

**U.S. SWORDFISH FISHERIES IN
THE NORTH PACIFIC OCEAN¹**

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INTRODUCTION

The United States is a major harvesting and consuming nation for swordfish (*Xiphias gladius*), with 3,920 t harvested from the Pacific Ocean, Atlantic Ocean and Gulf of Mexico in 2002 (NMFS, Fisheries Statistics and Economics Division, 2003). The U.S. North Pacific Ocean swordfish fisheries accounted for approximately 49% of the total U.S. domestic production in 2002 at 1,901 t which was down 21% from the previous year.

1. FISHERIES AND CATCHES

U.S. swordfish fisheries of the North Pacific Ocean are characterized by three distinct gear types (harpoon, drift gill net, and longline), and each has exhibited periods of increase, peak, and decline in effort and landings. Harpoon fishing for swordfish is the oldest of the three, with a long history that dates back to the early 1900s (Coan et al., 1998). This fishery primarily supplied the local market for swordfish until the late 1970s. The swordfish market expanded and harpoon landings reached a record high in 1978, subsided to a more typical level the following year, and remained at relatively low levels thereafter (Fig. 1). The California drift gill net fishery began in 1980 then expanded and replaced the harpoon fishery as the dominant swordfish fishery on the U.S. West Coast after only one year. Drift gill net landings grew rapidly, peaked in 1985 and then decreased, although 1992 and 1993 yielded relatively high landings. Swordfish-directed longlining began in Hawaii in 1988, grew rapidly to peak in 1993, and remained the largest U.S. swordfish fishery in the North Pacific Ocean from 1990 through 2000. It was replaced by the California-based longline fishery as the largest fishery in 2001 and 2002. The gear used to catch swordfish in California could not be determined; landings from such records are listed under “other” fishing gear landings (Table 1). In certain years, this “other” landings was substantial, especially in 1985 and 1986.

California Harpoon Fishery

The California harpoon fishery started in the early 1900s. The number of harpoon vessels peaked at 309 in 1978 (Fig. 2). Participation dropped below 200 vessels in the early 1980s and continued to decline into the late 1990's. There were only 29 active vessels in 2002.

Harpoon gear consists of a handle about 3-5 m long attached to a metal shank approximately 0.6 m long, which is tipped with a removable bronze or iron dart (Coan et al., 1998). The dart is attached to a mainline 15-46 m long, which terminates with floats and markers. Harpoon fishermen search for swordfish at the sea surface. The prevalent method is to sight swordfish while they are "finning" or basking on the surface in blue/green water of 12°-26°C. When a fish is spotted and harpooned, the handle is pulled free from the dart and the main line, marker flag, and floats are played out until free from the vessel. The fish is allowed to tire itself before being hauled aboard.

The fishing area extends from San Diego to San Francisco (Coan et al., 1998). The fishery begins in April or May in waters off San Diego, peaks in July or August, and ends in December in waters off San Francisco. The fishery also has small catches of sharks, mainly common thresher sharks (*Alopias vulpinus*).

Harpoon landings have been recorded since 1918. Harpoon landings of swordfish varied substantially ranging from 16 t in 1991 to 1,699 t in 1978 and was 90 t in 2002 (Table 1).

Harpoon fishery swordfish CPUE (number of fish per day) was higher for vessels that used spotter aircraft than for vessels that did not, except for 1980 through 1983 when spotter aircraft use was low (Coan et al., 1998). Combined swordfish CPUE (with and without aircraft) varied from 0.12 fish per day in 1983 to 0.46 fish per day in 1978 (Fig. 3) and was 0.43 fish per day (0.20 without aircraft and 0.75 with aircraft) in 2002.

California Drift Gill Net Fishery

The California drift gill net fishery for sharks (common thresher shark, *Alopias vulpinus*, and shortfin mako shark, *Isurus oxyrinchus*) and swordfish developed in the late 1970s (Hanan et al., 1993). The fishery was originally directed toward sharks, but changed in the early 1980s when regulations allowed for greater landings of swordfish. Incidental catches include tunas and other pelagic fish. Interactions with marine mammals and turtles also occur in this fishery (Herrick and Hanan 1988). The number of active drift gill net vessels peaked at 220 during 1985-86 and decreased to record low of 45 vessels during 2001-2002 (Fig. 4). California Department of Fish and Game (CDFG) currently limits the participants in the fishery to 150 permitted vessels.

Drift gill nets used in this fishery are made of 3-strand twisted nylon with 33-48 cm mesh size (Hanan et al., 1993). They range in length from 1.5-1.8 km long and are set 5.5-7.9 m below the surface. The nets are set in the evenings and retrieved before sunrise. The drift gill net

fishery begins in May of one year and continues until March or April of the next year, but peak swordfish catches usually occur in October and November. Fishing is concentrated in the Southern California Bight (waters off Point Conception down to Mexico) but can extend past San Francisco and the San Clemente Islands as far north as Oregon, with swordfish caught primarily within 200 miles of shore.

Swordfish landings by the drift gill net fishery grew from 160 t in 1980, peaked at 2,368 t in 1985 and declined thereafter. Swordfish landings by the drift gill net fishery was a record low 302 t in 2002 (Table 1).

Drift gill net CPUE rose from 0.6 swordfish per set in 1981-82 and peaked at 2.7 swordfish per set in the 1984-85 season (Fig. 5). Drift gill net CPUE ranged between 1.5 fish and 2.7 thereafter with CPUE at 0.6 fish in 2001-2002.

Hawaii-based Longline Fishery

The number of Hawaii-based longline vessels increased rapidly in the late 1980s and early 1990's as U.S. longliners from the Gulf of Mexico and the Atlantic swordfish fisheries joined the Hawaii-based longline fishery. Swordfish longline techniques from the Atlantic Ocean were introduced to Hawaii by this group of fishermen and helped establish Hawaii as a major producer of swordfish. The number of active Hawaii-based longline vessels rose from 37 vessels in 1987 and peaked at 141 vessels in 1991 (Fig. 6). A federal moratorium implemented in 1991 limited the number of longline permits to 167 in light of this rapid expansion. Some longline vessels during this time fished exclusively for swordfish throughout the entire year, but activity directed towards swordfish has since declined. The moratorium on permits was replaced with a limited entry program in 1994 which capped participation in Hawaii's longline fishery at 164 vessels. There were 100 active longline vessels in 2002. None targeted swordfish due to the prohibition of "shallow longlining". The Hawaii-based longline fleet now sets their gear "deep" and targets tunas exclusively.

