U.S. West Coast fisheries and data collections for swordfish and striped, blue and black marlin [1]

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Introduction

There are three commercial fisheries and one recreational fishery that target swordfish and striped, blue and black marlin in waters off the U.S. west coast and Baja California, Mexico. The commercial fisheries use longline, gill net (mainly drift gill net) and harpoon fishing gears. The longline fishery operates on the high seas and is based mainly in California, with a few vessels also porting in Oregon. The California longline fishery is part of a larger longline fishery that is based in Hawaii. The drift gill net and harpoon fisheries operate within the west coast 200-mile Exclusive Economic Zone (EEZ). The recreational fishery is composed of angling clubs in Southern California and Baja California, Mexico whose anglers usually catch and release striped, blue and black marlin and swordfish.

The purpose of this paper is to describe data collections from these fisheries that can be used for stock assessments of swordfish and striped, blue and black marlin in the Pacific Ocean. Three data sets will be described for commercial fisheries Category I (landings and vessels), Category II (logbooks) and Category III (size composition). Tagging and angler survey data will be described for recreational fisheries.

Category I: Commercial Landings and Vessels Data

Category I, landings and vessels fishing data are collected by the state agencies in California, Washington and Oregon and placed on a centralized data system, the Pacific Fisheries Information Network (PacFIN). Data on PacFIN date back to 1981. All of the billfish landings are swordfish, since landings of marlins are prohibited in California since 1937. Most of the swordfish landings are from California with small amounts from Oregon in some years. Category I data elements collected from longline, gill net and harpoon fisheries consist of catch in pounds, a conversion factor since fish are landed dressed, a location usually a 10-minute square, and other information on dealers, the vessel and port of unloading (Table 1).

The largest west coast fishery is the drift gill net fishery. Over 200 drift gill net vessels fished in 1981 to 1987 and that number decreased to 45 in 2002 and 57 in 2004 (Table 2). Gill net landings of swordfish peaked in 1985 at 2,370 t and decreased to a low of 181 t in 2004 (Table 3). The drift gill net fishery also targets mako and thresher sharks. While the majority of the swordfish landings are made by the drift gill net fishery, some landings are also made by set gill net gear.

Over 150 harpoon vessels participated in the fishery in 1981 and 1982 and decreased to 23 in 2001 before rebounding slightly to 35 in 2003. The harpoon fishery landed over 200 t of swordfish in 1981 and 1985 to 1987. Landings decreased to a record low of 16 t in 1991 and have fluctuated between 48 t and 169 t since then. The harpoon fishery targets only swordfish and occasionally records some catches of thresher and mako sharks.

Participation in the California-based longline fishery peaked at 44 vessels in 2000 as vessels that usually fished in the Hawaii-based fleet moved to California to avoid the prohibition on swordfish fishing in Hawaii. The number of vessels has since dropped to 18 in 2004. Longline swordfish landings peaked in 2000 at 1,884 t and decreased to 898 t in 2004. Longline vessels also target bigeye and yellowfin tuna.

Table 3 also shows some catch for hook and line and other gears. Recorded catches of hook and line are relatively small and are usually less than 30 t in most years. Other gear catches were unusually high in 1983 to 1991 and are probably misidentified landings from the gill net fishery.

Category II: Logbook data

Category II logbook data can be from two sources, mandatory logbook data and observer data. In most cases, logbook data are used when supplying Category II data to Regional Fisheries Organizations. Observer data is used to validate logbook data (especially species identifications), estimate by-catches and monitor protected and endangered species interactions.

Gill net and harpoon logbooks are collected by the California Department of Fish and Game (CDFG) and longline logbooks are collected by the National Marine Fisheries Service (NMFS), Southwest Fisheries Science Center (SWFSC). The coverage rate for all of the logbook programs is 100%. The gill net and longline fisheries are also monitored by NMFS observers. Coverage rate for the gill net fishery is targeted at 20% and for the longline fishery 100%. Logbook data elements collected from each fishery cover the main elements from each day of fishing such as location, date and catch, information about the fishing gear and setting of that gear and information on environmental conditions (Table 4).

The drift gill net fishery in 2004 operated in Southern California waters between 32°N and 36°N (Figure 1). However, in some years fishing effort and swordfish catch extends to areas off Oregon. While the logbooks do not show any catches of marlins, observer data do show catches of striped, blue and black marlin (Table 5). Most of these catches are discarded. However, there are some indications that some quantities of striped marlin are also kept even though they cannot be landed commercially. The highest catch was for striped marlin (68) and occurred in 1994.

The harpoon fishery, like the gill net fishery, typically operates in waters off of Southern California. However, swordfish catches for the harpoon fishery in 2004 are

confined to a slightly smaller area between 32°N and 35°N (Figure 2). No marlin catches are in the logbook data and no observer data is available for this fishery to determine if marlins are harpooned and discarded.

The California-based longline fishery operates outside the west coast EEZ and in 2004 in areas between 25°N and 35°N latitude and 120°W and 165°W longitude (Figure 3). Swordfish is the main species recorded in the logbooks. Some striped and blue marlin are recorded in logbooks but most are discarded (Table 6).

