Five sea turtle species are known to occur in Hawaii waters but only two, the green and hawksbill, nest in Hawaii or commonly occur in appreciable numbers in inshore waters. Of these two species, the green turtle is by far the most common. All five species are listed as either threatened or endangered under the Endangered Species Act, although the local population of green turtles appears to be stable or increasing. However, this population is afflicted with a tumor disease, fibropapilloma, which is indirectly fatal and may inhibit full recovery (see section 2.1 Green turtle (*Chelonia mydas*)).

Inshore fisheries are diverse in terms of the gear and methods used and the species captured. As seen in Table 1 commercial fisheries landed 27,058,229 lbs. in 1999. However, a significant proportion of these landings come from federally managed fisheries that are not covered by this permit application. This includes the largest fishery, pelagic longlining, which has also been the subject of a recent ESA Section 7 consultation resulting in a Biological Opinion setting terms and conditions for the conduct of this fishery in order to reduce sea turtle take. Additionally, the deepwater handline fishery in the NWHI, which represents a large proportion of the landings listed for "deepbottom handline" in the table, is also excluded. A list of fishing methods, prepared by HDAR for use on commercial catch report forms, lists 12 line fishing methods, 11 net methods, five types of traps, and three categories of commercial marine organism collection by divers.

---

[1] The pelagic fisheries (longline, trolling, tuna handline, akuboat) and bottomfish fisheries are covered by ESA Section 7 consultations, ESA Section 7 Consultation for the Authorization of Pelagic Fisheries under the Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Region (March 29, 2001) and another under development for Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region (NMFS 2002). Therefore, these fisheries are not included this Incidental Take Permit application.

The most recent, comprehensive survey of recreational fishing in Hawaii estimated that 260,000 saltwater anglers spend a total of cumulative 3,100,000 days of fishing in 1996 (USFWS et al. 1998). (Of this total, 130,000 anglers were state residents who spent 2,600,000 days fishing, or 85% of total fishing effort.) Recreational fishermen fish throughout the main islands in the southeastern part of the archipelago in all seasons and times of day. Most inshore fishing is from the shoreline and boats using hook-and-line, nets, spears, and traps and occurs within the 100 fm isobath; due to the steep bathymetric relief in the Hawaiian Islands, this is mostly within state waters.

Determining the incidental take of sea turtles in Hawaii's inshore fisheries is difficult for several reasons. Foremost, the State does not have an ongoing, comprehensive and detailed monitoring program focused on the incidental take of protected species. In addition, the State does not have a fishery observer program. For recreational fisheries in particular, there are no recent definitive estimates for total effort, effort for gear type and interactions with protected species. Documenting interactions is further hampered by the dispersed and lightly regulated nature of the recreational fishery. Sea turtles are more or less likely to interact with different gear types, depending on their configuration and method of deployment. The distribution of fishing effort, both temporally and spatially, in relation to turtle habitat and behavior is also not definitively known. This further complicates any assessment of the impacts of the activity.

This application has three major components. Section 2 summarizes what is known about the occurrence and biology of sea turtles in the Hawaiian Islands. This information helps to elucidate the potential relative impacts to different species. Section 3 describes fishing gear and methods and generally where they are used (offshore or inshore); the relative level of effort by gear type is also outlined. Each gear type is assessed for potential interactions with sea turtles based on its configuration, where it is used, and the relative level of use in comparison to other gear types. Section 4 is the Conservation Plan. It summarizes the probable impacts of inshore fishing on sea turtles and their habitat, including the expected incidental take. The Plan also describes those measures that DAR will implement during the permit period to monitor the impacts of recreational fishing on sea turtles and reduce the incidental take.

1.1 Type of Permit

Application for an Individual Incidental Take Permit Pursuant to the Endangered Species Act of 1973 for Listed Sea Turtles in Inshore Marine Fisheries in the Main Hawaiian Islands Managed by the State of Hawaii.

1.2 Date

July 1, 2002 to June 30, 2005

1.3 Applicant

State of Hawaii
Department of Land and Natural Resources

Division of Aquatic Resources
1151 Punchbowl St., Rm. 330
Honolulu, HI 96813
Voice: (808) 587-0100
FAX: (808) 587-0115
Email: dlnr_aquatics@exec.state.hi.us
Contacts: William S. Devick, Administrator
Walter N. Ikehara, Commercial Fisheries and Aquaculture Program Manager

2. Description of Listed Species Impacted by the Activity

Five sea turtle species may be affected by the action covered by this permit application:

- Green turtle (*Chelonia mydas*)
- Hawksbill turtle (*Eretmochelys imbricata*)
- Loggerhead turtle (*Caretta caretta*)
- Olive ridley turtle (*Lepidochelys olivacea*)
- Leatherback (*Dermochelys coriacea*)

2.1 Green turtle (*Chelonia mydas*)

In 1978 the green turtle was listed as Threatened under the Endangered Species Act (ESA), except for breeding populations in Florida and the Pacific coast of Mexico, which are listed as Endangered. This species is listed as Endangered worldwide by the International Union for the Conservation of Nature (IUCN) and appears on Appendix I of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), meaning that trade of this species, or products from it, between signatory nations is prohibited except by special permit.

Green turtles are distributed circumglobally in waters above 20º C and occur throughout the year in Hawaii coastal waters.. However, distinct subpopulations are recognized, with restricted gene flow between them. This is reinforced because sea turtles prefer to return to their natal beaches, resulting in demographically independent units (NMFS and USFWS 1998a). In the Pacific, scientists have identified two taxonomic units, an eastern Pacific population (identified as *C. mydas agassizii*) and the nominate species (*C. m. mydas*) in the rest of its Pacific range. Further, the Hawaii population is genetically distinct and geographically isolated. However, USFWS and NOAA/NMFS have not identified the Hawaii population as a "distinct population segment" for the purposes of listing, delisting, and reclassifying species under the ESA. (See 61 FR 4722 for the current policy on recognizing distinct population segments.) In offshore waters turtles from both populations may occur, as evidenced by genetic sampling of turtles taken in the Hawaii-based longline fishery (NMFS 2001).

Unlike green turtle populations elsewhere, the Hawaii population appears to be expanding. For example, the number of nesting green turtles at East Island at French Frigate Shoals has tripled since monitoring began in 1973 (NMFS and USFWS 1998a). However, these turtles are afflicted with a tumor disease, fibropapilloma, which is indirectly fatal. Work and Balazs (1998) cite it as the most common cause of morbidity and mortality in free-ranging green sea turtles in

Hawaii, especially among immature animals. Turtles become enfeebled in the advanced stage of the disease. When tumors occur around the neck, flippers, and eyes they can reduce vision, cause blindness, reduce swimming ability and cause glottal obstruction (NMFS and USFWS 1998a). In the advanced stages, debilitated turtles die from secondary causes. The tumors directly increase their risks of entanglement (Balazs, pers. comm.). The occurrence of this disease is highly variable across the population in different parts of the archipelago. At some sites, such as Kiholo Bay on the island of Hawaii, turtles are virtually free of the disease. At other sites more than half the individuals show some sign of it. Between 49% and 69% of stranded turtles exhibit this disease, and its occurrence has increased since biologists began monitoring strandings (NMFS 2001). The prevalence of fibropapillomatosis is inhibiting full recovery of local populations; at the very least it results in decreased growth rates (Balazs 1991; NMFS and USFWS 1998a).

Although about 150 nesting sites have been identified worldwide, only a few are large (>2,000 nesting females annually) (Groombridge 1982). In Hawaii more than 90% of the females in the population nest on several sand cays at French Frigate Shoals, an isolated atoll in the Northwest Hawaiian Islands (NWHI). Between 200 and 700 females nest there annually during a five month, May to September breeding season. Other sites in the NWHI include Laysan Island, Lisianski Island, and Pearl and Hermes Reef, where females nest in much smaller numbers. Green turtles historically have nested in the main Hawaiian Islands (Balazs, 1985a); monitoring by State biologists has documented low levels of nesting on Maui (Hau, pers. comm.). Further, terrestial basking by green sea turtles is reportedly on the rise in the main Hawaiian Islands (Scott 2001).

Green turtles can travel over long distances between nesting and foraging grounds. Post-hatchlings and juveniles reside offshore in the pelagic habitat. Generally, this pelagic range is unknown, although it is assumed that they remain on or near the surface along driftlines created by advection. Upon reaching sufficient size, green turtles move into the nearshore benthic habitat, where they feed on macroalgae and sea grasses. Adult turtles travel between feeding and breeding areas, which are often widely separated. In Hawaii, juveniles recruit to foraging areas in the main Hawaiian islands after at least two years in the pelagic habitat; only juveniles above 35 cm SCL are found inshore. Adult green turtles residing in the main Hawaiian Islands regularly remigrate to the breeding and nesting sites in the NWHI.

Important foraging and resting areas occur along the coastlines of all islands within the Hawaiian archipelago beginning from the island of Hawaii and extended up to and including Midway. Some individuals also travel to Johnston Atoll, approximately 713 nm south of the Hawaiian archipelago, to forage. Balazs et al. (1987) assessed habitat use by green turtles at several resident foraging areas in the main Hawaiian islands. Preferred foraging areas are generally protected or partially protected embayments where benthic macroalgae, green turtles' preferred food, grows. For example, Kawela Bay, the first study site described in the aforementioned study, is a shallow, protected water body. The bottom is a mixture of limestone, boulders, coral rubble, sand, silt, and live coral. According to this study and other sources (NMFS and USFWS 1998a), green turtles feed on benthic macroalgae in the genera *Codium*, *Amansia*, *Pterocladia*, *Ulva*, and *Gelidium*. *Codium arabicum* and *C. edule* are favored. Two exotic species, *Acanthophora spicifera* and *Hypnea musciformis* are also consumed. (Balazs et al. found that *A. spicifera* is an important dietary component, making up more than 99% of stomach contents in

10 out of 12 turtles sampled.) Sea grasses are a favored food source in other parts of the world. Two sea grass species exist in Hawaii: *Halophila hawaiiana*, an endemic species, and *H. decipiens*, an indigenous species. *H. hawaiiana* occurs on Maui, South Molokai, Oahu, and Anini, Kauai, and on Midway (Eldredge and Smith 2001). At Johnston Atoll they feed almost exclusively on *Caulerpa racemosa* and *Bryopsis pennata* (NMFS and USFWS 1998a).

Green turtles feed most actively at dawn and dusk and alternate between periods of active foraging and rest. During these rest periods they retreat to deeper water and seek out shelter in caves and outcroppings. These resting areas are usually within 2 km of foraging areas and at the edge of the coastal bench surrounding Hawaiian islands. Here, at depths of 18-27 m, the bottom begins dropping off rapidly. Turtles may also rest in vertical holes or crevices in the reef flat. This seems to be the preferred resting habitat for smaller turtles. All these resting habitats feature a fine sand or silty bottom where the turtle actually rests. Turtles can spend long periods underwater while resting; resting times up to 2.5 hours have been recorded for adult turtles (Balazs et al. 1987).

The type of habitat just described can be found along the shores of all the main Hawaiian Islands. Balazs (1980) lists the following important resident areas: Hawaii: Kau and North Kohaha Districts; Maui: Hana District and Paia; Lanai: northern and northeastern coastal areas bordering the Kalohi and Auau Channels; Molokai: southern coastal areas from Kamalo to Halena; Oahu: Kailua and Kaneohe Bays, and northwestern coastal areas from Mokuleia to Kawailoa Beach, Maunalua Bay and the Waikiki shoreline on Oahu's south coast; Kauai: Princeville, northwestern coastal areas of Na Pali, and southern coastal areas from Kukuiula to Makahuena Point.

2.2 Hawksbill turtle (*Eretmochelys imbricata*)

The hawksbill turtle is endangered throughout its range. They were listed as Endangered under the Endangered Species Conservation Act (now ESA) in 1970 and are also listed by IUCN. They appear in CITES Appendix I.

Hawksbill turtles are circumtropical in distribution, found generally between 30º N and 30º S in the Atlantic, Pacific and Indian Oceans. Researchers are divided on subspecific taxonomic distinctions, although it seems likely that distinct subpopulations reside in each major ocean basin. Genetic analysis suggests that Pacific nesting populations are distinguishable, but it is better to consider them "stocks" rather than separate subspecies (NMFS and USFWS 1998b). Hawksbills forage throughout the main Hawaiian Islands, although in much lower numbers than the green turtle. In the central Pacific, nesting sites are found in many insular areas, although only a few individuals nest at any given site. About 20-30 hawksbill turtles annually nest at several locations on the southeastern coast of the island of Hawaii. Beaches on Maui have also been selected by hawksbills for nesting activity (Hau, personal communication). Information on the Hawaii population is limited, but they are not abundant and the few individuals captured by researchers were immature. Capture sites include Kiholo Bay and Kau (Hawaii), Palaau (Molokai), and Makaha (Oahu). It is important to note that foraging hawksbills may come from many different natal beaches and may not be related to the females nesting on nearby beaches. Thus, in Hawaii the immature foraging hawksbills and the nesting females do not necessarily represent a single stock.

Like green turtles, hawksbills are pelagic for the first years of their lives and little is known about their habitat and distribution. In the Atlantic hatchlings seek cover in extensive *Sargassum* mats along drift lines. The equivalent habitat has not been found in the Pacific, but it is likely that they occur in similar areas of advection where flotsam accumulates. Juveniles move into the benthic habitat and as they mature tend to move from shallow to deeper water in concert with their ability to make deeper dives. Here they feed exclusively on a few species of marine sponges. (Their diet during the pelagic phase is unknown, but presumably consists of drifting macroalgae such as *Sargassum*. This is supported by research on captive neonates, which do well on a diet of *Sargassum*.)

2.3 Loggerhead turtle (*Caretta caretta*)

The loggerhead turtle was listed as Threatened throughout its range under the ESA in 1978. It is listed as Vulnerable by the IUCN, meaning that it is likely to move to Endangered status in the near future. It is listed in CITES Appendix I.

Loggerheads are circumglobal with a wide latitudinal distribution, occurring in tropical, subtropical and temperate waters (NMFS and USFWS 1998d). They are generally rare in the insular Pacific and there are no nesting sites in the region. Globally, the largest nesting aggregations occur in Oman and the Atlantic coast of Florida. In the Pacific nesting is restricted to the western margin, primarily Australia and Japan. Post-hatchlings and juveniles have a wide-ranging pelagic phase. For example, juveniles are relatively abundant between 30 and 60 km offshore of Baja California, yet the nearest nesting beaches are on the opposite side of the Pacific basin. After several years loggerheads recruit to inshore feeding grounds. In the Pacific these are mainly along the Australian coast. It may be that post-hatchlings are entrained in the North Pacific current gyre, with juveniles aggregating off Baja California and then eventually returning to the west Pacific. Thus their normal range is both pelagic and inshore. Satellite telemetry show that loggerheads follow the 17º and 20º sea surface temperature isotherms north of Hawaii (Polovina et al. 2000). These fronts may be important habitat for juvenile turtles. Almost all of the loggerheads caught in the Hawaii-based longline fishery originated from Japanese nesting stock.

Only four records exist for Hawaii (NMFS and USFWS 1998d). One was found in the stomach of a tiger shark from Kure atoll. Two others were sighted in the southeastern part of the archipelago. A fourth may have resided for some time off the south coast of Oahu (Balazs et al. 1993). (It was sighted several times in the vicinity of Waikiki.) All were juveniles and probably drifted to Hawaii during transpacific migration. Only one loggerhead stranding has been recorded in Hawaii since researchers began documenting them in 1982. No loggerhead turtles have been taken in the Hawaii-based longline fishery south of 22º N (NMFS 2001). The main Hawaiian Islands are at this latitude or south of it (only the north coasts of Kauai and Oahu are above 22º N), suggesting that they are at the edge of, or outside of, the loggerhead's pelagic range.

Adult loggerheads primarily feed on a wide range of benthic invertebrates, and occasionally fish and plants. Juvenile aggregations off Baja California have been observed feeding on concentrations of the pelagic red crab, *Pleurocondes planipes* (Bartlett 1989; Pitman 1990).

2.4 Olive ridley turtle (*Lepidochelys olivacea*)

Olive ridley turtles are considered the most abundant sea turtle species worldwide, but populations on the Pacific coast of Mexico are considered endangered. This population is listed as Endangered under the ESA; it is listed as Threatened in the remainder of its range. It is listed as Endangered by the IUCN and appears in CITES Appendix I.

