3.6.3.1 Endangered Marine Mammals

Endangered marine mammals in the Pacific Ocean include six cetaceans, two pinnipeds and the dugong (*Dugon dugon*). The cetaceans are the humpback whale (*Megaptera novaeangliae*), sperm whale (*Physeter macrocephalus*), northern right whale (*Eubalaena glacialis*), blue whale (*Balaenoptera musculus*), fin whale (*B. physalus*) and sei whale (*B. borealis*). The pinnipeds are the Hawaiian monk seal (*Monachus schauinslandi*), and the Steller sea lion (*Eumetopias jubatus*).

Although blue whales, fin whales, right whales, sei whales and Steller sea lions are found within the region and could potentially interact with the Pelagics FMP fisheries, there have been no reported or observed incidental takes of these species in these fisheries and therefore, these species are not discussed further in this document. No blue whales or right whales were seen in the 2002 NOAA surveys (Barlow, 2003).

Dugongs are seagrass specialists and frequent coastal waters including shallow protected bays, mangrove channels, the lee sides of large inshore islands, and deeper water farther offshore in areas where the continental shelf is wide, shallow and protected. Most of the world's population of dugongs is now found in northern Australian waters (Leatherwood et al., 1992). Interactions with Pelagics FMP fisheries are extremely unlikely and dugongs will not be considered further in this EIS.

Based on research, observer, and logbook data, the listed marine mammals most likely to be affected by the fisheries managed under the Pelagics FMP include the Humpback whale (*Megaptera novaeangliae*), the Sperm whale (*Physeter macrocephalus*) and the Hawaiian monk seal (*Monachus schauinslandi*). The sections below summarize available information on the biology and population status of these three species.

3.6.3.1.1 Humpback Whale (*Megaptera novaeangliae*)

The International Whaling Commission first protected humpback whales in the North Pacific in 1965. Humpback whales were listed as endangered under the ESA in 1973, and consequently are also automatically considered "depleted" and "strategic" under the MMPA. They are also protected by the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). Critical habitat has not been designated for this species, but some protections are afforded by the Humpback Whale National Marine Sanctuary while the whales are on their winter grounds in Hawaii.

Humpback whales typically migrate between tropical/sub-tropical and temperate/polar latitudes. The whales occupy tropical areas favoring shallow nearshore waters of usually 100 fathoms or less during winter months when they are breeding and calving, and polar areas during the spring, summer, and fall, when they are feeding. It is believed that minimal feeding occurs in wintering grounds, such as the Hawaiian Islands (Balcomb, 1987; Salden, 1987). Humpback whales can attain lengths of 16 m.

Genetic and photo identification studies indicate that within the U.S. EEZ in the North Pacific there are at least three relatively separate populations of humpback whales (Hill and DeMaster, 1999). The Central North Pacific stock of humpback whales winters in the waters of the Hawaiian Islands (Hill et al., 1997). Humpback whales occur off all eight main Hawaiian Islands, but particularly within the shallow waters of the “four-island” region (Kahoolawe, Molokai, Lanai, Maui), the northwestern coast of the island of Hawaii (Big Island), and the waters around Niihau, Kauai and Oahu (Wolman and Jurasz, 1977; Herman et al., 1980; Baker and Herman, 1981). The whales are generally found in shallow water shoreward of the 182 m (600-ft) depth contour (Herman and Antinoja, 1977), although Frankel et al. (1989) reported some vocalizing individuals up to 20 km (10.8 nm) off South Kohala on the west coast of the Big Island, over bottom depths of 1400 m (4593 ft). Cow and calf pairs appear to prefer very shallow water less than 18 m deep (10 fm [60 ft]) (Glockner and Venus, 1983).

There is no precise estimate of the worldwide humpback whale population. The Central North Pacific stock appears to have increased in abundance between the early 1980s and early 1990s; however, the status of this stock relative to its optimum sustainable population size is unknown (Hill and DeMaster, 1999). The humpback whale population in the North Pacific ocean basin is estimated to contain 6,000 to 8,000 individuals (Calambokidis et al., 1997; Cerchio, 1998; Mobley et al., 1999b).

Humpback whales exhibit a wide range of foraging behaviors, and feed primarily on small schooling fish and krill (Caldwell and Caldwell, 1983).

3.6.3.1.2 Sperm Whale (*Physeter macrocephalus*)

Sperm whales have been protected from commercial harvest by the IWC since 1981, although the Japanese continued to harvest sperm whales in the North Pacific until 1988 (Reeves and Whitehead, 1997). Sperm whales were listed as endangered under the ESA in 1973, and consequently the Hawaiian stock of sperm whales is automatically considered “depleted” and “strategic” under the MMPA. They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna. Critical habitat has not been designated for sperm whales.

The sperm whale is the most easily recognizable whale with a darkish gray brown body and a wrinkled appearance. The head of the sperm whale is very large, comprising up to 40 percent of its total body length. The current average size for male sperm whales is about 15 m, with females reaching up to 12 m.

Sperm whales are found in tropical to polar waters throughout the world (Rice, 1989). They are among the most abundant large cetaceans in the Western Pacific Region. They were the most abundant large whale in the Hawaii EEZ in the 2002 NOAA surveys (Barlow 2003).

Sperm whales have been sighted around several of the Northwestern Hawaiian Islands (Rice, 1960) and off the main islands of Hawaii (Lee, 1993). The sounds of sperm whales have been recorded throughout the year off Oahu (Thompson and Freidl, 1982). Sperm whales have been sighted in the Kauai Channel, the Alenuihaha Channel between Maui and the island of Hawaii, and off the island of Hawaii (Lee, 1993; Mobley, et al.,1999). Twenty-one sperm whales were sighted during aerial surveys conducted in nearshore Hawaiian waters conducted from 1993 through 1998. Sperm whales sighted during the survey tended to be on the outer edge of a 50 - 70 km distance from the Hawaiian Islands, indicating that presence may increase with distance from shore (Mobley, pers. comm. 2000). However, from the results of these surveys, NMFS has calculated a minimum abundance of 66 sperm whales within 25 nm of the MHI (Mobley et al., 2000).

Sperm whales feed primarily on mesopelagic squid, but also consume octopus, other invertebrates, and fish (Tomilin, 1967; Tarasevich, 1968; Berzin, 1971).

3.6.3.1.3 Hawaiian Monk Seal (*Monachus schauinslandi*)

Hawaiian monk seals comprise one of the two remaining species of the genus *Monachus*, one of the most primitive genera of seals. The species was listed as endangered under the ESA in 1976, and it is one of the most endangered marine mammal species in the United States. The Hawaiian monk seal is endemic to the Hawaiian Archipelago and Johnston Atoll, and is the only endangered marine mammal that exists wholly within the jurisdiction of the United States.

Hawaiian monk seals are brown or silver in color, depending upon age and molt status, and can weight up to 270 kg. Adult females are slightly larger than adult males. It is thought that monk seals can live to 30 years. Monk seals stay on land for about two weeks during their annual molts. Monk seals are nonmigratory, but recent studies show that their home ranges may be extensive (Abernathy and Siniff, 1998). Counts of individuals on shore compared with enumerated sub-populations at some of the NWHI indicate that monk seals spend about one-third of their time on land and about two thirds in the water (Forney et al., 2000).

The six major reproductive sites are French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and Hermes Reef, Midway Atoll and Kure Atoll. Small populations at Necker Island and Nihoa Island are maintained by immigration, and a few but growing number of seals are found throughout the Main Hawaiian Islands (MHI), where preliminary surveys have counted more than 50 individuals. NMFS researchers have also observed monk seals at Gardner Pinnacles and Maro Reef. Additional sightings and at least one birth have occurred at Johnston Atoll, excluding eleven adult males that were translocated to Johnston Atoll (nine from Laysan Island and two from French Frigate Shoals) over the past 30 years.

In 2001, the minimum population estimate for monk seals was 1,378 individuals (based on enumeration of individuals of all age classes at each of the subpopulations in the NWHI, derived estimates based on beach counts for Nihoa and Necker, and aerial survey estimates for the MHI) (Carretta et al., 2003). The best estimate of the total population size was 1,409.

Population trends for monk seals are determined by the highly variable dynamics of the six main reproductive sub-populations. The sub-population of monk seals on French Frigate Shoals has shown the most change in population size, increasing dramatically in the 1960s-1970s and declining in the late 1980s-1990s (Figure 3.6.1-6). In the 1960s-1970s, the other five sub-populations experienced declines. However, during the last decade the number of monk seals increased at Kure Atoll, Midway Atoll and Pearl and Hermes Reef while the sub-populations at Laysan Island and Lisianski Island remained relatively stable. At the species level, however, demographic trends over the past decade have been driven primarily by the dynamics of the French Frigate Shoals subpopulation, where the largest monk seal population is experiencing an increasingly unstable age distribution resulting in an inverted age structure. This age structure indicates that recruitment of females and pup production may soon decrease. In the near future, total population trends for the species will likely depend on the balance between continued losses at French Frigate Shoals and gains at other breeding locations including the Main Hawaiian Islands. The recent sub-population decline at French Frigate Shoals is thought to have been caused by male aggression, shark attack, entanglement in marine debris, loss of habitat and decreased prey availability. The Hawaiian monk seal is assumed to be well below its optimum sustainable population, and, since 1993, the overall population has declined approximately 0.7% per year (Carretta et al., 2003). The Hawaiian monk seal is characterized as a strategic stock under the MMPA.

Monk seals feed on a wide variety of teleosts, cephalopods and crustaceans, indicating that they are highly opportunistic feeders (Rice, 1964; MacDonald, 1982; Goodman-Lowe 1999).

3.6.3.2 Non-Endangered Marine Mammals

Marine mammals not listed as threatened or endangered under the ESA that have been observed in areas where fisheries in the Western Pacific Region operate are listed in Table 3.6.3-2. The Pacific white-sided dolphin and Dall's porpoise were not seen in the 2002 NOAA surveys (Barlow, 2003).

Table 3.6.3-2 Marine Mammals Not Listed as Threatened or Endangered Under the Endangered Species Act that have been Observed in Areas Where Fisheries in the Western Pacific Region Operate.

Common Name	Scientific Name
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*
Rough-toothed dolphin	*Steno bredanensis*
Risso's dolphin	*Grampus griseus*
Bottlenose dolphin	*Tursiops truncatus*
Pantropical spotted dolphin	*Stenella attenuata*
Spinner dolphin	*Stenella longirostris*
Striped dolphin	*Stenella coeruleoalba*
Melon-headed whale	*Peponocephala electra*
Pygmy killer whale	*Feresa attenuata*
False killer whale	*Pseudorca crassidens*
Killer whale	*Orcinus orca*
Pilot whale, short-finned	*Globicephala macrorhynchus*
Blainsville's beaked whale	*Mesoplodon densirostris*
Cuvier's beaked whale	*Ziphius cavirostris*

Common Name	Scientific Name
Bryde's whale	*Balaenoptera edeni*
Pygmy sperm whale	*Kogia breviceps*
Dwarf sperm whale	*Kogia simus*
Minke whale	*Balaenoptera acutorostrata*
Dall's porpoise	*Phocoenoides dalli*
Fraser's dolphin	*Lagenodelphis hosei*
Longman's beaked whale	*Indopacetus pacificus*
Northern elephant seal	*Mirounga angustirostris*
Northern fur seal	*Callorhinus ursinus*

One stock of non-endangered marine mammals, the Hawaii stock of the false killer whale, is classified as "strategic" under the MMPA, owing to serious injuries documented in the Hawaii-based longline fishery (Carretta et al., 2003). Strategic stocks are those that have a level of human-induced mortality that exceeds the number of animals that can be safely removed from the stock without interfering with that stock's ability to reach or maintain its optimum sustainable population level.

3.6.3.2.1 Delphinids

The Pacific white-sided dolphin is found throughout the temperate North Pacific (Hill and DeMaster, 1999). Two stocks of this species are recognized, but the stock structure throughout the North Pacific is poorly defined. Population trends and status of the Central North Pacific stock of Pacific white-sided dolphins relative to the optimum sustainable population are currently unknown (Hill and DeMaster, 1999).

The rough-toothed dolphin's distribution is worldwide in oceanic tropical and warm temperate waters (Miyazaki and Perrin, 1994). They have been sighted northeast of the Northern Mariana Islands during winter (Reeves et al., 1999). Rough-toothed dolphins are also found in the waters off the Main Hawaiian islands (Shallenberger, 1981) and have been observed at least as far north as French Frigate Shoals in the Northwestern Hawaiian Islands (Nitta and Henderson, 1993). The stock structure for this species in the North Pacific is unknown (Carretta et al., 2003). The status of rough-toothed dolphins in Hawaii's waters relative to their optimum sustainable population is unknown, and there are insufficient data to evaluate trends in abundance (Carretta et al., 2003).

Risso's dolphins are found in tropical to warm-temperate waters worldwide (Kruse et al., 1999) but appear to be rare in the waters around Hawaii. There have been four reported strandings of Risso's dolphins on the Main Hawaiian Islands (Nitta, 1991). Risso's dolphins have also been sighted near Guam and the Northern Mariana Islands (Reeves et al., 1999). Nothing is known about stock structure for this species in the North Pacific (Carretta et al., 2003). The status of Risso's dolphins in Hawaii's waters relative to their optimum sustainable population is unknown, and there are insufficient data to evaluate trends in abundance (Carretta et al., 2003).

Bottlenose dolphins are widely distributed throughout the world in tropical and warm-temperate waters (Reeves et al., 1999). The species is primarily coastal, but there are also populations in offshore waters. Bottlenose dolphins are common throughout the Hawaiian Islands (Shallenberger, 1981). Data suggest that the bottlenose dolphins in Hawaii belong to a separate stock from those in the eastern tropical Pacific (Scott and Chivers, 1990). Recent nearshore photo-identification studies off Oahu, Maui, Lanai and Hawaii suggest limited movement of bottlenose dolphins between islands and into offshore waters (Baird et al., 2002), but insufficient data are available to evaluate whether separate stocks may exist around the different islands and in offshore waters. Photographic mark-recapture studies off Maui and Lanai estimated 134 (95% C.I. 1070180) bottlenose dolphins inhabiting that area (Baird et al., 2002). Aerial surveys within 25 nm of the MHI yielded an abundance estimate of 743 bottlenose dolphins in that area (Mobley et al., 2000). The status of bottlenose dolphins in Hawaii's waters relative to their optimum sustainable population is unknown, and there are insufficient data to evaluate trends in abundance (Carretta et al., 2003).

As its name implies, the pantropical spotted dolphin has a pantropical distribution in both coastal and oceanic waters (Perris and Hohn, 1994). Pantropical spotted dolphins are common in Hawaii, primarily on the lee sides of the islands and in the inter-island channels (Shallenberger, 1981). They are also considered common in American Samoa (Reeves et al., 1999). Morphological differences and distribution patterns have been used to establish that the spotted dolphins around Hawaii belong to a stock that is distinct from those in the eastern tropical Pacific (Dizon et al., 1994). Aerial surveys within 25 nm of the MHI yielded an abundance estimate of 2,928 pantropical spotted dolphins in that area (Mobley et al., 2000). The status of pantropical dolphins in Hawaii waters relative to their optimum sustainable population is unknown, and there are insufficient data to evaluate trends in abundance (Forney et al., 2000).

Spinner dolphins are the cetaceans most likely to be seen around oceanic islands throughout the Pacific and are also seen in pelagic areas far from land (Perrin and Gilpatrick, 1994). This species is common around American Samoa (Reeves et al., 1999). There is some suggestion of a large, relatively stable resident population surrounding the island of Hawaii (Norris et al., 1994). Spinner dolphins are among the most abundant cetaceans in Hawaii's waters. Aerial surveys within 25 nm of the MHI yielded an abundance estimate of 3,184 spinner dolphins in that area (Mobley et al., 2000). However, the status of spinner dolphins in Hawaii's waters relative to their optimum sustainable population is unknown, and there are insufficient data to evaluate trends in abundance (Forney et al., 2000).

The striped dolphin occurs in tropical and warm temperate waters worldwide (Perrin et al., 1994). Several sightings were made in winter to the north and west of the Northern Mariana Islands (Reeves et al., 1999). In Hawaii, striped dolphins have been reported stranded 13 times between the years of 1936-1996 (Nitta, 1991), yet there have been only two at-sea sightings of this species (Shallenberger, 1981). Striped dolphin population estimates are available for the waters around Japan and in the eastern tropical Pacific, but it is not known whether any of these animals are part of the same population that occurs in Hawaii (Forney et al., 2000). Aerial surveys within 25 nm of the MHI yielded an abundance estimate of 114 striped dolphins in that area (Mobley et al., 2000). The status of striped dolphins in Hawaii's waters relative to their optimum sustainable population is unknown, and there are insufficient data to evaluate trends in abundance (Forney et al., 2000).

Fraser's dolphin is distributed worldwide in tropical waters (Perrin et al., 1994), but is one of the least known cetacean species. Until about 20 years ago, the species was known to science only by a single skeleton collected before 1895 at the mouth of the Lutong River in Borneo. Most records are from well offshore, where it occurs in groups of up to 1,000, often in mixed herds with pantropical spotted dolphins, false killer whales, sperm whales, melon-headed whales, spinner dolphins, and striped dolphins (Leatherwood, et al., 1982). It is known to eat deep-sea fish, squid and shrimp. Almost nothing is known of its reproductive biology or seasonal migration. Surprisingly, Fraser's dolphins were the second most abundant delphinid seen on the 2002 NOAA cetacean surveys in the Hawaii EEZ (Barlow, 2003), surpassed only by rough-toothed dolphins.

The pygmy killer whale has a circumglobal distribution in tropical and subtropical waters (Ross and Leatherwood, 1994). They have been observed several times off the lee shore of Oahu (Pryor et al., 1965), and Nitta (1991) documented five strandings on Maui and the island of Hawaii. According to the MMPA stock assessment reports, there is a single Pacific management stock (Forney et al., 2000). No pygmy killer whales were sighted in recent aerial surveys within 25 nm of the MHI (Mobley et al., 2000). The status of pygmy killer whales in Hawaii's waters relative to their optimum sustainable population is unknown, and there are insufficient data to evaluate trends in abundance (Forney et al., 2000).

False killer whales occur in tropical, subtropical and warm temperate seas worldwide (Stacey et al., 1994). This species occurs around the Main Hawaiian Islands, but its presence around the Northwestern Hawaiian Islands has not yet been established (Nitta and Henderson, 1993). Recent genetic analyses of tissue samples from Hawaiian false killer whales indicate that they may be genetically distinct from animals found in both the eastern and western North Pacific (S. Chivers, NMFS unpublished data); however, the offshore range of this population is unknown. For the MMPA stock assessment reports, there is a single Pacific management stock (Forney et al., 2000). Aerial surveys within 25 nm of the MHI yielded an abundance estimate of 121 false killer whales in that area (Mobley et al., 2000). The status of false killer whales in Hawaii waters relative to their optimum sustainable population is unknown, and there are insufficient data to evaluate trends in abundance (Forney et al., 2000). However, because the rate of serious injury to false killer whales within the U.S. EEZ in the Hawaii-based longline fishery (4.6-6.9 animals per year) exceeds the PBR (0.8), this stock is considered a strategic stock under the 1994 amendments to the MMPA.

The killer whale has a cosmopolitan distribution (Reeves et al. 1999). Observations from Japanese whaling or whale sighting vessels indicate large concentrations of these whales north of the Northern Mariana Islands and near Samoa (Reeves et al. 1999). Killer whales are rare in Hawaii's waters. There have been two reported sightings of killer whales, one off the Waianae coast of Oahu, and the other near Kauai (Shallenberger, 1981). No killer whales were seen during 1993-1998 aerial surveys within about 25 nm of the MHI (Mobley et al., 2000). Except in the northeastern Pacific, little is known about stock structure of killer whales in the North Pacific (Forney et al., 2000). The status of killer whales in Hawaii's waters relative to their optimum sustainable population is unknown, and there are insufficient data to evaluate trends in abundance (Forney et al., 2000).

The melon-headed whale has a circumglobal, tropical to subtropical distribution (Perryman et al., 1994). Large herds of this species are seen regularly in Hawaii's waters (Shallenberger, 1981). Strandings of melon-headed whales have been reported in Guam (Reeves et al., 1999). For the MMPA stock assessment reports, there is a single Pacific management stock (Forney et al., 2000). Aerial surveys within 25 nm of the MHI yielded an abundance estimate of 154 melon-headed whales in that area (Mobley et al., 2000). The status of melon-headed whales in Hawaii's waters relative to their optimum sustainable population is unknown, and there are insufficient data to evaluate trends in abundance (Forney et al., 2000).

The short-finned pilot whale ranges throughout tropical and warm temperate waters in all the oceans, often in sizable herds (Reeves et al., 1999). It is one of the most frequently observed cetaceans around Guam (Reeves et al., 1999). Short-finned pilot whales are commonly observed around the Main Hawaiian Islands, and are probably present around the Northwestern Hawaiian Islands (Shallenberger, 1981). Aerial surveys within 25 nm of the MHI yielded an abundance estimate of 1,708 short-finned pilot whales in that area (Mobley et al., 2000). Stock structure of short-finned pilot whales has not been adequately studied in the North Pacific, except in the waters around Japan (Forney et al., 2000). Recent genetic analyses of tissue samples from Hawaiian short-finned pilot whales indicate they may be genetically distinct from animals found in both the eastern and western North Pacific (S. Chivers, NMFS unpublished data); however, the offshore range of this population is unknown. The status of short-finned whales in Hawaii's waters relative to their optimum sustainable population is unknown, and there are insufficient data to evaluate trends in abundance (Forney et al., 2000).

3.6.3.2.2 Phocoenids

Dall's porpoise are characterized by a stocky, black body with contrasting white on the belly and flank, and a small triangular dorsal fin. They are fast vigorous swimmers and leave a characteristic rooster tail when traveling at the surface.

Dall's porpoise are widely distributed across the entire North Pacific Ocean. They have been sighted throughout the North Pacific as far north as 65° N (Buckland et al., 1993), and as far south as 28° N in the eastern North Pacific (Leatherwood and Fielding, 1974), to central Honshu in Japan in the west. They are abundant in the Sea of Okhotsk and the southern Bering Sea. The only apparent distribution gaps in Alaska waters are upper Cook Inlet and the shallow eastern flats of the Bering Sea. They are present in the oceanic zones of the western Pacific year around at least 100 km from shore, and are found over the continental shelf adjacent to the slope and over deep (2,500+m) oceanic waters (Hall, 1979). Dall's porpoise are found much closer to shore in specific areas, particularly Puget Sound, British Columbia, the inside waters of Alaska, the Kamchatka Penninsula, and Japan. Throughout most of the eastern North Pacific they are present during all months of the year, although there may be seasonal onshore-offshore movements along the U. S. West Coast (Loeb, 1972; Leatherwood and Fielding, 1974), and winter movements of populations out of Prince William Sound (Hall, 1979) and areas in the Gulf of Alaska and Bering Sea (NMFS unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115). Stock structure, abundance, and migration are poorly understood. However, Dall's porpoise appear to be abundant throughout their range (Leatherwood et al., 1983).