Category III: Size Composition Data

Size composition data are available for gill net fisheries from both observer and port sampling (Table 7 and 8). Harpoon size composition data are from port sampling only and gill net and longline size composition data are from port and observer sampling. Data elements collected consist of species, length, length type, weight, weight type, sex, date and location of the catch and information on the sampler and port (Table 9).

CDFG conducted a port sampling program from 1981 to 2000. Port samplers measured swordfish as fish were landed at various California ports (marlins cannot be commercially landed so no size samples were available). Fish were measured for cleithrum length and weighed and sex determined when possible. Samples of swordfish were taken from the gill net, harpoon and longline fishery (Table 7). The highest number of fish measured by port samplers occurred in 1986 when over 5,000 swordfish were measured from gill net and harpoon fisheries. Port samplers determined the sex of only 4 swordfish while taking length measurements during the 1981 to 2000 period.

Observers onboard gill net vessels took fork, eye to fork and/or cleithrum lengths and no weights during the period 1990 to 2004 (Table 8). The highest number of fish by species measured by gill net observers occurred in 1993 when over 1,600 swordfish and striped, blue and black marlin were measured. Observers determined the sex of 1,229 swordfish, 3 striped marlin and 1 blue marlin while taking length measurements in 1990 to 2004.

Other Data: Recreational Fisheries Data

The SWFSC also maintains a billfish tagging data base and an angler survey data base. The data in these data bases are obtained voluntarily from recreational anglers, sport fishing organizations and commercial fishers. Areas of the Pacific covered by these data include California, Hawaii, Mexico, Australia, Tahiti, Guatemala, Panama, and Costa Rica.

The billfish tagging data base elements include species, date tagged or recovered, length and weight, latitude, longitude, general location, angling club, angler name and address, bait used, fight times and fish condition upon release. The billfish tagging data base has over 32,358 swordfish, striped, blue and black marlin releases and 493 recoveries of these billfish species during the period 1963 to 2003 (Table 10) . The

majority of the releases and recaptures are of striped marlin and the highest return rates are for swordfish.

The angler survey data base elements include location fished, days fished, numbers of blue, black and striped marlin and swordfish caught, angler's name and address. The survey is sent out once a year to recreational anglers that have fished for billfish. The data base contains data from 1969 to 2003, 151,312 billfish and 327,330 angler days. The data in the angler survey data base are used to estimate nominal catch rates for striped, blue and black marlin (Figure 4).

Table 1: Pacfic Fisheries Information Network landings data elements

Name	Type	Size	Description
AGID	Text	255	Agency identification
FTID	Text	255	Fish ticket identificaation
YEAR	Long Integer	4	Landing year
MONTH	Long Integer	4	Landing month
DAY	Long Integer	4	Landing day
PARGRP	Text	255	Participation group
PORT	Text	255	Port of landing
VESSELTYPE	Text	25	Qualifies VEID i.e. state registration number
VEID	Text	25	Vessel identification
PROCESSORID	Text	25	Processor identification
DAYSFISHED	Long Integer	4	Number of days fished
DRVID	Text	25	Derived vessel identification i.e Coast Guard Number
ULID	Long Integer	4	Report number of original data feed or modification
VESSELUSED	Text	5	If vessel used - true/false
MODIFIED	Text	5	If this record modified - true/false
REMOVALTYPE	Text	25	Caught, Aquaculture
TDATE	Text	15	Date of last data feed
CATEGORY	Text	255	Market category or species ID
GRADE	Text	5	Grade and size category of landing
COND	Text	5	Condition of landing i.e. dressed
DISP	Text	5	Disposition of Landing - human consumption,canning, pet food
AREATYPE	Text	25	Type of area of this catch
AREA	Text	255	Source agency area code
GEAR	Text	255	Source agency fishing gear code
LANDED_WT	Long Integer	4	Landed weight
FACTOR	Double	8	Factor to convert landed weight to whole weight
NUM_FISH	Long Integer	4	Number of fish landed
PPP	Double	8	Price Per Pound
CDFG_ORIGIN	Long Integer	4	California Fish and Game block number
ESTIMATED	Text	5	True or false if landed value is estimated
WORST_EST	Text	5	Worst estimate was used - true/false

Table 2. Number of vessels fishing in the north Pacific in various U.S. fisheries that catch swordfish, or striped or blue marlin. 2004 data are preliminary

Year	GILLNET	HARPOON	LONGLINE	RECREATIONAL
1981	222	188	0	NA
1982	236	161	0	NA
1983	252	89	0	NA
1984	292	114	0	NA
1985	210	99	0	NA
1986	220	113	0	NA
1987	210	98	0	NA
1988	192	83	0	NA
1989	158	44	0	NA
1990	146	49	0	NA
1991	123	32	3	NA
1992	113	48	2	NA
1993	105	44	7	NA
1994	112	49	31	NA
1995	127	39	22	NA
1996	100	30	15	NA
1997	104	31	25	NA
1998	87	26	33	NA
1999	78	30	37	NA
2000	77	26	44	NA
2001	64	23	38	NA
2002	45	29	21	NA
2003	69	35	22	NA
2004	57	32	18	NA

Table 3. Landings of swordfish in the North Pacific from various U.S. fisheries that catch swordfish, or striped and blue marlin. 2004 data are preliminary, - is less than 0.6 tons.

