

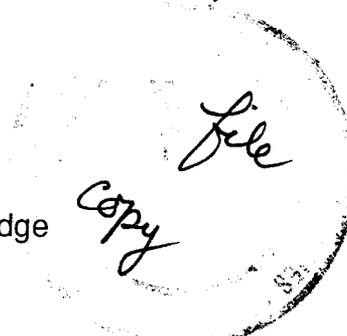
NOAA Technical Memorandum NMFS



FEBRUARY 1994

HOOK-AND-LINE FISHING STUDY AT CORDELL BANK, CALIFORNIA, 1986-1991

Maxwell B. Eldridge



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

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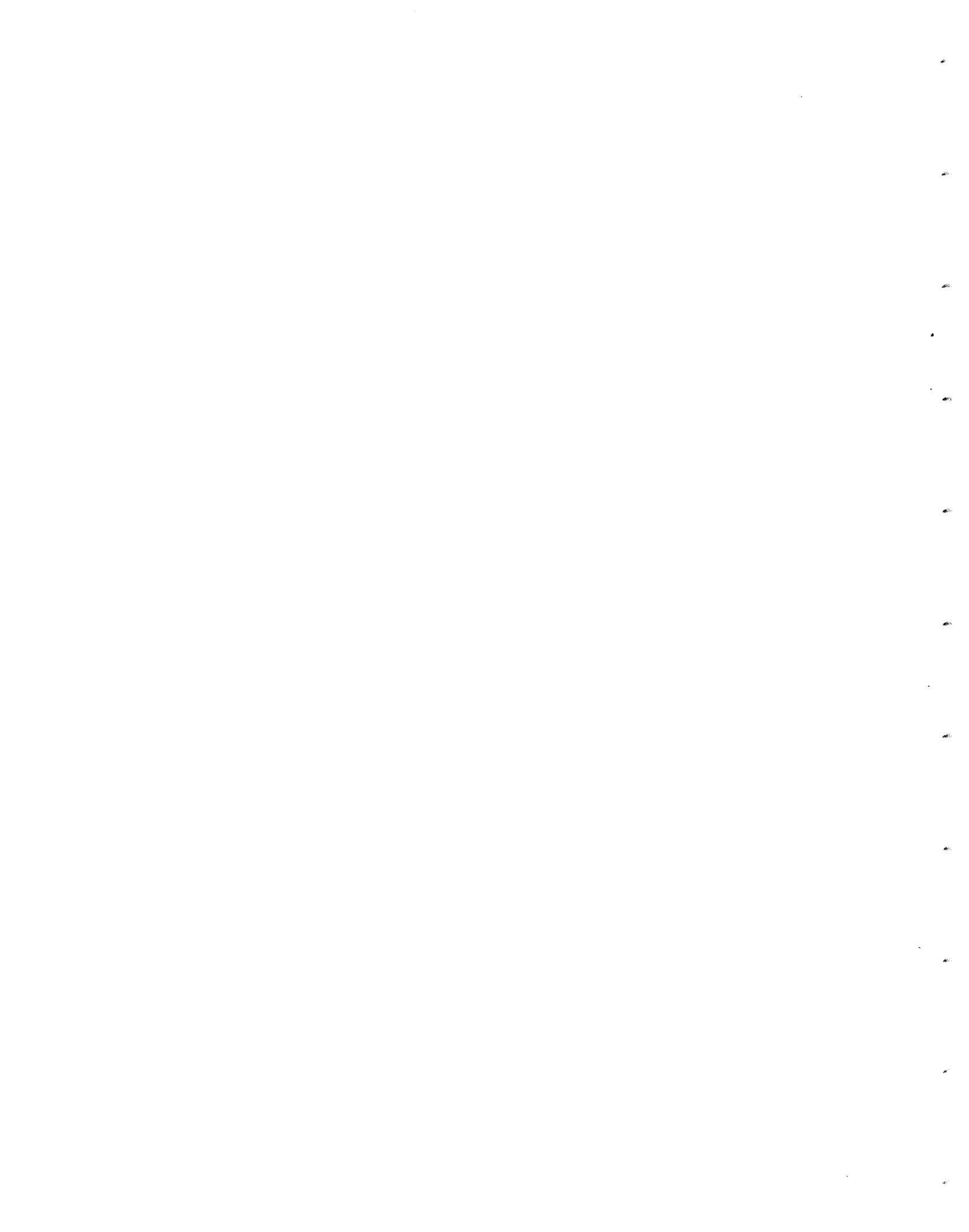
National Marine Fisheries Service

Rolland A. Schmitt, Assistant Administrator for Fisheries



ABSTRACT

Hook-and-line landings at the marine bank, Cordell Bank, California, were identified and quantified from 1986-1991. A total of 45 charter cruises were conducted in which an average 11.5 anglers expended 3.9 hours fishing. The mean vessel catch per trip was 162 fish landed, resulting in a total catch of 7,439 fish during the entire study. No annual pattern to the catch-per-unit effort was apparent, while interannual differences were found. Twenty-eight different fish species were identified during the study; a mean of 15.3 species per trip was observed. Rockfishes (genus Sebastes) dominated the catches, comprising over 80% of all landings. Yellowtail rockfish (S. flavidus), the target species of the research effort, made up 47.9% of the total catch. Sex ratios of the yellowtail rockfish exhibited an annual pattern, but the overall annual ratio was even. In comparison with coastwide landings, Cordell Bank was found to be a consistently productive fish habitat that supported a diverse fish community.



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INTRODUCTION

Preliminary studies of rockfishes (Sebastes spp.) at Cordell Bank, California, began as early as 1984. The purpose of this research was to examine the inherent and environmental factors that influence the physiology, behavior, and adaptive capacity of a variety of ecologically diverse rockfishes. After a review of the available species, the yellowtail rockfish (Sebastes flavidus) was selected for concentrated study as a model species because of coastwide commercial importance, wide distribution, and suitability for laboratory experimentation. The laboratory and field research consisted of assessment of physiological and nutritional condition and its relationship to reproduction. Procedures and analyses required freshly caught, and sometimes live, specimens. Thus, hook-and-line fishing was employed as a means of capture, and was conducted from a chartered commercial vessel. Although sampling efforts were directed at yellowtail rockfish, a variety of fish species was landed. When monthly charter cruises began in 1986, a study was begun to monitor the catch and effort of these trips in order to better understand the fish community of Cordell Bank. This report documents the results of that study and provides information on fish species associations and their temporal and spatial distributions.

