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ANNUAL REPORT OF THE HAWAII-BASED LONGLINE FISHERY FOR 1996

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PREFACE

The Western Pacific Regional Fishery Management Council (WPRFMC) developed the fishery management plan (FMP) for pelagic species authorized by the Magnuson Fishery Conservation and Management Act of 1976. This FMP regulates the U.S. domestic fisheries for tuna, swordfish, marlin, and other pelagic species in this region. The FMP for the Pelagic Fisheries of 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.

CONTENTS

INTRODUCTION

The Hawaii-based longline fishery is currently the largest domestic commercial fishery in Hawaii and has been so since 1988 (Pooley, 1989; Boggs and Ito, 1993; Western Pacific Regional Fishery Management Council, 1996). Broadbill swordfish (*Xiphias gladius*), tunas (*Thunnus* spp.) and sharks dominate the longline catch, but a variety of other pelagic species (Table 1) are also caught. The Hawaii-based longline fishery is the largest source of fresh pelagic fish in Hawaii and supplies local, U.S. domestic, and international markets (Pooley, 1993; Bartram et al., 1996).

Recent developments regarding the Hawaii-based longline fleet are discussed in this report. A description of data sources, data management procedures, and shortcomings of the data are also included. Nonconfidential data summaries on fleet activity, effort, catch, catch-per-unit-effort (CPUE), landings, market, and size of fish are also covered. Longline statistics for the entire period covered by the Federal longline logbook program (1991-96) and the shoreside market sampling (1986-96) are updated.

RECENT DEVELOPMENTS

Hawaii-based domestic longline landings were 21.5 million pounds, worth an estimated $42.8 million in 1996, essentially the same as in 1995. Some of the issues concerning the longline fishing industry and longline data in 1996 were: (1) interactions with sea turtles and increasing concern over seabird mortality, (2) the gear conflicts in the Cross Seamount area, which is outside the main Hawaiian Islands (MHI) area closure, and (3) the practice of finning sharks.

The NMFS Southwest Region (SWR) instituted a mandatory observer program in February 1994 in response to observer data collected from 1991-93 which indicated sea turtle interactions. The observer program has collected comprehensive and detailed data on protected species interactions, fish bycatch, discards, and fishing operations.

Interactions with turtles and birds remained a problem for the Hawaii-based longline fishery during 1996. Conservation groups and individuals have expressed concern over the interaction issues. Various government agencies [Western Pacific Regional Fishery Management Council (WPRFMC), U.S. Fish and

Wildlife Service (FWS), and National Marine Fisheries Service (NMFS)] have taken a proactive stance on these issues, and measures have been taken to work with the fishing industry on researching and mitigating the interactions.

Turtles retrieved on longline gear were fitted with satellite transmitters and released to document post release survivorship. Satellite plots of the results are encouraging, showing many of the turtles moving after being released. One turtle did not move and was presumed to have died. Satellite tracking of post-release turtle activity is ongoing.

Educating the fishing industry on the bird interaction issue is also being undertaken by the FWS, WPRFMC, and NMFS, with the primary objective of fishermen modifying their longline fishing techniques in order to reduce or eliminate bird mortality. A workshop to explain the problem and demonstrate mitigation techniques was held in September 1996. Instruction booklets have been translated into various languages and distributed to registered longline boats. Adoption of these mitigation techniques for reducing bird interactions is not yet widespread.

The Hawaii-based longline vessels have targeted bigeye and yellowfin tuna in the area of Cross Seamount for decades. The traditional style of longlining in Hawaii involves deep-set gear with setting operations conducted in the morning and hauling operations beginning in the afternoon. This style of longlining was compatible with handline fishing. Recently, some longliners began setting their gear shallow in the evening and hauling it in the morning. Longline gear set at night upcurrent of the seamount began to drift over the peak and tangle handline gear and sea anchors. Unsafe navigation and a lack of communication were also mentioned as problems. This conflict was brought to the WPRFMC's attention at the November 1996 meeting. Since that time the Council has held meetings with both parties trying to resolve the conflict without regulatory measures. The two user groups agreed to keep the lines of communication open, but the Council is exploring options to facilitate peaceful coexistence between the two parties.

VMS is a satellite-based tracking system which the U.S. Coast Guard and NMFS Enforcement use to determine if longline vessels fish in areas closed to longline fishing around the MHI and the Northwestern Hawaiian Islands (NWHI). As of 1996, 112 domestic longline vessels were equipped with an electronic VMS. VMS was used to identify several incidents of longline fishing activity within closed areas in 1996. When considering the time and manpower used to enforce areas prohibited to longline fishing in the Hawaiian Islands, the VMS system has proved to be a very cost-effective deterrent. VMS has also been useful in providing

compliance with the law. Since longline fishing within the U.S. EEZ off California is prohibited, a Hawaii-based longline vessel landing fish in California for its first time was faced with the possibility of losing its catch. VMS was used to prove that each vessel's longline operations did indeed occur outside of the EEZ. VMS also serves as an additional means of locating a vessel in distress. The possibility of using VMS data for research purposes and messaging in catch information while at sea is being investigated. Although VMS is in the last year of its pilot program phase, it will likely continue after 1997.

The percentage of sharks finned, predominantly blue sharks, increased in 1996 and is the reason for increased shark landings. The NMFS has seen no evidence of a shark stock conservation problem in the Western Pacific Region but is monitoring this issue closely.

Five Hawaii-based longline vessels with limited-entry permits were contracted to receive shark fins from foreign longline vessels outside the EEZ in 1996, up from three vessels in 1995. Letters from the NMFS Southwest Regional Administrator have been sent to foreign transshipment companies advising them to have the transfers take place beyond the 200-mile U.S. EEZ. Although no domestic vessels are dedicated to transshipment operations year round, transshipment activity has increased. These operations are appealing because the contract income is guaranteed and the risk of poor catches or poor prices is avoided. Also, the transshipment operation usually lasts less than a week and requires fewer crew members than longline fishing operations.

DATA SOURCES

The NMFS Fishery Monitoring and Economics Program (FMEP) relied on shoreside sampling for longline vessel activity and landings estimates from 1987 to 1991 (Ito, 1992). Subsequently, a Federal logbook system for domestic longliners operating in the western Pacific region was implemented in November 1990. Therefore, the time span covered in some summaries of this report may differ according to the data source. Logbook collection and summary procedures are documented in Dollar and Yoshimoto (1991).

Data sources, data formats, and estimation procedures have been updated throughout 1987-96. The basic data have been revised to correct data errors which had previously been overlooked. Therefore, this report supersedes previous summaries. These updates to the data bases have not changed any pattern revealed in previous reports, but they have improved the

accuracy of the data and increased the understanding of the Hawaii-based longline fishery.

Detailed information on vessel operations, areas of fishing, fishing effort, CPUE, and interactions with endangered and 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 a vessel's captain or deck boss. When either is unavailable for an interview or the log sheets are mailed in, trip type is determined by subjectively 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.

Mean weight of fish, weight-frequency distribution, and average fish prices are based on NMFS FMEP shoreside sampling data. Twice a week FMEP and Hawaii Division of Aquatic Resources (HDAR) biologists monitor the Honolulu auction where most of the longline landings are sold. In addition, similar information is obtained from seafood brokers who handle longline catch in Honolulu.

The weight of individual fish landed (whole or processed) was recorded as nominal weight. In some instances, processing or loss from damage occurred, and the nominal weight was adjusted to an estimated whole (round) weight. Post-1991 landing estimates are based on the product of a weighted average whole weight for each species from shoreside sampling and the corresponding number of fish kept as summarized from longline logbooks. The overall average whole weight is the mean sample weight for each trip type "weighted" up to the number of fish for each trip type in the logbook summaries. Revenue is estimated as the product of estimated landings and average prices for individual species from the shoreside sampling.

Mako and thresher shark fins and carcasses are kept, whereas only the fins from blue and other miscellaneous shark species are kept. Currently, there is no market in Hawaii for blue and miscellaneous shark carcasses. Although shark carcasses are discarded at sea, by logbook definition finning represents a "kept" fish. The average whole weight of blue shark was estimated from observer data collected during 1990-91 (Dollar, 1994). This procedure for estimating round weight of blue sharks was developed as a method to assess the volume of shark landings so that these landings could also be reported as weight.

LONGLINE VESSEL OPERATIONS

There were 164 vessels registered with Federal limited-entry permits in 1996. The following is a summary of those permits.

Active:	103
Inactive:	35
Permit but no vessel:	26

Long-term monitoring showed a rapid increase in the number of active longline vessels from 1987 to 1991, a period of stability during 1992-94 and decline in 1995 and 1996[2] (Fig. 1). Thirty-five longline vessels with limited-entry permits did not longline in 1996 (they may have been in other fisheries), while an additional 26 limited-entry permits were not attached to any longline vessel. Vessel turnover was limited in 1996: ten vessels which fished in 1995 did not fish in 1996, three vessels new to the longline fishery began fishing in 1996, and one active longline vessel sank.

Hawaii-based longline vessels were categorized by length in three size classes. The categories were small vessels (<56 ft), medium vessels (56-74 ft), and large vessels (>74 ft). The number of active vessels was down for two of the three size classes in 1996 (Fig. 1). Eighteen small vessels (3 fewer than in 1995), 49 medium vessels (4 fewer than in 1995), and 36 large vessels (the same number as in 1995) were active in 1996.

Longline Vessel Trip Activity

Hawaii-based longliner trips increased slightly to 1,100 trips in 1996 (Table 2). Although total trips have shown little change during the past 4 years, targeting strategies have changed substantially. Swordfish trip activity declined for the third year in a row with swordfish trips declining 32% in 1996. This decline was attributed to longline vessels redirecting their fishing activity toward tunas and mixed trips in 1995 and shifting more toward mixed species in 1996. Tuna trip activity was down slightly (4%) in 1996, the first decline in 5 years. Mixed trips increased again in 1996, up 15% from 1995. Swordfish trips consistently had the highest number of days fished per trip throughout 1991-96. Tuna and mixed trips had about the same

[2]Summaries on 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 is concluded.

number of days fished per trip. Fleet mean days fished per trip changed little in 1996 (Table 2).

Longline trip activity was high during the first, second, and fourth quarters (Fig. 2). The primary motivation for trip activity during those periods was relatively high catch rates for bigeye tuna and swordfish near the main Hawaiian Islands. Fishermen elect to target swordfish mostly during the first and second quarters when swordfish are concentrated closest to the Hawaiian Islands. Trip activity is usually 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 normally schedule annual maintenance during this quarter. Activity increases in the fourth quarter due to improving 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 next year.

FISHING EFFORT

Number of Sets

Fishing effort[3] was summarized by the number of days fished (approximately equal to the number of sets) and by number of hooks set. Days fished were at their highest level in 1991 and have fluctuated thereafter. Days fished in 1996 were down slightly from the previous year (Table 3) and were attributed to a decrease in swordfish trips and, to a lesser extent, tuna trips, down by 38% and 4%, respectively. Days fished by mixed trips increased by 25% in 1996. Fishing took place predominantly in the MHI EEZ and outside the EEZ, with much less effort in the NWHI and the other U.S. possessions (i.e., Baker Island, Howland Island, Kingman Reef, Jarvis Island, Johnston Atoll, Palmyra Island, and Wake Island) in the western Pacific. Days fished in the MHI dropped 15% in 1996, while effort increased by 19% in the NWHI and 3% outside the EEZ.

Number of Hooks Set

The total number of hooks fluctuated in a narrow range during 1991-94 but jumped to 14.2 million hooks in 1995 and

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

remained about the same in 1996 (Table 4). Tuna trips accounted for 72% of the hooks set, mixed trips accounted for 21%, and swordfish trips accounted for 6%. Hooks set by swordfish trips, which had been on the decline for the last 3 years, dropped again in 1996 by 37%. Hooks set by tuna trips remained about the same, while hooks set by mixed trips increased by 21%.

Hooks set in the MHI EEZ decreased by 17%, while hooks set in the NWHI EEZ increased by 43%. Effort outside of the EEZ increased by only 5%. The number of hooks set in the EEZ of U.S. possessions was up by 46% in 1996, but effort in this area was substantially lower than any of the other major areas.

The average number of hooks set per day fished again increased to a fleet average of 1,240 hooks per day fished (Table 5). The increase in overall fleet mean number of hooks per set was caused by the increased proportion of tuna-targeted sets. Tuna trips had the highest average number of hooks at 1,530 and the most noticeable and consistent increase throughout 1991-96. Mixed trip sets had the next highest average number of hooks (830 hooks) followed by swordfish trips (800 hooks).

CATCH

Unlike 1995, there were few record-breaking catches in 1996 (Table 6). Swordfish catch increased slightly but was still below the 1991-93 levels. The small catches in 1995 and 1996 resulted from less effort directed towards swordfish. Catch for all marlin species was smaller in 1996: blue marlin catch dropped by 25%, down from a peak in 1995, while striped marlin catch was down by 31%.

Bigeye tuna and albacore catch increased over 1995 record catches: bigeye tuna catch increased by 5%; albacore catch was up by 24% in 1996. Albacore catch showed the steadiest and largest increase of all species throughout 1991-96 (over 300%). Yellowfin tuna catch, down by 26% in 1996, fluctuated from year to year.

Mahimahi catch, which is highly variable on an annual basis, peaked in 1995 and dropped 61% to a record low in 1996. Ono catch also experienced a substantial decrease in 1996, down 34% from the previous year. Moonfish catch (up by 14% in 1996) has grown consistently throughout 1991-96 because of increased targeting for tunas.

