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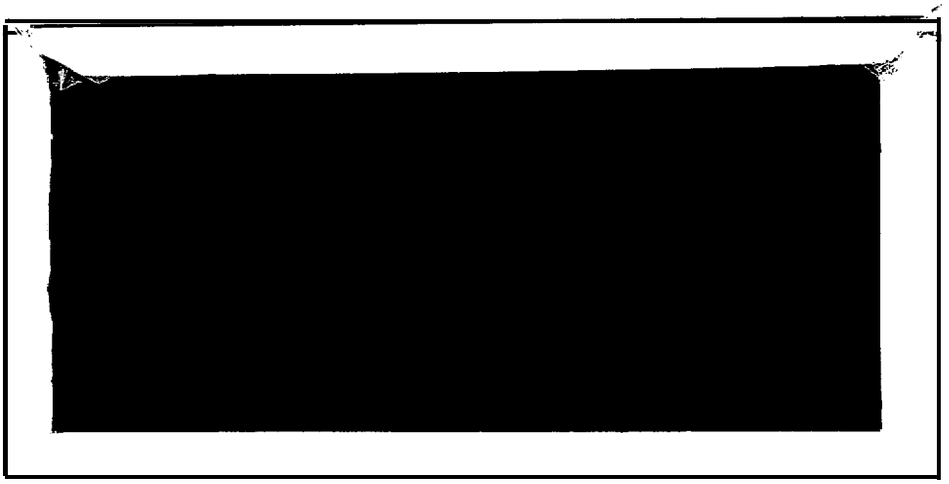

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INTERTIDAL STUDY OF THE SOUTHERN CALIFORNIA BIGHT

1.1.8

VARIATIONS IN THE ROCKY INTERTIDAL BIOTA NEAR DUTCH HARBOR, SAN NICOLAS ISLAND, CALIFORNIA

VOLUME 111

1.1.8 → 1.1.13

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1. 1.8 Variations in the Rocky Intertidal Biota near Dutch Harbor, San Nicolas Island, California

1. 1.8.1 Abstract

Seasonal patterns of 'distribution and abundance of rocky intertidal organisms were evaluated quarterly at San Nicolas Island from September 1976 to May 1977 by undisturbed techniques. Additionally, disturbed techniques were employed during the first quarter (September 1976). A total of 368 quadrats (184 0.15 m^2 and 184 1.0 m^2 were taken throughout the study; this included 256 undisturbed rocky, 16 disturbed rocky, 8 disturbed pool, and 88 undisturbed pool samples. The thrust of the study was to compare data from undisturbed sampling taken during 1975-76 with comparable data taken during the present study (1976-77), and, for this reason, disturbed cover, density, and frequency data were deleted from both data sets.

Totals of 88 macrophytes and 95 taxa were collected. New records of intertidal biota for the Dutch Harbor area of San Nicolas Island since the 1975-76 analysis include 20 macrophytes and 46 macroinvertebrate taxa. Total. mean biotic cover in the undisturbed quadrats increased by 23.4% (from 94.8% to 118.2%) during 1975-76 to 1976-77. This difference was due mostly to increases in macrophyte cover (from a mean of 67.8% in 1975-76 to 88.8% in 1976-77). Seasonal fluctuations in abundance patterns were again very pronounced and were caused in part by massive deposition of sand upon the upper half of the study area during the winter months . Both macrophytes and macroinvertebrates showed a drop in cover over most tidal intervals in February 1977 comparable to the 1975-76 decline that took place in December 1975; these declines both years were clearly related to times of maximum sand inundation.

There was only a slight change in mean cover of the four predominant macrophyte taxa from undisturbed samples during 1975-76 to 1976-77. Blue-green algae (24.2%), Gigartina canaliculata (18.8%), Chaetomorpha linum (11.0%), and Phyllospadix scouleri (8.2%) totaled 62.2% compared with 43.3% the preceding year. Most of this difference was attributable to a 20% increase in blue-green algal cover over the preceding year's data. Most of the important macrophytes showed cover declines during February 1977 at the time of maximum sand cover. Forms showing such a decline were the encrusting algae, blue-greens, Ralfsiaceae, and Lithophyllum proboscideum along with Gigartina canaliculata, Chaetomorpha linum, Phyllospadix scouleri, and the epiphytic Ceramium spp./Centroceras clavulatum. Similar declines were noted during December 1975, also related to the period of maximum sand inundation. Macroinvertebrate cover remained relatively constant over the seasons sampled, becoming only slightly reduced during February 1977 in association with the time of maximum sand.

Of the "major macroinvertebrates, the same five forms that dominated the cover in 1975-76 were again important during the present study. Four of these forms (i.e., Anthopleura elegantissima, Dodecaceria fewkesi, Chthamalus fissus/dalli, and Mytilus californianus) showed slight overall mean increases in cover, while Phragmatopoma californica showed a 3.8% decrease in cover from the previous year's values. Both A. elegantissima and C. fissus/dalli showed reductions in cover during the time of maxim-u sand cover, while "D. fewkesi showed a slight increase beginning at the time of maximum sa-nd.

As was the case in 1975-76, many of the widespread macrophytes (blue-green algae, frequency of 89..4%; Corallina officinalis var. chilensis, 57.3%; Ulva lobata, 56.8%; Gigartina canaliculata, 53.9%; and Chaetomorpha linum, 51.1%) were those that covered the majority of the substrate. The increased frequency of bleached thalli of Hydrolithon decipiens, C. officinalis var. chilensis, Lithophyllum proboscideum, G. canaliculata, Phyllospadix scouleri, Gastroclonium coulteri, and Lithothrix aspergillum during December 1976 reflects heat, insolation, and desiccation stresses imposed by "Santa Aria" winds during periods of daytime low tides. Anthopleura elegantissima repeated its dominance of macroinvertebrate frequency values occurring in 18.5% more samples than it did in 1975-76. Of the more widespread macroinvertebrate taxa, only A. elegantissima did not show a February 1977 decrease in association with sand inundation.

The most numerous macroinvertebrates were again Chthamalus fissus/dalli (yearly average of 2511 individuals/m^2, increase of 1076/m^2) and Anthopleura elegantissima (186/m^2, increase of 43/m^2). A dramatic increase also was shown by Tetraclita squamosa rubescens (increase of 124/m^2 over the 15/m^2 value of 1975-76). Both C. fissus/dalli and A. elegantissima reached minimum densities (2213/m^2 and 134/m^2, respectively) during the time of maximum sand cover in February 1977.

Macrophyte cover in the tidepools on San Nicolas Island ranged from a high of 124.4% during September 1976 to a low of 23.0% during February 1977 in inversely related to the maxima and minima of sand cover. Macroinvertebrate cover showed little seasonal variability in tidepools on San Nicolas Island, with only a slight peak reached in September 1976. The following three macrophytes monopolized the tidepool habitats: Corallina officinalis var. chilensis (19.1%), Phyllospadix scouleri (18.5%), and Chaetomorpha linum (17.0%). All three showed gains in cover over the preceding year's values, with C. officinalis var. chilensis showing a marked increase of 13.4%. Among the annual mean cover rankings of dominant macroinvertebrates in pools, Anthopleura elegantissima again was primary and showed a 1.0% increase over the preceding year's cover, followed by Tegula funebralis (0.5%) and Dodecaceria fewkesi (0.4%).

Of the most numerous macro invertebrates in tidepools, Tegula funebralis (24 individuals/m^2) showed an increase of 13/m^2 while Anthopleura elegantissima (22/m^2), showed a 6/m^2 increase. Pagurus hirsutiusculus (19/m^2), a species not occurring in high densities in pools during 1975-76, became important in 1976-77 along with Mopalia muscosa (3/m^2) and Tetraclita squamosa rubescens (2/m^2).

During the present investigation, an annual average of 37. more taxa were found in undisturbed samples than had been recorded the preceding year, 26 of which were macrophytes and 11 of which were macroinvertebrates. There was very little seasonal change in Shannon-Weaver diversity over the year and this seemed to parallel the small variations shown by the combined macroinvertebrate and macrophyte richness index.

1.1.8.2 Study Area

1.1.8.2.1 General

See Littler and O'Brien (1977) for the location and detailed physical description of the Dutch Harbor, San Nicolas Island study site.

1.1.8.2.2 Environmental Data

A detailed environmental characterization of this study site has been presented by Littler and O'Brien (1977). In general (Table 1.1.8-1), the patterns recorded in 1975-76 for the physical measurements were repeated during 1976-77.

1.1.8.3 Methods and Materials

A total of 368 quadrats (184 0.15 m^2 and 184 1.0 m^2) were taken throughout the study; this included 128 undisturbed rocky, 8 disturbed rocky, 4 disturbed pool, and 44 undisturbed pool samples (Table 1.1.8-2) of each size. The methods and materials employed were identical to those of the previous year's program (Littler and O'Brien, 1977) with the exceptions noted in the introductory chapter (Littler, Chapter 1.1.1, this report). The identical transects and quadrats sampled by undisturbed methods during 1975-76 (Littler and O'Brien, 1977) were re-occupied 4-6 September 1976, 3-5 December 1976, 31 January 1977 February 1977, and 29 April-1 May 1977. In addition, disturbed sampling was performed only in September of the present Study.

The purpose of this report will be to present the important findings of the 1976-77 program for Dutch Harbor and to emphasize any major deviations from the high-resolution analysis presented for 1975-76 (see Littler and O'Brien, 1977). To increase the comparability of the data gathered over the two-year span, only the undisturbed samples will be considered (i.e., disturbed data omitted) because our emphasis

Table 1.1.8-1. Environmental Data Measured during the Period of Study for Dutch Harbor, San Nicolas Island.

	Water Temp. (°C)	Air Temp. (°C)	Cloud Cover (%)	Salinity (°/oo)	Wave Ht. (ft)	Relative Humidity (%)	Wind Velocity (knots)
04-06 September 1976							
Range	20.0-22.0	18.0-23.0	0-1oo	33.0-34.0	1-3	--	0-5
Mean	21-0	21.4	22	33.6	2	--	3
03-05 December 1976							
Range	19.0	18.0-21.0	0-75	32.0-34.0	1-2	81-82	5-10
Mean	19	19.3	29	33.2	1	81	8
31 January - 02 February 1977							
Range	17.0-18.0	19.0-23.0	0-60	33.0-34.0	1-4	80-92	0-20
Mean	17.3	20.7	23	33.3	3	83	10
29 April - 01 May 1977							
Range	15.0-16.0	8.0-22.0	1-85	34.0	1-4	76-93	0-20
Mean	15.4	19.2	37	34.0	2	85	8

Table 1.1.8-2. Number of Undisturbed and Disturbed 0.15-m^2 and 1.0-m^2 Samples Obtained during the Pour Site Visits of 1976-77 to Dutch Harbor, San Nicolas Island.

	Sept. 1976	Dec. 1976	Feb. 1977	May 1977
Rocky Intertidal Samples				
Disturbed	8	--	--	--
Undisturbed	32	32	32	32
Subtotal				
Pool Samples				
Disturbed	4	--	--	--
Undisturbed	11	11	11	11
Total	55	43	43	43

this past year (1976-77) has been on undisturbed sampling (which produces the most extensive and useful data). The -1.0 ft. to MLLW (-.3 m to MLLW) interval was not sampled during the present study because of high waves and the unpredictability of sampling below MLLW.

1.1.8.4 Results

1.1.8.4.1 Floristics and Faunistics

During the 1976-77 sampling program, a total of 77 macrophytes (Table 1.1.8-3) was found in the quadrats. Fifty-three taxa were present in the disturbed samples and 72 occurred in the undisturbed samples. Five macrophytes were located only in the harvest samples while 24 were taken only in the undisturbed quadrats. An additional 11 taxa were collected outside the sample plots. The list of macrophytes found during 1976-77 (Table 1.1.8-3) includes 20 new records for Dutch Harbor, San Nicolas Island. As occurred the previous year, Rhodophyta (63) contributed the majority of taxa, followed by Phaeophyta (12), Chlorophyta (9), and Spermatophyte (2). Bacillariophyta and Cyanophyta were treated as single taxa. A total of 64 macroinvertebrates was recognized over the four sampling periods (Table 1.1.8-4), with 53 taxa found in disturbed samples and 48 recorded from undisturbed quadrats. Eleven macroinvertebrates were found only in the undisturbed samples and 16 only occurred in the harvest plots. An additional 31 species were collected outside of the quadrats. Table 1.1.8-4 includes 46 new records of macroinvertebrate taxa for the San Nicolas Island site. The most numerous taxa were members of the Mollusca (38), with 28 Gastropoda, 7 Bivalvia, and 4 Polyplacophora. In addition, the 1976-77 sample plots contained 12 Arthropoda, 6 Porifera, 3 Annelida, 2 Chordata, 2 Echinodermata, and 1 Cnidaria.

1.1.8.4.2 Standing Crop

1.1.8.4.2.1 Cover

Total mean biotic cover in the undisturbed samples increased by 23.4% (from 94.8% to 118.2%) during 1975-76 to 1976-77 (Tables 1.1.8-5 and 1.1.8-6). This difference was due mostly to increases in macrophyte cover (from a mean of 67.8% in 1975-76 to 88.8% in 1976-77). Both macrophytes and macroinvertebrates showed a drop in cover over most tidal intervals in February 1977 comparable to the 1975-76 decline that took place in December 1975. These declines both years were clearly related to times of sand inundation. As in 1975-76, macrophyte cover tended to be lowest (about 73%) in the +2.0 to +3.0 ft. (.6 to .9 m) and the +3.0 to +4.0 ft. (.9 to 1.2 m) tidal interval. However, all of the intertidal intervals sampled during 1976-77 showed considerable increases in macrophyte cover [+12.4% in the +1.0 to +2.0 ft.(.3 to .6 m) interval to 32.4% in the +4.0 to +5.0 ft. (1.2 to 1.5 m) interval].

Table 1.1.8-3. Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of San Nicolas Island. Additional species collected in the study area (C) but not present in samples have also been listed.

Species and Taxa	Sept. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	u	u	U	C
Bacillariophyta						
Benthic diatoms	x	x	x	x	x	
Chlorophyta						
Bryopsis corticulans		x			x	
Chaetomorpha linum	x	x	x	X	X	
Cladophora columbiana	x	x	x	X	x	
Cladophora spp.	x	x			x	
Cladophoropsis fasciculatus	x		x	x	x	
Codium fragile	x				x	
Enteromorpha intestinalis	x	x	X	x	x	
Ulva lobata	x	x	x	x	x	
Cyanophyta						
Blue-green algae	x	x	x	x	x	
Phaeophyta						
Colpomenia sinuosa	X	X	x	x	X	
Cylindrocarpus rugosus	x			x	x	
Ectocarpaceae	x[p]	x	x	x		
Egregia menziesii	x		X	x	x	
Endoplura aurea	x		x		x	
Halidrys dioica	x	x				
Leathesia nana	x[p]	x				
Macrocystis pyrifera					x[p]	
Pelvetia fastigiata						x
Ralfsiaceae	x	x	x	x	x	
Scytosiphon lomentaria					x	
Rhodophyta						
Acrochaetium sp. .					x	
Anisocladella pacifica	x		x[p]	x	x[p]	
Bossiella orbigniana ssp. dichotoma	x	x	X	x	x	
Callithamnion pikeanum					x	
Callithamnion rupicolum		x			x	

Table 11.8-3. Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods foreach Seasonal Assessment of San Nicolas Island. Additional species collected in the study area (C) but not present in samples have also been listed. (Continued)

Species and Taxa	Sept. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	u	u "	U	C
Callophyllis flabellulata						x
Callophyllis violacea					x	
Centroceras clavulatum		x				
Ceramium eatonianum/sinicola		x				
Ceramium pacificum					x	
Ceramium spp./ Centroceras clavulatum	x	x	x	x	x	
Chondria decipiens		x^p		x	x	
Chondria nidifica					x	
Corallina officinalis var. chilensis	x	x	x	x	x	
Corallina vancouveriensis	x	x	x	x	x	
cryptopleura crisps			x			
cryptopleura violacea	x	x	x	x	x	
Endocladia muricata	x	x	x	x	x	
Gastroclonium coulteri	x	x	x	x	x	
Gelidium coulteri	x	x	x	x	x	
Gelidium pusillum						x
Gigartina agardhii						x
Gigartina canaliculata	x	x	x	x	x	
Gigartina corymbifera						x
Gigartina harveyana						x
Gigartina leptorhynchos	x	x	x	x	x	
Gigartina papillata						x
Gigartina spinosa				x	x	
Gigartina volans						
Gracilaria verrucosa	x	x		x^p	x	
Grateloupia doryphora	x			x	x	
Herposiphonia plumula				x		
Hydrolithon decipiens	x	x	x	x	x	
Iridaea cordata var. splendens						x
Iridaea heterocarpa					x	
Laurencia pacifica		x				
Laurencia spectabilis	x	x		x	x	
Laurencia splendens		x	x^p	x^p	x	
Lithophyllum proboscideum	x	x	x	x	x	
Lithothrix aspergillum	x	x	x	x	x	
Melobesia mediocris	x		x	x	x	
Microcladia coulteri				x		
Neoagardhiella baileyi	x^p		x^p	x^p	x	

Table 11.8-3. Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of San Nicolas Island . Additional species collected in the study area (C) but not present in samples have also been listed. (.Continued)

Species and Taxa	Sept. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	u	u	U	C
Plocamium cartilagineum	x	x[p]	X	X	x[p]	
Plocamium violaceum		x[p]	X	X		
Polysiphonia acuminata		X		X	X	
Polysiphonia hendryi var. hendryi	x	X	X	X	X	
Polysiphonia paniculata		X		X	X	
Polysiphonia scopulorum var. villum		x		X		
Polysiphonia spp.		X				
Pogonophorella californica	x		X	X		
Porphyra perforata	X	x	X	X	X	
Prionitis lanceolata	x	x[p]				
Pterocladia capillacea		X				
Pterosiphonia baileyi	X	x	x	X	x	
Pterosiphonia bipinnata						
Pterosiphonia dendroidea	X	X	x	X	X[p]	x
Rhodoglossum affine	X	X	X	X	X	
Rhodymenia californica var. californica						X
Smithora naiadum	X			X	X	
Tiffaniella synderae	X	X	x	X		
Spermatophyte						
Phyllospadix scouleri	X	X	X	X	X	
Phyllospadix torreyi						X
88 Total Macrophytes						

[p] Refers to those taxa only obtained in tidepools.

Table 1.1.8-4. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Dutch Harbor, San Nicolas Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column.

Species and Taxa	Sept. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	u	u	u	c
Annelida						
Polychaeta						
Dodecaceria fewkesi	x		x	x	x	
Eupomatus gracilis						x
Phragmatopoma californica	x	x	x	x	x	
Spirobranchus spinosus					x	
Arthropods						
Crustacea						
Balanus glandula	x	x	x	x	x	
Balanus tintinnabulum californicus			x			
Cancer antennarius		x				
Cancer jordani						x
Chthamalus fissus/dalli	x	x	x	x	x	
Pachygrapsus crassipes	x	x	x	x	x	
Pagurus hirsutiusculus	x	x	x	x	x	
Pagurus samuelis	x	x[p]	x	x	x	
Pollicipes polymerus	x	x	x	x	x	
Pugettia products	x	x				
Tetraclita squamosa rubescens	x	x	x	x	x	
Chordata: Urochordata						
Ascideacea						
Archidistoma psammion						x
Archidistoma ritteri			x			
Distaplia occidentals						x
Euherdmania claviformis						x
Polyclinum planum						x
Ritterella aequalisiphonis		x[p]				

Table 1.1.8-4. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Dutch Harbor, San Nicolas Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued).

Species and Taxa	Sept. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	u	u	u	c
Cnidaria						
Anthozoa						
Anthopleura elegantissima	X	X	X	X	x	
Anthopleura xanthogrammica						x
Corynactis californica						x
Epiactis prolifera						x
Hydrozoa						
campanularia integra						X
Echinodermata						
Asteroidea						
Patiria miniata						X
Pisaster giganteus						x
Pisaster ochraceus		x[p]	x			
Echinoidea						
Strongylocentrotus purpuratus		x[p]				
Ectoprocta						
Tricellaria occidentals						x
Unknown bryozoan		x				
Mollusca						
Bivalvia						
Brachidontes adamsianus		x				
Hiatella arctica						X
Lasaea subviridis		X				
Modiolus capax		x				
Mytilus californianus	X	X	X	x	x	
Pseudochama exogyra		x	X			
Septifer bifurcates		x				
Septifer bifurcates/ Brachidontes adamsianus	x		x	x	x	

Table 1.1.8-4. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Dutch Harbor, San Nicolas Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued).

Species and Taxa	Sept. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	U	U	U	C
Gastropoda						
Acanthina punctulata	X	X	X	X	X	
Acanthina spirata			xP			
Acmaea (Collisella) asmi		X				
Acmaea (Collisella) digitalis	X	X	X	X	X	
Acmaea (Notoacmea) fenestrata						x
Acmaea (Notoacmea) insessa						X
Acmaea (Collisella) limatula	X	X	X	X	x	
Acmaea (Notoacmea) paleacea						X
Acmaea (Collisella) pelta	X	X	X	X	X	
Acmaea (Collisella) scabra	X	X	x	X	x	
Acmaea (Notoacmea) scutum						X
Acmaea (Collisella) strigatella	X	X	x	x	X	
Amphissa versicolor						X
Aplysia californica						X
Barleeia spp.		x				
Bittium attenuatum		xP				
Cerithiopsis cosmia						X
Conus californicus			X			
Crepipatella lingulata		xP				
Doriopsilla albopunctata						X
Epitonium tincture	X	X	X		X	
Fissurella volcano	x		X	X	X	
Flabellinopsis iodines						X
Haliotis cracherodii						X
Haliotis fulgens						X
Hopkinsia rosacea	X	X	X	X	x	
Lacuna porrecta		XP				
Lacuna unifasciata		X		X		
Littorina planaxis	X	X	X			
Littorina scutulata	X	X	X	X	X	

Table 1.1.8-4. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Dutch Harbor, San Nicolas Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued).

Species and Taxa	Sept. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D.	u	u	u	C
Lottia gigantea	x	x	X	X	x	
Macromphalina californica		x[p]				
Mitrella carinata		X		XP		
Nucella (Thais) emarginata	X	X	X	X		
Ocenebra circumtexta		X		X		
Opalia funiculata		x[p]	X		X	
Pseudomelatoma penicillata						X
Tegula funebralis	x	X	X	X	X	
Trinchesia sp.						X
Triphora pedroana						X
Williamia peltoides					x	
Polyplacophora						
Cyanoplax hartwegii	X	X	X		X	
Mopalia muscosa	x	X	X		X	
Nuttallina fluxa		X				
Nuttallina fluxa/californica	X		x		X	
Porifera						
Calcarea						
Leucandra heathi					x	
Leucilla nuttingi						X
Lucetta losangelensis					X	
Demospongiae						
Acarnus erithacus						X
Haliclona aff. permollis		X				
Ophlitaspongia pennata						X
Plocamia karykina .	X	X	X	X		
Spirasterella sp.		X				
Suberites ficus		X				
95 Total Macroinvertebrates						

p Refers to those taxa only obtained in tidepools.

TABLE 1.1.8-5. SEASONAL AND ANNUAL PATTERNS OF OVERALL MACROPHYTE COVER (%) AS A FUNCTION OF TIDAL HEIGHT FOR SAN NICOLAS ISLAND.

SEASON	TIDAL HEIGHT (FT). MLLW To 0.9	1.0 TO 1.9	2.0 To 2,9	3,(I TO 3,9	4.0 1"0 4.9
SEPTEMBER 1976	116.8	98.7	80,9	85.6	89.1
DECEMBER 1976	120.0	93.7	83.8	84.1	, 93.2
FEBRUARY 1977	91.4	80.9	57.0	37.0	64.6
MAY 1977	105.0	90.8	75,3	80.5	147.4
MEAN	108.3	91.0	74.2	71.8	98.6

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1,1.8-6. SEASONAL AND ANNUAL PATTERNS OF OVERALL MACRO-INVERTEBRATE LOVER. (%) AS A FUNCTIOI4 OF TIDAL HEIGHT FOR SAN NICOLAS ISLAND.

SEASON	TIDAL HEIGHT (FT). MLLW To 0,9	1,0 TO 1,9	2,0 To 2,9	3,0 To 3.9 ,	4.0 TO 4.9
SEPTEMBER 1976	30,7	12, $	35,2	37.6	34.9
DECEMBER 1976	27,1	22.6	33,8	35,6	27.0
FEBRUARY 1977	36,9	19,9	26,8	26.5	17.5
MAY 1977	42.2	25. $	37*O	34,8	25.2
MEAN	34,2	19,7	33.2	33.6	26.1

NOTE; 1 FOOT = 0.3048 METERS

Macroinvertebrate cover was reasonably constant during 1976-77 (Table 1.1.8-6) and reached a low in February 1977 at the time of maximum sand inundation. Macroinvertebrate cover increased in all four tidal intervals above +1.0 ft. (.3 m); however, in the interval from MLLW to +1.0 ft. (.3 m), cover decreased slightly (2.5%). Macroinvertebrate cover was reasonably uniform throughout all five tidal intervals sampled during 1976-77 with a minimum occurring in the +1.0 to +2.0 ft. (.3 to .6 m) interval.

There was only a slight change in mean cover of the four predominant macrophyte taxa from undisturbed samples during 1975-76 to 1976-77. Blue-green algae (24.2%), Gigartina canaliculata (18.8%), Chaetomorpha linum (11.0%), and Phyllospadix scouleri (8.2%) totaled 62.2% compared with 43.3% the preceding year (Table 1.1.8-7). Most of this difference was attributable to a 20% increase in blue-green algal cover over the preceding year's data. The epiphyte Smithora naiadum again showed a 1.8% cover peak in May 1977 as it had during the preceding year. However, most of the important macrophytes showed cover declines during February 1977 at the time of maximum sand cover. Form showing such a decline were the encrusting algae, blue-greens, Ralfsiaceae, and Lithophyllum proboscideum along with Gigartina canaliculata, Cheatomorpha linum, Phyllospadix scouleri, and the epiphytic Ceramium spp. Centroceras clavulatum. Similar declines were noted during December 1975, also related to the period of maximum sand inundation.

Yearly mean macrophyte cover distributions are shown in Figure 1.1.8-1 and the patterns over each of the four quarters are indicated in Figures 1.1.8-2 through 1.1.8-5. Important macrophytes with the broadest yearly distributional ranges, as indicated in Figure 1.1.8-1, were blue-green algae, Chaetomorpha linum, Corallina officinalis var. chilensis, and benthic diatoms (MLLW to +4.0 ft., 1.2 m). Gigartina canaliculata was important only below +4.0 ft. (1.2 m) and Phyllospadix scouleri was restricted to below +3.0 ft. (.9 m); both of these species reached maxima at the lowest tidal intervals and decreased higher on the shoreline. The same distributional patterns prevailed the previous year; however, during 1975-76, most of these species occurred in considerably less abundance at each of the five respective tidal intervals.

The total cover of sand in September 1-976 (Figure 1.1.8-2) was slight and only occurred in the uppermost interval sampled; but sand became more widespread and abundant during December 1976 with slight peaks in the upper interval and lower interval sampled (Figure 1.1.8-3). Sand then moved onto the site becoming extremely abundant during February 1977, particularly above +1.0 ft. (.3 m), after which it decreased but remained throughout the entire intertidal zone (Figures 1.1.8-4 and 1.1.8-5). The maxima and minima for sand as a function of tidal height during each of the four seasons were inversely related to the cover patterns shown by a large majority of the major macrophytic organisms (Figures 1.1.8-2 to 1.1.8-5).

TABLE 1.1.8-7. QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN NICOLAS ISLAND (CONTINUED ON NEXT PAGE).

TAXA	COVER (%) SEP. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
BLUE-GREEN ALGAE	28.1	27.2	17.5	24.1	24.2
GIGARTINA CANALICULATA	2104	18.9	17.5	17.2	18.8
CHAETOMORPHA LINUM	10.0	13.0	7.4	12.7	11*O
PHYLLOSPADIX SCOULERI	10,0	10.4	5.9	6,3	8.2
BENTHIC DIATOMS	<0.1	0.9	0.6	14,0	3.9
CORALLINA OFFICINALIS VAR. CHILENSIS	3*8	5.1	3.3	2.6	3.7
RALFSIACEAE	3.4	3,6	1.5	1,4	2.5
CERAMIUM SPP./CENTROCERAS CLAVULATUM	2.0	2.1	0.6	3.5	2.0
CORALLINA VANCOUVERIENSIS	0.8	2.1	2.4	1,7	1.8
GASTROCLONIUM COULTERI	1.1	1.1	1.4	2,7	1 . 6
ULVA LOBATA	1*4	0.8	1.3	1.8	1.3
HYDROLITHON DECIPIENS	1.2	1.4	1.3	1.3	1.3
GELIDIUM COULTERI	1.8	0.8	0.7	1.6	1,2
LITHOPHYLLUM PROBOSCIDEUM	1.2	1*7	0.6	0.4	1.0
ECTOCARPACEAE	0.0	2.5	0.6	0.0	0.8
SMITHORA NAIADUM	1,0	0.0	0.2	1.8	0.7
ENTEROMORPHA INTESTINALIS	0.5	0.3	<0.1	2*O	().7
CLADOPHORA COLUMBIANA	1,2	0.7	0.1	0.6	0.7
PORPHYRA PERFORATA	0.4	<0,1	<0.1	1.3	0.4
TIFFANIELLA SNYDERAE	0.7	0.3	0.2	(),0	0.3
PTEROSIPHONIA DENDROIDEA	0.6	0.2	0.2	0.0	0.3
LAURENCIA SPECTABILIS	0.4	0.2	0.3	0,1	0,3
ENDOCLADIA MURICATA	0.3	0.2	0.1	0.2	0.2
GIGARTINA LEPTORHYNCHOS	O*3	<0.1	<0.1	0.4	(1,2
PTEROSIPHONIA BAILEYI	0.5	0.1	<0.1	<0.1	0.2
PLOCAMIUM CARTILAGINEUM	0.5	0.2	<0.1	0.0	0.2

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8-7. QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN NICOLAS ISLAND (CONTINUED).

TAXA	COVER (%) SEP. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
RHODOGLOSSUM AFFINE	0.1	<O*1	0.2	0.2	0.2
CLADOPHOROPSIS FASCICULATUS	<0.1	0.2	0.2	<G*1	O*1
POLYSIPHONIA ACUMINATA	0.0	0,0	0.4	<0.1	0.1
OTHER MACROPHYTES	0.6	009	1.1	1.6	
NUMBER OF OTHER TAXA	(21)	(19)	(25)	(31)	

NOTE; 1 FOOT = 0.3048 METERS

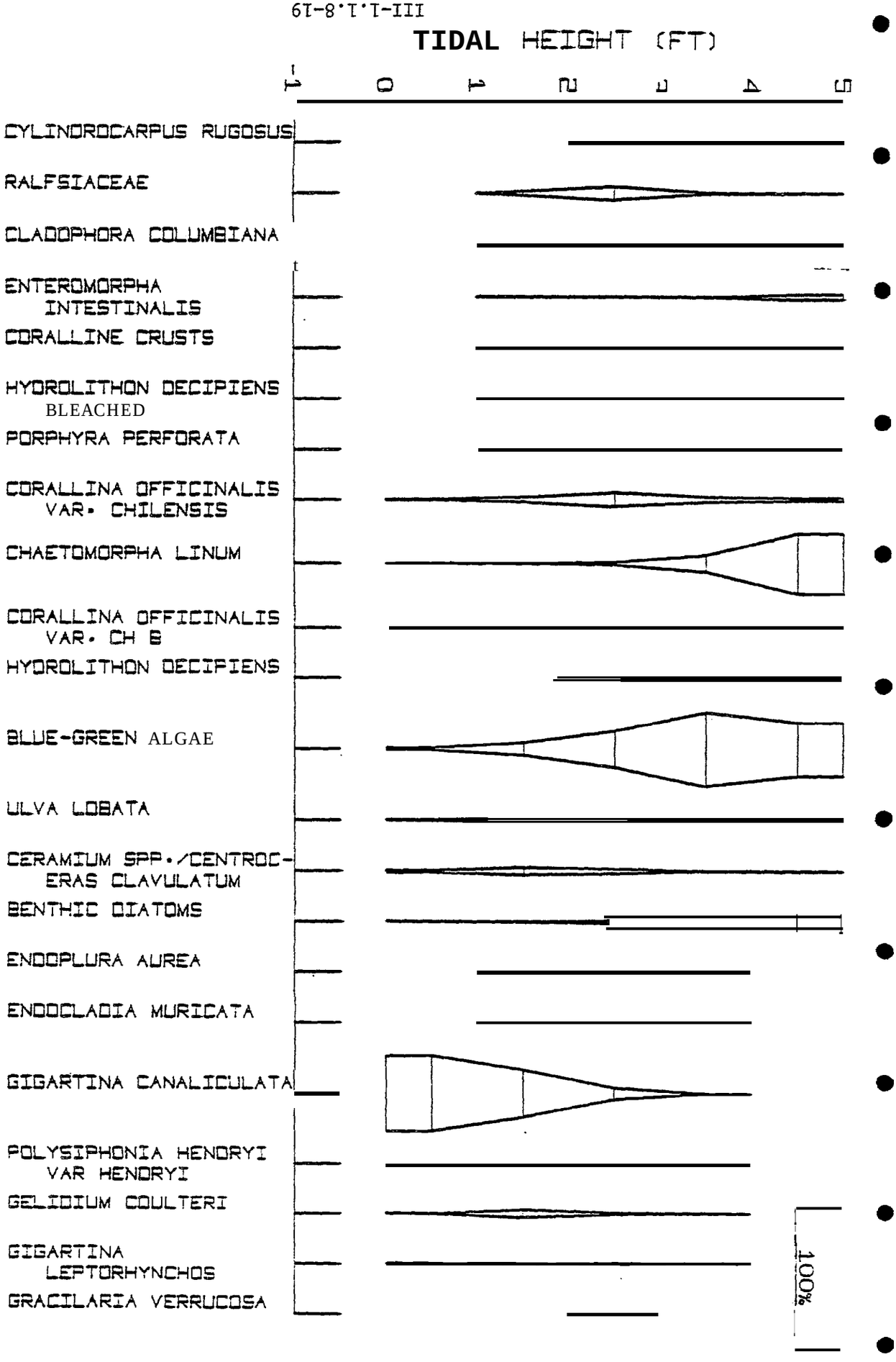

FIGURE 1.1.8-1. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1.1.8-1. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN NICOLAS ISLAND (CONTINUED).

