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Fish Bulletin 140. The Marine Environment offshore From Point Loma, San Diego County

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STATE OF CALIFORNIA THE RESOURCES AGENCY
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FISH BULLETIN 140
The Marine Environment offshore From Point Loma, San Diego County

By
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,
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1968

ABSTRACT

This is the third in a continuing series of marine environment surveys conducted by the California Department of Fish and Game in cooperation with the State's Regional Water Quality Control Boards.

During February and March, 1965, Department scuba diving biologists made an ecological investigation off the western shore of Point Loma, San Diego County (into water depths of 100 feet). Data from this study, conducted for the San Diego Regional Water Quality Control Board (#9), are to be used in evaluating the effects of a submarine outfall discharge on the marine life in the area.

Twenty diving and four intertidal stations were occupied along four transects run perpendicular to shore. A modified transect-quadrat method of survey was employed to sample the biota both quantitatively and qualitatively. In addition, three orange-peel grab samples were taken near the outfall terminus (200-foot depth) primarily to determine sludge build-up.

The animal and plant assemblages were both lush and varied. The recorded species, numbers and diversities appeared typical for this general area, water depth, and bottom type. Bathymetrically, the greatest species diversity occurred in the 60- to 80-foot depths—the least in the 20. Geographically, species diversity was greatest in the central portions of the study area, and the least diverse in the northern. This correlated with the height of the bottom relief.

Although it is difficult to make comparisons with prior studies, because of different sampling techniques, the area's general biotic assemblages appeared similar, and except for the occurrence of Capitella capitata (a "pollution-tolerant" polychaete worm) at the outfall terminus, no adverse changes, directly attributable to outfall operations, were apparent in 1965. Five plants and 14 animals are deemed particularly hardy; these index species should be closely monitored in future studies to detect changes in their abundance relative to associated species.

Similar ecological studies should be carried out at least annually to record biotic changes which may be relative to the outfall's operation.

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ACKNOWLEDGMENTS

We are most grateful to the many persons and organizations who assisted in the successful completion of this report.

The San Diego Harbor Department was most gracious in supplying berthing facilities for our diving boat *Dolphin*.

We appreciate the assistance of, and are indebted to Leonard Burtman, Regional Water Quality Control Board #9—San Diego, for defining the survey area, to John E. Fitch for editing the report, to Phil M. Roedel, John L. Baxter, Peter F. Major, Alec R. Strachan and Charles T. Mitchell for their help, and to the secretarial staff at the California State Fisheries Laboratory, Terminal Island, for the typing, particularly Constance Kenyon and Mary Dopp.

We are grateful to Donald J. Reish, California State College at Long Beach, for examining the polychaete samples.

The laboratory facilities made available to us at the United States Fish and Wildlife Service, Bureau of Commercial Fisheries Laboratory, La Jolla, were most helpful.

Although the expense of this study was reimbursed by Regional Water Quality Control Board #9—San Diego, the equipment was previously purchased with Federal Aid to Fish Resoration funds and the personnel employed were the staff of Dingell-Johnson Project California F-22-R, Environmental and Behavioral Studies of Coastal Sport Fishes.

The senior author is still with the DJ F22R studies; however, Ebert is now in charge of the Department's abalone investigations and Given is Resident Biologist at the University of Southern California's Santa Catalina Island Laboratory.

Charles H. Turner
Earl E. Ebert
Robert R. Given
December, 1967

1. INTRODUCTION[1]

The California Department of Fish and Game and the State Water Quality Control Board (through Regional Board #9—San Diego) entered into an agreement 1 July 1964, whereby Department biologist-divers made an ecological investigation of the marine environment from the intertidal zone to the 100-foot depth of the Pacific Ocean off the western shore of Point Loma. The investigation included, but was not limited to: (i) a general reconnaissance off the western shore of Point Loma, and (ii) an intensive examination in the southerly portion of the study area. The investigation was directed toward an ecological assessment, by direct observation where possible, of the numbers and diversity of animal life and associated vegetation in the area. Physical data (water temperature and clarity) were recorded each day field work was conducted.

We anticipate that these data gathered will be used by the Board to describe and evaluate environmental changes (if any) which have occurred due to the operation of an ocean outfall in this area.

This study is the third in a continuing series of marine environment surveys the Department is conducting in cooperation with the State's Regional Water Quality Control Boards. Because both the diving techniques employed and the results obtained have wider application than afforded through the limited distribution of an interdepartmental report, we consider formal publication proper and necessary.

2. AREA DESCRIPTION

Point Loma, a hilly peninsula extending south from Mission Bay, separates and protects San Diego Bay from prevailing ocean currents. Its western shoreline features high sea-eroded cliffs.

Our study area was the narrow to moderate intertidal zone at the seacliff base, and the broad (2,000- to 3,200-yard wide), gently sloping, pavement-like mudstone-sandstone submerged terrace paralleling the Point's western shore.

In the nearshore, some sand inundation of this sea terrace is observed and occasional "pocket" beaches adjoin the exposed cliffs. Seaward into the 80-foot depths the broad pavement-like terrace is incised by shallow surge channels and covered in parts by cobbles and boulders.

The terrace edge, the remnant of a now submerged seacliff, lies in the 100-foot depths. Here the bottom relief increases and pinnacles and and large boulders tower above the fine gray bottom sands. Beyond this depth, the limit of our diving survey, these fine gray sands persist into the deeper portions of the San Diego basin.

Wave action and shifting sand limited the inshore biota. In 60- to 80-foot depths, species diversity increased and prolific and complex biotic assemblages were encountered. Sand intrusion at the terrace

[1] This work was performed as part of Dingell-Johnson Project California F-22-R, "Environmental and Behavioral Studies of Coastal Sport Fishes," supported by Federal Aid to Fish Restoration funds.

edge limited invertebrate and plant speciation, but the fish fauna remained relatively high. Seaward, typical sand-bottom communities occurred.

3. METHODS

Field work was conducted during February and March, 1965. On the first day, a general reconnaissance was conducted from the beach and future transect locations determined. To retain continuity among studies in this area, our transects were laid out so they reached shore in close proximity to stations occupied in prior studies (San Diego Marine Consultants 1959 and 1962). During subsequent field days, four transects were run perpendicular to the shore (approximately 255° magnetic) into 100-foot depths (figure 1) :

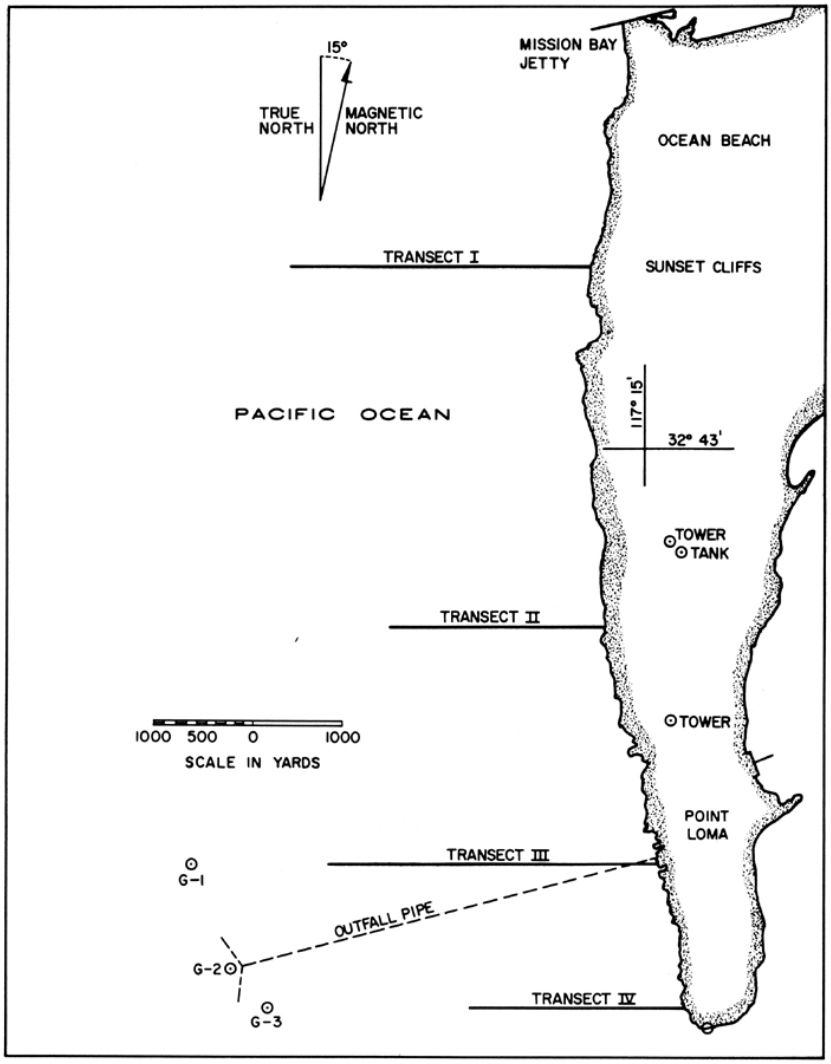

FIGURE 1 Location chart, transects surveyed and offshore collection sites, Point Loma, San Diego County.

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Transect I began at the base of a promontory seaward of a large, pink, two-story building in Ocean Beach, approximately 6,600 yards north of the outfall line. It extended some 3,205 yards across the rocky intertidal and subtidal, terminating near the edge of the submerged rock terrace (100-foot depth).

Transect II began at the cliff base beneath the Naval Electronics Laboratory's sea-water pumping station, approximately 3,000 yards north of the outfall line. After traversing the rocky intertidal, the nearshore sand-smothered rock and the offshore rock terrace, it terminated on sand (100-foot depth) 2,200 yards offshore.

Transect III began at the base of the outfall pumping station, traversed the rocky intertidal, the nearshore sand and the offshore rock terrace, and terminated at the terrace's seaward edge (100-foot depth), approximately 2,800 yards offshore.

Transect IV began below the bluffs between the Coast Guard Lighthouse Shore Station and the concrete foundation remains of the recently removed desalination plant, approximately 1,600 yards south of the outfall line. Extending seaward across the rocky intertidal, the nearshore sand-smothered rocks, and the rocky terrace, it terminated at the 100-foot depths in rock rubble just seaward of the uplifted edge of the submerged rocky terrace, approximately 1,860 yards offshore.

offshore operations were conducted from the Department's 20-foot cabin cruiser *Dolphin* equipped with a Raytheon DE-705A recording fathometer. Fathograms were made along each transect and then reconstructed diagrammatically for inclusion in this report (Figure 2) . Diving observations were made at 20-foot depth increments along these transects (Figure 2) commencing in the 100-foot depths and proceeding shoreward. Using scuba, we occupied 20 stations along these four transects. A marker flag anchored at each station enabled us to plot its position accurately with transit sightings from shore.

To make these diving survey results quantitatively meaningful and ecologically acceptable, we modified conventional principles of terrestrial quadrat-transect sampling for use underwater.

Our actual sampling site was the spot where our anchor "set" in the bottom. We then defined each study area by attaching a measured line to the anchor and traversing a circle with this line as its radius. Quantitative observations were made within the perimeter, while outside its boundaries only more-obvious bottom topography or biological features were noted.

The bottom area covered was not the same for each station, since the effectiveness of these techniques depends upon water clarity and the complexity of the biota. The poorer the visibility the more restricted the amount of bottom that can be surveyed using these techniques, and the more diverse the biota the smaller the area the divers can critically examine. Typically, on sand stations having a limited macro-biota, we use a 3.1-meter line (about 10 feet), inscribing a 30-square-meter area (about 320 square feet). In rocky bottom areas, where the biota is more diverse, we employ a 2.2-meter line (about 7 feet) which encompasses

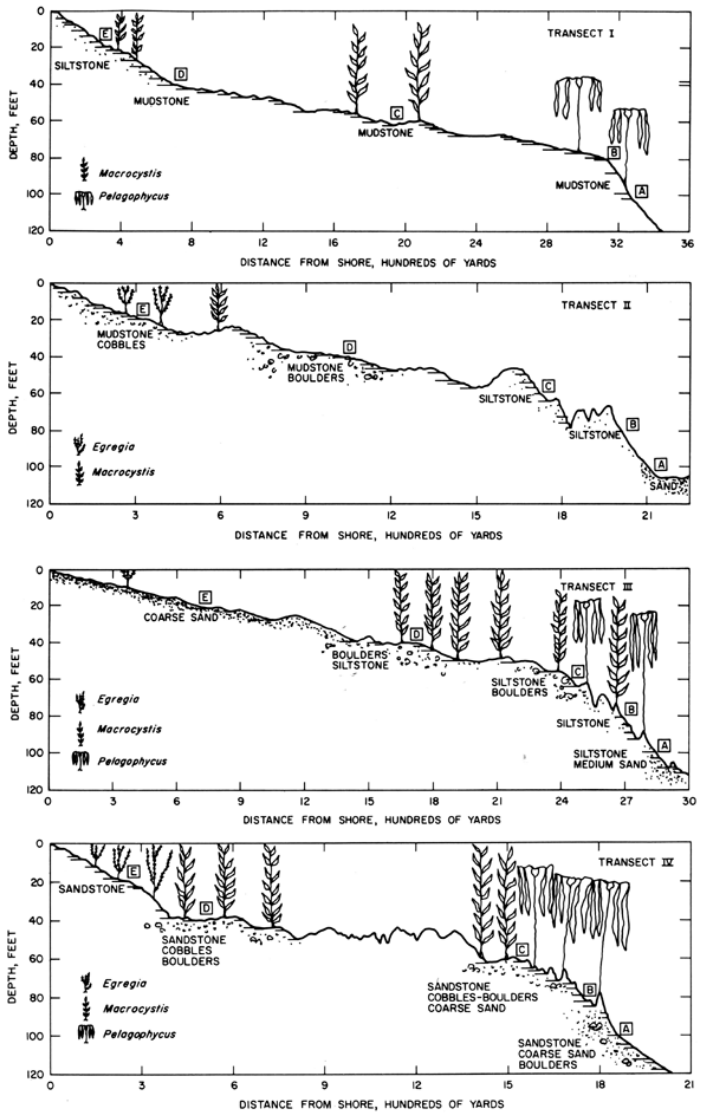

FIGURE 2 Bottom contours offshore from Point Loma, San Diego County, as interpreted from fathograms. The letter within the square indicates the sampling station.

FIGURE 2 Bottom contours offshore from Point Loma, San Diego County, as interpreted from fathograms. The letter within the square indicates the sampling station

15-square-meters (about 160 square feet). At three stations (I-E, III-D, and III-E) where the water visibility approached zero, or heavy surge hampered our work, we were unable to employ this are method to define the study area.

Sampling conducted and data obtained at each of the diving stations included (with modifications as the situations dictated): (i) a vertical plankton tow, using a standard 18 cm diameter oblong plankton net with 62-micron mesh; (ii) obtaining a core sample; (iii) taking a substrate sample for polychaetes and Foraminifera; (iv) recording the water depth; (v) recording the water temperature; (vi) estimating the water clarity; (vii) a general description of the bottom area; (viii) enumeration by estimate of the larger plants and animals (including fish); (ix) quantitative enumeration of the larger plants and animals in the are study area; (x) quantitative sampling (by actual removal) of growths within a quadrat 0.25 m^2; and (xi) making photographic records of general bottom conditions and of each quadrat prior to sample removal.

At each station, we determined the general conditions of the ocean floor (sediment composition and structure), carefully noting the presence or absence of ripple marks in sand-bottom areas.

In sand-bottom areas, we utilized a diver-held plastic coring tube to obtain a vertical profile of the sediments. This sample location is designated "C" on each station sheet. Cores were measured, the general uniformity and consistency of the sediments recorded, and the presence of putrefaction below the sediment surface (evidenced by the odor of hydrogen sulfide) noted (Appendix 1).

Water depth was measured at the anchor, using a standard (oil-filled) diver's depth gauge, calibrated in 5-foot increments, accurate to 3 feet. These were not interpolated to mean lower low water (MLLW).

We obtained water temperatures with both a diver-held thermometer and a continuously recording thermograph. Temperatures were recorded during each dive in °C at the surface, at the bottom, and at 10-foot increments above the bottom using the diver-held thermometer. We placed the thermograph on the bottom at two of the deeper diving stations (III-A and IV-B) to record diurnal-nocturnal variations.

We estimated water clarity (the horizontal distance objects were visible) throughout the water column at 10-foot depth increments to describe the general conditions under which our more-detailed biological observations were made. During previous studies (Turner, Ebert, and Given, 1964, 1965, MS) we have determined that these estimates are approximately one-half the distance recorded when a horizontal reading is made with a Secchi disc. These horizontal readings describe the transparency of the water masses within the entire water column better than the usual vertical Secchi disc readings taken from the surface.

Substrate samples were collected within each station area to determine diversity and abundance of polychaetes and Foraminifera. Polychaete samples, designated "P" on the station diagrams, consisted of approximately 1 pint of sediments skimmed from the top 1 to 2 inches of bottom. These were collected in wide-mouth quart jars, preserved in 10% formalin, and the polychaetes sent to Donald J. Reish,

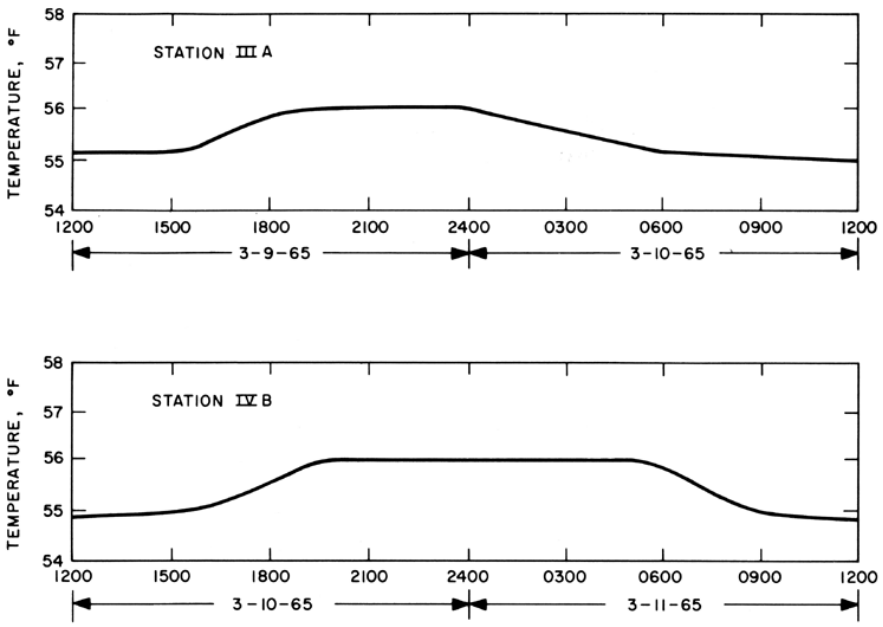

FIGURE 3 Twenty-four-hour thermograph records taken offshore from Point Loma, San Diego County, March 9, 10 and 11, 1965 (Stations III-A and IV-B).

FIGURE 3 Twenty-four-hour thermograph records taken offshore from Point Loma, San Diego County, March 9, 10 and 11, 1965 (Stations III-A and IV-B)

California State College at Long Beach, for examination. We identified the other organisms collected in these samples.

Foraminifera samples, designated "F" on station diagrams, consisting of about 2 ounces of sediment were collected in 1-pint wide-mouth jars and preserved immediately in a solution of rose bengal. They have been sent to a specialist for identification, which is still pending.

Observations were recorded underwater on plastic slates and later transcribed into laboratory logs, from which this report was written. Each plastic slate had a "study area" circle inscribed upon it to enable the divers to record accurately the position of the macroscopic animals and plants at each station. We use the term "macroscopic" to define plants and animals which were visible to the divers and the term "microscopic" for organisms living in and on the substrate too small to be seen readily with the unaided eye.

All samples were tentatively sorted and preserved during the field operations with complete analysis being done in the laboratory. During the laboratory sorting, we washed all samples through a 0.5-mm-mesh screen. Organisms passing through this screen were not retained.

We also employed a transect-quadrat method of survey at four intertidal stations occupied during low tides on February 15 and 17, 1965. Here we laid out the transect line directly across the intertidal zone, from extreme low water to the upper tidal reaches. The plants and animals along this line were enumerated (by estimate) at each 10-foot increment, and at the midpoint of the line a quantitative

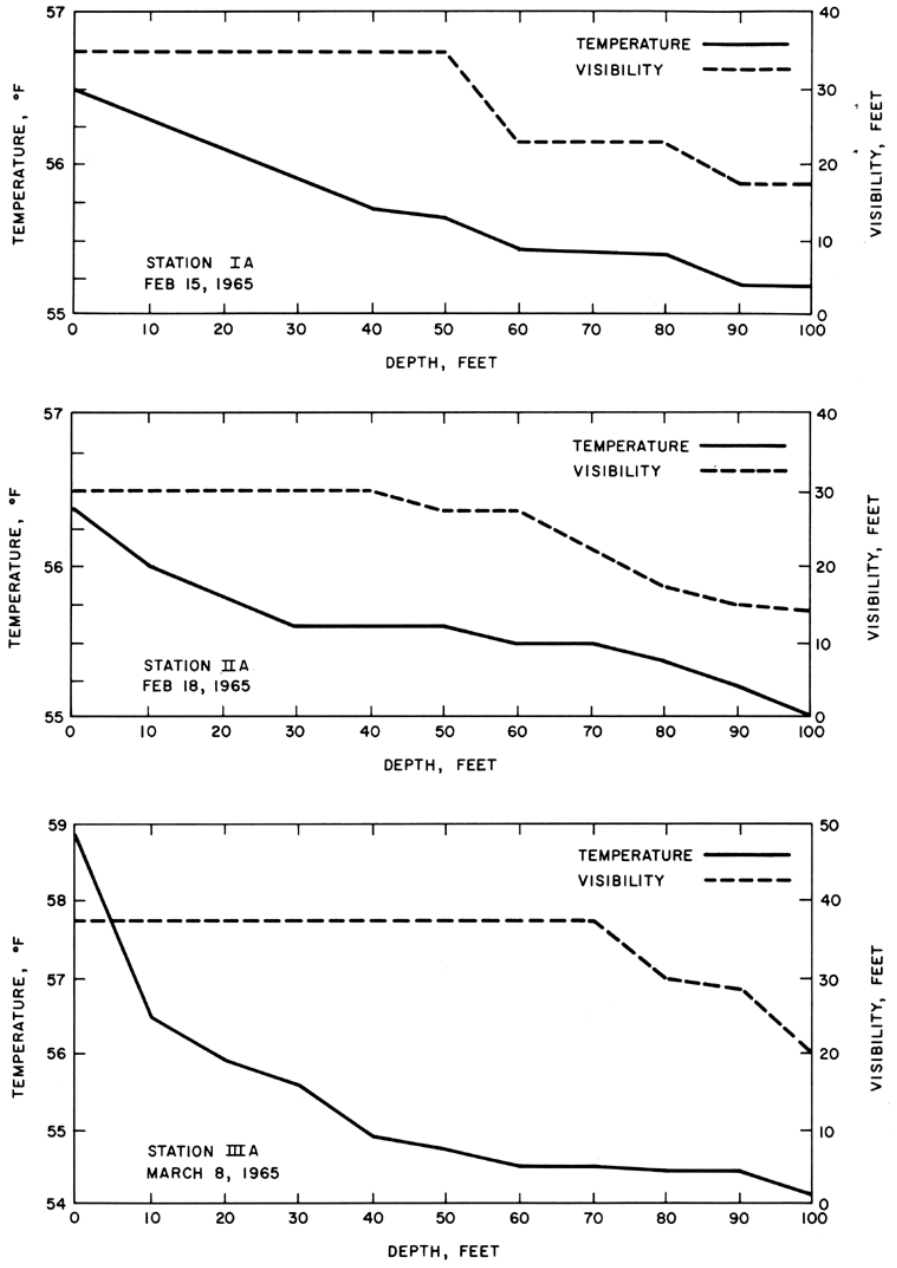

FIGURE 4 Temperature-visibility curves as functions of depth offshore from Point Loma, San Diego County, February and March 1965.

FIGURE 4 Temperature-visibility curves as functions of depth offshore from Point Loma, San Diego County, February and March 1965

sample (by actual removal from within a quadrat 0.25 m on a side) was taken for detailed analysis at the laboratory.

Three extralimital samples were collected with a small Hayward orangepeel grab, along the 220-foot depth contour near the outfall terminus, to note any sludge build up; these data are included.

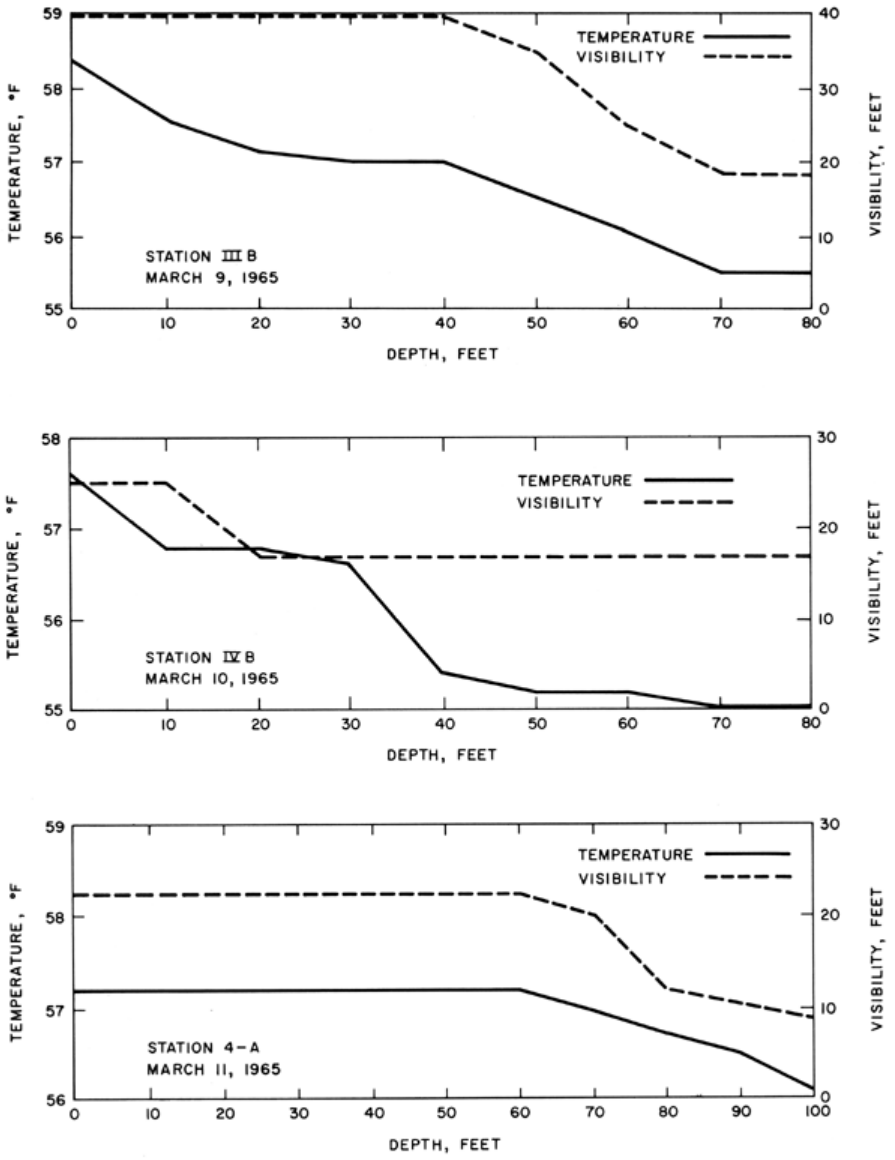

FIGURE 5 Temperature-visibility curves as functions of depth, offshore from Point Loma, San Diego County, March 1965.