Sharks dominated the catch from 1991 through 1996, peaking in 1993 and then leveling off. Much of the leveling off from 1993 has been related to the reduction in effort directed toward

swordfish. Swordfish trips caught more sharks than either tuna or mixed trips during 1991-95 but mixed and tuna trips caught more sharks than swordfish trips in 1996. Blue shark made up over 90% of the shark catch throughout 1991-96. Percentage of sharks retained increased to 43% in 1996 (Table 7).

Catch Composition

The 1996 catch composition was considerably different for each of the trip types (Fig. 3). Principle catch components for swordfish trips were sharks, swordfish, and albacore. Sharks accounted for almost half of the catch, swordfish made up 28% and albacore 11%. All other species combined made up less than 12% of the catch. In contrast, tunas dominated the tuna trip catch. The principle components of the tuna catch were bigeye tuna (26%), albacore (22%) and sharks (16%). Tuna trips also had the highest composition of marlin (12%). Composition of the catch for mixed trips showed sharks as the largest component (40%), swordfish the next largest (20%), followed by bigeye tuna (11%), and mahimahi (9%).

Marked differences in catch occurred by area. The dominant components of the catch in the MHI EEZ were bigeye tuna, sharks, and albacore (Fig. 4). Albacore catch in the MHI EEZ has increased significantly since 1992 (Table 8). Catches of marlin, bigeye tuna, yellowfin tuna, mahimahi, and moonfish were highest around the MHI EEZ. Catch composition in the NWHI EEZ resembled the MHI area with sharks, bigeye tuna, and albacore as the dominant components. Swordfish and mahimahi catch in the NWHI EEZ were down substantially; however, bigeye tuna, albacore, and moonfish catches increased considerably during 1996. Sharks were the dominant component of the catch outside of the EEZ. Swordfish and albacore were the next two largest components. Catch of the these three species from outside the EEZ was larger than those of the other areas. Small catches near the U.S. possessions were due to low effort in those areas.

Seasonality

Strong seasonal patterns occurred for many of the pelagic species caught by longliners, most noticeably the high catches of swordfish during the first and second quarters (Fig. 5). Swordfish catch was usually lowest during the third and fourth quarters. The relatively low level of longline activity in the third quarter magnified the seasonal decrease of swordfish. Striped marlin catch was high throughout most of the year except in the third quarter. Low third quarter catches are due to a relatively low level of longline activity, combined with low

catch rates. No seasonal pattern was apparent for blue marlin catch but is biased by the low level activity in the third quarter when catch rates are usually highest for this species.

Tunas also showed strong seasonal patterns (Fig. 6). For example, bigeye tuna catch was highest during the first and fourth quarters. Albacore catch, typically peaked in the fourth quarter and had the lowest catch in the third quarter. Yellowfin tuna catch was highest in the first quarter and lowest in the third and fourth quarters.

No consistent pattern of seasonal catch for sharks was observed, but high catches in the third and fourth quarters of 1993 were quite distinct (Fig. 7). Mahimahi catch also showed no consistent pattern but peaks in the third quarter of 1992 and first quarter of 1995 were noticeable. Moonfish catch was usually highest in the fourth quarter but showed a peak in the second quarter of 1996 (Fig. 8). Ono catch was consistently highest in the second quarter throughout 1991-96.

CATCH-PER-UNIT-EFFORT (CPUE)

CPUE from logbook data is measured as number of fish per 1,000 hooks. No dramatic changes in overall CPUE (all trip types combined) occurred in 1996 (Table 9). Overall catch rates do not reflect a changing targeting strategy (trip types) by the longline fleet and are not an accurate measure of the fishery performance or abundance or availability of fish. For this type of information CPUE indices must be calculated separately to account for targeting strategy or area of fishing.

CPUE By Trip Type

When separated by trip type categories CPUE was substantially different. Swordfish and mixed trips consistently showed the highest CPUE for swordfish, increasing by 12% and 17%, respectively. Mixed trips set longline gear relatively shallow and consistently had higher CPUEs for blue marlin, decreasing by 26% in 1996. In contrast, tuna trips typically set longline gear deep and had slightly higher CPUEs for striped marlin, decreasing by 33% in 1996. Tuna and mixed trips had the highest CPUEs for bigeye tuna, increasing by 8% for tuna trips and decreasing by 7% for mixed trips. Mixed trips showed consistently higher CPUE for yellowfin tuna; however, CPUE decreased by 44% in 1996. Swordfish trips had the highest catch rates for albacore, but both tuna trips and mixed trips have shown substantially higher CPUEs in the past few years. Albacore CPUE for swordfish trips increased slightly (up 7%) in 1996. Mixed trip CPUE for mahimahi

was highest of the three trip types, although dropping significantly for all types. Tuna trips had the highest CPUEs for ono and moonfish; ono decreased by 37% while moonfish CPUE increased by 13%. Shark CPUE, which was significantly higher for swordfish trips was down slightly (6%) in 1996.

CPUE By Area

Overall CPUE (all trip types combined) varied substantially according to fishing area. CPUE for blue marlin, yellowfin tuna, and moonfish was usually higher in the MHI EEZ where tuna fishing predominates, while CPUE for swordfish and sharks in the same area was consistently lower (Table 10). Bigeye tuna CPUE was highest in the areas of the MHI and NWHI. Although the EEZ surrounding the U.S. possessions yielded some of the highest CPUEs for certain species (i.e., bigeye tuna, yellowfin tuna, and ono), a high degree of year-to-year variability, but the distance (over 600 nautical miles to the nearest U.S. possession), and short shelf life of the catch are factors inhibiting increased fishing activity in these areas. CPUE for swordfish, albacore, and sharks outside the EEZ where swordfish and mixed target fishing predominates were consistently the highest.

LANDINGS

A comparison of commercial landings by the longline, troll-handline, and aku boat fisheries since 1948 shows a decline in aku boat landings from the mid-1970s, an increase in troll-handline landings from the early 1970s, and a dramatic increase in longline landings from the late 1980s (Fig. 9 and Table 11). Longline landings peaked in 1993 and changed very little from 1995 to 1996. Total landings were 21.5 million pounds, down 6% from 1995.

Slight declines in billfish, tunas, and other pelagics contributed to the decrease in 1996 (Fig. 10). Sharks (up 24% in 1996) was the only category showing an increase. The composition of landings also changed little because most effort was directed toward tuna. Swordfish has dominated the landings (by weight) for the past 7 years (Table 12). Swordfish landings were down by 8% in 1996. Landings of blue marlin and striped marlin decreased by 20% and 23%, respectively.

Of tunas, only albacore showed an increase in 1996; landings of all other major tuna species decreased. Bigeye tuna was the

third largest overall component of longline landings and has been the largest component of tuna landings from the beginning of the NMFS longline monitoring program. Bigeye tuna landings decreased by 14%, yellowfin tuna landings were down substantially (35%), albacore landings were up again by 35% in 1996. Bluefin tuna landings were down slightly from 1995. Although bluefin tuna is a small component of longline landings, the high ex-vessel price interests both fishermen and market wholesalers.

Sharks moved up to the second largest component of longline landings but only because blue and other miscellaneous sharks landed in processed "fins only" form are tabulated back into an estimated whole weight. Shark landings, composed predominantly of blue sharks, increased 23% in 1996. The practice of finning sharks is driving the increase in shark landings. 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. Fresh shark fillets account for only a fraction of total shark landings.

Landings of miscellaneous PMUS compose a small but growing category of total landings, the largest components being moonfish, mahimahi, and ono. Moonfish landings increased consistently from 1992 to a high of 760,000 pounds in 1996. Mahimahi and ono landings decreased by 35% and 40%.

MARKET

Revenue

The longline fishery has been the top ex-vessel revenue producer since 1983 (Fig. 11 and Table 13). Ex-vessel revenue by troll-handline gear has remained fairly constant throughout 1976-96 while aku boat ex-vessel revenue declined from highs in the late 1970s. Total estimated longline ex-vessel revenue was $42.8 million in 1996 and has remained about the same for the past 3 years.

Billfish revenue made up over a third of the total longline revenue (Fig. 12). Among billfish, swordfish ($13.7 million) accounted for most of the billfish revenue while marlins ($2.4 million) made up a smaller fraction (Table 14).

Tunas, the largest revenue-producing group, made up over half of the 1996 revenue. Bigeye tuna ($14.1 million), which

accounts for almost two-thirds of tuna revenue, was down 8% in 1996. Yellowfin tuna revenue was off by 30% from the previous year, while albacore revenue, up by 63%, topped $3 million in 1996. While bluefin tuna composed only a small fraction of the landings they are highly valued because of the high unit price ($18.26 in 1996). Bluefin tuna revenue was estimated to be $910,000 in 1996.

Although miscellaneous pelagics make up a small portion of total revenue, revenue from this group increased for the third consecutive year. Larger revenue from moonfish offset the decline in mahimahi and ono revenue and led to the overall increase in this group. Estimated revenue of sharks (both finned and whole) increased to $1.8 million in 1996. Shark fins are the reason behind the increase in shark revenue.

Average Price

Ex-vessel prices are based on actual or estimated whole weight. Average prices for major pelagic species in Table 15 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 of the swordfish landed in Hawaii are packed in air freight containers and flown to destinations across the continental U.S. The local market for swordfish is growing but is still small in relation to the amount of fish exported. The price for swordfish approached $2.50 per pound in 1996; the highest in 8 years. Prices for blue marlin and striped marlin were up in 1996. The increase in average price may be related to decreased landings for both species. 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 or grilling.

Tuna prices for all species were higher in 1996. Generally, the tuna market ranks northern bluefin tuna, bigeye tuna, yellowfin tuna, and albacore in decreasing order of desirability. Since most bluefin tuna bought in Hawaii are exported to Japan, the average price for this species was extremely high. Average price for bluefin tuna increased from $8.63 per pound in 1991 to $18.26 per pound in 1996. Although bigeye tuna and yellowfin tuna are also exported to Japan only the highest quality fish meet the standards of this sashimi market. Therefore, average prices of bigeye tuna and yellowfin tuna were considerably lower than for bluefin tuna. Bigeye tuna prices increased slightly to $3.58 per pound while the average price for yellowfin tuna peaked at $3.08 in 1996. Albacore is the least expensive of the larger

tunas due to its desirability for sashimi, however, a growing market for albacore in the U.S. mainland has helped enhance the demand for albacore. The average price for albacore was $1.30 in 1996, up from $1.08 in 1995.

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 average price for mahimahi increased over $2.00 per pound in 1996 because of the low volume and large average size of mahimahi landed. Ono received the highest average price, slightly above $2.00 per pound of all miscellaneous PMUS again in 1996. Moonfish, which was used mainly in restaurants, is becoming readily available at local retail fish markets. The average price for moonfish was about a $1.00 a pound in 1996.

SIZE OF FISH

The average size of longline-caught fish is expressed in round (whole) weights. Processed fish (i.e., swordfish which are landed headed, gutted, and finned) 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 mean weight of swordfish dropped by 14 pounds in 1996 (Table 16). Blue marlin has a long history of being one of the larger fish species with some of the highest mean weights. In contrast, the mean weight of striped marlin was much lower.

Bluefin tuna had the higehst mean weight of all tunas caught by longliners--in excess of 200 pounds for the past 3 years. Mean weights of bigeye tuna were consistently lower than those of yellowfin tuna for the past 10 years. The mean weight for both bigeye tuna (at 63 pounds) and yellowfin tuna (80 pounds) decreased about 15 pounds in 1996. Mean weight of albacore (52 pounds) increased slightly in 1996.

Mean weight of mahimahi increased by 6 pounds in 1996. Mean weight for ono and moonfish also increased slightly.

Mean Weight of Fish by Trip Type

Mean weight differed between trip types. Swordfish trips consistently landed the largest swordfish, blue marlin, striped marlin, and bigeye tuna. However, the mean weight of albacore and moonfish from swordfish trips was usually lower than that from other trip types. The mean weight of fish from tuna trips was usually lower, especially for billfish, bigeye tuna, and

yellowfin tuna. Mean weight of yellowfin tuna was consistently higher for mixed trips.

Weight-Frequency Distribution

Weight-frequency histograms were produced for selected billfish (swordfish, blue marlin, and striped marlin) and tunas (bigeye tuna, yellowfin tuna, and albacore). Prior to 1989 longliners targeting tunas accounted for almost all landings of swordfish in the Hawaii fishery (Kawamoto et al., 1989). These incidental swordfish catches were small; predominantly in the 1-25 pound size category (Fig. 13). The distribution of larger swordfish was rather flat. With the increasing success of longliners catching swordfish in 1989, swordfish histograms showed a higher distribution of large fish tapering off above the 76-100 pound increment. The frequency of very large swordfish (>475 pounds) is more noticeable from 1990 onward. The dominant mode that appears in 1992 shifts over one increment each year up to 1995. The swordfish weight-frequency distribution in 1996 showed a high frequency of fish in the 26-50 pound size class and a dominant mode of fish in the 76-100 pound size class.

Blue marlin showed no substantial changes in weight-frequency distribution throughout 1987-96 (Fig. 14). The dominant mode for blue marlin was consistently in the 101-125-pound increment except in 1990, with a low frequency of blue marlin below the 76-100-pound increment.