Cordell Bank is an elevated portion of the Salinian Block of the Pacific Plate. It is the northernmost seamount of a series of mounts that extend along the California Continental Shelf. It is located 37 km due west of Pt. Reyes, California, and approximately 100 km northwest of San Francisco, California (Fig. 1). The highly variegated rocky topography extends 15 km long by 8 km wide within the 91-m contour line (50 fathom). The Bank top covers approximately 47 km². While most of the Bank lies within the 60-m depth, some pinnacles reach to within 40 m of the surface. Eastward of the Bank lies the continental shelf that averages 110 m in depth. Immediately to the west is the continental slope leading to abyssal depths.

The biotic community is abundant and diverse (NOAA, 1989; Schmieder, 1991). Open waters and deep depths preclude large kelp colonization, but hard substrates are covered with encrusting algae and hydrocorals. Dense benthic invertebrate communities have been observed. No previous fish surveys have been done on Cordell Bank. Commercial trawl fishing has traditionally occurred in adjacent grounds. Both commercial and recreational fishing on the Bank have been restricted to hook-and-line gear. The relative far distance from the coast and rough sea conditions that prevail for much of the year have resulted in low exploitation.

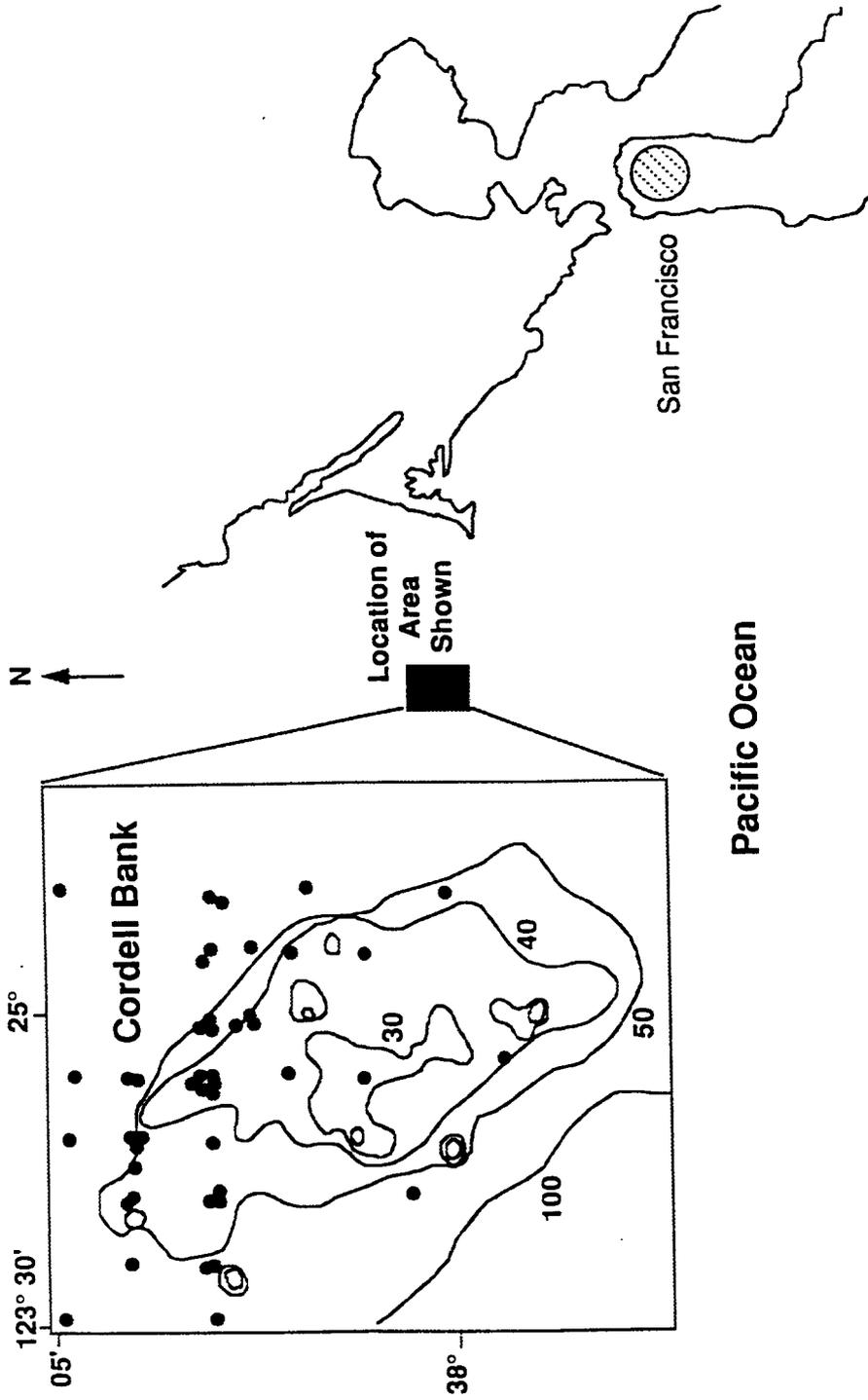


Figure 1. Map of sampling site for hook-and-line study at Cordell Bank, California. Dots in insert represent specific locations of individual sampling sites.

A species list of fishes was compiled as part of the final environmental impact statement and management plan for the Cordell Bank National Marine Sanctuary (NOAA, 1989). The compilation represents data from visual observations by divers of the Cordell Expeditions (Schmieder, 1991) and from preliminary catch records in this study and from commercial and recreational catches monitored by the California Department of Fish and Game. A total of 38 species was reported with no account of their relative abundance or seasonal distribution. Within this grouping, 17, or 45%, were Sebastes species. Yellowtail rockfish is known to form large aggregations above rock pinnacles. This commercially important species can be characterized as a semi-pelagic rockfish whose range extends from San Diego, California, to the Aleutian Islands, Alaska. The center of its abundance is off the central Oregon and Washington coasts.

While yellowtail rockfish were plentiful in the catches of our early studies of Cordell Bank, other fishes were also collected. The purpose of this study was to determine what fish species co-occur with the yellowtail rockfish, and to measure their relative seasonal abundances by their availability to hook-and-line fishing.