FIGURE 5 Temperature-visibility curves as functions of depth, offshore from Point Loma, San Diego County, March 1965

4. FINDINGS

4.1. Transect I

The most northerly of our transects, Transect I (Figure 2), was characterized by pavement-like siltstone and mudstone. Its major relief resulted from erosion-formed channels and ledges rather than boulders and rocky outcroppings. Most of these erosion channels were filled with sand or sand and shelly debris, severely limiting the habitats available to the biota.

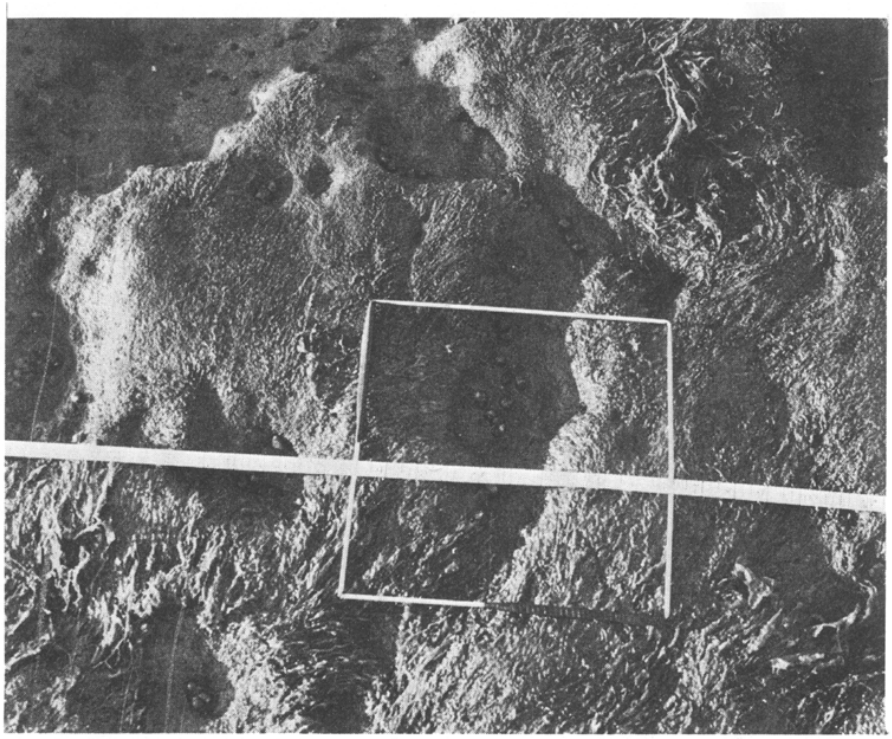

FIGURE 6 The intertidal quadrat; Transect I. Note the concentrations of littorine snails. *Photo by Robert R. Given.*

FIGURE 6 The intertidal quadrat; Transect I. Note the concentrations of littorine snails. Photo by Robert R. Given.

This line, beginning at the base of a sloping sea-cliff promontory, bordered by pocket beaches, crossed the moderate (90-foot wide) intertidal, with its deeply incised shelves, and extended across the submerged and gently sloping offshore shelf into the 100-foot depths, approximately 3,300 yards offshore.

The relatively high, sharp profile of the intertidal shelves made them a harsh environment for animal life, and speciation was severely limited: only two algae and six animals were recorded (Table 1). Most of these were on the sides of the shelf incisions rather than the shelf top. An exception was the green sea moss (Enteromorpha sp.) which grew abundantly throughout the spray zone (higher tide zone) environment. Littorine snails (Littorina planaxis) and green sea moss characterized the quadrat sample (Figure 6) .

Seaward, the shelves were frequently covered by sand. This sanding-over diminished somewhat at the 20-foot depths where heavily-bored and "rotted" mudstone shelves dominated (Station I-E).

Due to severe surge and restricted visibility (about 6 inches), we know this area only by "feel" and limited collecting. Surf grass (Phyllospadix torreyi) , 5 algae, and 37 animals were recorded (Table 1).

The first surface canopy of giant kelp (Macrocystis pyrifera) was encountered just seaward of Station I-E in depths of approximately

22 feet (300 yards offshore). This sparse bed was less than 200 yards wide and the plants did not appear particularly healthy. No giant kelp was recorded in the 40-foot depths (Station I-D) where we recorded, despite the restricted visibility (2 feet), 11 other algae and 32 animals (including 2 fishes) (Table 1). Low growing coralline and other red algae dominated the arc study area (Figure 7) . The bottom was composed of low, heavily-bored shelves, deeply incised with surge channels filled with shelly debris and some sand. This relatively flat, gently-sloping, pavement-like bottom continued into the 60- and 80-foot depths with only a scattering of low ledges forming relief of any substantial height.

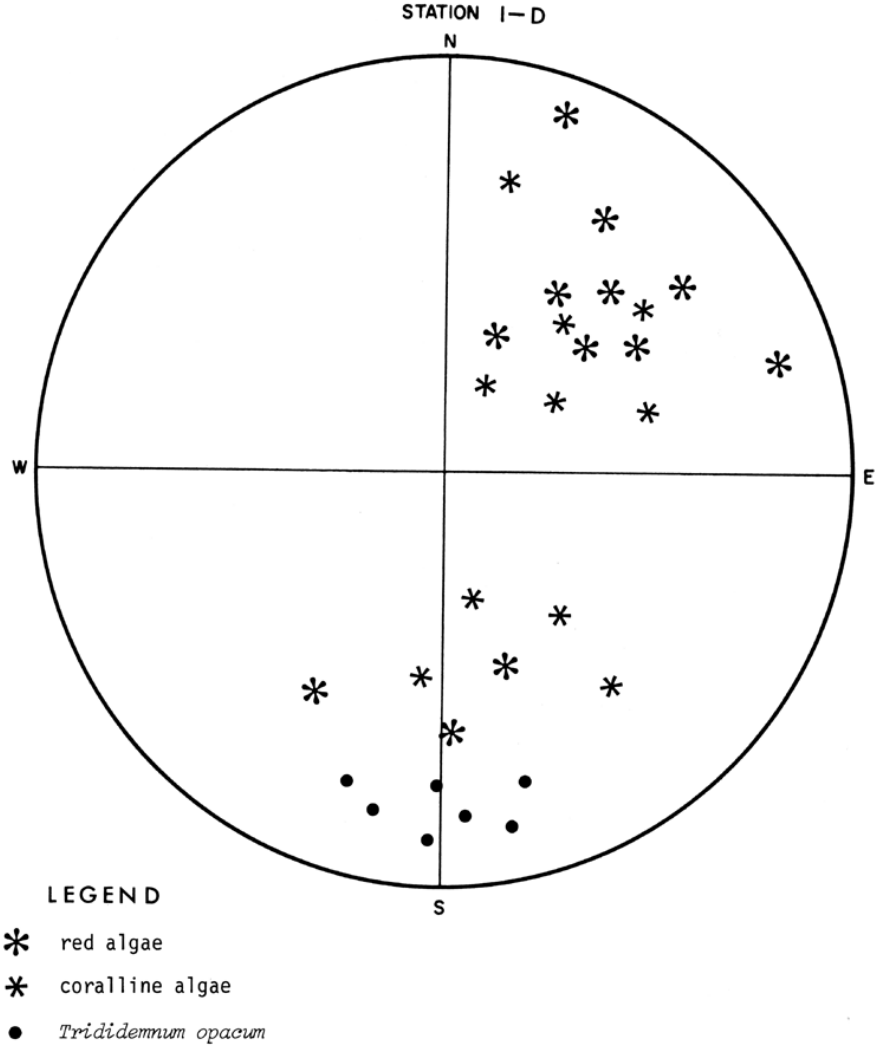

FIGURE 7 A pictorial representation of the arc study area, Station I-D (approximately 15 square meters of bottom area), 40-foot depth, depicting the more obvious biotic features.

FIGURE 7 A pictorial representation of the arc study area, Station I-D (approximately 15 square meters of bottom area), 40-foot depth, depicting the more obvious biotic features

An extensive surface canopy of giant kelp was encountered in a band approximately 1,600 to 2,100 yards from shore (waters 55 to 65 feet deep). Station I-C (60-foot depth) was in the central portion of this bed. Here the bottom was rocky, interspaced with low ledges. Eight algae and 80 animals (including 5 fishes) were recorded (Table 1). The numerous sea urchins were probably responsible for the lack of large algae in the immediate station area. Purple sea urchins (Strongylocentrotus purpuratus) were observed under the movable boulders (Figure 8) or far back in the crevices, while red sea urchins

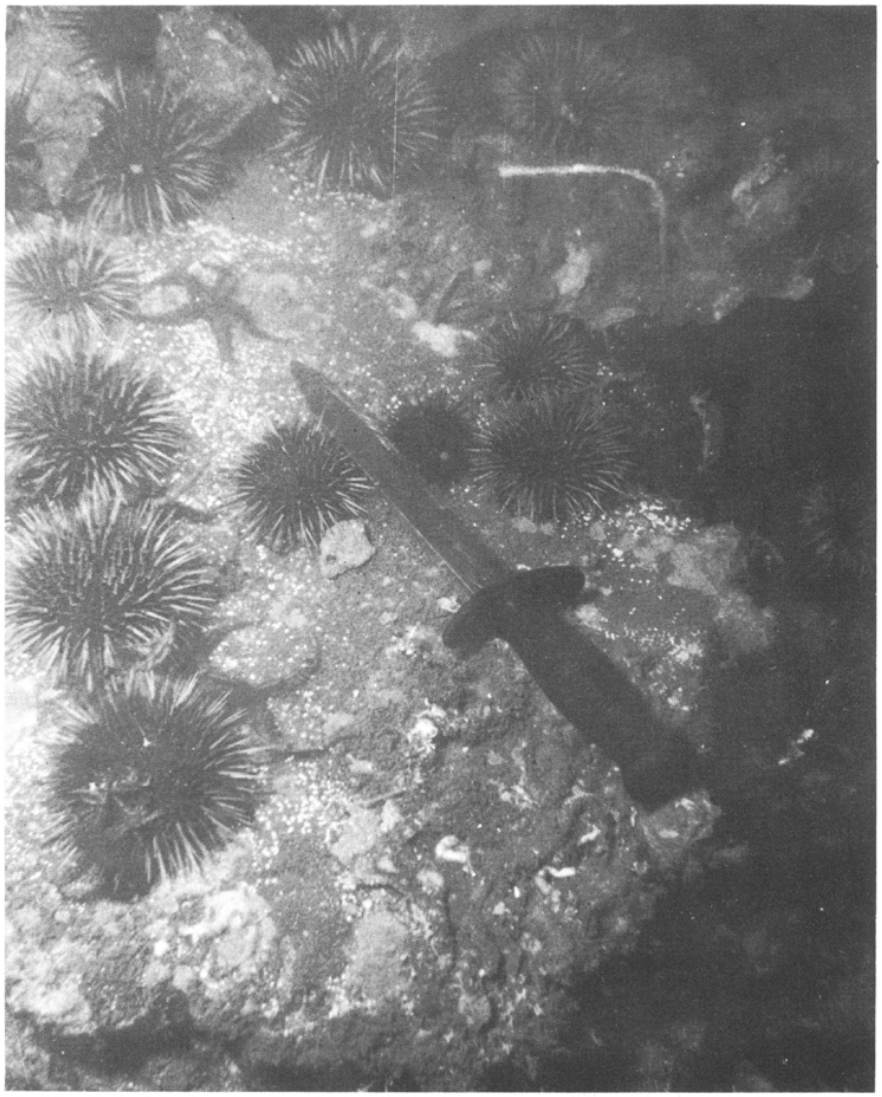

FIGURE 8 Purple sea urchin concentrations on the underside of a boulder. Station I-C (60-foot depth). *Photo by Charles H. Turner.*

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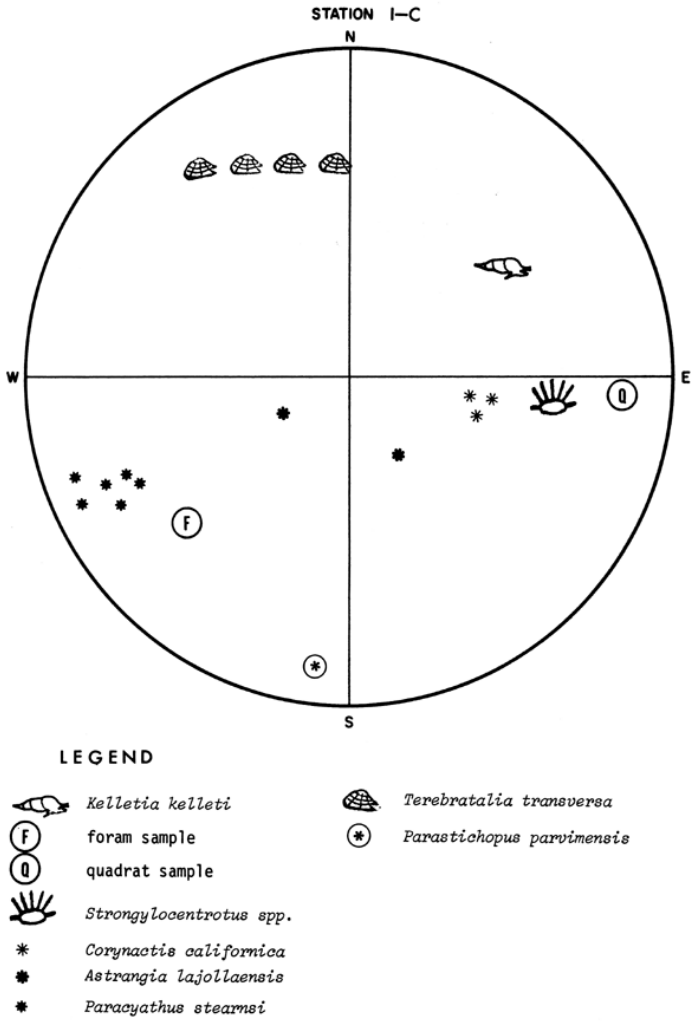

FIGURE 9 A pictorial representation of the arc study area, Station I-C (approximately 15 square meters of bottom area), 60-foot depth, depicting the more obvious biotic features and the sampling locations.

FIGURE 9 A pictorial representation of the arc study area, Station I-C (approximately 15 square meters of bottom area), 60-foot depth, depicting the more obvious biotic features and the sampling locations

(S. franciscanus) were observed in more open areas, at the mouths of crevices or overhangs and in the rock fissures. Stony corals (Paracyathus stearnsi, Astrangia lajollaensis) and aggregate anemones (Corynactis californica) were dominant in the are study area (Figure 9) .

The bottom relief was slightly more prominent at the 80-foot depths (Station I-B) despite the fact that sand and debris filled many of

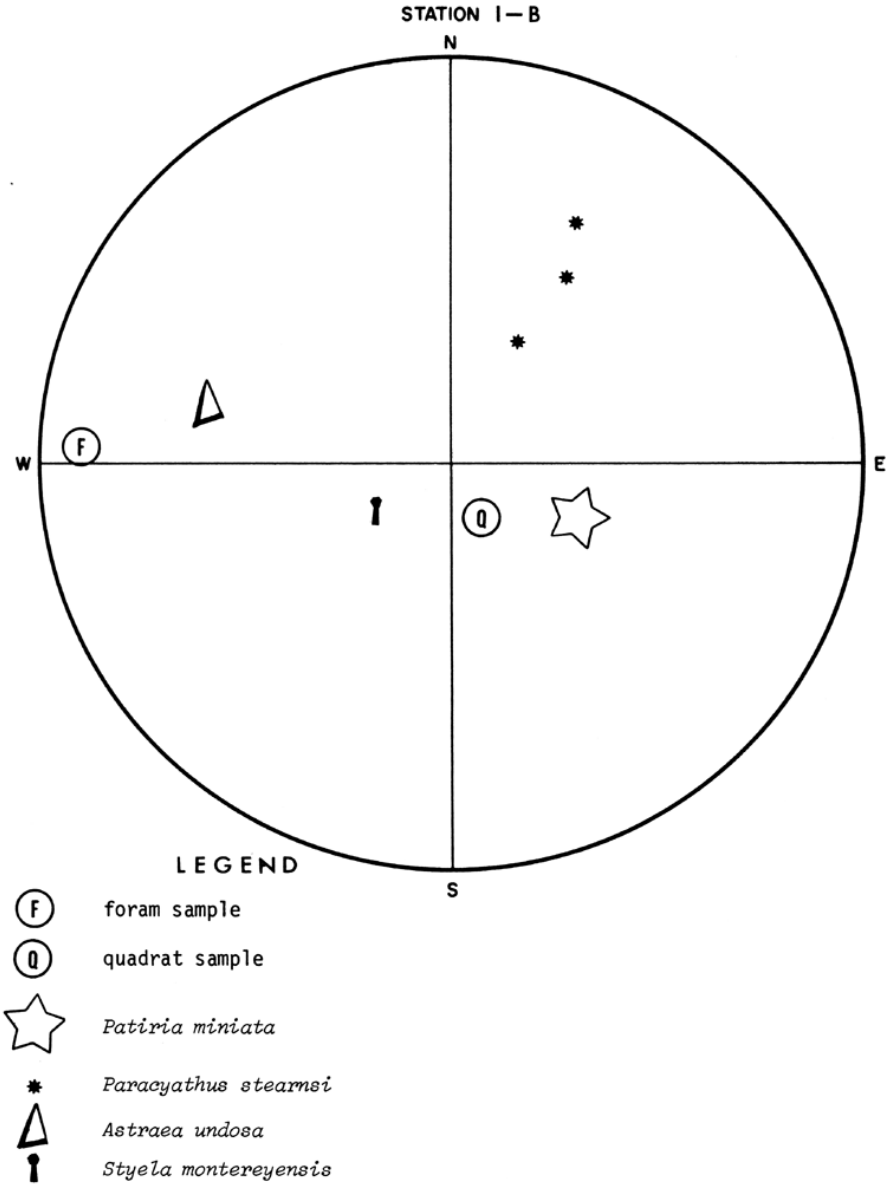

FIGURE 10 A pictorial representation of the arc study area, Station I-B (approximately 15 square meters of bottom area), 80-foot depth, depicting the more obvious biotic features and the sampling locations.

FIGURE 10 A pictorial representation of the arc study area, Station I-B (approximately 15 square meters of bottom area), 80-foot depth, depicting the more obvious biotic features and the sampling locations

TABLE 1
Plants and Animals Recorded from Transect I, Point Loma, February 15 and 17, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
ALGAE							
Codium setchelli		(1)				S to A,[A]	Sparse at low tide zone: abundant at high tidal zone
Enteromorpha sp.					P		To 10 inches high at station E: to 3 feet high at station B
Cystoseira osmundacea		C		P			Small plants to 6 feet high
Dictyota flabellata	1/4m²,(1)	S	S				One large plant seen
Laminaria farlowii							Healthy, to 10 feet tall at station A: grazed at station B
Macrocystis pyrifera	1/2m²	1/3m²					To 16 inches high
Pelagophycus porra					P		
Pterygophora californica				P	C		A small epiphyte
Aniseedadella pacifica		P	C	P	P		
Bossiella orbigniana					C		
Chondria californica	P,(P),[1]	C	P	P			Dominant alga
Corallina gracilis				P			To 6 inches high at station D
Corallina officinalis				P			A small epiphyte
Gelidium nudifrons				P			
Gelidium purpurascens				A			
Gigartina sp.		P	C	A			
Leptocladia binghamiae	C		P				
Plocamium pacificum			P				
Prionitis cornea			P	P			
Pterosiphonia dendroidea			1				
Rhodymenia arborescens	S,(P),[4]	C,[2]		(C)		C	Common at low tidal zone
Rhodymenia pacifica				(C)			
Rhodymenia sp.					P		A flowering plant
coralline unid.							
Rhodophyta unid.							
Phyllospadix torreyi							

TABLE 1
Plants and Animals Recorded from Transect I, Point Loma, February 15 and 17, 1965 Station and Abundance

INVERTEBRATA AND ASCIDIACEA						
Protozoa						
Discorbis columbiensis			C			On hydroids
Folliculina sp.			[P]			On corallines
Gromia oviformis	[C]		C,[C]		C	Found on most algae
Miniacina miniacea	[S]					An attached foraminiferan
Porifera						
Acarnus erithacus	C,(1)					
Axinella mexicana		P				
Craniella arb	P		(1)		S	Few small "pieces"
Dysidea amblia			(2)			
Esperiopsis originalis				P		Growing on red algae
Haliclona sp.	P,(1)	P	S	P	C	Numerous small patches; a few larger masses
Hymenamphiastra cyanocrypta	P	P				
Lissodendoryx noxiosa					S	Attached to coralline algae base
Microciona parthena				P		A small piece
microcionid unid.				P		
Stelletta estrella	P	P				
Sycon sp.		P	S		S	Few "clumps"
Tedania topsenti		P				
Tethya aurantia	P	P	P,(1)			
Trikentrion flabelliformis	P					
sponge, dark brown unid.			3			Large "patches"
sponge, encrusting unid.				P		
sponge, encrusting yellow unid.	P					
sponge, orange unid.				(1)		
Cnidaria						
Aglaophenia diegensis	[1]	(S)				Growing on coralline algae
Aglaophenia inconspicua	[P]	(P)				Growing on *Bossiella* at station B
Aglaophenia sp.				P		Growing on red algae
Obelia sp.	[P]					
Plumularia lagenifera		(S)				Small colonies
Sertularella pedrensis				C		Growing on red algae
Sertularella turgida			C			Growing on red algae
Hydroida unid.			(S)	C		Growing on red algae
Astrangia lajollaensis		S	(2)			
Balanophyllia elegans	P		P			
Corynactis californica	1	C	1			Small aggregation at stations C and A

TABLE 1—Cont'd.

TABLE 1—Continued
Plants and Animals Recorded from Transect I, Point Loma, February 15 and 17, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
Epiactis prolifera					P		
Eugorgia rubens	P						To 6 inches tall
Lophogorgia chilensis	P,(6)	S					To 15 inches high at station A
Muricea californica		1	S				Small colonies
Paracyathus stearnsi	(20/¼m²),[19]	P,(3),[3]	(6)				
Platyhelminthes			[1]				
Nematoda			[C]		[C]		
Annelida							
Phyllochaetopterus prolifica	P						
Cirratulidae			[1]				
Dorvilleidae			[1]				
Eunicidae			[1]		P		
Hesionidae			[1]	2			
Nereidae				1			
Onuphidae			[1]				
Opheliidae			[2]				
Polynoidae			[5]		P		
Sabellariidae			[1]		P		
Sabellidae					P		
Serpulidae				C	P		
Syllidae			[2]				
Polychaeta unid.			[3]				Fragmented
Arthropoda							
Ostracoda			[1]				
Balanus trigonus				S			
Pollicipes polymerus						P	Distributed in mussel beds
Scalpellum californicum	[4]						
Cumella sp.			[1]				
Tanaidacea					P		
cirolanid unid.			[1]				
Arcturidae			[1]				

TABLE 1
Plants and Animals Recorded from Transect I, Point Loma, February 15 and 17, 1965 Station and Abundance

Gammaridea	[C]	(P)	[12]	S		[3]	
Caprellidea	C		[1]	3	P		Seen under rocks
Pandalus gurneyi					1		
Pelia tumida					P		
Pugettia dalli			[1]				Juvenile specimen
Pugettia sp.				S	S		
Pycnogonida					P		
Mollusca							
Cyanoplax sp.			[1]				
Aegires albopunctatus			[3]				
Alvania acutilirata			C,[1]		P		
Amphissa versicolor	P		C				
Anisodoris nobilis	P	(1)	C				
Astraea gibberosa	C						
Astraea undosa	C	P					
Cadlina flavomaculata			[1]				
Cadlina limbaughi			[1]				
Calliostoma annulatum			1,[1]				
Calliostoma supragranosum				2			
Calliostoma tricolor			1		P		
Ceritthiopsis carpenteri	2						
Crepidula onyx	P		[1]				
Crepipatella lingulata					P		
Dendronotus frondosus			[1]				
Diaulula sandiegensis	[1]	P	(1)				
Epitonium sp.		S,[1]					
Erato columbella	1	5	[1]				One large adult at station A and B
Flabellina iodinea							
Glossodoris porterae	1		[1]				
Haliotis rufescens							
Hermissenda crassicornis	P		(1)	15/½m²			
Jaton festivus			5	P	P	S to A,[16]	Sparse at low tidal zone: abundant at high tidal zone
Kelletia kelleti						S to A	Sparse at low tidal zone: abundant at high tidal zone
Lacuna unifasciata				1			
Littorina planaxis			[2]	2			
Littorina scutulata			C		C		
Megathura crenulata					C		
Micranellum crebricinctum			[3]				
Mitra idae	1				P		
Mitrella carinata							
Mitrella gouldii							
Retusa harpa							
Seila montereyensis							

TABLE 1—Cont'd.