The weight-frequency distribution for striped marlin in 1987 and 1996 was broadly and evenly distributed (Fig. 15). Weight-frequency distributions of striped marlin between 1988 through 1995 were bimodal. A strong mode of small fish appeared in 1988 and 1989. The mode of small striped marlin typically occurred below the 36-40-pound increment while the mode of large striped marlin ranged from the 51-55-pound increment up to the 76-80-pound increment.

A strong mode (>12%) of small bigeye tuna occurred in 1994 and 1996 (Fig. 16). A low frequency of large bigeye tuna was apparent in 1996. Bigeye tuna weight-frequencies with even, bimodal distributions appeared in 1988, 1990, 1991, and 1993. The frequency distribution of bigeye tuna tapered off above the 96-100-pound increment.

Yellowfin tuna distributions showed the strongest mode of small fish (16-20 pounds) in 1996 (Fig. 17) with another weaker mode at both 71-75 pounds and 121-125 pounds. The distribution of larger yellowfin tuna began to taper off at the 141-145-pound increment in 1996. A comparison of yellowfin tuna histograms by

year showed a high degree of variation. The distributions varied from smooth and bimodal in 1987, trimodal in 1989, unimodal in 1991, to a relatively even distribution in 1992.

The distribution of albacore showed distinct periods of change throughout 1987-96 (Fig. 18). The largest fish appeared in the first 4 years during which time most of the effort was directed toward tunas. The following 4 years showed wider and flatter distributions as effort shifted gradually toward swordfish. The change in weight-frequency distribution was caused by increased landings of small fish by swordfish and mixed longline trips fishing in higher latitudes of the North Pacific. Albacore weight-frequency distribution was substantially different in 1995 and 1996, when the distribution became unimodal due to increasing albacore catches by tuna trips.

INTERACTIONS WITH ENDANGERED AND PROTECTED SPECIES

Interactions between longline gear and endangered and threatened 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. Fishermen may interact with greater numbers of protected species than actually reported in the protected species section of the logbook summaries. Suspected underreporting of interactions with protected species (turtles in particular) (DiNardo, 1993) was the major factor which led to the establishment of the mandatory observer program. The level of turtle interactions with the longline fleet is assessed by SWR observer data rather than logbook data.

A more detailed protected species interaction section was added to the revised logbooks in 1995. Fishermen who had not been 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 Table 17 and Figure 19. The annual report of the longline observer program provides a better estimate of interactions.

Thirty-five different Hawaii-based longline vessels reported interactions with endangered or protected species on 76 different trips in 1996 (Table 17). Reported interactions occurred on 242 sets (217,534 hooks) out of a possible 979 sets (897,237 hooks) for these 76 trips. A total of 406 interactions with endangered or protected marine species were reported. It is unlawful to retain any endangered or protected species; therefore, interactions are reported as animals released or lost. The

condition of animals upon release is categorized as either alive, injured, or dead.

Three hundred and one interactions involved seabirds, most of which were reported as albatrosses. The exact species of seabirds is unknown because the logbooks do not distinguish between albatross species and because of species identification problems. A high rate of mortality was reported with seabirds: 78% were reported dead upon retrieval, 7% were reported released alive but injured, and 16% were reported released alive in good condition.

The second most frequent interactions were with turtles. Again, it is important to remember that these turtles were identified by fishermen rather than trained technicians. Of 88 reported turtle interactions, most appeared to be with loggerhead and olive ridley turtles. The initial condition of most turtles upon retrieval appeared to be good. Eighty-nine percent of the turtles were reported as alive upon retrieval, 6% were reported as released and injured, and 6% were reported dead.

Seventeen incidents of interactions with cetaceans were reported. The incidents involved 12 dolphins, 4 false killer whales, and 1 whale. These interactions may have been a result of cetaceans either taking catch, taking bait, or getting fouled in longline gear. Observations of this behavior with longline and other Hawaii fisheries have been documented (Nitta and Henderson, 1993; Dollar, 1991). All but one cetacean (a false killer whale was retrieved dead) were reported to have been released alive. No interactions with seals were reported.

Interactions By Area

Interactions were summarized for three general areas: the MHI, the NWHI, EEZs, and outside the Hawaii EEZ. The majority of the reported interactions with seabirds occurred outside the EEZ and in the EEZ of the NWHI (Fig. 19). Two hundred thirty-five interactions with seabirds were reported outside the EEZ while 61 interactions were reported in the NWHI EEZ. Only 5 interactions with birds were logged within the MHI EEZ. The highest level of turtle interactions (74) were reported from outside the EEZ; the MHI had 12 reported interactions while the NWHI EEZ logged in 2. Most of the interactions with cetaceans were recorded outside the EEZ. Nine interactions with cetaceans were reported outside the EEZ, five interactions with cetaceans were reported in the NWHI EEZ, and three interactions were logged in the MHI EEZ.

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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*
ENDANGERED OR 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,* 1991-96.

Year	Number of active vessels	Trips	Number of days fished per trip
Fleet			
1991	141	1,670	7.3
1992	123	1,265	8.4
1993	122	1,192	9.5
1994	125	1,106	9.3
1995	110	1,125	10.2
1996	103	1,100	10.3
Swordfish trips			
1991	98	291	10.2
1992	66	277	11.5
1993	79	319	11.7
1994	74	310	11.7
1995	44	136	13.3
1996	33	92	12.4
Tuna trips			
1991	104	556	7.6
1992	55	458	8.1
1993	61	542	8.6
1994	83	568	8.7
1995	78	682	10.0
1996	76	657	10.1
Mixed trips			
1991	94	823	6.1
1992	72	530	7.1
1993	59	331	8.8
1994	51	228	7.8
1995	49	307	9.3
1996	51	351	10.1

*Based on date of landing

Table 3.--Number of days fished* by the Hawaii-based longline fleet, 1991-96.

		Trip type			Area			
Year	Total	Swordfish trips	Tuna trips	Mixed trips	Main Hawaiian Islands	Northwestern Hawaiian Islands	U.S. Possessions	Outside EEZ
1991	12,151	2,998	4,183	4,970	6,212	1,257	42	4,640
1992	10,704	3,159	3,745	3,800	4,145	753	13	5,793
1993	11,351	3,717	4,674	2,960	4,409	1,277	---	5,663
1994	10,108	3,607	4,901	1,600	4,442	1,929	127	3,610
1995	11,708	1,846	6,944	2,918	5,439	1,693	98	4,478
1996	11,432	1,146	6,647	3,639	4,634	2,019	134	4,633

*Sets based on date of haul.

Table 4.--Number of hooks set* by the Hawaii-based longline fleet, 1991-96.

		Trip type			Area			
Year	Total	Swordfish trips	Tuna trips	Mixed trips	Main Hawaiian Islands	Northwestern Hawaiian Islands	U.S. Possessions	Outside EEZ
1991	11,914,608	2,243,375	5,124,277	4,546,956	6,853,272	1,056,478	38,422	3,966,436
1992	10,946,721	2,515,909	5,072,525	3,358,287	4,880,514	694,626	16,030	5,355,551
1993	12,137,533	3,207,976	6,359,162	2,570,395	5,553,586	1,305,786	---	5,275,761
1994	11,319,023	3,079,634	6,842,517	1,396,872	5,451,028	2,225,352	172,590	3,470,053
1995	14,155,169	1,464,589	10,186,299	2,504,281	7,112,744	1,996,036	153,435	4,892,954
1996	14,141,256	913,292	10,195,560	3,032,404	5,900,867	2,855,327	223,585	5,151,597

*Number of hooks set based on date of haul.

Table 5.--Average number of hooks set per day fished, 1991-96.

Year	Fleet mean	Swordfish trips	Tuna trips	Mixed trips
1991	980	750	1,230	910
1992	1,020	800	1,350	880
1993	1,070	860	1,360	870
1994	1,120	850	1,400	870
1995	1,210	790	1,470	860
1996	1,240	800	1,530	830

Table 6.--Hawaii-based longline catch* (number of fish) by trip type, 1991-96.

	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	43,902	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	37,622	8,873	22,715	11,895	60,680	23,798	46,100	60,748	6,764	6,416	101,773
1996	38,225	6,685	15,789	7,806	63,575	17,586	57,329	23,311	4,461	7,315	101,002
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	18,916	950	1,007	231	3,458	1,653	8,103	9,978	241	23	40,561
1996	13,216	174	465	133	1,335	659	5,397	2,111	208	41	23,807
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	8,764	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	16,553
1994	1,118	2,074	8,699	4,305	38,877	8,164	14,273	14,318	2,280	5,032	15,621
1995	2,234	5,023	18,117	10,117	45,497	14,601	32,880	24,825	5,979	6,200	29,166
1996	1,720	3,912	12,170	6,602	49,116	11,767	41,318	10,662	3,758	7,023	30,086
Mixed trips											
1991	27,617	---	---	---	16,142	7,747	4,589	19,551	570	247	24,397
1992	31,411	2,030	2,594	1,522	14,474	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	16,472	2,900	3,591	1,547	11,725	7,544	5,117	25,945	544	193	32,046
1996	23,289	2,599	3,154	1,071	13,124	5,160	10,614	10,538	495	251	47,109

*Based on date of haul.

Table 7.--Hawaii-based longline incidental shark catch (number of fish), 1991-96.

Species	Number caught	Number released	Number kept		Percent retained
			Finned	Whole	
Blue sharks					
1991	65,481	65,481	0	0	0
1992	89,292	88,315	977	0	1.1
1993	150,216	135,861	14,355	0	9.6
1994	110,187	95,783	14,404	0	13.1
1995	95,312	64,944	30,368	0	31.9
1996	96,224	54,988	41,236	0	42.9
Total					
1991	71,183	68,894	0	2,289	3.2
1992	94,897	91,292	977	2,628	3.8
1993	154,608	137,846	14,355	2,407	10.8
1994	114,656	98,119	14,404	2,133	14.4
1995	101,773	68,029	32,731	1,013	33.1
1996	101,002	57,260	43,196	546	43.3

Table 8.--Hawaii-based longline catch* (number of fish) by area, 1991-96.

	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	13,598	---	---	---	22,517	7,150	5,763	17,672	1,885	2,569	13,295
1992	7,102	2,759	9,838	3,368	22,980	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	5,273	4,207	12,580	6,963	32,253	13,078	18,363	30,759	2,787	4,076	22,683
1996	4,634	3,556	7,163	3,404	29,803	7,715	19,259	11,676	1,527	3,094	19,428
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
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	98	122	95	472	588	296	254	207	5	908
1996	17	86	192	93	766	1,184	1,612	49	155	57	756
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	23,928	3,189	4,937	3,280	18,944	6,502	22,344	23,899	2,868	1,396	58,267
1996	29,495	1,878	4,250	2,658	17,588	6,227	23,719	9,507	2,116	1,776	64,081

*Based on date of haul.

Table 9.--Hawaii-based longline catch-per-unit-effort* (number of fish per 1000 hooks) by trip type, 1991-96.

	Billfish				Tunas			Miscellaneous			
Year	Swordfish	Blue marlin	Striped marlin	Other billfish	Bigeye tuna	Yellowfin tuna	Albacore	Mahimahi	Ono	Moonfish	Sharks
Fleet mean											
1991	5.56	---	---	---	3.43	1.11	1.18	3.32	0.23	0.26	5.97
1992	6.79	0.41	1.47	0.52	4.01	0.72	1.81	5.18	0.22	0.30	8.67
1993	6.55	0.42	1.50	0.47	4.52	1.32	2.51	2.14	0.37	0.37	12.74
1994	3.83	0.41	1.00	0.45	4.25	1.19	2.75	2.92	0.21	0.45	10.13
1995	2.66	0.63	1.60	0.84	4.29	1.68	3.26	4.29	0.48	0.45	7.19
1996	2.70	0.47	1.12	0.56	4.50	1.24	4.05	1.65	0.32	0.52	7.14
Swordfish trips											
1991	16.28	---	---	---	2.43	0.84	1.62	3.84	0.07	0.02	16.89
1992	16.50	0.22	0.87	0.15	1.80	0.52	3.45	5.35	0.07	0.03	22.06
1993	15.25	0.33	1.18	0.20	2.83	0.80	4.51	2.73	0.15	0.03	31.20
1994	11.77	0.24	0.51	0.09	1.15	0.47	5.10	2.98	0.05	0.01	26.68
1995	12.92	0.65	0.69	0.16	2.36	1.13	5.53	6.81	0.16	0.02	27.69
1996	14.47	0.19	0.51	0.15	1.46	0.72	5.91	2.31	0.23	0.04	26.07
Tuna trips											
1991	0.42	---	---	---	3.77	0.71	1.14	2.22	0.39	0.54	1.74
1992	0.28	0.38	2.22	0.75	4.91	0.55	0.89	1.73	0.35	0.62	2.48
1993	0.22	0.42	1.87	0.67	4.75	1.50	1.63	1.54	0.56	0.69	2.60
1994	0.16	0.30	1.27	0.63	5.68	1.19	2.09	2.09	0.33	0.74	2.28
1995	0.22	0.49	1.78	1.00	4.47	1.43	3.23	2.44	0.59	0.61	2.86
1996	0.17	0.38	1.19	0.65	4.82	1.15	4.05	1.05	0.37	0.69	2.95
Mixed trips											
1991	6.07	---	---	---	3.55	1.70	1.01	4.30	0.13	0.05	5.37
1992	9.35	0.60	0.77	0.46	4.31	1.13	1.97	10.26	0.15	0.03	7.98
1993	11.38	0.54	0.99	0.31	6.03	1.54	2.19	2.91	0.16	0.02	14.78
1994	4.28	1.35	0.73	0.38	4.07	2.79	0.83	6.81	0.07	0.02	12.08
1995	6.58	1.16	1.43	0.62	4.68	3.01	2.04	10.36	0.22	0.08	12.80
1996	7.68	0.86	1.04	0.35	4.33	1.70	3.50	3.48	0.16	0.08	15.54

*Based on date of haul.

