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SUMMARY

During spring 1975, rod and reel and 100-hook setlines were used to collect demersal fish at stations in Santa Monica Bay that had been previously sampled with otter trawl. The stations covered depths from 18 to 180 m and sites near and away from the Hyperion municipal wastewater outfalls of the City of Los Angeles.

A total of 393 fishes and invertebrates weighing 266.5 kg were taken from 15 stations in the survey. Setline catches averaged 5.9 animals per hour, and rod-and-reel fishing yielded 3.9 animals per hour. Twenty-four species of fish and two species of invertebrates were taken--all but two species had previously been taken by otter trawl in Santa Monica Bay. The greatest number and variety of fish were taken at the station nearest the Hyperion sludge outfall. In general, the largest setline catches were taken at the shallow stations (18 m) and the largest rod-and-reel catches were taken at deeper stations.

The hook-and-line methods sampled different communities: Rockfish, which were not taken by bottom setlines, dominated rod-and-reel catches. Setlines sampled wide-ranging bottom foragers. The hook-and-line catches also differed from those obtained with otter trawl. Rod-and-reel catches contained more large fish than otter trawl catches, but the size range sampled by otter trawls was wider than and inclusive of that obtained by hook and line.

INTRODUCTION

Routine monitoring of demersal soft-bottom fishes with small otter trawls has been underway in southern California for the last 20 years (Carlisle 1969; Southern California Coastal Water Research Project 1973; and others). The trawls are thought to be effective for sampling small bottom fishes that cannot escape the net. However, without data obtained using other sampling techniques, it has been difficult to determine whether or not otter trawl data are representative of the total demersal fish fauna. For instance, it is assumed that large predators can more easily avoid the net than smaller fish, and that fish with fin erosion disease are more likely to be captured than healthy individuals; the trawl data then may give an inaccurate picture of the frequency of large or diseased fishes in an area. The objective of our study was to determine if hook-and-line and otter trawl sampling yield different data on species composition, abundance, size, and disease frequencies of demersal fish.

There have been few hook-and-line studies in which the quantitative and qualitative aspects of the catch are noted. Most hook-and-line catch statistics on California fish species come from party boats (Young 1969) and emphasize species of sport interest. (We do know of one quantitative hook-and-line study conducted, on a limited basis, near the diffuser of a southern California municipal wastewater outfall (County Sanitation Districts of Orange County 1974, 1975).) In addition, hook-and-line studies of soft-bottom areas (where all otter trawl sampling is conducted) are seldom done because the species of sport and commercial interest are usually found near rocky bottoms. Thus, we needed to collect new data to compare hook-and-line and trawl sampling results.

METHODS

The Coastal Water Research Project conducted a hook-and-line study in Santa Monica Bay from 27 March to 9 May 1975 at 12 stations that have been sampled in the past by small (7.6-m headrope) otter trawls (Figure 1, Table 1). Three transects were sampled, each containing stations at four depths (approximately 20, 60, 90, and 180 m). (Trial runs were also conducted at three additional stations, two on soft bottoms at 50 and 91 m and one at 65 m near a rocky bottom.) Stations were located in the field by sextant and Gemtronics Mark II white line recording depth finder. The vessel used was a 6-m (18-ft) Cardiff lobster skiff.

Two hook-and-line methods were used. A 100-hook setline was laid across the bottom to catch the species within the vertical range of the trawl that might avoid the net. In addition, schools of fish located by sonar were fished with rod and reel to collect species that either dwell in the water column above the vertical range of the trawl or are highly clumped and therefore possibly missed by the trawl.

The setline was 24 m (80 ft) long and carried one-hundred No. 1/0 hooks with snap-on swivels spaced 0.23 to 0.25 m (9 to 10 in.) apart (Figure 2). An anchor and weights and a spar buoy were attached to each end of the setline. In the trial run at the 65-m rocky bottom station (Station T-24), we used a 91-m (300-ft) setline carrying 300 hooks (fifty No. 4, one-hundred and fifty No. 1/0, and fifty No. 7/0) spaced approximately 0.25 m (10 in.) apart. This setline proved too difficult to handle (in terms of length and small hooks) by a two-man crew in rough weather and was discarded in favor of the 100-hook setline.

The setline was baited with cut squid, dropped on station, and pulled up after 1 hour.

In the rod-and-reel portion of the survey, schools of fishes were located by cruising slowly in the vicinity of the stations with the recording depth finder running (Figure 3). We usually used six No. 1/0 hooks on a conventional rock-cod rig and cut squid as

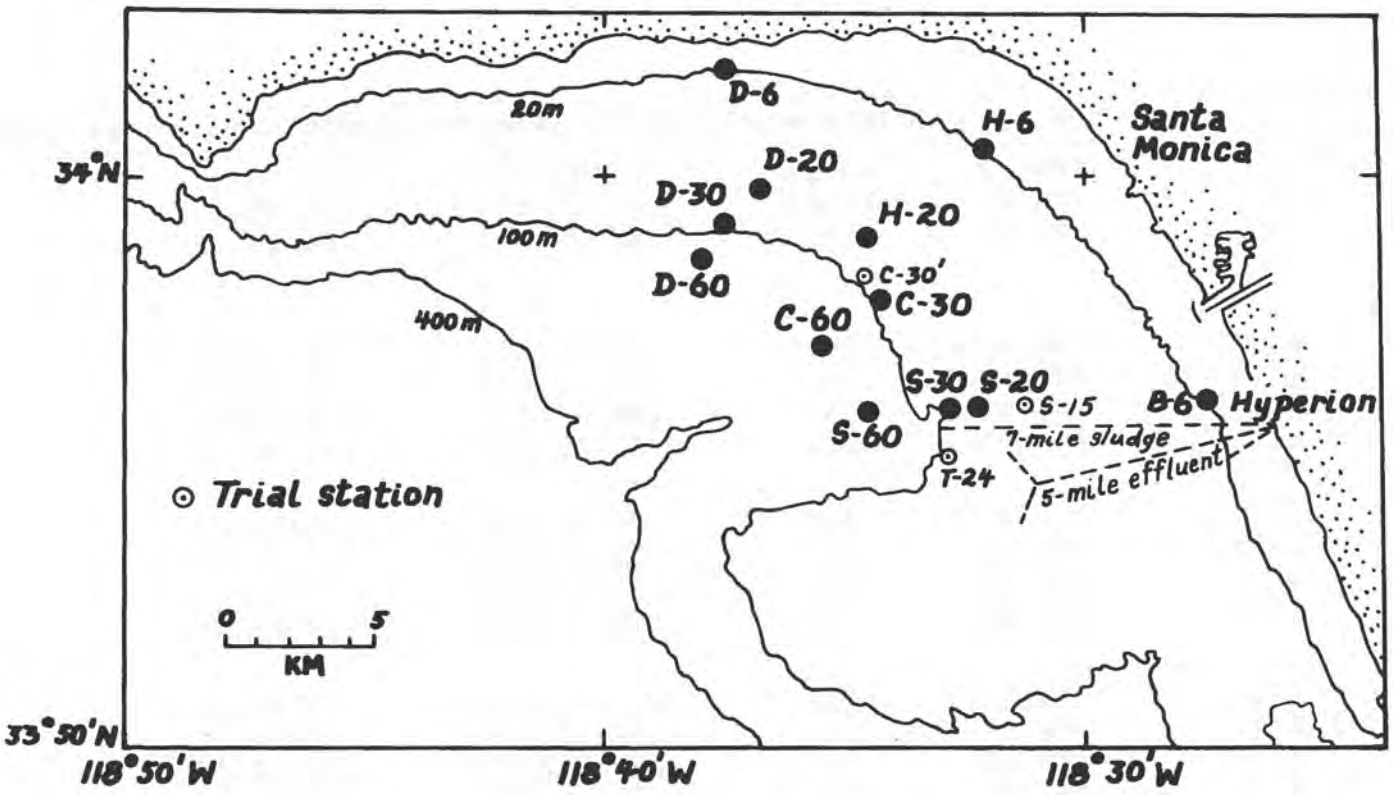

Figure 1. Stations sampled, hook-and-line survey, Santa Monica Bay, March to May 1975.