TABLE 1—Continued

Plants and Animals Recorded from Transect I, Point Loma, February 15 and 17, 1965

Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
Serpulorbis squamigerus					P		
Tegula regina	[1]						
Tricolia compta		[P]		2	P		
Turbonilla kelseyi			[1]				
Zonaria spadicea		S					
Ervilia californica			[16]				
Hiatella arctica			[1]		C		
Hinnites multirugosus	C	P	S				To 5 inches long at station A
Leptopecten latiaurata	[1]		[2]				
Lima hemphilli			[1]				
Mytilus californianus						P	Restricted to low tidal zone
Parapholas californica					P		
Penitella penita			C,(P)		P		
Pododesmus cepio				1			
Protothaca staminea			[7]				Small juveniles
Ectoprocta							
Cellaria mandibulata					1		A small colony
Costazia robertsoniae		(P)	C,[S]		P		Encrusting on *Bossiella* at station B
Crisia maxima	[S]		[1]				A small colony at station C
Crisia occidentalis			1		S		A small colony
Crisia sp.		C,(C)	(S)				Low colonies; some growing on stony corals
Cryptosula pallasiana			P				
Diaperoecia californica		S,(P)	(1)				Small colonies
Filicrisia sp.		C,(P)					
Phidolopora pacifica	P,(1)	S	(1)				Small colonies
Rhynchozoon tumulosum					P		
Scrupocellaria diegensis	P,(1)						
Scrupocellaria sp.				1			A small colony
Tubuliporidiae			[1]				A small colony
Cheilostomata	[P]			P			Small colonies
Phoronida	P						
Brachiopoda							
Terebratalia transversa	[S]		C,(6)	C			
Terebratulina unguicula	[4]						Attached to algae

TABLE 1

Plants and Animals Recorded from Transect I, Point Loma, February 15 and 17, 1965 Station and Abundance

Echinodermata							
Amphipholis pugetana			[6]		S		
Ophiothrix spiculata	[2]	(P)	[8]	1	S		
Dermasterias imbricata	P						
Henricia leviuscula	(2),[1]	P				✓	
Patiria miniata	1	P,(1)					
Cucumaria sp.				C			
Parastichopus californicus	C						
Parastichopus parvimensis	P		(1)				
Strongylocentrotus franciscanus			S,(1)	A			
Strongylocentrotus purpuratus			S			S	"Clumped" within small depressions intertidally
Ascidiacea							
Didemnum carnulentum		C					Growing on algae
Eudistoma sp.	[1]						A small piece
Polyclinum planum		[1]					
Sigillinaria aequali-stphonis			(P)				
Styela montereyensis		(1),[1]					
Trididemnum opacum		C,(C),[C]		C,(A)			Growing on algae at station B
ascidian unid.	P				P		Fragments
VERTEBRATA							
Paralabrax clathratus	8	1					8 to 12 inches long
Caulolatilus princeps	1						20 inches long
Embiotoca jacksoni				5			8 to 10 inches long
Chromis punctipinnis	500+		500+				2 to 12 inches long
Pimelometopon pulchrum	25	15	S				10 to 30 inches long
Oxyjulis californica	500						6 to 8 inches long
Coryphopterus nicholsi			A				
Sebastodes atrovirens			S				
Sebastodes dalli	25						5 to 7 inches long
Sebastodes miniatus	35						8 to 12 inches long
Sebastodes serranoides	50						8 to 12 inches long
Sebastodes vexillaris	15						10 to 14 inches long
Artedius lateralis		2					
Artedius sp.	1						1½ inches long
Scorpaenichthys marmoratus				1			14 inches long
Rathbunella hypoplecta			1				

* *Abundance symbols:*
P = Present in the area but relative abundance not estimated.
S = Sparse—widely scattered throughout the area but nowhere numerous.
C = Common—unevenly present throughout the area and only occasionally numerous.
A = Abundant—numerous and evenly distributed throughout the area.
[ ] = Brackets around the abundance symbol indicate occurrence within the quadrat; 0.25 m on a side.
( ) = Parentheses around the abundance symbol indicate occurrence within the are study area.

TABLE 1—Cont'd.

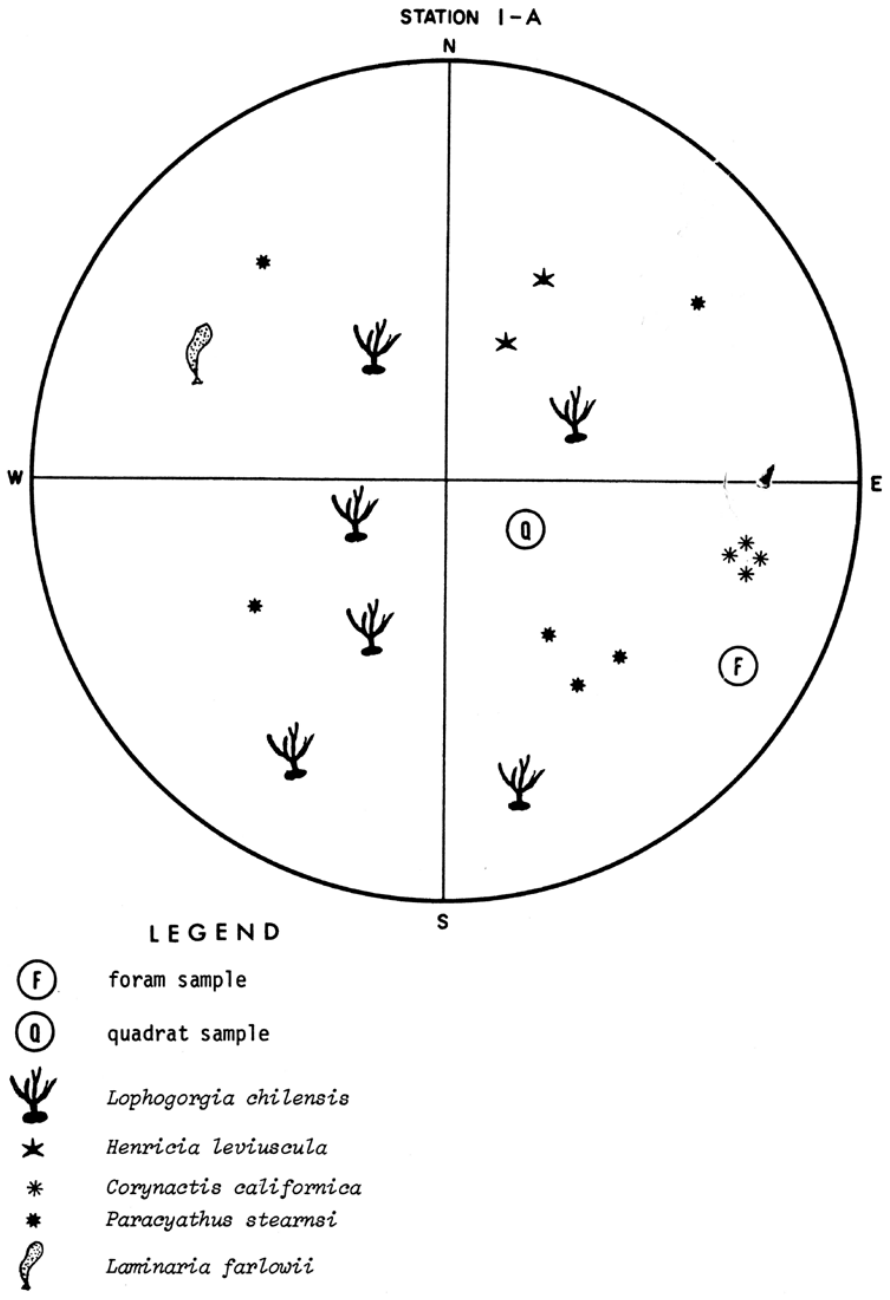

FIGURE 11 **A pictorial representation of the arc study area, Station I-A (approximately 30 square meters of bottom area), 100-foot depth, depicting the more obvious biotic features and the sampling locations.**

FIGURE 11 A pictorial representation of the arc study area, Station I-A (approximately 30 square meters of bottom area), 100-foot depth, depicting the more obvious biotic features and the sampling locations

the rock fissures. Low rock shelves and scattered boulders were common. Low-growing coralline and brown algae predominated and some elk kelp (Pelagophycus porra) was recorded in the area. These elk kelp plants all showed the effects of grazing. The arc study area was

relatively barren and not characteristic of the general station area (Figure 10) where 8 algae and 39 animals (including 3 fishes) were recorded (Table 1). A few red abalones (Haliotis rufescens) were observed, including one 8½ inches long.

Even at the 100-foot depths, this northern transect was characterized by pavement-like base rock and eroded channels filled with shelly debris. Five algae and 60 animals (including 10 fishes) were recorded; elk kelp and ribbon kelp (Laminaria farlowii) were the dominant algae (Table 1). The gorgonian Lophogorgia chilensis and the stony coral Paracyathus stearnsi were dominant in the are study area (Figure 11) . Only one abalone, a large adult red, was recorded in the area.

About 100 feet seaward of our are study area the bottom gradient dropped off more rapidly at the uplifted seaward edge of this rocky terrace. At the terrace's sheer face, fishes were numerous and diversified. A detailed study of this area, beyond the scope of this present investigation, may reveal important information about changes in these animal communities.

4.2. Transect II

In general, Transect II (Figure 2) was characterized by a pavement-like mudstone-siltstone and sandstone base overlain with cobbles and boulders in the nearshore and mid-depths. In the deeper portions of the transect (80- and 100-foot depths), the pavement-rock was deeply incised and ledges and pinnacles formed several high-relief areas. Beyond the 100-foot depths (the limit of this study) the bottom was fine gray sand.

Transect II began at the base of the steep seacliffs, below the U.S. Navy Electronics Laboratory's seawater pumping station. It crossed the broad (190-foot wide) intertidal shelf of low, flat, deeply-incised sandstone. The numerous tide pools in this area supported a lush biota of surf grass, algae, and animals (Table 2). Seaward, an extension of these shelves formed a shallow reef a few hundred feet offshore.

In the 20-foot depths (Station II-E), seaward of this reef area, the lush surf-grass beds diminished and the low rocky shelves and ledges were replaced by cobbles and small boulders, nearly all covered with a crustose red alga, Lithothamnium sp. Surf grass, eight algae and seven animals (including two fishes) were observed. Among these were eight adult green abalones (Haliotis fulgens) (Table 2). The coralline alga Corallina officinalis was dominant in the arc study area (Figure 12) .

The 40-foot depths (Station II-D) were infested with red and purple sea urchins, omnipresent across the heavily bored mudstone base rock and around the scattered boulders (Figure 13) . Only the hardiest coral-line algae (i.e., Calliarthron regenerans and Corallina officinalis) were present in any quantity. Other species were presumably grazed away by these sea urchin hordes. The arc study area (Figure 14) typified the general area. Four algae and 45 animals (including 8 fishes) were observed (Table 2). of particular interest, to us, was our finding numerous yellowfin fringeheads (Neoclinus stephensae) at this station. This relatively rare fish was ubiquitous in the empty pholad and Lithophaga holes honeycombing the mudstone base rock. We have not encountered such concentrations of this fish in any other area.

TABLE 2
Plants and Animals Recorded from Transect II, Point Loma, February 16–18, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
ALGAE							
Enteromorpha sp.						S,[S]	Seen in the mid-tidal zone
Ulva sp.						S,[1]	Seen in the mid-tidal zone
Colpomenia sinuosa						C,[2]	Seen from the mid-tidal to lower tidal zone
Cystoseira osmundacea					P,(2)	P	
Dictyopteris zonarioides		C,(1)	(1)		C	P	Dominant alga at station B
Dictyota flabellata						P	Seen in the lower tidal zone
Egregia laevigata					P	P,[1]	
Eisenia arborea					P,(6)		Heavily grazed by *Norrisia*
Laminaria farlowii		(1)	(1)		P,(2)		All small plants
Pterygophora californica						P	Seen from the low tidal to mid-tidal zone
Sargassum agardhianum						P	
Bossiella orbigniana		P	[P]	[1]		P,[C]	A large "clump" at station D
Calliarthron regenerans				C			Most common alga
Corallina gracilis						P	
Corallina officinalis		(S),[1]		S,(1)	P,(A)	C,[C]	
Cryptopleura crispa						[1]	A small specimen
Drouetia pellata	C						
Gelidium cartilagineum						P	
Gelidium nudifrons						P	Seen in the mid-tidal zone
Gelidium sp.						P	Seen in the lower tidal zone
Gigartina canaliculata						C	
Gigartina serrata					P		
Gigartina sp.						P	
Laurencia diegoensis						[P]	
Lithothamnium sp.					C,(C),[P]		Encrusting most cobbles and smoothish boulders
Plocamium pacificum						P,[1]	
Pterocladia pyramidale						1	
Rhodymenia pacifica			[1]				
Taenioma sp.				[P]			A tiny filamentous epiphyte
coralline unid.						C	Seen from the low tidal to mid-tidal zone
Phyllospadix torreyi					P	A	A flowering plant

TABLE 2
Plants and Animals Recorded from Transect II, Point Loma, February 16–18, 1965 Station and Abundance

INVERTEBRATA and ASCIDIACEA							
Protozoa							
Gromia oviformis	((P))		[C]	[A]		P,[C]	Attached to algae
Porifera							
Adocia sp.		1					A large, branched colony
Axinella mexicana	P					P	Seen in the low tidal zone
Cranilla arb	P						Large specimens
Geodia mesotriaena	C						Large specimens
Haliclona sp.						[1]	A small piece growing on a coralline alga
Hemectyon hyle		1					A small "piece"
Leucenia barbata		1					A 2-by 4-inch colony
Stelletta estrella			[1]				A large "piece"
Sycon sp.		1,(1)					
Tethya aurantia		P	C,(1)				
Trikentrion flabelliformis		[P]					Only two "leaves"
Cnidaria							
Anthopleura xanthogrammica						P	Seen in the mid-tidal zone
Astrangia lajollaensis		C,(C),[9]	15/¼m²,(C) [5]	[2]			
Balanophyllia elegans			(S)				A small aggregation at station C
Corynactis californica	C	C,(S),[2]					
Eugorgia rubens	S						
Lophogorgia chilensis	C	P,(1)					
Muricea californica			P,(2),[1]				To 6 inches high
Paracyathus stearnsi	A	C,(C),[4]	(S)	[1]			
Stylatula sp.	C,(3)						
zoantharian, white unid.			(P)				Several white polyps extending up from a basal mass
Platyhelminthes	((1))		((1))				
Nemertina				[1]			
Nematoda	((C))	C,((C))	[C],((C))			P	
Annelida							
Amphiomidae		((8))	((3))				
Capitellidae			((1))				
Phyllochaetopterus prolifica			[1]				
Chrysopetalidae			[1]			[1]	
Chaetozone corona	((14))						
Tharyx sp.	((3))						
cirratulid unid.		((2))					
Poecilochaetus johnsoni		((24))	((12))				
Flabelligeridae			[1]				
Glycera sp.	((4))	((1))	((1))				
Ophiodromus pugettensis		((2))	((5))				
hesionid unid.				[1]			

TABLE 2—Cont'd.

TABLE 2—Continued

Plants and Animals Recorded from Transect II, Point Loma, February 16–18, 1965

Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
Lumbrineris sp.	((3))	((2))	((5))				
Nephtys sp.		P					
Nereis procera	((1))						
nereid unid.	P					[4]	
Diopatra ornata	C,(10/¼m²)						
onuphid unid.	((2))						
Phyllodocidae	((1))	P,((10))	[2],((7))	[1]			
Polynoidae	P	P	[4]				
Chone sp.	((1))						
sabellid unid.				[2]			
Salmacina tribranchiata		P	P				
serpulid unid.						[C]	
Polydora sp.			((1))				
Prionospio pygmaeus	((6))						
Prionospio sp.			((3))				
spionid unid.						[5]	
Sphaerodorum sp.			((2))				
Exogone sp.			((1))				
Syllis sp.		((1))					
Trypanosyllis sp.		((1))					
syllid unid.			[1]			[3]	
Oligochaeta unid.			((14))				
Arthropoda							
Ostracoda	((2))					[1]	
Chthamalus fissus						P	Seen in the mid-tidal zone
Pollicipes polymerus						P	Seen in the mid-tidal zone
Tetraclita squamosa rubescens						C	Seen from the low tidal to mid-tidal zone
Cumella sp.			[1]	[1]			
cumacean unid.	((1))						
Tanaidacea			[S],((P))	[S]		P,[1]	
Cirolana harfordi			[1]			[2]	
cirolanid unid.		((1))				[9]	Pinkish coloration
Arcturidae	((1))						

TABLE 2

Plants and Animals Recorded from Transect II, Point Loma, February 16–18, 1965 Station and Abundance

Gammaridea	((4))	P,((1))	((2))	[A]		A	
Caprellidea		P	[S]	[S]		P	
Epialtoides hiltoni						[1]	
Lophopanopeus bellus						[P]	
Lophopanopeus lockingtoni	P						
Pachycheles sp.		P					
Pandalus gurneyi			10/m²				Under rocks
Panulirus interruptus			1				In crevice
Pelia clausa						[1]	
Petrolisthes sp.						P	Seen in the mid-tidal zone
Pugettia dalli		P	[1]				
Pugettia producta						[2]	
Pycnogonida			[1]			P	
Mollusca							
Octopus bimaculatus						P	Seen in the mid-tidal zone
Cyanoplax sp.						[3]	
Ischnochiton fallax			[3]				
Ischnochiton mertensii			[1]				
Mopalia ciliata				[1]			
Nuttallina californica						P	
chitons unid.						P	Seen in the mid-tidal zone
Acmaea fenestrata						P	
Acmaea paleacea						[1]	
Acmaea scabra						P	
Acmaea triangularis				[1]			
Acmaea sp.						C	Seen in the mid-tidal zone
Acteocina culcitella	((1))					[4]	
Alabina tenuisculpta							
Alania acutilirata	((1))	((1))					
Amphissa versicolor			[1]			P,[3]	
Anachis penicillata							
Anisodoris nobilis			P				
Aplysia californica				1			
Balcis rutila	C,(C)						Parasite on *Astropecten*
Burchia redondoensis	2,(1)						
Cadlina flavomaculata		[1]					
Cadlina limbaughi		P,(1)	C,(2)				
Cadlina marginata			C,(1)	(1)			
Caecum dalli			[3]				
Calliostoma annulatum		P					
Calliostoma gloriosum	P						
Calliostoma supragranosum				[1]			
Calliostoma tricolor	P						

TABLE 2—Cont'd.

TABLE 2—Continued
Plants and Animals Recorded from Transect II, Point Loma, February 16–18, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
Ceratostoma nuttallii						P	
Cerithiopsis carpenteri				[1]		[1]	
Conus californicus	P		[2]	S,[1]		P,[1]	Juvenile specimens in the intertidal
Crepidula onyx	2						Attached to *Burchia*
Crepipatella lingulata			[4]	[5]		1	
Dendrodoris albopunctata		P,(1)					
Diala acuta						[55]	Tiny specimens
Diaulula sandiegensis		P					
Diodora murina						P	
Epitonium sp.						1	
Fisurella volcano						P,[2]	
Flabellina iodinea	P	P,(1)	P				
Haliotis fulgens					S,(2)	P	
Hermissenda crassicornis				P			
Kelletia kelleti	P	C,(3)	P,(1)	C			
Lacuna unifasciata						C,[12]	Small specimens
Liotia fenestrata			((1))				
Littorina planaxis						P	Seen in the upper tidal zone
Littorina scutulata						P	Seen in the upper tidal zone
Lottia gigantea						P	
Macron lividus						P	
Marginella sp.			[1],((1))			[1]	
Megasurcula remondii	2						
Megathura crenulata		3	P		2	P	
Micranellum crebricinctum	((1))		[2],((1))			[6]	Tiny specimens
Mitra idae				S			
Mitrella gouldii						[117]	
Mitrella tuberosa			[2]				
Mitrella sp.						P	
Nassarius mendicus			[1]				
Norrisia norrisi				[1]	C,(C)		Grazing on *Eisenia* at station D
Odostomia sp.						P	
Olivella baetica	P	((2))					

TABLE 2
Plants and Animals Recorded from Transect II, Point Loma, February 16–18, 1965 Station and Abundance

Seila montereyensis			P				Tiny specimens
Serpulorbis squamigerus			P				
Tegula aureotincta						P	Seen near the mid-tidal zone
Tegula funebralis						P	Seen near the low tidal zone
Tegula ligulata						[2]	
Tegula sp.					(2)		
Tricolia compta			[1]			P,[1]	Tiny specimens
Triopha maculata			P				
Zonaria spadicea				1			
Arcuatula demissa			[3]				Small specimens
Chaccia aviolea			1				
Chama pellucida			[2]				
Cumingia californica						P	
Ervilia californica	((2))						Tiny specimens
Glans carpenteri						[1]	Tiny specimen
Hiatella arctica				[2]		[1]	
Hinnites multirugosus		P	P				
Hormomya adamsiana						P	Small specimen
Kellia laperousi	C		[1]	[1]			
Leptopecten latiaurata			[1]				
Lima hemphilli	P						Embedded in sponge (*Geodia*)
Lithophaga subula				10/¼m², (P)			
Lucinoma sp.			((1))				
Modiolus capax			[1]				
Mytilus californianus						S	Seen near the low tidal zone
Mytilus edulis						P	Seen near the mid-tidal zone
Parapholas californica				[1]			
Penitella penita			[2]				
Ectoprocta							
Cellaria mandibulata						[C]	
Coatazia robertsoniae		P	[P]				
Diaperoecia californica	C	P,(C)	P				
Hippodiplosia insculpta		P					
Phidolopora pacifica	C	P,(S)	P				
Rhynchozoon tumulosum				[P]			Growing on *Crepipatella*
Brachiopoda							
Terebratalia transversa						[2]	Small specimens
Terebratulina unguicula			[2]				
Echinodermata						[17]	
Amphipholis pugetana				[12]			
Amphiura diastata							
Ophionereis annulata			P				Under rocks

TABLE 2—Cont'd.

TABLE 2—Continued
Plants and Animals Recorded from Transect II, Point Loma, February 16–18, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
Ophiopteris papillosa			[6]				
Ophiothrix rudis						[2]	
Ophiothrix spiculata		C	[7]	A,[8]			
Ophiuroida unid.	((2))		((2))				Juvenile specimens
Astrometis sertulifera			P	[1]			
Astropecten verrilli	P,(5)						
Dermasterias imbricata		(1)	P,(1)				
Henricia leviuscula		P,(1)	P,(1),[1]				
Linckia columbiae			P				
Petalaster foliolata	(1)						
Mediaster aequalis	P						
Patiria miniata						1	Seen in the mid-tidal zone
Pisaster giganteus		P	P	C,(2)			
Parastichopus parvimensis	P	C	P				
Thyonepsolus nutriens						[1]	
Lytechinus anamesus	P,(8)	(3)	5/m²,5,[2], ((1))				
Strongylocentrotus franciscanus		P	C	20/m²,(16)			
Strongylocentrotus purpuratus				2/m²,(2)			
Strongylocentrotus sp.				[1]		[1]	Juvenile specimens
Centrechinoidea		((1))					A tiny juvenile specimen
Ascidiacea							
Cystodytes lobatus			C				Large masses present
Eudistoma sp.		P					Small, lobate specimens
Pyura haustor		P					Small specimens
Styela montereyensis		P	S		1		
Tridemnum opacum			(1)				
ascidian unid.		[1]					

TABLE 2
Plants and Animals Recorded from Transect II, Point Loma, February 16–18, 1965 Station and Abundance

VERTEBRATA							
Gymnothorax mordax		1					About 30 inches long
Paralabrax clathratus			10	2			3 to 14 inches long
Paralabrax nebulifer		10	10				14 to 20 inches long
Girella nigricans		1		75			18 inches long at Station B
Embiotoca jacksoni		30	10		6		4 to 12 inches long
Rhacochilus toxotes		1	1				16-inch specimens
Chromis punctipinnis	1000+	300+	50				3 to 9 inches long
Oxyjulis californica		100+	100+		100+		
Pimelometopon pulchrum		40	40				4 to 36 inches long
Coryphopterus nicholsi		100+,(4)	30,(2)	10,(2)			2 to 5 inches long
Scorpaena guttata	5						
Sebastodes atrovirens		15	3				
Sebastodes miniatus	7	50					
Sebastodes serranoides		P	5				
Sebastodes serriceps		1					
Sebastodes vexillaris			1				
Oxylebius pictus			10	1			5 to 7 inches long
Artedius lateralis				6/m²,(2)			2 to 3 inches long
Artedius sp.		C					1½- to 2 inches long
Gobiesox rhessodon				1			1¼-inches long
Cryptotrema corallinum				1			1 inch long
Neoclinus stephensae				35+,(3)			3 to 4 inches long
Rathbunella hypoplecta			15				
Rathbunella sp.		25					

* *Abundance symbols:*
P = Present in the area but relative abundance not estimated.
S = Sparse—widely scattered throughout the area but nowhere numerous.
C = Common—unevenly present throughout the area and only occasionally numerous.
A = Abundant—numerous and evenly distributed throughout the area.
[ ] = Brackets around the abundance symbol indicate occurrence within the quadrat; 0.25 m on a side.
( ) = Parentheses around the abundance symbol indicate occurrence within the arc study area.
(( )) = Double parentheses around the abundance symbol indicate occurrence in the polychaete sample.

TABLE 2—Cont'd.