Longline gear consists of a single continuous mainline with floats attached to the mainline supporting the gear horizontally in the water column. Branchlines with baited hooks are attached to the mainline between the floats. There are two basic techniques used when vessel operators target either swordfish (shallow set) or tunas (deep set). The technique used to target swordfish does not employ the use of a line thrower because the gear is set relatively shallow. Vessels targeting swordfish typically set longline gear in the evening, attach 2-5 hooks between floats, use squid for bait, attach chemical lightsticks to the branchlines, and haul gear the following morning. The other technique used to target tunas requires a line thrower, which sets the longline with a sag between floats. Vessels targeting tunas usually set the longline gear in the morning with 15-30 or more hooks between floats, use sanma for bait, use no lightsticks, and haul gear in the afternoon. Though the deep set longline technique is used to target tunas, it does catch swordfish incidentally.

A lawsuit was filed by the Earthjustice Legal Defense Fund against NMFS in U.S. District Court in February 1999 on behalf of two non-government organizations, the Center for Marine Conservation (now called the Ocean Conservancy) and the Turtle Island Restoration Network. The lawsuit was concerned about interactions between longline gear and sea turtles. Several regulations imposed by Court order with the intention of reducing turtle interactions affected swordfish-directed longline effort. The regulations that had the most impact on swordfish-directed effort were those that closed prime swordfish fishing grounds north of the main Hawaiian Islands on 27 December 1999 and limited the number of swordfish-directed sets on 23 June 2000. The final Environmental Impact Statement (EIS), approved on March 31, 2001, replaced the Court order regulations and prohibited shallow longline fishing using lightsticks, which essentially ended swordfish-directed longline effort by this fishery. In order to avoid these new restrictions, some Hawaii-based longline vessels that targeted swordfish relinquished their federal Hawaii longline limited entry permits and relocated to California to continue fishing for swordfish. Other fishermen opted to stay in Hawaii and comply with the new regulations by reconfiguring their gear to fish deep for tunas. As a consequence, there was a higher level of effort and swordfish catch in California during 1999-2002 as well as record bigeye tuna catches by the Hawaii-based longline fishery in 2002.

The Hawaii-based longline fishery was the largest producer of swordfish of all the U.S. North Pacific Ocean swordfish fisheries from 1990 through 2000. Swordfish landings² from this fishery began to increase in 1989 when a few vessels successfully targeted swordfish. Effort increased rapidly thereafter with swordfish catch peaking at 5,909 t in 1993 (Table 1). Swordfish catch dropped to 3,176 t the following year and stabilized with catch ranging from 2,502 t to 3,263 t throughout 1994-2000. Swordfish catch by the Hawaii-based longline fishery decreased significantly to 220 t and 204 t in 2001 and 2002, respectively, as a result of the prohibition on shallow sets to reduce sea turtle interactions. Other species typically caught by the Hawaii-based longline fishery include bigeye tuna (*Thunnus obesus*), yellowfin tuna (*T. albacares*), albacore (*T. alalunga*), marlins (Istophoridae), mahimahi (*Coryphaena hippurus*), moonfish (*Lampris guttatus*), ono (*Acanthocybium solandri*), pomfrets (Bramidae) and blue sharks (*Prionace glauca*).

Swordfish CPUE (number of fish per 1,000 hooks) vary substantially depending on targeting practice (Fig. 7). Swordfish CPUE for trips that specifically targeted swordfish ranged from 10.3 fish in 1994 to 15.4 fish in 1991 and 1997. Swordfish CPUE was 11.7 in 2001, the last year in which CPUE for this trip type and mixed trip type was available. Swordfish-targeted trips usually had the highest swordfish CPUE during the first and second quarters and lowest CPUE in the third quarter. Mixed target trips had intermediate swordfish CPUE throughout 1991-2001³, but like swordfish targeted trips that set gear shallow, this type of fishing was also

²Swordfish landings is based on estimated whole weight. The conversion factor for processed swordfish (typically landed without head, guts, and tail) was 1.45.

³Hawaii-based longline trips are categorized as swordfish, tuna, and mixed based on targeting information provided by vessel captains or by operational characteristics.

prohibited. Tuna-targeted trips had negligible swordfish CPUE relative to the two other trip types but was the only measure of longline swordfish CPUE still available. Tuna trip swordfish CPUE was 0.1 fish per 1000 hooks in 2002.

California-based Longline Fishery

The California-based longline fishery began in 1991 when 3 vessels based in San Pedro fished waters outside the U.S. EEZ (Vojkovich and Barsky, 1998). The longline fleet increased substantially to 31 vessels in 1994. Participation in the California-based longline fishery peaked at 44 vessels in 2000 (Fig. 8). The California-based longline fleet is composed predominantly of vessels that targeted swordfish in Hawaii and migrated to California as a result of the turtle interaction lawsuit. The configuration of the swordfish longline gear in the California-based longline fishery is the same as the Hawaii-based longline fishery.

Incidental catches in the California-based longline fishery include: sharks, yellowfin tuna (*Thunnus albacares*), bluefin tuna (*Thunnus thunnus oreintalis*), bigeye tuna (*Thunnus obesus*), albacore (*Thunnus alalunga*), mahimahi (*Coryphaena hippurus*), moonfish (*Lampris guttatus*), and oilfish (Gempylidae). Marlins are also caught but CDFG regulations prohibit landing them. Although interactions with marine mammals, birds, and turtles are seldom reported in logbooks submitted by fishermen, there is some evidence that these species are also caught incidentally.

Swordfish landings by the California-based longline fishery have increased dramatically from 1999. The California-based longline fishery was the largest U.S. swordfish fishery in the North Pacific Ocean in 2001 and 2002. Swordfish landings by the California-based longline fishery peaked at 1,908 t in 2000 and were 1,302 t in 2002 (Table 1).

California-based longline CPUE (fish per 1000 hooks) varied 3.5-fold (6.3 to 22.1 fish) throughout 1994-2000 (Fig. 9). Preliminary longline CPUE was a record 22.4 fish in 2002. Longline effort typically increases during the last quarter of each the year but the fishing season extended into the first two quarters in 2002 as some vessels fish above the Hawaiian Islands.

2. DATA SOURCES

Hawaii

There are six sources of data on swordfish in Hawaii: Federal daily longline logbooks; shoreside market sampling; State of Hawaii commercial fishermen catch reports; reports by at-sea observers deployed by NMFS; NOAA ships *Townsend Cromwell* and *Oscar Elton Sette* research cruises; and voluntary tag, release, and recovery information from fishermen (Tables 2 and 3). Each of the six data sets contains unique information that provides insight on the performance of the fishery and the biology and ecology of swordfish as well as other pelagic

species caught. Linking the data sets also allows NMFS scientists to evaluate the accuracy of the data.

