DISTRIBUTIONAL PATTERNS OF FISHES CAPTURED ABOARD COMMERCIAL PASSENGER FISHING VESSELS ALONG THE NORTHERN CHANNEL ISLANDS, CALIFORNIA

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ABSTRACT

We surveyed fishes taken aboard commercial passenger fishing vessels along the four northern Channel Islands (San Miguel, Santa Rosa, Santa Cruz, and Anacapa) within the Southern California Bight. Fourteen species declined in abundance along the Northern Channel Island chain. Colder water forms decreased to the east, while temperate species declined to the west. In the shallowest depth interval (0-36 m), the mean lengths of four rockfish species increased toward the west. In general, the size of these four species also increased with depth. We believe these phenomena are linked to the differences in water temperature between the islands – with cold, California Current water dominant in the west, and warmer Southern California Bight water entrained in the east.

The mainland coast of California is distinguished by two faunal provinces: A warm-temperate Californian Province lies south of Point Conception and a cold-temperate Oregonian Province exists to the north (Seapy and Littler 1980). In shallow waters, the fish fauna of the Californian Province is a mixture of eurythermic temperate and subtropical species, while the Oregonian Province is predominantly a colder temperate region, with few subtropical species present.

Recent studies examining the distributional patterns of marine intertidal invertebrates (Littler 1980; Seapy and Littler 1980), algae (Murray et al. 1980), and seabirds (Hunt et al. 1980) around southern California islands imply there is a replication of these two mainland faunal provinces along the 88 km, east-west lying, northern Channel Islands (San Miguel, Santa Rosa, Santa Cruz, Anacapa) (Fig. 1). Oregonian Province species dominate the western end of the chain, while the fauna of the eastern end is more Californian.

There is little published on the biogeography of fishes around the northern Channel Islands. Ebeling et al. (1980a, b) examined the fish populations of Santa Cruz Island kelp beds, and Hubbs (1967, 1974) stated that the fish communities of San Miguel were closely related to those of central California, while about Santa Cruz fish were typical of southern California. No other work has been published on this topic.

In this paper, we describe one aspect of the northern Channel Islands' fish fauna, utilizing data gathered by the California Department of Fish and Game in their Commercial Passenger Fishing Vessel creel census. This census (fully described in Methods) counted, measured, and noted the location and depth of capture of fishes taken by hook and line on sportfishing passenger vessels in southern California.

Data from this study could not give an unbiased estimate of species composition. Most angling involved fishing with live bait (primarily northern anchovies, *Engraulis mordax*) or with lures simulating fishes, and angling techniques were similar along the island chain. Thus, the sample was biased toward relatively large-mouthed, piscivorous species. However, the purpose of this study was to ascertain distributional patterns of whatever species were taken by these methods, rather than attempting to describe entire fish communities.

METHODS

Fishes taken aboard commercial passenger fishing vessels (CPFV) were sampled by the senior author and by California Department of Fish and Game personnel from April 1975 to December 1978. The sampling units (trips) were chosen randomly, and the population sampled consisted of all regularly scheduled trips by CPFV's operating south of Point Conception to the Mexican border.

The sampler assigned to each boat boarded the

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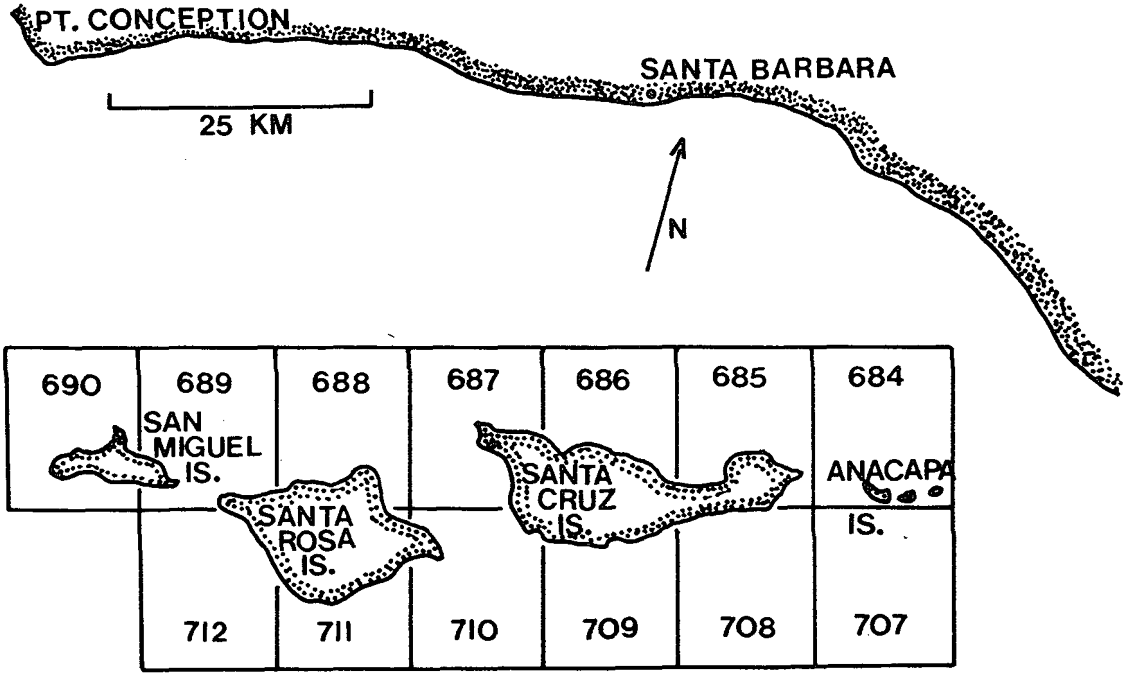