Table 1. Station characteristics, hook-and-line survey, Santa Monica Bay, March to May 1975.

Station	Latitude	Longitude	Depth (m)	Date	Temperature (°C) Surface	Bottom
Transect 1						
D-6	34°01.80'	118°37.50'	18	2 May	13.3	12.2
D-20	33°59.80'	118°36.70'	61	12 May	12.8	8.9
D-30	33°59.20'	118°37.50'	91	9 May	11.1	8.9*
D-60	33°58.50'	118°38.05'	182	7 May	11.6	8.9*
Transect 2						
H-6	34°00.40'	118°32.20'	18	30 Apr	13.0	10.6
H-20	33°58.95'	118°34.70'	60	28 Apr	11.6	8.9
C-30	33°57.75'	118°34.60'	91	24 Apr	12.8	9.4*
C-60	33°57.00'	118°35.65'	182	6 May	11.4	8.9*
Transect 3						
B-6	33°56.05'	118°27.55'	18	18 Apr	13.9	11.6
S-20	33°55.95'	118°32.40'	58	10 Apr	-	-
S-30	33°55.80'	118°33.00'	91	16 Apr	13.9	11.1*
S-60	33°55.85'	118°34.60'	182	27 Apr	13.3	9.4*
Trial stations						
C-30'	33°58.25'	118°35.55'	91	7 May	-	-
S-15	33°56.00'	118°31.30'	49-51	2 Apr	-	-
T-24	33°55.00'	118°32.95'	58-69	27 Mar	-	-

*Temperature at maximum depth measured by bathythermograph (60 m).

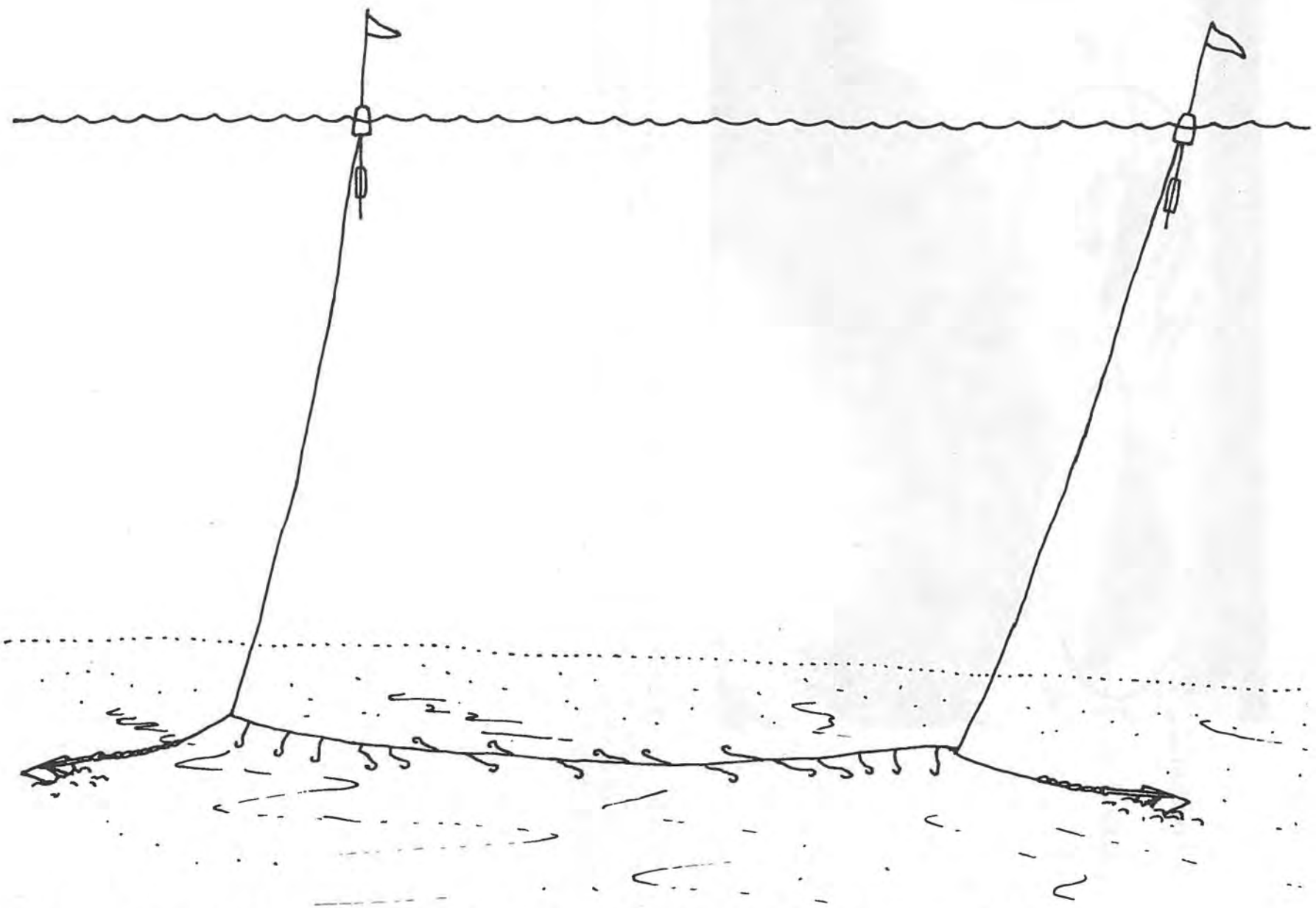

Figure 2. Setline used in hook-and-line survey, Santa Monica Bay, 1975.

