

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*). U.S. fisheries in the Atlantic Ocean, Gulf of Mexico, and Pacific Ocean harvested 2,896 metric tons (mt) in 2004 (NMFS, Fisheries Statistics and Economics Division, 2005). Of this total, 1,031 mt (36%) were taken by the U.S. North Pacific Ocean fisheries. This report summarizes historical trends and recent developments in the several U.S. North Pacific Ocean fisheries harvesting swordfish.

FISHERIES AND CATCHES

U.S. swordfish fisheries of the North Pacific Ocean can be categorized according to three distinct types of gear used: harpoon, drift gill net, and longline. Harpoon fishing is the oldest practice of the three, dating back to the early 1900's (Coan et al., 1998). The harpoon fishery primarily supplied the local market for swordfish in California until the late 1970s. 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 but expanded rapidly enough to replace the harpoon fishery as the largest U.S. swordfish fishery after only one year. Drift gill net landings continued to increase to a peak in 1985, but then began to decrease, although 1992 and 1993 yielded relatively high landings.

Swordfish-directed longline fishing began in Hawaii in 1988 and the associated catch grew rapidly to a peak in 1993. This longline fishery was, by far, the largest U.S. swordfish fishery in the North Pacific Ocean from 1990 through 2000. Longline vessels also operated out of California, recording above average landings from 1999-2004 and replacing Hawaii as the largest U.S. fishery for swordfish during 2001-2004. The Hawaii-based longline fishery was the largest producer of swordfish in 2005. Occasionally, California swordfish landing records do

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not specify the type of gear used. Landings from such records were categorized under “other” fishing gear. In certain years, especially during 1984-86, landings by “other” gear were substantial (Table 1).

California Harpoon Fishery

Harpoon gear consists of a handle about 3-5 m long attached to a metal shank approximately 0.6 m long 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 at 12°-26°C. When a fish is spotted and harpooned, the handle is pulled free from the dart and the mainline, marker flag, and floats are played out until free from the vessel. The fish is allowed to tire itself before being hauled aboard.

The California harpoon fishery started in the early 1900s, with landings recorded since 1918. 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 26 active vessels in 2005.

The fishing area typically ranges from San Diego to San Francisco but sometimes extends as far north as Oregon (Coan et al., 1998). Most fishing effort occurs within 200 miles of shore. The fishery usually begins in April or May in waters off San Diego, peaks in July or August, and ends in December in waters off San Francisco.

Harpoon landings of swordfish have varied by more than two orders of magnitude, ranging from 16 t in 1991 to 1699 in 1978. The preliminary estimate of swordfish landings by this fishery in 2005 is 50 t (Table 1). The fishery also has small catches of sharks, mainly common thresher sharks (*Alopias vulpinus*).

Harpoon catch-per-unit-effort (CPUE) is measured as number of fish per day. One important factor in the harpoon fishery is the use (or lack thereof) of spotter aircraft. Swordfish CPUE for vessels using spotter aircraft is about twice that of vessels that do not (Fig. 3). Aircraft were not used from 1978 through 1983 (Coan et al., 1998). The trends in swordfish CPUE for vessels using spotter aircraft and those not using aircraft assistance are similar, varying roughly in parallel, with the aircraft assisted CPUE higher. In 2004, swordfish CPUE values for harpoon vessels with and without aircraft assistance were 0.86 and 0.27, respectively.

California Drift Gill Net Fishery

Drift gill nets used in this fishery are made of 3-strand twisted nylon with 33-48 cm mesh size, with float and lead lines (Hanan et al., 1993). The drift gill net is stored on a large net reel. The length of the gill net ranges from 1.5-1.8 km. Fishing depth is controlled by tying buoy lines (5.5-7.9 m long) from the float line to bumper-balls at regular intervals. The nets are set in the evenings and retrieved before sunrise.

The California drift gill net fishery began in the late 1970s, with common thresher shark and shortfin mako shark (*Isurus oxyrinchus*) as the target species. Swordfish also has been a large component of the catch (Hanan et al., 1993). Swordfish catch by this fishery was initially low, but increased in the early 1980s when regulations were changed to allow for greater landings of swordfish. The number of active drift gill net vessels peaked at 220 during 1985-86, decreased to record low of 34 vessels during 2003-2004, and increased slightly to 38 vessels in 2004-2005 (Fig. 4). The California Department of Fish and Game (CDFG) currently limits the number of participants in the fishery to 150 permitted vessels.

Drift gill net fishing effort is concentrated in the Southern California Bight (waters off Point Conception down to Mexico), but can extend northward of San Francisco and San Clemente Island to Oregon. Most of the fishing effort occurs within 200 miles of shore. The drift gill net fishery begins in May and lasts about 10 months with peak swordfish catches in October and November.

Swordfish landings by the drift gill net fishery grew from 160 mt in 1980 to a peak of 2,368 mt in 1985 and declined thereafter. Swordfish landings by the drift gill net fishery were relatively low in the past two years, with a estimated record low catch of 148 mt in 2005 (Table 1). The drift gill net fishery also had incidental catches of other pelagic species that included tunas. Interactions with marine mammals and turtles also occur in this fishery (Herrick and Hanan 1988).

Drift gill net CPUE is measured as number of fish per set. Drift gill net CPUE rose from 0.6 swordfish per set in 1981-82 to a peak at 2.7 swordfish per set in the 1984-85 season (Fig. 5). This peak level was reached again in the 1992-93 season. Drift gill net CPUE declined after the 1992-93 season to 1.1 fish per set in the 2003-2004 season, then doubled to 2.2 in 2004-2005.

