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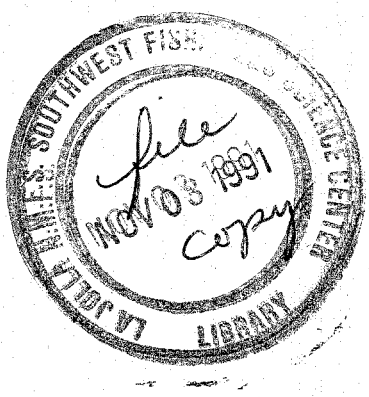

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Center

NOAA Technical Memorandum NMFS

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SAMUEL F. HERRICK, JR. AND DOYLE HANAN

I. INTRODUCTION

During the late 1970's and early 1980's the use of entangling nets in coastal California waters to harvest a number of oceanic and near-shore species expanded rapidly. However, development of the California entangling net fisheries has met with stiff opposition and public pressure from wide-ranging marine resource interest groups seeking limits or a complete ban on the use of entangling nets. Issues dealing with interactions between other commercial and recreational fisheries, as well as conservation and threats to protected species have become hotly debated.

In response to the issues raised over the use of entangling nets, the state of California has established a number of regulations that directly affect entangling gear fisheries in its coastal waters. These regulations pertain to the configuration and deployment of the gear itself as well as to the number of fisherman who can legally fish entangling nets. Additionally, entangling net fisheries off California are indirectly affected by the federally enacted Marine Mammal Protection Act of 1972 (16 U.S.C. ss 1513, et seq.) which imposes a moratorium on the taking of marine mammals except by federal permit, and the Migratory Bird Treaty Act (16 U.S.C. ss 703-711) which prohibits the taking or killing of migratory birds by any means unless authorized by regulation.

This paper provides background information on the operations and state management of the major entangling net fisheries occurring off California. It then reviews the size and composition of landings by entangling nets in California from 1981 through 1986. Emphasis is on the magnitude and diversity of entangling net landings vis a vis landings by other commercial and recreational fisheries. The incidence of marine mammal mortality due to entangling net fishing operations is also investigated. Special attention is given to vessels that participate in the drift gill net fishery with regard to their alternative fisheries activities and opportunities. The final section offers a summary and some observations concerning current difficulties and future directions of California entangling net fisheries.

II. BACKGROUND

A. Entanglement Net Types

The California Department of Fish and Game (CDFG) includes three specific nets within the entangling net category: set gill nets, trammel nets, and drift gill nets. Both the set gill nets and trammel nets (referred to collectively as set nets) are anchored at each end to the ocean floor and consist of vertical walls of webbing stretched between a weighted leadline, that pulls the gear towards the ocean floor, and a buoyant cork line, which lifts the net towards the surface, forming a fence-like barrier that catches fish swimming on or near the ocean bottom.

Set gill nets are made of one wall of webbing stretched tautly, with very little slack. They are designed to catch a particular size of fish that starts to swim through a mesh of the net but because the girth of the fish is larger than the opening it cannot pass through and if it tries to back out, its gills catch on the netting. The fish is thus caught or "gilled."

Trammel nets are constructed of three walls of webbing suspended between the same cork and lead lines. The loosely hung inner panel is made of a smaller mesh than the tautly hung outer panels, so that fish passing through carry some of the center net through the coarser opposite net and become entangled. Another type of trammel net is the suspendered gill net, which is a single-wall set gill net constructed with vertical lines (called suspenders) every few feet that are attached between the lead line and the cork line. The suspenders decrease the distance from the lead line to the cork line thereby increasing the vertical slack in the net; thus legally they are considered trammel nets (California Fish and Game Code, Section 8700).

The drift gill net hangs vertically near the sea surface, stretched between a cork line at the top and a lead line at the bottom. It is not anchored, and usually remains attached to the fishing boat. The net is gathered along the cork line to improve its entangling characteristics by increasing slack. The entire net is suspended by floats attached at intervals along the cork line by extension lines several fathoms in length. As a result, the top of the net hangs below the surface to the length of the extension lines (Bedford, 1985).

B. Fisheries

Set nets are the dominant gear in several commercial fisheries off California. Important set net fisheries off Southern California (Point Conception to the Mexican border) include a year-round halibut fishery that is most active during the fall and spring; a fishery for white sea bass that mainly occurs from mid-June through August (commercial fishing for white sea bass in California waters is prohibited from April 15th

through June 15th); and, shark (angel and soupfin) are also caught year round off southern California using set net gear. Yellowtail, white croaker, rockfish, perch, miscellaneous sharks, and barracuda are other species targeted by set nets in southern California waters (Collins, Vojkovich and Reed, 1985; Collins, Vojkovich, Reed and Heib, 1986).

Off the central California coast (from Point Conception northward) halibut, flounder, sharks, white croaker, and rockfish are fished by set nets (Wild, 1987; Wild, 1986; Haugen, nd). Many of the vessels will change their target species (halibut, flounder, or shark) seasonally without changing the nets, mesh sizes, and areas fished. Halibut are taken from May to October, with the bulk of the catch occurring in the summer; November through February is when the shark fishery is most active; and, flounder are targeted during March and April. These three fisheries range from Monterey Bay north to Bodega Bay. The white croaker fishery takes place year round, ranging from San Francisco to Monterey Bay in the south. Rockfish are caught throughout the year using set nets, all along the central coast, but relatively far offshore. There is also, a herring-roe fishery in San Francisco and Tomales Bays where the gill net is the predominant gear[1].

The modern California drift gill net fishery developed during the late 1970's in the waters surrounding the Channel Islands between Point Arguello and San Diego, off southern California. Initially pelagic sharks, primarily common thresher and bonito, were the targeted species. Since then, the fishery has developed rapidly and extensively along the coast as far north as Oregon, and seaward beyond 200 miles. Swordfish, has overtaken shark in both the quantity and the value of drift gill net landings, and two additional fish (opah and louvar) have become important components of the catch

Opposition to the the use of drift gill net gear focuses on its interaction with other commercial gears and recreational fisheries, and its threat to marine mammals and seabirds. Established swordfish harpoon fishermen have voiced fears that gill net landings would glut the market and drive down ex-vessel prices to the point where harpooners could no longer compete. Harpooners have also expressed concern regarding possible overfishing of swordfish with the introduction of gill nets, which unless checked, might lead to serious declines in the availability of fish. Attention to overfishing is not limited to swordfish. Biologists point out that most species of shark are characterized by low rates of reproduction, slow growth, and relatively late maturity. Therefore, shark populations may be particularly vulnerable to excessive fishing (Hanan, 1984; Holts,

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[1]Because of the unique nature of the herring-roe fishery it is excluded from the analysis herein.

1987). Recreational interests have strongly objected to the reported take of striped marlin (commercial fishing for striped marlin is prohibited in California) and other gamefish by gill nets. Sport fishermen have been joined by conservationists who argue that gill nets are inherently indiscriminant thereby resulting in a great waste of non-targeted species, and that marine mammals (seals, sea lions, porpoise and whales) are being inadvertently entangled.

Similar to the development of the drift gill net fishery, the quick growth of the set net fisheries along the central and southern coasts of California has aroused friction and controversies between set net fishermen, other commercial fishermen, recreational fishermen, and conservationists. Mainly at issue is the widespread mortality of marine mammals and seabirds inflicted by set nets deployed in nearshore (generally within three miles of land), shallow waters. The use of set nets in nearshore areas sometimes conflicts with the operations of other commercial and recreational fisheries. Prominent in this regard is the set net take of Dungeness crab, salmon, striped bass, and sturgeon off central California, as well as a number of species reserved for recreational fishermen off southern California.

C. Management

The state has introduced two types of regulations to deal with negative aspects of entangling net fisheries: (1) gear regulations, which affect the design of, or deployment of, the gear itself, and; (2) a limited entry program which restricts participation in entangling net fisheries.

Gear regulations, for the most part, address specific problems or situations. For example, limits on mesh size are in effect for certain types of entangling nets that are used to target particular species (there is a 8.0 inch minimum mesh size for trammel nets used to catch halibut in nearshore southern California waters; non-trammel halibut set nets in the same area are not subject to minimum mesh size regulations (Collins, Vojkovich and Reed, 1985)). Mesh size restrictions are used to prevent or reduce the capture of under- size fish, and non-target species. Other gear regulations specify conditions of use: how, where, and when the nets can be used. Time-area closures are typical in this case, where the intent can be to reduce conflict with other commercial and recreational fisheries, or to protect concentrations of marine mammals, or both.

In all, there have been 13 pieces of California legislation enacted since 1980 that impose some form of gear regulation on the state's entangling net fisheries. These laws have created a complex patchwork of time-area closures all along the California coast. The tenor of entangling net gear legislation reflects a general policy of identifying and addressing entangling net problems on a area-by-area, and species-by-species basis.