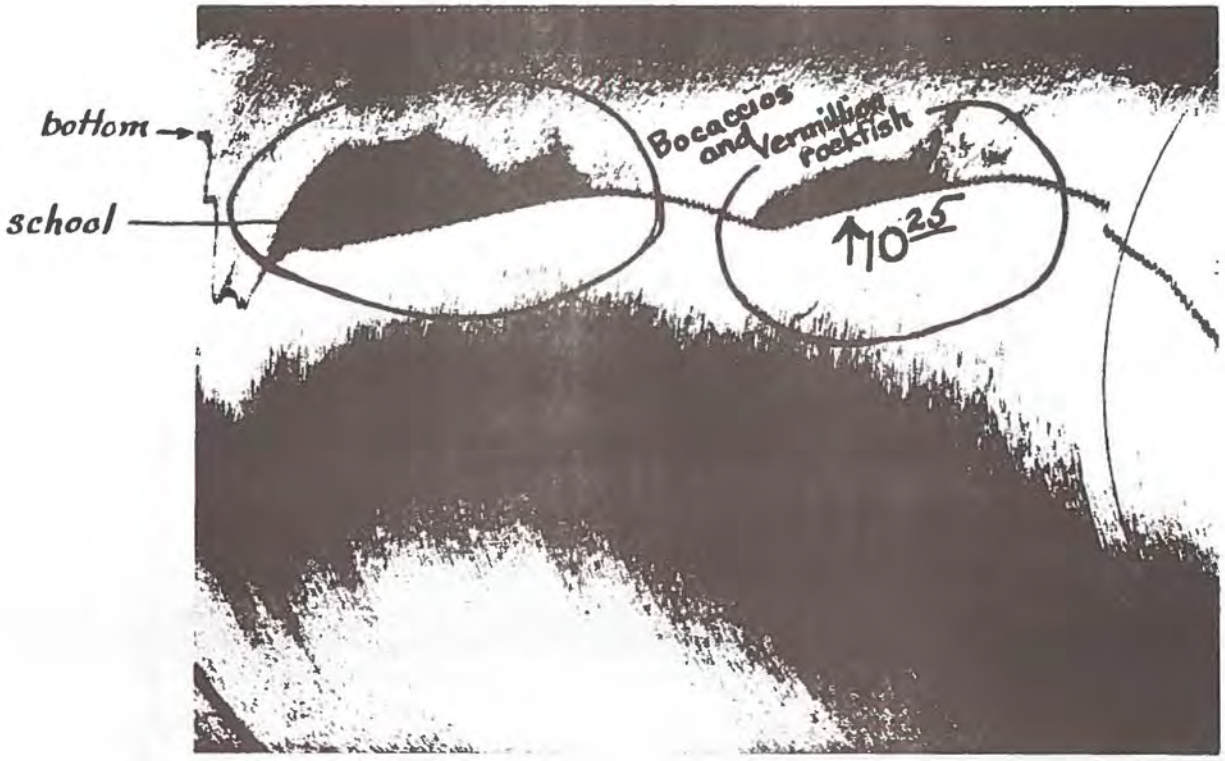

Figure 3. White line depth recording showing fish schools near the bottom at 91 m (Station S-30, 16 April 1975). Schools included bocaccio (Sebastes paucispinis) and vermilion rockfish (Sebastes miniatus).

bait. (Smaller hooks were occasionally used in combination with No. 1/0 hooks. On the trial run at Station S-15 (50 m, soft bottom), a leader with six No. 4 hooks and weights at each end was used; in this case, the rig was dragged across the bottom as the vessel drifted. This method was abandoned because we did not catch a wide size range of fishes.)

Each station was fished with rod and reel for about 4.5 hours. Care was taken to maintain the desired depth in steep slope areas. On several occasions when no schools were located, the lines were periodically dropped near the bottom in the station area.

Fishes taken by these methods were identified immediately and examined for diseases. Lengths (board standard length) were measured to the nearest millimeter, and weights were measured to the nearest 0.05 kg. Stomach contents were also noted: We only examined the stomach contents of specimens without swimbladders because as a fish with a swimbladder is brought to the surface, the bladder expands and forces the stomach and its contents out of the fish's mouth.

A 60-m bathythermograph was used to measure temperature profiles at each station.

RESULTS

Catch Parameters

A total of 393 marine organisms with a total biomass of 266.5 kg were taken during the survey (Table 2). When the catch from the three trial runs was excluded, the setline yielded a mean catch of 5.9 ± 0.8 individuals per hour per station and a mean biomass of 10.1 ± 3.5 kg per hour, and the rod and reel yielded a mean catch of 3.9 ± 0.7 individuals per hour per station and a mean biomass of 1.8 ± 0.4 kg per hour. An average catch per unit effort at each station for both methods cannot be determined because all 100 hooks of the setline were available to the fish for a full hour, whereas the six hooks on the two rock-cod rigs were available only during the time that they were dropped into a school.

Station B-6, a shallow station near the outfalls, yielded the greatest setline catch (12 individuals/hour with a biomass of 40.6 kg/hr; Table 2). The only species taken at this station was the spiny dogfish (Squalus acanthias). The lowest catch (two organisms) occurred at Station D-20; the biomass of this catch was about 0.6 kg. In general, the greatest catches by setline occurred at the 18-m stations.

Station S-30, the station nearest the end of the Hyperion 7-mile sludge pipe, yielded the greatest rod-and-reel catch (8.5 individuals/hour with a biomass of 23.2 kg/hr; Table 2). Six species

Table 2. Catch characteristics, hook-and-line survey, Santa Monica Bay, March to May 1975.

	Transect 1				Transect 2				Transect 3							Trial Stations				Grand Total
	D-6	D-20	D-30	D-60	H-6	H-20	C-30	C-60	B-6	S-20	S-30	S-60	Total	Mean (x)	Std Error	C-30'	S-15	T-24	Total	
Setline																				
Starting time	1020	0915	1115	1110	1030	1120	1120	1130	1120	0947	1105	1130	–	–	–	–	–	1200	–	–
Effort (hr)	1.0	1.0	1.0	1.3	1.0	1.0	1.0	1.0	1.0	1.2	1.0	1.0	12.5	1.0	0.0	–	–	1.0	1.0	13.5
No. of species	3	2	3	2	3	1	2	1	1	3	3	2	8	2.2	0.2	–	–	5	5	12.0
Individuals																				
Total	10	2	7	5	7	5	5	3	12	6	6	5	73	–	–	–	–	11	11	84
No./hr	10.0	2.0	7.0	3.8	7.0	5.0	5.0	3.0	12.0	5.0	6.0	5.0	–	5.9	0.8	–	–	10.0	–	–
Biomass																				
Total (kg)	10.7		4.6	2.1+	21.9+	8.3+	4.1	1.6	40.6	12.0	3.9	4.3	114.1+	–	–	–	–	15.6+	15.6+	129.7+
Kg/hr	10.7		4.6	1.6+	21.9+	8.3+	4.1	1.6	40.6	10.0	3.9	4.3	–	10.1+	3.5	–	–	15.6+	–	–
Rod and Reel																				
Starting time	0835	0850	0935	1000	0920	0955	0905	1000	0915	0840	0930	0900	–	–	–	1430	0805	0950	–	–
Effort (hr)	4.2	5.3	3.1	4.0	3.8	4.2	5.9	3.0	3.0	6.3	5.5	6.5	54.9	4.6	0.4	2.0	5.4	2.9	10.3	65.2
No. of species	1	6	4	2	1	5	5	0	1	3	6	3	14	3.1	0.6	3	8	6	13	18
Individuals																				
Total	18	25	19	3	16	16	31	0	2	42	47	14	233	–	–	16	31	29	76	309
No./hr	4.3	4.7	5.6	0.8	4.2	3.8	5.2	0.0	0.7	6.7	8.5	2.2	–	3.9	0.7	8.0	5.7	10.0	–	–
Biomass																				
Total (kg)	4.5	10.5+	5.8	2.4	1.8	2.9+	19.8	0.0	8.5	16.1	23.2	13.3	108.8+	–	–	8.4	9.6+	10.5	27.5+	136.3+
Kg/hr	1.1	2.0+	1.7	0.6	0.5	0.7	4.0	0.0	2.8	2.6	4.2	2.0	–	1.8+	0.4	4.2	1.8+	3.6	–	–
Total																				
No. of species	3	8	6	3	3	6	6	1	1	5	7	5	18	4.4	0.6	3	8	11	17	26
No. of indiv.	28	27	26	8	23	21	36	3	14	48	53	19	306	–	–	16	31	40	87	393
Biomass (kg)	15.2	10.5+	10.4	4.5+	23.7+	11.2+	23.9	1.6	49.1	28.1	27.1	17.6	222.9+	–	–	8.4	9.6+	25.6+	43.6+	266.5+

were taken at this station, but the bocaccio (Sebastes paucispinis) accounted for the greatest number of individuals and biomass. No organisms were taken by rod and reel at Station C-60. In general, we obtained the greatest rod-and-reel catches along the edge of the shelf (60 to 100 m) near the 7-mile sludge pipe.

A total of 26 species representing 16 families of fishes and invertebrates were taken in the survey (Table 3). Two species were invertebrates--a sand star (Astropecten verrilli) and an unidentified octopus (Octopus sp.). Eight species of rockfish (Scorpaenidae), three left-eyed flounders (Bothidae), and two right-eyed flounders (Pleuronectidae) were taken; only one species from each of the remaining 13 families was taken. All species taken, except the Pacific hagfish (Eptatretus stouti) and the swordspine rockfish (Sebastes ensifer), had been previously taken in Santa Monica Bay by otter trawl (these two species have been collected by trawl elsewhere in southern California).