The olive ridley is distributed circumglobally in tropical to warm temperate waters (NMFS and USFWS 1998e). As noted, it is the most common sea turtle in the eastern Pacific, but is relatively rare in the central Pacific. They also occur in the western Pacific, but they are much less abundant than in the east. (Another important nesting area is the state of Orissa, India.) Although observed mainly in neritic waters off of nesting beaches, this turtle has a latitudinal range of 30º N-15º S and has been sighted farther offshore. Historically, the eastern Pacific population off Mexico may have numbered10 million, but intensive harvesting has drastically reduced this population (NMFS 2001). The Mexican government instituted a nationwide ban on harvests in 1990, which has improved the situation and could allow this population to recover.

This species is primarily pelagic. As with other sea turtles, hatchlings move offshore and little is known about their pelagic habitat during this period. Adults in the eastern Pacific move between nesting beaches and foraging areas, which are usually farther south. (Nesting occurs on beaches from south central Mexico to Central America. Adults range as far south as northern Peru.)

One olive ridley was documented nesting on Maui in 1985 but there was no successful hatching (NMFS and USFWS 1998e). This was likely an anomaly and olive ridleys probably have not regularly nested in the Hawaiian archipelago. Stranding records reveal that 26 olive ridley turtles have been stranded in Hawaii since 1982, making it the third most common species after green and hawksbill turtles. Genetic analysis of olive ridleys taken in the Hawaii-based longline fishery shows that about two-thirds of the sampled animals came from the eastern Pacific while the remaining one-third originated in the western Pacific or Indian Ocean. Thus Hawaii represents a point of convergence for these source areas.

2.5 Leatherback (Dermochelys coriacea)

Of the sea turtle species discussed here, the leatherback is most in danger of extinction. It was listed as Endangered under the ESA in 1970. The IUCN describes it as critically endangered, meaning that there is an imminent threat of extinction. It is also listed in CITES Appendix I. This species appears to be declining throughout its range.

Leatherbacks are an almost exclusively pelagic species, as evidenced by their morphology; they have a smooth, streamlined body and large front flippers (NMFS and USFWS 1998c). They have the most extensive range of any sea turtle, and are found circumglobally in waters between 71º N and 42º S. Their ecology also means that relatively little is known about their movements. It is known, however, that they regularly move between nesting areas in tropical and sub-tropical areas and foraging areas in temperate and even boreal waters. These movements generally follow continental margins, but transoceanic migrations have been documented in the Atlantic. During these long pelagic migrations, they prefer convergence zones and upwelling areas in the open ocean, along continental margins and near larger archipelagos.

The largest Pacific nesting area is on the Mexican coast. They also nest throughout the western margin of the Pacific basin in China, Southeast Asia, Indonesia and Australia. They generally do not nest in the insular Pacific and are not known to nest in Hawaii, except for an isolated incident on Lanai where a female laid infertile eggs (Scott, 1997, confirmed by George Balazs).

Leatherbacks occur in offshore waters around Hawaii and are regularly sighted offshore at the southeastern end of the archipelago (NMFS 2001). In Hawaii, fishermen report regularly seeing them in waters deeper than 100 fm but within sight of shore. Stranding records document relatively few leatherbacks, only five since 1982. This species probably migrates through Hawaiian waters, but individuals may also forage in the region. Genetic analysis of individuals incidentally caught in the Hawaii-based longline fishery reveals that 12 out of 14 sampled came from the west Pacific. The remaining two, which were caught in the southern part of the fishery's range, originated from nesting beaches in the eastern Pacific.

Leatherbacks feed on jellyfish, siphonophores, pyrosomas and salps. Because these organisms have low nutritional value, leatherback turtles must consume a higher proportion of their body weight on a daily basis in comparison to other sea turtles. Although they often feed at the surface, this species is capable of deep dives and is observed to continuously dive while foraging. Since most of the time spent on these dives (which can reach depths of several hundred meters) is spent on descent and ascent, it is assumed that leatherbacks feed throughout the water column. However, research on the behavior of internesting females in the Caribbean suggested that nocturnal feeding focused on the deep scattering layer (Eckert et al. 1989).

2.6 Summary of the Occurrence and Status of Affected Species

Of the five species considered here, the green turtle is by far the most prevalent in the Hawaiian Islands. It is found throughout the archipelago, breeds and nests in the NWHI, and uses resident foraging areas throughout the main Hawaiian Islands. Based on censuses of nesting females, the Hawaiian population appears to be increasing. However, the high incidence of fibropapilloma disease is a major threat and could affect continued population growth. The hawksbill turtle is the only other species that has any appreciable resident population and also nests in Hawaii. It occurs mainly in the southeastern part of the archipelago. Worldwide, hawksbill populations are declining. Olive ridleys may be characterized as infrequent visitors to the inshore areas of Hawaii. Leatherbacks are rare visitors to state waters; individuals of this pelagic species may on occasion stray closer to shore. However, the offshore pelagic environment around Hawaii may be important to the leatherback and the loggerhead, which are more exclusively pelagic species. Loggerheads have been documented in state waters, but they too appear to be occasional visitors; based on the Waikiki record individuals may rarely reside in inshore waters. These two species' populations are declining worldwide. The olive ridley is declining in the Suriname and in adjacent areas, eastern Venezuela through northern Brazil.

3. Detailed Description of the Activity

This permit application is for marine inshore fisheries managed by the State of Hawaii. Therefore, the action area for the permit is marine waters from shore to the extent of state jurisdiction. From an ecological perspective, recreational fishing mostly occurs within the 100 fm isobath (Smith 1993). (Because of the marine topography of the Hawaiian islands this isobath occurs well within three miles of the shoreline in most areas.) Within this area fishermen use many different kinds of fishing methods and, in aggregate, fishing occurs throughout the year and along all accessible coastlines. The methods, distribution and seasonality of this activity are detailed below.

From a sociological perspective it is difficult to distinguish between recreational, subsistence and commercial fishermen in Hawaii. (This point is made in many of the papers on marine recreational fishing in Hawaii reviewed by Glazier (1999), for example.) Legally, if a person sells any amount of fish he is considered a commercial fisherman and must obtain a commercial license. However, this requirement is widely circumvented by individuals who do not derive their primary income from fishing and generally sell fish to cover costs. There are probably no true subsistence fishermen in Hawaii in the sense that non-monetary income represents the bulk of their overall livelihood. But many people may supplement their food budget with fish they catch. Hamilton (1998) developed a classification system for Hawaiian fishermen, validated by survey research and analysis that demonstrates significant differences in the characteristics of the four groups she uses. These categories of fishermen are: (1) recreational, defined as persons claiming not to have sold fish during the previous 12 months; (2) expense, who sell fish only to cover the cost of their fishing trips; (3) part-time commercial, who derive 50% or less of their income from fishing; and (4) full time commercial, who derive more than 50% of their income from fishing.

Commercial and recreational fisheries use many of the same gear types. But the largest commercial fisheries tend to occur in offshore waters. These include tuna handline, trolling, pole-and-line (baitboat) and bottomfish fisheries. Those species likely to be caught inshore (akule/opelu, jacks, inshore fish, and shellfish) make up about 7% of the catch.

Assessing the extent of the recreational fishery is difficult because, as mentioned, Hawaii does not have a licensing program and has not carried out consistent surveys or creel censuses. (However, as discussed in the Conservation Plan, the State is initiating a recreational fishing survey in cooperation with NMFS.) This lack of data also makes it difficult to determine the sea turtle take.

The approach taken here is to aggregate fishing gears and methods into categories that encompass gear type and the habitat in which it is used. These aggregates can then be compared to what is known about the behavior, ecology and distribution of sea turtles in Hawaii to estimate the impact of particular activities on the different species known to occur in Hawaiian waters.

Smith (1993) identifies four inshore habitats, along with associated gear types and fish species. These are:

- Shelf, slope and channel: rocky to sandy bottom. Deep bottom handlines are used to catch a variety of deep bottomfish, including eteline snappers, groupers, and Carangids. We assume that sea turtles are unlikely to occur in this habitat.

- Coastal pelagic: inter-island channels and inshore areas seaward of the coral reef. A range of net and hook-and-line gears are used to harvest pelagic species including akule (*Selar crumenopthalmus*) and opelu (*Decapterus macarellus*), tunas, billfish, and other gamefish such as wahoo, barracuda, and dolphinfish (mahi mahi). We assume that sea turtles may use part of this habitat for resting areas (refugia).

- Reef communities and rocky shorelines: open coast predominantly marine areas. Pole and line, spears, traps, and nets are used to harvest a range of reef and benthic species including goatfish (weke, *Mulloides* spp.) surgeonfish, parrotfish and jacks. We assume that turtle refugia may exist in deeper waters and foraging areas exist where macroalgae are abundant.

- Embayments and estuaries: including sand, mud and patch reef habitats. Nets, spears, hook-and-line and traps are used along with reef gleaning to harvest estuarine species including mullet (*Mugil cephalus*), milkfish (*Chanos chanos*), bonefish (*Albula glossodonta*), threadfin (*Polydactylus sexfilis*) and crabs (particularly the Kona crab, *Ranina ranina*). We assume that these areas are prime sea turtle foraging habitat.

For simplicity, these four habitats can be further grouped into two categories: offshore (shelf, slope and channel and coastal pelagic) and inshore (open coastline and embayments.)

Hawaiian fishermen utilize gear in four broad categories: hook-and-line, net, trap and spear. There is a diverse array of gear and gear configurations within these categories. (This is particularly true for hook-and-line and net.) It should be noted that many contemporary fishing methods derive from Native Hawaiian practices (as described in Kamakau 1992). Western contact and large-scale immigration from both the U.S. mainland and Asia introduced new materials, technologies, and techniques. As a result, a unique blend of gear, methods, lore, and nomenclature are found in contemporary Hawaii.

Rather than list and describe every gear and its variation in detail, four detailed surveys of localized fishing effort (Everson 1994; Friedlander and Parrish 1997; Hamm and Lum 1992; Kahiapo and Smith 1994) are used to identify prevalent gear types. Three of these reports were commissioned by the DAR: Everson surveyed inshore fisheries in Kaneohe Bay, Oahu from December 1990 to May 1992; Friedlander and Parrish surveyed Hanalei Bay, Kauai, for 18 months in 1992-1993 and Kahiapo and Smith summarize three surveys conducted in and around Hilo Bay, Hawaii between September 1985 and June 1990, which were creel censuses that only covered shoreline fishing. Hamm and Lum's March 1990 to May 1991 survey "consisted of counting boats and interviewing fishermen at eight public launching facilities on Oahu during selected days of each month and using the sample data collected to estimate island-wide catch and effort…" (Hamm and Lum 1992, p. 1). They ignored easily identifiable commercial vessels such as aku boats and longliners. (This survey is detailed and comprehensive with regard to the fishing gear identified. But it does not include fishing from shore, an important component of inshore, and especially recreational, effort.) These studies provide insight into prevalent gear types and relative effort. Common gear types can then be assessed for their likely impact on sea turtle incidental take. Additional information on methods and gear is derived from Hosaka (1973), Sakamoto (1985; 1988), and Rizzuto (1983). Pooley (1993) and Smith (1993) also provide a general overview of marine fisheries in Hawaii, focusing on the commercial sector.

For the purpose of completeness, fisheries outside of state waters are described in the following overview. It does not mean that this permit application is intended to cover all of the described fisheries, as some of them are managed by the Western Pacific Regional Fishery Management

Council. As noted earlier, pelagic and bottomfish fisheries are covered by ESA Section 7 consultations.

3.1 Offshore

The fishery in the shelf, slope and channel habitat primarily targets bottomfish. Bottomfish can be divided into shallow and deepwater species complexes (WPRFMC 1998). The shallow water complex is considered part of the inshore habitat category. The deepwater complex (>100 m) includes commercially valuable species such as opakapaka (*Pristipomoides filamentosus*) and hapuupuu (*Epinephelus quernus*). The deepwater fishery is predominantly commercial. Fishing occurs from boats, using electric, hydraulic or hand-powered reels to deploy and retrieve a monofilament leader, from which 4-6 droppers with baited hooks project. The mainline terminates in a heavy weight. A chum or *palu* bag can be used to attract fish. There is likely little or no interaction between marine turtles and these fisheries because marine turtles would not be concentrated in this habitat. Observer reports from the NWHI commercial bottomfish fishery, which paid special attention to protected species interactions, did not document sea turtle interactions (Nitta 1999). Nitta and Henderson (1993), in their review of protected species interactions, also do not identify marine turtle interactions in this fishery.

The Oahu small-boat fishery survey found that trolling was the most common method, accounting for about half of all trips (Hamm and Lum 1992). (This was followed by bottomfishing (12%), spearfishing (11%), spin casting (8%) and various netting techniques (7%). According to the 1999 commercial landings data (Table 1) trolling accounts for 11% of all landings. Troll gear can vary widely in the sophistication and expense of the gear used. At one extreme those targeting big game billfish may use heavy rods and reels; the most basic configuration is simply a heavy monofilament line and plastic lure. Common target species (mentioned above) include billfish, tunas, mahi mahi (*Coryphaena* spp.), barracuda (*Sphyraena* spp.), and wahoo (*Acanthocybium solandri*). Depending on the target species, trolling can occur offshore in open water or along the reef margin. Although it is possible that troll gear could snag turtles, especially along reef margins, it is unlikely that there is any significant interaction between this fishery and sea turtles. The Biological Opinion for the federal Pelagic Fishery Management Plan (NMFS 2001) estimates one non-lethal take for all sea turtles species annually for the commercial troll fisheries covered by the FMP.

A variety of handline methods are used in the pelagic environment. Most well-known are palu ahi and ika shibi. In the catch statistics these are collectively referred to as tuna handline and accounted for 12% of all fisheries landings in 1999 (seeTable 1). Ika shibi occurs mainly at night. It employs a vertical mainline with high-test monofilament leader, from which is suspended a single baited hook. A weight may be used between the mainline and leader, with four or more lines usually attached to the vessel by breakaway links. A sea anchor is used to control and slow (at times stop) the drift of the vessel. A small light is usually suspended from the boat to attract muhe‘e (“true squid”) or opelu, typically used as bait. The line may be hauled manually, mechanically or by any powered method. Palu ahi is a variation on this technique but usually occurs during the day and employs a chum bag. These two techniques target tuna and billfish in deep water (typically 500 - 1,000 fm). Friedlander and Parrish (1997) and Everson (1994) do not report these handline methods as part of the inshore fisheries they documented. Hamm and Lum (1992) report “mid-depth handline” and “tuna handline” as accounting for 1.4%

of total annual trips. Given the location and depth at which the gear is set it is unlikely that there are interactions between pelagic handline fisheries and sea turtles. The aforementioned Biological Opinion estimates one non-lethal take for all sea turtles species annually for the commercial handline fisheries covered by the FMP.

Three other techniques occurring offshore are reported in commercial catch reports. These are floatlines, hybrid techniques, and aku boats. The floatline is a pelagic longline. It differs from the federally permitted longline fishery in that by state law (in other words, to fish in state waters) the mainline must be less than one nautical mile in total length. Hybrid techniques denote a unique mixture of fishing methods used to catch pelagic species, primarily on offshore seamounts and near NOAA weather buoys. Methods can include handlining, trolling, baiting techniques and other methods used simultaneously. These two methods are not reported in commercial landings figures. Aku or pole-and-line boats target skipjack tuna, using live bait (such as nehu, *Encrasicholina purpurea*, or iao, *Atherinomorus insularum*) and/or artificial lures. This methods accounts for 5% of commercial landings. Generally, live bait and/or water is flung or sprayed out from the stern of the (often drifting) vessel to "chum up the school" and get them feeding. Fishermen on the stern of the boat often jig and slap the water with their poles to increase surface feeding behavior. Fish are hooked with pole and line, using a barbless hook (feathered, baited or not). These three fisheries target yellowfin and bigeye tuna and other pelagic species. They are not reported in the three inshore surveys or the small-boat survey, largely because they are exclusively commercial and they occur well offshore. Of the three, only the floatline is likely to have any direct interactions with sea turtles, given its similarity to the federally managed fishery, for which sea turtle interactions have been extensively researched (NMFS 2001). The Biological Opinion for the Pelagics FMP estimates one non-lethal take for the pole and line fishery.