Participation in California's entangling net fisheries is controlled through a general, gill/trammel net permit system, and through fishery specific limited entry programs. Special, annually renewable, non-transferable, revocable permits are required to operate in the drift gill net fishery for swordfish and shark, the central California nearshore gill net and trammel net fisheries, and the central California experimental drift gill net swordfish fishery. Because the number of fishery specific permits is fixed in each case, access to these fisheries is limited.

Special permits for shark drift gill net fishing were initially issued in 1980 (California Assembly Bill 2564, Kapiloff, 1980), to persons demonstrating prior shark drift gill net fishing experience, or to persons who had previously made a significant financial commitment to undertake such fishing activity. Several gear regulations, a logbook requirement, and an observer program were simultaneously implemented (Huppert and Odemar, 1986). Concern over excessive effort on the highly depletable shark resources brought about revisions to the permit system in 1982 (California Senate Bill 1573, Beverly, 1982). At that time, a limited entry program for drift gill nets was put into effect, with a target limit of 150 permits[2]. Also, additional gear regulations were implemented, and restrictions were removed on catches of swordfish by drift gill nets, the latter giving rise to a directed drift gill net fishery for swordfish. Limited entry has since become an important component in an overall drift gill net management regime designed to protect marine mammals, reduce inter-fishery conflicts, and prevent the depletion of shark populations.

In 1984, the California State Legislature passed a bill (California Senate Bill 2266, Marks, 1984) that required fishermen to obtain a special permit to use a set gill net or trammel net in nearshore waters off San Francisco and other central California areas (set gill/trammel net fishermen operating further offshore do not need this permit). This requirement, together with some time and area closures constitute a management program designed to reduce gear conflicts with other fisheries and protect marine mammals and seabirds. Currently there is a target level of 135 permits for the fishery (California Senate Bill 346, Marks, 1985), and only previous permit holders who can demonstrate active involvement by satisfying a minimum landings criterion are eligible to renew (Huppert and Odemar).

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[2]In 1982 there were more than 200 active permit holders in the drift gill net fishery for swordfish and shark. Therefore, no new permits would be issued until the number of active permits dropped below 150.

There is also a special permit required for participation in an experimental drift gill net swordfish fishery off central California. At present 35 permits exist for this fishery. Because permit holders in the drift gill net fishery for shark and swordfish off southern California may also fish north of Point Arguello, total participation in the central California fishery is not limited to 35. However, holders of central California drift gill net permits are prohibited from fishing for sharks in the south. Under current regulatory circumstances, when all drift gill net permit target levels are attained, there could be a maximum of 185 permittees fishing in the central California fishery, and a maximum of 150 in the fishery south of Point Arguello.

In addition to the specific permit, each participant in any one of the aforementioned fisheries or any other entangling net fishery in state waters must possess a general gill net/trammel net permit. These annually renewable, non-transferable, revocable general permits were introduced in 1981 as a means to insure that only fishermen who were proficient in its use would be permitted to fish with entangling net gear. Initially there was no limit on the number of general permits that could be issued, so that the program was essentially a "qualified entry system" (Huppert and Odemar). However, as of 1986, a moratorium on new general permits was established (California Assembly Bill 307, Wright, 1985), which effectively precludes newcomers from entering any entangling fishery at least until the moratorium expires in 1990.

Entangling net fisheries off California are also affected by requirements of the Marine Mammal Protection Act, and the Migratory Bird Treaty Act. Because of the qualified protection afforded marine mammals and absolute protection afforded non-game migratory birds under the respective acts, the State, in conformance with these acts, has established strict prohibitions on the use of set gill nets and trammel nets in certain coastal waters (California Senate Bill No. 40, Marks, 1987). These prohibitions which came into effect April 1, 1987, are specifically designed to protect harbor porpoise and common murres along California's central-northern coast.

In the next section, annual landings by California entangling net fisheries from 1981 through 1985 are presented and compared to landings by other California commercial and recreational fisheries. Of interest, are discernible trends in the landings of species that are taken by all fisheries. Also, the economic importance of the various species comprising annual entangling net landings is indicated through their relative contributions to total ex-vessel revenues.

III. ENTANGLING NET LANDINGS

A. All Entangling Net Types

The quantities of different species landed using entangling nets, and their corresponding monetary values were obtained from California landing receipts which the state uses in its commercial fisheries management and monitoring activities. Landing receipts record sales information from individual transactions between commercial fishermen and fish buyers[3], and contain information on the quantity of each species landed, the species' exvessel price, and the gear that was used to catch each species.

In this study any landing receipts reporting an entangling net as the gear used were compiled to obtain annual summaries for the volume and value of landings by gear and species. Figure 1 shows overall landings (all species) by drift gill nets, trammel and set gill nets from 1981 through 1986. Over the 6-year period, more than 180 distinct species or species groups were included in the overall entangling net landings (Table 1.). However, 84 percent of the landings, and 94 percent of the total revenues, on average, were made up of only 12 of these species/species groups (Table 2). Table 2 also shows that while the rockfish group consistently accounts for the greatest percentage of landings over the period, swordfish is responsible for the largest contribution to total ex-vessel revenues.

Between 1981 and 1984, overall entangling net landings remained fairly stable, averaging 5,341 tons annually. The sharp increase in landings that occurred in 1985 (Figure 1) was due to increased landings of all the major species, particularly of rockfish, swordfish, and shark. A decline in landings of all the major species, except rockfish, contributed to the slight downturn in 1986 (Figure 2).

Table 3 presents the proportion of annual entangling net landings of the major species/species groups by each type of entangling net, and the relative distribution of total (all species) entangling landings across all net types. From 1981 through 1983, set gill nets accounted for the greatest proportion of total entangling net landings, while for the remainder of the period the bulk of the landings were assigned to the unspecified entangling net category. Examination of the distributions of annual landings of the major species/species groups across net types reveals that in almost every case prior to 1984, set gill nets contributed the highest proportion of landings by major

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[3]Access to landings receipts data is accorded National Marine Fisheries Service Personnel through a confidentiality agreement with the State of California.

species/species group. For the rockfish, white croaker, halibut, and white sea bass this is expected, but it is unusual that the majority of swordfish, bonito shark, and common thresher shark landings in 1982 and 1983 were attributed to set gill nets. This suggests that there may have been a misreporting of gear type on landings receipts in these years.

Entangling net landings were compared to California landings for all commercial gears using annual summaries from the PACFIN research data base (Huppert, Thomson and Iacometti, 1984; Huppert and Thomson, 1985; Huppert and Thomson, 1986; Korson and Thomson, 1987)[4]. The annual PACFIN landings summaries were created by aggregating species into market categories. Landings from fish tickets reporting any of the entangling nets as the gear used were aggregated in the same way, and presented as percentages of total reported landings in Table 4. The only market categories in which entangling nets have made significant contributions to the total commercial landings over the 1981 to 1985 period, are halibut, shark, billfish, and other roundfish (the latter market category includes white sea bass, white croaker, and opha). More recently, entangling nets have increased their share of total landings in the other rockfish, and the ling cod and Pacific cod market categories. The remaining market categories are relatively unimportant in terms of the entangling net share.

A comparison of California landings by entangling nets with catches from California's marine recreational fisheries was done using results from the U.S. Department of Commerce's annual National Marine Recreational Fishery Statistics Survey, of the Pacific Coast Region for the years 1981 through 1986 (U.S. Department of Commerce, 1984, 1985, 1986, 1987). These results include estimated weights of fish caught by marine recreational fishermen in California coastal waters. Estimated recreational catches, by species, were aggregated into the market categories described above and compared to corresponding landings by entangling nets and other commercial gears (Table 5) to better understand the relative importance of each category to the different user groups. Table 5 shows that, relative to the total estimated catch or reported landings, rockfish is an important species category for all three user groups. Otherwise, the relative importance of each species category is fairly distinct for California recreational, entangling net, and other commercial fisheries.

Because certain species are reserved exclusively for recreational use, they will not be reported on landings receipts

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[4]The PACFIN Research Data Base contains fish ticket data for each commercial landing of fish and vessel characteristics for each registered fishing vessel in the states of California, Oregon, and Washington. The data base as of this writing covers the years 1981 through 1985 (Jacobson and Huppert 1986).

when they are caught using commercial gear because they cannot be sold commercially. Therefore, for some recreational species there is an incidental entangling net catch that goes unreported. Thus, it is desirable to have information on the catch composition of entangling net fisheries to further assess possible interactions between them and recreational fisheries. In this regard, sampling data gathered by CDFG observers on board vessels participating in the drift gill net fishery, the southern California nearshore set net fisheries, and the central California set net fisheries were aggregated to present observed catch compositions. Table 6 reveals that striped bass, chinook and coho salmon, and marlin -- important recreational species -- occur in sample catch compositions.