3.6.3.2.3 Balaenopterids

In the Pacific, Minke whales are usually seen over continental shelves (Brueggeman et al., 1990). In the North Pacific, Minke whales occur from the Bering and Chukchi Seas south to near the Equator (Leatherwood et al., 1982). The International Whaling Commission (IWC) recognizes three stocks of Minke whales in the North Pacific: one in the Sea of Japan/East China Sea, one in the rest of the western Pacific west of 180° N, and one in the "remainder" of the Pacific (Donovan, 1991). The "remainder" stock designation reflects the lack of exploitation in the eastern Pacific and does not indicate that only one population exists in this area (Donovan, 1991). In the "remainder" area, Minke whales are relatively common in the Bering and Chukchi Seas and in the inshore waters of the Gulf of Alaska (Mizroch,1992), but are not considered abundant in any other part of the eastern Pacific (Leatherwood et al., 1982; Brueggeman et al.,1990). Minke whales are known to penetrate loose ice during the summer, and some individuals venture north of the Bering Strait (Leatherwood et al., 1982). A recent survey in the central Bering Sea in July-August 1999 resulted in 20 on-effort sightings of Minke whales, most of which occurred along the upper slope in waters 100-200 m deep (Moore et al., in review). In the northern part of their range Minke whales are believed to be migratory, whereas they appear to establish home ranges in the inland waters of Washington and along central California (Dorsey et al., 1990). Minke whales occur year-round in California (Dohl et al., 1983; Forney et al., 1995; Barlow, 1997) and in the Gulf of California (Tershy et al., 1990). Minke whales are present at least in summer/fall along the Baja California peninsula (Wade and Gerrodette, 1993). No estimates have been made for the number of Minke whales in the entire North Pacific.

Bryde's whales have a pantropical distribution and are common in much of the tropical Pacific (Reeves et al., 1999). Shallenberger (1981) reported a sighting of a Bryde's whale southeast of Nihoa in 1977. Available evidence provides no biological basis for defining separate stocks of Bryde's whales in the central North Pacific (Forney et al., 2000). The status of Bryde's whales in Hawaii's waters relative to their optimum sustainable populations is unknown, and there are insufficient data to evaluate trends in abundance (Forney et al., 2000). Aerial surveys within 25 nm of the MHI did not detect the presence of Bryde's whales in the survey area (Mobley et al., 2000).

3.6.3.2.4 Beaked whales

The Blainsville's beaked whale has a cosmopolitan distribution in tropical and temperate waters (Mead, 1989). Sixteen sightings of this species were reported from the Main Hawaiian Islands by Shallenberger (1981). Cuvier's beaked whale probably occurs in deep waters throughout much of the tropical and subtropical Pacific (Heyning, 1989). Strandings of this species have been reported in the Main and Northwestern Hawaiian Islands (Nitta, 1991; Shallenberger, 1981). Aerial surveys within 25 nm of the MHI yielded abundance estimates of 68 Blainsville's beaked whales and 43 Cuvier's beaked whales in that area (Mobley et al., 2000). There is no information on stock structure of the Blainsville's beaked whale or Cuvier's beaked whale. The status of Blainsville's beaked whales and Cuvier's beaked whales in Hawaii's waters relative to their optimum sustainable populations is unknown, and there are insufficient data to evaluate trends in abundance (Forney et al.,2000).

The first recorded sighting of a Longman's Beaked whale within the Hawaii EEZ was reported from the 2002 NOAA cetacean surveys (Barlow, 2003). These whales are the least well known of all cetaceans. Sightings are rare due to their deep-ocean distribution, elusive behavior and possible low numbers. They have been seen at sea in tight groups of 5-20 animals, and sometimes up to 100 individuals. They are sometimes seen with short-finned pilot whales and bottlenose dolphins. They probably feed on deep-sea fish, squid and possibly crustaceans and echinoderms found on the sea floor. Because they lack functional teeth, they presumably capture most of their prey by suction. Nothing is known about breeding in this species.

3.6.3.2.5 Physeterids

The pygmy sperm whale is likely to occur all year in many parts of the tropical and subtropical Pacific (Caldwell and Caldwell, 1989). There have been at least nine reported strandings of this species in the Hawaiian Islands (Nitta, 1991). The dwarf sperm whale is rarely observed at sea in most areas but is apparently abundant in some (Nagorsen, 1985). Its distribution, as inferred mainly from strandings, is worldwide in tropical and temperate waters. There have been two strandings of this species in the Hawaiian Islands (Nitta, 1991). The status of pygmy sperm whales and dwarf sperm whales in Hawaii's waters relative to their optimum sustainable populations is unknown, and there are insufficient data to evaluate trends in abundance (Forney et al., 2000).

3.6.3.2.6 Pinnipeds

Northern fur seals and northern elephant seals commonly migrate into the northeastern portion of the historic Hawaii-based fishing zone (Bigg, 1990; Stewart and DeLong, 1995). Both species may occur in this region anytime of the year, but there are periods when the probability of their presence is greatest, especially for certain age and sex groups. Juvenile northern fur seals of both sexes are believed primarily to occur in the region during the fall, early winter and early summer (Bigg, 1990). Northern elephant seal adult females also migrate into the area twice a year, returning briefly to land to breed in the winter and molt in the spring (Stewart and Delong, 1995). The eastern Pacific stock of the northern fur seal is classified as a strategic stock because it is designated as depleted under the MMPA (Hill and DeMaster, 1999). A review of elephant seal population dynamics through 1991 concluded that the status of this species could not be determined with certainty, but that these animals might be within their optimal sustainable population range (Barlow et al., 1993).

3.6.3.3 Interactions of the Hawaii-based Longline Fleet with Marine Mammals

Port departures by Hawaii-based longline vessels numbered 1,128 during 2002, of which 278 carried observers. This represented about 24.6% observer coverage. Total observed fishing effort was approximately 6,786,303 hooks and 3,523 sets. There were 9 marine mammal interactions observed. Table 3.6.3-3 summarizes the observed interactions.

Table 3.6.3-3 Observed longline gear/marine mammal interactions, 2002

Marine Mammal Species	Condition		
	Released Alive/Injured	Dead	Total
Monk Seals	0	0	0
Humpback Whales	1	0	1
False Killer Whales	5	0	5
Unidentified Cetacean	2	0	2
Blainville's Beaked Whale	0	1	1
Dolphins	0	0	0
Total	8	1	9

3.7 Features of the Economic Environment

The description of the economic environment provided here focuses on pelagic fisheries that could be potentially affected by the proposed actions. These fisheries include the Hawaii pelagic longline fishery and the ika shibi component of the Hawaii pelagic handline fishery—two fisheries managed under the Pelagic Fisheries FMP—and the distant-water and Hawaii near-shore squid fisheries, which are currently not managed under the Pelagic Fisheries FMP. The affected environment description concentrates on important issues that have shaped the existing economic conditions within these fisheries. This context includes significant economic stress factors, including pertinent federal fishery management regulations. Where possible, trends in the economic condition of the fisheries are identified.

Comprehensive descriptions of the Hawaii longline and ika shibi fisheries are provided in Chapter 3 of the Pelagic Fisheries FMP FEIS (NMFS, 2001). The descriptions of these fisheries presented in the current document summarize the discussion in the Pelagic Fisheries FMP FEIS and incorporate new economic information that has become available since the Pelagic Fisheries FMP FEIS was released. The FMP EIS also provided economic profiles of the pelagic fisheries in Guam, American Samoa and the Northern Mariana Islands. The current EIS does not summarize or update that information because the proposed actions are not expected to have significant economic impacts in those areas of the Western Pacific Region.

Following the data requirements set forth in section 303(a)(2) of the Magnuson-Stevens Act, the descriptions of the Hawaii near-shore squid fishery and incipient distant-water squid fishery include the number of vessels involved, the type and quantity of fishing gear used, the species of fish involved and their location, actual and potential revenues from the fishery, any recreational interest in the fishery, and the nature and extent of foreign fishing and Indian treaty fishing rights, if any. These descriptions of the near-shore and distant-water squid fisheries of interest are prefaced by a general description of squid fisheries world-wide.

3.7.1 Overview of Hawaii's Pelagic Fisheries

This section examines the relative importance of Hawaii's pelagic fisheries in terms of catch, ex-vessel value and participation. The state's pelagic fisheries are unique and diverse. Hawaii-based longline vessels are capable of traveling long distances to high-seas fishing grounds, while the smaller handline and troll fisheries—which may be commercial, charter, recreational or subsistence—generally occur within 25 miles of land, with trips lasting only one day. All of Hawaii's pelagic fisheries are small in comparison with other Pacific pelagic fisheries such as distant-water purse seine fisheries and other foreign pelagic longline fisheries, but they comprise the largest fishery sector in the State of Hawaii. Tuna, billfish and other tropical pelagic species supply most of the fresh pelagic fish consumed by Hawaii residents and support popular recreational fisheries.

In recent years, Hawaii's commercial pelagic fisheries have been greatly affected by a series of legal decisions that resulted in federal regulatory measures. In 2001, total catch and ex-vessel value decreased by about 7.8 million lbs and $20.1 million, respectively, primarily as a result of the implementation of litigation-driven management measures that eliminated the swordfish portion of the Hawaii longline fishery (Table 3.7-1). Swordfish, the largest component of the catch by volume in 2000, has been a negligible component since that year (Table 3.7-2). In recent years, bigeye tuna has been the most important pelagic species by both volume and value, followed by yellowfin tuna and albacore. As a result of an increase in the catch of bigeye tuna the ex-vessel value of landings in Hawaii's pelagic fisheries increased to about $45.3 million in 2002.

Table 3.7-1 Volume and Ex-vessel Value of Landings in Hawaii's Commercial Pelagic Fisheries by Major Gear Type, 1999-2003. Source: WPFMC (2004a)

Year	Volume (1000 lbs)				Ex-Vessel Value ($1000)			
	Aku (Pole-and-Line)	Longline	Troll-Handline	Total	Aku (Pole-and-Line)	Longline	Troll-Handline	Total
1999	1,310	28,350	6,310	36,058	1,740	49,300	10,650	61,690
2000	710	23,810	4,970	29,600	1,120	51,300	10,170	62,590
2001	990	15,550	5,220	21,760	1,380	33,400	7,720	42,500
2002	530	17,160	3,710	21,400	750	37,500	5,650	43,900
2003[1]	1,020	17,640	3,700	22,360	1,000	37,500	8,210	46,710

[1] Preliminary data

Table 3.7-2 Volume and Ex-vessel Value of Landings in Hawaii's Commercial Pelagic Fisheries by Species, 1999-2002. Source: WPFMC (2004a)

Species	1999		2000		2001		2002	
	Volume (1000 lbs)	Ex-Vessel Value ($1000)	Volume (1000 lbs)	Ex-Vessel Value ($1000)	Volume (1000 lbs)	Ex-Vessel Value ($1000)	Volume (1000 lbs)	Ex-Vessel Value ($1000)
Bigeye Tuna	6,200	20,400	6,240	21,611	5,873	19,675	10,266	27,513
Yellowfin Tuna	4,000	8,100	4,833	12,343	4,145	9,492	2,462	5,589
Albacore Tuna	4,000	4,400	2,282	3,336	3,229	3,584	1,522	1,781
Skipjack Tuna	1,900	2,300	1,111	1,471	1,696	1,900	986	1,252
Blue Marlin	1,400	1,400	1,125	1,252	1,494	1,061	1,001	1,171
Striped Marlin	900	1,200	473	832	73	925	558	893
Swordfish	6,900	13,000	6,520	12,789	500	1,155	461	904
Mahimahi	1,300	2,800	1,543	2,987	1,191	1,918	1,164	2,223
Ono	1,000	1,700	673	1,549	922	1,558	620	1,364
Moonfish	1,200	1,400	693	1,109	756	930	915	1,226
Sharks	6,300	1,600	3,400	863	327	131	388	163
Other	920	1,150	808	1,186	749	866	1,049	1,275
Total	36,020	59,450	29,528	61,283	21,755	43,194	21,392	45,354

The longline fishery is the largest commercial fishery in Hawaii. In 2002, longline catch was 17.2 million lbs worth $37.5 million (Table 3.7-1). Catch in the commercial troll and handline fisheries has been relatively stable in recent years, while catch in the skipjack tuna or aku fishery continues to show a declining trend. An estimate of the level of participation in Hawaii's commercial pelagic fisheries can be derived from data collected by the HDAR Commercial Marine License, which asks fishermen to identify their primary fishing gear or method at the time of licensing. This does not preclude fishermen from using other gears or methods, but does indicate the primary fishing method. A total of 3,195 fishermen were licensed in 2002, including 2,025 who indicated that their primary fishing method would use fishing gear intended to catch pelagic fish (Table 3.7-3). Most licenses that indicated pelagic fishing as their primary method were issued to trollers (72%) and longline fishermen (18%). The remainder were issued to ika shibi and palu ahi (handline) (8%) and aku (pole-and-line) boat fishers (2%). The total number of licenses issued and licenses indicating pelagic fishing decreased six percent from the previous year.

Table 3.7-3 Primary Fishing Method Reported on HDAR Commercial Marine Licenses, 1999-2002. Source: WPFMC (2004a)

Fishing Method	1999	2000	2001	2002
Longline	546	553	465	367
Trolling	1,572	1,464	1,449	1,451
Ika shibi and palu ahi (handline)	199	190	163	164
Aku boat (pole-and-line)	62	41	44	43
Total pelagic	2,379	2,248	2,121	2,025
Total all methods	3,876	3,609	3,401	3,195

The pelagic fish resources in the EEZ around Hawaii also support important charter and recreational fisheries. Participants in Hawaii's charter boat fishery primarily troll for billfish. In 2002, blue marlin formed about half of the total annual charter vessel catch by weight (Table 3.7-4). Big game sportfishing rods and reels are used, with four to six lines trolled at any time with outriggers. Both artificial and natural baits are used. In addition to lures, trollers occasionally use freshly caught skipjack tuna and small yellowfin tuna as live bait to attract marlin, the favored landings for charter vessels, as well as yellowfin tuna. Charter fishing in Hawaii and elsewhere in the Western Pacific Region has elements of both recreational and commercial fishing. The primary motivation for charter patrons is recreation, while the charter vessel skipper and crew receive compensation in the form of patron fees and fish sales in local markets.

Table 3.7-4 Species Composition of Landings Made by Hawaii Charter Vessels, 2002. Source: WPFMC (2004a)

Species Caught	Landings (lbs.)	Percent
Mahi mahi	71,741	17.3
Skipjack tuna	18,712	4.5
Wahoo	31,115	7.5
Blue marlin	196,084	47.4
Yellowfin tuna	57,633	13.9
Other	38,069	9.3
Total	413,893	100.0

Hawaii's recreational fleet also primarily employs troll gear to target pelagic species. Although their motivation for fishing is recreational, some of these vessel operators sell a portion of their landings to cover fishing expenses and have been termed "expense" fishermen (Hamilton, 1999). While some of the fishing methods and other characteristics of this fleet are similar to those described for the commercial troll fleet, a survey of recreational and expense fishermen showed substantial differences in equipment, avidity and catch rates compared to commercial operations. Vessel operators engaged in subsistence fishing are included in this recreational category. An estimate of catch in Hawaii's recreational pelagic fishery is available from the NOAA Fisheries Marine Recreational Fisheries Statistical Survey (MRFSS), which was reinitiated in 2001 following a 20 year gap. The survey indicated that boat-based recreational fishing resulted in the harvest of 11.2 million lbs of pelagic species in 2002 (WPFMC, 2004a). The contributions by the six major pelagic species caught by boat-based recreational fishing is shown in Figures 3.7-1and 3.7-2. Skipjack is the most commonly caught pelagic species taken by recreational fishermen in terms of numbers, but it is only a minor fraction of the catch by weight. Yellowfin tuna and blue marlin are the most important species in terms of weight.

Figure 3.7-1 Estimated Hawaii Recreational Private Boat Catch of Pelagic Species by Number of Fish, 2002. Source: WPFMC (2004a)

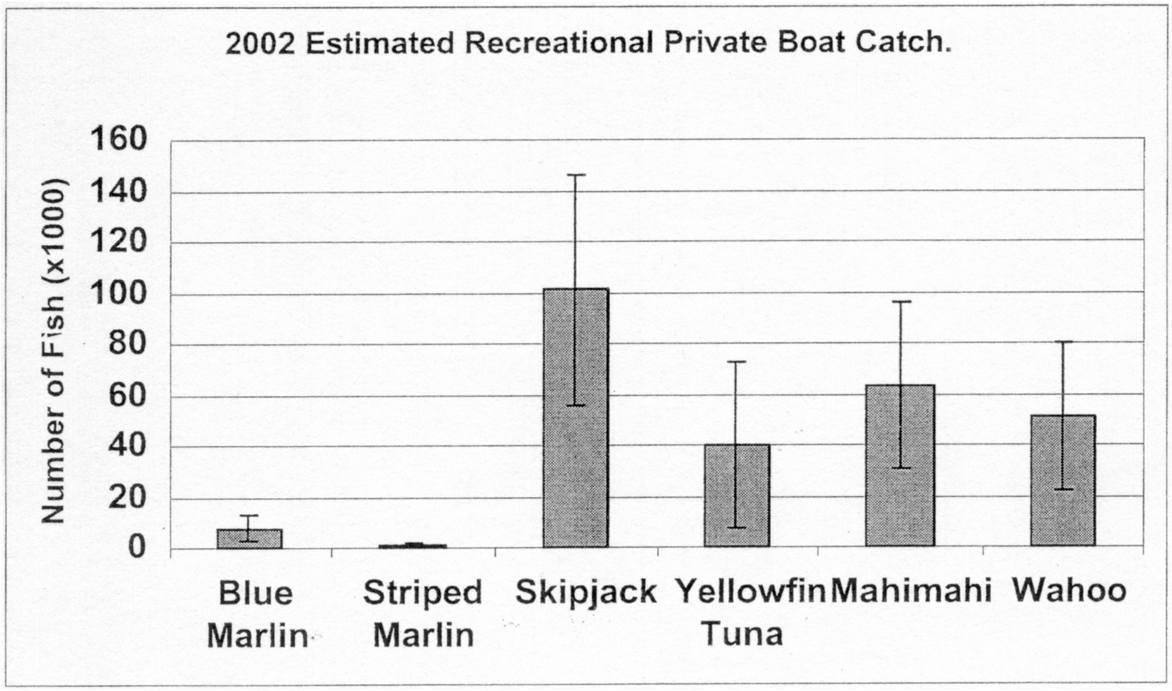
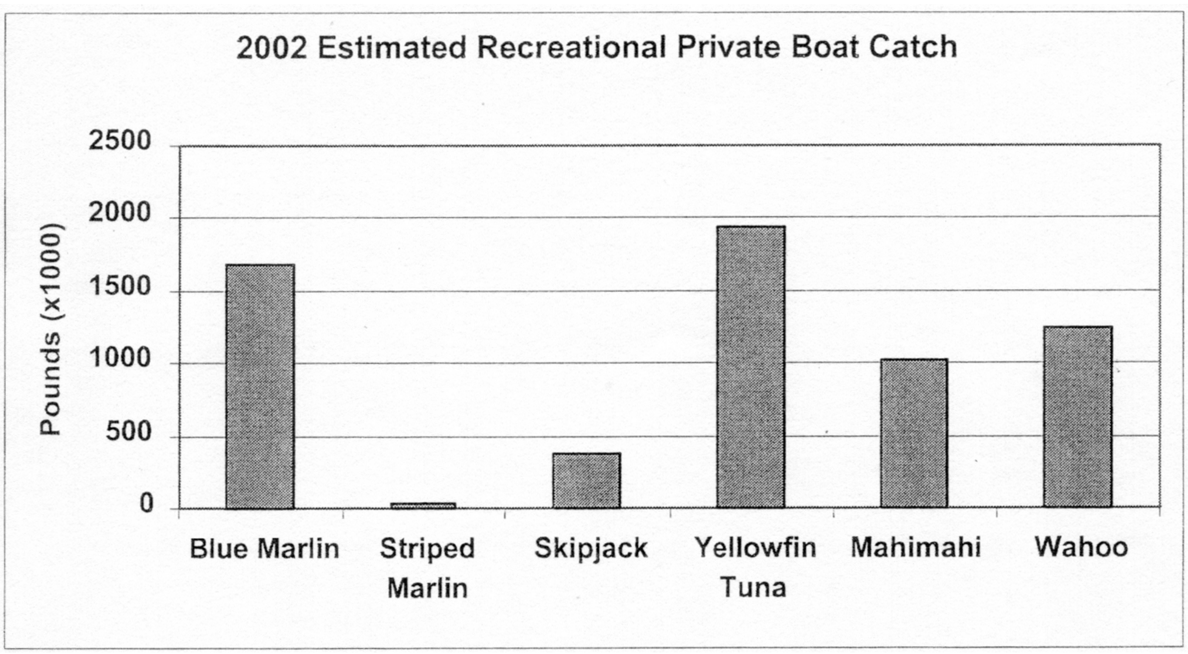


Figure 3.7-2 Estimated Hawaii Recreational Private Boat Catch of Pelagic Species by Weight of Fish, 2002. Source: WPFMC (2004a)



3.7.2 Hawaii Longline Fishery

3.7.2.1 Overview

The Hawaii longline fishery operates under a limited entry regime with a total of 164 transferable permits and a maximum vessel length of 101 ft. The longline fleet has historically operated in two distinct modes based on gear deployment: deep-set longline by vessels that target primarily tuna and shallow-set longlines by those that target swordfish or have mixed target trips including albacore and yellowfin tuna. Swordfish and mixed target sets are buoyed to the surface, have few hooks between floats, and are relatively shallow (5-60 m). These sets use a large number of light sticks, as swordfish are primarily targeted at night.

Vessels targeting tuna differ from those targeting swordfish in that they generally operate in warm waters further south and set their lines at relatively deep depths (15-180 m or greater). To facilitate the deployment of fishing gear at these depths vessels usually increase the longline sink rate by employing a hydraulic line-setting machine (line-shooter or line-setter) and branch lines with 40-80 g weights attached close (20-90 cm) to the hooks.

Total landings in the Hawaii longline fishery decreased by 8.2 million lbs (34%) in 2001 (Table 3.7-5). Dramatically lower catches of swordfish and shark following the closure of the swordfish-targeting segment of the fishery and the ban on shark finning, respectively, were the primary reasons for the overall decline. Ex-vessel value in the Hawaii longline fishery dropped from $51.3 million in 2000 to $33.4 million in 2001. The primary reason for the decrease was the cessation of swordfish-targeted fishing, but weak economic conditions in the U.S. and Japan also contributed to the decline. The recovery of Hawaii's tourist industry and increased demand for Hawaii's fresh fish in 2000 was short-lived as the U.S. economy slowed in 2001. A downturn in the economy in Japan resulted in lower prices for high grade bigeye tuna. Average prices for all species except swordfish declined in 2001.