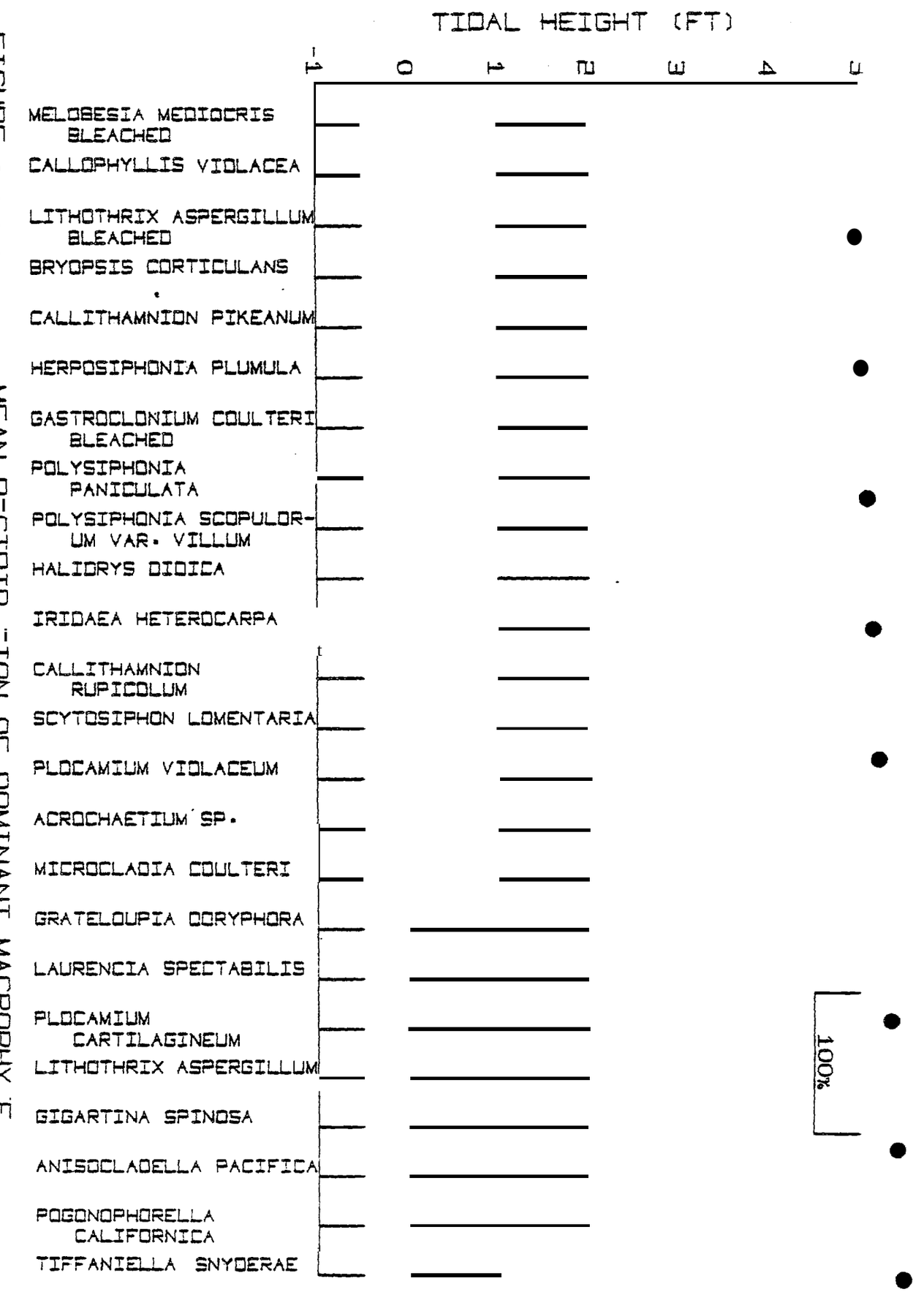

FIGURE 1.1.8-1. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1.1.8-1. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN ONOFRE (CONTINUATION).

FIGURE 1.1.8-2. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR SEPTEMBER 1976 AT SAN NICOLAS ISLAND CONTINUED

FIGURE 1.1.8-2. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR SEPTEMBER 1976 AT SAN NICOLAS ISLAND

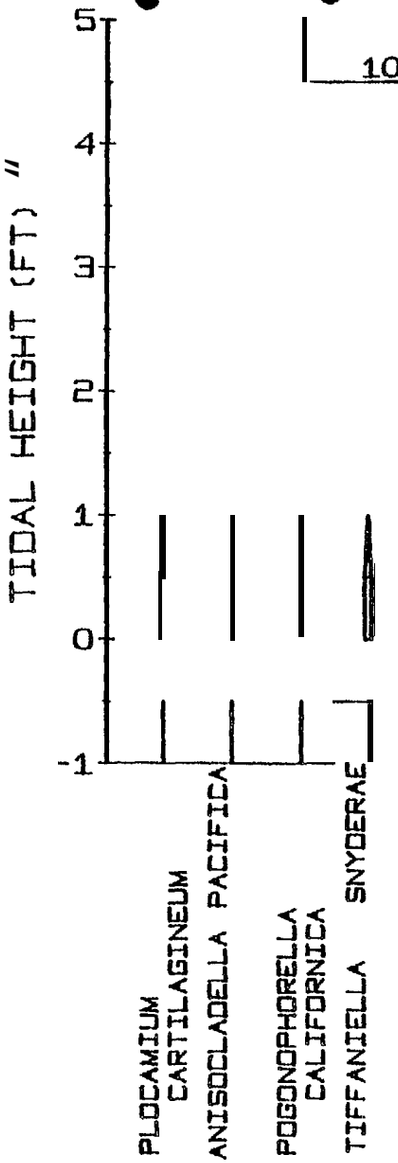

FIGURE 1.1.8-2. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR SEPTEMBER 1976 AT SAN NICOLAS ISLAND (CONTINUATION).

FIGURE 1.1.8-3. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1.1.8-3. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1.1.8-3. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1.1.8-4. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1987 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1.1.8-4. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SAN ONOFRE (CONTINUED).

FIGURE 1.1.8-4. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SAN NICOLAS ISLAND (CONTINUATION).

FIGURE 1.1.8-5. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1.1.8-1. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1.1.8-5. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SAN NICOLAS ISLAND (CONTINUATION)

The macro invertebrate cover remained relatively constant over the seasons sampled, becoming only slightly reduced during February 1977 in association with the time of maximum sand inundation. Of the-major macroinvertebrates (Table 1.1.8-8), the same five forms that dominated the cover during 1975-76 again dominated during the present study. Four of these forms (i.e., Anthopleura elegantissima, Dodecaceria fewkesi, Chthamalus fissus/dalli, and Mytilus californianus) showed slight overall mean increases in cover, while Phragmatopoma californica showed a 3.8% decrease in cover from the previous year's values. Both A. elegantissima and C. fissus/dalli showed reductions in cover during the time of maximum sand inundation (February 1977), while D. fewkesi showed a slight increase beginning at that time.

Mean yearly cover patterns for the major macroinvertebrates are plotted as a function of tidal height in 'Figure 1.1.8-6. Comparable to the previous year, the most widespread of the dominant macroinvertebrates were Anthopleura elegantissima and Phragmatopoma californica, which were found in all five intertidal intervals sampled but both of which reached maxima in the middle intervals. All of the major macroinvertebrates increased at every tidal height relative to their respective cover values for 1975-76. The largest increase in any given tidal interval was shown by Dodecaceria fewkesi which increased by 27.9% in the interval from MLLW to +1.0 ft. (.3 m). The macroinvertebrate distributional patterns of cover by season (Figures 1.1.8-7 through 1.1.8-10) revealed very little seasonality except a general reduction of macroinvertebrate cover associated with the time of maximum sand inundation (February 1977).

1.1.8.4.2.2 Frequency

The mean yearly percentages of samples containing the major macrophytes and macroinvertebrates are presented by season in Tables 1.1.8-9 and 1.1.8-10. As was the case in 1975-76, many of the widespread macrophytes (blue-green algae, frequency of 89.4%; Corallina officinalis var. chilensis, 57.3%; Ulva Lobata, 56.8%; Gigartina canaliculata, 53.9%; and Chaetomorpha linum, 51. 1%) were those that covered the majority of the substrate. These forms all showed increases in frequency during 1976-77 except U. lobata (decrease of 16.9%) and G. canaliculata (decrease of 2.9%). The increased frequency of bleached thalli of Hydrolithon decipiens, C. officinalis var. chilensis, Lithophyllum proboscideum, G. canaliculata, Phyllospadix scouleri, Gastroclonium coulteri, and Lithothrix aspergillum during December 1976 reflects insolation, heat, and desiccation stresses imposed by "Santa Aria" winds during daytime low tides. Anthopleura elegantissima repeated its dominance of macroinvertebrate frequency values (Table 1.1.8-10), occurring in 18.5% more samples than it did in 1975-76. The second most widespread species, Tegula funebralis, occurred in 14.5% more samples than it had the previ-ar, while Acmaea (Collisella) scabra was found in 2.6%

TABLE 1.1.8-8. QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SAN NICOLAS ISLAND.

TAXA	COVER (%) SEP. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
ANTHOPLEURA ELEGANTISSIMA	9.3	8.1	6.5	9.9	8.4
DODECACERIA FEWKESI	6.7	6.9	8.6	10.8	8.3
CHTHAMALUS FISSUS AND DALLI	6.9	5,8	3.5	5.5	5.4
MYTILUS CALIFORNIANUS	2.9	2,8	2.8	2.7	2.8
PHRAGMATOPOMA CALIFORNIA	1.0	2,6	1.6	1.4	1.7
HALIOTIS CRACHERODII	0.8	0.8	0.8	0.9	0.8
TEGULA FUNEBRALIS	1*3	O*7	0.7	0.3	0.7
ACMAEA (COLLISELLA) SCABRA	0.5	0.4	O*1	0.2	0.3
TETRACLITA SQUAMOSA RUBESCENS	0.1	0.3	0.5	0.2	0.3
CHTHAMALUS FISSUS & DALLI DEAD	0.2	0.2	<0.1	0.2	0.1
OTHER MACRO-INVERTEB RATES	0.6	0.6	0.3	0.4	
NUMBER OF OTHER TAXA	(22)	(27)	(20)	(23)	

NOTE: 1 FOOT = 0.3048 METERS

FIGURE 1.1.8-6.

MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1.1.8-6

MEAN DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN NICOLAS ISLAND CONTINENTATION.

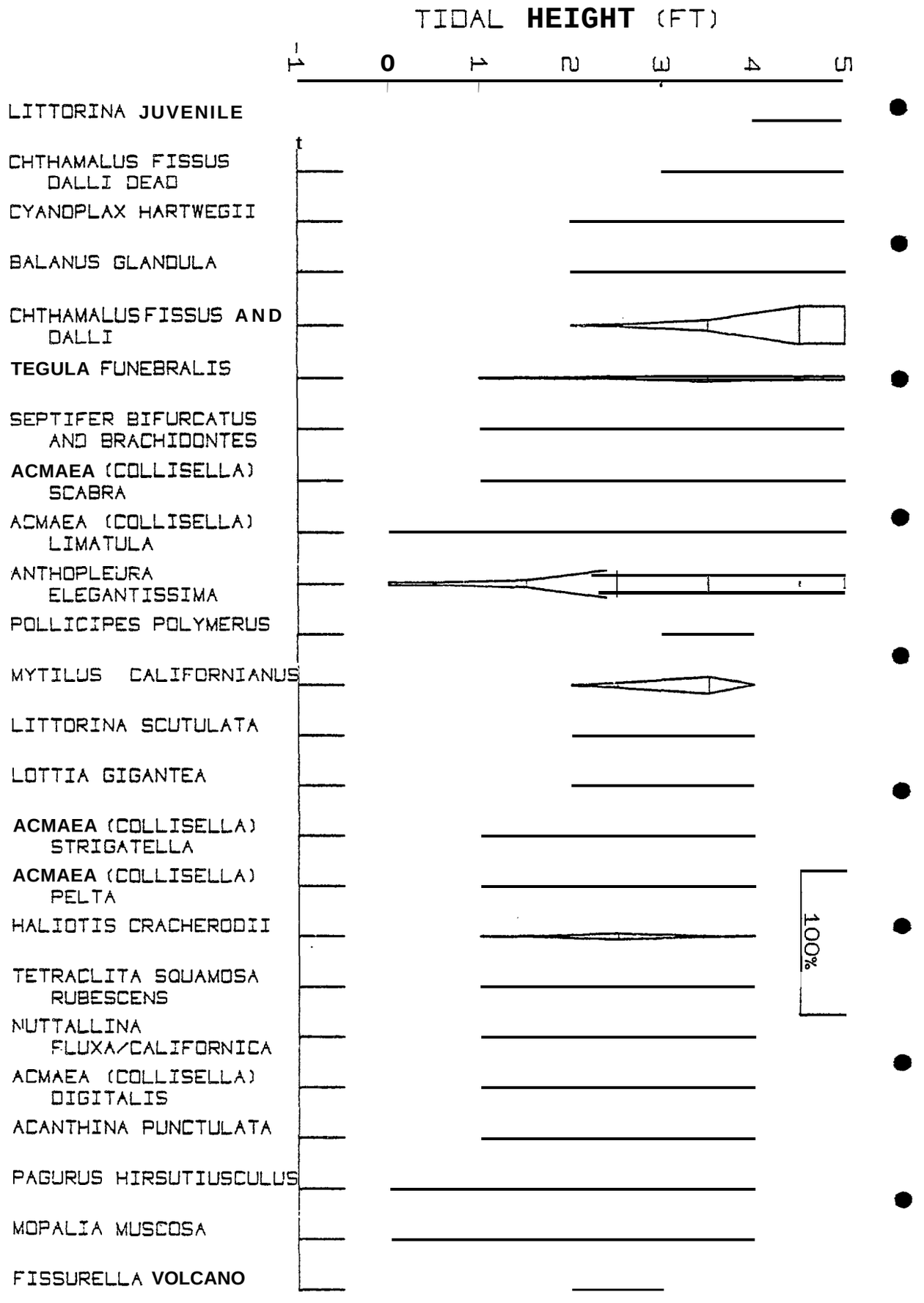

FIGURE 1.1.8-7. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR SEPTEMBER 1976 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1.1.8-7.

DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR SEPTEMBER 1976 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE III.1.8-CO.

DISTRIBUTION OF DOMINANT MACROINVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1.1.8-8. DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN NICOLAS ISLAND CONTINUATION

FIGURE 1.1.8-9. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SAN NICOLAS ISLAND (CONTINUED)

FIGURE 1.1.8-9.

DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SAN NICOLAS ISLAND

FIGURE 1.1.8-10. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SAN NICOLAS ISLAND CONTINUED.

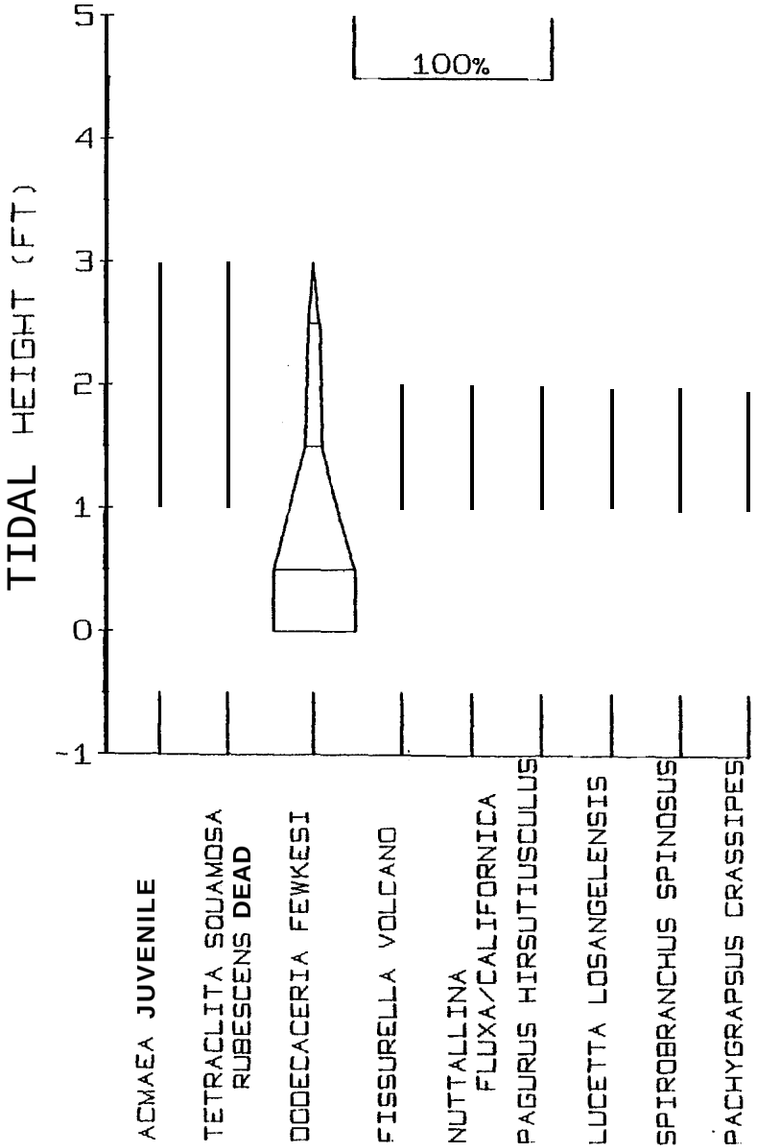

FIGURE 1.1.8-10. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SAN NICOLAS ISLAND (CONTINUATION).

TABLE 1.1.8-9. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN NICOLAS ISLAND (CONTINUED ON NEXT PAGE).

TAXA	FREQUENCY (%) SEP. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
BLUE-GREEN ALGAE	89.3	100.0	85.5	82.7	89*4
CORALLINA OFFICINALIS VAR. CHILENSIS	61,6	69.3	52.7	45.6	57.3
ULVA LOBATA	64.4	46.1	52.0	64,s	56*8
GIGARTINA CANALICULATA	57,9	52,5	52.9	52.5	53*9
CHAETOMORPHA LINUM	53*I	52,4	54.9	44,1	51.1
RALFSIACEAE	53.8	43.8	43.6	49.8	47.8
HYDROLITHON DECIPIENS	49.3	46.5	44.5	44*O	46.1
CERAMIUM SPP./CENTROCERAS CLAVULATUM	44,2	51,3	42.5	39,2	44.3
LITHOPHYLLUM PROBOSCIDEUM	38*9	36.4	37*5	31.9	36.2
PHYLLOSPADIX SCOULERI	36.6	36,1	35.0	31,7	35.3
GASTROCLONIUM COULTERI	33,6	33.6	35.0	33,6	34.0
BENTHIC DIATOMS	1,9.8	18.3	25.0	59,3	30,8
CLADOPHORA COLUMBIANA	50.6	17,9	15,0	34,9	29.6
GELIDIUM COULTERI	23.6	28.1	26.7	36.7	28.8
CORALLINA VANCOUVERIENSIS	20.3	33,6	19.2	15.8	22.2
COLPOMENIA SINUOSA	13.3	8.9	20.0	34.2	19.1
PTEROSIPHONIA DENDROIDEA	11.1	29,2	30.0	0.0	17.6
POLYSIPHONIA HENDRYI VAR HENDRYI	10.1	20.3	24.2	13.9	17.1
ENTEROMORPHA INTESTINALIS	14,2	22.0	5.0	26.4	16.9
PORPHYRA PERFORATA	17,8	2.2	12.9	33,8	16.7
GIGARTINA LEPTORHYNCHOS	10.1	2.5	16.7	33,9	15,8
LAURENCIA SPECTABILIS	20,0	17.8	11.7	11.1	15.1
ENDOCLADIA MURICATA	12.9	11.1	18.2	10.7	13.2
PTEROSIPHONIA BAILEYI	11.4	11.1	?.5	16.1	11.5
SMITHORA NAIADUM	13.3	0.0	5.0	26.9	11.3
MELOBESIA MEO1OCRIS	13.3	15,6	5.0	11.4	11.3

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8-9. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN NICOLAS ISLAND (CONTINUATION).

TAXA	FREQUENCY (%) SEP. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
CODIUM FRAGILE	407	O*O	0.0	2.2	1.7
LAURENCIA SPLENDENS	0.0	0.0	0.0	6.7	1.7
PHYLLOSPADIX SCOULERI B LEACHED	0.0	6.7	O*O	0.0	1.7
GIGARTINA VOLANS	0.0	6,7	O*O	0.0	1.7
CORALLINA VANCOUVERIENSIS BLEACHED	0.0	0.0	6.7	11,6	1.7
GRACILARIA VERRUCOSA	2.5	0.0	0.0	2.5	1.3
POLYSIPHONIA PANICULATA	0.0	000	2.5	2,2	1.2
NEOAGARDHIELLA BAILEYI	0,0	0,0	0.0	2.5	0.6
HERPOSIPHONIA PLUMULA	0,0	0.0	2.5	0.0	0.6
MICROCLADIA COULTERI	O*O	0.0	2.5	0.0	0.6
PRIONITIS LANCEOLATA	2.5	0.0	0.0	0.0	0.6
CHONDRIA NIDIFICA	0.0	0.0	0.0	2,5	0.6
POLYSIPHONIA SCOPULORUM VAR. VILLUM	0.0	0,0	2.5	6,0	0.6
BRYOPSIS CORTICULANS	0.0	0.0	0.0	2*2	0.6
GASTROCLONIUM COULTERI BLEACHED	0.0	2,2	0.0	0,0	0,6
IRIDAEA HETEROCARPA	0.0	0.0	0.0	2.2	0.6
SCYTOSIPHON LOMENTARIA	O*O	O*O	0.0	2,2	0 . 6
CALLOPHYLLIS VIOLACEA	0,0	0,0	C)*O	2,2	0,6
LITHOTHRIX ASPERGILLUM BLEACHED"	0"0	2,2	0.0	0.0	0.6
CALLITHAMNION PIKEANUM	0,0	0.0	O*O	202	0,6
MELOBESIA MEDIOCRIS BLEACHED	2*2	0.0	0.0	0.0	0.6
ACROCHAETIUM SP.	0.0	0,0	0.0	2,2	0.6
HALIDRYS DIOICA	2.2	0.0	0.0	0.0	0.6
CALLITHAMNION RUPICOLUM	0.0	0.0	O*O	2.2	0.6

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8-9. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN NICOLAS ISLAND (CONTINUED).

TAXA	FREQUENCY (%) SEP. 1976	DECO 1976	FEB. 1977	MAY 1977	MEAN
HYDROLITHON DECIPIENS BLEACHED	2.2	11.5	12.5	16.4	10.7
ENDOPLURA AUREA	5.0	9.7	7.5	19,5	10.4
LITHOTHRIX ASPERGILLUM	8.9	8.9	9.2	0,9	9.0
RHODOGLOSSUM AFFINE	6.9	4.4	14.2	9,2	0'7
CORALLINE CRUSTS	16.9	0.0	0.0	13,0	7.5
PLOCAMIUM CARTILAGINEUM	6.7	13.3	9.2	0.0	7.3
CORALLINA OFFICINALIS VAR. CH B	0.0	19s8	9.2	0.0	7.2
CRYPTOPLEURA VIOLACEA	7,2	11.4	5.0	2,2	6.5
ECTOCARPACEAE	0.0	15.8	10,0	0.0	6.5
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	4.4	6.9	9.2	4.4	6.2
CLADOPHOROPSIS FASCICULATUS	2.5	9.2	9.2	2.5	5.8
LITHOPHYLLUM PROBOSCIDEUM BLEACHED	2.2	13,6	2.5	4,7	5,8
GIGARTINA SPINOSA	0,0	0,0	265	20,0	5,6
POGONOPHORELLA CALIFORNICA	6.7	8.9	6,7	0,0	5.6
CYLINDROCARPUS RUGOSUS	11.5	0.0	7.5	2.5	5.4
GRATELOUPIA DORYPHORA	2.2	0,0	9.2	8,9	5.1
TIFFANIELLA SNYDERAE	6.7	6.7	6.7	O*O	5.0
CRYPTOPLEURA CRISPA	0.0	6.7	6.7	6,7	5.0
CLADOPHORA SPP.	13.6	0,0	0.0	4.7	4.6
POLYSIPHONIA ACUMINATA	0.0	'0.0	10*O	4.4	3.6
EGREGIA MENZIESII	4.4	2.2	2.5	4.4	3.4
CHONDRIA DECIPIENS	0.0	0.0	6.7	6.7	3.3
CERAMIUM PACIFICUM	0.0	0.0	6.7	4.7	2.8
ANISOCLADELLA PACIFICA	6.7	0.0	2.5	0,0	2.3
GIGARTINA CANALICULATA BLEACHED	O*O	7.5	0.0	0.0	1.9
PLOCAMIUM VIOLACEUM	0.0	4.4	2.5	0.0	1.7

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8-10 QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SAN NICOLAS ISLAND (CONTINUED ON NEXT PAGE),

TAXA	FREQUENCY (%) SEP. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
ANTHOPLEURA ELEGANTISSIMA	96.0	89.8	85.5	79*1	87.6
TEGULA FUNEBRALIS	53,7	54*8	46.3	48,4	50.8
ACMAEA (COLLISELLA) SCABRA	55.2	56.3	42.9	40,7	48.8
CHTHAMALUS FISSUS AND DALLI	26.9	44.2	34.1	44.1	37,4
DO DECACERIA FEWKESI	38.6	34.2	33.3	36.7	35.7
PHRAGMATOPOMA CALIFORNIA	21*1	53.4	31*7	34*9	35.3
TETRACLITA SQUAMOSA RUBESCENS	16,7	52,7	36.4	32.5	34.6
ACMAEA (COLLISELLA) STRIGATELLA	25.2	39,3	10.0	33,3	27.0
ACANTHINA PUNCTULATA	15,1	28.5	21.2	29.9	23.7
ACMAEA (COLLISELLA) PELTA	31,8	15*1	20.4	17.7	21.2
MYTILUS CALIFORNIANUS	21.8	18.9	23.9	16.1	2002
ACMAEA (COLLISELLA) LIMATULA	36.8	15.7	7.9	14.8	18.8
SEPTIFER BIFURCATUS AND BRACHIDONTES	14,2	17.4	14.7	16.9	15.8
CHTHAMALUS FISSUS & DALLI DEAD	13,7	19.1	16.6	13.7	15.8
MOPALIA MUSCOSA	23,7	16.8	14.2	6.9	15.4
ACMAEA (COLLISELLA) DIGITALIS	18.7	5.7	15.1	20.8	15.1
PAGURUS HIRSUTIUSCULUS	31,0	7.2	19,2	2,2	14.9
HALIOTIS CRACHERODII	12.6	12.6	12.9	12,6	12.6
LITTORINA SCUTULATA	5.4	6,5	8.6	26,9	11.8
LOTTIA GIGANTEA	7*9	10.7	13,2	14.5	11.6
BALANUS GLANDULA	20.9	6,9	6.9	10,9	11.4
CYANOPLAX HARTWEGII "	12*2	18,4	0.0	8.4	9.8
PLOCAMIA KARYKINA	11.1	11.1	11.7	0.0	8.5
TETRACLI 1A SQUAMOSA RUBESCENS DEAD	4*7	4.7	10.0	9.7	7,3
NUTTALLINA FLUXA/CALIFORNICA	15.2	9.2	0.0	4.4	7.2
PACHYGRAPSUS CRASSIPES	9.4	7,2	5.4	2*2	6.1

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8-10 QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SAN NICOLAS ISLAND (CONTINUATION).

TAXA	FREQUENCY (%) SEP. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
ACMAEA JUVENILE	0.0	0.0	O*O	2301	5.8
EPITONIUM TINCTUM	2.2	7.2	0.0	10*1	4.9
PAGURUS SAMUELIS	0.0	15.8	2.5	0.0	4,6
POLLICIPES POLYMERUS	2,9	5*1	5.7	2,9	4.1
FISSURELLA VOLCANO	2,5	202	5.0	4.4	3.5
NUCELLA (THAIS) EMARGINATA	5.0	2•9	5.7	000	3.4
PUGETTIA PRODUCTA	11.4	0.0	0.0	0,0	2.0
LITTORINA PLANAXIS	000	10.5	0.0	0.0	2,6
LITTORINA JUVENILE	8.0	0,0	0.0	0.0	2.0
PISASTER OCHRACEUS	0.0	6,9"	0.0	0.0	1.7
LACUNA UNIFASCIATA	0.0	0.0	6.7	O*O	1.7
OPALIA FUNICULATA	O*O	202	0.0	2.5	1.2
BALANUS GLANDULA DEAD	0,0	0,0	0.0	4.0	1.0
CONUS CALIFORNICUS	0,0	2.9	ooo-	0,0	0.7
OCENEBRA CIRCUMTEXTA	0.0	000	2.5	0.0	0.6
LUCETTA LOSANGELENSIS	0.0	0,0	0,0	2*2	0.6
BALANUS TINTINNABULUM CALIFORNICUS	0.0	2*2	0.0	0.0	0.6
PSEUDOCHAMA EXOGYRA	0.0	2.2	0.0	0.0	0,6
SPIROBRANCHUS SPINOSUS	O*O	0.0	0.0	2,2	0.6

NOTE: 1 FOOT = 0.3048 METERS

fewer 'samples . Of these more widespread species , only A. elegant issima did not show a February 1977 decrease in association with sand inundation at that time.

The mean seasonal distributions of the macrophytes with respect to frequency of occurrence, appear in Figure 1.1.8-11. In general, as during 1975-76, the distributional patterns paralleled the trends in cover (Figure 1.1.8-1). Similar 'relationships prevailed for the yearly frequency patterns shown by the macroinvertebrates (cf. Figures 1.1.8-12 and 1.1.8-6). Exceptions were certain abundant species (e.g., Phyllospadix torreyi) that were restricted in their distributions and other taxa that were widespread (e.g., Tends funebralis) but which contributed very little cover. Frequency values during this study increased over nearly all the tidal intervals for both macroinvertebrates and macrophytes relative to the 1975-76 values : the exception to this was a 5% reduction in frequency of Anthopleura elegantissima in the +4.0 to +5.0 ft. (1.2 to 1.5 m) interval.

1.1.8.4.2.3 Dens i ty

The most numerous macroinvertebrates (Table 1.1.8-11) were again Chthamalus fissus/dalli (yearly average of 2511 individuals/m^2, ' f 1076/m^2), and Anthopleura elegantissima (186/m^2, increase of 43/m^2). A drama'tic increase of 124/m^2 over the 15/m^2 values of 1975-76 was shown also by Tetraclita squamosa rubescens. Both C. fissus/dalli and A. elegantissima reached minimum densities (2213/m^2 and 134/m^2, respectively) during the time of maximum sand cover (February 1977) .-

Yearly density distributions on an expanded scale (Figure 1.1.8-13) and a compressed scale (Figure 1.1.8-14) have been plotted to show patterns as a function of tidal height. Seasonal distributions are indicated similarly in Figures 1.1.8-15 through 1.1.8-22. Density values of the major macroinvertebrates generally increased over 1976-76 values at all tidal intervals, except for a 315/m^2 reduction in Littorina scutulata in the +4.0 'to +5.0 ft. (1.2 to -1.5 m) interval.

1.1.8.4.2.4 Biomass

The contribution of the disturbed samples taken during September 1976 was to moderately alter the grand biomass means based on the prior four quarters of harvesting (Tables 1.1.8-12 through 1.1.8-15). The total wet biomass (WW) of 5131.8 g/m^2 (924.3 g/m^2 ODW) increased by 472.5 g/m^2 over the mean based on the first four sampling periods of 1975-76. This was made up of 3864.9 g/m^2 WW (784.3 g/m^2 ODW) macrophytes (increase of 161.9 g/m^2 WW) and 1266.9 g/m^2 WW (140.0 g/m^2 ODW) macroinvertebrates (increase of 310.6 g/m^2 WW).

FIGURE 1.8-11.

MEAN DISTRIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1.1.8-1. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDA HEIGHT DURING 1976/1977 A SAN NICOLAS ISLAND CONTINUED.

FIGURE 1.1.8-11. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 A SAN N COLAS ISLAND (CONTINUED).

FIGURE 1.1.8 11.

MEAN DISTRIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 A.1 SAN NICOLAS ISLAND (CONTINUATION).

FIGURE 1.1.8-12. MEAN STRIBUTION OF DOMINANT MACRO-INVERTEBRATE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT AND RING 1976/1977 AT SAN NICOLAS ISLAND (CONTINUED).

TIDAL HEIGHT (FT)
-1
0
1
2
3
4
5
ACMAEA (COLLISELLA) PELTA
HALIOTIS CRACHERODII
LOTTIA GIGANTEA
MYTILUS CALIFORNIANUS
NUTTALLINA FLUXA/CALIFORNICA
POLLICIPES POLYMERUS
PACHYGRAPSUS CRASSIPES
EPITONIUM TINCTUM
PAGURUS HIRSUTIUSCULUS
FISSURELLA VOLCANO
OPALIA FUNICULATA
TETRACLITA SQUAMOSA RUBESCENS DEAD
ACMAEA JUVENILE
PISASTER OCHRACEUS
PUGETTIA PRODUCTA
CANCER ANTENNARIUS
CANCER PRODUCTUS
CANCER OREGONENSIS
CANCER MAGISTER
CANCER GRACILIS
CANCER JORDANI
CANCER GRACILIS
CANCER JORDANI
CANCER GRACILIS
CANCER JORDANI

FIGURE 1.1.8-1.

MEAN DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 A SAN NICOLAS ISLAND (CONFIGURATION A

TABLE 1.1.8-11 QUARTERLY AND ANNUAL MEAN DENSITY (NO./M2) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SAN NICOLAS ISLAND.

TAXA	DENSITY (NO./M2) SEP. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
CH THAMALUS FI SSUS AND DALLI	2785	2473	2213	2574	2511
ANTHOPLEURA ELEGANTISSIMA	226	174	134	211	186
TETRACLITA SQUAMOSA RUBESCENS	80	154	150	170	139
MYTILUS CALIFORNIANUS	60	82	69	83	74
ACMAEA (COLLISELLA) SCABRA	78	71	24	33	51
TEGULA FUNEBRALIS	39	49	28	28	36
LITTORINA SCUTULATA	6	<1	5	109	30
LI TTORINA JUVENILE	25	0	0	0	6
ACMAEA JUVENILE	0	0	0	24	6
ACMAEA (COLLISELLA) STRIGATELLA	6	7	2	8	6
BALANUS GLANDULA	10	2	3	4	5
ACMAEA (COLLISELLA) PELTA	8	2	4	2	4
ACMAEA (COLLISELLA) DIGITALIS	4	<1	6	5	4
ACMAEA (COLLISELLA) LIMATULA	6	1	<1	2	2
ACANTHINA PUNCTULATA	1	2	1	4	2
SEPTIFER BIFURCATUS AND BRACHIDONTES	2	2	3	2	2
LOTTIA GIGANTEA	2	2	<1	3	2
PAGURUS HIRSUTIUSCULUS	4	<1	2	<1	2
LITTORINA PLANAXIS	0	6	0	0	2
HALIOTIS CRACHEROD II	2	1	2	1	1
MOPALIA MUSCOSA	2	2	<1	<1	1
OTHER MACRO- INVERTEBRATES	5	8	3	5	
NUMBER OF OTHER TAXA	(8)	(13)	(7)	(8)	
TOTALS	3351	3042	2652	3270	

NOTE: 1 FOOT = 0.3048 METERS

FIGURE 1.1.8-13. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1.1.8-13 MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN NICOLAS ISLAND (ON INUATION).