B. Drift Gill Nets

A closer look at the vessels that participate in the drift gill net fishery for swordfish and shark shows that these vessels can be quite diversified in their overall operations as indicated by the number of different gears and species recorded on their California landing receipts.

For each vessel that was operated under a special drift gill net permit in any one or more of the years 1981 through 1985, all of that vessel's landing receipts for each permit-year were compiled to obtain a view of the vessel's annual fishing activities. Based on the different gears and species recorded on its landing receipts , a vessel's principal gear (the gear accounting for the plurality of the vessel's annual ex-vessel revenue) and principal species/species group (the species/species group accounting for the plurality of the vessel's ex-vessel revenue) was determined. Each vessel was then categorized according to its principal gear and principal species for each of the years it was operated under a drift gill net permit (a particular vessel could be in a different category in different years). The resulting cross tabulation is shown in Table 7.

For the majority of vessels comprising Table 7, the principal species was swordfish, and the principal gear was an entangling net, which most likely reflects the economic importance of the swordfish/shark drift gill net fishery for these vessels. Many of these vessels were also active in other fisheries. For example, for five percent, tuna was the principal species, and hook and line the principal gear. This demonstrates the importance of the troll albacore fishery to these vessels, which tends to peak off southern California in July-August, just before the availability of swordfish heightens off the coast. Over 10 percent of the vessels had rockfish as their principal species, and for most of these some type of entangling net was their principal gear. A number of the drift gill netters also fish swordfish with harpoons. Several miscellaneous gears, including traps, pots, dip nets, and encircling nets, were the

principal gears for over eight percent of the drift gill net permittees.

The variety of gears used and species landed for vessels having permits to engage in the drift gill net fishery attests to the versatility of their fishing operations. Table 8 discloses that during the 1981-85 period, over 85 percent of the permitted vessels used two or more gears in their annual fishing operations, and 96 percent landed two or more different species. Although widely dispersed on the basis of number of gears and number of species combinations, the greatest concentration of vessels (7.4%) landed eight different species and fished three different gears: more than 29 percent of the vessels used three gears, and at least 21 percent landed eight different species.

In the next section, the incidence of various species of marine mammals and seabirds being accidentally taken in entangling nets is investigated.

IV. MARINE MAMMALS AND ENTANGLING NETS

One of the greatest concerns over the use of entangling nets is their impact on, and interaction with populations of marine mammals and seabirds. There has been much public outcry about the accidental catch of marine mammals and seabirds in entangling net fisheries. On the other hand marine mammals often create a nuisance for fishermen: entangling net fishermen attribute substantial lost revenues to depredation by marine mammals.

To acquire some understanding about the extent of entangling net-induced marine mammal and seabird mortality off California, catch composition data from the state's aforementioned entangling net observer programs were analyzed. The procedure involved calculating the rates at which marine mammals and seabirds were being incidentally killed in the major entangling net fisheries off California to discern overall trends, and species specific vulnerability.

Entangling net kill rates for all species of marine mammals and seabirds, based on observer data, are shown in Figure 3. Both total seabird and total marine mammal kill rates increased steadily over the period. However, neither of the overall rates is very evenly distributed across the major entangling net fisheries, as shown in Table 9.

From Table 9, the incidental kill of seabirds is highest in the central California set net fisheries, and is most severe for common murres (panel B). Observed seabird kill rates in the southern California nearshore set net fishery are relatively low (panel A), and non-existent in the drift gill net fishery for the years covered (panel C).

The observed kill rates for marine mammals is highest in the central California set net fisheries, where harbor seals and harbor porpoise seem to be most vulnerable to the entangling nets used in these fisheries (panel B). Sea lions also appear to be relatively susceptible to capture by entangling nets, particularly by drift gill nets (panel C). Marine mammal kill rates are lowest in the southern California nearshore set net fisheries (panel A).

Special studies by Diamond and Hanan (1986), and Hanan, et al (1986, 1987) investigated the incidental kill of harbor porpoise in the halibut/flounder/shark set net fishery off central California over the period April 1983, through March 1986. The investigators analyzed data from fishing log books, landings receipts, and the observer programs to estimate the total number of harbor porpoise killed in the April through March 1983-84, 1984-85, and 1985-86 fishing years. Based on their analyses, harbor porpoise mortality in the fishery was estimated to be 303, 226, and 227 animals in the respective years.

Sea otters are also accidentally taken in the central California halibut/flounder/shark set net fishery. Wendel, Hardy and Ames (1986) estimated annual accidental kill of sea otters in the fishery by expanding the average rate at which drowned sea otters were observed in set nets over the period June 1982 through June 1984. The mean take, from three estimates of accidental annual take presented in their report, was approximately 80 animals per year during the study period. Based on the relationship between the number of landings from the fishery, and the estimated accidental take of sea otters, the accidental take of sea otters was back calculated from 1983 to 1973: estimates for this period ranged from 48 to 166 animals annually, with an average of 103 taken per year.

V. DISCUSSION

This paper compiles and presents data from various sources that describe the major entangling net fisheries occurring off the coast of California. Attention is on the interaction of these fisheries with recreational and other commercial fisheries and their impact on other coastal marine resources.

Numerous commercial species are reported in the entangling net landings, but relatively few of these are important in terms of overall volume. Moreover, when landings compositions from the different entangling net fisheries are examined, distinct patterns emerge. This suggests that the different types of entangling nets can be quite selective with regard to the species landed. Except for halibut and swordfish, there appears to be very little direct competition between entangling net, and other commercial fisheries for the species in the major market categories. Halibut is also a popular recreational species, as

are white sea bass, rockfish and white croaker other species comprising entangling net landings. Marlin, chinook and coho salmon, striped bass, and kelp bass are other important recreational species that have been observed in entangling net catches.

Another area of concern over the use of entangling nets, has to do with the accidental take of marine mammals and sea birds. As the entangling net fisheries have grown, the incidental catch of these animals has become more highly publicized. This problem has been most severe in the set net fisheries off the central coast, but is present in all entangling net fisheries. Because a general solution (short of a complete ban on all entangling nets) to the problem has not been found, a number of regulations have been implemented on a fishery by fishery basis to deal with specific instances. In the past, efforts to alleviate accidental take problems have not been characterized by a willingness on the part of different interest groups to work together to find amicable outcomes. However, recently (as shown by SB40, Marks) the interest groups did work together to find acceptable compromises for the murre - harbor porpoise problem. Finding solutions to the marine mammal - seabird mortality problem is an ongoing process. Several pieces of state legislation are pending, and the federal Marine Mammal Protection Act is coming up for reauthorization.

The potential impact of more stringent regulations on the use of entangling nets is liable to be mitigated by the ability of affected vessels to engage in alternative fisheries. This is exemplified by those vessels operated under special permits for the drift gill net fishery. These vessels typically land two or more species during the course of the year, and use at least two different gears in their fishing operations. This flexibility not only eases the burden of a greater regulatory load, but enables vessels that participate in entangling net fisheries to more readily respond to changing biological, environmental, and economic conditions.

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Table 1. Percentage of different species reported in total entangling net landings (all nets) 1981 - 86.

SPECIES	%1981	%1982	%1983	%1984	%1985	%1986
American Shad	<1	0	<1	<1	<1	<1
Anchovy, Deepwater	0	0	0	0	<1	0
Anchovy, Northern	<1	<1	<1	<1	<1	<1
Bass, Barred Sand	<1	0	0	0	0	0
Bass, Giant Sea	<1	<1	<1	<1	<1	<1
Bass, White Sea	7	1	1	1	1	1
Bat Ray	<1	<1	<1	0	0	0
Blackfish	0	0	0	0	0	<1
Blacksmith	0	0	0	0	<1	0
Bluebanded Goby	0	0	0	0	<1	0
Bonefish	0	0	<1	0	0	0
CA Barracuda	1	1	0	0	0	0
CA Corbina	0	0	0	0	0	<1
CA Grunion	0	0	0	0	<1	0
CA Lizardfish	0	0	0	0	0	<1
CA Sheephead	<1	<1	<1	<1	<1	<1
Cabezon	<1	<1	<1	<1	<1	<1
Clam, Unsp.	0	0	0	<1	<1	0
Common Mola	0	0	0	<1	<1	<1
Coral, Purple	0	0	0	<1	0	0
Crab, Box	0	<1	0	0	<1	<1
Crab, Dungeness	<1	<1	<1	<1	<1	<1
Crab, King	<1	<1	<1	0	0	<1
Crab, Rock	<1	<1	<1	1	<1	<1
Crab, Sand	0	0	0	0	<1	0
Crab, Shore	0	0	0	<1	0	0
Crab, Spider	<1	<1	<1	<1	<1	<1
Crustacean, Unsp.	0	0	0	<1	0	<1
Dolphinfish	<1	<1	<1	<1	<1	0
Echinoderm, Unsp.	<1	0	0	0	0	0
Eel	0	0	<1	<1	0	0
Eel, CA Moray	0	0	0	<1	<1	0
Eel, Wolf	<1	0	<1	0	<1	<1
Fish, Unsp.	1	1	<1	<1	<1	<1
Flounder, ArTooth	<1	0	0	0	0	0
Flounder, Starry	<1	<1	<1	<1	<1	<1
Flounder, Unsp.	1	1	<1	<1	<1	<1
Flyingfish	1	1	<1	<1	<1	<1
Garibaldi	0	0	0	0	<1	0
Grouper	<1	0	<1	<1	<1	0
Grouper, Broomtail	0	0	0	0	<1	0
Guitarfish	<1	<1	<1	<1	<1	<1
Halfmoon	<1	<1	<1	<1	<1	<1
Halibut, CA	8	7	5	5	5	5
Halibut, Unsp.	0	<1	0	<1	<1	0
Kelp Greenling	0	<1	<1	<1	<1	<1
Lingcod	<1	1	2	1	1	1