Hawaii-based Longline Fishery

Longline gear consists of a single mainline about 30 to 80 km in length with floats attached to the mainline to support the gear horizontally in the water column. Branch lines with baited hooks are attached to the mainline between the floats. Different techniques are used when vessel operators target swordfish (on shallow sets) and tunas (deep sets). Vessels targeting swordfish typically set the longline gear in the evening and haul the following morning, attach 2-5 hooks between floats, use mackerel or mackerel-like bait, and attach chemical lightsticks to the branch lines. The gear is set relatively shallow so a line thrower is not needed. In contrast, vessels targeting tunas usually set the longline gear in the morning and haul in the afternoon, use 15-30 (or more) hooks between floats, sanma or sardines for bait, no lightsticks, and employ a line thrower, which causes the longline to sag between floats, thereby resulting in a "deep set". The Hawaii-based longline fishery was limited to the deep set longline technique from 2002 through 2003. As a result, only tunas were targeted with a small incidental catch of swordfish.

Swordfish longlining techniques from Florida were introduced to the Hawaii fleet by the fishing vessel *Magic Dragon* (Ito et al., 1998) and soon thereafter Hawaii developed into a major

producer of swordfish. The number of Hawaii-based longline vessels increased rapidly from 37 in 1987 to 141 in 1991 as U.S. longliners from the Gulf of Mexico and the Atlantic swordfish fisheries joined the Hawaii-based fleet (Fig. 6). To control the fleet expansion, a federal moratorium was imposed in 1991, limiting the number of longline permits to 167. Vessel participation has never reached that limit. The moratorium was replaced with a limited entry program in 1994 which capped participation in Hawaii's longline fishery at 164 vessels. Since then, the number of participating longline vessels has ranged from 100 to 125, with 124 vessels active in 2005.

A lawsuit filed against NMFS by the Earthjustice Legal Defense Fund in February 1999 resulted in Federal Court orders intended to reduce the interactions between longline gear and sea turtles. The first order, issued on December 27, 1999, closed prime swordfish fishing grounds north of the main Hawaiian Islands. The second order, issued on June 23, 2000, limited the number of swordfish-directed sets in the fishery. The Court-ordered regulations were replaced by rules under a final Environmental Impact Statement (EIS) approved on March 31, 2001. These EIS rules prohibited shallow longline fishing using lightsticks and temporarily halted swordfish-directed longline effort by this fishery. In response to these new restrictions, some Hawaii-based longline vessels relocated to California, and continued fishing for swordfish. Others opted to stay in Hawaii and reconfigured their gear to fish for tunas. The consequences of these changes were increased swordfish catches in California from 1999 to 2004 and increased bigeye tuna catches in Hawaii from 2002 to 2004.

The Hawaii-based longline fishery for swordfish reopened in April 2004 under new regulations promulgated by NMFS. As with the aforementioned court orders, the new regulations were intended to minimize interactions between longline gear and sea turtles. They included a limit of 2,120 shallow sets per year, controlled through transferable shallow-set certificates (one certificate per set) issued to, and traded amongst, eligible Hawaii longline limited access permit holders. They required that vessels notify NMFS of an intent to deploy shallow sets before any fishing trip and that vessel operators make sets only of the type declared (i.e., shallow sets or deep sets) throughout the trip. They required that all vessels intending to make shallow sets carry a NMFS observer. They established annual limits on the numbers of interactions with leatherback (*Dermochelys coriacea*) and loggerhead (*Caretta caretta*) sea turtles with mandatory fishery closures when either limit is reached. Finally, they imposed regulations on hook types, bait types, and setting and hauling operations, and required that vessels carry turtle de-hooking devices.

The California-based longline fishery for swordfish was closed in 2004 about the time that the Hawaii-based fishery was reopened. This resulted in relocation of most of the California-based vessels back to Hawaii. However, this move occurred after the height of the typical season for swordfish in Hawaii, which is usually the first half of the year. Many vessel operators were reluctant to engage in the newly opened fishery because of high fuel prices, high costs for supplies, an inadequate supply of bait, and lack of experience with the newly approved techniques. In 2004, catch by the California-based longline fishery declined by 50% and the swordfish catch by the Hawaii fleet remained low, with only 5 vessels targeting swordfish.

In 2005, the first year under the new management regime in which the Hawaii-based longline fleet could target swordfish during a complete fishing season, 30 Hawaii-based longline vessels engaged in the fishery. Over 3 times as many vessels targeted tuna with deep-set gear. For the Hawaii-based fleet as a whole, longline operations ranged from the equator to 40° N latitude and from 135° W to 180° W longitude.

Since 1991, the total range of the Hawaii-based fleet has extended from the equator to 50° N latitude and from 130° W to 175° E longitude. Effort by the fleet has been increasing in recent years, with a record 34.9 million hooks set in 2005. Most of the Hawaii-based longline effort was on the high seas and in the Main Hawaiian Islands (MHI) Exclusive Economic Zone (EEZ). Swordfish-directed effort was typically highest during the first half of the year, while tuna-directed effort usually increased in the last quarter of the year and reached a peak in either the fourth or first quarter of the year.

The Hawaii-based longline fishery was the largest producer of swordfish of all U.S. North Pacific Ocean fisheries from 1990 through 2000. Swordfish landings in this fishery peaked at 5,909 mt in 1993 (Table 1), dropped to 3,176 mt the following year and stabilized at 2,502 mt to 3,263 mt throughout 1994-2000. During 2001-2003, swordfish landings by the Hawaii-based longline fleet decreased significantly below 250 mt as a result of the prohibition on shallow sets. Landings remained low in 2004 due to several factors discussed above. In 2005, the Hawaii-based longline fleet landed 1,360 t of swordfish and reestablished itself as the largest U.S. fishery for swordfish in the North Pacific Ocean. Other species caught by the Hawaii-based longline fleet include bigeye tuna (*Thunnus obesus*), yellowfin tuna (*T. albacares*), albacore (*T. alalunga*), bluefin tuna (*T. thunnus orientalis*), marlins (Istophoridae), mahimahi (*Coryphaena hippurus*), moonfish (*Lampris guttatus*), ono (*Acanthocybium solandri*), pomfrets (Bramidae), oilfish (Gempylidae), and blue shark (*Prionace glauca*).