FIGURE 1.1.8-14. MEAN DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 A SAN NICOLAS ISLAND CALIFORNIA

FIGURE 1.1.8-14 MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 A SAN NICOLAS ISLAND CONTINUATION.

FIGURE 1.1.8 15. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR SEPTEMBER 1976 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1.1.8-15. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR SEPTEMBER 1976 AT SAN NICOLAS ISLAND (CONTINUATION).

FIGURE 1.1.8-16. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR SEPTEMBER 1976 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1.1.8-16. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR SEPTEMBER 1976 AT SAN NICOLAS ISLAND (CONTINUATION).

FIGURE 1.8-17. DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE 1 1.8-17, DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN NICOLAS ISLAND (CONTINUATION).

FIGURE 1.1.8-18.

DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN ONOFRE ISLAND (CONTINUED).

FIGURE 1.1.8-18, DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN NICOLAS ISLAND (CONTINUATION).

FIGURE 1.1.8-1. DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE .1.8-19.

DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SAN NICOLAS ISLAND (CONTINUATION).

FIGURE 3.1.8-20 DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1975 AT SAN NICOLAS ISLAND (CONTINUED).

FIGURE III.1.8-20

DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SAN NICOLAS ISLAND (CONTINUATION).

FIGURE 1.1.8-21.

DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SAN NICOLAS ISLAND (CONTINUED).

Table 1.1.8-14. Organic Dry Weight in g/m^2 for Dominant Macrophytes from Dutch Harbor, Sao Nicolas Island from September 1975 to September 1976. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros.

Taxa	Tidal Height (ft)						
	-1.0 to -0.1 (N=2)	MLLW to 0.9 (N=7)	1.0 to 1.9 (N=11)	2.0 to 2.9 (N=15)	3.0 to 3.9 (N=10)	4.0 to 4.9 (N=9)	Mean
Porphyra perforata		3.8	15.1	3.8	33.4	2.1	9.7
Gelidium coulteri		10.4	15.0	9.2	3.4	0.5	6.4
Cladophora columbiana		1.3	4.6	5.6	21.5	6.7	6.6
Chaetomorpha linum		<0.1	<0.1	<0.1	6.8	18.8	4.3
Enteromorpha intestinalis		<0.1	<0.1	<0.1	9.3	1.1	1.7
Ulva lobata		9.3	6.1	3.4	1.9	0.7	3.6
Corallina vancouveriensis*	0.5	17.5	5.4	22.7	8.2	0.6	9.2
Polysiphonia spp.	<0.1	3.4	2.1	8.2	<0.1	<0.1	2.3
Gigartina canaliculata	1.1	171.4	255.1	35.2	12.7	<0.1	79.3
Corallina officinalis var. chilensis*	0.4	0.7	2.7	4.0	7.0	0.4	2.6
Centroceras clavulatum				0.7	<0.1		0.1
Ceramium eatonianum/sinicola				0.5	1.3		0.3
Endocladia muricata				0.8	<0.1		0.1
Gigartina leptorhynchos				0.8	1.9		0.6
Lithothrix aspergillum*	0.1	0.7	0.4	0.1	<0.1		<0.1
Ceramium spp./Centroceras clavulatum		<0.1	0.1				
Pterocladia capillacea	<0.1	6.2	7.9	4.3	<0.1		3.1
Leathesia nana	1.0	<0.1		<0.1	<0.1		0.2
Rhodoglossum affine		4.1	6.7	1.8			0.3
				0.3			1.9

FIGURE 1.1.8-22. DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SAN NICOLAS IS. AND (CONTINUED).

FIGURE 1.1.8-22.

DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE
DENSITY AS A t40113Nfl.4 OF TIDAL HEIGHT FOR
MAY 1977 AT SAN NICOLAS ISLAND (CONTINUED)

1.1.8-83

TABLE 1.1.$-12. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM DUTCH HARBOR, SAN NICOLAS ISLAND FROM SEPTEMBER 1975 TO SEPTEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). ●1,0 TO -0.1 (N= 2)	MLLW TO 0.9 (N= 7	1.0 TO 1.9 1) (N=11)	2.0 TO 2.9 (N=15)	3*O TO 3.9 (N=10)	4*O TO 4.9 (N= 9)	MEAN
PORPHYRA PERFORATA		50.5	138.6	14.3	188.5	11.2	67.2
CHAETOMORPHA LINUM		(a l	<0.1	0.6	45.9	164.7	35.2
ULVA LOBATA		88.8	47.4	30.8	14.1	4.6	30.9
GELIDIUM COULTERI		46.7	78.0	40.9	12.1	2.5	36.0
ENTEROMORPHA INTESTINALIS		0.3	0.2	<0.1	46.5	9,9	9.8
CLADOPHORA COLUMBIANA		4.0	19.1	28.4	64.4	29.5	24.2
POLYSIPHONIA SPP.	0.3	17.9	9.4	33.0	<0.1	<0.1	10.1
GIGARTINA CANALICULATA	8.3	1257.5	1515.0	196.0	57*6	<0.1	505.7
CORALLINA OFFICINALIS VAR. CHILENSI	6.0	9.1	35.7	46.9	69,2	5,1	28.7
CORALLINA VANCOUVERIENSIS	13.2	482.6	159.6	563.6	185.2	15.8	233.3
POLYSIPHONIA HENDRYI VAR HENDRYI				0.7	<0.1		0.1
CERAMIUM EATONIANUM/SINICOLA				5.4	13.4		3.1
CENTROCERAS CLAVULATUM				5.0	<0.1		0.6
ENDOCLADIA MURICATA				3.1	<0.1		0.5
COLPOMENIA SINUOSA		2,3	2,0	0.2	<0.1		0.8
CALLITHAMNION RUPICOLUM		1.0		0.2	<0.1		0.2
GIGARTINA LEPTORHYNCHOS		3.4	6,2	4.0	10.0		3.9
CERAMIUM SPP./CENTROCERAS CLAVULATU	<0.1	47.8	40.6	24.8	<0.1		16.9
LITHOTHRIX ASPERGILLUM	1.7	0.3	1.7	1*7	0.1		0.9
PTILOCLADIA CAPILLACEA	4.6	<0.1		<0.1	<0.1		0.8
POLYSIPHONIA PANICULATA				4.5			0.7
LEATHESIA NANA				166.0			27.7

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8-12. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM DUTCH HARBOR, SAN NICOLAS ISLAND FROM SEPTEMBER 1975 TO SEPTEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 2)	MLLW TO 0,9 (N= 7)	1.0 TO 1.9 (N=11)	2.0 TO 2.9 (N=15)	3.0 TO 3.9 (N=10)	4,0 To 4.9 (N= 9 1)	MEAN
BENTHIC DIATOMS		1.0	0.7	0.5			0.4
CALLITHAMNION PIKEANUM		26.5	1.4	0.1			4.7
LAURENCIA SPECTABILIS		36.0	22.4	<0.1			9.7
CRYPTOPLEURA VIOLACEA		45.5		1.5			7.8
RHODOGLOSSUM AFFINE		20.0	43.8	1.8			12.4
CHONDRIA DECIPIENS		2.5	<0.1	0.5			0.5
GRACILARIA VERRUCOSA		1.2	3*9	<0.1			O*C
GASTROCLONIUM COULTERI	8.6	184.7	246.5	3.8			73*9
BRYOPSIS CORTICULANS	1.8			<0.1			0.3
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	180.9	52.0	23.9	10.5			44.6
SMITHORA NAIADUM	639.2	325,5	6.3	<0.1			162.5
PLOCAMIUM CARTILAGINEUM	446.4	29.4	22,6	5.4			64.0
PHYLLOSPADIX SCOULERI	3110.0	2472.7	1446.1	916.4			1325.9
PTEROSIPHONIA DENDROIDEA	57.4	65.6	4.3	9.0			21.9
PTEROSIPHONIA BAILEYI	5.4	41.3	8.8	13.7			11.5
CRYPTOPLEURA CRISPA	6.7	24.8	11.9	<0.1			7.2
HALIDRYS DIOICA	5084.6			0.9			847.6
IRIDAEA CORDATA VAR. SPLENDENS		5.3	3.6				1.5
COELOSEIRA COMPRESSA		1.4	<0.1				0,2
GIGARTINA SPINOSA		29.8	33.8				10.6
PHYLLOSPADIX TORREYI		1.5	0.2				0.3
PLOCAMIUM VIOLACEUM	8.7	63.2	22.1				15.7

NOTE:1 FOOT = 0.3048 METERS

TABLE 1.1.8-12. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM DUTCH HARBOR, SAN NICOLAS ISLAND FROM SEPTEMBER 1975 TO SEPTEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 2)	MLLW TO 0.9 (N= 7)	1.0 TO 1.9 (N=11)	2.0 TO 2.9 (N=15)	3.0 TO 3.9 (N=10)	4*O To 4.9 (N= 9)	MEAN
CLADOPHOROPSIS FASCICULATUS	3*9	0.1	1.6				0.9
ANISOCLADELLA PACIFICA	3.0	1,7	O*3				0.8
CRYPTOPLEURA SPP.	0.5	30.6	0.5				5.3
NEKPOSIPHONIA PLUMULA		0.7					0.1
CALLOPHYLLIS VIOLACEA		3,7					0.6
NIENBURGIA ANDERSONIANA		0.0					0.1
CLADOPHORA SPP.		1.0					0.2
ULVA TAENIATA		0.0					0.1
DESMARESTIA LIGULATA VAR. LIGULATA		1.2					0.2
EGREGIA MENZIESII	75.0	419.3					82.4
GRATELOUPIA DORYPHORA	2.4	2.0					0.7
IRIDAEA HETEROCARPA	6.4	3.6					1.7
PN1ONIT1S LANCEOLATA	402.6	9.5					68.7
GELIDIUM ROBUSTUM	146.6						24.5
GYMNOGONGRUS LEPTOPHYLLUS	2.4						0.4
OTHER MACROPHYTES (22)		0.2	0.4	0.5	0.4		
TOTAL WET WEIGHT IN G/M2	10235.0	5929.2	3938.9	2132.8	709.8	243.5	

NOTE: 1 FOOT = 0.3048METERS

TABLE 1.1.8-13. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM DUTCH HARBOR, SAN NICOLAS ISLAND FROM SEPTEMBER 1975 TO SEPTEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1*0 TO -0.1 (N= 2)	MLLW TO 0.9 (N= 7)	1.0 TO 1.9 (N=11)	2.0 TO 2.9 (N=15)	3.0 TO 3.9 (N=10)	4.0 TO 4.9 I N = 9)	MEAN
ACMAEA (NOTOACMEA) SCUTUM				0.6		<0.1	0.1
ACMAEA (COLLISELLA) LIMATULA				1.7	2.8	7.4	2.0
LITTORINA PLANAXIS				0.3	0.6	2.8	0.6
CHTHAMALUS FISSUS AND DALLI			0.7	230.6	93 a	595.8	153.3
LITTORINA SCUTULATA			<0.1	1.0	1.0	2.6	0.8
ACMAEA (COLLISELLA) DIGITALIS			<0.1	0.3	1.7	4.0	1.0
CYANOPLAX HARTWEGII			<0.1	4.1	5.5	5.3	2.5
ACMAEA (COLLISELLA) STRIGATELLA		0.2	0.3	0.4	1.4	0.5	0.5
ACANTHINA PUNCTULATA		1*4	4.0	4.0	3.6	0.7	2.3
BALANUS GLANDULA		5.2		14.0	4.0	4.6	4.6
ACMAEA (COLLISELLA) PELTA		2.7	1.6	3.7	3.7	1.0	2.1
TEGULA FUNEBRALIS		9.2	16.4	39.3	166.7	199*5	72.2
MOPALIA MUSCOSA		30.1	70.0	55.3	18.4	7,2	30.3
BRACHIDONTES ADAMSIANUS		2.5	1.6	4.1	16,2	16.0	6.7
PACHYGRAPSUS CRASSIPES		0.1	0.2	1.5	0.4	0.2	0.4
TETRACLITA SQUAMOSA RUBESCENS		2.9	29.9	10.2	<0.1	<0.1	7.2
NUCELLA (THAIS) EMARGINATA		1.5		1.1	1.2	1.1	0.8
ACMAEA (COLLISELLA) SCABRA		4.8	0.9	16.3	9.5	15.7	7.8
ANTHOPLEURA ELEGANTISSIMA	108.6	272.4	246.4	469.0	1906.0	60.1	511.4
POLLICIPES POLYMERUS				<0.1	4.5		0.7
LOTTIA GIGANTEA				5'.2	2.8		1.3
HALIOTIS CRACHERODII			<0.1	448.6	48.9		82.9

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8.-13. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM DUTCH HARBOR, SAN NICOLAS ISLAND FROM SEPTEMBER 1975 TO SEPTEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -001 (N= 2)	MLLW TO 0.9 (N= 7)	1.0 TO 1.9 (N=11)	2.0 TO 2.9 (N=15)	3.0 To 3.9 (N=10)	4.0 TO 4.9 (N= 9)	MEAN
NUTTALLINA FLUXA		0,7	<0.1	1*3	(1*3		0.4
PAGURUS HIRSUTIUSCULUS		0.7	.2.5	0.2	0 . 2		0.6
SEPTIFER BIFURCATUS		3.4	0.s	7.1	1.0		2.0
MODIOLUS CAPAX	4.9	3.2	1.3	0.4	0.1		1.7
MYTILUS CALIFORNIANUS	1.6	20.5	0 . 3	943.9	962.1		324.7
PSEUDOCHAMA EXOGYRA				2.1			0.4
CANCER ANTENNARIUS			3.4	<0.1			0.6
FISSURELLA VOLCANO			2.6	1*3			0.7
PUGETTIA PRODUCTA		3,2	1.1	0.3			0.8
SUBERITES FICUS		38.7		2.4			6.8
PLOCAMIA KARYKINA		141.5	15,2	2.4			26.5
PISASTER OCHRACEUS		26.0	4.6				5.1
BROWN SPONGE	26.3						4.4
OTHER MACRO-INVERTEBRATES (18)	0.4	Oil	1.4	0.9	0.8	0.3	
TOTAL WET WEIGHT IN G/M2	141.8	572.4	403.9	2274.1	3276.5	930.9	

NOTE; 1 FOOT = 0.3048 METERS

Table 1.1.8-14. Organic Dry Weight in g/m^2 for Dominant Macrophytes from Dutch Harbor, San Nicolas Island from September 1975 to September 1976. Species with ash free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros.

Taxa	Tidal Height (ft) -1.0 to -0.1 (N=2)	MLLW. to 0.9 (N=7)	1.0 to ..?" (N=11)	2.0 to 2.9 (N=15)	3.0 to 3.9 (N=10)	4.0 to 4.9 (N=9)	Mean
Porphyra perforata		3.8.	15.1	3.8	33.4	2.1	9.7
Gelidium coulteri		10.4	15.0	9.2	3.4	0.5	6.4
Cladophora columbiana		1.3	4.6	5,6	21.5	6.7	6.6
Chaetomorpha linum		<0.1	<0.1	<0.1	6.8	18.8	4.3
Enteromorpha intestinalis		<0.1	<0.1	<0.1	9.3	1.1	1.7
Ulva lobata		9.3	6.1	3.4	1.9	0.7	3.6
Corallina vancouveriensis*	0.5	17.5	5.4	22.7	8.2	0.6	9.2
Polysiphonia spp.	<0.1	3.4	2.1	8.2	<0.1	<0.1	2.3
Gigartina canaliculata	1.1	171.4	255. 1	35.2	12.7	<0.1	79.3
Corallina officinalis var. chilensis*							
Centroceras clavulatum	0.4	0.7	2.7	4.0	7.0	0.4	2.6
Centroceras gatonianum/sinicola				0.7	<0.1		0.1
Ceramium - muri- cata				0.5	1.3		0.3
Endocladia leptorhynchos				0.8	<0.1		0.1
Gigartina Lithothrix-aspergillum*		0.7	0.4	0.8	1.9		0.6
Ceramium spp./Centroceras clavulatum	0.1	<0.1	0.1	0.1	<0.1		<0.1
Pterocladia capillacea	<0.1	6.2	7.9	4.3	<0.1		3.1
Leathesia Rhodoglossum affine	1.0	<0.1		<0.1	<0.1		0.2
		4.1	6.7	1.8			0.3
				0.3			1.9

Table 1.1,8-14. Organic Dry Weight in g/m^2 for Dominant Macrophytes from Dutch Harbor, San Nicolas Island from September 1975 to September 1976. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros. (Continued).

Taxa	Tidal Height (ft) -1.0 to -0.1 (N=2)	MLLW to 0.9 (N=7)	1.0 to 1.9 (N=11)	2.0 to 2.9 (N=15)	3.0 to 3.9 (N=10)	4.0 to 4.9 (N=9)	Mean
Callithamnion pikeanum		2.7	0.2	<0.1			0.5
Laurencia spectabilis		2.5	2.4	<0.1			0.8
Cryptopleura violacea		5.0		0.2			0.9
Gracilaria verrucosa		<0.1	0.5	<0.1			0.1
Bossiella orbigniana ssp. dichotoma*	73.9	18.4	11.7	4.6			18.1
Phyllospadix scouleri	985.4	727.7	344.7	258.6			386.1
Plocamium cartilagineum	51.4	3.1	2.0	0.6			9.5
Pterosiphonia dendroidea	9.2	10.3	0.8	0.6			3.5
Gastroclonium coulteri	1.1	19.5	32.5	0.4			8.9
Bryopsis corticulans	1.1			<0.1			0.2
Pterosiphonia baileyi	0.5	4.1	1.2	1.5			1.2
Cryptopleura crisps	1.1	5.4	1.5	<0.1			1.3
Halidrys dioica	894.8			0.1			149.2
Smithora naiadum	112.0	39.1	0.6	<0.1			25.3
Iridaea cordata var. splendens		0.9	0.4				0.2
Gigartina spinosa		4.4	6.8				1.9
Plocamium violaceum	0.7	5.6	2.9				1.5
Cryptopleura spp.	<0.1	5.0	<0.1				0.8
Cladophoropsis fasciculatus	0*7	<0.1	0.4				0.2
Egregia menziesii	17.8	110.2					21.3

Table 1 1.8-14. Organic Dry Weight in g/m^2 for Dominant Macrophytes from Dutch Harbor, San Nicolas Island from September 1975 to September 1976. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros. (Continued).

Taxa	Tidal Height (ft) -1.0 to -0.1 (N=2)	MLLW to 0.9 (N=7)	1.0 to 1.9 (N=11)	2.0 to 2.9 (N=15)	3.0 to 3.9 (N=10)	4.0 to 4.9 (N=9)	Mean
Prionitis lanceolata	81.3	2.0					13.9
Grateloupia doryphora	0.4	0.4					0.1
Iridaea Heterocarpa	0.9	0.6					0.3
Gelidium robustum	30.8						5.1
Other Macrophytes (38)	0.7	2.8	≈ 5	≈ 9	≈ 1		
Total Organic Dry Weight in g/m^2	2,267.2	1,199.1	730.5	369.9	108.1	31.1	784.3

Note: 1 foot = 0.3048 meters

Table III.1.8-15. Organic Dry Weight in g/m^2 for Dominant Macroinvertebrates from Dutch Harbor, San Nicolas Island from September 1975 to September 1976. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros.

Taxa	Tidal Height (ft) -1.0 to -0.1 (N= 2)	MLLW to 0.9 (N= 7)	1.0 to 1.9 (N=11)	2.0 to 2.9 (N=15)	3.0 to 3.9 (N=10)	4.0 to 4.9 (N= 9)	Mean
Acmaea (Collisella) limatula*				0.2	0.3	0.9	0.2
Littorina planaxis*				<0.1	<0.1	0.3	0.1
Chthamalus fissus and dalli*			<0.1	6.4	3.1	19.7	4.9
Littorina scutulata*			<0.1	0.1	0.1	0.2	0.1
Acmaea (Collisella) digitalis*			<0.1	<0.1	0.1	0.3	0.1
Cyanoplax hartwegii*			<0.1	0.6	0.6	0.7	0.3
Acmaea (Collisella) strigatella*		<0.1	<0.1	<0.1	0.1	<0.1	<0.1
Acanthina punctulata*		0.4	1.1	1.1	1,0	0.2	0.6
Tetraclita squamosa rubescens*		0.1	1.1	0.4	<0.1	<0.1	0.3
Acmaea (Collisella) pelta*		0.2	0.2	0.4	0.4	0.1	0.2
Brachidontes adamsianus*		0.2	0.1	0.4	1.7	1.6	0.7
Balanus glandula*		0.3		0.3	0.2	0.3	0.2
Mopalia muscosa*		3.1	7.8	6.4	2.0	0.8	3.3
Tegula funebralis*		1.1	2.0	4.6	20.1	23.9	8.6
Acmaea (Collisella) scabra*		0.4	0.1	1.8	1*0	1.7	0.8
Nucella (Thais) emarginata*		0.1		0.1	0.1	0.1	0.1
Pachygrapsus crassipes*		<0.1	<0.1	0.3	<0.1	<0.1	0.1
Anthopleura elegantissima*	18.1	46.6	40.8	68*8	258.9	10.0	73.9
Lottia gigantea*				0.5	0.3		0.1
Pollicipes polymerus*				<0.1	0.4		0.1
Haliotis cracherodii*			<0.1	86.1	9.4		15.9
Pagurus hirsutiusculus*		<0.1	0.4	<0.1	<0.1		0.1

Table 1.1.8-15. Organic Dry Weight in g/m² for Dominant Macroinvertebrates from Dutch Harbor, San Nicolas Island from September 1975 to September 1976. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros. (Continued).

Taxa	Tidal Height (ft) -1.0 to -0.1 (N= 2)	MLLW to 0.9 (N= 7)	1.0 to 1.9 (N=11)	2.0 to 2.9 (N=15)	3.0 to 3.9 (N=10)	4.0 to 4.9 (N= 9)	Mean
Septifer bifurcates*		0.3	<0.1	0.5	0.1		0.2
Nuttallina fluxa*		0.1	<0.1	0.2	<0.1		0.1
Modiolus capax*	0.5	0.2	0.1	<0.1	<0.1		0.2
Mytilus californianus*	0.1	1.1	<0.1	63.4	65,7		21.7
Pseudochama exogyra*				0.1			<0.1
Cancer antennarius*			0.4	<0.1			0.1
Fissurella volcano*			0.3	0.1			0.1
Suberites ficus*		5.0		0 . 2			2.7
Plocamia karykina*		25.6	1.9	0.2			4.6
Pugettia products*		0.4	0.2	<0.1			0.1
Pisaster ochraceus*		3.2	0.6				0.6
Brown sponge*	2.4						0.4
Other Macroinvertebrates (19)	0.3	0.6	0.3	1.0	0.3	0.2	
Total Organic Dry Weight in g/m²	21.4	87.3	58.4	245.0	366.5	61.3	1.40.0

Note: 1 foot = 0.3048 meters

The distribution of wet and organic dry biomass remained similar in that macro phyte biomass increased from high to low tidal intervals, while macroinvertebrate biomass was greatest in the upper intervals. The dominant macrophyte taxa (Phyllospadix torreyi, 1325.9 g/m^2 WW; Halidrys dioica, 847.6 g/m^2 WW; and Gigartina canaliculata, 505.7 g/m^2 WW) remained the same as determined from 1975-76 data. Macroinvertebrate dominance retained the same order when September 1976 data were averaged with 1975-76 information i.e., Anthopleura elegantissima (511.4 g/m^2 WW). Mytilus californianus (324.7 g/m^2 WW), Chthamalus fissus/dalli (153.3 g/m2 WW), and Haliotis cracherodii (82.9 g/m^2 WW).

1.1.8.4.3 Tidepools

1.1.8.4.3.1 Standing Crop

Tidepools are common at Dutch Harbor and sampling was continued in the identical pools in the same manner as during the previous year. Seasonal and annual patterns of overall macrophytes and macroinvertebrate cover as a function of tidal height for tidepools at San Nicolas Island are presented in Tables 1.1.8-16 and 1.1.8-17, respectively. Macrophyte cover in the tidepools ranged from a high of 124.4% during September 1976 to a low of 23.0% during February 1977 in conjunction with the maximum and minimum of sand cover. Mean annual cover for macrophytes in tidepools did not change over the two years of study (1975-76 to 1976-77). However, when macrophyte cover as a function of tidal height was examined (Table 1.1.8-16), macrophytes in the two upper intervals (above +2.0 ft., .6 m) increased by an average of 7.2% while below this level, macrophyte cover decreased by 14.5% over the preceding year's values. Macroinvertebrate cover (Table 1.1.8-17) showed little seasonal variability in tidepools at San Nicolas Island, with only a slight peak reached in September 1976. The overall mean cover for tidepool macroinvertebrates in 1976-77 (4.8%) represented a 2.2% decrease over the preceding year's values with most of this decrease occurring in the lower two tidal intervals (mean decrease of about 3.8%). Cover of dominant tidepool macrophytes over all tidal intervals is given in Table 1.1.8-18. Three species monopolized the tidepool habitats (Corallina officinalis var. chilensis, 19.1% cover; Phyllospadix scouleri, 18.5%; and Chaetomorpha linum, 17.0%). All showed gains in cover over the preceding year's values, with C. officinalis var. chilensis showing a marked increase of 13.4%. 'Of the major tidepool macrophytes, only Ceramium spp./Centroceras clavulatum showed a decrease (4.0% from preceding year's values). Dominance patterns of macrophytes changed relative to the previous year because the tidal interval from -1.0 ft. (-.3 m) to MLLW was not sampled during the present investigation. In term of annual mean cover, the dominant macrophytes in pools at the various tidal heights are shown in Table 1.1.8-19. Phyllospadix scouleri exhibited a large increase (24.0% increase) in the lowest interval sampled (+1.0 to +2.0 ft., +.3 to +.6 m) while Ceramium spp./Centroceras

TABLE 1.1.8- 16. SEASONAL AND ANNUAL PATTERNS OF OVERALL MACROPHYTE COVER (%) AS A FUNCTION OF TIDAL HEIGHT FOR TIDEPOOLS AT SAN NICOLAS ISLAND.

SEASON	TIDAL HEIGHT (FT). 1.0 TO 1.9	"2,0 TO 2.9	3.0 TO
SEPTEMBER 1976	150.1	110,9	132.3
DECEMBER 1976	108.2	115.9	98.5
FEBRUARY 1977	43.1	9,8	16.1
MAY 1977	105,0	100.1	77.9
MEAN	101,6	" 84.2	76.2

NOTE; 1 FOOT = (),3040 METERS

TABLE 1.1.8.-17. SEASONAL AND ANNUAL PATTERNS OF OVERALL MACRO-INVERTEBRATE COVER (%) AS A FUNCTION OF TIDAL HEIGHT FOR TIDEPOOLS AT SAN NICOLAS ISLAND.

SEASON		TIDAL HEIGHT (FT). 1.0 TO 1.9	2*O TO 2,9	3.0 TO 3.9
SEPTEMBER	1976	8,5	6,6	3.7
DECEMBER	1976	5.9	4.1	2,3
FEBRUARY	1977	" 10.9	1.5	0.0
MAY	1977	8,1	5,4	0.4
MEAN		8.4	4.4	1.6

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8-18. ANNUAL MEAN COVER (%) FOR DOMINANT MACROPHYTES " OVERALL TIDAL INTERVALS FROM TIDEPOOLS AT SAN NICOLAS ISLAND, FROM SEPTEMBER 1976 TO MAY 1977.

TAXA	MEAN COVER (%)
CORALLINA OFFICINALIS VAR. CHILENSIS	19.1
PHYLLOSPADIX SCOULERI	18.5
CHAETOMORPHA LINUM	17.0
BLUE-GREEN ALGAE	9.1
CERAMIUM SPP./CENTROCERAS CLAVULATUM	5.0
BENTHIC DIATOMS	4*0
ULVA LOBATA	2,5
RALFSIACEAE	2.4
CORALLINA VANCOUVERIENSIS	2*1
SMITHORA NAIADUM	1*7
ENTEROMORPHA INTESTINALIS	1.7
PTEROSIPHONIA BAILEYI	1.4
GIGARTINA CANALICULATA	0.6
HYDROLITHON DECIPIENS	0.6
GRACILARIA VERRUCOSA	0.3
LITHOPHYLLUM PROBOSCIDEUM	0.3
CORALLINE CRUST BLEACHED	0.1
NEOAGARDHIELLA BAILEYI	0.1
POLYSIPHONIA HENDRYI VAR HENDRYI	0.1

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8.-19. ANNUAL MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR TIDEPOOLS AT SAN NICOLAS ISLAND DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). 1*0 TO 1.9	200 TO 2.9	3.0 TO 3.9
BLUE-GREEN ALGAE	6.7	8.2	12.4
CORALLINA OFFICINALIS VAR. CHILENSIS	13.5	36.0	7.8
ULVA LOBATA	2.6	3.9	0.9
ENTEROMORPHA INTESTINALIS	0,2	1*5	3,4
HYDROLITHON DECIPIENS	0,1	1.1	0.5
CORALLINA VANCOUVERIENSIS	4.3		2.0
BENTHIC DIATOMS	1.3	2.6	8.1
GRACILARIA VERRUCOSA	009		<0.1
CORALLINE CRUSTS	0.2		<0,1
CHAETOMORPHA LINUM	0.1	9.9	41.0
CERAMIUM SPP./CENTROCERAS CLAVULATUM	12.4	2.7	
GASTROCLONIUM COULTERI	0.2	<0.1	
RALFSIACEAE	1.4	5.7	
LITHOTHRIX ASPERGILLUM	0.2	<0.1	
PHYLLOSPADIX SCOULERI	44.1	11.3	
PTEROSIPHONIA DENDROIDEA	0.1	<0.1	
PTEROSIPHONIA BAILEYI	3.8	0.5	
CORALLINE CRUST BLEACHED	<0.1	0.4	
POLYSIPHONIA HENDRYI VAR HENDRYI	0.4	<0.1	
SMITHORA NAIADUM	5.1	<0.1	
MELOBESIA MEDIOCRIS	0.2	<0.1	
LITHOPHYLLUM PROBOSCIDEUM	0.8		
GIGARTINA CANALICULATA	1.9		
NEOAGARDHIELLA BAILEYI	0,4		

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8-19. ANNUAL MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR TIDEPOOLS AT SAN NICOLAS ISLAND DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3*9
GELIDIUM COULTERI	O*2		

NOTE: 1 FOOT = 0.3048 METERS

clavulatum had an 18.1% decrease and C. vancouveriensis showed a 6.5% decrease in the same lower tidal interval. In the +2.0 to +3.0 ft. (.6 to .9 m) pools, C. officinalis var. chilensis underwent a dramatic increase of 27.9% over the preceding year's values. In the upper intertidal tidepools samples (+3.0 to +4.0 ft., -.9 to -1.2 m), blue-green algae showed a 12.3% increase over the preceding year's data while benthic diatoms (8.1%) were not abundant during 1975-76.

Among the annual mean cover rankings of dominant macroinvertebrates (Table 1.1.8-20) in pools, Anthopleura elegantissima again was primary and showed a 1.0% increase over the preceding year's cover, followed by Tegula funebralis (0.5%) and Dodecaceria fewkesi (0.4%). The declines in A. elegantissima noted during the present study occurred in the +1.0 to +2.0 ft. (.3 to .6 m) interval (1.8% decrease) and in the +2.0 to +3.0 ft. (.6 to .9 m) interval (1.1.% decrease, Table 1.1.8-21).

Densities of the most numerous macroinvertebrates in tidepools are presented in Table 1.1.8-22. Of the individuals/m^2 while Tegula funebralis ($24/m^2$) showed a gain of 13 i by $6/m^2$ Pagurus ile Anthopleura elegantissima ($22/m^2$) increased by $6/m^2$ hirsutiusculus ($19/m^2$), a species not occurring in high densities in pools during 1975-76, became important in 1976-77 along with Mopalia muscosa ($3/m^2$) and Tetraclita squamosa rubescens ($2/m^2$). Tegula funebralis showed the bulk of its increase in density (Table 1.1.8-23) in the +3.0 to +4.0 ft. (-.9 to 1.2 m) interval (increase of $26/m^2$). Pagurus hirsutiusculus showed a dramatic increase of $51/m^2$ in the +2.0 to +3.0 ft. (+.6 to+.9 m) interval.

The tidepools harvested throughout 1975-76 were harvested once more in September 1976 and all of the data were lumped to obtain an overall picture of biomass (Tables 1.1.8-24 through 1.1.8-27). Phyllospadix scouleri862.7 g/m^2 WW) and Egregia menziesii (569.9 g/m^2 WW) remained the dominants of macroph-omass. Samples taken during September 1976 caused marked increases in the mean biomass figures for Corallina vancouveriensis (326.5 g/m^2 WW) and P. torreyi (299.0 g/m^2 WW). Of the tidepool macroinvertebrates, the same four again dominated the wet biomass; i.e., Tegula funebaralis (306.9 g/m^2), Anthopleura elegantissima (157.7 g/m^2), brown sponge (143.9 g/m^2), and Mytilus californianus (29.7 g/m^2).

1.1.8.4.3.2 Tidepool Finfishes

Six species of tidepool fishes (i.e., Clinocottus analis, C. recalvus, Oligocottus snyderi, O. rimensis, Gibbonsia elegans, and Girella nigricans) were collected by disturbed method-rig the present S tudy. All but O. rimensis was also collected during 1975-76: however, G. elegans had only been identified to genus.

TABLE 1.1.8-20. ANNUAL MEAN COVER (%) FOR DOMINANT MACRO - INVERTEBRATES OVER ALL TIDAL INTERVALS FROM TIDEPOOLS AT SAN NICOLAS ISLAND, FROM SEPTEMBER 1976 TO MAY 1977.

TAXA	MEAN COVER (%)
ANTHOPLEURA ELEGANTISSIMA	3.4
TEGULA FUNEBRALIS	0.5
DO DECACERIA FEWKESI	0.4
MOPALIA MUSCOSA	0.3

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8-21. ANNUAL MEAN COVER' (%] OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FGR TIDEPOOLS AT SAN NICOLAS ISLAND DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES, BLANK SPACES INDICATE ZEROS.

