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ANNUAL REPORT OF THE HAWAII-BASED LONGLINE FISHERY FOR 1998

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PREFACE

The Western Pacific Regional Fishery Management Council (WPRFMC) developed the fishery management plan (FMP) for pelagic species in accordance with the Magnuson-Stevens Fishery Conservation and Management Act of 1976. This FMP, which regulates the U. S. domestic fisheries for tunas, swordfish, marlins, and other pelagic species in the Western Pacific region, was first implemented by the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) on March 23, 1987.

The Fishery Monitoring and Economics Program (FMEP) of the Honolulu Laboratory, Southwest Fisheries Science Center, NMFS, NOAA, collects biological and economic information from U. S. domestic longline fishing vessels permitted to fish within the western Pacific U. S. Exclusive Economic Zones. This report focuses on information from federally permitted domestic longline vessels based in Hawaii.

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INTRODUCTION

The Hawaii-based longline fishery, the largest commercial fishery in Hawaii, (WPRFMC, in prep.), accounted for 85% of all commercial pelagic landings (28.6 million pounds) and pelagic ex-vessel revenue ($46.7 million) in 1998. This was an increase of 1.5 million pounds of fish but a decrease of $3.4 million from 1997. Tunas (*Thunnus* spp.), broadbill swordfish (*Xiphias gladius*), and sharks were the dominant components of the longline catch, but a variety of other pelagic species and some protected species were also caught (Table 1). Markets for the longline catch ranged from local fish markets to fine restaurants. Longline caught fish were also exported. Most swordfish, along with some high grade tunas, are air-freighted to the continental U. S. The best bigeye and yellowfin tunas, which command higher prices, are exported to Japan (Pooley, 1993; Bartram et al., 1996).

Recent developments regarding the Hawaii-based longline fleet are discussed in this report. Descriptions of data sources, data management procedures, and shortcomings of the data are provided. Nonconfidential data summaries on fleet activity, effort, catch, catch-per-unit-effort (CPUE), landings, revenue, average prices, size of fish, and fishery interactions with endangered and protected species are also covered. Finally, this report updates longline statistics for the entire period covered by the Federal longline logbook program (1991-98) and the shoreside market sampling program (1987-98).

RECENT DEVELOPMENTS

The most important issues facing the Hawaii longline fishery in 1998 concerned conservation. Sea turtle and sea bird interactions were at the forefront of the Western Pacific Regional Fishery Management Council (Council) management discussions and initiatives. The National Marine Fisheries Service (NMFS) Honolulu Laboratory (HL) has developed a statistical method for estimating seabird mortality caused by longline fishing. Point estimates, with confidence bounds, superimposed on distribution of estimates of seabird take and mortality have been computed and updated annually by the Honolulu Laboratory. The results of these estimates have been provided to the Council and U. S. Fish and Wildlife Service (FWS). The Council, HL, and FWS are cooperating to investigate factors affecting longline fishing interactions with seabirds. The HL is also evaluating mitigation strategies to reduce seabird interactions on dedicated research cruises with the NOAA ship

Townsend Cromwell. The Council and the FWS also provided the fishermen with information regarding the seriousness of interactions with protected species. Information on how to reduce interactions with birds has been translated into various languages and distributed to longline boats. However, these mitigation techniques have not been widely adopted by the fleet.

Sea turtles have been incidentally hooked on longline gear. NMFS is required by the Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA) to estimate the level of turtle takes and mortality and seek ways to eliminate them or reduce them to a practicable level. The Honolulu Laboratory has provided species-specific estimates of turtle takes and mortality using the same methodology to estimate sea bird interactions. The Honolulu Laboratory has also identified the factors of longline gear and fishing techniques that influence the likelihood of sea turtle interactions, developed a prototype turtle population simulator to assess the impact of longline fishing mortality on the turtle population, assisted in collecting biopsy samples for genetic analysis, and monitored post release movement of turtles by means of satellite transmitters. The Honolulu Laboratory continues basic research on sea turtle interactions and plans to expand research in areas such as looking at environmental indices and how they are related to longline fishing operations and turtle interactions.

Sharks, though incidentally caught in the Hawaii-based longline fishery, constitute the largest component of the longline catch. Though the demand for shark meat is small in Hawaii (limited primarily to mako and thresher sharks), fins are valuable as an export product to Asian markets. Shark fins are dealt in cash transactions and the revenues are usually distributed among crew members. Blue sharks retained for fins represent the majority of shark landings. However, finning sharks by the longline fishery has become a controversial practice with increasing concerns raised among shark conservationists, some fishermen, and the public seeking to have the practice banned. The Honolulu Laboratory monitors shark catch by the Hawaii-based longline fishery through the longline logbook program. Total shark catch, species composition of the shark catch, catch by trip type, percentage of sharks retained, and CPUE are derived from the logbook data. The Honolulu Laboratory has been monitoring shark fins caught by foreign longline vessels that are transshipped through Honolulu, and done collaborative research with Japanese fishery biologists to further investigate shark population biology in support of stock assessment. The aim of shark research at the Honolulu Laboratory is to ensure that populations of pelagic sharks in the central and western Pacific region remain healthy.

Increasing longline catch of blue marlin was a concern to the Hawaii Conservation Association, a group of charter boat, commercial, and recreational troll fishermen in Kona. They recommended a quota on longline catch of blue marlin and an extension of the current area closure boundary in the belief that this might improve the troll catch rate for blue marlin. As one of the justifications for these additional regulations, a fishery value comparison was presented. This presentation showed that direct and indirect revenue of the charter boat fishery, generated through charter sales, travel expenses, and fishing tournament prize money, was much greater than the ex-vessel value of longline-caught blue marlin. However, many fish marketers and fish processors also testified that blue marlin is an important source of locally produced fish that is regularly available at an affordable price for seafood consumers in Hawaii. Since Hawaii longline catch of blue marlin comprises less than 4% of the Pacific-wide blue marlin catch, it was also unclear if the quota and area closure would have an appreciable affect on improving troll catch rates for blue marlin. The Council did not propose any new regulations in 1998 to decrease longline catch of blue marlin but is interested in looking at blue marlin from a stock perspective. Billfish mortality on longline gear and state-of-the-art high technology tagging are also being reviewed, as are methodologies for comparing commercial and recreational values.

DATA SOURCES

The NMFS Fishery Monitoring and Economics Program (FMEP) relied exclusively on shoreside sampling for longline vessel activity and landings estimates from 1987-91 (Ito, 1992). A Federal logbook system for domestic longliners operating in the western Pacific region was then implemented in November 1990. Logbook collection and summary procedures are documented in Dollar and Yoshimoto (1991). Therefore, the time spans covered in some summaries in this annual report differ according to the source of data. Additional information can be found at:

http://www.nmfs.hawaii.edu/fmpi/fmep/index.htm

Logbook numbers are as provided by fishing captains, including any errors in species identification, unless corrected by those captains following discussions with FMEP staff. This report includes certain revisions to logbook data that rectify previously overlooked errors. Data in this report supersede previous summaries. These updates to the data bases have not changed any pattern revealed in previous reports, but have improved the accuracy of the data and increased the understanding of the Hawaii-based longline fishery.

Detailed information on vessel operations, area of fishing, fishing effort, CPUE, and interactions with protected species are based on Federal longline logbook data. Longline trips are categorized into one of three trip types according to species targeted: 1) swordfish, 2) tuna, or 3) mixed (targeting both swordfish and tuna). Trip target information is obtained by FMEP personnel from dockside interviews with the captain or deck boss. When the captain was unavailable for an interview or the log sheets were mailed in, trip type was determined by evaluating the set times, number of hooks and light sticks, area fished, duration of trip, catch composition, and previous history of trip types for that particular vessel.

In general, swordfish and mixed trips set gear with relatively few hooks between floats (2-5 hooks) which keeps the gear shallow. The gear is set in the evening, soaked overnight, and hauled the following morning, using squid for bait and employing lightsticks. The difference between these two trip types is the operator's discretion in determining target and fishing area. During 1989-94 when there was a lot of interest in longlining for swordfish, one of the distinguishing characteristics separating swordfish targeted trips and mixed target trips was the frequency of light sticks. Swordfish trips usually used a lightstick-to-hook ratio of one-to-one whereas mixed trips used a ratio ranging from one-to-five up to one-to-three. As east coast swordfish longline vessels emigrated from the Hawaii-based longline fishery in 1994 and 1995, the U. S. Gulf boats became increasingly proficient not only in catching swordfish but using a lower lightstick to hook ratio in the process. This technique using a lower lightstick to hook ratio is now the dominant technique used to target swordfish. In contrast, tuna trips typically set gear deep by attaching more hooks between floats (15-30+ hooks per float), setting and soaking gear in the day, hauling in the afternoon, using sanma for bait, and using no lightsticks. Interestingly, there were instances where techniques typically used to target swordfish or mixed species were used to fish for tunas with a high degree of success. The longline fishery targets certain pelagic fish species and, in addition, does catch a variety of other pelagics species in the process, but almost all the catch have been marketed quite successfully.

Mean weight of fish, weight-frequency distribution, and average fish prices are based on shoreside sampling. Currently, sampling occurs twice a week (Mondays and a random day chosen between Tuesday and Friday) when FMEP and Hawaii Division of Aquatic Resources (HDAR) fishery biologists collect biological and economic data at the United Fishing Agency, a public fish auction where most of the longline landings are unloaded and sold. In addition, similar information has been collected from seafood brokers who handled longline catch in Honolulu.

Weight of individual fish is recorded. When processing or loss from damage occurred, the weight was raised to an estimated whole (round) weight. Catch, landings, and revenue estimates were computed by two methods. From 1987-91 the estimates were computed by extrapolating from the number of days sampled at the auction and brokers to the total number of days the market was in operation. During this period the shoreside sampling captured about 75% to 90% of the days the market was operating. Landing estimates for 1992-98 were based on the multiplication of the average whole weight for each species from shoreside sampling and the corresponding number of fish kept as summarized by the longline logbooks. Since mean weights differ considerably among the different trip types, this computation was calculated for each trip type. All trip type totals were then summed to derive an overall estimate of total landings. The multiplication of the average price per pound for each species and the corresponding landing estimate to yield estimated revenue. This process was done for each trip type then summed to derive an overall total of estimated revenue. Revenue was calculated by multiplying the total landings by the average price per pound. Again this procedure was repeated for each trip type to derive total revenue for each trip type. The trip type totals were then summed to derive an overall estimate of total revenue. The rate of shoreside sampling decreased during 1992-93 due to personnel constraints and was 20% to 35% during 1995-98 for the major billfish and tuna species.

Mako and thresher shark fins and carcasses are usually kept whereas only the fins from blue and other shark species are kept. Currently, there is no market in Hawaii for blue and miscellaneous shark carcasses, and only a few sharks other than mako and thresher sharks were observed at the shoreside sampling site throughout the 12-year sampling period. Although carcasses of blue and other shark species are discarded out at sea, by logbook definition finning represents a "kept" fish and landings of such fish. Shark catch was estimated by multiplying the average weight of sharks from observer data collected during 1990-91 (Dollar, 1994) and the number of sharks kept from the logbook data. This procedure for estimating round weight of "kept" blue sharks was developed as a crude method to estimate shark biomass so that shark landings could be represented in the tables as a whole weight regardless of product form, just like all the other species tabulated. Shark landings are represented as estimated weight of the sharks kept for fins and whole carcasses.

LONGLINE VESSEL OPERATIONS

There are 164 Federal limited entry permits issued for the Hawaii-based longline fishery. The number of active vessels increased rapidly from 37 vessels in 1987 to a high of 141 vessels in 1991 (Fig. 1).[1] The number of vessels fluctuated from 103 to 125 from 1992 to the present. There were 114 active vessels in 1998, up from 105 active vessels in 1997.

The Hawaii-based longline vessels are categorized in three size classes: small (<56 ft), medium (56-74 ft), and large (>74 ft) vessels. Most of the vessels operating in the Hawaii-based longline fishery are medium- and large-sized vessels, respectively. The number of active medium-sized vessels ranged from 49 in 1996 to 61 in 1991, with 55 medium-sized vessels operating in 1998, an increase of 4 vessels from 1997. The number of active large-sized vessels ranged from 35 in 1997 to 49 in 1991, with 42 large-sized vessels operating in 1998. The number of active small vessels decreased from 31 in 1991 to 17 vessels in 1998.

The following is a summary of vessel entry and exit patterns for 1998:

Total Active:	114
Total Entries:	16
New vessels:	7
Reactivated:	9
Total Exits:	7
Inactive:	2
Left Hawaii:	5

This fishery included 16 vessels that did not fish in 1997, which either began (7) or resumed (9) fishing in 1998. Most of the new vessels were large- (n = 3) and medium-sized (n = 4). Among the vessels that resumed activity in this fishery, six were from the east coast. These east coast boats fished for swordfish in Hawaii during 1990-94, then returned to the mainland, and have targeted tunas since their return in 1998.

Seven vessels which longlined in 1997 did not in 1998. Five left Hawaii while two remained in Hawaii but were inactive. Three large vessels, two medium vessels and two small vessels left the longline fishery in 1998. One noticeable development in the longline fishery in 1997 and 1998 was the emigration of longline vessels in the latter part of the year. These boats either relocated to California to fish for swordfish or had repairs done in the summer months and then returned to Hawaii

[1]Number of vessels, number of trips, and average number of days fished per trip are based on date of landing (DOL) which is the date when a longline trip returned to port. Active vessels indicate longline vessels taking at least one trip during the calendar year.

repairs done in the summer months and then returned to Hawaii during the following winter. There were 18 Hawaii-based longline vessels that transited to California in the latter part of 1998; up from 15 vessels in 1997.

Longline Vessel Trip Activity

The number of trips made by Hawaii-based longliners increased slightly to 1,140 trips in 1998 (Table 2). Although the total number of trips showed little change in the past 6 years, targeting strategies have changed substantially. Swordfish trip activity decreased from about 300 trips during 1991-94 to 78 trips in 1997 and 84 trips in 1998 (Fig. 2). In contrast, the number of tuna trips increased from 458 trips in 1992 to a high of 760 trips in 1998. The number of mixed trips decreased substantially from 823 trips in 1991 to 228 trips in 1994, but has remained relatively stable since 1995. Longliners made 296 mixed trips in 1998.

Longline trip activity was high during the first, second, and fourth quarters (Fig. 3). The primary motivation for trip activity during those periods is the relatively high catch rates for bigeye tuna and swordfish. Fishermen elect to target swordfish mostly during the first and second quarters when swordfish catch rates are high or the swordfish migrate near the Hawaiian Islands. Trip activity is lowest in the third quarter due to poor catch rates for both swordfish and tuna in all areas of fishing. Consequently, vessel owners and operators usually schedule annual maintenance during this quarter. Activity increases in the fourth quarter due to improved bigeye tuna catch rates and high prices for sashimi (raw fish) during the holiday season. The high level of longlining for bigeye tuna typically carries over into the first quarter of the following year.

The distance traveled to the first set was determined by calculating the difference from Honolulu and the location of the first set from the logbook data. Because these calculations include trips which embarked from California and fished en route to Hawaii, the calculations are somewhat biased. The average miles to the first set for the fleet has ranged from 318 miles to 465 miles with the average miles to the first set at 422 miles in 1998 (Table 2). Swordfish trips usually traveled farthest from Hawaii to make their first set (708 miles in 1998) while tuna trips traveled the shortest distance to make their first set (384 miles in 1998).

The average number of days fished per trip for the longline fleet increased gradually from 1991 through 1998 (Table 2). Swordfish trips consistently had greater fishing days per trip than other trip types. The average number of days fished for swordfish trips increased from an average of 10.7 days per trip in 1991 to 14.6 days per trip in 1998. The average number throughout 1991-98. Swordfish trips fish an average of 3-5 days more than tuna or mixed trips because swordfish retains its quality longer than tuna.

FISHING EFFORT

Number of Sets

Fishing effort[2] was summarized by the number of days fished (i.e., number of sets) (Table 3) and by number of hooks set (Table 4). The range for total days fished was 10,799 (1994)-12,635 (1991) with 12,506 days fished in 1998, up by 660 days fished from the previous year (Table 3). The number of days fished on swordfish trips during the 1996-98 period was substantially less than in 1991-94. The number of days fished on tuna trips more than doubled from its low in 1992 with 7,874 days fished in 1998. Mixed trips fished 3,409 days in 1998.

Most of the fishing activity occurred outside of the EEZ and MHI EEZ, with much less effort in the NWHI or the other U. S. possessions (i.e. Baker Island, Howland Island, Kingman Reef, Jarvis Island, Johnston Atoll, Palmyra Atoll, and Wake Island). The number of days fished outside the EEZ increased from 4,288 days fished in 1994 to 5,732 days fished in 1998. In contrast, the number of days fished in the MHI EEZ decreased from 5,454 days fished in 1995 to 3,493 days fished in 1998. Fishing activity in the NWHI EEZ varies substantially year to year but has generally increased since 1992. Fishing in the EEZ of other U. S. possessions was low during 1991-97 but increased substantially in 1998. This reflected good catches of tunas near Kingman Reef and Palmyra Atoll.

Number of Hooks Set

The total number of hooks set fluctuated between 12.0 to 13.0 million hooks during 1991-94 but has since increased up to a record of 17.4 million hooks in 1998 (Table 4). Tuna, mixed, and swordfish trips accounted for 78%, 16%, and 6% of the hooks set, respectively. Hooks set by swordfish trips peaked to 3.8 million hooks in 1993 and decreased to a low of 0.8 million hooks in 1997. Hooks set on swordfish trips increased slightly to 1.0 million hooks in 1998. Hooks set on tuna trips increased consistently from 5.2 million hooks in 1991 to a high of 13.5

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[2]These units of effort are based on date of haul, i.e., the actual date of fishing operations. This is to insure that these detailed units of measurements are summarized within the actual time period and not included in a time period which the operations of a trip are concluded (i.e., date of landing).

million hooks in 1998. Hooks set on mixed trips ranged from 1.5 million hooks to 4.7 million hooks in this time period. Mixed trips set 2.9 million hooks in 1998. The hooks set by area show most of the effort occurred outside of the EEZ (Fig. 4). Hooks set outside the EEZ has been on a steady increase from 4.1 million hooks in 1994 up to 7.4 million hooks in 1998. The effort in the MHI EEZ has been on the decline from 7.1 million hooks in 1995 to 5.0 million hooks in 1998. Effort in the NWHI EEZ has been increasing steadily from 0.7 million hooks in 1992 peaking at 4.1 million hooks in 1997. The lowest level of effort was in the EEZ of other U. S. possessions, however, hooks set in this area jumped to 1.9 million hooks in 1998. Most of this effort was expended in the EEZ of the Kingman Reef and Palmyra Atoll. Hooks set by area in 1998 reveal most of the effort in or near the EEZ of the Hawaiian Islands and high effort in the EEZ of the Kingman Reef and Palmyra Atoll (Fig. 5).

The average number of hooks per day fished for the longline fleet has increased consistently from 980 in 1991 to 1,390 in 1998 (Table 5). The fleet average increased because of the rise of the average number of hooks on tuna sets and tuna trips compromising a higher proportion of total number of days fished. The average number of hooks set per day fished for tuna trips was highest for all trip types. The average number of hooks set per day fished on tuna trips increased steadily from 1,220 in 1991 to 1,710 in 1998. Mixed and swordfish trips set about the same number of hooks per day fished. The average number of hooks set per day fished for these two trip types ranged from 750 to 910 during 1991-98.

CATCH

Catch is the sum of fish kept, released, and discarded. With the exception of a record year for bigeye tuna catch and a substantial decline in albacore, yellowfin tuna, and mahimahi catch in 1998, catch for other pelagics species were about the same as in 1997.

Swordfish catch totaled 66,289 fish in 1991, peaked at 79,554 fish in 1993, then dropped substantially to 43,345 fish in 1994 (Table 6). Despite the low effort directed toward swordfish during 1994-98, swordfish catch increased gradually after dropping to 37,428 fish in 1995. Swordfish catch increased 17% in 1998 from 1995. Swordfish catch in the first and second quarters is about twice as high as catch the third and fourth quarters. The majority of swordfish were caught on swordfish directed trips during 1991-95 but mixed trips accounted for most swordfish catch from 1996 through 1998. Swordfish catch was lowest for tuna directed trips. In any given year, tuna trips account for less than 7% of the total number of swordfish caught.

Most (63-83%) of the swordfish were caught outside of the U. S. EEZ (Table 7).

Blue marlin catch ranged from 4,012 fish in 1991 up to 8,806 fish in 1995. Blue marlin catch was 5,350 fish in 1998, down by 35% from the previous year. Blue marlin catch is highest in the second and third quarters and lowest in the first quarter of the year. Most of the blue marlin were caught on tuna trips. Tuna trips account for 43% to 63% of the total blue marlin catch. Swordfish trips had the smallest blue marlin catches (3%-21%). Blue marlin catch was highest in the MHI EEZ during 1991-97, but shifted outside of the U. S. EEZ in 1998.