Table 3.7-5 Hawaii Pelagic Longline Fishery Activity, 1999-2003. Source: WPFMC (2004a)

Category	1999	2000	2001	2002	2003 [1]
Total landings (million lbs)	28.3	23.8	15.6	17.2	17.6
Catch composition (1000 lbs)					
Bigeye tuna	5,995	5,788	5,217	9,669	7,768
Albacore tuna	3,250	2,026	2,802	1,156	1,157
Yellowfin tuna	1,042	2,506	2,233	1,257	1,820
Swordfish	6,835	6,520	485	450	301
Miscellaneous	4,712	3,462	4,022	3,960	NA
Sharks	6,272	3,297	327	388	NA
Active vessels	119	125	101	100	110
Total trips	1,137	1,034	1,034	1,164	1,216
Number of hooks set (millions)	19.1	20.3	22.3	27.2	29.3
Total ex-vessel value (adjusted for inflation) ($million)	49.3	51.3	33.4	37.5	37.5

[1] Preliminary data

The total number of longline trips remained fairly constant between 1997 and 2002, although effort patterns changed considerably. The longline fishery shifted its effort from swordfish to tuna throughout the 1990s, with the number of tuna-directed trips more than doubling between 1992 and 2001. The closure of the swordfish portion of the longline fishery in 2001 led to especially high tuna catches. The longline fleet now targets primarily bigeye tuna, for which catch nearly doubled between 2001 (5.2 million lbs) and 2002 (9.7 million lbs), and more than doubled from the 16-year average (4.8 million lbs). The increasing number of hooks set is attributed to the increase in tuna-targeted sets, which typically set a higher number of hooks per day fished in comparison to swordfish-targeted sets.

The number of active Hawaii-based longline vessels grew from 37 vessels in 1987 to 141 in 1991, but then decreased to 103 in 1996 as vessels left for the U.S. mainland and Fiji (WPFMC, 2003). In addition, some Hawaii-based swordfish vessels began to routinely fish outside the EEZ off of California and make landings in that state during part of each year, typically from October through February. Apparently, swordfish catch rates in the eastern Pacific are higher than those in the central Pacific during these months, possibly because of a seasonal eastward migration of the fish stock. Longline vessels operating out of California also retain marketable non-target species such bigeye tuna, albacore tuna, and thresher shark. In the latter part of 1997, 15 Hawaii-based longline vessels migrated to California. The number of vessels migrating to California increased to 18 in 1998 (Ito and Machado, 1999). By 1999, over 30 Hawaii-based longliners fished out of California during part of the year. In 2000, the size of the Hawaii longline fleet gradually increased to 125 with the return of boats that had migrated to the U.S. mainland, along with a few new participants from the West Coast and Alaska. However, the number of Hawaii-based longline vessels fell to 101 in 2001. Many of the longline vessels that targeted swordfish moved to California. Twenty-one California-based longline vessels submitted federal high seas longline logbook data in 2002. All but one of them fished out of Hawaii before 2000. Almost all the longline vessels participating in the California-based longline fishery continued to target swordfish, and some fished in the same areas of the North Pacific that they had previously fished in under a Hawaii longline limited access permit. However, in April 2004, NOAA Fisheries issued a rule that prohibits shallow longlining targeting swordfish on the high seas in the Pacific Ocean east of 150°W and N of equator (69 FR 11540, March 11, 2004).

A survey conducted by O'Malley and Pooley (2003) provides estimates of average income for various vessel classes in the Hawaii-based longline fleet in 2000 (Table 3.7-6). Only vessels that were interviewed in the survey are included in the final income statements, which include fixed costs, variable costs, labor costs, and gross and net revenue. These tables were calculated by including zero costs in the calculated averages for each vessel target and classification. Swordfish and tuna vessels earned a net return of $27,484 and $55,058, respectively. Among the tuna vessels, the small vessels were the most profitable. These vessels had higher gross revenues and, consequently, higher labor costs but lower fixed and variable costs. On average swordfish vessels were larger than tuna vessels and had higher levels of capitalization and greater operating expenses (NMFS, 2001).[11] Large swordfish vessels were generally more profitable than smaller swordfish vessels due to higher gross revenues.

Table 3.7-6 Reported Average Annual Revenue and Costs for the Hawaii-based Longline Fleet, 2000.[1] Source: O'Malley and Pooley (2003)

Category	Swordfish average	Tuna average	Small tuna average	Medium tuna average	Large tuna average	Medium swordfish average	Large swordfish average
Gross revenue ($)	490,301	495,456	502,740	496,578	485,286	459,465	526,277
Fixed costs total ($)	93,207	90,597	66,409	93,056	84,433	81,520	105,633
Variable costs total ($)	230,232	184,986	147,503	182,868	239,749	239,928	221,449
Labor costs ($)	139,379	164,815	187,685	167,378	142,896	114,422	160,619
Total costs ($)	462,818	440,398	401,597	443,302	467,078	435,870	487,701
Net revenue ($)	27,483	55,058	101,143	53,276	18,208	23,595	385,776

[1]Vessels are classified by size (small <56 ft, medium 56.1 ft to 73.9 ft, large >74 ft) and target (tuna or swordfish)

3.7.2.2 Description of Impacts of Recent Regulatory Changes

The focus of this section is recent federal fishery management regulations that have played an significant role in the cumulative economic stress on the Hawaii-based longline fleet. To the extent possible, important cause-and-effect relationships between regulatory changes and the economic performance of the Hawaii longline fishery are described. The regulations that have been identified for discussion pertain to sea turtle and seabird interactions in the Hawaii longline fishery and the practice of shark finning.

3.7.2.2.1 Sea Turtle Interaction Measures

In late 1999, a series of federal closures and fishing restrictions began when vessels registered for use under Hawaii longline limited access permits were prohibited from engaging in fishing in certain accustomed areas and with certain gear. The management measures were initially the result of injunctions issued by the U.S. District Court for the District of Hawaii to reduce the number of sea turtles injured and killed incidental to fishing operations. In 2001, after completion of a BiOp that assessed the Hawaii longline fishery's impacts on sea turtles, NOAA Fisheries implemented by emergency rule measures that prohibited Hawaii-based longline vessels from deploying shallow-longline gear (swordfish-target longline gear) and from fishing in an area south of 15°N from April 1 through May 31. In 2002, NOAA Fisheries published an emergency regulation setting a limit of 10 swordfish per trip for any longline vessel arriving in Honolulu because some vessels were suspected of targeting swordfish.

The implementation of regulations designed to reduce interactions between the longline fishery and sea turtles resulted in a dramatic change in the size and composition of the Hawaii longline fleet. Vessels targeting swordfish were forced to either convert to targeting tuna or leave Hawaii and fish elsewhere. Since 2001, of the estimated 45 Hawaii-based longline vessels that were not

[11] Swordfish vessels were typically larger than tuna vessels because they generally operated in the rougher sea and weather conditions of more northerly waters (NMFS, 2001). In addition, the fishing grounds for swordfish are more distant. Between 1991 and1998, the average distance traveled to first set by swordfish vessels was 570 miles, whereas the average distance traveled by tuna vessels was 275 miles.

equipped with line-shooters (and therefore restricted to targeting swordfish or a mixture of swordfish and tuna), about 20 dropped their Hawaii longline limited access permits and relocated to southern California.[12]

The swordfish vessels that stayed in Hawaii after the gear restrictions were forced to target tuna, which entailed converting their gear. O'Malley and Pooley (2003) note that because bigeye and yellowfin tuna are fished deeper than swordfish, tuna gear is considerably heavier; hence most of the swordfish gear was rendered useless. O'Malley and Pooley estimated the cost to purchase new gear to be approximately $35,925 per vessel (Table 3.7-7). This cost estimate does not include the 20 person-days of labor required to install the line-shooter and rig the tuna gear; nor does it include the economic loss that swordfish vessels that switched to targeting tuna experienced while learning to fish for tuna (NMFS, 2001).

Table 3.7-7 List of Items and Their Costs Associated with Converting Gear from Targeting Swordfish to Tuna. Source: O'Malley and Pooley (2003)

Item	Quantity	Cost per unit ($)	Total cost/Item ($)
Line-shooter	1 + hydraulics	7,000	7,000
Mainline	40 miles	320	12,800
Buoys	110	35	3,850
Floatline	-	-	1,500
Branchline	-	-	1,720
Wire leader	-	400	400
Snap swivels	1,500	1	1,500
Weights	2,500	0 .70	1,750
Hooks	2,500	1	2,500
Sleeves	35 bags	35	1,225
Vinyl tubes	4 bags	20	80
Side roller	1	1,600	1,600
Total cost			35,925

As noted above, those displaced fishermen who elected to target tuna or shift to the California-based swordfish fishery recovered some portion of the revenue previously generated from the swordfish-targeting segment of the Hawaii longline fishery. In addition, owners of Hawaii-based longline vessels received financial assistance from a federal direct economic assistance program (DEAP) because of the unanticipated and serious business impairment and disruption participants experienced as a result of the series of restrictive management actions that began in late 1999 (66 FR 58440, November 21, 2001).[13] Owners of tuna vessels received $16,000, while

[12] Federal regulations effectively prevent Hawaii-based longline vessels from periodically fishing for swordfish outside the jurisdiction of the Pelagics FMP during part of the year. In order for a vessel "coupled" with a Hawaii longline limited access permit to fish for swordfish outside the EEZ off of California (or anywhere else) the vessel has to be "decoupled" from the permit because of gear restrictions. Further, regulations stipulate that vessels can not be "recoupled" with a permit until the following October.

[13] The Consolidated Appropriations Act of 2001 made $3.0 million available to NOAA Fisheries to provide economic assistance to fishermen and fishing communities affected by federal closures and fishing restrictions in the Hawaii longline fishery. Vessel owners that fished under a Hawaii longline limited access permit and harvested pelagic species in the Hawaii longline fishery between January 1, 1999, and November 29, 1999 were eligible to participate in the program. This eligibility period directed financial assistance to owners of vessels engaged in harvesting activity under a Hawaii longline limited access permit in the months immediately preceding the

owners of swordfish vessels received $32,000. The amount of financial assistance swordfish vessels received was twice what tuna vessels received because NOAA Fisheries concluded that restrictions imposed on the Hawaii longline fishery had larger operational impacts on vessels targeting swordfish than on vessels targeting tuna. Further, NOAA Fisheries stated that swordfish vessels were anticipated to incur additional costs of $12,000 - $15,000 for outfitting for conversion to tuna fishing (i.e, deep-set fishing activity). O'Malley and Pooley (2003) note that the amount given to the swordfish vessels covered about 89 percent of the estimated cost to convert to tuna fishing (not including the labor to assemble the gear and the time spent learning to fish for tuna).

The DEAP did not take into account that the vessels that targeted swordfish are generally larger and have larger engines than tuna vessels because they traveled to more distant fishing grounds and generally operated in the rougher sea and weather conditions of more northerly waters. Therefore, their fuel costs are much higher. In addition, fixed costs are generally higher for swordfish vessels than for tuna vessels, as the need for larger vessels led many owners to acquire substantial bank loans (according to the Pelagic Fisheries FMP FEIS (NMFS, 2001), loan repayments typically amount to $10,000 per month).[14] While vessels suited for the swordfish portion of the Hawaii longline fishery can target tuna (with the proper gear additions), the vessels that do so are overcapitalized for the tuna fishery and are therefore at a distinct cost disadvantage. The DEAP did not benefit the crew members of swordfish or tuna longline vessels. The Pelagic Fisheries FMP FEIS (NMFS, 2001) noted that crew members of swordfish boats would arguably be the most severely impacted by closure of the fishery, as their relatively low level of job skills and formal education would make finding a suitable alternative job difficult (NMFS, 2001). To date, no published study has examined the actual economic hardships that crew members experienced as a result of the 2001 closure of the swordfish-targeting segment of the longline fishery.

Although tuna-targeting longline fishing expanded, it was constrained to some extent by the annual seasonal (April-May) longline closure of about one million square nautical miles (nm) of ocean bounded by 15°N to the equator and from 145°W to 180°W. The Pelagic Fisheries FMP FEIS (NMFS, 2001) noted that the closure denies the fleet access to yellowfin and bigeye catches at a time when these stocks are known to be especially productive in equatorial regions, particularly in the U.S. EEZ around Palmyra Atoll and Kingman Reef (NMFS, 2001). Moreover, the closure occurs during or immediately preceding periods when the demand for tuna is relatively high (e.g., Lent, Mothers Day, Fathers Day, and school graduation and wedding celebrations). Consequently, the seasonal closure would result in a substantial reduction in the income of some vessels. The FEIS (NMFS, 2001) concluded that the financial situation of many tuna longline vessels is sufficiently marginal that the effects of a seasonal closure may drive some fishing enterprises into insolvency. In addition, the FEIS noted that it is likely fish dealers in the state would increase their purchases of imported fish to offset the loss of Hawaii-produced pelagic fish during the seasonal closure. As imports establish a greater foothold in the Hawaii

implementation of restrictive management actions.

[14] For some owners of swordfish vessels the need to repay large bank loans acquired to purchase their vessels forced them to switch to tuna fishing or relocate to California before the financial assistance was disbursed (pers. comm., Stewart Allen, NOAA Fisheries Pacific Islands Fisheries Science Center, ½0/04).

market they may depress the prices that Hawaii-based vessels receive for tuna during the open season.

However, annual tuna catches in the EEZ surrounding the U.S. possessions, which mainly consists of the waters around Palmyra Atoll and Kingman Reef, do not show an appreciable decrease since the closure was implemented in 2001 (Table 3.7-8). It is also important to note that average prices for the longline fishery have been increasing, from $1.67/lb in 1999 to $2.19/lb in 2002. However, the average price of bigeye tuna decreased in 2002, probably due to the record catch of this particular species.

Table 3.7-8 Hawaii-based Longline Catch in the U.S. Possessions, 1991-2002. Source: WPFMC (2004a)

Year	Bigeye tuna (no.)	Yellowfin tuna (no.)	Albacore tuna (no.)	Total (no.)
1991	374	439	30	843
1992	70	42	0	112
1993	_	_	_	_
1994	1,127	1,649	151	2,927
1995	460	583	296	1,339
1996	766	1,184	1,612	3,562
1997	2,070	1,932	4,052	8,054
1998	17,666	6,313	3,784	27,763
1999	4,514	5,737	4,514	14,765
2000	7,483	21,788	8,766	38,037
2001	5,563	20,777	9,493	35,833
2002	18,110	12,826	6,342	37,278

In April 2004, NOAA Fisheries reopened the swordfish-targeting segment of the Hawaii longline fishery under new federal rules. Instead of the more typically used J-hooks and squid bait, boats targeting swordfish are required to use circle hooks sized 18/0 or larger with a 10-degree offset and mackerel-type bait. Research conducted in the Atlantic longline fishery demonstrated that circle hooks and different bait greatly reduced accidental hooking of sea turtles. A maximum of 2,120 swordfish sets will be allowed per calender year, or about half of the average annual number of longline sets targeting swordfish prior to the 2001 ban. NOAA Fisheries also eliminated the April-May tuna fishing area closures.

The annual effort limit of 2,120 swordfish sets is divided and distributed each calendar year in equal portions (in the form of transferable single-set certificates valid for a single calendar year) to all holders of Hawaii longline limited access permits (according to the number of permits held) that provide written notice to NOAA Fisheries no later than November 1 prior to the start of the calendar year of their interest in receiving such certificates (for the 2004 fishing year the deadline was May 1, 2004). Hawaii-based longline vessels are prohibited from making more shallow-sets north of the equator during a trip than the number of valid shallow-set certificates on board the vessel, and operators of these vessels must submit to NOAA Fisheries within 72 hours of each landing of pelagic management unit species, with the logbooks, one valid shallow-set certificate for every shallow-set made north of the equator during the trip.

Every boat intending to make a shallow-setting trip is required to carry a NOAA Fisheries-certified observer (operators of Hawaii-based longline vessels are required to notify NOAA Fisheries before leaving port of their trip type—either deep-setting or shallow-setting). NOAA Fisheries is bearing the costs of the increased observer coverage. If a total of either 16 leatherback turtles or 17 loggerhead turtles are hooked, no swordfish fishing is allowed for the remainder of the year.

The relaxation of the restrictions on longlining is expected to have positive overall economic impacts on participants in the Hawaii longline fishery. Holders of Hawaii longline limited access permits that choose not to engage in shallow-setting are likely to benefit each year by being able to sell their share of shallow-set certificates to other permit holders. Holders of Hawaii longline limited access permits that choose to engage in shallow-setting are likely to benefit from the required hook-and-bait combination, as it has been found in experiments in the Atlantic Ocean to result in higher catch rates of swordfish relative to conventionally used hook and bait types (WPFMC, 2004b). These permit holders would also be subject to new costs, which would partly offset the new benefits available from shallow-setting. These include the costs of acquiring an adequate number of shallow-set certificates each year and acquiring and using circle hooks of the required size. The cost to rig over from tuna fishing to swordfish fishing is reported to be about $15,000. There are also very minor new costs associated with the requirement to notify NOAA Fisheries each year if they are interested in receiving shallow-set certificates and with the requirement to submit shallow-set certificates to NOAA Fisheries after each trip. There may also be new costs (relative to the costs associated with conventional practices) associated with the need to use only mackerel-type bait.

Currently, shallow-set certificates are divided equally among interested permit holders at the beginning of each season. While this allocation method maintains administrative flexibility for unforeseen eventualities that may oblige changes in the distribution of effort shares, it precludes creating a stable set of privileges with a long time horizon that, in turn, would promote the efficiency and stability of the fishery. In addition, the “hard limit” on hookings of leatherback and loggerhead turtles may create an incentive for each holder of shallow-set certificates to do as much shallow-setting as possible before the fishery is closed, thereby encouraging fishermen to shallow-set under what would otherwise be sub-optimal conditions (in terms of both economic performance and safety).

About two-thirds of the 164 Hawaii longline limited access permit holders requested shallow-set certificates for 2004. Among those requesting certificates were permit holders who have no historical participation in the swordfish portion of the Hawaii longline fishery and permit holders who do not currently own a longline vessel. The large number of requests suggests that certificates are perceived by permit holders as having substantial cash value in the “created market” for fishing effort. It is also possible that speculation that future allocations may be based on swordfish catch or effort history may lead some fishermen to increase their amount of swordfish fishing activity (the phenomenon of increasing catch history in anticipation of a quota allocation is commonly referred to as “fishing for quota”).

3.7.2.2.2 Seabird Interaction Mitigation Methods

Owners and operators of vessels registered for use under Hawaii limited access longline permits are currently required to comply with several measures intended to reduce interactions between seabirds and the Hawaii longline fishery. When making deep-sets north of 23°N, these vessels must employ a line-setting machine (line-shooter) with at least 45 g of weight attached within 1 m of each hook. When making shallow-sets north of 23°N, these vessels are required to begin setting the longline at least one hour after local sunset and complete the setting process by local sunrise, using only the minimum vessel lights necessary. In addition, all Hawaii-based vessels operating north of 23°N must use thawed blue-dyed bait and strategic offal discards to distract birds during the setting and hauling of longline gear. Regardless of the area fished, longline vessel operators and crew must follow certain handling techniques to ensure that hooked seabirds are handled and released in a manner that maximizes the probability of their long-term survival, and vessel operators are required to annually complete a protected species educational workshop conducted by NOAA Fisheries.

Up until April 2004, the only Hawaii limited access longline permit holders affected by the seabird interaction mitigation measures were those making deep-sets, as shallow "swordfish-style" setting was prohibited to protect sea turtles. With the reopening of the swordfish-targeting segment of the Hawaii longline fishery under new regulations, it is anticipated that the impacts of employing the methods to reduce seabird interactions will be concentrated among vessels targeting swordfish, as these vessels will likely account for most the total longline fishing effort (sets) above 23°N.

The compliance costs of the seabird interaction mitigation measures implemented in the Hawaii longline fishery are minimal. Vessels targeting tuna (i.e., making deep-sets) routinely use a line-shooter and weighted branch lines. Although vessels targeting swordfish (i.e., making shallow-sets) routinely set at night, the requirement to begin setting the longline at least one hour after local sunset and complete the setting process by local sunrise could potentially have a negative effect on catch rates. Some fishermen claim that hooks set before dusk are more effective. In addition, the night setting requirement may provide less soak time for vessels fishing at high latitudes during summer months. While there is insufficient information to quantify these effects on catch rates, the impact on the overall economic performance of individual fishing enterprises is likely to be low. The investment and operational costs of dying bait are small, although some preparation time is required. The cost of dyeing bait blue using a dye such as Virginia Dare FDC No. 1 Blue Food Additive is about $14 per set (Gilman et al., 2003). Assuming a typical longline vessel makes 100 sets per year, the total annual cost of dyeing bait is about $1,400. Dyeing bait requires that crew spend significant extra time preparing the bait in lieu of personal time. In addition, blue-dyed bait is messy, dying the crew's hands and clothes and the vessel deck. Despite these difficulties, some participants in the Hawaii longline fishery routinely dye a portion of their bait blue in order to increase its allure to target fish species.

The addition of weight near the hook can be a danger to fishermen if hooks are suddenly pulled loose from the weight of a captive fish. Night setting is another mitigation method that could be dangerous if vessels are not equipped for this type of operation. As noted above, however, vessel operators that target swordfish often set at night, and vessel operators targeting tuna often use line-setting machines and weights of up to 60 grams. It is expected that vessels operators employing these mitigation methods are not compromising the safety of human life at sea as they are already familiar with these techniques.

During 2002 and 2003, additional seabird mitigation research field tests were conducted aboard Hawaii-based longline vessels with underwater setting chutes, blue-dyed bait and side setting (Gilman et al., 2003). Side setting, as the term implies, means setting the longline from the side, rather than from the stern of the vessel. While all the mitigation methods worked well, side setting was the only method which virtually reduced the interaction rate between longline gear and seabirds to zero.

3.7.2.2.3 Shark Finning Measures

Prior to 2000, swordfish and tuna longline vessels were actively taking shark fins. The longline fleet suffered an economic setback from a state statute enacted in 2000 that prohibits landing shark fins without the associated carcass. Later that year the Shark Finning Prohibition Act was passed by the U.S. Congress. Federal regulations implementing the Act prohibit any person under U.S. jurisdiction from engaging in shark finning, possessing shark fins harvested on board a U.S. fishing vessel without corresponding shark carcasses or landing shark fins harvested without corresponding shark carcasses (67 FR 30346 May 6, 2002). Shark catch by longline vessels, which was predominantly blue sharks retained for their fins only, decreased by 6 million lbs in the two years after the ban on shark finning. Longline caught mako and thresher sharks continue to be landed and sold, as the meat for these species has a market value.

O'Malley and Pooley (2003) note that the ban on shark finning resulted in a financial loss primarily to crew members because, in most cases, the revenue generated from the sales went directly to the crew, not the vessel owner. The approximate annual loss of revenue per tuna vessel was $10,652 (Table 9). This equates to approximately ten percent of the annual pay to tuna crews, which is similar to the percentages estimated by McCoy and Ishihara (1999). The approximate annual loss of revenue per swordfish vessel was $20,435, and this equaled one-fifth of the annual pay to swordfish crew. Although there was no direct economic impact on longline vessel owners or captains, the lost supplement to crew income may have increased the difficulty of hiring crew.