Table 10.--Hawaii-based longline catch-per-unit-effort* (number of fish per 1000 hooks) by area, 1991-95.

	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	0.59	1.77	0.98	4.53	1.84	2.58	4.32	0.39	0.57	3.19
1996	0.79	0.60	1.21	0.57	5.05	1.31	3.26	1.98	0.26	0.52	3.29
Northwestern Hawaiian Islands EEZ											
1991	8.97	---	---	---	4.23	1.30	0.46	1.90	0.13	0.07	10.04
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	4.21	0.69	2.54	0.78	4.51	1.82	2.55	2.92	0.45	0.47	9.98
1996	1.40	0.39	1.47	0.58	5.40	0.86	4.46	0.70	0.23	0.84	5.79
U.S. Possessions											
1991	0.49	---	---	---	9.73	11.43	0.78	2.19	0.55	0.00	6.17
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	0.31	0.21	1.00	0.32	6.53	9.55	0.87	0.21	0.45	0.14	4.08
1995	0.14	0.64	0.80	0.62	3.08	3.83	1.93	1.66	1.35	0.03	5.92
1996	0.08	0.38	0.86	0.41	3.43	5.30	7.21	0.22	0.69	0.25	3.38
Outside EEZ											
1991	10.89	---	---	---	3.42	1.09	1.96	4.98	0.18	0.11	11.86
1992	11.57	0.28	0.83	0.37	3.40	0.67	2.90	7.66	0.22	0.13	13.80
1993	12.43	0.36	0.93	0.28	4.17	0.98	4.27	2.72	0.30	0.16	23.53
1994	8.55	0.21	0.56	0.32	2.66	0.88	4.19	3.54	0.25	0.21	20.50
1995	4.89	0.65	1.01	0.68	3.87	1.33	4.57	4.88	0.59	0.29	11.91
1996	5.73	0.36	0.82	0.52	3.41	1.21	4.60	1.85	0.41	0.34	12.44

*Based on date of haul.

Table 11.--Hawaii commercial pelagic landings (by 1,000 pounds) by major gear types, 1976-96.

Year	Longline	Troll & handline	Aku boat
1976	838	2,241	9,896
1977	1,101	2,548	7,780
1978	1,125	3,272	6,849
1979	1,432	2,889	6,549
1980	1,740	3,592	4,194
1981	2,047	3,947	4,229
1982	2,355	2,941	3,342
1983	2,663	3,442	2,683
1984	2,970	3,257	3,527
1985	3,278	3,439	2,114
1986	3,585	5,232	2,351
1987	3,893	5,737	3,503
1988	6,733	4,038	3,943
1989	9,844	4,046	2,962
1990	12,790	4,128	1,116
1991	19,600	5,054	2,146
1992	21,120	4,439	1,736
1993	24,980	4,898	2,137
1994	17,990	5,422	1,158
1995	22,660	6,412	1,290
1996	21,540	5,363	1,722

Table 12.--Hawaii's longline landings (by 1,000 pounds) of selected pelagic species, 1987-96.

	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

Table 13.--Inflation-adjusted ex-vessel revenue by major Hawaii pelagic fisheries, 1976-96.

Year	Longline	Troll & handline	Aku boat
1976	3,920	4,913	11,211
1977	5,021	5,977	10,290
1978	5,741	7,567	11,289
1979	8,127	7,444	8,018
1980	6,027	8,716	6,671
1981	7,883	8,959	6,240
1982	7,768	7,298	4,146
1983	9,893	8,249	4,522
1984	9,782	8,287	4,838
1985	12,714	8,347	3,641
1986	11,450	10,338	3,514
1987	15,135	12,367	5,667
1988	22,134	9,399	5,932
1989	28,505	9,578	6,125
1990	38,675	8,619	2,348
1991	50,580	8,996	3,128
1992	49,291	7,934	2,666
1993	56,654	8,627	2,586
1994	44,796	10,674	1,917
1995	47,302	9,625	1,584
1996	42,760	8,946	2,261

Table 14.--Hawaii's longline ex-vessel revenue (by $1,000) by species, 1987-96.

	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	30	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	1,230	440	270	390	510
1994	16,240	1,020	1,220	290	14,620	3,910	1,360	690	540	240	570	500
1995	13,460	1,110	1,080	300	15,340	6,110	2,080	1,010	810	330	600	860
1996	13,740	1,030	1,140	230	14,140	4,250	3,390	910	760	300	810	1,780

Table 15.--Hawaii's longline ex-vessel prices (based on estimated whole weight) by species, 1987-96.

	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

Table 16.--Mean whole weight of catch (in pounds), 1987-96.

	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
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	---
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
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

Table 17.--Western Pacific longline logbook summary for protected species interactions for January 1996 to December 1996.
(Vessels landing or based in Hawaii)
Report: Date of haul; All Areas - All Species

Trip Information

Number of vessels reporting interactions	35
Number of trips reporting interactions	76
Number of sets reporting interactions	242
Number of sets during haul period	979
Number of hooks set with interactions	217,534
Number of hooks set during haul period	897,237

Reported Protected Species Interactions

Species	Alive	Injured	Dead	TOTAL
Seals	0	0	0	0
Whales/Dolphins	16	0	1	17
Turtles	78	5	5	88
Birds	47	20	234	301
Other Species	0	0	0	0

Date and time of summary: 06/30/97 (09:33:26)

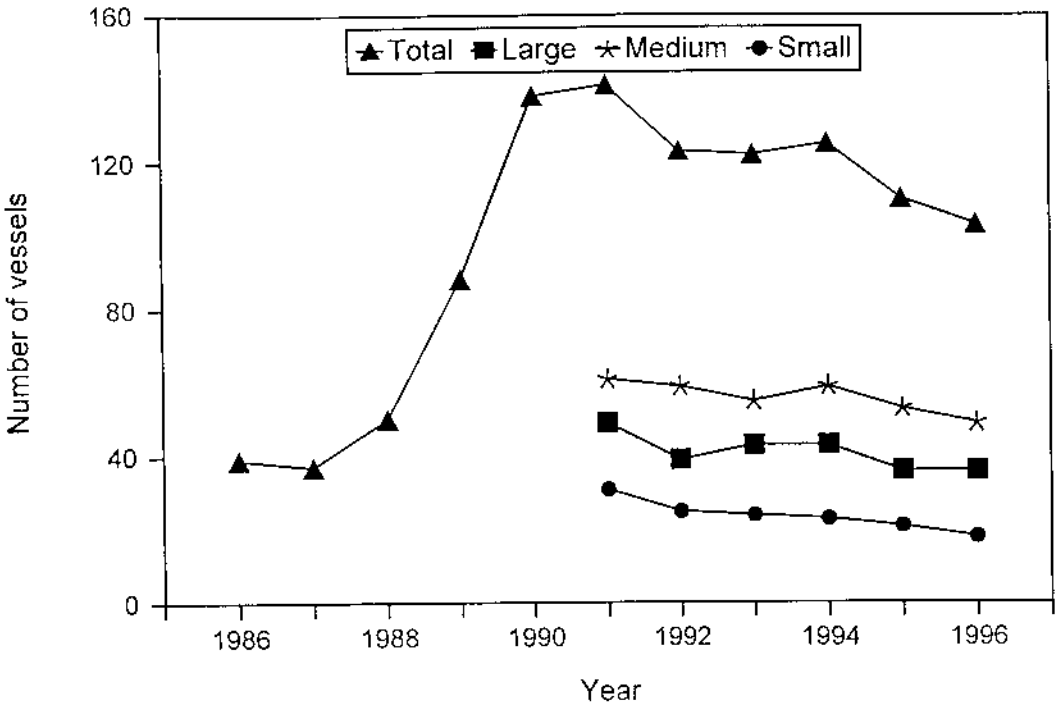

Figure 1.--Number of active Hawaii-based longline vessels, 1986-96.

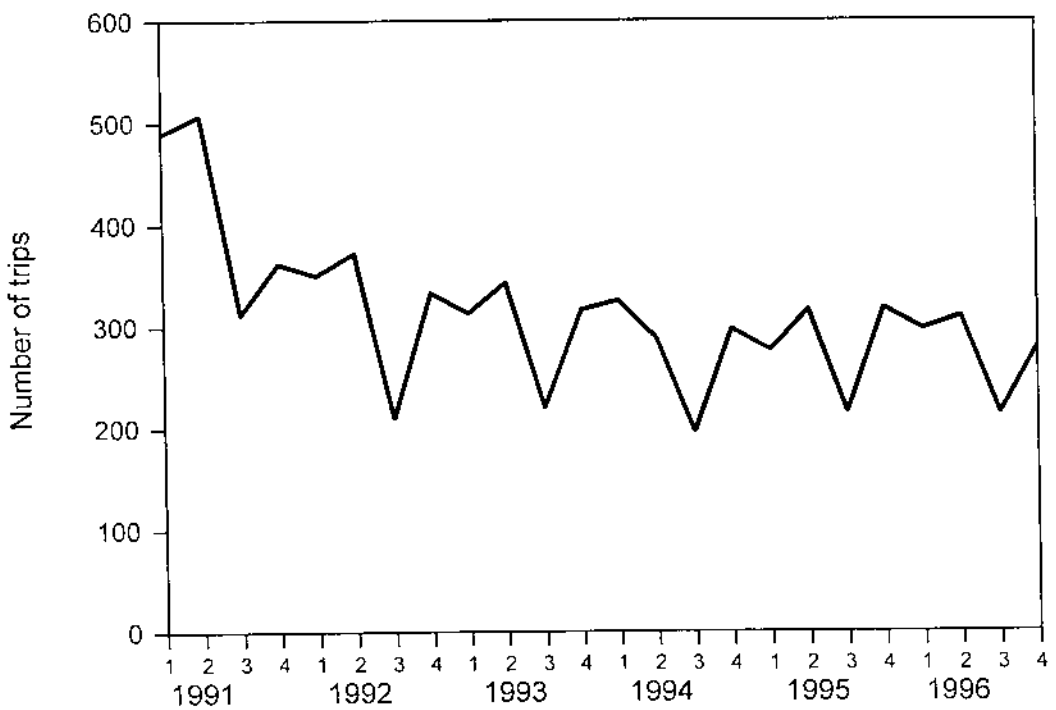

Figure 2.--Number of trips by quarter, 1991-96.

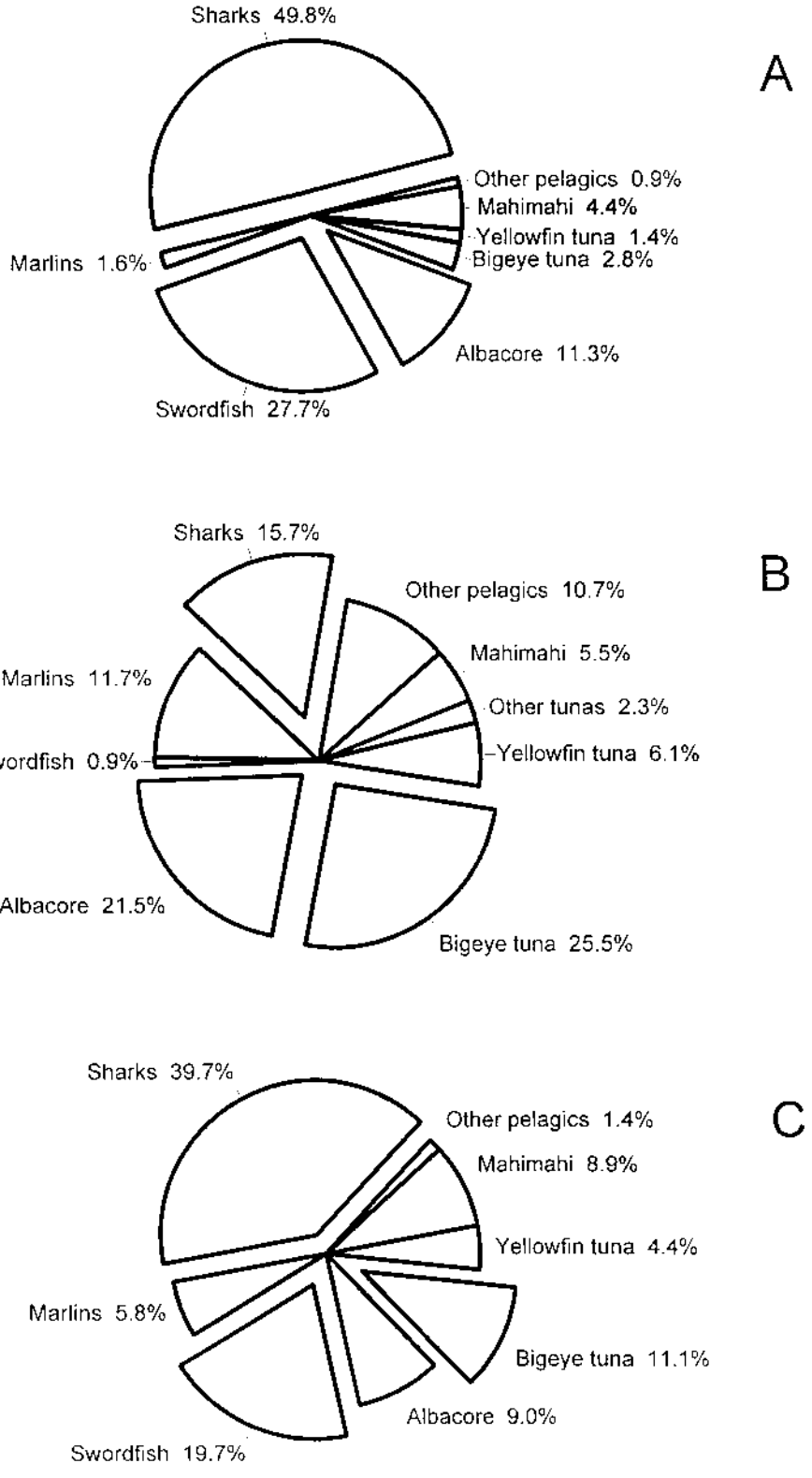

Figure 3.--Species composition of the catch (%) by A) swordfish trips, B) tuna trips, and C) mixed trips, 1995.

