A SURVEY OF THE MARINE ENVIRONMENT OFFSHORE FROM PALOS VERDES POINT, LOS ANGELES COUNTY, CALIFORNIA

by

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and

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DAN B. ODENWELLER [2/] and JOHN M. DUFFY [3/]
Marine Resources Region

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ABSTRACT

The results of a three year, quarterly survey of the subtidal marine environment offshore from Palos Verdes Point, Los Angeles County, California are recorded. Both a 100 m (328 ft) transect consisting of 21 stations at 5 m (16 ft) intervals established in 14 to 17 m (45 to 55 ft) and a series of five arc stations located at 6, 12, 18, 24 and 30 m (20, 40, 60, 80 and 100 ft) were surveyed. Significant results included the documentation of long term cycles in the large brown kelps, *Egregia laevigata* and *Eisenia arborea*. A herbivore cycle which followed this algal cycle was also tentatively identified.

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ACKNOWLEDGMENTS

The study was planned, and directed by Charles H. Turner until his untimely death in late 1970.

Alec R. Strachan, Robert A. Hardy, Jack A. Ames, Ronald H. McPeak, Charles T. Mitchell, and Richard L. Moe assised in the execution of the field work and the analysis of the samples in the laboratory during their tenure as project members. Robert R. Given provided his files on the early meetings of the CONES planning, without which the early history of the program would have been lost. Alec R. Strachan, Jack A. Ames and Richard L. Moe performed the algal identifications, and Robert A. Hardy identified the polychaete samples.

Rodney Aoto, Claire A. Eves and Kim Odenweller assisted in the reduction of data and in the preparation of the species lists. Jean D. Edwards and Kim Odenweller edited the species lists, and P. Patricia Powell assisted in the location of reference material, and in the assembly of the manuscript. Robert A. Hardy, the current project leader, supervised the final typing of the manuscript. The final thanks goes to the typists, without whose patience the species lists might never have been recorded.

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INTRODUCTION

The Southern California Bight, extending from Point Conception, California, to Cabo Colnett, Baja California, and bounded on the west by the California Current has been the subject of numerous scientific investigations, relating to both the nearshore, and the pelagic, offshore biota. Investigations into the nearshore biota have lacked a coordinated approach, coordinated goals, or even a standard methodology which would allow comparisons of data from different areas. These deficiencies become even more obvious when comparisons between the "natural" communities, and communities which exist as a result of man's impact on the marine environment are attempted.

The concept of a series of cooperative nearshore environmental surveys, to document conditions along the coast of southern California, was first formalized in late 1966. The first official meeting of the Cooperative Nearshore Environmental Studies (CONES) program was held on February 3, 1967. From this meeting, and later meetings, the CONES program was formalized. The goals of the program were stated as: (1) To establish a base line for assessing the existing conditions in the nearshore environment, against which future changes and modifications could be measured; (2) To increase the basic knowledge of the flora and fauna of the subtidal regions; and (3) From the above, to possibly gain a knowledge of how to manipulate and modify the nearshore environment for greater productivity and use.

The program was to incorporate several existing survey lines, and new survey lines to be established specifically for the program. The existing transects included one at Santa Catalina Island (University of

Southern California), one at Anacapa Island (U.C. Santa Barbara), one at Del Mar (Westinghouse Research) and one at Point Loma (California Institute of Technology). The new transect lines were to include one at Goleta (U.C. Santa Barbara), one at Palos Verdes Peninsula (California Department of Fish and Game), one at Corona Del Mar (California Institute of Technology), and one at Point La Jolla (Westinghouse Research) (Figure 1). Interest was also expressed, tentatively, for transects at Point Saint George, Trinidad Head, Fort Bragg, Bodega Bay, Gulf of the Farallones, Pigeon Point, Monterey Bay and Morro Bay (Figure 2).

This series of transects, all using the same methodology, was to provide data which would hopefully then be used to assess the impact of man's actions on the nearshore environment, and perhaps on the biota of the entire Southern California Bight.

The California Department of Fish and Game (Department), through its Environmental and Behavioral Studies of Coastal Sportfishes Project (DJ F-22-R) (project) began planning, in 1967, to establish a CONES study transect off Palos Verdes Point, Los Angeles County, California. The purpose of the transect was to establish a base line in time of the subtidal biota in the area, and to document, if possible, seasonal and annual variations in these communities. This information might then be related to fluctuations in nearshore, reef oriented sportfish populations, and to surveys of artificial reefs conducted by the project. In addition, the CONES data available from other sources, when compared to our data, could then form the basis for separating natural community fluctuations from the effects of man-made changes, specifically to the artificial reef flora and fauna, and generally to the southern California nearshore environment.

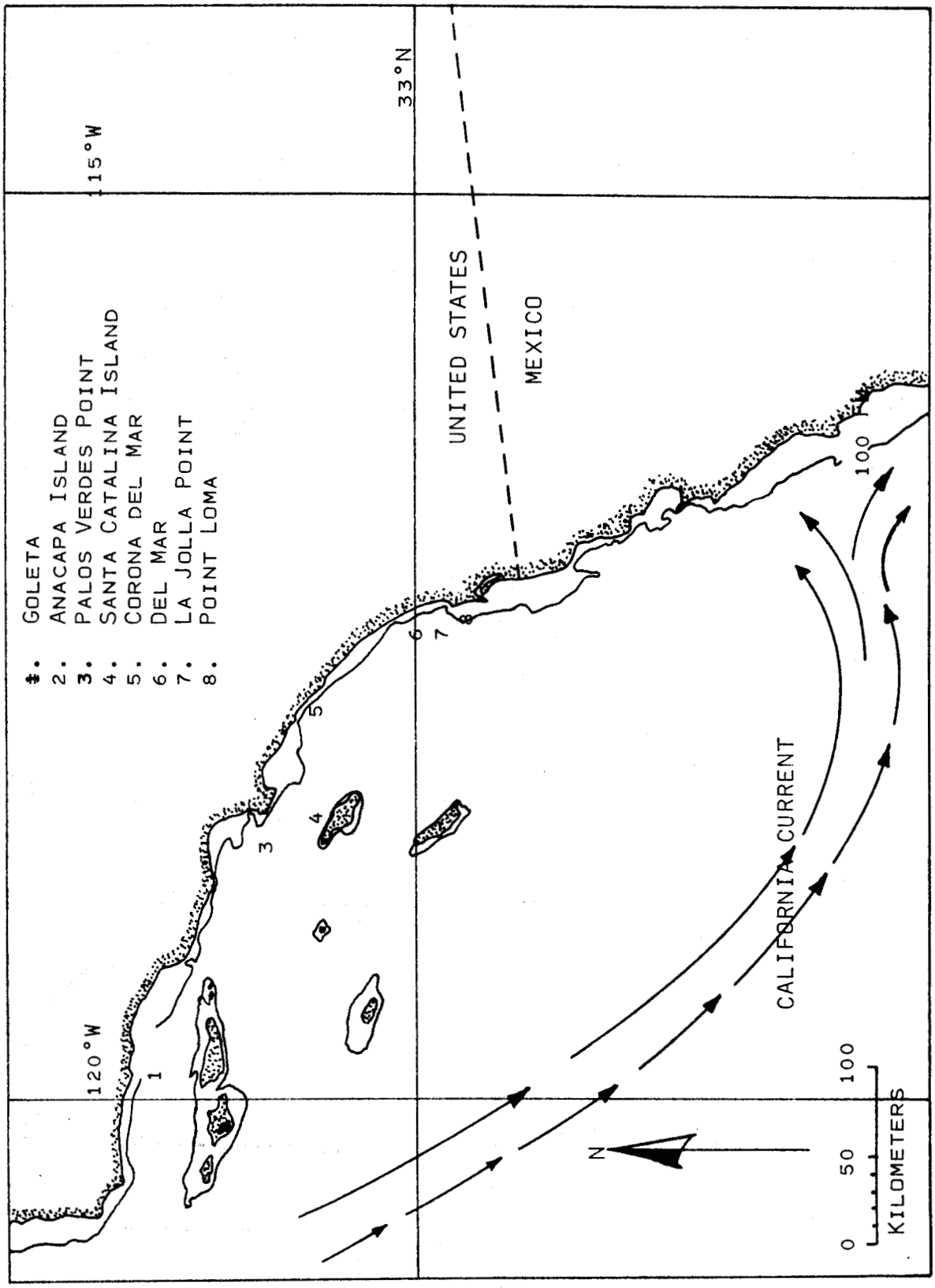

FIGURE 1. THE SOUTHERN CALIFORNIA BIGHT, SHOWING THE LOCATION OF STUDY AREAS PROPSED FOR THE CONES PROGRAM. AFTER SCCWRP.

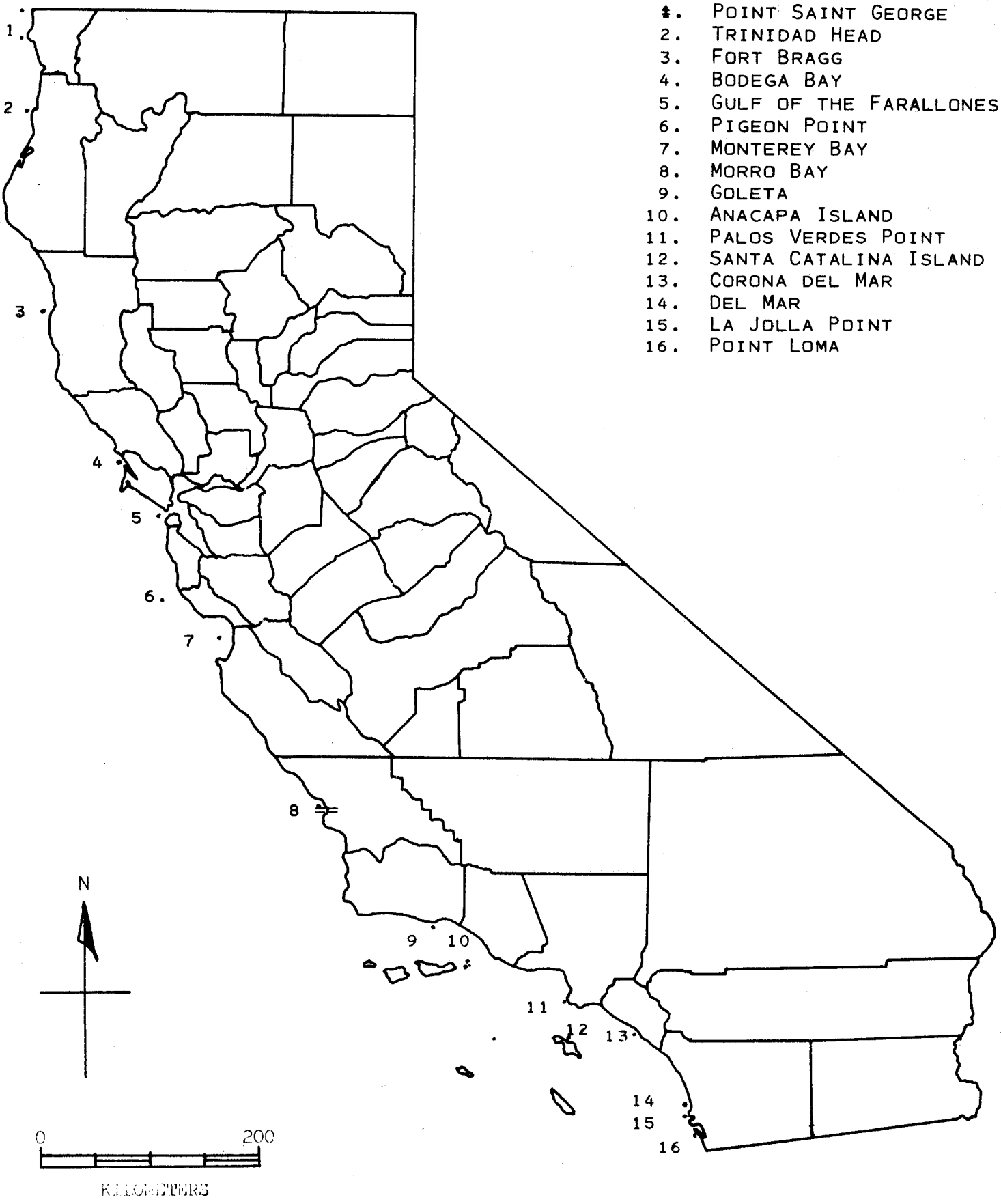

FIGURE 2. MAP OF CALIFORNIA SHOWING THE PROPOSED CONES STUDY SITES.

The CONES study undertaken by the project consisted of two segments. The first, a 100 m (328 ft) transect, normal to the shoreline, was established in 14 to 17 m (45 to 55 ft) of water. The second segment was composed of five stations, also on a line normal to the shoreline, at nominal depths of 6, 12, 18, 24 and 30 m (20, 40, 60, 80 and 100 ft).

This combination was chosen to allow a detailed examination of the quadrats located along the transect, within a restricted depth range. The arc stations were included to cover a broader bathymetric range, with a few, large stations. The combination of these two sampling schemes was intended to better describe the study area.

AREA DESCRIPTION

The Palos Verdes Peninsula consists of steep rocky cliffs capped by a series of raised marine terraces. The peninsula is a promontory in a series of coastal promontories and crescent bays which make up the coastline of the Southern California Bight. In this instance, the promontory separates Santa Monica Bay from San Pedro Bay and the Orange County coastline (Figure 3).

Palos Verdes Point (Rocky Point) is the westernmost point of land on the peninsula, and the site of our study area. Located 3.2 km (2 mi) north-northwestward of Point Vicente, Palos Verdes Point is a steep shale cliff 37 m (120 ft) high, which rises abruptly from the ocean. Offshore, the profile consists of a wide shallow terrace, followed by a rocky slope which reaches from the 6 m (20 ft) terrace to depths of 24 m (80 ft). Here the bottom topography becomes flatter, consisting of a flat mud-sand bottom (Figure 4).

The shallow nearshore shelf has numerous rocky outcroppings, many of which break the surface near the point. A small cove (Lunada Bay) is located inside the point. The bottom of the cove is rock, with rubble and pockets of sand overlying the rock base. This is the general

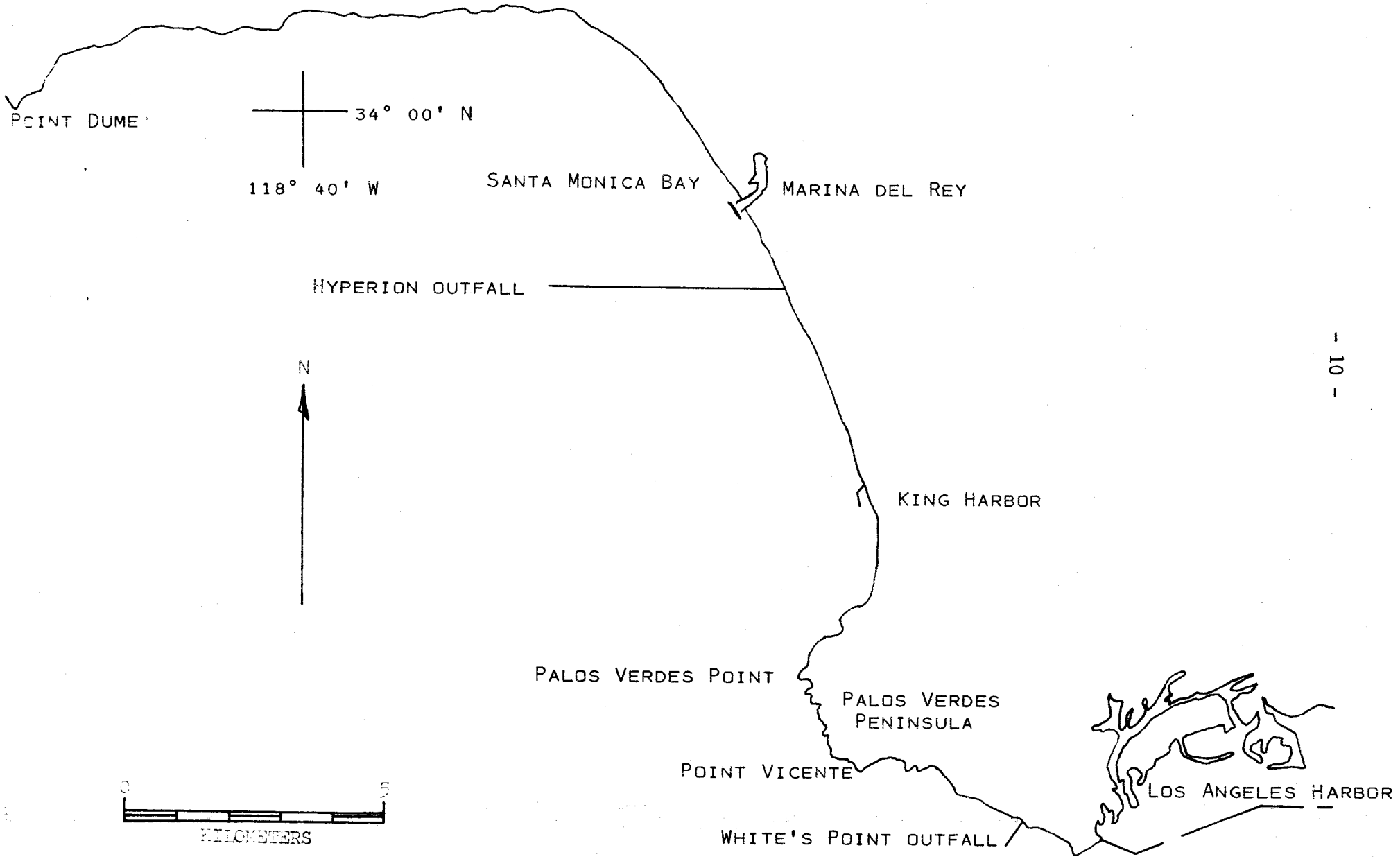

FIGURE 3. LOCATION MAP, SHOWING THE CONES STUDY AREA IN RELATION TO OTHER MAJOR FEATURES.