MATERIALS AND METHODS

From June, 1986, to April, 1991, chartered cruises were made at approximate monthly intervals to Cordell Bank from Bodega Bay, California. The chartered vessel was a 19-m party boat run by the owner-captain who had familiarity with the Bank. Departures from Bodega Bay were at 0700 hours and transit times to the Bank averaged 1.75h with times varying according to sea conditions and the area of the Bank to be fished.

Fishers consisted of NMFS staff and experienced fishermen from the local fishing fleet. Fishing was by hook-and-line using either single-weighted simulated shrimp lures or six-hook shrimp fly jigs with one- or two-pound sinkers. Fishing locations were selected on the basis of the suitable images visible on the vessel's sonar color scanner. Start and finish fishing times were recorded at each location where fish were landed and their corresponding navigational positions and bottom depths noted. These timed efforts were then summed to arrive at a total time fished for each day. The number of persons actively fishing was recorded for each day. All fish that were hooked and landed were identified and enumerated regardless of their dispensation.

RESULTS

Effort

From June, 1986, to April, 1991, a total of 45 trips to Cordell Bank was completed. All but a few (i.e., 40 of 45) fishing days were spent in the northern half of the Bank (Fig. 1) with an average fishing depth of 85.4m (SD = 9.9m) and a range of 62-135m.

The expenditure of effort among the years was not even (Tables 1 and 2). Years 1987 and 1990 had 12 consecutive months of sampling with no interruptions. Years 1989 and 1991 had reduced effort with four and three collections respectively. When the total numbers of trips made for individual months are pooled over the five years, the distribution of effort is even among the 12 calendar months. The overall mean number of trips per month calculated to 3.8 trips per month with a range of 3.0-4.5.

An average of 11.5 fishers per trip (range 5-20) actively participated in the fishing. Fishing always began mid-morning with a mean start time of 0949 hours. The average time spent collecting fish was 3.9h (SD = 1.2, range 1.7-6.0h).

Catch

The total number of fish caught during the five-year study amounted to 7,439. These trip catches averaged 162 fish per trip, with a range of 111-241. No general temporal pattern in catches was found among the 12 months (Table 1). Highest catches occurred in December; lowest catches were in November. The more accurate measure of catchability and relative fish abundance, CPUE (number of fish caught per angler per hour), likewise displayed no annual pattern. The highest mean CPUE occurred in February and the lowest in October. Interannual differences were marked, both in total catches and per unit effort catches. Total catches naturally reflected the total number of monthly trips made during the respective year. The directly comparable mean catch per trip and CPUE values showed that 1990 was the most productive year, while 1987 was the least.

Species Composition

During the five-year study, 28 different fish species were identified (Table 3). The mean number of species by month varied from 13 to 19 (Table 1); nonetheless, the number of species throughout the year varied relatively little (CV = 11.8%) around a mean of 15.3 species per trip. Similarly, both the total number of species for each year and the annual mean number of species per trip were consistent (mean \pm SD = 17.1 \pm 1.5 total species for the year; 10.0 \pm 0.6 number of species per trip).

The most abundant species collected was our target species, yellowtail rockfish, which made up 47.4% of the total catch (Table 5). Succeeding four species combined with the yellowtail rockfish comprised over 80% of all fish landed (S. rosaceus, S. paucispinis, S. serranoides, S. chlorostictus). Of the 13 most abundant species, all but one (Ophiodon elongatus) were Sebastes species. Of the 28 species collected, 21 were Sebastes species. Together they comprised 95.6% of all fish landed. There was no particular seasonal pattern to landings of the above five abundant species. All were captured throughout the year suggesting year-round residency. S. ruberrimus and S. ovalis were also caught during all months, though in lower numbers. Other species, namely S. entomelas, S. goodei, and S. mystinus, occurred in high numbers during restricted periods (i.e., July, March, and September, May, respectively).

Yellowtail Rockfish

Yellowtail rockfish were sexed as well as counted with a total count of 3,057, composed of 1,622 males and 1,885 females (Table 4). The resultant mean ratio of all trips was essentially even (i.e., 1.01); the overall ratio for the summed totals was 0.86 males/females. An intra-annual cycle was observed with males dominating the catches during the winter and females more abundant the remainder of the year (Table 4). There were significant (ANOVA; $P < 0.01$) interannual differences in the ratios; there was no apparent temporal pattern but there were considerable differences in the number of trips per year. The overall annual ratios indicated that females were more abundant in five of the six years. The sixth year (1991) was sampled only the first three months. The mean ratios for each year showed a mixed result and no apparent trend.

DISCUSSION

The 45 hook-and-line collections that spanned six years and included two consecutive 12-month sampling periods provided the most comprehensive database to date on the fish community of Cordell Bank, California. The study also demonstrated the wide diversity and productivity of this marine bank.

This study's findings combined with the observations of Schmeider (in U.S. Department of Commerce, 1989) document 49 different fish species (Table 6). Schmeider's non-quantitative findings were based on SCUBA observations and included 20 species that would not be expected to be commonly collected by hook-and-line methods off party boats. Examples are Mola mola, Thunnus alalunga, and the small cottids. Likewise, this study produced five rockfish species that were not observed by Schmeider

(Sebastes hopkinsi, S. nebulosus, S. proriger, S. rosenblatti, and S. saxicola).

It was readily apparent from this study and others that Sebastes species dominated the fish community at Cordell Bank. Rockfishes represented 95.6% of all fish landed (Table 5). Unpublished data from a California Department of Fish and Game study of partyboat catches from Cordell Bank over 32 consecutive months from 1987-1989 (pers. comm. Diana Watters, California Department of Fish and Game) showed Sebastes comprised 96.3% of the catch. Dominance of Sebastes is typical of waters off the entire Pacific coast, especially off central and northern California. Recreational fish catch reports, beginning in 1981, noted up to 44% of all catches were Sebastes species (U.S. Department of Commerce, 1985, 1987, 1989; Witzig et al., 1992). In a historical comparison of party boat catch in central and northern California, it was found that 18 of the 20 most frequently caught species were rockfishes (California Department of Fish and Game, 1993). A 1987 to 1991 study of commercial passenger fishing vessel (CPFV) catches in waters from Ft. Bragg to Morro Bay, California, documented that Sebastes species accounted for 88.5 to 97.9% by number of the observed landings (Reilly et al., 1993). Even in southern California, 30 of 49 recreationally caught species from the Channel Islands were rockfishes (Love et al., 1985).