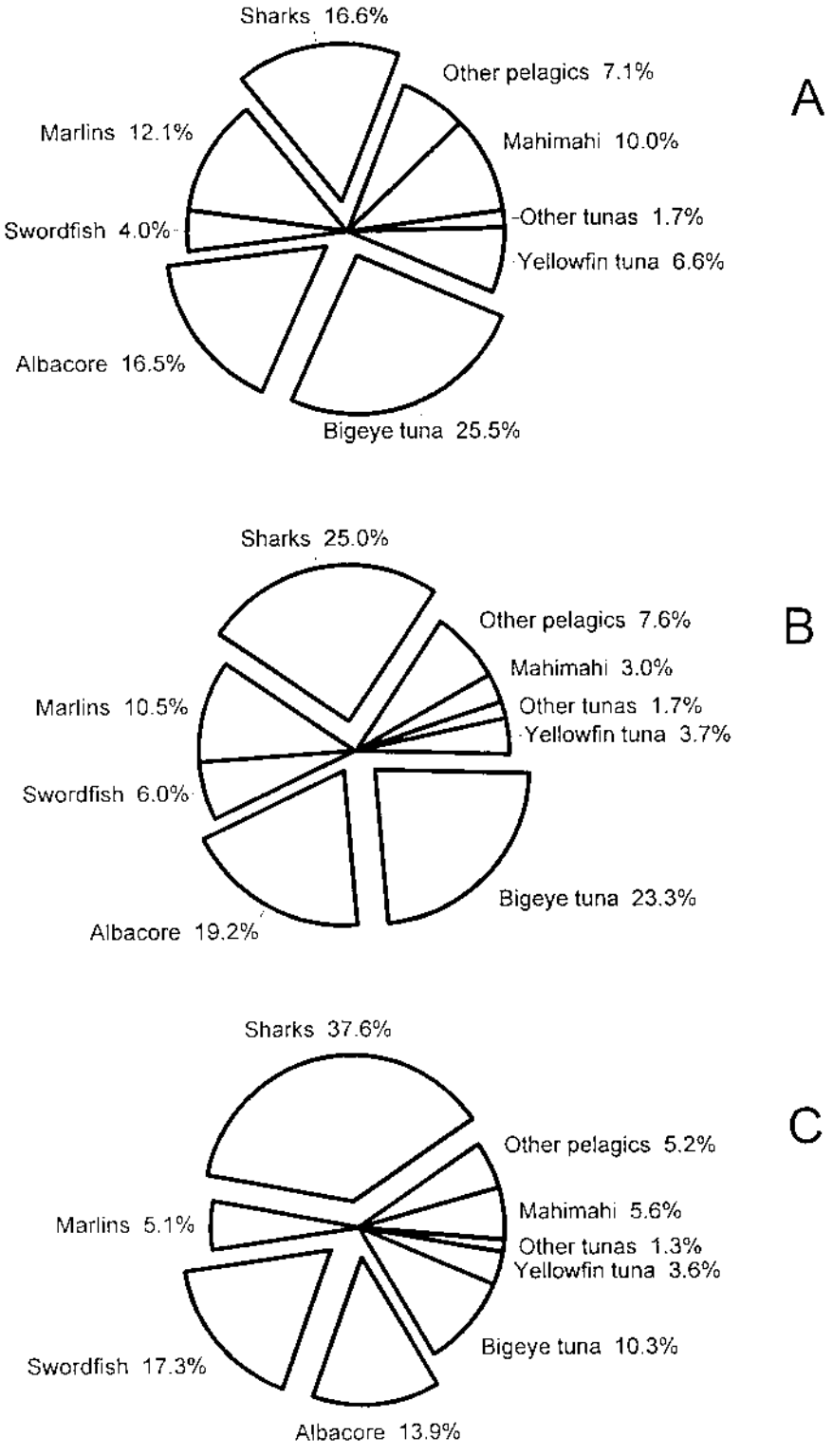

Figure 4.--Species composition of the catch (%) in the A) main Hawaiian Island Exclusive Economic Zone (EEZ), B) northwestern Hawaiian EEZ, and C) outside the EEZ, 1996.

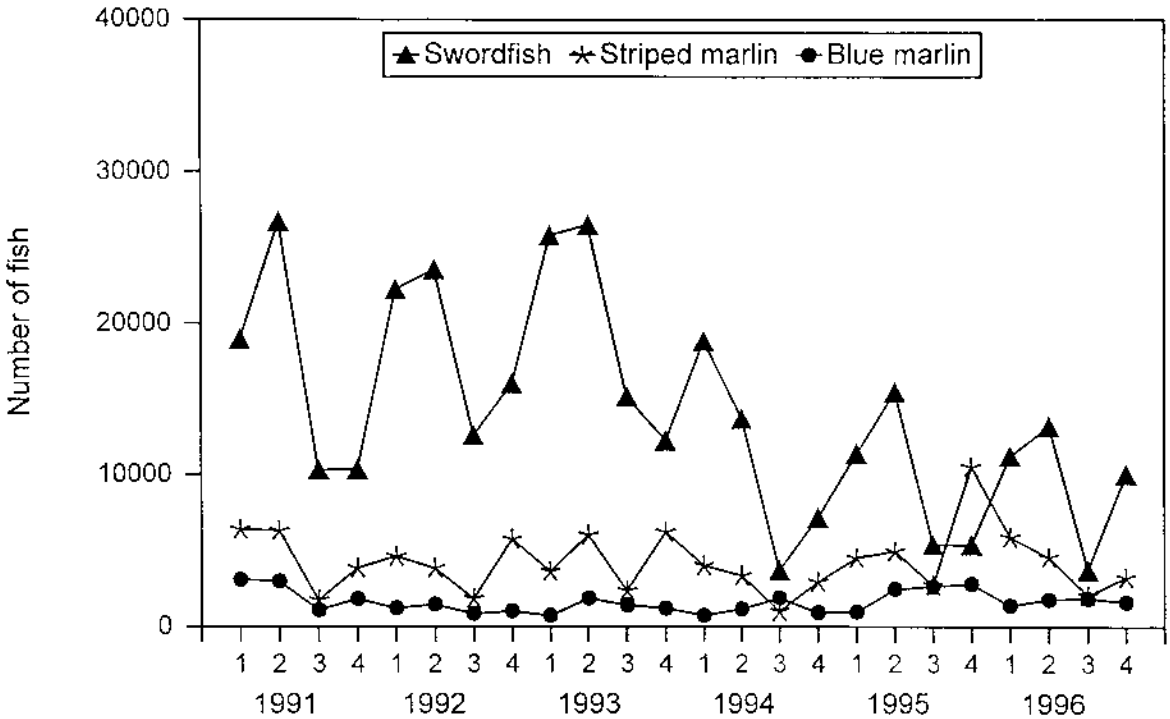

Figure 5.--Catch of billfish by quarter, 1991-96.

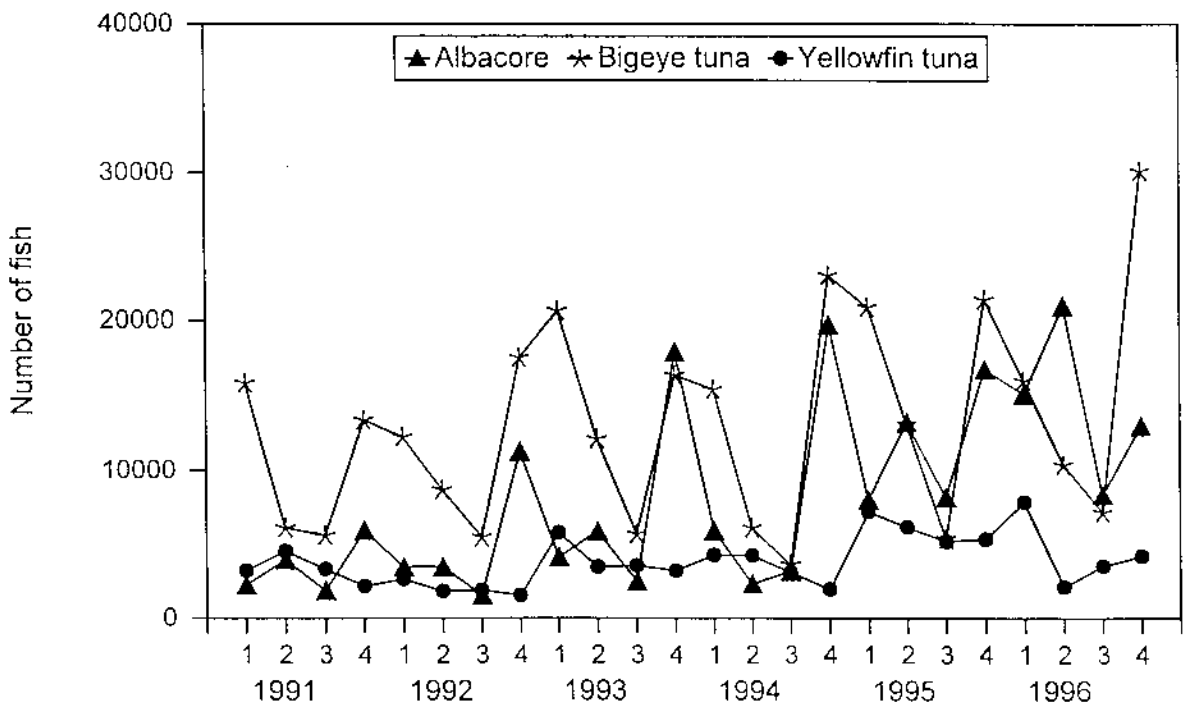

Figure 6.--Catch of tunas by quarter, 1991-96.

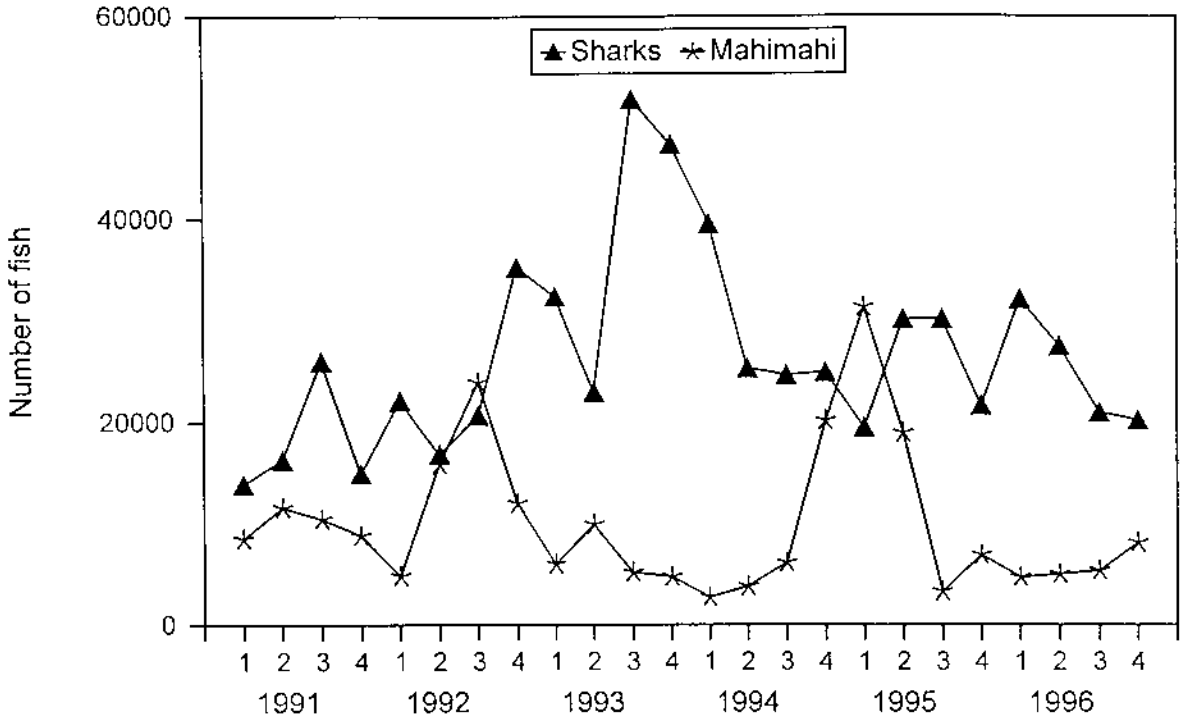

Figure 7.--Catch of sharks and mahimahi by quarter, 1991-96.