FIGURE 4. REPRODUCTION OF FATHOGRAM ALONG THE CONES ARC STATION LINE.

area in which our 6 m (20 ft) station was located. Offshore from this initial terrace, the slope consists of a series of upturned parallel rock ridges which run normal to the shoreline. The ridges are generally 6 to 10 m (20 to 30 ft) apart, and provide relief of up to 3 m (10 ft). The spaces between the ridges are generally filled with sand and rubble deposit which overlies the rock substrate. This general habitat extends from the 5 to 6 m (15 to 20 ft) shallow shelf to a depth of approximately 24 m (80 ft), where the rock ridges disappear. Our 12 and 18 m (40 and 60 ft) stations were located on this slope. The 24 m (80 ft) station was located beyond the rock ridges, in a boulder field at the base of the slope. The boulders ranged from 0.5 to 1 m (1 to 3 ft) in diameter, with sand-mud intrusions forming the base. Beyond this point the bottom becomes relatively flatter, with little relief. This sand-mud bottom was the substrate for our 30 m (100 ft) station.

The CONES transect ran across the parallel rock ridges on the slope, in an area similar to that in which the 12 and 18 m (40 and 60 ft) stations were located. The transect began on the edge of one rock ridge at a depth of 14 m (45 ft), crossed one sand pocket, and then crossed a second rock ridge at a shallow angle, terminating at a depth of 17 m (55 ft). Blocks 1, 2, 3, 5, 6, and 8 to 21 were located on rock reef, with varying amounts of sand cover, while stations 4 and 7 were located in deep sandy pockets, overlying a rock substrate.

MATERIALS AND METHODS

Methods for the arc stations were developed directly from those used in earlier Department ecological surveys (Turner, Ebert and Given 1965, 1966, 1968). The methods for the transect study were developed from those proposed for the standard CONES survey, and consisted of a 100 m (328 ft) transect.

The CONES 100 m (328 ft) transect was established during 1968, offshore from Palos Verdes Point. The transect ran normal to the shoreline, approximately east-west in this area, and consisted of 21 stations located at 5 m (16.4 ft) intervals. Permanently marked with weighted, numbered concrete blocks, the study area at each station consisted of a quadrat 0.5 m (1.6 ft) on a side (0.25 m^2, 2.6 ft^2), positioned on the north and south sides of the station markers. We identified and enumerated the macroscopic plants and animals in each quadrat on a quarterly basis from August 1970 to May 1972, and once again in April 1973. On occasion we noted that some of the station markers had moved slightly during periods of strong swells and surge. Since we could not relocate these positively, we used their new location for the remainder of the survey.

The second segment of the survey, consisting of five stations located in nominal 6 m (20 ft) depth increments, was established in January, 1969, on a line between Palos Verdes Point and the Palos Verdes Point Lighted Whistle Buoy No. 10 (U.S. Coast Guard Light List No. 16.55), located 1.45 km (0.9 mi) offshore. The stations were selected by running on a straight line btween these two points and dropping a weighted marker buoy when our fathometer first indicated depths of 6, 12, 18, 24 and 30 m (20, 40, 60, 80 and 100 ft). Where the weighted marker first hit the bottom we established our permanent station markers, consisting of weighted concrete blocks. Due to the irregular bottom topography, not all stations were located at their nominal depths; thus the 12 m (40 ft) station was located in 16 m (55 ft) of water, and the 30 m (100 ft) station in 33.5 m (110 ft). Shoreside bearings were established for each of the stations, and for the transect, after which the surface buoys were removed to prevent damage or loss of the station markers. The actual study area at each station consisted of a circle, generated with a radius line. On

mud-sand substrate (30 m (100 ft) station) we used a 3.1 m (10.2 ft) line to inscribe a circle with an area of 30 m^2 (322.8 ft^2). At the other stations (rock substrate), we used a 2.2 m (7.22 ft) line to inscribe a circle with an area of 15 m^2 (161.4 ft^2). Using compass bearings we noted the relative positions of, and identified and enumerated the macroscopic fauna and flora on the same quarterly basis as at the transect.

Incidental collections for infaunal components were occasionally made at these stations, however the collections were taken from the area immediately surrounding the arc so as not to disturb the arc or quadrat area.

Physical observations taken at each station included water temperatures and estimates of water clarity. Water temperatures were taken either by the diver, with a mercury thermometer graduated in increments of 1 F, or later, from the surface, with a Yellow Springs Telethermometer graduated in increments of 1 C. Several long term thermograph records were also made, utilizing Ryan thermographs. Estimates of water quality were made by divers following the methods outlined in previous Department publications (Turner, Ebert and Given 1964, 1965).

RESULTS

Physical

Physical observations taken in the course of this study are summarized in Tables 1 and 2. The temperature regime in the study area conformed to the general patterns found in nearby Santa Monica Bay, and most of the rest of coastal southern California (Turner, Ebert and Given 1969). In August 1970, a well defined thermocline was present, followed by a breakdown of the thermocline, and homogenous conditions in November 1970. By March 1971, vertical thermal gradients had begun to form, and they continued developing through the spring. A strong thermocline was again present in August 1971 (Figure 5).

TABLE 1. Water Temperature and Visibility For Stations Along Cones Transect, January 1968 to May 1972.

Depth (meters)	Temp	Vis	7-2-68		9-12-68		9-13-68		9-23-68		12-3-68		12-6-68		1-6-69		1-10-69		7-25-69	
	1-24-68																			
Air							21.5													
SS	14.1	20'	19.4	10'	20.6	30'	20.8		19.0	15'	14.3	20'	13.9	15'		35'	14.6	45'		8'
3	14.1	20'			20.6	30'	20.5		15.8	15'		20'		15'		35'	14.6	45'		8'
6	14.2	20'			20.6	30'	20.4		14.8	15'		20'		15'		35'	14.6	45'		8'
9	14.2	20'			20.6	30'	20.2		14.6	15'		20'		15'		35'	14.6	45'		15'
12	14.3	20'			20.3	30'	19.4		14.4	15'		20'		15'		35'	14.6	45'		15'
15					20.3	30'	17.9		14.9	15'	12.5	20'	13.8	15'		35'	14.6	45'		15'

Depth (meters)	Temp	Vis	4-8-70		4-8-70		4-10-70		4-16-70		5-1-70		6-25-70		9-14-70		9-15-70		9-16-70	
	10-30-69																			
Air																				
SS	16.7	10'		30'		30'	16.1	30'	14.4	15'		20'			18.9	5'	18.9	5'	17.8	5'
3		15'		30'		30'		30'	14.4	15'		20'					16.7	30'	12.2	20'
6		20'		30'		30'	15.6	30'	14.4	15'		20'					13.3	30'	11.7	40'
9		20'		30'		30'	15.6	30'	13.9	15'		20'					12.2	30'	11.7	40'
12		20'		30'		30'	15.0	30'	13.3	15'		20'					12.2	30'	11.7	40'
15	15.6	20'	12.8	30'	11.7	30'	13.3	30'	12.2	15'			10.6	15'	11.1	20'	11.7	30'	11.7	40'

Depth (meters)	Temp	Vis	3-11-71		3-16-71		3-30-71		4-1-71		5-25-71		5-26-71		6-17-71		8-10-71		8-12-71	
	11-18-70																			
Air																				
SS	16.7	15'	12.2	5'							15.0	10'	15.0	15'			22.2		21.1	10'
3			11.7	10'							14.2	10'	14.4	15'			22.2			
6			11.4	10'							10.3	30'	13.9	15'			22.0			
9			11.4	10'							10.0	30'	11.7	15'			22.0			
12			11.4	10'							10.0	30'	11.1	15'			22.1			
15	15.6	10'	11.1	10'		1'	11.1		11.1		10.0	30'	11.1	15'	11.7	15'	17.0	25'	16.7	20'

Depth (meters)	Temp	Vis	11-17-71		11-18-71		2-3-72		2-22-72		2-23-72		3-2-72		5-12-72		5-16-72			
	8-23-71																			
Air																				
SS		10'	13.6	10'	13.9											5'				
3			13.6	10'	13.9											5'				
6			13.3	10'	13.9											5'				
9			13.3	10'	13.6											5'				
12			13.0	10'	13.6											5'				
15	16.1	15'	13.0	25'	13.3			20'	11.7	5'	11.7	5'	12.8	20'		25'	11.1	20'		

TABLE 2. Temperature and Visibility in Water Column at Cones Stations, September 1968 to May 1972

Station 6	Depth (meters)	Temp 9-24-68	Vis	11-20-69		5-1-70		8-4-70		11-4-70		4-7-71		5-24-71		9-1-71		12-10-71		5-5-72			
	Air											21.1						13.3		22.2			
	SS		20'		25'		20'	17.2	15'	16.1	10'	13.3	8'		25'			13.7	20'	19.4			
	3		20'		25'		20'			16.1	10'	13.3	10'					11.7	20'	19.4			
	6		20'		25'		20'		15'	16.1	10'	13.3	15'	13.9	25'	20.0		11.7	20'	18.9			
	9																						
12		9-26-68		11-20-69		8-5-70		11-5-70		11-12-70		3-11-71		5-7-71		8-26-71		12-21-71		3-1-72		5-3-72	
	Air																	13.3					
	SS		20'		25'	16.7	20'		15'	13.9	25'	12.2	5'	13.3	20'	21.7		11.7	10'				
	3				25'		20'		15'	13.3	25'	11.7	10'	13.3	15'	15.6		11.7	10'				
	6				25'		15'		15'	13.3	20'	11.4	10'	12.8	15'	13.9		11.4	20'				
	9				25'		15'		15'	12.8	15'		10'	11.7	15'	12.8		11.4	20'				
	12				25'		15'		15'	12.8	10'		10'	11.1	25'	12.8		11.3	20'				
	15						20'		15'	12.8	10'	11.1	10'	10.8	25'	12.8		11.3	20'	12.8	15'	11.1	
18		9-24-68		11-6-69		12-4-69		1-9-70		5-1-70		8-7-70		8-12-70		11-10-70		11-12-70		3-9-70		5-3-71	
	Air							12.2															
	SS	19.2	25'	16.7		16.7	10'				20'			18.3	20'	16.1	15'	15.6	30'	11.7	5'	14.2	10'
	3	18.8	25'								20'			17.2	10'	16.1	10'	15.6	20'	10.6	15'	13.3	
	6	18.4	25'								20'			15.6	10'	15.6	10'	15.0	20'	10.6	20'	13.3	
	9	14.8	25'								20'			13.9	10'	15.0	15'	14.4	15'	10.6	20'	12.8	
	12	14.1	25'								20'			12.8	10'	14.4	20'	13.9	15'	10.6	20'	11.7	
	15		25'								20'			10.6	25'	13.9	15'	13.9	15'	10.6	20'	10.0	
	18	13.9	25'	16.7	60'	16.7	2'			10.0	20'		15'	10.0	20'	13.9	10'	13.9	15'	10.0	20'	9.7	15'
	21															13.9	10'						
18-contd.		8-18-71		11-19-71		12-14-71		2-25-72		5-4-72													
	Air	23.9				12.8																	
	SS	21.4	10'	13.3		12.0	10'	15.0		15.6													
	3	21.1				12.0	10'	14.7															
	6	19.4				11.7	10'	14.4															
	9	18.9				11.7	10'	13.9															
	12	15.8				11.4	10'	13.3															
	15	15.8				11.1	10'	12.0															
	18	15.3	25'			10.8	20'	12.0		11.1													
	21																						

TABLE 2 - contd.

Station 24	Depth (meters)	Temp Vis 9-26-68	1-9-70	8-10-70	11-5-70	11-17-70	3-12'71	3-15-71	5-4-71	5-5-71	8-13-71	12-8-71
	Air										23.9	
	SS	20.2 20'	12.8	17.2 10'	16. 30'	16.4 20'	11.7 5'	13.3 10'	14.4 5'	14.7 20'	22.8 5'	11.1
	3	20'		10'		20'	11.7 10'			13.3	18.6	11.1
	6	18.3 20'		5'		20'	11.4 10'			13.0 10'	18.3	11.1
	9	20'		5'		20'	11.1 15'	10.0		12.2 10'	17.8	11.1
	12	16.2 20'		15'		10'	11.1 20'	10.0		11.1	15.8	11.1
	15	20'		15'		10'	11.1 20'	10.0		10.3	14.2	11.1
	18	15.6 20'		20'		10'	11.1 20'	10.0		10.0	14.2	11.1
	21	20'		20'		10'	11.1 20'	10.0		9.4	13.9	11.1
	24	14.8 20'	12.2 15'	20'	15.6 20'	15.6 10'	11.1 20'	10.0 8'	10.0 20'	9.3 25'	13.9 15'	10.6
	27											

24-contd.		12-10-71	12-14-71	2-24-72	5-9-72
	Air		12.8		
	SS	11.7	11.7 10'		30'
	3	11.7	11.7 10'		
	6	11.7	11.7 10'		
	9	11.7	11.7 10'		
	12	11.7	11.7 10'		
	15	11.7	11.7 10'		
	18	11.7	11.7 10'		
	21	11.7	11.7 10'		
	24	11.4	10.6 20'		11.1 15'
	27				

30		9-24-68	1-13-69	11-6-69	11-20-69	1-9-70	8-3-70	8-4-7-	8-7-70	11-4-70	3-16-71	4-1-71
	Air					12.2						
	SS	25'		16.7 70'	30'	12.2	20.0 25'	16.1	16.7 12'	16.7 40'	12.8 10'	
	3	19.8 25'		70'	30'				15.6	16.7 40'	12.2 10'	
	6	18.6 25'		70'	30'	12.2	17.8 10'		14.4	16.7 40'	12.2 10'	
	9	25'		70'	30'				13.3	16.7 40'	12.2 10'	
	12	25'		70'	30'	13.3	15.6 10'		12.2	16.7 40'	12.2 10'	
	15	14.2 25'		70'	30'				11.7	16.7 40'	12.2 10'	
	18	15.8 25'		16.7 70'	30'		11.7 10'		10.6	16.7 30'	11.1 10'	
	21	25'		70'	30'					20'	11.1 5'	
	24	25'		70'	30'	12.8	11.7 20'		10.0	20'	11.1 5'	
	27	25'		70'	30'					20'	11.1 2'	
	30	13.4 25'		13.9 20'	30'		11.7 20'	10.0 10'	9.4 12'	20'	11.1 2'	
	33					12.8 10'				15.6 20'	10.0 1'	10.0 20'

Blocks placed

TABLE 2 - contd.