Table 3.7-9 Reported Average Vessel Annual Loss of Revenue to the Hawaii-based Longline Fleet Because of the 2000 Shark Finning Regulations.[1] Source: O'Malley and Pooley (2003)

Vessel Classification	Average ($)	Standard Deviation ($)	Number
Swordfish	20,435	14,618	7
Tuna	10,947	5,660	29
Small tuna	7,656	4,050	8
Medium tuna	11,684	4,343	16
Large tuna	13,850	9,513	5
Medium swordfish	20,663	18,285	4
Large swordfish	20,133	11,801	3

[1]Vessels are classified by size (small <56 ft, medium 56.1 ft to 73.9 ft, large >74 ft) and target (tuna or swordfish)

3.7.2.3 Changes in Net Revenue and Regional Impacts

To evaluate the overall economic effects of recent regulatory changes in the Hawaii longline fishery it is necessary to estimate changes in net revenues and induced and indirect impacts on the local economy.

3.7.2.3.1 Changes in Net Revenue

Estimating changes in net revenue requires the collection of cost data from vessel owners and operators. While the study by O'Malley and Pooley (2003) provides baseline economic information associated with operating a pelagic longline vessel in Hawaii in 2000, it does not provide the time series information necessary to fully assess the economic effects of the management measures implemented during 2000 and after. Nevertheless, it is possible to examine the initial effects of these regulatory changes by comparing the 1993 cost-earning study of the Hawaii-based longline fleet (Hamilton et al., 1996) with the more recent study by O'Malley and Pooley (Table 3.7-10). O'Malley and Pooley state that a striking difference between the two studies is the amount of gross revenue generated by the tuna fleet, with the 2000 fleet having substantially higher gross returns and therefore higher net revenue. The researchers note that to a certain extent this may reflect the transition of some larger swordfish and mixed target vessels that began targeting tuna in the late 1990s. The curtailing of the swordfish fleet in late 2000 may be responsible for the decrease in the swordfish vessels' gross revenue and variable costs compared to 1993. In addition, many of the most expensive swordfish vessels left the fishery in the mid-1990s.

Table 3.7-10 Comparison of the Average Annual Revenue and Costs in Costs-Earning Studies of the Hawaii-based Longline Fleet, 1993 and 2000. Source: O'Malley and Pooley (2003)

Category	Swordfish		Tuna	
	1993 avg. ($1000)	2000 avg. ($1000)	1993 avg. ($1000)	2000 avg. ($1000)
Gross revenue ($)	633	490	355	495
Fixed costs total ($)	127	93	89	91
Variable costs total ($)	356	230	133	185
Labor costs ($)	139	139	113	165
Total costs ($)	622	462	335	441
Net revenue ($)	11	27	20	55

In April 2004, NOAA Fisheries reopened the swordfish-targeting segment of the Hawaii longline fishery under new federal rules. While it is uncertain at this early stage of the reopening what the impacts will be on the economic performance of the Hawaii longline fleet, the effects are likely to be positive and significant. Moreover, should the measures to mitigate sea turtle interaction prove successful, the amount of swordfish fishing effort allowed may be increased, resulting in additional economic benefits for longline fishery participants.

3.7.2.3.2 Regional Impacts

Changes in the economic performance of the longline fleet do not take into account impacts to the overall economy. Additional revenue, employment and income are generated in the Hawaii economy by businesses whose goods and services are purchased by longline fishery participants and by businesses that use products from the fishery as inputs for production of goods and services.[15] People earning incomes directly or indirectly from the fishery also generate additional employment and income by making expenditures within the economy. A more complete assessment of the effects of changes in economic conditions in the pelagic longline fishery on the state's economy can be obtained by combining input/output model multipliers with estimates of total sales from this fishing sector.

Leung and Pooley (2002) used a supply-driven approach to estimate the potential economy-wide impacts to Hawaii on output, employment, and income resulting from a 100 percent reduction in longline output of $43.88 million (the 1992 output or gross revenue). Such a reduction would create a potential decrease of $106.2 million in output, 1,600 jobs and $47.21 million in household income. The corresponding output supply-driven multiplier is 2.42, the employment multiplier is 2.46, and the income multiplier is 2.22. Linear interpolations can he used to estimate the impacts with a less than 100 percent reduction in longline output. For example, the $17.9 million reduction in gross revenue that occurred in the longline sector in 2001 is estimated to have created a potential decrease of $43.3 million in output, 653 jobs and $19.2 million in household income.

In addition, the fishery has an impact on businesses that use fishery products as inputs for their own production of goods and services. Firms that buy, process or distribute fishery products include seafood wholesale and retail dealers, restaurants, hotels and retail markets. Leung and Pooley estimated a input supply-driven multiplier of 1.6540 for the longline sector. A reduction of $17.9 million in gross revenue in this sector will cause a total economy-wide output reduction of $29.5 million from a forward linkage point of view.

Leung and Pooley state that the backward linkage effects cannot he added to the forward linkage effects to arrive at some "total" economy-wide impacts because that would amount to double counting the effects of the same exogenous change under two different configurations of the same input-output model. Furthermore, Leung and Pooley note that while the backward linkage effect is relatively straightforward, the same cannot he said about the forward linkage effect. For example, one can assume the reduction in output of the longline sector would certainly reduce the outputs of other sectors in the economy that sell to the longline sector, as well as the subsequent indirect and induced effects. However, the forward linkage impact is generally less well defined. For instance, most seafood buyers, restaurants and other businesses that lost access to a local supply of swordfish simply replaced the local catch with imports from abroad.[16] Fish

[15] Included are individuals or firms that process, distribute and sell fishery products and enterprises that provide goods and services to the fish harvesting sector in Hawaii such as chandlers, gear manufacturers, boatyards, and insurance brokers.

[16] The U.S. is the world's largest swordfish market, and prior to the closure of the swordfish portion of the Hawaii longline fishery in 2001 Hawaii was a major supplier for this market—Hawaii swordfish represented between 37.3 percent and 47.8 percent of the total domestic production between 1997 and 2000 (Bartram and Kaneko, 2004). However, the closure of the fishery had little effect on the domestic market. This is because

quality and wholesale price do not appear to have been affected; hence, the price of swordfish at restaurants and thus final demand did not change.

It is also important to note that the contribution of the pelagic longline fishery to overall economic activity in Hawaii is small. The downturn in the fishery in 2001 had a negligible effect on total state output, income and employment.[17] Moreover, the negative regional impacts gradually lessened as fishermen recovered some portion of the revenue previously generated from swordfish fishing by outfitting their vessels to participate in fisheries on other stocks (most notably tuna) or by finding other jobs in Hawaii that may or may not be fishing-related.

In April 2004, NOAA Fisheries reopened the swordfish-targeting segment of the Hawaii longline fishery under new federal rules. While it is uncertain at this early stage of the reopening what the regional impacts will be, the effects are likely to be positive. Moreover, should the measures to mitigate sea turtle interaction prove successful, it is likely that the amount of swordfish fishing effort allowed will be increased, resulting in additional regional economic benefits.

3.7.3 Squid Fisheries

The domestic fisheries potentially affected by the proposed action can be separated into two distinct categories based on the location of the fisheries and target species. One category consists of the incipient domestic distant-water squid jigging fishery occurring in various areas of the Pacific Ocean. This fishery typically occurs outside the U.S. EEZ, and the major target species include *Ommastrephes bartramii*. A description of the distant-water fishery is presented in section 3.7.3.2. The second category of fisheries potentially affected by the proposed action includes the long-established ika shibi component of the Hawaii pelagic handline fishery, in which squid are caught and used as tuna bait, and a small artisanal fishery in Hawaii that mainly captures squid for human consumption. These fisheries occur in the U.S. EEZ or state waters around the Main Hawaiian Islands and mainly target *Sthenoteuthis oualaniensis*. A description of the ika shibi portion of the Hawaii pelagic handline fishery is provided in section 3.7.3.3, while the artisanal directed squid fishery is described in section 3.7.3.4.

There are no directed commercial squid fisheries in any sub-region of the Western Pacific Region other than Hawaii (although small amounts of squid may occasionally be sold in local markets in Guam, American Samoa and the Northern Mariana Islands). It is possible that squid are sometimes caught for personal consumption in Guam, American Samoa and the Northern Mariana Islands, but no data on the subsistence catch in these islands are available. The only sub-region in the Western Pacific Region in which the ika shibi style of fishing is widely practiced is Hawaii. While early experiments with ika shibi fishing in Guam showed promise (Amesbury and

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swordfish is a global commodity (Ward, 2000), and U.S. fresh fish marketers were able to replace Hawaii-caught swordfish with foreign imports (Bartram and Kaneko, 2004). Marketers who were formerly major dealers in Hawaii swordfish products identified the primary sources of fresh swordfish replacing Hawaii products as eastern Pacific suppliers—California (as a consequence of the relocation of Hawaii-based swordfish longline boats), Mexico, Panama, Costa Rica—and South Africa. In general, the U.S. fresh swordfish supply is becoming increasingly dependent on imported products (Bartram and Kaneko, 2004). Fresh swordfish imports to the U.S. market began to increase in the mid-1990s. By 2002, swordfish imports accounted for about 71 percent of the total domestic supply.

[17] Hawaii's agricultural and fishery production sectors combined account for only about 1.8% of total state output, 1.8% of labor income and 3.0% of employment (Sharma et al., 1999).

Meyers, 2001), it is a rarely used method of catching pelagic species in the Territory (Meyers, 1993). Similarly, exploratory ika shibi fishing was conducted in the Northern Mariana Islands (Palacios, 1989), but no commercial fishery developed, A survey of the literature revealed no reports of ika shibi fishing in American Samoa or the U.S. Pacific remote island areas.

Squid is an international commodity produced and sold in many areas around the world. Consequently, the economic aspects of squid fisheries, particularly those involving distant-water fleets producing squid products for export, can only be fully understood by examining trends in squid fisheries worldwide. To provide this global perspective, the descriptions of the near-shore and distant-water squid fisheries of interest are prefaced by an overview of 1) landings trends in the major squid fisheries in the U.S. EEZ and elsewhere in the world; 2) squid capture methods; 3) squid handling and processing techniques; and 4) market trends for squid products.

3.7.3.1 Overview of Global Squid Fishery[18]

3.7.3.1.1 Harvesting Sector

3.7.3.1.1.1 Production

Squid fisheries are among the fastest growing fisheries in the world (Sonu, 1993). World squid production nearly doubled during the past two decades in order to keep pace with the rise in demand and appears to be still growing. Currently, more than 2 million mt of squid are landed throughout the world (FAO, 2000). From landing trends it seems that squid and other cephalopods are one of the few remaining marine groups of resources where some species in some areas are still experiencing increases in landings, in a world fishery marked by overfishing and decline of many finfish (FAO, 1992, 1994 cited in Caddy and Rodhouse, 1998). The fast pace of growth in squid fisheries is generally attributed to the development of squid fisheries in several regions around the world. In addition, it has been hypothesized that fishing-related reductions in predatory fish biomass and declines of other cephalopod predators such as marine mammals (e.g., toothed whales (Odontocetidae) have, in fact, positively affected oceanic squid and other cephalopod populations (Caddy and Rodhouse, 1998). Just as fast growing weeds can quickly colonize an area of ground that has been denuded of vegetation, it has been suggested that the rapid growth of squid and their short life cycles may have enabled them to move into regions that have been heavily overfished (Jackson, 2001). An increase in water temperature due to global warming could also favor population expansion of squids over fish (Christie, 2002; Jackson, 2001).

What is remarkable is that as recently as three decades ago squid fisheries were concentrated in the Northwest Pacific and virtually dominated by one nation, Japan, and one species, Japanese flying squid (*Todarodes pacificus*) (Sonu, 1993) (Figure 3.7-3). For instance, the 1968 catch of *T. pacificus* which totaled 668,000 mt, an historical high for this species, comprised 73 percent of

[18] This section depends heavily on reported landings provided by FISHSTAT Plus (FAO, 2000). Caddy (1989) notes that the quality of the information available to the FAO depends greatly on national reporting by governments. He suggests that the quality of government reporting may be decreasing as evidenced by a growing proportion of squid catch remaining unidentified to species group in official statistics.

the total world landings of squid for that year. Japan's share of the world catch for 1968 was nearly 83 percent (Sonu, 1993).

Figure 3.7-3 Annual Squid Catch in the Southwest Atlantic and Northwest Pacific, 1950-2000. Source: FAO, 2000

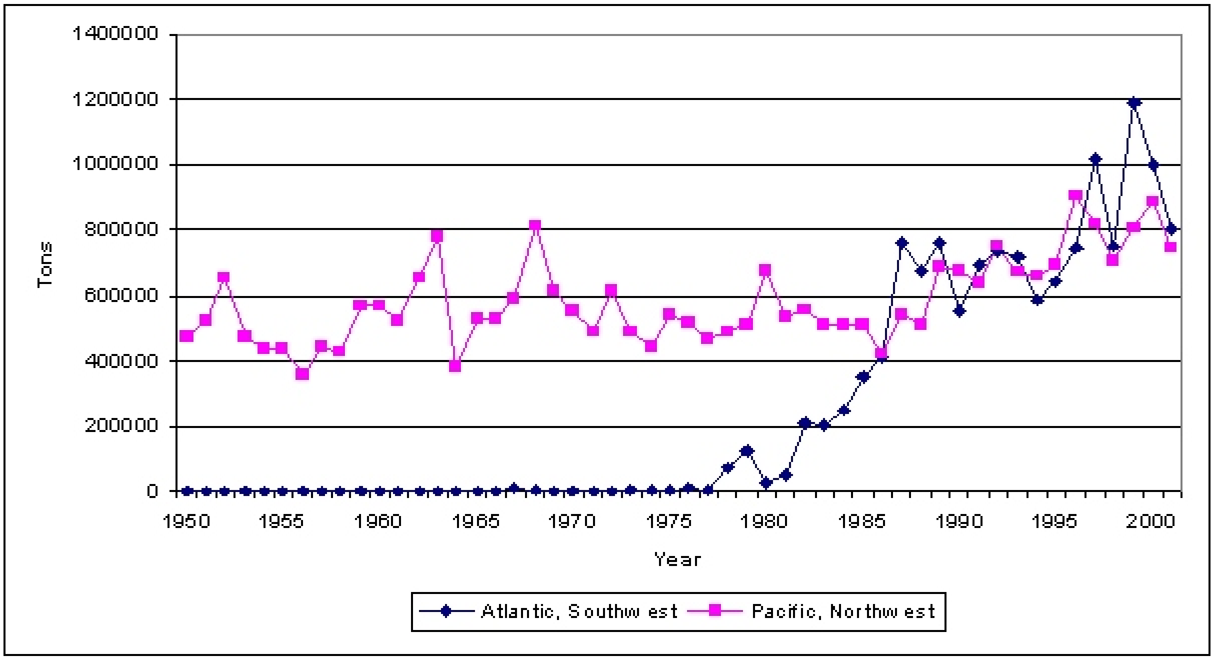
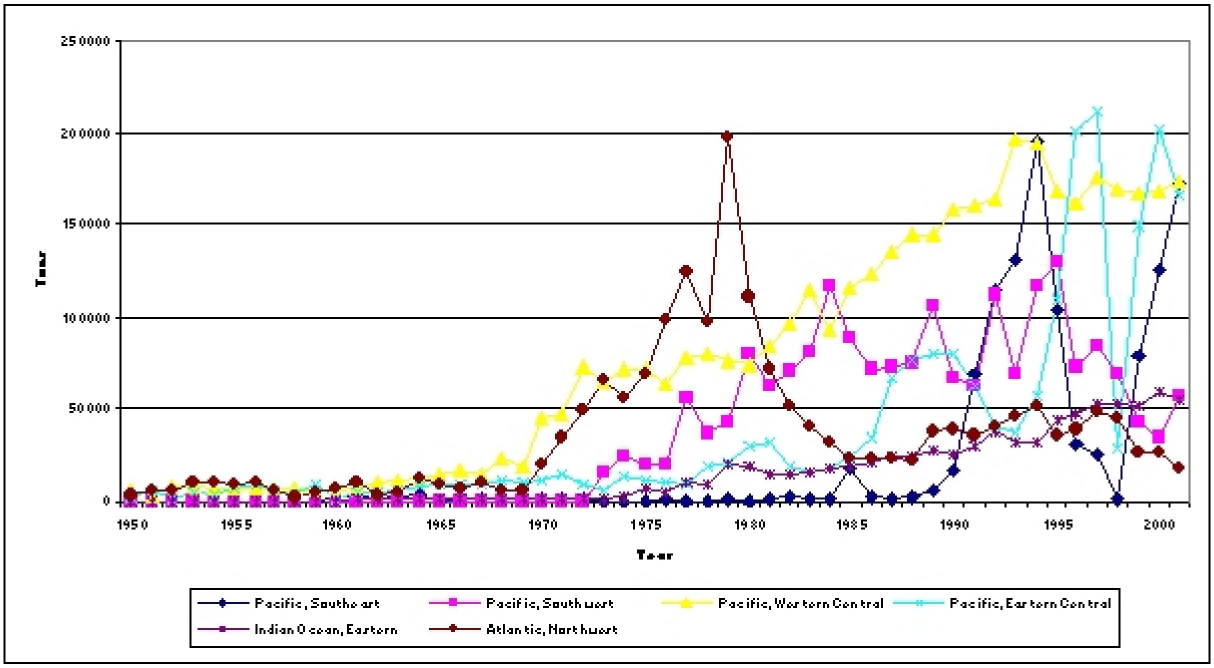


Figure 3.7-4 Annual Squid Catch in the Southeast Pacific, Southwest Pacific, Western Central Pacific, Eastern Central Pacific, Eastern Indian Ocean and Northwest Atlantic, 1950-2000. Source: FAO, 2000



The catch of *T. pacificus* in the waters near Japan dropped precipitously between 1969 and 1974 as a result of environmental factors and increasingly intense fishing pressure. However, by that time Japanese squid jigging vessels had increased in size and were using more sophisticated navigational and fishing equipment. These changes improved the ability of vessels to locate seasonally migrating schools of oceanic squid species over considerable distances and to select those areas of densest squid concentration to carry out their fishing operations (Murata, 1989). Beginning in the 1970s, there was an expansion of the Western Central Pacific fisheries by Japan using jigging and driftnet techniques and a development of fisheries outside the North Pacific targeting several different species (Sonu, 1993) (Figure 3.7-4). The diversification of squid fisheries in terms of regions and species was accompanied by an increase in the number of nations actively engaged in squid fisheries, as countries sought to increase export earnings as well as domestic food supplies (Japan External Trade Organization, 1993 cited in Sonu, 1993). The number of nations with more than 20,000 mt in annual squid catch rose from two in 1966 to 12 in 1990 (Sonu, 1993). Between 1975 and 1989, the world squid catch more than doubled, from 929 thousand mt to about 2.2 million mt.

One region in which an especially major expansion occurred was the Southwest Atlantic around the Falkland Islands and off Argentina (Figure 3.7-3). Japanese fishermen began to increase the harvest of Argentine shortfin squid (*Illex argentinus)* off Argentina in 1978 (Kohrin Sha, 1989 cited in Sonu, 1993). Typically, Japanese squid jiggers would fish for Wellington flying squid (*Nototodarus sloanii*) off of New Zealand for a short time before continuing on to the Southwest Atlantic. Eventually, Eastern European countries also began participating in this fishery and through this participation became important suppliers of squid to the world market. By the late 1980s, vessels from Japan, the Republic of Korea, Russia, Spain, Argentina, Poland, Germany, the United Kingdom and the Ukraine were fishing for squid in the region. During the late 1990's, the Southwest Atlantic fishery accounted for about one-third of world squid landings and was worth up to $1 billion (Bostano, 2002; FAO, 2000). The proceeds from the sale of squid fishing licenses in the EEZ around the Falkland Islands dramatically improved the economy of that country (Thomas, 2002). However, *Illex* catches in the Southwest Atlantic declined sharply in 2002. Some researchers are of the opinion that overfishing did not cause the fishery to collapse; rather, they believe that temperature-driven ocean currents swept squid larvae into the open ocean (Bostano, 2002). Catches in the Southwest Atlantic rebounded in 2003, but another drastic decrease in 2004 resulted in an early closure of the fishery by the Falkland Islands and Argentina.

Large fluctuations in abundance and availability are a feature of squid fisheries worldwide. They are short-lived animals, and catches of most species fluctuate widely from year to year, depending on water temperature and many other factors (SeaFood Business, 2000). It is difficult to count, with any degree of confidence, on a guaranteed supply from any one source. For example, Canada was the major supplier of frozen squid to Japan until 1982, when squid catches by Canadian vessels decreased sharply and exports to Japan from that country dwindled to zero (Sonu, 1993). From 1982 to 1990, Poland was the main squid supplier to Japan, but its exports declined in half in 1991 due to poor catches off the Falkland Islands.

Although individual squid fisheries tend to be very irregular, there is rarely a shortage because squid are now fished around the world. Generally, squid are always readily available from somewhere. Moreover, because squid reproduce rapidly, they tend to recover quickly from environmental factors or fishing effort. For example, stock abundance of *O. bartramii* in the Western Central Pacific was extremely low in 1993, probably due to high fishing rates derived from the driftnet fishery (Yatsu et al., 1999). After the driftnet fishery ended in 1992 as a result of an United Nations global moratorium on all large-scale driftnet fisheries, the *O. bartramii* stock seemed to quickly recover and abundance was high during 1994-96. Stock abundance was again depressed in 1997, the most prominent El Niño year in this century, but was high in 1998.

There is also the possibility that some squid species are considerably underutilized. Although almost a hundred species of squid are fished commercially, two species, the *T. pacificus* and *I. argentinus*, account for over half the world harvest (Pacific Seafood Group, 2001-2002). Fewer than a dozen species of squid account for almost 90 percent of the world production (SeaFood Business, 2000). Results from experimental fisheries suggest that there are squid species existing in substantial quantities that have yet to be significantly exploited. For example, one likely candidate for expanded harvests is the seven star flying squid (*Martialia hyadesi*), a Subantarctic, oceanic species (Rodhouse, 1994).

Major U.S. Squid Fisheries

Squid are harvested by U.S. vessels along both the East and West Coasts. Three species of squid are commercially important in U.S. waters, market squid (*Loligo opalescens*) on the Pacific coast, and long-finned squid *(L. pealei* and short-finned squid (*I. illecebrosus*) on the Atlantic coast. Vessels based in California and Rhode Island produced 92 percent of the total national harvest in 2001 (USDA, 2003). Annual landings of the U.S. squid fishery averaged approximately 69 thousand mt from 1980 through 2001 (FAO, 2000). However, the U.S. squid supply is characterized by cyclical periods of relative scarcity and abundance. The El Niño periods of 1983-1985 and 1997-1998 on the West Coast had an especially dramatic negative effect on domestic production.

A large portion of the U.S. catch is exported to markets in Europe and Asia/Southeast Asia (Pacific Seafood Group, 2001-2002). Despite the wide fluctuations in harvest, squid exports are an important component of U.S. seafood trade, increasing steadily from $25.5 million in 1990 to $91.5 million in 1997, a 258 percent increase (USDA, 2003). U.S. squid exports fell sharply in 1998 but averaged around $72.2 million from 1999 through 2002. China has generally been the largest single destination for U.S. squid exports since the mid-1990s, receiving $24.5 million, or about 40 percent of the total U.S. exports in 2002 (USDA, 2003).