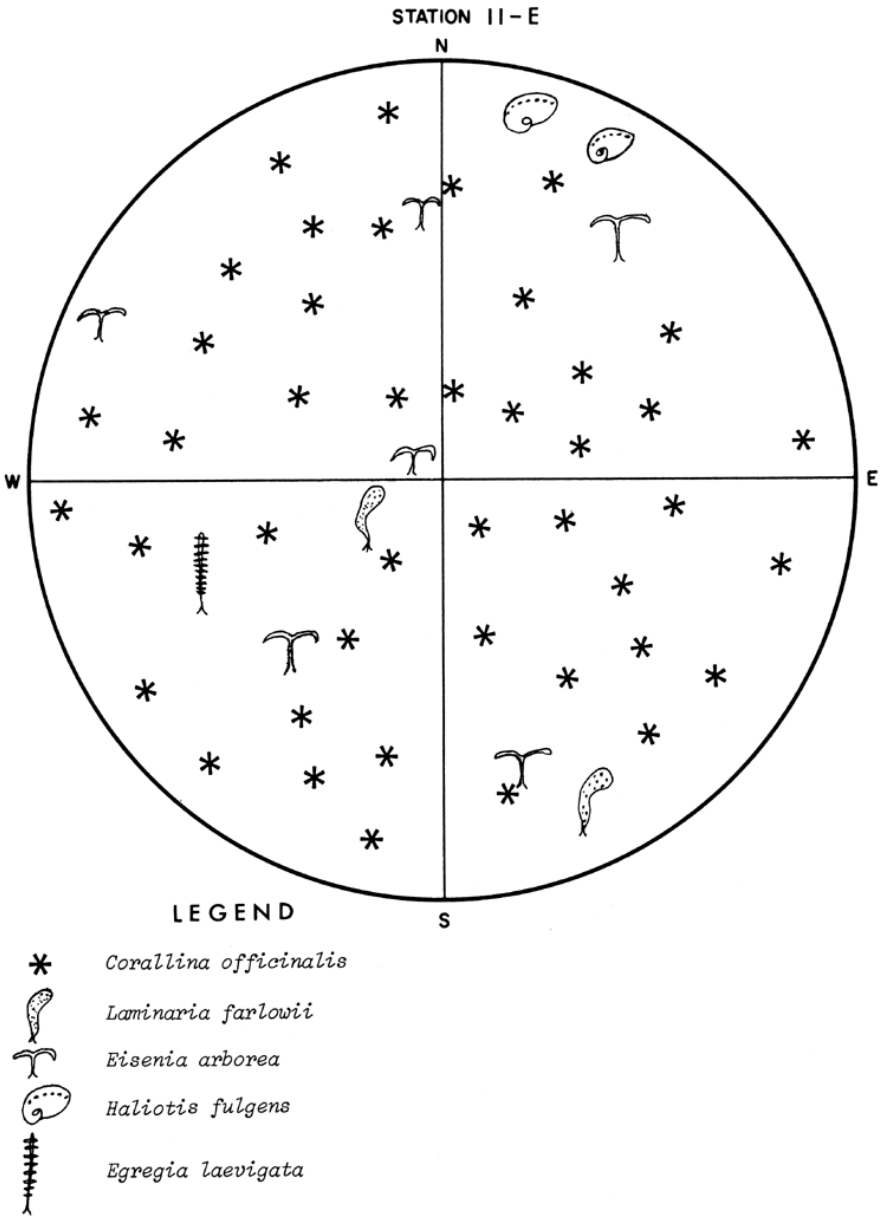

FIGURE 12 A pictorial representation of the arc study area, Station II-E (approximately 15 square meters of bottom area), 20-foot depth, depicting the more obvious biotic features.

FIGURE 12 A pictorial representation of the arc study area, Station II-E (approximately 15 square meters of bottom area), 20-foot depth, depicting the more obvious biotic features

The 60-foot depths (Station II-C) were just seaward of a high relief ridge. Here the bottom was still pavement rock but numerous ledges and boulders were nearby (Figure 15) . Although giving the appearance of harboring an impoverished biota, possibly due to the lack of large floral and faunal growths, 4 algae and 88 animals (including 13

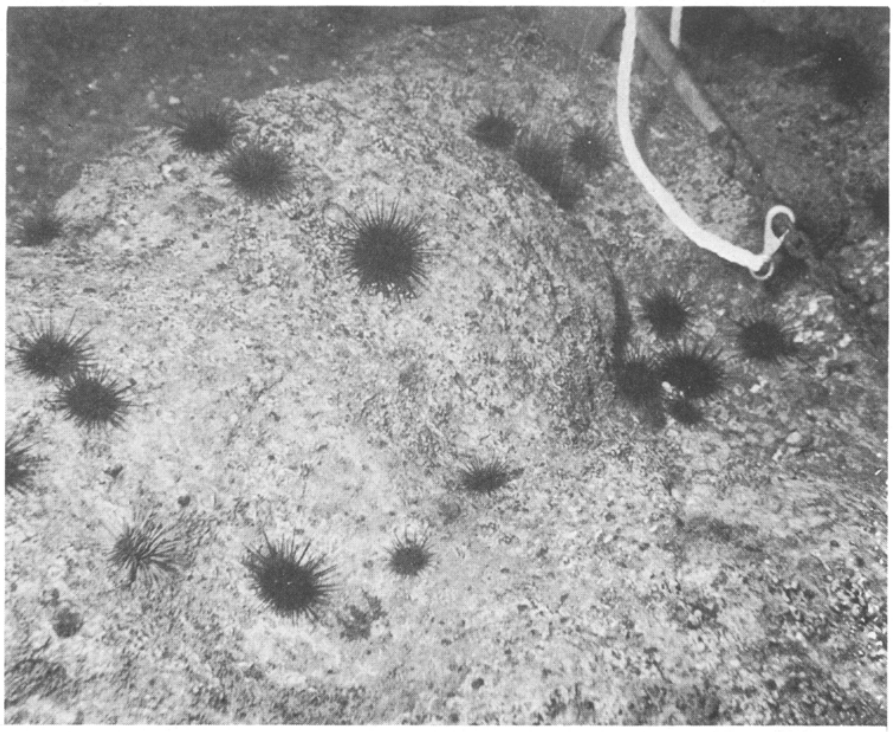

FIGURE 13 The sparse biota and omnipresent sea urchins at Station II-D (40-foot depth). *Photo by Charles H. Turner.*

FIGURE 13 The sparse biota and omnipresent sea urchins at Station II-D (40-foot depth). Photo by Charles H. Turner.

fishes) were recorded, making this one of the more lush areas surveyed during this study (Table 2). Sea urchins were present but not in the concentrations observed at Station II-D. White sea urchins (Lytechinus anamesus) replaced the purple and red sea urchins which were dominant in the shallows (Figure 16) . The ledges and crevices were relatively free from sand and debris, offering an area of concealment for spiny lobsters (Panulirus interruptus) , observed only at this station.

The bottom relief increased in height at the 80-foot depths (Station II-B) and 10- to 15-foot high ledges and pinnacles were encountered. Most of these appeared to be tilted upward at their seaward edge, and all terminated in a sheer face. Algae remained sparse but the animals were numerous and diversified. In all, 4 algae and 61 animals (including 15 fishes) were recorded (Table 2). White sea urchins were present but only in limited numbers. The are study area (Figure 17) typified the general area and its biotic assemblage.

The 100-foot depths (Station II-A) represented the seaward edge of the broad mudstone-siltstone and sandstone shelf lying offshore of Point Loma. At this point (approximately 2,100 yards offshore), the shelf deteriorated into pinnacles and boulders randomly scattered on broad areas of sand. A few hundred feet seaward the bottom became pure sand with ripple marks the only relief. Our Station II-A was on a broad expanse of medium gray sand (uniform throughout the entire 8-inch core) in close proximity to large pinnacles and rocky outcrops (30 to 60 feet west). Only 18 animal species were recorded within the

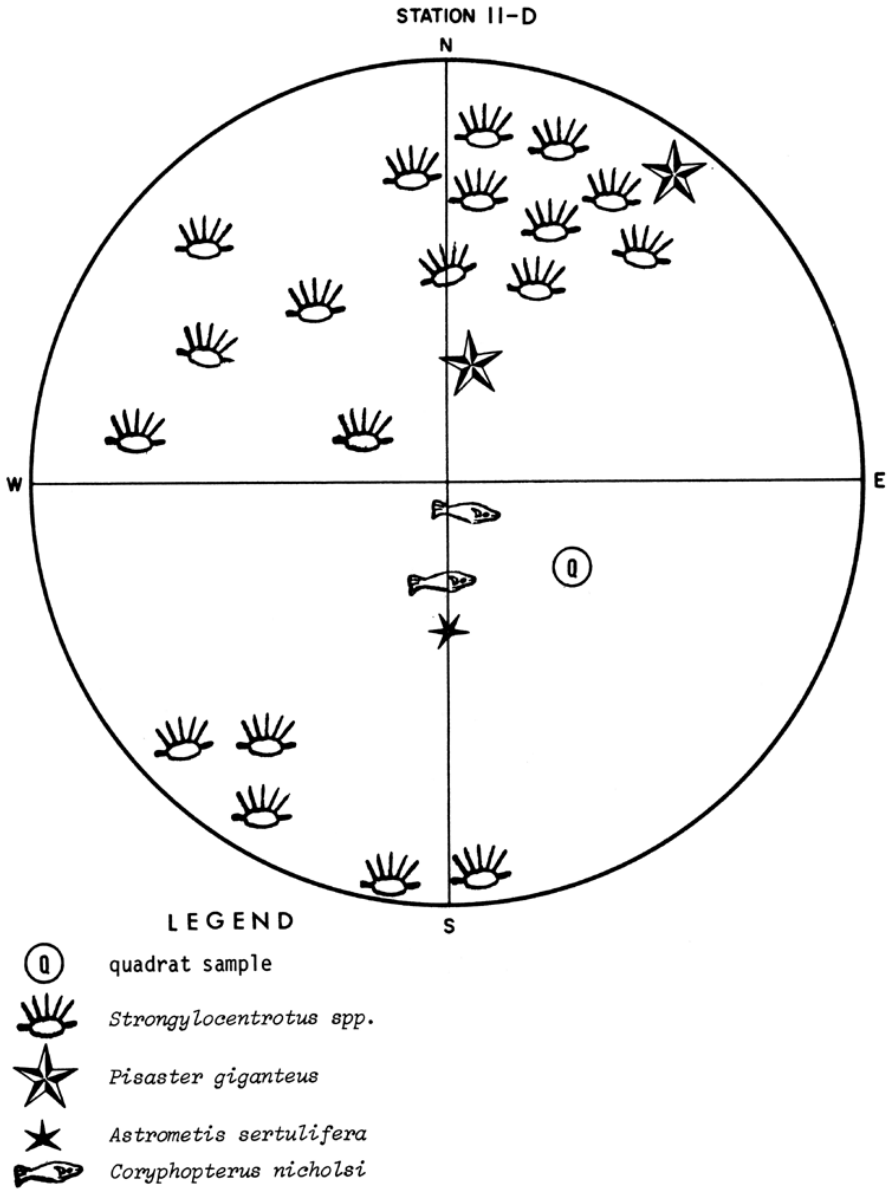

FIGURE 14 A pictorial representation of the arc study area, Station II-D (approximately 15 square meters of bottom area), 40-foot depth, depicting the more obvious biotic features and the sampling locations.

FIGURE 14 A pictorial representation of the arc study area, Station II-D (approximately 15 square meters of bottom area), 40-foot depth, depicting the more obvious biotic features and the sampling locations

arc study area: the others an alga and 34 animals (including 3 fishes) were associated with these nearby rocks (Table 2). The arc study area (Figure 18) illustrates the sand dwellers.

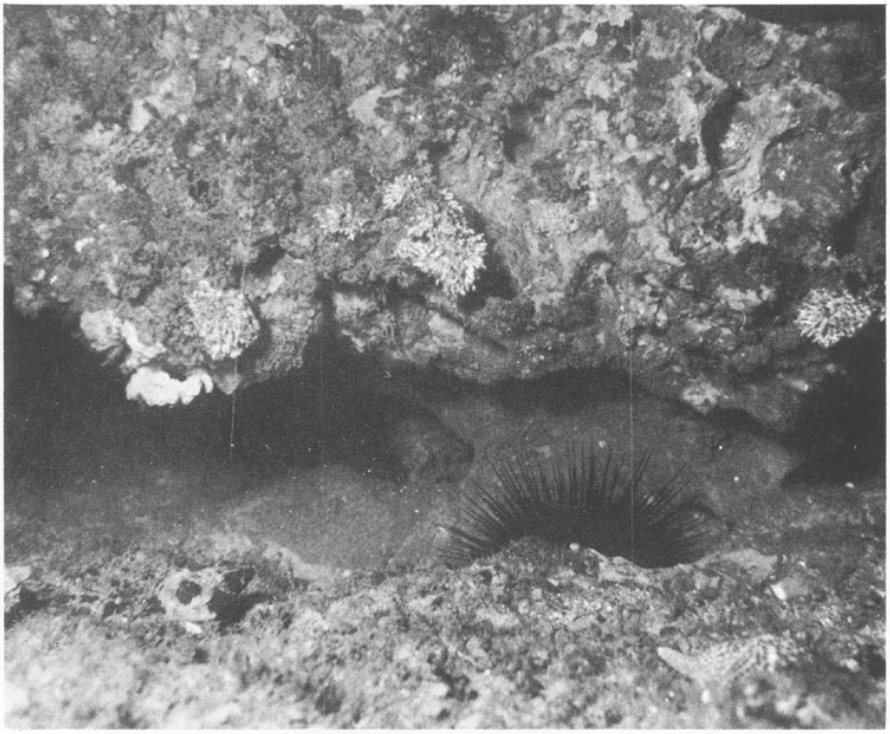

FIGURE 15 A rocky ledge and its epibiose, typical of Station II-C (60-foot depth). *Photo by Charles H. Turner*

FIGURE 15 A rocky ledge and its epibiose, typical of Station II-C (60-foot depth). Photo by Charles H. Turner

4.3. Transect III

Pursuing a course directly seaward (255° magnetic) from the sewage treatment plant outfall base, this transect (Figure 2) terminated in the 100-foot depths approximately 2,850 yards offshore. Its narrow intertidal zone, backed by steep, often overhanging cliffs, consisted of low sandstone shelves, shallow surge channels and a few small tidepools. Low-growing green (Chlorophyta) and red (Rhodophyta) algae were abundant, and surf grass formed a moderate bed in the low tidal zone. Numerous chitons (Amphineura) and limpets (Acmaea spp.) were present in the crevices and depressions and several tiny snails and crustaceans occurred throughout the transect (Table 3).

Seaward, the low reefs and prominent surge channels effected such turbulent surf conditions and reduced visibility that our diving observations and collections were severely curtailed even at the 20-foot depth (Station III-E), approximately 700 yards offshore. Here the low shelves were covered by a thick accumulation of coarse red sand. The only organisms identified came from the polychaete sample.

The bottom in the 40-foot depths (Station III-D) consisted of relatively flat, pavement-like sandstone. The numerous boulders observed appeared out-of-place and may have been rip-rap associated with the nearby outfall pipe.

The substantial bed of adult giant kelp contained numerous juvenile plants. Again, surge and restricted visibilities hampered our general survey, however, an extensive invertebrate fauna was recorded

(Table 3). No fishes were seen and low-growing red algae appeared dominant.

Fathometer traces indicate an irregular bottom between Stations D and C with at least three distinct terraces (Figure 2), each covered

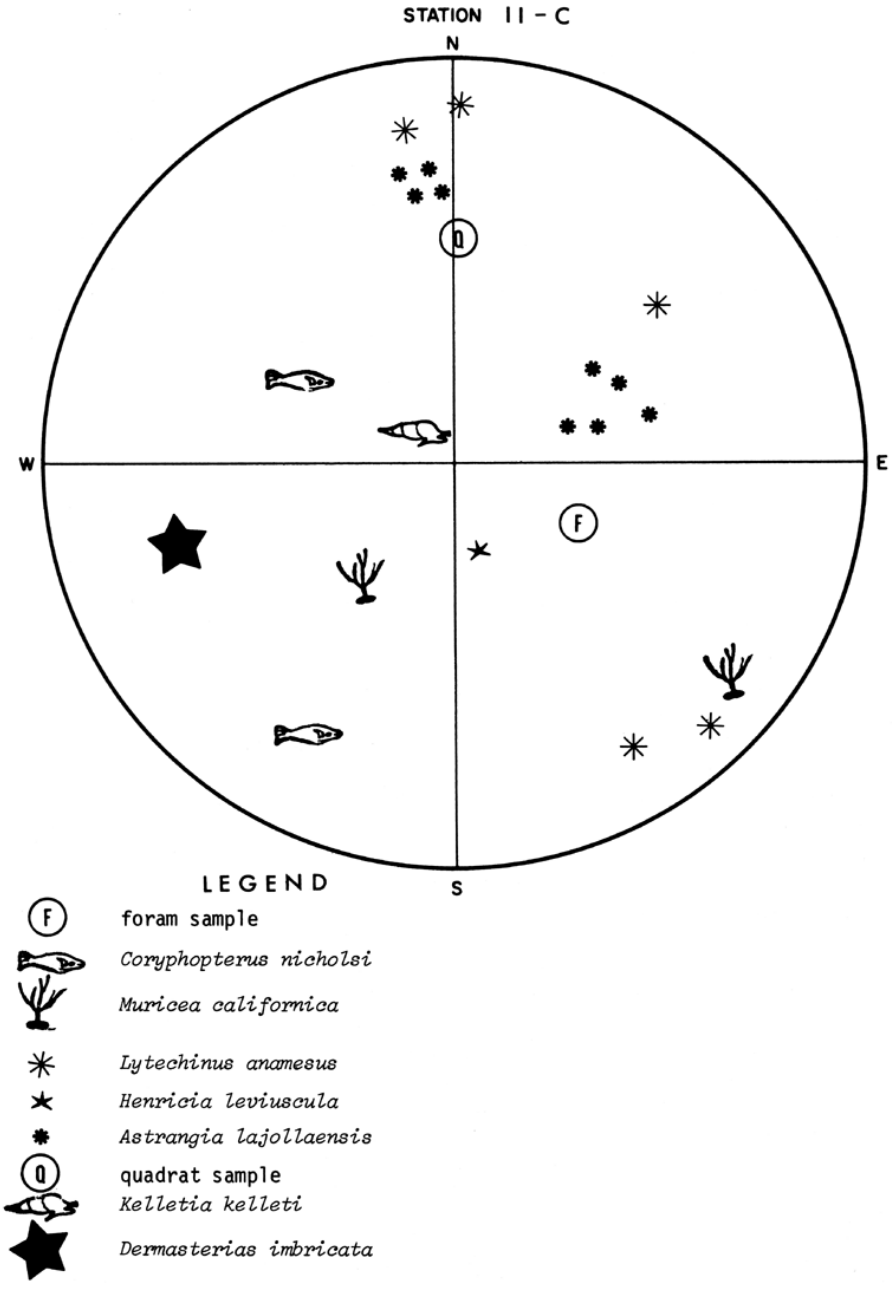

FIGURE 16 A pictorial representation of the arc study area, Station II-C (approximately 15 square meters of bottom area), 60-foot depth, depicting the more obvious biotic features and the sampling locations.

FIGURE 16 A pictorial representation of the arc study area, Station II-C (approximately 15 square meters of bottom area), 60-foot depth, depicting the more obvious biotic features and the sampling locations

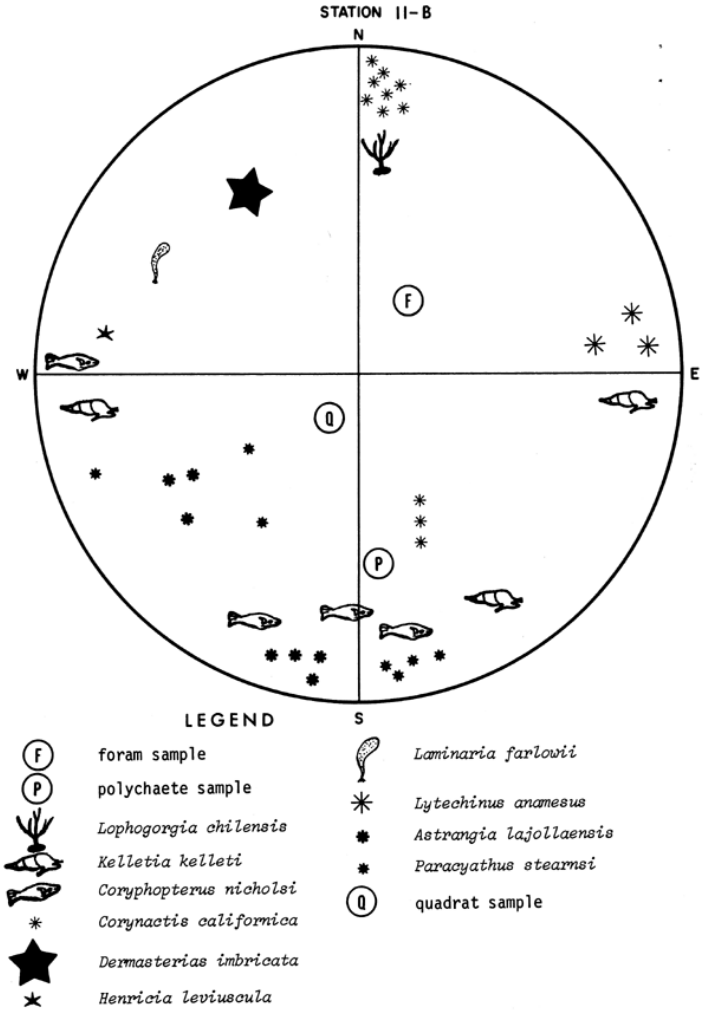

FIGURE 17 A pictorial representation of the arc study area, Station II-B (approximately 15 square meters of bottom area), 80-foot depth, depicting the more obvious biotic features and the sampling locations.

FIGURE 17 A pictorial representation of the arc study area, Station II-B (approximately 15 square meters of bottom area), 80-foot depth, depicting the more obvious biotic features and the sampling locations

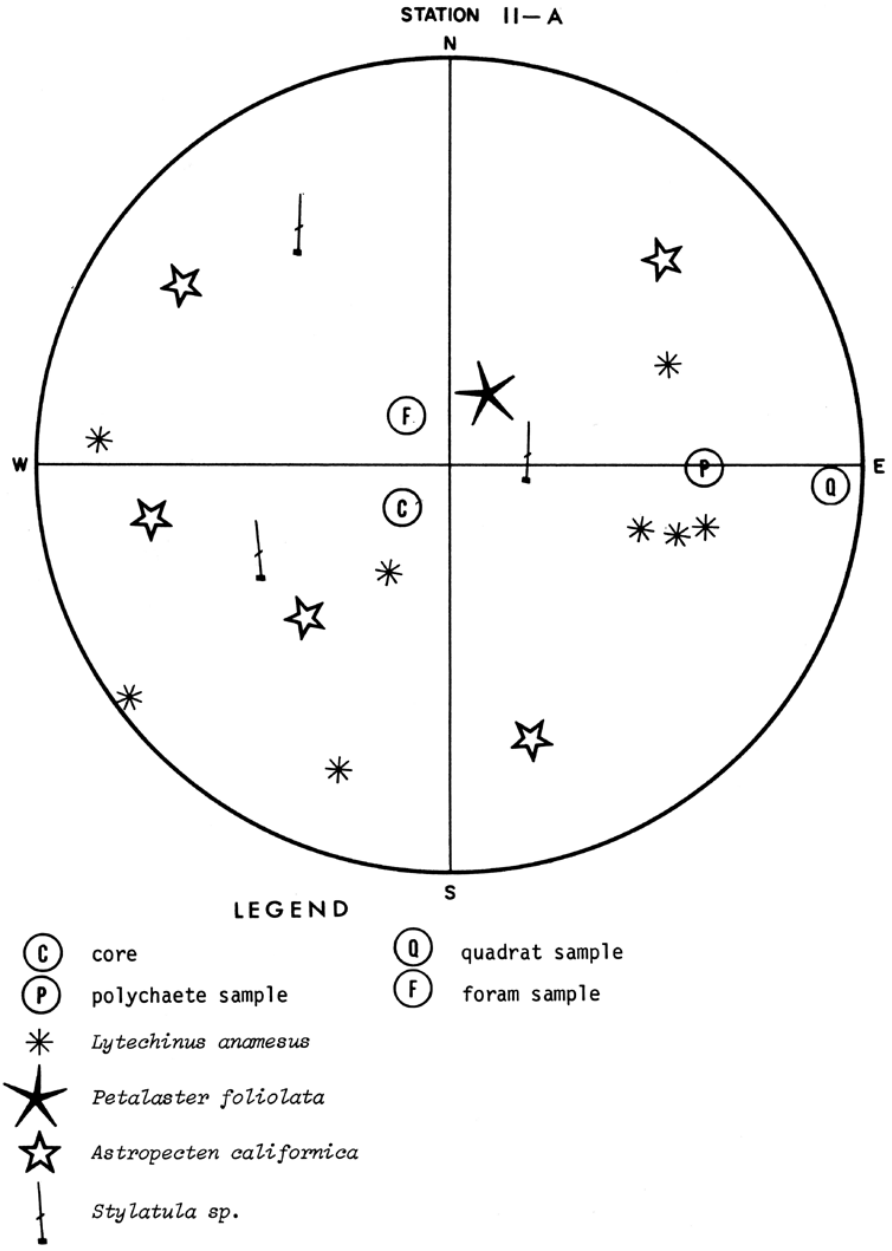

FIGURE 18 A pictorial representation of the arc study area, Station II-A (approximately 15 square meters of bottom area), 100-foot depth, depicting the more obvious biotic features and the sampling locations.

FIGURE 18 A pictorial representation of the arc study area, Station II-A (approximately 15 square meters of bottom area), 100-foot depth, depicting the more obvious biotic features and the sampling locations

with scattered giant kelp plants which combine to form a continual surface canopy.