Table 1. cont.

SPECIES	%1981	%1982	%1983	%1984	%1985	%1986
Lobster, CA Spiny	<1	<1	<1	<1	<1	<1
Mackerel, Bullet	0	0	0	0	<1	<1
Mackerel, Jack	1	<1	<1	<1	<1	<1
Mackerel, Unsp.	<1	<1	<1	<1	1	1
Mackerel. Pac.	1	1	<1	2	1	<1
Market Squid	<1	<1	<1	<1	3	<1
Mussel	0	<1	<1	<1	<1	0
Ocean Whitefish	<1	<1	<1	<1	<1	<1
Octopus	<1	<1	<1	<1	<1	<1
Opaleye	<1	<1	<1	<1	<1	<1
Opha	<1	1	1	3	2	1
Pac. Bonito	2	<1	1	<1	4	1
Pac. Butterfish	<1	<1	<1	<1	<1	<1
Pac. Cod'	0	<1	0	0	0	0
Pac. Hake	<1	<1	<1	<1	<1	<1
Pac. Ocean Perch	0	<1	<1	<1	<1	0
Pac. Sardine	<1	0	0	<1	<1	<1
Pac. Tomcod	0	<1	0	0	0	0
Prawn, Ridgeback	<1	<1	0	<1	<1	<1
Prawn, Spot	<1	<1	0	<1	<1	<1
Queenfish	<1	<1	0	0	0	0
Ratfish	0	<1	<1	0	<1	0
Rkfish, Bank	0	0	0	0	<1	1
Rkfish, Black	<1	<1	0	<1	<1	<1
Rkfish, Blkgill	0	0	<1	<1	<1	1
Rkfish, Blue	<1	<1	<1	<1	<1	<1
Rkfish, Boc./Chili	0	<1	2	12	13	23
Rkfish, Bocaccio	4	7	4	<1	<1	0
Rkfish, Bolina	0	<1	<1	<1	<1	<1
Rkfish, Brown	<1	<1	<1	<1	<1	<1
Rkfish, Chili.	<1	<1	0	0	<1	<1
Rkfish, China	0	<1	<1	0	<1	<1
Rkfish, Copper	0	0	0	0	0	<1
Rkfish, Cowcod	1	<1	1	1	<1	<1
Rkfish, D.W. Reds	0	0	0	0	0	<1
Rkfish, Gopher	<1	<1	<1	<1	<1	0
Rkfish, Gopher	0	0	0	<1	<1	<1
Rkfish, Greenspot.	0	<1	0	0	0	0
Rkfish, Olive	<1	0	0	0	0	0
Rkfish, Reds	0	<1	1	2	2	3
Rkfish, Rosefish	0	0	<1	<1	<1	1
Rkfish, Rosey	0	0	0	0	<1	<1
Rkfish, Small Reds	0	0	0	<1	<1	<1
Rkfish, Splitnose	0	0	0	0	<1	0
Rkfish, Starry	0	0	0	0	0	<1
Rkfish, Unsp.	20	21	29	13	15	16
Rkfish, Vermilion	<1	0	<1	0	0	0
Rkfish, Whitebelly	<1	<1	<1	<1	<1	<1
Rkfish, Widow	0	<1	<1	<1	3	4
Rkfish, Yelloweye	1	<1	<1	0	0	0

Table 1. cont.

SPECIES	%1981	%1982	%1983	%1984	%1985	%1986
Rkfish, Yellowtail	<1	1	1	1	<1	<1
Sablefish	<1	<1	<1	<1	<1	1
Salmon	<1	0	0	0	0	0
Sanddab	<1	<1	<1	<1	<1	<1
Sanddab, Pac.	0	<1	0	0	0	0
Sargo	<1	<1	<1	0	0	0
Scallop, Unsp.	0	0	0	0	<1	0
Scorpionfish	<1	<1	<1	<1	<1	<1
Shark, Bigeye Thr.	0	<1	1	1	1	<1
Shark, Black Tip	0	0	0	<1	0	0
Shark, Blue	<1	<1	<1	<1	<1	<1
Shark, Bonito	2	4	3	2	1	2
Shark, Br Smhound	<1	<1	<1	<1	<1	<1
Shark, Com. Thr.	18	21	14	11	7	3
Shark, Cow	<1	<1	<1	<1	<1	<1
Shark, Dusky	<1	0	<1	0	0	0
Shark, Gray Smhnd	0	<1	<1	<1	<1	<1
Shark, Horn	<1	<1	<1	<1	<1	0
Shark, Leapord	<1	<1	1	<1	<1	<1
Shark, Pac. Angel	2	2	2	4	6	7
Shark, Plg. Thr.	0	0	<1	<1	<1	<1
Shark, Salmon	0	<1	<1	0	<1	<1
Shark, Sevengill	<1	<1	<1	<1	<1	<1
Shark, Sixgill	0	0	0	<1	<1	0
Shark, Sm. Hmhead	<1	<1	<1	<1	<1	<1
Shark, Soupfin	2	2	1	2	1	1
Shark, Swell	0	0	0	<1	0	0
Shark, Unsp.	5	2	1	<1	<1	<1
Shark, White	<1	<1	<1	<1	<1	<1
Shrimp, Ghost	0	0	0	0	<1	0
Shrimp, Pac. O.	<1	0	0	0	<1	0
Shrimp, Red Rock	0	0	0	0	<1	0
Shrimp, Unsp.	<1	0	0	<1	<1	<1
Silversides	<1	<1	<1	<1	<1	<1
Skate, Big	0	0	0	<1	0	0
Skate, Thornback	0	0	0	<1	0	0
Skate, Unsp.	<1	<1	<1	<1	<1	<1
Smelt, Jack	<1	<1	<1	0	<1	<1
Smelt, Night	0	<1	0	0	<1	0
Smelt, Surf	<1	<1	0	<1	<1	0
Smelt, True	<1	<1	<1	<1	<1	<1
Smelt, Whitebait	0	<1	<1	0	<1	<1
Snail, Moon	0	<1	0	0	0	0
Snail, Sea	<1	<1	<1	<1	<1	<1
Sole, Butter	0	<1	<1	<1	<1	<1
Sole, Dover	0	<1	0	0	<1	<1
Sole, English	<1	<1	<1	<1	<1	<1
Sole, Fantail	0	<1	<1	<1	0	<1
Sole, Patrale	<1	<1	<1	<1	<1	<1
Sole, Rex	<1	<1	<1	0	<1	<1

Table 1. cont.