Swordfish CPUE (number of fish per 1,000 hooks) varies substantially according to targeting practice (Fig. 7). Swordfish CPUE for trips specifically targeting 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 the pre-litigation period. On swordfish-directed trips in the fourth quarter of 2004, under the new regulatory regime, the CPUE was 12.7. Swordfish CPUE reached a record 15.5 in 2005. Swordfish-targeted trips usually had their highest CPUE during the first and second quarters and lowest CPUE in the third. Compared with swordfish trips, tuna-targeted trips have negligible swordfish CPUE -- only 0.1 fish per 1,000 hooks in 2005.

California-based Longline Fishery

The California-based longline fishery began in 1991 when three vessels based in San Pedro fished waters outside the U.S. EEZ (Vojkovich and Barsky, 1998). The longline fleet increased more than 10-fold from 3 in 1991 to 31 vessels in 1994. Participation in the California-based longline fishery peaked at 44 vessels in 2000 but has since decreased to only 1 vessel in 2005 (Fig. 8). Prior to regulations that prohibit California longliners from targeting swordfish, the California-based longline fleet was 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 fleet was the same as in the Hawaii-based longline fleet. As of April 2004, California-based longline vessels are only allowed to target tunas and must set their gear deep.

California does not allow pelagic longline fishing within the EEZ; therefore, the California-based longline fishery operated exclusively on the high seas. When this fishery first began, effort typically peaked late in the year. When targeting of swordfish by longliners was allowed out of California, relatively high levels of effort continued throughout the winter months as the fleet began fishing closer to Hawaii.

Swordfish landings by the California-based longline fleet increased from negligible levels in the early 1980s to a peak of 1,908 mt in 2000. The landings total for 2004 was 619 mt (Table 1). The California-based longline fishery was the largest U.S. swordfish fishery in the North Pacific Ocean from 2001 to 2004. Incidental catches in the California-based longline fishery include: sharks, yellowfin tuna, bluefin tuna, bigeye tuna, albacore, mahimahi, moonfish, and oilfish. 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 CPUE by California-based longline vessels varied 4-fold over the 11 year period, from 6.3 fish per 1,000 hooks in 1995 to 25.3 in 2004 (Fig. 9). Swordfish CPUE was 25.3 in 2004.

DATA SOURCES

Hawaii

There are six types of data sets on swordfish in Hawaii. Fishery-dependent data include: Federal daily longline logbooks, NMFS market sampling data, State of Hawaii Division of Aquatic Resources (DAR) commercial fishermen catch reports, DAR fish dealer reports, and detailed records of at-sea observers deployed by NMFS. Fishery-independent data include observations by scientists on research cruises of the NOAA Ships *Townsend Cromwell* and *Oscar Elton Sette* and voluntary tag and release data from fishermen (Tables 2 and 3). Cross-referencing of certain data sets allows NMFS scientists to evaluate the accuracy of the data. Each of the data sets contains unique information, but in the aggregate the data sets provide considerable insight to the performance of the fishery and the biology and ecology of swordfish and other pelagic species caught.

Federal longline logbooks have been mandatory for Hawaii-based longline vessels since November 1990. The Federal longline logbook data represent the most complete coverage of all data sets for the Hawaii-based longline fishery. Logbooks must be maintained by vessel operators and submitted to NMFS after each trip. Data recorded in the logbooks include: vessel, date, fishing location, effort and gear configuration, catch by species, and interactions with protected species.

Market data on longline landings were first collected at the Honolulu fish auction by the NMFS in 1987. The sample size from the market ranged from 25%- 90% of fish landed by the Hawaii-based longline fishery throughout 1987-2000. Individual fish weights were recorded to the nearest half pound. Nominal weights were raised to an estimated whole weight when processing or damage was observed. Sex of fish could not be determined as most swordfish were landed in processed form (headed, finned, and gutted). The responsibility for collecting market data was transferred from NMFS to DAR in 2002. Currently, coverage of the DAR fish dealer data is estimated to be in excess of 90%.

The DAR commercial fish catch data have been collected from 1948 to the present. The DAR requires longline fishermen to submit longline trip reports listing the pelagic species caught. The DAR longline data include, for each species; number of fish caught, pounds caught, pounds sold, and total value.

Data collection by at-sea observers was initiated in 1990 when a few 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) under a pilot statistical sampling framework designed to estimate levels of incidental sea turtle take (DiNardo, 1993). Observers covered about 5% of the total longline trips from 1994-1999. Observer coverage was then increased in response to new regulations and has remained at or above 20% from the latter part of 2000 through 2003 (Wetherall, 2003). Beginning in 2004, observer coverage on trips targeting swordfish has been 100%. The observer data are similar to logbooks, although more detailed, and in some aspects, more accurate. In particular, the observer data are used to assess the fleet-wide impact of longlining on protected and endangered species.

The NOAA research vessel *Townsend Cromwell* began a series of research cruises devoted to collecting detailed data on swordfish biology and ecology in 1991. 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, stomachs, 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) traces, and acoustic Doppler current profiler (ADCP) transects (Boggs, pers. commun.). The *Townsend Cromwell* was decommissioned in 2002 and replaced with the NOAA research vessel *Oscar Elton Sette*.