Striped marlin catch varied substantially from year to year. The catch ranged from 11,292 in 1994 up 26,967 in 1991. The 1998 striped marlin catch was 14,347 fish, up 14% from 1997. Striped marlin catch was lowest in the third quarter. Tuna trips catch was 65% to 80% of the total striped marlin catch. Striped marlin catch is usually highest in the EEZ of the MHI but the 1998 catch was highest in the NWHI EEZ.

The longline fishery focused on good year round catches of bigeye tuna which drove bigeye tuna catch to a record high in 1998. This concerted effort directed specifically towards bigeye tuna resulted in a decline in yellowfin tuna and albacore catch in 1998. Bigeye tuna catch increased steadily from 48,102 fish in 1994 to 98,795 fish in 1998. Bigeye tuna catch was highest in the fourth quarter and declined to a low in the third quarter. Most of the bigeye tuna catch was taken on tuna trips (74% to 87% from 1994 to the present). The highest bigeye tuna catches were in the MHI EEZ from 1991-96. However, the largest bigeye tuna catch was outside of the EEZ in 1997 and 1998. The bigeye tuna catch of U. S. possessions, especially in the areas of Kingman Reef and Palmyra Atoll EEZ, was exceptionally high in 1998.

Yellowfin tuna catch fluctuated from year to year in a general upward pattern peaking at 29,045 fish in 1997. Yellowfin tuna catch was down 25% to 21,721 fish in 1998. Longline catch of yellowfin tuna is typically highest in the first quarter and declines gradually to a fourth quarter low. Mixed trips had the highest yellowfin tuna catch back in 1991 and 1992 but tuna trips have accounted for most (60% to 80%) of the yellowfin tuna catch. Yellowfin tuna catches were typically highest in the MHI EEZ but catch was highest outside the EEZ in 1998. Yellowfin tuna catch was also high in the EEZ of U. S. possessions in 1998.

Albacore catch showed a consistent increase from 14,051 fish in 1991 peaking at 71,084 fish in 1997. Albacore catch then dropped about 30% to 48,833 fish in 1998. The recent increase in albacore catch was driven by a growing market to the U. S. mainland for fresh albacore. Albacore catch also rose as a result of increasing albacore catch by swordfish trips during 1992-94 and by tuna trips from 1993 through 1997. Albacore catch was highest in the fourth quarter during 1992-95 but peak catches shifted to the second quarter in 1996-98. This shift in peak albacore catch coincides with the decline in effort directed towards swordfish and increasing effort towards tunas. Albacore catch was highest outside the EEZ. Albacore catch in the EEZ of U. S. possessions was low during 1991-93 but have risen steadily from 1994 through 1997.

Mahimahi catch showed a high degree of variability throughout 1991-98 with high catches in 1992, 1995, and 1997. Catch ranged from 22,183 in 1998 up to 59,813 fish in 1995. Tuna trips and mixed trips account for most of the mahimahi catch. The highest catches were outside of the EEZ and in the MHI EEZ. Ono catch in 1997 and 1998 has more than tripled from its low in 1994. Ono was caught predominantly by tuna trips. Ono catch was high in the MHI EEZ during 1991-94 but have been highest outside the EEZ from 1995 through 1998. Moonfish catch increased consistently from 3,079 fish in 1991 up to 9,184 fish in 1998. Moonfish catch is up as a result of increased targeting for tunas. Tuna trips account for almost all of the moonfish caught by longliners. The area with the highest catch for moonfish was in the MHI EEZ.

Sharks have consistently dominated the total longline catch throughout the entire history of the logbook catch summaries. Shark catch peaked at 154,608 fish in 1993, dropped by 26% in 1994, and then declined to 85,838 fish in 1997. Shark catch was up slightly to 99,919 fish in 1998. Much of the decline from 1993 was related to the reduction in effort directed toward swordfish. Shark catch by swordfish trips was most prominent during 1991-94 but increasing shark catches by mixed and tuna trips has outpaced swordfish trips since 1995. Blue shark catch is highest outside the EEZ, where it accounts for 57% to 80% of the total shark catch. Blue shark made about 95% of the shark catch throughout 1991-98 (Table 8). The remainder of the shark catch is composed of mako, thresher, and other miscellaneous shark species. The percentage of sharks kept for their fins and flesh increased from 3% in 1991 to 61% in 1998, most of which were blue sharks retained for their fins.

Catch Composition

Composition of the catch in 1998 was similar to the previous year. The three largest components of the longline catch in 1998 were sharks, bigeye tuna, and albacore (Fig. 6A). The proportions of sharks (+4%) and bigeye tuna (+5%) increased while albacore (-5%) and mahimahi (-6%) decreased from the previous year. The proportion of other components of the catch was about the same as 1997, however, the composition of the catch was considerably different for each of the trip types (Fig. 6B-D).

Sharks and swordfish were the major components of the catch for swordfish trips in 1998. Sharks constituted half of the catch while swordfish accounted for about a third of the catch. Catch components of swordfish trips were relatively specific as the remainder of the catch made up only 18%. The principal components of the tuna trips catch were bigeye tuna, albacore, and sharks (63%). Tuna trips also had the highest percentage of marlin and the lowest percentage of swordfish of all trip types. Sharks, swordfish, and bigeye tuna were the major components of the mixed trip catch. Sharks made up about a third of the catch while swordfish represented about a quarter of the catch.

There were some similarities in catch composition when comparing the different areas (Fig. 7A-D). Swordfish represented 14% of the catch in the NWHI EEZ and outside the EEZ while catch composition for marlins were highest in the MHI EEZ and NWHI EEZ. Bigeye tuna constituted a considerable portion of the catch in all areas but was exceptionally high (43%) in the EEZ of U. S. possessions because of high catches in the area of Palmyra Atoll and Kingman Reef. The composition for albacore was highest in the MHI EEZ and outside the EEZ where it represented 13% of the catch. The highest composition of yellowfin tuna was 16% which occurred in the EEZ of other U. S. possessions.

CATCH-PER-UNIT-EFFORT (CPUE)

CPUE from logbook data is measured as number of fish per 1,000 hooks. There were no dramatic changes in overall CPUE (all trip types combined) for 1998 (Table 9). However, overall catch rates do not reflect the change over time with respect to fleet targeting strategies (trip types) and area fished by the longline fleet. Therefore, overall CPUE has been determined not to be an accurate measure of fishery performance or fish availability. For these types of information, CPUE indices were calculated separately to account for targeting strategy or fishing area.

Swordfish trips consistently had the highest CPUE for swordfish. The swordfish CPUE for swordfish trips fell from 15.4 fish in 1991 to a low of 10.3 fish in 1994 and rose back to 15.4 fish in 1997. Swordfish CPUE for swordfish trips was slightly lower at 14.5 fish in 1998. The best swordfish CPUEs in 1998 were broadly distributed ranging from longitude 130°W to the dateline, and between latitudes 30° to 35°N and in the NWHI EEZ (Fig. 8). The high swordfish catch rates far east of the Hawaiian Islands were attained by vessels from California that fished en route to Hawaii. Swordfish CPUE was lowest in the MHI EEZ and south of the Hawaiian Islands.

Blue marlin CPUE for all trip types was low relative to swordfish CPUE. Mixed trips consistently had the highest CPUEs for blue marlin, at 0.5 fish to 1.3 fish throughout 1991-98.

Mixed trips also had the highest blue marlin catch rates in the summer months, which coincided with the blue marlin season for the troll fishery. The highest blue marlin CPUE for mixed trips in 1998 was north of Oahu and southeast of Kauai (Fig. 9). Blue marlin CPUE was lowest in the areas north 30°N.

Striped marlin catch rates for all trips were higher than blue marlin CPUE. Tuna trips had slightly better or comparable striped marlin catch rates than the other two trip types. Striped marlin CPUE for tuna trips ranged from 0.8 fish up to 2.2 fish with CPUE at 0.9 in 1998. The highest striped marlin CPUE in 1998 occurred in the EEZ of the Hawaii EEZ (Fig. 10).

Tuna targeted trips usually had the highest CPUEs for bigeye tuna although mixed trips had comparable, sometimes higher, catch rates for bigeye tuna. Bigeye tuna CPUE for tuna trips rose from 4.4 in 1995 to a record 6.1 fish in 1998. Bigeye tuna CPUE was highest in the fourth quarter. CPUE declines slightly in the first quarter and decreases to a low in the third quarter. The bigeye tuna CPUE for tuna trips in 1998 was highest in the area in or near the Kingman Reef and Palmyra Atoll EEZ and north of the Hawaiian Islands (Fig. 11).

Yellowfin tuna CPUE was relatively low in comparison to bigeye tuna and albacore. Although tuna trips caught more yellowfin tuna, mixed trips had higher CPUEs for yellowfin tuna. The yellowfin tuna CPUE for mixed trips ranged from 1.0 to 3.3 between 1991-98 with a CPUE of 1.3 in 1998. Yellowfin tuna CPUE for mixed trips was highest in the third quarter and lowest in the fourth quarter. This high yellowfin tuna CPUE in the third quarter is about the same time as the yellowfin tuna season for the troll and handline fishery. The highest yellowfin tuna CPUE for mixed trips was located south of the MHI, lowest above latitude 20°N (Fig. 12).

Swordfish trips had the highest catch rates for albacore during 1991-96 but tuna trip CPUE for albacore showed consistent increases from 1992-97 and had the highest albacore CPUE of the trip types in 1997 and 1998. Albacore CPUE declined for all trip types in 1998. Albacore CPUE for tuna trips peaked in the second quarter and then declined throughout the remainder of the year. Albacore CPUE for tuna trips in 1998 was highest near Johnston Island, the MHI EEZ, and NWHI EEZ near the MHI (Fig. 13). In general, albacore CPUE was slightly better between latitudes 15° and 25°N.

Blue shark had the highest catch rate of all species caught by the Hawaii-based longline fleet. Blue shark CPUE for swordfish trips were much higher than tuna and mixed trips, and CPUE ranged from 14.2 up to 27.6 throughout 1991-98 and at 23.0 in 1998. Blue shark catch rates were lowest in the second quarter and highest in the third quarter. Vessels traveling and fishing in the northernmost extent of the longline fishery were responsible for high blue shark CPUE in the third quarter. Ocean conditions in the north Pacific Ocean are usually calm during this time of the year. The highest blue shark CPUE in 1998 was observed above latitude 30°N (Fig. 14).

Mahimahi CPUE was highest with mixed trips. There was substantial variation in annual mahimahi CPUE with catch rates dropping to 3.3 fish in 1998. No clear seasonal pattern was observed with mahimahi CPUE. The highest mahimahi CPUE for mixed trips occurred north of Oahu between latitudes 20° and 30°N and north of Necker and Nihoa (Fig. 15). Tuna trips had the highest CPUEs for ono and moonfish. Ono CPUE was highest during the second and third quarters while slightly better moonfish CPUEs were observed during the second through fourth quarters of the year. Ono CPUE, by area, for tuna trips show slightly higher CPUEs in and around the EEZ of the MHI (Fig. 16) while moonfish CPUE was best northeast of the Big Island in 1998 (Fig. 17).

LANDINGS

A comparison of commercial landings by the longline, troll-handline, and aku boat fisheries from 1948 show aku boat landings as the largest pelagic fishery throughout the 1950s and 1960s declining in the mid-1970s (Fig. 18). Troll and handline landings grew from the early 1970s through the mid-1980s and remain relatively steady thereafter. Longline landings decreased from the 1950s through the mid-1970s and rose gradually through the mid-1980s increasing dramatically in the late 1980s into the early 1990s. The dramatic increase in longline landings was driven by an increase in the number and size of boats participating in the longline fishery and the exploitation of swordfish. Longline landings show a steady increase from 1987 with a peak of 25.0 million pounds in 1993 (Fig. 19). This peak is attributed primarily to swordfish landings which grew to 13.1 million pounds in 1993 and dropped to 7.0 million pounds in 1994 (Table 11). Swordfish landings ranged between 5.5 and 7.2 million pounds throughout 1994-98. Although total swordfish landings fluctuated in a narrow range during this time, the fishery began to change in 1996, with most swordfish landings produced by mixed trips. This trend continued through 1998. Marlin landings were substantially less than swordfish. Blue marlin landings increased suddenly from 230,000 pounds in 1988 to 770,000 pounds in 1989, stayed about the same until 1994, and increased to 1.2 million pounds in 1995. Blue marlin landings were 830,000 pounds in 1998. Striped marlin nearly doubled from 1987 to 1988, peaked at 1.5 million pounds in 1991 and ranged between 720,000 and 1.2 million pounds thereafter. Tuna trips account for the majority of marlin landings.

Tuna and shark landings are responsible for the increase in total landings from 1994 to 1998. Bigeye tuna is the principal tuna species landed by the Hawaii-based longline fishery. Bigeye tuna landings reached a record 7.1 million pounds in 1998. Landings of yellowfin tuna fluctuated from year to year while albacore landings increased consistently from 1991. Both yellowfin tuna and albacore reached their maximum landings in 1997 (2.5 million and 3.6 million pounds, respectively). Tuna trips account for most of the bigeye tuna, yellowfin tuna, and albacore landings. Bluefin tuna landings decreased slightly from 1997. Although bluefin tuna is a small component of longline landings, the high ex-vessel price interests both fishermen and market wholesalers.

Shark landings are composed predominantly of blue sharks landed in processed "fins only" form. These finned sharks were tabulated back into an estimated round weight. Shark landings have increased due to the practice of finning. Sharks landings (round weight) quadrupled from 1992 to 1993, doubled from 1994 to 1995, and increased up to 6.0 million pounds in 1998. Almost all the shark fins landed in Hawaii are shipped out by local traders or shipping agents to Asian markets. Mako and thresher sharks are finned and also marketed for fillets. Shark sold for its flesh accounted for about 2% of the total shark landings in 1998.

Landings of miscellaneous pelagic species were relatively low but they have well established reputations in fishmarkets and restaurants. The largest components of miscellaneous pelagic species were moonfish, mahimahi, and ono. Mahimahi landings rose from 50,000 pounds in 1987 to 590,000 pounds in 1992 and ranged between 320,000 pounds and 570,000 pounds thereafter. Ono landings varied between 50,000 pounds in 1987 up to 260,000 pounds in 1998. Moonfish landings increased consistently from 1992 to 920,000 pounds in 1998. Mixed and tuna trips account for 95% of the mahimahi landings. Tuna trips also produce more than 95% of the moonfish landings and more than 70% of the ono landings.

MARKET

Revenue

The aku boat and longline fishery were the two largest revenue producing fisheries from 1948 through the 1980s (Fig. 20). Revenue generated from the troll and handline fishery grew in the 1970s and became the largest revenue producing fishery, peaking at $12.6 million in 1987. Ex-vessel revenue by troll-handline gear has remained fairly constant throughout 1976-96 while aku boat ex-vessel revenue declined from the 1980s into the 1990s. 1987 was also the same year which the longline fishery became and maintained its status as the largest ex-vessel revenue producing commercial fishery in Hawaii. The Hawaii-based longline fishery accounted for $46.7 million or approximately 85%

of the total ex-vessel revenue generated by all Hawaii commercial pelagic fisheries in 1998.

Billfish revenue made up 31% of the total longline revenue (Fig. 21). Among billfish, swordfish ($11.9 million) accounted for the most revenue. Marlins ($2.3 million) comprised a substantially smaller fraction (Table 12). Tunas, the largest revenue producing group, made up 61% of the total revenue in 1998. Revenue from bigeye tuna, which accounted for 61% of the revenue from all tuna sales, was a record $21.1 million in 1998. Yellowfin tuna revenue was down substantially (-41%) from a record $6.7 million in the previous year. Albacore revenue was also down (-32%) from a record $4.5 million in 1997. Bluefin tuna revenue dropped by 70% to $250,000 in 1998 due to the economic crisis in Asia. Although miscellaneous pelagics make up a small portion of total revenue, revenue from this group increased for the fifth consecutive year. Greater revenue for moonfish, pomfrets, and ono in 1998 contributed to this increase. Estimated revenue of sharks (both finned and whole) decreased to $1.5 million in 1998. The slight decline is attributed to the lower unit price paid for shark fins as a result of the Asian economic crisis.

Average Price

Ex-vessel prices are based on actual or estimated whole weight. Average prices for major pelagic species in Table 13 are aggregate nominal ex-vessel prices. The ex-vessel price for swordfish was the highest of all billfish. To a great extent, the price for swordfish is determined by the U. S. mainland market. Most swordfish landed in Hawaii are packed in insulated air freight containers and flown to destinations across the continental U. S. The local market for swordfish is growing and its availability is increasing. Swordfish is noticeable in fish market displays and local restaurant menus but the volume is still small in relation to the amount exported. The price for swordfish dropped from $2.49 in 1996 to an all time low of $1.66 in 1998. The sudden drop in 1998 is related to the boycott on swordfish by upscale restaurants in the east coast. This ban by restaurants was in response to the decline in Atlantic swordfish stock. The average price for blue marlin varied little ranging from $0.84 to $1.26. The average price for striped marlin had a little more interannual variation than blue marlin, ranging from $0.90 to $1.70. Marlin is one of the most affordable local fresh fish species and is commonly found at retail markets and restaurants year round. A few select blue marlin and striped marlin are used for sashimi but most marlins are used for cooking, grilling, and preparing low grade raw fish (poke).

The effect of the Asian economic crisis was evident by substantially lower average bluefin tuna prices and, to a lesser extent, lower bigeye tuna and yellowfin tuna prices in 1998.

Generally, the Japan tuna market ranks northern bluefin tuna, bigeye tuna, yellowfin tuna, and albacore in decreasing order of desirability. Since the majority of the bluefin tuna bought here in Hawaii are exported to Japan, the average price for this species was high in relation to the price paid for other tuna species. Average price for bluefin tuna increased from $8.63 in 1991, peaked at $18.26 in 1996, and declined the following 2 years to a low of $7.00 in 1998. Although bigeye tuna and yellowfin tuna are also exported to Japan, only a few select fish meet the high standards set by this market. Most of the good grade fish are either marketed to the mainland or fine local restaurants. Therefore, the average price of bigeye tuna and yellowfin tuna were considerably lower than the average price of bluefin tuna. Bigeye tuna prices were usually in the mid-$3.00 range but was slightly lower in 1998. The average price for yellowfin tuna ranged from $1.81 in 1988 to a high of $3.06 in 1996 and declined to $2.50 in 1998. Albacore is the least expensive of all the major tunas landed by the Hawaii-based longline fleet and showed the least amount of variation in average annual price ranging from $1.08 to $1.48 with the average price at $1.24 in 1998. A growing market for albacore in the U. S. mainland has helped enhance the demand for albacore. Although landings of albacore have increased almost tenfold from 1990 to 1997, the average price remained relatively steady.

Fresh mahimahi and ono have been in strong demand by both the Hawaii restaurant and local markets for some time (Takenaka et al., 1984). The price paid for mahimahi is dependent on the freshness and size of the fish. Large fresh mahimahi costs more than small fish of lesser freshness. Supply of mahimahi from local trollers also affects mahimahi prices to longline vessels. The average price of mahimahi varied substantially during 1987 through 1998, ranging from $1.24 to $2.73 with the average price at $1.72 in 1998. Ono received the highest average price of all miscellaneous PMUS. The average price for ono varied from $1.56 to $2.60 and was $1.88 in 1998. Moonfish, which was sold primarily in restaurants, is now becoming readily available at local retail fish markets. The average price for moonfish was about $1.00 per pound in 1998.

SIZE OF FISH

The average size of longline caught fish is expressed in round (whole) weights. Processed fish (e.g., headed, gutted, and finned swordfish) were raised to an estimated round (whole) weight. Fish, which were either released alive or discarded, are not represented in the following size summaries. The weight of individual fish could not be directly linked to the exact area of capture. However, the change in fish size is often related to increasing catches from certain areas which were previously lightly exploited. Therefore, the mean weight of fish and subsequent changes in mean weight over time by location is referenced in general terms.

Longlining was exclusively directed towards tunas in 1987-88 and swordfish was caught incidentally. During this time the mean weight of swordfish was below 130 pounds (Table 14). As the effort of targeting swordfish increased from 1989 to its peak in 1993, mean weight of swordfish increased in excess of 170 pounds. Swordfish mean weight fluctuated between 157 pounds and 176 pounds thereafter. Swordfish directed trips frequently landed the largest swordfish during 1991-98 (Table 15). Tuna trips had the widest year to year variation in mean size and often landed the smallest sized swordfish.

Blue marlin is one of the larger fish species landed by the Hawaii-based longline fleet. Mean weight of blue marlin rose slightly from about 160 pounds in 1987-89 up to 175 pounds in 1991-92 and declined from 170 pounds in 1994 to a low of 134 in 1997. The blue marlin mean weight increased up to 164 pounds in 1998. Swordfish and mixed trips had the highest mean weights for blue marlin.

Striped marlin were much smaller than swordfish and blue marlin. The year to year variation in mean weight of striped marlin throughout the 11-year sampling period was small. There was only a 10-pound difference in mean weight for striped marlin throughout 1987-98 ranging between 56 pounds in 1990 and 66 pounds in 1987. Swordfish trips, which fish predominantly north of the Hawaiian Islands, consistently had the highest mean weight for striped marlin throughout 1991-98.