FIGURE 1.–Location and block numbers of sampling sites about the northern Channel Islands, CA.

boat at the beginning of the trip and remained aboard, measuring and identifying all fish caught by the passengers, until the boat returned to dock. A particular effort was made to measure every fish landed, even those returned alive to the water because of undesirability or in compliance with bag or size limit regulations. Also noted were the number of anglers aboard the vessel, the hours of fishing, and the location and depth of fishing effort.

Each fish was placed on a plastic measuring sheet held in a two-sided aluminum frame and the length marked. Total length (tip of snout to tip of depressed caudal fin) was recorded for all fish except members of the jack (Carangidae) and mackerel (Scombridae) families, from which fork length was taken.

A portion of the caudal fin was clipped from each fish measured so that the fish could be recognized later. When fish were brought aboard too rapidly for all to be measured, samplers gave immediate priority to those being returned to the water and measured the remaining fish at the end of fishing or during a break in activity. When samplers were uncertain of the identification of a fish, they retained it for positive identification. After completing a trip, the samplers tallied and recorded by species the data collected. Individual fish lengths were measured on the plastic sheet with a meter stick.

The California Department of Fish and Game has divided marine waters off California into numbered blocks. For this study, we utilized data from block numbers 684-690 and 707-712 (Fig. 1). Care was taken to remove data from mainland fishing sites in block number 684. Block 710 was Santa Rosa Island alone.

We measured fish abundances by catch per unit effort, which was defined as number of fish taken per angler hours (where angler hours = number of anglers × number of hours fished).

RESULTS

One hundred and nineteen trips were made, and the catches from 3,712 anglers were sampled. A total of 23,089 fishes of 78 species were tallied, of which 49 are listed in Table 1. Rockfishes (particularly bocaccio, *Sebastes paucispinis*; blue rockfish, *S. mystinus*; and olive rockfish, *S. serranoides*) and kelp bass, *Paralabrax clathratus*, were numerically dominant. Among the 20 most abundant species, only 4 (*Paralabrax clathratus*; chub mackerel, *Scomber japonicus*; lingcod, *Ophiodon elongatus*; ocean whitefish, *Caulolatilus princeps*) were not rockfishes.

We stratified our data by depth (36 m intervals).

TABLE 1.—Partial list of fishes taken aboard commercial passenger fishing vessels during sampling from April 1975 to December 1978 around the northern Channel Islands. Only those species where 10 or more individuals were taken are listed.

Sebastes paucispinis	3,183
Sebastes mystinus	3,074
Paralabrax clathratus	2,985
Sebastes serranoides	2,632
Sebastes goodei	1,619
Sebastes atrovirens	1.509
Sebastes miniatus	1,119
Sebastes caurinus	1,069
Scomber japonicus	671
Sebastes chlorostichus	632
Sebastes rufus	491
Sebastes carnatus	409
Sebastes entomelas	372
Sebastes constellatus	332
Ophoidon elongatus	304
Sebastes rosaceus	296
Sebastes ovalis	235
Caulolatilus princeps	215
Sebastes levis	197
Sebastes elongatus	195
Sebastes auriculatus	156
Sebastes rosenblatti	148
Semicossyphus pulcher	142
Sebastes rubrivinctus	121
Sebastes eos	120
Sebastes hopkinsi	105
Sebastes chrysomelas	102
Scorpaena guttata	60
Sebastes serriceps	54
Medialuna californiensis	49
Sebastes pinniger	46
Sebastes rastrelliger	43
Genyonemus lineatus	36
Sarda chiliensis	33
Eopsetta jordani	32
Sebastes gilli	21
Sphyraena argentea	20
Citharichthys sordidus	19
Scorpaenichthys marmoratus	19
Trachurus symmetricus	19
Sebastes simulator	18
Chromis punctipinnis	17
Prionace glauca	17
Seriola lalandei	17
Sebastes ensifer	15
Seriphus politus	15
Sebastes nebulosus	12
Paralichthys californicus	10
Sebastes ruberrimus	10

As virtually all fishing effort in waters deeper than 72 m was carried out in the eastern part of the chain, no analyses were conducted of catches in these depths. Most species' abundance trends occurred in the shallowest (0-36 m) depth interval. No samples in 0-36 m were taken in blocks 688, 689, and 709, and none in 37-72 m in blocks 690, 709, 720, 411, and 712.