The dominance of yellowtail rockfish in this study's catch (47.4%) demonstrated that the species was an obvious target of effort. Nonetheless, yellowtail rockfish has been shown to be a prominent species in hook-and-line recreationally caught landings. CPFV data from northern Cordell Bank had S. goodei as the most numerous catch (39.7%) followed by S. flavidus (17.8%), S. chlorostictus (8.6%), and S. paucispinis (7.7%) (pers. comm. Diana Watters). The more spatially and temporally comprehensive survey of Reilly et al. (1993) showed that coastwide the five most abundant fishes were, in order of relative abundance, S. goodei, S. mystinus, S. flavidus, S. entomelas, and S. paucispinis. The prevalence of yellowtail rockfish, whose region of highest abundance is located from northern California northward (Alverson et al., 1964; Westrheim, 1970), declined in catches from waters to the south of Cordell Bank.

Catch rates from this study indicated that Cordell Bank was a productive habitat for finfish. The overall mean CPUE (numbers of fish per angler hour) for all 45 trips was 4.44 ± 3.16 SE. The California Department of Fish and Game survey was comparable with a value of 3.57 for northern Cordell Bank. On a catch basis of number of fish per angler-day, averaged for the entire study, the catch rate was 15.0 ± 2.6 . For comparison, the coastwide long-term rate found in the Recreational Fishery Statistics Survey was 8.6, with a range of 5.4-11.2 (Witzig et al., 1992). The more regionally confined central and northern California

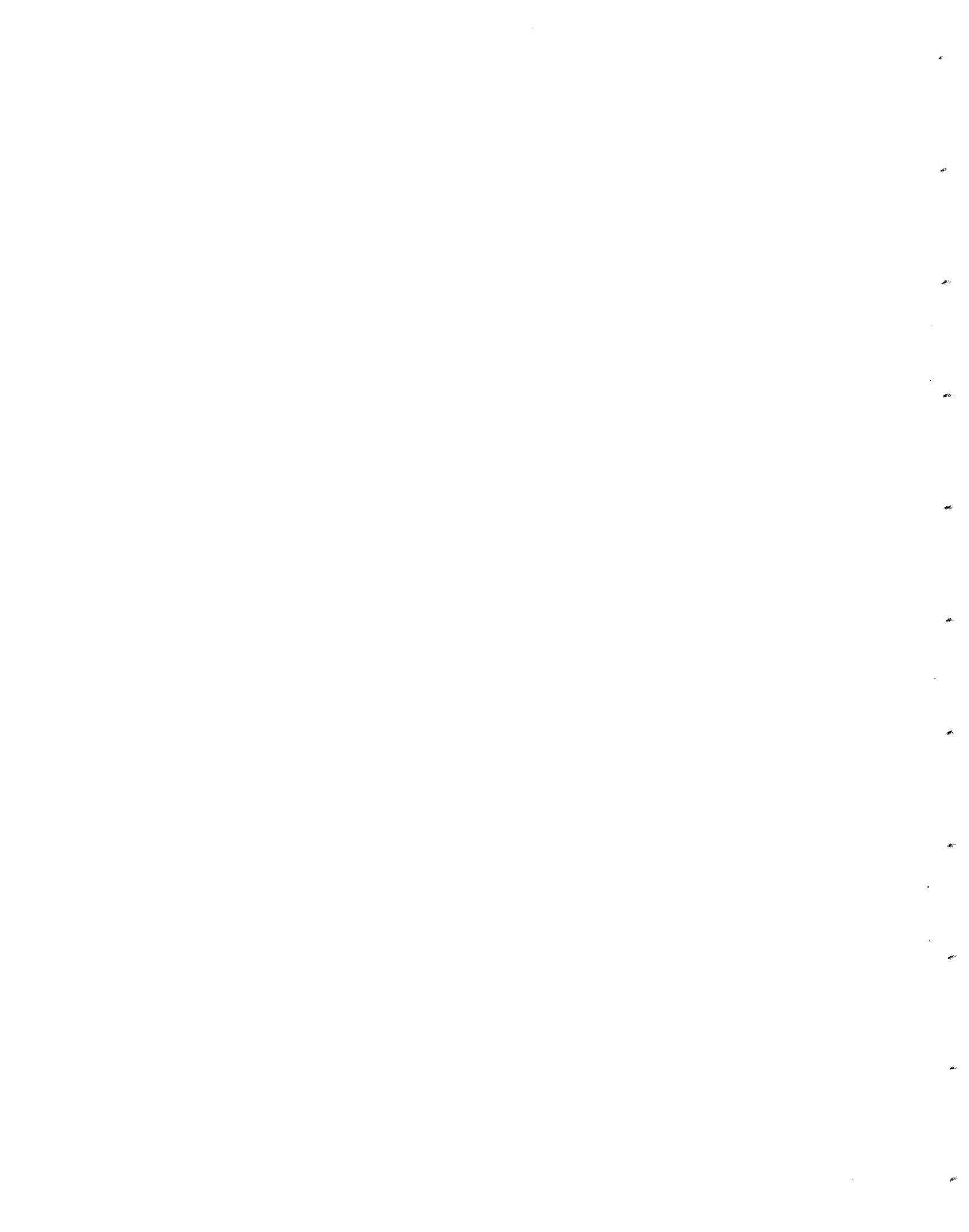
survey of Reilly et al. (1993) produced a mean catch rate of 11.8. Thus, Cordell Bank appears to have an abundant and relatively stable fish population. A possible explanation for this is the low exploitation rate due, in part, to the fact that trawlers are unable to fish the rocky, uneven bottom, and the difficulty in traveling to the distant offshore bank, an area known for rough sea conditions.

The monthly pattern of sex ratios of yellowtail rockfish probably reflects changes in behavior during the annual reproductive cycle (Eldridge et al., 1991). The period when males were most frequently landed occurred during the period of gestation in the females. Laboratory observations of gestating females indicate that feeding is suppressed during the latter stages of gestation, prior to parturition.

In summary, the six calendar year, 45-trip study of hook-and-line caught fishes from Cordell Bank, California, documented a fish community that was among the most diverse and abundant along the Pacific coast.

ACKNOWLEDGEMENTS

The owner/operator of the charter vessel F/V New Sea Angler, Rick Powers, demonstrated his seamanship, cooperative nature, and keen fishing abilities during this study. Over the course of this study, many volunteer anglers offered their services. Without their assistance and cheerful cooperation, often during inclimate and uncomfortable circumstances, this study would not have been possible.