All U.S. longline vessels based in Hawaii have been required to maintain a daily Federal longline logbook and submit it after each trip since November 1990. The Federal longline logbook data represents the most complete coverage of all data sets for the Hawaii-based longline fishery. Data recorded in the logbooks include: fishing effort, number of fish caught by species, location, gear configuration, and interactions with protected species. Number of vessels, effort (hooks), catch (in numbers of fish), and CPUE were summarized from logbook data.

Market data on longline landings were first collected by the NMFS in 1987 and contain detailed biological and economic information at the wholesale level. The sample size from the market ranged from 25%- 90% of fish landed by the Hawaii-based longline fishery throughout 1987-2000. Fish sampled at the market and individual fish weights were recorded to the nearest half pound. Weights were raised to an estimated whole weight when processing or damage was observed. Average size, size frequency, and average ex-vessel price by species were summarized from this data set. Sex of fish was not available as most swordfish were landed in processed form (headed, finned, and gutted). This sampling program was replaced by the State of Hawaii's fish dealer report data in 2001. Coverage of market data from the State dealer data is thought to be nearly complete.

The State of Hawaii Division of Aquatic Resources (HDAR) commercial fisheries data have been collected from 1948 to the present. The HDAR requires longline fishermen to submit longline trip reports which list the pelagic species caught. The HDAR longline data includes: number caught, pounds caught, pounds sold and total value for each species.

Data collection by at-sea observers was initiated in 1990 when Hawaii-based longline vessels volunteered to take observers aboard to investigate longline fishery interactions with Hawaiian monk seals (*Monachus schauinslandi*) (Dollar, 1991). A mandatory observer program began in February 1994 (Dollar, 1994) to improve the estimates of incidental take of sea turtles. Observers covered about 5% of the total longline trips from 1994-1999 but coverage increased to a minimum of 20% in the latter part of 2000 through 2002. Data collected are similar to logbook data but contain more detailed observations. These data were used to assess the fleet-wide impact of longlining on protected and endangered species.

Since 1991, the NOAA research vessel *Townsend Cromwell* dedicated one or two research cruises a year to collecting detailed data on swordfish biology and ecology. The cruises deployed standard monofilament longline gear to catch swordfish. Hook timers and time-depth recorders (TDRs) were used to collect information on fishing depth of the gear and on swordfish behavior. Observations on condition of the catch and biological measurements were recorded. Biological samples such as muscle tissue, gonads, stomach, otoliths, and anal fin rays were also collected. Some live swordfish specimens were tagged and released. Oceanographic conditions were monitored with expendable bathythermographs (XBTs), conductivity-temperature depth

(CTD) casts, thermosalinograph (TSG), and acoustic Doppler current profile (ADCP) transects (Boggs, pers. commun.). The *Townsend Cromwell* was decommissioned in 2002 and replaced with the research vessel *Oscar Elton Sette*.

Swordfish tagging is conducted with the voluntary participation of longline fishermen and on research cruises. Tag, release, and recapture information such as names of fishermen, gear type, tagging and recovery location, and size estimates of fish are collected (Kazama, pers. commun.).

California

The California-based longline fishery is monitored through landing receipts, vessel logbooks, and size samples of landings by the CDFG. Landing receipts have been collected since the start of the fishery through a landings receipt system (Table 2). Vessel logbook data were collected on a voluntary basis from 1993 to 1994 before being replaced by a mandatory CDFG logbook system in 1995. Logbook information is recorded by fishermen daily. Positions were entered at the start and finish of each set. Hooks, catch, and bycatch were recorded for tunas, billfish, sharks, and other fish, as well as interactions with marine mammals, turtles, and seabirds. Other information on gear configuration, weather, and sea conditions were also collected. The CDFG longline logbook program was discontinued in 1999 as data reporting became a requirement under the federal High Seas Fisheries Compliance Act. Size sampling of longline-caught swordfish began in 1991 in conjunction with sampling of the drift gill net landings (Childers and Halko 1994, Table 3).

The California drift gill net fishery is monitored through landing receipts, vessel logbooks, size sampling by the CDFG, and an observer program. Landing receipts and mandatory logbooks have been collected since the fishery's inception in 1980 (Table 2). Fishermen are required to record daily operations and catch. Location of operations and catch are recorded in 10 minute squares. The swordfish catch was sampled size at local markets beginning in 1981 (Table 3). An observer program to monitor the drift gill net fishery was initiated and maintained by CDFG from 1980 to 1989 and has continued from 1990 under NMFS. The observer program is used to monitor bycatch, especially of marine mammals.

The California harpoon fishery is also monitored through landing receipts, vessel logbook, and size sampling by the CDFG. Landings have been collected since the early 1900s through a landings receipt system (Table 2). A mandatory vessel logbook system for the harpoon fishery started in 1974. These logbooks were completed daily and allow recording of catches by location using CDFG 10-minute square codes. Information on aircraft assistance, water color, sea surface temperature and condition, harpooning success, and areas searched is also included. Size sampling of swordfish landings began in 1981 in conjunction with the drift gill net sampling (Table 3).

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Table 1.--U.S. North Pacific swordfish landings* (metric tons).

Year	Hawaii	California				Total U.S. North Pacific
	Longline	Longline	Gill net	Harpoon	Other	
1970	5	-	-	612	10	627
1971	1	-	-	99	3	103
1972	0	-	-	171	4	175
1973	0	-	-	399	4	403
1974	0	-	-	406	22	428
1975	0	-	-	557	13	570
1976	0	-	-	42	13	55
1977	17	-	-	318	19	354
1978	9	-	-	1,699	13	1,721
1979	7	-	-	329	57	393
1980	5	-	160	566	62	793
1981	3	1	461	267	20	752
1982	5	2	911	156	43	1,117
1983	5	1	1,321	58	378	1,763
1984	3	14	2,101	96	678	2,892
1985	2	46	2,368	211	792	3,419
1986	2	4	1,594	236	696	2,532
1987	24	4	1,287	211	300	1,826
1988	24	19	1,092	180	344	1,659
1989	218	29	1,050	54	224	1,575
1990	2,436	18	1,028	50	137	3,669
1991	4,508	39	836	16	137	5,536
1992	5,700	95	1,332	74	44	7,245
1993	5,909	165	1,400	169	36	7,679
1994	3,176	740	799	153	8	4,876
1995	2,713	279	755	96	31	3,874
1996	2,502	347	752	81	10	3,692
1997	2,881	664	707	84	3	4,339
1998	3,263	422	924	48	13	4,670
1999	3,100	1,333	606	81	2	5,122
2000	2,949	1,908	646	90	9	5,602
2001	220	1,763	375	52	5	2,415
2002	204	1,302	302	90	3	1,901

Dashes indicate no fishery.