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9
TEGULA FUNEBRALIS	<0.1	"0.4	0.9
ANTHOPLEURA ELEGANTISSIMA	7.1	3.1	<0.1
MOPALIA MUSCOSA	<0.1	0.4	0.5
PAGURUS HIRSUTIUSCULUS	<0.1	0.2	<0.1
DODECACERIA FEWKESI	1.1	0.2	

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8.-22. ANNUAL MEAN DENSITY (NO./M2) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM TIDEPOOLS AT SAN NICOLAS ISLAND, FROM SEPTEMBER 1976 TO MAY 1977,

TAXA	MEAN DENSITY (NO./M2)
TEGULA FUNEBRALIS	24
ANTHOPLEURA ELEGANTISSIMA	22
PAGURUS HIRSUTIUSCULUS	19
MOPALIA MUSCOSA	3
TETRACLITA SQUAMOSA RUBESCENS	2

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8-23. ANNUAL MEAN DENSITY (NO./M_2) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR TIDEPOOLS AT SAN NICOLAS ISLAND DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS.

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9
ACMAEA (COLLISELLA) LIMATULA		1	1
SEPTIFER BIFURCATUS AND BRACHIDONTES		<1	2
CYANOPLAX HARTWEGII		1	<1
TETRACLITA SQUAMOSA RUBESCENS		2	4
TEGULA FUNEBRALIS	4	26	43
ANTHOPLEURA ELEGANTISSIMA	43	23	<1
MOPALIA MUSCOSA	<1	4	6
PAGURUS HIRSUTIUSCULUS	7	51	1

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1,1.8-24. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM TIDEPOOLS AT DUTCH HARBOR, SAN NICOLAS ISLAND FROM SEPTEMBER 1975 TO SEPTEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 (N= 4)	MLJ TO 1,9 (N= 3)	2.0 TO 2.9 (N= 3)	3*O To 3.9 (N= 3)	4.0 TO 4.9 (N= 2)	MEAN
GELIDIUM COULTERI				2.1	<0.1	<0.1	0.4
CLADOPHORA COLUMBIANA				104.2	2,7	12,6	19.9
CHAETOMORPHA LINUM		1.5	0.7	2,8	203.6	1134.1	223.6
ULVA LOBATA		37.5	10.6	30.8	16.4	95,9	31.7
ENTEROMORPHA INTESTINALIS		2.0	0,1	<0.1	190,7	21.6	35.8
ULVA TALNIATA		1.4				4.0	0.9
CORALLINA VANCOUVERIENSIS	9*3	73.8	13.9	1783.7	18.0	60.4	326.5
CORALLINA OFFICINALIS VAR. CHILENSI		217.8	108.4	8.6	2,3		56.2
GIGARTINA CANALICULATA		2.8	177.6	231.9	0.3		68.8
PTEROCLADIA CAPILLACEA	6.5		16.0		0.5		3.8
CERAMIUM EATONIANUM/SINICOLA				6.0			1.0
POLYSIPHONIA PANICULATA				1.6			0.3
PLOCAMIUM VIOLACEUM			8.4	196.9			34.2
GASTROCLONIUM COULTERI			2.4	8.2			0.4
PTEROSIPHONIA DENDROIDEA		0,6	3.7	0.?			0.7
LITHOTHRIX ASPERGILLUM		2.4	1.7	0.2			0.7
CHONDRIA DECIPIENS		2.0	1.6	1.8			0.9
CRYPTOPLEURA VIOLACEA		1.3		<0*1			0.2
LAURENCIA SPECTABILIS		5.1	14.2	43.9			10.5
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	15.2	59.7	<0.1	27,9			17.1
PTEROSIPHONIA BAILEYI	2.1	54.1	65.4	39.3			26.8
PHYLLOSPADIX SCOULERI	12032,9	3760.1	907.4	47n.1			2862,7

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8-24. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM TIDEPOOLS AT DUTCH HARBOR, SAN NICOLAS ISLAND FROM SEPTEMBER 1975 TO SEPTEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 (N= 4)	1.0 To 1.9 (N= 3)	2.0 To 2.9 (N= 3)	3.0 To 3.9 (N= 3)	4.0 To 4.9 (N= 2)	MEAN
PRIONITIS LANCEOLATA	15.0			4.5			3.3
CALLITHAMNION RUPICOLUM			0.7				0.1
LAURENCIA SPLENDENS			76.3				12.7
CERAMIUM SPP./CENTROCERAS CLAVULATU		40.3	14.1				9*1
PHYLLOSPADIX TORREYI		1206.7	587.1				299.0
GRACILARIA VERRUCOSA		666.3	641.1				217.9
SMITHORA NAIADUM		619.7	11.5				105.2
POLYSIPHONIA SPP.		34.2	2.0				6.0
PLOCAMIUM CARTILAGINEUM	421.5	79.8	64.9				94.4
RHODYMENIA CALIFORNICA VAR. CALIFOR	1.5	6.5	0.5				1.4
ANISOCLADELLA PACIFICA	0.6	5.9	23.7				5*0
MONOSTROMA OXYSPERMUM		117.4					19.6
ECTOCARPACEAE		5,7					0.9
GIGARTINA SPINOSA	10.2	4.6					2.5
COELOSEIRA COMPRESSA	1.4	O*2					0.3
CRYPTOPLEURA SPP.	5.5						0*9
EGREGIA MENZIESII	3419.6						569.9
OTHER MACROPHYTES (13)		0.5	0.2	0.9		0.3	
TOTAL WETWEIGHT IN G/M2	15941.3	7009.6	2754.7	2964.0	434.5	1327.1	

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8-25. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM TIDEPOOLS AT DUTCH HARBOR, SAN NICOLAS ISLAND FROM SEPTEMBER 1975 TO SEPTEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW To 0.9 (N= 4)	1.0 TO 1.9 (N= 3)	2.0 To 2.9 (N= 3)	3*D To 3.9 (N= 3)	4.0 TO 4.9 (N= 2)	MEAN
ACMAEA (COLLISELLA) LIMATULA					0.5	2.4	0.5
ACMAEA (COLLISELLA) SCABRA					0.8	0.5	0.2
CYANOPLAX HARTWEGII				1.3	0,7	0.8	0.5
ANTHOPLEURA ELEGANTISSIMA			29.4	855.1	0.7	61.2	157.7
TEGULA FUNEBRALIS		0.2	3,2	141.0	1509.0	180.1	306.9
LITTORINA SCUTULATA		0.6	1.5			0.2	0.4
BRACHIDONTES ADAMSIANUS		0.4		6.6	86.3	15.2	18.1
ACMAEA (COLLISELLA) ASMI					2.1		0,3
MOPALIA MUSCOSA				76.4	15.8		15.4
ACMAEA (COLLISELLA) STRIGATELLA			0.1	0.4	O*9		0,2
PAGURUS HIRSUTIUSCULUS		2.8	0.7	2.0	0.8		1.0
TETRACLITA SQUAMOSA RUBESCENS	13.1				<0.1		2.2
MYTILUS CALIFORNIANUS	<0,1		0.3	159.7	17.9		29.7
LOTTIA GIGANTEA				3.5			0.6
PAGURUS SAMUELIS				3.5			0.6
MODIOLUS CAPAX				2.5			0.4
STRONGYLOCENTROTUS PURPURATUS				6.0			1.0
NUTTALLINA FLUXA				1.2			0.2
OPALIA FUNICULATA				0.8			0.1
PISASTER OCHRACEUS		51.3		59.1			10.4
PUGETTIA PRODUCTA		8.7		<0.1			1.5
LACUNA UNIFASCIATA		0.3	1.8	<0.1			0.4

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8-25. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM TIDEPOOLS AT DUTCH HARBOR, SAN NICOLAS ISLAND FROM SEPTEMBER 1975 TO SEPTEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 (N= 4)	1.0 TO 1.9 (N= 3)	2.0 TO 2.9 (N= 3)	3.0 TO 3.9 (N= 3)	4.0 TO 4.9 (N= 2)	MEAN
BROWN SPONGE	769.3	93.9					143.9
BALANUS GLANDULA	1.0						0.2
CANCER ANTENNARIUS	15.0						2.5
OTHER MACRO-INVERTEBRATES 17)		0.9	0.2	1.2	0.8		
TOTAL WET WEIGHT IN G/M2	798.5	159.0	37.3	1320.5	1636.	268.4	

NOTE: 1 FOOT = 0.3048 METERS

ABLE 1.1.8-26. DRY WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM TIDEPOOLS AT DUTCH HARBOR, SAN NICOLAS ISLAND FROM SEPTEMBER 1975 TO SEPTEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 (N= 4)	1.0 TO 1.9 (N= 5)	2.0 TO 2.9 (N= 5)	3.0 TO 3.9 (N= 3)	4.0 TO 4.9 (N= 2)	MEAN
GELIDIUM COULTERI				0.7	<0.1	<0.1	0.1
CLADOPHORA COLUMBIANA				26.1	0.6	2.2	4.8
CHAETOMORPHA LINUM		0.	0.1	0.3	21.8	106.8	21.5
ULVA LOBATA		5.	1.6	5.3	1.1	10.9	4.0
ENTEROMORPHA INTESTINALIS		0.	<0.1	<0.1	17.1	4.6	3.8
ULVA TAENIATA		0.				0.7	0.1
CORALLINA VANCOUVERIENSIS	2.9	34.	5.7	909.7	6.7	31.8	165.3
CORALLINA OFFICINALIS VAR. CHILENSI		122.	60.9	5.4	0.9		31.6
GIGARTINA CANALICULATA		0.	37.4	51.4	<0.1		14.9
PTEROCLADIA CAPILLACEA			4.6		<0.1		0.9
PLOCAMIUM VIOLACEUM			1.3	20.1			4.9
PTEROSIPHONIA DENDROIDEA		<0.1	1.2	<0.1			0.2
LITHOTHRIX ASPERGILLUM		1.2	0.9	0.2			0.4
LAURENCIA SPECTABILIS		0.5	1.9	6.3			1.5
PTEROSIPHONIA BAILEYI	0.3	7.3	10.6	7.6			4.3
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	7.3	38.3	<0.1	17.1			10.5
PHYLLOSPADIX SCOULERI	5043.4	1063.3	205.9	97.9			1068.4
PRIONITIS LANCEOLATA	0.6			0.8			0.2
LAURENCIA SPLENDENS			13.3				2.2
CERAMIUM SPP./CENTROCERAS CLAVULATU		5.0	4.4				1.6
PHYLLOSPADIX TORREYI		307.7	157.0				77.4
GRACILARIA VERRUCOSA		142.2	114.7				42.8

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.8-26. DRY WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM TIDEPOOLS AT DUTCH HARBOR, SAN NICOLAS ISLAND FROM SEPTEMBER 1975 TO SEPTEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 (N= 4)	1.0 TO 1.9 (N= 3)	2.0 TO 2.9 (N= 3)	3.0 TO 3.9 (N= 3)	4.0 TO 4.9 (N= 2)	MEAN
SMITHORA NAIADUM		81.7	1.1				13.6
POLYSIPHONIA SPP.		6.3	0.8				1.2
PLOCAMIUM CARTILAGINEUM	55.4	10.0	9.2				12.4
RHODYMENIA CALIFORNICA VAR. CALIFOR	0.1	0.9	<0.1				0.2
ANISOCLADELLA PACIFICA	0.1	0.7	3.6				0.7
MONOSTROMA OXYSPERMUM		13.5					2.2
GIGARTINA SPINOSA	1.2	0.8					0.3
EGREGIA MENZIESII	588.3						98.1
OTHER MACROPHYTES (22)	0.7	0.6	0.6	1.2		0.1	
TOTAL DRY WEIGHT N G/M2	5701.4	1843.9	637.0	1158.2	48.3	157.3	

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1,1,8-27. DRY WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM TIDEPOOLS AT DUTCH HARBOR, SAN NICOLAS ISLAND FROM SEPTEMBER 1975 TO SEPTEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 (N= 4)	1.0 TO 1.9 (N= 3)	2.0 TO 2.9 (N= 3)	3.0 TO 3.9 (N= 3)	4.0 TO 4.9 (N= 2)	MEAN
ACMAEA (COLLISELLA) LIMATULA					0.3	1.6	0.3
ACMAEA (COLLISELLA) SCABRA					0.4	0.3	O*1
CYANOPLAX HARTWEGII				0.7	0.4	0.6	0.3
ANTHOPLEURA ELEGANTISSIMA			7,6	173.5	0.2	14.8	32.7
TEGULA FUNEBRALIS		O*1	2.8	118.9	1102.9	149.3	229.0
LITTORINA SCUTULATA		0.4	0.9			0.1	0.2
BRACHIDONTES ADAMSIANUS		O*2		3.7	46.1	6*7	9.6
ACMAEA (COLLISELLA) ASHI					185		0.2
MOPALIA MUSCOSA				38.6	7.8		7.7
ACMAEA (COLLISELLA) STRIGATELLA			<0,1	0.3	0.5		6.1
PAGURUS HIRSUTIUSCULUS		0.8	O*2	0.5	0,2		(J.3
TETRACLITA SQUAMOSA RUBESCENS	8.6				<0.1		1.4
MYTILUS CALIFORNIANUS	<0.1		0.2	124.3	11.5		22.7
LOTTIA GIGANTEA				2.4			0.4
PAGURUS SAMUELIS				3.1			0.5
MODIOLUS CAPAX				1.2			0.2
STRONGYLOCENTROTUS PURPURATUS				2.4			0.4
MUTTALLINA FLUXA				0.6			0.1
OPALIA FUNICULATA				0.6			0.1
PISASTER OCHRACEUS		30.7		22.7			6.9
PUGETTIA PRODUCTA		1.5		<0.1			0.3
LACUNA UNIFASCIATA		0.2	1.2	<0.1			0.2

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.,1.8-27. DRY WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM TIDEPOOLS AT DUTCH HARBOR, SAN NICOLAS ISLAND FROM SEPTEMBER 1975 TO SEPTEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 (N= 4)	1.0 TO 1.9 (N= 3)	2.0 TO 2.9 (N= 3)	3.0 TO 3.9 (N= 3)	4.0 TO 4.9 (N= 2)	MEAN
BROWN SPONGE	409.5	39.2					74.1
CANCER ANTENNARIUS	3.5						0.6
OTHER MACRO-INVERTEBRATES (18)	0.4	0.6	0.2	0.9	0.3		
TOTAL DRY WEIGHT IN G/M2	418.2	73.6	13.1	494.5	1172.1	175.5	

NOTE: 1 FOOT = 0.3048 METERS

1. 1.8.4..4 Community Analysis

1.1.8 .4.4.1 *Species* Diversity

The mean numbers of taxa, Shannon-Weaver (1949) diversity (H'), Pielou's (1975) evenness index (J'), and Margalef's (1969) richness index (D') determined according to cover and densities for macrophytes , macroinvertebrates , and the combination of the two are reported in Table 1.1.8-28. During the present investigation, 37 more taxa on the average were found in undisturbed samples than had been recorded the preceding year, 26 of which were macrophytes and 7 of which were macroinvertebrates (Table 1.1.8-28). This increase in taxa no doubt reflects our ability to identify more species than during the previous year and has resulted in a subsequent increase in D', which was closely related to the seasonal values for number of taxa. There was very little seasonal change in H' over the year and this seemed to parallel the small variations shown by the combined macroinvertebrate and macrophyte richness index. On the whole, macroinvertebrate diversity decreased slightly while macrophyte values increased slightly resulting in a concomitant increase in the combined macroinvertebrate and macrophyte H' diversity. Shannon-Weaver values based on density also indicated a slight decrease in macroinvertebrate diversity over the preceding year.

1.1.8.4.4.2 Species Assemblages

As was done the previous year, the entire array of samples for each of the four seasons was subjected to statistical cluster analysis using a correlation of coefficient of similarity. This technique afforded objective seasonal comparisons to be made by determining if the sample quadrats consistently grouped together throughout the year.

Dendogram displays of the levels of correlation among the various samples obtained during September 1976 and December 1976 are presented in Figures 1.1.8-23 and 1.1.8-24 to compare with those for the same period in 1975-76 (cf. Figures 2.1.8-11 and 2.1.8-12 in Littler and O'Brien, 1977). Sand was not included in the data set for 1976-77, so there were different interpretations for assemblages and zones than during 1975-76, particularly in December. Figure 1.1.8-25 illustrates the distributional patterns of the various assemblages, defined by the clustering program, in respect to their appropriate quadrat placements along both transect lines and these are contrasted with those presented in Figure 1.1.8-13 of Littler and O'Brien (1977).

Of the nine clustered groups determined from 1975-76 data, all but two (i.e., the sand group and the Phyllospadix group) were recognized during 1976-77. However, two additional groups (Chthamalus/Chaetomorpha group, AD; and Mytilus group, D) were noted by the present investigation. When compared with the same season of the preceding year, the September 19.76 zonal communities showed important shifts in

TABLE 1.1.8-28. SEASONAL AND ANNUAL DIVERSITY FOR SAN NICOLAS ISLAND.

GROUPS AND DATES	NO. TAXA.	COVER (%) D'	COVER (%) H'	COVER (%) J'	OCPJSX'T% (NO./M2) D'	OCPJSX'T% (NO./M2) H'	OCPJSX'T% (NO./M2) J'
MACRO-INVERTEBRATES							
SEP. 1976	32	9.09	1*85	0.53	3.82	0.79	0.23
DEC. 1976	37	10.67	1.92	0.53	4.49	0.82	0.23
FEB. 1977	30	8.95	1.81	0.53	3.68	0.74	0.22
MAY 1977	33	9.19	1.71	0.49	3.95	0,93	0.27
MEAN	33	9.47	1.82	0.52	3*9Y	0.82	0.23
MACROPHYTES							
SEP. 1976	48	10.34	2.27	0.59"			
DEC. 1976	46	9.88	2,27	0.59			
FEB. 1977	54	12.64	2,29	G*57			
MAY 1977	56	11.95	2.43	0.60			
MEAN	51	11.20	2.31	0.59			
COMBINED MACRO-INVERTEBRATES AND MACROPHYTES							
SEP. 1976	80	16.38	2.72	0,62			
DEC. 1976	83	17,01	2.73	0.62			
FEB. 1977	84	16.37	2.75	0.62			
MAY 1977	.89	16.01	2.81	0.63			
MEAN	84	17.44	2.75	0.62			

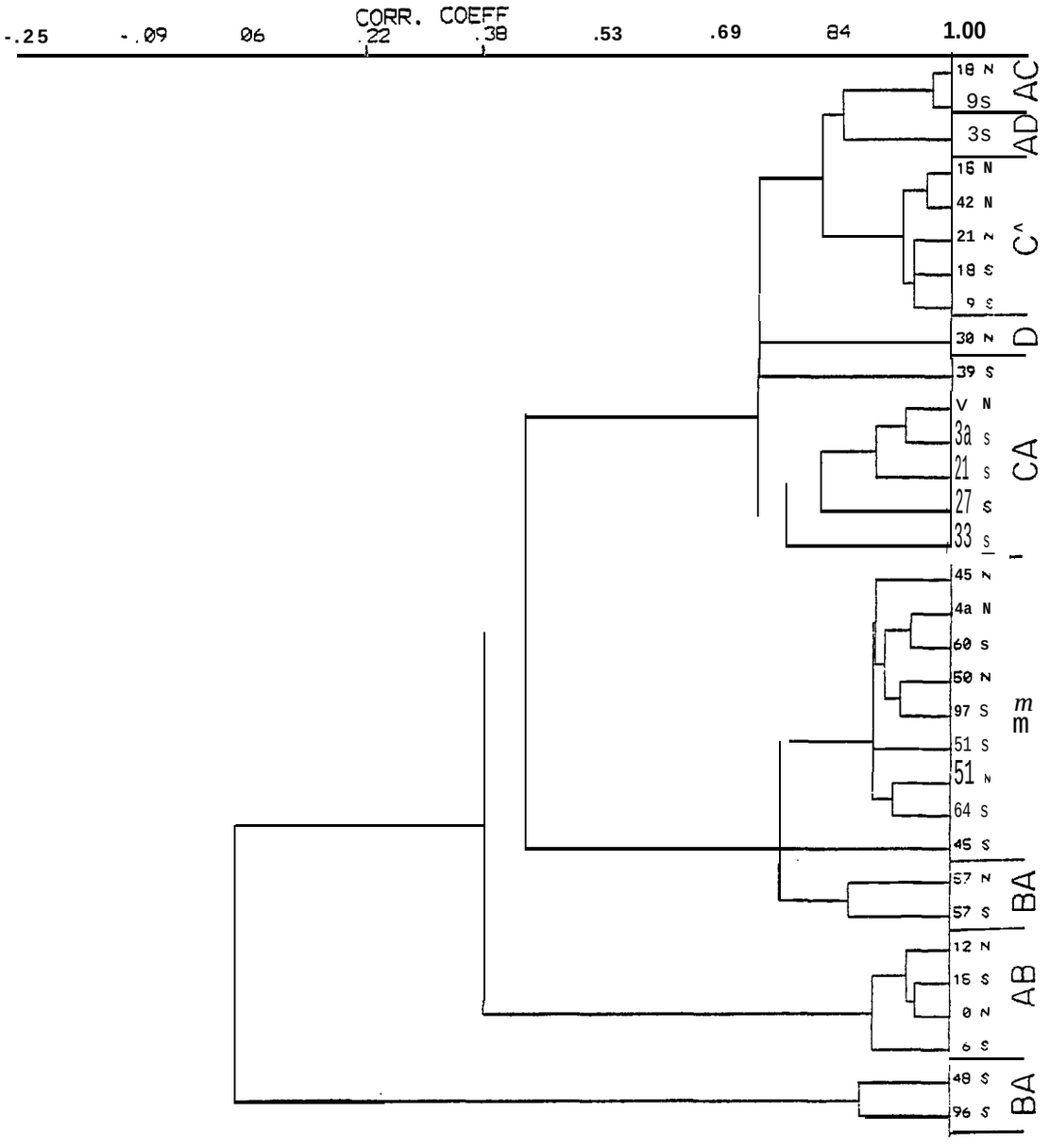

Figure 1.8-23. Dendrogram Display of Differential Clustering of Quadrats Sampled During September 976 from San Nicolas Island.

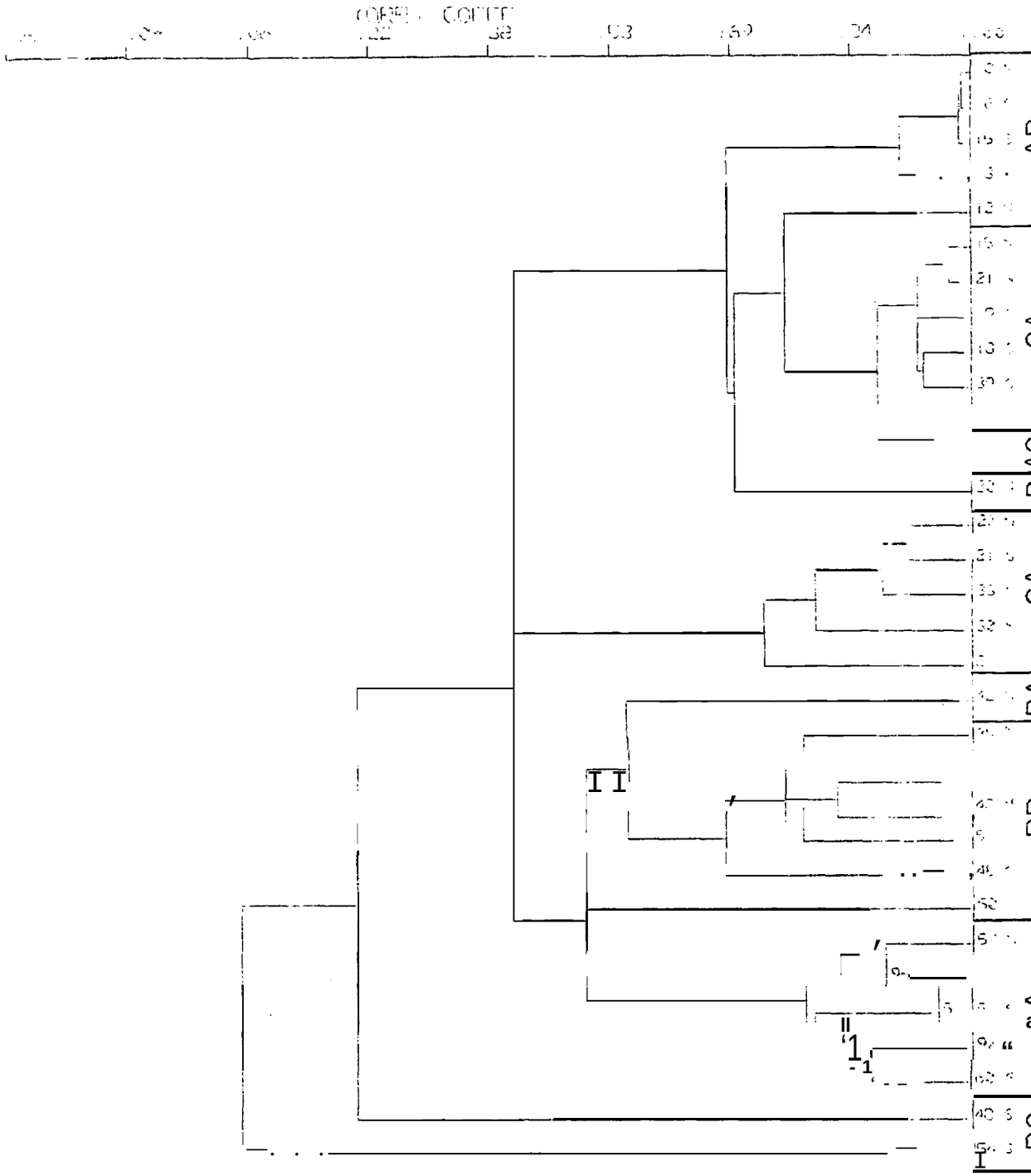

Figure 1.8-24 Dendrogram Display of Differential Clustering of Quadrats Sampled During December 1976 from San Nicolas Island.

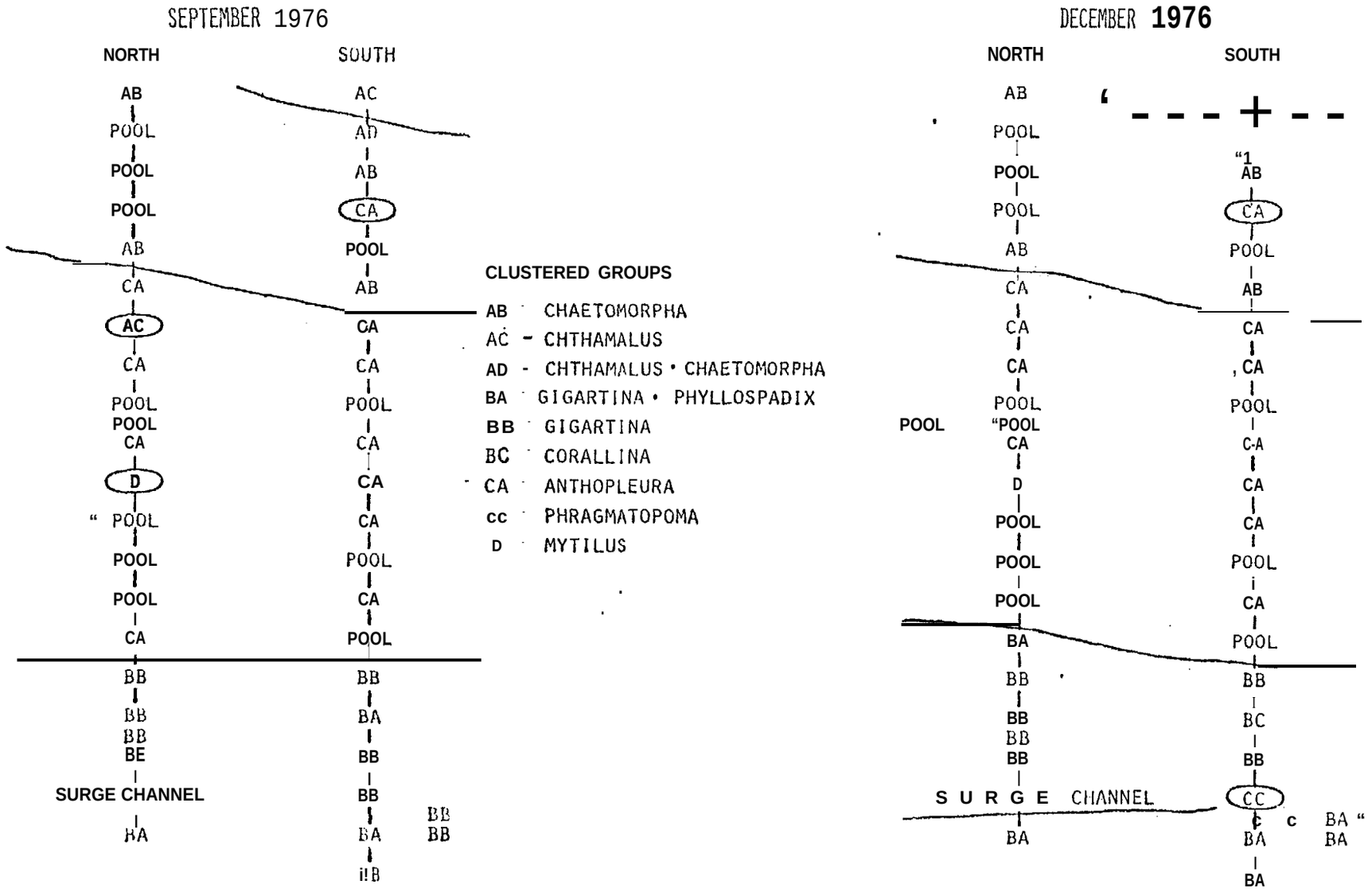

Figure 1.1.?3-25. Distributional Patterns of Species Groups from San Nicolas Island for September 1976 and December 1976 in Relation to Position of Transects and Locations of Quadrats.

dominance. The middle intertidal zones dominated by the Corallina group (BC) and Anthopleura group (CA) became entirely-overshadowed by the Anthopleura group during September 1976. Additionally, the lower zone characterized by the Gigartina-Phyllospadix group (BA) in 1975 had become predominantly a Gigartina assemblage (BB) one year later. In December 1975, much of the upper and middle zones were buried beneath sand. One year later, these zones were dominated by the Chaetomorpha group (AB) in the upper intertidal and by the Anthopleura group in the mid-intertidal. The lower intertidal at the San Nicolas Island site has remained quite constant throughout both years of study and consisted primarily of the Gigartina-Phyllospadix assemblage and the Gigartina group with patches dominated by either coralline algae or the sand-castle worm Phragmatopoma (Figure 1.1.8-25).

1.1.8.5 Discussion

As pointed out by Littler and O'Brien (1977), subtidal sampling has been carried out by Nicholson and Cimberg (1971) near San Nicolas Island. The only previous study of intertidal ecology (Kaplan and Boolootian, 1967) on San Nicolas Island *was* a descriptive assessment within the tidal ranges of +2.0 to +10.0 ft. (.6 to 3.0 m). The taxonomic lists generated by the present work (Table 1.1.8-3 and 1.1.8-4) provide 17 new records for macrophytes and 23 new records of macroinvertebrate taxa for Dutch Harbor, San Nicolas Island. The overall cover of biota in the undisturbed samples was observed to increase by 23.4% (from 94.8% to 118.2%) during 1975-76 to 1976-77. This difference *was* due mostly to gains in macrophyte cover (from a mean of 67.8% in 1975-76 to 88.8% in the present investigation). Both macrophytes and macroinvertebrates showed a drop in cover over most of the tidal intervals during February 1977 comparable to the 1975-76 decline that took place in December 1975. The declines both years were clearly related to times of maximum sand inundation. All of the intertidal intervals sampled during 1976-77 showed considerable increases in macrophyte cover (i.e., from 12.4% to 32.4%). Macroinvertebrate cover was reasonably constant during 1976-77 and reached a low in February 1977 at the time of maximum sand inundation.

There was only a slight change in mean cover of the four predominant macrophyte taxa from undisturbed samples during the period from 1975-76-to 1976-77. Blue-green algae (24.2%), Gigartina canaliculata (18.8%), Chaetomorpha linum (11.0%), and Phyllospadix scouleri (8.2%) totaled 62.2% compared with 43.3% the preceding year. Most of this difference was attributable to a 20% increase in blue-green algal cover over the preceding year's data. Macrophyte forms showing *a* decline during the February 1977 period of maximum sand inundation were the encrusting algae (Blue-greens, Ralfsiaceae, and Lithophyllum proboscideum) along with Gigartina canaliculata, Chaetomorpha linum, Phyllospadix scouleri, and the epiphytic Ceramium spp./Centroceras clavulatum). Similar declines were noted during December 1975 (Littler and O'Brien, 1977), also related to the period of maximum sand inundation.

Macroinvertebrate cover remained relatively constant over the seasons sampled, becoming only slightly reduced during February 1977 in association with the time of maximum sand cover. Of the major macroinvertebrates, the same five forms that dominated the cover during 1975-76 were again important throughout the present study. Four of these forms (i.e., Anthopleura elegantissima, Dodecaceria fewkesi, Chthamalus fissus/dalli, and Mytilus californianus) showed overall mean increases in cover, while the fifth (Phragmatopoma californica) showed a 3.8% decrease in cover from the previous year's values. Both A. elegantissima and C. fissus/dalli showed reductions in cover during the time of maximum sand inundation, while D. fewkesi showed a slight increase beginning at this time.

As was the case in 1975-76, many of the widespread macrophytes (blue-green algae, frequency of 89.4%; Corallina officinalis var. chilensis, 57.3%; Ulva lobata, 56.8%; Gigartina canaliculata, 53.9%; and Chaetomorpha linum, 51.1%) were those that covered the majority of the substrate. These forms all showed increases in frequency during 1976-77 except U. lobata (decrease of 16.9%) and G. canaliculata (decrease of 2.9%). The increased frequency of bleached thalli of Hydrolithon decipiens, C. officinalis var. chilensis, Lithophyllum proboscideum, G. canaliculata, Phyllospadix scouleri, Gastroclonium coulteri, and Lithothrix aspergillum during December 1976 reflects heat and desiccation stresses imposed by "Santa Ana" winds during daytime low tides. Anthopleura elegantissima repeated its dominance of macroinvertebrate frequency values, occurring in 18.5% more samples than it did in 1975-76. The second most widespread species, Tegula funebralis, occurred in 14.5% more samples than it had the previous year, while Acmaea (Collisella) scabra was found in 2.6% fewer samples. Of these more widespread species only A. elegantissima did not show a February 1977 decrease in frequency-associated with sand inundation.

The most numerous macrinvertebrates were again Chthamalus fissus/dalli (yearly average of 2511/m^2, increase of 1076/m^2), and Anthopleura elegantissima (186/m^2, increase of 43/m^2). A dramatic increase also was shown by Tetraclita squamosa rubescens (increase of 124/m^2 over the 15/m^2 values of 1975-76). Both C. fissus/dalli and A. elegantissima reached minimum densities (2213/m^2 and 134/m^2, respectively] during the time of maximum sand cover (February 197"7). Density values of the major macroinvertebrates generally increased over 1975-76 values at all tidal internals, except for a 315/m^2 reduction in Littorina scutulata in the +4.0 to +5.0 ft. (1.2 to-1.5 m) interval.