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Table 1. Summary of effort and catch data by month and year for Cordell Bank hook-and-line survey, 1986-91.

Month	EFFORT				CATCH			
	No. of Trips	\bar{x} No. of Fishermen	\bar{x} No. of Hours Fished	Total Catch	\bar{x} No. of Per Trip	No. of Species	\bar{x} No. Spp. Per Trip	CPUE
January	4	10.5	4.5	843	211	14	10.5	4.893
February	4	8.5	3.8	649	162	13	8.5	6.803
March	4	11.5	3.8	685	171	14	11.5	4.173
April	4	14.3	4.2	715	179	19	10.8	3.415
May	2	11.0	3.9	330	165	13	9.0	4.010
June	3	9.7	3.4	499	166	16	10.7	6.070
July	4	12.3	3.1	739	185	17	12.3	5.323
August	4	11.3	4.1	670	168	15	11.1	3.785
September	4	11.8	3.0	633	158	16	9.3	4.805
October	3	13.3	4.0	514	171	14	8.6	3.100
November	3	9.3	4.3	363	121	15	9.3	3.857
December	6	11.3	4.2	799	133	17	11.3	3.327
<u>Years</u>								
1986	7	10.3	5.1	889	127	18	10.7	2.513
1987	12	11.5	4.8	1393	116	18	9.2	2.403
1988	7	13.3	3.8	945	135	17	9.4	2.741
1989	4	12.3	3.0	730	104	15	10.0	4.853
1990	12	11.0	2.7	2920	243	19	10.5	8.087
1991	3	9.0	3.5	562	187	16	10.3	5.923
All	45	11.5	3.9	7439	165	28	10.0	4.441

Table 2. Depths, number of fishermen, hours fished and the total catch of fish and species of monthly charter boat hook-and-line surveys, 1986-91.

<u>Year</u>	<u>Month</u>	<u>Fishing Depth (F)</u>	<u>No. of Fishermen</u>	<u>Hours Fished</u>	<u>Total Catch</u>	<u>Total No. of Species</u>	
1986	June	55	11	4.6	164	12	
	July	44	10	4.5	121	10	
	August	73	9	6.0	233	11	
	October	55	10	4.6	85	9	
	November	44	9	5.0	73	11	
	December	48	9	6.0	92	12	
	December	44	14	4.5	121	10	
	1987	January	45	8	5.4	201	10
		February	40	5	6.0	47	8
		March	50	6	5.3	51	7
		April	49	19	4.8	92	9
		May	60	11	4.0	74	8
June		47	8	3.5	119	10	
July		72	11	4.0	86	9	
August		47	13	5.3	173	8	
September		61	18	5.4	92	11	
October		40	13	3.8	137	8	
November		37	13	5.4	179	11	
December		43	13	4.3	143	11	

Table 2 (Cont.). Depths, number of fishermen, hours fished and the total catch of fish and species of monthly charter boat hook-and-line surveys, 1986-91.

<u>Year</u>	<u>Month</u>	<u>Fishing Depth (F)</u>	<u>No. of Fishermen</u>	<u>Hours Fished</u>	<u>Total Catch</u>	<u>Total No. of Species</u>	
1988	January	54	14	5.3	128	12	
	February	50	12	4.2	174	9	
	March	52	12	3.3	143	8	
	April	61	19	4.8	232	10	
	July	48	8	2.0	60	7	
	September	51	12	2.0	62	9	
	December	36	16	4.8	146	11	
	1989	March	44	11	3.5	179	9
		August	40	13	2.6	158	11
		September	74	14	2.9	167	10
		December	45	11	3.0	226	10
	1990	January	39	13	3.3	371	11
February		36	6	2.3	199	10	
March		41	17	3.1	312	13	
April		34	10	3.5	202	13	
May		36	11	3.7	256	10	
June		40	10	2.0	216	10	
July		40	20	1.8	472	13	
August		38	10	2.5	106	11	
September		35	16	1.7	312	7	
October		38	17	3.7	292	9	
November		40	6	2.5	111	11	
December		40	5	2.8	71	8	
1991	January	40	7	4.1	144	9	
	February	46	11	2.8	229	11	
	April	50	9	3.5	189	11	

Table 3. Names, total catches, mean catches per trip, and the maximum numbers caught per trip of fishes collected by hook and line at Cordell Bank, California, from 1986-91.

<u>Common Name</u>	<u>Scientific Name</u>	<u>Total Catch</u>	<u>Mean Catch Per Trip</u>	<u>Max. Catch Per Trip</u>
Spiny dogfish	<u>Squalus acanthias</u>	1	.02	1
Chinook salmon	<u>Oncorhynchus tshawytscha</u>	3	.07	1
Lingcod	<u>Ophiodon elongatus</u>	287	6.38	33
Greenspotted rockfish	<u>Sebastes chlorostictus</u>	381	8.47	83
Starry rockfish	<u>S. constellatus</u>	143	3.18	9
Greenstriped rockfish	<u>S. elongatus</u>	32	.71	15
Widow rockfish	<u>S. entomelas</u>	375	8.33	182
Yellowtail rockfish	<u>S. flavidus</u>	3528	77.60	247
Chilipepper rockfish	<u>S. goodei</u>	47	1.04	27
Squarespot rockfish	<u>S. hopkinsi</u>	2	.04	1
Cowcod rockfish	<u>S. levis</u>	1	.02	1
Quilback rockfish	<u>S. maliger</u>	2	.04	2
Vermillion rockfish	<u>S. miniatus</u>	14	.31	3
Blue rockfish	<u>S. mystinus</u>	36	.80	15
China rockfish	<u>S. nebulosus</u>	1	.02	1
Speckled rockfish	<u>S. ovalis</u>	134	2.98	34
Bocaccio rockfish	<u>S. paucispinis</u>	717	15.93	58
Canary rockfish	<u>S. pinniger</u>	308	6.84	82
Redstripe rockfish	<u>S. proriger</u>	1	.02	1
Rosy rockfish	<u>S. rosaseus</u>	725	16.11	68
Green blotched rockfish	<u>S. rosenblatti</u>	18	.40	15
Yelloweye rockfish	<u>S. ruberrimus</u>	110	2.44	10
Stripetail rockfish	<u>S. saxicola</u>	2	.04	2
Olive rockfish	<u>S. serranoides</u>	521	11.58	109
Jack mackerel	<u>Trachurus symmetricus</u>	25	.56	12
Pacific mackerel	<u>Scomber japonicus</u>	14	.31	14
Pacific sanddab	<u>Citharichthys sordidus</u>	1	.02	1
Rock sole	<u>Lepidopsetta bilineata</u>	10	.22	3

Table 4. Numbers of male and female and the male:female mean ratios and overall ratio of yellowtail rockfish for all individual months and years.