SPECIES	%1981	%1982	%1983	%1984	%1985	%1986
Sole, Rock	<1	<1	<1	<1	<1	<1
Sole, Sand	<1	<1	<1	<1	<1	<1
Sole, Unsp.	<1	<1	<1	<1	<1	<1
Spiny Dogfish	<1	<1	<1	<1	<1	<1
Spotted Cabrilla	<1	0	0	0	0	0
Staghorn Sculpin	<1	0	0	0	0	0
Stingray	0	0	<1	0	0	0
Striped Mullet	<1	<1	<1	<1	<1	<1
Sturgeon	0	0	0	0	<1	0
Surfperch, Barred	0	<1	0	0	0	<1
Surfperch, Black	<1	0	0	<1	0	0
Surfperch, Pile	0	<1	0	0	0	0
Surfperch, Redtail	0	0	0	0	<1	0
Surfperch, Shiner	<1	0	0	0	<1	0
Surfperch, Unsp.	<1	1	<1	<1	<1	<1
Surfperch, Walleye	0	0	0	0	0	<1
Surfperch, White	<1	0	0	<1	<1	<1
Swordfish	7	12	16	29	20	15
Thornyhead	<1	<1	<1	<1	<1	<1
Triggerfish	0	0	<1	<1	<1	0
Tuna, Albacore	<1	<1	1	2	3	2
Tuna, Bigeye	<1	<1	<1	<1	<1	<1
Tuna, Blk. Skjack	0	0	0	0	<1	0
Tuna, Bluefin	<1	<1	<1	<1	<1	<1
Tuna, Skipjack	<1	<1	<1	<1	0	0
Tuna, Unsp.	<1	<1	<1	<1	<1	<1
Tuna, Yellowfin	<1	<1	<1	<1	<1	<1
Turbot	<1	<1	<1	<1	<1	<1
Wahoo	0	<1	<1	0	<1	0
Whelk	0	<1	0	0	<1	0
White Croaker	8	8	3	1	5	5
Yellowtail	2	<1	<1	1	1	<1
Zebraperch	0	0	0	0	0	<1

Source: National Marine Fisheries Service, Southwest Region

Table 2. Percent of total landings and total revenues by major species groups comprising entangling net landings 1981 - 86.

Species	%1981 Total Land/Rev	%1982 Total Land/Rev	%1983 Total Land/Rev	%1984 Total Land/Rev	%1985 Total Land/Rev	%1986 Total Land/Rev
Bass, White Sea	7/11	1/1	1/1	1/1	1/1	1/1
Halibut, CA	8/17	7/13	5/8	5/8	5/11	5/11
Opah	<1/<1	1/<1	1/<1	3/1	2/1	1/<1
Pac. Bonito	2/1	<1/<1	1/<1	<1/<1	4/<1	1/<1
Rkfish, Bocaccio/ Chilipepper/Reds	4/2	8/3	7/3	14/5	15/8	26/11
Rockfish Unsp.	20/12	21/10	29/11	13/5	15/7	16/7
Shark, Bonito	2/2	4/3	3/2	2/1	1/1	2/2
Shark, Com. Thr.	18/17	21/19	14/12	11/9	7/9	3/4
Shark, Pac. Angel	2/1	2/1	2/1	4/2	6/3	7/4
Shark, Soupfin	2/1	2/1	1/1	2/1	1/1	1/1
Shark, Unsp.	5/5	2/1	1/1	<1/<1	<1/<1	<1/<1
Swordfish	7/23	12/40	20/53	29/61	20/50	15/47
White Croaker	8/3	8/3	3/1	1/<1	5/2	5/3
Total Landings (tons)	5130	5674	5042	5518	9063	8283
Total Revenues ($1,000)	7911	9841	9313	12428	15629	13883

Source: National Marine Fisheries Service, Southwest Region

Table 3. Percentage of total entanglement net landings of major species by specific net type[1] 1981 - 86.

Species	1981 Net Type				1982 Net Type				1983 Net Type				1984 Net Type				1985 Net Type				1986 Net Type			
	60	61	65	66	60	61	65	66	60	61	65	66	60	61	65	66	60	61	65	66	60	61	65	66
Bass, White Sea	5	0	13	82	0	5	2	93	0	1	1	98	79	0	0	21	97	0	1	2	95	0	3	2
Halibut, CA	2	22	1	76	0	20	0	80	0	20	0	80	62	7	0	31	93	3	0	4	95	3	0	2
Opah	0	0	37	63	0	0	38	62	0	0	16	84	55	0	7	38	87	0	9	4	86	0	12	2
Rkfish, Bocaccio/ Chilipepper/Reds	0	0	2	98	1	0	2	97	0	2	0	98	53	0	0	47	96	0	0	4	99	0	0	1
Rockfish Unsp.	0	0	1	99	0	1	0	99	0	1	0	99	39	0	0	60	92	0	0	8	96	0	0	4
Shark, Bonito	0	0	57	43	0	0	38	62	0	0	21	78	69	0	9	21	84	0	12	4	87	0	11	2
Shark, Com. Thr.	0	0	57	42	0	0	35	65	0	0	14	86	52	0	10	38	80	0	11	9	88	0	9	2
Shark, Pac. Angel	0	21	1	78	0	25	0	75	0	18	0	82	64	5	2	29	97	1	0	2	99	0	0	1
Shark, Soupfin	0	6	9	86	0	9	3	88	0	15	2	84	73	2	1	25	89	2	1	7	96	3	0	0
Shark, Unsp.	2	2	39	57	0	6	4	91	0	7	4	89	12	1	4	84	65	7	6	22	93	5	1	2
Swordfish	0	0	59	41	0	0	23	77	0	0	18	82	56	0	14	31	84	0	8	7	92	0	5	3
White Croaker	0	0	5	95	0	0	0	100	0	0	1	99	66	0	0	33	93	0	0	7	99	0	0	1
Percent total landings all species	<1	3	21	75	<1	3	13	83	0	3	7	90	52	1	6	41	88	0	3	9	96	0	2	2

1. Net type 60 = unspecified
61 = trammel net
65 = drift gill net
66 = set gill net

Source: National Marine Fisheries Service, Southwest Region

Table 4. Percentage of Annual entangling net Landings of all commercial landings in California by market category, 1981-1985.

	California Commercial Landings (tons)									
Market Category	1981 Total Commercial Landings	Percent Entangling	1982 Total Commercial Landings	Percent Entangling	1983 Total Commercial Landings	Percent Entangling	1984 Total Commercial Landings	Percent Entangling	1985 Total Commercial landings	Percent Entangling
Salmon	3011	0	4001	0	1205	0	1489	0	2323	0
Dover Sole	10176	0	11080	0	9429	0	10778	0	13248	0
Pertrale Sole	886	<1	872	0	631	0	651	<1	944	<1
English Sole	1884	<1	1610	0	1293	0	1049	0	1171	<1
Other Sole	1088	<1	914	<1	821	<1	704	<1	1141	<1
Ca & Pac. Halibut	627	67	607	67	564	44	554	53	628	74
Other Flatfish	872	6	853	5	599	3	686	2	896	5
Pac. Ocean Perch	11	0	28	0	58	0	16	0	4	0
Yellowtail RK	*	*	*	*	*	*	*	*	160	23
Widow RK	*	*	*	*	*	*	*	*	*	*
Other Rk	21948	6	29114	6	22002	9	19283	8	12988	24
Ling & Pac. Cod	1417	1	1990	4	984	8	1050	3	766	14

Table 4. cont.

Market Category	California Commercial Landings (tons) 1981 Total Commercial Landings	Percent Entangling	1982 Total Commercial Landings	Percent Entangling	1983 Total Commercial Landings	Percent Entangling	1984 Total Commercial Landings	Percent Entangling	1985 Total Commercial landings	Percent Entangling
Thorny-heads	*	*	*	*	*	*	2335	0	3243	<1
Sablefish	7351	0	10509	0	7286	<1	5318	0	5653	<1
Pacific Whiting	734	0	1126	0	1081	0	2574	0	3302	<1
N. Anchovy	57597	0	46462	0	4879	0	3205	0	1792	0
Mackerels	58594	<1	61378	<1	56548	<1	58463	<1	49215	<1
Pac. Bonito	8292	1	3031	<1	4077	1	3090	<1	3045	10
Albacore Tuna	10773	0	16384	<1	15504	<1	21623	<1	10196	2
Yellowfin Tuna	83551	0	78541	<1	69109	<1	39396	<1	16562	<1
Skipjack Tuna	64924	0	98186	0	98516	<1	45130	<1	3772	0
Other Tuna	2420	<1	4610	<1	977	4	4697	<1	5551	<1
Sharks	2147	74	2139	86	1675	70	1806	63	1951	77
Billfish	547	64	846	82	1338	75	2238	72	2598	69
Other Roundfish	1539	69	1798	39	1361	26	1893	22	2016	42
Pink Shrimp	2045	0	2275	0	576	0	829	<1	1691	0

Table 4. cont.

Market Category	California Commercial Landings (tons) 1981 Total Commercial Landings	Percent Entangling	1982 Total Commercial Landings	Percent Entangling	1983 Total Commercial Landings	Percent Entangling	1984 Total Commercial Landings	Percent Entangling	1985 Total Commercial Landings	Percent Entangling
Other Shrimp	327	0	624	0	639	0	1041	<1	1365	<1
Dungeness Crab	5108	0	3487	0	2687	0	2670	0	3105	<1
Other Crab	690	<1	648	<1	722	3	868	4	891	5
Other Crustaceans	513	0	415	0	300	0	322	0	336	<1
Clams	39	0	226	0	173	0	232	0	328	0
Oysters	*	*	555	0	21	0	0	0	0	0
Squid	25763	0	17977	0	2010	<1	622	0	11326	2
Abalone	546	0	620	0	420	0	414	0	412	0
Other Mullusks	247	0	134	0	120	0	59	0	57	0
Scallops	68	0	3	0	0	0	0	0	0	0
Echinoderms	12454	0	9721	0	8896	0	7525	0	9999	0
Misc.	92	45	306	12	95	26	70	26	107	7

Table 4. cont.