Rod-and-reel fishing from boats, or spin casting, generally uses fairly light gear. A wide range of gear configurations are used to catch various small to medium size pelagic and benthic species. Almost all rod-reel fishing is recreational, although a tiny percentage of total commercial landings falls in this category. It should be emphasized that casting from boats is also popular along reef faces, open coasts and in the deeper sections of large embayments. As noted above, spin casting ranked fourth in total effort (number of trips) in Oahu small-boat survey, accounting for 7.9% of total trips (Hamm and Lum 1992). "Boat line" ranks third in the Hanalei Bay survey (Friedlander and Parrish 1997) but was still less than one fifth the total effort of the first-ranked category, line fishing from shore.[2] Everson (1994) does not distinguish different pole-and-line techniques but does note that 60% of total pole-and-line effort did not occur from shore. As noted, both of these surveys covered waters in and immediately adjacent to embayments. (In Everson's case this was Kaneohe Bay on Oahu, the largest enclosed coastal water body in the state.) There may be interactions between casting from boats and sea turtles, especially in inshore environments. Even though light tackle is used, it is our understanding that low-test monofilament line presents a higher risk of entanglement and possible injury to sea turtles than high-test line used in other fisheries because it becomes easily wrapped around

[2] Friedlander and Parrish only report total effort in a bar chart. It is thus difficult to present effort values beyond noting their relative magnitude.

appendages or the neck (G. Balazs, pers. comm. 2002). However, some of the entanglements may be due to fishing line that was lost or discarded, rather than while actively being fished.

Net fishing mainly occurs in inshore areas, but some surround netting (usually used to target akule and opelu) may occur in deep water. (Smith (1993) lists akule and opelu as coastal pelagic species.) According to the Oahu small-boat survey, akule/opelu[3] account for 5% of trips (Hamm and Lum 1992). (These two species, both Carangids, are the bigeye scad, *Selar crumenopthalmus* and the mackerel scad, *Decapterus macarellus*, respectively). According to Smith (1993) the scad fishery is the most productive inshore fishery in Hawaii. According to the 1999 HDAR data all commercial net fishing accounts for 4.5% of commercial landings, but akule/opelu accounts for the largest proportion of those species that would be most likely caught close to shore (see Figure 2). This method is also, and in fact mainly, used in areas close to shore, such as embayments. Friedlander and Parrish (1997) found that it ranked behind shoreline fishing, crab netting, boat line fishing, and gill netting in total annual effort, although the actual amount of effort was much smaller than these top four ranked methods. This fishery is almost exclusively a commercial enterprise. Because of the size and configuration of these nets, turtles are likely to interact with them, especially if deployed in nearshore areas. The aku boats mentioned above also employ surround or purse nets to capture baitfish, commonly nehu. Everson (1994) notes that these boats fished in Kaneohe Bay; the surround net effort in his study accounted for less than 0.1% of total annual effort for all gear types. Some proportion of these trips could have been in deep water. (Purse nets could also be used in deep water; they accounted for 1% of total effort by gear type in this survey.) In aggregate, all the other net methods rank below other methods in the Oahu small-boat survey, accounting for 7% of all trips. (These methods are not used offshore, however.)

3.2 Inshore

In the three surveys of inshore areas used here (Everson 1994; Friedlander and Parrish 1997; Kahiapo and Smith 1994) line fishing from shore was by far the most important method in terms of effort. For example, Friedlander and Parrish estimate total annual shore fishing effort in Hanalei Bay, Kauai at about 18,000 gear hours, while the next ranked gear, crab net, accounted for less than 6,000 gear hours. Everson estimates that shore-based line fishing accounts for 21% of total annual effort in Kaneohe Bay, across all gear types surveyed. The Hilo Bay survey does not report effort by gear type per se, but does give figures on “gear abundance.” Rod and reel and handpole[4] account for 80-90% of gear in use, depending on the time of day. Ulua, generally Carangids in the genus *Caranx*, and especially the giant trevally *(Caranx ignobilis)*, are among the most prized game fish in Hawaii (Rick Gaffney and Associates 2000) and shore fishing is one of the most popular methods used to catch them. (In the 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation for Hawaii, fishing for ulua ranked first for number of days fished by identified species (USFWS et al. 1998).) In Hanalei Bay “Carangids were

[3] Although not explicitly described as a net fishery by Hamm and Lum, they are presumably referring to the use of surround nets to capture schools of these fish.

[4] The handpole is a bamboo or fiberglass pole and line, without a reel. It is used to catch relatively small fish on light tackle. It is also commonly used to catch live bait that can then be used with rod-and-reel (Sakamoto 1985).

clearly the most important family of fishes in the catch, even with the exclusion of the small, schooling coastal pelagic species [i.e., akule/opelu]. They were taken mostly (and about equally) by lines from shore, lines from boat, and trolling, with much smaller catches by gill net and spear" (Friedlander and Parrish 1997, p. 42). Hawaiian terminology distinguishes uluas by their size or growth stages. They are classed as papiopio or papio (young), pa'u'u (intermediate), and ulua (adult) (Rick Gaffney and Associates 2000). Different gear and methods are used to target these size classes. Another prized inshore gamefish is the 'o'io or bonefish (*Albula glossodonta*).

Based on the popular, or "how-to" literature on sports fishing in Hawaii, three methods dominate rod-and-reel shore fishing. Light spinning tackle, essentially the same gear mentioned above for boat-based fishing, is used particularly to target papio. The technique of "whipping," where a lure or bait is retrieved at the water's surface with an erratic motion to simulate the action of bait fish, is widely used. As noted above, turtles may interact with this gear, and because light lines are usually used, there is probably more danger of serious, debilitating entanglement. However, fishermen can avoid turtles if they see them in the vicinity.

A second widely used shorecasting method, to target the larger ulua, is "slide-bait." There are many variations on this configuration, but the basic idea is to cast and set a heavy, weighted mainline and then slide leaders with baited hooks down the line. The line can remain in the water for several hours. When a fish takes the hook, the weight breaks free and the fisherman is free to retrieve the fish. This method is commonly used along open coastlines where deep water is relatively close by. Turtles can bump into the tensioned line and sometimes get entangled in the leader and/or hook and have occasionally been known to swallow the baited hook. Anecdotal evidence suggests that this method has a relatively high rate of interaction with sea turtles, but fishermen generally release any turtles that get entangled and so mortality is generally low. Open or semi-protected coastlines also provide important resident habitat for turtles, increasing the likelihood of interactions.

A third method is called "dunking," and it involves simply dangling a baited hook in the water. The rod may be handled at all times by the angler, or it may be placed in a rod holder with the angler watching nearby. Medium-weight gear is used and a wide variety of species are caught. It is probably the most popular of all the shore line fishing methods. Interactions with this gear are likely to be low, mainly because the anglers can retrieve their gear quickly if a turtle is observed nearby.

Inshore handline is generally used from a boat to catch reef fishes that live on slopes and flats at the outer edge of the reef. This is essentially the same technique used in shelf, slope and channel habitat to catch deep-water bottomfish, but the gear is lighter and smaller. Typical species caught include goatfishes, razor wrasses, akule and opelu. The gear is composed of a monofilament mainline terminated by a leader with several baited hooks attached, followed by a terminal weight. It is usually deployed and retrieved manually. Unlike the slide bait rig, this gear uses line ranging from light to medium weight line and may impact sea turtles. The area of deployment, in deeper water at the edge of reefs or on slopes makes interactions less likely, although it may impact turtles moving from forage areas to refugia or resting areas (G. Balazs, pers. comm.)..

Bottom longline, or "kaka line" is reported on commercial catch reports but landings are not reported in a separate category. As with pelagic longline gear, it consists of a mainline to which are attached multiple branchlines with baited hooks, but it is set on or near the bottom. (To be legal in state waters the mainline must be less than one nautical mile in length and cannot be used to catch deep-water bottomfish species.) Catch varies depending on the intended target and area of deployment. According to Hamm and Lum (1992), this gear accounts for 0.1% of total annual boat trips. This gear appears in the Hanalei Bay study, but it is the lowest ranked gear in terms of effort (Friedlander and Parrish 1997). Everson (1994) does not list this gear type for Kaneohe Bay. There is no information on the level of interaction with sea turtles, but given its configuration and area of deployment it could have a rate similar to that of shore fishing. Balazs (pers. comm.) notes that there have been some confirmed mortalities due to this gear. However, this gear appears to be very infrequently deployed, based on the effort estimates in the two surveys just mentioned. Thus the total number of interactions is expected to be much less.

A wide variety of nets are used in inshore areas, including the surround net already discussed, gill nets, purse nets, beach seine (or *hukilau*), bullpen nets, fence nets, crab (hoop) nets, and cast nets. Surround, purse, seine and cast nets are all fairly "active" gear. They are pulled through the water or cast to trap fish. As such, even if a turtle were to become trapped or entangled in the net, it would be released relatively rapidly (as part of the fishing operation) before it was seriously injured or killed. Gill nets, crab nets and bullpen nets are generally passive: the gear is deployed and left for fish (or crabs) to become trapped or entangled.

The crab, gill and cast net are the only net gear that show up in all of the surveys discussed here.[5] The surround net appears in all except for the Hilo Bay survey (Kahiapo and Smith 1994). Crab nets are hoop nets laid flat on sandy bottoms, particularly to catch Kona crab. The baited nets catch the crabs by entanglement. They rank second in the Hanalei Bay survey in terms of annual effort (Friedlander and Parrish 1997). In Everson's study of Kaneohe Bay crab nets account for 4.4% of annual effort for all gear types and are the highest ranked net gear in terms of effort across all gear types. The Hilo Bay survey shows that crab nets account for up to 8% of the gear in use, depending on the time of day. In the small-boat survey they ranked much lower, less than 1%. (This is probably because the survey concentrated on boats originating from major landing sites and harbors. It may be that crab nets are more often deployed by smaller boats launched directly from the adjacent shoreline.) Although they lie flat on the bottom and would not normally entangle turtles, Kona crab nets have been implicated in at least one entanglement death of a green turtle (G. Balazs, pers. comm.). Kona crabs occur at depths of 50-150 ft, so this is where the net is set. These depths are outside sea turtle foraging areas, but could be in refuge depths. The lobster nets mentioned by the small-boat survey may be similar in configuration and deployment; they account for a very small proportion of trips (0.1%). These are likely set at similar depths.

The gillnets used in Hawaii waters are much smaller than gillnets used in the now prohibited pelagic drift gillnet fishery or the Pamlico Sound flounder gillnet fishery (Gearhart 2001). The

[5] Hamm and Lum also list aquarium nets, other nets and lobster nets. Everson also lists aquarium nets, dip nets and fence nets. These gear types all have fairly low levels of total effort.

gillnets used here are available in lengths of 100-125 feet and 4, 7, or 12 feet in height. Fishermen often link the nets end to end to extend the length. They can be configured to sink and lie on the bottom or float at the surface. They are popular with recreational fishermen and some commercial fishermen. Gillnets rank fifth in the Hanalei Bay survey (the second-ranked net gear). In the other two surveys they accounted for 2.8% of total effort by gear type in the small-boat survey (Hamm and Lum 1992) and 1.7% in the Hanalei Bay study (Everson 1994). Gillnets were prohibited in Hilo Bay during the survey period there. This gear type is not reported in the "gear abundance" figures for Hilo Bay. However, that survey also covered a shoreline area adjacent to the bay and there gillnets accounted for about 9% of gear in use. Of all the net gear types, the gillnet is most problematic in terms of interactions with sea turtles. They are set in reef channels or over sand near the reef edge to catch fish moving over the reef. As noted, they are passive; gillnets are generally set and may not be actively tended or monitored. They are made of monofilament line, intended to be invisible to prey and configured to entangle or "gill" fish. Turtles can easily become entangled in this type of net, especially if fibropapilloma tumors are present. According to state law gillnets must have a minimum stretched mesh size of 2 3/4" and be inspected at least every two hours and all undersized, illegal, or unwanted fish removed. They cannot be fished for more than four hours within any 24-hour period (DAR 2001). Even if these regulations were obeyed by all fishermen, the two hour interval between inspections could result in a mortality if the entangled turtle cannot reach the surface.

Cast nets (throw nets) are circular and weighted around the edge. As the name implies, they are thrown over a school of fish by a fisherman standing on the shore or in shallow water. They ranked eighth (second to last) in the Hanalei Bay study (Friedlander and Parrish 1997), but accounted for more of total effort than gillnets (at 2.1%) in Kaneohe Bay study (Everson 1994). In the Hilo Bay surveys they were generally the most common net gear, accounting for about 4-14% of gear in use (Kahiapo and Smith 1994). (The highest value, 13.6%, is for the adjacent Keaukaha shoreline during weekdays.) They accounted for a tiny percentage of trips in the small-boat survey (0.05%) because cast netting normally occurs from shore (Hamm and Lum 1992). A boat trip would suggest a journey to a shoreline area where this technique would then be used. Because the fisherman can see the prey he is targeting, this gear type is very unlikely to interact with turtles. Even if one were entangled, it could be easily and rapidly released by the fisherman. The Hilo Bay creel censuses also record the scoop net as a popular gear type. For similar reasons, it is unlikely that turtles interact with this gear type.

Bullpen nets consist of several vertical panels that are deployed in such a manner as to intercept fish moving along the coast (or in relation to a prevailing current) and funnel them into an enclosure, the "bullpen." (For commercial catch reporting, DAR actually considers this gear a trap rather than a net.) Balazs et al. (1987) used bullpen nets to capture turtles for research purposes. They report that only two of these nets are in use, both on Molokai. Clearly turtles interact with these nets, depending on where and how they are employed. But it is unlikely that these interactions are harmful since the gear is intended to shepherd the catch into the pen where there is adequate area for unrestricted movement. The fishermen can then easily release any unwanted catch, including sea turtles (Smith 1993, p. 43). Beach seines are a traditional, communal fishing method. Given the inshore areas where they are used they could capture turtles. As noted above, because it is an active gear type it is likely that turtles could be released before serious harm occurred. In addition, their use is very infrequent today, making interactions very unlikely.

Free and scuba divers commonly use sling spears and spear guns to catch reef fish and octopus. Spearing figures prominently in the small-boat survey, accounting for 6.3% of all trips, ranking third, and 24% of total effort in Kaneohe Bay (ranking second) (Everson 1994; Hamm and Lum 1992). In Hanalei Bay spearing ranked fairly low, with about the same effort level as surround nets. In the Hilo Bay censuses spearing accounted for 6-10% of effort during daylight hours (6 AM-6 PM). According to Everson (1994), 85% of the estimated annual spear catch in Kaneohe Bay consisted of octopus. Another scuba diving fishery targets aquarium fish. Collectors use barrier nets, which they set in reef areas and then drive desired fish into the net. These nets are generally quite small. As mentioned in footnote 5, aquarium nets are identified in two of the surveys but for a tiny proportion of effort (1.0 and 0.03%). These nets are used to collect fish for the aquarium trade and this is an exclusively commercial fishery. These methods are very selective; spearing in particular produces virtually no incidental catch. It is thus unlikely that sea turtles interact with these gear types to any degree. However, divers frequently enter the inshore habitat of sea turtles and they are commonly sighted by sports divers and spear fishermen alike.

Traps are listed in all three surveys. They are used to catch lobsters and various fish. In all the studies they accounted for a small proportion of total effort (around 1%). They are constructed from wire mesh or plastic. Their construction and mesh size makes entanglement by sea turtles unlikely and the entrances are too small to admit juvenile and adult turtles that have recruited to inshore areas. It is unlikely that turtles interact with these gear.

3.3 Summary of Recreational Effort and Distribution

Commercial landings by island are summarized in Table 2. Longline landings from Table 1 have been subtracted from the total for Oahu. These landings are from the federally managed fishery and are made exclusively at Oahu. As the table reveals, 85% of landings are made at Oahu and Hawaii, about evenly divided. More generally, Smith (1993) details the distribution of inshore commercial effort across the state. These data may be used to describe the relative distribution of recreational effort to the degree that both sectors target the same species under similar environmental conditions. She divides the state into four “complexes”: Kauai, Oahu, Maui, and Hawaii (the “Big Island”). On Kauai the southwestern coast supports more reef and coastal pelagic fisheries. Most of the state’s population is concentrated on Oahu; according to the last national census 72% of the state’s 1,211,537 population resides there. Smith mentions bottomfish handlining, spearing and trapping as notable fisheries, depending on the island’s wider coastal shelf. The state’s two largest embayments, Pearl Harbor and Kaneohe Bay, are also on Oahu and account for more than 80% of the state’s estuarine habitat. (Kaneohe Bay is also an important resident area for sea turtles.) Pelagic fisheries are more prevalent on the drier leeward (western) coast. The Maui complex consists of the inshore (<100 fm) waters around and between Maui, Molokai, Lanai and Kaho‘olawe. The protected waters between these islands are important sea turtle habitat and also suitable for a wide range of marine recreational activities. Spearfishing, surround and gill netting are used on Maui’s windward coast and throw (cast) nets and handlining occurs on the leeward coast. Penguin Bank, a large shelf, extends off the western end of Molokai and is an important area for bottom handlining and Kona crab netting. The island of Hawaii tends to have a much narrower coastal shelf in comparison to the other complexes. Deep inshore waters, particularly along the Kona (southwest) coast favor fishing for large pelagic species close to shore. The opelu/akule fishery is very important in this area.