The mean weight of bigeye tuna ranged between 64 pounds and 86 pounds. No apparent trend with respect to the size of bigeye tuna was observed. Swordfish trips, which conducted fished north of the Hawaiian Islands, often had the largest size bigeye tuna; mixed trips landed bigeye tuna of near comparable size; and tuna trips had the smallest mean weights for bigeye tuna.

There was considerable variation in the mean weight of yellowfin tuna. Mean weight of yellowfin tuna was as low as 76 pounds up to 118 pounds throughout 1987-98. The mean weight has been on a general decline which can be attributed to increasing catches of smaller size yellowfin tuna by tuna directed fishing trips in the area near Kingman Reef and Palmyra Atoll from 1994 during the first and second quarters. Mixed trips usually landed the largest yellowfin tunas. Mixed trip catch of yellowfin tuna were typically caught in the third quarter, a time which usually coincides with catches of large yellowfin tuna caught by the troll and handline fishery.

The mean weight of albacore declined from 62 pounds in 1987 to 41 pounds in 1994. This decline is related to increasing incidental catches of small albacore caught north of the Hawaiian Islands from longliners targeting swordfish. As swordfish-directed effort declined and effort towards tuna increased during 1995-98, the mean size of albacore began to increase. Tuna longliners have the ability to target albacore when they are abundant. Tuna trips typically had the largest mean weights for albacore, while swordfish trips consistently had the smallest mean weights.

Bluefin tuna was the largest tuna with the greatest variation in annual mean weight of all the tunas caught and landed by the Hawaii-based longline fishery. Bluefin tuna were incidentally caught on swordfish trips with fishing activity occurring up north of the Hawaiian Islands. Mean weight of bluefin tuna increased from 184 pounds in 1991 to 269 pounds in 1995 and fluctuated thereafter. Mean weight for bluefin tuna was 177 pounds in 1998.

Mean weight of mahimahi ranged from 10 pounds to 23 pounds. The mean weight for ono had a narrower range of between 30 pounds to 35 pounds. Moonfish were relatively large with the mean weight ranging from 97 pounds to 111 pounds. There were no apparent long term trends with respect to mean size for these three fish species.

Weight-Frequency Distribution

Weight-frequency histograms were computed for swordfish, blue marlin, striped marlin, bigeye tuna, yellowfin tuna, and albacore from the shoreside sample data. These weight-frequencies from sample data were corrected in proportion to the numbers for each trip type from the logbook. One difficulty in interpreting annual weight-frequency histograms was the seasonal catch of certain species peaking and declining at the end of one year into the next year. For example, catch for bigeye tuna and striped marlin increase and peak sometime during the fall and winter and are lowest during the summer months. Therefore, a year ending with a strong of class of fish also shows up in the following year's weight frequency distribution. However, weight-frequency histograms summarized sample data collected within each calendar year.

Prior to 1989, longliners targeting tunas accounted for all of the longline landings of swordfish in the Hawaii fishery (Kawamoto et al., 1989). These incidental catches of swordfish were small and consisted primarily of small fish (< 25 pounds) (Fig. 22). The distribution of swordfish larger than 25 pounds was rather flat with only a few fish above 300 pounds. With the increasing success of longliners catching swordfish in 1989, swordfish histograms showed a greater representation of large fish peaking around 100 pounds and tapering off thereafter. The frequency of very large swordfish (>475 pounds) appear from 1989 and compose about 2% of the fish caught from 1990-98. The dominant mode that appears in 1991-92 shifts over one or two increments each year up to 1995, appears as a weak secondary mode in 1997, and disappears in 1998. The swordfish weight-frequency distribution was predominantly in the 51-75-pound weight class in 1997 and 101-125-pound weight class in 1998.

Blue marlin showed no substantial changes in weight-frequency distribution throughout 1987-98. The dominant mode for blue marlin consistently fell in the 101-125- pound increment, except when a slightly larger size class of fish appeared as the dominant mode with a higher than usual frequency of large blue marlin in 1990 (Fig. 23). There was a higher than usual frequency of fish in the 76-100 pound weight class and a very low frequency of blue marlin above 200 pounds in 1996 and 1997. The weight-frequency distribution was predominantly between 76 and 150 pounds with a somewhat erratic distribution of the tail in 1998.

Weight-frequency distributions of striped marlin were bimodal except in 1987 and 1996, when striped marlin were evenly distributed across a wide range of sizes (Fig. 24). A strong mode of small fish appeared in 1988 and 1989. The years which a bimodal distribution was present, the mode of small striped marlin typically occurred between 21 pounds and 40 pounds increment, while a flatter more broadly distributed secondary mode of large striped marlin appears between 51 pounds and 80 pounds. The frequency of striped marlin diminishes above 90 pounds.

Strong modes of small bigeye tuna occurred in 1994 and 1996 (Fig. 25). A very low frequency of large bigeye tuna was apparent in 1996. Bigeye tuna weight-frequencies with even, bimodal distributions appeared in 1988, 1990, 1991, 1993, and 1997. The frequency of bigeye tuna above 100 pounds diminishes and was particularly flat in 1997.

A comparison of yellowfin tuna histograms by year shows distributions with a high degree of variation. The histograms show unimodal, bimodal, and sometimes trimodal distribution (Fig. 26). A pronounced mode of large fish was noticeable in 1991, 1997, and 1998. The distribution of yellowfin tuna was relatively flat with distribution across a wide range of weight classes in 1990 and from 1992 through 1995. The strongest mode of small fish was observed in 1996. The distribution of yellowfin tuna usually begins to taper off above 150 pounds, however, percent frequency of these large fish decreased from 27% in 1990 to 2% in 1998. Increasing catches of small yellowfin tuna in the EEZ of other U. S. possessions by tuna trips from 1994 is contributing to this decrease.

The distribution of albacore showed distinct periods of change throughout 1987-98 (Fig. 27). The distribution of albacore consisted predominantly of large fish during 1987-90 when longline effort was directed primarily towards tunas. The following 4 years showed albacore with wider and flatter distributions as longline effort shifted predominantly towards swordfish. The change in weight-frequency distribution is because of the increased landings of small fish caught by swordfish and mixed longline trips fishing in higher latitudes of the North Pacific. Albacore distribution was substantially different in 1995-98 when the shape of the distribution became more bell-shaped as a result of most of the longline effort being redirected back towards tunas. The weak bimodal distribution in 1994 shows a dominant mode at 41-42 pounds and is barely noticeable. The distribution becomes unimodal the following year with the mode shifting three increments in 1995 and another three increments in 1996. The mode shifts two increments in 1997 and two increments again in 1998.

INTERACTIONS WITH ENDANGERED AND PROTECTED SPECIES

Interactions between longline gear and protected marine species were summarized from the daily longline logbook data. Interactions are defined in this report as any endangered or threatened species caught (hooked or entangled) in longline fishing gear. Suspected underreporting of interactions with protected species (turtles in particular) was the major factor that led to the establishment of the mandatory observer program (DiNardo, 1993). Assessment of the level of turtle interactions with the longline fleet is done with stratified interaction rates from Southwest Region observer data and applied to effort from logbook data. A more detailed protected species interaction section was added to the revised logbooks in 1995. Fishermen who were not trained to identify different protected species may have contributed to incorrect reporting of interactions. Consequently, there may be species identification and underreporting problems in the summary of protected species interactions presented in this section.

Thirty-two different Hawaii-based longline vessels reported interactions with protected species on 59 different trips in 1998 (Table 16). Reported interactions occurred on 192 sets (161,674 hooks) out of a possible 781 sets (719,485 hooks) for these 59 trips. A total of 337 interactions with endangered or protected marine species was reported. It is unlawful to retain any endangered or protected species, therefore, interactions are reported as animals are released or lost. The condition of animals upon release is categorized as either alive, injured, or dead.

Two hundred and thirty-four interactions involved seabirds, 232 of which were with albatrosses. The exact species of albatross is unknown because there is no distinction between albatross species in the protected species interaction section of the logbooks. A high rate of mortality was reported with seabirds: 75% were reported dead upon retrieval; 7% were reported released alive but injured; and 18% were reported released alive in good condition.

Interactions with turtles were the second most frequent type of interaction. Again, it is important to remember that these turtle identifications were done by fishermen and not by trained technicians. Of 102 reported turtle interactions, 65 were with loggerhead turtles, 13 with leatherback turtles, 12 with green sea turtles, 7 with olive ridley turtles, and 1 a hawksbill turtle. In addition, 4 turtle interactions occurred with species which could not be positively identified. The initial condition of most turtles upon retrieval appeared good. Seventy-three percent of the turtles were reported as alive, 20% of the turtles were reported as released injured, and 8% of the turtles were reported dead upon retrieval. Three green sea turtles, 2 olive ridley turtles, 2 unidentified turtles, and 1 leatherback turtle were reported to be dead upon retrieval.

Only one incident of interaction with a cetacean was reported in 1998. The incident involved one humpback whale. This interaction may have been a result of the whale getting fouled in longline gear. Very few observations of this behavior with longline and other Hawaii fisheries have been documented (Nitta and Henderson, 1993; Dollar, 1991). No interactions with monk seals were reported.

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TABLES

Table 1.--List of common and scientific names of fishes and endangered or protected species commonly encountered by fishing vessels in the western Pacific longline fishery.

Common name	Scientific Name
	PELAGIC MANAGEMENT UNIT SPECIES
Billfish	
Swordfish	*Xiphias gladius*
Black marlin	*Makaira indica*
Blue marlin	*Makaira mazara*
Striped marlin	*Tetrapturus audax*
Shortbill spearfish	*T. angustirostris*
Sailfish	*Istiophorus platypterus*
Tunas	
Bigeye tuna	*Thunnus obesus*
Albacore	*T. alalunga*
Yellowfin tuna	*T. albacares*
Northern bluefin tuna	*T. thunnus orientalis*
Skipjack tuna	*Katsuwonus pelamis*
Kawakawa	Euthynnus affinis
Sharks	
Blue shark	*Prionace glauca*
Thresher (big eye)	*Alopias superciliosus*
Mako (short fin)	*Isurus oxyrinchus*
White tip (oceanic)	*Carcharhinus longimanus*
Tiger shark	*Galeocerdo cuvieri*
Miscellaneous sharks	Families Carcharhinidae, Alopiidae, Sphyrnidae, and Laminidae
Miscellaneous PMUS	
Mahimahi	*Coryphaena hippurus*
Wahoo (ono)	*Acanthocybium solandri*
Moonfish	*Lampris guttatus*
Pomfret	Family Bramidae
Oilfish	Family Gempylidae
	MISCELLANEOUS PELAGICS
Lancet fish	*Alepisaurus* spp.
Barracuda	*Sphyraena barracuda*
Brown stingray	*Dasyatis violacea*
	PROTECTED SPECIES
Hawaiian monk seal	*Monachus schauinslandi*
Humpback whale	*Megaptera novaengliae*
Dolphins	Family Delphinidae
Green turtle	*Chelonia mydas*
Olive ridley turtle	*Lepidochelys olivacea*
Hawksbill turtle	*Eretmochelys imbricata*
Leatherback turtle	*Dermochelys coricea*
Laysan albatross	*Diomedea immutabilis*
Black-footed albatross	*D. nigripes*
Brown booby	*Sula leucogaster plotus*

Table 2.--Hawaii-based longline vessel activity*, 1991-98.

Year	Number of active vessels	Trips	Average miles to first set	Maximum miles to first set	Average number of days fished per trip
Fleet					
1991	141	1,671	318	1,792	7.6
1992	123	1,266	424	1,871	9.1
1993	122	1,192	465	2,122	10.3
1994	125	1,106	430	2,814	9.8
1995	110	1,125	441	2,097	10.4
1996	103	1,100	367	2,037	10.6
1997	105	1,125	332	1,973	10.5
1998	114	1,140	422	1,611	11.0
Swordfish trips					
1991	98	292	585	1,792	10.9
1992	66	277	733	1,871	12.7
1993	79	319	820	2,122	13.5
1994	74	310	833	2,814	13.2
1995	44	136	884	2,097	13.6
1996	33	92	790	2,037	12.7
1997	26	78	623	1,973	13.8
1998	32	84	708	1,522	14.6
Tuna trips					
1991	104	556	240	1,508	7.7
1992	55	458	260	1,156	8.5
1993	61	542	222	1,432	8.8
1994	83	568	252	945	8.9
1995	78	682	273	945	10.2
1996	76	657	284	1,866	10.3
1997	83	745	288	1,002	10.1
1998	92	760	384	1,154	10.4
Mixed trips					
1991	94	823	276	1,408	6.3
1992	72	531	404	1,543	7.8
1993	59	331	522	1,616	9.8
1994	51	228	323	1,298	7.3
1995	49	307	397	1,609	9.5
1996	51	351	410	1,547	10.5
1997	44	302	365	1,323	10.7
1998	50	296	439	1,611	11.5

*Based on date of landing from NMFS logbooks.

Table 3.--Number of days fished* by the Hawaii-based longline fleet, 1991-98.

		Trip type			Area			
Year	Total	Swordfish trips	Tuna trips	Mixed trips	Main Hawaiian Islands	Northwestern Hawaiian Islands	U.S. Possessions	Outside EEZ
1991	12,635	3,184	4,280	5,171	6,213	1,258	55	5,109
1992	11,546	3,531	3,879	4,136	4,145	753	13	6,635
1993	12,318	4,322	4,747	3,249	4,409	1,277	---	6,630
1994	10,799	4,098	5,041	1,660	4,442	1,929	140	4,288
1995	11,732	1,848	6,964	2,920	5,454	1,695	98	4,485
1996	11,638	1,170	6,773	3,695	4,634	2,021	134	4,837
1997	11,846	1,076	7,549	3,221	3,840	2,657	255	5,093
1998	12,506	1,223	7,874	3,409	3,493	2,214	1,057	5,732

*Sets based on date of haul from NMFS logbooks.

Table 4.--Number of hooks set* by the Hawaii-based longline fleet, 1991-98.

		Trip type			Area			
Year	Total	Swordfish trips	Tuna trips	Mixed trips	Main Hawaiian Islands	Northwestern Hawaiian Islands	U.S. Possessions	Outside EEZ
1991	12,328,081	2,376,918	5,220,717	4,730,446	6,854,472	1,056,778	53,938	4,362,893
1992	11,717,246	2,811,710	5,252,605	3,652,931	4,880,514	694,626	16,030	6,126,076
1993	13,026,432	3,755,526	6,455,816	2,815,090	5,553,586	1,305,786	---	6,164,660
1994	11,996,072	3,506,653	7,039,227	1,450,192	5,451,028	2,225,352	192,100	4,127,592
1995	14,190,219	1,466,339	10,216,899	2,506,981	7,135,744	1,999,136	153,435	4,901,904
1996	14,400,031	932,777	10,388,580	3,078,674	5,902,777	2,858,527	223,585	5,405,262
1997	15,564,321	840,539	12,207,913	2,515,869	5,057,410	4,096,303	441,740	5,968,568
1998	17,365,852	1,019,960	13,486,035	2,859,857	4,969,630	3,095,321	1,923,471	7,362,130

*Number of hooks set based on date of haul from NMFS logbooks.

Table 5.--Average number of hooks set* per day fished, 1991-98.

Year	Fleet mean	Swordfish trips	Tuna trips	Mixed trips
1991	980	750	1,220	910
1992	1,010	800	1,350	880
1993	1,060	870	1,360	870
1994	1,110	860	1,400	870
1995	1,210	790	1,470	860
1996	1,240	800	1,530	830
1997	1,310	780	1,620	780
1998	1,390	830	1,710	840

*Average number of hooks set based on date of haul from NMFS logbooks.

Table 6.--Hawaii-based longline catch[*] (number of fish) by trip type, 1991-98.

	Billfish				Tunas			Miscellaneous			
Year	Swordfish	Blue marlin	Striped marlin	Other billfish	Bigeye tuna	Yellowfin tuna	Albacore	Mahimahi	Ono	Moonfish	Sharks
Fleet											
1991	66,289	4,012	26,967	12,464	40,923	13,269	14,051	39,525	2,735	3,079	71,183
1992	74,314	4,516	16,049	5,668	43,904	7,879	19,813	56,684	2,448	3,293	94,897
1993	79,554	5,124	18,210	5,681	54,803	16,062	30,460	26,018	4,442	4,515	154,608
1994	43,345	4,677	11,292	5,117	48,102	13,516	31,129	33,017	2,513	5,090	114,656
1995	37,428	8,806	22,554	11,771	59,947	23,650	45,789	59,813	6,565	6,367	101,292
1996	38,225	6,685	15,789	7,806	63,575	17,586	57,329	23,311	4,461	7,315	100,992
1997	39,682	8,255	12,637	9,024	79,784	29,045	71,084	49,319	8,312	8,254	85,838
1998	43,776	5,350	14,347	11,516	98,795	21,721	48,833	22,183	8,281	9,184	99,919
Swordfish trips											
1991	36,516	---	---	---	5,453	1,876	3,631	8,609	152	44	37,880
1992	41,503	564	2,184	375	4,533	1,301	8,680	13,448	176	87	55,507
1993	48,920	1,073	3,781	648	9,086	2,552	14,472	8,753	475	102	100,075
1994	36,245	724	1,569	277	3,541	1,453	15,701	9,181	140	29	82,155
1995	18,865	950	1,007	231	3,440	1,651	8,096	9,908	241	23	40,436
1996	13,216	174	465	133	1,335	659	5,397	2,111	208	41	23,807
1997	12,956	330	484	144	2,628	1,569	2,416	8,607	243	12	11,936
1998	14,791	294	431	73	2,373	761	2,502	1,558	126	13	23,466
Tuna trips											
1991	2,156	---	---	---	19,328	3,646	5,831	11,365	2,013	2,788	8,906
1992	1,400	1,922	11,271	3,771	24,895	2,781	4,519	8,796	1,773	3,122	12,599
1993	1,372	2,661	11,895	4,252	30,205	9,552	10,348	9,776	3,557	4,372	16,533
1994	1,118	2,074	8,699	4,305	38,877	8,164	14,273	14,318	2,280	5,032	15,621
1995	2,225	4,960	17,959	9,995	44,803	14,487	32,633	24,293	5,785	6,151	28,917
1996	1,720	3,912	12,170	6,602	49,116	11,767	41,318	10,662	3,758	7,023	30,086
1997	1,669	5,004	9,198	8,173	69,319	19,185	61,702	17,794	7,186	8,093	32,717
1998	2,631	3,389	11,424	10,177	82,664	17,274	40,754	11,337	7,388	9,044	41,672
Mixed trips											
1991	27,617	---	---	---	16,142	7,747	4,589	19,551	570	247	24,397
1992	31,411	2,032	2,594	1,522	14,476	3,797	6,614	34,440	499	84	26,791
1993	29,262	1,390	2,534	781	15,512	3,958	5,640	7,489	410	41	38,000
1994	5,982	1,879	1,024	535	5,684	3,899	1,155	9,518	93	29	16,880
1995	16,338	2,896	3,588	1,545	11,704	7,512	5,060	25,612	539	193	31,939
1996	23,289	2,599	3,154	1,071	13,124	5,160	10,614	10,538	495	251	47,099
1997	25,057	2,921	2,955	707	7,837	8,291	6,966	22,918	883	149	41,185
1998	26,354	1,667	2,492	1,266	13,758	3,686	5,577	9,288	767	127	34,781

[*]Based on date of haul from NMFS logbooks.

Table 7.--Hawaii-based longline catch* (number of fish) by area, 1991-98.

Year	Billfish: Swordfish	Billfish: Blue marlin	Billfish: Striped marlin	Billfish: Other billfish	Tunas: Bigeye tuna	Tunas: Yellowfin tuna	Tunas: Albacore	Miscellaneous: Mahimahi	Miscellaneous: Ono	Miscellaneous: Moonfish	Miscellaneous: Sharks
Main Hawaiian Islands EEZ											
1991	13,598	---	---	---	22,517	7,150	5,763	17,672	1,885	2,569	13,295
1992	7,102	2,761	9,838	3,368	22,982	3,846	3,979	13,313	1,194	2,387	11,748
1993	4,388	2,720	10,426	3,440	25,031	8,895	6,496	9,366	2,641	3,261	12,955
1994	2,842	3,344	6,494	3,213	27,022	6,815	10,833	17,660	1,332	3,626	14,455
1995	5,262	4,168	12,472	6,900	31,899	13,018	18,271	30,410	2,656	4,041	22,560
1996	4,634	3,556	7,163	3,404	29,803	7,715	19,259	11,676	1,527	3,094	19,418
1997	4,873	4,085	4,193	3,662	21,397	10,982	19,025	11,660	2,525	2,847	16,476
1998	4,721	1,698	4,856	4,254	26,723	4,678	12,482	7,664	2,305	3,585	14,685
Northwestern Hawaiian Islands EEZ											
1991	9,472	---	---	---	4,473	1,375	481	2,003	134	70	10,604
1992	5,228	244	1,776	330	2,624	396	311	2,321	77	187	9,042
1993	9,565	509	2,861	754	7,760	2,019	1,413	2,279	198	398	17,507
1994	9,752	554	2,679	719	10,726	2,015	5,592	3,037	227	707	28,346
1995	8,400	1,379	5,076	1,557	9,011	3,630	5,097	5,836	902	939	19,915
1996	3,987	1,114	4,184	1,651	15,409	2,451	12,738	1,995	659	2,388	16,539
1997	5,148	1,519	4,109	2,250	30,168	5,139	17,118	6,321	1,789	2,887	17,921
1998	10,611	1,217	5,757	2,927	16,629	2,713	6,802	3,527	761	1,862	20,152
U.S. Possessions											
1991	25	---	---	---	374	439	30	84	21	0	237
1992	16	7	1	7	70	42	0	6	8	0	223
1993	---	---	---	---	---	---	---	---	---	---	---
1994	53	37	173	55	1,127	1,649	151	37	77	24	705
1995	21	94	121	94	460	583	296	252	206	5	895
1996	17	86	192	93	766	1,184	1,612	49	155	57	756
1997	33	194	255	293	2,070	1,932	4,054	591	328	206	1,503
1998	174	308	307	450	17,666	6,313	3,784	831	1,127	258	5,892
Outside EEZ											
1991	43,194	---	---	---	13,559	4,305	7,777	19,766	695	440	47,047
1992	61,968	1,506	4,434	1,963	18,228	3,595	15,523	41,044	1,169	719	73,884
1993	65,601	1,895	4,920	1,486	22,008	5,147	22,551	14,367	1,600	856	124,139
1994	30,698	742	1,946	1,130	9,227	3,037	14,553	12,283	877	733	71,150
1995	23,745	3,165	4,885	3,220	18,577	6,419	22,125	23,315	2,801	1,382	57,922
1996	29,495	1,878	4,250	2,658	17,588	6,227	23,719	9,507	2,116	1,776	64,081
1997	29,627	2,457	4,080	2,819	26,149	10,990	30,887	30,730	3,668	2,314	49,935
1998	28,269	2,125	3,408	3,872	37,762	8,004	25,621	10,157	4,068	3,462	59,180

*Based on date of haul from NMFS logbooks.