Fourteen species (Table 2) decreased in abundance along the island chain in 0-36 m (Table 3, Kolmogorov-Smirnov goodness of fit test). Of these, eight species (*Ophiodon elongatus*; *Paralabrax clathratus*; Pacific bonito, *Sarda chiliensis*; *Scomber japonicus*; China rockfish, *Sebastes nebulosus*; yellowtail, *Seriola lalandei*; Pacific barracuda, *Sphyraena argentea*; jack mackerel, *Trachurus symmetricus*) were absent around either the extreme eastern or western end of the chain. The abundance of seven species (*Paralabrax clathratus, Sarda chiliensis, Scomber japonicus, Scorpaena guttata, Seriola lalandei, Sphyraena argentea, Trachurus symmetricus*) decreased toward the west and seven (*Ophiodon elongatus*; copper rockfish, *Sebastes caurinus*; *S. miniatus*; *S. mystinus*; *S. nebulosus*; *S. paucispinis*; *S. serranoides*) decreased toward the east.

The catch per unit effort (CPUE) of six species (*Ophiodon elongatus, Sebastes caurinus, S. miniatus, S. mystinus, S. paucispinis, S. serranoides*) increased in the next (37-72 m) depth interval (Table 4). The largest increases occurred around Anacapa (blocks 684, 707) and the eastern end of Santa Cruz (685, 708). In most instances, catches increased by a factor of 10 or more in these four blocks. The CPUE of three species (*Sebastes miniatus, S. serranoides*, and *S. paucispinis*) were over 100× as great in several blocks.

There was a cline in the mean lengths of four species (*Sebastes caurinus, S. mystinus, S. paucispinis, S. serranoides*) in the shallowest depth interval along the island chain (Fig. 2). All four species were largest in the shallow waters of the more westerly islands, particularly San Miguel.

We compared mean lengths of each species between blocks within the 0-36 m and 37-75 m depth intervals using the Student-Newman-Keuls multiple range test (Sokal and Rohlf 1969). In the shallowest interval, *Sebastes caurinus, S. mystinus*, and *S. serranoides* were largest off San Miguel, while *S. paucispinis* lengths were greatest at San Miguel and Santa Rosa. Two groupings, San Miguel-Santa Rosa and Santa Cruz-Anacapa, were evident in three species (*Sebastes mystinus, S. paucispinis, S. serranoides*) as mean lengths of these tended to form somewhat discrete units. For *Sebastes caurinus*, San Miguel, Santa Rosa, and the west end of Santa Cruz formed one entity – eastern Santa Cruz and Anacapa another.

For these four species, mean lengths were, in most instances, greater in each block in deeper (37-75 m) waters. Though some of the groupings of 0-36 m existed, there was some breakdown of this pattern. In *Sebastes paucispinis*, for instance, the mean lengths of Santa Rosa (block 688) and Anacapa (707) fish were similar, though they were different in 0-36 m.

TABLE 2.—Catch per unit effort × 100, of 14 species taken about the northern Channel Islands in 0-36 m. Block numbers are arranged approximately west to east. The unit of effort is number of fish taken per angler hours (where angler hours = number of anglers × number of hours fished). tr = < 0.01.

Blocks:	690	712	711	710	687	686	685	708	684	707
Ophiodon elongatus	1.1	0.80	0.41	0.23	0.33	0.02	0.03	0.03	tr	0.09
Paralabrax clathratus	0.0	3.62	7.10	0.78	2.65	31.85	2.97	68.33	2.11	22.10
Sarda chiliensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.06	0.0
Scomber japonicus	0.02	0.0	0.0	0.97	0.52	0.0	0.21	15.00	0.43	16.88
Scorpaena guttata	0.01	0.0	0.0	0.07	0.0	0.0	0.04	0.03	0.05	1.17
Sebastes caurinus	2.84	7.63	29.68	1.19	1.31	1.45	0.34	0.53	0.16	0.26
Sebastes miniatus	2.92	1.30	0.31	1.26	0.0	0.0	0.04	0.01	tr	0.86
Sebastes mystinus	9.70	17.01	8.85	16.05	3.06	7.61	3.00	1.02	0.21	8.51
Sebastes nebulosus	2.08	2.07	0.36	0.86	0.0	0.0	0.06	0.0	0.03	0.82
Sebastes paucispinis	0.06	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sebastes serranoides	21.31	42.72	16.09	0.69	1.56	3.46	0.41	0.63	0.19	0.86
Seriola lalandei	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.92
Sphyraena argentea	0.0	0.0	0.0	0.0	0.14	0.0	0.0	0.0	tr	tr
Trachurus symmetricus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.03	0.0