Station 30 contd.	Depth (meters)	Temp Vis 4-2-71	5-24-71	6-17-71	6-18-71	8-16-71	8-17-73	12-2-71	2-4-72	2-29-72	5-5-72	5-10-72
	Air				18.3	23.9	23.9					18.3
	SS	11.1	16.1	16.7	16.7 15'	22.0 10'	18.3 10'		12.8 20'	14.2	16.4	16.4
	3	11.1	14.7	16.1	15'	17.2	17.5	13.9	12.8 20'	14.2	15.6	15.6
	6	11.1	13.0	15.0	15'	16.1	16.1	13.9	12.8 20'	13.9	13.9	13.9
	9	11.1	12.5	14.4	10'	15.8	15.6	13.9	12.8 20'	13.9	13.3	13.3
	12	11.1	12.0	13.9	10'	15.3	15.6	13.9	12.8 20'	13.6	12.2	12.2
	15	11.1	10.8	12.2	10'	14.4	15.6	13.9	12.8 20'	13.6	12.2	12.2
	18	11.1	10.3	11.1	10'	14.4	14.7	12.8	12.8 20'	13.6	11.7	11.7
	21	11.1	10.0	10.6		14.2	14.7	12.8	12.8 20'	13.6	11.4	11.4
	24	11.1	9.4	10.3	15'	14.2	14.7	12.5	12.8 20'	13.0	11.1	11.1
	27	11.1	9.2	10.0	15'	13.3	14.7	12.2	12.8 20'	12.8	11.1	11.1
	30	11.1	9.2 15'	10.0	10.0 15'	12.8	14.4	12.2	12.8 15'	12.8	11.1	11.1
	33	10.0	9.2 15'	10.0		12.5 25'	14.2 25'		12.2 15'		10.8	10.8

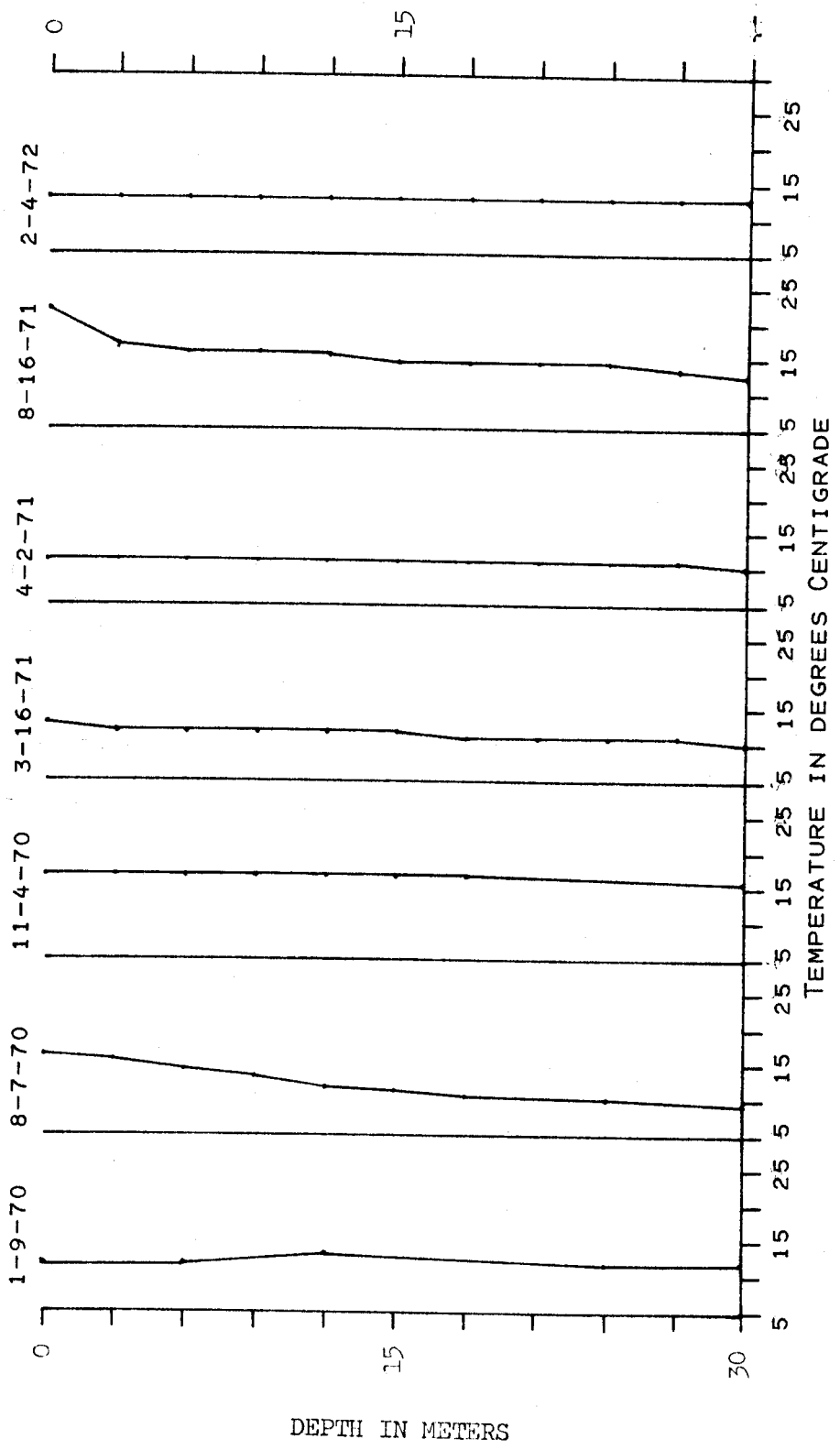

FIGURE 5. TEMPERATURE PROFILES AT THE CONES 30M (100 FT) STATION.

We did note several unusual temperature fluctuations during the course of this study. One, almost as large as the annual range, occurred at the 6 m (20 ft) station in September 1971, when the bottom temperature was 16.3 C on the seventh, and rose to 22.8 C on the fourteenth. Other interesting temperature fluctuations included surface temperatures of 15.0 C and 13.9 C, recorded fifteen minutes apart at the 12 m (40 ft) station on November 12, 1970. April 3, 1971 we observed a change in the bottom temperature at the 18 m (60 ft) station of 9.7 to 11.7 C during one hour's time. At the CONES transect, one similar observation yielded a change from 17.5 to 13.9 C at a depth of 15 m (50 ft) over a three hour period.

Visibility estimates during our surveys varied from 3 to 12 m (10 to 20 ft). On several occasions, visibilities of less than 1.5 m (5 ft) were noted, but we did not attempt to work at these times. During the summer of 1971 survey we experienced a visibility inversion which was associated with a red tide bloom in the warm upper waters. We recorded a visibility of 1.25 m (4 ft) from the surface to a depth of 6 m (20 ft). As we crossed the termolcine, the water clarity improved to about 7.6 m (25 ft), though the light level was greatly reduced.

Biological

The data from the biological section of the study is presented in its entirety in the Appendix, due to the bulk of the species lists. Selected data have been summarized, and are presented with the text.

Algal species listed in the tables are those observed in the quadrats and arc stations. An expanded algal species list resulted from intensive collections made in late 1972 (Moe, unpublished, pers. commun.). These collections were made at 6, 12, 18 and 24 m (20, 40, 60 and 80 ft) stations in an attempt to duplicate the stations used by Strachan and Koski (1969). The 18 m (60 ft) station corresponds to station V used by

Grigg and Kiwala (1970). Our collections were not limited to the arc station proper, thus if suitable habitat for algae was not present in the arc station, collections were made at that depth nearby, to assure a representative collection for that depth. Our collections resulted in the identification of 78 species of algae, many of them epiphytes on larger algae. These numbers exceeded those listed by both Strachan and Koski and Grigg and Kiwala in every category (Table 3). These differences may be attributable to the difference in season during which the collections were made, to the methods used in the collection of the algae, or to improved water quality.

CONES Transect

Our data from the CONES transect failed to reveal any significant variations or cycles, which might be attributable either to seasonality, or to the activities of man. Extralimital observations of the larger brown algae such as *Eisenia arborea* and *Egregia laevigata* coincided with observations made at the 6 m (20 ft) station. The encrusting coralline algae (*Lithophyllum* sp., *Lithothamnion* sp. and *Peysonellia* sp.) were present wherever rock as available, and covered at least 80% of the rock surface. A total of 84 different taxa, fifteen algae among them, were identified from the transect. Counts of individual organisms which are capable of camouflaging their presence showed variation, but the variation is without question attributable to the actions of the biologist, disturbing the organisms prior to the counts. For this reason, counts of *Podoesmus cepio*, cerianthid anemones and boring bivalves should be interpreted with caution. The transect appears to be a relatively stable area, with a well defined flora and fauna. Sand transport in the area was negligible during the period of the survey. Pins inserted at the beginning of the survey were relocated at the end of the survey, and showed no net movement of sand at that location, although seasonal changes

TABLE 3. COMPARISON OF ALGAL SPECIES NUMBERS FOUND DURING THREE SURVEYS CONDUCTED OFF PALOS VERDES POINT.

DEPTH	CLASS OF ALGAE	STRACHAN AND KOSKI (1969)	GRIGG AND KIWALA (1970)	MOE (1972)
6 M	BLUE-GREEN	0		0
	GREEN	0		2
	BROWN	4		6
	RED	12		34
12 M	BLUE-GREEN	0		1
	GREEN	0		3
	BROWN	3		11
	RED	11		42
18 M	BLUE-GREEN	0	0	1
	GREEN	0	0	0
	BROWN	0	1	1
	RED	6	2	16
24 M	BLUE-GREEN	0		1
	GREEN	0		0
	BROWN	0		0
	RED	2		5

were noted by the divers. One note of interest resulted from the use of zinc plated eyebolts to locate the stations along the transect. Within 30 minutes of the installation of the eyebolts, *Pisaster giganteus* were observed clustering on the new eyebolts. This same behavior was noted when the weighted blocks, equipped with similar eyebolts, were first installed, at both the transect and the arc stations.

CONES Arc Stations

The CONES arc stations, covering a greater bathymetric range, showed several trends, and yielded information on individual species. This data will be summarized by stations, since some of the patterns show interrelationships.

The 6 m (20 ft) station showed some of the most obvious changes, as one would expect in this shallow, relatively exposed area. The area offshore from Palos Verdes Point once supported lush beds of the giant kelp, *Macrocystis pyrifera*, (California Water Quality Control Board 1964). When the station markers for this station were installed in January 1969, none of the large brown kelps were present in the area, and it might have been termed "barren." This condition had not changed by November, 1969; however by May 1970, *Eisenia arborea* and *Egregia laevigata* were so numerous as to completely obscure the station markers (Table 4). We made five searches for the station in June and July of 1970, but were unable to locate the station. We finally located the station in August 1970, exactly where our shore marks indicated the station should be. There were 118 *Egregia laevigata* and 9 *Eisenia arborea* plants within the 15 m^2 (161.4 ft^2) study site. By April 1971 the *Egregia laevigata* had been reduced to 35 plants, almost all supporting large numbers of the limpet *Notoacmaea insessa*. The reduction in numbers continued, until only two plants remained in May 1972, and none were present in April 1973 (Figure 6). The reduction in numbers of plants in this instance appears

TABLE 4. SELECTED SPECIES LIST OF INVERTEBRATES AND ALGAE RECORDED AT THE CONES ARC STATIONS.

STATION	ORGANISM	8/70	11/70	4/71	6/71	8/71	12/71	2/72	5/72	4/73
6 M	CYSTOSEIRA OSMUNDACEA	5	2	38	45	19	20	53	16	7
	EISENIA ARBOREA	9	P	9	10	22	13	12	13	4
	EGREGIA LAEVIGATA	118	A	35	25	17	12	15	2	0
	DYCTIOPTERIS ZONARIOIDES	5	3	S	C	31	2	4	0	0
	GELIDIUM SP.	26	5	A	92	26	17	37	15	0
	HALIOTIS CRACHERODII	3	3	5	4	10	24	27	25	12
	STRONGYLOCENTROTUS FRANCISCANUS	39	24	33	41	33	37	50	50	35
12 M	KELLETIA KELLETI	6	11	9	15	11	5	14	25	
18 M	ACMAEA MITRA	8	7	49	30	26	6	15	16	
	KELLETIA KELLETI	6	4	5	8	1	13	19		
24 M	ACMAEA MITRA	2		12	6	11	9	16	4	
	KELLETIA KELLETI	7	7		2	9	8	6	2	
30 M	RICTAXIS PUNCTOCAELATUS		300	100	3	12	360	240	240	
	PYROMAIA TUBERCULATA	1080			1	1				

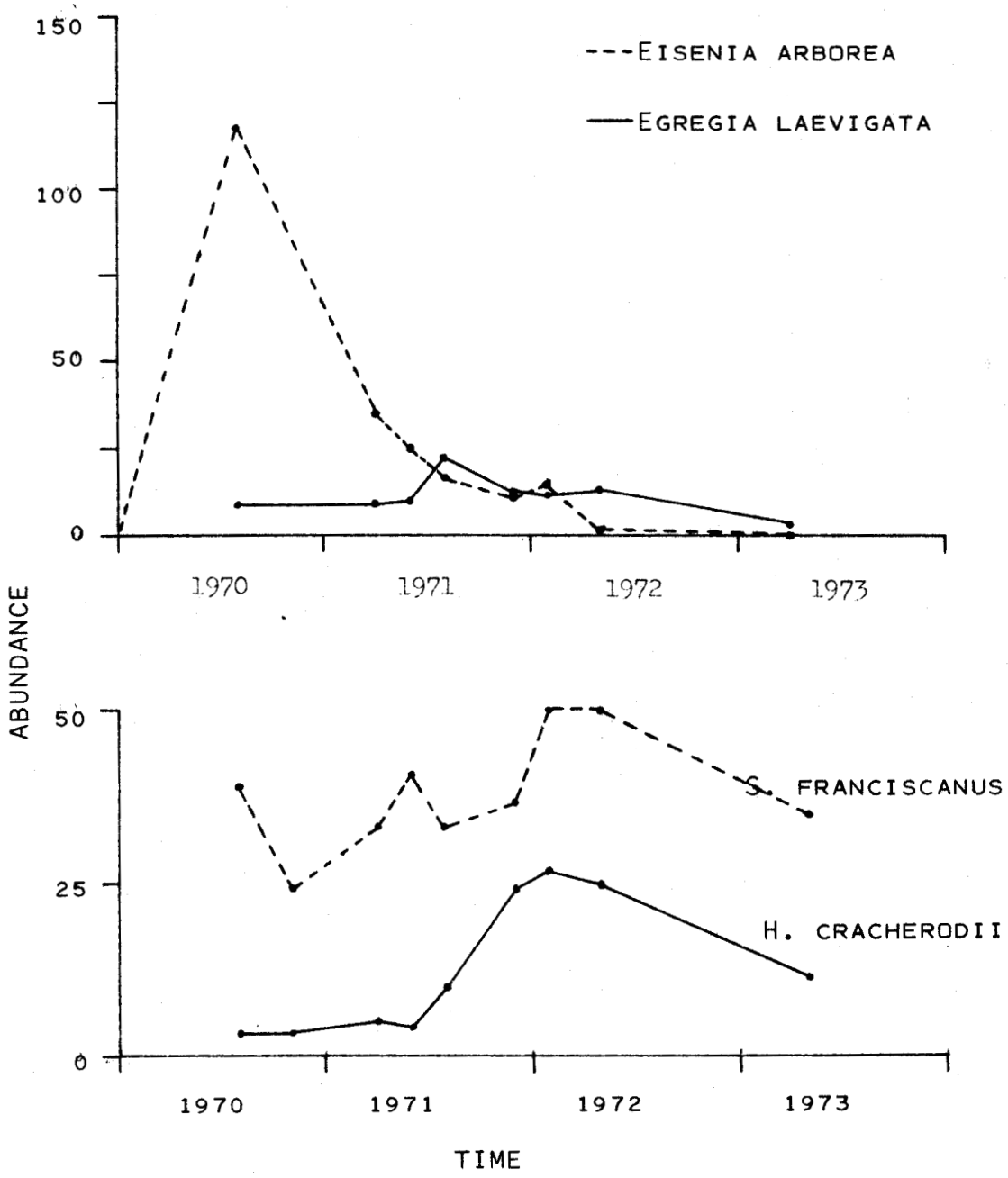

FIGURE 6. PLOT OF THE SEASONAL ABUNDANCE OF ALGAE AND HERBIVORES AT THE CONES 6 M (20 FT) STATION.

to be attributable, at least in part, to a weakening of the stipes by *Notoacmaea insessa*, combined with strong winter surf and surge (McLean 1969). In contrast, the *Eisenia arborea* numbers fluctuated, but plants remained present throughout the study, ranging from a low of nine in August 1970, to a high of 22 plants in September 1971. At the completion of the study, in April, 1973, only four *Eisenia arborea* remained in the study area, a return to conditions present when the first station markers were established.