California

As noted above, much of the variability in U.S. squid landings during the past decade is accounted for by periodic increase and decline in the catch of *L. opalescens* in the California fishery. In general, this harvest involves luring the animals to the surface with high wattage lamps, encircling them with purse seine nets and pumping and/or using brail nets to remove the squid from the water. The California fishery has a long history, dating back to the mid-nineteenth century, although catches were usually less than 10,000 tons until the 1960s (CDFG, 2003). During the early 1990s, the waters of California saw a rapid squid fishery expansion due to the exploitation of a previously "underutilized" population of squid off of southern California and an increased market demand fueled by the emergence of international markets (notably China). In the 1996-1997 season, California fishermen caught a record 124,309 tons of market squid, with an estimated dockside value of $33.3 million. *L. opalescens* was the most valuable commercial fishery product to the state in terms of volume and revenue and became one of the most highly sought after fisheries in California (Lutz and Pendleton, 2000). However, landings plummeted to less than 12,000 tons during the El Niño of 1997-1998. The fishery bounced back during the 1999-2000 season, surpassing the previous record with a catch of 126,772 tons, worth nearly $35 million. This catch was followed by another good year in which 119,000 tons were caught with a value of $22.8 million. However, the 173 licensed purse seiners and 39 light boats brought in only 39,000 tons during 2003.

The market squid resource is managed by the California Department of Fish and Game and California Fish and Game Commission. Prior to 1997, the market squid fishery was largely an unregulated, open access fishery. In that year, California legislators placed a moratorium on the number of vessels in the fishery as a result of the increasing market interest and rising squid landings. There is currently no quota on squid; however, the Department of Fish and Game is preparing a fishery management plan for this species.

New England

L. pealei is an important U.S. commercial squid species because of its comparatively high value (Rathjen, 1983 cited in Sonu, 1993). This species is preferred in the European markets for its excellent taste and texture qualities compared to *I. illecebrosus* and larger size compared to *L. opalescens*, and brings a considerably higher price on foreign markets than the other two species.[19] Both *L. pealei* and *I. illecebrosus* inhabit deep waters of the continental shelf through most of the year, moving into shallow waters in spring and summer at which time they become available to fishermen employing bottom trawl gear (Rathjen, 1973). While foreign vessels had been catching these species since the mid-1960s, heavy fishing by U.S. fishermen only began after 1983. During the early 1980s, NOAA Fisheries and the Mid-Atlantic Fishery Management Council initiated a policy of tying foreign fishing allocations to agreements by foreign interests to purchase squid from U.S. fishermen. As a result, foreign allocations and catches declined, while the U.S. domestic catches increased. Between 1981 and 1990, the domestic catches of *L. pealei* and *I. illecebrosus* rose from 2,947 mt to 26,509 mt, while foreign catches dropped from about 35,000 mt to zero. In 2001, about 14,211 mt of *L. pealei* and 4,009 mt of *I. illecebrosus* were landed in the East Coast fishery, accounting for around 14 percent and 4 percent of the domestic squid catch, respectively.

Both the *L. pealei* and *I. illecebrosus* fisheries are managed by the Mid-Atlantic Fishery Management Council under provisions of the Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan. The fisheries are managed under separate limited entry programs. Every year the Council establishes the maximum allowable biological catch for each species. The commercial quota for *L. pealei* is allocated into quarterly periods. With some exemptions, otter trawl vessels possessing *L. pealei* are subject to a mesh size restriction.

Difficult economic conditions for New England's commercial fishing fleet have led to a search for new fishery resources, and alternative species of squid are among the potential resources of interest (Vecchione and Galbraith, 2001). Moreover, there is interest in adopting alternatives to bottom trawl gear in order to reduce bycatch, interactions with marine mammals, gear conflicts with other types of fishing operations, and disturbance of bottom habitat. To further these combined goals, an experimental jig fishery was conducted by a private firm in 1996 under a Saltonstall-Kennedy grant. The fishery tested the feasibility of a commercial fishery for squid using jigging gear and assessing the availability and distribution of oceanic squid resources along the edge and off the margins of the continental shelf in the New England and the Mid-Atlantic regions. While there were hopes to find an abundance of orangeback squid (*Sthenoteuthis pteropus*) and other squid species, *O. bartramii* was the only species that showed any potential for future expanded exploitation.

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[19] In general, the loligo species, which account for about 20 percent of the world catch, are generally preferred because they are considered more tender (SeaFood Business, 2000). As a rule, squid belonging to the Ommastrephidae family are larger and have a tougher membrane, which gives them a more coarse texture.

3.7.3.1.1.2 Types of Fishing Gear Used

Squid are caught in a variety of ways, but on a worldwide basis jigging has historically been the most important single fishing method employed (Rathjen, 1991). This technique is especially favored for harvest of pelagic species of squid, including *O. bartramii*. Jigging also accounts for the bulk of production of *I. argentinus* taken from the southwest Atlantic (Rathjen, 1991). The fishing gear description presented here centers upon that method of fishing, but a number of squid netting techniques are briefly described and contrasted in various ways with jig gear.

Jigging

Squid jigging is carried out on very specialized boats. Almost all aspects of the jigging fishery have undergone rapid changes within the past few decades (Saharuddin et al., 1990). Automatic squid jigging machines have been widely used since around 1965. Computer operated automatic jigging machines were developed in the late 1980s (Lee et al., 1997). These changes were related to boat size and reflected the increase in fishing intensity as squid fisheries changed from coastal to distant-water fisheries (Saharuddin et al., 1990).

Japanese researchers are responsible for many, if not most, of the advancements in squid jigging techniques. While these researchers have published numerous articles on squid fishing technology in trade journals and scientific publications, a major portion of this literature is written in Japanese and thus is difficult for non-Japanese to utilize (Rathjen, 1991). The description of squid jigging gear provided here represents a précis of the more accessible literature.

Many automatic jigging machines are available on the world markets today for both hydraulic and electric power (Bjarnason, 1992). A modern 50-70 m vessel will be equipped with 50-70 jigging machines (Rathjen, 1993).[20] These machines work on the same principle as jigging by hand but are made less labor intensive by the use of electric or hydraulic motors which automatically move the line up and down in a jigging motion and retrieve the line when squid are hooked. The adoption of this technology led to a significant reduction in the number of crew employed on each vessel (Murata, 1990).

The jigging machines wind a line over an elliptical or oval shaped reel. Normally a single squid jigging machine drives two reels. Two reels are mounted on each side of a shaft and one sinker-weighted line is attached to each drum (Court, 1978). Most machines are equipped with a line-laying device. Earlier machines had an externally mounted sliding-train device, while on later machines the whole shaft moves slowly back and forth, causing the line to wind onto the reel at intervals along its axis. A mesh-covered frame extending the full width of the machine is hinged outboard, and when lowered during fishing, projects about one meter over the water. Lures or jigs equipped with sharp, barb-less hooks are attached to each line at short (e.g.,70 to 90 cm) intervals, and the lines are passed over rollers mounted on the outboard edge of the mesh-covered frame.

[20] The number of jigging machines that can be placed on a vessel depends on the vessel's deck configuration as well as its size.

The lines are lowered to a 30 to 100 m depth depending on the strength of the lights used (Bjarnason, 1992). The turning of the reels causes the lure to move upwards through the water in a rhythmic jerking movement which attracts the squid and helps ensure that they remain on the hooks (Black et al, 1987).[21] As the lures are recovered over the front rollers this pressure is released, and the squid drop onto the mesh-covered frame between the two rollers. The screen is sloped so that the squid will drop onto the deck or into a flume which carries them below deck for processing. The jigging machines are designed to fish continuously, and when everything is operating properly, a minimal amount of labor is needed (Lemon and Rycroft, 1982). Most machines will stop automatically when they malfunction. Because a machine continuously reels many jigs, it functions best in dense concentrations of squid (Court, 1978). The machines are operated so that adjacent lines move in opposite directions; thus, no matter when a school of squid passes under the boat, half the lines are apt to be productive. A vessel fishing a large school of squid will often deploy a sea anchor in order to maintain position (Lemon and Rycroft, 1982).

Most automatic jigging machines have an easily operated control board which can be adjusted to suit most fishing conditions. Variables that can be controlled include: hauling power and speed; jigging speed and span or length; jigging timing in relation to span or length; depth or distance from bottom; and sensitivity when hauling to prevent slackening or overloading of the line even when the boat rolls. These variables can be adjusted using a computer console to increase fishing efficiency and catch rates (Lee et al., 1997).

A typical lure is about 70-mm long and consists of one or more rings of hooks with an ellipsoid lure above. However, the lures are manufactured in various sizes, shapes and colors, and new ones types are continually being developed. For example, Guo et al. (1997) describe two new kinds of jigs that have been devised, the impeller-jig and the roller-jig, which attract the squid and hold them firmly with the visual stimulation of the rotating parts. In addition, some fishermen attach lights to the lines to increase catch rates (Flores, 1982).

Jigging uses the squid's natural behavioral characteristics to make catching easier. The boats have powerful lights strung above the deck that illuminate the water and attract small fish. The squid group in the boat's shadow and then dart into the light to feed on the fish. The knowledge that squid can be attracted to light has been utilized as an aid in harvesting squid for centuries (Flores, 1982). Torches were replaced by the electrified fishing lamp around 1950, and since then, the invention of the high intensity discharge (HID) lamp and other types of lamps have improved the performance of jigging operations. The optimal light intensity is the most important item in jigging activity and has been the subject of intense study in Japan (Flores, 1982).

The light arrangement on a squid jigging vessel basically consists of a row of lamps along the fore-and-aft line of the vessel which are hung to a pole or a line stretched horizontally between the fore mast and the mizzen mast (Flores, 1982). Large vessels may have two of such rows with 25 - 50 2,000-4,000 watt lamps per row. This specific arrangement of the lamps over the vessel rather than over the water is due to the peculiar reaction of the squid, which prefer to aggregate in

[21] The hooks may penetrate the skin of the tentacles as a squid grasps the lure, but they generally leave only barely perceptible marks on the animal (pers. comm., Mike Seki, NOAA Fisheries Pacific Islands Fisheries Science Center, 10/21/03).

the boundary area between the shadow of the vessel and the lighted area. The position of the lines in relation to the location of the boundary area is therefore of great importance. The location of the boundary area can be adjusted by the height of the lamp and by its distance from the centerline of the vessel. The position of the lines can be adjusted by the length of the roller arm. Ogura (1981 cited in Flores, 1982) reports that if the lines are set in the boundary area the catch is best. Further investigations showed that the relationship between the lamp light beam, water line, and fishing lines influences the catch considerably. Results showed that the catch is better when the so called triangle falls below the waterline. This is achieved by adjusting the length of the roller arm and position of the fishing lamp. Catches of some species of squid may be affected by the phases of the moon, with lower catches during the full moon period (Flores, 1982).

Sometimes underwater lights are used on large boats. They are sunk as deep as possible and then slowly hauled back to the boat (Bjarnason, 1992). This is done to try to lure the squid from deep water into the light or shade from the above deck lights. In addition to experimenting with different lighting arrangements, researchers have investigated other ways to increase catch rates, such as using artificial sound (Choo and An, 1998).

Jigging can be a very productive form of fishing. For example, near New Zealand one jigging machine reportedly caught 1,491 kg of squid in six hours (Wolfe, 1973 cited in Court, 1978), and Voss (1973 cited in Court, 1978) notes similar catch rates for boats which had 20 to 24 machines. A representative of the Hawaii-based distant-water squid jigging operation reports that the catch of that operation reaches 16,000-18,000 kg per night when fishing in the waters off New Zealand; while the catch on North Pacific fishing grounds can reach 8,000 kg per night (pers. comm., Bob Endreson, 10/8/03). The representative notes that the squid caught in New Zealand are substantially smaller than those caught in the North Pacific.

Moreover, the quality of the squid caught with jigging tends to be comparatively high — the squid arrive on deck still alive and with little or no mechanical damage. The time lag between being caught and frozen is low with jigging, as this fishing method tends to assure steady and controlled catches (Court, 1982; Leta, 1982). Furthermore, jigging has the benefit of being a "clean" fishing method with little incidental catch of non-targeted species and no destructive interference with benthic fauna or habitat (Rathjen, 1993). A representative of the Hawaii-based distant-water squid jigging operation reports that operation brings no bycatch species on-board, but it loses a large quantity of fishing gear due to interactions with blue sharks (pers. comm., Bob Endreson, 10/8/03). The operation uses fishing lines that are 30-60 lb test, and the lines quickly break when sharks attack the hooked squid.

Bower (2004) cites Japanese studies indicating that large squid often drop from jigs as they break the surface due to their weak tentacles. Surveys of *O. bartramii* fisheries in the North Pacific central and eastern sea areas reported drop-off rates of 36 to 52 percent (JAMARC, 2003a, 2003b cited in Bower, 2004). Guo et al. (1997) note that the long, thin arms of *O. bartramii* make this species susceptible to drop-off when pulled up by jigs. Japanese researchers have developed new jig designs in an effort to reduce the number of drop-offs (Guo et al., 1997; Yada et al., 1997).

Netting

The use of various types of nets is the method often used for harvesting loliginids, which generally occur in shallow, nearshore waters. The most productive netting technique is trawl fishing. At present, trawling tends to be the most important squid harvesting technique in the North Atlantic, probably due to the intensive use of trawling gear in the fisheries of this region (Rathjen, 1991). The principal fishing gear used in the U.S. *L. pealei* and *I. illecebrosus* fisheries is the squid otter trawl. This gear type is also commonly used to catch squid and cuttlefish in the Gulf of Thailand. In all types of otter trawls, the diverting ("paravaning") effect of otter boards or doors keeps the otter trawl spread open horizontally. A weighted groundrope and floats on the headrope keep the net open vertically as the nets are towed over the seabed.

While trawling can be an economically efficient method of catching squid, catch quality may be more difficult to control in comparison to jigging. A major deteriorative reaction bringing about a loss in quality in squid has been identified as enzymatic proteolysis that results in the formation of free protein degradation products such as peptides and amino acids (Rathjen and Stanley, 1982). The enzymes responsible for this reaction are present in squid in levels much higher than other marine species. This reaction leads to a softer texture and probably enhanced bacterial action with concomitant off odors and flavors. Trawling exposes the susceptible squid tissue to high levels of physical forces including squeezing and compression that could initiate liberation of proteolytic enzymes and the ensuing loss of quality.

Moreover, unlike jigging, trawls may produce large amounts of species that are not targeted. For example, the directed fisheries for *L. pealeii* in the Northwest Atlantic frequently catch large amounts of butterfish (*Peprilus triacanthus*) (Kolator and Long, 1979; Rathjen, 1991). This finfish is itself commercially valuable, but the small individuals caught in the squid fishery are unmarketable and therefore discarded. In October 2001, a Northeast Fisheries Center observer documented the take of a leatherback sea turtle in a bottom otter trawl fishing for *L. pealeii* off of Delaware. The mainland squid trawl fishery in New Zealand has generated opposition from environmental advocacy groups because of incidental catches of sea lions, fur seals, basking sharks, and seabirds (Weeber, 2004).

Seine and lift nets of various forms are also employed to harvest squid (Rathjen, 1991). Although seining is for the most part a comparatively little used technique, the purse seine is important in the California market squid fishery (Lutz and Pendleton, 2000; Rathjen, 1991). Purse seine gear functions by encircling squid in a netted bag. When deploying the net (making a set), a motor skiff is used to position the net around a school of squid. A typical seine net used in the California fishery is 185 fathoms long and 22 fathoms deep. A crew of four or five is commonly needed to handle typical seine gear although fewer are needed if a drum seine is used, which rewinds the net onto a large reel. After the net has been set and closed, the squid are typically sucked into the hold by centrifugal wet pump machinery lowered into the drawn net. In a seining operation, spotter planes and satellite and sonar technology assist fishermen in locating and tracking schools of squid. Additionally, at night, "light boats" equipped with generators and a large array of high-powered electrical lights are employed to attract and maintain schools of squid.

The incidental catch of non-target species is minimal in the commercial market squid fishery, although it cannot be avoided entirely (CDFG, 2003). Most of the incidental catch is other coastal pelagic species, including Pacific sardine (*Sardinops sagax*), Pacific mackerel (*Scomber japonicus*), northern anchovy (*Engraulis mordax*) and jack mackerel (*Trachurus symmetricus*). Smaller vessels in the California fishery use power-assisted lift nets (brail nets) in conjunction with attracting lights (CDFG, 2003). A similar fishing method is used in Southeast Asia, especially in the Gulf of Thailand and Philippines squid fisheries (Rathjen, 1989; SEAFDEC, 2002-2003).

The now largely defunct high-seas driftnet squid fishery targeting *O. bartramii* was prosecuted in the waters of the central North Pacific by fleets from Japan, Korea and Taiwan. Squid driftnets were made of transparent, monofilament nylon and manufactured in panels (tans or poks) approximately 9 meters wide and 50 meters long (Gong et al., 1993; Yatsu et al., 1993). The mesh size that was employed varied with the fleet and with the time of year. Mesh sizes increased as the squid grew during the fishing season. Individual net panels were attached together to form sections a few kilometers long. A lead line was attached to the bottom of the driftnet to stretch it out. Larger buoys, flashing lights and radio beacons were usually attached to help locate the driftnet for retrieval. Most of the larger vessels deployed 810 sections per night or between 40 and 60 kilometers of netting (Wetherall, 1989). The sections were strung along a float line with 100 to 1000 meters between sections. Sometimes sections were set parallel to one another and/or a fleet of vessels would form an array of nets.

During the 1980s, between 200,000 and 300,000 mt of squid were caught annually by driftnets in the North Pacific, with a landed value exceeding $250 million (Gong et al., 1993; Wetherall, 1989). Lee et al. (1997) report that the fishing efficiency of driftnets was higher than that of jigging when targeting *O. bartramii*. This species has long, thin arms which may break off when pulled up by jigs (Guo et al., 1997). In addition, the shape of their fins, which form an angle at the point of attachment to the mantle, is conducive to entanglement at certain combinations of body size/mesh size (Rathjen, 1991). The catch per boat per fishing day using driftnets was 1.5-3.8 times greater than that of jigging in the same fishing grounds (Murata, 1990). In addition, operating costs were less with driftnet fishing, as no lights were used to attract the squid, resulting in lower fuel consumption (Yeh and Tung, 1993). Driftnet fishing was also attractive because capital costs were comparatively low. Many different types of vessels could easily shift to this fishing method with the purchase of relatively cheap, second-hand nets.

Although driftnets were deemed more effective in catching squid than jigs, the non-selective nature of this gear and the impacts of the fishery on marine mammals, seabirds and other marine life led to United Nations General Assembly Resolution 46-215 which mandated a global moratorium on all large-scale driftnet fisheries by December 31, 1992. However, despite the actions taken by the international community to implement the UN moratorium, sporadic large-scale high seas driftnet fishing activity persists in the North Pacific. For example, the USCG received two unconfirmed reports of illegal high seas driftnet activity in the North Pacific in July and August 2002 (NMFS, 2002). On 25 July 2002, Japanese squid jigging vessels reported three driftnet vessels operating at 41°25'N, 169°06'E. One of the vessels was identified as a vessel from China. Approximately two weeks later, U.S. and Canadian commercial tuna fishermen observed two vessels tending driftnets near 42°06'N, 166°12'E. It is possible that the sightings may have involved the same vessel or vessels.

3.7.3.1.2 Processing Sector

3.7.3.1.2.1 On-Board Processing

In addition to being highly perishable, squid are more susceptible to damage than gutted finfish if not handled carefully; crushing, scuffing or tearing of the skin, and burst ink sacs are indicative of rough handling (Stroud, 2001). An important factor in maintaining good quality is speed and workmanship (Kreuzer, 1984). Furthermore, in today's highly competitive markets, generating top quality seafood often means freezing products at sea at very low temperatures (20 degrees below zero or colder). By freezing a fishery product at sea, the natural deterioration of fish products is halted. In addition, preservation of the skin color of fresh squid (an important quality criterion in the demanding Japanese market) entails freezing the squid as soon as they are brought on board in order to prevent drying (Sugiyama et al., 1980). On-board freezing of squid increased in importance with the development of distant-water fishing in the 1960s (Kreuzer, 1984). Today, freezing is the most important method of preservation in squid fisheries, and frozen at-sea squid is of considerable importance in international trade. In order to produce a high quality product, the squid are blast frozen within 20 minutes of being caught.

On a typical industrial-scale squid jigging vessel, squid which have been caught are transmitted directly to the below-deck working area by trough, slipway, conveyor, etc. (Lemon and Rycroft, 1982). Water washing and drainage occurs at the working area, although some vessels are equipped to carry out water washing during transit. Squid in poor condition are culled out and thrown overboard. The squid are hand sorted into different size classes and carefully packed in two or three layers, laid out evenly tail by tail with tentacles folded under and along the outside of the block. The traditional block size is 8.5 kg.[22] Each block carries a tag indicating the number of squid per block. This is an important marketing consideration, for in the market, all things being equal, larger squid command a higher price (Lemon and Rycroft, 1982).

The blocks of squid are quickly frozen in a freezing chamber using the contact-freezer or semi-air blast method. At the completion of freezing, the squid are removed and a glaze is applied by immersing the frozen blocks in fresh water for 5 to 6 seconds. The glazed squid are then placed in a corrugated board box for sheathing and are stored in the fish hold at -25°C to -35°C. Glazing and packing the frozen blocks are essential in order to prevent dessication during cold storage (Kreuzer, 1984). In addition, stowage in boxes is generally better than bulk stowage because there is less risk of crushing and bursting the ink sac. Whole squid keep in good condition in cold storage at -30°C for 9 months or more.

Squid are not normally gutted at sea because many markets prefer them whole; the ink and the tentacles are often used along with the flesh of the mantle when preparing squid for eating. The form in which squid is frozen at sea is changing. While in the past they were all frozen whole, now some vessels freeze their catch as skin-on uncleaned tubes (Kreuzer, 1984). The fins and

[22] Sorted squid may be packed in containers of different sizes. For example, large squid such as *O. bartramii* are packed in containers of 10 kg or larger (Sugiyama et al., 1980).

head and tentacles are removed and packed onto separate freezing trays. Next, the mantles are butterflied, the viscera are removed and discarded, and the product is placed on a third set of trays. Alternatively, the squid are headed and eviscerated and only the tubes are frozen.

Vessels that supply markets for squid in which product color is not an important quality criterion may forego investments in on-board freezing capacity. No difference in taste is apparent between squid that are frozen immediately or after having been properly chilled or iced for 1-2 days or so, provided optimal handling procedures are followed on board the vessels from the time the squid are caught (Kreuzer, 1984). For example, in the California market squid fishery none of the vessels have on-board flash freezing capability. However, the fishery occurs in shallow waters (generally within a mile of shore), and usually the squid are landed within hours of capture (Lutz and Pendleton, 2000). After being offloaded, the squid are trucked to processing facilities where most of the squid is frozen whole in blocks or individually quick frozen.