Year	GILLNET	HARPOON	LONGLINE	HOOK AND LINE	OTHER	TOTAL
1981	461	267	-	1	20	749
1982	910	156	-	2	43	1,111
1983	1,321	58	-	1	377	1,757
1984	2,101	96	12	2	678	2,889
1985	2,370	211	-	46	790	3,417
1986	1,594	236	0	4	696	2,530
1987	1,287	211	0	4	300	1,802
1988	1,092	180	-	19	344	1,635
1989	1,050	54	0	29	224	1,357
1990	1,028	50	0	18	139	1,235
1991	836	16	27	13	137	1,029
1992	1,332	74	63	33	44	1,546
1993	1,400	169	27	139	36	1,771
1994	799	153	721	19	7	1,699
1995	755	96	271	8	31	1,161
1996	752	81	346	-	10	1,189
1997	707	84	664	1	3	1,459
1998	924	48	418	5	14	1,409
1999	606	81	1,317	16	1	2,021
2000	646	90	1,884	24	9	2,653
2001	375	52	1,749	18	0	2,194
2002	302	90	1,320	0	2	1,714
2003	216	107	1,811	1	-	2,135
2004	181	68	898	37	1	1,185

Table 4. Logbook data elements for various U.S. fisheries landing swordfish

Name	Type	Size	Description
Gillnet Logbook Data Elements			
BOATNO	Double	8	CDFG VESSEL REGISTRATION NUMBER (PLATE NUMBER)
PERMNO	Double	8	PERMIT NUMBER
PERMTYPE	Text	1	PERMIT TYPE
PERMLOC	Text	1	PERMIT LOCATION (Long Beach, San Diego, etc.)
TARSPC	Text	1	TARGET SPECIES
DATE1	Date/Time	8	DATE OF SET
DATE	Text	10	DATE OF SET
TOTSET	Integer	2	TOTAL SETS (INVALID DATA - do not use at this time)
SETNO	Integer	2	SET NUMBER
BLOCK	Integer	2	CDFG BLOCK NUMBER
BL_SIZE	Integer	2	Size of CFG block
QUADRANT	Integer	2	Quadrant code
LAT_DEG	Integer	2	Latitude in degrees
LAT_MIN	Integer	2	Latitude in minutes
LONG_DEG	Integer	2	Longitude in degrees
LONG_MIN	Integer	2	Longitude minutes
DEPTH	Integer	2	DEPTH (FATHOMS) OF NET
LEN	Integer	2	LENGTH (FATHOMS) OF NET
MESH	Double	8	STRETCHED MESH SIZE (INCHES)
BDEPTH	Integer	2	BUOY DEPTH (FATHOMS)?
HRSOAK	Integer	2	TOTAL HOURS NET WAS SET
EPROBCODE	Integer	2	PROBLEM CODE FOR EFFORT
DFTORSET	Text	1	DRIFT OR SET NET
SPCODE1	Integer	2	STATE SPECIES CODE
SPCNUM1	Integer	2	NUMBER OF FISH CAUGHT
SPCWT1	Integer	2	WEIGHT (POUNDS) OF FISH CAUGHT
CKR1	Text	1	Disposition of catch Kept or released
Harpoon Logbook Data Elements			
TRIPNO	Text	50	Trip number
LASTNAME	Text	15	Captain's last name
FIRSTNAME	Text	15	Captain's first name
PERMNO	Double	8	Permit number
BOATNAME	Text	15	Vessel name
FGBOATNO	Double	8	California Department of Fish and Game boat number
DATE	Text	10	Date of fishing
TIME	Text	4	Time of fishing
FISHNUM	Integer	2	Fish number of fish caught this day
SPCCODE	Integer	2	Species code
CFGBNO	Integer	2	CDFG block number
AIRCRAFT	Integer	2	aircraft used y/n
SEATEMP	Integer	2	Sea surface temperature
FISHLOC	Integer	2	Location of fish when fist seen - finning, underwater, jumping
FISHPURS	Integer	2	Whether fish pursued - y/n
FISHHARP	Integer	2	Whether fish harpooned - y/n
FISHLAND	Integer	2	Whether fish landed - y/n
ESTWT	Integer	2	Estimated whole weight
BL1SEARCH	Integer	2	Other CDFG blocks searched
BL2SEARCH	Integer	2	Other CDFG blocks searched
BL3SEARCH	Integer	2	Other CDFG blocks searched
BL4SEARCH	Integer	2	Other CDFG blocks searched
BL5SEARCH	Integer	2	Other CDFG blocks searched
BL6SEARCH	Integer	2	Other CDFG blocks searched
BL7SEARCH	Integer	2	Other CDFG blocks searched
WEATHER	Integer	2	Weather condition - excellent, good, bad
SEA_STATE	Integer	2	Sea state - windy, calm
SEA_COLOR	Integer	2	Ocean color - blue, green, blue/green

Table 4. Continued.