<u>Month</u>	<u>No. of Males</u>	<u>No. of Females</u>	<u>Mean Ratio M:F</u>	<u>Overall M:F Ratio</u>
January	175	256	0.76	0.68
February	206	171	1.57	1.20
March	233	146	2.06	1.60
April	148	131	1.32	1.13
May	46	55	1.05	0.84
June	142	124	1.83	1.15
July	148	171	0.91	0.87
August	116	151	0.85	0.77
September	163	207	0.61	0.78
October	98	150	0.53	0.65
November	51	80	0.66	0.64
December	96	245	0.42	0.39
<u>Years</u>				
1986	101	120	1.11	0.84
1987	300	357	1.27	0.84
1988	183	224	0.78	0.82
1989	165	244	1.02	0.68
1990	715	802	0.88	0.89
1991	158	138	1.10	1.14
ALL	1622	1885	1.01	0.86

Table 5. List of fish species in the order of relative abundance and percent of total catch.

<u>Rank</u>	<u>Scientific Name</u>	<u>% Composition</u>
1	Sebastes flavidus	47.4
2	Sebastes rosaceus	9.7
3	Sebastes paucispinis	9.6
4	Sebastes serranoides	7.0
5	Sebastes chlorostictus	5.1
6	Sebastes entomelas	5.0
7	Sebastes pinniger	4.1
8	Ophiodon elongatus	3.9
9	Sebastes constellatus	1.9
10	Sebastes ovalis	1.8
11	Sebastes ruberrimus	1.5
12	Sebastes goodei	0.6
13	Sebastes mystinus	0.5
14	Sebastes elongatus	0.4
15	Trachurus symmetricus	0.3
16	Sebastes rosenblatti	0.2
17	Scomber japonicus	0.2
18	Sebastes miniatus	0.1
19	Lepidopsetta bilineata	0.1
20	Oncorhynchus tshawytscha	0.04
21	Sebastes maliger	0.03
22	Sebastes hopkinsi	0.03
23	Sebastes saxicola	0.03
24	Sebastes proriger	0.01
25	Sebastes levis	0.01
26	Citharichthys sordidus	0.01
27	Squalus acanthias	0.01
28	Sebastes nebulosus	0.01

Table 6. List of fish species observed at Cordell Bank, California.

<u>Family</u>	<u>Scientific Name</u>		<u>Common Name</u>
Squalidae	Squalus	acanthias	spiny dogfish
Lamnidae	Isurus	oxyrinchus	bonito shark
Carcharinidae	Prionace	glauca	blue shark
Torpedinidae	Torpedo	californica	Pacific electric ray
Chimaeridae	Hydrolagus	colliei	ratfish
Engraulidae	Engraulis	mordax	northern anchovy
Salmonidae	Oncorhynchus	tshawytscha	king salmon
Scomberesocidae	Cololabis	saira	Pacific saury
Scorpaenidae	Sebastes	constellatus	starry rockfish
	S.	chlorostictus	greenspotted rockfish
	S.	entomelas	widow rockfish
	S.	elongatus	greenstriped rockfish
	S.	flavidus	yellowtail rockfish
	S.	goodei	chilipepper rockfish
	S.	hopkinsi	squarespot rockfish
	S.	levis	cowcod rockfish
	S.	maliger	quillback rockfish
	S.	melanops	black rockfish
	S.	miniatus	vermillion rockfish
	S.	mystinus	blue rockfish
	S.	nebulosus	China rockfish
	S.	ovalis	speckled rockfish
	S.	paucispinis	bocaccio
	S.	pinniger	canary rockfish
	S.	proriger	red striped rockfish
	S.	rosaceus	rosy rockfish
	S.	rosenblatti	greenblotched rockfish
	S.	ruberrimus	yelloweye rockfish
	S.	saxicola	stripetail rockfish
	S.	serranoides	olive rockfish

Table 6 (cont.). List of fish species observed at Cordell Bank, California.

<u>Family</u>	<u>Scientific Name</u>		<u>Common Name</u>
Anoplopomatidae	Anoplopoma	fimbria	sablefish
Hexagrammidae	Hexagrammos	decagrammus	kelp greenling
	Ophiodon	elongatus	lingcod
	Oxylebius	pictus	painted greenling
Cottidae	Arteidius	corralinus	corraline sculpin
	A.	meanyi	Puget sound sculpin
	Hemilepidotus	spinosus	brown Irish lord
Agonidae	Xeneretmus	triacanthus	bluespotted poacher
Serranidae	Paralabrax	clathratus	kelp bass
Branchiostegidae	Caulolatilus	princeps	ocean whitefish
Carangidae	Trachurus	symmetricus	jack mackerel
Stichaeidae	Chirolophis	nugator	mosshead warbonnet
Scombridae	Scomber	japonicus	Pacific mackerel
	Thunnus	alalunga	albacore tuna
Bothidae	Citharichthys	sordidus	Pacific sanddab
Pleuronectidae	Eopsetta	jordani	petrale sole
	Lepidosetta	bilineata	rock sole
	Psettichthys	melanostictus	sand sole
Molidae	Mola	mola	common mola

Appendix A. Landings of fish species at Cordell Bank, California, by individual cruises by date (month/year).