Smith also reports commercial effort (mean annual trips) by island quadrant. These data are presented in Table 3, along with an indication of relative distribution (percent). It can be seen that Hawaii accounts for the most effort by island, and the southwest quadrant has the most effort of any quadrant in the state. This probably reflects opelu/akule fishing, which she notes is significant in this area. Oahu ranks second by island for total effort. Summing effort by quadrant across all islands, the southwest quadrants receive the most effort, but this may be disproportionately affected by the high level of effort expended in this quadrant on Hawaii. More generally, on all islands except Maui the southwest and southeast quadrants rank first or second and the northwest and northeast quadrants rank third or fourth. As Smith points out, southern parts of the islands are more protected from the weather and this probably favors boat fishing in these quadrants.

Two of the inshore surveys (Everson 1994; Friedlander and Parrish 1997) report seasonal variation and found that catches were lower in the winter months, although Friedlander and Parrish state that "the level of overall catch is perhaps surprisingly stable seasonally" (Friedlander and Parrish 1997, p. 41). They note that particular gear types show more marked trends, with trolling and hook-and-line fishing (from shore and boats) being lower in the winter. The Hilo Bay survey also stratifies census results by time of day (for Hilo Bay only). Fishing activity was recorded at all hours of the day although, as might be expected, it was highest during daylight hours. Rod and reel and handpole gear were much more prevalent at night. Since all the inshore surveys focused on recreational fishing, effort was much higher on weekends than during the weekday.

The most recent statewide data on effort comes from the 1996 National Survey, which collects data mainly through telephone interviews (USFWS et al. 1998). The survey report does not provide any detailed effort estimates for marine angling beyond estimates of the total number of anglers and the total number of trips (subdivided by residents and non-residents). As noted above, it also provides data by species, but the list is limited to a few, mostly pelagic species (marlin, tuna, ono, mahi mahi, ulua, shellfish) and two non-specific categories (anything, another type of fish), which accounted for a large part of the effort (74%). The total number of anglers is reported at 260,000 and the total days fished is 3,100,000.

A very rough idea of the distribution of inshore fishing effort by gear type, focusing on recreational activity, can be developed by using information from three of the surveys discussed above (Everson 1994; Friedlander and Parrish 1997; Hamm and Lum 1992). This calculated distribution can then be applied to the USFWS/NMFS Hawaii recreation survey (USFWS et al. 1998) value for total recreational effort to estimate absolute effort (days fished) by gear type. This can be used to estimate the distribution of effort by gear type and these values can be applied to the estimate of total recreational days fished in the Main Hawaiian Islands. Table 4 summarizes this process. Gear types are grouped by broad category and the distribution of effort in percentage terms for each survey is presented. The Oahu small-boat survey is the most comprehensive of the three surveys and thus may be the best source to calculate the distribution of effort. But it does not cover fishing from shore. Therefore, the values from that survey have been adjusted. The ratio of shore-based to boat-based line fishing (5:1) from Friedlander and

Parrish is used for the adjustment. [Note: preliminary telephone survey data from the HMRFS project indicates that the ratio may be closer to 3:1 (Michael Nelson, pers. comm.)] The boat-based percentage from the small-boat survey was multiplied by five to derive the shore-based component and the percentages then re-calculated to arrive at this adjustment. Because of the high degree of uncertainty inherent in this approach, fishing methods have been grouped into a few broad categories. Because gill nets are involved in sea turtle takes it is left as a separate entry in the table. It can be seen that the two inshore surveys (Everson and Friedlander and Parrish) are broadly similar in terms of the distribution of effort, except that shoreline line fishing accounts for a much higher proportion of in the Hanelei Bay study. Another noticeable difference in these two surveys is in the "other" category, which groups many different methods. Spear fishing was very significant in Kaneohe Bay and accounts for the relatively large value in the other category.

4. Conservation Plan

This Conservation Plan is divided into two sections. The first part describes the likely impact of inshore fishing on sea turtles and presents and estimates of the anticipated take. The second part describes the measures DAR will implement to more accurately assess sea turtle take and reduce it.

4.1 Anticipated Impact of the Activity on Sea Turtles

4.1.1 Impacted Species

Given the abundance and distribution of sea turtle species in Hawaii, the green turtle is most likely to be affected by recreational fisheries. The best data set to assess the relative impact of fishing gear interactions on sea turtles is information on strandings collected by George Balazs of the NMFS Southwest Fisheries Science Center Honolulu Laboratory. From 1982 to 2000, 3,058 strandings have been reported (Murakawa et al. 2000 and Balazs, pers. comm.). Of these, 2,994, or 98%, have been green turtles. Olive ridleys and hawksbills account for about 1% each, with a very few reports for leatherbacks and loggerheads (see Table 5). Looking at the distribution among species for just those stranding reports where there was evidence of gear involvement does not change the proportions much, except that the small number of leatherbacks reported all had evidence of gear involvement.

4.1.2 Gear Interactions

The stranding data in Table 5 suggests the relative degree of gear interactions by broad gear type and by species. It is very important to note that the source gear, whether commercial or recreational, or offshore or inshore cannot be distinguished. Further, some of the gear interactions implicated in strandings may have originated outside the region as discarded gear. Finally, for those stranded turtles found dead it is difficult to say whether the gear entanglement was the proximate cause of their death. Keeping these caveats in mind, it can be seen that interactions with nets account for about half of all gear interactions. Line entanglement and then hookings follow. This pattern holds true across all species. In this data set the proportion of dead stranded turtles versus those released alive is lowest for hook involvement, at a little over a third. For monofilament line and nets the proportion is much higher; about two-thirds of turtles entangled in these materials were reported dead. Again, it must be emphasized that a range of factors make it difficult to correlate stranding condition with the effects of particular gear types. However, in relative terms it is valid to say that line and net entanglement are more likely to kill turtles than snagging or ingestion of hooks.

Table 6 summarizes the qualitative assessments made in the fishing gear descriptions above. Gill nets and slide bait hook-and-line fishing probably have the highest likelihood of interactions with sea turtles. Gill nets in particular have the potential for fatal interactions due to the chance of entangled turtles drowning in untended nets. Several other gear types have configurations that increase the likelihood of interaction but because of either their infrequent use, or use in habitats where there are few sea turtles, they are ranked lower than the two aforementioned types. These include longlining (float and bottom), bullpen nets, and crab nets. Although spin casting (from shore and boats) probably represents a large proportion of recreational effort, it is ranked in the second ("+") category because interactions are probably less frequent and also less harmful to turtles because of the lightweight line and small hooks that are generally used. Finally, many gear types are rated "0" to indicate that interactions are thought to be unlikely, or if they do occur are not injurious to sea turtles.

4.1.3 Types of Impacts

Available evidence suggests that impacts mostly result from gear interactions that cause entanglement or hooking. Given the high level of awareness in Hawaii about sea turtles, intentional harassment is probably infrequent, although educational efforts still need to be continued and expanded. As discussed below, habitat impacts are not likely to be significant either.

Balazs (1985b) reviewed reports of sea turtle entanglement in and ingestion of marine debris. He notes that "sea turtles are prone to all kinds of entanglement as a result of their body configuration and behavior" (p. 389). Both ingestion and entanglement were more common among immature turtles. Depending on the species, between 3.2% and 5.9% of the cases reviewed showed signs of ingestion of monofilament fishing line. (Multiple types of debris may be found in any one turtle's digestive tract, however.) Ingested materials, including monofilament line, can cause intestinal blockage or inhibit digestion. There may also be some toxic effect stemming from plasticizers in the material. Monofilament fishing line was the most common material described in entanglement reports, accounting for a third of all reports. Entanglement is likely a more common and serious impact, in terms of fishing gear, except for fishing gear with large hooks, such as the ulua slide-bait fishery. As noted above, and reiterating Balazs' discussion, entanglement inhibits normal behavior and function. Constricting lines can cause lesions and restricted blood flow. Limbs may be amputated as a result. Since fishing gear is made of synthetic materials it cannot rot away and thus persists until the turtle dies, frees itself, or is freed from the material. The high prevalence of fibropapilloma tumorous growths on green turtles in Hawaii is believed to be a contributing factor to fishing line and hook interactions (George Balazs, pers. comm.).

The Biological Opinion for the Pelagics FMP (NMFS 2001) describes effects directly related to gear interactions. Turtles can be injured or killed from four broad categories of effects: forcible submergence, entanglement, trailing gear and hooking. Although sea turtles can drown due to forcible submergence, respiratory and metabolic stress leading to severe disturbance of their acid-base balance (acidosis) is a more likely effect. This condition can be lethal by itself and can also reduce overall fitness. Because of their body configuration, turtles are prone to entanglement in lines, nets and marine debris (including discarded gear). Entanglement can injure turtles by causing lesions or constricting blood flow to limbs. Trailing gear can entangle other objects or lodge on the bottom, preventing the turtle from moving. As noted above, it can also be ingested by the turtle (if attached to an ingested hook), possibly causing intestinal blockage. Turtles can be hooked externally or internally. External hooking is less serious, although it can result in lesions and allow infection. Although turtles may eventually expel ingested hooks, there is a chance of internal organ damage. Internal hooking can lead to erosion of the gut wall or interception (telescoping of the gut) due to the line.

In summary, fishery impacts can be divided into three broad categories. Turtles may be killed directly as a result of their interaction with the gear. This would most likely result from entanglement or hooking that prevents the turtle from surfacing and causes it to drown, or induces fatal acidosis. Second, turtles may be seriously injured or killed by hook or line ingestion or snagging, or entanglement in fishing line or netting. The turtle does not die immediately, but eventually dies as a direct consequence of the gear interaction. Third, entanglement or ingestion, along with other factors, makes the turtle less fit. The impacts of discarded gear may be added to this category in that it is an indirect impact that does not result from the actual process of fishing. Terrestrial impacts to sea turtles are likely negligible in Hawaii since they do not nest in significant numbers in the main Hawaiian Islands where recreational fishermen are concentrated. (The remote nesting sites in the NWHI are part of a National Wildlife Refuge and thus protected from almost all human impacts.) Hawksbill turtles do nest on several remote beaches on the island of Hawaii. However, most of these beaches are within the Hawaii Volcanoes National Park and thus afforded some protection. To the degree that there are any terrestrial impacts stemming from recreational fishing, they would result from access to the shoreline that results in disturbance of nesting and basking sites.

4.2 Anticipated Impact of the Activity on Habitat

Federal regulations (50 CFR 222.102) define harm as part of ESA-defined take as “an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding or sheltering.” Such habitat impacts stemming from inshore fishing may be generally divided into two categories: impacts resulting directly from gear deployment and impacts resulting from activities ancillary to the activity, such as vessel noise and pollution. Evidence for habitat impacts is at best anecdotal and largely speculative. But it seems unlikely that habitat impacts due to fishing activities may be linked directly and causally to injury or death.

Gear impacts would mostly be a consequence of direct contact with the sea bottom, leading to habitat disturbance. Of all gear types, nets used in shallow water or that come in contact with the bottom are likely to have the most habitat impacts. If used in shallow water fishermen may walk across the bottom during gear deployment and retrieval. The gear itself is also likely to come in contact with the bottom. Hard coral and other sessile invertebrates can be damaged or killed by these activities. Coral polyps in particular are sensitive to abrasion that removes the protective layer of mucus covering the colony. Line gear can also damage the bottom, particularly if heavy weights are attached to the gear. Lines that become entangled on the bottom could also harm sessile benthos, particularly if line retrieval abrades surfaces or removes attached organisms. Generally, these impacts have no direct impact on sea turtles except to the degree that they compromise the growth of benthic macroalgae that turtles feed on. Because sea turtles do not nest in appreciable numbers in the main Hawaiian Islands, no significant impacts to terrestrial habitat as a result of recreational or commercial fishing are anticipated.

The impact of vessel activities is likely to be equally minor. Engine discharge from small craft likely to operate in nearshore foraging and resting areas is generally negligible. According to Hirth (1997), green turtles generally acclimate to human presence.

4.3 Anticipated Take

Anticipated take is projected on an annual basis using the stranding report data collected by NMFS (Murakawa et al. 2000 and G. Balazs, pers. comm.), which appear to be the best data available. Total annual projected take (T_y) is presented as the sum of the annual take associated with hook-and-line gear (T_{Hy}) and annual take associated with net gear (T_{Ny}). Take associated with other gear, e.g., spear and traps, is assumed to be negligible (see discussion below). Table 7. presents the projected values for T_y, T_{Hy}, and T_{Ny} in the years 2001 through 2005. The following equations are used to calculate these values:

$$T_y = T_{Ny} + T_{Hy}$$

$$T_{Ny} = L_{Ny} + E_{Ny} \qquad T_{Hy} = L_{Hy} + E_{Hy}$$

$$L_{Ny} = D_{Ny} \cdot s \cdot r \qquad L_{Hy} = D_{Hy} \cdot s \cdot r$$

$$E_{Ny} = L_{Ny}/q - L_{Ny} \qquad E_{Hy} = L_{Hy}/q - L_{Hy}$$

Where:

T_y = total take caused by all gears during year y

T_{Ny} = total take caused net gear during year y

T_{Hy} = total take caused by hook and line gear during year y

L_{Ny} = lethal take caused by net gear during year y

E_{Ny} = non-lethal take caused by net gear during year y

L_{Hy} = lethal take caused by hook and line gear during year y

E_{Hy} = non-lethal take caused by hook and line gear during year y

D_{Ny} = projected number of reported dead strandings resulting from net interactions for year y based on linear regression analysis of available NMFS stranding report data

D_{Hy} = projected number of reported dead strandings resulting from hook and line interactions for year y based on linear regression analysis of available NMFS stranding report data

s = ratio of total lethal takes caused by any gear to total lethal takes caused by any gear that result in reported strandings = 2/1 = 2

r = ratio of total lethal strandings to lethal strandings that are reported = 5/4 = 1.25

q = proportion of total takes that result in lethal takes = 0.36

4.3.1 Discussion of anticipated take calculations and assumptions

As discussed earlier, the lack of data on fishery specific take and mortality rates by species makes the task of estimating anticipated takes for the purposes of this permit application extremely difficult. A number of assumptions have to be made in order to generate an estimate, most of which have no basis in empirical data. It is the intention of the DAR to obtain adequate data during the duration of the permit to develop the fishery specific take and mortality rates necessary to update and refine the take estimates.

It is only possible at this time to make estimates or projections of sea turtle take associated with these fisheries. These projections are made considering the best data available, i.e., the stranding report data collected since 1982 by George Balazs of NMFS and his associates in the NMFS Honolulu Laboratory Marine Turtle Research Program (Murakawa et al. 2000 and G. Balazs, pers. comm.). These data suggest that green turtles, and to a much lesser extent hawksbills account for virtually all interactions with fishing gear associated with Hawaii-managed fisheries. In order to make the take projections, fisheries are aggregated into the four categories used above: hook-and-line, net, spear and trap. However, it is assumed that no interactions occur with trap fisheries and spear fisheries (skin and scuba diving).

Figures 3 and 4 present the above-mentioned annual stranding reports of turtles that had evidence of hooking or entanglement in monofilament line (combined in Figure 3), and entanglement in nets (Figure 4). Correlating stranding data with the actual level of take in inshore fisheries is complicated by several factors. First, it can be seen that strandings have been increasing since data were first collected in 1982. (Regression lines are presented in the figures to show trends in the data.) This increase could be due to a number of factors. First, the green turtle population is increasing, given that nesting counts at French Frigate Shoals in the NWHI have roughly tripled since monitoring began in 1973 (Figure 1). Even if the mortality rate remained constant, the number of turtles likely to die in a given year, for any reason, will increase. Second, green turtles have been afflicted with fibropapilloma disease in recent years; this may increase the actual mortality rate and could contribute to the increased mortality from gear interactions. Third, the increase could reflect an increase in the level of reporting, but this may be true only for islands outside Oahu (G. Balazs, pers. comm.). Oahu represents about 75% of the reported strandings.