Twelve species were taken with setline, and 18 species were taken with rod and reel (Table 3). The setline was most effective at sampling wide-ranging species that forage on the bottom, such as the spiny dogfish, sablefish (Anoplopoma fimbria), and white croaker (Genyonemus lineatus); we did not catch rockfish with the setline. Rod-and-reel fishing into schools located by sonar was effective at catching species such as rockfishes that range higher off the bottom and are generally clumped rather than evenly dispersed throughout an area. Only four species were taken by both methods--spiny dogfish, sablefish, white croaker, and Pacific sanddab (Citharichthys sordidus). In contrast to hook-and-line methods, small otter trawls are more efficient at capturing species that normally remain close to the bottom, such as flatfishes, sculpins, and small rockfishes (Table 4).

When the data from both hook-and-line methods were combined, we obtained a mean of 4.4 ± 0.6 species per station (Table 2); Station D-20 yielded the most species (eight). Rod-and-reel fishing yielded somewhat more species per station (3.1 ± 0.6) than did the setline (2.2 ± 0.2). Both methods yielded considerably fewer species per station than did small otter trawls (10.4 ± 0.4) taken throughout the same depth zone in Santa Monica Bay (Table 5). Setlines yielded a maximum of three species per station (we caught this number of species at five of the twelve transect stations). Rod-and-reel fishing yielded greatest numbers of species (six) at Stations D-20 and S-30 (the latter is the station nearest the end of the Hyperion 7-mile sludge pipe).

A Coastal Water Project study of the marine life along the Hyperion wastewater discharge pipes using photographs taken by divers in submersibles (Allen, Pecorelli, and Word, in preparation) showed large numbers of schooling rockfishes in the vicinity of the pipes at these depths. In the hook-and-line study, we also found a high diversity of schooling rockfishes at Stations S-30 and

Table 3. Marine organisms taken, hook-and-line survey, Santa Monica Bay, March to May 1975.

Family	Species	Common Name	Set-line	Rod and Reel	Total
Astropectinidae	*Astropecten verrilli*	Sand star	1		1
Octopodiae	*Octopus* sp.	Octopus, unidentified		1	1
Myxinidae	*Eptatretus stouti*	Pacific hagfish	3		3
Squalidae	*Squalus acanthias*	Spiny dogfish	36	6	42
Myliobatidae	*Myliobatis californica*	Bat ray	1		1
Chimaeridae	*Hydrolagus colliei*	Ratfish	5		5
Synodontidae	*Synodus lucioceps*	California lizardfish		1	1
Ophidiidae	*Chilara taylori*	Spotted cusk-eel		1	1
Scorpaenidae	*Sebastes chlorostictus*	Greenspotted rockfish		21	21
	Sebastes elongatus	Greenstriped rockfish		11	11
	Sebastes ensifer	Swordspine rockfish		1	1
	Sebastes miniatus	Vermilion rockfish		60	60
	Sebastes paucispinis	Bocaccio		88	88
	Sebastes rosenblatti	Greenblotched rockfish		14	14
	Sebastes saxicola	Stripetail rockfish		3	3
	Sebastes vexillaris	Whitebelly rockfish		2	2
Hexagrammidae	*Zaniolepis latipinnis*	Longspine combfish		2	2
Anoplopomatidae	*Anoplopoma fimbria*	Sablefish	22	34	56
Cottidae	*Chitonotus pugetensis*	Roughback sculpin		1	1
Sciaenidae	*Genyonemus lineatus*	White croaker	11	61	72
Serranidae	*Paralabrax nebulifer*	Barred sand bass	1		1
Bothidae	*Citharichthys sordidus*	Pacific sanddab	1	1	2
	Citharichthys stigmaeus	Speckled sanddab	1		1
	Hippoglossina stomata	Bigmouth sole	1		1
Pleuronectidae	*Eopsetta jordani*	Petrale sole		1	1
	Microstomus pacificus	Dover sole	1		1
Total Number of Individuals			84	309	393
Total Number of Species			12	18	26

Table 4. Dominant species taken on soft bottoms off southern California (20 to 180 m).

Species	Rank in Abundance: Otter Trawl (346 samples)	Setline (13 samples)	Rod and Reel (15 samples)
Sebastes saxicola	1		
Microstomus pacificus	2		
Citharichthys stigmaeus	3		
Citharichthys sordidus	4		
Icelinus quadriseriatus	5		
Squalus acanthias		1	
Anoplopoma fimbria		2	4
Genyonemus lineatus		3	2
Hydrolagus colliei		4	
Eptatretus stouti		5	
Sebastes paucispinis			1
Sebastes miniatus			3
Sebastes chlorostictus			5

Table 5. Comparison of collecting methods used by the Coastal Water Project in Santa Monica Bay.

		Hook and Line		
	Otter Trawl	Rod and Reel	Setline	Submersible Photographs
Total samples (stations)	124	15	13	399
Depth range (m)	20-190	20-190	20-190	10-100
Habitat	soft	soft	soft	pipe
Time spent on station (hr)	0.2	4.6	1.0	-
Total fish species	87	17	11	31
Fish species/ station (mean ± std. error)	10.4 ± 0.4	3.1 ± 0.6	2.2 ± 0.2	-

S-20, close to the end of the sludge pipe. These rockfishes may use the pipe as a point of reference or may be attracted to food organisms associated with the pipe. Schools of rockfishes presumably are common along the edge of the shelf at about 60 to 100 m in depth.

Community Structure

A recurrent group analysis of the hook-and-line data revealed six recurrent groups of species (Figure 4). Two of these are fairly representative groups, but the others are somewhat chance associations due to the low number of samples. The major groups are composed of two species each. Group 1 includes the white croaker and spiny dogfish and was found primarily in shallow water (Figure 5). Group 2 includes the bocaccio and sablefish and was found in deeper water. The white croaker and spiny dogfish both feed on the bottom and on organisms swimming in the water column (the spiny dogfish feeds in the water column to a greater degree). These species are separated ecologically by size; the spiny dogfish is considerably larger than the white croaker, and because it is a live-bearing species, is never in its life cycle as small as the juvenile white croakers. As it is larger, we assume that the spiny dogfish will generally eat larger food items than the white croaker; in fact, the white croaker is often a food item of the spiny dogfish. Thus, the association of these two species may partially result from an attraction of spiny dogfish to white croaker schools. The sablefish and bocaccio, on the other hand, forage in different parts of the water column: The sablefish forages near the bottom, locating food on the bottom and in the water column, and the bocaccio forages only in the water column, generally several meters off the bottom.

The depth distributions of the species in this survey (Table 6) suggest that the sablefish may replace the spiny dogfish in deep water. Both species feed on about the same size and type of food organisms and therefore probably perform the same feeding role in their respective communities. In addition, the green-blotched rockfish (Sebastes rosenblatti) appears to replace the ecologically similar greenspotted rockfish (Sebastes chlorostictus) in deeper water.