In the tidepool samples, mean annual cover for macrophytes did not change over the two years of study. However, when macrophyte cover as a function of tidal height was examined, macrophytes in the two upper intervals (above +2.0 ft., --- 6 m) increased by an average of 7.2% while below this level macrophyte cover decreased by 14.5% over the preceding year's values. Macroinvertebrate cover showed little

seasonal variability in tidepools at San Nicolas Island, with only a slight peak reached in September 1976. The overall mean cover of macroinvertebrates in tidepools during 1976-77 (4.8%) represented a 2.2% decrease over the preceding year's values with most of this decrease occurring in the lower two tidal intervals (mean decrease of about 3.8%). Three species of macrophytes monopolized the tidepool habitats (Corallina officinalis var. chilensis, 19.1%; Phyllospadix scouleri, 18.5%; and Chaetomorpha linum, 17.0%). All showed gains in cover over the previous year's values, with C. officinalis var. chilensis showing a marked increase of 13.4%.

Among the annual mean cover rankings of dominant macroinvertebrates in tidepools, Anthopleura elegantissima again was primary and showed a 1.0% increase over the preceding year's cover, followed by Tegula funebralis (0.5%), and Dodecaceria fewkesi (0.4%). The declines in A. elegantissima noted during the present study occurred in the +1.0 to +2.0 ft. (.3 to .6 m) interval (1.8% decrease) and in the +2.0 to +3.0 ft. (.6 to .9 m) interval (1.1% decrease). Densities of the most numerous macroinvertebrates in tidepools were dominated by Tegula funebralis (24 individuals/m^2) which showed a gain of 13 individuals/m^2 while Anthopleura elegantissima (22/m^2) showed a 6/m^2 increase. Pagurus hirsutiusculus (19/m^2) a species not occurring in high densities in pools during 1975-76, 'became important in 1976-77 along with Mopalia muscosa (3/m^2) and Tetraclita squamosa rubescens (2/m^2).

During the present investigation, 21 more taxa on the average were found in undisturbed samples than had been recorded the preceding year (Littler and O'Brien, 1977), 14 of which were macrophytes and 7 of which were macroinvertebrates. This increase in taxa no doubt reflects *our* ability to recognize more species than during the previous year and has resulted in *a* subsequent increase in richness (D'), which in turn was closely related to the seasonal values for number of taxa. Shannon-Weaver diversity (H') changed very little over the year and this was paralleled by the small variations of the combined macroinvertebrate and macrophyte richness (D') index. On the whole, macroinvertebrate diversity decreased slightly while macrophyte values increased slightly resulting in a concomitant increase in the combined macroinvertebrate and macrophyte H' diversity.

Of the nine clustered groups determined from 1975-76 data (Littler and O'Brien, 1977), all but two (i.e., the sand group and the Phyllospadix group) were recognized during 1976-77. Sand was not included in the data set for 1976-77 and this accounts for the elimination of that assemblage. Two additional groups, however, were noted by the present investigation (i.e., Chthamalus/Chaetomorpha group and Mytilus group). The middle intertidal zones dominated in 1975-76 by the Corallina group and Anthopleura group became largely overshadowed by increases in the Anthopleura group during September 1976. Additionally, the lower zone characterized by the Gigartina-Phyllospadix group in 1975-76 had become predominantly a Gigartina assemblage one year

later. . In December of 1975, much of the upper and middle zones became buried beneath sand. One year later, these zones were dominated by the Chaetomorpha group in the upper intertidal and by the Anthopleura group in the mid-intertidal. The lower intertidal at the San Nicolas Island site has remained quite constant throughout both years of study and consisted primarily of the Gigartina-Phyllospadix assemblage and the Gigartina group.

The present study documents environmental stresses imposed by sand movement, the normal tidal cycles, and seasonal weather conditions (e.g., desiccation and insolation concomitant with afternoon low tides during the winter). Most of the intertidal biota at the San Nicolas Island site appeared to again be severely affected by sand burial. As during the previous year, the effects of sand were greatest in the high intertidal and decreased near the lower intertidal. This confirms the earlier observation (Littler and O'Brien, 1977) that the distributional patterns of the biotic communities observed at this site were likely due to the regular and perhaps annual deposition of sand and it now has been shown that the extent and duration of sand deposition varies annually. Again an apparent subclimax association of species dominated the areas which were buried by sand and exhibited a zonational pattern reflecting both tidal height and degree of sand cover (Figure 1.1.8-25). In those areas where the rock contours provided a higher point of refuge from sand deposition, species assemblages characteristic of relatively mature communities were isolated on the upper portions of these habitats and these also developed extensively along the eastern edge of the bench where sand did not penetrate.

Therefore, pioneer, subclimax and mature intertidal communities were intermingled throughout the study area. The upper intertidal Chaetomorpha group, in particular, possesses a number of characteristics associated with pioneer stages of community development including: (1) high productivity, (2) low biomass, (3) opportunistic life histories, and (4) emphasis on the herbivore trophic level. Opportunistic reproductive strategies have been documented for Enteromorpha SP. and Ulva SP. which are also predominant taxa within the Chaetomorpha group. The lower intertidal region characterized by the Gigartina assemblage and the Gigartina-Phyllospadix group was never completely buried and the organisms in this zone are characteristic of more mature communities dominated by perennial organisms. The community to-the south of the southern-most transect line is characterized by Mytilus californianus and its associated epizoic biota along with the black abalone Haliotis cracherodii. This community also dominates the refuge habitat formed by isolated pinnacles of raised portions of the intertidal bench that extend above the highest point of sand inundation. As documented by Littler and O'Brien (1977) organisms in this community are characterized by relatively large biomass, slow growth, strong competitive interactions, predatory interactions, and other features usually found in relatively mature communities (see Odum, 1969).

1. 1.8.6." Literature Cited

Kaplan, R. I., and R. A. Boolootian, "Intertidal Ecology of San Nicolas Island, " pages 203-207 in R. N. Philbrich, ed. Proceedings of the Symposium on the Biology of the California Islands (Santa Barbara, California, Santa Barbara Botanic Garden, Inc. 1967).

Littler, M. M. and P. Y. O'Brien, "Biological Features of Rocky Intertidal Communities Near Dutch Harbor, San Nicolas Island, California," pages 605-686 in M. M. Littler, cd., Spatial and Temporal Variations in the Distribution and Abundance of Rocky Intertidal and Tidepool Biotas in the Southern California Bight, Unpubl. Tech. Compl. Rept., U. S. Department of the Interior, Bureau of Land Management (1977).

Margalef, R., "Perspectives of Ecological Theory" (Chicago, University of Chicago Press, 1968).

Nicholson, N., and R. L. Cimberg, "The Santa Barbara Oil Spills of 1969: A Post Spill Survey of the Rocky Intertidal," pages 325-399 in D. Straughan, cd., Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill 1969-1970, Vol. I, Allan Hancock Foundation, University of Southern California (1971).

Odum, E. P., "The Strategy of Ecosystem Development," Science 164, 262-270 (1969).

Pielou, E. C., "Ecological. Diversity," (New York, John Wiley & Sons, 1975)*

Shannon, C. E., and W. Weaver, "The Mathematical Theory of Communication ," (Urbana, University of Illinois Press, 1949).

INTERTIDAL STUDY OF THE SOUTHERN CALIFORNIA BIGHT

1.1.9

VARIATIONS IN THE ROCKY " INTERTIDAL BIOTA NEAR WILLOWS ANCHORAGE, SANTA CRUZ ISLAND, CALIFORNIA

VOLUME III

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1. 1.9 Variations in the Rocky Intertidal Biota Near Willows Anchorage, Santa Cruz Island, California

1. 1.9.1 Abstract

Undisturbed sampling was conducted in the rocky intertidal zone at Willows Anchorage, Santa Cruz Island during October 1976, December 1976, February 1977 and May 1977. Disturbed samples were collected in October 1976. A total of 74 macrophyte and 73 macroinvertebrate taxa were identified from the study area during 1976-77, compared to 92 macrophyte and 105 macroinvertebrate taxa during 1975-76.

Total mean cover of the microbiota was 110.8%; 29.7% higher than in 1975-76. In addition to the higher total cover, differences in cover between quarterly visits were negligible in contrast to the decreased cover recorded in February 1976 caused by a macrophyte die-back. Little change in macrophyte cover was detectable between quarterly visits, except for an upper shore increase and a lower shore decrease between October and December 1976, probably related to the increased wetting effects on the upper shore and shearing effects on the lower shore associated with winter increases in surf and surge activity. The four most important macrophyte taxa in terms of mean cover (blue-green algae, Lithophyllum proboscideum, Corallina officinalis var. chilensis, and Endocladia muricata) were the same as in 1975-76, and all taxa contributed higher cover values, especially the blue-green algae (a 25.0% increase). The six macroinvertebrates that ranked highest in percent cover during 1975-76 were also top ranked in 1976-77. Four of these species contributed greater than 1.0% cover and included Anthopleura elegantissima, Tetraclita squamosa rubescens, Mytilus californianus, and Serpulorbis squamigerus. Recruitment between December and May was shown by T. squamosa rubescens. Percent frequencies for the dominant macrophytes and macroinvertebrates were comparable with 1975-76, except in the cases of T. squamosa rubescens and Spirobranchus spinosus (which increased in density) and Littorina scutulata (which decreased in density). Recruitment was shown for L. planaxis, T. squamosa rubescens, Chthamalus fissus/dalli, Acmaea (Collisella) scabra, A. (Collisella) pelta, A. (Collisella) strigatella, and Spirobranchus spinosus.

Wet and dry organic biomass was determined for disturbed samples in October 1976 and added to the biomass data from 1975-76. The additional samples changed the mean biomass values little for each tidal interval, although three samples contributed to the formation of an added higher intertidal interval at +9.0 to +9.9 ft. (+2.7 to +3.0 m).

Two undisturbed mid- and high intertidal tidepools which were sampled during 1975-76 were sampled in the present study. Lithophyllum proboscideum and Lithothrix aspergillum were the dominant cover organisms in both pools, and both increased in cover over their values

for 1975-76. In the high pool, cover by Phyllospadix scouleri declined noticeably. In both pools, Anthopleura elegantissima was the dominant macroinvertebrate in terms of percent cover. Phragmatopoma californica was of secondary importance in cover in both pools, although it increased markedly in the mid pool over 1975-76. Recruitment by juvenile Acmaea and Spirobranchus spinosus was observed in the high pool. Mid- and high fish pools were again sampled in 1976-77, and species composition and abundances were essentially unchanged, with Clinocottus analis as the most important of these these species.

Species diversity for the macrobiota and macrophytes treated separately was lower than in 1975-76 in terms of total number of taxa, Margalef's richness index, Pielou's evenness index, and the Shannon-Weaver measure. For the macroinvertebrates, total number of taxa and the richness measure was higher in 1975-76, although the evenness index and Shannon-Weaver values were higher for 1976-77.

Cluster analysis was performed on the December 1976 undisturbed quadrat samples in order that the results could be compared with December 1975. Despite obvious differences in the appearance of the dendrograms for 1975 and 1976, the five zones identified on the shore for 1975 were repeated for 1976, although the upper and lower boundaries for several of the zones shifted slightly, and there were compositional changes in the dominant cover organisms in Zone I (Endocladia muricata declined in cover) and Zone II (Pelvetia fastigiata declined in cover).

1.1.9.2 Study Area

Location of the study area at Willows Anchorage, Santa Cruz Island and its physical characterization and environmental features have been described for 1975-76 (Seapy and Littler, 1977). Environmental data for 1976-77 are summarized in Table 1.1.9-1. Salinity was basically similar during the second to fourth site visits, averaging about 34.4 °/oo, which was 0.4 °/oo higher than recorded for the same visits in 1975-76. Salinity was high in October 1976, averaging 35.0 °/00, but no readings were made during October 1975 with which this value can be compared. Cloud cover during the study period ranged from average quarterly values of 35 to 68%, but during any given quarterly visit cloud cover was much more variable than these mean values would suggest, ranging from 0 to 98 or 100% during all but the December visit. This variability was also observed during 1975-76. During the quarterly visits wave height never exceeded an estimated 2.5 ft. (.65 m), and the mean values were quite comparable between visits, ranging from +1.0 to +1.5 ft. (+.3 to +.5 m). Water temperature declined steadily from October (19.9°C) to May (14.8°C). In contrast, the records from 1975-76 showed a gradual increase from December (13.0°C) to May (17.0°C). During the quarterly visits oil tars were not observed washed ashore nor were desiccating Santa Ana winds ever observed by us or by island personnel during 1976-77, as had been recorded in 1975-76.

Table 1.1.9-1. Environmental Data Measured during the Period of Study for Willows Anchorage, Santa Cruz Island.

	Water Temp. (°C)	Air Temp. (°C)	Cloud Cover (%)	Salinity (°/00)	Wave Ht. (ft)	Relative Humidity (%)	Wind Velocity (knots)
12-25 October 1976							
Range	19.5-20.5	19.5-23.0	0-98	34.9-35.0	0.5-1	60-100	--
Mean	19.9	21.2	53	35.0	1	80	
17-19 December 1976							
Range	17.0	17.9-20.0	30-80	33.8-34.0	1-2.5	44-75	8-15
Mean	17.0	18.6	68	33.9	1.5	61	12
12-15 February 1977							
Range	16.1-16.6	19.0-24.5	0-100	34.0-35.0	0.5-2.5	40-87	0-10
Mean	16.4	22.8	35	34.5	1	57	5
12-14 May 1977							
Range	14.8-14.9	15.0-15.4	0-100	34.0	0.5-2	82-100	0-30
Mean	14.8	15.2	67	34.0	1	89	15

The undisturbed quadrats along the north and south transect lines occupied during 1975-76 (Seapy and Littler, 1977) were used in the present study during October 1976, December 1976, February 1977, and May 1977. In order to increase the number of quadrat replicates in several of the one-ft. tidal intervals where inadequate replication existed in 1975-76, six new quadrats were added during October on the north transect line at meter 9 (identified as 9A and 9B), at meter 16 (as 16A and 16B) and at meter 23 (as 23A and 23B).

1.1.9.3 Methods and Materials

The methods employed were the same as those used during the study in 1975-76 (see Seapy and Littler, 1977; Littler, 1977), with the exceptions noted in the introductory chapter (Littler, Chapter One, this report). A total of 12 disturbed samples were collected from the high, mid- and low intertidal zones during October 1976. The mid-intertidal disturbed samples were located on the same shelf between the north and south transect lines, as during 1975-76, while the high and low samples were situated 3.5 to 10.8 m south of the south transect. Because disturbed samples were collected only during the initial visit in October, comparisons with the results from 1975-76 can only be based on the undisturbed samples from both years. For this reason, the disturbed quadrat cover data will not be considered here. A total of 54 undisturbed quadrat samples were taken during each of the quarterly visits, except for May 1976, when the low intertidal was not accessible and only 44 samples were taken. Thus, a total of 206 undisturbed quadrats on the north and south transect lines were occupied during 1976-77. In addition, the high and mid-undisturbed pools used in 1975-76 were sampled in 1976-77, providing a grand total of 214 undisturbed samples for the year.

1.1.9.4 Results

1.1.9.4.1 Floristics and Faunistics

A total of 74 macrophyte taxa were identified from the study area (Table 1. 1.9-2). The Rhodophyta contained the highest number of taxa (50), followed by the Phaeophyta (15), and the Chlorophyta (5). There were two cyanophyte taxa, a single benthic diatom (Bacillariophyta) taxon, and one spermatophyte. Among the taxa identified from the study area, only a single species, Herposiphonia verticillata, was collected that did not occur in disturbed or undisturbed quadrat samples. Only three species (belonging to the Rhodophyta) were restricted to the disturbed samples. A total of 36 taxa occurred in the disturbed samples while 70 were recorded from the undisturbed samples. For the 1975-76 study period (Seapy and Littler, 1977), a total of 92 macrophytes were recorded, of which 60 were rhodophytes, 18 were phaeophytes, and 10 were chlorophytes. These values represent a difference of 10 rhodophytes, 3 phaeophytes, and 5 chlorophytes.

Table 1.1.9 -2. Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of Willows Anchorage, Santa Cruz Island. Additional species collected in the study area (C) but not present in samples have also been listed.

Species and Taxa	Oct. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	u	u	U	C
Bacillariophyta						
Benthic diatoms	x		x	x	x	
Chlorophyta						
Chaetomorpha linum				X		
Cladophora columbiana	X		x	x	x	
Codium fragile	x	x	x	x	x	
Enteromorpha flexuosa	x		x	X	x	
Ulva californica	x	x	x	x	x	
Cyanophyta						
Blue-green algae	x	x	x	x	x	
Blue-green colony	x	x	x	x	X	
Phaeophyta						
Colpomenia sinuosa	x	x	x	x	x	
Cylindrocarpus rugosus	x	x	x	x	x	
Dictyota flabellata	x		x	x	x	
Ectocarpaceae	X		X	X	x	
Egregia menziesii	x	x	x			
Eisenia arborea	x	x				
Endarachne binghamiae		x		x	x	
Halidrys dioica	x	x	x	x	x	
Hapterophycus canaliculatus		x	x	x	x	
Pachydictyon coriaceum	x	x	x	x		
Pelvetia fastigiata	X	X	X	X	x	
Pseudolithoderma nigra	x	x	x	x	x	
Ralfsiaceae	x	x	x	x	x	
Ralfsia sp.	x		x	x	x	
Scytosiphon dotyi					x	
Rhodophyta						
Amphiroa zonata	x					
Bossiella orbigniana ssp. dichotoma			x	x	x[p]	
Ceramium spp.			X			

Table 1.1.9 -2. Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of Willows Anchorage, Santa Cruz Island. Additional species collected in the study area (C) but not present in samples have also been listed. (Continued)

Species and Taxa	Oct. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	u	u	U	C
Ceramium eatonianum/sinicola	x	x"				
Ceramium viscainoense	x			x	X	
Corallina officinalis var. chilensis	x	x	x	X	X	
Corallina vancouveriensis	x	x	x	X	X	
Cryptopleura corallinara	x	x		X		
Cryptopleura crisps		x				
Cryptopleura lobulifera		x				
Cumagloia andersonii	x					
Endocladia muricata	x	x	X	x	x	
Erythrocystis saccata	x	x		X		
Gastroclonium coulteri	x		x	x		
Gelidium coulteri	x	x	x	x	x	
Gelidium purpurascens	x		x	X		
Gelidium pusillum					x	
Gigartina canaliculata	x		X	x	x	
Gigartina spinosa	x		X	x		
Grateloupia sp.	x				X	
Herposiphonia littorals			x	X		
Herposiphonia plumula	x	x	x	x		
Herposiphonia verticillata						X
Hydrolithon decipiens			x	X	x	
Iridaea cordata var. splendens			x			
Laurencia lajolla	x	x	x	x	x	
Laurencia masonii					xp	
Laurencia pacifica	x	x	x	x	x	
Laurencia spectabilis	X	X			X	
Lithophyllum proboscideum	x	x	x	X	x	
Lithothrix aspergillum	x		X	X	x	
Melobesia mediocris	x		X	x		
Nemalion helminthoides	x		X	x	x	
Ophidocladus simpliciusculus	x					
Petrocelis franciscana	x		x	x		
Peyssonneliaceae/ Hildenbrandiaceae	x		x	x	x	
Plocamium violaceum			x			
Polysiphonia acuminata				x		
Polysiphonia hendryi var. hendryi	x			x	x	

Table 1.1.9-2. Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of Willows Anchorage, Santa Cruz Island. Additional species collected in the study area (C) but not present in samples have also been listed. (Continued)

Species and Taxa	Ott. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	u	u	U	C
Polysiphonia spp.		X	X	X	X	
Porphyra perforata				X	X	
Prionitis lanceolata	X	X		X		
Pterocladia capillacea		X				
Pterosiphonia baileyi	X	X	X	X	X	
Pterosiphonia dendroidea	X		X		X	
Rhodoglossum affine	X	X	X	X	X	
Tenarea dispar	X		X		X	
Spermatophyte						
Phyllospadix scouleri	X	X	X	X	X[P]	
74 Total Macrophytes						

P Refers to those taxa only obtained in tidepools.

This difference probably does not reflect a real difference between the two annual sampling periods, since during 1975-76 a total of 15 taxa were vouchered only and 12 taxa only occurred in the disturbed samples (note that 48 disturbed samples were taken in 1975-76 compared to 12 in 1976-77). If the number of taxa present in undisturbed samples were compared between the two years, slightly fewer (65) were recorded in 1975-76 than in 1976-77 (70).

A total of 74 macroinvertebrate taxa were identified from the study area (Table 1.1.9-3). The Gastropod were most numerous (30 taxa), followed by the Crustacea (14), Bivalvia (7), Polyplacophora (6), Asteroidea (4), Polychaeta (4), Demospongiae (3), Ascidiacea (2), Anthozoa (2), and Echinoidea (l). Seven of these taxa were collected from the study area and were not recorded from the undisturbed and disturbed samples. A total of 61 taxa occurred among the undisturbed samples, while 47 were present in the disturbed samples. These data suggest a decrease over 1975-76, when 105 macroinvertebrate taxa were identified from the study area. That this difference may be real is supported by the following comparisons. Using the number of taxa only from the undisturbed samples, there were 80 present in 1975-76 compared to 61 in 1976-77. There were substantially more species recorded from only the disturbed samples in 1975-76 (20 vs. 5), while the number of species vouchered only were comparable (5 in 1975-76 vs. 7 in 1976-77). The difference in number of taxa recorded only from disturbed samples is possibly the result of differences in disturbed sampling effort, as discussed above. Disregarding the disturbed sample records, there appeared to be a net decrease in number of macroinvertebrate taxa for 1976-77, while the number of macrophyte taxa were basically comparable.

1.1.9.4.2 Standing Crop

1.1.9.4.2.1 Cover

Total mean cover of the macrobiota (macrophytes and macroinvertebrates combined) over all tidal intervals sampled was 110.8% (data combined from Tables 1.1.9-4 and 1.1.9-5), varying by only 2.6% from a low of 109.5% in May to 112.1% in February. These values represent a substantial increase over 1975-76 (mean of 81.1%), as well as a marked stabilization in total cover between quarterly visits, which can be contrasted with the oscillation during 1975-76 from 68.8% in October to 92.2% in December, to 68.1% in February, and to 95.2% in May. The February 1976 decrease in total cover was attributed (Seapy and Littler, 1977) to desiccating conditions during and preceding the February sampling period. No such deleterious environmental conditions were observed during 1976-77, which partially accounts for the stability in total cover between visits. The pronounced differences during each of the quarterly visits for 1975-76 compared to 1976-77 are not attributable to the macroinvertebrates, which increased 1.9% in average cover from 8.8 to 10.7%, but rather to the macrophytes, which increased 27.3% from 72.3 to 99.6%.

Table 1.1.9-3. Presence of Macro invertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Willows Anchorage, Santa Cruz Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column.

Species and Taxa	Oct. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D"	u	u	u	C
Annelida						
Polychaeta						
Phragmatopoma californica	X	X	x	x	x	
Spirobranchus spinosus	X	X	X	x	X	
Spirorbis spp.	X		x	x	x	
Arthropods						
Crustacea						
Balanus glandula	X	X	x	x	x	
Balanus tintinnabulum californicus		x				
Cancer antennarius	X	x				
Chthamalus fissus/dalli	x	x	x	x	x	
Pachycheles pubescens		X				
Pachygrapsus crassipes	X	x	x	x	x	
Pagurus hirsutiusculus	X		X			
Pagurus samuelis			X	x	X	
Paraxanthias taylori	X					
Pollicipes polymerus	x	x	x	X	x	
Pugettia products	X	x	x			
Pugettia richii	X		x	X		
Tetraclita squamosa rubescens	X	x	x	X	x	
Chordata: Urochordata						
Ascidiacea						
Archidistoma ritteri						x
Distaplia occidentals						x

Table 1.1.9-3. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Willows Anchorage, Santa Cruz Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued).

Species and Taxa	Oct. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	u	u	u	C
Cnidaria						
Anthozoa						
Anthopleura elegantissima	X	X	X	X	X	
Epiactis prolifera	X		X	X		
Echinodermata						
Asteroidea						
Henricia leviuscula		X				
Leptasterias pusilla	X	X	X	X	X	
Patiria miniata						X
Pisaster ochraceus	X	X	X	X	X	
Echinoidea						
Strongylocentrotus purpuratus	X	X	X	X	X	
Mollusca						
Bivalvia						
Brachidontes adamsianus		X				
Glans subquadrata	X	X	X	X	X	
Lasaea subviridis				X		
Mytilus californianus	X	X	X	X	X	
Mytilus edulis	X	X	X	X	X	
Pseudochama exogyra	X	X	X	X	X	
Septifer bifurcates		X				
Septifer bifurcates/ Brachidontes adamsianus	X		X	X	X	

Table 1.1.9-3. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Willows Anchorage, Santa Cruz Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued).

Species and Taxa	Ott. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	U	U	U	C
Gastropoda						
Acanthina punctulata		x	x	x	x	
Acanthina spirata				x		
Acmaea (Collisella) digitalis	X	X	x	x	x	
Acmaea (Collisella) limatula	x	x	x	x	x	
Acmaea (Collisella) pelta	x	x	x	x	x	
Acmaea (Collisella) scabra	x	x	x	x	x	
Acmaea (Collisella) strigatella	x	x	x	x	x	
Aeolidia papillosa			x		x	
Amphissa versicolor	x	x	x	X		
Aplysia californica				x		
Ceratostoma nuttalli			x	x	x	
Crepidula perforans				x		
Crepipatella lingulata				x	x	
Dendropoma lituella				x	X	
Epitonium tincture	x	x	x	x	X	
Fissurella volcano	x	X	x	x	x	
Haliotis fulgens	x	X	x	x	x	
Hipponix antiquates		x				
Hipponix tureens		X				
Homalopoma luridum	x		X			
Lacuna unifasciata				x		
Littorina planaxis	X	x	x	x	x	
Littorina scutulata	X	x	x	x	x	
Lottia gigantea	x	x	X	x	x	
Mitra idae				x		
Nucella (Thais) emarginata	x	x	x	x	x	
Ocenebra circumtexta	x	x	x	x	x	
Petaloconchus montereyensis	x	x	x	X	x	
Serpulorbis squamigerus	x	x	x	x	x	
Tegula funebralis						x

Table 1.1.9-3. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Willows Anchorage, Santa Cruz Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued) ,

Species and Taxa	Ott 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	U	U	U	C
Polyplacophora						
Cyanoplax hartwegii	X	x	x	x	x	
Mopalia muscosa	x	x		x		
Mopalia porifera						x
Nuttallina californica	x			x	x	
Nuttallina fluxa	x	x	x	x	x	
Tonicella lineata		x			x	
Porifera						
Demospongiae						
Haliclona sp.						x
Leptoclathria asodes						x
Plocamia karykina	x	x	x	x	x	
73 Total Macroinvertebrates						

TABLE 1.1.9-4 SEASONAL AND ANNUAL PATTERNS OF OVERALL MACROPHYTE COVER % AS A FUNCTION OF TIDAL HEIGHT FOR SANTA CRUZ ISLAND.

SEASON		TIDAL HEIGHT (FT) 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9	11.0 TO 11.9	12.0 TO 12.9
OCTOBER	1976	97.9	109.8	132.7	116.4	114.5	121.8	111.2	93.2	76.4	65.0	81.0	70.2
DECEMBER	1976	92.0	104.8	122.5	107.0	103.7	99.6	98.1	98.0	94.5	90.2	92.6	85.0
FEBRUARY	1977	101.1	110.8	113.5	104.8	107.4	100.3	98.9	89.9	97.4	98.0	95.8	95.0
MAY	1977	--	95.7	102.0	102.4	106.7	96.8	101.0	99.6	97.8	98.0	95.0	95.0
MEAN		97.0	103.9	105.2	107.7	108.1	04.6	102.3	95.2	91.5	92.8	91.1	86.3

NOTE; 1 FOOT = 0.3048 METERS

ABLE 1.1.9-5. SEASONAL AND ANNUAL PATTERNS OF OVERALL MACRO-INVERTEBR E COVER % AS A FUNCTION OF TIDAL HEIGHT FOR SANTA CRUZ ISLAND.

SEASON		TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9	11.0 TO 11.9	12.0 TO 12.9
OCTOBER	1976	29.4	24.0	11.1	16.1	22.5	10.0	7.6	4.4	1.9	0.1	0.1	--
DECEMBER	1976	32.1	30 2	16.0	15.5	17.7	7.5	6.1	4.3	2.5	0.5	0.1	--
FEBRUARY	1977	25.1	25.1	13.9	18.5	20.7	8.4	6.6	5.4	1.7	0.4	0.1	0.1
MAY	77	--	17.7	24.0	25.9	18.4	6.9	6.2	3.9	0.3	0.1	0.1	--
MEAN		29.9	24	7.7	19.0	20.4	8.2	6.4	4.5	1.6	0.3	0.1	0.1

NOTE; 1 FOOT = 0.3048 METERS

Macro phyte cover during 1976-77 was high in all tidal intervals sampled, ranging from 115.2% in the +3.0 to +4. 0-ft. (+.9 to +1.2 m) tidal interval to 86.3% in the +12.0 to +13. 0-ft. (3.6 to 3.9-m) tidal interval. Except for the October visit, little change in macrophyte cover was recorded between quarterly visits for each tidal interval, and this fact is supported by the low range in total average cover values pointed out above. Comparing the October and December visits, higher cover was recorded below +8.0 ft. (+2.4 m) in October, while higher cover was present above +8.0 ft. (+2.4 m) in December. This pattern of change is correlated with winter conditions producing the physical cropping back of lower shore. species (below about +8.0 ft., +2.4 m) and the enhancement of upper shore forms, such as blue-green algae, resulting from the increased wetting.

Macroinvertebrate cover during 1976-77 averaged over the tidal intervals sampled was 10.7% (Table 1.1.9-5), and was maximal in December (12.1%), being lower in October (10.7%) and declining after December to 11.0% in February and 10.4% in May. These changes between quarterly visits do not parallel those observed for macrophytes. Mean cover for each tidal interval declined fairly steadily from 25.9% between +1.0 and +2.0 ft. (+.3 and +.6 m) to 0.1% above +11.0 ft. (-l-3.3 m). This steady decrease in macroinvertebrate cover with increased tidal height was also observed for 1975-76.

Mean cover of the various macrophyte taxa (Table 1.1.9-6) was highest for the blue-green algae (55.0%), followed by Lithophyllum proboscideum (11. 1%), Corallina officinalis var. chilensis (9.1%), Endocladia muricata (4.8%), C. vancouveriensis (3.3%), and Gigartina canaliculata (2.3%). Except for C. vancouveriensis, which increased 2.3% in mean cover for 1975-76 to 1976-77, the ranked order of the above mentioned dominant macrophyte taxa was unchanged. For the top five species, mean cover was notably higher in 1976-77, especially for the blue-green algae (increased from 30.0 to 55.0%). The sixth ranked species, Gigartina canaliculata, decreased in mean cover from 3.3% in 1975-76 to 2.3% in 1976-77, although this decrease is not considered to be significant. Seasonal changes during 1976-77 are noteworthy for several macrophytes. The blue-green algae increased steadily by 17.1% between October (47.6%) and May (64.7%); a change that represents upper shore increases for the most part. Lithophyllum proboscideum increased from a mean of 8.2 to 12.0% between October and December. This increase occurred broadly over the vertical range of the species (Figures 1.1.9-1 and 1.1.9-2). Endocladia muricata declined steadily from a mean cover of 7.1% in October to 3.2% in MaY. The cause of this decline is not apparent, since this species occurs on the upper shore (Figure 1.1.9-1) between +5.0 and +9.0 ft. (+1.5 and +2.7 m) and would be expected to increase during the winter period. Corallina officinalis var. chilensis also underwent a substantial decline from 10.3% in February to 3.0% in May (Table 1.1.9-6).

TABLE 1.1.9-6. QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SANTA CRUZ ISLAND (CONTINUED ON NEXT PAGE).

TAXA	COVER (%) OCT, 1976	DEC, 1976	FEB, 1977	MAY 1977	MEAN
BLUE-GREEN ALGAE	47.6	50.9	56.9	64.7	55.0
LITHOPHYLLUM PROBOSCIDEUM	8.2	12.0	12.7	11.6	11.1
CORALLINA OFFICINALIS VAR. CHILENSIS	11.3	11.9	10.3	3.0	9.1
ENDOCLADIA MURICATA	7.1	5.4	3.3	3.2	4.8
CORALLINA VANCOUVERIENSIS	2.9	3.0	2.9	4.4	3.3
GIGARTINA CANALICULATA	3.3	2.4	2.4	1.0	2.3
PELVETIA FASTIGIATA	1.9	1.5	1.3	1.0	1.4
PSEUDOLITHODERMA NIGRA	1.2	1.4	1.6	1.5	1.4
CYLINDROCARPUS RUGOSUS	2.6	1.3	0.6	0.3	1.2
LAURENCIA LAJOLLA	2.1	0.5	0.7	1.0	1.1
RALFSIA SP.	0.6	1.0	1.2	0.7	0.9
GELIDIUM COULTERI	1.1	0.4	0.2	1.3	0.8
COLPOMENIA SINUOSA	<0.1	0.3	0.7	1.5	0.7
LITHOTHRIX ASPERGILLUM	0.2	0.6	1.2	0.3	0.6
RHODOGLOSSUM AFFINE	1.3	0.2	0.4	0.3	0.5
ULVA CALIFORNICA	0.9	0.4	0.4	0.3	0.5
CERAMIUM EATONIANUM/SINICOLA	1.9	0.0	0.0	<0.1	0.5
LAURENCIA PACIFICA	1.5	<0.1	0.2	0.0	0.4
PHYLLOSPADIX SCOULERI	0.5	0.4	0.5	0.0	0.4
HERPOSIPHONIA LITTORALIS	0.0	0.8	0.5	0.0	0.3
CODIUM FRAGILE	0.6	0.4	0.1	<0.1	0.3
HALIDRYS DIOICA	<0.1	0.3	0.4	0.4	0.3
CORALLINE CRUSTS	<0.1	0.0	0.0	1.0	0.2
POLYSIPHONIA HENDRYI VAR HENDRYI	0.6	0.0	0.3	<0.1	0.2
BLUE-GREEN COLONY	0.3	0.2	0.?	0.2	0.2
HERPOSIPHONIA PLUMULA	0.3	<0.1	0.5	0.0	0.2

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.9-6 QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SANTA CRUZ ISLAND (CONTINUATION).