Name	Type	Size	Description
Longline Logbook Data Elements			
TRIPTYPE	Text	2	Type of Trip - tuna, swordfish, mixed
TRIPNUM	Integer	2	Trip number
LANDYEAR	Integer	4	Landing year
LANDMONTH	Integer	2	Landing month
CAPTAIN NAME	Text	20	Captain's name
PERMIT NUMBER	Text	8	Permit number
VESSEL NAME	Text	20	Vessel name
F MONTH	Integer	2	Fishing month
F YEAR	Integer	4	Fishing year
NO FISH MONTH	Integer	2	Non fishing Month
NO FISH YEAR	Integer	4	Non fishing year
CREW SIZE	Integer	2	Crew sixe
OBSERVER ON BOARD	Text	1	Observer is onboard
TARGET	Integer	2	Target species
SET YEAR	Integer	4	Set year
SET MONTH	Integer	2	Set month
SET DAY	Integer	2	set day
HAUL YEAR	Integer	4	Haul Year
HAUL MONTH	Integer	2	Haul Month
HAUL DAY	Integer	2	Haul day
BEGIN SET TIME	Integer	4	begin set time
BEGIN SET TIME A/P	Text	2	AM/PM
END SET TIME	Integer	4	End set time
END SET TIME A/P	Text	1	AM/PM
BEGIN HAUL TIME	Integer	4	Begin haul time
BEGIN HAUL TIME A/P	Text	1	AM/PM
END HAUL TIME	Integer	4	End haul time
END HAUL TIME A/P	Text	1	AM/PM
BEGIN SET LATITUDE DEGREES	Integer	2	Latitude in degrees
BEGIN SET LATITUDE MINUTES	Integer	2	Latitude in minutes
BEGIN SET LATITUDE 100ths MINUTES	Integer	2	Latitude in 100ths minutes
BEGIN SET LATITUDE DIRECTION	Text	1	N/S
BEGIN SET LONGITUDE DEGREES	Integer	3	Longitude in degrees
BEGIN SET LONGITUDE MINUTES	Integer	2	Longitude in minutes
BEGIN SET LONGITUDE 100ths MINUTES	Integer	2	Longitude in 100ths minutes
BEGIN SET LONGITUDE DIRECTION	Text	1	E?W
OFFLOAD YEAR	Integer	4	Offloading year
OFFLOAD MONTH	Integer	2	Offloading Month
OFFLOAD DAY	Integer	2	Offloading day
PORT	Text	35	Port of offloading
SURFACE WATER TEMPERATURE	Integer	2	Sea surface water temperature
FIRST SET OF TRIP Y/N	Text	1	Is this the first set of the trip - y/n
NUMBER HOOKS SET	Integer	8	Number of hooks set
USE LINE THROWER Y/N	Text	1	Was a line thrower used - y/n
NUMBER HOOKS BETWEEN FLOATS	Integer	8	Number of hooks between floats
NUMBER OF LIGHT STICKS	Integer	5	Number of light sticks used
MAINLINE LENGTH (nm)	Integer	5	Mainline length
GANGION LENGTH (ft)	Integer	5	Gangion length
FLOATLINE LENGTH (ft)	Integer	5	Floatline length
BAIT USED LIVE / DEAD	Text	1	Bait used
SPECIES CODE	Integer	3	Species caught
NUMBER KEPT	Integer	5	Number kept
NUMBER RELEASE	Integer	5	Number released
RET LBS	Integer	5	Estimated pounds kept
RELEASE ALIVE	Integer	5	Number released alive
RELEASE DEAD	Integer	5	Number released dead
TURTLE / BIRD CODE	Integer	5	Turtle or bird code
TURTLES CODE	Integer	5	Turtle code
INVOLVED	Integer	5	Number involved
INJURED	Integer	5	Number injured

Table 5. Number of billfish kept and released from drift gill net observer records.

Year	Swordfish		Striped Marlin		Blue Marlin		Black Marlin	
	Kept	Released	Kept	Released	Kept	Released	Kept	Released
1990	492	15	2	11	1	1	0	0
1991	737	4	19	21	0	4	0	0
1992	1802	14	1	11	1	4	0	0
1993	1649	6	8	34	0	9	0	4
1994	1080	3	14	54	0	4	0	1
1995	1249	13	5	16	0	10	0	0
1996	762	4	10	5	0	4	0	0
1997	1516	25	1	42	0	2	0	0
1998	1346	36	0	35	0	9	0	0
1999	1023	10	0	12	0	2	0	0
2000	990	14	0	6	0	0	0	0
2001	393	10	0	15	0	0	0	0
2002	501	15	0	22	0	0	0	0
2003	325	8	0	27	0	0	0	0
2004	7	0	0	0	0	0	0	0

Table 6. Numbers of swordfish, striped, blue and black marlin recorded in longline logbooks

YEAR	SWORDFISH		STRIPED MARLIN		BLUE MARLIN		BLACK MARLIN	
	KEPT	RELEASED	KEPT	RELEASED	KEPT	RELEASED	KEPT	RELEASED
1991	41	3	0	0	0	0	0	0
1992	541	23	0	3	0	1	0	0
1993	225	23	0	16	0	1	0	0
1994	20	0	0	0	0	1	0	0
1995	672	57	2	15	0	1	0	0
1996	1,909	151	1	6	0	0	0	0
1997	5,603	157	9	7	0	0	0	0
1998	5,957	176	0	0	0	0	0	0
1999	9,339	325	0	4	0	4	0	0
2000	18,989	517	0	2	1	2	0	0
2001	20,961	85	0	3	0	0	0	0
2002	15,963	0	0	0	0	0	0	0
2003	16,909	0	0	0	0	0	0	0
2004	9,456	0	0	0	0	10	0	0

Table 7. Number of swordfish measured for length and weight at various ports in California. Length measurements are cleithrum lengths and weights are dressed weights.