* Based on estimated whole weight and does not include discards.

Table 2.--U.S. North Pacific swordfish catch-effort data catalog.

Year	Country/State	Gear	Data set*	Measurement of catch	Type of effort	Time strata	Geographic resolution
1974	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
1975	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1976	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1977	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1978	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1979	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1980	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1981	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1982	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1983	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1984	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1985	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1986	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1987	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1988	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1989	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---

Table 2 (continued).--U.S. North Pacific swordfish catch-effort data catalog.

Year	Country/State	Gear	Data Set*	Measurement of catch	Type of effort	Time strata	Geographic resolution
1990	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LOGLINE	OBS(V)	NO. FISH	NO. HOOKS	DAY	1 MIN
1991	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LOGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
1992	USA/HI	LOGLINE	OBS(V)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
1993	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LOGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	OBS(V)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
1994	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/CA	LOGLINE	LB	NO. FISH	SETS/HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LOGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
1995	USA/HI	LOGLINE	OBS(M)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
1996	USA/CA	LOGLINE	LB	NO. FISH	SETS/HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LOGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	OBS(M)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN

Table 2 (continued).--U.S. North Pacific swordfish catch-effort data catalog.

Year	Country/State	Gear	Data Set*	Measurement of catch	Type of effort	Time strata	Geographic resolution
1997	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/CA	LOGLINE	LB	NO. FISH	SETS/HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LOGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	OBS(M)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN
1998	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/CA	LOGLINE	LB	NO. FISH	SETS/HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LOGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	OBS(M)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN
1999	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/CA	LOGLINE	LB	NO. FISH	SETS/HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LOGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	OBS(M)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN
2000	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/CA	LOGLINE	LB	NO. FISH	SETS/HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LOGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	OBS(M)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN
2001	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/CA	LOGLINE	LB	NO. FISH	SETS/HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LOGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	OBS(M)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN
2002	USA/CA	GILL NET	LB	NO. FISH	SETS/DAYS	DAY	10 MIN
	USA/CA	GILL NET	OBS(M)	NO. FISH	SETS/DAYS	DAY	1 MIN
	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/CA	LOGLINE	LB	NO. FISH	SETS/HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LOGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	OBS(M)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN

*CR=STATE CATCH REPORT, LB=LOGBOOK DATA, OBS=OBSERVER DATA (V=VOLUNTARY, M=MANDATORY), RC=RESEARCH CRUISE DATA

Table 3.--U.S. North Pacific swordfish size frequency data catalog.

Year	Country/State	Gear	Data set*	Time strata	Type square	Length	Interval	Weight	Interval
1981	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
1982	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
1983	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
1984	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
1985	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
1986	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
1987	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
1988	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
1989	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
1990	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
1991	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
1992	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
1993	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB

Table 3 (continued).--U.S. North Pacific swordfish size frequency data catalog.

Year	Country/State	Data gear	Time set*	Type strata	Square	Length	Interval	Weight	Interval
1994	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	LONGLINE	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/HI	LONGLINE	MKT	LAND DATE	---	N	---	Y	0.5 LB
	USA/HI	LONGLINE	OBS(M)	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	RC	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	TAG	DAY FISH	1 MIN	Y	EST	Y	0.5LB/EST
1995	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	LONGLINE	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/HI	LONGLINE	MKT	LAND DATE	---	N	---	Y	0.5 LB
	USA/HI	LONGLINE	OBS(M)	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	RC	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	TAG	DAY FISH	1 MIN	Y	EST	Y	0.5LB/EST
1996	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	LONGLINE	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/HI	LONGLINE	MKT	LAND DATE	---	N	---	Y	0.5 LB
	USA/HI	LONGLINE	OBS(M)	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	RC	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	TAG	DAY FISH	1 MIN	Y	EST	Y	0.5LB/EST
1997	USA/CA	GILL NET	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	HARPOON	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/CA	LONGLINE	MKT	LAND DATE	10 MIN	Y	1 MM	Y	1 LB
	USA/HI	LONGLINE	MKT	LAND DATE	---	N	---	Y	0.5 LB
	USA/HI	LONGLINE	OBS(V)	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	RC	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	TAG	DAY FISH	1 MIN	Y	EST	Y	0.5LB/EST
1998	USA/HI	LONGLINE	MKT	LAND DATE	---	N	---	Y	0.5 LB
	USA/HI	LONGLINE	OBS(M)	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	RC	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	TAG	DAY FISH	1 MIN	Y	EST	Y	0.5LB/EST
1999	USA/HI	LONGLINE	MKT	LAND DATE	---	N	---	Y	0.5 LB
	USA/HI	LONGLINE	OBS(V)	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	RC	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	TAG	DAY FISH	1 MIN	Y	EST	Y	0.5LB/EST
2000	USA/HI	LONGLINE	MKT	LAND DATE	---	N	---	Y	0.5 LB
	USA/HI	LONGLINE	OBS(M)	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	RC	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	TAG	DAY FISH	1 MIN	Y	EST	Y	0.5LB/EST

*MKT=MARKET DATA, OBS=OBSERVER DATA (V=VOLUNTARY, M=MANDATORY), RC=RESEARCH CRUISE DATA, TAG=TAGGING STUDIES

Table 3 (continued).--U.S. North Pacific swordfish size frequency data catalog.