Table 8.--Hawaii-based longline incidental shark catch* (number of fish), 1991-98.

Species	Number Caught	Number Released	Number Kept: Finned	Number Kept: Whole	Percent Retained	Percent Finned
Blue sharks						
1991	65,481	65,481	0	0	0	0
1992	89,292	88,315	977	0	1.1	1.1
1993	150,216	135,861	14,355	0	9.6	9.6
1994	110,187	95,783	14,404	0	13.1	13.1
1995	94,881	64,696	30,185	0	31.8	31.8
1996	96,214	54,982	41,149	83	42.9	42.8
1997	80,008	34,087	45,704	217	57.4	57.1
1998	91,228	35,771	55,410	47	60.8	60.7
Total						
1991	71,183	68,894	1,082	1,207	4.9	1.5
1992	94,897	91,292	2,362	1,243	3.8	2.5
1993	154,608	137,846	15,473	1,289	10.8	10.0
1994	114,656	98,119	15,374	1,163	14.4	13.4
1995	101,292	67,760	32,842	690	33.1	32.4
1996	100,992	57,254	43,109	629	43.3	42.7
1997	85,838	36,496	48,552	790	57.5	56.6
1998	99,919	39,062	60,083	774	60.9	60.1

*Based on date of haul from NMFS logbooks.

Table 9.--Hawaii-based longline catch-per-unit-effort* (number of fish per 1000 hooks) by trip type, 1991-98.

	Billfish				Tunas			Miscellaneous			
Year	Swordfish	Blue marlin	Striped marlin	Other billfish	Bigeye tuna	Yellowfin tuna	Albacore	Mahimahi	Ono	Moonfish	Sharks
Fleet mean											
1991	5.38	---	---	---	3.32	1.08	1.14	3.21	0.22	0.25	5.77
1992	6.34	0.39	1.37	0.48	3.75	0.67	1.69	4.84	0.21	0.28	8.10
1993	6.11	0.39	1.40	0.43	4.21	1.23	2.34	2.00	0.34	0.35	11.87
1994	3.61	0.39	0.94	0.43	4.01	1.13	2.59	2.75	0.21	0.42	9.56
1995	2.64	0.62	1.59	0.83	4.22	1.67	3.23	4.22	0.46	0.45	7.14
1996	2.65	0.46	1.10	0.54	4.41	1.22	3.98	1.62	0.31	0.51	7.01
1997	2.55	0.53	0.81	0.58	5.13	1.87	4.57	3.17	0.53	0.53	5.52
1998	2.52	0.31	0.83	0.66	5.69	1.25	2.81	1.28	0.48	0.53	5.75
Swordfish trips											
1991	15.36	---	---	---	2.29	0.79	1.53	3.62	0.06	0.02	15.94
1992	14.76	0.20	0.78	0.13	1.61	0.46	3.09	4.78	0.06	0.03	19.74
1993	13.03	0.29	1.01	0.19	2.42	0.68	3.85	2.33	0.13	0.03	26.65
1994	10.34	0.21	0.45	0.08	1.01	0.41	4.48	2.62	0.04	0.01	23.43
1995	12.87	0.65	0.69	0.16	2.35	1.13	5.52	6.76	0.16	0.02	27.58
1996	14.17	0.19	0.50	0.14	1.43	0.71	5.79	2.26	0.23	0.04	25.52
1997	15.41	0.39	0.58	0.17	3.13	1.87	2.87	10.24	0.29	0.01	14.20
1998	14.50	0.29	0.42	0.07	2.33	0.75	2.45	1.53	0.12	0.01	23.01
Tuna trips											
1991	0.41	---	---	---	3.70	0.70	1.12	2.18	0.39	0.53	1.71
1992	0.27	0.37	2.15	0.72	4.74	0.53	0.86	1.67	0.34	0.59	2.40
1993	0.21	0.41	1.84	0.66	4.68	1.48	1.60	1.51	0.55	0.68	2.56
1994	0.16	0.29	1.24	0.62	5.52	1.16	2.03	2.03	0.32	0.71	2.22
1995	0.22	0.49	1.76	0.98	4.39	1.42	3.19	2.38	0.57	0.60	2.83
1996	0.17	0.38	1.17	0.64	4.73	1.13	3.98	1.03	0.36	0.68	2.90
1997	0.14	0.41	0.75	0.67	5.68	1.57	5.05	1.46	0.59	0.66	2.68
1998	0.20	0.25	0.85	0.75	6.13	1.28	3.02	0.84	0.55	0.67	3.09
Mixed trips											
1991	5.84	---	---	---	3.41	1.64	0.97	4.13	0.12	0.05	5.16
1992	8.60	0.56	0.71	0.42	3.96	1.04	1.81	9.43	0.14	0.02	7.33
1993	10.39	0.49	0.90	0.28	5.51	1.41	2.00	2.66	0.15	0.01	13.50
1994	4.12	1.30	0.71	0.37	3.92	2.69	0.80	6.56	0.06	0.02	11.64
1995	6.52	1.16	1.43	0.62	4.67	3.00	2.02	10.22	0.21	0.08	12.74
1996	7.56	0.84	1.02	0.35	4.26	1.68	3.45	3.42	0.16	0.08	15.30
1997	9.96	1.16	1.17	0.28	3.12	3.30	2.77	9.11	0.35	0.06	16.37
1998	9.22	0.58	0.87	0.44	4.81	1.29	1.95	3.25	0.27	0.04	12.16

*Based on date of haul from NMFS logbooks.

Table 10.--Hawaii-based longline catch-per-unit-effort* (number of fish per 1000 hooks) by area, 1991-98.

	Billfish				Tunas			Miscellaneous			
Year	Swordfish	Blue marlin	Striped marlin	Other billfish	Bigeye tuna	Yellowfin tuna	Albacore	Mahimahi	Ono	Moonfish	Sharks
Main Hawaiian Islands EEZ											
1991	1.98	---	---	---	3.29	1.04	0.84	2.58	0.28	0.37	1.94
1992	1.46	0.57	2.02	0.69	4.71	0.79	0.82	2.73	0.24	0.49	2.41
1993	0.79	0.49	1.88	0.62	4.51	1.60	1.17	1.69	0.48	0.59	2.33
1994	0.52	0.61	1.19	0.59	4.96	1.25	1.99	3.24	0.24	0.67	2.65
1995	0.74	0.58	1.75	0.97	4.47	1.82	2.56	4.26	0.37	0.57	3.16
1996	0.79	0.60	1.21	0.57	5.05	1.31	3.26	1.98	0.26	0.52	3.29
1997	0.96	0.81	0.83	0.72	4.23	2.17	3.76	2.31	0.50	0.56	3.26
1998	0.95	0.34	0.98	0.85	5.38	0.94	2.51	1.54	0.46	0.72	2.95
Northwestern Hawaiian Islands EEZ											
1991	8.96	---	---	---	4.23	1.30	0.46	1.90	0.13	0.07	10.03
1992	7.53	0.35	2.56	0.48	3.78	0.57	0.45	3.34	0.11	0.27	13.02
1993	7.33	0.39	2.19	0.58	5.94	1.55	1.08	1.75	0.15	0.30	13.41
1994	4.38	0.25	1.20	0.32	4.82	0.91	2.51	1.36	0.10	0.32	12.74
1995	4.20	0.69	2.54	0.77	4.51	1.82	2.55	2.92	0.45	0.47	9.96
1996	1.39	0.39	1.46	0.58	5.39	0.86	4.46	0.70	0.23	0.84	5.79
1997	1.26	0.37	1.00	0.55	7.36	1.25	4.18	1.54	0.44	0.70	4.37
1998	3.43	0.39	1.86	0.94	5.37	0.88	2.20	1.14	0.25	0.60	6.51
U.S. Possessions											
1991	0.46	---	---	---	6.93	8.14	0.56	1.56	0.39	0.00	4.39
1992	1.00	0.44	0.06	0.44	4.37	2.62	0.00	0.37	0.50	0.00	13.91
1993	---	---	---	---	---	---	---	---	---	---	---
1994	0.28	0.19	0.90	0.29	5.87	8.58	0.79	0.19	0.40	0.12	3.67
1995	0.14	0.61	0.79	0.61	3.00	3.80	1.93	1.64	1.34	0.03	5.83
1996	0.08	0.38	0.86	0.41	3.43	5.30	7.21	0.22	0.69	0.25	3.38
1997	0.07	0.44	0.58	0.67	4.69	4.37	9.18	1.34	0.74	0.47	3.40
1998	0.09	0.16	0.16	0.23	9.18	3.28	1.97	0.43	0.59	0.13	3.06
Outside EEZ											
1991	9.90	---	---	---	3.11	0.99	1.78	4.53	0.16	0.10	10.78
1992	10.12	0.25	0.72	0.32	2.98	0.59	2.53	6.70	0.19	0.12	12.06
1993	10.64	0.31	0.80	0.24	3.57	0.83	3.66	2.33	0.26	0.14	20.14
1994	7.44	0.18	0.47	0.27	2.24	0.74	3.53	2.89	0.21	0.18	17.24
1995	4.84	0.65	1.00	0.66	3.79	1.31	4.51	4.76	0.59	0.28	11.82
1996	5.46	0.35	0.79	0.49	3.25	1.15	4.39	1.76	0.39	0.33	11.86
1997	4.96	0.41	0.68	0.48	4.38	1.84	5.17	5.15	0.61	0.39	8.37
1998	3.84	0.29	0.46	0.53	5.13	1.09	3.48	1.38	0.55	0.47	8.04

*Based on date of haul from NMFS logbooks.

Table 11.--Hawaii's longline landings* (X 1,000 pounds) of selected pelagic species, 1987-98.

	Billfish				Tunas				Miscellaneous			
Year	Swordfish	Blue marlin	Striped marlin	Other marlin	Bigeye tuna	Yellowfin tuna	Albacore	Bluefin tuna	Mahimahi	Ono	Moonfish	Sharks*
1987	50	110	600	100	1,790	580	330	---	50	50	150	40
1988	50	230	1,110	150	2,740	1,310	680	---	40	90	180	100
1989	620	770	1,340	290	3,140	2,160	550	---	180	200	270	200
1990	4,190	760	1,100	120	3,020	2,230	370	---	350	70	250	200
1991	10,120	660	1,500	350	3,420	1,620	690	---	520	110	510	290
1992	12,570	760	1,010	300	3,280	760	730	20	590	90	320	420
1993	13,100	750	1,040	220	4,660	1,390	970	90	320	140	450	1,740
1994	7,000	800	720	220	3,940	1,340	1,100	40	380	90	520	1,720
1995	6,010	1,280	1,200	410	4,580	2,150	1,930	60	570	200	630	3,490
1996	5,520	1,030	920	260	3,950	1,390	2,610	50	370	140	760	4,300
1997	6,350	1,070	780	320	5,400	2,520	3,620	50	520	240	820	5,010
1998	7,190	870	830	380	7,110	1,590	2,450	40	340	260	920	6,000

*Estimated from NMFS and HDAR shoreside sampling and NMFS logbook data.

Table 12.--Hawaii's longline ex-vessel revenue* (X $1,000) by species, 1987-98.

	Billfish				Tunas				Miscellaneous			
Year	Swordfish	Blue marlin	Striped marlin	Other marlin	Bigeye tuna	Yellowfin tuna	Albacore	Bluefin tuna	Mahimahi	Ono	Moonfish	Sharks
1987	170	140	810	240	6,510	1,500	520	---	100	150	240	60
1988	160	190	1,200	260	9,160	3,270	910	---	110	240	270	100
1989	1,130	640	1,370	290	10,640	5,070	710	---	400	450	350	100
1990	9,710	710	1,530	160	10,940	5,750	550	---	590	200	330	120
1991	21,450	510	1,490	320	12,760	4,440	910	40	670	230	590	170
1992	24,130	880	1,280	310	11,710	2,210	910	260	830	220	350	220
1993	26,590	640	1,070	200	16,640	3,810	1,170	1,330	440	270	390	510
1994	16,240	1,020	1,220	290	14,620	3,910	1,360	680	540	240	570	500
1995	13,460	1,110	1,080	300	15,340	6,110	2,080	980	810	330	600	860
1996	13,740	1,030	1,140	230	14,140	4,250	3,390	880	760	300	810	1,780
1997	14,040	910	980	310	17,390	6,740	4,450	810	640	370	940	2,010
1998	11,940	1,090	990	250	21,110	3,970	3,040	250	580	490	960	1,510

*Estimates from NMFS and HDAR shoreside sampling and NMFS logbook data.

Table 13.--Hawaii's longline ex-vessel prices* (based on estimated whole weight) by species, 1987-98.

	Billfish			Tunas				Miscellaneous				
Year	Swordfish	Blue marlin	Striped marlin	Bigeye tuna	Yellowfin tuna	Albacore	Bluefin tuna	Mahimahi	Ono	Moonfish	Mako	Thresher
1987	3.23	1.02	1.39	3.56	1.86	1.57	---	2.31	2.60	1.55	1.65	0.83
1988	2.87	0.84	1.02	3.33	1.81	1.30	---	2.73	2.56	1.49	1.17	0.81
1989	2.28	0.84	1.10	3.24	2.14	1.30	---	2.26	2.47	1.28	0.85	0.40
1990	2.32	0.92	1.38	3.33	2.19	1.48	---	1.97	2.52	1.31	0.71	0.43
1991	2.12	0.78	0.99	3.73	2.74	1.32	8.63	1.28	2.10	1.15	0.64	0.46
1992	1.92	1.16	1.27	3.57	2.91	1.24	12.33	1.40	2.46	1.10	0.76	0.50
1993	2.03	0.85	1.03	3.57	2.74	1.21	13.42	1.36	1.94	0.86	0.64	0.56
1994	2.32	1.28	1.70	3.71	2.92	1.24	15.53	1.41	2.70	1.10	0.68	0.52
1995	2.24	0.87	0.90	3.35	2.84	1.08	17.26	1.42	1.64	0.95	0.65	0.62
1996	2.49	1.00	1.24	3.58	3.06	1.30	18.26	2.05	2.13	1.07	0.66	0.68
1997	2.21	0.85	1.27	3.22	2.68	1.23	15.59	1.24	1.56	1.14	0.35	0.27
1998	1.66	1.26	1.19	2.97	2.50	1.24	7.00	1.72	1.88	1.04	0.41	0.19

*Estimates from on NMFS and HDAR shoreside sampling and NMFS logbook data.

Table 14.--Mean whole weight of catch* (in pounds), 1987-98.

	Billfish			Tunas				Miscellaneous				
Year	Swordfish	Blue marlin	Striped marlin	Bigeye tuna	Yellowfin tuna	Albacore	Bluefin tuna	Mahimahi	Ono	Moonfish	Mako	Thresher
Fleet												
1987	129.3	161.4	66.2	76.3	81.9	62.3	---	21.1	33.3	110.6	124.0	96.6
1988	119.2	157.3	56.9	83.2	102.5	59.7	---	20.0	31.9	108.3	136.7	121.6
1989	131.1	164.7	61.5	77.0	103.7	62.0	---	23.0	34.6	103.9	160.6	157.5
1990	147.6	172.0	55.8	85.5	117.2	53.3	---	14.5	31.6	98.2	161.2	166.8
1991	155.3	174.6	59.2	85.0	117.7	51.9	184.2	14.8	31.6	97.2	131.0	177.1
1992	177.6	174.5	65.5	76.8	99.2	45.2	192.3	11.0	35.1	98.3	144.4	176.2
1993	172.2	156.7	63.7	87.9	92.1	44.1	192.6	12.9	32.6	101.2	147.2	198.5
1994	162.6	170.6	63.5	80.9	97.4	41.3	203.6	11.8	34.2	103.3	152.6	163.6
1995	171.1	157.3	57.7	79.0	94.5	49.9	269.2	10.2	30.6	100.6	176.1	175.2
1996	157.1	153.9	58.2	63.8	80.4	52.6	222.8	16.6	31.3	104.5	176.8	156.1
1997	162.7	133.8	65.5	70.9	88.6	54.5	239.1	12.6	29.5	103.0	160.7	160.0
1998	175.6	164.4	60.4	73.6	75.9	55.3	177.4	15.9	32.2	101.3	178.7	167.9

*Estimates from on NMFS and HDAR shoreside sampling and NMFS logbook data.

Table 15.--Mean whole weight of catch* (in pounds) by trip type, 1991-98.

	Billfish			Tunas				Miscellaneous				
Year	Swordfish	Blue marlin	Striped marlin	Bigeye tuna	Yellowfin tuna	Albacore	Bluefin tuna	Mahimahi	Ono	Moonfish	Mako	Thresher
Swordfish trips												
1991	165.1	185.6	71.6	96.8	123.6	44.1	164.3	15.0	35.3	103.5	107.2	173.2
1992	192.7	277.7	83.4	94.6	101.4	37.5	194.6	10.4	36.5	77.5	130.5	235.0
1993	180.2	173.6	78.4	83.3	92.8	34.4	183.7	13.0	36.4	99.5	141.3	260.6
1994	173.3	202.1	83.6	94.7	94.7	34.2	205.2	10.6	40.1	76.0	118.5	195.8
1995	184.8	151.9	79.9	93.0	102.4	37.0	176.3	7.8	34.2	80.3	140.5	---
1996	169.2	239.1	81.7	110.5	108.9	48.6	225.0	18.8	37.7	88.0	233.0	---
1997	167.0	108.3	96.9	85.1	107.5	43.3	236.5	12.2	36.4	101.8	74.2	---
1998	182.4	148.0	109.4	97.7	113.3	47.5	230.0	13.5	39.0	76.0	123.0	---
Tuna trips												
1991	82.7	152.7	51.0	76.5	87.9	57.9	---	14.9	31.2	97.2	154.6	188.0
1992	77.3	144.0	59.0	71.4	68.8	56.0	159.0	13.9	33.8	98.9	157.9	157.3
1993	121.1	145.2	58.8	84.0	87.0	57.5	219.7	13.1	31.7	101.2	152.9	188.7
1994	90.7	156.7	59.6	77.4	81.2	48.9	247.0	12.1	33.7	103.5	176.2	166.9
1995	124.3	151.6	55.8	74.7	77.3	51.4	342.0	11.9	30.2	100.9	181.6	176.0
1996	144.0	143.1	56.4	64.1	63.7	53.0	200.8	15.5	30.8	104.9	172.9	194.1
1997	167.7	133.5	60.7	68.9	75.4	55.2	---	13.5	28.7	103.0	165.6	156.3
1998	125.7	146.6	55.7	71.3	69.9	56.0	---	16.1	32.0	101.4	175.4	166.2
Mixed trips												
1991	142.4	186.5	66.0	91.5	132.2	49.0	191.7	14.7	33.7	96.4	148.0	177.5
1992	162.4	178.0	81.2	80.6	119.8	44.6	191.8	10.4	39.0	99.5	139.7	192.5
1993	158.4	169.0	74.5	99.8	106.5	36.4	217.1	12.6	36.9	113.0	141.9	208.8
1994	118.7	174.6	67.6	93.5	128.5	57.2	153.5	12.4	38.6	96.0	141.5	148.4
1995	161.3	168.7	63.8	91.3	125.4	46.2	223.6	9.2	34.2	93.6	172.9	136.5
1996	151.2	164.7	62.4	58.1	113.0	51.4	249.0	17.4	33.1	94.8	174.0	127.4
1997	160.1	136.8	77.8	83.7	115.2	48.4	240.6	11.9	33.9	100.7	160.4	173.4
1998	175.8	205.7	73.6	83.3	97.2	50.2	163.3	16.1	33.0	91.5	199.8	187.8

*Estimates from on NMFS and HDAR shoreside sampling and NMFS logbook data.