Scientific Name	Month/Year												
	6/86	7/86	8/86	10/86	11/86	12/86	12/86	12/86	12/86	12/86	12/86	1/87	
Squalus acanthias	0	0	0	0	0	0	0	0	0	0	0	0	0
Oncorhynchus tshawytscha	0	0	0	0	0	0	0	0	0	0	0	0	0
Sebastes constellatus	2	4	1	1	2	3	3	3	3	3	9	0	0
S. chlorostictus	1	2	83	14	25	8	8	8	8	8	3	12	12
S. elongatus	2	0	15	0	3	1	1	1	1	1	1	0	0
S. entomelas	0	0	0	0	0	0	0	0	0	0	0	5	5
S. flavidus	66	56	34	29	3	9	9	9	9	9	45	124	124
S. goodei	0	0	3	0	2	0	0	0	0	0	0	0	0
S. hopkinsi	0	0	0	0	0	0	0	0	0	0	0	0	0
S. levis	0	0	0	0	0	0	0	0	0	0	0	0	0
S. maliger	0	0	0	0	0	0	0	0	0	0	0	0	0
S. miniatus	1	0	1	0	0	0	0	0	0	0	0	0	0
S. mystinus	2	0	0	0	0	0	0	0	0	0	0	0	0
S. nebulosus	0	0	0	0	0	0	0	0	0	0	0	0	0
S. ovalis	1	0	0	0	0	0	0	0	0	0	0	5	5
S. paucispinis	0	0	15	8	12	23	23	23	23	23	13	33	33
S. pinniger	5	1	41	2	7	3	3	3	3	3	4	7	7
S. proriger	0	0	0	0	0	0	0	0	0	0	0	0	0
S. rosaceus	68	49	36	18	7	27	27	27	27	27	32	5	5
S. rosenblatti	0	0	0	1	0	2	2	2	2	2	0	0	0
S. ruberrimus	2	2	1	10	9	5	5	5	5	5	7	3	3
S. saxicola	0	0	0	0	0	0	0	0	0	0	0	0	0
S. serranoides	12	2	3	0	0	1	1	1	1	1	0	2	2
Ophiodon elongatus	2	1	0	1	2	10	10	10	10	10	5	5	5
Trachurus symmetricus	0	3	0	0	0	0	0	0	0	0	0	0	0
Scomber japonicus	0	0	0	0	0	0	0	0	0	0	0	0	0
Citharichthys sordidus	0	1	0	0	0	0	0	0	0	0	0	0	0
Lepidopsetta bilineata	0	0	0	1	1	0	0	0	0	0	0	0	0

Appendix A (cont.). Landings of fish species at Cordell Bank, California, by individual cruises by date (month/year).

Scientific Name	Month/Year												
	2/87	3/87	4/87	5/87	6/87	7/87	8/87	9/87					
Squalus acanthias	0	0	0	1	0	0	0	0	0	0	0	0	0
Oncorhynchus tshawytscha	0	0	0	0	1	0	0	0	0	0	0	0	0
Sebastes constellatus	0	1	5	0	8	0	3	0	0	0	0	0	0
S. chlorostictus	2	1	13	21	2	29	11	6	0	0	0	0	0
S. elongatus	0	0	0	0	0	4	0	0	0	0	0	0	0
S. entomelas	0	0	1	0	5	0	0	1	0	0	0	0	0
S. flavidus	19	25	51	14	79	35	64	19	0	0	0	0	0
S. goodei	0	14	1	0	0	0	0	0	0	0	0	0	0
S. hopkinsi	0	0	0	0	0	0	0	0	0	0	0	0	0
S. levis	0	0	0	0	0	0	0	0	0	0	0	0	0
S. maliger	0	0	0	0	0	0	0	0	0	0	0	0	0
S. miniatus	0	0	0	2	0	2	0	0	0	0	0	0	0
S. mystinus	0	0	0	0	0	0	0	0	0	0	0	0	0
S. nebulosus	0	0	0	0	0	0	0	0	0	0	0	0	0
S. ovalis	0	0	0	0	0	0	0	0	0	0	4	10	0
S. paucispinis	6	0	6	3	8	3	21	30	0	0	0	0	0
S. pinniger	4	2	0	28	2	7	0	1	0	0	0	0	0
S. proriger	0	0	0	0	0	0	0	0	0	0	0	0	0
S. rosaceus	11	7	8	0	9	2	44	6	0	0	0	0	0
S. rosenblatti	0	0	0	0	0	0	0	0	0	0	0	0	0
S. ruberrimus	1	1	1	3	4	3	4	2	0	0	0	0	0
S. saxicola	0	0	0	0	0	0	0	0	0	0	0	0	0
S. serranooides	0	0	1	0	0	0	0	0	0	0	0	0	0
Ophiodon elongatus	1	0	5	2	1	1	18	4	0	0	0	0	0
Trachurus symmetricus	0	0	0	0	0	0	0	12	0	0	0	0	0
Scomber japonicus	0	0	0	0	0	0	0	0	0	0	0	0	0
Citharichthys sordidus	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidopsetta bilineata	3	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A (cont.). Landings of fish species at Cordell Bank, California, by individual cruises by date (month/year).

Scientific Name	Month/Year								
	10/87	11/87	12/87	1/88	2/88	3/88	4/88	7/88	
<i>Squalus acanthias</i>	0	0	0	0	0	0	0	0	0
<i>Oncorhynchus tshawytscha</i>	0	0	0	0	0	0	0	0	0
<i>Sebastes constellatus</i>	9	9	8	1	4	2	0	0	2
S. chlorostictus	8	19	1	8	7	12	53	1	1
S. elongatus	0	2	1	2	0	0	0	0	0
S. entomelas	0	1	6	0	0	0	0	0	0
S. flavidus	70	79	74	51	98	92	57	45	0
S. goodei	0	0	0	0	0	0	0	0	0
S. hopkinsi	0	0	0	0	0	0	0	0	0
S. levis	0	0	0	0	0	0	0	0	0
S. maliger	0	0	0	0	0	0	0	0	0
S. miniatus	0	0	0	0	0	0	0	0	0
S. mystinus	0	0	0	1	0	0	0	0	0
S. nebulosus	0	0	0	0	0	0	0	0	0
S. ovalis	0	2	1	0	0	0	0	0	0
S. paucispinis	25	25	22	14	15	14	7	1	7
S. pinniger	7	6	4	14	23	6	82	0	0
S. proriger	0	0	0	0	0	0	0	0	0
S. rosaceus	10	29	22	17	24	3	1	2	2
S. rosenblatti	0	0	0	0	0	0	15	0	0
S. ruberrimus	1	1	3	5	2	0	5	2	2
S. saxicola	0	0	0	0	0	0	0	0	0
S. serranooides	0	0	0	0	0	1	0	0	0
<i>Ophiodon elongatus</i>	7	6	0	11	0	13	9	1	1
<i>Trachurus symmetricus</i>	0	0	1	0	0	0	0	0	0
<i>Scomber japonicus</i>	0	0	0	0	0	0	0	0	0
<i>Citharichthys sordidus</i>	0	0	0	0	0	0	0	0	0
<i>Lepidopsetta bilineata</i>	0	0	0	1	1	0	2	0	0

Appendix A (cont.). Landings of fish species at Cordell Bank, California, by individual cruises by date (month/year).