These fluctuations in the abundance of brown algae are of significance when the fluctuations in the populations of known kelp grazers are analyzed. Leighton and Boolotian (1963) have shown that *Egregia laevigata* is the preferred food of the black abalone, *Haliotis cracherodii*. It is not surprising then, that the population of this grazer increased from a low of three animals at this station in August 1970, to a high of 27 animals in February 1972 (Table 4). A similar pattern is present for another grazer, the red sea urchin, *Strongylocentrotus franciscanus*, which increased from 39 animals in August 1970, to a high of 50 animals in May 1972. Figure 7 shows that the increase in brown kelps and kelp grazers follow one another temporarily. Early in our study, when algal cover was abundant, the herbivore *Haliotis cracherodii* began to show an increase in numbers. This increase reached a relatively stable high during 1971 and early 1972. As one would expect in this situation, the increase in herbivores lagged the increase in algae by a period of time, and after the algal numbers decrease, the herbivore remained in large numbers. It is unfo-tunate that our study was terminated at this point in time, because to complete a classical "predator-prey" population cycle, we would have to follow a decrease in herbivore numbers, a decrease which should have lagged the decrease in the numbers of brown kelps.

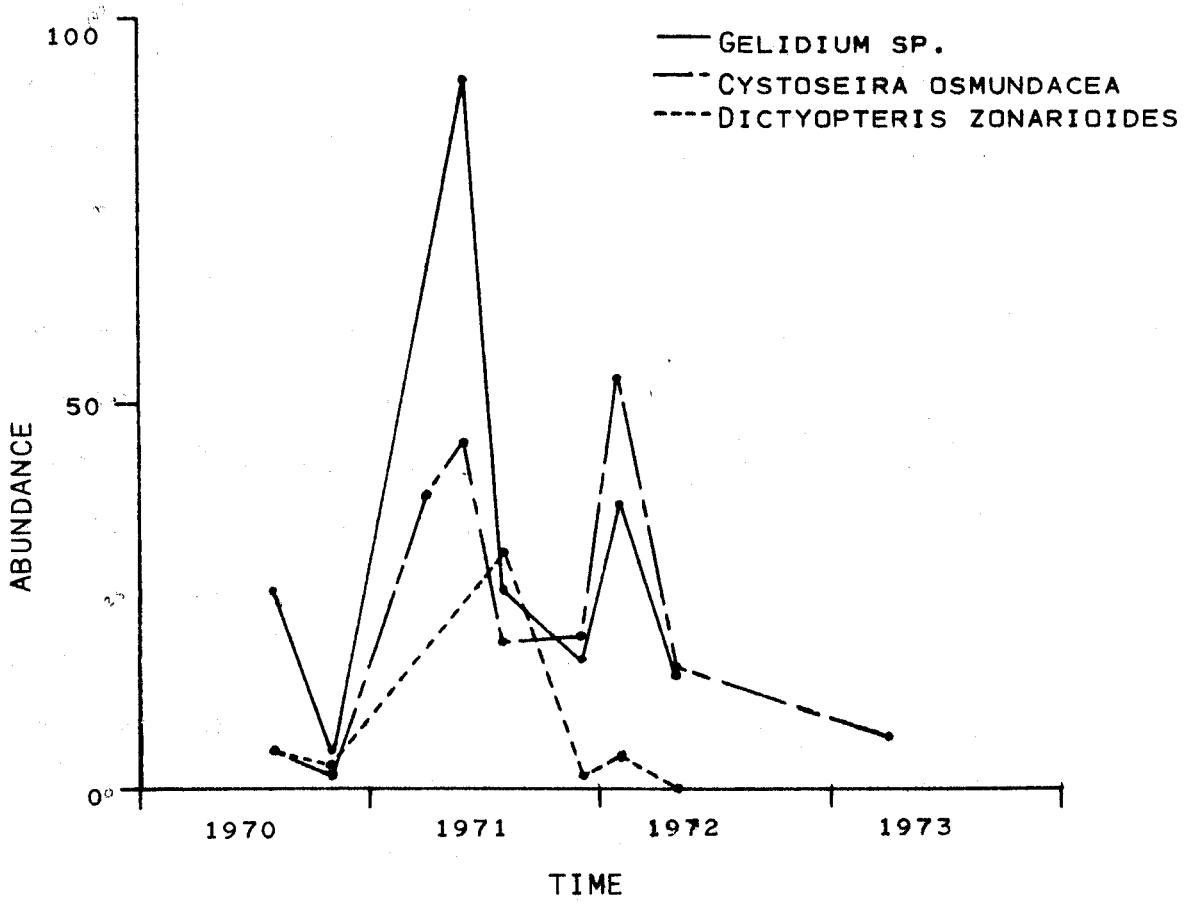

FIGURE 7. SEASONAL ABUNDANCE OF ALGAE AT 6 M (20 FT) STATION.

The other kelp grazer which showed a cycle, the red urchin, never reached the low numbers recorded for black abalone. This animal has been shown to posess the ability to subsist on dissolved nutrients in the water (Clark 1969).

The abundances of three other algae showed some annual periodicity. *Cystoseira osmundacea* and *Dyctiopteris zonariodes*, both phaeophytes, and the red algae *Gelidium* sp. showed annual variations, with spring and summer high counts, and subsequent reduction in numbers during the fall and winter months (Table 4, Figure 7). The encrusting coralline algae again covered in excess of 80% of the available rock habitat at this and all arc stations.

The 12 m (40 ft) station showed only one cycle of note. In general, water clarity at this depth precluded the presence of the brown algae, thus the lack of these cycles at this station. A possible annual periodicity to the numbers of the snail *Kelletia kelleti* was noted (Table 4). This station, as the transect, appeared to be a relatively stable community, in equilibrium with conditions in the area.

The 18 m (60 ft) station again appeared to be a relatively stable habitat, and only one new cycle, that of the limpet *Acmaea mitra* was discernible. Again periodicity appears to be annual, but the data is not sufficient for a positive conclusion (Table 4).

Similar patterns were present at the 24 m (80 ft) station, with the general habitat, flora and fauna for these three stations being quite similar.

The 30 m (100 ft) station was a completely different habitat, and the biota was quite different from the other stations. We documented another example of annual periodicity at this station. No specimens of the barrel snail, *Rictaxis (Acteon) punctocaelatus*, were recorded during

the August 1970 survey, but by November 1970 there were 300 present in the 30 m^2 (322.8 ft^2) station. Their numbers declined to 100 in April 1971, three in June 1971, then rose to 12 in August 1971. By December 1971 there were 360 present, 240 in February and May 1972. McLean (1969) states that *Rictaxis punctocaelatus* is common at times on sandy bottoms in bays, and at low tide in shallow sublittoral areas. Most of the shallower substrate off Palos Verdes Point is rock, perhaps accounting for the absence of this snail elsewhere. Our only other record for this animal was at the 24 m (80 ft) station, where three were observed in August 1971. We recorded large numbers, 1080 per 30 m^2 (322.8 ft^2) of the crab, *Pyromaia tuberculata*, in August 1970, but did not see them in large numbers again (Table 4).

Polychaete Samples

Incidental collections were taken for infaunal analysis outside the 30 m (100 ft) station. These occasional samples were taken beyond the limits of the arc station, to avoid disturbing the station. The polychaetes collected in this fashion are recorded here without further analysis (Table 5).

Fish Observations

This study had among its objectives the comparison of reef-oriented sportfish population fluctuations to variations in the benthic communities. The fish observed within the arc proper during this study are recorded in Appendix 3. No apparent trends were discernible, when the observations were compared with the Department's sportfish catch figures for the immediate area, in spite of the large fluctuations in the algal communities at the 6 m (20 ft) station. The absence of any trends may be the result of integrating conditions over a sizeable area into the catch figures for one statistical block. Since the observations showed

TABLE 5. Polychaete Samples from the Cones 30 m (100 ft) Station

	August 1970	November 1970	August 1971	February 1972
Ampharete labrops	P(2)	P		
Armandia bioculata			P(4)	
Chone mollis		P	P(5)	
CIRRATULIDAE		P	P(3)	
Cistenides brevicoma		P		
Diopatra ornata		P		
Glycera sp.		P		
Harmothoe sp.		P		
Hemipodus borealis		P		
Laonice cirrata		P	P(2)	
Lumbrineris latreilli		P	P(4)	
Lyseippe annectens	P(1)	P	P(1)	
Melinna oculata			P(2)	
Nephtys cornuta franciscana			P(1)	
Nephtys sp.		P		
NEREIDAE			P(1)	
Nothria conchylega				P
Nothria iridescens				P
Nothria stigmatis paradiopatra		P		
Ophiodromus pugettensis		P	P(2)	
Pectinaria californiensis			P(1)	P
Pherusa neopapillata		P		
Pholoe glabra		P		
PHYLLODOCIDAE		P	P(4)	
Polydora sp.		P		
Prionospio malmgreni	P(6)	P	P(6)	
Prionospio pinnata		P		
Scalibregma inflatum		P		
Scionella japonica		P		
SPIONIDAE			P(1)	
Spiophanes bombyx		P	P(1)	
Sthenelanella uniformis			P(1)	
Tharyx multifillis			P(9)	

that algal trends in our study area were out of phase with surrounding areas, and since fish populations are highly motile, the sportfish populations may have been moving from one area to another, within the block, thus preventing the catch statistics from reflecting the shifts in population concentrations.

DISCUSSION

Physical

The conditions present at the CONES study site conformed generally to those common to the area. In general, temperature regimes were those of nearby Santa Monica Bay, but appear to have been modifed by the presence of both upwelling from the Redondo Submarine Canyon, and offshore circulation patterns. These two influences could account for the rather sudden water temperature fluctuations encountered during the study.

Water quality in the area was also subject to the influence of both the Redondo Submarine Canyon, and Santa Monica Bay. Visibilities were tied closely to both suspended material in the water column, and to the presence of "red tides." Suspended material, whether from storm action, or from the City of Los Angeles' Hyperion outfall and the County of Los Angeles White's Point outfall decreased visibilities by clouding the water with suspended particulate matter, while the "red tides" reduced visibilities by reducing the amount of light penetrating the water column. At times the "red tides", in combination with a strong thermocline, created a visibility inversion, consisting of warm "red tide" water at the surface, and cold clear water below the thermocline.

The influence of these conditions on the biota in the CONES study area is unknown, but the reduction in light levels is most significant, since the large brown algae were unable to establish themselves at the 12 m (40 ft) station. These same algae thrive at this depth in other

areas where the water clarity is better. The abundance of nutrients, whether from upwelling or from man-made sources must also have an impact on this area. The lack of control study areas makes it impossible to compare the results of this study with an area which is not subject to the influence of large municipal outfalls.

Biological

The Palos Verdes Peninsula, and the CONES study area, have without question been heavily impacted by man's actions (Grigg and Kiwala, 1970). Young (1964) ran a series of experiments in 1956, which demonstrated the deleterious effects of direct exposure to the sewer effluent on the black abalone, *Haliotis cracherodii*. Our studies on the other hand showed the presence of this animal in large numbers, and in fact, cycles in the population of this animal appear to be correlated to the cycles in the larger brown kelps of the study area. Other Department surveys have shown large populations of black abalone along the Palos Verdes Peninsula, extending to either side of the White's Point discharge. This would indicate that the conditions along the peninsula have improved since the earlier work was done.

Other early studies (California Water Quality Control Board 1964) demonstrated the deleterious effects of the sewer effluents on the algal populations off the Palos Verdes Peninsula. The once lush beds of giant kelp no longer existed when this study began. Our study documented cycles in the populations of some kelps, but we found no giant kelp, *Macrocystis pyrifera*, in our study areas. Recently however, due to the efforts of Dr. Wheeler North, and of the Department's Sportfish-Kelp Habitat Study (Dingell-Johnson Study California F-27-D), large, spreading beds of giant kelp have been established along Abalone Cove, and at Point Vicente on the Palos Verdes Peninsula. This information would tend to support the conclusion that conditions along the peninsula are improving, but they

have not yet reached the level present during the early 1950's.

CONCLUSIONS

The absence of data from control sites initially proposed as an integral part of the CONES program makes analysis of our results difficult. We have a three year, quarterly view of one point in space, without reference to other points. Since our study areas was centered between the two largest municipal waste discharges in the state, the lack of control stations makes interpretations of the data difficult. It is significant however, that in spite of these shortcomings, we were able to identify trends in the area. One can only speculate on the wealth of information we might have derived from a full implementation of the CONES program, had it been diligently pursued. The need for such a base line study program is still present, and the need will continue as long as man continues to use the marine environment as a receptacle for the byproducts of his activities.

REFERENCES

California Water Quality Control Board, 1964. An investigation of the effects of discharged wastes on kelp. Calif. Water Quality Control Board, Publ. (26): 1-124.

Clark, Mary E., 1969. Dissolved free amino acids in seawater and their contribution to the nutrition of sea urchins. Calif. Institute of Technology, Kelp Habitat Improvement Project, Annual Report 1 July 1968 to 30 June 1969, pp. 70-93.

Grigg, Richard W., and Robert S. Kiwala, 1970. Some ecological effects of discharged wastes on marine life. Calif. Fish Game, 56(3): 145-155.

Leighton, David L., and Richard A. Boolotian, 1963. Diet and growth in the black abalone, *Haliotis cracherodii*. Ecology, 44(2): 227-238.

McLean, James H., 1969. Marine shells of southern California. Los Angeles County Mus. Nat. Hist., Sci. ser. 24, Zool. (11): 1-104.

Strachan, Alec R., and Robert T. Koski, 1969. A survey of algae off Palos Verdes Point, California. Calif. Fish Game, 55(1): 47-52.

Turner, Charles H., Earl E. Ebert and Robert R. Given, 1964. An ecological survey of a marine environment prior to installation of a submarine outfall. Calif. Fish Game, 50(3): 176-188.

_____, 1965. Survey of the marine environment offshore of San Elijo Lagoon, San Diego County. Calif. Fish Game, 51(2): 81-112.

_____, 1966. The marine environment in the vicinity of the Orange County sanitation district's ocean outfall. Calif. Fish Game, 52(1): 28-48.

_____, 1968. The marine environment offshore from Point Loma, San Diego County. Calif. Dept. Fish and Game, Fish. Bull., (140): 1-93.

_____, 1969. Man-made reef ecology. Calif. Dept. Fish and Game, Fish. Bull., (146): 1-221.

Young, Parke H., 1964. Some effects of sewer effluent on marine life. Calif. Fish Game, 50(1): 33-41.