Table 16.--Western Pacific longline logbook summary for protected species interactions for January 1998 to December 1998
(Vessels landing or based in Hawaii)
Report: Date of haul; All Areas - All Species

Trip Information

Number of vessels reporting interactions	32
Number of trips reporting interactions	59
Number of sets reporting interactions	192
Number of sets during haul period	781
Number of hooks set with interactions	161,674
Number of hooks set during haul period	719,485

Reported Protected Species Interactions

Species	Alive	Injured	Dead	TOTAL
Seals				
Monk Seals	0	0	0	0
Other Seals	0	0	0	0
Total	0	0	0	0
Whales/Dolphins				
Humpback Whales	1	0	0	1
False Killer Whales	0	0	0	0
Other Whales	0	0	0	0
Dolphins	0	0	0	0
Total	1	0	0	1
Turtles				
Green Turtles	8	1	3	12
Hawksbill Turtles	1	0	0	1
Leatherback Turtles	11	1	1	13
Loggerhead Turtles	49	16	0	65
Ridley Turtles	4	1	2	7
Unidentified	1	1	2	4
Other Turtles	0	0	0	0
Total	74	20	8	102
Birds				
Albatross	42	16	174	232
Bobby	0	0	2	2
Other Birds	0	0	0	0
Total	42	16	176	234
Other Species	0	0	0	0

Date and time of summary: 06/25/99 (14:39:50)

FIGURES

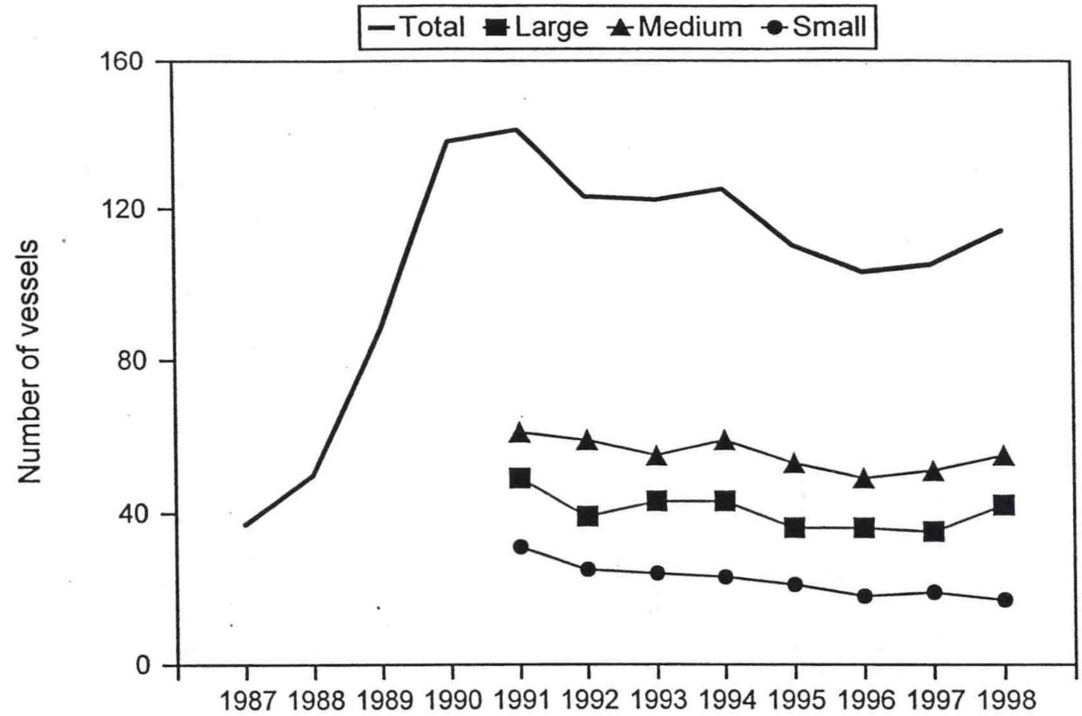

Figure 1.--Number of active Hawaii-based longline vessels, 1987-98.

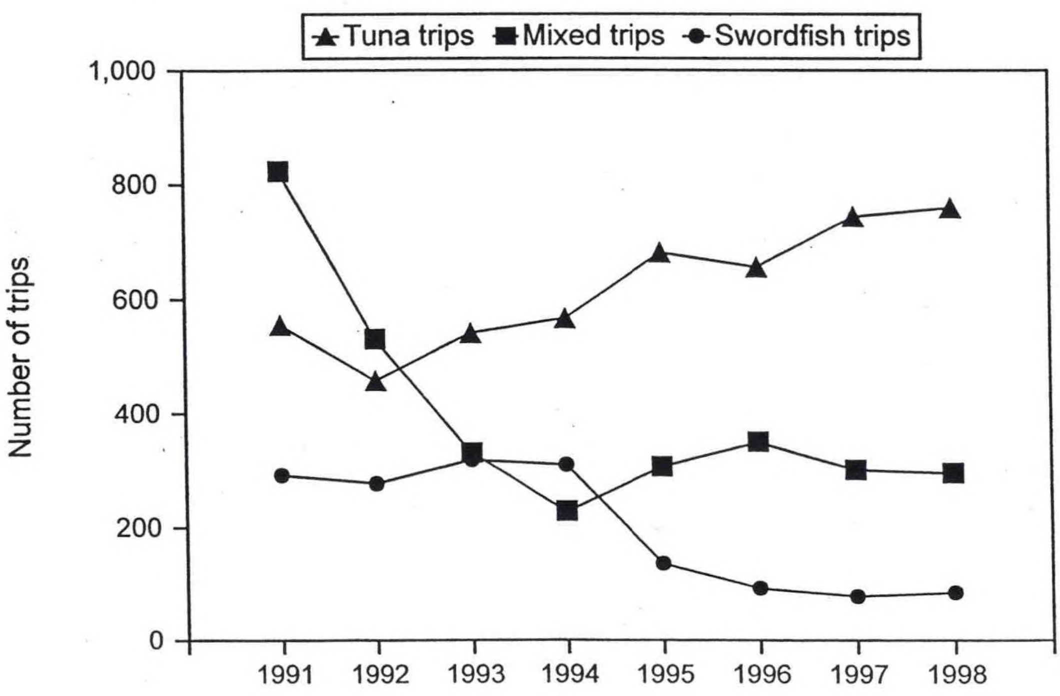

Figure 2.--Number of trips, 1991-98.

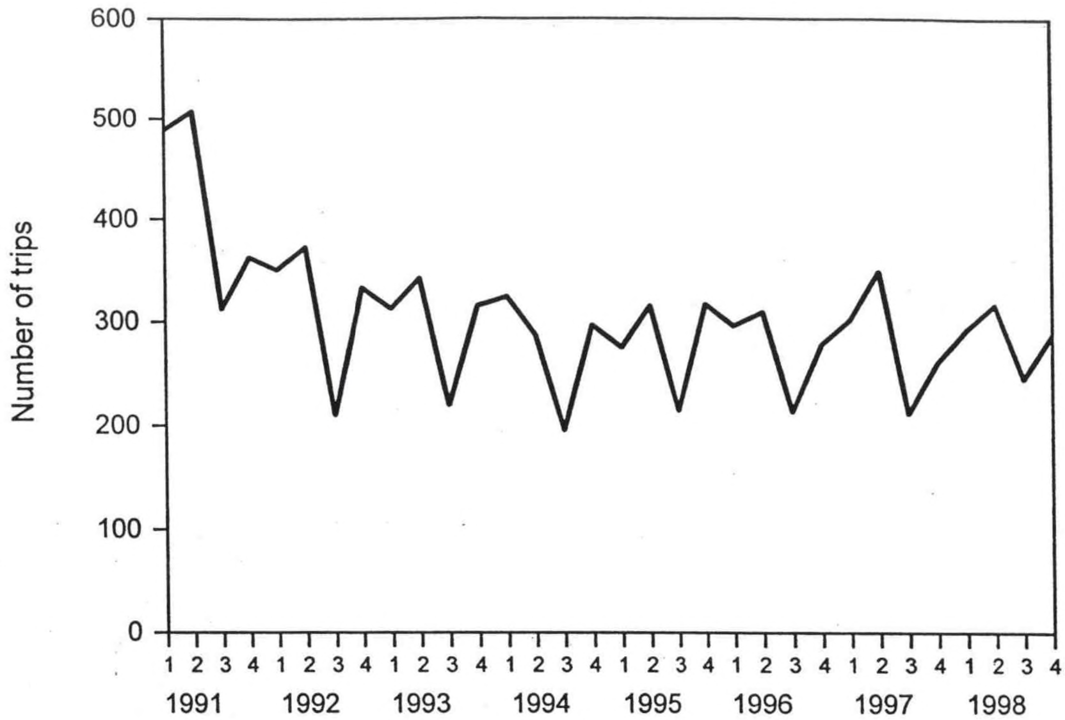

Figure 3.--Number of trips by quarter, 1991-98.

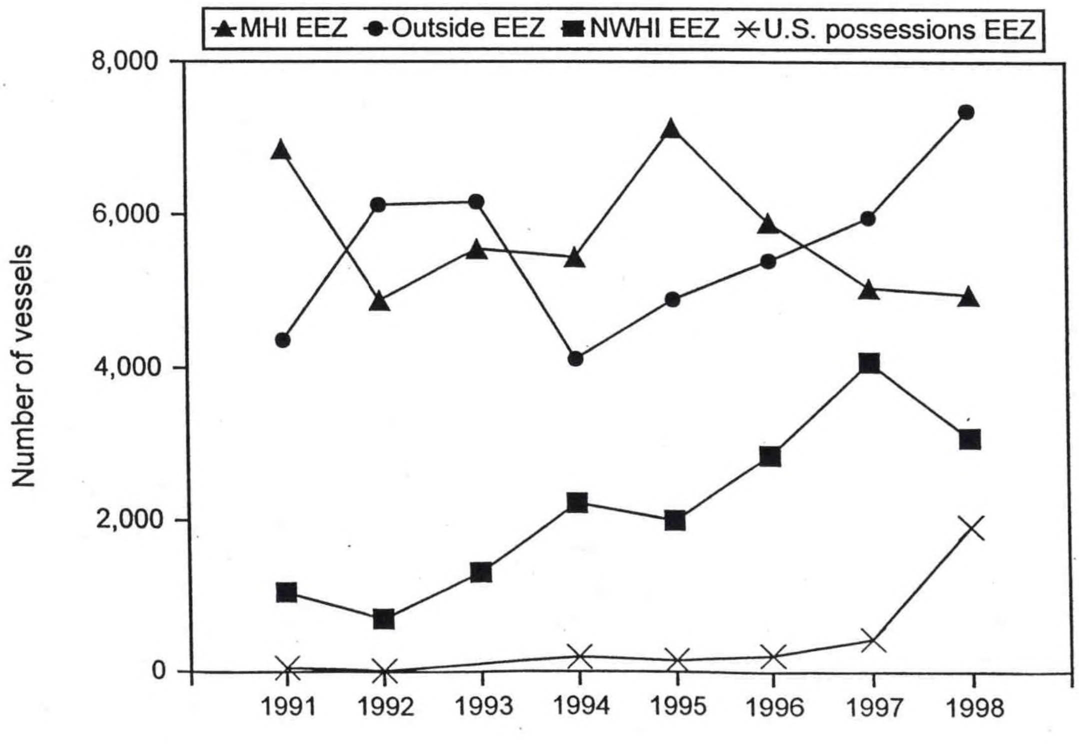

Figure 4.--Number of hooks set by area, 1991-98.

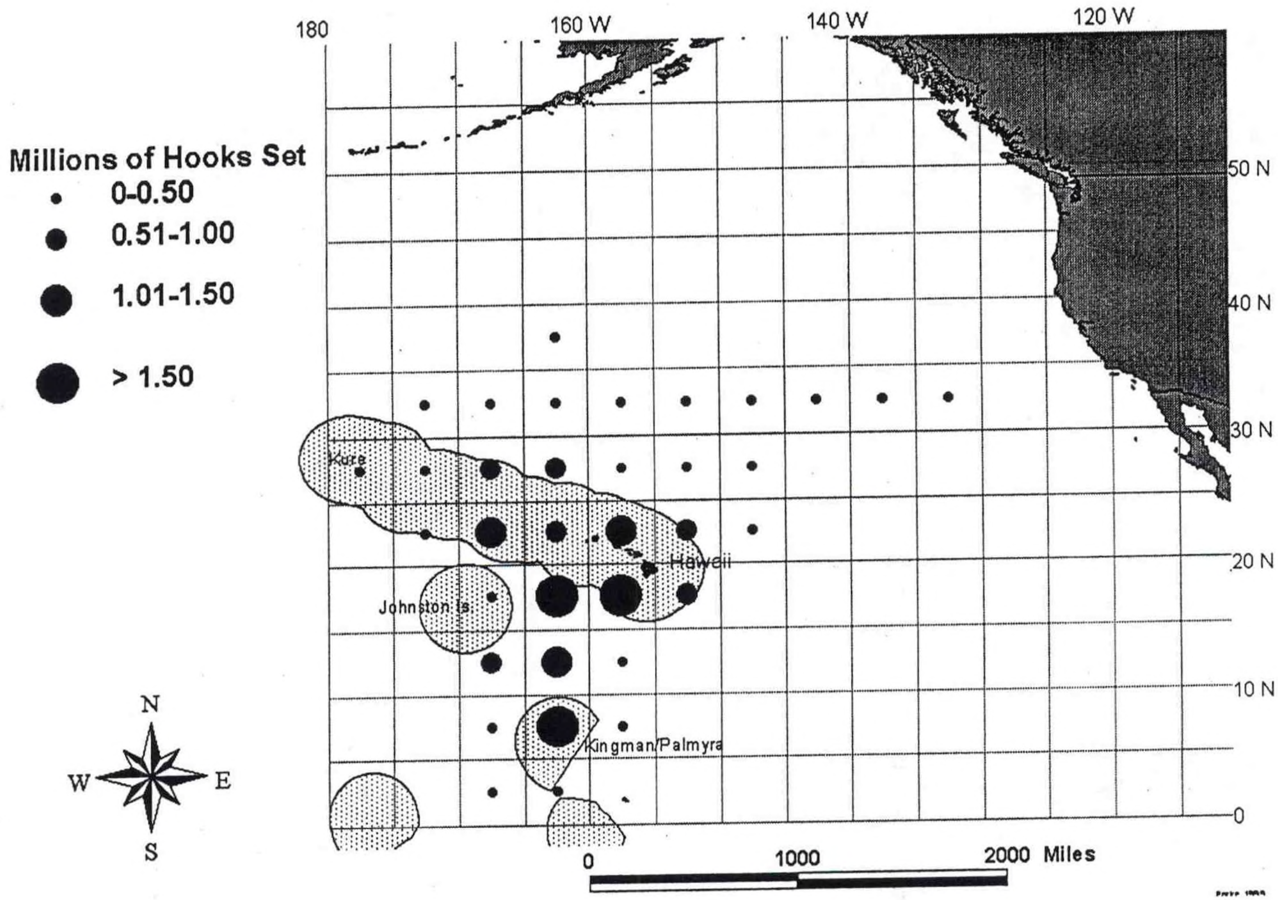

Figure 5.–Total number of hooks set by area, 1998.

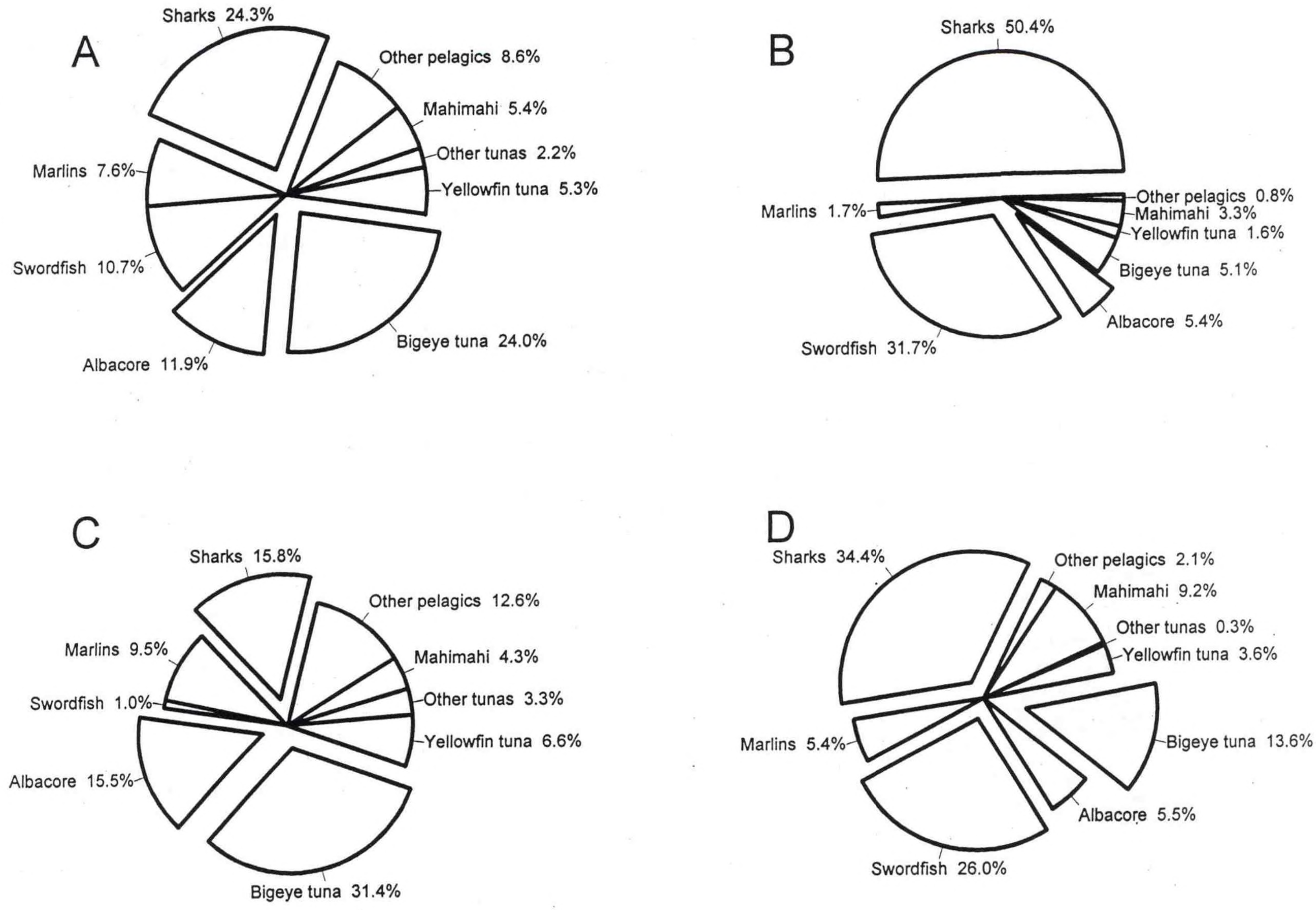

Figure 6.--Species composition (%) of the A) overall catch, B) swordfish trips, C) tuna trips, and D) mixed trips, 1998.