Year	Gill Net		Harpoon		Longline	
	Length	Weight	Length	Weight	Length	Weight
1981	207	27	29	17	0	0
1982	688	239	41	22	0	0
1983	2,135	480	17	14	0	0
1984	2,951	687	79	31	10	0
1985	3,152	1,119	40	16	0	0
1986	4,973	1,719	56	34	0	0
1987	2,148	902	36	35	0	0
1988	3,140	1,480	41	28	0	0
1989	2,370	771	3	3	22	0
1990	1,029	623	1	1	0	0
1991	87	26	0	0	0	0
1992	8	0	0	0	0	0
1993	248	76	29	12	334	626
1994	342	92	195	120	743	1,463
1995	380	72	142	37	592	1,224
1996	180	157	16	4	254	500
1997	0	0	0	0	6	0
1998	30	0	0	0	0	0
1999	37	3	0	0	0	0
2000	4	0	0	0	0	0

* Only 4 fish for the etire seriies were sexed.

Table 8. Number of fish measured by species by gill net observers. Lengths could be Cleithrum, eye to fork or fork length.

Year	Swordfish	Striped Marlin	Blue Marlin	Black Marlin
1990	381	8	0	0
1991	534	36	0	0
1992	1,449	8	0	0
1993	1,589	38	2	4
1994	1,060	57	4	1
1995	1,146	17	4	0
1996	720	13	5	0
1997	1,456	39	2	0
1998	1,308	32	7	0
1999	998	12	1	0
2000	951	5	2	0
2001	373	13	8	1
2002	490	22	2	0
2003	314	24	0	0
2004	6	0	0	0

* 1,229 sworfish, 3 striped marlin and 1 blue Marlin sexed.

Table 9. Size composition data elements.

Name	Type	Size	Description
SAMPMON	Integer	2	Month sample taken
SAMPDAY	Integer	2	Day sample taken
SAMPYR	Integer	4	Year sample taken
LANDMON	Integer	2	Month catch landed
LANDDAY	Integer	2	Day catch landed
LANDYR	Integer	4	Year catch landed
BOATNO	Integer	9	Vessel ID number
SPECIES	Integer	3	Species code
LENGTH	Integer	5	Length (cm)
LENGTH TYPE	Integer	2	Code for the type of length taken
WEIGHT	Double	5	Weight (pounds)
WEIGHT TYPE	Integer	2	Code for the type of weight taken
SEX	Integer	1	Sex
CONDITION	Text	1	Condition of fish (dressed, whole)
GEAR	Integer	3	Gear used to catch fish
PORT	Integer	3	Port of unloading
MARKET	Integer	3	Fish buyer
SAMPLER	Text	20	Sampler name
QCOD1	Integer	2	Quality of data code
BLOCKNO	Integer	5	Block number code
SIZECODE	Integer	3	Size of square code
QUAD	Integer	1	Quadrant code
LAT_DEG	Integer	2	Latitude in degrees
LAT_MIN	Integer	2	Latitude in minutes
LONG_DEG	Integer	3	Longitude in degrees
LONG_MIN	Integer	2	Longitude in minutes

Table 10. Swordfish and marlin in the SWFSC Tagging data base

Species Name	Release	Recapture	Rate%
Broadbill Swordfish	521	17	3.26
Striped Marlin	21,666	335	1.55
Pacific Blue Marlin	6,816	72	1.06
Black Marlin	3,355	69	2.06