Scientific Name	Month/Year												
	9/88	12/88	3/89	8/89	9/89	12/89	1/90	2/90					
Squalus acanthias	0	0	0	0	0	0	0	0	0	0	0	0	0
Oncorhynchus tshawytscha	0	0	0	0	0	0	0	0	0	0	0	0	0
Sebastes constellatus	1	1	3	2	0	2	0	6	0	2	6	0	0
S. chlorostictus	1	2	0	1	10	3	4	4	1	0	4	1	0
S. elongatus	0	0	0	0	1	0	0	0	0	0	0	0	0
S. entomelas	1	1	4	17	9	24	24	24	6	0	24	6	0
S. flavidus	30	34	87	78	74	138	177	177	118	0	177	118	0
S. goodei	0	0	0	0	27	0	0	0	0	0	0	0	0
S. hopkinsi	0	0	0	0	0	0	0	0	0	0	0	0	0
S. levis	0	0	0	0	0	0	0	0	0	0	0	0	0
S. maliger	0	2	0	0	0	0	0	0	0	0	0	0	0
S. miniatus	0	1	0	0	0	0	0	0	0	0	0	0	0
S. mystinus	0	1	0	0	0	0	0	0	6	0	0	6	0
S. nebulosus	0	0	0	0	0	0	0	0	0	0	0	0	0
S. ovalis	0	0	4	5	0	0	0	4	1	0	4	1	0
S. paucispinis	11	24	35	5	32	23	52	52	19	0	52	19	0
S. pinniger	2	0	0	0	9	8	3	3	3	0	3	3	0
S. proriger	0	0	0	0	0	0	0	0	0	0	0	0	0
S. rosaceus	4	19	7	13	0	18	29	29	8	0	29	8	0
S. rosenblatti	0	0	0	0	0	0	0	0	0	0	0	0	0
S. ruberrimus	2	5	4	1	2	4	1	1	0	0	1	0	0
S. saxicola	0	0	0	0	0	0	0	0	0	0	0	0	0
S. serranoides	0	43	3	0	0	2	58	58	29	0	58	29	0
Ophiodon elongatus	10	13	30	2	2	4	13	13	8	0	13	8	0
Trachurus symmetricus	0	0	0	4	0	0	0	0	0	0	0	0	0
Scomber japonicus	0	0	0	0	0	0	0	0	0	0	0	0	0
Citharichthys sordidus	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidopsetta bilineata	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A (cont.). Landings of fish species at Cordell Bank, California, by individual cruises by date (month/year).

Scientific Name	Month/Year									
	3/90	4/90	5/90	6/90	7/90	8/90	9/90	10/90		
Squalus acanthias	0	0	0	0	0	0	0	0	0	0
Oncorhynchus tshawytscha	0	0	0	0	0	0	0	0	0	0
Sebastes stellatus	5	5	4	6	5	4	0	0	0	8
S. chlorostictus	8	0	0	0	0	1	0	0	0	0
S. elongatus	0	0	0	0	0	0	0	0	0	0
S. entomelas	5	0	1	6	182	9	26	9	9	9
S. flavidus	173	96	87	131	191	58	247	149		
S. goodei	0	0	0	0	0	0	0	0	0	0
S. hopkinsi	0	1	0	0	0	0	0	0	0	1
S. levis	0	0	0	0	1	0	0	0	0	0
S. maliger	0	0	0	0	0	0	0	0	0	0
S. miniatus	0	1	3	0	0	0	0	0	0	0
S. mystinus	0	7	15	0	4	0	1	0	0	0
S. nebulosus	0	0	0	0	4	0	0	0	0	0
S. ovalis	5	5	0	5	0	0	0	0	0	0
S. paucispinis	58	8	4	10	34	4	0	20		
S. pinniger	6	1	0	3	15	5	2	17		
S. proriger	1	0	0	0	1	0	0	1		
S. rosaceus	24	27	25	17	0	0	0	0		
S. rosenblatti	0	0	0	0	4	6	11	13		
S. ruberrimus	4	1	1	3	0	0	0	0		
S. saxicola	0	0	0	0	0	0	0	0		
S. serranooides	10	46	109	14	30	10	23	41		
Ophiodon elongatus	12	3	7	7	3	4	2	33		
Trachurus symmetricus	0	0	0	0	2	3	0	0		
Scomber japonicus	0	0	0	14	0	0	0	0		
Citharichthys sordidus	0	0	0	0	0	0	0	0		
Lepidopsetta bilineata	0	1	0	0	0	0	0	0		

Appendix A (cont.). Landings of fish species at Cordell Bank, California, by individual cruises by date (month/year).

Scientific Name	Month/Year				
	11/90	12/90	1/91	2/91	4/91
Squalus acanthias	0	0	0	0	0
Oncorhynchus tshawytscha	0	0	0	0	0
Sebastes constellatus	2	0	7	4	4
S. chlorostictus	5	1	2	0	0
S. elongatus	0	0	0	0	0
S. entomelas	4	2	1	16	9
S. flavidus	49	41	79	142	75
S. goodei	0	0	0	0	0
S. hopkinsi	0	0	0	0	0
S. levis	0	0	0	0	0
S. maliger	0	0	0	0	0
S. miniatus	1	0	0	0	0
S. mystinus	0	0	0	0	1
S. nebulosus	0	0	0	0	1
S. ovalis	2	0	0	7	9
S. paucispinis	5	6	36	27	13
S. pinniger	1	4	4	6	0
S. proriger	0	0	0	0	0
S. rosaceus	11	4	5	14	29
S. rosenblatti	0	0	0	0	0
S. ruberrimus	0	0	0	2	1
S. saxicola	0	0	0	0	1
S. serranoides	26	10	3	5	37
Ophiodon elongatus	5	3	7	6	8
Trachurus symmetricus	0	0	0	0	0
Scomber japonicus	0	0	0	0	0
Citharichthys sordidus	0	0	0	0	0
Lepidopsetta bilineata	0	0	0	0	0

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