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

California

There are four types of data on the California-based longline fishery, all fishery-dependent: CDFG landing receipts; CDFG and Federal daily longline logbooks; dockside sampling of swordfish landings collected by the CDFG; and data collected at sea by NMFS observers. Landing receipts have been collected by the CDFG since the start of the fishery in 1991 (Table 2). Daily longline logbook data were first collected by the CDFG on a voluntary basis from 1993 to 1994. Collecting and submitting CDFG longline logbook data (Pacific Offshore) became mandatory in 1995. This system was replaced in 1999 by a NMFS longline logbook data reporting system in response to Federal requirements under the High Seas Fisheries Compliance Act. Data recorded in the logbooks include: vessel, date, fishing location, effort and gear configuration, as well as numbers of fish caught by species and interactions with protected species. Collection of size samples from longline caught swordfish began in 1991 in conjunction with drift gill net swordfish sampling (Childers and Halko, 1994) but was discontinued in 2000. NMFS began placing observers on longline vessels from 2001 to investigate interactions with sea turtles and collect detailed catch and effort data.

The California drift gill net fishery is monitored by use of CDFG landing receipts, vessel logbooks, size sampling, and a CDFG and NMFS observer program. Landing receipts have been collected by the CDFG since the fishery's inception in 1980 (Table 2). Drift gill net fishermen are required to collect logbook data on daily operations and catch. Location is recorded in 10 minute squares. CDFG sampled drift gill net swordfish catch for length 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 since 1990 under NMFS. The observer program is used to monitor bycatch, especially of marine mammals. The NMFS observer program also collects size samples of swordfish.

The California harpoon fishery is also monitored through landing receipts, vessel logbooks, 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 are completed by vessel captains daily and record catches by location in the 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). The sampling program was discontinued in 2000.

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Table 1. -- U.S. North Pacific swordfish landings (estimated whole weight, metric tons). Dashes indicate no fishery. Estimates for 2005 based on preliminary data. Does not include discards.

Year	California				Hawaii	Total U.S. North Pacific
	Harpoon	Gill net	Other	Longline	Longline	
1970	612	---	10	---	5	627
1971	99	---	3	---	1	103
1972	171	---	4	---	0	175
1973	399	---	4	---	0	403
1974	406	---	22	---	0	428
1975	557	---	13	---	0	570
1976	42	---	13	---	0	55
1977	318	---	19	---	17	354
1978	1,699	---	13	---	9	1,721
1979	329	---	57	---	7	393
1980	566	160	62	---	5	793
1981	267	461	20	1	3	752
1982	156	911	43	2	5	1,117
1983	58	1,321	378	1	5	1,763
1984	96	2,101	678	14	3	2,892
1985	211	2,368	792	46	2	3,419
1986	236	1,594	696	4	2	2,532
1987	211	1,287	300	4	24	1,826
1988	180	1,092	344	19	24	1,659
1989	54	1,050	224	29	281	1,638
1990	50	1,028	137	18	2,437	3,670
1991	16	836	137	39	4,508	5,536
1992	74	1,332	44	95	5,700	7,245
1993	169	1,400	36	165	5,909	7,679
1994	153	799	8	740	3,176	4,876
1995	96	755	31	279	2,713	3,874
1996	81	752	10	347	2,502	3,692
1997	84	707	3	664	2,881	4,339
1998	48	924	13	422	3,263	4,670
1999	81	606	2	1,333	3,100	5,122
2000	90	646	9	1,908	2,949	5,602
2001	52	375	5	1,763	220	2,415
2002	90	302	3	1,320	204	1,919
2003	107	216	0	1,812	147	2,282
2004	62	169	37	898	213	1,379
2005	50	148	0	na	1,360	1,558

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	LONGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1976	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LONGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1977	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LONGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1978	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LONGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
1979	USA/CA	HARPOON	LB	NO. FISH	PURSUIITS/DAY	DAY	10 MIN
	USA/HI	LONGLINE	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	LONGLINE	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	LONGLINE	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	LONGLINE	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	LONGLINE	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	LONGLINE	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	LONGLINE	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	LONGLINE	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	LONGLINE	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	LONGLINE	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	LONGLINE	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	LONGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LONGLINE	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	LONGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LONGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LONGLINE	OBS(V)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LONGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN
1992	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	LONGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LONGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LONGLINE	OBS(V)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LONGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN
1993	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	LONGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LONGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LONGLINE	OBS(V)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LONGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN
1994	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	LONGLINE	LB	NO. FISH	SETS/HOOKS	DAY	1 MIN
	USA/HI	LONGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LONGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LONGLINE	OBS(M)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LONGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN
1995	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	LONGLINE	LB	NO. FISH	SETS/HOOKS	DAY	1 MIN
	USA/HI	LONGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LONGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LONGLINE	OBS(M)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LONGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN
1996	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	LONGLINE	LB	NO. FISH	SETS/HOOKS	DAY	1 MIN
	USA/HI	LONGLINE	CR	NO.&WT. FISH	DAYS/TRIP	TRIP	---
	USA/HI	LONGLINE	LB	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LONGLINE	OBS(M)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LONGLINE	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	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	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	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	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	OBS(M)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN
2003	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	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
2004	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	OBS(M)	NO. FISH	NO. HOOKS	DAY	1 MIN
	USA/HI	LOGLINE	RC	NO. FISH	NO. HOOKS	DAY	1 MIN
2005	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	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 (continued). -- U.S. North Pacific swordfish size frequency data catalog.