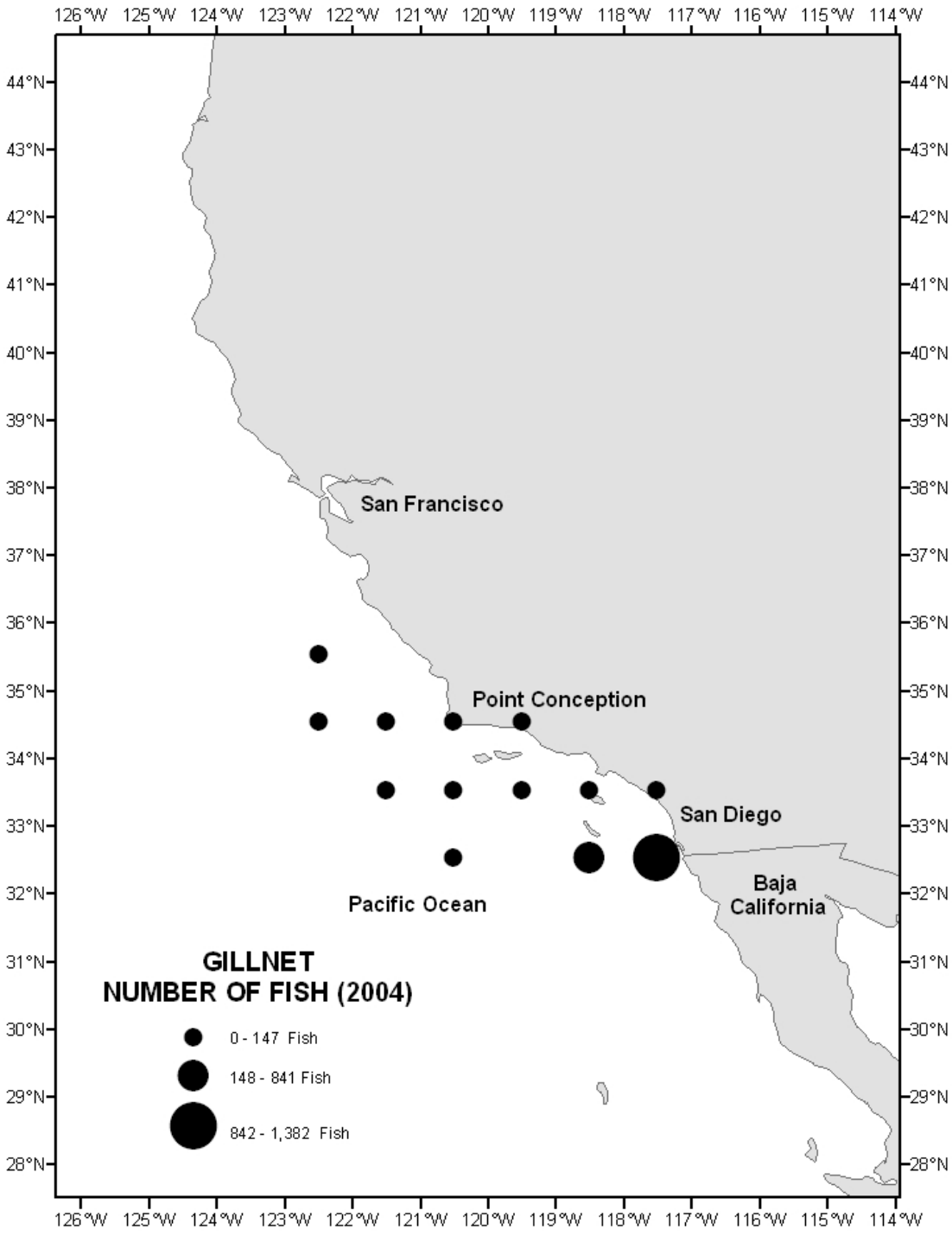


Figure 1. Distribution of swordfish catches in the 2004 gill net fishery.