3.7.3.1.2.2 Shoreside Processing

Land processing methods vary according to type of fishery, kind of raw material and specific products produced (Kreuzer, 1984). However, after being transported frozen to a processor, the edible parts of squid are generally prepared in the following manner. First, the whole squid are thawed by hot water and washed. The tentacles are cut off just in front of the eyes and retained, as they can be eaten once the suckers have been removed. The head is twisted and the mantle is squeezed while the head, pen and viscera are gently pulled out. The mantle can be left whole, with the gut cavity washed out, or it can be split and opened so that any remaining guts can be scraped or washed away. The skin on the mantle can be peeled or scraped off; blanching in hot water at 25-30°C for about 15 seconds makes the skin easier to remove. Machinery for the entire process of heading, gutting, skinning and cutting is available.

The yield of edible meat from squid depends on various factors such as species, size, season, processing methods, etc. (Kreuzer, 1984). Although squid have a much higher yield than finfish, at least 30 percent of the animal may be inedible when processing products for human consumption. However, most inedible parts can be transformed into potentially valuable products. The skin can be used to produce a high protein solution that is added to animal feed (Learson et al., 1982). The viscera can also be used as animal feed. The eyes can be used in the paint industry for their high luminosity, and certain parts of the gut wall may be used in the cosmetics industry. The lipid and fatty acid compositions of the integument of *O. bartramii* is being assessed as a possible new source of phospholipids containing docosahexaenoic acid (DHA) (Deng et al., 1999). Omega-3 fatty acids, specifically DHA, are widely touted for their health benefits. Its high chitin content (90 percent) also makes the internal shell useful for many other medical and health-related applications (Learson et al., 1982). For example, it is currently used for bandages and burn dressings, as it reduces scars and infection and improves healing. At one time the integument was also investigated for its use in the manufacture of contact lenses (Learson et al., 1982). Finally, the squid beak is prized in Japan for its purported aphrodisiacal attributes (Learson et al., 1982).

As a result of the extensive international trade of frozen squid, costs largely dictate the level of processing that occurs in various countries. For example, due to lower labor costs overseas, many

U.S. processors freeze whole squid into blocks and export the blocks to China and other countries for secondary processing into tubes, tentacles, rings, breaded or canned seafood products for re-export. Relatively small quantities of U.S.-caught squid receive additional domestic processing.

In addition to being processed for human consumption, squid are frozen for bait and supplied to domestic commercial and recreational anglers. Squid is an especially desirable bait in longline fisheries because it holds up well in the water and will not easily tear off the hook (Sonu, 1993). The market for *I. illecebrosus* has primarily been for bait. This species is preferred over *L. pealei* because it is larger, has a thicker and tougher mantle, and also because it is significantly less expensive. In addition to providing bait to domestic fishermen, East Coast producers provide *I. illecebrosus* to export bait markets in Canada, Iceland and other countries. The *L. opalescens* fishery is an important source of both frozen bait and live bait for the California recreational fishing industry (CDFG, 2003).

3.7.3.1.3 Market Trends for Squid Products

The volume and value of international trade in squid products have increased dramatically over the past two decades. World imports of squid in all forms (frozen, fresh or chilled, seasoned, dried, salted or pickled) rose from about 89,000 mt (valued at approximately $138 million) in 1980 to just over 506,000 mt ($849 million) in 2001 (FAO, 2000). Squid have a well-defined group of consumers concentrated in relatively few markets, the principal ones being Japan and countries of Southern Europe (primarily Spain). In these markets, squid products have a definite segment of the food market and compete with meat or other fish products to a limited extent only. There is, however, significant competition within the global squid market. For the most part squid products are commodities that face strong international competition for access to export markets. For example, California market squid competes with squid from the New Zealand and Falkland Islands fisheries for the Chinese market. Because of the international competition, prices tend to move in parallel over the medium to long term, with Japanese demand setting the trend (ITC, 1989).

In some markets, particularly Japan, there is also competition between domestic and imported products (Sonu, 1993). To supplement its domestic catch Japan imports around 50,000 mt of squid each year. These imports make up about 10 percent of the Japanese market. Before Japanese landings of *T. pacificus* dropped sharply in 1971 Japan prohibited imports of squid. In 1971, imports were allowed but import quotas are maintained on seven product forms of squid and cuttlefish: live, fresh, chilled, frozen, salted, brine-soaked and dried. Product forms which are exempt from import regulations include processed squid which has been flavored, such as smoked and prepared or preserved products (i.e., canned, boiled, seasoned or fermented products). Import quotas are set every six months. Because imports represent a small percentage of total domestic consumption of squid, they are too small to influence domestic prices.

Japan's quota system sets not only the amount of annual imports but also decrees recipients of import quotas (Sonu, 1993). Quota allocations can be purchased for a fee, which varies according to prevailing squid prices. The transferred import quota is, however, credited to the original holder. Since the import quota allocation is based mainly on previous import records, the system guarantees that the same holders will continue to be given allocations even if they have no intention of buying squid themselves. There is a great deal of variation in the amount of quota held by individual importers, who are reported to number more than 200. In Japan (and other countries such as China) a major share of squid imports has been handled by trading companies, which usually have one or more seafood import departments (ITC, 1989). In recent years, however, the numerous supermarkets under large national chains have also become a significant factor in Japan's seafood industry.

Because of the limited import quotas, importers seek items which bring high profitability, usually those that fill special niches in the Japanese market (Sonu, 1993). Even with import quotas it appears that the volume of imports is affected by prices of domestic squid. When prices are low, importers have little incentive to use their allotted quotas.

Imports of squid into Japan are also subject to tariffs (Sonu, 1993). As Japan and the United States are signatories to the General Agreement on Tariffs and Trade, lower tariffs apply to U.S. exports of squid products: five percent for fresh or frozen products, and 15 percent for salted, dried, prepared or preserved products (including products in airtight containers). Tariff rates are calculated as a percentage of CIF (cost, insurance, freight) value.

Squid prices have a seasonal cycle, being lower in July-September owing to Japanese landings during that period (Food Market Exchange.com). Another important element influencing squid prices are catches in the Southwest Atlantic. Eastern European countries have tended to sell at low prices when catches in the area are high, often depressing world market prices for other varieties of squid as well. In general, Japanese importers pay higher prices than Europeans, and most of the world supply goes to Japan for as long as the national import quota remains unfilled.

With respect to the prospect of market expansion, some of the traditional markets, including Japan and Spain, are expected to show little or no growth (Anon., 2001). Squid and cuttlefish combined remains the leading seafood consumed in Japan due to the wide range of utilization of these seafoods such as sashimi, family cooking use, institutional and restaurant use, and many kinds of processed food. The market for these cephalopods in Japan has returned to normal following the financial crisis in the late-1990s. However, the long-term demand is uncertain because of the switch of younger Japanese to a more western-style diet (Anon., 2001).

On the other hand, squid consumption is expanding in Northern Europe and the United States, which are areas traditionally having low consumption figures. Americans generally prefer to call squid "calamari," the Italian name for squid, and the average U.S. consumer has a strong aversion to buying whole, wet squid (although that may not be true of some ethnic groups in the United States, such as those with an Asian or Mediterranean background). Nevertheless, imports of squid into the United States are increasing and this trend is expected to continue. Since 1990, U.S. squid imports have grown from 13,000 to 47,600 mt in 2001 (SeaFood Business, 2000). Dozens of countries are now exporting squid to the United States. The biggest supplier is Asia, where squid from all over the world is reprocessed into a variety of products, including steaks, rings, cleaned tubes and tentacles. China, the single largest supplier of squid, accounts for about one-quarter of all U.S. squid imports, followed by Taiwan, India, South Korea, and Thailand.

Almost all of the squid imported from China is reprocessed product, including large volumes of California market squid.

The domestic consumption of squid is spreading among the non-ethnic as well as the ethnic U.S. population (Sonu, 1989). New products catering to the non-ethnic groups, such as battered, breaded squid rings and steak strips are being successfully marketed. Other favorable factors include the so-called “grazing” trend — the tendency for restaurant patrons to forgo a full meal and be satisfied with an appetizer only — and the fact that squid products are easy to prepare at restaurants. Brown (2002:116) notes the mass-appeal of squid to restaurant patrons:

> *Fried calamari may be the most popular restaurant appetizer in all of Christendom. I’m amazed that McSquid hasn’t started popping out of drive-thrus worldwide.*

SeaFood Business (2000) describes the attraction of squid as a menu item in the U.S. food service industry. They note that the world-wide abundance of squid maintains a downward pressure on prices. Recently, cleaned tubes and tentacles may be purchased from importers for $1.10 to $1.85 a pound. The cheapest squid are small (3- to 5-in) product from China, while large (8- to 12-in) tubes from Thailand are at the high end. Squid steaks may sell to distributors for $2.45 to $2.65 a pound. Restaurants can take 3 oz of squid, costing less than 50 cents, and charge $6.95 or $7.95 for it breaded or battered as an appetizer.

3.7.3.2 Domestic Distant-Water Squid Fishery in the Pacific

The domestic distant-water squid jigging fishery in the Pacific is currently being prosecuted by a single operation and is a very small contributor to the Pacific squid harvest. The vessels of this one operation occasionally call into Honolulu and Dutch Harbor, but the operation may be relying mostly on at-sea transshipment to deliver product to buyers. The level of on-board processing depends on the size of the squid caught and the preferences of buyers (pers. comm., Bob Endreson, 10/8/03). All of the product of the operation is currently destined for the Japanese market (pers. comm., Bob Endreson, 10/8/03).

3.7.3.2.1 Number of Vessels Involved

According to a representative of the U.S. distant-water squid harvesting operation, the operation consists of four catcher vessels (pers. comm., Bob Endreson, 10/8/03). The mothership is 47 m long and holds 1 million lbs of squid. It is a Japanese-built vessel that was seized by the USCG for illegal driftnet fishing, bought at auction, and given a U.S. fisheries endorsement. It has 38 jigging machines on board and cost $1.5 million to convert. The other three catcher boats are converted crab boats from Alaska. They range from 32 m to 34 m in length, and each holds between 450,000 lbs and 850,000 lbs of squid (Table 3.7-11). Fitting out the vessels for squid fishing was costly (the least expensive boat was $1.2 million) because of the need to install blast freezers aboard each boat (pers. comm., Bob Endreson, 10/8/03). The total investment of the operation is about $20 million.

Table 3.7-11 Characteristics of the Vessels Participating in the Domestic Distant-Water Squid Fishery in the Pacific. Source: NOAA Fisheries PIRO.

Vessel Name	HSFCA permit issue date	Length (m)	Gross tonnage	Hold capacity (m^3)	Crew no.
Pacific Wind	22-Apr-02	47.1	642	443.77	18
Pacific Ballad	04-Sep-01	32.5	327	438.27	12
Pacific Star	04-Sep-01	33.3	277	208.19	12
Pacific Venture	04-Sep-01	34.2	335	527.05	12

Honolulu is listed on the High Seas Fishing Compliance Act (HSFCA) fishing permit and application as the hailing port of all the vessels. Each vessel is incorporated under a different name, but the owner's address listed in the USCG vessel data base is the same for all vessels.

3.7.3.2.2 Type and Quantity of Fishing Gear Used

The U.S. distant-water operation relies solely on the jigging method of harvesting squid. The four catcher boats each carry 21-38 jigging machines (pers. comm., Bob Endreson, 10/8/03).

3.7.3.2.3 Species of Fish Involved and Their Location

According to the HSFCA fishing permit and application, the vessels participating in the U.S. distant-water operation are licensed to fish in the following six FAO fishing areas:

61. Northwest Pacific;
67. Northeast Pacific;
71. Western Central Pacific;
77. Eastern Central Pacific;
81. Southwest Pacific; and
87. Southeast Pacific.

The U.S. distant-water operation competes directly with international fleets in oceanic squid fisheries outside the U.S. EEZ. The operation fishes to the north of the Hawaiian Archipelago (at around 45°N) in zones of enhanced biological productivity. The primary species targeted in the North Pacific fishery is *Ommastrephes bartramii* (commonly referred to as the neon flying squid or red flying squid). This fishery is seasonal, usually occurring during the summer months of the Northern Hemisphere.

In addition, the U.S. distant-water operation fishes in the New Zealand EEZ where it operates under charter to a New Zealand-owned company. The New Zealand fishery is managed by an individual transferable quota (ITQ) system (Easton, 1989). The target species in the fishery is *Nototodarus sloanii* (Wellington flying squid). Participation by the U.S. distant-water operation in this fishery generally occurs between October and February.

3.7.3.2.4 Actual and Potential Revenue from the Fishery

A representative of the U.S. distant-water operation reports that the squid catch can be as high as 35,000 to 40,000 lbs per night when fishing in the waters off New Zealand; while the catch on the North Pacific fishing grounds can reach 18,000 lbs per night (pers. comm., Bob Endreson, 10/8/03). At an assumed ex-vessel price of $1,000 per ton, these catches would generate gross revenues ranging from $9,000 to $20,000 per night of fishing. However, average catches and revenues may be much lower. During fishing trips made in the 2003 fishing season, the combined squid catch of three of the vessels participating in the U.S. distant-water operation was only 44,596 lbs after about 22 days of fishing on the North Pacific grounds (these fishery statistics are based on 2003 North Pacific high seas squid jig logbook data provided by the NOAA Fisheries Pacific Islands Regional Office).

3.7.3.2.5 Recreational Interest in the Fishery

Access to the *O. bartramii* resource by the general public is limited. There is likely no recreational fishing for this species in the Western Pacific Region.

3.7.3.2.6 Nature and Extent of Foreign Fishing and Indian Treaty Fishing Rights, If Any

There are no foreign fishing or Indian treaty fishing rights associated with the distant-water squid jigging fishery.

<u>3.7.3.3 Ika Shibi Component of the Hawaii Pelagic Handline Fishery</u>

Handline fishing is an ancient technique used to catch yellowfin and bigeye tunas with simple gear and small boats. Handline gear is set below the surface to catch relatively small quantities of large, deep-swimming tuna that are suitable for sashimi markets. This fishery continues in isolated areas of the Pacific and is the basis of an important commercial fishery in Hawaii. Three methods of pelagic handline fishing are practiced in Hawaii, the ika shibi (nighttime) method, the palu-ahi (daytime) method and seamount fishing (which combines both handline and troll methods).

The ika shibi method of catching tuna developed from a squid fishery that was started in the early 1900s by early immigrants to Hawaii from Okinawa (Yuen, 1979). The incidental tuna caught in the squid fishery were known as "ika-shibi" (squid-tuna in Japanese). After World War II, participants in the fishery who owned boats equipped with iceboxes began to target tuna using the squid as bait (Yuen, 1979). Assisted by increased demand for sashimi grade tuna, the ika shibi fishery became a well established component of the Hawaii pelagic fishery (Itano, 2004).

3.7.3.3.1 Number of Vessels Involved

In the late 1970s and early 1980s, participation in the ika shibi component of the Hawaii pelagic handline fishery increased as a result of the introduction of fuel-efficient small-scale vessels and the expansion of the restaurant market in Honolulu (Pooley, 1993). The rising price for fresh tuna and reduced shipping costs made air shipment to Honolulu economically feasible (Boggs and Ito, 1993; Yuen, 1979). In 1977, about 40 boats (many of them part-timers) were involved in the fishery from Hilo and about 10 or so boats were fishing from Kona on the west side of the island (Yuen, 1979). By 1980, at least 230 boats were participating in the fishery (Ikehara, 1981). However, during the early 1990s, some of the larger handline boats began to shift their fishing effort to the seamount and weather buoy fishery 100-200 nm from the coast (Boggs and Ito, 1993). More recently, some handline fishermen have focused their effort on home-made "private" fish aggregation devices (PFADs) anchored offshore.[23] The first of these private buoys appears to have been set in 1999. With the shift of many pelagic handline vessels to fishing around FADs there has been a significant decrease in the size of the ika shibi fleet. Currently, the ika shibi fleet based in Hilo consists of only one to three boats that fish regularly (pers. comm., Craig Severance, University of Hawaii-Hilo, 7/2/04).

3.7.3.3.2 Type and Quantity of Fishing Gear Used

A wide assortment of boats have adopted the ika shibi method of harvesting tuna. The fishery generally employs small boats, between 18 and 30 feet in length. In a 1995-1996 survey the average length of an ika shibi boat was eight meters (26.65 ft) (Hamilton and Huffman, 1997). Many of the smaller boats are trailered to launching ramps such as those located on the Wailua River in Hilo and at Pohoiki, southeast of Hilo and south of Cape Kumukahi (Itano, 2004). Some of the larger boats tie up at wharves and slips on either side of the lower Wailua River.

The average trip length in the ika shibi fishery during 1995-1996 was one day. The boats are usually manned by two people, but fishermen will often go out alone (Yuen, 1979). Typically, participants in the fishery leave port to get to the grounds at sundown (Yuen, 1979). Upon arrival, the engine is turned off and a parachute sea anchor is attached to the bow and lowered into the water. The sea anchor reduces the drift of the vessel allowing it to stay fishing over a congregation of squid and/or tuna longer. It also reduces the pitch and roll of the vessel to produce a more stable working platform. Surface and underwater lights powered by storage batteries are turned on to attract the squid. Above surface lights are usually 25-watt incandescent bulbs with polished metal reflectors. Often two of these are used. The single underwater light is a 50-watt incandescent bulb that has been waterproofed and weighted. Brighter bulbs are sometimes used for moonlit nights.

Yuen (1979) reports that the squid are caught by angling and gaffing. In angling for the squid, hooks are baited with mackerel scad by cutting off the tail so that the body of the scad is the proper length to fit on the shank of the hook and inserting the shank of the hook through the length of the fish starting with the cut end and ending at the mouth. A light line or wire attached to the proximal tip of the shank is wound around the fish to keep it from falling apart. This makes it possible to use the same piece of bait repeatedly despite the squid bites that are inflicted upon it. The baited hook is tossed out about 5 m and slowly pulled back to the boat. In this manner the hook is used not only to hook squid but also to lure the school of squid to within gaffing range of the boat. A few fishermen prefer to gaff the squid exclusively. In this case the

[23] The State of Hawaii also constructs and deploys FADs. To date, there are 55 state-funded FADs: 18 are in the waters surrounding the Big Island, 14 are in Oahu, 14 are in Maui County (which include Lanai, Molokai, and Kahoolawe) and 9 are in Kauai.

squid are lured to the boat by tossing out a whole scad hooked through the head with a fish hook and retrieving it in the same manner applied to the squid hook.

Itano (2004) reports that some ika shibi fishermen also employ a variety of jigs to capture squid. All of the jigs are locally made and most are relatively small, thin and dense in comparison to many commercially available squid jigs. Typically, the jigs are constructed of or painted with a green luminescent material. Squid jigs are usually fished with a light fishing rod with a spinning reel equipped with 8 - 15 lb test monofilament. The jig is allowed to sink and retrieved with a steady or jerky motion. Fiberglass rods with a short, fixed length of monofilament line are also used with the smaller jigs. These rods are swung in a rapid "figure-8" motion to entice squid to strike near the surface.

In the past, fishing for tuna began after five to 10 squid had been caught. Today most fishermen bait their tuna lines with mackerel scad and proceed with fishing while catching squid for bait. The tuna bait is typically fished at a 30 m depth (Nitta and Henderson, 1993).

3.7.3.3.3 Species of Fish Involved and Their Location

In the ika shibi component of the Hawaii pelagic handline fishery squid are caught and used as bait to capture yellowfin tuna and to a lesser extent bigeye tuna and albacore tuna. The squid species primarily caught is *Sthenoteuthis oualaniensis* (purpleback flying squid).

The ika shibi fleet is based largely on the island of Hawaii (Big Island), but this style of fishing is also occasionally employed by fishermen on the other MHI (Ikehara, 1989; Nitta and Henderson, 1993). The Big Island ika shibi fishery occurs predominantly south of the island from Hilo to around the town of Captain Cook. Fishing effort is generally focused at the edge of the island shelf near the 600 to 1,000 fathom contour from 2 to 20 km from shore (Ikehara, 1989; Nitta and Henderson, 1993). The ika shibi season may start as early as April and continue through December (Rizzuto, 1987). Peak fishing activity usually occurs in the summer months. The west side of the Big Island may also have a winter "run" of large tuna near the South Point area. Specific ika shibi fishing locations and seasons on the Big Island are provided in Table 3.7-12.

Table 3.7-12 Ika Shibi Fishing Locations and Seasons in the Waters Around the Island of Hawaii. Source: Ikehara (1989)

Region	Area/Season
East Hawaii	Pohoiki - March-June. 92.50
	Hilo/Pepeekeo - July-September
	North Pepeekeo - October-November
	South Point - December-January
West Hawaii	Keauhou - June-August
	Milolii - September-December

The effectiveness of the fishing lights to attract squid is influenced by the phase of the moon, with the new moon producing higher catches of squid. During the full moon phase fewer squid are attracted to the lights. Brighter bulbs are sometimes used for moonlit nights (Yuen, 1979). Some ika shibi fishermen believe the highest tuna catches occur when the moon is in the first or third quarter (Ikehara, 1989). However, other fishermen indicate that the tuna catch is unaffected by the moon phase.

3.7.3.3.4 Actual and Potential Revenue from the Fishery

Some of the ika-shibi catch of yellowfin tuna is marketed through the Honolulu fish auction. However, the majority of the catch is sold through the fish auction in Hilo and through intermediary buyers on the island of Hawaii. Most of the catch is sold fresh, but surpluses caught during the peak summer season are sometimes dried and smoked.

Output of the pelagic commercial handline fishery was estimated at $9.35 million in 1995-1996. This total was composed of $0.36 million in sales for palu ahi vessels, $2.82 million for ika shibi vessels, and $6.17 million for seamount vessels (Hamilton and Huffman, 1997). In more recent years, however, tuna landings by the ika shibi fleet have reportedly sharply declined. While the reasons for the collapse of the fishery are uncertain, questions have been raised concerning whether or not the privately owned fish aggregation devices (PFADs) deployed off the Big Island in recent years are intercepting fish that would otherwise be available to the ika shibi boats and other small handline vessels (Environment Hawaii, 2001; WPFMC, 2003). There is also concern that the increasing effort on FADs may be resulting in unsustainable harvests of small, pre-reproductive yellowfin and bigeye tuna.

A 1995-1996 survey of Big Island full-time ika shibi vessels indicated that ika shibi fishermen earned 92 percent of their personal income from fishing (Table 3.7-13).

Table 3.7-13 The 1995-1996 Average Characteristics of Island of Hawaii Full-Time Ika Shibi Vessels. Source: Hamilton and Huffman (1997)

Respondent Characteristic	Value
Percent of Personal Income from Fishing	92.50
Total Household Income	$46,111
Age	42.10 yrs.

Average pro forma cost and earnings estimates for Big Island full-time ika shibi vessels for 1995-1996 are shown in Table 3.7-14. The average full-time ika-shibi handline vessel generated $70,813 in gross revenues from the sale of pelagic species in 1995-1996. After fixed costs and variable costs for the average of 99 pelagic trips during the year are subtracted, the vessel has a net operating income of about $38,948 (Table 3.7-14). After one-third of net operating income for crew share is subtracted, income to the owner and/or the captain of the vessel is $25,706. Sales of tuna account for nearly all of this income; although ika shibi fishermen may occasionally sell surplus catches of squid, the revenue earned from these sales is probably negligible. Although no recent economic data are available, the aforementioned recent decline in the catch of the ika shibi fleet has likely had an adverse effect on the economic performance of this fleet, although some of these vessels have presumably switched to more lucrative pelagic handline fisheries.