APPENDIX 1

CONES Transect Species List BLOCK 17

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Chlorophyta unident.	P	P	P	P																
Phaeophyta																				
Colpomenia sinuosa			P	P							1		1							
Dictyopteris zonarioides	C	C																		
Rhodophyta																				
Bossea orbigniana	P	P	P	P			P	P	S		S			S	S					
Lithophyllum/Lithothamnion sp.	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A
Peyssonnella pacifica							P	P	S		S		C	S		S	S	S		
Rhodymenia sp.							P	P	S		C	P							S	
Rhodophyta unident.	P	P	P	P							C	P	A	C	C		S	S	A	A
INVERTEBRATA																				
Porifera																				
Leuconia barbata					P	P														
Coelenterata																				
Hydrozoa unident.			P	P											A				S	
Anthozoa																				
Corynactis californica	50	50	10		50	30	C	C	75	20	25	20	50	10	75	20	50	25	100	30
Paracyathus stearnsi	1																		1	
Muricea californica	1		1																	
Annelida																				
Diopatra ornata							C	6	1	3		3		15		10	1	7		
Polychaeta unident.									10		10		A		C		C			10
Salmacina tribranchiata														S		S		1		
Spirobranchus spinosus					1	1	C	S	2		2		2			1	3		6	
Crustacea																				
Cirripedia																				
Balanus sp.											P									
Malacostraca																				
Hermit crab unident.							1													
Mollusca																				
Amphineura unident.							1													
Gastropoda																				
Cadlina sp.	P	P																		
Acmaea mitra					1		7			4	1	4		2	2		2			1
Astraea gibberosa									1		2									
Conus californicus										3										
Cypraea spadicea					1															
Kelletia kelletii	P	P			1						2		1			1	2			
Maxwellia santarosana																	1		1	
Megathura crenulata			1																	
Pteropurpura festiva										1										
Serpulorbis squamigerous							1													

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Pelecypoda																				
Boring bivalves unident.					P									S	C	S	S	S	S	S
Chaceia ovoidea											2									
Hinnites multirugosus			1	1	1		1								2		1		3	
Lithophaga plumula	P		15	10						S	C									
Pododesmus cepio					20	3	A	A	12	6	15	4	30	6	10	5	A	5	10	7
Bryozoa																				
Bryozoa unident.											C		A	S						S
Diaperoecia californica	P	P	3	2	P	P	C	5	A	1	A	P	C	S					S	S
Echinodermata																				
Asteroidea																				
Pisaster giganteus	P	P																		
Echinoidea																				
Strongylocentrotus franciscanus					1	1	1				1								1	
CHORDATA																				
Ascidia unident.												1				S	C			

APPENDIX 1

CONES Transect Species List BLOCK 8

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Phaeophyta																				
Colpomenia sinuosa									5											
Dictyopteris zonarioides	P	P			P	P													A	
Dictyota flabellata																				P
Rhodophyta																				
Bossea orbigniana																			3	
Gelidium sp.													C	C						
Lithophyllum sp./*Lithothamnion*	P	P							P	P			C	C			C	C		
Peyssonnelia pacifica									P	P			S	S			S	S		
INVERTEBRATA																				
Coelenterata																				
Hyrozoa unident.													S	S						
Anthozoa																				
Anthozoa unident.																			1	
Muricea californica	1																		1	
Muricea fruticosa																				1
Annelida																				
Chaetopterus variopedatus	P	P			P	P														
Diopatra ornata					P	P			4				6						P	P
Polychaeta unident.			P	P	P	P			10											
Crustacea																				
Malacostraca																				
Hermit crab unident.																				P
Mollusca																				
Gastropoda																				
Kelletia kelletii											99								2	
Megathura crenulata							1													
Mitra idae																				1
Pelecypoda																				
Lithophaga plumula			P																P	
Bryozoa																				
Diaperoecia californica	P	P																		
Echinodermata																				
Asteroidea																				
Pisaster giganteus	2																		1	
Echinoidea																				
Lytechinus anamesus	3		P	P																
CHORDATA																				
Ascidia unident.																1				

APPENDIX 1

CONES Transect Species List BLOCK 10

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Chlorophyta unident.	P	P																		
Phaeophyta																				
Dictyopteris zonarioides	P	P	6		P	P	5		4		6		1	C	C	C				
Dictyota flabellata											1									
Eisenia arborea					P	P	1		4		3									
Rhodophyta																				
Bossea orbigniana	P	P	P	P	P	P	1		18				A		S	S		1		
Corallina sp.	P	P	3																	
Lithophyllum sp./*Lithothamnion*	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A			
Peyssonnelia pacifica														S				S		
Rhodymenia sp.							1		S				C							
Rhodophyta unident.	P	P	P	P							S		A							
INVERTEBRATA																				
Porifera																				
Leuconia barbata					1															
Tethya aurantia	1				1															
Coelenterata																				
Hydrozoa unident.													C	C						
Anthozoa																				
Anthopleura xanthogrammica					1		1		1		1				1		1			
Anthozoa unident.									1											
Corynactis californica	6						10		1	1	30	5	15	10	4	3	1			
Clavularia/*Cornularia* sp.	1																			
Lophogorgia chilensis	1																			
Muricea californica	4		4								1			1						
Muricea fruticosa	1				1		1		1		1		1		1		1			
Zaolutis actius	1		1																	
Annelida																				
Chaetopterus variopedatus	S																			
Phyllochaetopterus sp.													C							
Polychaeta unident.					1				C					S	C					
Spirobranchus spinosus									S	S										
Mollusca																				
Gastropoda																				
Astraea undosa											1						1			
Kelletia kelletii					1										3		2	1		
Mitra idae	3								1				1							
Pelecypoda																				
Boring bivalves unident.					P	P	C	C	A					A		A	A			
Chace a ovoidea																	A	A		
Hinnites multirugosus	P								1		1		1		1					
Lithophaga plumula			50				C			A	A	A	A	A			A	A		
Pododesmus cepio							6		3	1	4	1	10	1	5	1	6	1	6	5

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Bryozoa																				
Bryozoa unident.													1	C						
Diaperoecia californica	P	P			P	P	S	S	A	C	6	3	A	C	C	C	C	S	S	S
Phoronis vancouverensis													C							
Echinodermata																				
Asteroidea																				
Astrometis sertulifera											1									
Pisaster giganteus			1		1		1						1							
Echinoidea																				
Lytechinus anamesus	1																			
Strongylocentrotus franciscanus	P	P											1				1			
Strongylocentrotus purpuratus	P	P																		
Holothuroidea																				
Parastichopus parvimensis	1														1					

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CONES Transect Species List BLOCK 6

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Phaeophyta																				
Dictyopteris zonarioides	P	P	P	P	P	P	P	P								S	S			
Rhodophyta																				
Lithophyllum sp./*Lithothamnion*	P	P	P	P			P	P	P				S	S			S	S		S
Peyssonnelia pacifica							P	P												
Rhodymenia sp.							P	P	P	P	S									
INVERTEBRATA																				
Coelenterata																				
Anthozoa																				
Cerianthidae unident.					1		1		1		2						2		2	
Corynactis californica							5				5						5		2	
Annelida																				
Diopatra ornata							S	S			3		7				4			
Polychaeta unident.							P	P	3											
Crustacea																				
Malacostraca																				
Hermit crab unident.									1											
Mollusca																				
Gastropoda																				
Kelletia kelletii											2	2								
Pelecypoda																				
Lithophaga plumula									C	C										
Echinodermata																				
Ophiuroidea																				
Ophiuroidea unident.					5		1												5	
Echinoidea																				
Lytechinus anamesus	1		2																	

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CONES Transect Species List BLOCK 13

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
ALGAE	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Phaeophyta																				
Dictyopteris zonarioides	P	P																1		
Rhodophyta																				
Bossea orbigniana	P	P	P	P													S			
Lithophyllum sp./*Lithothamnion*	P	P	P	P	P	P	P	P	P	P	P	P	A		A	A	A	A	C	C
Peyssonnelia pacifica									S	S						S		C		C
Rhodymenia sp.					P	P					C	S	C					5		3
Rhodophyta unident.					P	P							C	C	S	S	S	S	C	C
INVERTEBRATA																				
Porifera																				
Tethya aurantia																				1
Coelenterata																				
Hydrozoa unident.	A	A	P	P											1					
Anthozoa																				
Anthopleura xanthogrammica						1		1		1				1		1		1		
Anthozoa unident.											1									1
Cerianthidae unident.					P	P														
Corynactis californica	A	A	P	50	10		10	2	7		10	P	15	10	24		20	1	21	
Clavularia/Cornularia sp.	15				P				5		20		C		C		C		C	
Paracyathus stearnsi					1		1		1	1	1	1	1		1		1	1	1	
Zaolutis actius	1																			
Annelida																				
Diopatra ornata	P	P	P	P	10				S		3	16	5		2	9		11		10
Phyllochaetopterus sp.			P	P																
Polychaeta unident.	P	P										A		10	S	S				
Spirobranchus spinosus					3				2		2									
Crustacea																				
Cirripedia																				
Barnacle unident.																1				
Mollusca																				
Gastropoda																				
Cadlina limbaughi					1				1											
Cadlina sp.	P	P																		
Acmaea mitra										1		1		1		2		3		1
Astraea gibberosa										1										
Astraea undosa			1				1													
Conus californicus									1											
Kelletia kelletii	1				3		2		1									1	1	
Maxwellia santarosana											2					1	1	3		
Mitra idae											1		1				1			
Pelecypoda																				
Boring bivalves unident.							C	C	A	A		A		A	C	A	C	A	P	S
Hiatella arctica																			P	
Hinnites multirugosus															4					
Lithophaga plumula			P	P	P	P			P	P	A		A						P	
Pododesmus cepio			6		P		17		5		5		5		1	5	4	4	9	2

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Bryozoa																				
Bryozoa unident.													P	S	C	S		S		
Diaperoecia californica	P	P	P	P	3				C		2			S		S	S	5	1	
Phoronis vancouverensis	20											A	S	A			S		S	S
Echinodermata																				
Asteroidea																				
Pisaster giganteus									1								1			
Ophiuroidea																				
Ophioderma panamensis							1								1					
Echinoidea																				
Strongylocentrotus franciscanus					2		2			1			1	2		3	1			
Holothuroidea																				
Parastichopus parvimensis										1	1									
CHORDATA																				
Ascidia unident.	A	A																	1	

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CONES Transect Species List BLOCK 12

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Phaeophyta																				
Dictyopteris zonarioides													3		2		S			
Rhodophyta																				
Bossea orbigniana					P	P	P	P	C		C		C	S	C		S			
Lithophyllum sp./*Lithothamnion*	P	P	P	P	P	P	P	P	P	P	P	P	A	A	C	A	A	A	A	A
Peyssonnelia pacifica							P	P	S	S		P	S	C	C		C		P	
Rhodymenia sp.											S	S								
Rhodophyta unident.													A	A	C	C			C	C
INVERTEBRATA																				
Coelenterata																				
Hydrozoa unident.	P	P	P	P			C	C					C	S						
Anthozoa																				
Cerianthidae unident.					1															
Corynactis californica	8	A	8		2	10	3	25	25		25		5	30	10	30	30		10	
Clavularia/Cornularia sp.	A	A											C							
Paracyathus stearnsi					3															
Astrangia lajollaensis	A	A	P	P																
Annelida																				
Diopatra ornata	2				1		5		2		5	2	3		2		2	2	1	
Phyllochaetopterus sp.							S	S					S							
Polychaeta unident.	2				P	P							A	C	C	C	C			
Spirobranchus spinosus							1						2	1						
Crustacea																				
Cirripedia																				
Balanus sp.					1															
Barnacle unident.															1					
Malacostraca																				
Hermit crab unident.											1		3							
Mollusca																				
Gastropoda																				
Acmaea mitra									1	1	3		1	1			2		1	
Conus californicus											1									
Kelletia kelletii	P	P			2						2	1					1			
Maxwellia santarosana														1	2	1		1		
Mitra idae	1				2							1								
Trivia californiana					1															
Pelecypoda																				
Boring bivalves unident.					A	A	S	A	S	A		A		A	C	A	S			C
Chaceia ovoidea																		S		
Hinnites multirugosus	1																			
Lithophaga plumula	P	P							P	P										
Pododesmus cepio	5		13		5		7			2	2		8	1	1	1	7	2	5	2
Bryozoa																				
Bryozoa unident.													C	S						
Diaperoecia californica	P	P	P	P	1		S	S	S	S	S				S					
Phoronis vancouverensis																				S

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Echinodermata																				
Asteroidea																				
Astrometis sertulifera			1																	
Pisaster giganteus	4								1										1	
Echinoidea																				
Lytechinus anamesus																			1	
Strongylocentrotus franciscanus					1				1	1					2		2			
Holothuroidea																				
Parastichopus parvimensis	1																			
CHORDATA																				
Ascidia unident.											1									

APPENDIX 1

CONES Transect Species List BLOCK 1

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Phaeophyta																				
Dictyopteris zonarioides	P	P	P	P	P	P	C	C				S	S	S	S	S	S			
Dictyota flabellata													S		S				A	A
Rhodophyta																				
Bossea orbigniana	P	P	P	P	C	C	P	P	P	P	S		S	C	S	C	S	S		
Corallina sp.																	S	S		
Gelidium sp.					P	P														
Lithophyllum sp./*Lithothamnion*	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A
Peyssonnelia pacifica									P	P			S	S						S
Rhodymenia sp.							S	S	S	S			C	C	S		S		S	
Rhodophyta unident.	P	P			P	P					S		A	A			S	S	A	
INVERTEBRATA																				
Porifera																				
Rhabdodermella nuttingi					1	1														
Coelenterata																				
Hydrozoa unident.	P	P											C	C						
Anthozoa																				
Anthozoa unident.													1							
Cerianthidae unident.					1															
Corynactis californica	(N) 35		15		200		150		27		20		15		31		30		15	
	(S)	15		35						75		100		100		15		120		75
Clavularia/Cornularia sp.													A	1						
Astrangia lajollaensis														10		21		17		
Annelida																				
Diopatra ornata							20		3					1	1	1				
Phragmatopoma sp.													1							
Phyllochaetopterus sp.							30													
Polychaeta unident.									20				A	A	C	2	5	3		
Salmacina tribranchiata					P															
Spirobranchus spinosus													S	2						3
Crustacea																				
Malacostraca																				
Hermit crab unident.	1				1				1		6									
Loxorhynchus grandis																				1
Mollusca																				
Gastropoda																				
Cadlina limbaughi																			1	
Dendrodoris fulva																		4		1
Acmaea mitra	1		1																	
Kelletia kelletii					1		1		1		1		1				3	1	3	1
Serpulorbis squamigerous									1											

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Pelecypoda																				
Boring bivalves unident.							100		A						C	S		C	4	
Lithophaga plumula													S							
Pododesmus cepio					5		20		2	12	3	18	2	15	6	7		6	2	7
Bryozoa																				
Bryozoa unident.													C	S	C		S			
Diaperoecia californica	P	P	P	P	P	P	C	C	C	C	3	4	S	S			S	2		
Phoronis vancouverensis													C							
Echinodermata																				
Asteroidea																				
Astrometis sertulifera							1													
Pisaster giganteus											2	1			1					
Ophiuroidea																				
Ophioderma panamensis														1						
Echinoidea																				
Strongylocentrotus franciscanus	1		1				1				1		1							

APPENDIX 1

CONES Transect Species List BLOCK 2

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Phaeophyta																				
Dictyopteris zonarioides	P	P	1	1	P	P	1	1					S	S	8	C	S		1	5
Dictyota flabellata			P	P																
Egregia laevigata							P	1												
Eisenia arborea					P		5		3											
Rhodophyta																				
Bossea orbigniana	P	P	P	P	P	P	P	1		5		1	S	S		S				S
Lithophyllum sp./*Lithothamnion*	P	P	P	P	P	P	P	P	P	P	P	P	A	A	C	A	C	A	C	C
Peyssonnelia pacifica					P	P	P	P	P			P								C
Rhodymenia sp.					P	P							S							
Rhodophyta unident.	P	P	P	P								S		C				5	P	A
INVERTEBRATA																				
Coelenterata																				
Hydrozoa unident.					P	P							S							
Anthozoa																				
Anthopleura xanthogrammica					1		1		1		1			1	1		1		1	
Cerianthidae unident.											1									
Corynactis californica															1		1	2		
Muricea californica	1		1		1															
Zaolutis actius					1															
Annelida																				
Chaetopterus variopedatus	P	P	C	C	P	P														
Diopatra ornata					P	P	A	A	25	A	10	A	A	A	2		A	2	P	A
Phyllochaetopterus sp.			A	A														1		
Polychaeta unident.					P	P			10					A	5					
Crustacea																				
Malacostraca																				
Hermit crab unident.					1				1											
Mollusca																				
Amphineura unident.																				C
Gastropoda																				
Acmaea mitra							P	P												
Conus californicus																				2
Kelletia kelletii	2						1						1					1	2	
Maxwellia santarosana																		1		
Mitra idae																				1
Pelecypoda																				
Boring bivalves unident.																				A
Chaceia ovoidea																				1
Pododesmus cepio												1								
Bryozoa																				
Bryozoa unident.					2															
Diaperoecia californica					P		5													
Echinodermata																				
Asteroidea																				
Pisaster giganteus																				3

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Ophiuroidea																				
Ophiuroidea unident.			P																	
Echinoidea																				
Lytechinus anamesus			1								1		1							
Strongylocentrotus franciscanus					1		1		2						1		2			
CHORDATA																				
Ascidia unident.					P										2					