TAXA	COVER (%) OCT, 1976	DEC, 1976	FEB, 1977	MAY 1977	MEAN
PETROCELIS FRANCISCANA	0,3	0,5	<0,1	0,0	0,2
DICTYOTA FLABELLATA	<0,1	0,4	0,2	<0,1	0,2
BENTHIC DIATOMS	0,2	<0,1	0,2	0,2	0,2
GIGARTINA SPINOSA	0,2	0,2	0,2	0,0	0,2
PTEROSIPHONIA BAILEY	0,3	0,2	<0,1	<0,1	0,2
OTHER MACROPHYTES	1,4	1,3	0,7	0,4	
NUMBER OF OTHER TAXA	(23)	(20)	(23)	(16)	

NOTE: 1 FOOT = 0,3048 METERS

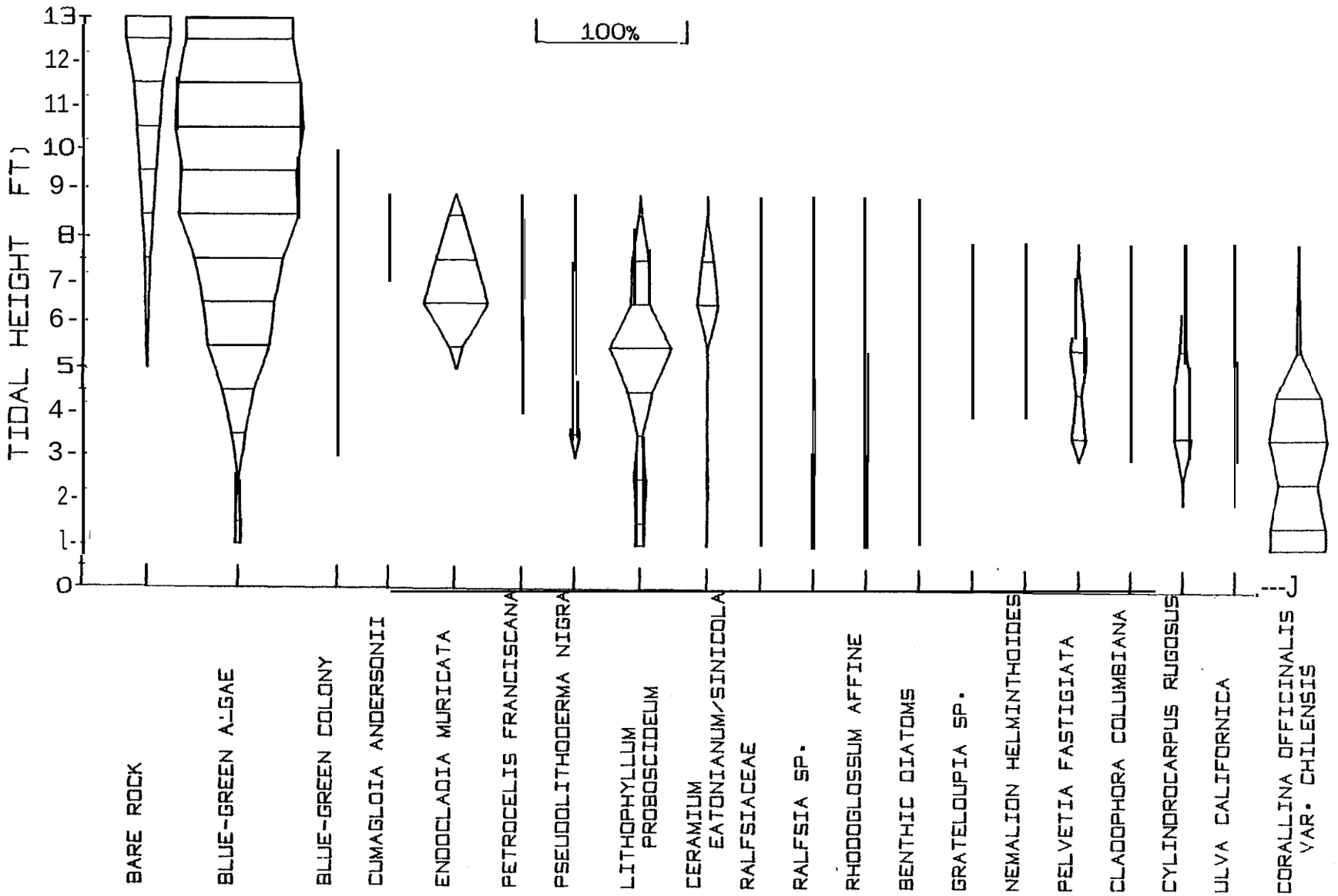

FIGURE 1.1.9-1. DISTRIBUTION OF DOMINANT MACRCIPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA CRUZ ISLAND (CONTINUED).

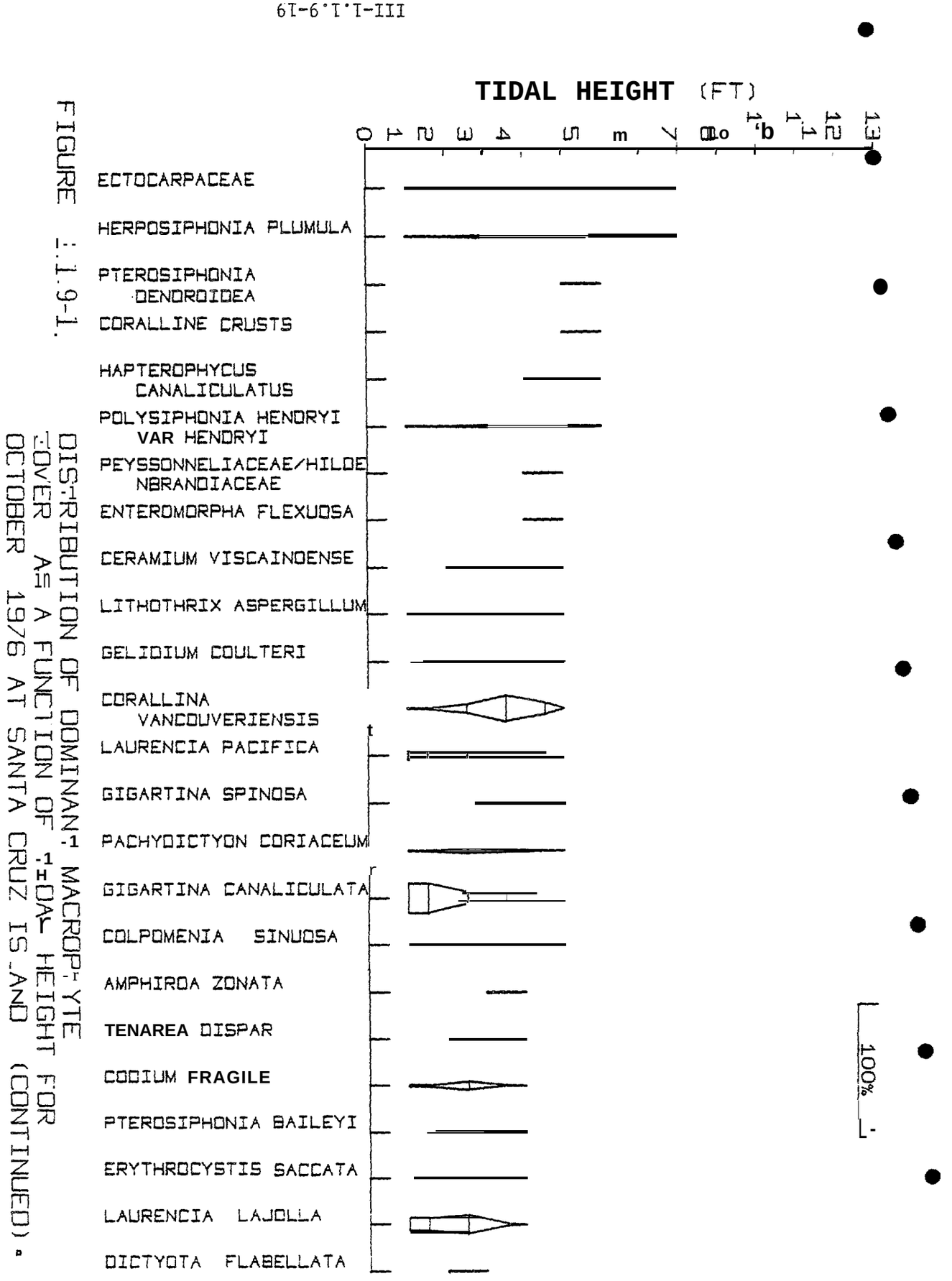

FIGURE III.1.9-1. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA CRUZ ISLAND (CONTINUED).

FIGURE 1.1.9-1. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA CRUZ ISLAND (CONTINUATION).

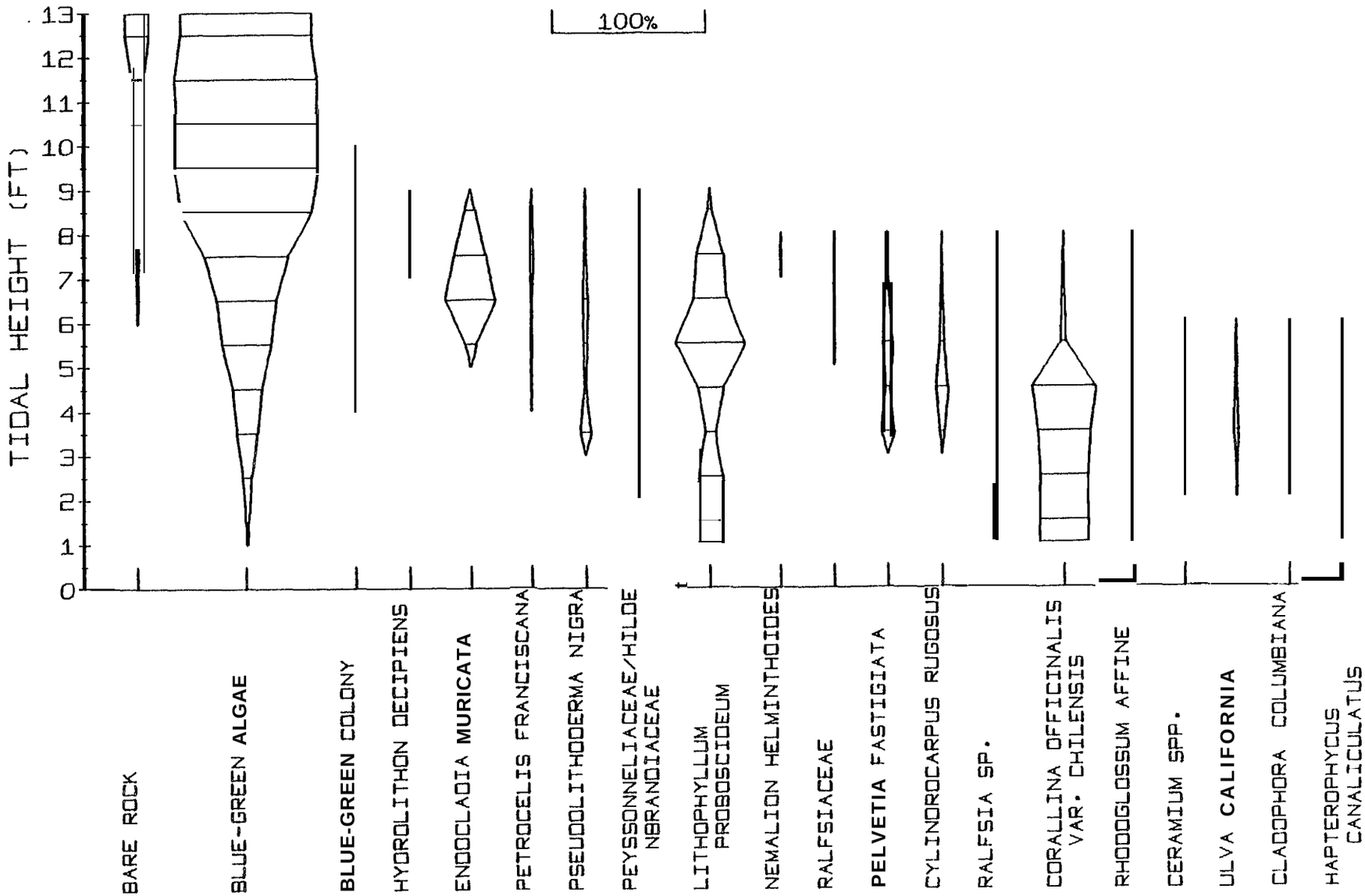

FIGURE 1.1.9-2. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA CRUZ ISLAND (CONTINUED).

FIGURE 1.1.9-2. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 A-1 SAN ONOFRE (CONTINUED)

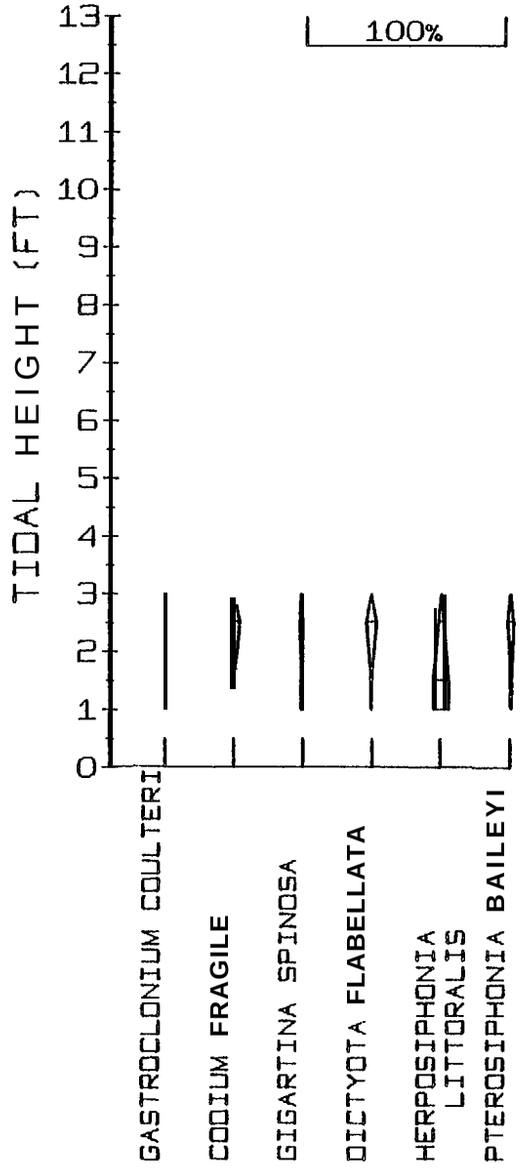

FIGURE 1.1.9-2. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA CRUZ ISLAND (CONTINUATION).

The distributions of the dominant macrophytes as a function of tidal height during each quarterly visit in 1976-77 are given as kite diagrams in Figures 1.1.9-1 to 1.1.9-4. The cover dominance by the blue-green algae, particularly above +8.0 ft. (+2.4 m) is clearly evident in the kite diagrams. Between about +5.0 and +9.0 ft. (+1.5 and +2.7 m) the most important secondary cover macrophytes were Endocladia muricata and Lithophyllum proboscideum. Below about +5.0 ft. (+1.5 m), L. proboscideum continued to be an important species, but Corallina officinalis var. chilensis, C. vancouveriensis, and Gigartina canaliculata contributed most noticeably to the lower shore macrophyte cover. The decline of C. officinalis var. chilensis from the February to May visits is clearly seen in the kite diagrams for these two sampling periods (Figures 1.1.9-3 and 1.1.9-4).

Macroinvertebrate cover averaged over the tidal intervals sampled (Table 1.1.9-7) was highest for Anthopleura elegantissima (2.1%), followed by Tetraclita squamosa rubescens (2.0%), Mytilus californianus (1.2%), and Serpulorbis squamigerus (1.1%). The top ranked six species for 1976-77 were the same as the top six species in 1975-76, although the order was somewhat different. Anthopleura elegantissima appeared to have declined from December (3.3% mean cover) to May (0.7% mean cover); although this apparent decrease may actually be due to the lack of our ability to sample the low quadrats because of unusual surf conditions. Recruitment is suggested for T. squamosa rubescens, which increased from 1.4% mean cover in December, to 2.0% in February, and to 3.1% in May.

Distributions of the dominant macroinvertebrates as a function of tidal height during each quarterly visit are given as kite diagrams in Figures 1.1.9-5 to 1.1.9-8. The cover dominants included Littorina scutulata between about +7.5 and +8.5 ft. (+2.0 and +2.5 m), Mytilus californianus between about +4.0 and +6.5 ft. (+1.2 and +2.0 m), Tetraclita squamosa rubescens between about +3.0 and +7.0 ft. (+.9 and +2.1 m), Anthopleura elegantissima, Strongylocentrotus purpuratus, and Serpulorbis squamigerus below about +3.0 ft. (+.9 m). The seaonal changes in cover discussed in the preceding paragraph are shown in the kite diagrams and are not repeated here.

1.1.9.4.2.2 Frequency

The percent frequencies of the dominant macrophytes and macroinvertebrates during each quarterly visit and as annual means are given in Tables 1.1.9-8 and 1.1.9-9. As in 1975-76, blue-green algae and Lithophyllum proboscideum, both of which are broad-ranging and abundant taxa, had the highest percent frequencies (95.7% and 56.9%, respectively). Ralfsia sp. ranked third (47.7%) in frequency due to its broad vertical range (Figure 1.1.9-1) from +1.0 to +9.0 ft. (.3 to 2.7 m) and in spite of its low cover, ranking eleventh in mean cover with 0.9% (Table 1.1.9-6). Rhodoglossum affine averaged 41.4% frequency, and was similar to Ralfsia sp. in ranging broadly but

FIGURE 1. .9-3. CONTINUED.

CHSTRIBUTHON OF DOMINANT MACROPHYTE COVER AS A FUNC.ION OF .1 HDAL HEIGHT FOR FEBRUARY 1977 A.1 SANTA nRUN HS-ANO

FIGURE 1.1.9-3. DISTRIBUTION OF DOMINANT MACROPHYTE CANOPY AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SANTA CRUZ ISLAND (CONTINUED).

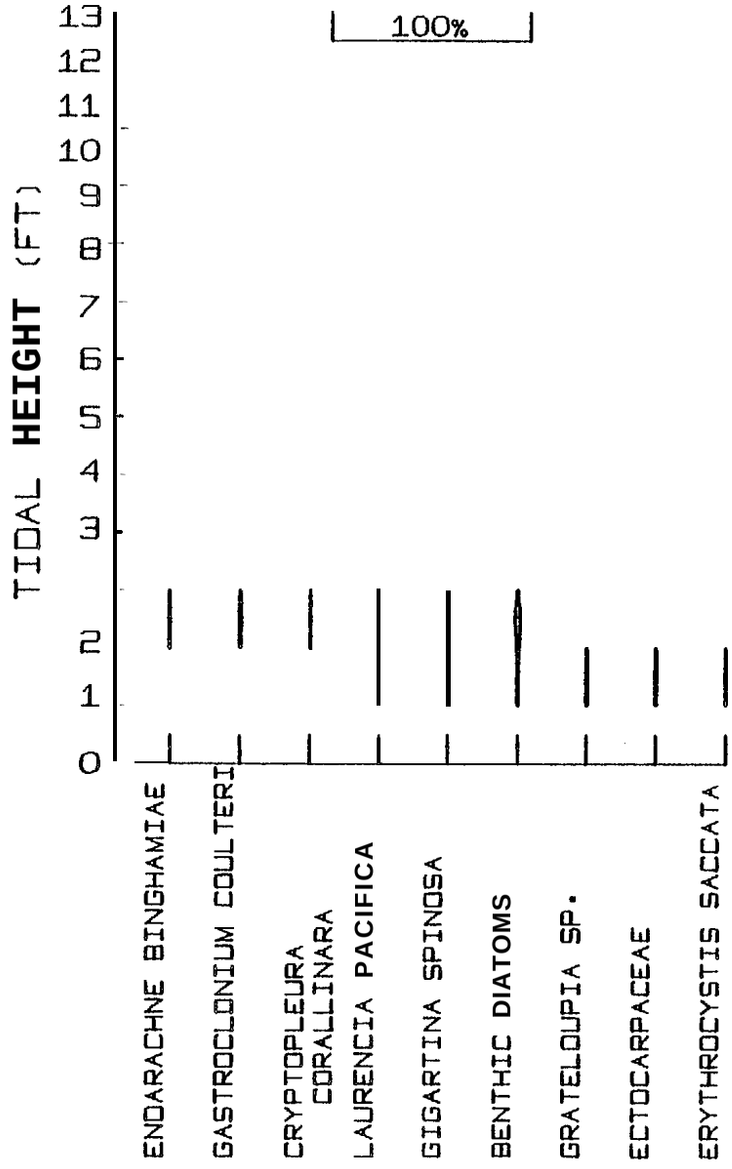

FIGURE 1. .9-3. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SANTA CRUZ ISLAND (CONTINUATION).

FIGURE 1.1.9-4. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF THDA- HEIGHT FOR MAY 1977 A-1 SANTA ROSA ISLAND CONTINUED).

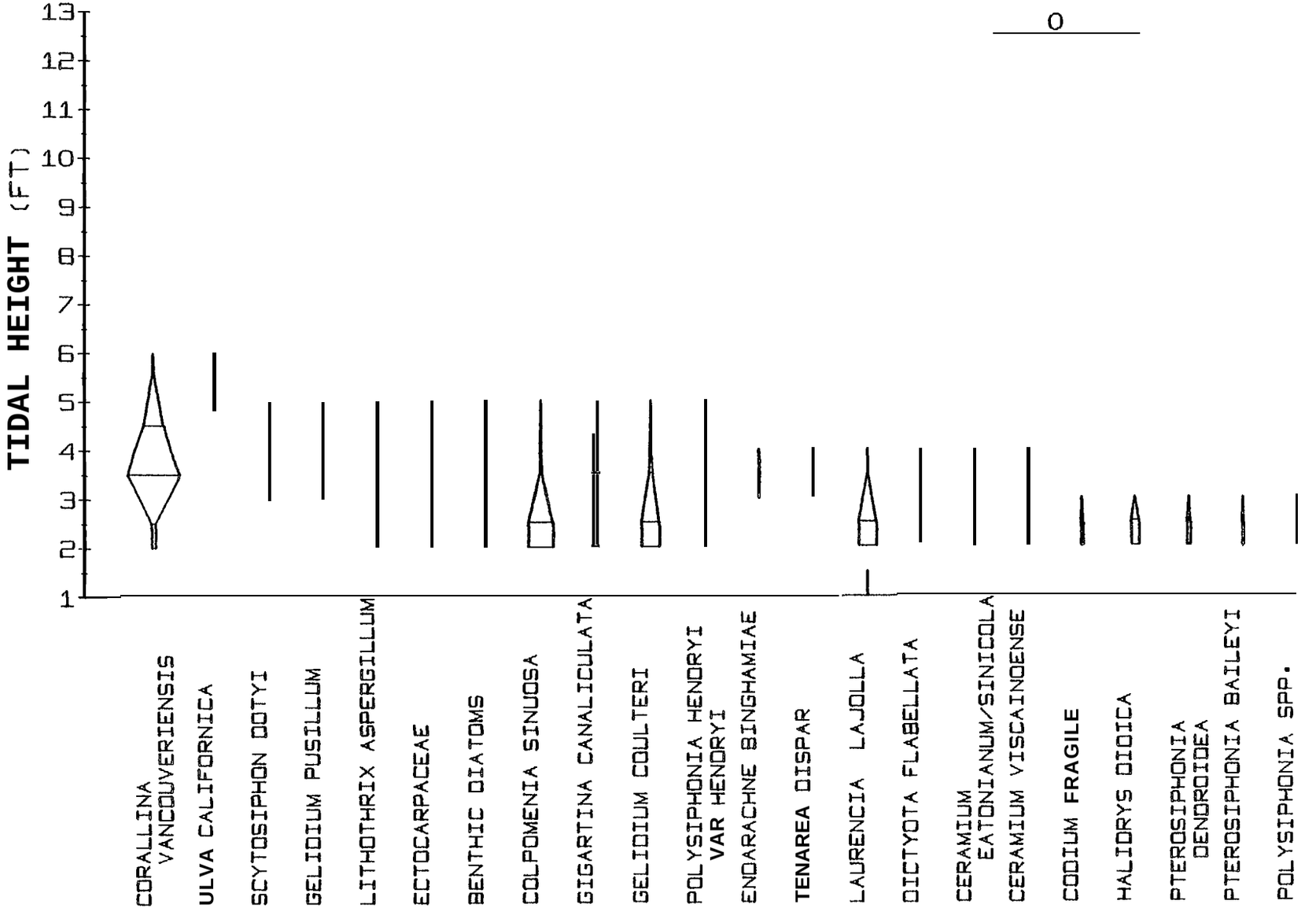

FIGURE 1.1.9-4. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SANTA CRUZ ISLAND (CONTINUATION).

TABLE 1.1.9-7. QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SANTA CRUZ ISLAND.

TAXA	COVER (%) OCT, 1976	DEC, 1976	FEB, 1977	MAY 1977	MEAN
ANTHOPLEURA ELEGANTISSIMA	2,3	3,3	1,9	0,7	2,1
TETRACLITA SQUAMOSA RUBESCENS	1,4	1,4	2,0	3,1	2,0
MYTILUS CALIFORNIANUS	1,3	1,1	1,2	1,3	1,2
SERPULORBIS SQUAMIGERUS	1,0	1,2	1,6	0,8	1,1
STRONGYLOCENTROTUS PURPURATUS	0,8	1,0	0,8	0,2	0,7
LITTORINA SCUTULATA	1,0	0,6	0,6	0,4	0,6
LITTORINA PLANAXIS	0,2	0,4	0,5	0,4	0,4
PHRAGMATOPOMA CALIFORNICA	0,3	0,3	0,5	0,4	0,4
ACMAEA (COLLISELLA) SCABRA	0,3	0,2	0,3	0,3	0,3
CHTHAMALUS FISSUS AND DALLI	0,4	0,2	0,2	0,3	0,3
PSEUDOCHAMA EXOGYRA	0,2	0,2	0,2	0,3	0,2
SPIROBRANCHUS SPINOSUS	0,1	0,2	0,2	0,1	0,2
NUTTALLINA FLUXA	<0,1	0,2	0,1	0,3	0,2
SEPTIFER BIFURCATUS AND BRACHIDONTES	<0,1	<0,1	0,2	0,2	0,1
OTHER MACRO-INVERTEBRATES	0,5	0,6	0,7	0,7	
NUMBER OF OTHER TAXA	(27)	(31)	(37)	(29)	

NOTE: 1 FOOT = 0,3048 METERS

FIGURE 1.1.9-5. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA CRUZ ISLAND. (CONTINUED)

FIGURE 1.9-5. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA CRUZ ISLAND (CONTINUATION).

FIG. III-1 1.1.9-6. DISTRIBUTION OF DOMINANT MACROINVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA CRUZ ISLAND (CONTINUED)

FIGURE 1.1.9-6. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA CRUZ (EXTINCTION).

FIGURE 1.1.9-7. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FEBRUARY 1977 AT SANTA CRUZ ISLAND (CONTINUED)

FIGURE 1.1.9-7. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SANTA CRUZ ISLAND (CONTINUED).

FIGURE 1.1.9-7.

DISTRIBUTION OF DOMINANT 5 PERCENT INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SANTA CRUZ ISLAND (CONTINUATION).

FIGURE 1.1.9-8. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SANTA CRUZ ISLAND (CONTINUED).

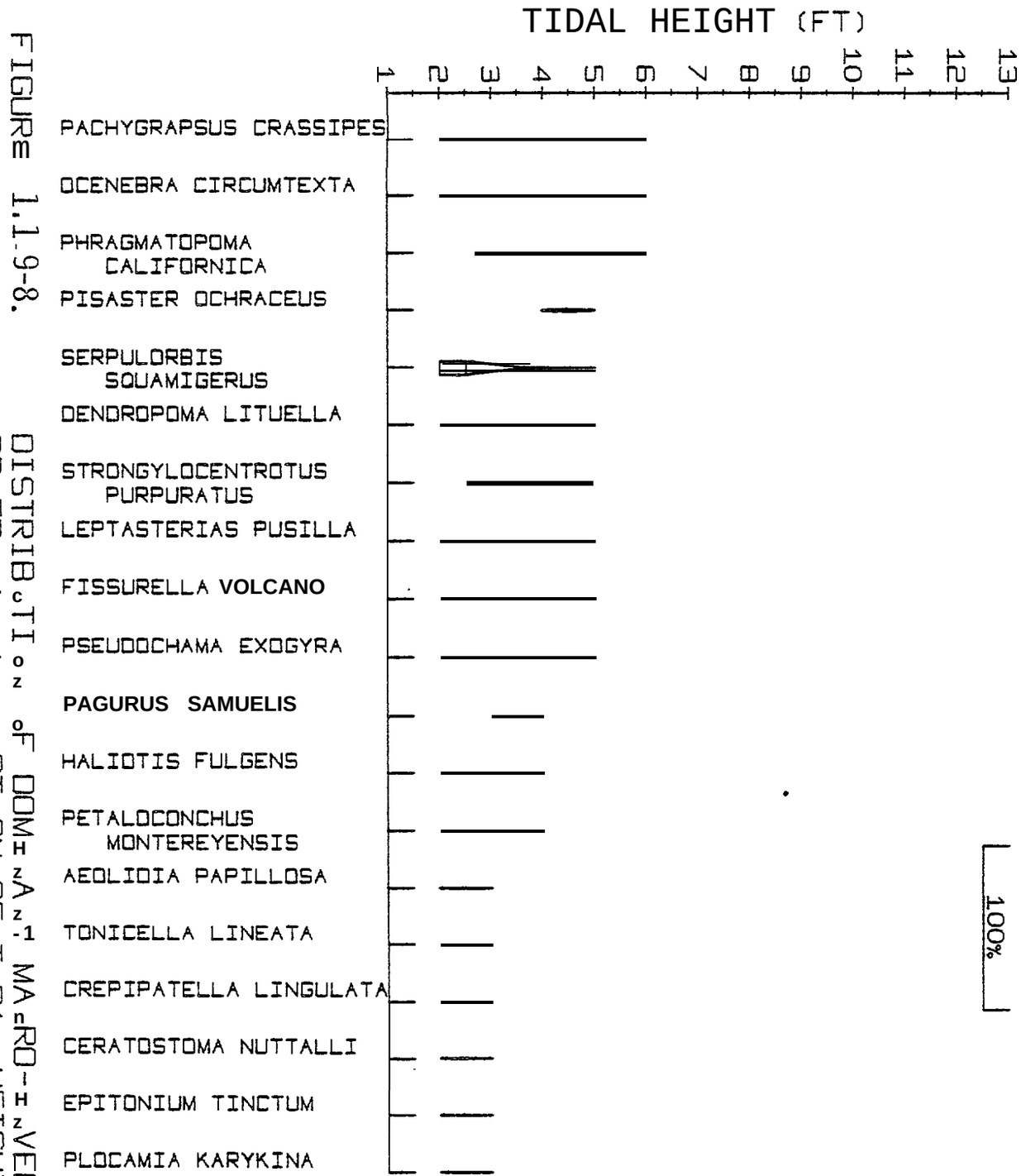

FIGURE 1.1.9-8. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF THE DAY HEIGHT FOR MAY 1977 AT SANTA CRUZ ISLAND (CONTINUATION).

TABLE 1.1.9-8. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SANTA CRUZ ISLAND CONTINUED ON NEXT PAGE).

TAXA	FREQUENCY (%) OCT, 1976	DEC, 1976	FEB, 1977	MAY 1977	MEAN
BLUE-GREEN ALGAE	95,8	100,0	91,7	95,5	95,7
LITHOPHYLLUM PROBOSCIDEUM	55,2	57,9	59,6	54,8	56,9
RALFSIA SP,	50,5	45,8	47,2	47,5	47,7
RHODOGLOSSUM AFFINE	46,1	39,8	45,8	34,0	41,4
CORALLINA OFFICINALIS VAR, CH LENSIS	42,6	41,5	41,5	28,1	38,4
PSEUDOLITHODERMA N GRA	34,2	37,8	37,4	38,8	37,1
BLUE-GREEN COLONY	39,1	26,9	32,6	32,4	32,7
ENDOCLADIA MURICATA	31,0	29,8	29,8	32,5	30,7
CYLINDROCARPUS RUGOSUS	39,6	28,7	25,2	19,5	28,2
CORALLINA VANCOUVERIENSIS	27,1	32,4	25,9	27,3	28,2
ULVA CALIFORNICA	34,6	23,5	27,2	26,6	28,0
GIGARTINA CANALICULATA	26,0	26,5	22,6	17,0	23,0
COLPOMENIA SINUOSA	15,7	25,9	28,2	22,1	23,0
GELIDIUM COULTERI	30,1	21,1	17,2	21,6	22,5
LITHOTHRIX ASPERGILLUM	14,9	14,5	23,5	20,3	18,3
LAURENCIA LAJOLLA	20,0	20,7	20,7	10,9	18,1
PETROCELIS FRANCISCANA	22,1	26,1	14,2	0,0	15,6
PELVETIA FASTIGIATA	16,8	13,2	13,3	15,7	14,7
CLADOPHORA COLUMBIANA	3,9	10,2	19,0	20,3	13,3
BENTHIC DIATOMS	9,0	15,7	11,5	15,2	12,8
POLYSIPHONIA HENDR I VAR HENDRYI	26,6	0,0	13,6	10,8	12,7
LAURENCIA PACIFICA	23,0	11,5	14,6	0,0	12,3
RALFSIACEAE	20,3	4,6	6,8	13,8	11,4
CERAMIUM EATONIANUM/SINICOLA	27,7	0,0	0,0	6,4	8,5
PEYSSONNELIACEAE/HILDENBRANDIACEAE	1,2	6,8	8,7	15,9	8,1
ECTOCARPACEAE	11,6	5,4	2,1	12,1	7,8

NOTE; 1 FOOT = 0,3048 METERS

TABLE 1.1.9-8. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SANTA CRUZ ISLAND (CONTINUED).