Market Category	California Commercial Landings (tons) 1981 Total Commercial Landings	Percent Entangling	1982 Total Commercial Landings	Percent Entangling	1983 Total Commercial Landings	Percent Entangling	1984 Total Commercial Landings	Percent Entangling	1985 Total Commercial landings	Percent Entangling
Fish Roe	0	0	0	0	0	0	1	0	1	0
Algae & Kelp	*	0	*	*	*	*	1	0	0	0

Sources:

Huppert, Thomson and Iacometti, 1984; Huppert and Thomson, 1985, 1986; Korson and Thomson, 1987.
National Marine Fisheries Service, Southwest Region.

Notes * = not reported.

Table 5. Total landings (tons) and percentages taken by recreational(R)[1], fisherman; entangling nets (E)[2] and other commercial gear (O)[3], 1981 - 1986.

Market Category	Percent Estimated Catch/Landings of Total Landings 1981 R	E	O	TOTAL	1982 R	E	O	TOTAL	1983 R	E	O	TOTAL	1984 R	E	O	TOTAL	1985 R	E	O	TOTAL	1986 R	E	O	TOTAL
Other Salmon	*	0	100	3011	*	0	100	4001	*	0	100	1205	*	0	100	1489	*	0	100	2323	*	0	100	3802
Dover Sole	0	0	100	10176	*	0	100	11080	*	0	100	9429	*	0	100	10778	*	0	100	13248	*	a	99	12183
Petrale Sole	*	1	99	886	*	0	100	872	*	0	100	631	*	a	99	651	*	a	99	948	*	a	99	800
English Sole	*	a	99	1865	*	0	100	1610	*	0	100	1293	*	0	100	1049	*	a	99	1159	*	a	99	1193
Other Sole	*	a	100	1077	a	a	99	914	a	a	99	821	a	a	99	704	a	a	99	1141	a	a	99	1177
CA & Pac. Halibut	24	51	25	821	24	51	25	794	a	44	56	564	15	45	40	651	28	53	19	878	33	41	26	917
Other Flatfish	22	5	73	1124	10	5	85	950	14	3	83	694	4	2	94	718	6	5	89	951	4	5	91	786
Pacific Ocean Perch	*	0	100	11	*	0	100	28	*	0	100	58	*	0	100	16	*	0	100	16	*	0	100	2
Yellowtail Rockfish	98	2	*	454	99	a	*	1367	99	a	*	636	99	1	*	428	22	2	76	1954	37	10	53	838
Widow	*	*	*	*	99	1	*	202	79	21	*	72	86	14	*	99	2	8	90	3333	2	13	85	2678

Table 5. cont.

Percent Estimated Catch/Landings of Total Landings

Market Category	1981 R	E	O	TOTAL	1982 R	E	O	TOTAL	1983 R	E	O	TOTAL	1984 R	E	O	TOTAL	1985 R	E	O	TOTAL	1986 R	E	O	TOTAL
Other Rockfish	18	5	77	26888	18	5	77	35516	15	8	78	25736	16	7	77	22975	26	18	56	17564	25	23	52	16298
Ling & Pac. Cod	43	a	57	2474	27	3	70	2744	35	5	60	1521	29	2	69	1484	56	6	38	1737	61	8	31	1480
Thorny-heads	*	100	*	1	*	100	*	1	*	100	*	1	*	0	*	2335	*	a	99	3243	*	a	99	3247
Sable-fish	a	0	100	7351	*	0	100	10509	a	a	99	7285	a	0	100	5318	a	a	99	5617	a	2	98	6793
Pacific Whiting	a	0	100	734	a	0	100	1126	a	0	100	1081	a	0	99	2574	a	a	99	3356	1	a	98	3332
Northern Anchovy	*	0	100	57597	*	0	100	46462	a	0	99	4879	*	0	100	3205	a	0	99	1792	*	0	100	1692
Mackerals	2	0	98	49571	3	0	97	62625	2	0	98	57519	2	a	97	59400	3	a	96	50008	2	a	97	59149
Pacific Bonito	13	a	86	9540	23	a	76	3947	28	a	71	5671	31	a	68	4541	9	9	82	3339	76	6	24	1100
Albacore Tuna	*	a	99	10773	*	a	99	16384	b	a	99	15504	b	a	99	21623	b	2	97	10196	b	a	95	3624

Table 5. cont

Market Category	1981 R	1981 E	1981 O	1981 TOTAL	1982 R	1982 E	1982 O	1982 TOTAL	1983 R	1983 E	1983 O	1983 TOTAL	1984 R	1984 E	1984 O	1984 TOTAL	1985 R	1985 E	1985 O	1985 TOTAL	1986 R	1986 E	1986 O	1986 TOTAL
	Percent Estimated Catch/Landings of Total Landings																							
Other Tuna	*	a	99	2420	*	a	99	4610	25	3	72	1299	19	a	80	5878	15	a	84	6590	8	a	91	5907
Sharks	a	74	26	2147	a	86	14	2139	10	63	27	1842	a	63	37	1806	12	68	20	2229	a	45	54	2438
Billfish	*	64	36	547	*	82	18	846	*	75	25	1339	*	72	28	2238	*	67	33	2598	*	63	37	1923
Other Roundfish	64	25	11	4217	64	14	22	5010	71	18	21	4713	59	9	32	4655	56	18	26	4554	73	13	14	5563
Clams	*	0	100	39	*	0	100	226	*	0	100	173	*	0	100	232	*	0	100	378	*	0	100	17
Oysters	*	0	*	0	*	0	100	555	*	0	100	21	*	0	0	0	*	0	0	0	*	0	0	0
Squid	*	0	100	25763	*	0	100	17977	*	a	100	2009	*	0	100	622	*	2	98	11376	*	a	99	23454
Abalone	*	0	100	546	*	0	100	620	*	0	100	420	*	0	100	414	*	0	100	412	*	0	100	308
Other Mollusks	*	0	100	247	*	0	100	134	*	0	100	120	*	0	100	59	*	0	100	57	*	0	100	19
Scallops	*	0	100	68	*	0	100	3	*	0	0	0	*	0	0	0	*	0	0	0	*	0	0	0
Echino-derms	*	0	100	12454	*	0	100	9271	*	0	100	8896	*	0	100	7525	*	0	100	9999	*	0	100	17109

Table 5. cont.

Market Category	Percent Estimated Catch/Landings of Total Landings																							
	1981				1982				1983				1984				1985				1986			
	R	E	O	TOTAL	R	E	O	TOTAL	R	E	O	TOTAL	R	E	O	TOTAL	R	E	O	TOTAL	R	E	O	TOTAL
Fish Roe	*	0	0	0	*	0	0	0	*	0	0	0	*	0	100	1	*	0	100	1	*	0	0	0
Algae & Kelp	*	0	*	0	*	0	*	0	*	0	*	0	*	0	100	1	*	0	*	0	*	0	0	0
Total	4	1	95	397964	3	1	95	423903	4	2	96	327387	1	2	97	250393	6	5	89	185158	6	5	89	203145

Sources:

1. U.S. Department of Commerce; 1984, 1985, 1986, 1987.
2. National Marine Fisheries Service, Southwest Region.
3. Huppert, Thomson and Iacometti, 1984; Huppert and Thomson, 1985, 1986; Korson and Thomson, 1987/ California Department of Fish and Game.

Notes: * = none reported,
a = less that 1%,
b = reported as other tuna.