The other difficulty with using stranding data is that the correlation between strandings and actual interaction with fishing gear is unknown. This is compounded because other fisheries besides the inshore fisheries managed by the State or the Federal government could account for some of the strandings. However, with no other data source, strandings data have been used to estimate take rates. To make a conservative estimate (in this case, a higher take value) it is assumed that all gear involvement observed in the strandings reports resulted from interactions with inshore (Hawaii-managed) fisheries. This conservative assumption may be balanced somewhat by the fact that within the total pool of stranding reports some stranded turtles without evidence of gear interaction were probably injured or killed as a result of gear interactions. Although it is unlikely that stranding reports are a representative (or random) sample of the total number of gear interactions, this assumption must be made also, in the absence of any data that could be used to stratify or adjust the strandings data.

It is assumed that one of every two turtles killed at sea reach shore. A ratio of 1:4 was agreed to by NMFS and the North Carolina Department of Marine Fisheries for use in developing take estimates for the Pamlico Sound gill net fishery (Gearhart 2001). We did not use the Pamlico Sound ratio because it is likely that reported strandings here probably are probably closer to the actual number of strandings. Most of the fishing related strandings are probably from fishing gear that is set from shore and entanglements are also more likely to occur close to shore. With our year-round good weather, the popularity of ocean recreation and activities, and the generally high level of environmental awareness here, it's more likely that entangled turtles. As George Balazs noted, a vigorous stranding network has been underway on the island of Oahu since 1982 and Oahu represents about 75% of all stranding reports.

The following steps are used to develop a take estimate. First, the 1982-2000 strandings data for all species are sub-divided into two categories: strandings with hook or line involvement and strandings with net involvement.[6] One would expect that the number of lethal gear interactions would be a small proportion of total interactions. Yet in the stranding data more dead turtles are encountered than live ones. This is likely because a smaller proportion of turtles surviving a gear interaction are likely to be observed as stranded than those who die and are subsequently found. This means that the proportion of live versus dead turtles should not be used directly to estimate non-lethal versus lethal take. The approach taken here, therefore, is to use only the number of dead strandings in these calculations. Estimates of the proportion of turtles that die as a result of gear interactions have been made. For example, the Western Pelagic Fisheries FMP Biological Opinion uses a range of estimates depending on the nature of interaction, varying between 0% for entangled turtles to 100% for turtles that are retrieved dead. It is assumed that the dead stranded turtles represent a fraction of all the turtles killed by gear interactions, either immediately or later (which can be termed 'latent mortality'). If it is assumed that 10% of turtles

---

[6] Because the values for all species besides green turtles are so small it is difficult to analyze them separately. Estimates by species are made simply by apportioning pooled results based on the rough proportion of strandings of individual species.

are killed during the gear interaction and there is a 29% latent mortality rate[7] among the remaining 90% that survive, then 36% (0.10 + (0.29 x 0.90) = 0.36 = q in equations above) of turtles interacting with gear will eventually die as a consequence of the interaction. As noted above, it is assumed that the dead stranded turtles represent one half of the total number of turtles that interacted with fishing gear and subsequently died. Thus, the annual number of dead stranded turtles (by gear involvement category) can be expanded by two. In addition, the expanded number of lethal takes is further expanded by a factor of 1.25, based on the assumption that an additional 20% of turtle strandings occur on remote or inaccessible beaches and hence may go unreported. So, the number of expanded dead stranded turtles would be 2.5 times the reported dead stranded turtles. This figure represents 36% of the total take; the remaining 64% represents the non-lethal take. It is then a simple matter to compute the estimated total take (the lethal take divided by 0.36) and subtract the estimated lethal take to determine the estimated non-lethal take. These expansions are applied to the 1982-2000 annual strandings data to derive an estimate of the lethal and non-lethal take in each of those years using the equations presented above (see Table 7).

As can be seen in Figure 3 and Figure 4, the number of strandings has increased over the sample period. The trend lines, computed by linear regression, can be used to estimate annual lethal takes in the near future (L_{Hy} and L_{Ny})). Using regression also has the advantage of taking into account the variance in the historical data. In this case the years 2001 through 2005 are used and the regression-based projections of take for these five years are also reported for the two gear categories (hook-monofilament line and net). These values are the anticipated take estimate for the purposes of this application.

Using the distribution of turtle species in the total strandings data, these values can be proportioned among species using the assumption that 97% will be green turtles and olive ridleys, hawksbills, and leatherbacks will account for 1% each. The projected 2002-2005 values are averaged and apportioned using these percentages. The results are presented in Table 8.

4.4 Monitoring and Mitigation of Anticipated Impacts

This Conservation Plan identifies a range of alternatives that will be implemented during the permit period to reduce the incidental take of sea turtles by Hawaii recreational fisheries. It is organized around requirements established by federal law and policy. Plan elements are related to biological goals and objectives (described in the five-point addendum to the Habitat Conservation Planning and Incidental Take Permit Processing Handbook (USFWS and NMFS 1996) published at 65 FR 35242). Under each objective a range of alternative actions are presented and a preferred alternative is identified under each objective. This addresses the requirement that Plans detail "alternative actions to such taking that were considered and the reasons why those alternatives were not being used" (50 CFR 220.307 (b) (4) (iv)). These are alternatives considered to reduce take levels below those anticipated in this permit application

---

[7] These values are somewhat arbitrary but is based on values used in the Western Pacific Pelagic Fisheries FMP Biological Opinion. Observer reports tabulated in the BO show that of 10 green turtles taken in the pelagic longline fishery between 1994 and 1999 one was already dead when the gear was retrieved. The 29% latent mortality rate is simply an average of the range of values used in the BO for latent mortality rates under different hooking conditions.

(USFWS and NMFS 1996, p. 3-35). The reasons for rejecting those measures not adopted in the Conservation Plan are discussed in Section 4.8. Funding commitments, including the mobilization of DAR staff time, for the preferred alternatives are discussed in Section 4.10.

4.5 Biological Goal 1: Monitoring

GOAL: DAR to have the information necessary to accurately assess the impacts of the activity on sea turtles.

Objective 1: Establish a monitoring program to accurately estimate the annual take of sea turtles by inshore fisheries.

Objective 2: Establish a monitoring program to assess the effect of mitigation measures on addressing goals and objectives.

Alternative 1: No action. Under this alternative DAR would not apply for an Incidental Take Permit and no new monitoring efforts pursuant to a permit would be implemented. However, DAR has several ongoing efforts to monitor incidental take, which would continue under this alternative. These include:

- DAR is collaborating with the Division of Conservation and Resources Enforcement (DOCARE) in DLNR to develop a database to manage information on natural resource conservation enforcement incidents. The database would record interactions between marine turtles and fishing gear documented during enforcement activities. Existing paper records would be entered into the database and future incidents entered directly from field offices. Progress in implementing the system has been stalled due to the lack of funds to acquire the necessary hardware for field offices on each island.

- DAR staff have developed a networked database to record incidents of protected species interactions reported by the public, other agencies, and other DLNR staff, to DAR. In addition to recording strandings or interactions of all protected species (sea turtles, monk seals, seabirds, whales, etc.), it stores specific information about the locations and results of interactions, which can be retrieved by DAR for use by other agencies.

- The Main Hawaiian Islands Marine Resource Investigations (MHI-MRI) program began in 1987. The inshore fishery surveys conducted at Hanalei Bay, Kauai and Kaneohe Bay, Oahu, which were used as sources of information for this permit application, as well as surveys along much of the coast of the Big Island, are some of the projects it has sponsored. These surveys collected anecdotal evidence on protected species interactions.

- After a 20-year hiatus, DAR and NMFS have begun the Hawaii Marine Recreational Fisheries Survey (HMRFS), which is collecting data from July 2001 through June 2002 (http://www.state.hi.us/dlnr/dar/surveys/). This is part of the national MRFSS program conducted by NMFS that uses telephone and intercept surveys to collect data on participation, catch and effort (http://www.st.nmfs.gov/st1/recreational/) in recreational fisheries. The random digit dialing telephone survey samples households state-wide to generate total fishing effort and participation rates. The HMRFS surveyors currently collect intercept surveys from private boat fishermen on the island of Oahu and in Kona on the island of Hawaii, and charter boat fishermen state-wide. DAR will work with NMFS to develop and implement additional questions for the HMRFS in order to develop incidental take estimates for recreational fisheries.

The HMRFS survey will yield estimates of total fishing effort by gear type and island. The supplemental protected species interaction survey will be used to estimate incidental take rates and since it will be collected at the same time as the intercept survey, MRFSS expansion algorithms can be used to estimate total incidental takes.

- State law requires that all Hawaii fishermen who take marine life for commercial purposes must first obtain a Commercial Marine License (Hawaii Revised Statutes Chapter §189-2). Licensed fishermen must also submit regular (usually monthly) commercial fishing reports to DAR (Hawaii Revised Statutes Chapter §189-3). DAR has been collecting catch and effort data from commercial fishermen since 1948. The forms collect information on date fished, gear type, general location, weight and number caught by species, and amount sold and value.

  The forms currently do not collect specific protected species interaction data, partly because there are some legal issues regarding self-incrimination of fishermen who report interactions. However, fishermen sometimes report interactions anecdotally. The reporting forms are currently being revised to collect more detailed effort data, which will improve the precision of CPUE calculations, and will be implemented shortly (http://www.state.hi.us/dlnr/dar/ctchrpt/). The additional information collected will include units of gear and soak time or duration.

<u>Alternative 2: Build on existing efforts in Alternative 1</u>. These efforts can be undertaken with additional resources and staff or diversion of existing resources and staff to the activity. Contingent upon availability of staff and/or funding. (PREFERRED)

- DAR will continue and/or expand existing monitoring and data collection programs as a means of monitoring incidental take.

- DAR will assist DOCARE to implement the enforcement incident database. This database will also receive the gear interaction reports reported directly to DOCARE by fishermen or the existing Protected Species Incident database currently operated by DAR will be used.

- DAR would sponsor several new projects, similar to past localized surveys of inshore fishing, focusing on interactions between different gear types, fisheries and sea turtles, in consultation with the NMFS Honolulu Laboratory Marine Turtle Research Program.

- If the HMRFS project receives supplemental funding next fiscal year (July 2002 – June 2003), DAR proposes to expand sampling of private boats to Maui, Kauai, and the entire island of Hawaii. Surveyors will continue to interview fishermen about interactions. Assessment of mitigation measures will be based on the results of these efforts. Any change in the level of take would be attributed to the effectiveness of implemented measures.

- DAR will incorporate a mechanism for commercial fishermen to report turtle interactions with commercial fishing report forms by providing a supplemental form to collect interaction data. Reporting of interactions will be made mandatory and will be covered by the ITP.

- DAR will work with NMFS Marine Turtle Research Program to facilitate and encourage reporting of sea turtle interactions by Hawaii shoreline fishermen.

Alternative 3: Continue efforts in Alternative 1 and 2 and expand Fishing Surveys and Establish a Protected Species Coordinator. Contingent upon a permanent funding allocation to support expanded efforts

.• Implement a comprehensive survey to assess incidental take in inshore fisheries and program performance. Provided that adequate resources can be found, DAR would establish an ongoing state-wide survey of inshore fisheries (including recreational and subsistence), expanding on the HMRFS program, using both telephone and intercept (creel) surveys, to estimate inshore fisheries catch and effort and incidental take rates of protected species. These surveys would include both boat and shoreline fisheries operating within state jurisdiction. The information would be used to obtain information on incidental take rates in a wide variety of fisheries. While changes in the level of take would be a primary program assessment measure, additional survey questions would also assess public awareness of and compliance with take reduction measures.

  The comprehensive survey would, in essence, substitute for an observer program as used in other fisheries. An observer program would be infeasible for the fisheries covered by this application.

- DAR would apply to NMFS for support to fund a Protected Species Coordinator position in the Division. This person would coordinate activities related to ongoing monitoring efforts and reduction of incidental take of turtles and other protected species, and lead planning and other efforts to protect listed marine species in the department. The Coordinator would be responsible for monitoring the effectiveness of DAR protected species programs, preparing reports to NMFS on the incidental take estimates and status of the permit, and coordinate with the appropriate Federal and State agencies. This would be a new position within the Division and would require an external funding source to implement.

4.6 Biological Goal 2: Take Reduction

GOAL: By the end of 2005, to reduce the lethal take of sea turtles (all species combined) by 25% from 2002 levels. To reduce the total take by 10%.

Objective: Achieve a measurable reduction in take during the initial permit period. The levels were set based on what was felt to be achievable given available resources.

Alternative 1: No action. Under this alternative DAR would not apply for an Incidental Take Permit and no new take reduction efforts pursuant to a permit would be implemented. However, DAR has several ongoing efforts to reduce or mitigate incidental take which would continue even under a no-action alternative.

- DAR has an Information and Education Program to promote public awareness of marine resource management and conservation issues. Disseminating information on protected resources is an important part of the program. DAR has worked with NMFS to develop and/or distribute two printed products. First, DAR funded several printings of a brochure discussing the biology of and conservation issues related to the sea turtle species that occur in the state. Second, NMFS recently (late 2001) printed a sticker "Help Hawaiian Sea Turtles With Safe Fishing Practices" that can be affixed to tackle boxes and car bumpers. It includes a list of recommendations for dealing with gear interactions as well as contact information to report injured turtles. DAR has distributed >300 of the stickers to date, all that NMFS could provide. DAR will continue to assist with the dissemination of the brochures and stickers.

- DAR participates in various public educational events by setting up displays and giving presentations. DAR personnel staff booths and distribute brochures and other information. These activities are often in conjunction with the State Department of Education, University of Hawaii Sea Grant program, NMFS or US Fish and Wildlife Service, and other State agencies.

- The State has an Endangered Species Law (Hawaii Revised Statutes (HRS) Chapter §195D) which largely echoes the federal Endangered Species Act and mandates protection and procedures for protecting listed species and habitats. DAR has existing regulations (Hawaii Administrative Rules) which protect listed species and prohibit the harassment and taking of sea turtles.

Alternative 2: Build on existing education and outreach efforts. Under this alternative DAR would expand its existing efforts. New gillnet rules will be proposed. (PREFERRED).

Expand Information and Education: Public sentiment in Hawaii makes the implementation of regulatory measures that manage or monitor recreational fishing extremely difficult. This is reflected by the fact that the DAR has not been able to obtain the authority from the State Legislature to establish a marine recreational fishing license, even after many years of effort. Given this situation, particular emphasis is put on education and outreach. Education efforts will help fishermen to avoid areas where incidental take is likely and to reduce the likelihood of lethal interactions by providing information on how to safely release turtles from fishing gear. DAR will initiate the following additional outreach activities, pending availability of funding and resources necessary to accomplish the tasks:

- Disseminate an additional 5,000 copies of the aforementioned brochure and tackle box sticker.

- Provide information on how to avoid and mitigate interactions to recreational fishing related media outlets and encourage them to disseminate it. This includes Hawaii Fishing News, a print publication, and the television show Fishing Tales, which airs weekly.

- Develop public service announcements for print, radio and television media outlets.

- Develop web pages for incorporation into the DAR web site (http://www.state.hi.us/dlnr/dar/) to disseminate information widely to the public.

- Develop posters with maps showing areas where there is a high reported incidence of sea turtles and therefore should be avoided by anglers. Posters will be specific to each of Hawaii's counties and will be posted in tackle shops, marinas and other locations frequented by fishermen.

- Outreach staff will meet with interested citizens groups and fishing organizations to discuss ways to avoid interactions with sea turtles and to encourage reporting of interactions and strandings. Groups include: boating and fishing clubs, diving clubs, fishing cooperatives and associations. Outreach staff will need to be hired.

- Outreach staff will attend the following marine recreation related events to give presentations and disseminate printed materials: Fishermen's Forum, Ocean Expo and Boat Shows, etc. . Outreach staff will need to be hired.

- Continue and expand on ongoing outreach and education efforts with NMFS Honolulu Laboratory, University of Hawaii Sea Grant Program and the Hawaii Department of Education.