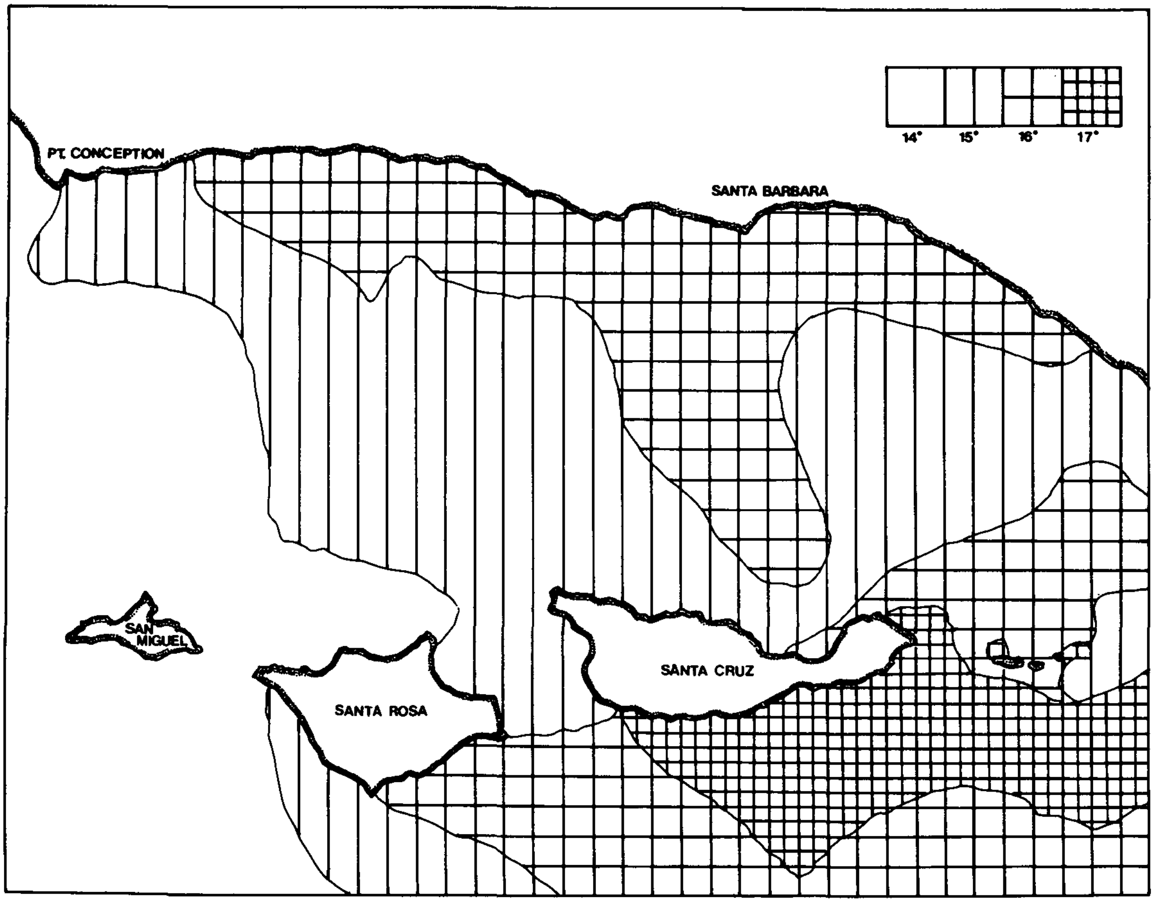

FIGURE 2.–Mean lengths of four species in two depth intervals (0-36 m and 36-76 m) captured along the northern Channel Islands. Dots represent means; bars represent 95% confidence intervals.

TABLE 3.—Fourteen species demonstrating significant catch per unit effort trends (Kolmogorov-Smirnov goodness of fit test) along the northern Channel Islands in 0-36 m.