Year	Country/State	Data gear	Time set*	Type strata	Square	Length	Interval	Weight	Interval
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
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
2003	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
2004	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

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
2005	USA/HI	LOONGLINE	MKT	LAND DATE	---	N	---	Y	0.5 LB
	USA/HI	LOONGLINE	OBS(M)	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LOONGLINE	RC	DAY FISH	1 MIN	Y	1 MM	Y	0.5 LB
	USA/HI	LOONGLINE	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

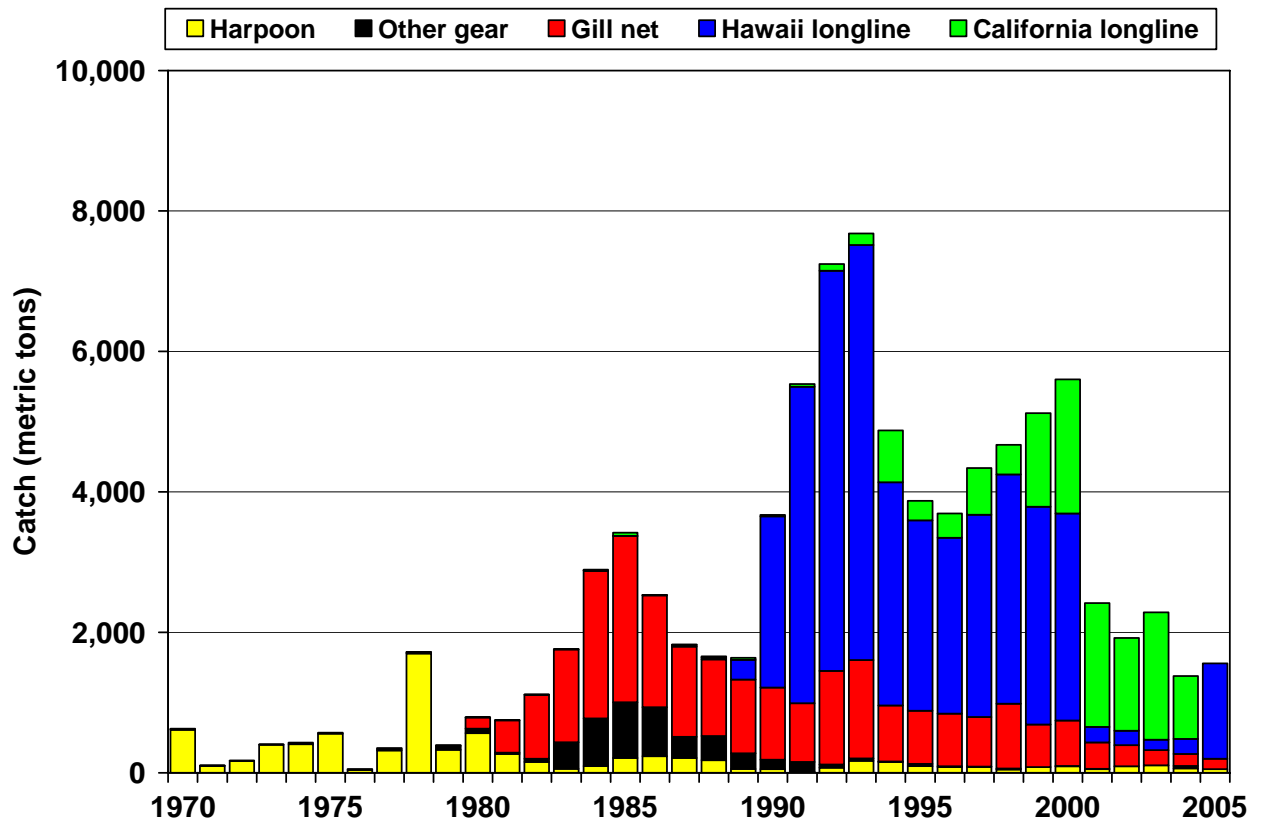


Figure 1. Catch by the U.S. swordfish fisheries of the North Pacific Ocean, 1970-2005.

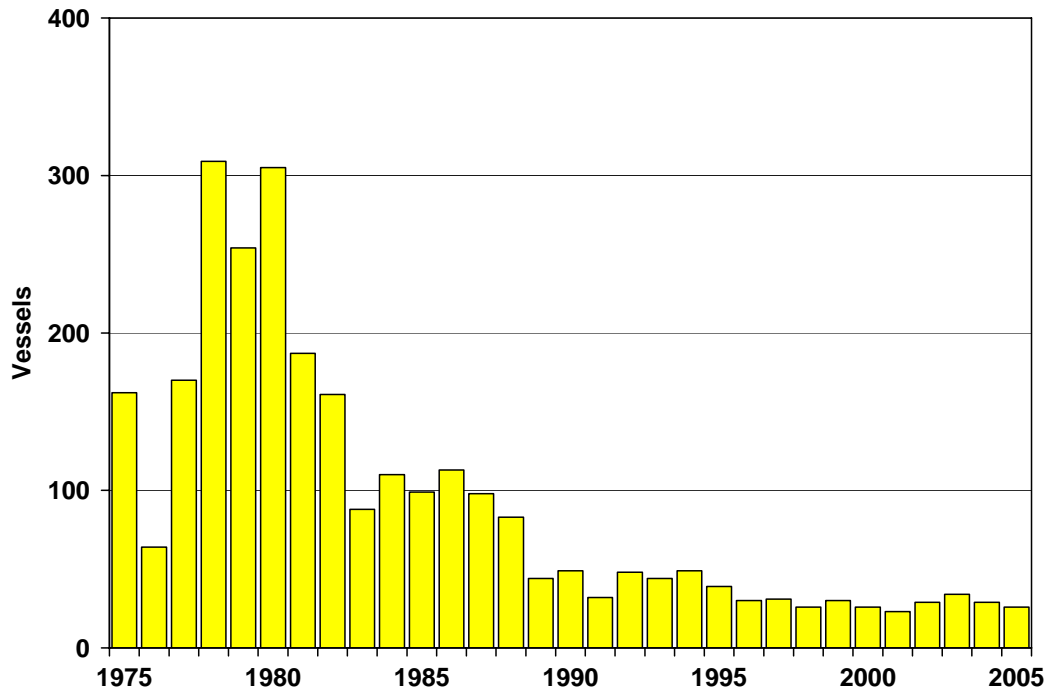


Figure 2. Number of California harpoon vessels, 1974-2005.