Small otter trawl surveys over the same depth range throughout southern California have yielded many more recurrent groups, most containing larger numbers of species, than the hook-and-line survey (this is partially due to the fact that more species have been taken with the otter trawl and the analysis can be based on more samples). The white croaker, which is associated with the spiny dogfish in the hook-and-line survey, appears in an otter trawl recurrent group with the shiner perch, Cymatogaster aggregata (Figure 6). The spiny dogfish did not appear in any of the otter trawl recurrent groups (at a 0.05 or greater level of

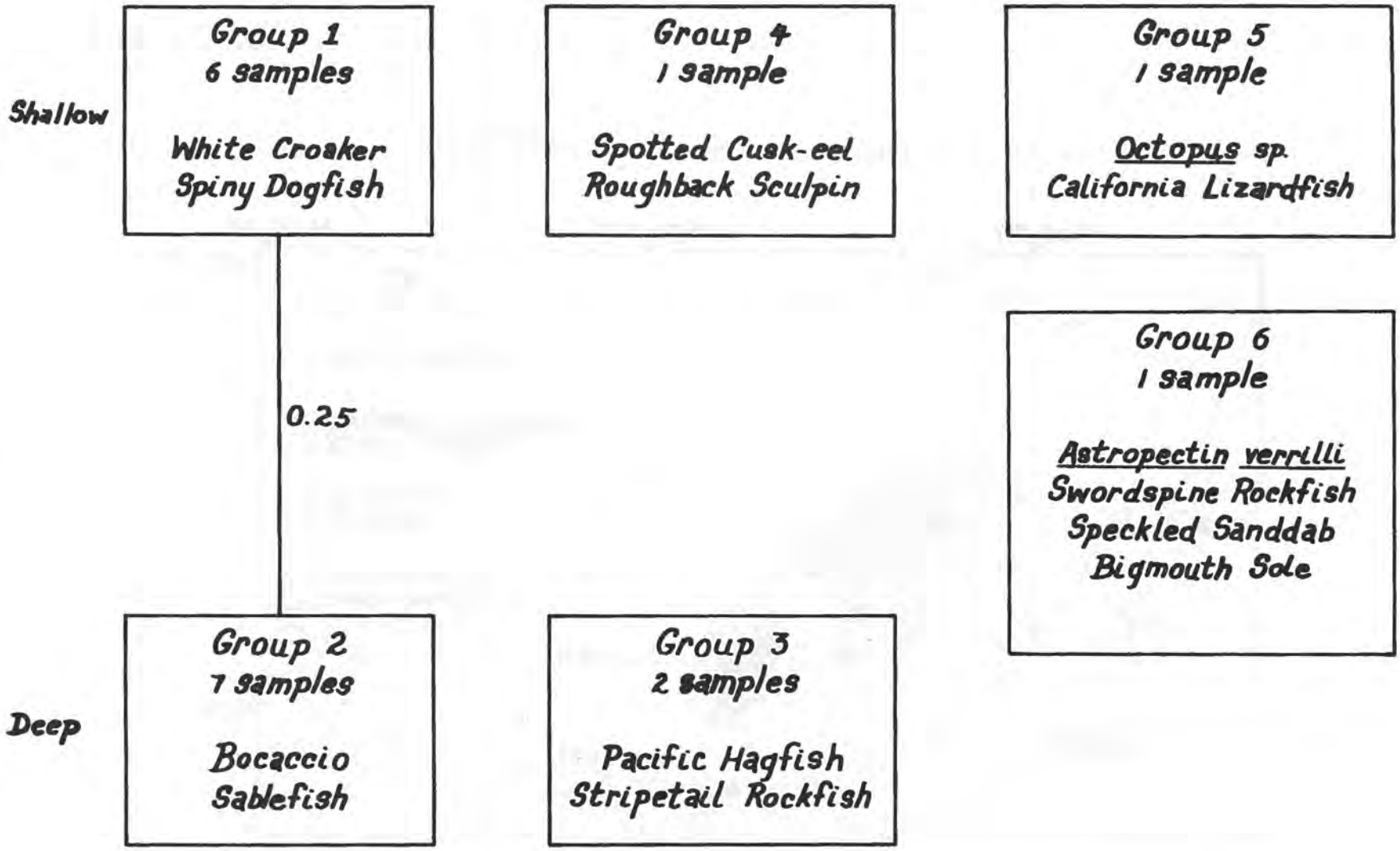

Figure 4. Recurrent groups of fishes, hook-and-line survey, March to May 1975. (15 samples; index of affinity = 0.50.)

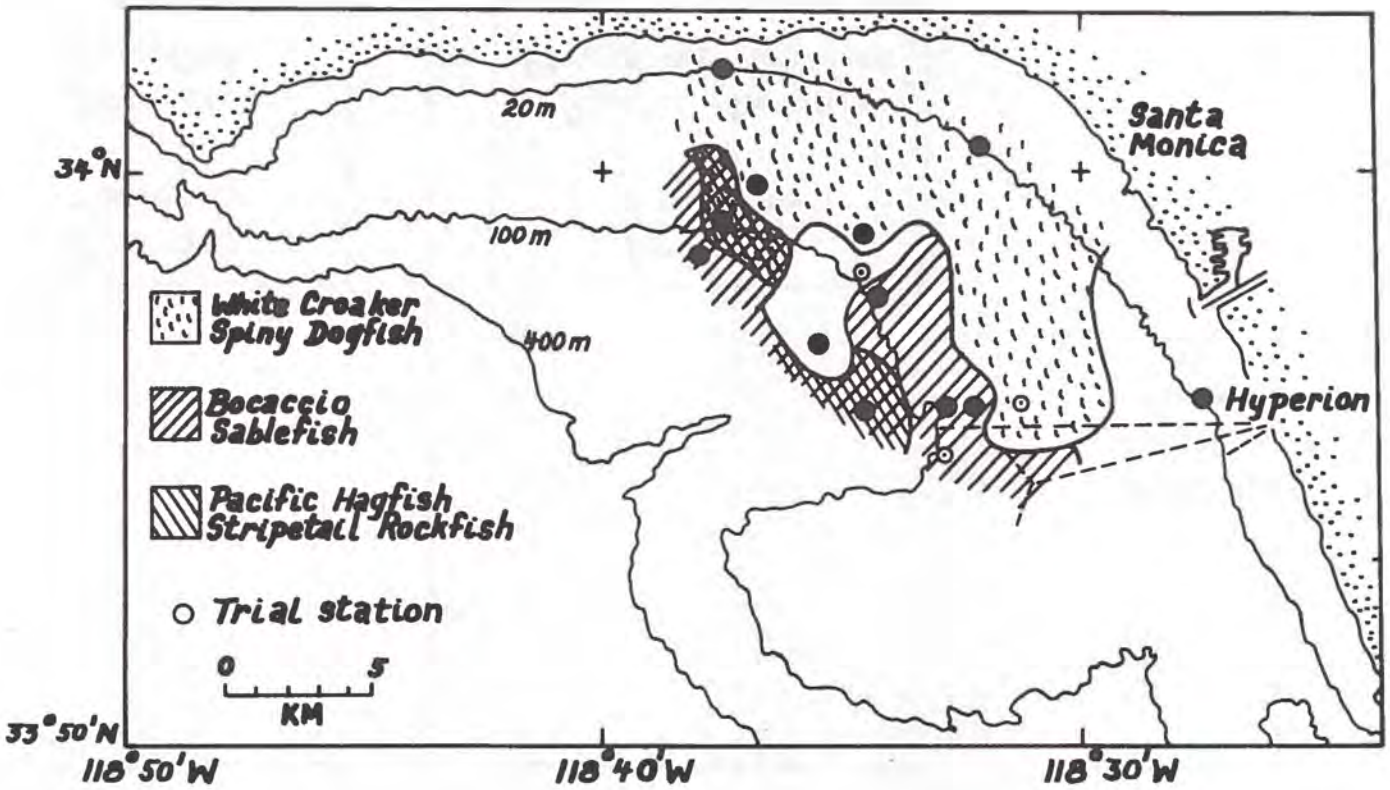

Figure 5. Major recurrent groups, hook-and-line survey, March to May 1975.

Table 6. Average abundance with depth of fish species taken in hook-and-line survey.