	Z	*P*
Ophiodon elongatus	1.64	0.009
Paralabrax clathratus	1.89	0.002
Sarda chiliensis	2.72	< 0.001
Scomber japonicus	1.72	0.002
Scorpaena guttata	2.39	< 0.001
Sebastes caurinus	2.24	< 0.001
Sebastes miniatus	1.57	0.014
Sebastes mystinus	2.10	< 0.001
Sebastes nebulosus	2.69	< 0.001
Sebastes paucispinis	1.49	0.024
Sebastes serranoides	1.97	0.001
Seriola lalandei	2.52	< 0.001
Sphyraena argentea	1.92	0.001
Trachurus symmetricus	2.43	< 0.001

proximity to Point Conception and to the California Current (Reid et al. 1958; Neushul et al. 1967; Kolpack 1971; Seapy and Littler 1980). At Point Conception, as the land extends eastward, the cold California Current continues flowing southward. As it flows offshore, the eastern edge surrounds San Miguel Island and some water spills into the Santa Barbara Channel, flowing along the northern sides of Santa Rosa and Santa Cruz Islands (slowly warming as it travels). Much of the California Current continues to flow southeastward and is later entrained in a slow-moving and warm counterclockwise eddy (Southern California Eddy) within the Southern California Bight. Areas influenced by this eddy, such as Anacapa Island, the southern sides of Santa Rosa and Santa Cruz Islands, and, to a certain extent, the

TABLE 4.—Comparison of catch per unit effort × 100 of six species between two depth intervals (0-36 m and 37-72 m). Block numbers are arranged approximately west to east.

		Blocks										
	Depth	690	688	712	711	710	687	686	685	708	684	707
Ophiodon elongatus	0-36	1.1	—	0.80	0.41	0.23	0.33	0.02	0.03	0.03	tr[1]	0.09
	37-72	—	100.02	—	—	—	1.14	—	0.08	1.53	4.08	0.38
Sebastes caurinus	0-36	2.84	—	7.63	29.68	1.19	1.31	1.45	0.34	0.53	0.16	0.26
	37-72	—	33.28	—	—	—	6.41	—	0.92	8.36	7.68	3.61
Sebastes miniatus	0-36	2.92	—	1.30	0.31	1.26	0.0	0.0	0.04	0.01	tr[1]	0.86
	37-72	—	12.41	—	—	—	6.25	—	0.29	2.04	3.61	0.68
Sebastes mystinus	0-36	9.70	—	17.01	8.85	16.05	3.06	7.61	3.00	1.02	0.21	8.51
	37-72	—	17.08	—	—	—	12.77	—	5.28	16.92	57.21	7.41
Sebastes paucispinis	0-36	2.08	—	2.07	0.36	0.86	0.0	0.0	0.06	0.0	0.03	0.82
	37-72	—	18.21	—	—	—	13.81	—	0.54	10.21	22.81	10.25
Sebastes serranoides	0-36	21.31	—	42.72	16.09	0.69	1.56	3.46	0.41	0.63	0.19	0.86
	37-72	—	4.11	—	—	—	1.63	—	2.89	2.91	22.81	0.28

[1]tr = < 0.01.

Similarly, the distinctions between mean lengths of *S. serranoides* in 0-36 m off Santa Rosa versus Anacapa were not evident in 37-75 m. There was no difference in *S. mystinus* mean lengths between Santa Rosa, Santa Cruz, and Anacapa.

DISCUSSION

Temperature Regime

Previous studies indicate that temperature plays a major role in the community structure of invertebrates and algae along the northern Channel Islands (Littler 1980; Murray et al. 1980; Seapy and Littler 1980), and water temperature was correlated with patterns we observed in fish species abundances and size frequencies. Water temperatures surrounding these islands are strongly influenced by their relative

northern sides of Santa Rosa and Santa Cruz, are warmer than areas bathed by the California Current alone. Surface water temperature differences may be as much as 12°C between San Miguel and Anacapa, and 8°C between the west end of Santa Cruz and Anacapa (Hubbs 1967).

Figure 3 exemplifies this condition. It represents the mean of surface temperatures observed by the NOAA-7 satellite on 8 d throughout 1981[3]. Though 1981 was a relatively warmwater year within the Southern California Bight, the influence of the California Current is plain around San Miguel, much of Santa Rosa, and the western end of Santa Cruz Islands. Warm water from southern California bathes southern and eastern Santa Cruz and the

[3]Data taken from observations on 29 January, 15 February, 22 March, 16 May, 4 August, 30 September, 11 October, and 25 November 1982.