The 55-foot depths (Station III-C), about 2,450 yards offshore, were characterized by pavement-like sandstone without boulders. An increase in the floral and faunal assemblages was readily apparent when we

TABLE 3
Plants and Animals Recorded from Transect III, Point Loma, February 16, March 8 and 9, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
ALGAE							
Codium setchelli		5					
Enteromorpha sp.						P	Seen near the low tidal zone
Cystoseira osmundacea			3				Small plants
Dictyopteris zonarioides		P				P	
Egregia laevigata						P	Seen at the low tidal zone
Laminaria farlowii	S		C				Small plants at station A
Macrocystis pyrifera		S,(1)	C,(2)	C			Moderate beds at stations C and D
Pelagophycus porra		C,(3)	1/4m²(1)				Extend to within 10 feet of surface; appear healthy
Pterygophora californica			C				
Amplisiphonia pacifica		[P]					
Bossiella orbigniana	S	[C]	S,[P]				Scattered "clumps" at station C
Calliarthron regenerans	S		P				
Callophyllis marginifructa			[2]				Small specimens
Corallina officinalis		C,[1]	S,[S]			[1]	Scattered "clumps" at station C
Gelidium purpurascens						P	Seen near low tidal zone
Gigartina volans						[1]	A small specimen
Gigartina sp.						P	Seen at the low tidal zone
Lithothamnium sp.		[P]		P			Encrusting rocks
Microcladia sp.	A						
Peyssonelia rubra		[P]					
Plocamium pacificum	A						
Pterocladia pyramidale						[1]	
Rhodymenia arborescens	C						
Rhodymenia pacifica			C				
Rhodymenia sp.	P,(C)	A,(S),[5]					
coralline unid.		(P)	(P)	A		P,[P]	
Phyllospadix torreyi						P	A flowering plant

TABLE 3 Plants and Animals Recorded from Transect III, Point Loma, February 16, March 8 and 9, 1965 Station and Abundance

TABLE 3—Continued
Plants and Animals Recorded from Transect III, Point Loma, February 16, March 8 and 9, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
INVERTEBRATA AND ASCIDIACEA							
Protozoa							
Gromia aviformis	((1))	[C]	[C]	[C],((1))		[S]	Attached to coralline algae
Miniacina miniacea		[1]					
Porifera							
Acarnus erithacus	(C)	(C)					
Axinella mexicana	(C)	(P)	(P)				Thin growth form; almost encrusting
Craniella arb	C	P					Large specimens at station A
Cyamon sp.		[1]					A small fragment
Geodia mesotriaena	C,(1)						Large specimens
Halichona tunisimilis	(1)						
Halichona sp.	(C)		(P),[C]				Grayish, amorphous sponge
Hymenamphiastra cyanocrypta		(P),[C]					
Leuconia barbata				P			
Leucosolenia botryoides		[S]					A few small "pieces"
Lissodendoryx noxiosa		[P]					
Plocamia karykina			[1]				A small "patch"
Prianos problematicus		[1]					A small "piece"
Sycon sp.		[S]		P,[C]			Small "clumps"
Tedania topsenti			(P)				
Tethya aurantia	C,(C)	(P),[1]					
Trikentrion flabelliformis	(2)						Large specimens
sponge, encrusting yellow, unid.		[1]					A small "piece"
Cnidaria							
Plumularia setacea		[1]	[C]				Several colonies
Plumularia sp.				P			
Anthopleura xanthogrammica						P	Seen near the low tidal zone
Astrangia lajollaensis	C	P,[1]					
Balanophyllia elegans	C,(S)	(P),[1]	10/¼m²,[3]				
Ceriantiopsis sp.		1					
Corynactis californica	P,S		C,(10/¼m²), [2]				

TABLE 3 Plants and Animals Recorded from Transect III, Point Loma, February 16, March 8 and 9, 1965 Station and Abundance

Eugorgia rubens	S						
Lophogorgia chilensis	C,(2)	10					Specimens to 2 feet high at station A
Paracyathus stearnsi	C,(20/¼m²)	(15/¼m²), [4]					
Stylatula elongata	1						
Tealia coriacea	1						5 inch diameter
zoantharian, white unid.		C,(P)					Long white polyps extending up from basal mass
Platyhelminthes	((1))						
Nemertina							
Micrura nigrirostris			[1]				
Micrura pardalis			[1]				
Nematoda	((5))	[A]		((S))	((P))		
Annelida							
Capitellidae				1,[1]			
Cirriformia sp.			[1]				
cirratulid unid.	P						
Poecilochaetus johnsoni				((2))			
Dorvillea sp.				((1))			
Eunice longicirrata				1,[1]			
Eunice				1,[3]			
eunicid unid.		[2]					
Pherusa inflata				[3]			
Glycera sp.	P						
Ophiodromus pugettensis				((3))			
Ophiodromus sp.	P						
hesionid unid.		[1]					
Lumbrineridae	P	[2]					
Maldanidae				[P]			
Nereidae		[4]	[2]			[7]	
Diopatra ornata			(5¼m²)	P			
onuphid unid.	P						
Opheliidae		[1]					
Cistenides brevicoma				((1))			
Phyllodocidae		[2]	[2]	((2)),[1]	((20))		
Polynoidae		[9]	[8]	[2]			
Phragmatopoma californica			[4]				
Sabellaria cementarium			[1]	[1]			
Sabellaria gracilis				[2]			
Sabellidae			[1]	P			
Dexiospira spirillum		(P),[C]					Growing on coralline algae
Salmacina tribranchiata	(S)	C,(S)	C				Small colonies
Serpula vermicularis		[2]					
serpulid unid.				P			
Spionidae						[1]	

TABLE 3—Cont'd.

TABLE 3—Continued

Plants and Animals Recorded from Transect III, Point Loma, February 16, March 8 and 9, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
Sphaerosyllis sp.				((1))			
syllid unid.		[9]	[1]	[1]			
Sipunculida			[1]				
Arthropoda							
Mysidacea			[1]	((1))			
Bodotria sp.		[1]					
Cumella			[1]				
Tanaidacea		[3]		[5]			
cirolanid unid.			[8]	((2))		[13]	Pinkish coloration
Anthuridae		[5]					
Gammaridea		[C]	[C]	((2))	((2))	[S]	
Caprellidea		[5]	[4]	[S]			
Pandalus gurneyi	S	C	40				Seen beneath rocks
Petrolisthes cinctipes						[2]	
Pugettia dalli		[3]					
pagurid unid.		1					Found in abandoned worm tube
insecta unid.						[2]	Larval stage
Mollusca							
Callistochiton palmulatus				[1]			
Chaetopleura gemma			[1]				
Cyanoplax dentiens				[3]			
Cyanoplax sp.			[2]				Small specimens
Dendrochiton sp.		[4]	[1]	1			Small specimens
Acmaea sp.		[2]	[1]	1		C	Small specimens
Acteon punctocoelata			1				
Aegires albopunctatus		[1]					
Agathotoma densilineata				((1))			
Alvania acutilirata			[7]	((2))			
Amphissa versicolor		[1]					
Aniseodoris nobilis		P					
Astraea gibberosa		2					
Astraea undosa		15					

TABLE 3 Plants and Animals Recorded from Transect III, Point Loma, February 16, March 8 and 9, 1965 Station and Abundance

Barleeia sp.						[2]	
Bulla gouldiana						[1]	
Cadlina limbaughi			P				
Cadlina marginata		[1]					
Caecum dalli	((1))			((1))			
Calliostoma tricolor		[2]					
Conus californicus		[2]	(1),[1]				
Crepidula nummaria			[1]				
Crepipatella lingulata		[8]	[16]	[4]			
Dendrodoris albopunctata		(1),[1]	40,(C)				
Dendronotus frondosus	1						
Diala acuta						[3]	
Dianulula sandiegonis	P						
Epitonium sp.						[2]	
Fissurella volcano						[1]	
Flabellina iodinea	P	C,(S)					
Haliotis rufescens		1					Large specimen
Hermissenda crassicornis	P						
Hipponix tumens				[1]			
Kelletia kelleti		(S)	C				
Lacuna unifasciata						[29]	Abundant
Marginella jewettii			[1]				
Marginella sp.		[2]					
Micranellum crebricinctum	((3))	[7]	[11]	((8))		[2]	
Mitra catalinae		5					
Mitrella gouldii		[2]	[8]			[4]	
Nassarius sp.		[2]					Juvenile specimens
Odostomia donilla			[1]				
Odostomia terricula						[1]	
Olivella biplicata						1	Seen near the low tidal zone
Phidiana pugnax		[1]					
Serpulorbis squamigerus				3			
Tegula funebralis						P	Seen near the low tidal zone
Tricolia compta		[1]	[4]			[1]	
Triopha maculata		1					
Turbonilla chocolata				((1))			
Volvulella cylindrica	((1))						
Zonaria spadicea		C					
Arcuatula demissa		[2]	[6]				Small specimens
Ervilia californica	((1))	[1]	[19]				
Glans carpenteri				((1))			
Hiatella arctica		[3]	[2]			[2]	
Hinnites multirugosus	C	P	5				Small specimens at station B
Kellia laperousi			[2]	1			

TABLE 3—Cont'd.

TABLE 3—Continued

Plants and Animals Recorded from Transect III, Point Loma, February 16, March 8 and 9, 1965

Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
Leptopecten latiaurata		(S),[1]	C,(C),[C]				
Lithophaga subula				1			
Penitella penita				2			
Philobrya setosa		[2]					
Ectoprocta							
Costazia robertsoniae		(C)		P			
Crisia occidentalis		(S),[2]	[1]				A small colony at station C
Crisia sp.		[S]					
Diaperoecia californica	[1]	C,[2]	(C)				Small colonies
Hippodiplosia insculpta	C	(S),[2]	[C]				
Parasmittina sp.				[1]			A small colony
Phidolopora pacifica		(S)	(1)				A small colony at station C
Rhynchozoon tumulosum		[C]	[C]	[C]			Growing on most *Crepipatella* at station C
Tubulipora sp.		[1]	[1]				Small colonies
Brachiopoda							
Terebratalia transversa			P				
Echinodermata							
Amphipholis pugetana		[6]		[3]			
Ophiopteris papillosa		[3]					
Ophiothrix spiculata		[8]	[5]	[1]			
Ophiuroidea unid.	((1))						A juvenile specimen
Astrometis sertulifera						1	Seen near the low tidal zone
Astropecten verrilli	C,(6)						
Dermasterias imbricata		P	1				
Henricia leviuscula	(2)	(1)					
Patiria miniata	(1)	P,(S)					
Parastichopus parvimensis		5,[1]					
Pentamera sp.		[1]					A small specimen
Lytechinus anamesus			[1]				
Strongylocentrotus franciscanus		10		P			
Strongylocentrotus purpuratus		8					

TABLE 3 Plants and Animals Recorded from Transect III, Point Loma, February 16, March 8 and 9, 1965 Station and Abundance

Ascidiacea							
Amaroucium californicum		S					Small colonies
Pyura haustor		[1]					A small specimen
Styela montereyensis	P	(C)	3/¼m²,(C), [2]				
Trididemnum opacum		C		S			Small patches growing on corallines at station D
VERTEBRATA							
Branchiostoma californiense	((2))						A cephalochordate
Citharichthys stigmaeus	P,(6)						
Paralabrax clathratus		20					
Medialuna californiensis			10				
Embiotoca jacksoni	100						5 to 12 inches long
Hypsurus caryi	50	50					5 to 7 inches long
Rhacochilus vacca	15						5 to 10 inches long
Chromis punctipinnis	100	200					1 to 8 inches long
Ozyjulis californica		200					6 to 7 inches long
Pimelometopon pulchrum	40	40					10 to 28 inches long
Coryphopterus nicholsi	25	50					2 to 5 inches long
Sebastodes atrovirens		10					10 to 12 inches long
Sebastodes miniatus	10						6 to 10 inches long
Sebastodes serranoides	3	3					10 to 14 inches long
Sebastodes vexillaris	1						14 inches long
Ozylebius pictus		20					5 to 6 inches long
Artedius corallinus		10	3				2 to 4 inches long
Artedius sp.			20				3 to 5 inches long
cottid unid.						P	Seen near low tide; not collected
Agonopsis sterletus		4					3 to 7 inches long
Rathbunella hypoplecta	30+	20					3 to 6 inches long
Rathbunella sp.		10					3 to 6 inches long
Atherinops affinis	1000+		1000+				6 to 7 inches long

* *Abundance symbols:*
P = Present in the area but relative abundance not estimated.
S = Sparse—widely scattered throughout the area but nowhere numerous.
C = Common—unevenly present throughout the area and only occasionally numerous.
A = Abundant—numerous and evenly distributed throughout the area.
[] = Brackets around the abundance symbol indicate occurrence within the quadrat; 0.25 m on a side.
() = Parentheses around the abundance symbol indicate occurrence within the arc study area.
(()) = Double parentheses around the abundance symbol indicate occurrence in the polychaete sample.

TABLE 3—Cont'd.

compared this station's species list with those of previous stations on this transect. Elk kelp was conspicuous, and other brown and red algae also were present. Sixty invertebrates were identified (Table 3), but only four fish species were observed, possibly due to the lack of protective niches in the pavement-like substrate. The are study area (Figure 19) was typical of our general station findings.

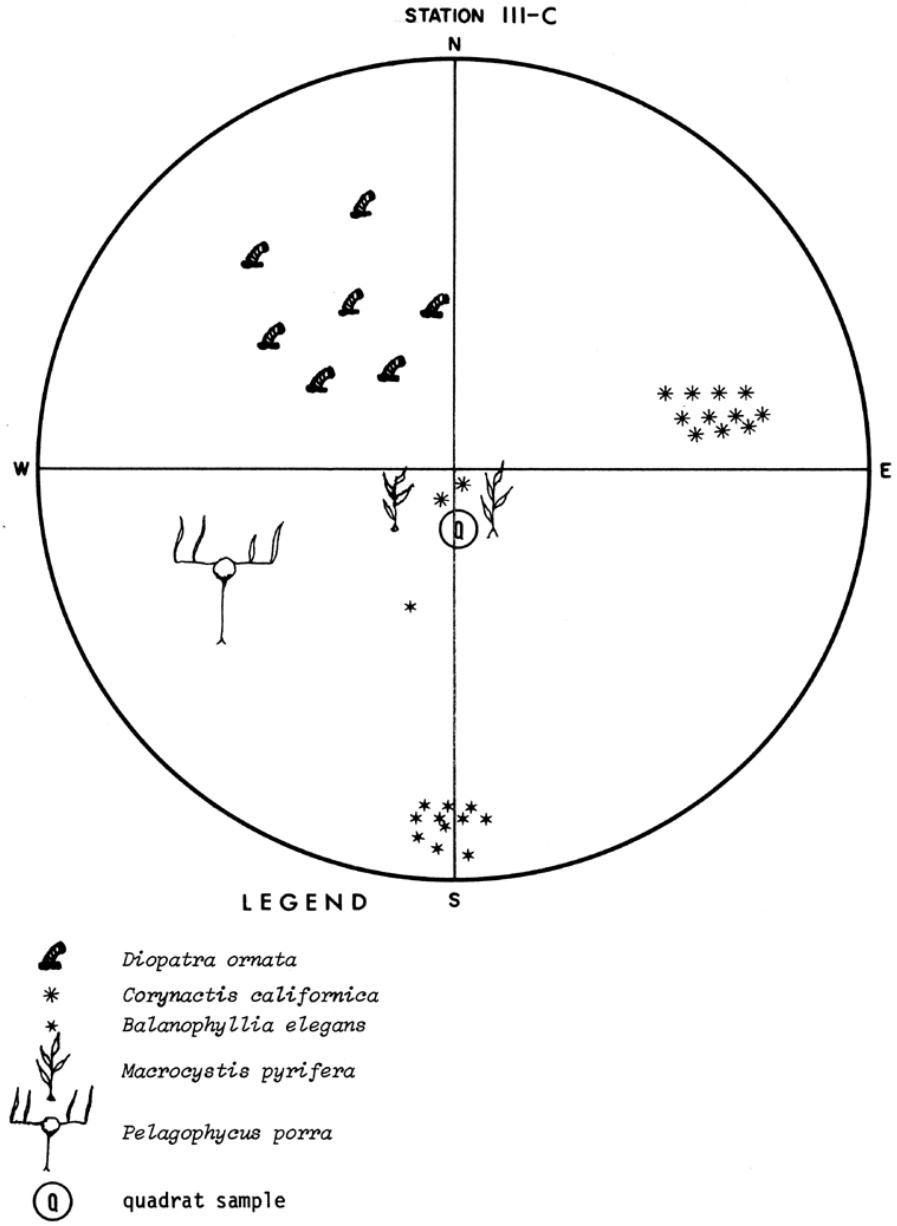

FIGURE 19 **A pictorial representation of the arc study area, Station III-C (approximately 15 square meters of bottom area), 60-foot depth, depicting the more obvious biotic features and the sampling locations.**

FIGURE 19 A pictorial representation of the arc study area, Station III-C (approximately 15 square meters of bottom area), 60-foot depth, depicting the more obvious biotic features and the sampling locations

The 75-foot depths (Station III-B) represented the most diverse community organization along this transect. This station, almost 2,700 yards offshore was on sloping pavement-like sandstone. Within 100 feet of our study are were numerous, large, flat-topped rocky prominences, their sheer and often undercut sides extending 15 to 20 feet above the sea floor. Elk kelp and small red algae, especially Rhodymenia sp. were common, but giant kelp was sparse. Ninety-three invertebrates and ascidians were identified, including numerous sponges, stony corals, the gorgonian Lophogorgia chilensis, 30 different mollusks, and red and purple sea urchins (Table 3). The are study area (Figure 20) was representative of this station.

The fish fauna increased here and of the 13 species recorded (Table 3), blacksmiths (Chromis punctipinnis) and señoritas (Oxyjulis californica) were the most common.

The 100-foot depths (Station III-A) approximate the seaward edge of the Point Loma submerged shelf. Scattered, large, rocky outcroppings were prominent, but interspersed with extensive sandy areas. Here our study are included both sand and rock. Sand stars (Astropecten verrilli) characterized the sandy areas, with low red algae, a large sponge (Geodia mesotriaena) , and gorgonian corals conspicuous on the rock (Figure 21) . Numerous fishes were also encountered (Table 3).

4.4. Transect IV

Our most southerly transect (Transect IV), near the southern tip of Point Loma, pursued a seaward course of 255° magnetic. The bottom, as interpreted from fathometer tracings (Figure 2) sloped moderately into 40-foot depths, then became irregular, but without any substantial depth increase, almost to Station IV-C (60-foot depths). Beyond this, it declined sharply, becoming quite irregular. Large pinnacle-like projections appeared, continued a short distance, then sharply graded onto sand (100-foot depths) about 1,900 yards from shore.

The broad (300-foot) intertidal zone of Transect IV was backed by low, vertical sandstone cliffs. Numerous gullies, tide pools, low shelves, and 3- to 4-foot high rocky outcrops provided innumerable habitats for the diverse plant and animal assemblages observed here. Fifty-one species were recorded, including 24 mollusks (Table 4). Sea mussels (Mytilus californianus) and stalked barnacles (Pollicipes polymerus) formed large dense beds on the upper surfaces of the higher rocky outcrops, while chitons and numerous small crabs predominated on the rock undersides. Near the lower tidal zone and extending seaward into the sub-tidal was a moderate surf-grass bed.

The 20-foot depths (Station IV-E) lie approximately 300 yards offshore. The heavily bored pavement-like sandstone is profuse with cobbles and boulders, and interlaced with numerous, small rifts filled with sand and shelly debris. A 2- to 3-foot high brown alga (Pterygophora californica) was abundant and dominant at this station, but was not represented in the arc study area. Strap kelp (Egregia laevigata) , extending upward to the surface, and low-growing coralline algae were also common (Figure 22) . This station is subjected to moderate or strong surge action, so speciation is restricted to those organisms tolerating these harsh conditions (Table 4). No fish were recorded.

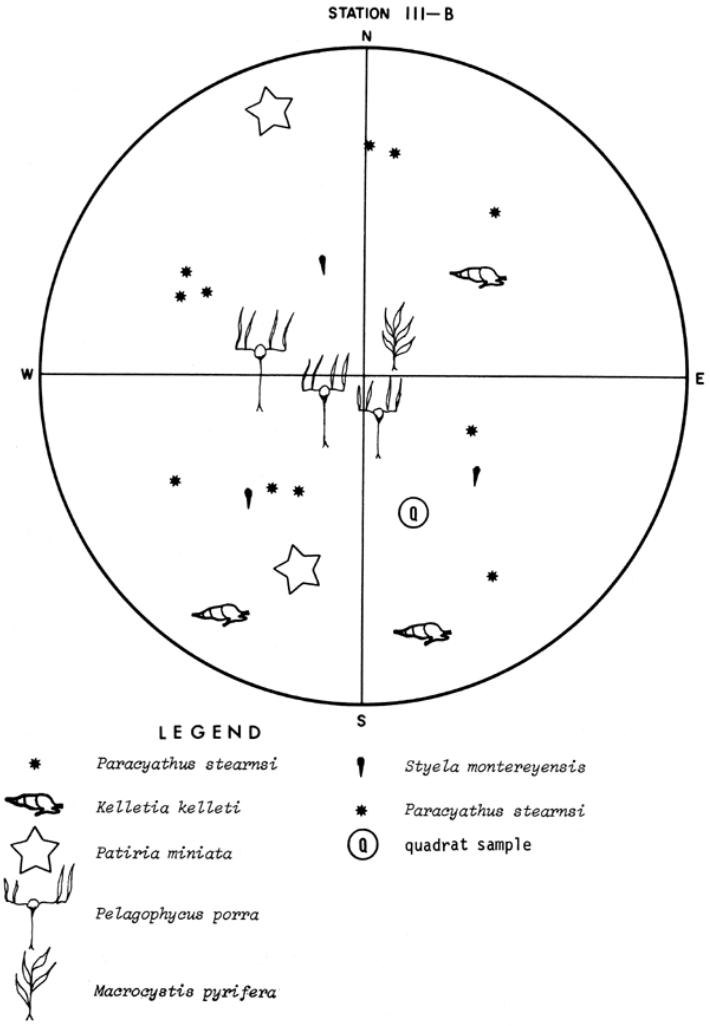

FIGURE 20 A pictorial representation of the arc study area, Station III-B (approximately 15 square meters of bottom area), 80-foot depth, depicting the more obvious biotic features and the sampling locations.

FIGURE 20 A pictorial representation of the arc study area, Station III-B (approximately 15 square meters of bottom area), 80-foot depth, depicting the more obvious biotic features and the sampling locations

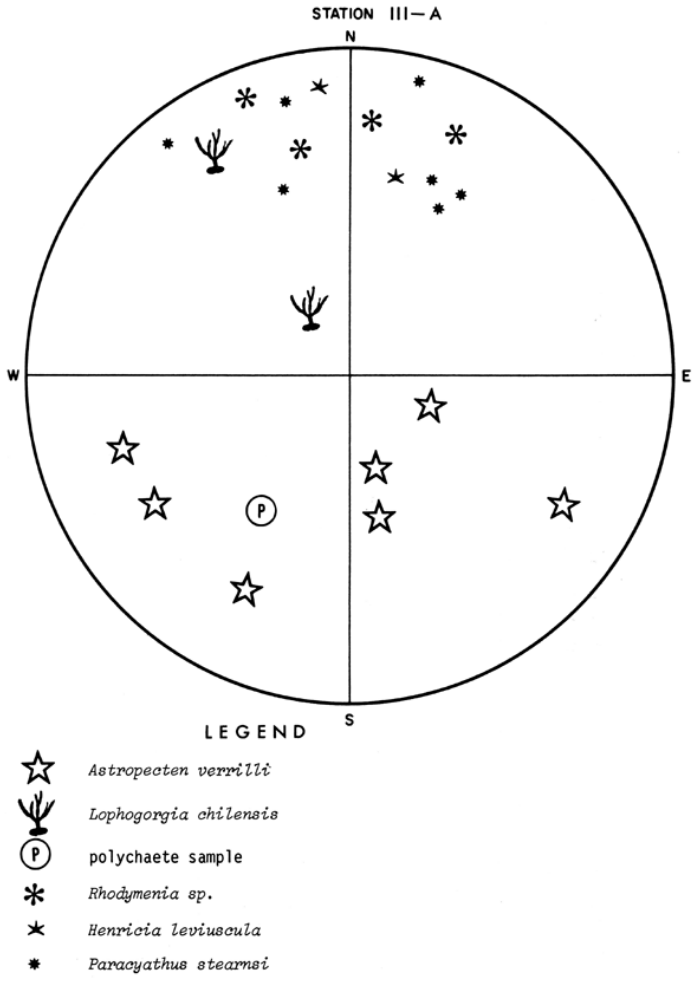

FIGURE 21 A pictorial representation of the arc study area, Station III-A (approximately 30 square meters of bottom area), 100-foot depth, depicting the more obvious biotic features and the sampling locations.

FIGURE 21 A pictorial representation of the arc study area, Station III-A (approximately 30 square meters of bottom area), 100-foot depth, depicting the more obvious biotic features and the sampling locations

TABLE 4
Plants and Animals Recorded from Transect IV, Point Loma, February 16, March 10 and 11, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
ALGAE							
Enteromorpha sp.						P	Seen throughout the intertidal zone
Colpomenia sinuosa						P	Seen throughout the intertidal zone
Cystoseira osmundacea					(P),[3]		6 to 12 inches high
Dictyota flabellata						P	Seen at the low tidal zone
Egregia laevigata				5	C,(1)	P	
Macrocystis pyrifera			P	4/m²			
Pelagophycus porra		1/3m²	2/m²	2/m²			Both juvenile and adult plants present
Pelvetia fastigiata						P	Seen in the mid-tidal zone
Pterygophora californica				A,(P),[2]	A		
Bossiella orbigniana			[C]	S,[S]	[C]		
Botryocladia sp.		C,[1]					
Calliarthron regenerans				A			
Corallina officinalis	S	C	C	C	A,[P]	P	
Gelidium nudifrons						P	Seen at the low tidal zone
Gelidium purpurascens					[1]		A large "clump"
Gelidium sp.						P to S	From the low to mid-tidal zone
Lithophyllum imitans				[S]			Encrusting a rock
Lithothamnium sp.					(C)		
Plocamium pacificum						P	Seen near the low tidal zone
Rhodymenia pacifica	C,[1]						
Rhodymenia palmettiformis			[1]				A small colony
Rhodymenia sp.		C,(P)	(P)				Small plants
coralline unid.	(S)	(C)	(P)		(C)	P	
Rhodophyta unid.		[P]		(C)		S	
Phyllospadix torreyi						C to S	A flowering plant

TABLE 4 Plants and Animals Recorded from Transect IV, Point Loma, February 16, March 10 and 11, 1965 Station and Abundance

INVERTEBRATA AND ASCIDIACEA							
Protozoa							
Folliculina sp.				[C]			Attached to coralline algae
Gromia oviformis			[C]	[C],((P))	[S]		
Porifera							
Acarnus erithacus	P	[1]					
Axinella mexicana	P			P			
Craniella arb	(S)						
Cyamon sp.				P			
Haliclona sp.				[1]			
Hymenamphiastra cyanocrypta	(1)	(1)		P			
microcionid unid.		[1]					
Stelletta estrella				P			
Sycon sp.	(S),[1]	[S]	[1]	P			
Tetilla arb	(S)						
Trikentrion flabelliformis	(2)						Two "leaves"
sponge, encrusting unid.				(C)			
sponge, encrusting yellow unid.	(P)						
Cnidaria							
Aglaophenia lophocarpa		[P]					
Aglaophenia sp.		(P)					
Eudendrium sp.		[1]					A small colony
Plumularia setacea		[C]					
Plumularia sp.		(P)		P			
Anthopleura elegantissima						P,[6]	Seen from the mid-tidal to high tidal zone
Anthopleura xanthogrammica				P		P	
Astrangia lajollaensis		[1]		P			
Balanophyllia elegans			(A)				
Corynactis californica	(S),[S]	(S)	(C),[9]				
Epiactis prolifera					[2]		
Eugorgia rubens	S,(2)						
Lophogorgia chilensis	C,(2)	S					To 2 feet high
Pachycerianthus sp.			3				
Paracyathus stearnsi	(25/¼m²),[14]	(C),[4]	(6/¼m²)				
cerianthid unid.			(P)	1			
Platyhelminthes			[2],((2))	((P))			
Nemertina	((1))	[1],((1))	((2))	[1]			
Nematoda	[C]	((P))	((C))				
Annelida							
Ampharetidae		[1]					
Capitellidae			[2]				
Phyllochaetopterus prolifica		[3]		[1]			

TABLE 4—Cont'd.