Year	Country/State	Data gear	Time set*	Type strata	Square	Length	Interval	Weight	Interval
2001	USA/HI	LONGLINE	MKT	LAND DATE	---	N	---	Y	0.5 LB
	USA/HI	LONGLINE	OBS(M)	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	RC	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	TAG	DAY FISH	1 MIN	Y	EST	Y	0.5LB/EST
2002	USA/HI	LONGLINE	MKT	LAND DATE	---	N	---	Y	0.5 LB
	USA/HI	LONGLINE	OBS(M)	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	RC	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LONGLINE	TAG	DAY FISH	1 MIN	Y	EST	Y	0.5LB/EST

*MKT=MARKET DATA, OBS=OBSERVER DATA (V=VOLUNTARY, M=MANDATORY), RC=RESEARCH CRUISE DATA, TAG=TAGGING STUDIES

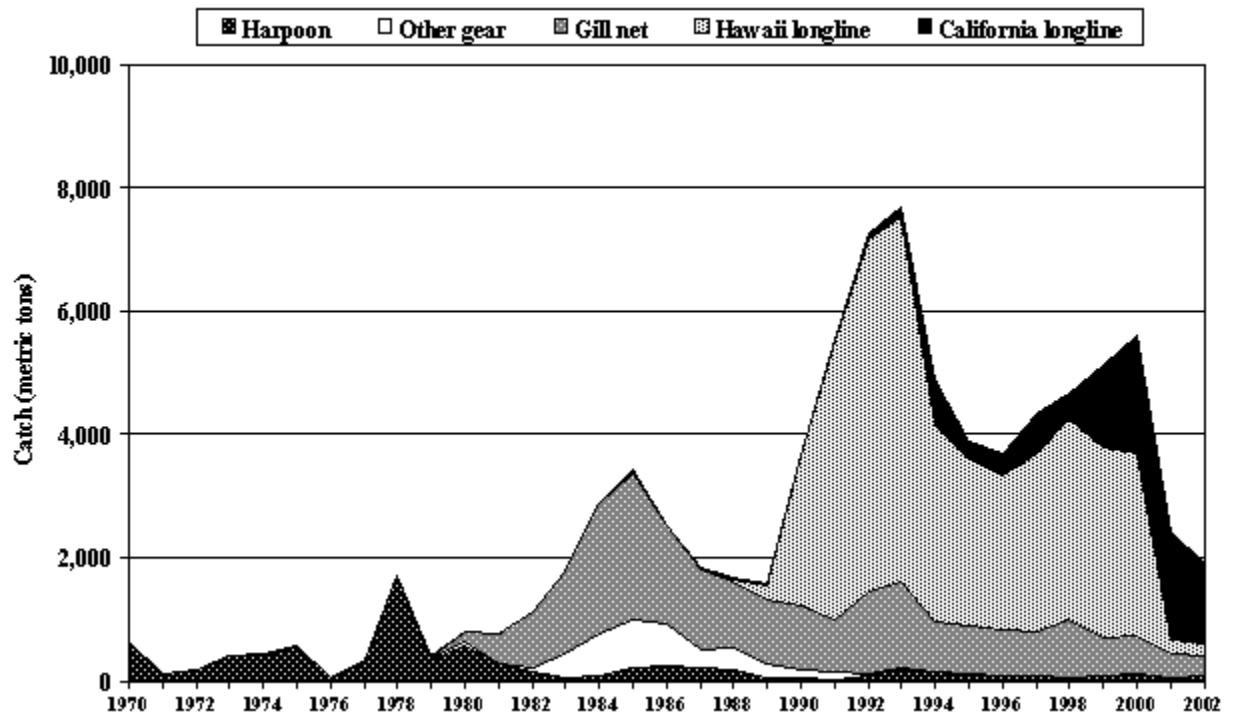


Figure 1.—Catch by the U.S. swordfish fisheries of the North Pacific Ocean, 1970-2002.

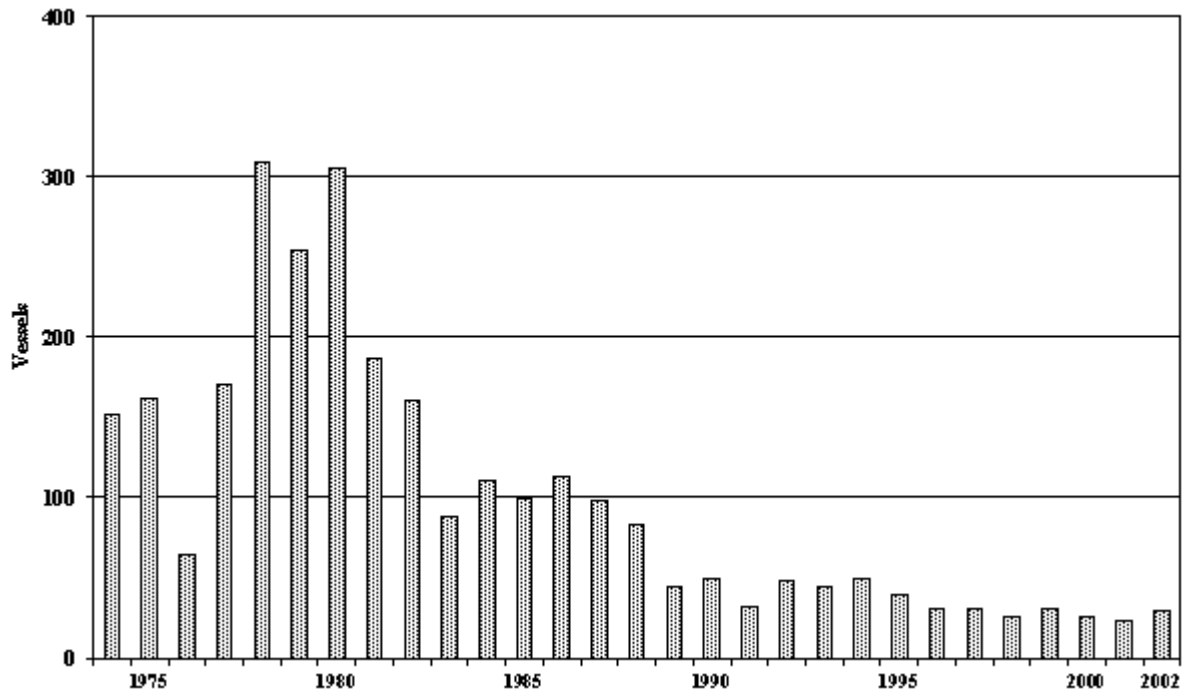


Figure 2.--Number of California harpoon vessels, 1974-2002.