APPENDIX 1

CONES Transect Species List BLOCK 4

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Phaeophyta																				
Colpomenia sinuosa																			P	P
Dictyopteris zonarioides	P	P	P	P	P	P	S	S			1	S	S	S	S	A	C	S	7	
Dictyota flabellata												S								
Rhodophyta																				
Bossea orbigniana	P	P	P	P	P	P	S	S	S	S	C	C	S		S	C	S	2	1	A
Coralline unident.			P	P																
Gelidium sp.					P	P														
Lithophyllum sp./*Lithothamnion*	P	P	P	P	P	P	P	P	P	P	P	P	C	C	C	C	S	A	A	A
Peyssonnelia pacifica							P	P			P	P		S						
Rhodymenia sp.												S	S							
Rhodophyta unident.					P	P	S	S					S	S			S	S		P
INVERTEBRATA																				
Porifera																				
Leuconia barbata					P	P														
Porifera unident.																			S	
Coelenterata																				
Anthozoa																				
Cerianthidae unident.			1																	
Corynactis californica	100	25	30		100		75		10		100		25		50		65		80	
Clavularia/Cornularia sp.			P																	
Muricea californica	3				1		1		1				1		1		1		1	
Annelida																				
Chaetopterus variopedatus	S	S	A	A																
Diopatra ornata	25		5		6		C	C	S	S	15		15	5	31		9		A	A
Phyllochaetopterus sp.							C	C												
Polychaeta unident.			P						15						C	10				
Spirobranchus spinosus							1													
Crustacea																				
Cirripedia																				
Barnacle unident.															5					
Mollusca																				
Gastropoda																				
Kelletia kelletii			1								2									
Pteropurpura festiva									1											
Pelecypoda																				
Boring bivalves unident.					C	C														A
Lithophaga plumula			30						C	C										20
Pododesmus cepio							2								4					
Bryozoa																				
Diaperoecia californica	P	P	P	P					S	S	S	S								5
Echinodermata																				
Echinoidea																				
Lytechinus anamesus	2		1						1		1									
Strongylocentrotus franciscanus													3		1					

APPENDIX 1

CONES Transect Species List BLOCK 18

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Chlorophyta unident.	P	P																		
Phaeophyta																				
Dictyopteris zonarioides	P	P	P	P																
Dictyota flabellata																				S
Rhodophyta																				
Bossea orbigniana	P	P	P	P							1		2	3				3		
Lithophyllum/Lithothamnion sp.	P	P	P	P	P	P	P	P	P	P	P	P	A	C	A	S	A	A	A	S
Peyssonnelia pacifica							P	P	S	S	P		S							
Rhodymenia sp.									S		C									
Rhodophyta unident.	P	P			P	P					P	C	S		S	C	S		S	C
INVERTEBRATA																				
Porifera																				
Rhabdodermella nuttingi																S				
Coelenterata																				
Hydrozoa unident.			A	P											S			S		
Anthozoa																				
Anthozoa unident.											1									
Cerianthidae unident.																		6		
Corynactis californica	50		10	30	20	50	20	60	75	75	100	50	75	40	100	75	30		75	75
Paracyathus stearnsi											1									
Lophogorgia chilensis	1		1		1															
Muricea californica					1		1		2		2		2		2		2		2	
Zaolutis actius					1															
Annelida																				
Diopatra ornata						10	1	15	7	2	C		10	5	6	10	3	5	6	
Phyllochaetopterus sp.					15	10														
Polychaeta unident.			P	P					2				2	10		10	5			
Salmacina tribranchiata																		S	1	
Spirobranchus spinosus									1				1							
Crustacea																				
Malacostraca																				
Hermit crab unident.	1																			
Mollusca																				
Gastropoda																				
Acmaea mitra										1		1		1						
Conus californicus			1																	
Kelletia kelletii															1	1		1	3	2
Megathura crenulata														1						
Mitra idae					1															
Trivia californiana	1																			

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Pelecypoda																				
Boring bivalves unident.					50		25			S		P					S			
Hinnites multirugosus											1		2						1	
Pododesmus cepio	20		30	5	3		3		4	5	2	2	5	5	2	4	2	2	6	
Bryozoa																				
Bryozoa unident.					P	P					P		S	S		C				
Diaperoecia californica	P	P		C			C		C	1	C		S							
Phoronidea vancouverensis																				S
Echinodermata																				
Asteroidea																				
Astrometis sertulifera													1							
Pisaster giganteus							1													
Echinoidea																				
Lytechinus anamesus														1						
Strongylocentrotus franciscanus			1														S		1	1
CHORDATA																				
Ascidia unident.														C						

APPENDIX 1

CONES Transect Species List BLOCK 3

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Phaeophyta																				
Colpomenia sinuosa	P	P																		
Dictyopteris zonarioides	P	P	3		P	P	C	C			S	C							2	4
Dictyota flabellata			P	P	P	P							S	S	6	C	C	6	5	4
Eisenia arborea					1		1		1											
Rhodophyta																				
Bossea orbigniana			P	P	P	P	C	C	S	A	3	C	C	S	C	S	S	6	1	A
Gelidium sp.							1							1						
Lithophyllum sp./*Lithothamnion*	P	P	P	P	P	P	P	P	P	P	P	P	A	C	C	C	C	A	C	C
Peyssonnelia pacifica							S	S	S	S	S	S	S	S			S	S		1
Rhodymenia sp.							S	S	S	S	C	S	C	S	C				P	
Rhodophyta unident.			P	P							C	C	C	S			S	S		P
INVERTEBRATA																				
Porifera																				
Leuconia barbata					1															
Rhabdodermella nuttingi							1													
Coelenterata																				
Hydrozoa unident.			P	P									C	C						
Anthozoa																				
Anthozoa unident.									3		2	2								
Cerianthidae unident.	3		2																	
Corynactis californica	40		45		50		25	25	10		10	50	30				2	13	11	4
Clavularia/Cornularia sp.													S							
Muricea californica	1		1		2		2		2		1	2	2		2		2		2	
Annelida																				
Chaetopterus variopedatus	P						C													
Diopatra ornata									S	S	C	1			11	1	10	5		P
Phragmatopoma sp.													S							
Phyllochaetopterus sp.			P		C															
Polychaeta unident.			P						15						C					
Spirobranchus spinosus											1		S							
Crustacea																				
Cirripedia																				
Balanus sp.							1													
Malocostraca																				
Hermit crab unident.											1									
Mollusca																				
Gastropoda																				
Conus californicus	1										1								1	
Kelletia kelletii	1				1						1						1			3
Maxwellia santarosana																	1			
Pteropurpura festiva					1															
Trivia californiana																			1	
Pelecypoda																				
Boring bivalves unident.									A	A		S					C			
Chaceia ovoidea	3		15																	
Hinnites multirugosus															1					
Lithophaga plumula											C		S						20	
Pododesmus cepio							1								4					

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Bryozoa																				
Diaperoecia californica	P	P	2		1				S	S	2	C	S	S			S	S	2	1
Echinodermata																				
Asteroidea																				
Astrometis sertulifera	1																			
Pisaster giganteus											2	1								
Echinoidea																				
Lytechinus anamesus	1								1											
Strongylocentrotus franciscanus	1												1	1			1			
Holothuroidea																				
Parastichopus parvimensis	1																			
CHORDATA																				
Ascidia unident.																	1		2	

APPENDIX 1

CONES Transect Species List BLOCK 14

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Phaeophyta																				
Colpomenia sinuosa			P	P																
Dictyopteris zonarioides	P	P	P	P	S	S	2				3		S		3		5		6	
Rhodophyta																				
Bossea orbigniana	P	P	4										1		1		2			
Gelidium sp.											P									
Lithophyllum/Lithothamnion sp.	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A
Peyssonnelia pacifica													S	S			S	C		
Rhodymenia sp.							1				C	P								S
Rhodophyta unident.	P	P	P	P	P	P							S	C	S	C		5	P	A
INVERTEBRATA																				
Porifera																				
Tethya aurantia																1				
Coelenterata																				
Hydrozoa unident.													C				A			
Anthozoa																				
Anthozoa unident.													1						2	
Corynactis californica	20	A	10	10	50		C	C	15	100	50	15	50	20	100	25	50	50	77	60
Paracyathus stearnsi							1		1		1									
Lophogorgia chilensis			1																	
Muricea californica	1																			
Muricea fruticosa												1		1		1		1		1
Annelida																				
Diopatra ornata					5	5	15	5	15	6	10	10	6	5	5	4		2		8
Phyllochaetopterus sp.																				
Polychaeta unident.	P	P	P	P					10	1			C		S					
Spirobranchus spinosus														1						
Crustacea																				
Malacostraca																				
Hermit crab unident.											1									
Spirontocaris sp.	1																			
Mollusca																				
Gastropoda																				
Dendrodoris fulva	P	P																		
Acmaea mitra															1					
Conus californicus			1																	
Kelletia kelletii	1								1		4		1		2		1		4	
Maxwellia santarosana																				2
Mitra idae							1					1		1						
Pteropurpura festiva					1															
Trivia californiana							1												2	

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Pelecypoda																				
Boring bivalves unident.					25		C				C		C		C		A		C	
Hinnites multirugosus	P	P			1		1													
Lithophaga plumula	P	P							A	A										
Pododesmus cepio	3		4	1	3		C	C		1	12	1	13		14	1	12		12	
Bryozoa																				
Bryozoa unident.			P	P													S		2	
Diaperoecia californica		1	S	1	P	P	S	S	S	S	C	S	S							
Phoronidea vancouverensis												P	C	A		S		A		A
Echinodermata																				
Asteroidea																				
Astrometis sertulifera																	1			
Pisaster giganteus														1		1				
Ophiuroidea																				
Ophioderma panamensis													1		1		1			
Echinoidea																				
Strongylocentrotus franciscanus									3											
Holothuroidea																				
Parastichopus parvimensis																	1			

APPENDIX 1

CONES Transect Species List BLOCK 20

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Chlorophyta unident.	P	P	P	P																
Phaeophyta																				
Dictyopteris zonarioides	P	P	P	P																
Dictyota flabellata																				S
Rhodophyta																				
Bossea orbigniana							P	P						S		S		S		
Lithophyllum/Lithothamnion sp.	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A
Peyssonnelia pacifica							P	P			P		S	S		S		S		S
Rhodymenia sp.							1		C		C	1	S							
Rhodophyta unident.	P	P			P	P	P	P	C			A	P	A	S	A	C		P	C
INVERTEBRATA																				
Porifera																				
Porifera unident.													S		1		S			
Rhabdodermella nuttingi											4									
Coelenterata																				
Hydrozoa unident.															S					
Anthozoa																				
Cerianthidae unident.	1																			
Corynactis californica	100	15	40	50	100	30	A	C	60	20	30	20	30	20	100		30	22	65	25
Paracyathus stearnsi						1	2	1		1				1		1		1	P	1
Muricea californica	2			1	2		2		2		1		2		2		2		2	
Annelida																				
Chaetopterus variopedatus	P	P																		
Polychaeta unident.			P	P					5							S	S			
Spirobranchus spinosus			P	P	1		C			C			2	6		2		3		2
Crustacea																				
Cirripedia																				
Barnacle unident.																2		1		1
Malacostraca																				
Hermit crab unident.													1							
Mollusca																				
Gastropoda																				
Acmaea mitra											1				1		1	2		2
Astraea gibberosa												1								
Conus californicus											1									
Kelletia kelletii	1		1		1								1	1	1					2
Mitra idae											1									
Simnia vidleri													1							
Pelecypoda																				
Boring bivalves unident.					A	P	C	C	A	A			C		C	C	A	C		C
Chacea ovoidea																				P
Chlamys hastata							1													
Hiatella arctica											1									
Lithophaga plumula											A	50							P	
Pododesmus cepio	7		15		2	25	A	A	3	30	2	29	6	25	7	25	3	20	4	28

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Bryozoa																				
Bryozoa unident.	P	P	P		P								C	S		S				
Diaperoecia californica	P	P	4	P	P	P			5		2	1	C							
Phoronidea vancouverensis											A		A	S			S		S	
Echinodermata																				
Asteroidea																				
Pisaster giganteus					3															
Echinoidea																				
Strongylocentrotus franciscanus	1											1		1		1				
CHORDATA																				
Ascidia unident.											2		C				S			

APPENDIX 1

CONES Transect Species List BLOCK 21

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Phaeophyta																				
Dictyopteris zonarioides	P	P	P	P																
Rhodophyta																				
Bossea orbigniana	P	P																		
Lithophyllum/Lithothamnion sp.	P	P	C	C	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A
Peyssonnelia pacifica							P	P			P					S		S		S
Rhodymenia sp.					P	P			C		P			S						
Rhodophyta unident.	P	P									S	P	A	C	C				P	A
INVERTEBRATA																				
Coelenterata																				
Hydrozoa unident.			P	P	P	P									S					
Anthozoa																				
Anthozoa unident.																1				1
Corynactis californica	60		13		75	A	50	A	200	100	50	120	100	150	A	160	100	50	98	75
Clavularia/Cornularia sp.														S					P	
Paracyathus stearnsi													1							
Muricea fruticosa					1		1		1			1	1		1		1		1	
Annelida																				
Diopatra ornata	P	P							1		3									
Polychaeta unident.							P	P			3		S	S			S	S		
Spirobranchus spinosus					15	A	1	C		S	1			3		2	1	5	2	1
Crustacea																				
Cirripedia																				
Balanus sp.											3									
Barnacle unident.														1						3
Mollusca																				
Gastropoda																				
Dendrodoris fulva										1										
Acmaea mitra					1		1						2		1	1			1	1
Astraea gibberosa																		2		
Astraea undosa	1											1								
Conus californicus			2															2		
Kelletia kelletii					1										2		2		1	1
Rictaxis punctocaelatus							1													
Pelecypoda																				
Boring bivalves unident.					P		A		A		C				A	S	A		A	
Hinnites multirugosus					2				1		1				2		2			
Lithophaga plumula											A		A						A	
Pododesmus cepio	4	P	5	10	A	15	10	A	5		1	20	2	12	2	16	5	15	4	18
Bryozoa																				
Bryozoa unident.			P	P			1				P		C							
Diaperoecia californica	P	P	S	S	P	P			C	S	C	8		S		C		S	2	S
Phoronidea vancouverensis	P	P			P	P					A		A							

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Echinodermata																				
Asteroidea																				
Pisaster giganteus			1		4				1			1	1		1		1			
Echinoidea																				
Lytechinus anamesus															2					
Strongylocentrotus franciscanus							1						1	1			1			
CHORDATA																				
Ascidia unident.							P	P							1					

APPENDIX 1

CONES Transect Species List BLOCK 15

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Chlorophyta unident.			P	P																
Phaeophyta																				
Dictyopteris zonarioides	P	P	P	P												S				
Dictyota flabellata										S										S
Rhodophyta																				
Bossea orbigniana					P	P	P	P	S											
Lithophyllum/Lithothamnion sp.	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A
Peyssonnella pacifica																	S	S		
Rhodymenia sp.							P	P	S		S	S	C				S			S
Rhodophyta unident.	P	P			P	P							A	C	S	S	S	S	A	A
INVERTEBRATA																				
Porifera																				
Leuconia barbata					P	P														
Rhabdodermella nuttingi							15						A							
Coelenterata																				
Hydrozoa unident.	P	P													S		C			
Anthozoa																				
Anthozoa unident.													1							
Corynactis californica	13	40	15	5	20	10	50		25	50	25	25	15	40	30	50	20	50	10	50
Clavularia/Cornularia sp.	P	P	P	P																
Astrangia lajollanensis											P									
Muricea californica	4	2	3	1	1		1		1		1		1		1		1		1	
Muricea fruticosa			1		2				2		1		2		2		2		1	
Annelida																				
Diopatra ornata					3						3									
Phyllochaetopterus sp.							15													
Polychaeta unident.									S											
Salmacina tribranchiata							P	P												
Mollusca																				
Gastropoda																				
Cadlina sp.																			1	
Acmaea mitra					1		1			2		2		1					1	1
Cypraea spadicea									1					1						
Kelletia kelletii					1					1					1					1
Maxwellia santarosana												1		1						
Mitra idae					2		1							1						1
Simnia vidleri					1												1		1	
Pelecypoda																				
Boring bivalves unident.							A	A	A	C		A		A	A	A	C	A	A	A
Hinnites multirugosus										1										
Lithophaga plumula	A	A	A	S	A	P				C	A		P						A	
Pododesmus cepio	1				3	2			2	5	3	5			C		6		4	2