TABLE 4—Continued

Plants and Animals Recorded from Transect IV, Point Loma, February 16, March 10 and 11, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
Cirratulidae	((1))		[1]				
Poecilochaetus johnsoni	((1))		((1))				
Pherusa inflata		[1]	[1]				
Glycera sp.	((1))						
Ophiodromus pugettensis	((1))			((6))			
hesionid unid.		[1]					
Lumbrineridae			[2]				
Nereidae		[1]					
Diopatra ornata		(S)	(P)	(6)			
onuphid unid.		P					
Phyllodocidae			((1))				
Polynoidae	((1))	[6]	[4]	((2))			
Sabellaria cementarium			[2]				
Chone sp.				((1))			
sabellid unid.	((1))	[2]	[3]				
Salmacina tribranchiata	S						
Serpula vermicularis			[1]			C	Seen in the mid-tidal zone
serpulid unid.					(P)		
Prionospio sp.				((1))			
Spiophanes bombyx	((1))						
Syllidae	[2]	[3]	[5]				
Polychaeta unid.	[1]						
Sipunculida							
Dendrostomum pyroides			[1]				
Golfingia sp.						1	In rock, near the low tidal zone
sipunculid unid.		[2]					
Arthropoda							
Ostracoda	[1]	((S))	((1))	((1))			
Balanus concavus pacificus			(P)				
Balanus glandula						P	Seen near the upper tidal zone
Chthamalus fissus						P	Seen from the mid-tidal to high tidal zone

TABLE 4 Plants and Animals Recorded from Transect IV, Point Loma, February 16, March 10 and 11, 1965 Station and Abundance

Pollicipes polymerus						P	Seen near the mid-tidal zone
Tetraclita squamosa rubescens						P	Seen from the mid-tidal to high tidal zone
Cumacea		[1]					
Tanaidacea		[C]	[C]	[S],((S))			
cirolanid unid.		((1))	[4],((1))		[7]		Pinkish coloration; associated with coralline algae
Arcturidae		[1]					
Idothea rufescens			[1]				
Isopoda unid.				((1))			
Gammaridea	[S]		[S],((1))	[S],((A))	[S]		
Caprellidea		[C]	[C]		[2]		
Pachygrapsus crassipes						C	Seen from the mid-tidal to high tidal zone
Pagurus samuelis						P to A	Seen throughout the intertidal zone; many in *Olivella* shells
Pandalus gurneyi		C	C				
Petrolisthes cinctipes						P,[C]	Seen near the mid-tidal zone
Pugettia dalli			[1]				
Pugettia sp.		[1]					Juvenile specimen
Mollusca							
Octopus bimaculatus				P			
Callistochiton palmulatus		[1]					
Chaetopleura gemma	[P]	[1]					
Cyanoplax sp.						P	
Dendrochiton sp.				[8]			
Ischnochiton mertensii				[2]			
Ischnochiton radians				[1]			
Ischnochiton sp.		[6]					
Mopalia muscosa						P	
Stenoplax conspicuus						P	
Amphineura unid.						P	
Acanthina spirata						P	Seen at the mid-tidal zone
Acmaea asmi						P	
Acmaea scabra						P	
Acmaea sp.				P		P	
Amphissa versicolor						P	Seen near the mid-tidal zone
Alvania acutilirata		[3]					
Anisodoris nobilis	P						
Aplysia californica				P,(15),[1]		3	
Astraea gibberosa			1	P			
Barleeia sp.				P			
Cadlina limbaughi	(P)		1	P			
Cadlina marginata	(P)						

TABLE 4—Cont'd.

TABLE 4—Continued
Plants and Animals Recorded from Transect IV, Point Loma, February 16, March 10 and 11, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
Ceratostoma nuttallii						P	
Conus californicus		(P)		5			
Crepidula onyx				P			
Crepipatella lingulata		[14]	[1]	[2]			
Dendrodoris albopunctata	P	(1)		P			
Diala acuta			[1]				
Diaulula sandiegensis				P			
Diodora murina			2				
Fissurella volcano				C		P	
Flabellina iodinea	(P)	P,(1)					
Haliotis fulgens				1			
Haliotis rufescens		2,(1)	1				Large specimens
Hopkinsia rosacea						2	Seen near the low tidal zone
Kelletia kelleti			(P)	100+,(P),[1]			
Littorina planaxis						P	
Marginella californica						1	
Micranellum crebricinctum		[4],((7))	((15))	[1],((5))	((1))		
Mitra catalinae				20			
Mitra idae				S			
Mitrella gouldii			[1]	P,[1]	[1]	1	
Odostomia terricula				[1]			
Olivella baetica			((1))				
Pterynotus trialatus				1			
Serpulorbis squamigerus				P		P	
Solariella varicosa				[2]			
Tegula aureotincta						P	Seen near the mid-tidal zone
Tegula funebralis				[1]		P	
Tegula sp.						P	
Tricolia compta			[2]	P,[2]	[11]		
Tritonia festiva	P						
Zonaria spadicea				S			
Arcuatula demissa		[2]					
Chama pellucida					C,(P)	P,[1]	

TABLE 4 Plants and Animals Recorded from Transect IV, Point Loma, February 16, March 10 and 11, 1965 Station and Abundance

Chlamydoconcha orcutti		1	1				
Diplodonta orbella						P	
Ervilia californica	[P]	[8]					
Hiatella multirugosus		S		1			
Kellia laperousi				[1]			
Leptopecten latiaurata		[2]	(P),[3]				
Lithophaga nubula				C			
Mytilus californianus						P	Seen from the mid-tidal to upper tidal zone
Mytilus edulis						P	Seen near the upper tidal zone
Parapholas californica				P			
Penitella penita				C			
Etoprocta							
Cellaria mandibulata	(P)						
Crisia occidentalis	(P)						
Crisia sp.		(P)					
Diaperoecia californica	(S),[2]						Small colonies
Lyrula hippocrepis		[1]					A small colony
Membranipora tuberculata					[P]		Growing on *Cystoseira*
Phidolopora pacifica	S,(S),[1]						
Rhynchozoon tumulosum				[P]			Growing on *Crepipatella*
Cheilostomata unid.		[1]					A small colony
Brachiopoda							
Terebratalia transversa			3,[C]				
Terebratulina unguicula	[1]		3				
Echinodermata							
Amphipholis pugetana		[45]	[9]				
Ophiopteris papillosa		[6]	[1]				
Ophiothrix spiculata		(P),[5]	[3]				
Ophiuroidea unid.	((1))	((1))		[2]			Tiny specimens
Astrometis sertulifera			2				
Dermasterias imbricata	P	C	3	P			
Henricia leviuscula	P	P					
Patiria miniata	P	C,(5)	20,(4)	P		1	
Pisaster giganteus			3	3			
Pycnopodia helianthoides			(1)				
Solaster dawsoni		1					
Cucumaria sp.	P						
Pentamera sp.		[1]	[1]	[1]			
psolid unid.		[2]					
Dendraster excentricus		((1))					A juvenile specimen
Lytechinus anamesus		[3]					Juvenile specimens
Strongylocentrotus franciscanus		20		C,(8)			
Strongylocentrotus purpuratus			10	C,(2)		1	
centrechinoid unid.		((1))					A juvenile specimen

TABLE 4—Cont'd.

TABLE 4—Continued

Plants and Animals Recorded from Transect IV, Point Loma, February 16, March 10 and 11, 1965

Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
Ascidiacea							
Tridemnum opacum	(S)			C,[1]	(P)		
ascidian unid.	[1]					P	
VERTEBRATA							
Myliobatis californicus			1				36 inches long
Paralabrax clathratus	20	30	(S)				10 to 20 inches long
Paralabrax nebulifer	1						18 inches long
Embiotoca jacksoni	75						4 to 10 inches long
Chromis punctipinnis	300	200	300+,(25)				5 to 10 inches long
Pimelometopon pulchrum	30	50	14,(8)				12 to 36 inches long
Oxyjulis californica	70	100		75			6 to 9 inches long
Coryphopterus nicholsi	50,[1]	A,(1)	C,(C)				2 to 5 inches long
Sebastodes dalli	15						5 to 7 inches long
Sebastodes miniatus	25						8 to 12 inches long
Sebastodes serranoides	20	15					10 to 18 inches long
Oxylebius pictus	15	15					6 to 7 inches long
Clinocottus analis						P	
Neoclinus uninotatus			1				9 inches long
Rathbunella hypoplecta		10	1				6 to 7 inches long
Rathbunella sp.	1						

* *Abundance symbols:*
P = Present in the area but relative abundance not estimated.
S = Sparse—widely scattered throughout the area but nowhere numerous.
C = Common—unevenly present throughout the area and only occasionally numerous.
A = Abundant—numerous and evenly distributed throughout the area.
[ ] = Brackets around the abundance symbol indicate occurrence within the quadrat; 0.25 m on a side.
( ) = Parentheses around the abundance symbol indicate occurrence within the arc study area.
(( )) = Double parentheses around the abundance symbol indicate occurrence in the polychaete sample.

TABLE 4 Plants and Animals Recorded from Transect IV, Point Loma, February 16, March 10 and 11, 1965 Station and Abundance

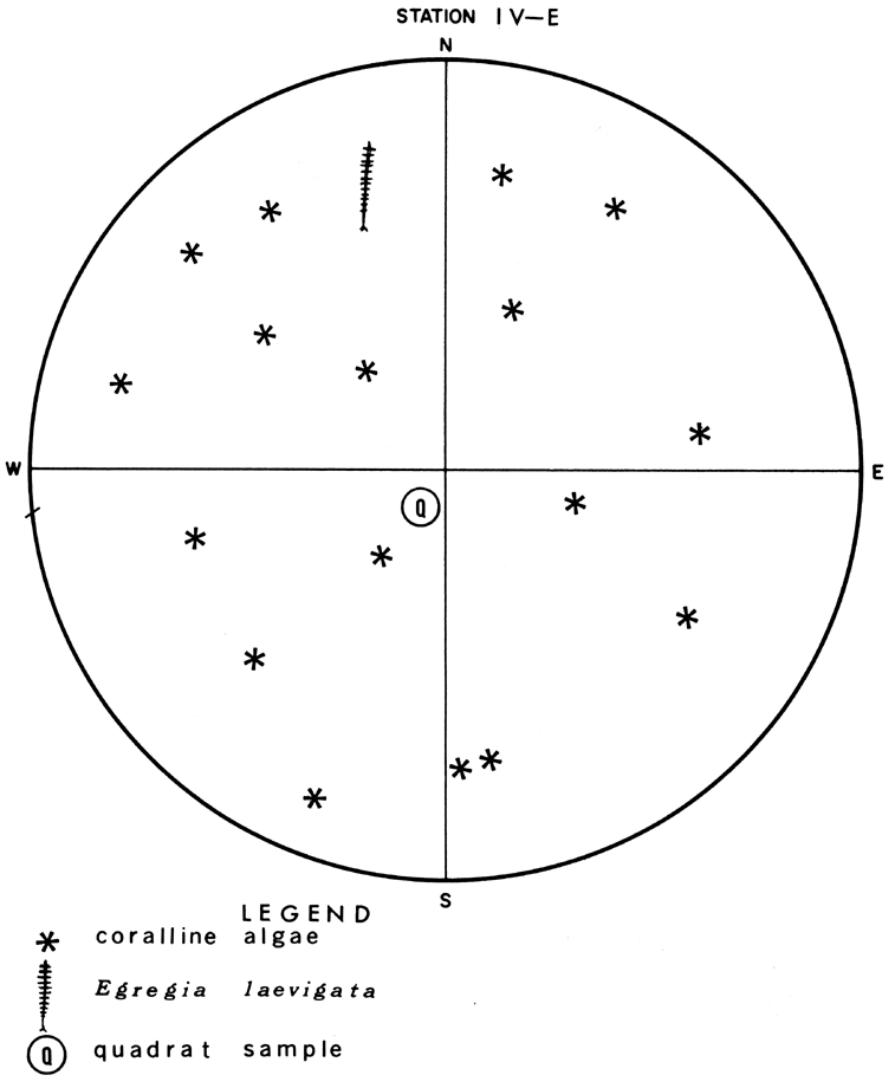

FIGURE 22 A pictorial representation of the arc study area, Station IV-E (approximately 15 square meters of bottom area), 20-foot depth, depicting the more obvious biotic features and the sampling locations.

FIGURE 22 A pictorial representation of the arc study area, Station IV-E (approximately 15 square meters of bottom area), 20-foot depth, depicting the more obvious biotic features and the sampling locations

Forty-foot depths (Station IV-D) were reached about 500 yards offshore. Here the bottom was characterized by low mudstone shelves, 8 to 10 inches high, topped with numerous cobbles and medium-sized boulders. A dense bed of giant kelp formed an extensive canopy, shading the lower growing algae. Pterygophora remained abundant but strap kelp was quite sparse, approaching its bathymetric limit. Significant increases in the invertebrate populations were readily apparent (Table 4). Red and purple sea urchins, inveterate kelp grazers, were common, but confined themselves to crevices and beneath the

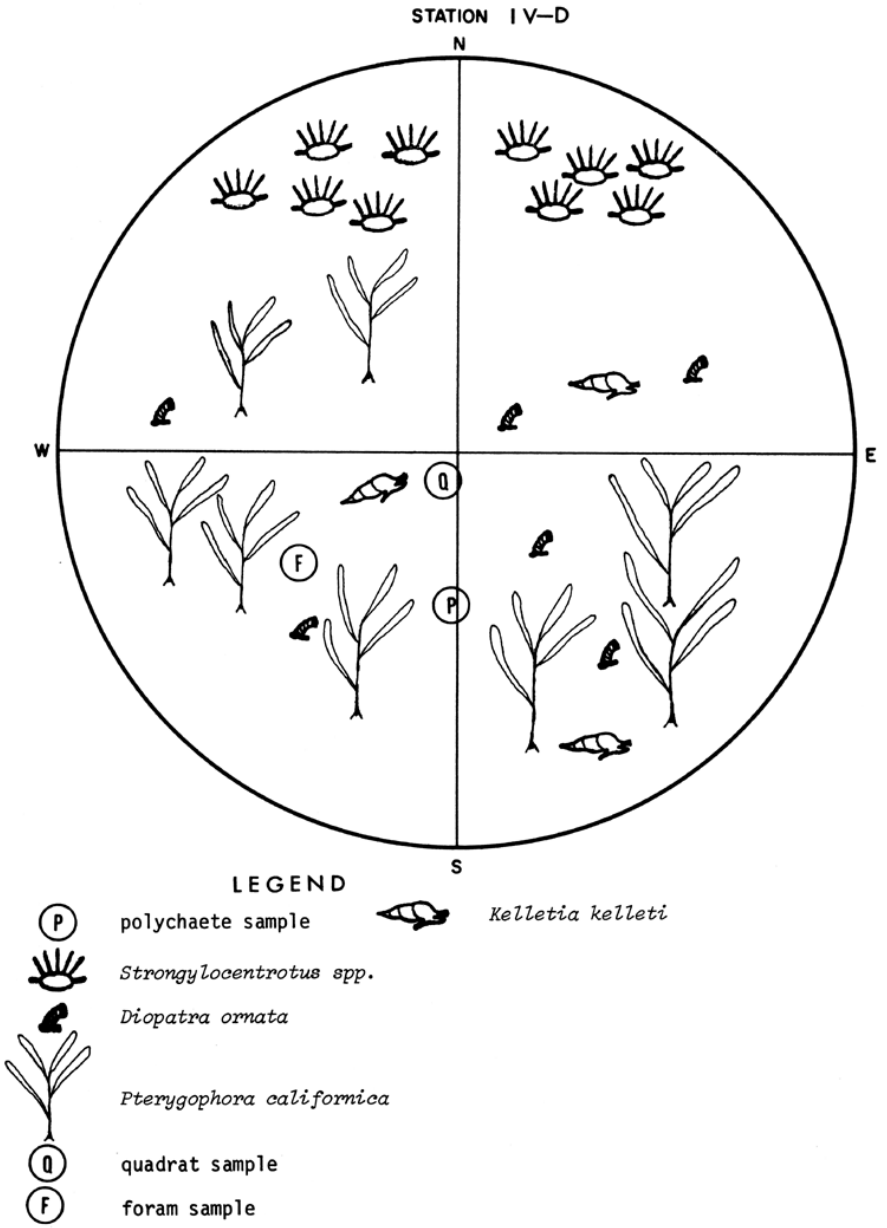

FIGURE 23 A pictorial representation of the arc study area, Station IV-D approximately 15 square meters of bottom area), 40-foot depth, depicting the more obvious biotic features and the sampling locations.

FIGURE 23 A pictorial representation of the arc study area, Station IV-D approximately 15 square meters of bottom area), 40-foot depth, depicting the more obvious biotic features and the sampling locations

ledges. of the abundant mollusks, the whelk Kelletia kelleti was dominant. Fishes were lacking; only señoritas were recorded. The are study area diagram (Figure 23) is especially representative of this station's general biota.

In the 60-foot depths (Station IV-C), about 1,500 yards offshore, low shelves, exposed large boulders, and numerous, shallow, sand-filled rifts characterize the bottom. Giant kelp and elk kelp produce an extensive canopy. Solitary stony corals were common on the rocks, with the tube worm Diopatra ornata prevalent in the numerous sand-filled areas. Sea stars, particularly the bat star Patiria miniata, were well-represented. Kelp was absent from the arc study area (Figure 24) . An increase in the fish fauna was readily apparent (Table 4).

The 80-foot depths (Station IV-B) were also characterized by pavement-like substrate, criss-crossed with narrow, sand-filled rifts and scattered cobbles and medium-sized boulders. Proximal to the quantitative study area were low (8 to 10 inches high) ledges, and 70 feet away, 2- to 3-foot high rocky outcrops were distinctive.

Elk kelp, extending to within 20 feet of the surface, dominated the macroscopic biota but again was absent from the quantitative are study area (Figure 25) . Low-growing red algae comprised the remainder of the algal community. Stony corals and sea stars were common, and 20 red sea urchins were recorded in the general station area. The gorgonian Lophogorgia chilensis, a normal inhabitant of these depths, was also observed. Numerous polychaete worms, crustaceans, and mollusks, not seen in the general survey, were recorded in our quadrat sample (Table 4).

of the eight fish species recorded at this station, California sheep-head (Pimelometopon pulchrum) , attaining estimated lengths of 36 inches, were the most obvious. Bluespot gobies (Coryphopterus nicholsi) were more abundant, but due to their cryptic habits and small size, were less apparent.

The shelf edge, reached at the 100-foot depths (Station IV-A), was pavement-like sandstone, with large boulders, low shelves, and pockets of sand and shelly debris (Figure 26) . No large kelps or algae occurred, although low-growing red algae were common (Table 4). Solitary stony corals (Paracyathus stearnsi) were especially abundant, with two species of gorgonians particularly obvious (Figure 27) . Again, a variety of sea stars was observed. Twelve species of fishes were recorded, including three rockfish, all common to these depths along the rocky southern California coastline.

4.5. Extralimital Sampling

Three offshore stations (designated G-1, G-2, and G-3 on Figure 1) were occupied in addition to the transect diving stations. One sample was collected at each (with a small Hayward orange-peel grab) to note the presence or absence of sludge. No sludge was observed in these samples, but hydrogen sulfide (H_2S) odors were common to two (G-1 and G-2). Concurrent and subsequent corings taken by the San Diego Regional Water Quality Control Board staff revealed varying depth layers of sludge (Leonard Burtman, pers. comm.).

Station G-1 was contiguous with Transect III in 220-foot depths. Its sample consisted of 3 to 4 quarts of soft, silty mud with a slight H_2S odor. Many dead gastropod and scaphopod shells were noted.

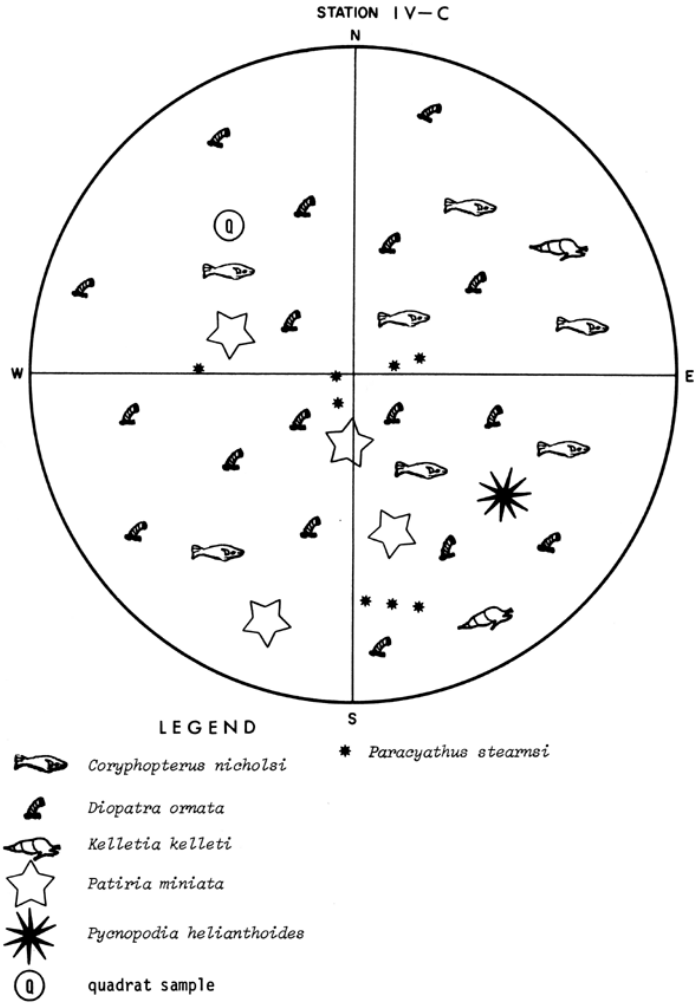

FIGURE 24 A pictorial representation of the arc study area, Station IV-C (approximately 15 square meters of bottom area), 60-foot depth, depicting the more obvious biotic features and the sampling locations.

FIGURE 24 A pictorial representation of the arc study area, Station IV-C (approximately 15 square meters of bottom area), 60-foot depth, depicting the more obvious biotic features and the sampling locations

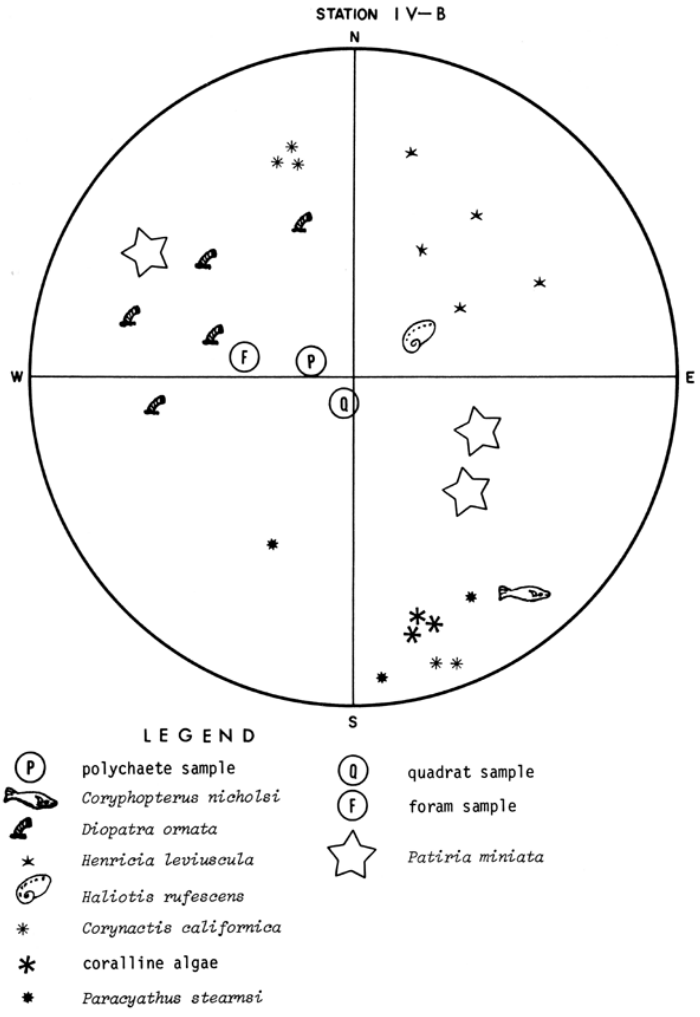

FIGURE 25 A pictorial representation of the arc study area, Station IV-B (approximately 30 square meters of bottom area), 80-foot depth, depicting the more obvious biotic features and the sampling locations.