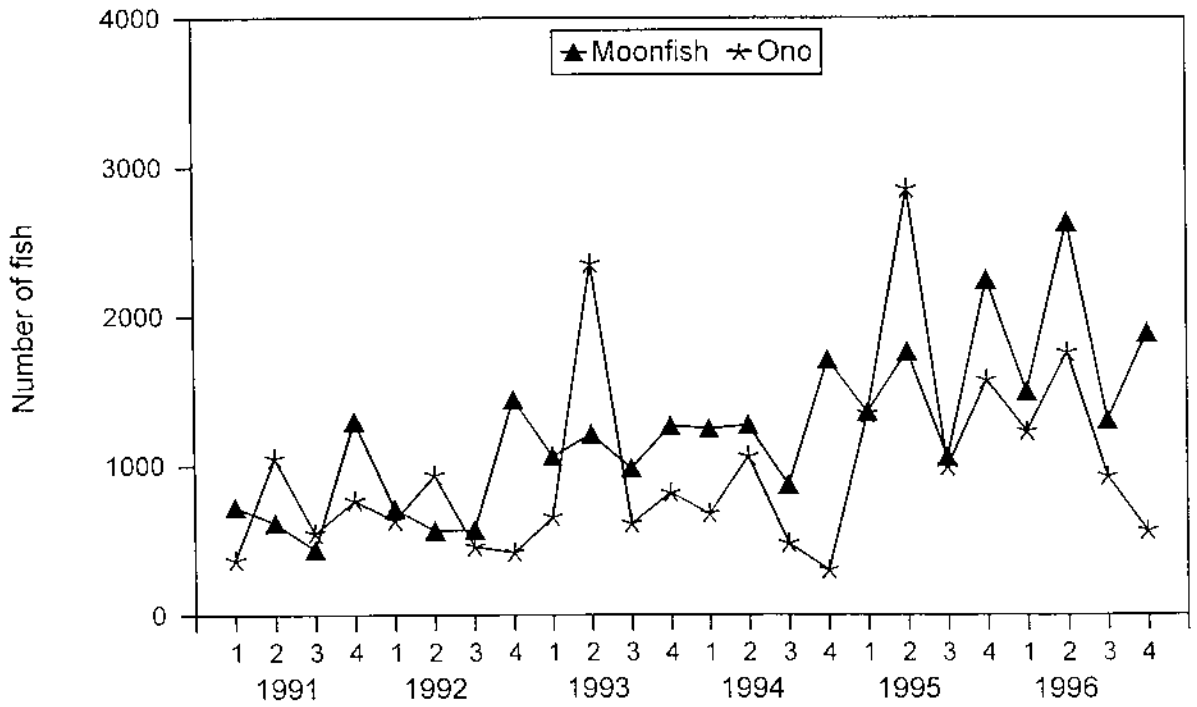

Figure 8.--Catch of moonfish and ono by quarter, 1991-96.

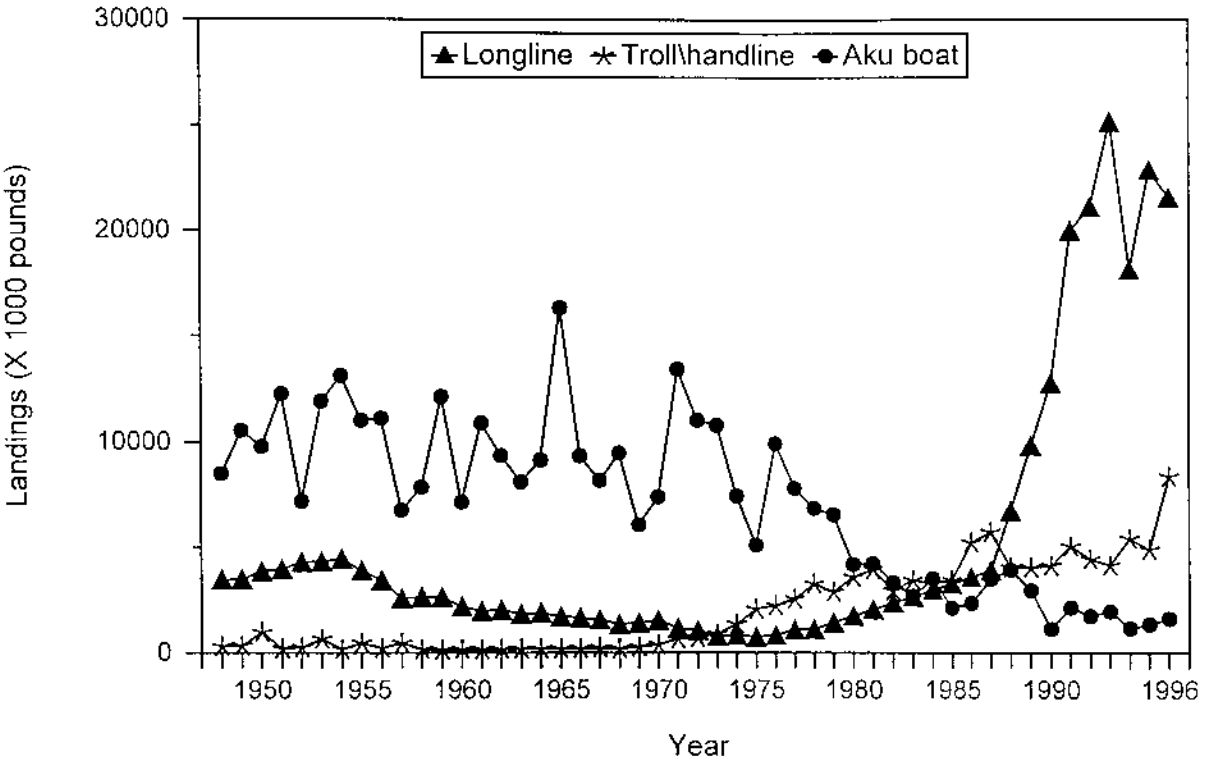

Figure 9.--Hawaii commercial pelagic landings by major gear types, 1948-96.

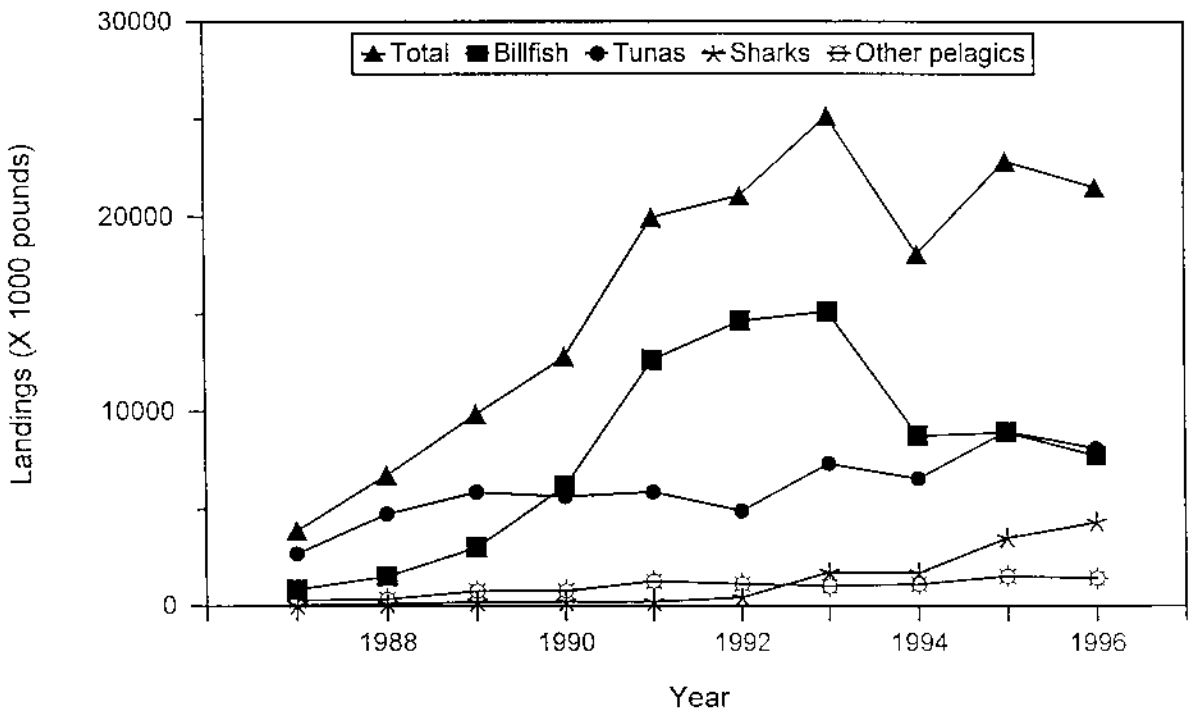

Figure 10.--Longline landings by major pelagic groups, 1987-96.

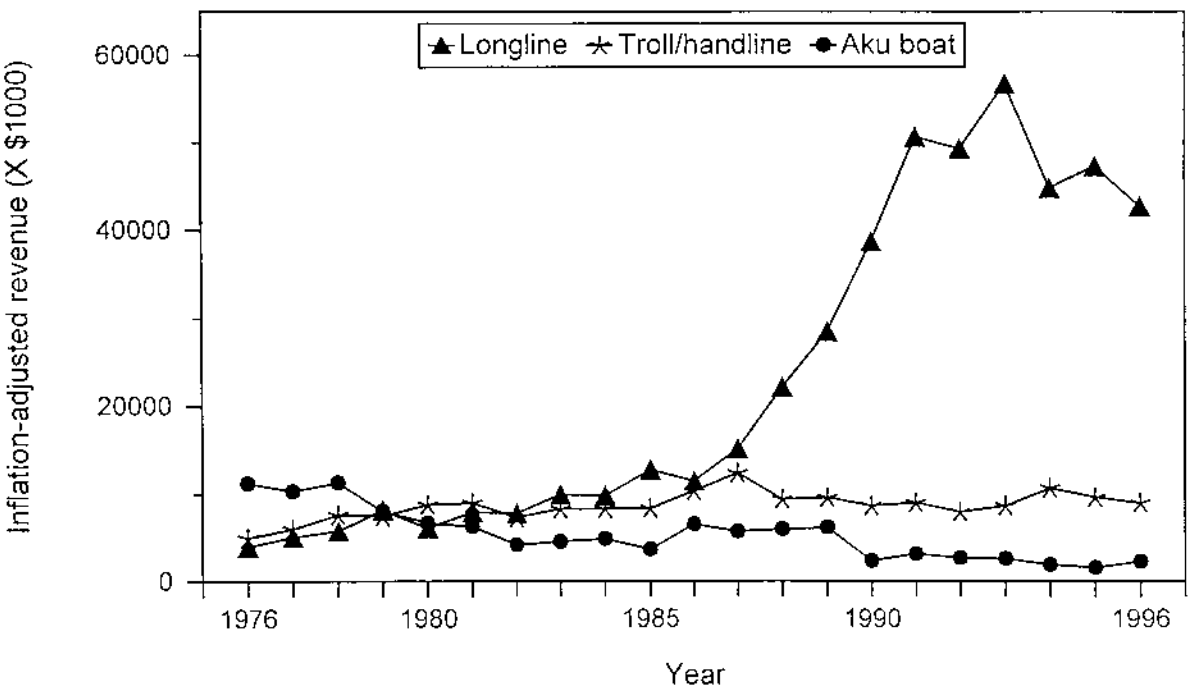

Figure 11.--Inflation-adjusted ex-vessel revenue by major Hawaii pelagic fisheries, 1976-96.

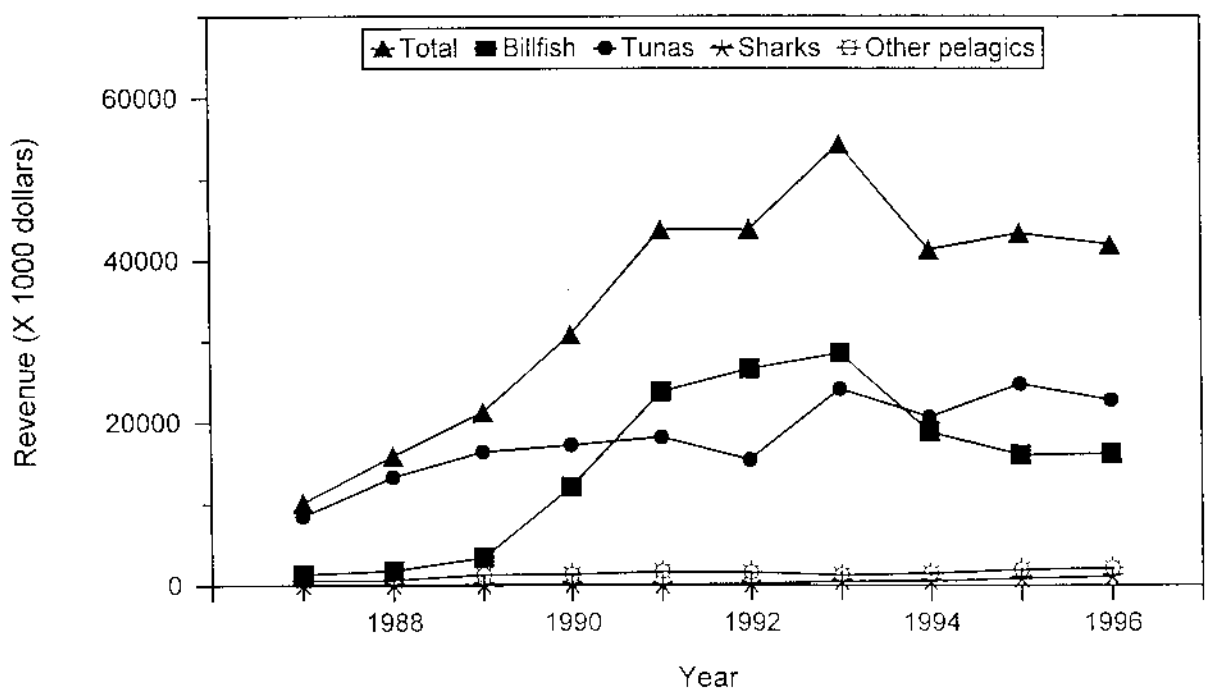

Figure 12.--Longline ex-vessel revenue by major pelagic groups, 1987-96.