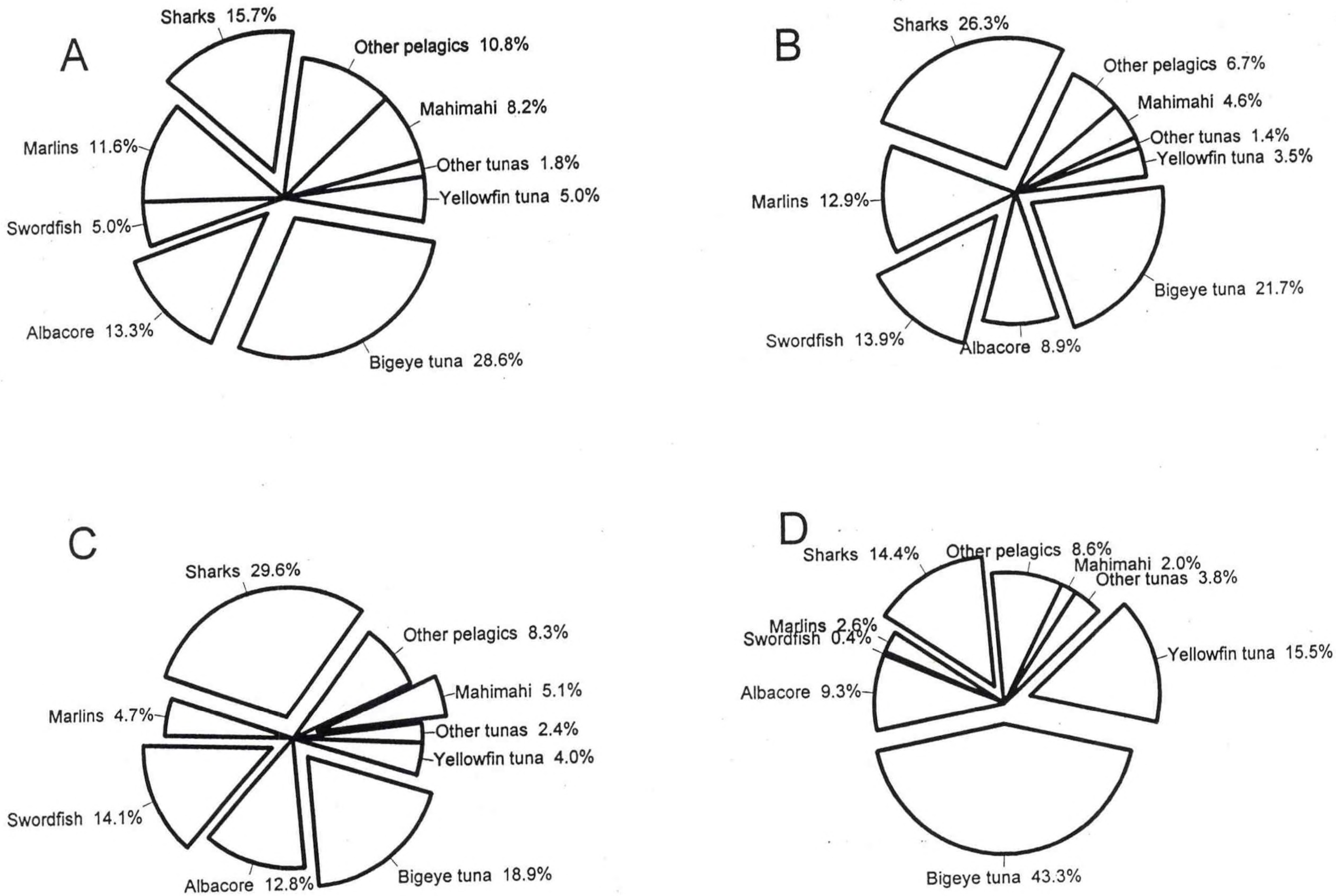

Figure 7.--Species composition of the catch (%) in the A) main Hawaiian Island Exclusive Economic Zone (EEZ), B) northwestern Hawaiian EEZ, C) outside the EEZ, and D) U.S. possessions, 1998.

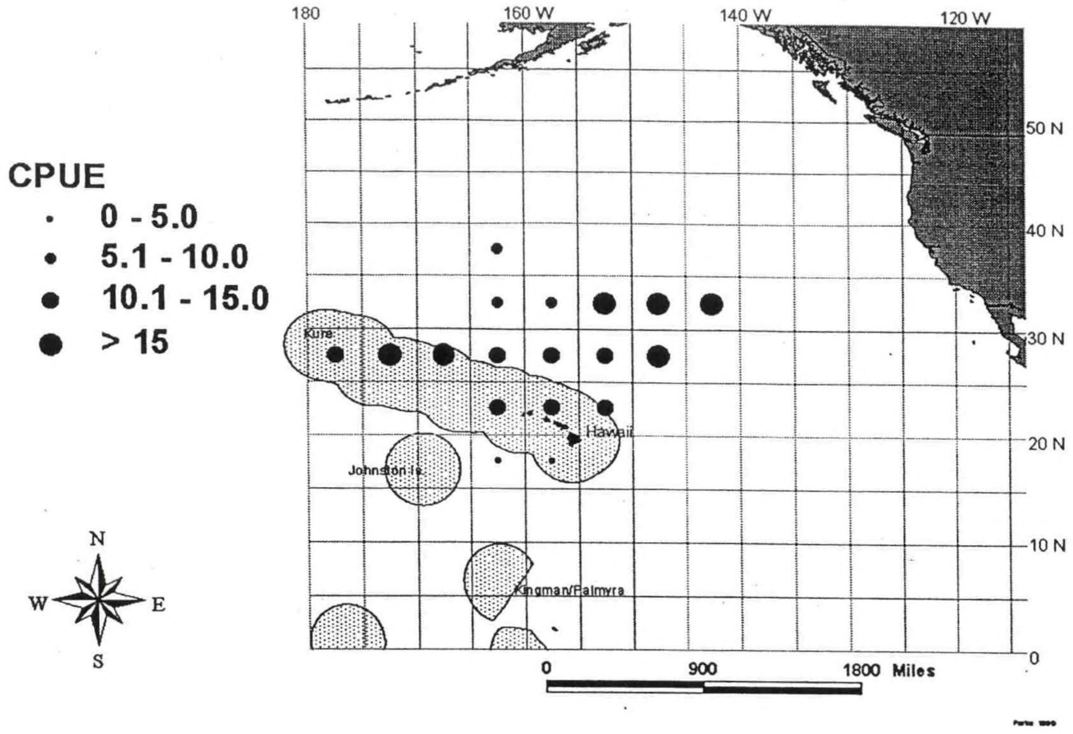

Figure 8.–Swordfish CPUE (fish per 1000 hooks) by area for swordfish directed and mixed target trips,1998.

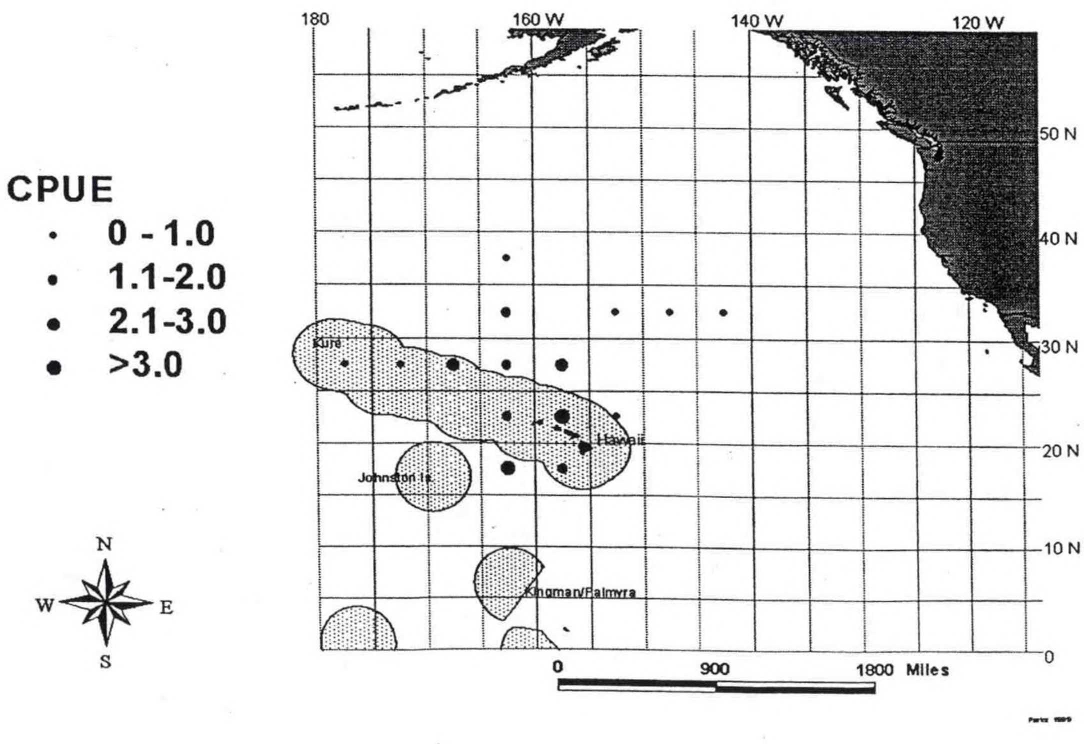

Figure 9.–Blue marlin CPUE (fish per 1000 hooks) by area for mixed target trips, 1998.

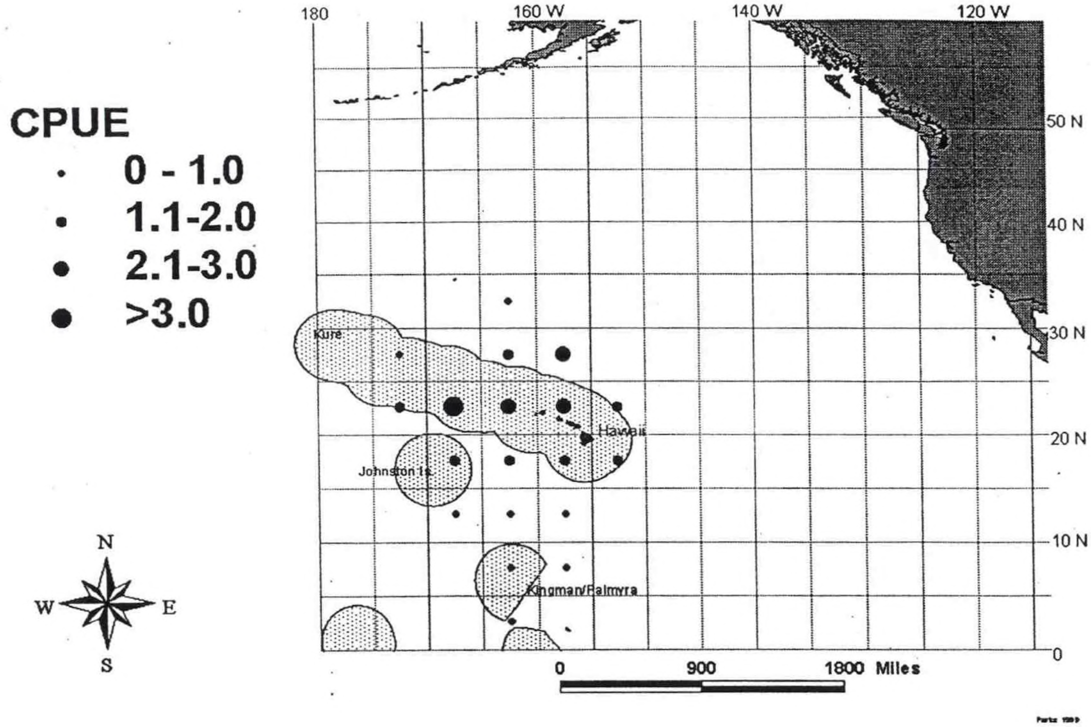

Figure 10.–Striped marlin CPUE (fish per 1000 hooks) by area for tuna directed trips, 1998.

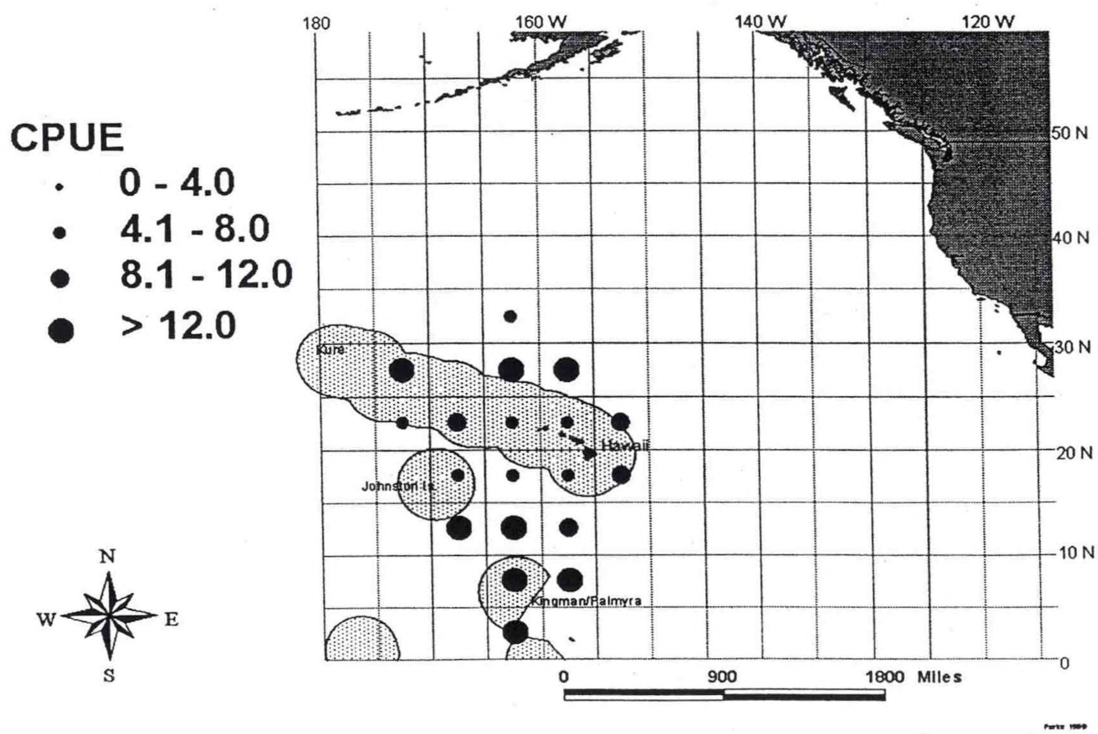

Figure 11.–Bigeye tuna CPUE (fish per 1000 hooks) by area for tuna directed trips, 1998.

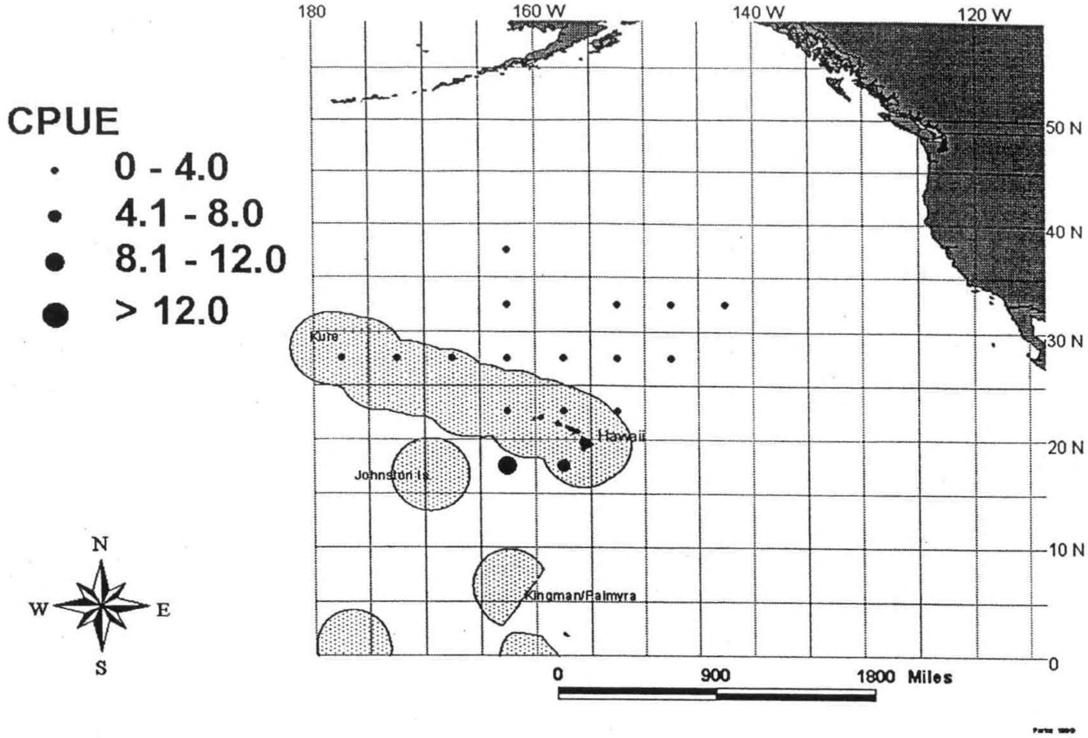

Figure 12.–Yellowfin tuna CPUE (fish per 1000 hooks) by area for mixed target trips, 1998.

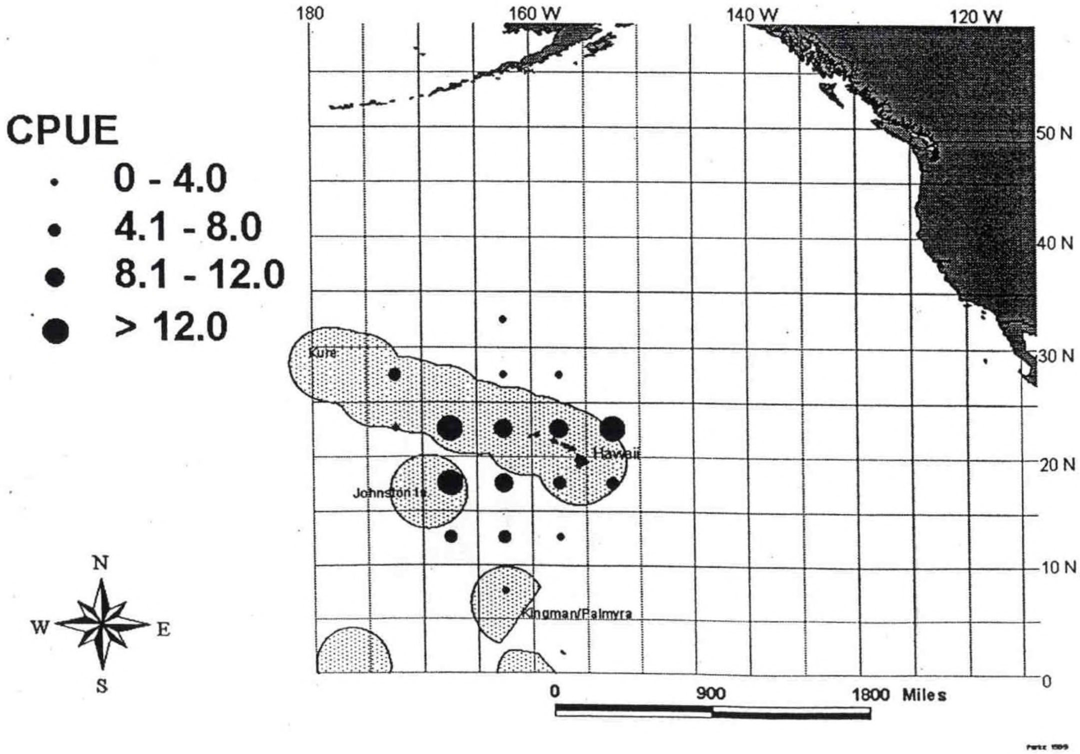

Figure 13.–Albacore CPUE (fish per 1000 hooks) by area for tuna directed trips, 1998.

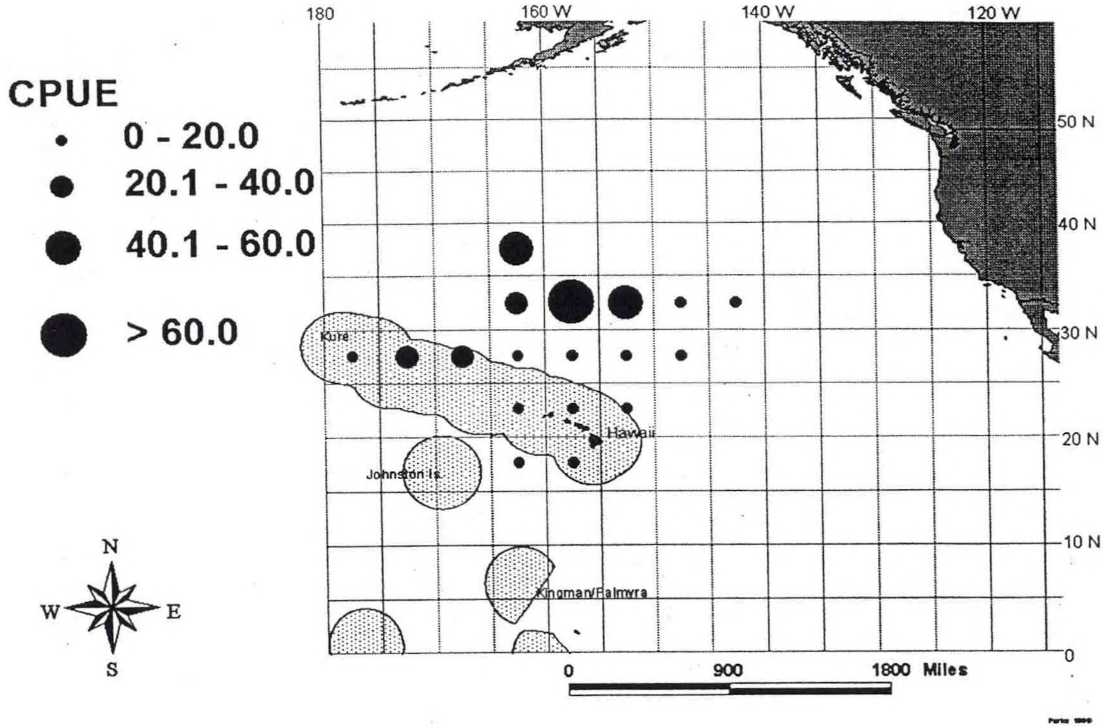

Figure 14.–Blue shark CPUE (fish per 1000 hooks) by area for swordfish directed and mixed target trips,1998.