Species	Depth Class 18 m, 3 sta.	49-69 m, 5 sta.	91 m, 4 sta.	182 m, 3 sta.
Bottom fishes foraging in water column				
Synodus lucioceps		0.2		
Citharichthys sordidus		0.2	0.2	
Citharichthys stigmaeus		0.2		
Hippoglossina stomata		0.2		
Eopsetta jordani			0.2	
Bottom fishes foraging in water column and on bottom				
Zaniolepis latipinnis		0.4		
Chitonotus pugetensis		0.2		
Bottom fishes foraging on bottom				
Microstomus pacificus	0.3			
Chilara taylori		0.2		
Myliobatis californica		0.2		
Eptatretus stouti		0.2		0.7
Water-column fishes foraging in water column				
Sebastes ensifer		8.2	4.8	
Sebastes saxicola		0.4		0.3
Sebastes miniatus		0.2		
Sebastes paucispinis		5.6	13.8	1.7
Water-column fishes foraging in water column and on bottom				
Squalus acanthias	6.3	3.6	1.2	
Anoplopoma fimbria		3.6	6.5	4.0
Sebastes chlorostictus		2.4	2.2	
Sebastes rosenblatti			1.0	3.3
Sebastes vexillaris		0.4		
Sebastes elongatus		1.0	1.5	
Paralabrax nebulifer	0.3			
Water-column fishes foraging on bottom				
Genyonemus lineatus	14.7	5.4	0.2	
Hydrolagus colliei		0.2	1.0	
Mean number of individuals/station	21.7	33.0	32.7	10.0
Total species/depth class	4	20	11	5
Mean species/station	1.2	4.0	2.8	1.4

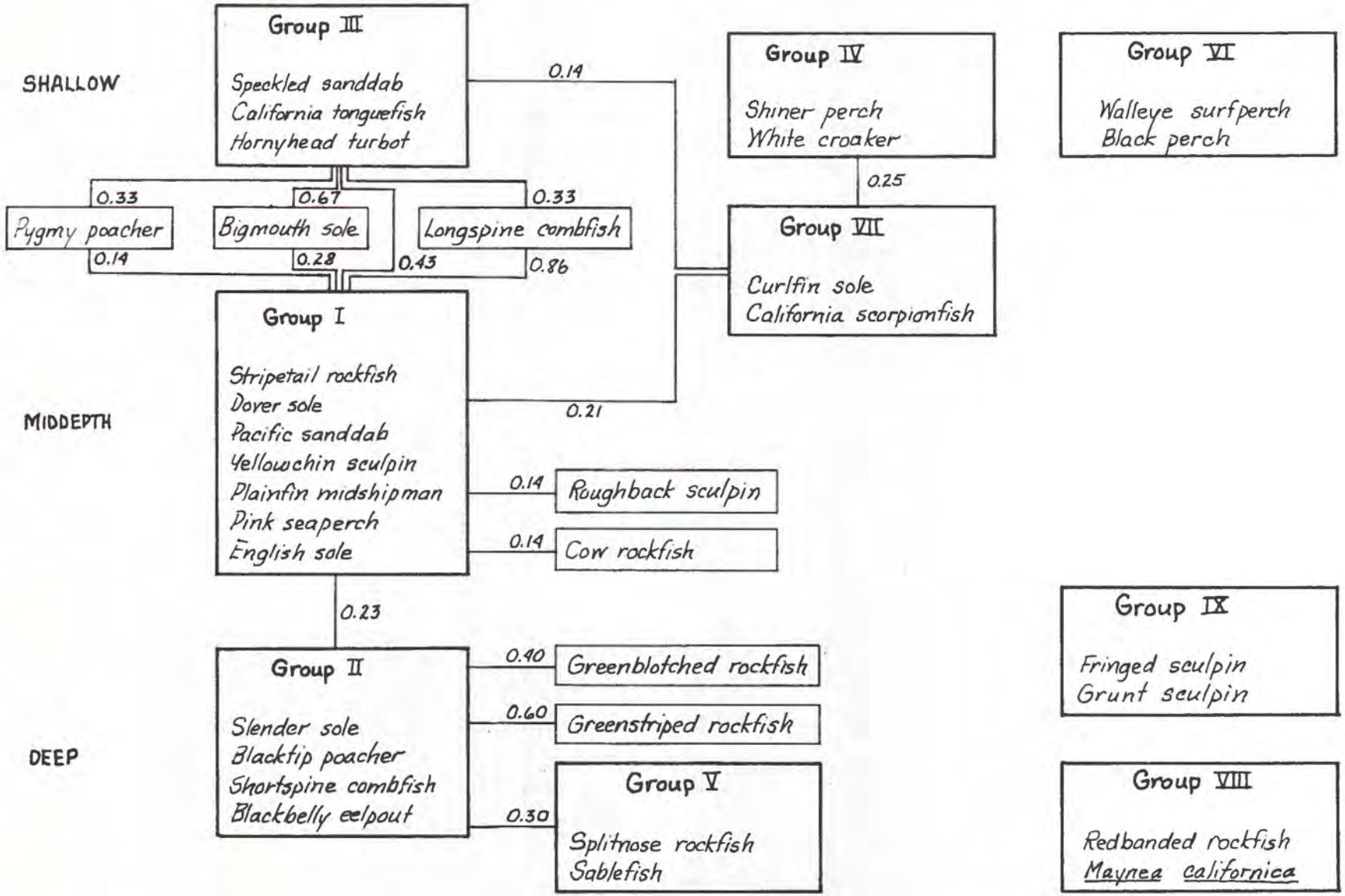

Figure 6. Recurrent groups of fishes taken by otter trawl in southern California.

the index of affinity*), and the shiner perch was not taken in the hook-and-line survey. Spiny dogfish presumably escape the trawl net frequently and are therefore not well represented in otter trawl surveys. Shiner perch, on the other hand, have small mouths and must take small hooks. Schools of fishes were noted by sonar in shallow water, but no fish were taken with the large hooks; these may have been schools of shiner perch. Presumably a more representative community would include shiner perch, white croaker, and spiny dogfish.

The sablefish appears in an otter trawl recurrent group with the splitnose rockfish (Sebastes diploproa), but the bocaccio (associated with the sablefish in the hook-and-line survey) does not appear in any otter trawl recurrent groups. Bocaccio apparently escape the net more frequently than sablefish, probably because they generally swim higher in the water column. The splitnose rockfish taken with the trawl were generally in deeper water than the bocaccio taken with hook and line. Thus the differences in the otter trawl and hook-and-line recurrent groups involving these species probably result from the differences in the depth ranges of the three species and the amount of sampling effort applied to each depth zone with the two sampling techniques.

Specimen Size

Although hook-and-line methods took a proportionately greater number of large fishes than does the small otter trawl (Figure 7), hook-and-line catches generally fell within the size ranges sampled by otter trawl. However, the one bat ray (Myliobatis californica) taken in the hook-and-line survey was much larger than those taken by trawl (presumably larger bat rays can outswim the trawl net).

The fish species with the greatest average biomass per individual taken in the hook-and-line survey are:

Species	Mean Biomass per Individual (kg)
Myliobatis californica	12.5
Squalus acanthias	2.8
Paralabrax nebulifer	2.4
Eopsetta jordani	1.0
Hydrolagus colliei	0.9
Sebastes rosenblatti	0.8
Anoplopoma fimbria	0.5
Sebastes paucispinis	0.5
Sebastes miniatus	0.4
Sebastes vexillaris	0.4

*This index of affinity is defined by Fager (1957, 1963) as $I.A. = (c/\sqrt{ab}) - 1/(2\sqrt{b})$, where a is the number of occurrences of Species A in the survey, b is the number of occurrences of Species B, and c is the number of joint occurrences of Species A and Species B.