It should be noted that the education and outreach effort will raise the awareness of turtle interactions among all sectors of the public, including visitors and non-fishers. Interactions of non-fishing visitors with turtles have been reported (Scott 2001).

<u>Propose New Gillnet Fishing Regulations</u>. The existing regulation (Hawaii Administrative Rule Chapter 13-75) intended to reduce sea turtle take limits gill net soak times to four hours per 24-hours and requires that they be checked every two hours. The State Legislature passed the necessary implementing legislation in 1992 in response to recommendations provided by the Department of Land and Natural Resources.

In 1998 the Hawaii Gill Net Task Force was organized. They made recommendations for more effective enforcement of the current gill net restrictions. The recommendations included: defining gill net distinctly, limiting soak time, registering and marking nets and establishing responsibility, requiring an annual survey, establishing length and height restrictions, and implementing forfeiture procedures.

- DAR will propose new state-wide regulations on inshore gill-nets in 2002. Among the proposed regulations will be requirements for fishermen to register their gill-nets, to mark the nets with identifying tags, and to attend the gill-nets more frequently. An existing Administrative Rule will be amended to accomplish the changes (Hawaii Administrative Rule Chapter 13-75, (http://www.state.hi.us/dlnr/dar/regs/ch75.pdf). A draft amendment has been prepared and will be presented to the public in late spring 2002.

- The reductions in take and mortalities would be monitored and assessed using the NMFS Marine Turtle Research Program's stranding database, data collected by the HMRFS fishing survey, and interaction reports from fishermen. The assessment methodology will be reviewed and refined in consultation with the NMFS Marine Turtle Research Program.

<u>Alternative 3: Expand existing information and education efforts as noted in Alternative 2 and implement regulatory restrictions as soon as possible on specific gear and fisheries</u>. Under this

alternative the state would implement new controls on inshore fishing intended to reduce take. New measures would build on regulatory action already implemented by the State of Hawaii and DAR to reduce sea turtle take in state-managed commercial and recreational fisheries.

- DAR will propose restrictions on shore fishing and ulua shorecasting (slide-bait) by designating waters adjacent to haul-out areas and nesting areas, or areas where turtles concentrate to forage, restricted to fishing and other activities that would exacerbate turtle interactions. The DAR has the authority to establish Fishery Management Areas where specific fishing methods can be regulated via the Administrative Rule process. The State has jurisdiction up to the limit of the highest high tide mark. If shoreline areas on land need to be restricted, DAR must work with appropriate government agencies to implement restrictions.

- Nets which have the highest incidence of turtle takes and mortalities will be banned for use in state waters. However, fishery specific take and mortality rates will need to be determined for each gear type proposed for restrictions.

4.7 Biological Goal 3: Habitat Protection

GOAL: To protect critical inshore foraging and resting habitat from the impacts of the permitted activity.

Objective: DAR will identify critical inshore habitat for sea turtles and work to include these areas as part of the state's marine protected area network.

Alternative 1: No action. Under this alternative the DAR would not apply for an Incidental Take Permit and no additional measures would be implemented to protect inshore habitat critical to sea turtles. However, the State already has a system of marine managed areas.

Current Habitat Protection Efforts: The State has a system of marine protected areas that includes 10 Marine Life Conservation Districts (MLCDs) and 13 Fishery Management Areas (FMAs). Fishing is either prohibited or tightly restricted in MLCDs while specific gear, methods or fishing seasons are prohibited in FMAs. Table 9 summarizes these restrictions and Figure 4 shows their location. To the degree that fishing is limited in important turtle habitat, these managed areas reduce turtle take. Of particular note is the Kiholo Bay FMA, which was established in 1997 specifically to protect sea turtles from net entanglement. DAR is also working to protect hawksbill turtle nesting sites at Kamehame Beach on the Island of Hawaii. See http://www.state.hi.us/dlnr/dar/mlcd/ and http://www.state.hi.us/dlnr/dar/regbk/index.html for further information on MLCDs and FMAs.

Alternative 2: Identify and designate additional MLCDs and/or FMAs to protect critical habitat. (PREFERRED)

During the permit period DAR will develop a detailed set of recommendations for the establishment of additional marine protected areas specifically for the protection of sea turtles. These areas will include areas where turtles congregate in foraging areas and areas seaward of nesting or basking beaches. These areas will be designated as protected areas via the normal administrative processes of the Department of Land and Natural Resources.

Alternative 3: Emergency Designation of Protected Areas

The DAR and the Department of Land and Natural Resources would move immediately to designate additional marine protected areas specifically for the protection of sea turtles. These areas will include areas where turtles congregate in foraging areas and areas seaward of nesting or basking beaches. Such emergency designations are valid only for a limited period and must be replaced by designation via the normal administrative process to remain protected.

4.8 Rejected Alternatives

Biological Goal 1: Monitoring

Alternative 1: No Action. The Division of Aquatic Resources has committed to applying for an Incidental Take Permit and will continue existing monitoring programs as funding permits.

Alternative 3: Continue efforts in Alternative 1 and 2 and expand Fishing Surveys and Establish a Protected Species Coordinator. Funding is the primary constraint. There are no funds available to accomplish Alternative 3 due to the State's poor fiscal condition.

Biological Goal 2: Take Reduction

Alternative 1: No Action. The Division of Aquatic Resources has committed to applying for an Incidental Take Permit and will continue existing take reduction programs as funding permits.

Alternative 3: Expand existing information and education efforts as noted in Alternative 2 and implement regulatory restrictions as soon as possible on specific gear and fisheries. Implementing immediate and wide-ranging restrictions on fishing gear and fisheries could have the short-term desired effect of reducing turtle takes, but would be unlikely to receive the support of the fishing public. Public support for a precipitate course of action without proof of a causal relationship would be nil and threaten the effectiveness of future turtle protection programs. Furthermore, there are no funds available to accomplish Alternative 3 due to the State's poor fiscal condition.

Biological Goal 3: Habitat Conservation

Alternative 1: No Action. The Division of Aquatic Resources has committed to applying for an Incidental Take Permit and will continue existing habitat conservation programs as funding permits.

Alternative 3: Emergency Designation of Protected Areas. Designating protected areas via immediate and unilateral departmental emergency designation will not allow DAR to develop public support for the protected areas program and would lead to great difficulties in implementing permanent protected areas when the emergency period expires. Such actions would be counterproductive and likely to lead to more resistance from the public.

4.9 Funding

Because of the state's poor current fiscal situation, exacerbated by recent terrorist attacks and their adverse impacts on tourism, Hawaii's most important economic sector, tax revenues are reduced. Hawaii State agency budgets are extremely constrained and will be further cut. Staff cuts are possible, pending the outcome of the budget process in the 2002 State Legislature (http://starbulletin.com/2002/02/21/news/index3.html). Therefore, Conservation Plan implementation will mainly rely on the commitment of staff time and existing resources. Whenever possible outside funding sources will be used to cover new expenditures. Table 10 summarizes proposed commitment of staff time, new expenditures and possible funding sources.

The DAR will institute and fund the provisions and actions required by the Incidental Take Permit (ITP), in accordance with the requirements of State and Federal regulations. See H.R.S. § 195D-4(g); 50 C.F.R. § 222.22(c)(2). The State may use monies from its ESA Trust Fund and seek other sources of funding to support this program. See H.R.S. § 195D-31. In the event the State is unable to fund or implement any component of this plan, the State will immediately notify NMFS and will initiate appropriate restrictions to eliminate unauthorized take as specified by NMFS.

4.10 Enforcement

The impacts of inshore fisheries will be monitored through permits, gear interaction reporting requirements, and surveillance by the Division of Conservation and Resources Enforcement (DOCARE) and other authorized entities. Gear impacts will be minimized through the implementation and enforcement of management measures specified previously, as well as those developed through coordination with NMFS.

Sea turtle species are recognized as either threatened or endangered under Hawaii State law and associated implementing regulations. See H.R.S. §13-124. Any person who violates the State's ESA is subject to fines and imprisonment, in addition to those penalties imposed by federal law. See H.R.S. §195D-9; 16 U.S.C. §1540. State law enforcement officers possess jurisdiction to enforce State laws and rules related to endangered and threatened species in coastal waters. See H.R.S. §195D-7. Such species include federally-listed sea turtle species. See H.R.S. §195D-4(a). The DAR has authority to close or restrict coastal waters with respect to taking or attempting to take any listed species, or to otherwise regulate fishing gear and locations for the conservation of listed species. See H.R.S. §195D-3(b). The State will use these and other applicable authorities to conserve listed turtle species and minimize the amount incidental take occurring in these fisheries.

4.11 Gear Evaluation

The State will use data from commercial fishing reports and the fishing survey program to develop estimates of catch per unit effort for various turtle species using a range of commonly used recreational and commercial fishing gear. The State will use information obtained from this evaluation to manage its fisheries and to reduce incidental take. Reductions in incidental take may be achieved by prohibiting certain gear configurations in certain locations or during certain time periods. Such information will also help increase the accuracy of incidental take estimates by validating assumptions concerning the impacts of various inshore fisheries on turtles.

4.12 Reporting

The DAR will provide the NMFS Pacific Islands Area Office (PIAO), and NMFS Headquarters, Endangered Species Division, with semi-annual reports summarizing sea turtle takes (non-lethal and lethal) recorded in the monitoring programs. These reports will include the total number of turtles taken, locations, and species. The DAR will also provide a summary of all takes over the sampling period. Data will be recorded on DAR provided data forms.

The DAR will provide NMFS with a report of actions implemented pursuant to the ITP within 120 days of the issuance of the ITP. The report will describe management measures taken to protect sea turtles and will include information from commercial fishing reports, creel survey data, gear interaction reports from fishers, stranding reports, and DAR reports of violations in commercial and recreational fisheries. The DAR report will also include an evaluation of the program's effectiveness in protecting threatened and endangered sea turtles and management recommendations for commercial and recreational fisheries. If at any time the State believes it has exceeded authorized take levels, the State will immediately notify NMFS, and enact appropriate restrictions to eliminate unauthorized take.

5. Application

The Division of Aquatic Resources, 1151 Punchbowl St., Rm. 330, Honolulu, HI 96813 (Ph. 808-587-0100) makes an application for an Individual Incidental Take Permit under Section 10 of the Endangered Species Act authorizing implementation of management measures for protection of threatened and endangered sea turtles while allowing inshore fisheries to continue in State waters. It is requested that the ITP be valid from July 1, 2002 through June 30, 2005. The ITP will authorize the DAR to implement management measures for inshore fisheries in State waters to protect sea turtles. It is estimated that approximately 200,000 individuals will participate in recreational fisheries managed under the ITP in 2002.

6. References

Balazs, G.H. 1978. Terrestrial critical habitat for sea turtles under United States jurisdiction in the Pacific region. 'Elepaio 39(4):37-41.

Balazs, G.H. 1980. Synopsis of biological data on the green turtle in the Hawaiian Islands. NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFC-7, National Marine Fisheries Service Southwest Science Center Honolulu Laboratory, Honolulu.

Balazs, G.H. 1985a. History of sea turtles at Polihua Beach on northern Lanai. 'Elepaio 46(1):1-3.

Balazs, G.H. 1985b. Impact of ocean debris on marine turtles: Entanglement and ingestion. Pages 387429 *in* Shomura, R.S. and H.O. Yoshida, editors. Proceedings of the Workshop on the

Fate and Impact of Marine Debris, National Marine Fisheries Service, Southwest Fisheries Center, Honolulu.

Balazs, G.H. 1991. Current status of fibropapillomas in the Hawaiian green turtle, *Chelonia mydas*. *in* Balazs, G.H. and S. Pooley editors. Research Plan for Marine Turtle Fibropapilloma. National Marine Fisheries Service-Southwest Fisheries Science Center, Honolulu.

Balazs, G.H., R.G. Forsyth and A.K.H. Kam 1987. Preliminary Assessment of Habitat Utilization by Hawaiian Green Turtles in Their Resident Foraging Pastures. NOAA Tech. Memo. NOAA-TM-NMFS-SWFC-71, National Marine Fisheries Service, Southwest Fisheries Center Honolulu Laboratory, Honolulu.

Balazs, G.H., R.K. Miya and M.A. Finn. 1993. Aspects of green turtles in their feeding, resting, and cleaning areas off Waikiki Beach. Pages 15-18 *in* Schroeder, B.A. and B.E. Witherington, editors. Proceedings of teh Thirteenth Annual Symposium on Sea Turtle Biology and Conservation, National Marine Fisheries Service, Southeast Fisheries Science Center, Jekyll Island, GA.

Bartlett, G. 1989. Loggerheads invade Baja Sur. Noticias Caguamas 2:2-10.

DAR. 2001. Hawaii Fishing Regulations. Division of Aquatic Resources, Department of Land and Natural Resources, State of Hawaii, Honolulu.

Eckert, S.A., K.L. Eckert, P. Pongamia and G.H. Koopman. 1989. Diving and foraging behavior of leatherback sea turtles *Dermochelys coriacea*. Canadian Journal of Zoology 67:2834-2840.

Eldredge, L. G. and C. M. Smith, editors. 2001. A Guidebook of Introduced Marine Species in Hawai'i. Bishop Museum Technical Report 21. 104 p.

Everson, A. 1994. Fishery Data Collection System for Fishery Utilization Study of Kaneohe Bay Two-Year Interim Report. Technical Report 94-01, Division of Aquatic Resources, Department of Land and Natural Resources, State of Hawaii, Honolulu.

Firth, H.F. 1997. Synopsis of the Biological Data on the Green Turtle *Chelonia Mydas* (Linnaeus 1758). Biological Report 97(1), Fish and Wildlife Service, Department of the Interior, Washingtion, DC.

Friedlander, A.M. and J.D. Parrish. 1997. Fisheries harvest and standing stock in a Hawaiian bay. Fisheries Research 32:33-50.

Gearhart, J. 2001. Turtle Bycatch Monitoring of the 2000 Fall Flounder Gillnet Fishery of Southeastern Pamlico Sound, North Carolina. Fisheries Management Section, Division of Marine Fisheries, North Carolina Department of Environment and Natural Resources, Morehead City, NC.

Glazier, E.W. 1999. Non-Commercial Fisheries in the Central and Western Pacific: A Summary Review of the Literature. SOEST 99-07 / JIMAR Contribution 99-326, University of Hawaii, Honolulu.

Groombridge, B.C. 1982. The IUCN Amphibia-Reptilia red data book. Part 1. Testudines, Crocodylia, and Rhynchocephalia. IUCN, Gland, Switzerland.

Hamilton, M.S. 1998. A system for classifying small boat fishermen in Hawaii. Marine Resources Economics 13:289-291.

Hamm, D.C. and H.K. Lum 1992. Preliminary Results of the Hawaii Small-Boat Fisheries Survey. Administrative Report H-92-08, National Marine Fisheries Service, Southwest Fisheries Science Center Honolulu Laboratory, Honolulu.

Hau, S. 2002. Personal Communication. Division of Aquatic Resources. DLNR. State of Hawaii.

Hosaka, E.Y. 1973. Shore Fishing in Hawaii. Honolulu, Petroglyph Press.

Kahiapo, J. and K. Smith 1994. Shoreline Creel Survey of Hilo Bay Hawaii: 1985-1990. Technical Report 94-02, Division of Aquatic Resources, Department of Land and Natural Resources, State of Hawaii, Honolulu.

Kamakau, S.M. 1992. The Works of the People of Old (Na Hana a ka Po'e Kahiko). Honolulu, Bishop Museum Press.

Murakawa, S. K. K., G. H. Balazs, D. M. Ellis, S. Hau, and S. M. Eames. 2000. Trends in fibropapillomatosis among green turtles stranded in the Hawaiian Islands, 1982-1998. In H. Kalb and T. Wibbels (comps.), Proceedings of the Nineteenth Annual Symposium on Sea Turtle Conservation and Biology, March 2-6, 1999, South Padre Island, Texas, p. 239-241. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-443.

Nitta, E.T. 1999. Summary Report Bottomfish Observer Trips in the Northwestern Hawaiian Islands October 1990 to December 1993 (Draft). Pacific Islands Area Office, National Marine Fisheries Service, Honolulu.

Nitta, E.T. and J.R. Henderson. 1993. A review of interactions between Hawaii's fisheries and protected species. Marine Fisheries Review 55(2):83-92.