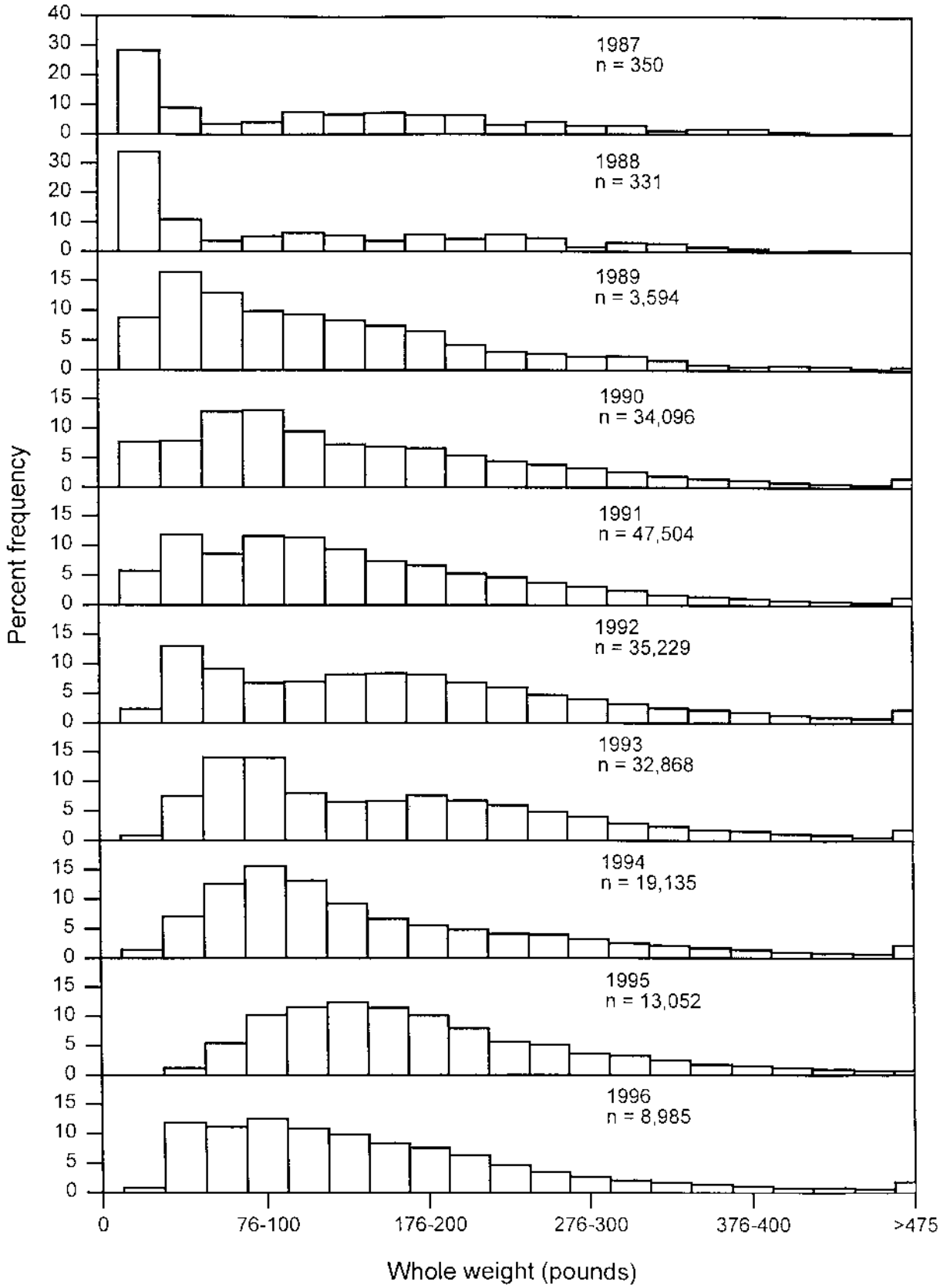

Figure 13.--Swordfish weight-frequency histograms, 1987-96.

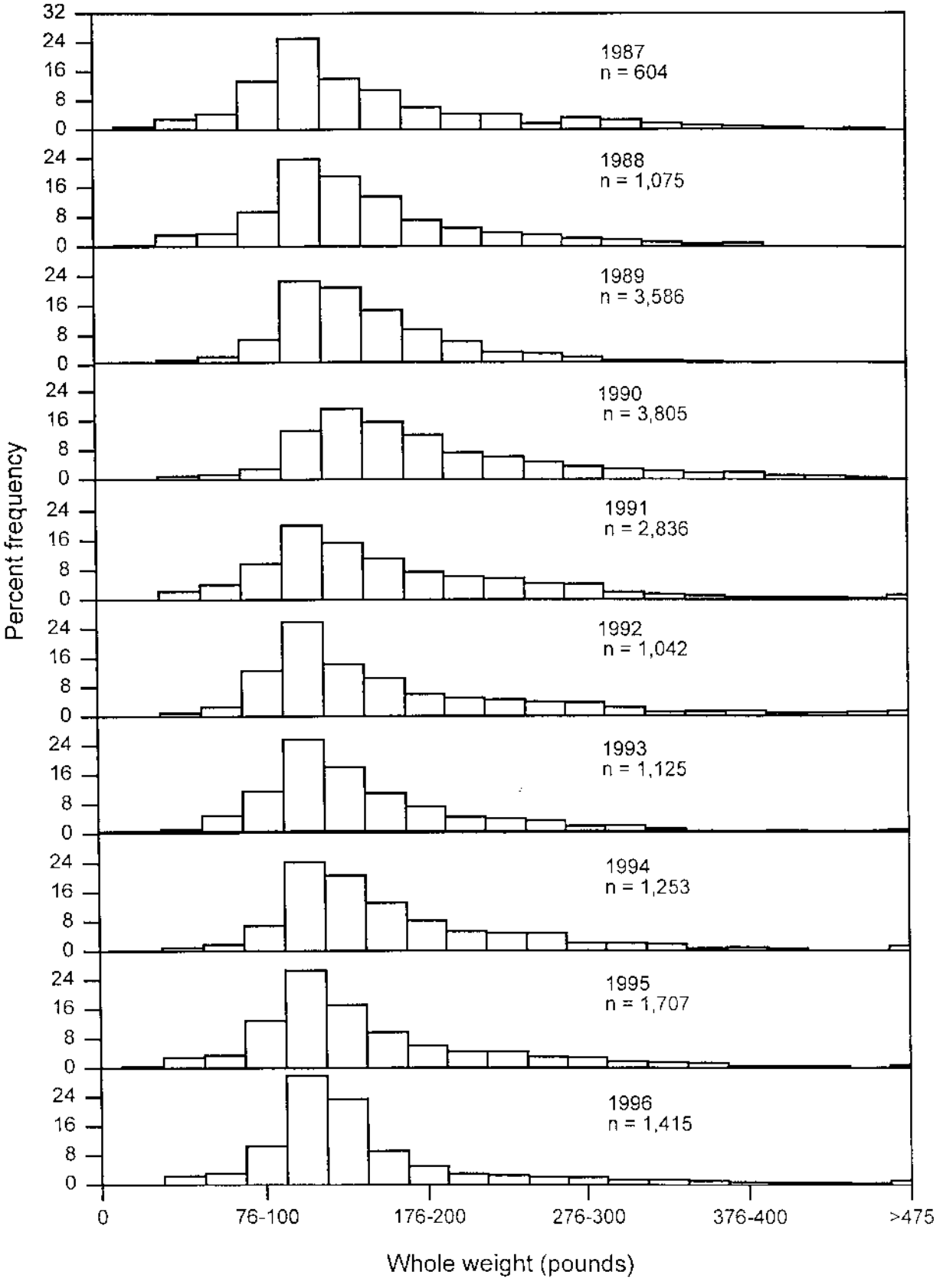

Figure 14.--Blue marlin weight-frequency histograms, 1987-96.

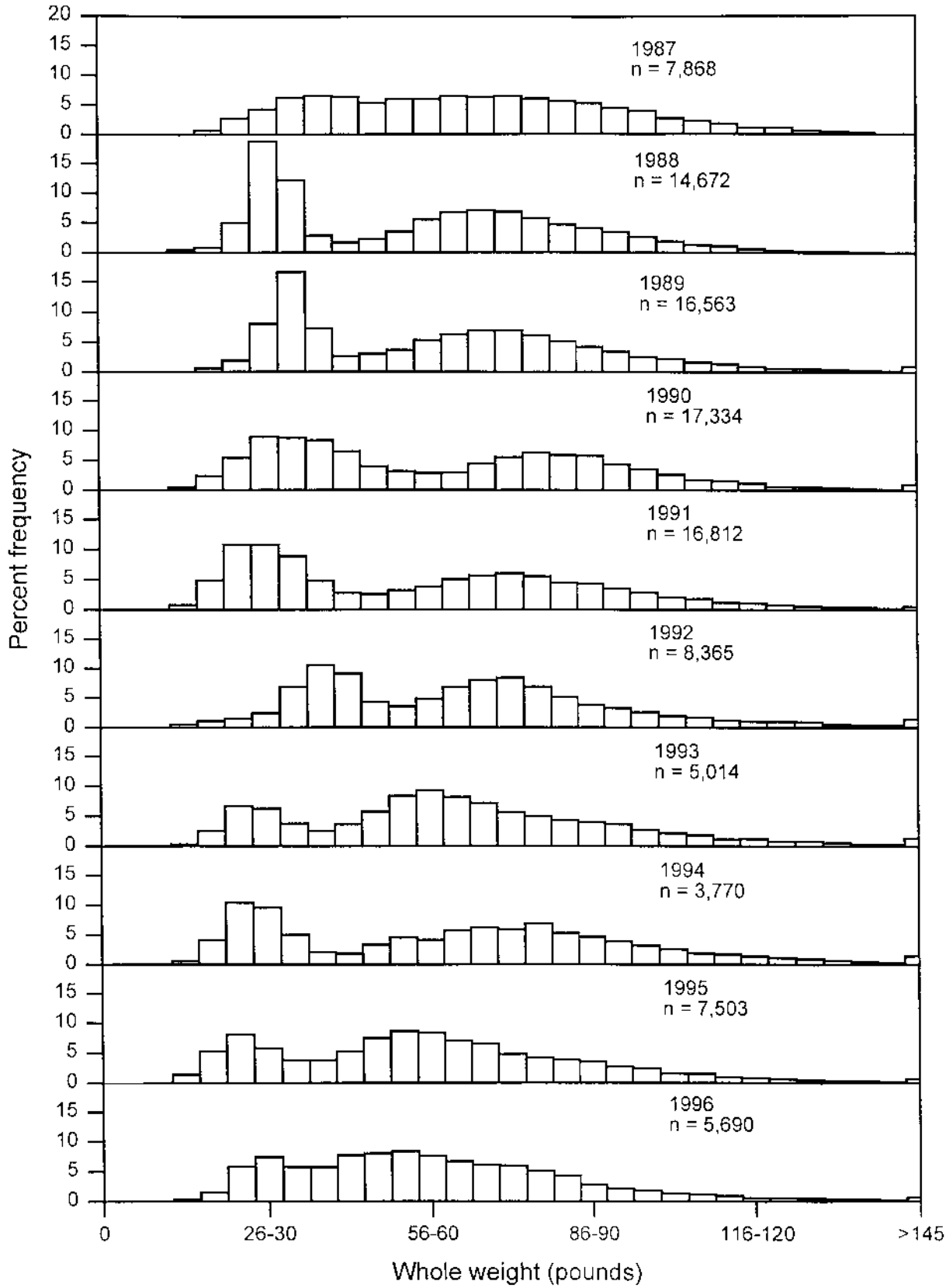

Figure 15.--Striped marlin weight-frequency histograms, 1987-96.