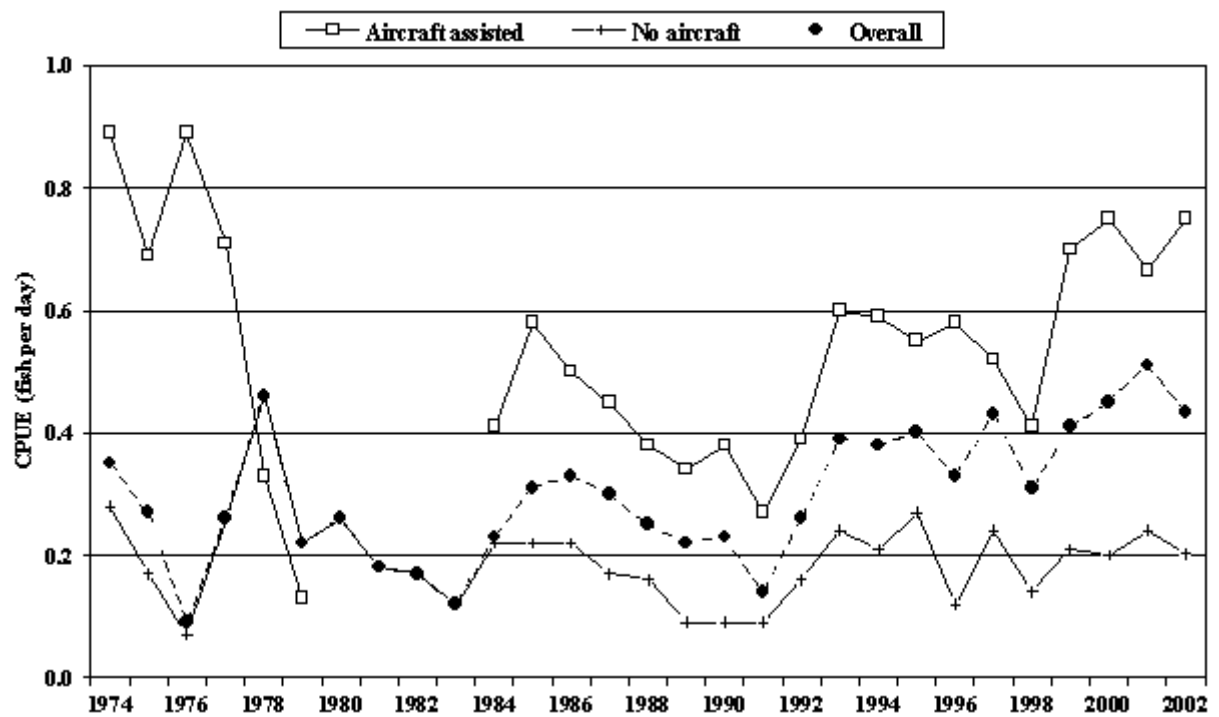


Figure 3.--California harpoon fishery swordfish catch-per-unit-effort (CPUE), 1974-2002.

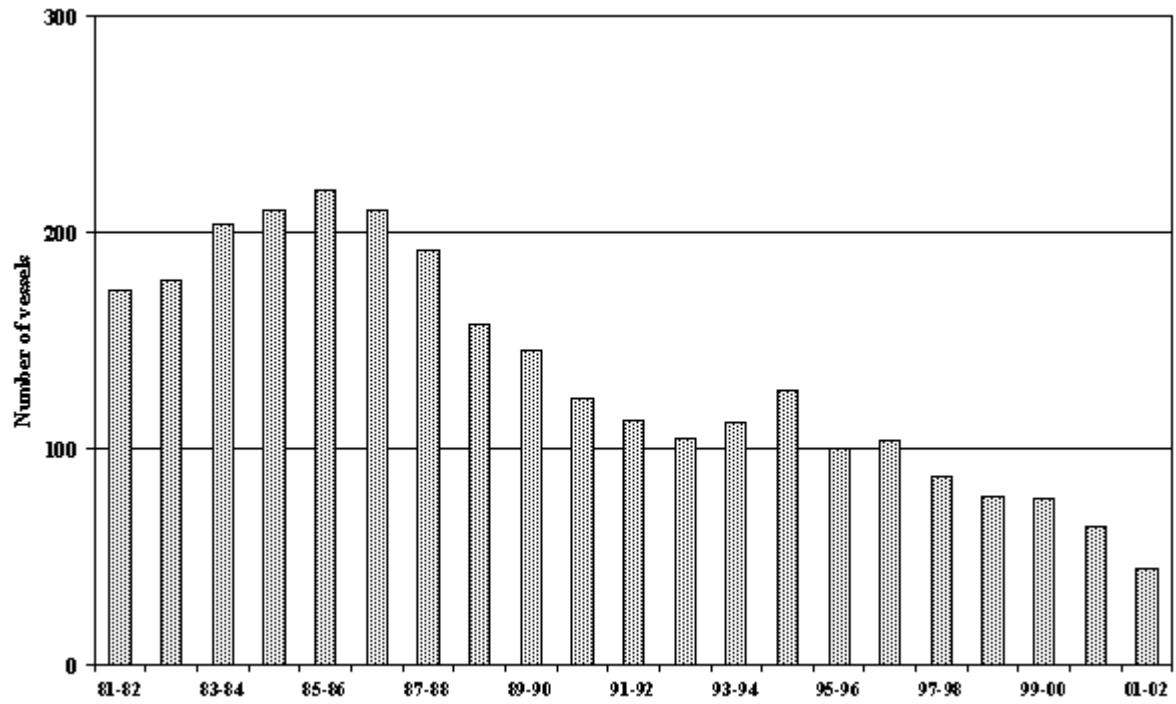


Figure 4.--Number of California drift gill net vessels, 1981-1982 through 2001-2002.