NMFS (National Marine Fisheries Service). 2001. Biological Opinion on the Authorization of Pelagic Fisheries under the Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Region. National Marine Fisheries Service (Southwest Region), Long Beach, CA.

NMFS and USFWS (National Marine Fisheries Service and U.S. Fish and Wildlife Service). 1998a. Recovery Plan for U.S. Pacific Populations of the Green Turtle *(Chelonia mydas*). National Marine Fisheries Service, Silver Spring, MD.

NMFS and USFWS (National Marine Fisheries Service and U.S. Fish and Wildlife Service). 1998b. Recovery Plan for U.S. Pacific Populations of the Hawksbill Turtle *(Eretmochelys imbricata*). National Marine Fisheries Service, Silver Spring, MD.

NMFS and USFWS (National Marine Fisheries Service and U.S. Fish and Wildlife Service). 1998c. Recovery Plan for U.S. Pacific Populations of the Leatherback Turtle (*Dermochelys coriacea*). National Marine Fisheries Service, Silver Spring, MD.

NMFS and USFWS (National Marine Fisheries Service and U.S. Fish and Wildlife Service). 1998d. Recovery Plan for U.S. Pacific Populations of the Loggerhead Turtle *(Caretta caretta*). National Marine Fisheries Service, Silver Spring, MD.

NMFS and USFWS (National Marine Fisheries Service and U.S. Fish and Wildlife Service). 1998e. Recovery Plan for U.S. Pacific Populations of the Olive Ridley Turtle (*Lepidochelys olivacea*). National Marine Fisheries Service, Silver Spring, MD.

NOAA. 2001. NOAA FISHERIES COLLECTS RECREATIONAL FISH DATA IN HAWAII: Hawaiians to Participate in National Survey. NOAA 2001-R129. http://www.publicaffairs.noaa.gov/releases2001/aug01/noaa01r129.html.

Pitman, R.L. 1990. Pelagic distribution and biology and sea turtles in the eastern tropical Pacific. Pages 143-148 *in* Richardson, T.H., J.I. Richardson and M. Donnelly editors. Tenth Annual Workshop on Sea Turtle Biology and Conservation. U.S. Dep. Commer, Miami.

Polovina, J.J., D.R. Kobayashi, D.M. Parker, M.P. Seki and G.H. Balazs. 2000. Turtles on the edge: movement of loggerhead turtles (Caretta carreta) along oceanic fronts, spanning longline fishing grounds in the central North Pacific, 1997-1998. Fish. Oceanogr. 9:71-82.

Pooley, S.G. 1993. Hawaii's marine fisheries---some history, long-term trends, and recent developments. Marine Fisheries Review 55(2):7-19.

Rick Gaffney and Associates, Inc. 2000. Evaluation of the Status of the Recreational Fishery for Ulua in Hawai'i and Recommendations for Future Management. DAR Technical Report 20-02, Division of Aquatic Resources, Department of Land and Natural Resources, State of Hawaii, Honolulu.

Rizzuto, J. 1983. Fishing Hawaiian Style. Honolulu, Hawaii Fishing News.

Sakamoto, M.R. 1985. Pacific Shore Fishing. Honolulu, University of Hawaii Press.

Sakamoto, M.R. 1988. How to Hook and Cookbook. Honolulu, Bess Press.

Scott, Susan. 2001. Healthy Turtles Often Bask in Human Company. Ocean Watch, Honolulu Star-Bulletin, April 20, 2001.

Smith, M.K. 1993. An ecological perspective on inshore fisheries in the main Hawaiian Islands. Marine Fisheries Review 55(2):34-49.

USFWS and NMFS. 1996. Habitat Conservation Planning and Incidental Take Permit Processing Handbook. Departments of Interior and Commerce, Washington, D.C.

USFWS, NMFS and Bureau of the Census. 1998. 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, Hawaii. FHW/96-HI,

Work, T. M. and G. H. Balazs. 1998. Causes of sea turtle mortality in Hawaii. In S. P. Epperly and J. Braun (comps.) Proc. 17th Ann. Symp. Sea Turtle Biology and Conservation, March 4-8, 1997, Orlando, Florida. p. 291-292. NOAA Tech. Memo. NMFS-SEFSC-415.

WPRFMC (Western Pacific Regional Fishery Management Council). 1998. Magnuson-Stevens Act Definitions and Required Provisions (Amendment 6 to the Bottomfish and Seamount Grounfish Fisheries Management Plan). Western Pacific Regional Fishery Management Council, Honolulu.

7. List of Preparers

Dr. Christopher "Kit" Dahl, consultant, primary author
Walter N. Ikehara, DAR Program Manager, Commercial Fisheries and Aquaculture
Dr. Jeffrey S. Walters, State Sanctuary Co-Manager, Hawaiian Islands Humpback Whale National Marine Sanctuary
Francis G. Oishi, DAR Program Manager, Recreational Fisheries

8. Certification

I hereby certify that the foregoing information is complete, true, and correct to the best of my knowledge and belief. I understand that this information is submitted for the purpose of obtaining a permit under the Endangered Species Act of 1973 (U.S.C. 1531 et seq.) and regulations promulgated thereunder, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or to penalties under the Endangered Species Act of 1973.

William S. Devick, Administrator
Division of Aquatic Resources

_______________________________________ ____________________
Signature Date

Table 1. Calendar year 1999 commercial landings by fishing method. (Source: DAR).

Fishing Method	Lbs.	Percent Total
Aku pole & line	1,309,307	4.8%
Longline	16,564,649	61.2%
Deepbottom handline	705,235	2.6%
Inshore handline	481,601	1.8%
Tuna handline	3,296,797	12.2%
Other handline	97,682	0.4%
Trolling	3,064,810	11.3%
Diving	90,831	0.3%
Net	1,205,584	4.5%
Trap	223,617	0.8%
Rod & reel (casting, dunking, etc.)	709	0.0%
Handpick (limu & opihi)	15,826	0.1%
Miscellaneous	1,581	0.0%
TotalL	27,058,229	100.0%

Table 2. Calendar year 1999 commercial landings by island. (Source: DAR).

Island	Lbs.	Percent Total
Oahu	4,621,348*	44.0%
Hawaii	4,336,482	41.3%
Maui	621,059	5.9%
Kauai & Niihau	848,559	8.1%
Molokai	46,784	0.4%
Lanai	19,348	0.2%
Total	10,493,580	100.0%

*Not including longline landings of 16,564,649 lbs.

Table 3. Effort (mean annual trips) by island and quadrant (source: Smith 1997).

Island	Quadrant	Mean annual trips	Percent
Kauai	NE	269	2.4%
Kauai	NW	231	2.1%
Kauai	SW	571	5.1%
Kauai	SE	336	3.0%
Kauai Total			**12.7%**
Oahu	NE	539	4.9%
Oahu	NW	500	4.5%
Oahu	SW	1442	13.0%
Oahu	SE	1073	9.7%
Oahu Total			**32.0%**
Maui	NE	219	2.0%
Maui	NW	491	4.4%
Maui	SW	399	3.6%
Maui	SE	190	1.7%
Maui Total			**11.7%**
Molokai	NE	49	0.4%
Molokai	NW	55	0.5%
Molokai	SW	244	2.2%
Molokai	SE	125	1.1%
Molokai Total			**4.3%**
Hawaii	NE	573	5.2%
Hawaii	NW	814	7.3%
Hawaii	SW	2025	18.2%
Hawaii	SE	965	8.7%
Hawaii Total			**39.4%**

Table 4. Estimates of distribution of effort by gear type. Estimates derived from sources (Everson 1994; Friedlander and Parrish 1997; Hamm and Lum 1992) expressed as percent of total. Adjusted Ham & Lum percentages are applied to total days of fishing from USFWS (1998) in the last column.

Gear	Everson	Friedlander & Parrish	Hamm & Lum	Hamm & Lum Adjusted	Distributed total effort (days of fishing)
Line					
Boat	32.2	9.5	12.0	7.5	217,575
Shore	21.4	60.3	-	37.5	1,087,875
Net					
Gill net	1.7	2.6	7.9	4.9	143,237
Other	8.6	20.6	16.6	10.4	300,979
Troll	7.6	4.1	55.2	34.5	1,000,845
Other	28.5	2.9	8.3	5.2	150,852

Table 5. Total strandings with evidence of fishing gear involvement, 1982-2000 (source: George Balazs, NMFS)

	Green			Olive ridley			Hawksbill		
	No.	% gear strandings	% all standings	No.	% gear strandings	% all standings	No.	% gear strandings	% all standings
Hook	49	10.21%	1.60%	0	0.00%	0.00%	0	0.00%	0.00%
Line	173	36.04%	5.66%	0	0.00%	0.00%	1	0.21%	0.03%
Net	244	50.83%	7.98%	5	1.04%	0.16%	3	0.63%	0.10%
Sub-total	466	97.08%	15.24%	5	1.04%	0.16%	4	0.83%	0.13%
All strandings	2,994		97.9%	26		0.9%	32		1.0%

	Leatherback			Loggerhead			Total, all species		
	No.	% gear strandings	% all standings	No.	% gear strandings	% all standings	No.	% gear strandings	% all standings
Hook	1	0.21%	0.03%	0	0.00%	0.00%	50	10.42%	1.64%
Line	2	0.42%	0.07%	0	0.00%	0.00%	176	36.67%	5.76%
Net	2	0.42%	0.07%	0	0.00%	0.00%	254	52.92%	8.31%
Sub-total	5	1.04%	0.16%	0	0.00%	0.00%	480	100.00%	15.70%
All strandings	5		0.2%	1		<0.01%	3,058		

Table 6. Qualitative assessment of interactions by gear type.

Gear Type	Rating
Line	
handline, bottom and midwater	0
trolling	0
longline, floatline, bottom*	+
baitboat*	0
hybrid	0
spin casting (incl. "whipping")	+
slide bait	++
Net	
Gill net	++
Crab net	+
Cast net	0
Surround and purse nets*	+
Bullpen*	+
Beach seine	0
Aquarium	0
Spear	0
Trap	0

0- interaction unlikely
+- possible interaction, not likely to cause fatalities
++- interaction likely, could cause fatalities
*- predominantly commercial fishery

Table 7. Expanded estimated take from strandings data 1982-2000 and projected 2001-2005.

	Net Gear			Hook and Monofilament Line Gear		
Year	Lethal take	Non-lethal take	Total	Lethal take	Non-lethal take	Total
1982	13	22	35	0	0	0
1983	5	9	14	0	0	0
1984	3	4	7	5	9	14
1985	10	18	28	8	13	21
1986	10	18	28	10	18	28
1987	23	40	63	5	9	14
1988	8	13	21	3	4	7
1989	13	22	35	20	36	56
1990	18	31	49	10	18	28
1991	50	89	139	13	22	35
1992	45	80	125	20	36	56
1993	33	58	90	28	49	76
1994	23	40	63	20	36	56
1995	25	44	69	33	58	90
1996	30	53	83	33	58	90
1997	53	93	146	25	44	69
1998	48	84	132	18	31	49
1999	8	13	21	53	93	146
2000	20	36	56	38	67	104
Year (y)	Lethal take (L_{Ny})	Non-lethal take (E_{Ny})	Total (T_{Ny})	Lethal take (L_{Hy})	Non-lethal take (E_{Hy})	Total (T_{Hy})
2001*	38	68	106	40	71	110
2002*	40	71	110	42	74	116
2003*	41	73	115	44	78	122
2004*	43	76	119	46	82	129
2005*	44	79	123	48	86	135

*Projected values.

Table 8. Anticipated (expanded) annual lethal, non-lethal and total take by species, using average of annual projected takes for 2002-2005.

	Net gear			**Hook and monofilament line gear**		
	Lethal take	Non-lethal Take	Total	Lethal Take	Non-lethal Take	Total
Green turtle (97%)	41	72	113	44	78	122
Olive ridley (1%)	0	1	1	0	1	1
Hawksbill (1%)	0	1	1	0	1	1
Leatherback (1%)	0	1	1	0	1	1
Total	41	75*	116*	44	81*	125*

*Values are adjusted for rounding errors.

Table 9. Summary of marine managed areas in Hawaii.

	Type	Restrictions
Oahu		
Hanauma Bay	MLCD	Fishing prohibited
Pupukea	MLCD	Scuba spearfishing, net fishing prohibited, except in subzone
Waikiki	MLCD	Fishing prohibited
Waikiki-Diamond Head	FMA	Closed to fishing odd-numbered years
Coconut Island-Hawaii Marine Laboratory	Refuge	Fishing prohibited
Waialua Bay (Haleiwa Harbor)		Specified fishing gear/methods permitted
Honolulu Harbor		Specified fishing gear/methods permitted
Pokai Bay		Specified fishing gear/methods permitted
Hawaii		
Kealakekua	MLCD	Specified fishing gear/methods permitted in subzone, otherwis prohibited
Lapakahi	MLCD	Fishing prohibited except for opelu lift net in subzone
Waialea	MLCD	Specified fishing gear/methods permitted
Old Kona Airport	MLCD	Specified fishing gear/methods permitted
Hilo Bay, Wailoa River, and Wailuku River	FMA	Specified fishing gear/methods permitted, nets prohibited except as specified
Kailua Bay	FMA	Specified fishing gear/methods permitted, net and spear fishing in subzone only
Puako Bay and Reef	FMA	Fishing prohibited
Kawaihae Harbor	FMA	Specified fishing gear/methods permitted
Keauhou Bay	FMA	Specified fishing gear/methods permitted, net fishing limited
Kona Coast	FMA	Aquarium fish collecting, fish feeding prohibited
Kiholo Bay	FMA	Only aquarium net fishing permitted, gill nets prohibited
West Hawaii	FMA	Aquarium fish collecting, fish feeding prohibited

Table 9. (cont.)

Kauai		
Hanamaulu Bay and Ahukini Recreation Pier	FMA	spear and net fishing prohibited within subzones
Waimea Bay and Recreational Pier	FMA	Spearing and trapping prohibited, limits on pole-and-line gear
Maui-Lanai-Molokai		
Molokini Shoal	MLCD	Fishing prohibited except for trolling in subzone
Honolua-Mokuleia Bay	MLCD	Fishing prohibited
Kahului Harbor	FMA	Specified fishing gear/methods permitted
Manele-Hulopoe (Lanai)	MLCD	Specified fishing gear/methods permitted, vessel operation restrictions within subzone
Manele Harbor (Lanai)	FMA	Specified fishing gear/methods permitted
Kaunakakai Harbor (Molokai)	FMA	Specified fishing gear/methods permitted in subzones
Other Management Areas		
Kahoʻolawe Island	Reserve	Entry and use prohibited except as authorized
Paiko Lagoon (Oahu)	Wildlife Sanctuary	Fishing prohibited
Ahihi-Kinau (Maui)	Natural Area Reserve	Fishing prohibited, vessel operation restrictions

Table 10. Conservation Plan estimated funding summary. FTE = Full time equivalent.