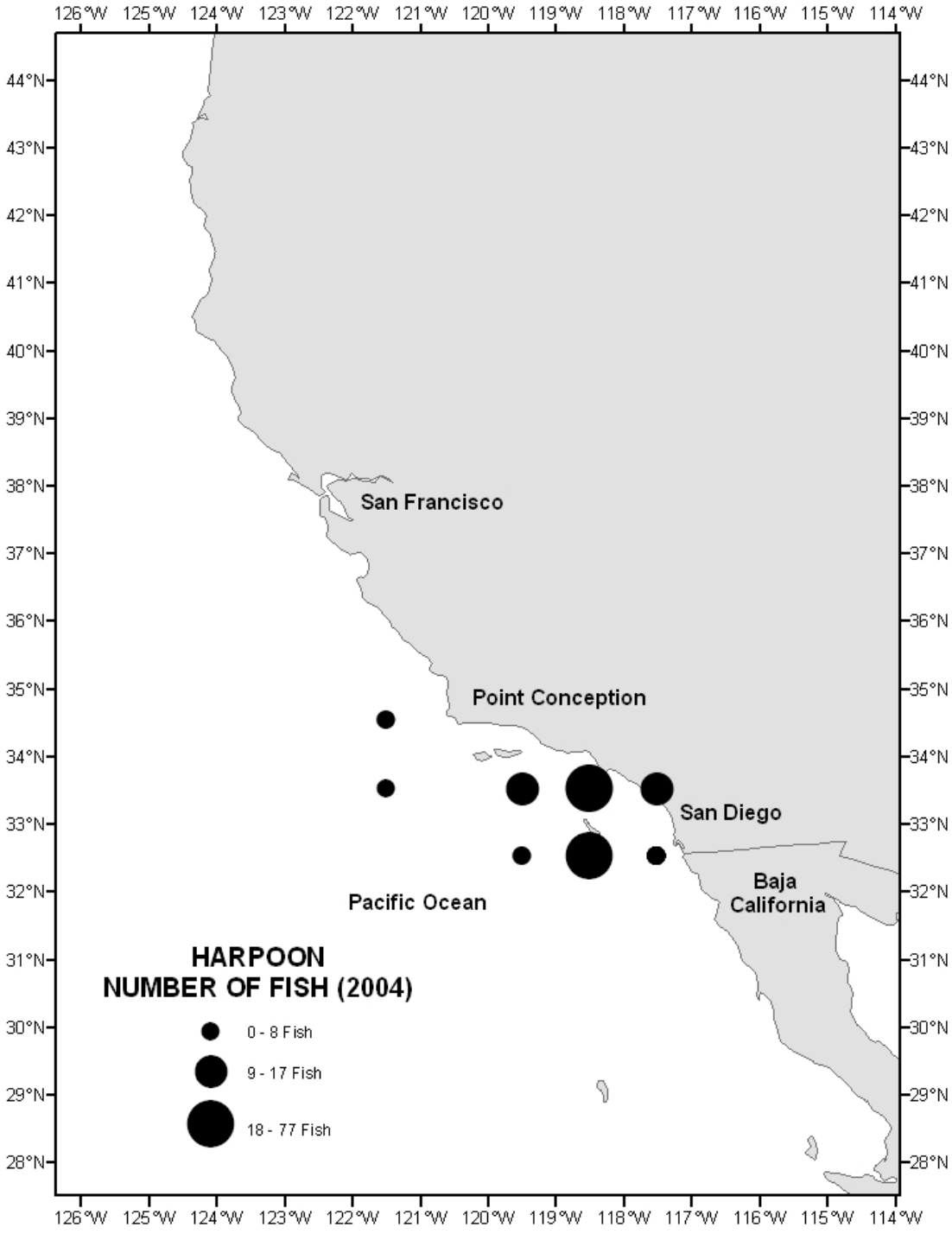


Figure 2. Distribution of swordfish catches in the 2004 harpoon fishery.

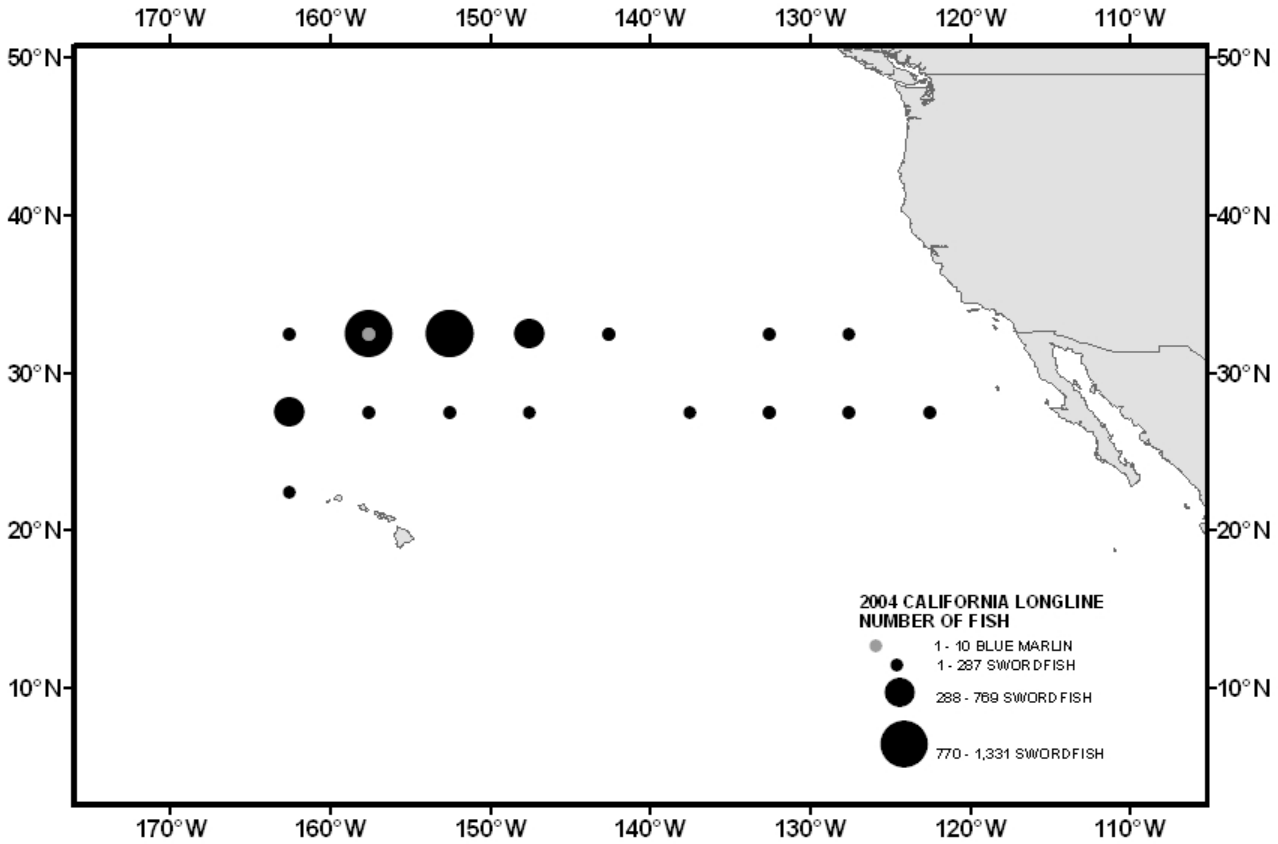
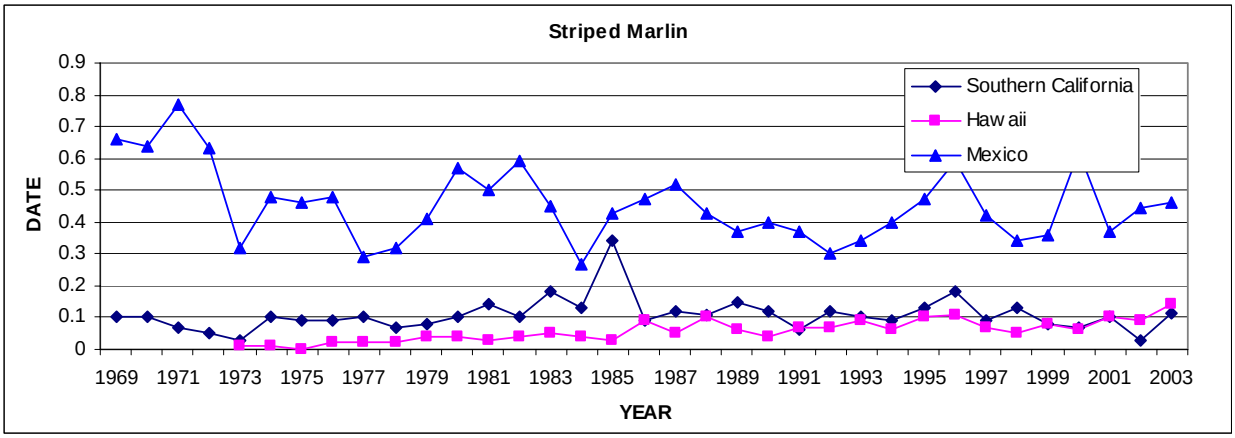
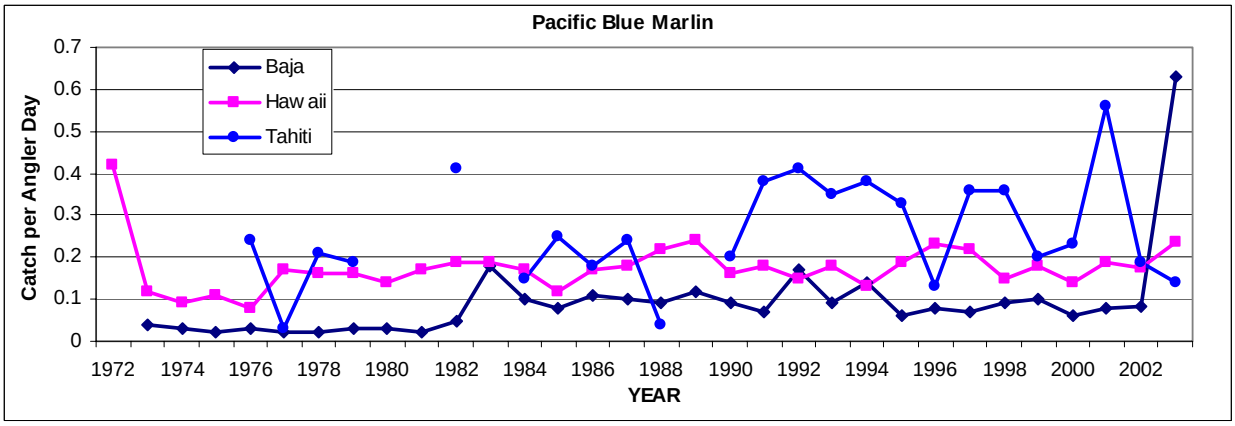