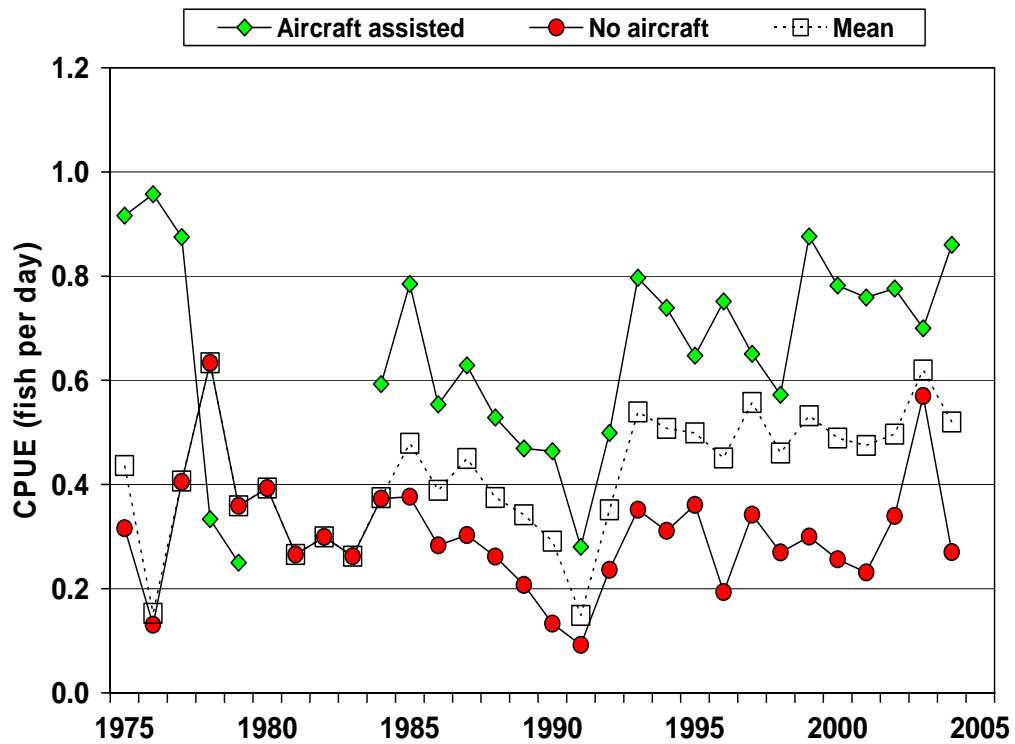


Figure 3. California harpoon fishery swordfish catch-per-unit-effort (CPUE), 1975-2004.

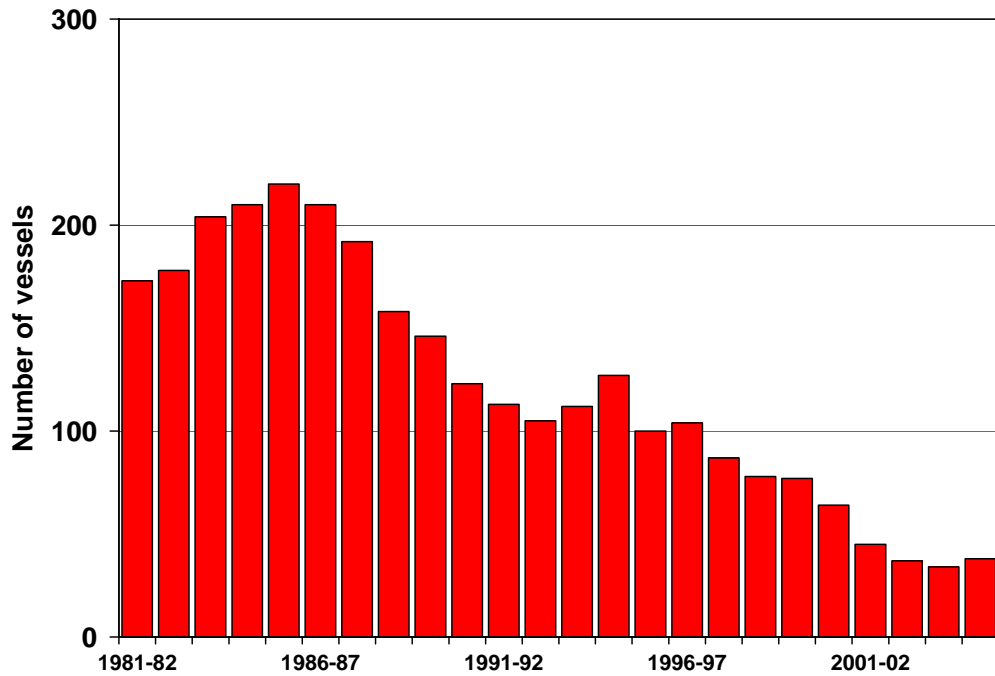


Figure 4. Number of California drift gill net vessels, 1981-1982 through 2004-2005.