TAXA	FREQUENCY (%) OCT, 1976	DEC, 1976	FEB. 1977	MAY 1977	MEAN
HALIDRYS DIOICA	1,0	12,7	12,7	4,5	7,8
HERPOSIPHONIA PLUMULA	14,8	3,1	10,0	0,0	7,0
HERPOSIPHONIA LITTORALIS	0,0	10,4	16,8	0,0	6,8
CODIUM FRAGILE	12,1	7,3	3,1	4,5	6,8
TENAREA DISPAR	8,5	14,7	0,0	3,6	6,7
NEMALION HELMINTHOIDES	9,5	1,0	2,9	11,9	6,3
PORPHYRA PERFORATA	0,0	0,0	2,4	21,9	6,1
PTEROSIPHONIA BAILEYI	12,1	6,3	1,0	4,5	6,0
POLYSIPHONIA SPP.	0,0	18,3	1,0	4,5	6,0
CERAMIUM VISCAINOENSE	6,1	0,0	5,2	10,9	5,6
GASTROCLONIUM COULTERI	10,4	9,4	2,1	0,0	5,5
GELIDIUM PURPURASCENS	7,3	5,2	9,3	0,0	5,4
DICTYOTA FLABELLATA	1,0	8,3	5,2	6,4	5,2
GIGARTINA SPINOSA	8,1	5,2	5,2	0,0	4,6
PACHYDICTYON CORIACEUM	13,7	2,1	1,0	0,0	4,2
HAPTEROPHYCUS CANALICULATUS	2,4	4,5	5,7	3,9	4,1
ERYTHROCYSTIS SACCATA	12,1	0,0	2,1	0,0	3,5
CORALLINE CRUSTS	1,2	0,0	0,0	11,8	3,2
CERAMIUM SPP.	0,0	12,9	0,0	0,0	3,2
POLYSIPHONIA ACUMINATA	0,0	0,0	11,6	0,0	2,9
PTEROSIPHONIA DENDROIDEA	1,2	5,1	0,0	4,5	2,2
HYDROLITHON DECIPIENS	0,0	3,8	2,7	1,6	2,1
GRATELOUPIA SP.	5,8	0,0	2,1	0,0	2,0
ENTEROMORPHA FLEXUOSA	1,2	2,9	1,2	2,4	1,9
OPHIDOCLADUS SIMPLICIUSCULUS	6,3	0,0	0,0	0,0	1,6
GELIDIUM PUSILLUM	0,0	0,0	0,0	5,7	1,4

NOTE: 1 FOOT = 0,3048 METERS

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TABLE 1.1.9-8. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SANTA CRUZ ISLAND (CONTINUATION).

TAXA	FREQUENCY (%) OCT, 1976	DEC, 1976	FEB, 1977	MAY 1977	MEAN
LAURENCIA SPECTABILIS	4,2	0,0	1,0	0,0	1,3
EGREGIA MENZIESII	1,0	3,9	0,0	0,0	1,2
PHYLLOSPADIX SCOULERI	1,0	1,0	1,0	0,0	0,8
CRYPTOPLEURA CORALLINARA	2,1	0,0	1,0	0,0	0,8
MELOBESIA MEDIOCRIS	1,0	1,0	1,0	0,0	0,8
SCYTOSIPHON DUTYI	0,0	0,0	0,0	3,1	0,8
ENDARACHNE BINGHAMIAE	0,0	0,0	1,0	1,6	0,7
CUMAGLOIA ANDERSONII	2,7	0,0	0,0	0,0	0,7
BOSSIELLA ORBIGNIANA SSP, DICHOTOMA	0,0	1,0	1,0	0,0	0,5
AMPHIROA ZONATA	1,7	0,0	0,0	0,0	0,4
PLOCAMIUM VIOLACEUM	0,0	1,7	0,0	0,0	0,4
IRIDAEA CORDATA VAR, SPLENDENS	0,0	1,0	0,0	0,0	0,3
UNKNOWN ALGAE CRU AF	1,0	0,0	0,0	0,0	0,3
CHAETOMORPHA LINUM	0,0	0,0	1,0	0,0	0,3

NOTE; 1 FOOT = 0,3048 METERS

TABLE 1.1.9-9. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SANTA CRUZ ISLAND (CONTINUED ON NEXT PAGE).

TAXA	FREQUENCY (%) OCT, 1976	DEC, 1976	FEB, 1977	MAY 1977	MEAN
LITTORINA PLANAXIS	57,6	53,6	61,9	64,9	59,5
CHTHAMALUS FISSUS AND DALLI	50,6	49,7	54,4	66,4	55,3
TETRACLITA SQUAMOSA RUBESCENS	53,8	50,6	53,8	50,7	52,2
ACMAEA (COLLISELLA) SCABRA	48,8	45,6	50,8	50,7	49,0
ACMAEA (COLLISELLA) PELTA	38,0	45,7	44,3	46,1	43,5
ANTHOPLEURA ELEGANTISSIMA	44,3	44,3	44,3	39,2	43,0
LITTORINA SCUTULATA	36,6	50,0	37,6	47,5	43,0
SPIROBRANCHUS SPINOSUS	41,4	41,5	41,4	36,2	40,1
ACMAEA (COLLISELLA) STRIGATELLA	29,3	40,0	44,9	46,1	40,1
SEPTIFER BIFURCATUS AND BRACHIDONTES	28,9	32,5	41,4	49,7	38,1
NUTTALLINA FLUXA	35,5	37,0	39,4	36,2	37,0
PHRAGMATOPOMA CALIFORNICA	32,9	32,0	34,1	33,8	33,2
SPIRORBIS SPP.	30,5	37,5	36,5	23,5	32,5
MYTILUS CALIFORNIANUS	28,9	30,0	30,1	39,7	32,2
ACMAEA (COLLISELLA) DIGITALIS	29,7	23,5	24,7	38,6	29,1
FISSURELLA VOLCANO	28,8	26,9	26,2	20,8	25,7
ACMAEA (COLLISELLA) LIMATULA	15,4	17,5	30,3	37,3	25,2
PACHYGRAPSUS CRASSIPES	29,1	18,8	22,6	19,6	22,5
SERPULORBIS SQUAMIGERUS	24,8	22,4	23,6	14,0	21,2
STRONGYLOCENTROTUS PURPURATUS	27,1	21,2	24,0	12,2	21,1
CYANOPLAX HARTWEGII	22,4	17,9	19,5	20,0	19,9
ACMAEA JUVENILE	0,0	0,0	41,8	34,1	19,0
PSEUDOCHAMA EXOGYRA	17,3	17,1	17,0	20,1	17,9
OCENEBRA CIRCUMTEXTA	18,9	14,9	14,4	17,8	16,5
POLLICIPES POLYMERUS	13,8	12,6	11,9	12,7	12,8
PLOCAMIA KARYKINA	10,6	12,6	19,7	4,5	11,9

NOTE: 1 FOOT = 0,3048 METERS

TABLE 1.1.9-9. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SANTA CRUZ ISLAND (CONTINUED).

TAXA	FREQUENCY (%) OCT, 1976	DEC, 1976	FEB, 1977	MAY 1977	MEAN
PETALOCONCHUS MONTEREYENSIS	15.1	4.5	14.5	10.9	11.3
LEPTASTERIAS PUSILLA	10.3	10.5	11.8	7.7	10.1
EPITONIUM TINCTUM	8.2	10.3	13.5	4.5	9.1
HALIOTIS FULGENS	4.0	2.7	13.0	12.7	8.1
NUTTALLINA CALIFORNICA	7.6	7.6	7.6	8.3	7.8
NUCELLA (THAIS) EMARGINATA	10.2	9.1	6.3	1.3	6.7
BALANUS GLANDULA	6.0	1.7	5.6	6.2	4.9
CREPIPATELLA LINGULATA	0.0	0.0	14.6	4.5	4.8
MYTILUS EDULIS	5.1	2.4	5.2	2.6	3.8
EPIACTIS PROLIFERA	3.1	5.2	5.2	0.0	3.4
LOTTIA GIGANTEA	2.4	1.2	4.8	3.9	3.1
DENDROPOMA L. TUELLA	0.0	0.0	5.6	5.8	2.9
CERATOSTOMA NUTTALLI	0.0	1.0	5.2	4.5	2.7
ACANTHINA PUNCTULATA	0.0	1.2	6.1	2.6	2.5
AMPHISSA VERSICOLOR	3.1	4.2	2.1	0.0	2.3
PAGURUS HIRSUTIUSCULUS	4.0	4.0	0.0	0.0	2.0
PISASTER OCHRACEUS	0.0	3.9	2.7	1.3	2.0
AEOLIDIA PAPILLOSA	0.0	3.3	0.0	4.5	2.0
PUGETTIA RICHII	4.2	2.1	1.0	0.0	1.8
CREPIDULA PERFORANS	0.0	0.0	6.3	0.0	1.6
MITRA IDEA	0.0	0.0	5.2	0.0	1.3
TONICELLA LINEATA	0.0	0.0	0.0	4.5	1.1
PAGURUS SAMUELIS	0.0	1.2	1.2	1.8	1.0
MOPALIA MUSCOSA	1.2	0.0	2.1	0.0	0.8
APLYSIA CALIFORNICA	0.0	0.0	2.1	0.0	0.5
LACUNA UNIFASCIATA	0.0	0.0	2.1	0.0	0.5

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.9-9. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SANTA CRUZ ISLAND (CONTINUATION).

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
ACANTHINA SPIRATA	0.0	0.0	2.1	0.0	0.5
PARAXANTHIAS TAYLORI	2.1	0.0	0.0	0.0	0.5
UROLOPHA LURIDUM	0.0	1.2	0.0	0.0	0.3
PUGETTIA PRODUCTA	0.0	1.0	0.0	0.0	0.3
CANCER ANNULARIUS	1.0	0.0	0.0	0.0	0.3
LASAEA SUBVIRIDIS	0.0	0.0	1.0	0.0	0.3

NOTE; 1 FOOT = 0.3048 METERS

having 'low cover. At the opposite extreme, certain species with narrow vertical ranges and moderate abundance showed low frequencies, e.g., Endocladia muricata (4.8% mean cover and 30.7% mean frequency), Laurencia lajolla (1.1% cover and 18.1% frequency), and Phyllospadix scouleri (4.3% cover in the +2.0 to +3.0 ft., +.6 to +.9 m, tidal interval, 0.4% mean cover, and 0.8% frequency).

The macroinvertebrate species that ranged broadly over the intertidal zone had high frequencies, and included Littorina planaxis (59.5%), Chthamalus fissus/dalli (55.3%), Tetraclita squamosa rubescens (52.2%), and Acmaea (Collisella) scabra (49.0%). Littorina planaxis increased 15.6% in mean frequency from 1975-76, and C. fissus/dalli increased 8.5X. Other species had comparable frequencies.

1.1.9.4.2.3 Density

Quarterly and annual mean densities of the dominant macroinvertebrate taxa are given in Table 1.1.9-10. Littorina planaxis and Tetraclita squamosa rubescens were the most numerous species, with mean densities of 444/m^2 and 439/m^2 respectively. While T. squamosa rubescens ranked second in per cent cover (Table 1.1.9-7), L. planaxis, because of its small size, ranked seventh in percent cover. Anthopleura elegantissima, which ranked first in cover, owing in part to its large size, ranked ninth in density (41/m^2). Density increases over 1975-76 were most pronounced in the cases of T. squamosa rubescens (increased an average of 103/m^2) and Spirobranchus spinosus (increased an average of 105/m^2). Littorina scutulata declined by an average of 71/m^2 from 1975-76 to 1976-77.

The density data are particularly instructive in showing patterns of mortality and recruitment. Littorina planaxis recruited heavily between December (278/m^2) to February (557/m^2) to May 688/m^2), as did Tetraclita squamosa rubescens, from 271/m^2 in May. Minor recruitment by Chthamalus fissus/dalli is indicated by the increase from 205/m^2 in February to 258/m^2 in May. Acmaea (Collisella) scabra recruited heavily between February (95/m^2) and May (298/m^2). In actuality, the recruitment took place between December and February as evidenced by the appearance of unidentifiable juvenile Acmaea in February (68/m^2), and the subsequent recognition of many of them as A. (Collisella) scabra in May. A number of these unidentified juveniles also contributed to the observed recruitment of A. (Collisella) pelts and A. (Collisella) strigatella in May. Spirobranchus spinosus recruited between October (65/m^2), December (114/m^2), and February (200/m^2), but suffered mortality losses by May (160/m^2). A parallel pattern of increase and decline was shown by Spirorbis spp. The apparent mortality in Anthopleura elegantissima between February (45/m^2) and May (25/m^2), may have been due to our inability to sample the low quadrats because of unusual surf conditions.

TABLE 1.1.9-10. QUARTERLY AND ANNUAL MEAN DENSITY (NO./M2) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SANTA CRUZ ISLAND (CONTINUED ON NEXT PAGE).

TAXA	DENSITY (NO./M2) OCT. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
LITTORINA PLANAXIS	254	278	557	688	444
TETRACLITA SQUAMOSA RUBESCENS	309	277	271	899	439
CHTHAMALUS FISSUS AND DALLI	178	201	205	258	211
LITTORINA SCUTULATA	172	188	186	198	186
ACMAEA (COLLISELLA) SCABRA	82	66	95	298	140
SPIROBRANCHUS SPINOSUS	65	114	200	160	135
SPIRORBIS SPP.	49	137	195	63	111
MYTILUS CALIFORNIANUS	42	39	38	46	41
ANTHOPLEURA ELEGANTISSIMA	43	41	45	25	39
PHRAGMATOPOMA CALIFORNICA	34	30	41	40	36
NUTTALLINA FLUXA	27	25	32	42	32
SERPULORBIS SQUAMIGERUS	26	35	41	21	31
ACMAEA JUVENILE	0	0	66	27	24
ACMAEA (COLLISELLA) PELTA	11	18	16	39	21
SEPTIFER BIFURCATUS AND BRACHIDONTES	10	15	24	28	19
ACMAEA (COLLISELLA STRIGATELL°	12	15	18	30	19
STRONGYLOCENTROTUS PURPURATUS	22	24	19	9	18
ACMAEA (COLLISELLA DIGITALIS	22	14	17	15	17
FISSURELLA VOLCANO	7	9	10	11	9
ACMAEA (COLLISELLA LIMA ULA	4	3	6	15	7
PSEUDOCHAMA EXOGYRA	3	4	4	5	4
PETALOCONCHUS MONTEREYEI SIS	2	<1	6	5	3
NUTTALLINA CALIFORNICA	3	3	3	3	3
PACHYGRAPSUS CRASSIPES	6	2	3	2	3
POLLICIPES POLYMERUS	2	2	3	3	3
CYANOPLAX HARTWEGII	3	3	2	2	2

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.9-10. QUARTERLY AND ANNUAL MEAN DENSITY (NO./M2) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SANTA CRUZ ISLAND (CONTINUATION).

TAXA	DENSITY (NO./M2) OCT. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
OCENEBRA CIRCUMTEXTA	2	2	2	1	2
EPITONIUM TINCTUM	1	2	3	<1	2
CREPIPATELLA LINGULATA	0	0	5	<1	2
LEPTASTERIAS PUSILLA	1	2	1	1	1
BALANUS GLANDULA	1	<1	1	1	1
HALIOTIS FULGENS	<1	<1	2	1	1
OTHER MACRO-INVERTEBRATES	3	4	7	3	
NUMBER OF OTHER TAXA	(10)	(15)	(18)	(10)	
TOTALS	1399	1572	2129	2542	

NOTE: 1 FOOT = 0.3048 METERS

Density " distributions as a function of tidal height for the dominant macroinvertebrates were plotted as kite diagrams for each quarterly visit on an expanded scale (Figures 1.1.9-9 to 1.1.9-12) and on a compressed scale (Figures 1.1.9-13 to 1.1.9-16). These kite diagrams show the patterns of seasonal change summarized in Table 1.1.9-10 and discussed in the preceding paragraph.

1. 1.9.4.2.4 Biomass

The 12 disturbed samples collected during October 1976 are included with the wet and dry organic biomass data from October 1975 to May 1976 to give a composite summary of biomass distribution among the dominant macrophytes (Tables 1.1.9-11 and 1.1.9–12) and dominate macroinvertebrate (Tables 1.1.9-13 and 1.1.9-14) as a function of tidal height. The additional samples increased the number of replicates in the +3.0 to +2.9 ft. (+.6 to +.9 m) interval from 4 to 8, the number in the +6.0 to +5.9 ft. (+1.5 to +1.8 m) interval from 13 to 17, and the number between +9.0 to +8.9 ft. (+2.4 to +2.7 m) from 4 to 5. The three remaining quadrats contributed to the previously unoccupied tidal interval of +9.0 to +10.0 ft. (+2.7 to +3.0 m). In this latter interval there was no macrophyte wet weight biomass, and only four macroinvertebrates were present, which included Chthamalus fissus/dalli (40.4 g/m^2), Littorina planaxis (9.5 g/m^2), and Acmaea 'sells) pelts 0.1 g/m^2). The basic patterns of biomass distribution discussed at length in Seapy and Littler (1977) were not altered by the addition of these data, and are not reiterated here.

1. 1.9.4.3 Tidepools

1. 1.9.4.3.1 Standing Crop

Two undisturbed pools sampled during 1975-76 were sampled during 1976-77. Annual mean cover for these two pools (Table 1.1.9-15) was highest for Lithophyllum proboscideum (56.0% in the mid-pool and 36.4% in the high pool). Lithothrix aspergillum (7.9%) and Corallina officinalis var. chilensis (7.6%) were species of secondary importance in the mid-pool. Lithothrix aspergillum (16.7%), Ulva californica (14.2%), and blue-green algae were secondary cover species in the high pool . Lithophyllum proboscideum increased in cover in both pools from 1975-76, while C. officinalis var. chilensis declined in both pools. In the high pool, Phyllospadix scouleri was an important cover organism in 1975-76 (19.9%), but died back to 2.4% in 1976-77. Ulva californica changed little over time, however, L. aspergillum increased greatly from 3.0 to 7.9% in the mid pool and from 2.9 to 16.7% in the high pool.

Macroinvertebrate cover in the mid-pool (Table 1.1.9-16) was greatest for Anthopleura elegantissima (9.8%), Strongylocentrotus purpuratus (7. 9%), and Phragmatopoma californica (5.7%). In 1975-76, S. purpuratus had higher cover (11.1%) and A. elegantissima had lower

FIGURE 1.1.9-9. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA CRUZ ISLAND (CONTINUED).

FIGURE 1.1.9-9.

DISTRIBUTION OF DOMINANT MACRO VERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA CRUZ ISLAND (CONTINUATION).

FIGURE 1.1.9-10. DISTRIBUTION OF DOMINANT MACROINVERTEBRATE DENSITY AMONG FUCUS ZONE OF TIDAL HEIGHT FOR DECEMBER 1977 AT SAN ONOFRE (CORRIDOR)

FIGURE 1.1.9-10. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA CRUZ ISLAND (CONTINUED).

FIGURE 1.1.9-10. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1978 AT SANTA CRUZ ISLAND (CONTINUED)

FIGURE 1.1.9-11. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SANTA CRUZ ISLAND (CONTINUED).

FIGURE 1.1.9-11. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SANTA CRUZ ISLAND (CONTINUED).

FIGURE 1.1.9-11.

DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SANTA CRUZ ISLAND (CONTINUATION).

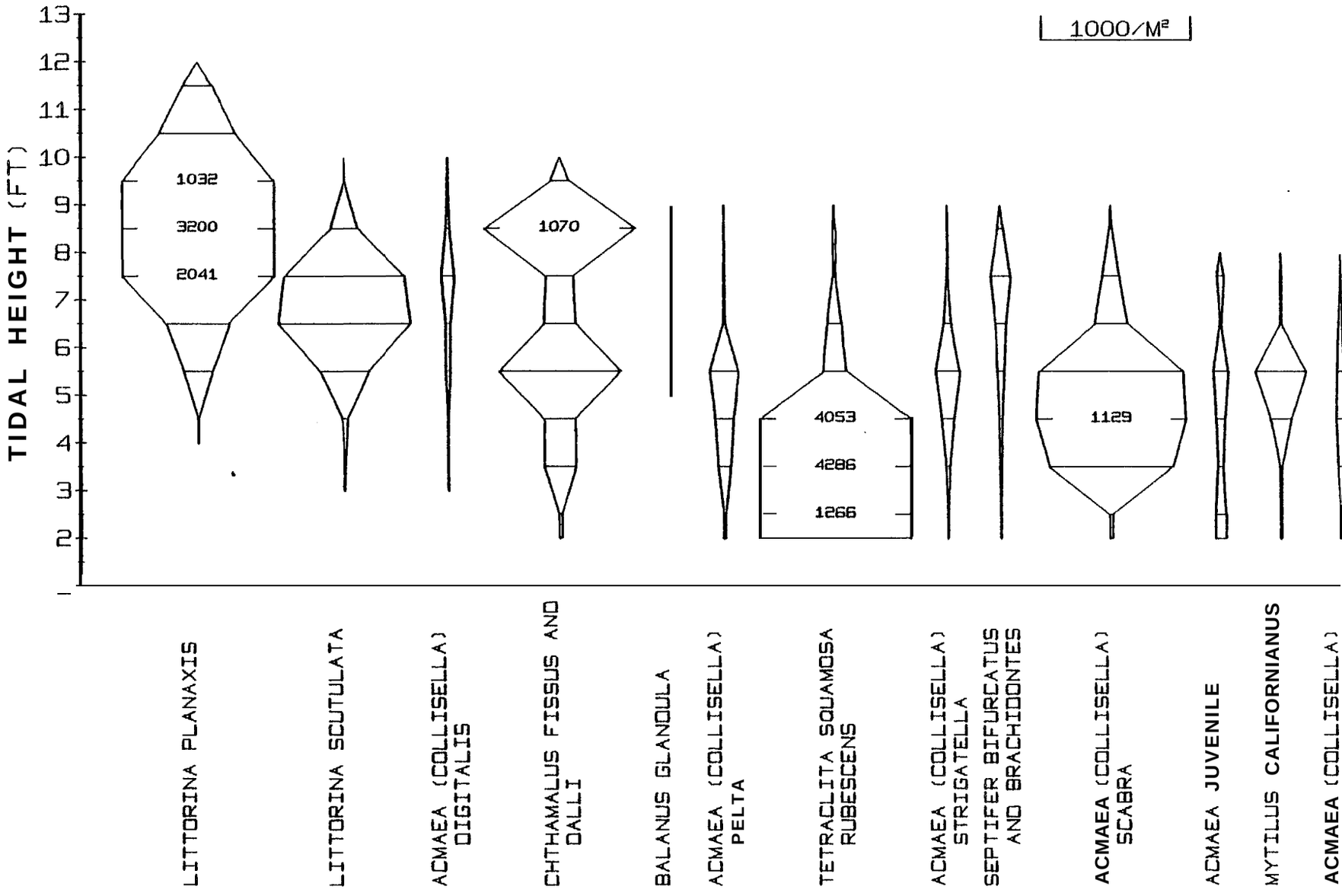


FIGURE 1.1.9-12. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SANTA CRUZ ISLAND (CONTINUED

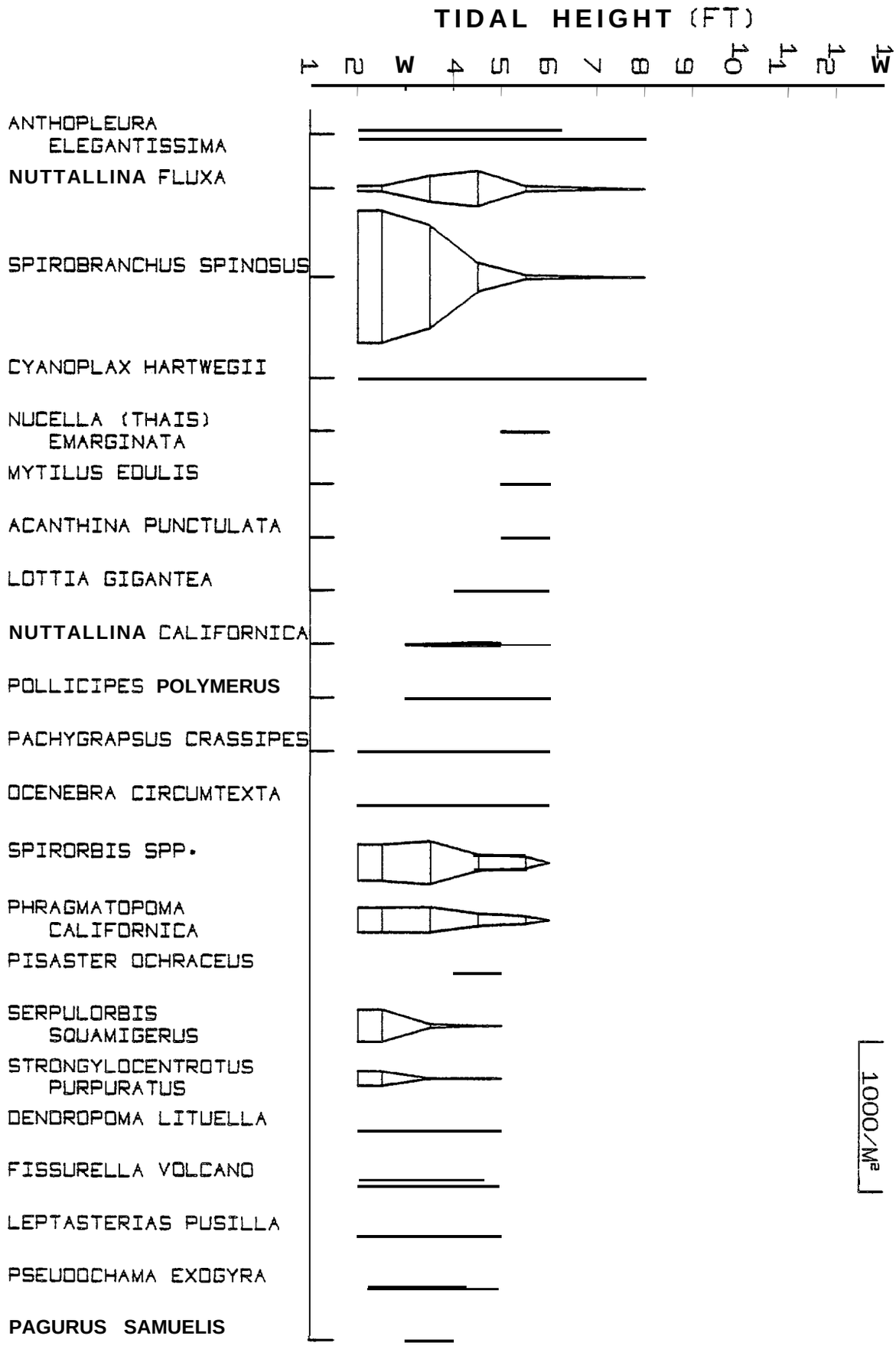


FIGURE 1.1.9-12. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SANTA CRUZ ISLAND (CONTINUED).

FIGURE 1.1 9-12. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SANTA CRUZ ISLAND (CONTINUATION).

FIGURE .1.9-13. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA CRUZ ISLAND (CONTINUED).

FIGURE 1.1.9-13. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA CRUZ ISLAND CONTINUED.

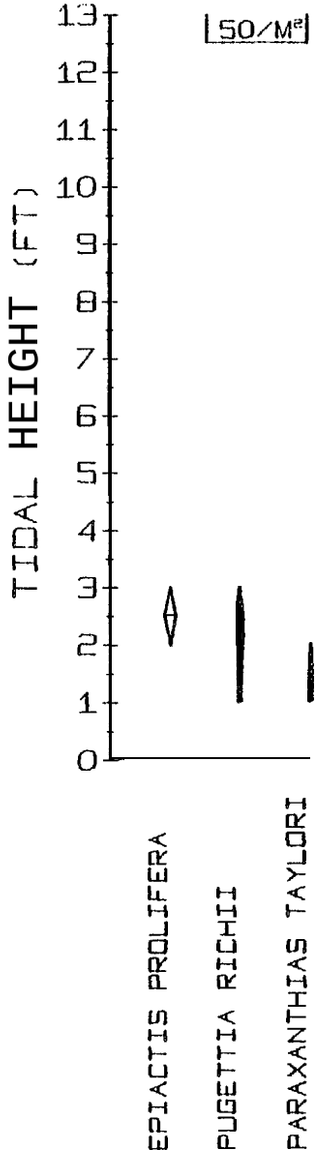


FIGURE 1.1.9-13. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA CRUZ ISLAND (CONTINUATION).

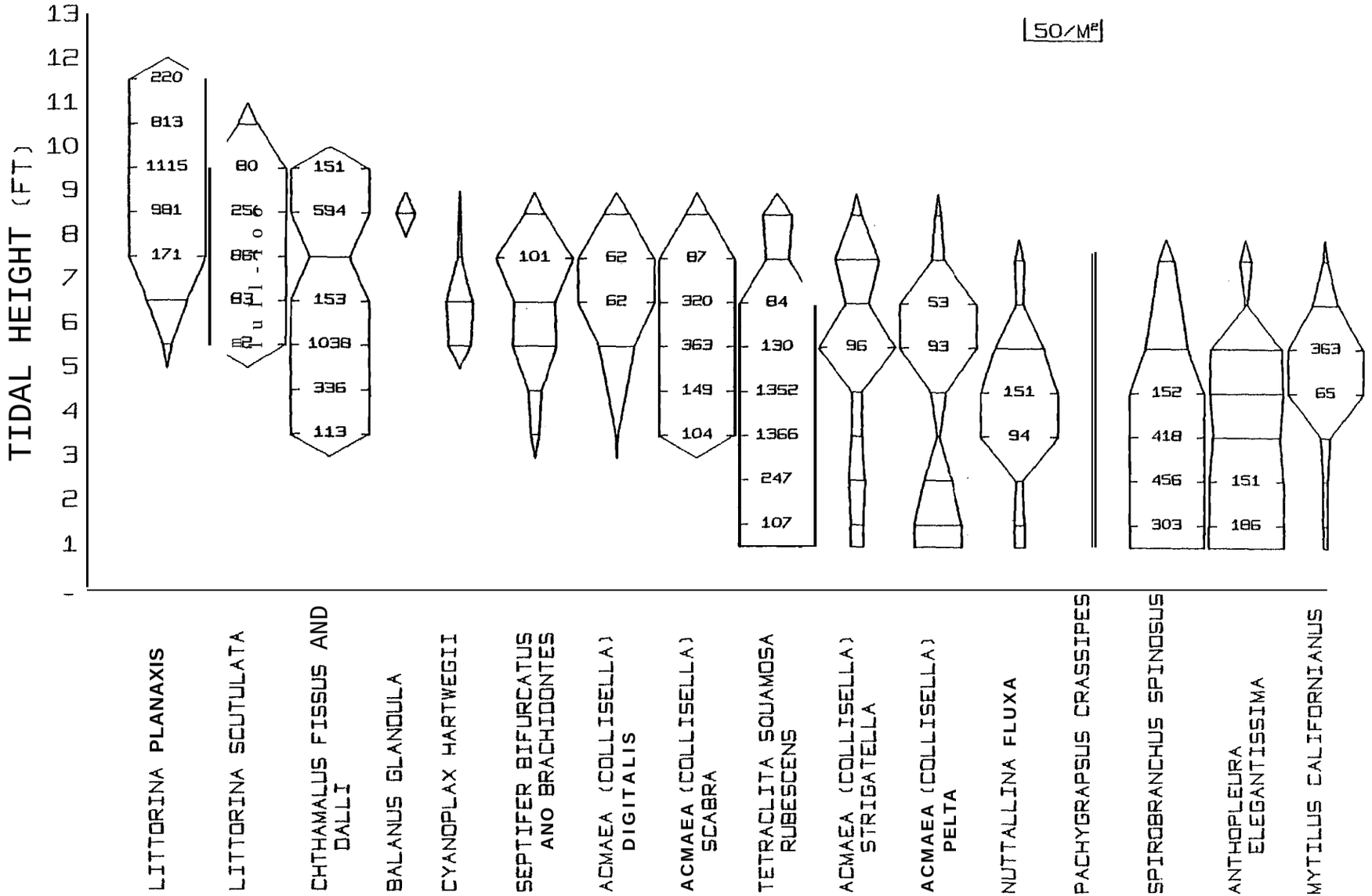


FIGURE 1.1.9-14. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA CRUZ ISLAND (CONTINUED).

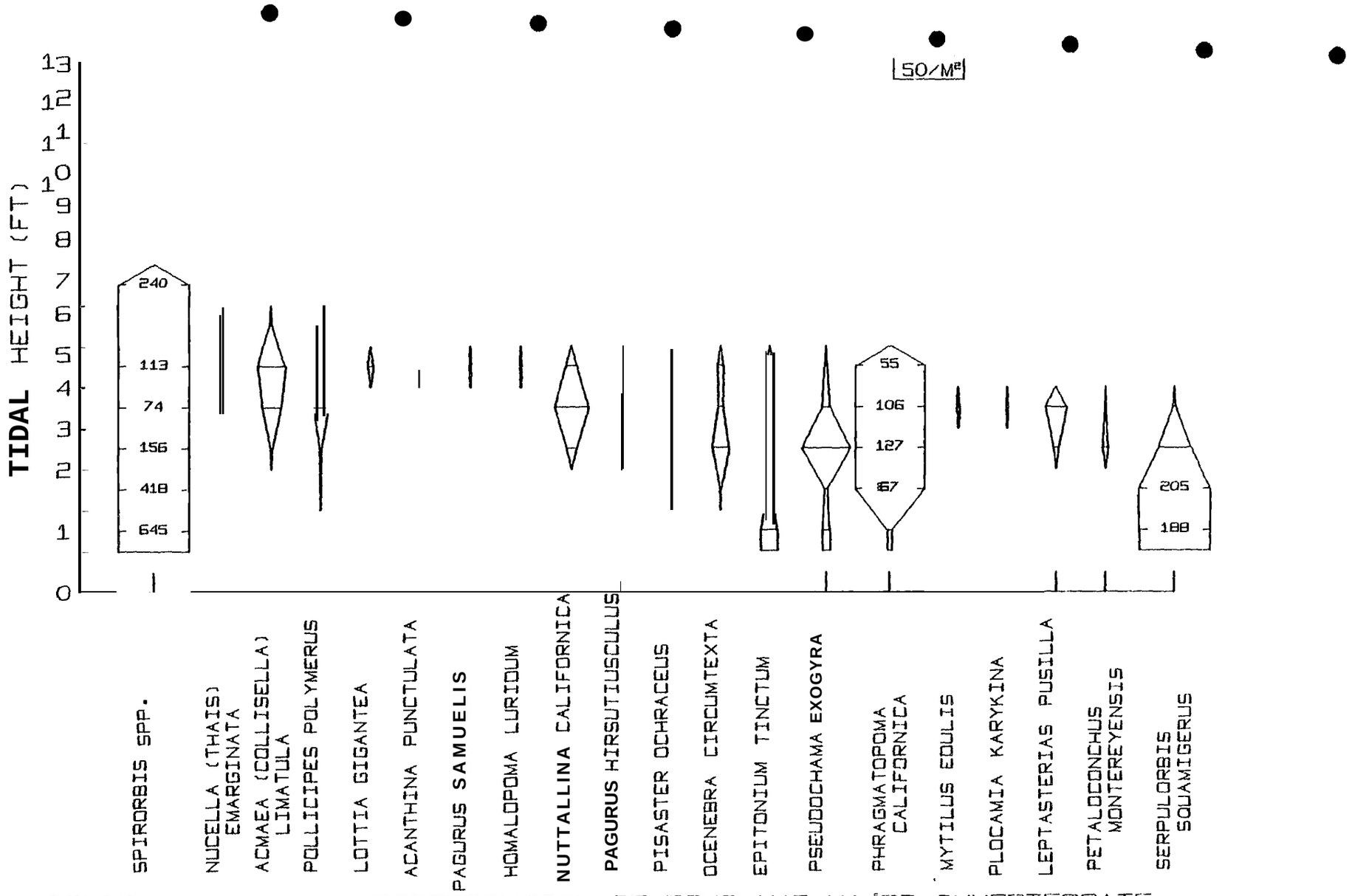


FIGURE 1.1.9-14. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA CRUZ ISLAND (CONTINUED).