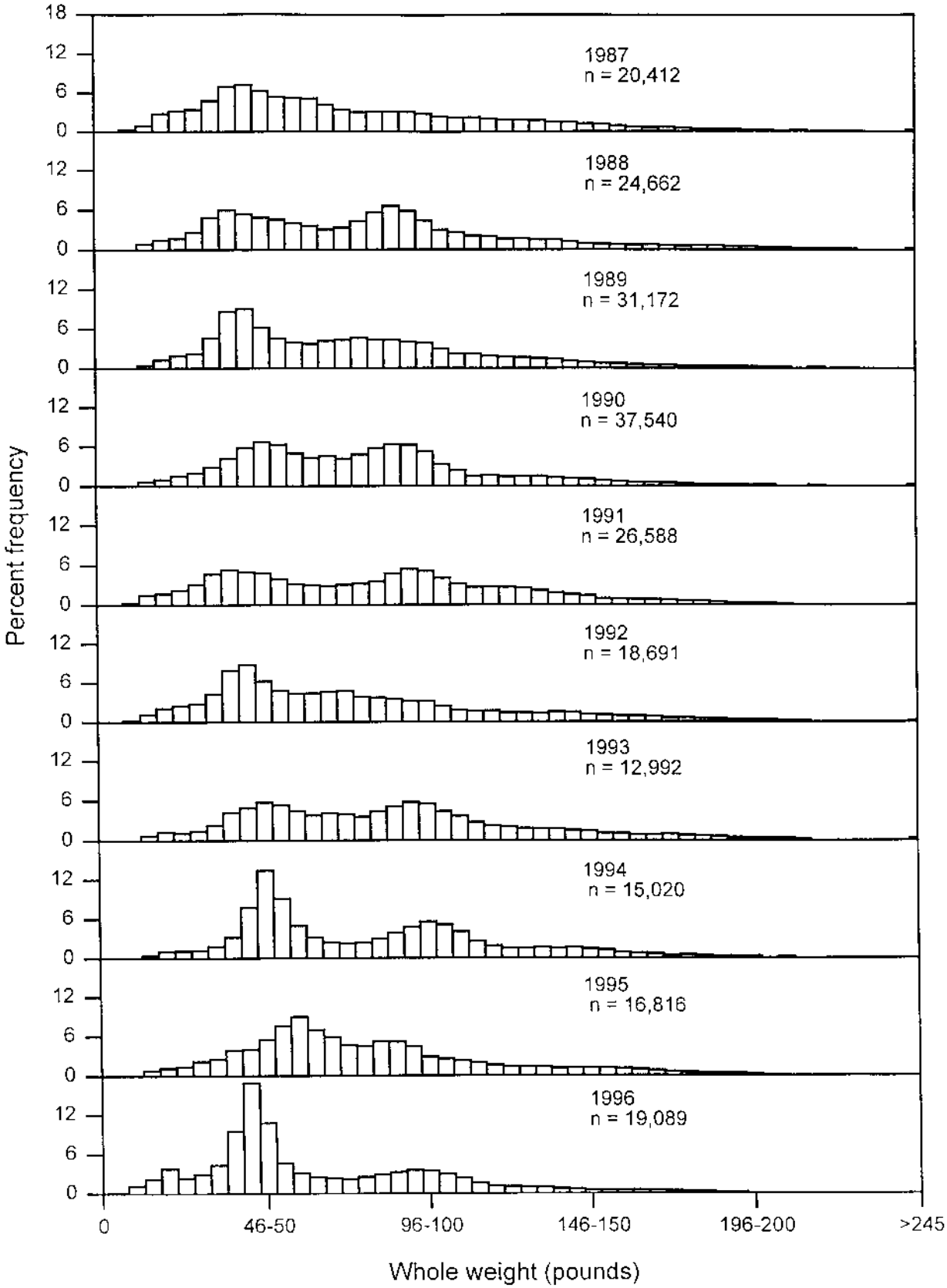

Figure 16.--Bigeye tuna weight-frequency histograms, 1987-96.

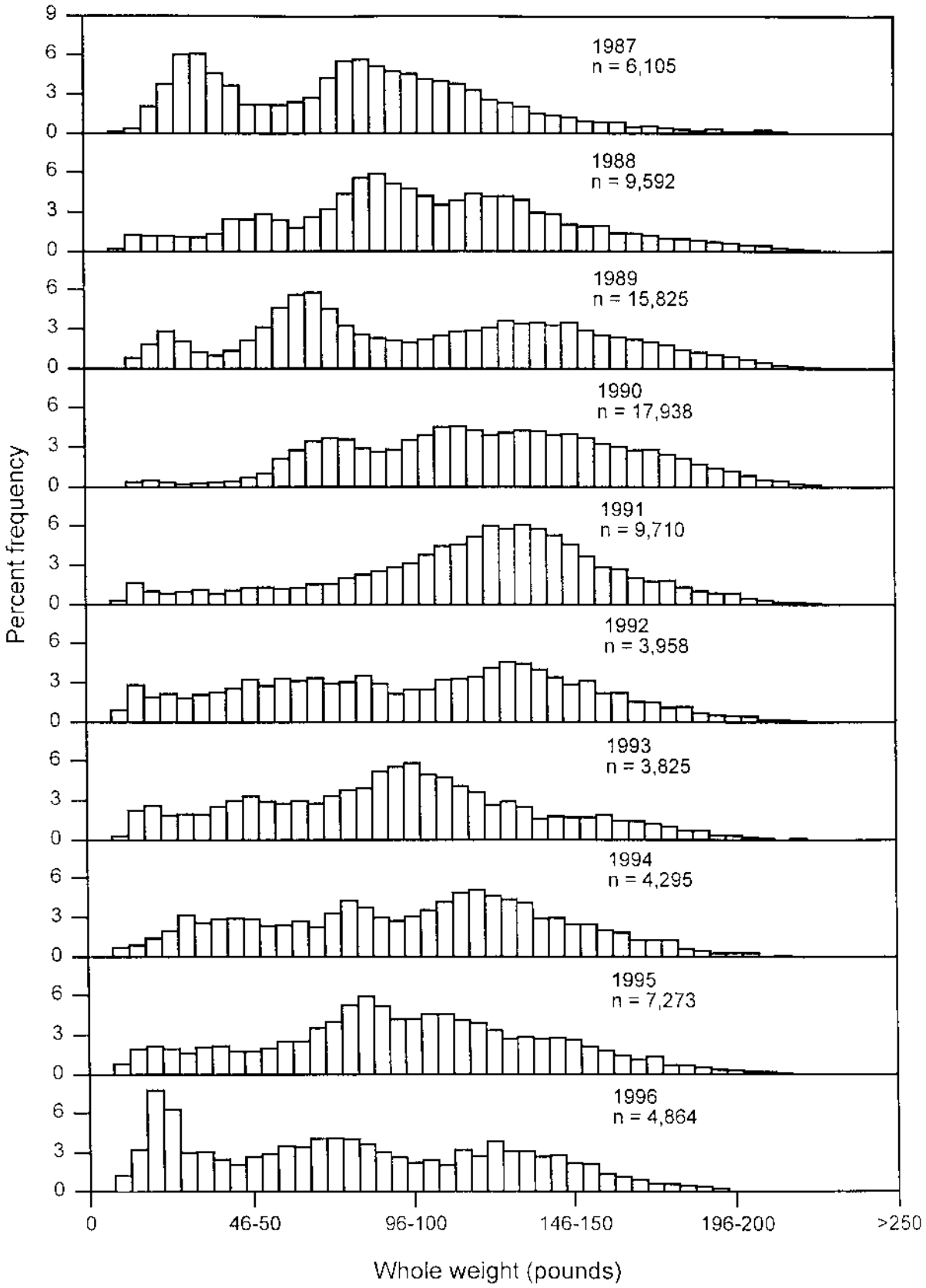

Figure 17.--Yellowfin tuna weight-frequency histograms, 1987-96.

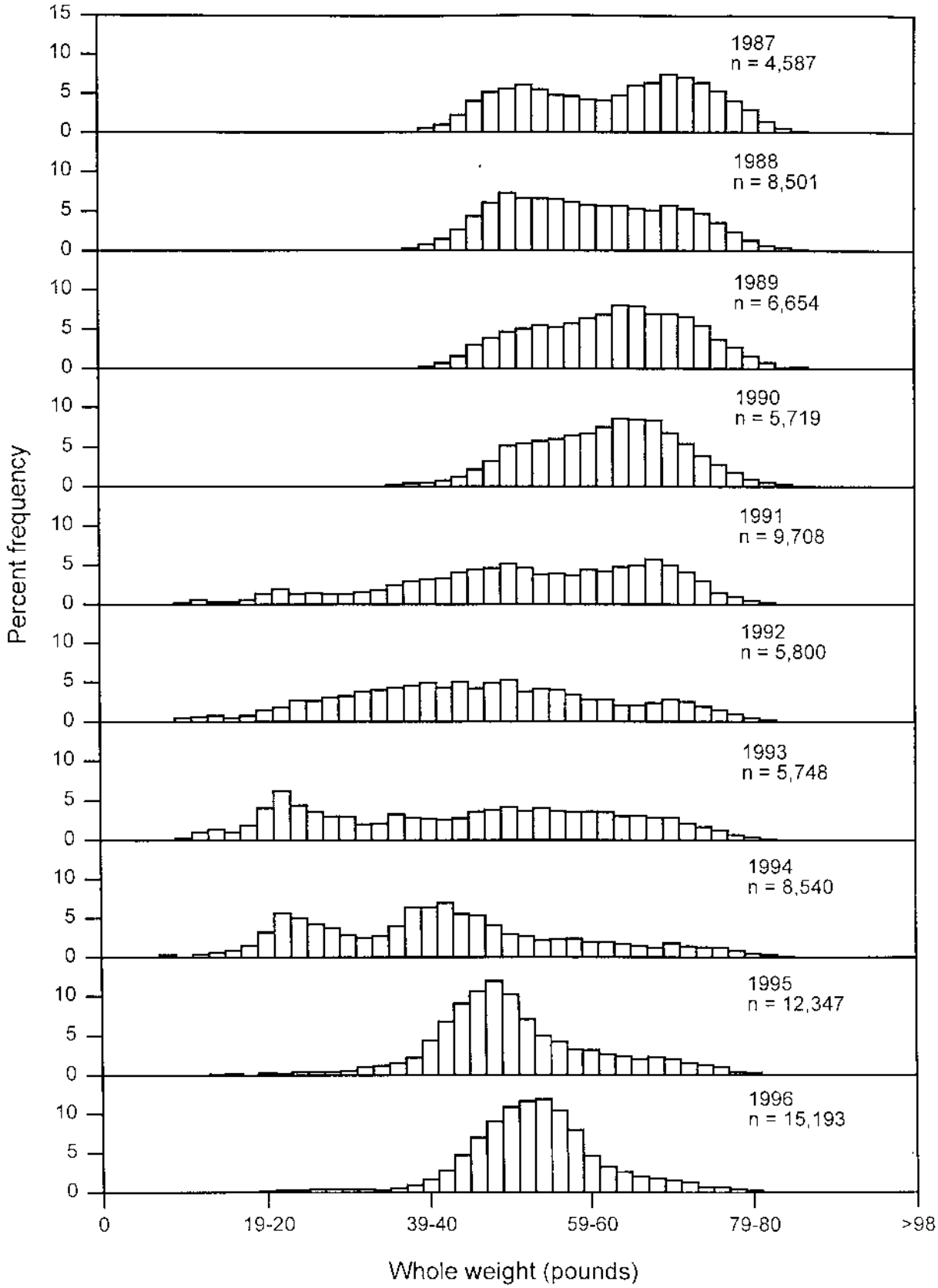

Figure 18.--Albacore weight-frequency histograms, 1987-96.

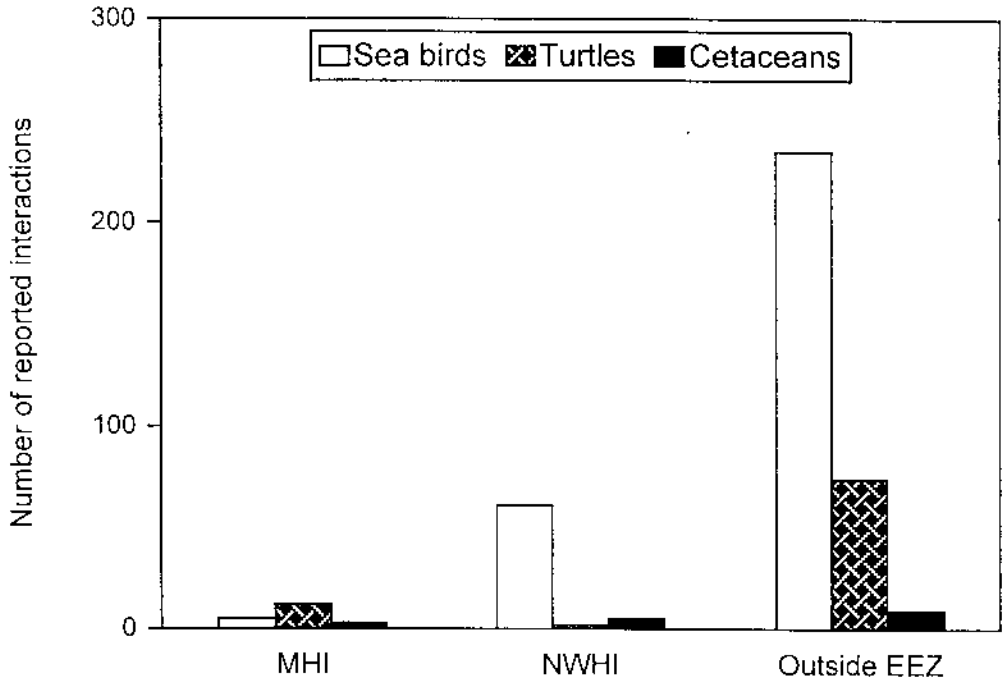

Figure 19.--Reported interactions with protected or endangered species by area, 1996.