FIGURE 25 A pictorial representation of the arc study area, Station IV-B (approximately 30 square meters of bottom area), 80-foot depth, depicting the more obvious biotic features and the sampling locations

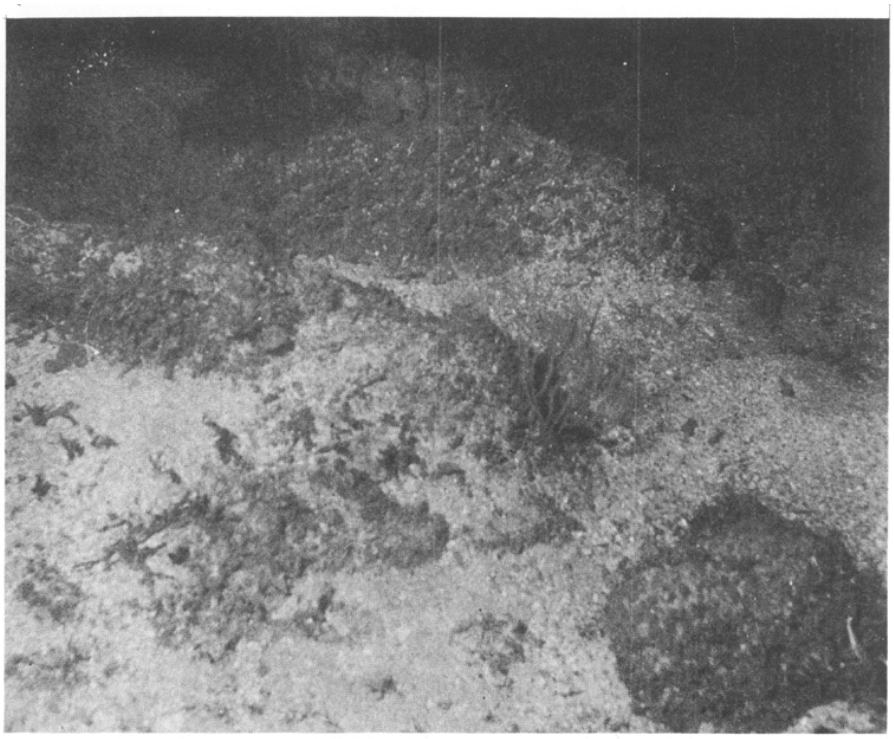

FIGURE 26 Pockets of sand and shell cover portions of the pavement rock at the terrace edge, Station IV-A (100-foot depths). Photo by Charles H. Turner.

FIGURE 26 Pockets of sand and shell cover portions of the pavement rock at the terrace edge, Station IV-A (100-foot depths). Photo by Charles H. Turner

Station G-2 was in the center of the outfall's "Y"-shaped terminus in 220-foot depths. Six quarts of fine, dark, silty mud with a slight H_2S odor were collected and screened.

Station G-3 was contiguous with Transect IV in the 220-foot depths. Three quarts of dark silty mud, without an H2S odor, were collected and screened.

We identified the animals in each sample and sent the polychaete worms, foraminiferans, and gammarid amphipods to specialists. Only the polychaete identifications are included in this report (Table 5).

This offshore area, between 20 and 50 fathoms deep, has been characterized by Barnard and Ziesenhenene (1961) as typically harboring an Amphiodia urtica community. Therefore, it was not unexpected to find this ophiuroid dominant in our samples. of particular significance, however, is the occurrence of Capitella capitata in the sample nearest the outfall. This "Pollution-tolerant" polychaete previously had not been recorded in this immediate area, and its presence is indicative of an adverse environmental change, according to Donald J. Reish (pers. comm.). Defining the areal distribution of Capitella capitata will help delimit the present area influenced by the outfall.

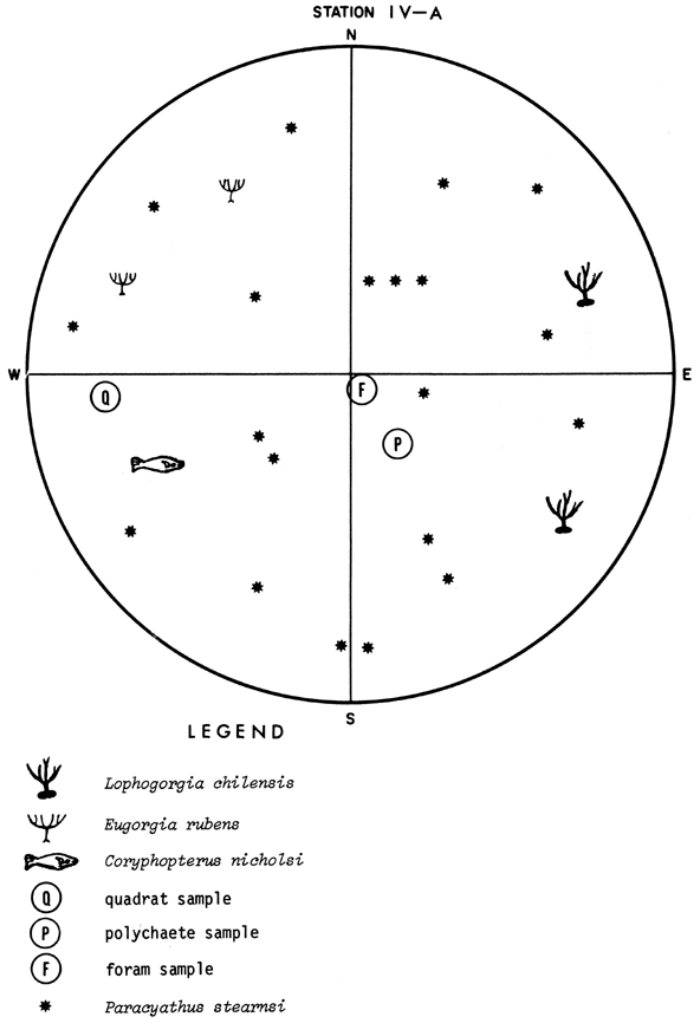

FIGURE 27 A pictorial representation of the arc study area, Station IV-A (approximately 15 square meters of bottom area), 100-foot depths, depicting the more obvious biotic features and the sampling locations.

FIGURE 27 A pictorial representation of the arc study area, Station IV-A (approximately 15 square meters of bottom area), 100-foot depths, depicting the more obvious biotic features and the sampling locations

TABLE 5

Animals Recorded from the Orange-Peel Grab Samples Taken Offshore from Point Loma, March 9, 1965

Species	G-1	G-2	G-3	Species	G-1	G-2	G-3
Platyhelminthes	2			*Pilargis hamatus*	1	1	
Nematoda		P*	P	pilargid unid.		1	
Annelida				Polynoidae	7	16	P
Capitella capitata		2		*Laonice cirrata*		1	
Capitita ambiseta	P	1	1	*Prionospio pinnata*	1		1
Cossura candida	1		1	*Prionospio pygmaeus*	4		1
Tharyx parvus	3			*Prionospio* sp.		5	
cirratulid unid.		1		*Spiophanes missionensis*	1	2	
flabelligerid unid.		1		spionid unid.		3	
Glycera sp.	2	3	P	*Sternaspis fossor*	1	1	1
Goniada littorea	1		P	Terebellidae		4	
Ophiodromus pugettensis	1	1	1	*Terebellides stroemi*	1		
Lumbrineris sp.	7	4	P	Echiuroidea			
Magelona pacifica			P	*Listriolobus pelodes*	2		
Magelona sp.	1			Arthropoda			
Axiothella sp.	1			Ostracoda	P	P	P
Praxillella affinis pacifica		1		Cumacea	P		1
Praxillella sp.	1			Tanaidacea	1		
maldanid unid.	1	3	P	Gammaridea	P	P	P
Nephtys sp.	8	19	1	Caprellidea	P		
Nereis procera	1		P	Mollusca			
Armandia bioculata		1		Aplacophora			2
Travisia brevis	2			*Cylichna alba*	4	5	5
Haploscoloplos elongatus	2	2		*Ophiodermella incisa*			1
Paraonis sp.	8	10		*Volvulella cylindrica*	2	5	3
paranoid unid.		1	P	*Tellina* sp.			2
Pectinaria californiensis	4			Echinodermata			
Rhepe sp.		1		*Amphiodia urtica*	86	133	69
phyllodocid unid.	1	2	P				

* P = Present in the sample but relative abundance not estimated.

TABLE 5

Animals Recorded from the Orange-Peel Grab Samples Taken offshore from Point Loma, March 9, 1965

5. DISCUSSION

Oceanographic studies along the westerly shore of Point Loma were conducted by San Diego Marine Consultants (1959, 1962) prior to the construction and operation of the submarine outfall. These surveys evaluated the marine environment, giving background information which, when compared with subsequent surveys, might indicate changes attributable to operation of the outfall; outfall operation commenced late in 1963.

Six of our stations (two intertidal and four nearshore) approximated those surveyed by San Diego Marine Consultants in 1961. We have attempted pre- and post-operative comparisons with these stations despite the fact that: (i) considerable variation exists between sampling techniques of this and the previous study; and (ii) emphasis on pertinent environmental features varied considerably between the studies. In general the biotic conditions observed (1961 and 1965 survey) appear similar and no adverse changes, directly attributable to outfall operations, were noted.

The intertidal stations selected for comparative purposes, Transects I and IV, correspond to Stations G and E respectively of San Diego Marine Consultants (1962). Intertidal-I was largely characterized in our studies by its algal distributions and associated littorine snails; it had only a fraction of the speciation reported in 1962. The 1965 paucity of species appears to be the result of severe wave action and continual erosion and sanding-in of the ledges, rather than outfall operation.

Intertidal-IV exhibited excellent species diversity during both studies, with the exception that top-snails (Astraea undosa) and chitons (Ischnochiton sp.), prevalent in 1961, were not recorded by us, and the fishes reported as "teeming" in the upper tide pools during 1961 were not seen during our study. The algal diversity existing in 1965 approximated that recorded in 1961.

The four nearshore diving stations we selected for comparison, and their 1961 counterparts (in parentheses) were: I-C (K-7), III-D (K-4), IV-D (K-3), and IV-A (L-6).

Station I-C was described as an extremely lush area in 1961; coralline and brown algae dominated, and animal forms were abundant. Occasional giant kelp plants were noted, and many dead hold-fasts were seen. In 1965, we found a moderate bed of giant kelp apparently somewhat more extensive than that which existed in 1961. Sea urchins were present (as in 1961) but were largely restricted to crevices and beneath boulders. Contrasting with this areal increase in the giant kelp, we noted a decrease in the lower-growing brown algae—a normal sequence in plant succession within a bed of giant kelp. In general, there was favorable agreement between species recorded in the 1961 and 1965 surveys. Differences, in most instances, were attributable to survey techniques.

Station III-D exhibited gross biotic changes between 1961 and 1965, not an unexpected occurrence since its location corresponds closely to the outfall pipe—a non-existent structure in 1961. Significantly the changes (apparently brought about by substrate improvement) have been favorable. Giant kelp, absent in 1961, formed a moderate

to heavy bed throughout the general station area. Purple sea urchins, the dominant biotic form in 1961, were not seen by us. Twenty-one animal and two plant species were noted in 1961, about half the diversity we observed in 1965 (46 animal and 3 plant species).

Although Station IV-D had similar invertebrate speciation in both 1961 and 1965, with boring clams, purple and red sea urchins, and bat stars dominating, distinct changes in the algal community were noted. Coralline algae, recorded as the dominant plants in 1961 were still abundant in 1965, but the dominant species was giant kelp, which formed a dense bed with an expansive canopy. In addition, elk kelp, strap kelp, and a low-growing brown alga, Pterygophora californica, which were sparse to abundant in our general station area, were not recorded in 1961.

Station IV-A, located in the 100-foot depths, roughly approximated station L-6 (92 feet deep) of San Diego Marine Consultants (1962). Here we recorded the coralline alga Corallina officinalis (dominant in 1961) as sparse. A juvenile giant kelp plant found at Station L-6 in 1961 (a depth considered marginal for giant kelp in this area) is notable. We did not find giant kelp beyond Station IV-C (60-foot depth) along this transect. Solitary corals proved to be the dominant sessile animals in both 1961 and 1965, and estimates of their abundance were identical. Three plant and 16 animal species were recorded in 1961, considerably fewer than the 3 plant and 49 animal species we recorded in 1965. This greater diversity in 1965 appears to reflect differences in sampling techniques. Only three fish species were recorded in 1961; we observed 12.

An initial recognizable feature of unfavorable environmental conditions is the lack of biotic diversity. As environmental conditions become harsh, mobile animal forms, finding conditions untenable, emigrate; attached plants and animals, intolerant to the situation, succumb. Those remaining are tolerant forms which, due to reduced competition, exhibit high abundance levels. This sequence of events has been observed, not infrequently, along the southern California coastline.

Tolerant sessile forms of the open coast are usually eurybathic (tolerating wide depth distributions), eurythermic (tolerating wide temperature ranges), and euryhaline (tolerating wide salinity ranges).

Disregarding all other environmental factors, we grouped those plants and animals recorded at five consecutive depth-stations (i.e. intertidal to 80-foot, or 20-foot to 100-foot depths). Interestingly, most of the species usually associated with impoverished biotic conditions (on rocky substrates) appear in this list (Table 6). Increases in their abundance levels, relative to associated species, probably would be indicative of an unfavorable environment such as would be caused by sewage discharge. of the five algae listed, two articulated corallines Bossiella and Corallina were found from the intertidal to depths exceeding 100 feet. These two have also been noted as abundant off the Palos Verdes Peninsula (near Los Angeles), an area influenced by an outfall discharge. The other three algae may also be tolerant forms indicative of restrictive environmental situations.

TABLE 6

Plants and Animals Observed at Five or More Consecutive Depth-stations Offshore from Point Loma, February and March, 1965

ORGANISM	DEPTH, FEET										
	0	10	20	30	40	50	60	70	80	90	100
ALGAE											
Cystoseira osmundacea	x	x	x	x	x	x	x	x	x		
Dictyopteris zonarioides	x	x	x	x	x	x	x	x	x		
Bossiella orbigniana	x	x	x	x	x	x	x	x	x	x	x
Corallina officinalis	x	x	x	x	x	x	x	x	x	x	x
Plocamium pacificum	x	x	x	x	x	x	x	x	x	x	
INVERTEBRATES											
Protozoa											
Gromia oviformis	x	x	x	x	x	x	x	x	x	x	x
Porifera											
Axinella mexicana	x	x	x	x	x	x	x	x	x	x	x
Craniella arb			x	x	x	x	x	x	x	x	x
Mollusca											
Crepipatella lingulata	x	x	x	x	x	x	x	x			
Megathura crenulata	x	x	x	x	x	x	x	x			
Micranellum crebricinctum	x	x	x	x	x	x	x	x	x	x	x
Mitrella gouldii	x	x	x	x	x	x	x	x			
Tricolia compta	x	x	x	x	x	x	x	x			
Hiatella arctica	x	x	x	x	x	x	x	x			
Brachiopoda											
Terebratalia transversa	x	x	x	x	x	x	x	x	x	x	
Echinodermata											
Amphipholis pugetana	x	x	x	x	x	x	x	x			
Ophiothrix spiculata			x	x	x	x	x	x	x	x	
Patiria miniata	x	x	x	x	x	x	x	x	x	x	x
Strongylocentrotus spp.	x	x	x	x	x	x	x	x			

TABLE 6
Plants and Animals Observed at Five or More Consecutive Depth-stations offshore from Point Loma, February and March, 1965

of the 14 invertebrate species exhibiting this wide bathymetric distribution, sea urchins (Strongylocentrotus spp.), brittle stars (Amphipholis pugetana and Ophiothrix spiculata) , bat stars (Patiria miniata) , and three mollusks (Crepipatella lingulata, Megathura crenulata, and Hiatella arctica, are known to flourish in harsh environments. Less is known about the environmental requirements of the others, but we suggest that they too are hardy, tolerant forms that should be closely monitored in future surveys.

6. SUMMARY

The subtidal area (into 100-foot depths) west of Point Loma, San Diego County, was visually surveyed by biologist-divers to ascertain the number and diversity of marine life. These data were compiled for, and will be used by, the San Diego Regional Water Quality Control Board in its evaluation of environmental changes (if any) which have occurred due to operation of an ocean outfall in this area.

Field work was conducted during February and March 1965. During this period, 20 diving stations and 4 intertidal areas were occupied along four transects, lying perpendicular to shore from the intertidal into 100-foot depths.

We employed a modified transect-quadrat method of survey, quantitatively and qualitatively sampling the animals and plants present.

General observations, including core samples of the substrate in sand bottom areas, were made at each station. Quantitative sampling, by actual removal of all organisms within a quadrat 0.25 m on a side, were identified and recorded.

In addition, three orange-peel grab samples were taken in the 220-foot depths around the outfall terminus, primarily to determine sludge build-up. No sludge build-up was observed in these samples but analysis of the animals present indicated an adverse change in the environment near the outfall terminus. Concurrent and subsequent corings by the Regional Board's staff have shown a build-up of sludge.

Only two of the diving stations were sufficiently sandy for cores to be taken: Station II-A was uniform fine gray sand; Station II-E, coarse red sand (Appendix 1).

Water visibility (clarity) was generally poor at the inshore stations, becoming more favorable at intermediate and offshore locations. Water clarity at the sample areas ranged from less than 1 foot (Station I-E) to an estimated 25 to 30 feet at Station II-D (Appendix 1).

Bottom temperatures at the sample areas ranged from 54.1°F at Station III-A (100-foot depth) to 56.3°F at Station III-D (40-foot depth) (Appendix 1). Twenty-four-hour thermograph recordings, taken at Stations III-A and IV-B, indicated uniform diurnal-nocturnal fluctuations, of about 1°F; maximum temperatures occurred nocturnally (Figure 3). At all stations, temperature and visibility generally decreased with depth (Figures 4, 5).

Giant kelp was sparse in the northern survey areas (Transect I), did not occur in the central sector (Transect II), and was sparse to heavy in the south (Transects III and IV). Bathymetrically it ranged from 20- through 75-foot depths.

Elk kelp was common at the deeper stations, and strap kelp persisted in the shallows (less than 20-foot depths). Several low-growing browns were common to abundant in the 20- and 40-foot depths.

The animal life was varied and lush with sponges, solitary stony corals, whelks, limpets, boring pholads, nudibranchs, bat stars, brittle stars, sea urchins, solitary and colonial tunicates, sea cucumbers, and a wide variety of bryozoans dominating. In general, the recorded species, numbers, and diversities were typical for this geographic area, water depth, and bottom type.

Bathymetrically the most diverse speciation occurred in the 60- to 80- foot depths, while the least was in 20. Central Point Loma (Transect II) had the most varied biota, closely followed by the southern area (Transects III and IV). To the north, Transect I, due to its extremely low relief, exhibited the least diversity.

Six of our stations approximated those surveyed by San Diego Marine Consultants in 1961. Although direct comparisons were difficult, because of differences in sampling techniques, significant increases in giant kelp were apparent at three of the stations. In general, the biotic conditions observed along this submerged terrace (1961 and 1965 surveys) appeared similar and no adverse changes, directly attributable to outfall operations, were apparent in 1965. Five plants and 14 animals are mentioned as particularly hardy; these should be closely monitored in future surveys to detect changes in their abundance levels relative to associated species.

Because the outfall was operative only 18 months when our survey was conducted, insufficient time may have elapsed for the more subtle changes to have become apparent in the rocky areas. Therefore, we recommend continued surveillance of this area, along the lines of the 1965 study, at least annually for the next several years. During this period, any biotic changes, relative to the outfall operations, should become apparent.

offshore, near the outfall terminus, the presence of Capitella capitata (a hardy polychaete worm) indicates an adverse environmental change attributable to the outfall. Further study of this area, beyond the scope of our investigation, is definitely warranted.

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APPENDICES

APPENDIX 1

Physical Data for 24 Stations Occupied During a Survey of the Marine Environment Offshore from Point Loma February–March 1965

Station	Date	Depth (feet)	Bottom temp. °F	Diver estimated bottom visibility (feet)	Characteristic features and remarks
TRANSECT I Intertidal	2–17–65	--	--	--	Transect 90 feet long extending across deeply incised sandstone shelves from low water (−1.2-foot tide) to the cliff base. Quadrat sample taken at midpoint of transect (45 feet).
E	2–15–65	17	--	0.5	*General area:* Low mudstone shelves; heavily bored. *Remarks:* Strong surge and reduced visibility impaired the survey.
D	2–15–65	40	55.9	2–4	*General area:* Low mudstone shelves; heavily bored. *Arc area:* Incised with shallow surge channels which were filled with extensive shelly debris.
C	2–15–65	54	55.8	12–15	*General area:* Rocky; large crevices. *Arc area:* Rocky; shelves to 12 inches high, interspersed by gullies. Heavy sediment accumulation on the shelves and in the gullies.
B	2–15–65	80	55.2	15	*General area:* Low rocky shelves; scattered boulders. *Arc area:* Rocky; low relief.
A	2–15–65	94	55.2	15–20	*General area:* Pavement-like rock, large rock shelves recorded 60 feet from arc area at (240° magnetic). A marked increase in the bottom slope was noted. One hundred feet from the arc area (at 240°) the depth was 105 feet.
TRANSECT II Intertidal	2–16–65	--	--	--	Transect 190 feet long extending across deeply incised (to 3 feet) sandstone shelves from the low tidal to the cliff base. Numerous small tide pools were observed. The quadrat sample was removed at the transect midpoint (95 feet).
E	2–17–65	18	--	15–17	*General area:* Low sandstone shelves 4 to 12 inches high. *Arc area:* Low sandstone shelves 6 to 8 inches high, with scattered cobbles on top. *Remarks:* Strong surge; much detrital matter in suspension.

APPENDIX 1
Physical Data for 24 Stations Occupied During a Survey of the Marine Environment offshore from Point Loma February-March 1965

D	2–17–65	40	55.6	25–30	*General area:* Large boulders to 2 feet high scattered about on the heavily bored pavement-like sandstone. *Arc area:* Pavement-like sandstone base, heavily bored; on top of this were two large boulders and a small ledge 8 to 10 inches high.
C	2–17–65	60	55.5	20	*General area:* Pavement-like sandstone covered in parts with coarse sand, and boulders and rocky outcrops. One rocky outcrop 8 feet high only 40 feet east of the arc area. *Arc area:* Pavement-like sandstone with an overlay of coarse sand.
B	2–17–65	80	55.4	20	*General area:* Rocky pinnacles 8 to 10 feet high, surrounded by low rock rubble and coarse sand. Sandy areas moderately extensive 10 to 12 feet across and 3 to 4 inches in thickness. *Arc area:* Rock ledge 8 to 14 inches high on the pavement sandstone; partially covered by intruded coarse sand.
A	2–18–65	100	55.0	12–15	*General area:* Extensive sandy areas interspaced between large (to 15 feet high) rocky outcrops. One, 8 feet high, was located 40 feet east of the arc area. *Arc area:* Sand; core 8 inches long consisting of uniform medium gray sand. Ripple marks 1 to 2 inches high; 10 to 12 inches between their crests, aligned in a north-south direction (parallel to shore).
TRANSECT III Intertidal	2–16–65	--	--	--	Transect 35 feet long extending across the narrow sandstone shelf from low water to the base of the cliff. The quadrat sample was removed 11 feet from low water.
E	3– 8–65	20	--	1–3	*General area:* Coarse red sand. Core 9 inches long; uniform coarse red sand and shelly debris. Ripple marks 3 to 4 inches high; 6 to 8 inches between their crests, aligned parallel to shore. *Remarks:* Strong surge and reduced visibilities impaired the survey.
D	3– 8–65	40	56.3	3–5	*General area:* Pavement-like sandstone substrate cut by numerous 1- to 2-inch deep rifts, extensively bored. Several large boulders seen; possibly rip-rap from the outfall pipe coverings. The outfall pipe and rip-rap was not seen. *Remarks:* A strong surge was encountered impairing the survey.
C	3– 8–65	55	54.5	12–15	*General area:* Pavement-like rock, with scattered boulders and low rock ledges. *Arc area:* Low, flat, heavily bored, light colored sandstone; easily broken in handling. Numerous pits and depressions filled with sand.
B	3– 9–65	75	55.5	15–20	*General area:* Rocky outcrops 3 to 4 feet high interspersed on the pavement-like sandstone. Some cobbles and boulders. *Arc area:* Low, flat sandstone; deeply pocked. Just seaward of the arc area was the edge of this flat shelf. The shelf's sheer face dropped 20 feet onto a fine gray sand and boulder strewn bottom.
A	3– 8–65	105	54.1	15–20	*General area:* Extensive sandy areas interspersed with large, rocky outcrops, to 20 feet high. *Arc area:* On sand and rock; rock projecting 3 feet above the sand. *Remarks:* This station represents the seaward juncture of the rocky and sandy substrates along Transect III.

APPENDIX 1—Cont'd.

APPENDIX 1—Continued

Physical Data for 24 Stations Occupied During a Survey of the Marine Environment Offshore from Point Loma February–March 1965

Station	Date	Depth (feet)	Bottom temp. °F	Diver estimated bottom visibility (feet)	Characteristic features and remarks
TRANSECT IV Intertidal	2–16–65	--	--	--	Transect 306 feet long extending across the extensive flat sandstone shelves from low water to the base of the cliffs. A quadrat sample was removed 150 feet from low water.
E	3–10–65	20	56.1	8–10	*General area:* Pavement-like sandstone; heavily bored; coarse sand filling in the shallow rifts with shelly debris, cobbles, and medium to large boulders also being present. *Arc area:* An area of boulders each about one-half covered by the coarse red sand. *Remarks:* A strong surge was present indicating that these boulders undergo extensive covering and uncovering.
D	3–10–65	40	55.4	8–10	*General area:* Pavement-like sandstone with 8- to 10-inch high shelves; extensively bored. Cobbles and boulders present. *Arc area:* Low cobble shelf; heavily pocked and bored. *Remarks:* A moderate surge was encountered.
C	3–11–65	60	55.2	20	*General area:* Coarse sand, cobbles and boulders on a pavement-like sandstone base. *Arc area:* Typical of the general area.
B	3–10–65	80	55.0	15–20	*General area:* Pavement-like sandstone; some cobbles and boulders. *Arc area:* Many cobbles, a few boulders, coarse sand and shelly debris on top of the yellowish sandstone base.
A	3–11–65	105	56.1	8–10	*General area:* Pavement-like sandstone; overlain by coarse sand and shelly debris, several scattered boulders were noted. This station was near the seaward edge of the submerged terrace. *Arc area:* Several exposed boulders on the sandstone base; areas of coarse sand between the boulders. *Remarks:* Only a slight surge was encountered, but due to inclement weather (rain) light penetration was reduced and the bottom was poorly illuminated, impairing the survey.