Table 3.7-14 The 1995-1996 Average Annual Revenue and Costs for Full-time Ika Shibi Vessels. Source: Adapted from Hamilton and Huffman (1997)

Statement	Value ($)
Gross revenue	70,813
Fixed costs total	11233
Variable costs total	20632
Total costs	31865
Net revenue	38948

3.7.3.3.5 Recreational Interest in the Fishery

Charter boats occasionally engage in ika shibi fishing, as described in the following excerpt from the Web page of a Kauai-based charter boat operation:

> *There is a fishery called IKA/SHIBI, or Squid/Tuna. It is a very productive method to fish for Tuna.*
>
> *Basically, we head out before sunset to deeper waters, find our spot where we deploy a parachute (sea anchor) off our bow. This will slow our drift. We then submerge a light off the side and start chumming. Soon you will be catching Squid on light spinning tackle using Squid lures (good fun). Those same Squid will then be used to bait the big Yellow Fin Tuna or AHI. If you're lucky and the AHI find the boat, watch out because you are in for the battle of your angler's life. This type of fishing is seasonal and the conditions have to be favorable* (True Blue Fishing Tours).

No information is available on the current level of take of squid in the charter or recreational ika shibi component of the Hawaii pelagic handline fishery.

Some ika shibi fishermen occasionally hook squid for home consumption, provide gifts for friends and family or to supply a specific banquet or large social gathering with fresh squid (Itano, 2004). The amount of this recreational or subsistence catch is unknown.

3.7.3.3.6 Nature and Extent of Foreign Fishing and Indian Treaty Fishing Rights, If Any

There are no foreign fishing or Indian treaty fishing rights associated with the ika shibi component of the Hawaii pelagic handline fishery.

3.7.3.4 Kauai-based Directed Squid Fishery

A small directed squid fishery exists in Hawaii, primarily on Kauai. In addition, a few Hilo-based fishermen may occasionally make directed fishing trips for squid, mainly for personal consumption.

3.7.3.4.1 Number of Vessels Involved

It is estimated that there are currently 20 to 30 participants in the Kauai-based fishery (Itano, 2004).

3.7.3.4.2 Type and Quantity of Fishing Gear Used

The Kauai-based squid fishery is primarily conducted from trailered boats ranging in size from around 16 to 22 ft and powered by single or twin gasoline powered outboard engines of 30 to 70 hp (Itano, 2004). Due to the small size of the vessels, two or more boats may fish in the same general area for safety, but fishermen indicate that catches may suffer if vessels fish too close to one another. Vessels are usually manned with two or three fishermen equipped with a single baited handline rig.

Fishery participants use a standardized style of fishing with little apparent variation (Itano, 2004). The common luminous squid jigs are generally not used in favor of bait covered steel rods armed with two "baskets" of barbless hooks set at one end. Fishermen typically make their own rigs by soldering hooks to a short section of 3/16-in diameter stainless steel rod. A three-foot section of fine stainless steel wire is attached close to the hooks for wrapping the bait. Each lure is wrapped with a thin section of squid mantle and secured in place with the attached wire.

Most fishermen prefer to fish the baited rigs with a small monofilament handline spooled on a wooden handreel (Itano, 2004). The handreels are fished from drifting vessels, while fishing rods and reels are sometimes preferred when fishing for bait squid from slower moving vessels that are drifting on a parachute anchor. A 12-volt, 25-watt above water light is used to attract the squid or to attract the small fish and crustaceans that attract squid. The above water lights are believed to be more efficient than submersible lights. In addition, they create a shadow under the hull where the squid often wait to ambush prey. Sometimes only a very small light or no light at all may be used.

An essential piece of gear is a round scoop net to land the squid caught on the baited rigs (Itano, 2004). Wood handled nets with 14- to 18-in diameter circular hoops are typical. Hooked squid are hauled quickly to the surface and netted or lifted from the water and stored in 5-gal buckets or small ice chests.

3.7.3.4.3 Species of Fish Involved and Their Location

The small-scale jig fishery targets *Sthenoteuthis oualaniensis* (purpleback flying squid) (Itano, 2004). A small amount of *Thysanoteuthis rhombus* (diamondback squid) is also caught. The primary fishing grounds lie along the south and southwest coasts of Kauai between Makahuena

Point (Koloa) and Kekaha. Fishermen indicate that the squid on the windward coast are larger but much less abundant. Boats typically launch from Port Allen or the Kikiaola small boat harbor in Kekaha. These launch sites are preferred due to their location in relation to prevailing winds and currents that transport boats along the shore or slightly offshore. A small amount of squid fishing effort may also be based in Nawiliwili and Hanalei Bay. However, Nawiliwili Harbor is not commonly used by the squid fleet, as the drift is strongly onshore, requiring vessels to run several miles south of the harbor to set up for a safe longshore or offshore drift.

The fishing grounds are close to shore, often only 2 to 4 miles from the southern harbors (Itano, 2004). Vessels normally do not attempt to slow their drift with a sea anchor or parachute drogue as is typical in the ika shibi fishery. Once a drift is set up, an above water light is activated to attract squid or squid prey and the vessel allowed to drift freely with the wind. On the southeast coast of Kauai, the prevailing wind will transport a vessel in an east-northeast to west-southwest direction parallel to the shoreline and depth contours. This provides the fisherman a considerable advantage as he can maintain a near constant depth over productive grounds and be confident that he will not be taken toward the reef or too far out to sea.

Squid fishing is a seasonal activity (Itano, 2004). Participants may also engage in the ika shibi fishery, pelagic troll fishery or handline fishery for akule, squirrelfish or bonefish. Fishermen noted that as a rule of thumb the season for squid jigging roughly coincides with the months when humpback whales are not found in local waters, i.e., April to November, although there is no apparent link between the species. The main squid jigging time occurs from the beginning of May to October. Larger, egg bearing females were reported as being more common early in the season, with small squid being more common during July and August.

In order to take advantage of the maximum period of dark in the early evening hours (most of the fishing occurs from sunset to about 10 pm), squid jigging generally begins two days after the full moon, continues through the dark new moon period, and ends between the quarter to half moon period (Itano, 2004). This strategy equates to a maximum of 18 to 20 fishing nights per lunar month.

3.7.3.4.4 Actual and Potential Revenue from the Fishery

Catches of purpleback squid generally remain within the community for home consumption; however, some of the squid caught are sold. No cost-earnings studies have been conducted for the Kauai-based fishery; however, a rough estimate of gross revenues can be derived from the data available. Fishery participants measure catch in terms of how many 5-gal buckets are filled in an evening of fishing (Itano, 2004). It is estimated that one bucket contains approximately 130 to 200 squid. Roughly speaking, two buckets of squid is considered a good catch, while a half bucket represents a poor catch. Itano (2004) reports that seafood buyers on the Big Island purchase fresh squid from handline fishermen at $1.00 - $1.25/lb.[24] Assuming that a typical daily catch is one 5-gal bucket of squid weighing 45lbs, a fisherman could gross about $50 per fishing trip. If a fisherman made 114 trips per year, his total income from squid fishing would be about

[24] Some fishermen may earn more by selling their squid directly to grocery outlets, thus eliminating the wholesalers and gaining a slightly higher price (Itano, 2004).

$5,700. This estimate is consistent with Itano's (2004) finding that revenues in the directed squid fishery are modest.

3.7.3.4.5 Recreational Interest in the Fishery

As noted above, catches of purpleback squid in the Kauai-based fishery generally remain within the community for home consumption. Another important function of the fishery is to provide a special food item for banquets, outdoor barbecues and large social gatherings (Itano, 2004). The squid is favored as a local delicacy, and fishermen sometimes fish to fulfill social obligations. Occasionally, surplus catch may be sold to local grocery stores or markets. The small catches of diamondback squid made are never sold, as this particular delicacy is used for personal consumption or shared among friends.

3.7.3.4.6 Nature and Extent of Foreign Fishing and Indian Treaty Fishing Rights, If Any

There are no foreign fishing or Indian treaty fishing rights associated with the Kauai-based fishery squid fishery.

3.8 Sociocultural Setting and Fishing Communities

The description of the sociocultural environment focuses on the pelagic fisheries that could be potentially affected by the proposed actions. These fisheries include the Hawaii longline fishery and the ika shibi component of the Hawaii pelagic handline fishery—two fisheries managed under the Pelagic Fisheries FMP—and the distant-water and Hawaii near-shore squid fisheries, which are currently not managed under the Pelagic Fisheries FMP. This description of the affected environment records the present social context of the affected fisheries, including socioeconomic problems, opportunities and conflicts created in the fisheries and communities by recent federal fishery management regulations.

Comprehensive descriptions of the sociocultural settings of the Hawaii longline and ika shibi fisheries are provided in Chapter 3 of the Pelagic Fisheries FMP FEIS (NMFS, 2001). The sociocultural descriptions of these fisheries presented in the current document summarize the discussion in the Pelagic Fisheries FMP FEIS and incorporate new information that has become available since the Pelagic Fisheries FMP FEIS was released. The FMP EIS also described the sociocultural settings of the pelagic fisheries in Guam, American Samoa and the Northern Mariana Islands. The current EIS does not summarize or update that information because the proposed actions are not expected to cause significant social or cultural impacts in those areas of the Western Pacific Region.

The sociocultural analysis provided in this section is driven by requirements of the National Environmental Policy Act, Executive Order 12898 and the Magnuson-Stevens Act. Under NEPA, "social" and "cultural" effects are specific environmental consequences of the proposed action to be examined (40 CFR 1508.8).

Beyond NEPA requirements, this section takes into account Executive Order 12898 (59 FR 7629 February 16, 1994), which requires federal agencies to address environmental justice concerns by identifying disproportionately high and adverse human health and environmental effects on minority and low-income populations. Consistent with these requirements, the sociocultural analysis presented here includes data on affected minority and low-income populations. Although other minority group participants in the affected fisheries are discussed, the analysis focuses on Vietnamese Americans because vessel owners and crew members belonging to this minority group were especially adversely affected by the management measures that eliminated the swordfish portion of the Hawaii longline fishery in 2001. The discussion highlights ways in which these fishery participants have adapted to various stress factors.

This section is also guided, in part, by National Standard 8 under the Magnuson-Stevens Act. National Standard 8 is part of a set of standards that apply to all FMPs and regulations promulgated to implement such plans. Specifically, National Standard 8 states that:

> *Conservation and management measures shall, consistent with the conservation requirements of this [Magnuson-Stevens] Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities and (B) to the extent practicable, minimize adverse economic impacts on such communities (Sec. 301(a)(8)).*

The Magnuson-Stevens Act defines a "fishing community" as "...a community that is substantially dependent upon or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew, and fish processors that are based in such communities" (Sec. 3 (16)). NOAA Fisheries further specifies in the National Standard guidelines that a fishing community is "...a social or economic group whose members reside in a specific location and share a common dependency on commercial, recreational, or subsistence fishing or on directly related fisheries dependent services and industries (for example, boatyards, ice suppliers, tackle shops)" (63 FR 24235, May 1, 1998). "Sustained participation" is defined by NOAA Fisheries as "...continued access to the fishery within the constraints of the condition of the resource" (63 FR 24235, May 1, 1998). Consistent with National Standard 8, this section first identifies sub-regions and communities and then describes and assesses the nature and magnitude of their dependence on and engagement in the affected pelagic fisheries.

3.8.1 Hawaii Sociocultural Setting

<u>3.8.1.1 Longline Fishery</u>

As noted in the Pelagic Fisheries FMP FEIS (NMFS, 2001), the sociocultural context of fishing in Hawaii has been shaped by the multi-ethnicity of local fisheries. The Hawaii longline fishery is an example of a fishery that experienced rapid development as a result of the participation of new groups of fishers of various ethnic backgrounds. The contemporary longline fishery is ethnically complex, and the ethnic composition of its participants differs markedly from that of the state population as a whole.

Prior to the 2001 prohibition on deployment of swordfish-target longline gear, differences in the ethnicity of participants in the longline fishery were linked to differences within the fleet in terms of a number of related factors, including target species, fishing grounds, and vessel operating characteristics. Nearly all of the swordfish/mixed vessels were owned and crewed by Vietnamese Americans. In contrast, this ethnic group operated only about four or five longline vessels targeting tuna. Demographic data on vessel owners and operators collected in a 2000 survey of the Hawaii-based longline fleet conducted by O'Malley and Pooley (2002) showed this ethnic differentiation within the longline fleet (Table 3.8-1).

Table 3.8-1 Ethnicity of Hawaii Longline Vessel Owners in 2000.[1] Source: O'Malley and Pooley (2003)

Vessel Classification	Caucasian (%)	Korean-American (%)	Vietnamese American (%)	Number
Fleet	27	30	43	120
Swordfish	6	0	94	70
Tuna	41	53	6	50
Small tuna	31	64	6	16
Medium tuna	31	64	6	36
Large tuna	72	22	6	18
Medium swordfish	11	0	89	18
Large swordfish	3	0	97	32

[1]Vessels are classified by size (small <56 ft, medium 56.1 ft to 73.9 ft, large >74 ft) and target (tuna or swordfish)

This ethnic differentiation within the longline fleet based on target species largely disappeared after the 2001 prohibition on deployment of swordfish-target longline gear. Twenty to 30 of the longline vessels owned by Vietnamese Americans dropped their Hawaii longline limited access permit and relocated to southern California where they continued to target swordfish. Three swordfish vessels relocated to American Samoa and changed ownership (O'Malley and Pooley, 2002). The remainder of the Vietnamese American vessel owners elected to stay in Hawaii and switch to targeting tuna.

The Pelagic Fisheries FMP FEIS stated that Vietnamese American vessel owners nearly exclusively hired other individuals of Vietnamese ancestry (NMFS, 2001). Boat owners of Korean descent reportedly hired predominately crews from the Federated States of Micronesia, while the crews of longline vessels owned by Caucasians were reported to generally be a mixture of Micronesians and established Hawaii residents of various ethnicities. However, the aforementioned survey conducted by O'Malley and Pooley (2002) indicated that a recent trend among Hawaii-based longline vessels is the hiring of foreign crew, primarily from the Philippines. In 2000, only six interviewed vessels employed foreign crews. By 2001, over 54 percent of the vessels employed foreign crew. Currently, about 75 percent of crew members are Filipinos who commit to a one-year contract, working and living on the vessel while their families remain in the Philippines (Allen and Gough, 2004). The survey questionnaire administered by O'Malley and Pooley asked vessel owners who changed from hiring local to foreign crews what motivated them to switch. Three answers were given, corresponding to the ethnicity of the vessels' owners. Korean Americans stated the foreign crew members were easy to work with; Caucasian Americans found foreign crew to be cheaper than local crew; and

Vietnamese Americans switched because they could not find Vietnamese American crew who wanted to fish for tuna.

Vietnamese American vessel owners in particular have become increasingly dependent on Filipino crews (pers. comm., Stewart Allen, NOAA Fisheries Pacific Islands Fisheries Science Center, ½0/04). With this increased reliance on foreign crews, some Vietnamese American vessel owners have become concerned that new U.S. immigration policies may make it difficult to hire and retain a sufficient number of crew members (pers. comm., Stewart Allen, NOAA Fisheries Pacific Islands Fisheries Science Center, ½0/04).

The majority of the Filipino crew are from fishing families or communities in the Philippines (Allen and Gough, 2003). About half have education or training in a marine related field, and the majority have considerable experience as fishermen outside of the Philippines. For example, individuals have worked in Guam, South Africa, Taiwan, Latin America, and California in a variety of fishing fleets. They are hired through a recruitment agency and brought to Hawaii utilizing a C-1 transit visa. Their transit status does not allow them to leave the pier, which increases their desirability as workers as they tend to the vessels while in port. Most 2003 arrivals came to Hawaii via California, as the latter state offers easier access to the U.S. With respect to job satisfaction, the majority of Filipino crew would rather work on a cargo vessel than on a Hawaii-based longline boat. However, Hawaii-based longline vessels are generally preferred over boats in other fleets (e.g., the Japanese fleet based in Guam). Those with larger families or more education are less satisfied with the pay.

The increasing dependence on Filipino crews has been accompanied by a change in the way in which crew members are paid in the Hawaii-based longline fleet. In 2000, the majority of the interviewed vessel owners were paying the captain and crew using the share method (O'Mally and Pooley, 2002). First, specific expenditures such as fuel, oil, ice, bait, provisions, gear, and auction fees were deducted from the gross revenue. The remaining revenue was then split in half, 50 percent for crew and 50 percent for the vessel owner. However, Filipino crew members are paid a monthly salary and in some cases a tonnage or captain's bonus depending on the catch. Salaries start at $385 per month and are arranged between the vessel owner, manning agency and individual (Allen and Gough, 2004). The average monthly salary of these foreign workers is $475. Local and Micronesian crew continue to be paid a percentage of the earnings rather than a set salary.

O'Malley and Pooley (2002) noted that the type of crew remuneration used can significantly affect the cost of operating a longline vessel. The researchers compared the annual costs to pay crew using the share method and those that paid a fixed salary. The 2000 fleet average annual cost using the crew shares method was $152,097, and the annual cost to pay the crew a monthly salary was $44,333 (this figure does not include the agency and immigration fees associated with the hiring of foreign crew).

The Pelagic Fisheries FMP FEIS predicted that the closure of the swordfish-targeting segment of the Hawaii longline fishery would disproportionately and negatively affect Vietnamese American fishermen (NMFS, 2001). The FEIS described the predicted effects on vessel owners as "immediate and substantial," as well as imposing "severe economic hardship" on crew members of Vietnamese descent. The FEIS cited a study of workers laid off from the sugar industry on the island of Hawaii to describe the range of possible effects, including sustained unemployment and loss of income and the resulting social and psychological impacts. These included heightened feelings of anxiety, depression, illness, and increased problems in relationships among laid-off employees and family members.

A subsequent exploratory study of the impacts to Vietnamese American vessel owners and captains conducted by Allen and Kleiber (2003) revealed that many of the effects predicted by the FEIS were present, as well as some additional impacts that had not been anticipated. Many Vietnamese Americans had already been regulated out of other U.S. fisheries; several mentioned that they have dealt with hardships and challenges in the industry before but the closure of the swordfish portion of the Hawaii longline fishery was the toughest situation they'd faced. Swordfish fishing is a lucrative business, and the loss of income that Vietnamese American fishermen experienced after the closure of the Hawaii fishery had many direct and indirect negative socioeconomic effects on individuals, families and households, and the Vietnamese community. The passage below excerpted from Allen and Kleiber (2003) summarizes some of the effects:

> *Many [Vietnamese Americans] mentioned having to cut back on educational expenses at all levels, such as not being able to afford private schools or having to borrow for college expenses, accumulating additional debt. Nearly all spoke about wanting their children to have quality educations so they would not have to fish for a living.*
>
> *Interviewees reported a range of effects on the closeness and cohesion of their families. Family solidarity suffers when a family member is not present for extended time periods. Fishing families are accustomed to their husband or father being gone on long fishing trips, which is especially the case with swordfishing in Hawaii, which typically required longer trips than tuna fishing. Although family members may not like this, they adapted because of the financial benefits. Fishermen and family members also mentioned that the time between trips allowed for high-quality family time, including vacations. People who moved boats to California had many additional expenses aside from moving the boat there. Wives who travel to Los Angeles to meet boats between swordfish trips and assist with many aspects of the business incur direct costs are such as airfare, car rental, and hotels. In addition, being gone 7-10 days a month makes it more difficult to obtain a job to supplement income. Disruption of normal behavior, coupled with financial stress, can cause friction among family members, reflected by increased arguments and conflicts.*
>
> *Interviewees expressed a range of emotions including bewilderment at the closure and its reported justification; loss of confidence that the family would be adequately cared for; shame at not being able to help family members here or elsewhere; sadness at the decrease in the quality of life, which many suggested was quite high before the ban; anger at the federal government for closing the fishery; frustration at being unable to thwart the ban legally or politically, at*

having to rely on others, and that the international fleet is not regulated; blame on entities both inside and outside the industry for their inability to prevent or lessen the ban despite rallies and financial support.

When the ban was first introduced, fishermen pulled together to fight it but that enthusiasm and solidarity waned as time dragged on and the ban became permanent. Several interviewees mentioned existence of a Vietnamese Fishing Association that previously existed and dissolved following the ban. Such associations are an important source and indicator of cohesion and support among the fishing community.

Owners of Hawaii-based longline vessels that fished during 2001 received economic assistance from the federal direct economic assistance program because of the sudden impact of the regulations. Owners of tuna vessels received $16,000, while owners of swordfish vessels received $32,000 because the new regulations had a greater impact on their operations. O'Malley and Pooley (2003) note that the amount given to the swordfish vessels covered about 89 percent of the estimated cost to convert to tuna fishing (not including the labor to assemble the gear and the time spent learning to fish for tuna). However, the need for many of the owners of swordfish vessels to repay large bank loans acquired to purchase their vessels forced some to relocate to California or switch to tuna fishing before the economic assistance was disbursed (pers. comm., Stewart Allen, NOAA Fisheries Pacific Islands Fisheries Science Center, ½0/04). The economic assistance program did not benefit the crew members of swordfish or tuna longline vessels.

During fishing experiments conducted by NOAA Fisheries to test fishing methods and gears that may reduce turtle interactions in the Hawaii longline fishery, five vessels (all owned by Vietnamese Americans) were contracted to participate in the experiments. The vessel owners received a total of $311,147 for conducting a total of 194 sets (pers. comm., Stewart Allen, NOAA Fisheries Pacific Islands Fisheries Science Center, ½0/04). While this was a short-term source of income, it was a substantial amount to a vessel owner making payments on a vessel as well as supporting a family. The contribution of the pelagic longline fishery to overall economic activity in Hawaii is small. Moreover, the economic impacts of the closure of the swordfish portion of the Hawaii longline fishery on fishermen and their families gradually lessened as fishermen outfitted their vessels to participate in fisheries on other stocks (most notably tuna), relocated to California and continued to fish for swordfish in areas that remained open (e.g., the high seas in the Pacific Ocean east of 150° W), or found other jobs that may or may not be fishing-related.

The relaxation of the restrictions on longlining is expected to have positive overall economic impacts on participants in the Hawaii longline fishery. Holders of Hawaii longline limited access permits that choose to engage in shallow-setting are likely to benefit from catches of swordfish, a high value pelagic species. Holders of Hawaii longline limited access permits that choose not to engage in shallow-setting are likely to benefit each year by being able to sell their share of shallow-set certificates to other permit holders.

One hundred and twenty (73%) of the 164 Hawaii longline limited access permit holders requested shallow-set certificates for 2004. As shown in Table 3.8-2, about 80 percent of the permit holders who currently own vessels categorized as swordfish boats in 1999 requested certificates. Four of these vessel owners relocated in California after the swordfish component of the longline fishery was closed in 2001.[25] Also among those who requested certificates were permit holders who currently own vessels categorized as tuna boats in 1999 and permit holders who do not currently own a longline vessel. The majority of individuals who own vessels categorized as tuna boats in 1999 are of European or Korean descent (Table 3.8-1).