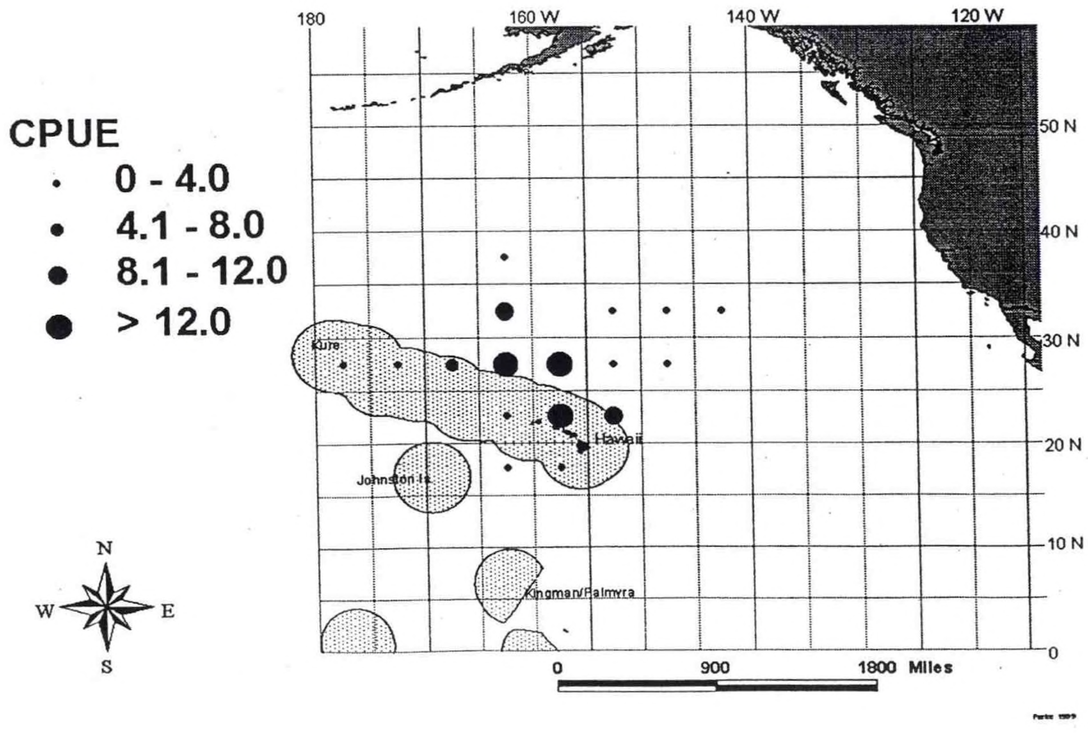

Figure 15.–Mahimahi CPUE (fish per 1000 hooks) by area for mixed target trips, 1998.

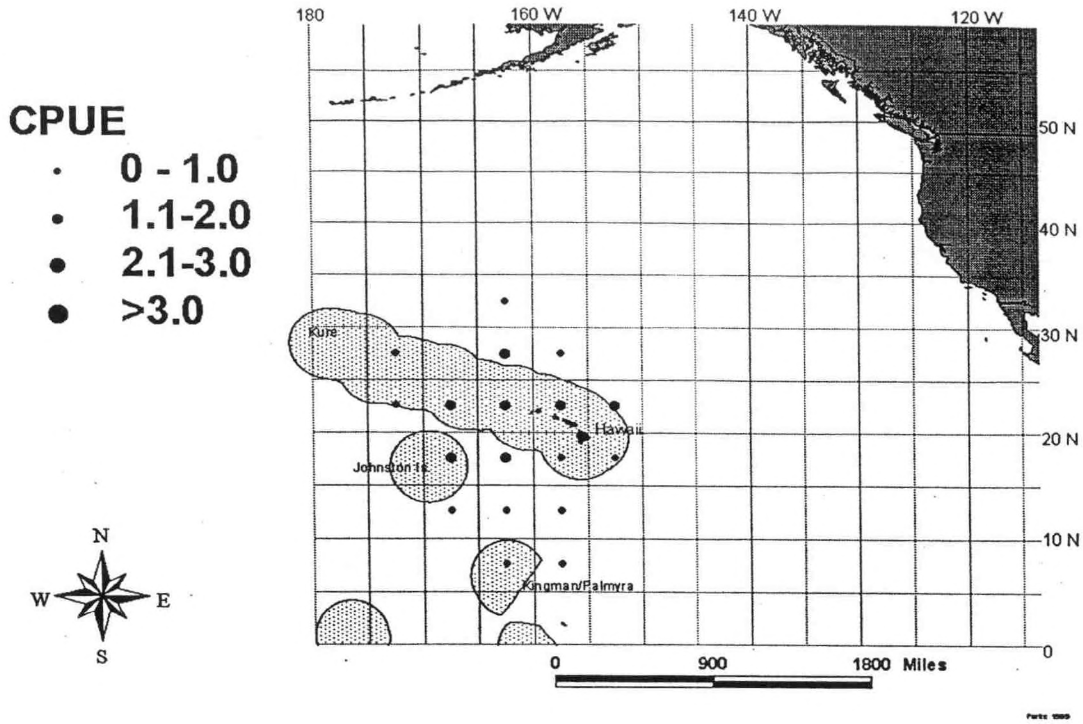

Figure 16.–Ono CPUE (fish per 1000 hooks) by area for tuna trips,1998.

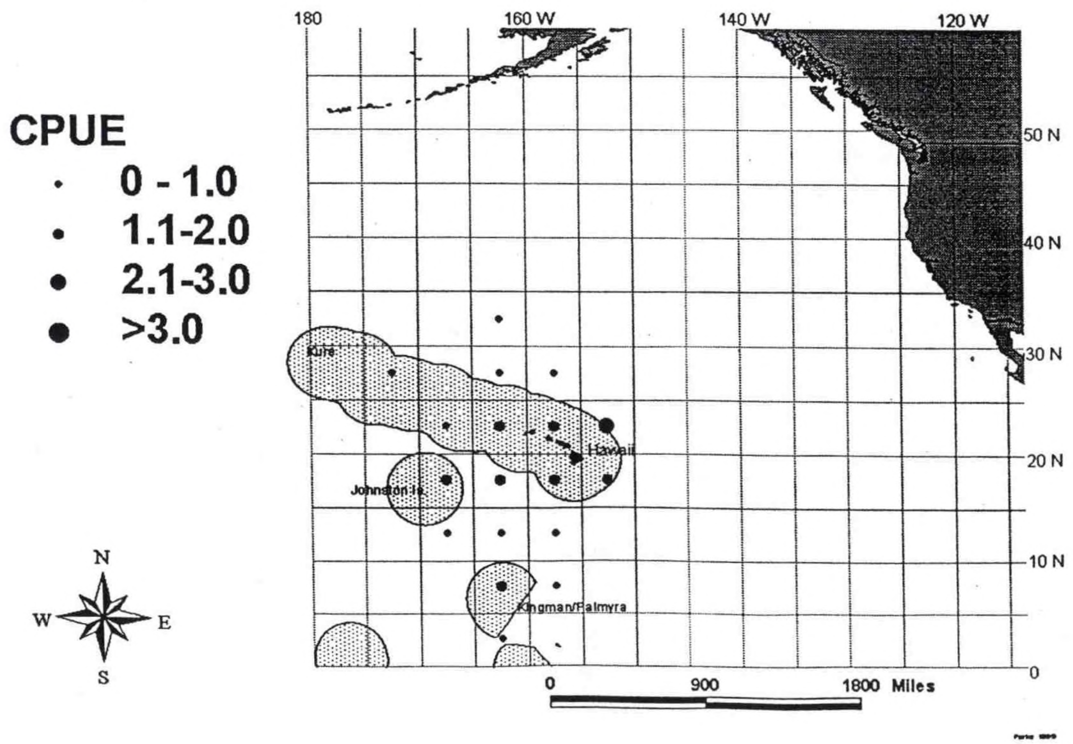

Figure 17.–Moonfish CPUE (fish per 1000 hooks) by area for tuna directed trips, 1998.

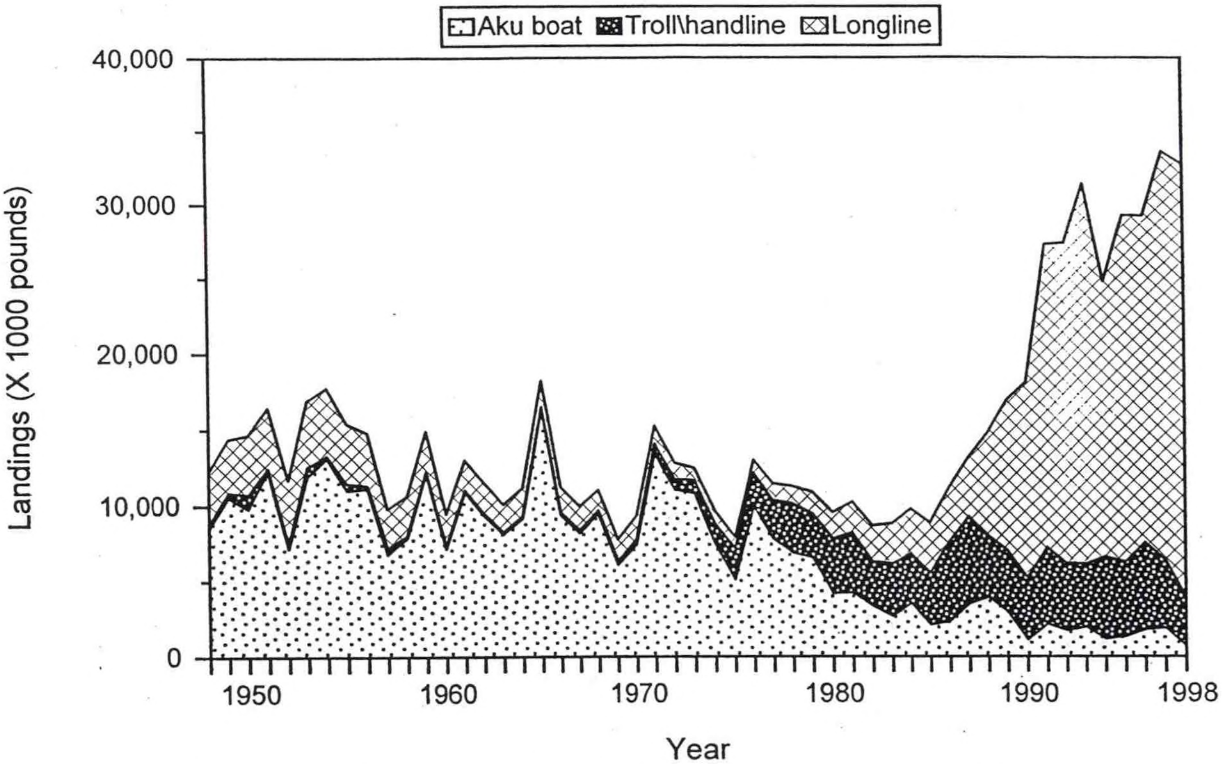

Figure 18.--Hawaii commercial pelagic landings by major gear types, 1948-98.

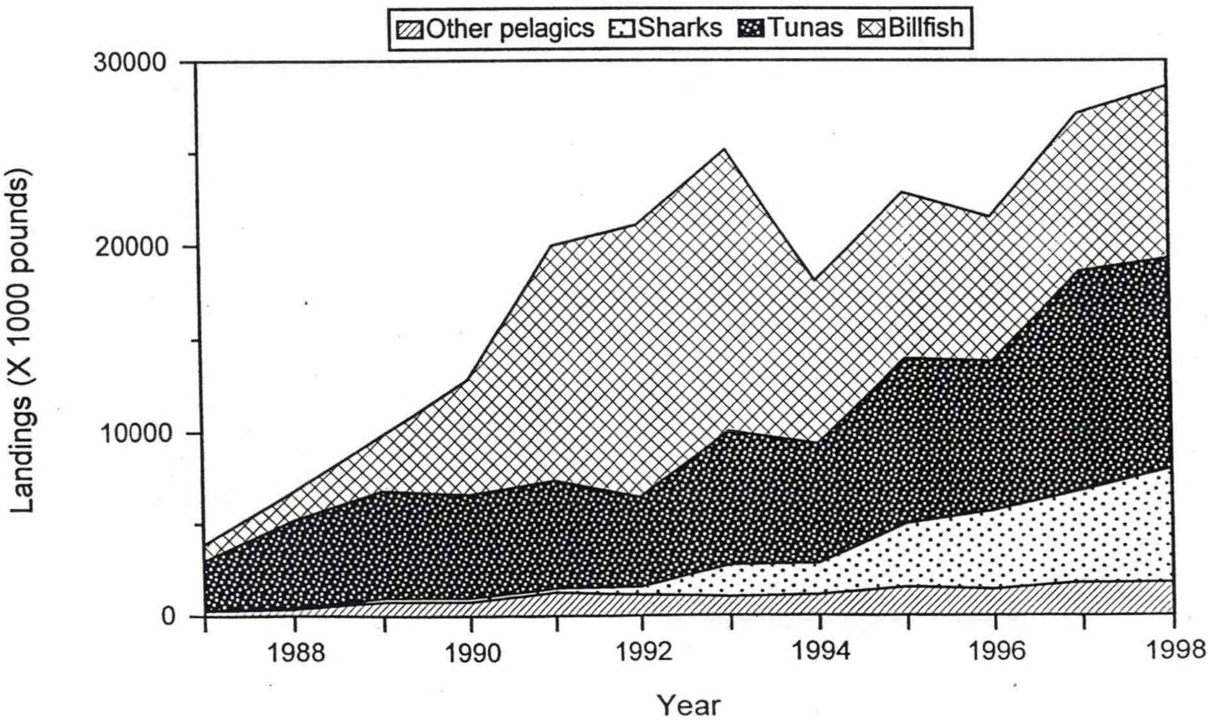

Figure 19.--Longline landings by major pelagic groups, 1987-98.

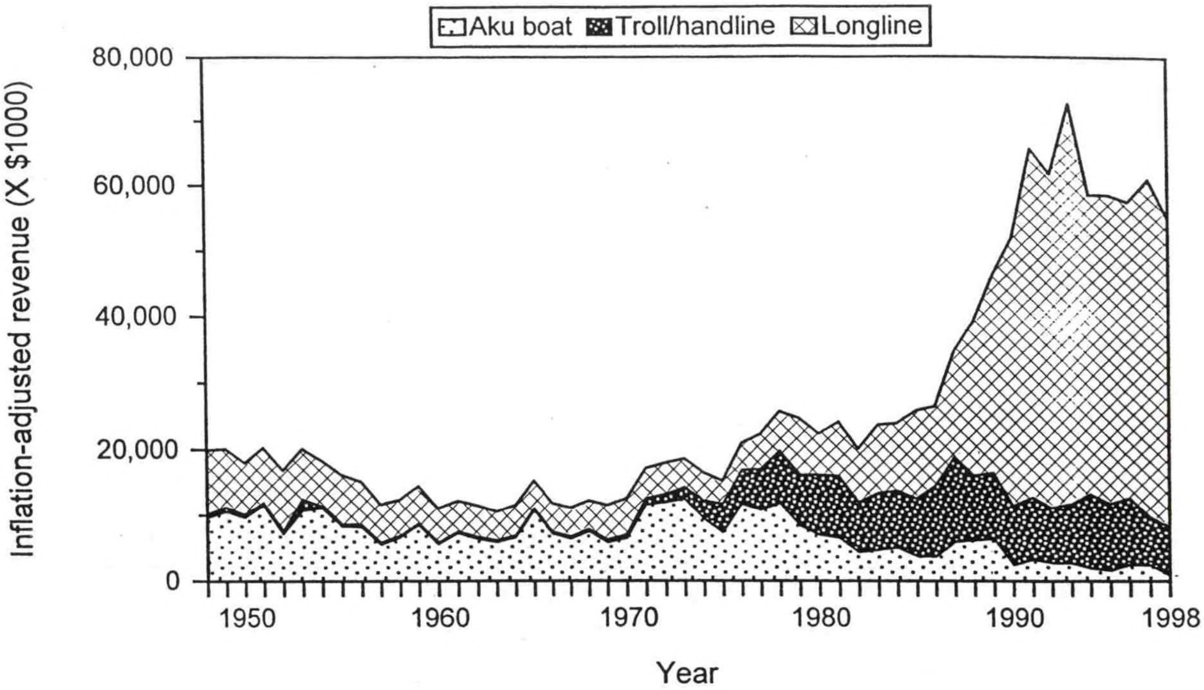

Figure 20.--Inflation-adjusted ex-vessel revenue by major Hawaii pelagic fisheries, 1948-98.

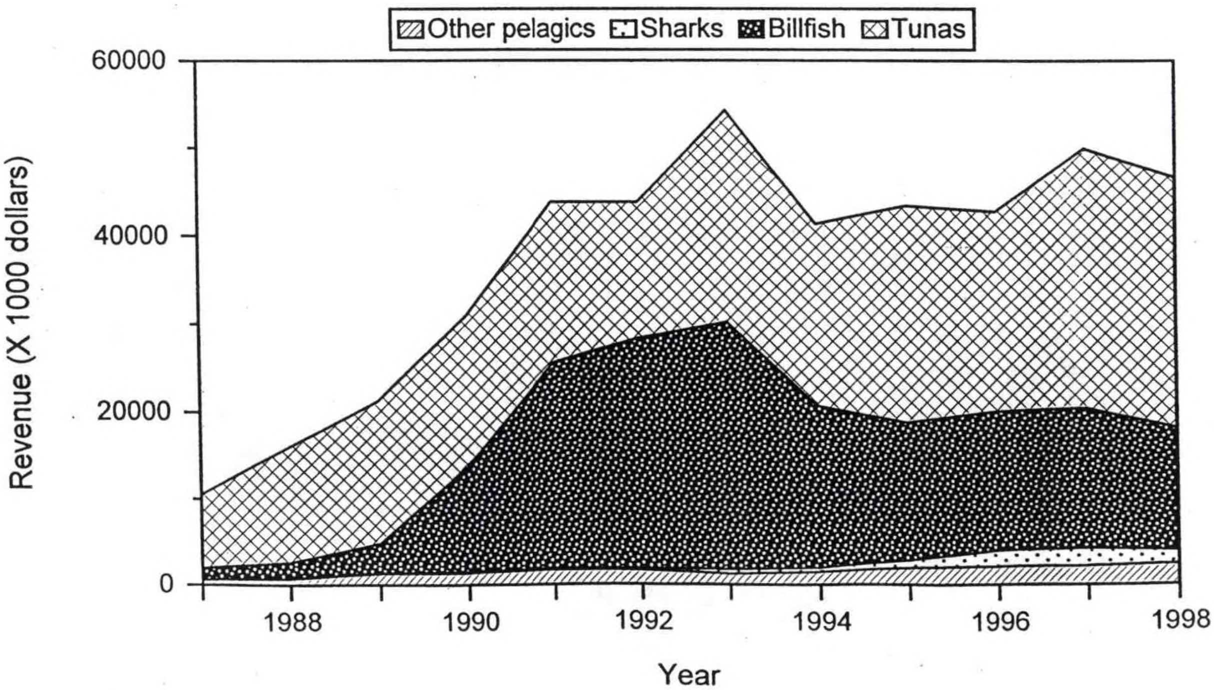

Figure 21.--Longline ex-vessel revenue by major pelagic groups, 1987-98.

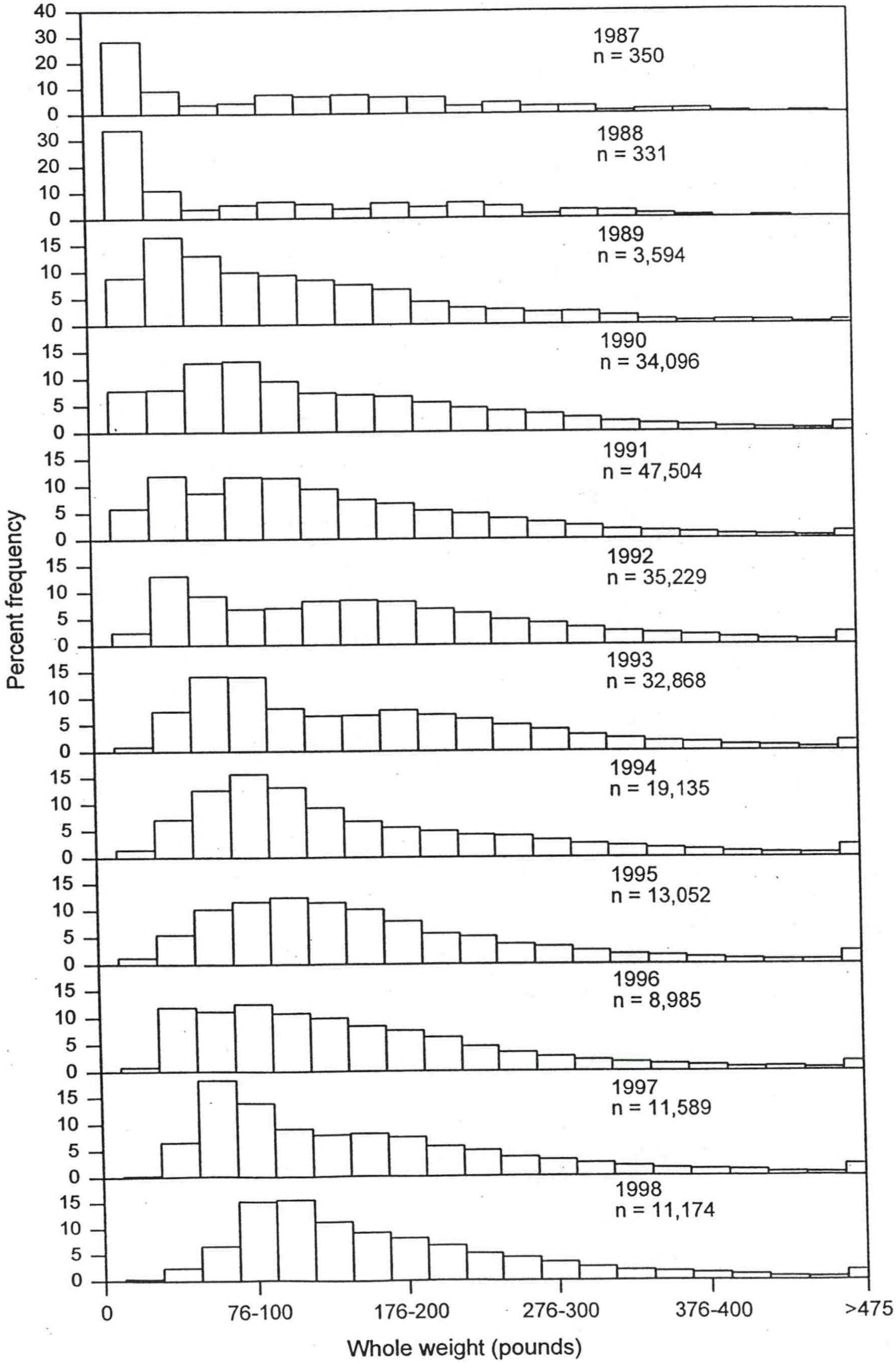

Figure 22.--Swordfish weight-frequency histograms, 1987-98.