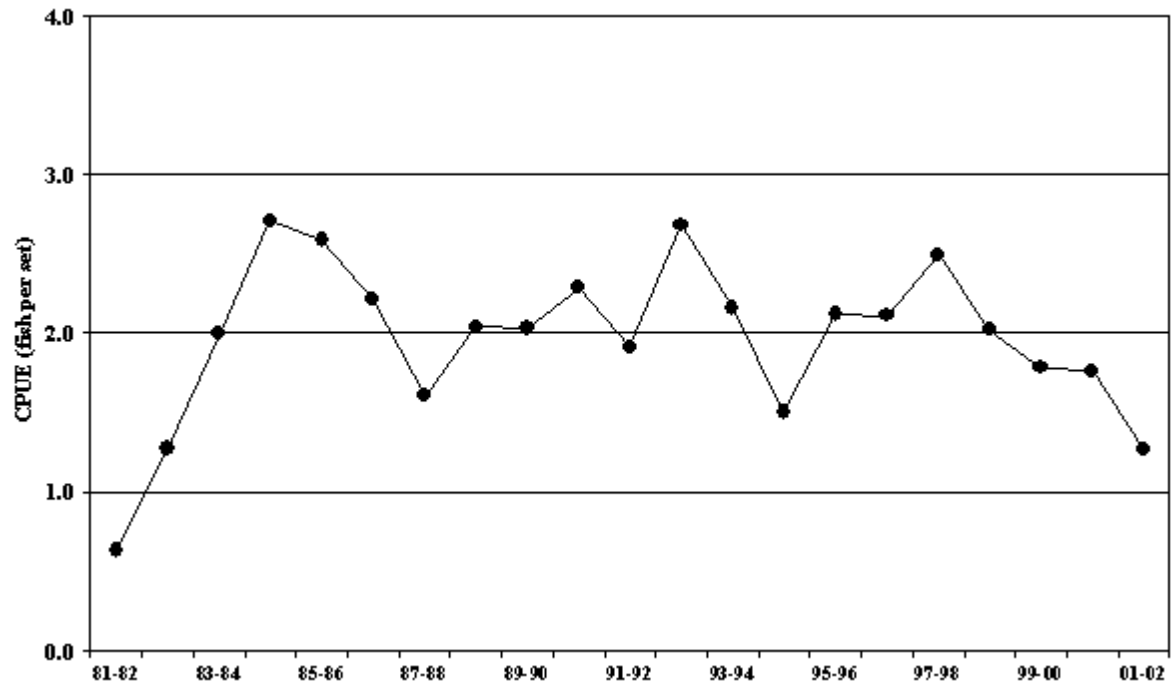


Figure 5.--California drift gill net fishery swordfish catch-per-unit-effort (CPUE), 1981-1982 through 2001-2002.

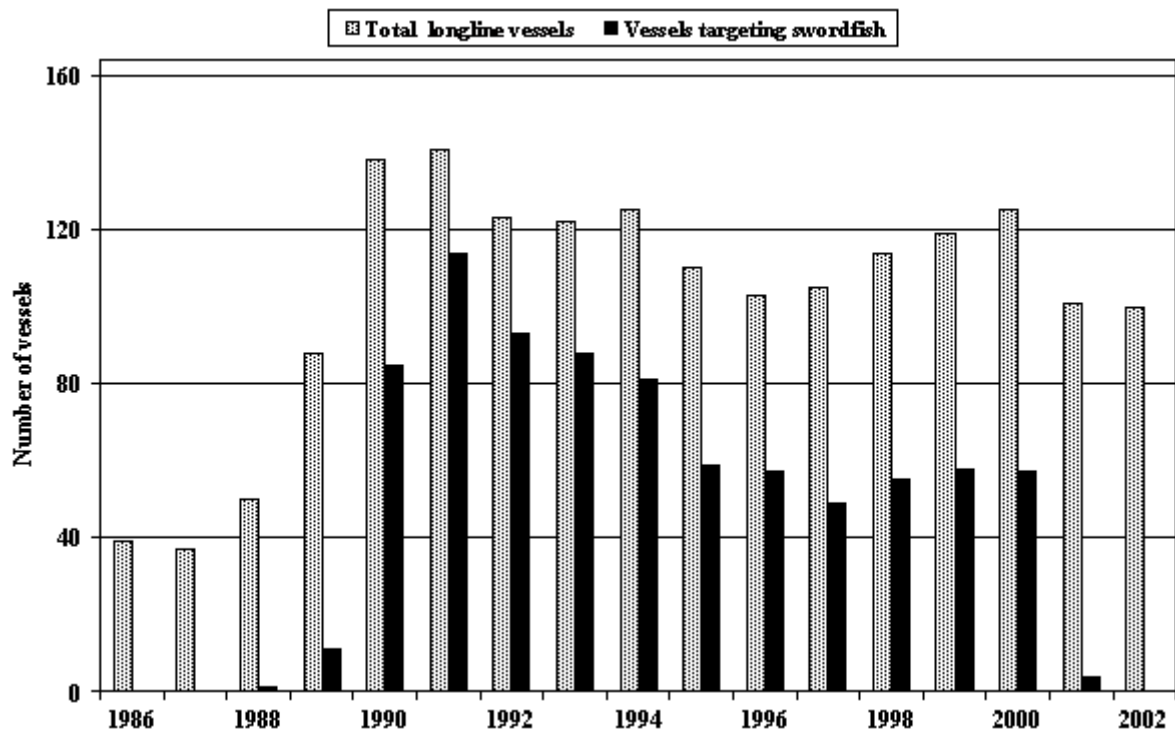


Figure 6.—Total number of active Hawaii-based longline vessels and longliners targeting swordfish, 1986-2002.

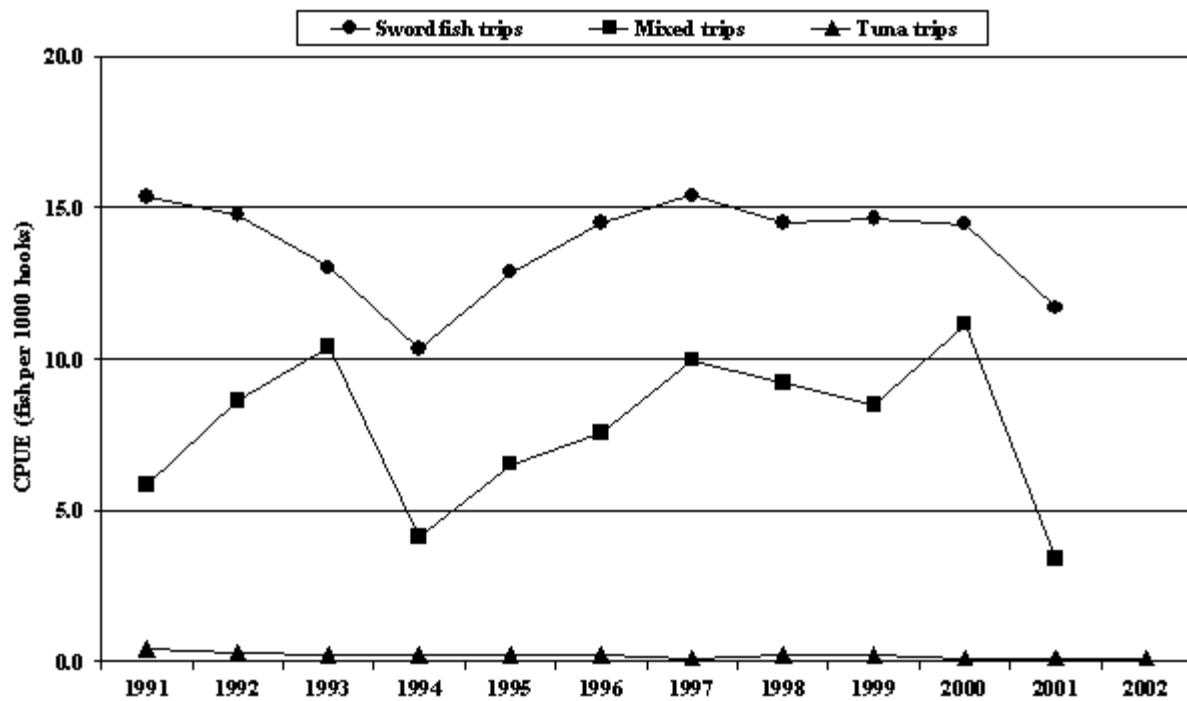


Figure 7.—Hawaii-based longline catch-per-unit-effort (CPUE) for swordfish by trip type, 1991-2002.