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Bryozoa																				
Bryozoa unident.											P			C						
Diaperoecia californica	P	P	P	P	P	P	S	S	C	S	S	C	S				S	C		C
Phoronidea vancouverensis	P	50	2	2							10	C	S	S						C
Echinodermata																				
Asteroidea																				
Pisaster giganteus	2									1	1		2				1			1
Echinoidea																				
Strongylocentrotus franciscanus	2						2												1	
Holothuroidea																				
Parastichopus parvimensis									1											1

APPENDIX 1

CONES Transect Species List BLOCK 16

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Phaeophyta																				
Colpomenia sinuosa											1									
Dictyopteris zonarioides	P	P																		
Rhodophyta																				
Bossea orbigniana			P	P	P	P														
Lithophyllum/Lithothamnion sp.	P	P	P	P	P	P	P	P	P	P	P	P	A	A		C	A	C		C
Peyssonnella pacifica					P	P					P			S		S	S			S
Rhodymenia sp.					P	P					S									C
Rhodophyta unident.											A		S	C	S	C		S		C
INVERTEBRATA																				
Coelenterata																				
Hydrozoa unident.			P	P	P	P							S		S					
Anthozoa																				
Cerianthidae unident.					1															
Corynactis californica	25	A	25	A	30	50	40	50	60	50	40	50	55	100	55	C	50	50	69	60
Clavularia/Cornularia sp.											S	P								
Paracyathus stearnsi	1		1									1								
Lophogorgia chilensis	1																			
Muricea californica	2		2						1		1			1		1		1	1	1
Zaolutis actius					1															
Annelida																				
Diopatra ornata					20	P	4	7	20	10	20	16	A	10	6	25	20	35		
Polychaeta unident.	P	P	P	P	P	P					A			1	S					20
Spirobranchus spinosus					P	P														
Crustacea																				
Cirripedia																				
Balanus sp.													1							
Mollusca																				
Gastropoda																				
Acmaea mitra					1				1				2		1				2	
Kelletia kelletii			1							1		3	3	1	1			1	1	1
Maxwellia santarosana																	1			
Rictaxis punctocaelatus					2															
Pelecypoda																				
Boring bivalves unident.							S	C						C	C	C	8	C		S
Hinnites multirugosus					1														1	
Lithophaga plumula	A	A	A	A	P	P					10	P								P
Pododesmus cepio	1				5		5	15		10		10	3	3	5	8		1	3	5
Bryozoa																				
Bryozoa unident.					P	P					C		C	S		S				
Diaperoecia californica	P	P	P	P	P	P	S	S			S									S
Phoronidea vancouverensis	A	A			P	P									C	S		S		

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Echinodermata																				
Asteroidea																				
Pisaster giganteus	2		1																	
Echinoidea																				
Lytechinus anamesus							1												1	
Strongylocentrotus franciscanus			P	1					1	1			1							
CHORDATA																				
Ascidia unident.													1					S		

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CONES Transect Species List BLOCK 19

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Chlorophyta unident.	P	P																		
Phaeophyta																				
Dictyopteris zonarioides					P	P														
Dictyota flabellata					P	P														
Rhodophyta																				
Bossea orbigniana	P	P	P	P																
Lithophyllum/Lithothamnion sp.	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A
Peyssonnelia pacifica							P	P			S									S
Rhodymenia sp.									S	S	C									S
Rhodophyta unident.	P	P									A	P	A		S	C		S	P	C
INVERTEBRATA																				
Coelenterata																				
Anthozoa																				
Corynactis californica	20	20	25	10	40	50	50	50	75	50	20	45	30	35	50	25	50	16	65	40
Muricea californica					1									1						
Annelida																				
Chaetopterus variopedatus	P	P			1															
Polychaeta unident.			P	P					5				S		C		S			
Spirobranchus spinosus					1		2	2	1		2		4	2		2	1		2	2
Crustacea																				
Cirripedia																				
Balanus sp.													C							
Barnacle unident.														C		S				
Mollusca																				
Gastropoda																				
Acmaea mitra														1	1	1	4	2	2	2
Astraea gibberosa										1									1	
Astraea undosa					2							1								
Collisella scabra															1					
Conus californicus			1																	
Kelletia kelletii					1								1		1		1		2	
Megathura crenulata														1						1
Pelecypoda																				
Boring bivalves unident.							A			S			C		C	S			P	S
Chaceia ovoidea											A	25								
Hinnites multirugosus									1		1		8							1
Lithophaga plumula													A						A	
Pododesmus cepio	15		35	5	30	10	25	25	20	20	15	15	15	15	3	15	12	12	18	20
Bryozoa																				
Bryozoa unident.											P		C	S	S			S		
Diaperoecia californica	P	P	4	5	1	5	3	3	A	C	5	9	C	C		C	3	2	P	C
Phoronidea vancouverensis											A		C							C

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Echinodermata																				
Asteroidea																				
Pisaster giganteus											1		1				1			
Echinoidea																				
Strongylocentrotus franciscanus			1										1						1	
Strongylocentrotus purpuratus																				2
Holothuroidea																				
Parastichopus parvimensis												1					1		1	
CHORDATA																				
Ascidia unident.											1	3			4		1	5		

APPENDIX 1

CONES Transect Species List BLOCK 7

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Phaeophyta																				
Dictyopteris zonarioides	P	P	1																	
Eisenia arborea											1									
Rhodophyta																				
Lithophyllum sp./*Lithothamnion*	P	P	P	P			S	S			S	S					S	S		
Rhodophyta unident.			P	P																
INVERTEBRATA																				
Coelenterata																				
Anthozoa																				
Corynactis californica			P	P																
Muricea californica											1									
Annelida																				
Chaetopterus variopedatus	4																			
Diopatra ornata					5		9													
Polychaeta unident.																	2	6		
Mollusca																				
Gastropoda																				
Kelletia kelletii											25									
Mitra idae																			1	
Pteropurpura festiva									1											
Echinodermata																				
Asteroidea																				
Pisaster giganteus			2				2		1		2									
Ophiuroidea																				
Ophiuroidea unident.		2		2																

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CONES Transect Species List BLOCK 11

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Phaeophyta																				
Colpomenia sinuosa					P	P														
Dictyopteris zonarioides																				S
Rhodophyta																				
Lithophyllum sp./*Lithothamnion*	P	P	P	P	P	P	P	P	P	P	P	P	A	A	A	A	A	A	A	A
Rhodymenia sp.					P	P	P	P			S	C	S							
Rhodophyta unident.	P	P	P	P	P	P			S		S	C	S	C			S		C	A
INVERTEBRATA																				
Coelenterata																				
Hydrozoa unident.	P	P			P	P														
Anthozoa																				
Anthozoa unident.											3		1						1	
Balanophyllia elegans																	2			
Corynactis californica	6		10		8		10		5	50	8	20	5		10		1		2	
Clavularia/Cornularia sp.													A							
Paracyathus stearnsi	1		2				1		2		1								1	
Astrangia lajollaensis													25		20				35	
Annelida																				
Chaetopterus variopedatus	A	A	A	A																
Diopatra ornata			P	P	C	C				2		5					1		1	4
Polychaeta unident.					P	P					S	S								
Salmacina tribranchiata																		S		
Spirobranchus spinosus							S	S	3		3		C							
Mollusca																				
Gastropoda																				
Cadlina limbaughi					1															
Dendrodoris fulva							1													
Acmaea mitra			1		1		1				1		1		3		1	3		1
Kelletia kelletii					1		2						2		1	1		1		
Mitra idae							1													
Pelecypoda																				
Boring bivalves unident.					P	P	A	A	A	S	A	A	A	A	A	A	A		A	C
Hiatella arctica																				P
Lithophaga plumula	A	A											A							
Pododesmus cepio	2				5	P	A	A	4	10	4	3	8	5	1	5	6	7		
Bryozoa																				
Bryozoa unident.											C	C							S	S
Diaperoecia californica					P	P	C	C	S	S	5	S					1		S	S
Phoronis vancouverensis													A	A					S	S
Echinodermata																				
Asteroidea																				
Pisaster giganteus					1				1									1		

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Ophiuroidea																				
Ophioderma panamensis			1										1				1			
Echinoidea																				
Strongylocentrotus franciscanus			P	P	1		1		1		1				1		2			
Holothuroidea																				
Parastichopus parvimensis									1										1	
CHORDATA																				
Ascidia unident.																			S	S

APPENDIX 1

CONES Transect Species List BLOCK 9

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Phaeophyta																				
Colpomenia sinuosa			P	P																
Dictyopteris zonarioides	P	P			6		A	A	C		2	6	A	S	A		C			
Dictyota flabellata																			1	1
Eisenia arborea					1		1			P										
Rhodophyta																				
Bossea orbigniana			P	P	P	P	C	C	A		2		A	A	C		S	S		P
Corallina sp.							1		S		C	1			C		S	S		
Gelidium sp.					P															
Lithophyllum sp./*Lithothamnion*	P	P	P	P	P	P	P	P	P	P	P	P	A	S	A	C	C	C		
Peyssonnelia pacifica							P	P	S	S			S	S			S	S		
Rhodymenia sp.									C											P
Rhodophyta unident.	P	P			P	P							S	C		C			P	P
INVERTEBRATA																				
Porifera																				
Porifera unident.																	S			
Coelenterata																				
Hydrozoa unident.			P	P									C							
Anthozoa																				
Anthozoa unident.									2		2		2		2		1		1	
Cerianthidae unident.					1				1		1									
Corynactis californica	13	P	13	P	15		25		15		5		2				7		6	
Clavularia/Cornularia sp.	10												S							
Lophogorgia chilensis			P																	
Muricea californica	6		P		2				2										1	1
Muricea fruticosa		2		1		1		1		1		1		1						
Annelida																				
Chaetopterus variopedatus	S	S	S	S																
Diopatra ornata					5		C	C	1				2	5	1	2		7		
Phragmatopoma sp.													S							
Phyllochaetopterus sp.							C	C												
Polychaeta unident.									10							C	S			
Salmacina tribranchiata																			2	
Crustacea																				
Malacostraca																				
Hermit crab unident.	1				2				1				1							
Loxorhynchus crispatus													1							
Mollusca																				
Gastropoda																				
Dendrodoris fulva							2													
Acmaea mitra															1					
Kelletia kelletii					1													1		
Pteropurpura festiva							1													
Pelecypoda																				
Boring bivalves unident.							A	S	A								S			
Chaceia ovoidea																			A	A
Lithophaga plumula																			A	A
Pododesmus cepio											1		1						8	1

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Bryozoa																				
Diaperoecia californica	P	P	P	P			C	C	C		3		S				C		3	4
Echinodermata																				
Asteroidea																				
Pisaster giganteus	7		1		1										1	1	1	1		
Echinoidea																				
Lytechinus anamesus							1										1			
Strongylocentrotus franciscanus															1			2		
Holothuroidea																				
Parastichopus parvimensis	2																			
CHORDATA																				
Ascidia unident.							1										S			

APPENDIX 1

CONES Transect Species List BLOCK 5

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		5/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
ALGAE																				
Phaeophyta																				
Dictyopteris zonarioides	P	P	P	P	P	P	P	P			P		1	C	C	5		2		2
Dictyota flabellata					1										C				2	
Rhodophyta																				
Bossea orbigniana	P	P	P	P			P	P	S		1	S								
Gelidium sp.											3		1		C		S			
Lithophyllum sp./*Lithothamnion*	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	A	C	A	C	C
Peyssonnelia pacifica							P	P	S	S	S		P		S		S	S		
Rhodymenia sp.									S		C	S	S							
Rhodophyta unident.											S		S	C	C	C				
INVERTEBRATA																				
Porifera																				
Leuconia barbata	P	P																		
Tethya aurantia					1				1									1	1	1
Coelenterata																				
Hydrozoa unident.			P	P									C	C						
Anthozoa																				
Anthozoa unident.																				1
Corynactis californica	10	75	1	50	P	P	12	50	25	C	10	100	20	20	15	100	8	10	20	90
Clavularia/Cornularia sp.			10										S						2	
Muricea californica					2		2		1				1		1				1	
Muricea fruticosa	P	P			1		1			1		1		1		1		1		1
Annelida																				
Chaetopterus variopedatus	A	A	A	A																
Diopatra ornata							4		20	5	A	10	S	15	C	10	10	8		C
Polychaeta unident.									15		1									
Spirobranchus spinosus													1							
Crustacea																				
Cirripedia																				
Balanus sp.											1									
Malacostraca																				
Hermit crab unident.									1	3		1								C
Loxorhynchus grandis	1																			
Mollusca																				
Gastropoda																				
Acmaea mitra									2								2		1	
Astraea undosa					1															
Collisella scabra					1															
Kelletia kelletii					1				1									1	1	
Maxwellia santarosana											1	1						1		2
Serpulorbis squamigerous	P	P																		
Pelecypoda																				
Boring bivalves unident.					P	P			C			S				A	S			C
Hiatella arctica	P																			
Lithophaga plumula			100								10		C						8	
Pododesmus cepio			2				9						1							

	9/ 68		12/ 68		9/ 70		11/ 70		3/ 71		5/ 71		8/ 71		11/ 71		2/ 72		8/ 72	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
Bryozoa																				
Bryozoa unident.											1									
Diaperoecia californica	P	P	2		1							S	S	S		S	S			
Phoronis vancouverensis											15		S							
Echinodermata																				
Asteroidea																				
Pisaster giganteus			1						1								1			
Ophiuroidea																				
Ophioderma panamensis			1																	1
Echinoidea																				
Lytechinus anamesus			1		1															
Strongylocentrotus franciscanus			2				1													
CHORDATA																				
Ascidia unident.											1									

APPENDIX 2

CONES Station Species List 6 Meter (20 foot) Station

	8/ 70	11/ 70	4/ 71	6/ 71	8/ 71	12/ 71	2/ 72	5/ 72	4/ 73
ALGAE									
Rhodophyta									
Bossea orbigniana		19	6						
Bossea sp.	13			C	27	8	15	P	
Corallina officinalis		P							
Corallina sp.	P		C	C	7	1	4	P	
Gelidium sp.	26	5	A	92	26	17	37	15	
Lithophyllum/Lithothamnion sp.	A	A	A	A	A	A	A		
Rhodymenia sp.	P	P				P	P		
Phaeophyta									
Cystoseira osmundacea	5	2	38	45	19	20	53	16	7
Dictyopteris zonarioides	5	3	S	C	31	2	4		
Dictyota flabellata	P		C	C	1	1	P	7	2
Egregia laevigata	118	A	35	25	17	12	15	2	
Eisenia arborea	9	1	9	10	22	13	12	13	4
PORIFERA									
Leuconia barbata		P							
Rhabdodermella nuttingi		1							
COELENTERATES									
Anthopleura xanthogrammica							P		
Corynactis californica	6	2	10	6	6	5	8	15	
Tealia sp.								P	
Muricea californica		1							
Cerianthid unid							3	1	
POLYCHAETES									
Diopatra ornata	C		P	P	P	P	P	P	P
Lumbrineris erecta	P								
Phragmatopoma californica								P	
Phyllochaetopterus prolifica	P								
Sabellidae unident.	P								
Terebellidae unident.	P								
Thormora johnsoni	P								
CRUSTACEA									
Xanthias taylori			P						
MOLLUSCA									
Aplysia californica		2						1	
GASTROPODA									
Acmaea mitra	P		2	1	2	4	3	11	
Haliotis cracherodii	3	3	5	4	10	24	27	25	
Haliotis fulgens	1							1	