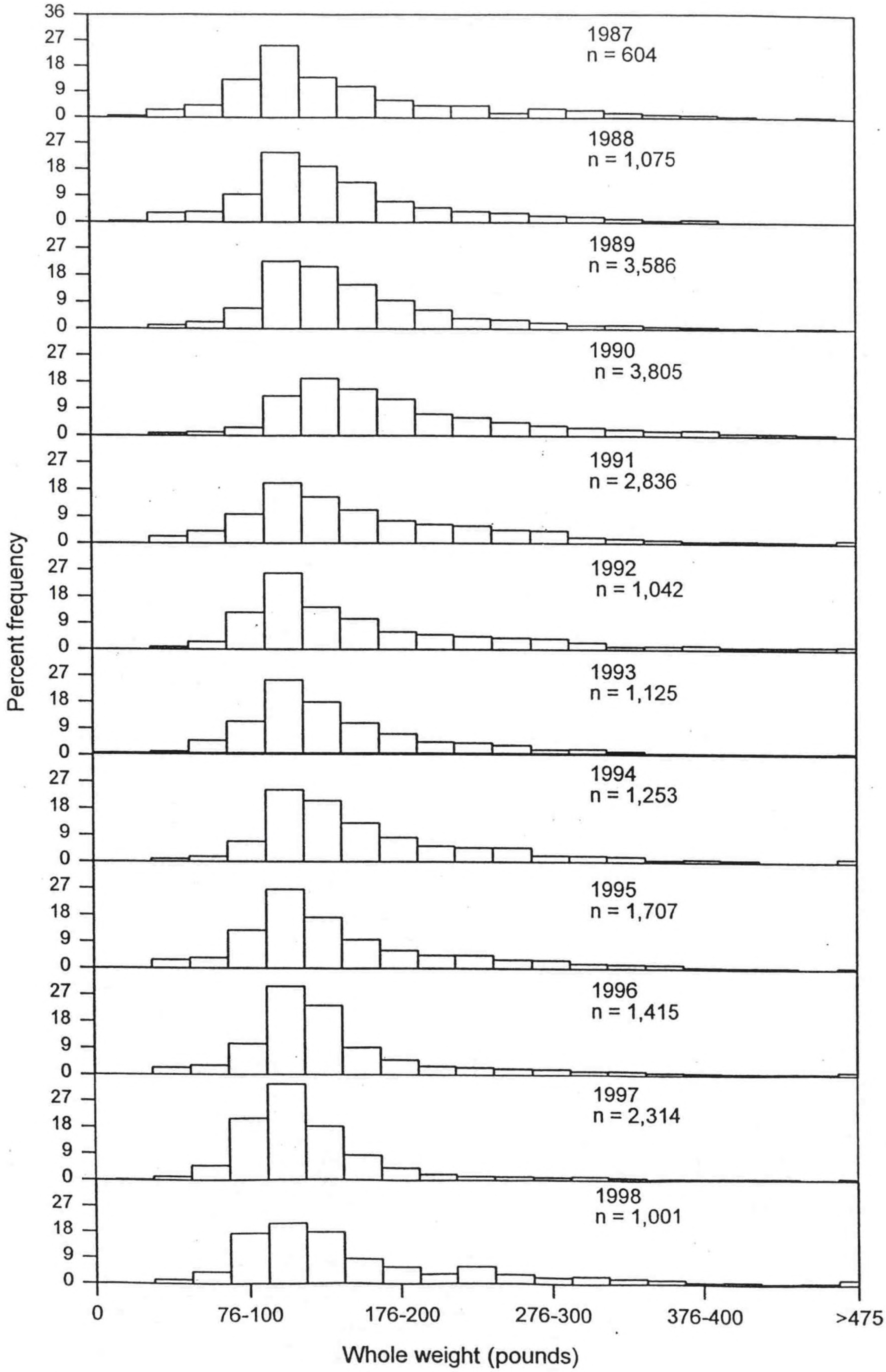

Figure 23.--Blue marlin weight-frequency histograms, 1987-98.

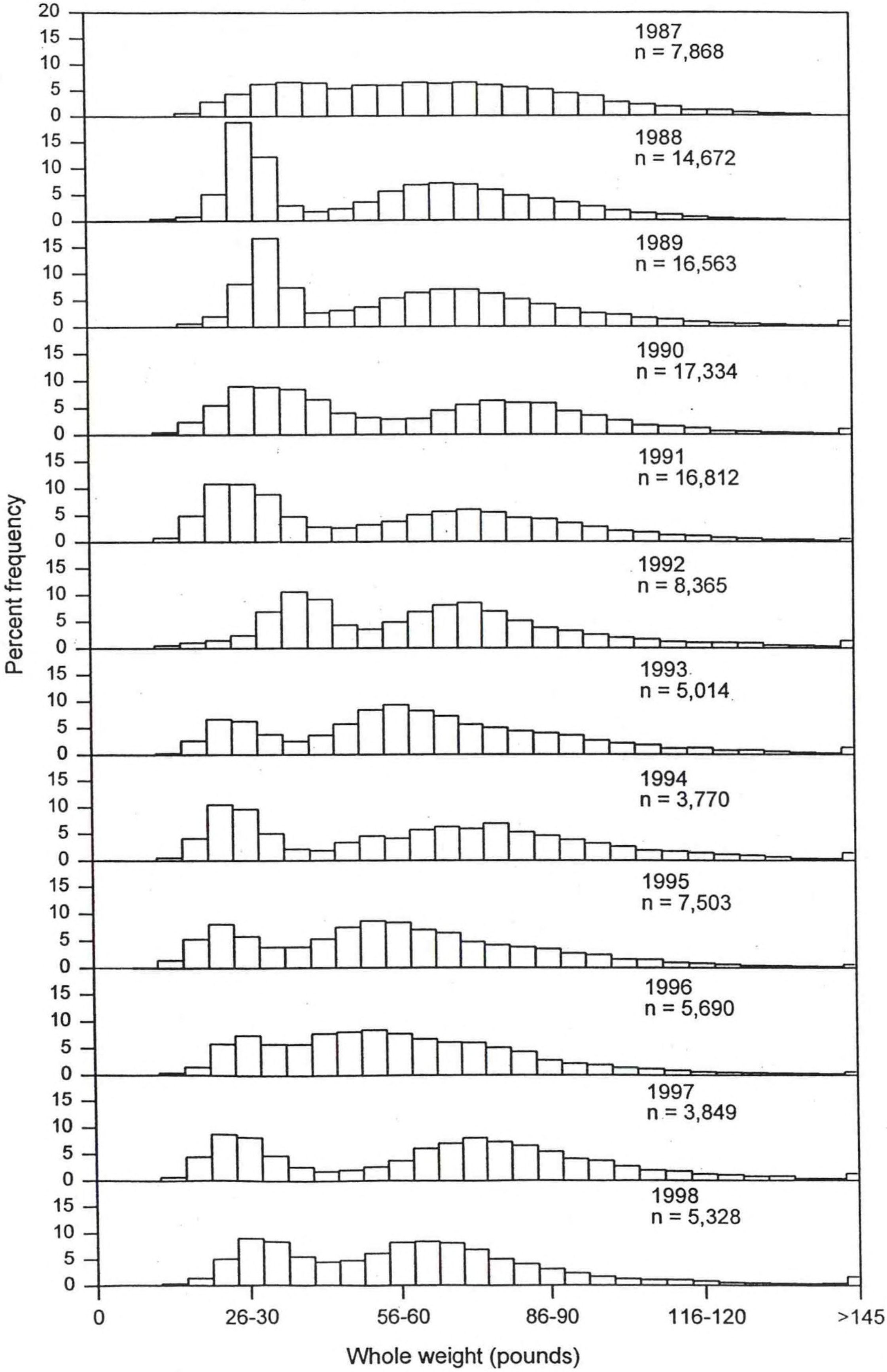

Figure 24.--Striped marlin weight-frequency histograms, 1987-98.

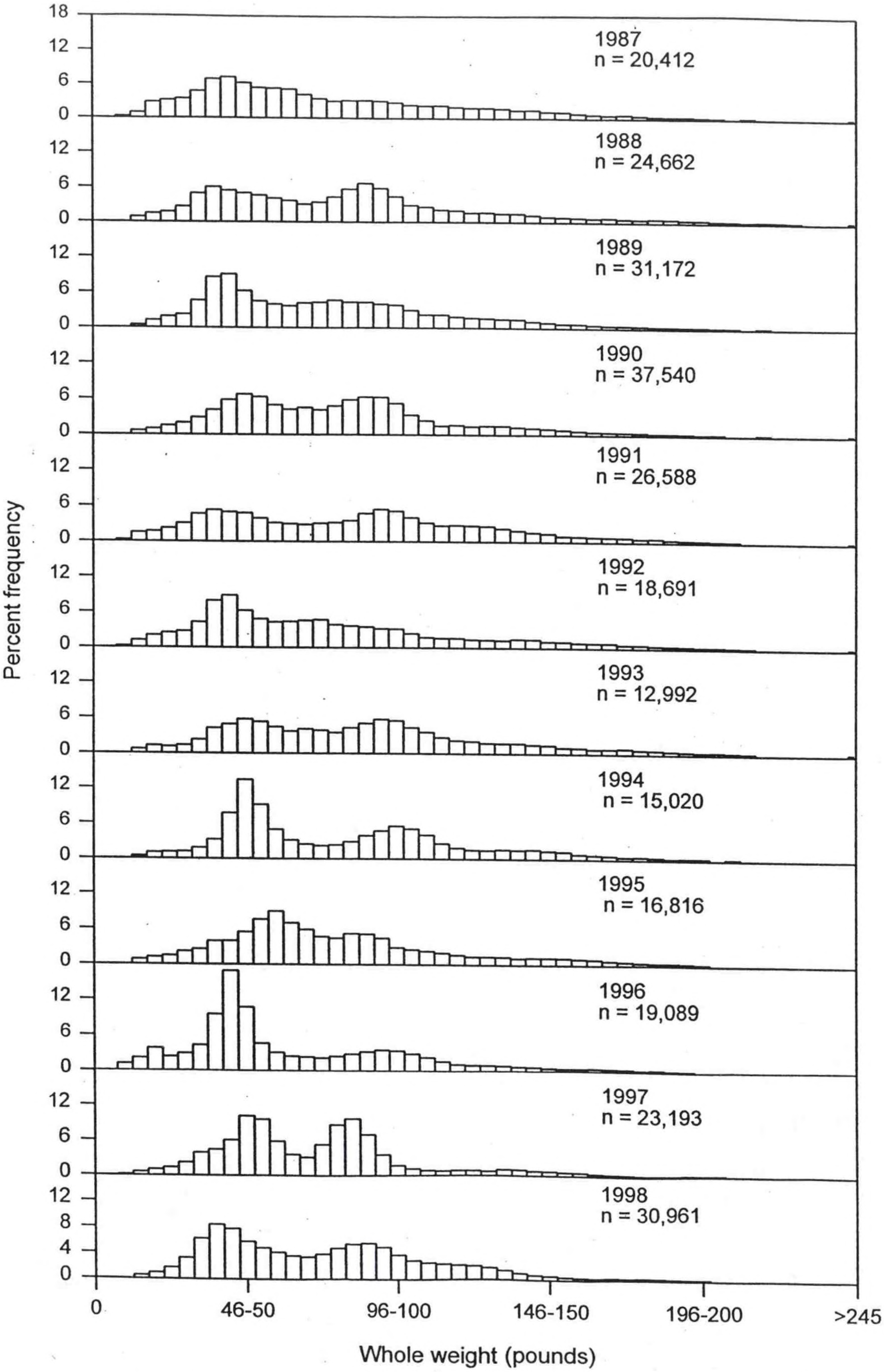

Figure 25.--Bigeye tuna weight-frequency histograms, 1987-98.

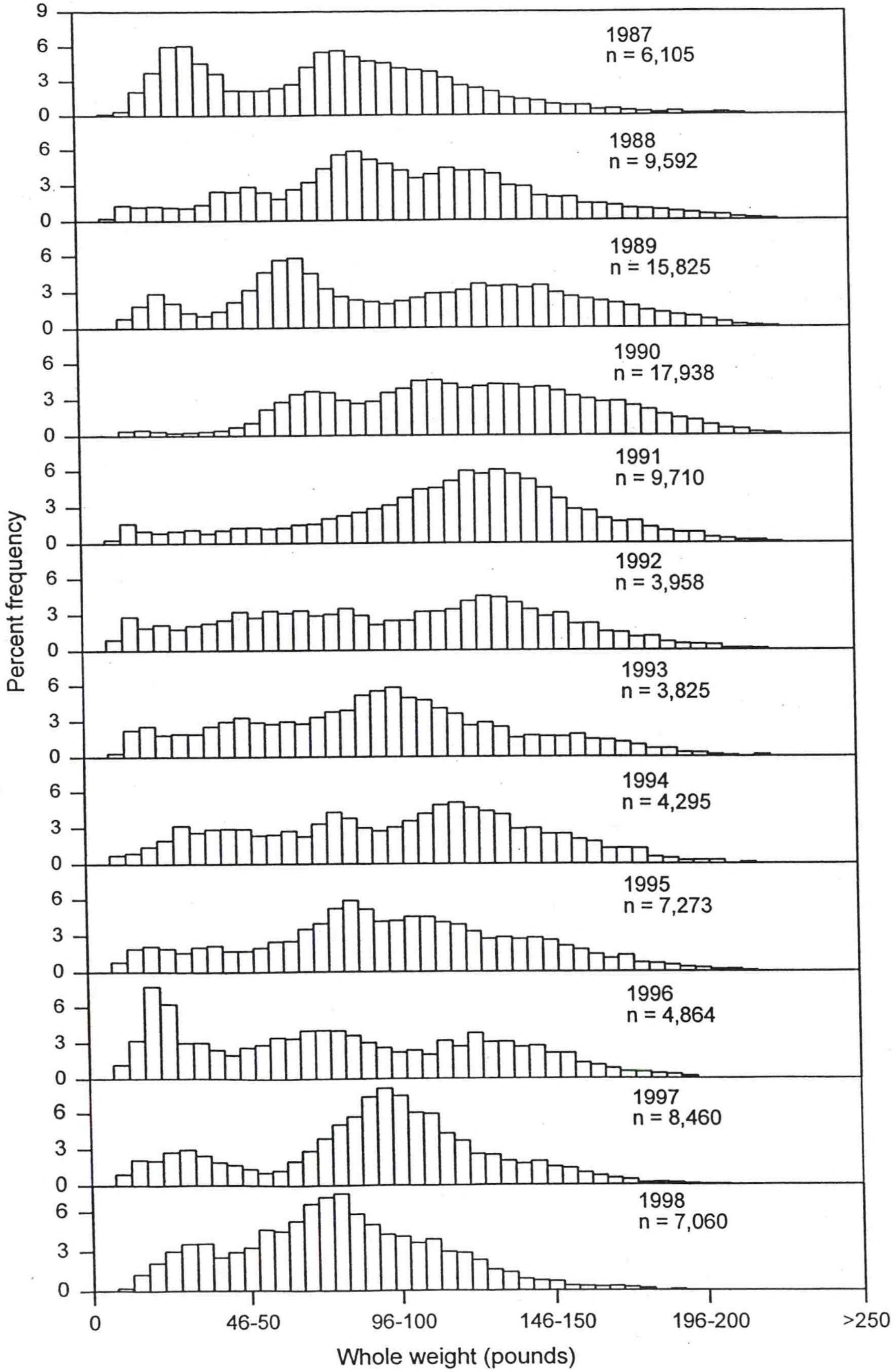

Figure 26.--Yellowfin tuna weight-frequency histograms, 1987-98.

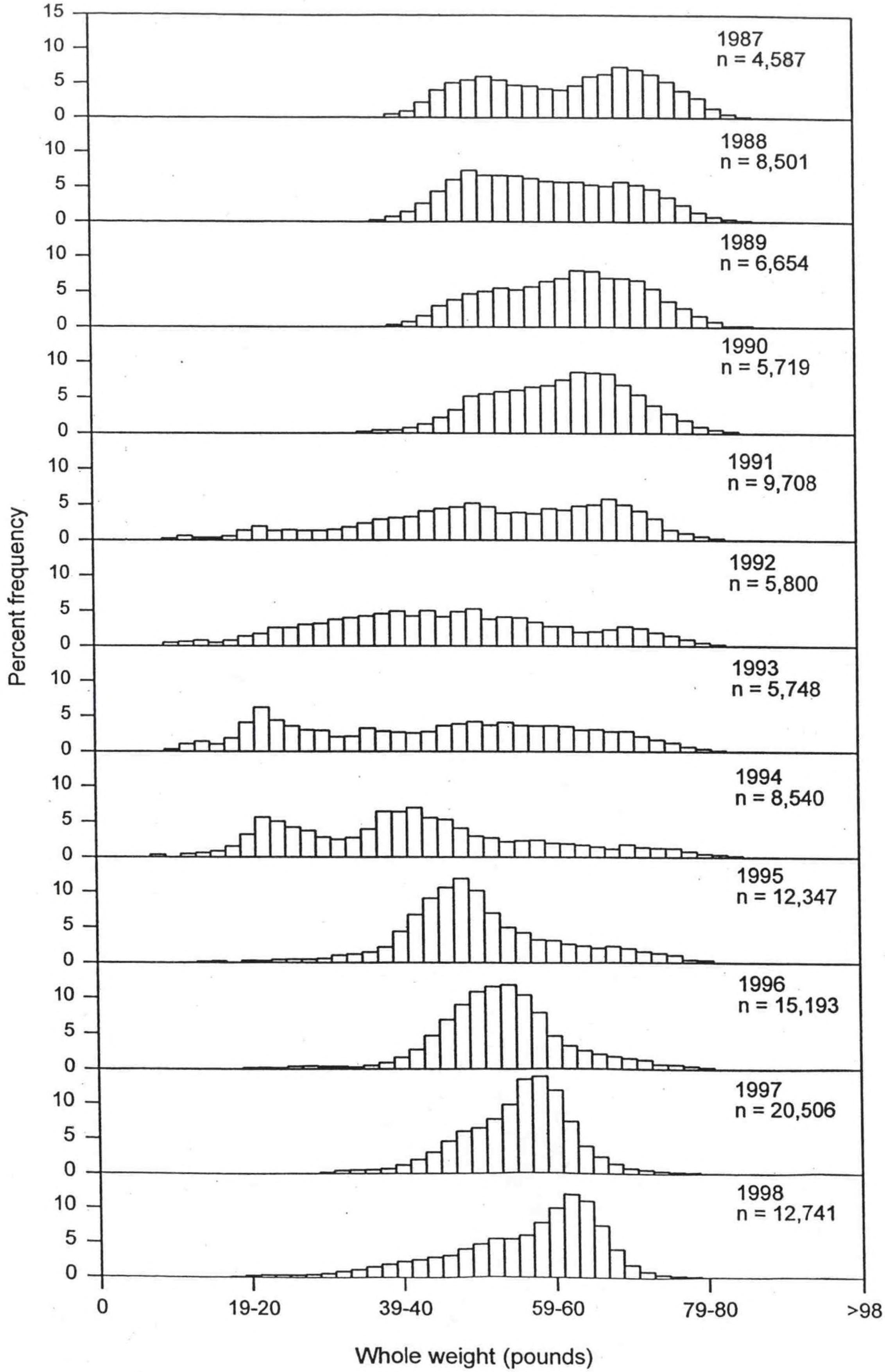

Figure 27.--Albacore weight-frequency histograms, 1987-98.