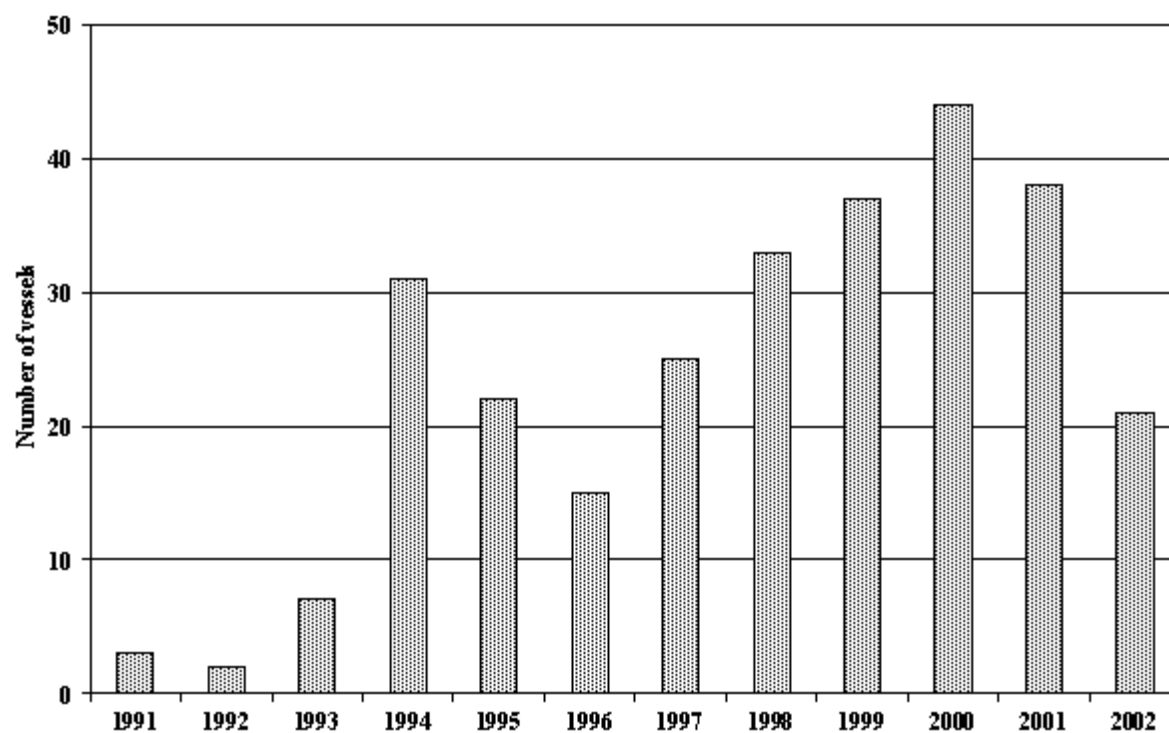


Figure 8.—Number of California longline vessels, 1991-2002.

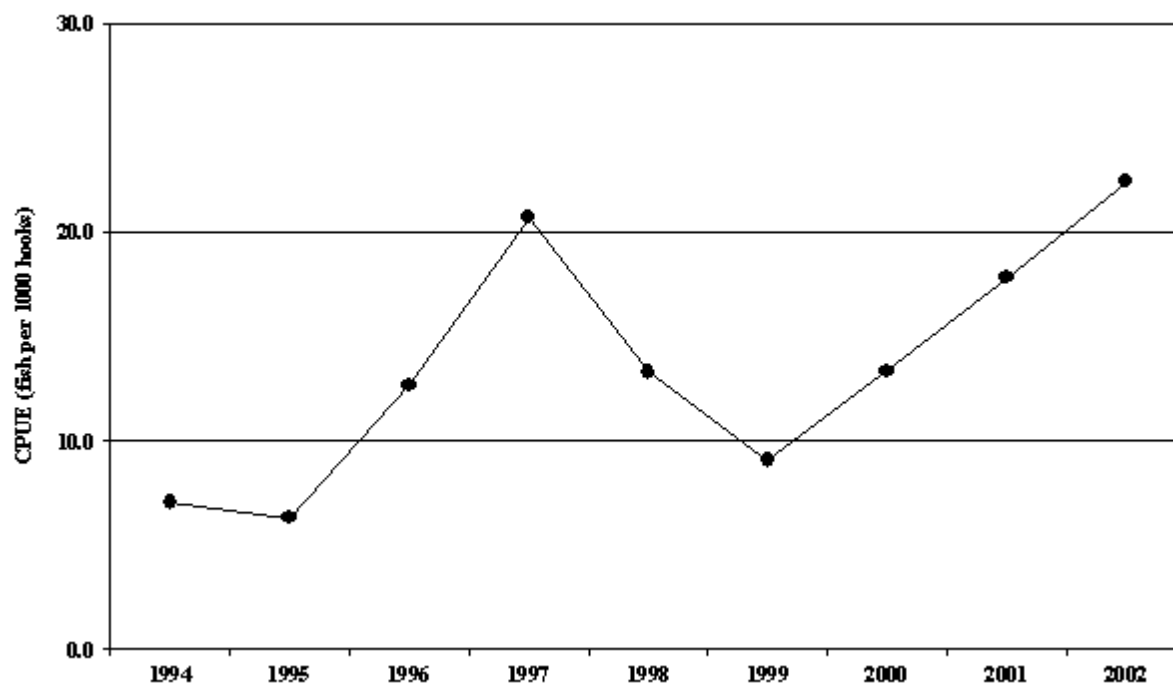


Figure 9.—California-based longline catch-per-unit-effort, 1994-2002.