Table 3.8-2 Allocation of Shallow-set Certificates Among Hawaii Longline Limited Access Permit Holders. Source: NOAA Fisheries PIRO

Category	Permit holders as of May 1, 2004		
	Requested 2004 certificates	Did not request 2004 certificates	Total
Permit holders who owned vessels categorized as tuna vessels in 1999[1]	30	15	45
Permit holders who owned vessels categorized as swordfish vessels in 1999[1]	20	5	25
Permit holders who owned vessels that can not be linked to 1999 vessel categorizations[2]	41	19	60
Permit holders who did not own vessels in 2004	29	5	34
Total	120	44	164

[1] Vessel categorizations are based on an analysis conducted by NOAA Fisheries to identify vessels qualifying for the 2001 Direct Economic Assistance Program.[2] Vessel names rather than permit numbers or permit holders were used to establish linkages between the permits in 2004 and 1999. Consequently, a given vessel categorized in 1999 may have been under different ownership in 2004. If a vessel name change occurred between 1999 and 2004, no link between the permits in 2004 and 1999 could be identified. In addition, for seven of the 118 vessels categorized in 1999 the vessel name could not be identified.

A number of factors may make it difficult for Vietnamese Americans to regain a dominant position in the swordfish portion of the Hawaii longline fishery. Under the effort quota allocation scheme developed for the reopened fishery vessel owners must bear the costs of acquiring an adequate number of shallow-set certificates each year, and those owners that switched to tuna fishing in 2001 would incur the costs to rig over from tuna fishing to swordfish fishing—these latter costs are reported to be about $15,000 (WPFMC, 2004b). In addition, Vietnamese American vessel owners that have hired Filipino crews may find these crew members unwilling to endure the longer fishing trips that swordfish fishing entails (pers. comm., Stewart Allen, NOAA Fisheries Pacific Islands Fisheries Science Center, ½0/04).[26]

3.8.1.2 Squid Fisheries

The squid species occurring around the Main Hawaiian Islands were known as *muheʻe* by the early Hawaiians (Titcomb, 1978). Although squid were eaten, they were not as popular as

[25] One other vessel owner who relocated in California requested certificates, but that person's vessel was not categorized. In addition, between April 30 and mid-July, 2004, at least seven vessels owners who shifted to California applied to have their vessels registered for use under Hawaii longline limited access permits. Some of these vessels owners may also have requested certificates.

[26] According to the Pelagic FMP EIS, longline trips typically last between 14 and 21 days when yellowfin and bigeye tuna are targeted, and 30 to 45 days when swordfish are targeted (NMFS, 2001).

octopus (*he'e*).[27] Squid also had mythological significance for early Hawaiians. The god Kanaloa was represented in the deep ocean depths by squid, octopus and certain kinds of seashells. A reference book on ancient Hawaiian myths by Beckwith (1970), which was published in 1940, stated that Hawaiian fishermen "still solicit [Kanaloa's] protection, but on the whole the squid is today looked upon with distrust as an aumakua." (p. 60).[28] Beckwith noted that, "This attitude is reflected in a tendency by Hawaiian antiquarians to equate Kanaloa with the Christian devil" (p. 60). The contemporary spiritual significance of Kanaloa is uncertain; however, the creation of a Web site (http://www.bluecoast.org/kanaloa.html) dedicated to the study of Kanaloa suggests a continuing interest in the deity

As discussed in Section 3.7.3.3, commercial squid fishing in Hawaii was initiated in the 1920's by Japanese immigrants who brought squid fishing techniques from their native islands of Okinawa. The directed squid fishery has since largely disappeared, although a remnant continues as a small, artisanal fishery on Kauai. A description of this fishery is provided in Section 3.7.3.4. Although the Kauai-based directed squid fishery has been in existence since at least the immediate post-World War II era, only a few communities and social networks on Kauai are familiar with it (Itano, 2004). The squid caught in the fishery that are sold are typically marketed in local grocery stores.

Presently, there are 20 to 30 participants in the Kauai-based fishery (Itano, 2004). Many of the participants are elderly, with some individuals being 80 years of age or older. Itano (2004) estimated that about 50 percent of the participants have a Japanese ethnic background, 22 percent are of Filipino ancestry, 18 percent are of mixed Portuguese descent and 10 percent have a mixed Hawaiian ancestry. Catches of purpleback squid in the fishery generally remain within the community for home consumption (Itano, 2004). Another important function of the fishery is to provide a special food item for banquets, outdoor barbecues and large social gatherings. Squid is favored as a local delicacy, and fishermen sometimes fish to fulfill social obligations.

Squid also continues to be caught in the waters around the Big Island for bait in the ika shibi component of the pelagic handline fishery. The ika shibi method of fishing for tuna evolved from the directed squid fishery and is currently employed by a few small-boat owner-operators targeting yellowfin tuna. A detailed description of the fishery is provided in Section 3.7.3.3.

The domestic distant-water squid jigging fishery in the Pacific is currently being prosecuted by a single operation. Honolulu is listed on the HSFCA fishing permit as the hailing port of the four vessels involved in this operation, and the vessels occasionally call into Honolulu. However, the operation may be relying mostly on at-sea transshipment to deliver product to the Japanese market. The ethnic composition of the vessels' crews is unknown.

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[27] In contemporary Hawaii the term "squid" is used indiscriminately to signify both squid and octopus (Titcomb, 1978).

[28] *'Aumākua* are family or personal deities that can be called upon for protection, comfort, and spiritual support. An *'aumākua* can manifest itself in varying forms, including an animal, plant, or rock.

3.8.2 Hawaii Fishing Communities

In 1998, the Council identified the islands of American Samoa, the Northern Mariana Islands and Guam as fishing communities for the purposes of assessing the effects of fishery conservation and management measures on fishing communities, providing for the sustained participation of such communities, minimizing adverse economic impacts on such communities, and for other purposes under the MSA (submitted in September 1998; approved April 19,1999; 64 FR 19067). In 2002, the Council identified each of the islands of Kauai, Niihau, Oahu, Maui, Molokai, Lanai and Hawaii as a fishing community (submitted in December 2002; approved August 5, 2003; 68 FR 46112).

The Pelagic Fisheries FMP FEIS noted that the City of Honolulu on the island of Oahu is the base of the longline and other industrial-scale fleets and the center of the state's fish marketing/distribution network (NMFS, 2001). However, the total number of pelagic fisheries-related jobs in the Honolulu metropolitan area compared to the overall number of jobs in the area is very small. Oahu contains approximately three-quarters of the state's total population, and over one-half of Oahu's residents live in the "primary urban center," which includes greater Honolulu. Thus, although Oahu has a high level of engagement in fishing and especially longline fishing relative to the other islands in Hawaii, the island's level of dependence on it is lower due to the size and scope of Oahu's population and economy.

As described in Section 3.7, during the past few years the Hawaii longline fishery has been affected by a series of legal decisions that resulted in changes in the federal management regime for the fishery. In 2001, total catch and ex-vessel value in the fishery decreased by about 34 percent, primarily as a result of the implementation of litigation-driven management measures that eliminated the swordfish portion of the Hawaii longline fishery. Swordfish, the largest component of the longline catch in 2000, became a negligible component in 2001.

Although the closure of the swordfish portion of the Hawaii longline fishery had a negative economic impact on some local businesses, the closure did not affect the sustained participation of any fishing community in Hawaii's pelagic fisheries. Many of the fishermen that formerly targeted swordfish outfitted their vessels to target other pelagic species, most notably tuna. In recent years, bigeye tuna has been the largest component of the pelagic catch, followed by yellowfin tuna, and albacore. As a result of an increase in the catch of bigeye tuna the ex-vessel value of landings in Hawaii's pelagic fisheries increased to about $45.3 million in 2002.

In April 2004, NOAA Fisheries reopened the swordfish-targeting segment of the Hawaii longline fishery under new federal rules. While it is uncertain at this early stage of the reopening what the regional impacts will be, the effects are likely to be positive. Moreover, should the measures to mitigate sea turtle interaction prove successful, it is likely that the amount of swordfish fishing effort allowed will be increased, resulting in additional regional economic benefits.

The nature and magnitude of Hawaii communities' dependence on and engagement in pelagic fisheries have also been affected by the overall condition of the state's economy. As described in the Pelagics FEIS (NMFS, 2001), tourism is by far the leading industry in Hawaii in terms of generating jobs and contributing to gross state product. In the first years of the new century

Hawaii's tourism industry suffered major external shocks, including the September 11 terrorist attacks and SARS epidemic (Brewbaker, 2003). The market for tuna weakened due to the decline in tourists arriving from Japan and elsewhere and due to a weak export demand. More recently, the decline in the value of the U.S. dollar compared with other currencies such as the Euro and the Japanese yen has made it more expensive for Americans to travel overseas and cheaper for foreign visitors to visit Hawaii. The weak U.S. dollar, combined with moderate growth in the national economy, is expected to help boost the state's tourism industry. Both domestic and international visitor counts have shown a general increasing trend (Brewbaker, 2003). These improvements in Hawaii's tourist industry will likely have a positive economic effect on local businesses engaged in the harvesting, processing and marketing of pelagic fishery resources.

3.9 Administration and Enforcement

3.9.1 Permitting, Data Collection and Enforcement under the Pelagics FMP

3.9.1.1 Permitting

Permitting and data collection under the Pelagics FMP are accomplished by the Sustainable Fisheries Division of the PIRO. At this time, of all the Pelagics FMP fisheries only the longline fishery is controlled by permit. The Hawaii-based longline fishery is a limited-access fishery with a maximum of 164 permits. Longline fisheries elsewhere in the region operate under a currently unlimited number of general longline permits. During 2002 (2002 Ann Rept), all 164 of the Hawaii-based permits were maintained, although 46 of these were held without vessels. In 2003, all 164 permits were maintained, 123 with vessels registered to them (PIRO, unpub. data).

There were also 88 active general longline permits, all for vessels based in American Samoa. In 2003, 66 General Longline Permits were issued, 64 for vessels in American Samoa, one in Guam and one in the CNMI (PIRO unpub. data)

A U.S. fishing vessel must be registered for use under general longline permit if that vessel is used: (1) to fish for PMUS using longline gear in the EEZ around American Samoa, Guam, the Northern Mariana Islands, or other U.S. island possessions in the Pacific Ocean; or (2) to land or transship, shoreward of the outer boundary of the EEZ around American Samoa, Guam, the Northern Mariana Islands or other U.S. island possessions in the Pacific Ocean, PMUS that were harvested with longline gear. In addition, a U.S. fishing vessel of the United States must be registered for use under a Hawaii longline limited access permit if that vessel is used: (1) to fish for PMUS using longline gear in the EEZ around Hawaii; or (2) to land or transship, shoreward of the outer boundary of the EEZ around Hawaii, PMUS that were harvested with longline gear. A receiving vessel must be registered for use with a receiving vessel permit if that vessel is used to land or transship, shoreward of the outer boundary of the fishery management area, PMUS that were harvested with longline gear.

In 2002, the Council approved Amendment 11 to the Pelagics FMP, which is intended to create a limit access permit system for American Samoa. NMFS has recently published a request for comments on the proposed rule (69 FR 43789, July 22, 2004). The intent of this action is to avoid gear conflicts in the American Samoa EEZ outside of the 50 nm area closed to large longline vessels and to avoid overcapitalization in the fleet. The estimated maximum number of permits will be 138. To qualify for a permit an individual must have owned a vessel used to legally harvest PMUS in the EEZ around American Samoa prior to March 22, 2002. Permits would be established for four categories based on vessel length (less than 40 ft, 40-50 feet, 50-70 feet, and over 70 feet). "Upgrade permits" (26) will be available to permit holders in the smallest vessel size class. Vessels greater than 40 feet in length will be required to carry observers, if requested by NMFS.

3.9.1.2 Observer Program

The National Marine Fisheries Service, Pacific Islands Region Office, Hawaii Longline Observer Program implements field aspects of the Marine Mammal Protection Act, Endangered Species Act, and the Magnuson-Stevens Fishery Conservation and Management Act. NMFS observers have been deployed in the Hawaii-based longline fishery since February 1994. Due to court decisions in recent years, observer coverage of the fleet has increased considerably.

The mission of the program is to observe and document all species caught, including sea turtles, seabirds, marine mammals, swordfish, tunas, sharks, and other non-target fishes and to collect selected biological specimens. The observer program, therefore, collects data on interactions between the pelagic longline fleet and protected sea turtles, marine mammals, and Seabirds. In addition to protected species catch rates, the program has also gathered data on sea turtle life history. The program provides DNA samples, turtle morphometrics, and a means for gathering satellite telemetry data. Secondarily, data and tissue samples from target species (swordfish, tuna) are also collected.

More specifically, among other tasks, observers:

- identify protected species, target, and bycatch species by number and location;
- record incidental mortality and injury of sea turtles, and tally all sea turtle observations during fishing activity;
- dissect post-mortem marine species as instructed (gonads, stomachs, otoliths);
- record sea turtle life history data, and tag all live sea turtles without existing tags;
- record life history data on other selected marine species;
- collect data on vessel activity and fishing operations;
- review and enter all data into a computer data base when on-shore; and
- collection of bird/fishing vessel interaction data including observations of deployed deterrents.

The PIFSC Honolulu Laboratory analyzes the data in conjunction with logbook data (from PIRO) to estimate total sea turtle takes and mortalities. Data are used to prepare annual reviews of BiOps, quarterly reports to the Western Pacific Fishery Management Council, and estimates of bird mortality to the U.S. Fish and Wildlife Service.

The docks are surveyed daily and vessels absent from the harbor are assumed to be fishing.

3.9.1.3 Enforcement

The USCG patrols the region with C-130 aircraft and surface vessels, however, since 9/11 the Homeland Security mission has taken precedence over fisheries surveillance and enforcement activities. In FY02, the USCG flew approximately 800 hours of fisheries patrols, including 520 hours in the MHI, 8 hours in the NWHI, 105 hours in Guam and the CNMI, 56 hours in American Samoa, 15 hours in Palmyra Atoll/Kingman Reef, 49 hours in Jarvis Island, and 41 hours in Howland/Baker Islands. Over 1300 cutter hours of fisheries patrols were conducted in the region with almost 200 vessel boardings (133 U.S. and 63 foreign vessels).

Enforcement for the Hawaii-based longline fishery is facilitated by use of a Honolulu-based vessel monitoring system (VMS) operated by NMFS and USCG. A VMS is an automated real-time, satellite-based tracking system that obtains accurate and near-continuous position reports from vessels at sea. The VMS in Hawaii was established in 1994 to help enforce area closures around the Hawaiian Islands in which fishing with longline gear is prohibited. NMFS certifies the VMS system hardware and software aboard each vessel and assigns each VMS unit a unique identification number.

The VMS, monitored in the 14th District Command Center by NMFS and USCG personnel, has proven to be an effective, cost-saving technology for the monitoring and enforcement of restricted areas over great distances. In 2002, there were three significant enforcement cases cued by information obtained from VMS. Using “signature analysis,” USCG and NMFS identify possible incursions into the main Hawaiian Island longline closure area and the Northwestern Hawaiian Island Protected Species Zone. This information is passed to patrolling cutters for investigation during at-sea enforcement boarding. In addition to enhancing government enforcement capability, VMS has yielded benefits for the fishers on equipped vessels, such as increased navigational capacity and secure, low-cost communications. The equipment also allows domestic fishers to transmit catch and effort data to NMFS and accurately report the position of illegal foreign fishing activity in the EEZ.

Special Agents of NMFS’ Office of Law Enforcement (OLE) conduct investigations of alleged violations of NOAA statutes and regulations, including the Magnuson-Stevens Act, the Lacey Act, the Shark Finning Prohibition Act, the Marine Mammal Protection Act and the Endangered Species Act based on case packages forwarded from the Coast Guard.

3.9.1.4 Data Collection

There are no federal reporting and recordkeeping requirements for any specific pelagic fishery occurring in the Western Pacific Region other than the longline fishery. The Pelagics FMP requires federal logbooks be kept by participants in longline fisheries. The implementing regulations require participants in pelagic fisheries in the region other than longline to comply with the data collection programs maintained by the respective state or territories.

The Western Pacific Fishery Information Network (WPacFIN) is a federal and state partnership for collecting, processing, analyzing, sharing and managing fisheries data from the Western Pacific Region. Through the cooperative efforts of the member agencies, WPacFIN provides fisheries data and information when, where, and in the quality needed by NOAA Fisheries and the WPRFMC and its various support groups to develop, implement, evaluate and amend FMPs for the region. WPacFIN assists island agencies in designing and implementing appropriate local fisheries data collecting, monitoring, analyzing and reporting programs, complete with associated microcomputer-based data processing systems, and helps promote data standards to facilitate information analyses and reports. WPacFIN manages the data used by the Pelagics Plan Team to produce the annual report for the Pelagics FMP.

Brief descriptions of the fisheries data collection systems for the pelagic fisheries in each island area are provided below.

3.9.1.4.1 Hawaii

State of Hawaii regulations require any person who takes marine life for commercial purposes, whether within or outside of the state, to first obtain a commercial marine license from the Hawaii Division of Aquatic Resources (HDAR). Every holder of a commercial marine license must furnish to HDAR a monthly catch report. Any commercial albacore troll vessel that lands its catch in Hawaii is required to complete the HDAR Albacore Trolling Trip Report. Pole-and-line vessels in Hawaii are required to record their catches on the HDAR Aku Catch Report. Longline vessels are required to complete the NMFS Western Pacific Daily Longline Fishing Log, which requires recording of protected species interactions, and the HDAR Longline Trip Report. When fishing on the high seas, they must also complete the HSFCA logbook.

Every commercial marine dealer must furnish to HDAR a monthly report detailing the weight, number and value of each species of marine life purchased, transferred, exchanged or sold and the name and current license number of the commercial marine licensee from whom the marine life was obtained.

NMFS formerly administered a fish market sampling program in Honolulu. In cooperation with the state, staff from both NMFS and HDAR visited the fish auction managed by the United Fishing Agency and obtained size frequency and economic data on pelagic fish and bottomfish sold. These data are now submitted electronically to HDAR by the auction as part of the commercial marine dealer reporting system.

3.9.1.4.2 American Samoa

Longline vessels are required to complete the NMFS Western Pacific Daily Longline Fishing Log. Catch data for other fishing methods are collected through the Offshore Creel Survey administered by the Department of Marine and Wildlife Resources (DMWR) of the American Samoa Government. Since 1985, the Offshore Creel Survey conducted on the island of Tutuila has examined both commercial and recreational boat trip catches at five designated sites. For two weekdays and one weekend day per week, DMWR data collectors sample offshore fishers between 0500 and 2100 hours. Two DMWR data collectors also collect fishing data on the islands of Tau and Ofu in the Manua Group.

Data on fish sold to outlets on non-sampling days or caught during trips missed by data collectors on sampling days are accounted for in a Commercial Purchase System (receipt book) or in the Cannery Sampling Form. A Daily Effort Census is used to monitor the activity of the longline fleet. A vessel inventory conducted twice a year provides data on other vessel numbers and fishing effort.

3.9.1.4.3 Guam

An Offshore Creel Survey program administered by the Division of Aquatic and Wildlife Resources (DAWR) of the Government of Guam provides estimates of island-wide catch and effort for all the major fishing methods used in commercial and recreational fishing. In 1982, WPacFIN began working with the Guam Fishermen's Cooperative Association to improve their invoicing system and obtain data on all fish purchases on a voluntary basis. Another major fish wholesaler and several retailers who make purchases directly from fishers also voluntarily provide data to WPacFIN using the Commercial Fish Receipt Book Program. That program, however, is not yet mandatory for local fish vendors. The Guam Department of Commerce also maintains a mandatory data submission program to monitor landings from foreign longliners transshipping their catch through Guam.

3.9.1.4.4 Northern Mariana Islands

The Division of Fish and Wildlife (DFW) of the Commonwealth of the Northern Mariana Islands monitors the commercial fishery by summarizing sales ticket receipts from commercial establishments (commercial purchase database collection system). DFW staff routinely distribute and collect invoice books from 80 participating local fish purchasers on the island of Saipan, including fish markets, stores, restaurants, government agencies and roadside vendors. Similar systems are being developed for Tinian and Rota.

3.9.2 Permitting, Data Collection and Enforcement under the High Seas Fishing Compliance Act

The High Seas Fishing Compliance Act of 1995 (HSFCA) (16 U.S.C. 5501 et seq.) establishes a system of permitting, reporting and regulation for all U.S. fishing vessels operating on the high seas. Applications for high seas permits are issued by NMFS Regional Offices. With the creation of the new Pacific Islands Region, this function will be transferred from the Southwest Region, headquartered in La Jolla, California to Honolulu. Permits are valid for five years. Permitted vessels must be marked, and operators must submit reports of fishing operations and catch.

The Act is enforced by the Secretary of Commerce and the Secretary of the department in which the Coast Guard is operating, using personnel and facilities of other federal or state agencies by agreement. Enforcement officers have enumerated powers, including searches, inspections, arrests and seizures of high seas fishing vessels used in violation of the Act and living marine resources taken unlawfully. Violators of the Act are liable for costs of storage, care and maintenance of living marine resources or other property seized in connection with the violation. Violations of the Act are subject to civil penalties of up to $100,000, with each day of a continuing violation a separate offense, and are also subject to criminal penalties. The Secretary may suspend, revoke, deny or impose additional conditions on a permit as a sanction for violation. High seas fishing vessels used, and living marine resources taken, in connection with a violation are subject to forfeiture to the U.S.

3.9.3 Permitting, Data Collection and Enforcement under the South Pacific Tuna Treaty

The SPTT, entered into in 1988, is an international agreement between the United States and sixteen members of the South Pacific Forum. The current agreement allows annual access for up to 50 U.S. purse seiners (with an option for 5 more if agreed to by all parties) to the EEZs of various Pacific island countries. U.S. operational, administrative, and enforcement commitments under the SPTT are carried out by NMFS on behalf of the Secretary of Commerce. The NMFS maintains a field station in American Samoa to monitor and administer the U.S. purse seine fleet operating under the SPTT. The office's responsibilities include collection and transmission of fishing data, placement of observers, and sampling of landings. Data on the U.S. and other pelagic fishing fleets in the Western and Central Pacific is collected and reported by the Secretariat of the Pacific Community's Oceanic Fisheries Program (OFP), which provides the secretarial support for the annual Standing Committee on Tuna and Billfish (SCTB). Licensed vessels are required to submit various reports detailing, among other things, catch, port schedules, and national zone entry and exit.

The Secretary of Commerce, in cooperation with the Secretary of State, is charged with enforcing the South Pacific Tuna Act, which implements the SPTT. The Act directs the Secretary to investigate, at the request of a Pacific Island Party, alleged Treaty infringements involving a U.S. vessel and report to the Party on corrective action taken or proposed. After conducting an investigation, the Secretary, with the concurrence of the Secretary of State, and on the request of the Pacific Island Party concerned, may, based on specified findings, order a fishing vessel that has not submitted to the jurisdiction of that Party immediately to leave the area. Authorized Officers may make arrests, board, and search or inspect vessels subject to the Act, and seize samples of fish or other items for evidence related to a violation.

The Act mandates that vessel operators and crew members allow individuals named by Pacific Island Parties as observers under the Treaty to board vessels for scientific, compliance, monitoring and other functions and engage in other specified activities.