	8/ 70	11/ 70	4/ 71	6/ 71	8/ 71	12/ 71	2/ 72	5/ 72	4/ 73
GASTROPODA Cont.									
Kelletia kelletii						1			
Megathura crenulata	2	4	3	3	1	4			
Norrisia norrisii			1			1	P		
Notoacmaea insessa			A						
Pseudochama exogyra	P								
PELECYPODA									
Boring bivalve unident.	P	P	P			P	A	C	
Chaceia ovoidea	3			C	C	C	11	9	
Cumingia californica	1								
Hinnites multirugosus			1						
Mytilus edulis	P								
Parapholas californica	3			C				P	
Penitella penita	1								
Semele decisa	1								
CEPHALOPODA									
Octopus sp.		1							
BRYOZOA									
Diaperoecia californica	2								
Phidolophora pacifica	1								
ECHINODERMATA									
Astrometis sertulifera			1	1		1	2	1	
Patiria miniata	1	1				1	1		
Pisaster brevispinus					1				
Pisaster giganteus	2	8	5	8	5	4	7	16	
Pisaster ochraceous								1	
Lytechnius anamesus	1								
Strongylocentrotus franciscanus	39	24	33	41	33	37	50	50	
Strongylocentrotus purpuratus	2		4	2	5	8	9	5	
Parastichopus parvimensis				1			1	2	

APPENDIX 2

CONES Station Species List 12 Meter (40 foot) Station

	8/ 70	11/ 70	4/ 71	6/ 71	8/ 71	12/ 71	2/ 72	5/ 72	4/ 73
ALGAE									
Rhodophyta unident.					C		P	C	
Bossea orbigniana	7								
Bossea sp.		S		P	S	S	P	P	
Lithophyllum/Lithothamnion sp.	A	A	A	A	A	A	A	A	A
Maripelta rotata	C								
Peyssonnelia sp.			C	P	S		S		P
Rhodymenia sp.	A	S	S	P				P	
PHAEOPHYTA									
Phaeophyta unident.	P								
Dictyopteris zonarioides	S								
PORIFERA									
Porifera sp.					P			P	
Leuconia barbata					1				
Tethya aurantia	1		1	2	1				
COELENTERATES									
Anthopleura xanthogrammica			1			1			
Corynactis californica	19	C	C	C	A	A	A	A	
Tealia sp.								1	
Astrangia lajollensis							1		
Balanophyllia elegans							1		
Paracyathus stearnsi	2	3	5	3	5	1	3		
Muricea californica	12	8	11	12	11	10	10	11	
Muricea fruticosa	2	1	2	3	2	2	2	2	
Cerianthid unident.	7	2	3	5	7	15	3	18	
POLYCHAETES									
Polychaete unident.							P		
Diopatra ornata	P	C	C	C	C	C	C	C	
Halosydna johnsoni	P								
Petaloproctus sp.	P								
Salmacina tribranchiata	3			P	4	7	5	2	
Spirobranchus spinosus			1	4	9		5	3	
CRUSTACEA									
Hermit crabs unident.			1						
MOLLUSCA									
Anisodoris nobilis	1		1						
Dendrodoris albopunctata					1				
Flabellina iodinea	5								
Pleurobranchus californicus				1					

	8/ 70	11/ 70	4/ 71	6/ 71	8/ 71	12/ 71	2/ 72	5/ 72	4/ 73
GASTROPODA									
Acmaea mitra	P	4	4	4	6	1	5	10	
Rictaxis punctocoelata		2	1			1	3		
Bursa californica						1			
Calliostoma annulatum	2								
Crepidula onyx				2					
Hiatella arctica			1						
Kelletia kelletii	6	11	9	15	11	5	14	25	
Limpets unident.							3	3	
Megasurcula carpenteriana		2	1	1		2	3		
Megathura crenulata	P								
Mitra idae					1				
Pteropurpura trialata								1	
Simnia vidleri								1	
PELECYPODA									
Boring bivalve unident.			A	A		A	A	A	
Cumingia californica				1					
Hiatella arctica	3	1	1	3	1			8	
Hinnites multirugosus					3				
Penitella penita	23	A	33	49	105	A	A	A	
Semele decisa				1					
BRYOZOA									
Bryozoans unident.					C		P	P	
Diaperoecia californica	14	P	P	15	P	P			
Phidolophora pacifica						1			
Phoronidea vancouverensis								2	
ECHINODERMATA									
Astrometis sertulifera	1		1		1				
Henricia leviuscula	1		1						
Linckia columbiae		1							
Patiria miniata	3			1			1	1	
Pisaster giganteus	2	10	9	7	5	6	4	4	
Lytechnius anamesus					3		1		
Strongylocentrotus franciscanus	16	17	24	16	13	14	11	11	
Strongylocentrotus purpuratus						1	1	2	
Ophioderma panamensis		2		3		2	1	1	
Cucumaria sp.						1		1	
VERTEBRATA									
Ascidia unident.			2	P	P	P	P		
Boltenia villosa							2	2	

APPENDIX 2

CONES Station Species List 18 Meter (60 foot) Station

	8/ 70	11/ 70	4/ 71	6/ 71	8/ 71	12/ 71	2/ 72	5/ 72	4/ 73
ALGAE									
Rhodophyta unident.					S	S	S	C	
Lithophyllum/Lithothamnion sp.	C	A	A	A	A	A	A	A	
Peyssonnelia sp.			S	S	C		S		
COELENTERATES									
Coelenterate unident.								P	
Corynactis californica	P	P	P	C	C	C	C	C	
Balanophyllia elegans						1			
Paracyathus stearnsi	3	7	4	2	3	2	3	4	
Eugorgia rubens	4	3	4	3	4	2	4	3	
Lophogorgia chiliensis	1	1			1	1	1		
Muricea californica		4	6	3	5	4	3	7	
Muricea fruticosa	2	1							
Cerianthid unident.	12	35	36	43	121	34	40	94	
Cornularia sp.					P				
POLYCHAETES									
Polychaete unident.					A	P	P		
Diopatra ornata	P	P	C	A	A		C	C	
CRUSTACEA									
Loxorhynchus crispatus					1				
Hermit crabs unident.			1	1					
Paguristes sp.	1								
Balanus sp.			2		1		2	2	
MOLLUSCA									
Anisodoris nobilis					1				
Dendrodoris albopunctata		1			1				
Dendrodoris			2						
Dorid unident.							2		
Hermissenda crassicornis	2								
GASTROPODA									
Acmaea mitra	8	7	49	30	26	6	15	16	
Astraea gibberosa			1		1		1		
Calliostoma gloriosum							1		
Conus californicus	1								
Crassispira seminflata					1				
Crepidula onyx							1		
Cypraea spacidea								1	
Kelletia kelletii	6	4	5	8	1	13	19		
Maxwellia santarosana			1	1			6		
Megathura crenulata		1							
Simnia vidleri						1			

	8/ 70	11/ 70	4/ 71	6/ 71	8/ 71	12/ 71	2/ 72	5/ 72	4/ 73
PELECYPODA									
Boring bivalve unident.			A	P	P	A		A	
Hinnites multirugosus					1		1		
Pododesmus cepio					3			1	
Ventricolaria fordi						1			
BRYOZOA									
Diaperoecia californica	P	1	5	4	1	2	3		
Phoronidea vancouverensis				P	S				
ECHINODERMATA									
Astrometis sertulifera					1				
Henricia leviuscula					1	1			
Linckia columbiae							2		
Patiria miniata	3	4	1	4	4	5		2	
Pisaster giganteus	1	1	1	1	2	3	2	2	
Lytechnius anamesus		13	1	2	11	4	3	2	
Strongylocentrotus franciscanus	50	36	42	36	27	27	21	30	
Strongylocentrotus purpuratus		1				4			
Ophioderma panamensis	3	2			1		1		
Ophioderma unident.	P	2	3	2	14		P	P	
Parastichopus parvimensis	1		3	1		1		2	
VERTEBRATA									
Ascidia unident.				1			P		

APPENDIX 2

CONES Station Species List 24 Meter (80 foot) Station

	8/ 70	11/ 70	4/ 71	6/ 71	8/ 71	12/ 71	2/ 72	5/ 72	4/ 73
ALGAE									
Rhodophyta									
Rhodophyta unident.							S		
Lithophyllum/Lithothamnion sp.	A	A	A	A	A	A	A	A	
Peyssonnelia sp.			C	C	C	S	S	S	
PORIFERA									
Rhabdodermella nuttingi				1	1		1	3	
COELENTERATES									
Coelenterate unident.				P	P	P	P		
Corynactis californica	P		P	P	P	P		P	
Paracyathus stearnsi		3	18	16	10	5	18	4	
Eugorgia rubens	2	2	3	3	5	6	6	2	
Lophogorgia chiliensis		1	3	1	1	1	1	2	
Muricea californica		1	1		1	1	1	1	
Muricea fruticosa	1								
Cerinthid unident.	34	28	43	55	48	37	37	46	
Cornularia sp.			5		3		2		
POLYCHAETES									
Polychaete unident.		P	P		A		C		
Diopatra ornata		P	C	C	C	C	C	C	
Myxicola infundibulum							20		
CRUSTACEA									
Hermit crabs unident.	1			1					
MOLLUSCA									
Cadlina leuteomarginata							2		
Dendrodoris fulva				1	1	2			
Dendrodoris sp.				3			1		
Dorid unident.								1	
Flabellina iodinea				2	1			1	
Hermissenda crassicornis	3						1		
Pleurobranchus californicus						1			
Tritonia festiva	3				2			1	
GASTROPODA									
Acmaea mitra	2		12	6	11	9	16	4	
Rictaxis punctocoelata					3				
Astraea gibberosa	1	1	3	2	8			1	
Astraea undosa							1		
Conus californicus							1		
Crassispira semiinflata		1					1		
Cypraea spacidea							1		
Kelletia kelletii	7	7		2	9	8	6	2	

	8/ 70	11/ 70	4/ 71	6/ 71	8/ 71	12/ 71	2/ 72	5/ 72	4/ 73
GASTROPODA Cont.									
Limpets unident.				P					
Maxwellia santarosana				1	5			1	
Mitra idae								1	
Simnia vidleri							1		
PELECYPODA									
Boring bivalve unident.		P	A	P			A	C	
Hinnites multirugosus		1		1		1		2	
Lithophaga plumula				P	A	P	P	C	
Ventricolaria fordi		1							
BRYOZOA									
Diaperoecia californica									1
Phoronidea vancouverensis						2	3		
ECHINODERMATA									
Astrometis sertulifera				1			1	1	
Henricia leviuscula		1	1	1	2	1			
Linckia columbiae					1			1	
Mediaster sp.	9	3	1	5	6	7	4	8	
Pisaster brevispinus	2		1			3		1	
Pisaster ochraceous	2	2	2	3	1		1		
Lytechinus anamesus	15	6	13	23	18	7	1	1	
Strongylocentrotus franciscanus	4	1	1		3	2			
Strongylocentrotus purpuratus		2		3		2	1	1	
Ophioderma panamensis			1			3	1		
Ophioderma unident.				6					
Cucumber unident.						1		2	
Cucumaria sp.					1				
VERTEBRATA									
Ascidia unident.							P		

APPENDIX 2

CONES Station Species List 30 Meter (100 foot) Station

	8/ 70	11/ 70	4/ 71	6/ 71	8/ 71	12/ 71	2/ 72	5/ 72	4/ 73
COELENTERATES									
Coelenterate unident.		1							
Cerianthid	C	1		1		2			
Stylatula elongata		1	2		1		3		
POLYCHAETES									
Polychaete unident.	C	P	A			A	A		
Phyllochaetopteris prolifica		P		A	A				
CRUSTACEA									
Heterocrypta occidentalis					1		1		
Pyromaia tuberculata	1080			1	1				
Anasimus spinosus	5								
Hermit crabs unident.		1	3	P	C	1	P		
Paguristes sp.			1						
Randallia ornata				2	1				
Seriolis carinata					3				
Lepas sp.				3					
GASTROPODA									
Rictaxis punctocoelata		300	100	3	12	360	240	240	
Bursa californica			2			1			
Conus californicus	5	7	1		5	2	2	5	
Crassispira semiinflata		3			7	4	8	3	
Crepidula onyx			30						
Kellettia kelletii	8	1	4	3	3	2	1	2	
Megasurcula carpenteriana							1	1	
Mitra idae			1	3	1				
Nassarius perpinguis		1				A			
Olivella sp.							P	P	
Pteropurpura triolata			2						
CEPHALOPODA									
Octopus sp.				1					
Squid egg cases				1					
ECHINODERMATA									
Patiria miniata	7	3	6	4	1	4	1	3	
Pisaster giganteus						3			
Ophiuroid unident.								P	
Cucumaria sp.							P	P	

APPENDIX 3

CONES Fish Species List 6 Meter (20 foot) Station

Species	8/ 70	11/ 70	4/ 71	5/ 71	8/ 71	12/ 71	2/ 72	5/ 72
Embiotoca jacksoni	P	1	P	P	P		P	
Gibbonsia elegans					P		P	P
Girella nigricans	P	A	P	P	P		P	
Halichoeres semicinctus					P		P	
Heterostichus rostratus							P	
Hypsypops rubicundus	P	C	P	P	P	P	P	
Medialuna californiensis			P	P	P			
Orthonopias triacis						P	P	
Oxyjulis californica	P	A	P	P	P		P	
Paralabrax clathratus	P	1	P		P		P	
Damalichthys vacca							P	
Scorpaena guttata						P		
Scorpaenichthys marmoratus			1					
Sebastes mystinus				P				

APPENDIX 3

CONES Fish Species List 12 Meter (40 foot) Station

Species	8/ 70	11/ 70	3/ 71	5/ 71	8/ 71	12/ 71	3/ 72	5/ 72
Coryphopterus nicholsi	P	2		P	3	3	5	
Embiotoca jacksoni		P		P	P	P	P	
Halichoeres semicinctus					P		P	
Hypsypops rubicundus					P			
Lythripnus dalli	P							
Orthonopias triacis		P	P	P	4		3	
Oxyjulis californica		P			P	P	P	
Oxylebius pictus					P			P
Paralabrax clathratus		P			P	P	P	P
Pimelometopon pulchrum				P	P		P	P
Pleuronichthys coenosus			P					
Damalichthys vacca		P			P			
Sebastes chrysomelas								P
S. mystinus					P			P
S. serranoides						P		
S. serriceps					P			
Seriola dorsalis					P			

APPENDIX 3

CONES Fish Species List 18 Meter (60 foot) Station

Species	8/ 70	11/ 70	3/ 71	5/ 71	8/ 71	12/ 71	2/ 72	5/ 72
Artedius sp.	P							
Coryphopterus nicholsi	P	4	3	4	6	3	3	2
Embiotoca jacksoni				P	P		P	
Lythripnus dalli					P			
Neoclinus stevensi			P					
Orthonopias triacis		P	P		8	2	4	
Oxyjulis californica	P	P	P	P			P	
Oxylebius pictus		2	P		1			
Paralabrax clathratus		P	P				P	
Pimelometopon pulchrum			P					
Scorpaena guttata					1			
Sebastes sp.	P							
S. carnatus							P	
S. mystinus		P	P		P	P		
S. serranoides		P	P		P			
S. serriceps			P					

APPENDIX 3

CONES Fish Species List 24 Meter (80 foot) Station

Species	8/ 70	11/ 70	3/ 71	5/ 71	8/ 71	12/ 71	2/ 72	5/ 72
Caulolatilus princeps						P	P	
Coryphopterus nicholsi	5	10	4	3	8	9	9	1
Embiotoca jacksoni								P
Girella nigricans						P		
Lythripnus dalli		P		P	P	P		
Neoclinus uninotatus	1		1	1	1	1	1	
Orthonopias triacis				1	2	3		P
Oxyjulis californica					P	P	P	
Oxylebius pictus				P	P	P	P	
Paralabrax clathratus			P			P	P	P
Rathbunella hypoplecta		P						
Damalichthys vacca								P
Sebastes sp.	P			P				
S. dalli		P			P	P		
S. hopkinsi						P		
S. miniatus					P	P		
S. mystinus				P	P	P		P
S. rubrivinctus						P		
S. serranoides						P	P	
S. serriceps		P	P	P		P	P	
S. umbrosus						P		
Torpedo californica								P
Triakis semifasciata						P		

APPENDIX 3

CONES Fish Species List 30 Meter (100 foot) Station

Species	8/ 70	11/ 70	4/ 71	6/ 71	8/ 71	12/ 71	2/ 72	5/ 72
Citharichthys sp.		P	P		P	P	P	P
C. sordidus	P			P				
Coryphopterus nicholsi		2					P	
Neoclinus blanchardi					P			
N. uninotatus		2	1	1	P		P	2
Pleuronichthys coenosus					P			
Sebastes miniatus		P		P	P			
S. paucispinnus		P			P			
Xystreurys liolepis					P			