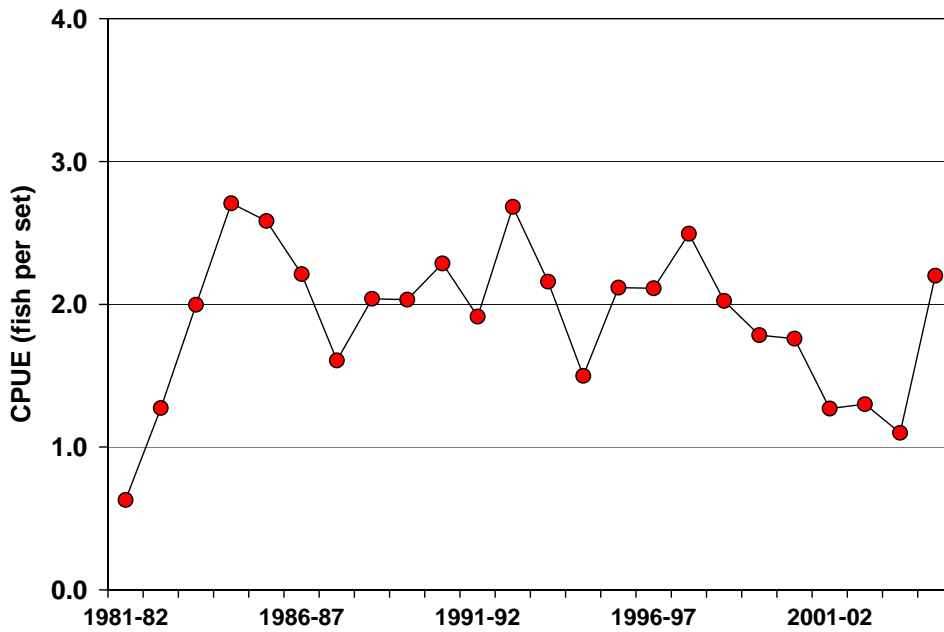


Figure 5. California drift gill net fishery swordfish catch-per-unit-effort (CPUE), 1981-1982 through 2004-2005.

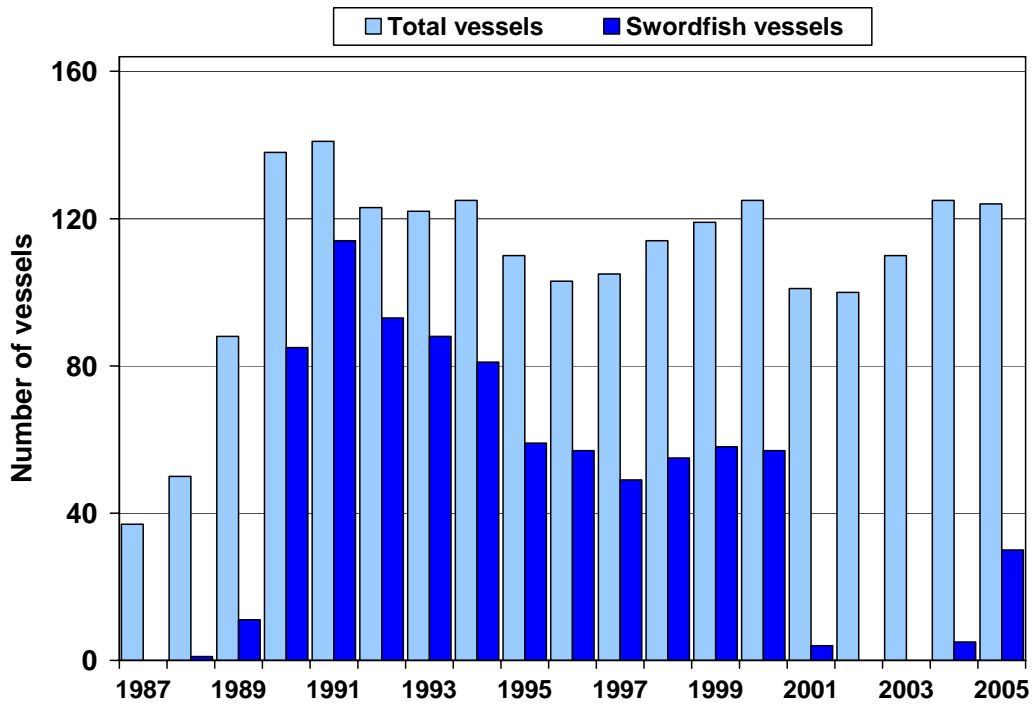


Figure 6. Number of active Hawaii-based longline vessels and longliners targeting swordfish, 1987-2005.

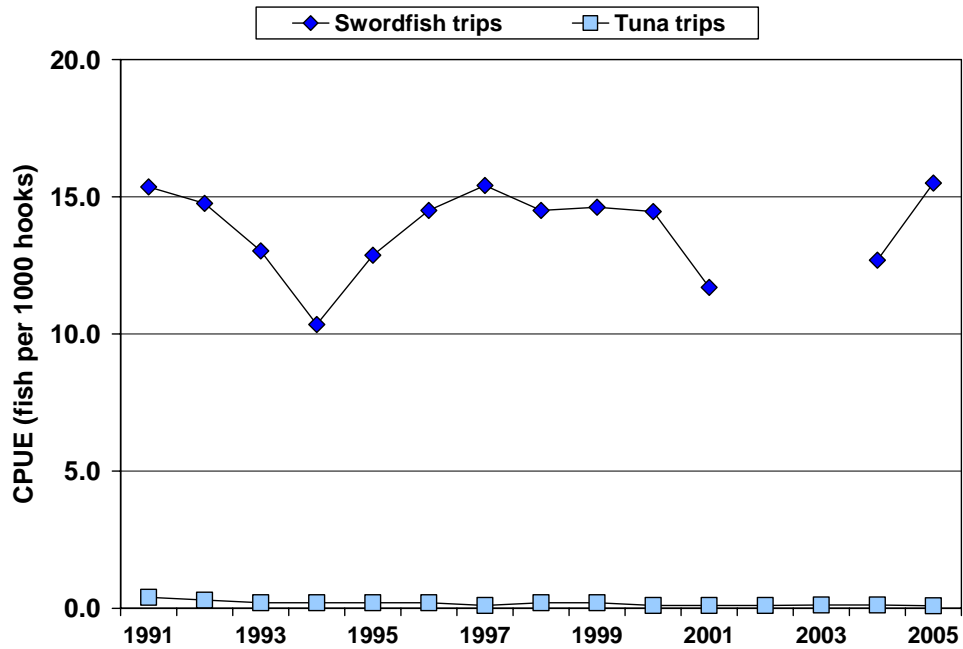


Figure 7. Hawaii-based longline swordfish catch-per-unit-effort (CPUE) by trip type, 1991-2005.