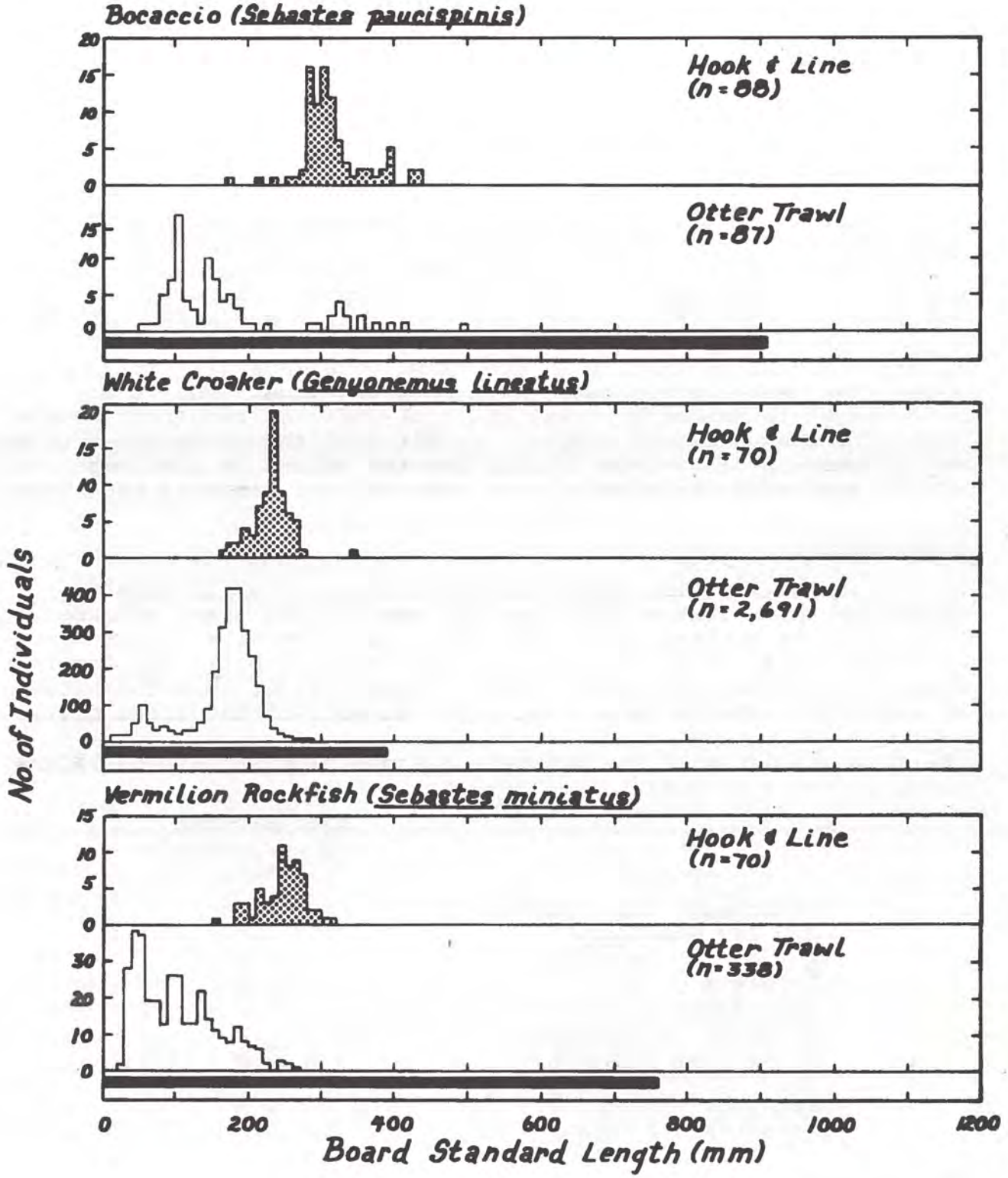

Figure 7. Size distribution of fishes, hook-and-line survey, 1975. Horizontal bar is size range of species as given in Miller and Lea 1972. (Sheet 1 of 3)

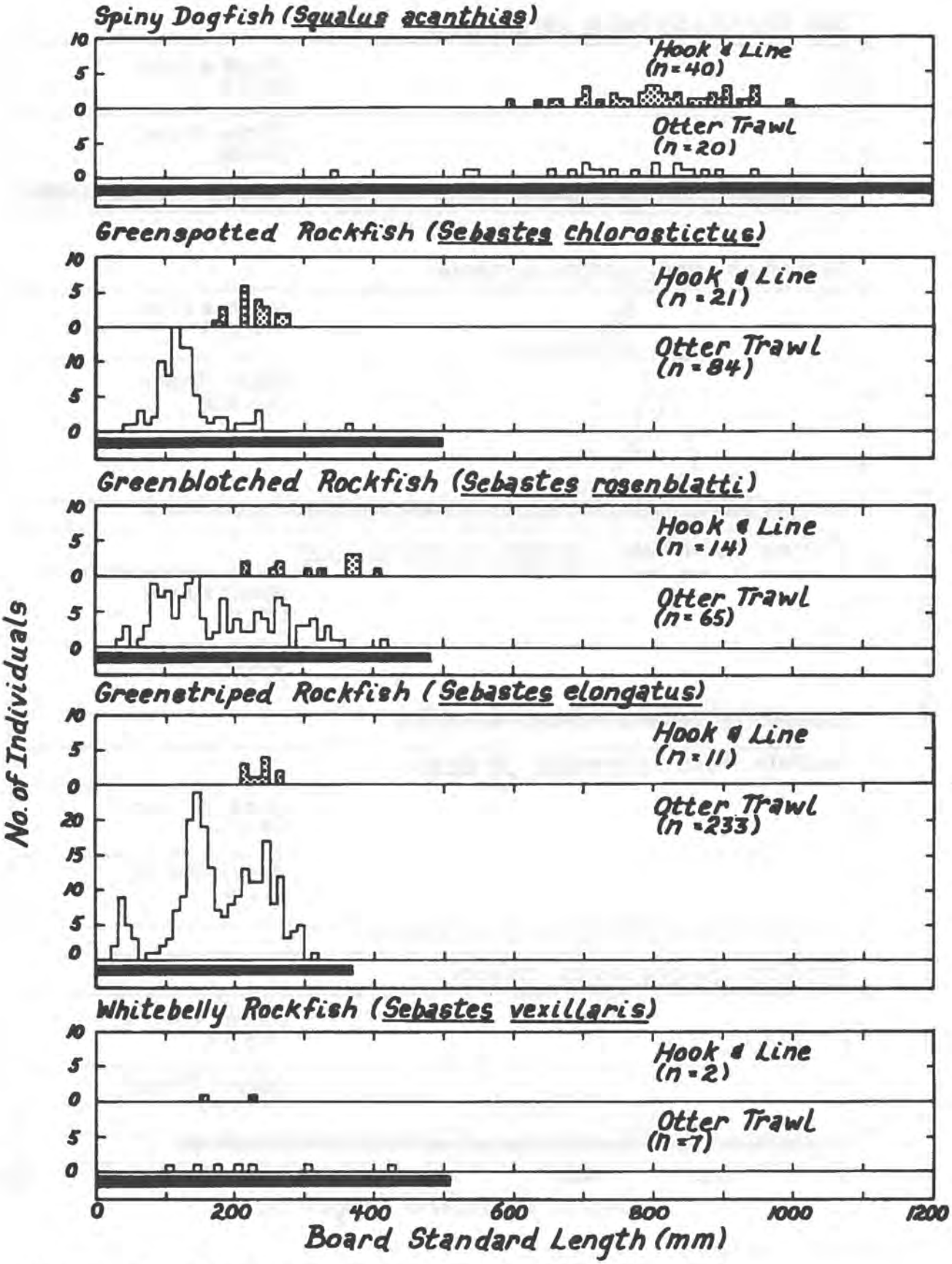

Figure 7. (Sheet 2 of 3)