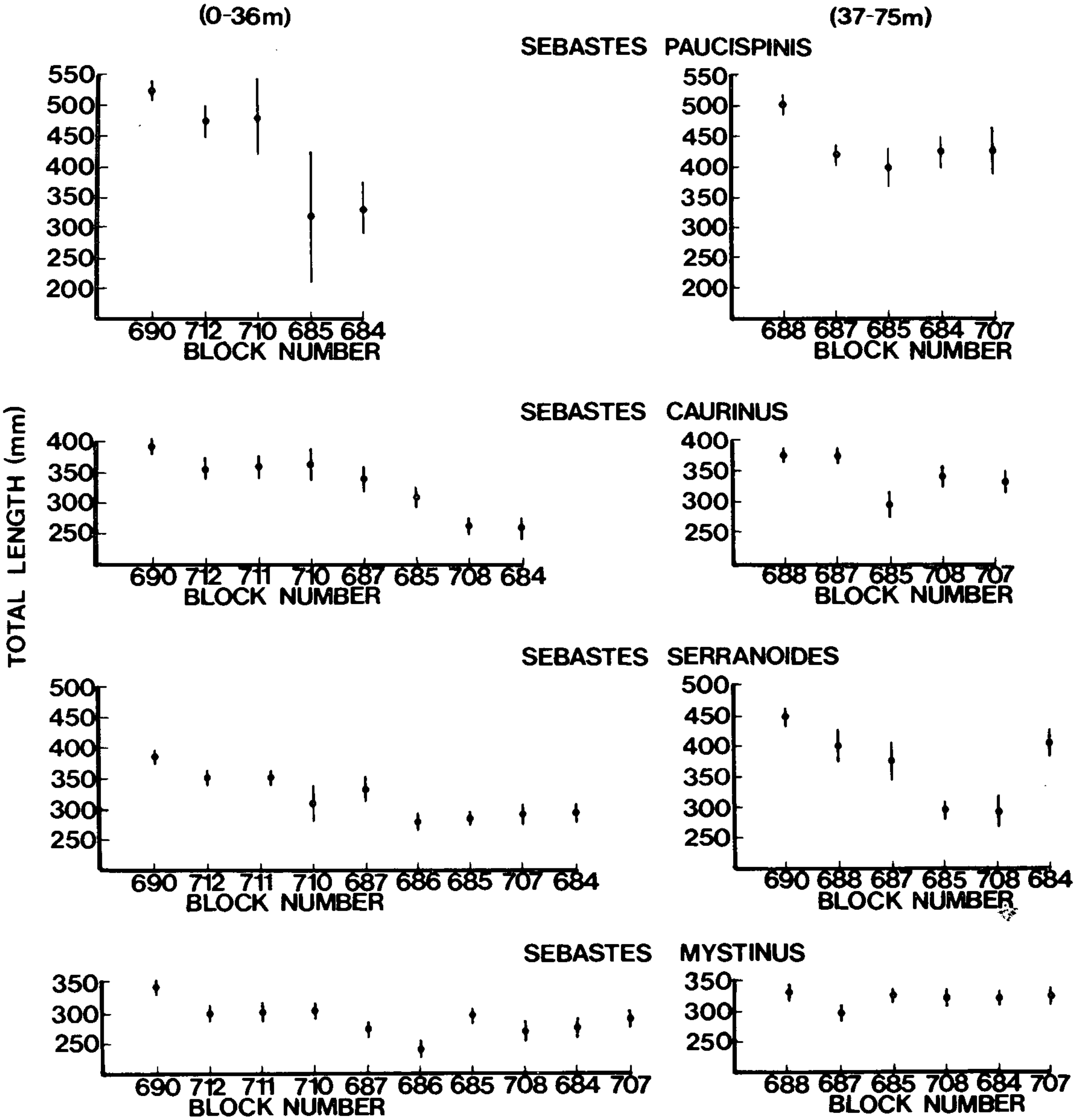

FIGURE 3.—Mean surface temperatures about the northern Channel Islands, based on 8 d throughout 1982 (see text footnote 3).

southeastern corner of Santa Rosa Islands. Warm water occurred close to shore around Anacapa Island, while cooler (perhaps upwelled) conditions occurred slightly offshore to the east.

Fish Distribution

Data from our study suggest that the fish communities of the northern Channel Islands resemble those of the central and southern California mainland. San Miguel and Santa Rosa harbor a more temperate fauna than Santa Cruz and Anacapa. A number of species characteristic of southern California (i.e., *Sarda chiliensis*, *Scomber japonicus*, *Seriola lalandei*, *Sphyraena argentea*) were not found off San Miguel or Santa Rosa, while other southern California species (*Scorpaena guttata* and *Paralabrax clathratus*) were less abundant around the western islands. Similarly, fishes more characteristic of the Oregonian Province (*Ophiodon elongatus, Sebastes caurinus, S. nebulosus*) were less abundant or absent off Santa Cruz and Anacapa. Evidence from Miller and Lea (1972) bolsters this impression. Nineteen species have geographic range limits along the island chain; of these, 9 (*Anoplarchus purpurescens, Artedius harringtoni, Chirolophis nugator, Hippoglossus stenolepis, Nautichthys oculofasciatus, Radulinus vinculus, Sebastes nebulosus, Stichaeopsis*? sp., *Synchirus gilli*) are temperate and 10 (*Alloclinus holderi, Caranx caballus, Chaenopsis alepidota, Cryptotrema corallinum, Gibbonsia erythra, Gnathephis catalinensis, Gobiesox rhessodon, Leiocottus hirundo, Mobula japonica, Paraclinus integrippinis*) are subtropical or tropical. With only one exception (*Radulinus vinculus*), species on the list typical of the Oregonian Province have their southern limit about San Miguel or Santa Rosa, while most southern forms are limited to Anacapa and Santa Cruz.