Figure 3. Distribution of swordfish and blue marlin catch in the 2004 California-based longline fishery.





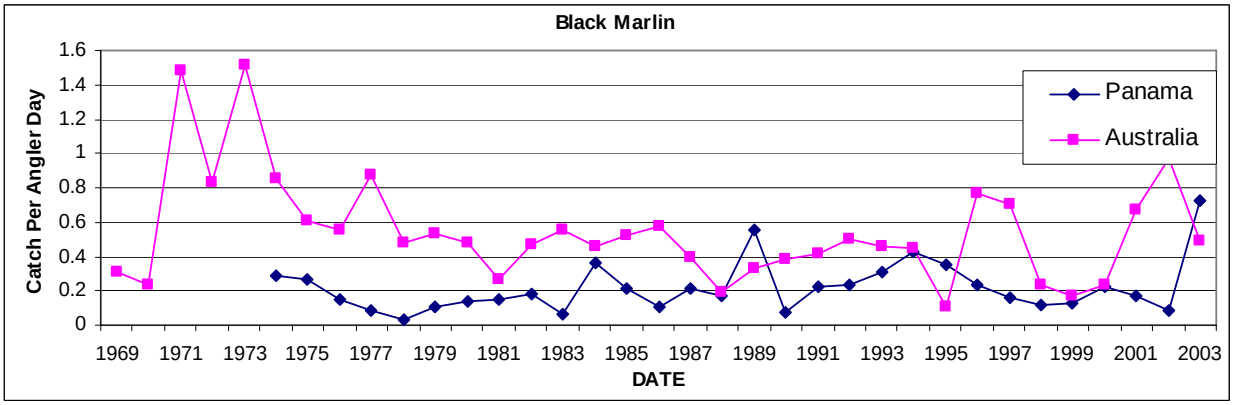


Figure 4. Striped, blue and black marlin catch per angler day by year and area fished. The data are compiled from the angler survey data base.