APPENDIX 1

Physical Data for 24 Stations Occupied During a Survey of the Marine Environment offshore from Point Loma February-March 1965

APPENDIX 2

Scientific and Common Names of the Plants and Animals Observed Offshore from Point Loma February and March, 1965

Scientific Name	Common Name
ALGAE	
Amplisiphonia pacifica Hollenberg	red alga
Anisocladella pacifica Kylin	red alga
Bossiella orbigniana (Decaisne) Silva	coralline alga
Botryocladia sp.	red alga
Calliarthron regenerans Manza	coralline alga
Callophyllis marginifructa Setchell and Sweezy	red alga
Chondria californica (Collins) Kylin	red alga
Codium setchelli Gardner	green alga
Colpomenia sinuosa (Roth) Derbés and Solier	brown alga
Corallina gracilis Lamouroux	coralline alga
Corallina officinalis Linnaeus	coralline alga
coralline unid.	coralline algae
Cryptopleura crispa Kylin	red alga
Cystoseira osmundacea (Menzies) C. Agardh	brown alga
Dictyopteris zonarioides Farlow	brown alga
Dictyota flabellata (Collins) Setchell and Gardner	brown alga
Drouetia pellata Dawson	red alga
Egregia laevigata Setchell	feather boa
Eisenia arborea Areschoug	southern sea palm
Enteromorpha sp.	green alga
Gelidium cartilagineum Gardner	red alga
Gelidium nudifrons Gardner	red alga
Gelidium purpurascens Gardner	red alga
Gelidium sp.	red alga
Gigartina canaliculata Harvey	red alga
Gigartina serrata Gardner	red alga
Gigartina volans (C. Agardh) J. Agardh	red alga
Gigartina sp.	red alga
Laminaria farlowii Setchell	ribbon kelp
Laurencia diegoensis Dawson	red alga
Leptocladia binghamiae J. Agardh	red alga
Lithophyllum imitans Foslie	coralline alga
Lithothamnium sp.	coralline alga
Macrocystis pyrifera (Linnaeus) C. Agardh	giant kelp
Microcladia sp.	red alga
Pelagophycus porra (Leman) Setchell	elk kelp
Pelvetia fastigiata (J. Agardh) G. De Toni	brown alga
Peyssonelia rubra Weber van Bosse	red alga
**Phyllospadix torreyi* S. Watson	surf grass
Plocamium coccineum var. *pacificum* (Kylin) Dawson	red alga
Prionitis cornea (Okamura) Dawson	red alga
Pterocladia pyramidale (Gardner) Dawson	red alga
Pterosiphonia dendroidea (Montagne) Falkenberg	red alga
Pterygophora californica Ruprecht	brown alga
Rhodophyta unid.	red algae (division)
Rhodymenia arborescens Dawson	red alga
Rhodymenia pacifica Kylin	red alga
Rhodymenia palmettiformis Dawson	red alga
Rhodymenia sp.	red alga
Sargassum agardhianum Farlow	brown alga
Taenioma sp.	red alga
Ulva sp.	green alga

Scientific Name	Common Name
INVERTEBRATES AND ASCIDIANS	
Acanthina spirata (Blainville)	muricid snail
Acarnus erithacus de Laubenfels	sponge
Acmaea asmi (Middendorf)	limpet
Acmaea fenestrata (Reeve)	limpet
Acmaea scabra (Gould)	limpet
Acmaea paleacea Gould	limpet
Acmaea triangularis (Carpenter)	limpet
Acmaea sp.	limpet
Acteocina culcitella Gould	snail
Acteon punctocoelata (Carpenter)	barrel snail
Adocia sp.	sponge
Aegires albopunctatus MacFarland	dorid nudibranch
Agathotoma densilineata Dall	turrid snail
Aglaophenia diegensis Torrey	hydroid
Aglaophenia inconspicua Torrey	hydroid
Aglaophenia lophocarpa Allman	hydroid
Aglaophenia sp.	hydroid
Alabina tenuisculpta Carpenter	cerithid snail
Alvania acutilirata Carpenter	snail
Amaroucium californicum Ritter and Forsyth	compound ascidian
Ampharetidae	polychaete worm (family)
Amphineura unid.	chitons (class)
Amphinomidae	polychaete worm (family)
Amphiodia urtica (Lyman)	brittle star
Amphipholis pugetana (Lyman)	brittle star
Amphissa versicolor Dall	snail
Amphiura diastata McClendon	brittle star
Anachis penicillata Carpenter	snail
Anisodoris nobilis (MacFarland)	dorid nudibranch
Anthopleura elegantissima (Brandt)	aggregate anemone
Anthopleura xanthogrammica (Brandt)	solitary anemone
Anthuridae	isopod (family)
Aplacophora	mollusk (order)
Aplysia californica Cooper	sea hare
Arcuatula demissa (Dillwyn)	horsemussel
Arcturidae	isopod (family)
Armandia bioculata Hartman	polychaete worm
ascidian unid.	compound ascidian
Astraea gibberosa Dillwyn	turban snail
Astraea undosa Wood	turban snail
Astrangia lajollaensis Durham	aggregate coral
Astrometis sertulifera (Xantus)	sea star
Astropecten verilli de Loriol	sand star
Axinella mexicana de Laubenfels	sponge
Axiothella sp.	polychaete worm
Balanophyllia elegans Verrill	solitary coral
Balanus concavus pacificus Pilsbry	acorn barnacle
Balanus glandula Darwin	acorn barnacle
Balanus trigonus Darwin	acorn barnacle
Balcis rutila Carpenter	snail
Barleeia sp.	rissoid snail
Bodotria sp.	cumacean
Bulla gouldiana Pilsbry	tectibranch
Burchia redondoensis Burch	tower snail
Cadlina flavomaculata MacFarland	dorid nudibranch
Cadlina limbaughi Lance	dorid nudibranch
Cadlina marginata MacFarland	dorid nudibranch
Caecum dalli Bartsch	snail

* Flowering plant.

APPENDIX 2
Scientific and Common Names of the Plants and Animals Observed offshore from Point Loma February and March, 1965

APPENDIX 2—Continued

Scientific Name	Common Name
INVERTEBRATES AND ASCIDIANS—continued	
Calliostoma annulatum Solander	trochid snail
Calliostoma gloriosum Dall	trochid snail
Calliostoma supragranosum Carpenter	trochid snail
Calliostoma tricolor Gabb	trochid snail
Callistochiton palmulatus Carpenter	chiton
Capitella capitata (Fabricius)	polychaete worm
Capitellidae	polychaete worm (family)
Capitita ambiseta Hartman	polychaete worm
Caprellidea	amphipod (suborder)
Cellaria mandibulata Hincks	bryozoan
Centrechinoidea	sea urchin (order)
Ceratostoma nuttallii Conrad	snail
Cerianthidae	tube anemone (family)
Cerianthiopsis sp.	tube anemone
Certhiopsis carpenteri Bartsch	snail
Chaceia ovoidea (Gould)	piddock
Chaetopleura gemma Carpenter	chiton
Chaetozone corona Berkeley and Berkeley	polychaete worm
Chama pellucida Sowerby	agate chama
Cheilostomata	bryozoan (suborder)
Chlamydoconcha orcutti Dall	clam
Chone sp.	polychaete worm
Chrysopetalidae	polychaete worm (family)
Chthamalus fissus Darwin	acorn barnacle
Cirolana harfordi (Lockington)	isopod
cirolanid unid.	isopod (family)
Cirratulidae	polychaete worm (family)
cirratulid unid.	polychaete worm
Cirratulus sp.	polychaete worm
Cirriformia sp.	polychaete worm
Cistenides brevicoma (Johnson)	polychaete worm
Conus californicus Hinds	cone snail
Corynactis californica Carlgren	aggregate anemone
Cossura candida Hartman	polychaete worm
Costazia robertsoniae Canu and Bassler	bryozoan
Craniella arb de Laubenfels	sponge
Crepidula nummaria Gould	slipper snail
Crepidula onyx Sowerby	slipper snail
Crepipatella lingulata (Gould)	half-slipper snail
Crisia maxima Robertson	bryozoan
Crisia occidentalis Trask	bryozoan
Crisia sp.	bryozoan
Cryptosula pallasiana (Moll)	bryozoan
Cucumaria sp.	sea cucumber
Cumacea	arthropod (order)
Cumella sp.	cumacean
Cumingia californica Conrad	clam
Cyamon sp.	sponge
Cyanoplax dentiens (Gould)	chiton
Cyanoplax sp.	chiton
Cylichna alba Brown	snail
Cystodytes lobatus (Ritter)	compound ascidian
Dendraster excentricus (Eschscholtz)	sand dollar
Dendrochiton sp.	chiton
Dendrodoris albopunctata (Cooper)	dorid nudibranch
Dendronotus frondosus (Ascanius)	dorid nudibranch
Dendrostomum pyroides Chamberlin	sipuneulid worm
Dermasterias imbricata (Grube)	sea star
Deziospira spirillum (Linnaeus)	polychaete worm
Diala acuta Carpenter	litiophid snail
Diaperoecia californica (d'Orbigny)	bryozoan
Diaulula sandiegensis (Cooper)	dorid nudibranch
Didemnum carnulentum Ritter and Forsyth	compound ascidian
Diodora murina Arnold	limpet
Diopatra ornata Moore	polychaete worm
Diplodonta orbella Gould	clam
Discorbis columbiensis Cushman	foraminiferan
Dorvillea sp.	polychaete worm
Dorvilleidae	polychaete worm (family)
Dysidea amblia de Laubenfels	sponge
Epiactis prolifera Verrill	prolific anemone
Epialtoides hiltoni (Rathbun)	crab
Epitonium sp.	wentletrap snail
Erato columbella Menke	snail
Ervilia californica Dall	clam
Esperiopsis originalis de Laubenfels	sponge
Eteone sp.	polychaete worm
Eudendrium sp.	hydroid
Eudistoma sp.	compound ascidian
Eugorgia rubens Verrill	gorgonian
Eunice longicirrata Webster	polychaete worm
Eunice sp.	polychaete worm
Eunicidae	polychaete worm (family)
eunicid unid.	polychaete worm
Exogone sp.	polychaete worm
Filicrisia sp.	bryozoan
Fissurella volcano Reeve	limpet
Flabelligeridae	polychaete worm (family)
flabelligerid unid.	polychaete
Flabellina iodinea (Cooper)	aeolid nudibranch
Folliculina sp.	ciliate protozoan (attached)
Gammaridea	amphipod (suborder)
Geodia mesotriaena Lendenfeld	sponge
Glans carpenteri Lamy	carditid clam
Glossodoris porterae (Cockerell)	dorid nudibranch
Glycera sp.	polychaete worm
Golfingia sp.	sipuneulid worm
Goniada littorea Hartman	polychaete worm
Gromia oviformis Dujardin	testate protozoan
Haliclona lunisimilis de Laubenfels	sponge
Haliclona sp.	sponge
Haliotis fulgens Philippi	green abalone
Haliotis rufescens Swainson	red abalone
Haploscoloplos elongatus (Johnson)	polychaete worm
Hemectyon hyle de Laubenfels	sponge
Henricia leviuscula (Stimpson)	sea star
Hermissenda crassicornis (Eschscholtz)	aeolid nudibranch
Hesionidae	polychaete worm (family)
hesionid unid.	polychaete worm
Hiatella arctica (Linnaeus)	rough nestling clam
Hinnites multirugosus (Gale)	rock scallop
Hippodiplosia insculpta (Hincks)	bryozoan
Hipponix tumens Carpenter	snail
Hopkinsia rosacea MacFarland	aeolid nudibranch
Hormomya adamsiana (Dunker)	mussel
Hydroida	hydroid (order)
Hymenamphiastra cyanocrypta de Laubenfels	blue encrusting sponge
Idothea rufescens Fee	isopod
insect larvae unid.	insect
Ischnochiton fallax Carpenter	chiton

APPENDIX 2
Scientific and Common Names of the Plants and Animals Observed offshore from Point Loma February and March, 1965

APPENDIX 2—Continued

Scientific Name	Common Name
INVERTEBRATES AND ASCIDIANS—continued	
Ischnochiton mertensii (Middendorff)	chiton
Ischnochiton radians Carpenter	chiton
Ischnochiton sp.	chiton
Isopoda	isopod (order)
Jaton festivus Hinds	muricid snail
Kelletia kelleti Forbes	whelk snail
Kellia laperousi Deshayes	nestling clam
Lacuna unifasciata Carpenter	littorinid snail
Laonice cirrata (Sars)	polychaete worm
Leptopecten latiaurata (Conrad)	kelp scallop
Leuconia barbata (Duchaissing & Michelotti)	sponge
Leucosolenia botryoides (Ellis & Solander)	sponge
Lima hemphilli Hertlein and Strong	file shell
Linckia columbiae Gray	sea star
Liotia fenestrata Carpenter	snail
Lissodendoryx noxiosa de Laubenfels	sponge
Listriolobus pelodes Fisher	echiuroid worm
Lithophaga subula (Reeve)	date mussel
Littorina planaxis Philippi	snail
Littorina scutulata Gould	snail
Lophogorgia chilensis (Verrill)	pink gorgonian
Lophopanopeus bellus (Stimpson)	crab
Lophopanopeus lockingtoni Rathbun	crab
Lottia gigantea Sowerby	owl limpet
Lucinoma sp.	clam
Lumbrineridae	polychaete worm (family)
Lumbrineris sp.	polychaete worm
Lyrula hippocrepis (Hincks)	bryozoan
Lytechinus anamesus H. L. Clark	white sea urchin
Macron lividus Adams	snail
Magelona pacifica Monro	polychaete worm
Magelona sp.	polychaete worm
Maldanidae	polychaete worm
maldanid unid.	polychaete worm
Marginella californica Tomlin	snail
Marginella jewettii Carpenter	snail
Marginella sp.	snail
Mediaster aequalis Stimpson	sea star
Megasurcula remondii Gabb	tower snail
Megathura crenulata Sowerby	keyhole limpet
Membranipora tuberculata (Bosc)	bryozoan
Micranellum crebricinctum Carpenter	snail
Microciona parthena de Laubenfels	sponge
microcionid unid.	sponge
Micrura nigrirostris Coe	nemertean worm
Micrura pardalis Coe	nemertean worm
Miniacina miniacea (Pallas)	colonial foraminiferan
Mitra catalinae Dall	miter snail
Mitra idae Melville	miter snail
Mitrella carinata Hinds	keeled snail
Mitrella gouldii Carpenter	snail
Mitrella tuberosa Carpenter	snail
Mitrella sp.	snail
Modiolus capax Conrad	fat horsemussel
Mopalia ciliata (Sowerby)	chiton
Mopalia muscosa (Gould)	chiton
Muricea californica Verrill	gorgonian
Mysidacea	crustacean (order)
Mytilus californianus Conrad	mussel
Mytilus edulis Linnaeus	bay mussel
Nassarius mendicus Gould	whelk snail
Nassarius sp.	whelk snail
Nematoda	nematode worm (phylum)
Nemertina	nemertean worm (phylum)
Nephtys sp.	polychaete worm
Nereidae	polychaete worm (family)
Nereis procera Ehlers	polychaete worm
Norrisia norrisi Sowerby	trochid snail
Nuttallina californica (Reeve)	chiton
Obelia sp.	hydroid
Octopus bimaculatus Verrill	octopus
Odostomia donilla Dall and Bartsch	snail
Odostomia terricula Dall and Bartsch	snail
Odostomia sp.	snail
Olivella baetica Carpenter	olive snail
Olivella biplicata Sowerby	olive snail
Onuphidae	polychaete worm (family)
onuphid unid.	polychaete worm
Opheliidae	polychaete worm (family)
opheliid unid.	polychaete worm
Ophiodermella incisa Carpenter	snail
Ophiodromus pugettensis (Johnson)	polychaete worm
Ophiodromus sp.	polychaete worm
Ophionereis annulata Le Conte	brittle star
Ophiopteris papillosa (Lyman)	brittle star
Ophiothrix rudis Lyman	brittle star
Ophiothrix spiculata Le Conte	brittle star
Ophiuroidea	brittle star (class)
Ostracoda	crustacean (subclass)
Pachycerianthus sp.	tube anemone
Pachycheles sp.	crab
Pachygrapsus crassipes Randall	shore crab
Pagurus samuelis (Stimpson)	hermit crab
pagurid unid.	hermit crab
Pandalus gurneyi Stimpson	shrimp
Panulirus interruptus (Randall)	spiny lobster
Paracyathus stearnsii Verrill	solitary coral
paraonid unid.	polychaete worm
Paraonis sp.	polychaete worm
Parapholas californica (Conrad)	scale-sided piddock
Parasmittina sp.	bryozoan
Parastichopus californicus (Stimpson)	sea cucumber
Parastichopus parvimensis (Clark)	sea cucumber
Patiria miniata (Brandt)	bat star
Pectinaria californiensis Hartman	polychaete worm
Pelia clausa Rathbun	crab
Pelia tumida (Lockington)	crab
Penitella penita (Conrad)	flap-tipped piddock
Pentamera sp.	sea cucumber
Petalaster foliolata (Grube)	sand star
Petrolisthes cinctipes (Randall)	crab
Petrolisthes sp.	crab
Pherusa inflata (Treadwell)	polychaete worm
Phidiana pugnax Lance	aeolid nudibranch
Phidolopora pacifica (Robertson)	lacy bryozoan
Philobrya setosa Carpenter	clam
Phoronida	phoronid worm (phylum)
Phragmatopoma californica (Fewkes)	polychaete worm
Phyllochaetopterus prolifica Potts	polychaete worm
Phyllodocidae	polychaete worm (family)
phyllodocid unid.	polychaete worm
pilargid unid.	polychaete worm

APPENDIX 2

Scientific and Common Names of the Plants and Animals Observed offshore from Point Loma February and March, 1965

APPENDIX 2—Continued

Scientific Name	Common Name
INVERTEBRATES AND ASCIDIANS—continued	
Pilargis hamatus Hartman	polychaete worm
Pisaster giganteus (Stimpson)	sea star
Platyhelminthes	flatworm (phylum)
Plocamia karykina de Laubenfels	sponge
Plumularia lagenifera Allman	hydroid
Plumularia setacea (Ellis)	hydroid
Plumularia sp.	hydroid
Pododesmus cepio (Gray)	abalone jingle
Poecilochaetus johnsoni Hartman	polychaete worm
Pollicipes polymerus Sowerby	stalked barnacle
Polychaeta unid.	segmented worms (class)
Polyclinum planum (Ritter and Forsyth)	compound ascidian
Polydora sp.	polychaete worm
Polynoidae	polychaete worm (family)
Porifera, dark brown unid.	sponge
Porifera, encrusting unid.	sponge
Porifera, encrusting yellow unid.	sponge
Porifera, orange unid.	sponge
Prazillella affinis pacifica Berkeley	polychaete worm
Prazillella sp.	polychaete worm
Prianos problematicus de Laubenfels	sponge
Prionospio pinnata Ehlers	polychaete worm
Prionospio pygmaeus Hartman	polychaete worm
Prionspio sp.	polychaete worm
Protothaca staminea Conrad	clam
psolid holothurian unid.	sea cucumber
Pterynotus trialatus (Sowerby)	murex snail
Pugettia dalli Rathbun	crab
Pugettia producta (Randall)	crab
Pugettia sp.	crab
Pycnogonida	arthropod (class)
Pycnopodia helianthoides (Brandt)	sea star
Pyura haustor (Stimpson)	solitary ascidian
Retusa harpa Dall	snail
Rhynchozoon tumulosum (Hincks)	bryozoan
Sabellaria cementarium Moore	polychaete worm
Sabellaria gracilis Hartman	polychaete worm
Sabellariidae	polychaete worm (family)
Sabellidae	polychaete worm (family)
sabellid unid.	polychaete worm
Salmacina tribranchiata (Moore)	polychaete worm
Scalpellum californicum Pilsbry	stalked barnacle
Scrupocellaria diegensis Robertson	bryozoan
Scrupocellaria sp.	bryozoan
Seila montereyensis Bartsch	snail
Serpula vermicularis Linnaeus	polychaete worm
Serpulidae	polychaete worm (family)
Serpulorbis squamigerus (Carpenter)	tube-building snail
Sertularella pedrensis Torrey	hydroid
Sertularella turgida (Trask)	hydroid
Sigillinaria aequali-siphonis (Ritter and Forsyth)	social ascidian
Sipunculida	sipunculid worm (phylum)
Solariella varicosa Mighels and Adams	snail
Solaster dawsoni Verrill	sea star
Sphaerodorum sp.	polychaete worm
Sphaerosyllis sp.	polychaete worm
Spionidae	polychaete worm (family)
spionid unid.	polychaete worm
Spiophanes bombyx (Claparède)	polychaete worm
Spiophanes missionensis Hartman	polychaete worm
Stelletta estrella de Laubenfels	sponge
Stenoplax conspicuus (Pilsbry)	chiton
Sternapsis fossor Stimpson	polychaete worm
Strongylocentrotus franciscanus (Agassiz)	red sea urchin
Strongylocentrotus purpuratus (Stimpson)	purple sea urchin
Strongylocentrotus sp.	sea urchin
Styela montereyensis (Dall)	solitary ascidian
Stylatula elongata (Gabb)	sea pen
Stylatula sp.	sea pen
Sycon sp.	sponge
Syllidae	polychaete worm (family)
Syllis sp.	polychaete worm
Tanaidacea	tanaid crustacean (order)
Tealia coriacea (Cuvier)	sea anemone
Tedania topsenti de Laubenfels	sponge
Tegula aureotincta Forbes	trochid snail
Tegula funebralis (Adams)	trochid snail
Tegula ligulata Menke	trochid snail
Tegula regina Stearns	trochid snail
Tegula sp.	trochid snail
Tellina sp.	clam
Terebellidae	polychaete worm (family)
Terebellides stroemi Sars	polychaete worm
Terebratalia transversa (Sowerby)	brachiopod
Terebratulina unguicula Carpenter	brachiopod
Tethya aurantia (Pallas)	orange sponge
Tetraclita squamosa rubescens Darwin	acorn barnacle
Tharyx parvus Berkeley	polychaete worm
Tharyx sp.	polychaete worm
Thyonepsolus nutriens Clark	sea cucumber
Travisia brevis Moore	polychaete worm
Tricolia compta Gould	snail
Trididemnum opacum (Ritter)	compound ascidian
Trikentrion flabelliformis Hentschel	leaf sponge
Triopha maculata MacFarland	dorid nudibranch
Tritonia festiva (Stearns)	nudibranch
Trypanosyllis sp.	polychaete worm
Tubulipora sp.	bryozoan
Tubuliporididae	bryozoan (family)
Turbonilla chocolata Carpenter	turbonille snail
Turbonilla kelseyi Dall and Bartsch	turbonille snail
Volvulella cylindrica Carpenter	snail
zoantharian, white unid.	enidarian (subclass)
Zonaria spadicea (Swainson)	chestnut cowry
VERTEBRATES	
Agonopsis sterletus Gilbert	sea poacher
Artedius corallinus (Hubbs)	coralline sculpin
Artedius lateralis (Girard)	smoothhead sculpin
Artedius sp.	true sculpin
Atherinops affinis (Ayres)	topsmelt
Branchiostoma californiense Andrews	California lancelet
Caulolatilus princeps (Jenyns)	ocean whitefish
Chromis punctipinnis (Cooper)	blacksmith
Citharichthys stigmaeus Jordan and Gilbert	sanddab
Clinocottus analis (Girard)	wooly sculpin
Coryphopterus nicholsi (Bean)	bluespot goby
Cottidae	cottid (family)
Cryptotrema corallinum Gilbert	coralline clinid
Embiotoca jacksoni Agassiz	black perch
Girella nigricans (Ayres)	opaleye

APPENDIX 2

Scientific and Common Names of the Plants and Animals Observed offshore from Point Loma February and March, 1965

APPENDIX 2—Continued

Scientific Name	Common Name	Scientific Name	Common Name
VERTEBRATES—continued		*Rhacochilus toxotes* Agassiz	rubberlip perch
Gobiesox rhessodon Rosa Smith	clingfish	*Rhacochilus vacca* (Girard)	pile perch
Gymnothorax mordax (Ayres)	moray eel	*Scorpaena guttata* Girard	sculpin
Hypsurus caryi (Agassiz)	rainbow seaperch	*Scorpaenichthys marmoratus* (Ayres)	cabezon
Medialuna californiensis (Steindachner)	halfmoon	*Sebastodes atrovirens* (Jordan and Gilbert)	kelp rockfish
Myliobatis californicus Gill	bat ray	*Sebastodes dalli* (Eigenmann and Beeson)	calico rockfish
Neoclinus stephensae Hubbs	yellowfin fringehead	*Sebastodes miniatus* (Jordan and Gilbert)	vermilion rockfish
Neoclinus uninotatus Hubbs	onespot fringehead	*Sebastodes serranoides* Eigenmann and Eigenmann	olive rockfish
Oxyjulis californica (Günther)	señorita	*Sebastodes serriceps* (Jordan and Gilbert)	treefish
Oxylebius pictus Gill	painted greenling	*Sebastodes vexillaris* (Jordan and Gilbert)	whitebelly rockfish
Paralabrax clathratus (Girard)	kelp bass		
Paralabrax nebulifer (Girard)	sand bass		
Pimelometopon pulchrum (Ayres)	sheephead		
Rathbunella hypoplecta (Gilbert)	smooth ronquil		
Rathbunella sp.	ronquil		

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