Table 6. Selected finfish species in catch compositions from entanglement net observer programs, 1981 - 1986

Species	1980-82 Drift[1] Gill Net	1980-82 S.Ca[2] Set Net	1980-82 Cen.Ca[3] Set Net	1983 Drift[1] Gill Net	1983 S.Ca[2] Set Net	1983 Cen.Ca[3] Set Net	1984 Drift[1] Gill Net	1984 S.Ca[2] Set Net	1984 Cen.Ca[3] Set Net	1985 Drift[1] Gill Net	1985 S.Ca[2] Set Net	1985 Cen.Ca[3] Set Net	1986 Drift[1] Gill Net	1986 S.Ca[2] Set Net	1986 Cen.Ca[3] Set Net
Bass, kelp	yes	NA	NA	yes	yes	NA	yes	yes	NA	no	yes	no	NA	NA	no
Bass, striped	no	NA	NA	no	no	NA	no	no	NA	no	no	yes	NA	NA	yes
Croaker, spotfin	no	NA	NA	no	yes	NA	no	no	NA	no	yes	no	NA	NA	no
Croaker, yellowfin	no	NA	NA	no	yes	NA	no	yes	NA	no	yes	no	NA	NA	no
Greenling, rock	no	NA	NA	no	no	NA	no	no	NA	no	no	yes	NA	NA	yes
Greenling, white spot	no	NA	NA	no	no	NA	no	no	NA	no	no	yes	NA	NA	yes
Hagfish, Pacific	no	NA	NA	no	yes	NA	no	no	NA	no	yes	yes	NA	NA	yes
Irish Lord	no	NA	NA	no	no	NA	no	no	NA	no	no	yes	NA	NA	yes
Marlin	yes	NA	NA	yes	no	NA	yes	no	NA	yes	no	no	NA	NA	no
Midshipmen, plainfin	no	NA	NA	no	yes	NA	no	yes	NA	no	yes	yes	NA	NA	yes

Table 6. cont.

Species	1980-82 Drift[1] Gill Net	1980-82 S.Ca[2] Set Net	1980-82 Cen.Ca[3] Set Net	1983 Drift[1] Gill Net	1983 S.Ca[2] Set Net	1983 Cen.Ca[3] Set Net	1984 Drift[1] Gill Net	1984 S.Ca[2] Set Net	1984 Cen.Ca[3] Set Net	1985 Drift[1] Gill Net	1985 S.Ca[2] Set Net	1985 Cen.Ca[3] Set Net	1986 Drift[1] Gill Net	1986 S.Ca[2] Set Net	1986 Cen.Ca[3] Set Net
Midshipman, specklefin	no	NA	NA	no	yes	NA	no	yes	NA	no	yes	no	NA	NA	no
Ray, Pac. electric	no	NA	NA	no	yes	NA	no	yes	NA	yes	yes	yes	NA	NA	yes
Salmon, chinook	no	NA	NA	no	no	NA	no	no	NA	no	no	yes	NA	NA	yes
Salmon, coho	no	NA	NA	no	no	NA	no	no	NA	no	no	yes	NA	NA	yes
Stargazer, smooth	no	NA	NA	no	yes	NA	no	yes	NA	no	yes	no	NA	NA	no
Tongefish, CA	no	NA	NA	no	no	NA	no	no	NA	no	no	yes	NA	NA	yes

Notes:

[1]Source: Diamond et al; 1987.

[2]Source: Collins et al; 1984, 1985, 1986.

[3]Source: Wild; 1986, 1987.

Table 7. Crosstabulation of principle gear by principle species for vessels holding special California drift gill net permits: each cell shows the percentage of permitted vessels, 1981-85 inclusive, having the corresponding principle gear and principle species.

		Principle Gear						
		Unknown	Hook & Line	Misc.	Harpoon	Trawl Nets	Entangling nets	
Principle Species	Swordfish	4.3	.4	.3	4.6	.1	48.0	57.6
	Rockfish	.4		.1		.3	9.9	10.7
	CA Halibut		.3				1.8	2.1
	W. Seabass						1.8	1.8
	Crustaceans			2.6				2.6
	Tuna	.1	5.0	.5			5.1	6.1
	Sharks	.3					7.1	7.3
	Other	.7	1.2	4.7		1.4	3.8	11.7
Column Total		5.7	6.8	8.2	4.6	1.8	72.8	100.0

Source: National Marine Fisheries Service, Southwest Fisheries Center

Table 8. Cross tabulation between number of gears used by a vessel and number of different species landed by the vessel, for vessels holding special California drift gill net permits in one or more of the years 1981-1985. Each cell shows the precentage of permitted vessels by the number of gears fished and the number of species landed.

Number of Species	Number of Gears: 0	1	2	3	4	5	6	7	Row Total
1	.3	3.0	.4	.3					4.0
2		.3	1.8	.3					2.4
3		1.2	1.8	.8	.8				4.6
4	.4	1.3	2.7	2.0	.7				7.1
5	.4	1.7	2.7	2.9	1.7	.3			9.7
6		1.0	4.0	4.0	3.8	.8	.1		13.7
7	.1	.8	3.4	6.0	2.9	1.7	.3		15.2
8		2.0	4.3	7.4	5.2	2.1	.3		21.3
9		.1	2.7	2.9	2.7	1.7	1.2	.1	11.4
10		.4	.5	1.7	2.2	.9	.1	.1	5.9
11		.1	.5	1.2	.7	.5	.3		3.3
12			.1	.5	.4	.3	.1		1.4
13						.1			.1
Column Total	1.2	11.9	25.2	29.9	21.0	8.3	2.3	.3	100.0

Source: National Marine Fisheries Service, Southwest Fisheries Center

Table 9. Marine mammal and sea bird kill rates observed in California entangling net fisheries, 1983-86.

Species	Annual Observed Kill Rates[1] 1983	1984	1985	1986
A. Southern California Nearshore Set Net Fisheries[2]				
Birds				
Cormorant	.003	.019	.001	NA
Grebe	.000	.004	.000	NA
Guillemot	.000	.000	.008	NA
Unspecified	.000	.002	.003	NA
Total	.002	.025	.013	NA
Mammals				
Dolphin, common	.010	.004	.001	NA
Dolphin, Pac. white-sided	.000	.000	.001	NA
Sea lion, CA	.029	.027	.049	NA
Seal, harbor	.003	.012	.019	NA
Total	.042	.042	.070	NA
Observed Sets	596	523	882	NA
B. Central California Set Net Fisheries[3]				
Birds				
Cormorants	NA	.043	.048	.168
Murre, common	NA	1.293	2.298	1.860
Fulmars	NA	.000	.000	.016
Grebes	NA	.005	.005	.006
Guillemots	NA	.027	.005	.121
Loons	NA	.003	.010	.012
Murrelets	NA	.000	.000	.002
Scoters	NA	.024	.007	.002
Shearwaters	NA	.000	.167	.000
Total	NA	1.395	2.539	2.185
Mammals				
Dolphin, Pac. white-sided	NA	.000	.002	.000
Porpoise, harbor	NA	.040	.067	.027
Sea lion, CA	NA	.022	.007	.004
Sea lion, stellar	NA	.000	.000	.002
Seal, elephant	NA	.005	.010	.010
Seal, harbor	NA	.062	.086	.119
Total	NA	.129	.172	.160
Observed Sets	NA	372	419	514

Table 9. cont.

C. Drift Gill Net Fishery[4]

	1983[5]	1984	1985	1986
Birds	.000	.000	.000	NA
Mammals				
Dolphin, common	.068	.000	.106	NA
Dolphin, northern right whale	.000	.000	.015	NA
Sea lion, CA	.023	.085	.015	NA
Seal, elephant	.000	.028	.030	NA
Seal, harbor	.000	.000	.015	NA
Whale, minke	.023	.000	.015	NA
Whale, beaked	.000	.000	.030	NA
Total	.114	.113	.197	NA
Observed Sets	44	71	66	NA

D. All Entangling Net Fisheries

	1983	1984	1985	1986
Birds				
All	.003	.551	.826	2.185
Mammals				
All	.047	.081	.108	.160
Observed Sets	640	966	1,367	514

Notes:

[1]Kill rate = observed animals dead/number of observed sets.

[2]Source: Collins et al; 1984, 1985, 1986.

[3]Source: Wild; 1985, 1986, 1987.

[4]Source: Diamond et al; 1987.