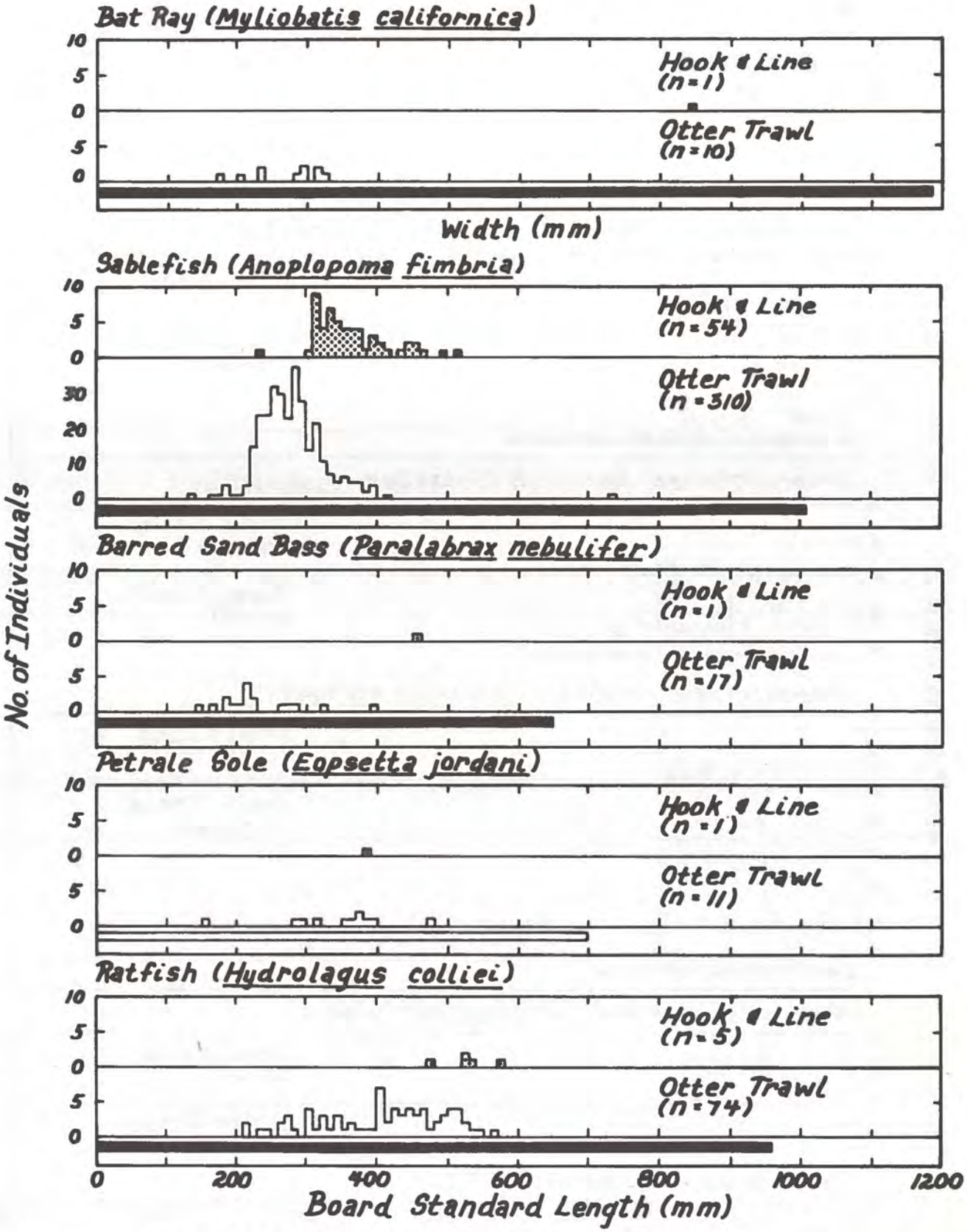

Figure 7. (Sheet 3 of 3)

Stomach Contents

We examined the stomach contents of sixteen large specimens of species without swimbladders (Table 7). One white croaker regurgitated a sanddab (Citharichthys sp.); another individual had a live spotted cusk-eel (Chilara taylori) stuck in its gill cavity. Spiny dogfish stomach contents included nemerteans (Cerebratula sp.), ridgeback prawns (Sicyonia ingentis), rockfish (Sebastes sp.), ratfish (Hydrolagus colliei), and white croaker. The bat ray had been feeding entirely on clams and clam siphons. Sablefish stomach contents included schooling fishes such as shortbelly rockfish (Sebastes jordani) and northern anchovy (Engraulis mordax). A vermilion rockfish (Sebastes miniatus), a species generally thought to feed only in the water column, regurgitated a pygmy poacher (Odontopyxis trispinosa), a bottom fish.

Diseased Fish

Four fish with anomalies were taken during the survey (Table 8)--a sablefish with a mouth deformity, two greenblotched rockfish with fin erosion, and one white croaker with a lip papilloma. The fin erosion disease found in the two greenblotched rockfish is generally found on the pectoral fins, often with a cyst that is possibly caused by a parasite. Fin erosion was not encountered in white croaker in this survey (the white croaker is the only species abundant in the catch from this survey that is frequently found to be diseased in otter trawl surveys). However, white croaker taken by otter trawl in this area at the same time also did not have eroded fins. Thus, we still cannot determine whether or not healthy fish escape the trawl more frequently than unhealthy fish. The white croaker with the lip papilloma was taken at Station D-6 near Malibu; the other anomalous fishes taken in the survey came from Station S-30, near the end of the Hyperion 7-mile sludge discharge pipe.

CONCLUSIONS

1. All species taken by hook and line in this study have also been taken by otter trawl in southern California.

2. The hook-and-line methods gave fewer species per station than otter trawl. The technique of locating schools of fish by sonar and fishing into them with rod and reel yielded more species per station than did the 100-hook setlines.

3. Setlines were most effective at sampling wide-ranging fishes that forage on the bottom; we did not catch rockfishes with the setline.

4. Rod-and-reel fishing was more effective than the setline or otter trawl at sampling species such as rockfishes that range higher off the bottom or are clumped.

Table 7. Stomach contents of fish caught by hook and line, Santa Monica Bay, 1975.

Species*	Length (mm)	Bio-mass (kg)	Stomach Contents
Genyonemus lineatus			
2 Apr, Station S-15	260	0.30	Chilara taylori (in gills)
2 May, Station D-6	215	0.15	Citharichthys sp.
Squalus acanthias			
10 Apr, Station S-20	775	2.45	Sebastes sp., unident.
28 Apr, Station H-20	795	2.2	Sicyonia ingentis
	782	2.2	Cerebratula sp.
	808	2.2	Hydrolagus colliei
30 Apr, Station H-6	797	2.5	Engraulis mordax
2 May, Station D-6	800	2.8	Genyonemus lineatus
Myliobatis californica			
30 Apr, Station H-6	845	12.5	Clams; clam siphons
Anoplopoma fimbria			
9 May, Station D-30	330	0.45	Sebastes jordani
	345	0.40	Engraulis mordax
Sebastes miniatus			
12 May, Station D-20	210	0.20	Odontopyxis trispinosa

*Squalus acanthias and Myliobatis californica taken by setline; other species taken with rod and reel.

Table 8. Anomalous fishes caught by hook and line, Santa Monica Bay, 1975.

Species*	Length (mm)	Bio-mass (kg)	Type of Disease
Anoplopoma fimbria			
16 Apr, Station S-30	230	0.20	Mouth deformity
Sebastes rosenblatti			
16 Apr, Station S-30	372	1.4	Fin erosion
	220	0.30	Fin erosion
Genyonemus lineatus			
2 May, Station D-6	232	0.35	Lip papilloma

*Sebastes rosenblatti taken with rod and reel; other species taken with setline.

5. The limited recurrent group analysis that was possible with the data from this survey revealed several species associations that were different from those shown by otter trawl data.

6. Hook-and-line catches contained more large fish than otter trawl catches. However, with one exception (a bat ray), hook-and-line specimens feel within the size ranges sampled by otter trawl.

7. Although a few anomalous fishes were taken in the survey, the fin erosion disease common in trawl-caught white croaker was not noted during this survey nor in otter trawl surveys in the same area at the same time. Thus, we cannot yet determine whether or not healthy fish escape the net more frequently than do fish with this disease.

8. Station S-30, the station nearest the end of the Hyperion 7-mile sludge pipe, yielded high numbers of species and the greatest biomass of rod-and-reel-caught fish. Three of the four diseased fish taken in the survey were collected at this station.

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