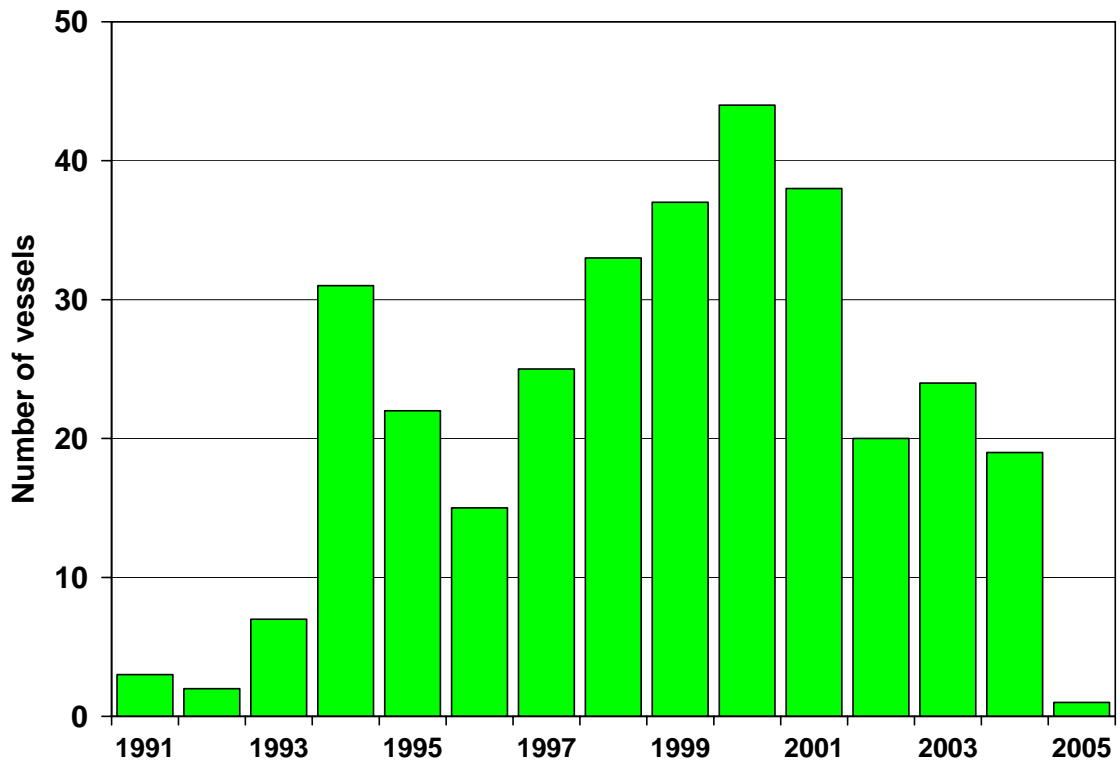


Figure 8. Number of California longline vessels, 1991-2005.

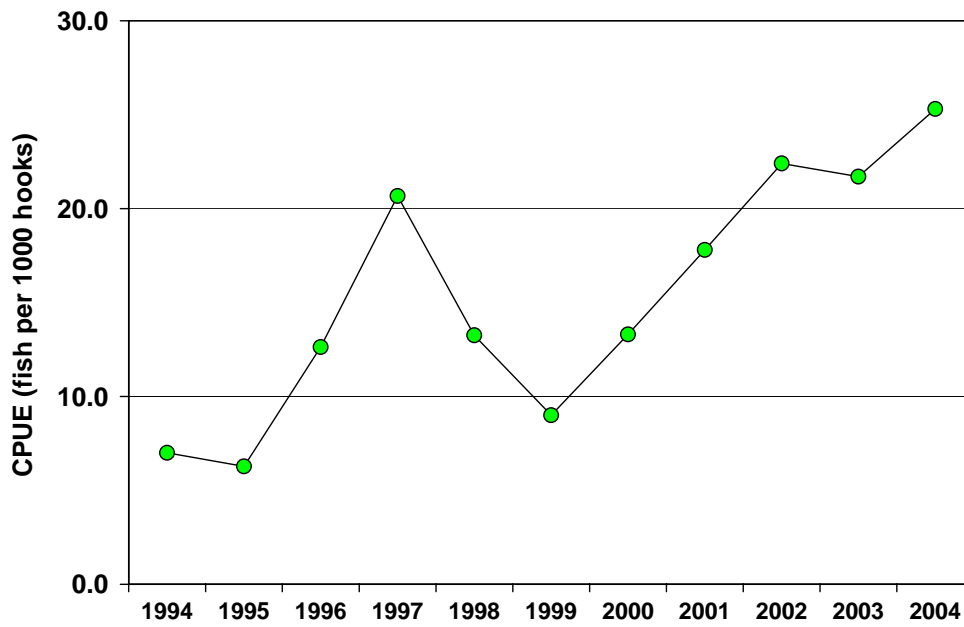


Figure 9. California-based longline swordfish catch-per-unit-effort (CPUE), 1994-2004.