NA = not available

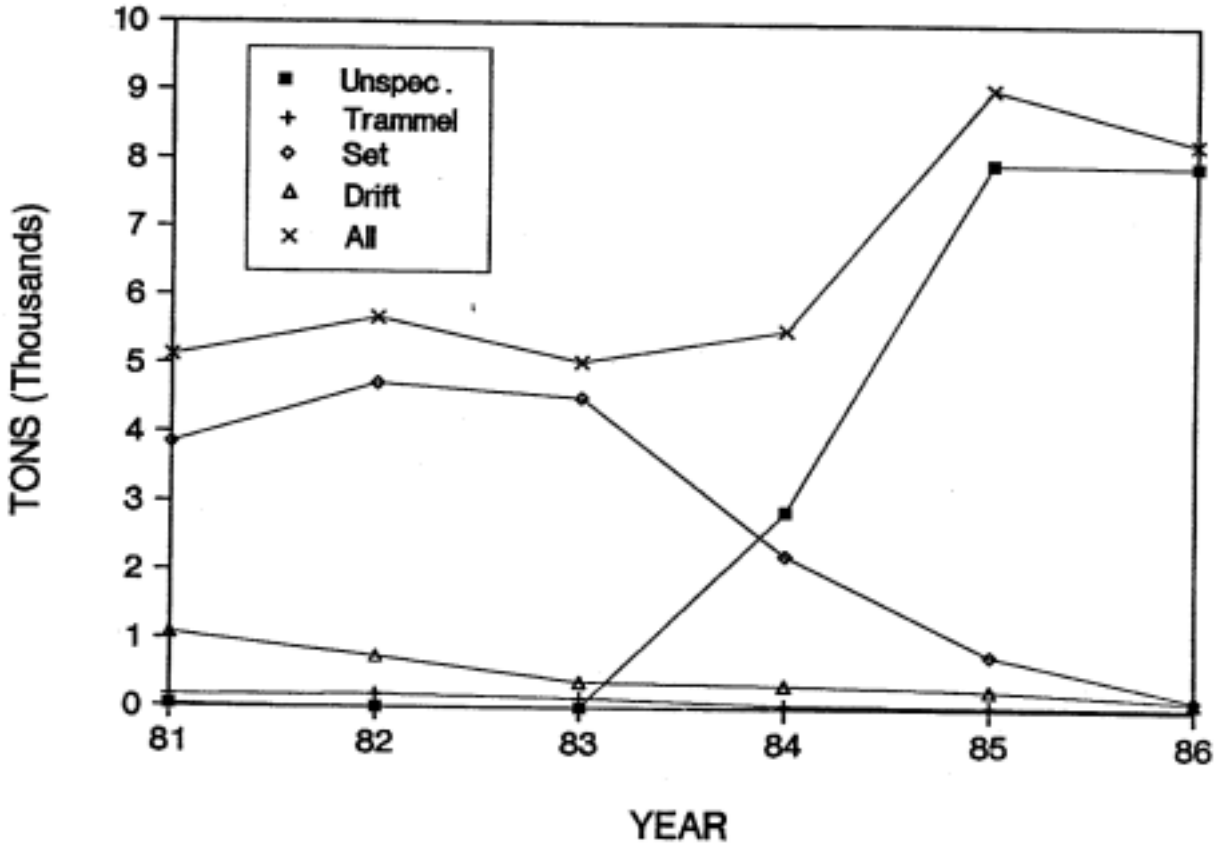

Figure 1. Entangling net catch by net type 1981-86.

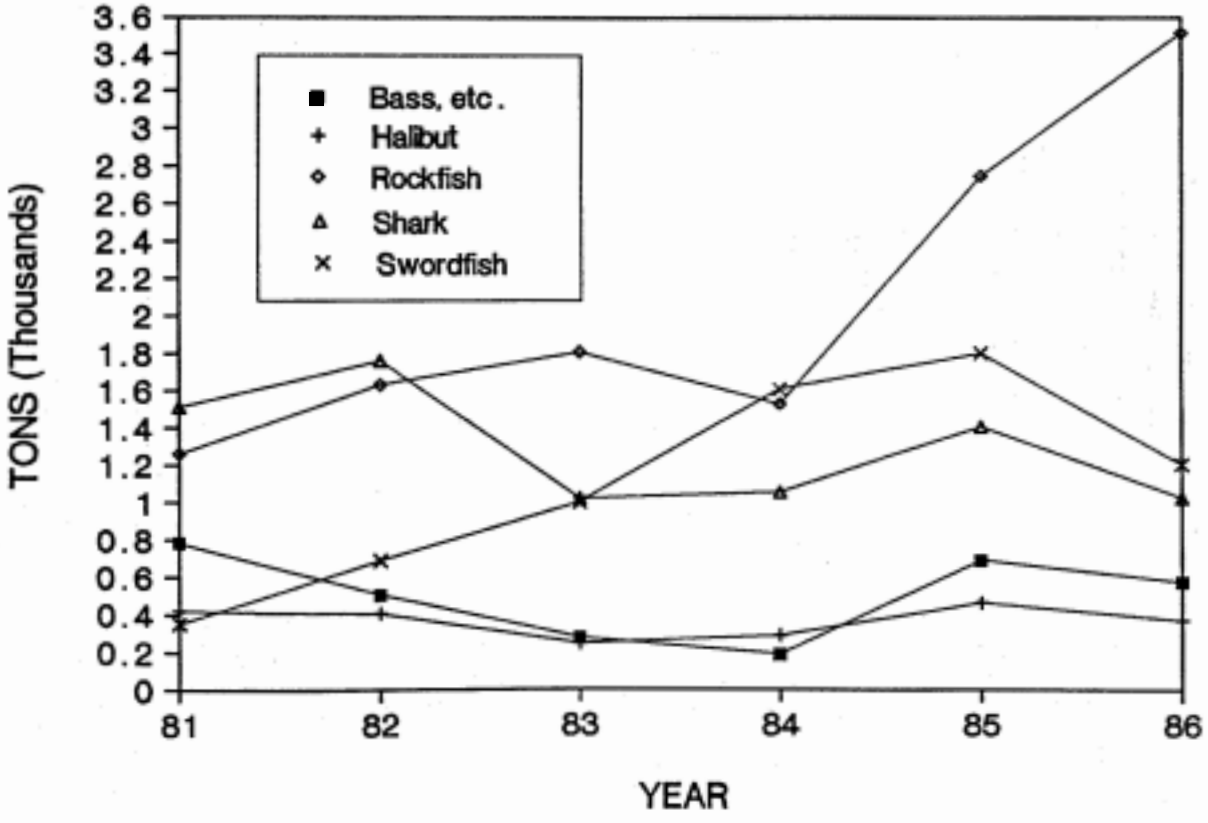

Figure 2. Entangling net landings by species/species group, 1981-86.

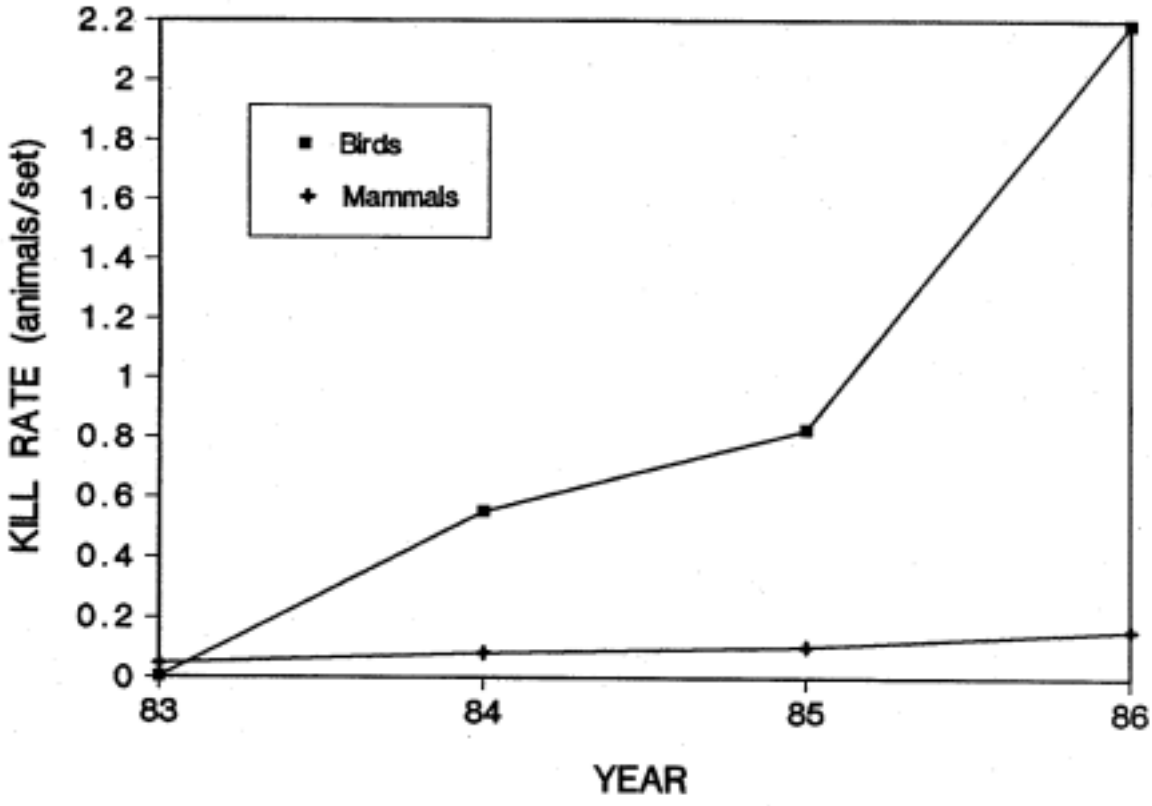

Figure 3. Entangling net seabird and marine mammal kill rates 1983-86.

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