Program Component		Staff Commitment	Additional Budgetary Commitment	Projected Funding Source
Monitoring	1	6 FTE	$0	State
	2	8 FTE	$50,000	State and NMFS
	3	11 FTE	$130,000	State and NMFS
Take Reduction	1	4 FTE	$0	State
	2	6 FTE	$60,000	State and NMFS
	3	8 FTE	$100,000	State and NMFS
Habitat Protection	1	1 FTE	$0	State
	2	1 FTE	$20,000	State and NMFS
	3	2 FTE	$50,000	State and NMFS

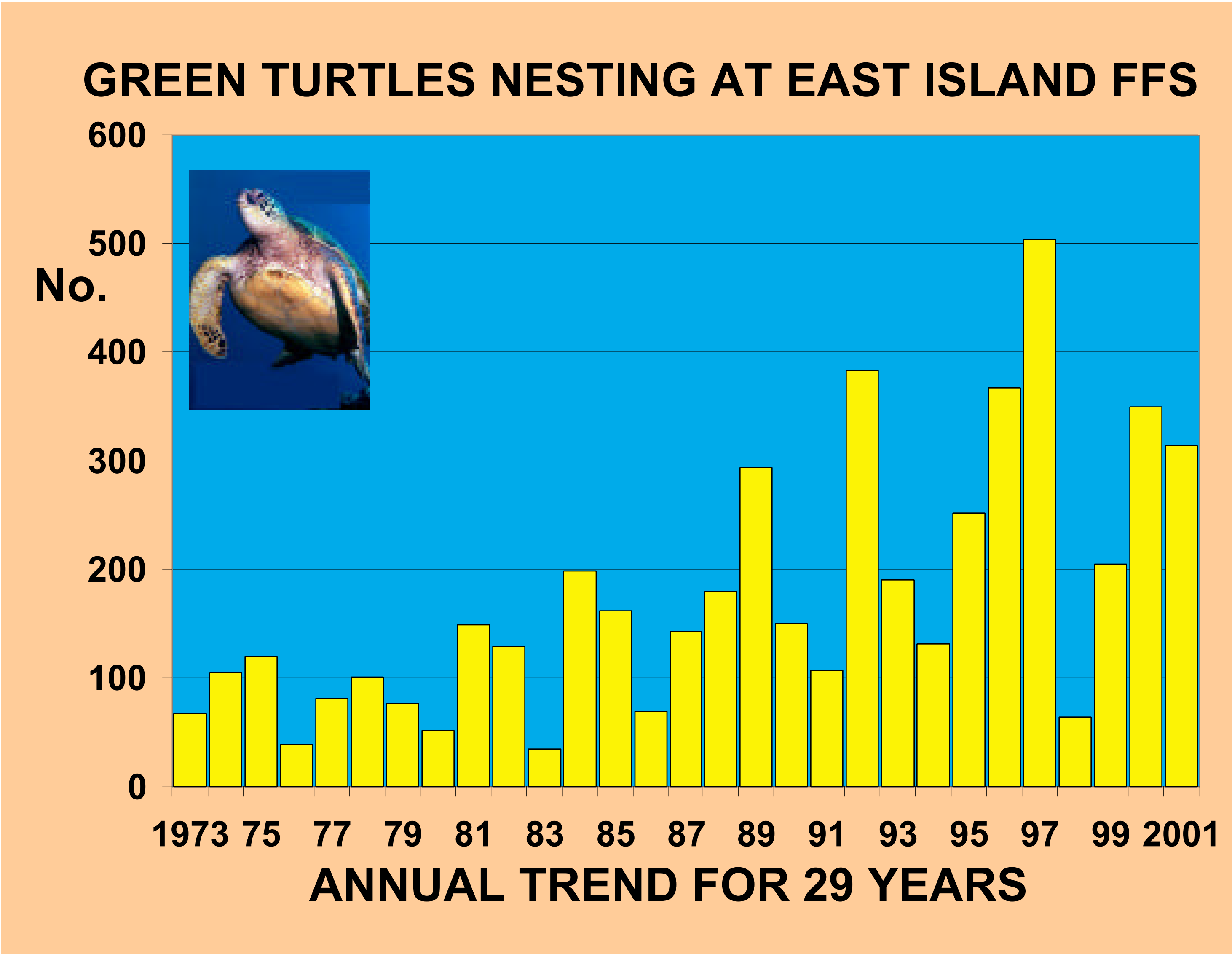

Figure 1. Counts of Green Sea Turtle Nesting at East Island, French Frigate Shoals 1973 – 2001. Figure courtesy of George Balazs, 2002.

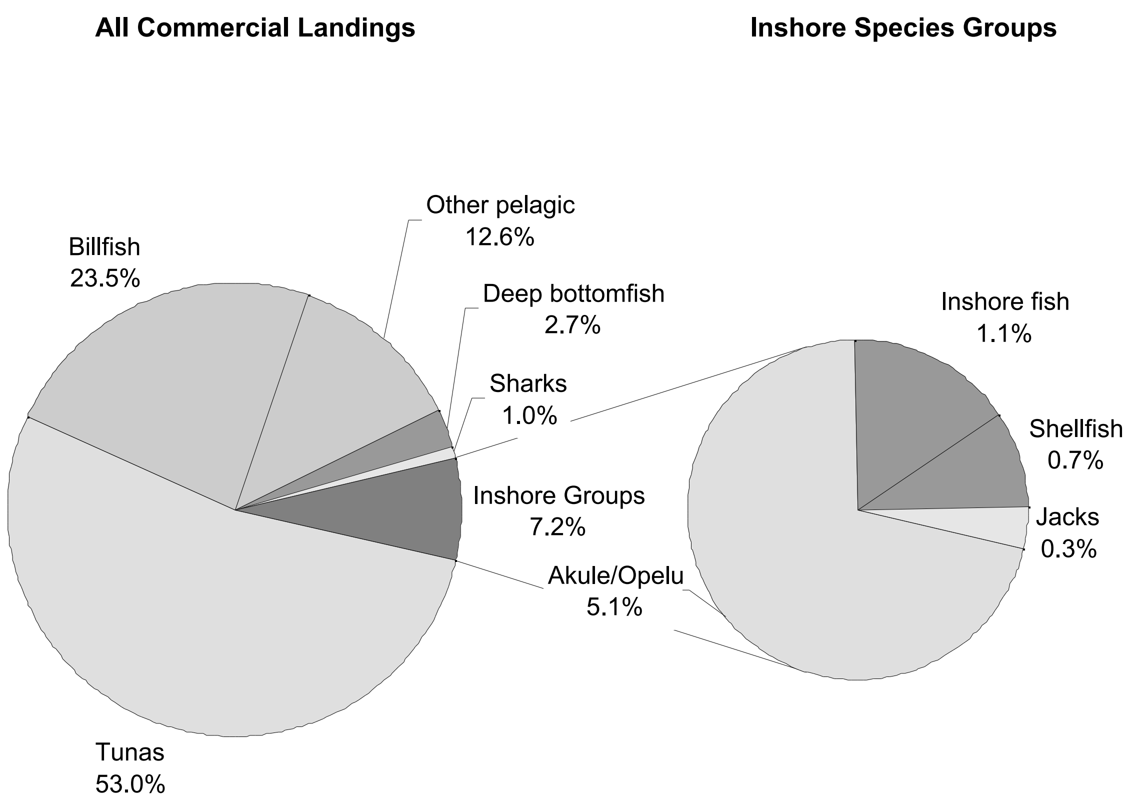

Figure 2. 1999 commercial catch by species group. (Source: HDAR).

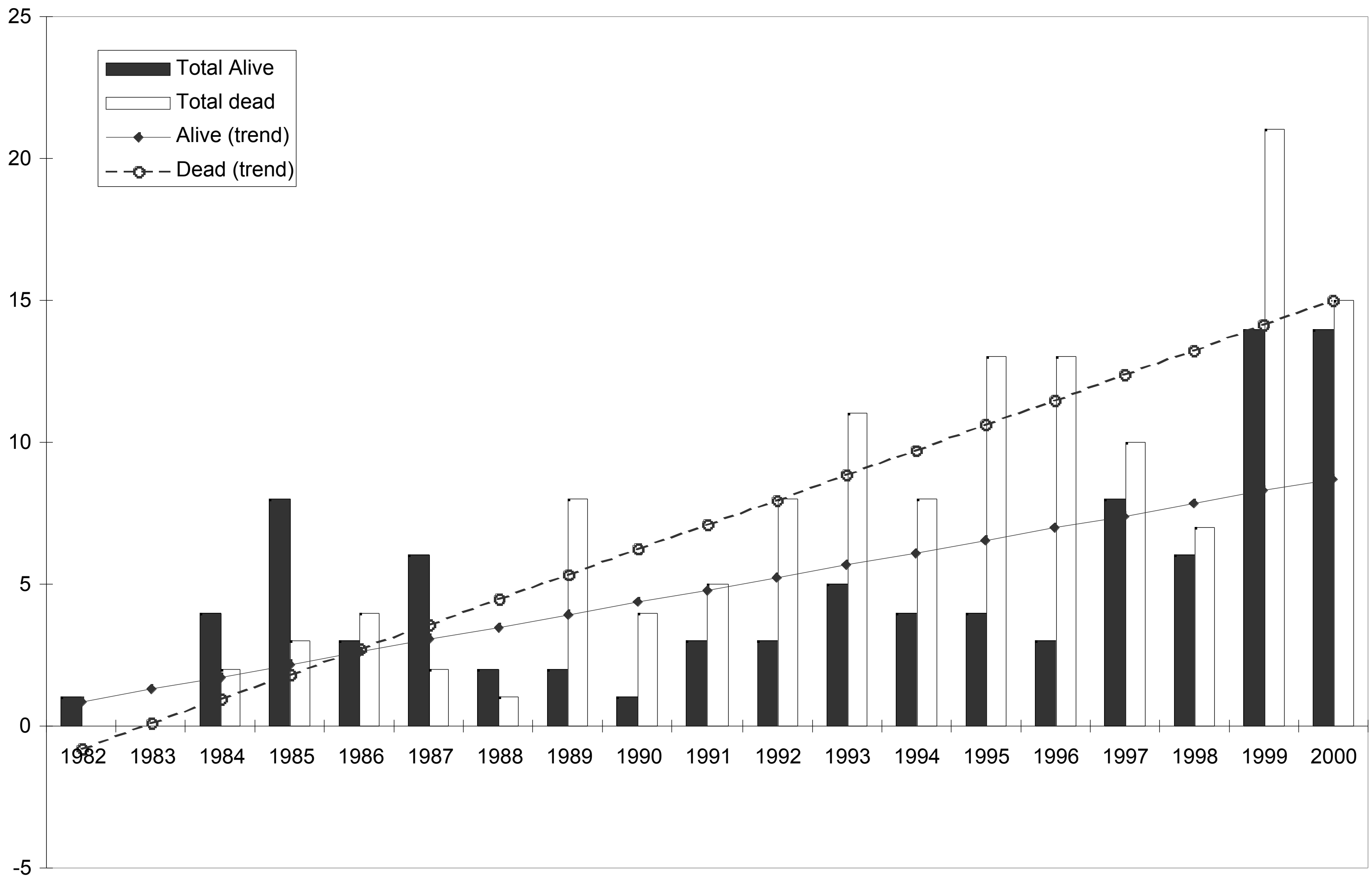

Figure 3. Stranding data, hook or monofilament line implicated combined.

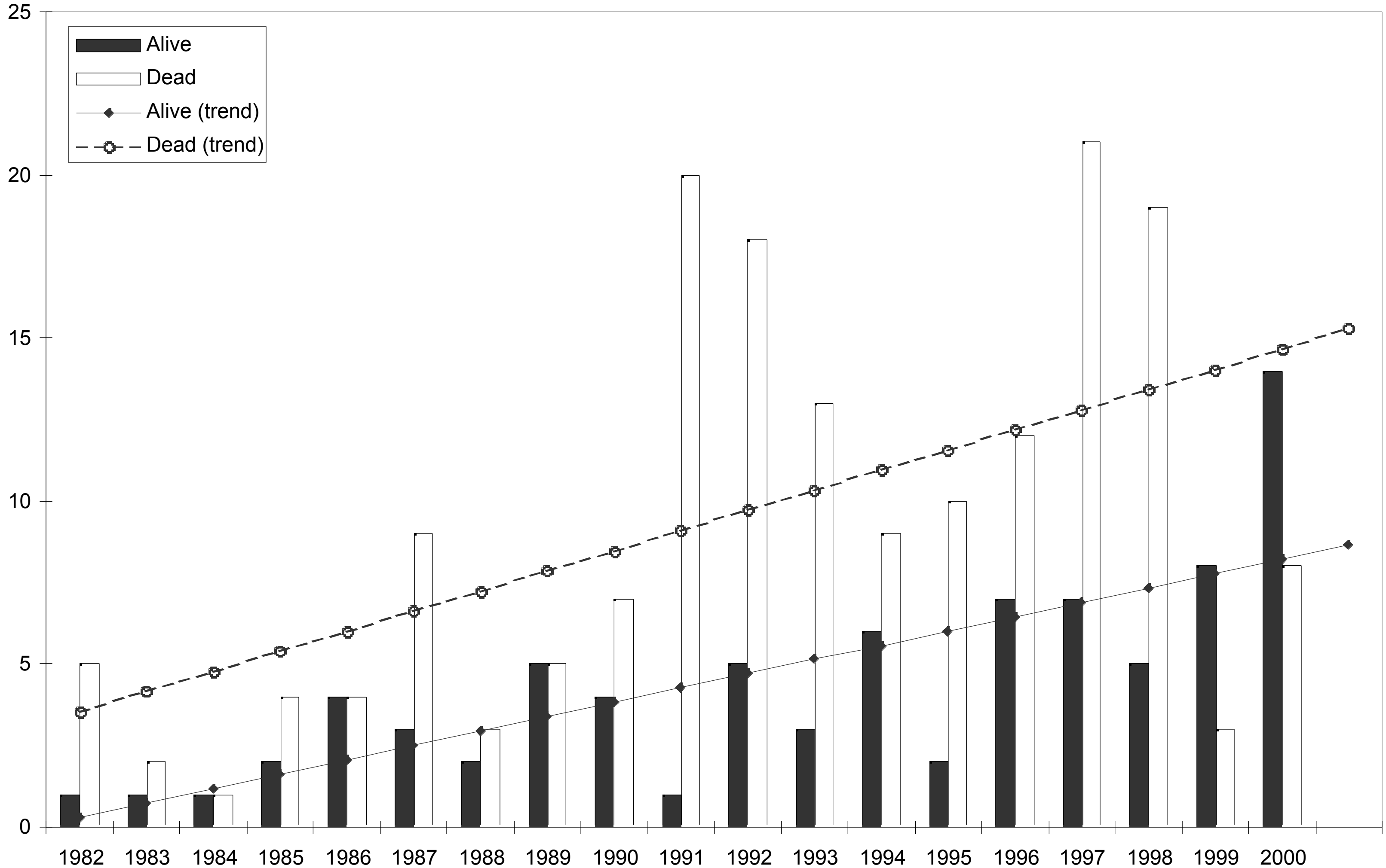

Figure 4. Standing data, net involvement.

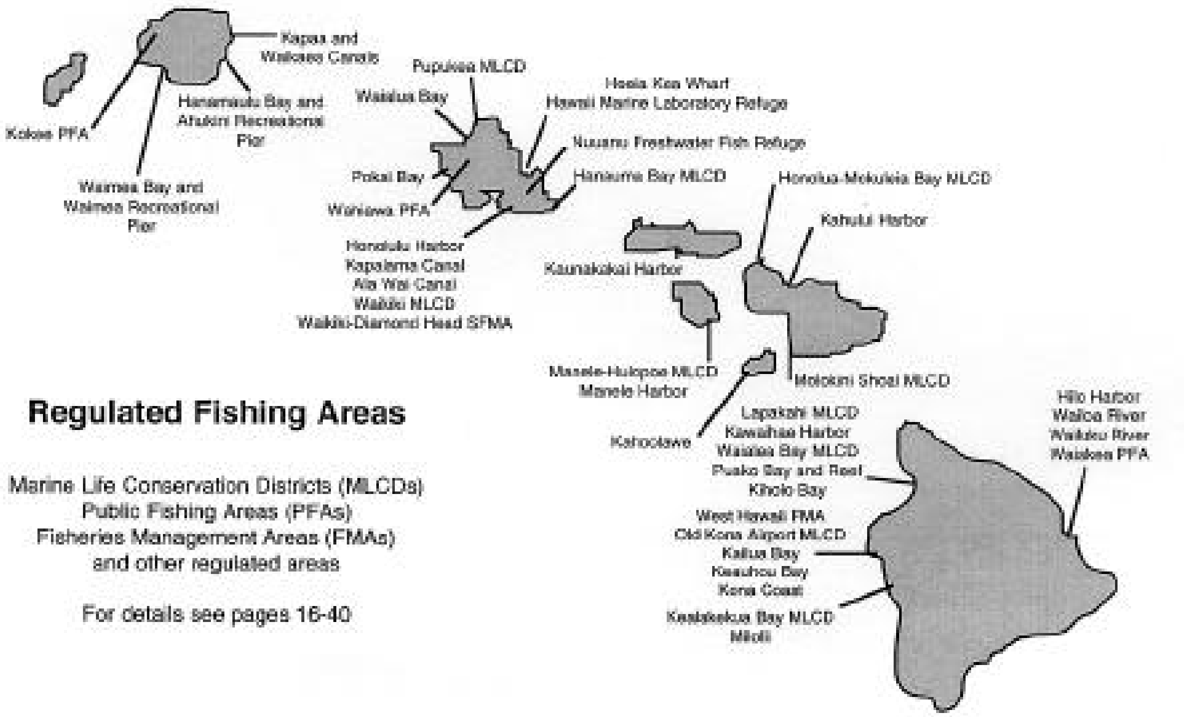

Figure 5 Marine managed areas in Hawaii