Around Anacapa and the eastern end of Santa Cruz, six species (*Ophiodon elongatus, Sebastes caurinus, S. miniatus, S. mystinus, S. paucispinis, S. serranoides*) found in shallow water (0-36 m) to the west were more abundant over deeper (37-72 m) reefs. This is an example of "isothermic submergence" (Briggs 1974). Discussing the mainland southern California fish fauna, Briggs noted that cooler preferring, temperate species sought deeper, cooler waters in the warmer parts of their ranges. All six species are temperate forms, all are found in shallower waters off central California than along the mainland of the Southern California Bight.

The increased length of four rockfishes (*Sebastes caurinus, S. mystinus, S. paucispinis, S. serranoides*) in shallow water around the western islands is at least partially due to a variant of isothermic submergence. Among rockfishes, juveniles are more eurythermic than adults (Miller and Geibel 1973; Love 1978), favoring shallower, warmer waters. Juveniles of these four species were found in shallow waters along all the islands (though in decreasing abundance toward the warmer east), while adults were abundant in shallow waters only in the cooler, more westerly part of the island chain.

Might the trend toward decreased mean sizes in the eastern section be, in part, due to relatively high fishing pressure? There are no records of total fishing effort, stratified by depth, around these islands. However, the California Department of Fish and Game does have data on total angler-hours within each block, derived from operator log-book records. We present these data for 1975-78 in Table 5. It is

TABLE 5.—Partyboat effort about the northern Channel Islands, 1975-78.

	Year	No. anglers	No. anglers-hours
Block 684	1978	11,129	56,571.5
	1977	3,295	14,743.4
	1976	6,152	27,250.5
	1975	7,465	35,296.5
			133,861.9
Block 685	1978	3,048	14,596.0
	1977	2,765	13,951.4
	1976	4,689	23,135.5
	1975	7,088	32,997.9
			84,680.8
Block 686	1978	951	4,588.0
	1977	1,044	5,293.9
	1976	1,500	7,941.0
	1975	2,504	11,803.2
			29,626.1
Block 687	1978	947	4,534.0
	1977	1,213	6,400.0
	1976	2,115	9,928.0
	1975	3,193	16,016.5
			36,878.5
Block 688	1978	1,397	6,723.4
	1977	1,363	6,838.5
	1976	2,745	15,161.5
	1975	2,840	15,425.0
			44,148.4
Block 689	1978	1,259	5,986.4
	1977	1,318	6,423.0
	1976	1,951	9,193.5
	1975	1,692	7,795.5
			29,398.4
Block 690	1978	4,732	19,885.3
	1977	5,065	23,292.7
	1976	6,204	27,576.5
	1975	6,565	28,374.0
			99,128.5
Block 707	1978	3,994	19,580.6
	1977	1,498	7,297.0
	1976	877	3,974.5
	1975	2,448	11,636.5
			42,488.6
Block 708	1978	4,650	23,008.0
	1977	5,931	28,793.8
	1976	2,701	13,807.4
	1975	2,202	10,268.0
			75,877.2
Block 709	1978	1,615	7,796.0
	1977	582	2,975.5
	1976	499	2,208.0
	1975	1,129	6,229.0
			19,208.5
Block 710	1978	5,556	24,435.0
	1977	2,800	13,792.5
	1976	1,019	4,964.4
	1975	2,390	12,544.0
			55,735.9
Block 711	1978	764	3,661.5
	1977	1,264	6,528.0
	1976	556	2,459.0
	1975	739	3,530.0
			16,178.5

our experience that much of the fishing effort in these blocks is in the two depth regimes discussed here. Thus we believe the figures in Table 5 are reflective of the relative fishing effort between blocks.

The data indicate that Anacapa (blocks 684, 707) and eastern Santa Cruz (blocks 685, 708) were indeed among the most heavily fished areas. On the other hand, the westernmost section of San Miguel (block 690), with generally the largest fish size frequencies, was also fished intensively. There are other discrepancies between fishing pressure and size frequencies (Fig. 2). Though block 686 (mid-Santa Cruz) is only moderately fished, *Sebastes serranoides* mean lengths (0-36 m) are similar to those of the more heavily impacted areas to the east. The drop in *S. mystinus* length (0-36 m) begins in block 687 (western Santa Cruz), another moderately fished site. In fact, both *S. mystinus* and *S. caurinus* taken in adjacent block 710 (eastern Santa Rosa) are larger than block 687, even though more fishing took place in block 710. This is not to imply that differences in fishing effort between areas may not play a role. Rather, we believe that the response to temperature by these species is also important.

The marine fauna of the Southern California Bight is notable for its temporal fluctuation. Studies of both fossil (Fitch 1969) and present day records (Hubbs 1948; Radovich 1961; Stephens et al. in press) indicate considerable fluctuation in relative abundance between temperate and tropically derived species. Much of this faunal variability is due to unstable water temperature patterns over the continental shelf. Weakening of the California Current allows for a northerly flow of subtropical water and its associated fauna. During periods of strong California Current, temperate forms increase in abundance. Data for this paper were gathered during the end of a cold cycle (1976) and the beginning of a warm one (which continues to the present–1984).

Juveniles and adults may move with insurgent water masses. This is particularly true of such pelagic or semipelagic species as *Seriola lalandei*, *Sphyraena argentea*, *Sarda chiliensis*, and *Scomber japonicus*. All occur about Santa Cruz and Anacapa Islands (and throughout much of the Southern California Bight) in warmwater periods. During the strong 1983 El Niño, the tropical yellowfin tuna, *Thunnus albacares*, and skipjack tuna, *Euthynnus pelamis*, ventured far north of their usual range up to Santa Cruz Island. Even relatively sedentary species may follow currents. The finescale triggerfish, *Balistes polylepis*, was an early migrant into southern California at the beginning of the warm cycle in the mid-1970's and remains relatively common about inshore reefs as far north as Santa Barbara.

Larval transport and subsequent species recruitment may be affected by changes in water masses. During 1983, a number of warm-temperate species (including rock wrasse, *Halichoeres semicinctus*; garibaldi, *Hypsypops rubicunda*; spotted sandbass, *Paralabrax maculatofasciatus*; *Seriola lalandei*; *Sphyraena argentea*; salema, *Xenistius californiensis*) recruited off Santa Barbara, well north of their usual range.[4] Similar unusual northerly recruitment of *Semicossyphus pulcher* and Catalina goby, *Lythrypnus dalli*, occurred during the same period off central California.[5]

Young of-the-year of warm-temperate species have recruited north of their usual range in past warm periods, e.g., 1957-58 (Radovich 1961). In many cases, such as that of the opaleye, *Girella nigricans*, off Monterey, only a single year class (i.e., 1958) survives, leading in succeeding years to populations of similar-sized individuals.[6] During the early 1970's, we observed that the population of *Semicossyphus pulcher* around San Miguel, was composed entirely of large individuals. Perhaps these, too, were the survivors of a successful year class during the 1957-58 warmwater period.

Conversely, during the years of strengthened California Current, species more representative of central California recruit south. The early 1970's were a relatively cool water period and temperate species such as kelp greenling, *Hexagrammos decagrammus*; *Ophiodon elongatus*; *Sebastes mystinus*; and *S. serranoides* young-of-the-year successfully recruited in southern California (Stephens and Zerba 1981; Stephens et al. in press). These maintained themselves in the locally cool habitat at the head of Redondo Submarine Canyon, well after they disappeared from much of the Bight. Water temperature is also responsible for the continuation of long-term temperate species remnant populations on the southern sides of several Baja California points (Hubbs 1960). Here, upwelling water creates suitable conditions for a number of temperate species, which are either missing from, or found in deeper water off of, southern California.

[4]S. Anderson and J. McCullaugh, Marine Science Institute, University of California, Santa Barbara, CA 93106, pers. commun. November 1983.

[5]D. Miller, California Department of Fish and Game, 2201 Garden Road, Monterey, CA 93940, pers. commun. January 1977.

[6]F. Henry, California Department of Fish and Game, 2201 Garden Road, Monterey, CA 93940, pers. commun. November 1983.

It is likely that a continuing warmwater regime has or will alter the species' composition we found. For instance, we might expect less successful year classes among the rockfishes about the eastern islands. Stephens et al. (in press) noted the essentially complete failure of *Sebastes mystinus* and *S. serranoides* recruitment off Palos Verdes and Redondo Beach (on the southern California mainland) during this current warmwater cycle. On the other hand, warmwater species, such as *Paralabrax clathratus* or *Scorpaena guttata,* might recruit more successfully around the previously cool westerly islands. Migratory species, such as *Seriola lalandei, Sphyraena argentea,* or *Scomber japonicus* may also be more abundant about these westerly islands.

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