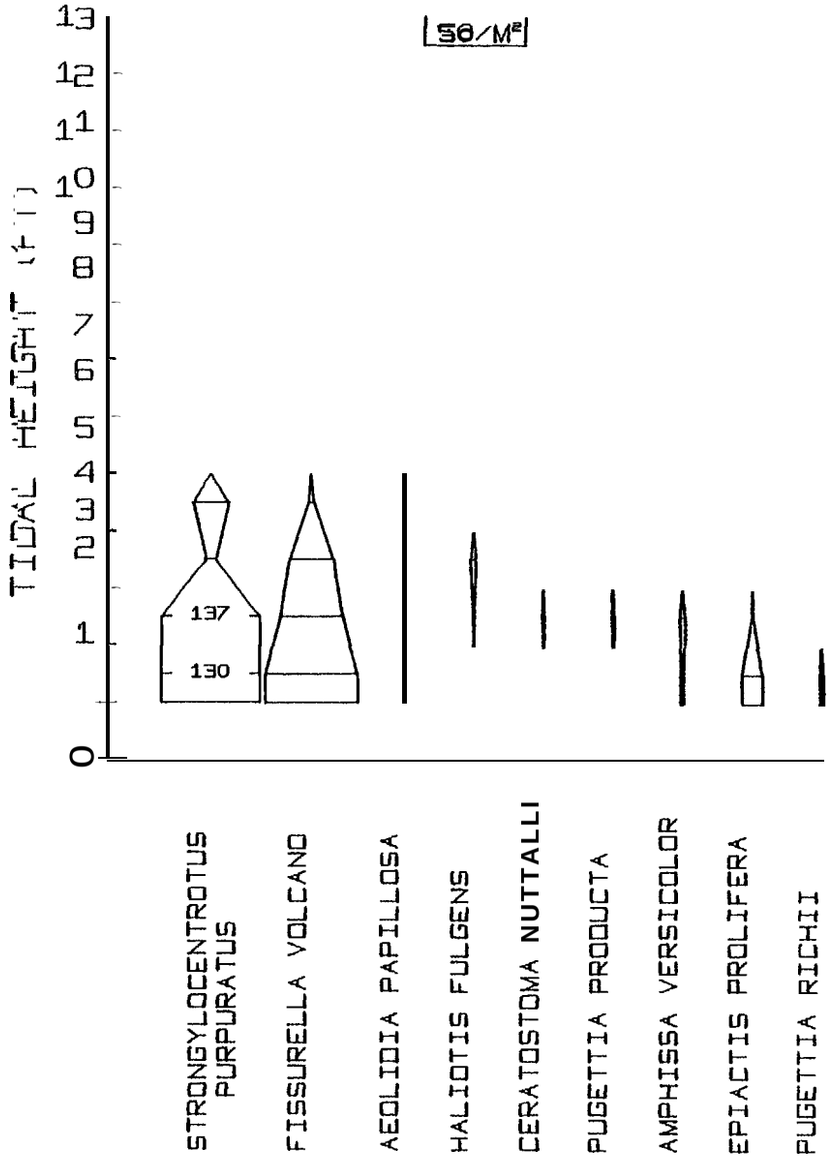


FIGURE 1.1.9-14. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA CRUZ ISLAND (CONTINUATION).

FIGURE 1.1.9-15. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SANTA CRUZ ISLAND (CONTINUED).

FIGURE 1.1.9-15. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SANTA CRUZ ISLAND (CONTINUED).

E 1,1,9-15.

DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SANTA CRUZ ISLAND (CONTINUATION).

FIGURE 1.1.9-16. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SANTA CRUZ ISLAND (CONTINUED).

FIG. 1.9-16. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SANTA CRUZ ISLAND (CONTINUED).

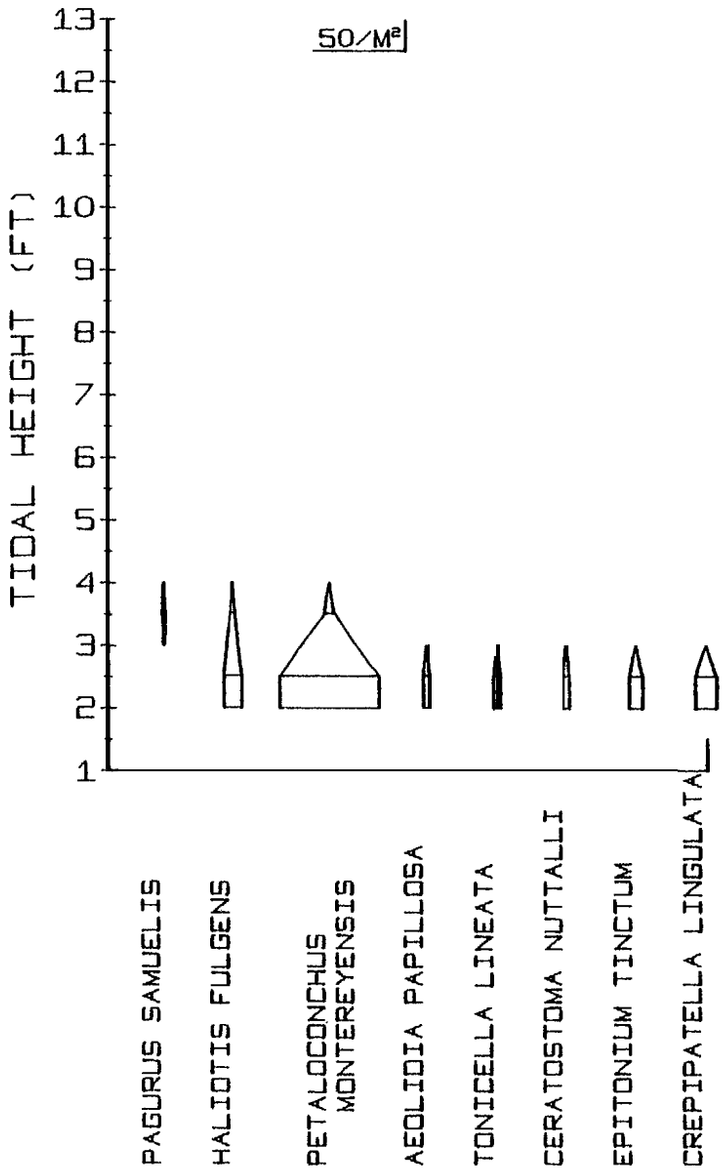


FIGURE 1.1.9-16. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SANTA CRUZ ISLAND (CONTINUATION).

TABLE 1.1.9-11. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM WILLOWS ANCHORAGE, SANTA CRUZ ISLAND FROM OCTOBER 1975 TO OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT.) 1.0 TO 1.9 (N= 6)	2.0 TO 2.9 (N= 6)	3.0 TO 3.9 (N= 7	4.0 TO 4.9 (N= 4)	5.0 TO 5.9 (N=17)	6.0 TO 6.9 N= 0	7.0 TO 7.9 (N=12)	8.0 TO 8.9 (N= 5	9.0 TO 9.9 (N = 3	MEAN
ENDOCLADIA MURICATA				4.6	21.4		254.9	13.6		36.6
PORPHYRA PERFORATA	0.5	<0.1		225.5	0.3			0.2		25.3
PTEROSIPHONIA BIPINNATA	22.0	3.0	13.2					<0.1		4.8
CORALLINA OFFICINALIS VAR. CHILENSIS	51.1	199.8	617.4	54.1	158.6		<0.1	<0.1		157.1
POLYSIPHONIA HENDRYI VAR HENDRYI		0.1	<0.1	<0.1	<0.1		10.1			1.3
PELVETIA FASTIGIATA		0.6	55.6	1040.5	886.0		<0.1			240.1
SCYTOSIPHON LOMENTARIA		1.8					<0.1			0.2
ULVA CALIFORNICA	3.2	5.1	12.6	51.4	66.5		<0.1			17.4
DESMAROPHYCUS HARVEYANUS					56.7					7.1
CYLINDROCARPUS RUGOSUS		3.3	3.2		7.6					1.6
ULVA SP.		0.2			1.5					0.3
PLOCAMIUM COLUMBIANA		<0.1	3.7		1.8					0.7
GIGARTINA CANALICULATA	5.8	3.2	164.8	0.1	3.1					24.6
CORALLINA VANCOUVERIENSIS	10.7	20.4	493.3	11.4	69.0					75.5
LAURENCIA PACIFICA	17.3	169.3	38.2		<0.1					28.1
LAURENCIA CAUDELLA	38.1	293.2	216.4		0.6					68.5
ECTOCARPACEAE	1.2	<0.1	<0.1	2.5	<0.1					0.5
GELIDIUM PUSILLUM	8.0		2.7	11.1	0.1					2.7
GELIDIUM COULTERI	52.3	166.7	181.3		2.0					50.2
CRYPTOPLEURA CRISPA	39.3	20.5	<0.1		<0.1					7.5
LITHOTHRIX ASPERGILLUM	<0.1		2.4		0.9					0.4
COLPOMENIA SINUOSA	0.1	3.4	0.6	0.2	1.3					0.7

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.9- . WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM WILLOWS ANCHORAGE, SANTA CRUZ ISLAND FROM OCTOBER 1975 TO OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED).

TAXA	TIDAL HEIGHT FT. 1.0 TO 1.9 (N= 6)	2.0 TO 2.9 (N= 6)	3.0 TO 3.9 (N= 7)	4.0 TO 4.9 (N= 4)	5.0 TO 5.9 (N=17)	6.0 TO 6.9 (N= 0)	7.0 TO 7.9 (N=12)	8.0 TO 8.9 (N= 5)	9.0 TO 9.9 (N= 3)	MEAN
PLOCAMIUM VIOLACEUM	0.3		2.2		0.1					0.3
CALLIARTHRON TUBERCULOSUM	62.4	8.9			<0.1					8.9
MICROCLADIA COULTERI	3.7			0.4	<0.1					0.5
CRYPTOPLEURA CORALLINARA	181.0	26.1	2.4		<0.1					26.2
ENTEROMORPHA FLEXUOSA	0.1			1.0	<0.1					0.1
POLYSIPHONIA SPP.	0.4	5.8	2.6		1.4					1.3
RHODOGLOSSUM AFFINE	4.3	12.1	28.8	14.8	15.5					9.4
CERAMIUM VISCAINOENSE	3.3	0.8	0.3		<0.1					0.6
CERAMIUM EATONIANUM/SINICOLA	1.9	0.3	0.4		<0.1					0.3
GIGARTINA SPINOSA	98.9	8.7		0.8	0.6					13.6
HETEROSIPHONIA VERTICILLATA	90.4	57.6	7.0		1.4					19.5
ERYTHROCYSTIS SACCATA		3.9	<0.1							0.5
EGREGIA MENZIESII		190.4	621.4							101.5
CODIUM FRAGILE		41.1	72.2							14.2
MALIOMYS DIGITA	1958.5	657.3	6.0							326.7
LAURENCIA SPECTABILIS	66.4	19.1	0.5							10.8
PTEROSIPHONIA BAILEYI	32.8	74.7	33.0							17.8
MACROCYSTIS PYRIFERA	0.3	0.3	3.5							0.5
GASTROCLONIUM COULTERI	31.3	<0.1	33.1							5.0
CERAMIUM SPP.	0.8	<0.1	1.8							0.3
PACHYDICTYON CORIACEUM	7.3	98.0	7.1							14.0
DICTYOTA FLABELLATA	1.8	11.7	1.4							1.9

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.9-11. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM WILLOWS ANCHORAGE, SANTA CRUZ ISLAND FROM OCTOBER 1975 TO OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (ft) 1.0 TO 1.9 (N= 6)	2.0 TO 2.9 (N= 6)	3.0 TO 3.9 (N= 7)	4.0 TO 4.9 (N= 4)	5.0 TO 5.9 (N=17)	6.0 TO 6.9 (N= 0)	7.0 TO 7.9 (N=12)	8.0 TO 8.9 (N= 5)	9.0 TO 9.9 (N= 3)	MEAN
CERAMIUM CODICOLA		9.5								1.2
FRIABILITIS LANCEOLATA		5.6								0.7
PHYLLOSPADIX SCOULERI		1.8								0.2
CRYPTOPLEURA LOBULIFERA		5.2								0.7
HERPOSIPHONIA PLUMULA		96.8								12.3
POSSIELLA ORBIGNIANA SSP. DICHOTOMA	36.7	17.2								6.7
GIGARTINA PAPILLATA	20.1	2.5								4.6
PTILOCLADIA CAPILLACEA	9.1	<0.1								1.1
FIDELIA ARBOREA	48.3	0.2								6.1
GRATELOUPIA DORYPHORA	4.7	0.7								0.7
CYSTOSEIRA OSMUNDACEA	14.0	5.6								2.4
HYPNEA HYPNOIDES	3.2									0.4
HERPOSIPHONIA LITTORALIS	1.9									0.2
FRIABILITIS CORNEA	10.2									1.3
OTHER MACROPHYTES (24)	0.2	0.7	0.1	0.0	0.7		0.0			
TOTAL WET WEIGHT IN G/M2	2935.8	2254.5	2649.4	1418.4	1283.6		265.1	13.8		

NOTE: 1 FOOT = 30.3048 METERS

Table 1.1.9-12. Organic Dry Weight in g/m^2 for Dominant Macrophytes from Willows Anchorage, Santa Cruz Island from October 1975 to October 1976. Species with ash-free dry weights are indicated by an asterisk (* . Blank spaces indicate zeros.

Taxa	Tidal Height (ft 1.0 to 1.9 (N= 6)	2.0 to 2.9 (N= 6)	3.0 to 3.9 (N= 7)	4.0 to 4.9 (N= 4)	5.0 to 5.9 (N=17	6.0 to 6.9 (N= 0)	7.0 to 7.9 (N=12)	8.0 to 8.9 (N= 5)	9.0 to 9.9 (N= 3)	Mean
Endocladia muricata				0.5	2.9		46.9	1.7		6.5
Porphyra perforata	<0.1	0.1		23.7	<0.1			<0.1		3.0
Pterosiphonia dendroidea	1.8	0.2	1.3					<0.1		0.4
Corallina officinalis var. chilensis*	2.2	10.3	44.7	2.5	7.5		<0.1	<0.1		7.5
Polysiphonia hendryi var hendryi		<0.1	<0.1	<0.1	<0.1		0.9			0.1
Pelvetia fastigiata		0.3	18.5	334.7	262.3		0.1			77.0
Ulva californica	0.3	0.3	1.4	4.5	6.2		0.1			1.6
Hesperophycus harveyanus					8.0					1.0
Cylindrocarpus rugosus		0.8	0.5		0.9					0.3
Ulva sp.		<0.1			0.9					0.1
Gigartina canaliculata	0.5	0.5	32.3	<0.1	0.5					4.2
Corallina vancouveriensis*	0.4	0.9	27.3	0.6	3.6					3.6
Laurencia pacifica	1.0	11.8	3.9		<0.1					2.1
Laurencia lajolla	2.4	19.2	22.4		<0.1					5.5
Gelidium pusillum	0.9		0.5	2.2	<0.1					0.5
Gelidium coulteri	7.3	30.8	39.4		0.2					9.7
Cryptopleura crispa	2.4	1.6	<0.1		<0.1					0.5
Lithothrix aspergillum*	<0.1		0.1		<0.1					<0.1
Calliarthron tuberculosum*	4.6	0.7			<0.1					0.6

Table 1.1.9-12. Organic Dry Weight in g/m^2 for Dominant Macrophytes from Willows Anchorage, Santa Cruz Island from October 1975 to October 1976. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros. (Continued).

Taxa	Tidal Height (ft) 1.0 to 1.9 (N= 6)	2.0 to 2.9 (N= 6)	3.0 to 3.9 (N= 7)	4.0 to 4.9 (N= 4)	5.0 to 5.9 (N=17)	6.0 to 6.9 N= 0)	7.0 to 7.9 (N=12)	8.0 to 8.9 (N= 5)	9.0 to 9.9 (N= 3)	Mean
Cryptopleura corallinara	16.3	2.2	0.4		<0.1					2.4
Polysiphonia spp.	<0.1	1.6	0.3		<0.1					0.2
Rhodoglossum affine	0.5	1.5	4.3	2.0	2.4					1.3
Herposiphonia verticillata	8.7	5.0	1.4		0.3					1.9
Gigartina spinosa	12.6	1.6		<0.1	<0.1					1.8
Egregia menziesii		29.1	86.4							14.4
Codium fragile		3.0	6.5							1.2
Halidrys dioica	432.3	104.4	0.8							67.2
Laurencia spectabilis	6.1	1.3	<0.1							0.9
Pterosiphonia baileyi	2.5	6.6	4.4							1.7
Gastroclonium coulteri	2.8	<0.1	3.1							0.7
Pachydictyon coriaceum	1.0	10.5	0.8							1.5
Dictyota flabellata	0.2	1.5	0.2							0.2
Prionitis lanceolata		1.3								0.2
Herposiphonia plumula		10.8								1.4
Bossiella orbigniana ssp. dichotoma*	2.0	0.8								0.3
Gigartina papillata	3.1	0.3								0.4
Pterocladia capillacea	1.6	<0.1								0.2
Eisenia arborea	14.0	<0.1								1.7
Grateloupia doryphora	0.8	<0.1								0.1

Table 1.1.9-.2. Organic Dry Weight in g/m^2 for Dominant Macrophytes from Willows Anchorage, Santa Cruz Island from October 1975 to October 1976. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros. (Continued).

Taxa	Tida. Height (ft) 1.0 to 1.9 (N= 6	2.0 to 2.9 (N= 6)	3.0 to 3.9 (N= 7)	4.0 to 4.9 (N= 4	5.0 to 5.9 (N=17)	6.0 to 6.9 (N= 0)	7.0 to 7.9 N=12	8.0 to 8.9 (N= 5)	9.0 to 9.9 (N= 3)	Mean
Gelidium robustum	2.1	0.7								0.3
Prionitis cornea	1.7									0.2
Other Macrophytes (41)	1.3	2.0	1.6	0.4	0.6					
Total Organic Dry Weight in g/m^2	533.7	262.3	≥2.8	371.4	297.4		48.1	2.0		227.2

Note: 1 foot = 0.3048 meters

TABLE 1.1.9-13. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM WILLOWS ANCHORAGE, SANTA CRUZ ISLAND FROM OCTOBER 1975 TO OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9 (N= 6)	2.0 TO 2.9 (N= 6)	3.0 TO 3.9 (N= 7)	4.0 TO 4.9 (N= 4)	5.0 TO 5.9 (N=17)	6.0 TO 6.9 (N= 0)	7. TO 7.9 (N=12)	8.0 TO 8.9 (N= 5)	9. TO 9.9 (N= 3)	MEAN
CHTHAMALUS FISSUS AND DALLI			<0.1	5.2	12.8		76.7	284.6	40.4	52.5
LITTORINA PLANAXIS		<0.1			0.3		27.3	35.3	9.5	9.1
ACMAEA (COLLISELLA) PELTA	1.2	0.3	1.8	9.4	21.6		0.2		<0.1	4.3
ACMAEA (COLLISELLA) DIGITALIS					0.5		3.9	3.0		0.9
LITTORINA SCUTULATA				1.0	7.8		28.2	0.1		4.6
MOPELLA (TOMIS) EMARGINATA					2.1		0.6			0.3
ACMAEA (COLLISELLA) LIMATULA			0.4	19.7	19.7		<0.1			5.0
SEPTIFER BIFURCATUS			1.3		2.3		0.5			0.5
BALANUS GLANDULA			1.1	1.1	0.9		1.0			0.5
MUTTALLINA FLUXA/CALIFORNICA	3.4	7.=	80.0	225.6	62.8		<0.1			47.4
ACMAEA (COLLISELLA) SCABRA	<0.1		0.5	52.7	9.3		2.4			0.1
MYTILUS EDULIS	5.4	3.2	6.3	1.4	9.7		0.2			3.3
CYANOPLAX HARTWEGII	0.4		1.0	2.0	14.4		<0.1			2.3
BRACHIDONTES ADAMSIANUS	0.2		4.3	12.4	11.5		7.9			4.5
MYTILUS CALIFORNIANUS	17.2	7.0	72.0	786.4	3.42.3		0.9			503.2
ACMAEA (COLLISELLA) STRIGATELLA	<0.1			<0.1	0.8		0.3			0.2
LOTTIA GIGANTEA					5.7					0.7
STELLETTA ESTRELLA					3.1					0.4
POLLICIPES POLYMERUS				67.2	20.5					11.0
CCENEBRA CIRCUMTEXTA		0.5	1.3	0.5	1.6					0.5
HALIOTIS FULGENS		0.4	0.3	0.2	1.4					0.3
MUTTALLINA FLUXA		4.6			11.3					2.0

NOTE: 1 FOOT = 0.3048 METERS

ABLE 1.1.9-13. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM WILLOWS ANCHORAGE, SANTA CRUZ ISLAND FROM OCTOBER 1975 TO OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED).

TAXA	TIDAL HEIGHT FT. 1.0 TO 1.9 (N= 6)	2.0 TO 2.9 N= 6	3.0 TO 3.9 N= 7	4.0 TO 4.9 (N= 4	5.0 TO 5.9 (=17)	6.0 TO 6.9 N= 0	7.0 TO 7.9 N=12)	8.0 TO 8.9 (N= 5)	9.0 TO 9.9 (N= 3)	MEAN
LEPTASTERIAS PUSILLA		0.7	0.6	0.4	0.2					0.2
MODIOLUS CAPAX		<0.1	0.7	2.7	0.5					0.5
PUGETTIA PRODUCTA	4.6	5.3	1.9		<0.1					1.5
LEPTASTERIAS HEXACTIS	0.8	1.4	4.4		2.8					1.2
PACHYGRAPSUS CRASSIPES	0.5	1.6	3.7	2.6	9.0					2.2
HOPALIA MUSCOSA	2.6	4.3			14.7					2.7
PSEUDOCHAMA EXOGYRA	37.7	25.7	28.8	24.6	78.2					24.4
SPIROBRANCHUS SPINOSUS	3.7		0.5	2.3	1.7					1.0
FISSURELLA VOLCANO	10.4	6.4	25.1	2.4	0.9					5.9
PAGURUS SAMUELIS	<0.1		<0.1		1.3					0.2
PHRAGMATOPOMA CALIFORNICA	14.8	0.8	1.7	4.3	18.8					5.0
HENRICIA LEVIUSCULA	1.2	0.4	0.8	0.2	<0.1					0.3
STRONGYLOCENTROTUS PURPURATUS	1872.5	777.7	417.3		1.5					383.6
ANTHOPLEURA ELEGANTISSIMA	687.6	596.7	119.9	2.0	12.7					177.6
ACANTHINA PUNCTULATA	0.4				3.3					0.5
TETRACLITA SQUAMOSA RUBESCENS	11.0	7.5	176.7	981.4	196.7					171.1
PISASTER OCHRACEUS	50.6	<0.1	10.7							7.7
PUGETTIA RICHII	195.2	0.1	0.3							24.5
TRICELLARIA SPP.	23.6	0.7								3.6
SERPULORBIS SQUAMIGERUS	714.2	254.6								121.1
HOPALIA PORIFERA	0.9	0.2								0.1
CANCER ANTENNARIUS	2.7	2.7								0.7

NOTE: 1 FOOT = 0.3048 METERS

TABLE 11.9-W. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM WILLOWS ANCHORAGE, SANTA CRUZ ISLAND FROM OCTOBER 1975 TO OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9 (N= 6)	2.0 TO 2.9 (N= 6)	3.0 TO 3.9 (N= 7)	4.0 TO 4.9 (N= 4)	5.0 TO 5.9 (N=17)	6.0 TO 6.9 (N= 0)	7.0 TO 7.9 (N=12)	8.0 TO 8.9 (N= 5)	9.0 TO 9.9 N= 3	MEAN
TOMICELLA LINEATA	1.2	0.9								0.3
BALANUS TINTINNABULUM CALIFORNICUS	1.3	<0.1								0.2
HEMIGRAPSUS NUDUS	55.1	6.7								7.7
LOPHOPANOPEUS BELLUS	14.9	2.5								2.6
PETALOCOLCHUS MONTEREYENSIS	0.6	11.3								1.5
HALICLONA SP.C	4.7									0.6
EUDENTIA GRACILIS	1.4									0.2
HIPPOMIX TUMENS	3.2									0.4
LEUCANDRA HEATHI	1.7									0.2
MORRISIA MORRISI	1.2									0.2
CREPIDATELLA LINGULATA	1.4									0.2
CERATOSTOMA NUTTALLI	2.6									0.3
OTHER MACRO-INVERTEBRATES (29)	1.5	1.6	0.0	0.9	1.9		0.0			
TOTAL WET WEIGHT IN G/M2	3753.3	1737.6	966.4	2209.8	3700.4		156.3	325.0	50.0	

NOTE 1 FOOT = 0.3048 METERS

Table 1.1.3-14. Organic Dry Weight in g/m^2 for Dominant Macroinvertebrates from Willows Anchorage, Santa Cruz Island from October 1975 to October 1976. Species with ash-free weights are indicated by an asterisk (*). Blank spaces indicate zeros.

Taxa	Tidal Height (ft) 1.0 to 1.9 (N= 6)	2.0 to 2.9 (N= 6)	3.0 to 3.9 (N= 7)	4.0 to 4.9 (N= 4)	5.0 to 5.9 (N=17)	6.0 to 6.9 (N= 0)	7.0 to 7.9 (N=12)	8.0 to 8.9 (N= 5	9.0 to 9.9 (N= 3)	Mean
Chthamalus fissus and dalli*			<0.1	0.2	0.6		4.0	16.2	3.1	3.0
Littorina planaxis*		<0.1			<0.1		1.2	1.4	0.6	0.4
Acmaea (Collisella) pelta*	0.1	<0.1	0.2	0.8	2.2		<0.1		<0.1	0.4
Acmaea (Collisella) digitalis*					<0.1		0.2	0.2		0.1
Littorina scutulata*				0.1	0.4		1.4	0.1		0.2
Nucella (Thais) emarginata*					0.1		<0.1			<0.1
Acmaea (Collisella) limatula*			<0.1	1.5	1.8		<0.1			0.4
Septifer bifurcatus*			0.1		0.2		<0.1			<0.1
Balanus glandula*			0.1	0.1	0.1		0.1			<0.1
Nuttallina fluxa/californica*	0.4	0.7	8.6	21.8	6.7		<0.1			4.8
Mytilus edulis*	0.3	0.2	0.3	0.1	0.5		<0.1			0.2
Mytilus californianus*	0.9	0.4	3.2	45.6	184.3		<0.1			26.1
Acmaea (Collisella) scabra*	0.1		<0.1	2.8	0.5		0.1			0.4
Brachidontes adamsianus*	0.1		0.3	0.9	0.8		0.5			0.3
Cyanoplax hartwegii*	0.1		0.1	0.3	1.6		<0.1			<0.2
Lottia gigantea*					0.3					<0.1
Stelletta estrella					0.9					0.1
Pollicipes polymerus*				7.4	2.2					1.1
Nuttallina fluxa*		0.5			1.3					0.2
Ocenebra circumtexta*		<0.1	0.1	<0.1	0.1					<0.1
Haliotis fulgens*		<0.1	<0.1	<0.1	0.2					0.1

Table 1. .9-1e. Organic Dry Weight in g/m^2 for Dominant Macroinvertebrates from Willows Anchorage, Santa Cruz Island from October 1975 to October 1976. Species with ash-free weights are indicated by an asterisk (*). Blank spaces indicate zeros. (Continued).

Taxa	Tidal Height (ft 1.0 to 1.9 (N= 6)	2.0 to 2.9 (N= 6)	3.0 to 3.9 N= 7)	4.0 to 4.9 N= 4)	5.0 to 5.9 (N=17	6.0 to 6.9 (N= 0)	7.0 to 7.9 (N=12)	8.0 to 8.9 (N= 5)	9.0 to 9.9 (N= 3)	Mean
Modiolus capax*		<0.1	<0.1	0.1	<0.1					<0.1
Leptasterias pusilla*		0.2	0.1	<0.1	<0.1					0.1
Pseudochama exogyra*	1.5	1.0	1.2	0.8	3.0					0.8
Pugettia producta*	0.6	0.7	0.4		<0.1					0.2
Leptasterias hexactis*	0.1	0.2	0.5		0.3					0.1
Pachygrapsus crassipes*	<0.1	0.6	0.9	0.3	1.2					0.3
Mopalia muscosa*	0.3	0.6			1.6					0.3
Anthopleura elegantissima*	112.7	76.0	17.7	0.3	1.8					23.2
Spirobranchus spinosus*	0.1		<0.1	0.1	0.1					<0.1
Fissurella volcano*	0.9	0.7	2.1	0.2	0.1					0.4
Phragmatopoma californica*	0.5	<0.1	<0.1	0.2	0.6					0.2
Henricia leviuscula*	0.2	0.1	0.1	<0.1	<0.1					0.1
Strongylocentrotus purpuratus*	78.7	31.0	16.9		0.1					15.8
Acanthina punctulata*	<0.1				0.2					<0.1
Tetraclita squamosa rubescens*	0.5	0.4	7.8	42.4	8.7					7.5
Pugettia richii*	68.5	<0.1	<0.1							8.6
Pisaster ochraceus*	5.7	<0.1	1.4							0.8
Tricellaria spp.	4.2	<0.1								0.5
Cancer antennarius*	0.4	0.3								0.1
Serpulorbis squamigerus*	53.9	14.5								8.6
Tonicella lineata*	0.2	0.1								<0.1
Hinnites multirugosus *	3.1	0.4								0.4

Table 1.1.9-14. Organic Dry Weight in g/m^2 for Dominant Macroinvertebrates from Willows Anchorage, Santa Cruz Island from October 1975 to October 1976. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros. (Continued).

Taxa	Tidal Height (ft) 1.0 to 1.9 (N= 6)	2.0 to 2.9 (N= 6)	3.0 to 3.9 (N= 7)	4.0 to 4.9 (N= 4)	5.0 to 5.9 (N=17)	6.0 to 6.9 (N= 9)	7.0 to 7.9 (N=12)	8.0 to 8.9 (N= 5)	9.0 to 9.9 (N= 3)	Mean
Petaloconchus montereyensis*	<0.1	0.8								0.1
Lophopanopeus bellus*	2.3	0.3								0.3
Hipponix tumens*	0.1									<0.1
Norrisia norrisi*	0.1									<0.1
Crepipatella lingulata*	0.1									<0.1
Ceratostoma nuttalli*	000									<0.1
Other Macroinvertebrates (36)	9.2	1.0	0.1	0.4	1.5		0.1			
Total Organic Dry Weight in g/m^2	340.0	131.6	63.6	126.8	224.6		8.4	17.9	3.8	114.6

Note: 1 foot = 0.3048 meters

TABLE 1.1.9-15. ANNUAL MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR TIDEPOOLS AT SANTA CRUZ ISLAND DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS.

TAXA	TIDAL HEIGHT (FT). 2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9
HALIDRYS DIOICA				5.5
PHYLLOSPADIX SCOULERI				2.4
CLADOPHORA COLUMBIANA				2.3
LITHOPHYLLUM PROBOSCIDEUM	56.0			36.1
ULVA CALIFORNICA	<0.1			14.2
CORALLINA VANCOUVERIENSIS	0.9			<0.1
CYLINDROCARPUS RUGOSUS	<0.1			1.0
LITHOTHRIX ASPERGILLUM	7.9			16.7
CORALLINA OFFICINALIS VAR. CHILENSIS	7.6			6.3
BLUE-GREEN ALGAE	5.0			12.5
RALFSIA SP.	1.3			2.0
GELIDIUM PURPURASCENS	0.8			
COLPOMENIA SINUOSA	0.4			
GELIDIUM COULTERI	0.3			
CHONDRIA CALIFORNICA	0.2			
PACHYDICTYON CORIACEUM	3.7			
GASTROCLONIUM COULTERI	<0.1			
LAURENCIA MASONII	0.5			

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.9-16. ANNUAL MEAN COVER (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR TIDEPOOLS AT SANTA CRUZ ISLAND DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES, BLANK SPACES INDICATE ZEROS.

TAXA	TIDAL HEIGHT (FT), 2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9
TEGULA FUNEBRALIS				0.6
NUTTALLINA FLUXA				0.3
ACMAEA (COLLISELLA) LIMATULA	1.2			1.1
TETRACLITA SQUAMOSA RUBESCENS	0.3			0.2
ANTHOPLEURA ELEGANTISSIMA	9.8			5.3
STRONGYLOCENTROTUS PURPURATUS	7.9			1.2
PHRAGMATOPOMA CALIFORNICA	5.7			2.2
SPIROBRANCHUS SPINOSUS	0.3			0.8
DENDROPOMA LITUELLA	0.4			
SERPULORB S SQUAMIGERUS	1.3			

NOTE: 1 FOOT = 0.3048 METERS

cover *(5.6%).* Phragmatopoma californica more than doubled in cover between *1975-76* and 1976-77 from 2.7 to 5.7%. In the high pool A. elegantissima was the dominant cover macroinvertebrate during 1975-76 (3.1%) and 1976-77 (5.3%). Other species were not of importance as cover organisms.

Densities of the macroinvertebrates in the two pools are summarized in Table 1.1.9-17. The most numerous species in the mid-pool were Phragmatopoma californica (283/m^2), Acmaea (Collisella) limatula (141/m^2), and Strongylocentrotus purpuratus (105/m^2). These data compare favorably with those for 1975-76, although Spirorbis spp. declined noticeably from 187/m^2 to 26/m^2 in 1976-77. In the high pool, high numbers (255/m^2) of juvenile Acamea were recorded in 1976-77, while such recruitment was not observed in 1975-76 in this pool. Spirorbis spp. was highly abundant both years. Spirobranchus spinosus increased in the high pool noticeably from 33/m^2 to 173/m^2 in 1976-77.

1. 1.9.4.3.2 Tidepool Finfishes

The mid- (+2.0 ft., +.6 m) and high (+3.4 ft., +1.0 m) fish pools sampled quantitatively in 1975-76 were sampled in the same manner (see Seapy and Littler, 1977) in 1976-77. Species composition and proportionate abundances were basically unchanged. The most abundant species during each quarterly visit was Clinocottus analis, followed by Girella nigricans. Three species were captured during 1976-77 that were not collected in 1975-76, and included Gibbonsia elegans, Hermosilla azurea, and Hypsoblennius gilberti.

1.1.9.4.4 Community Analysis

1. 1.9.4.4.1 Species Diversity

Patterns of seasonal and annual diversity (Table 1.1.9-18) differed somewhat from 1975-76. Total numbers of macrophyte and macroinvertebrate taxa were higher in 1975-76 (104 vs. 94), as were the values for Margalef's (1968) richness index (23.52 vs. 19.67), the Shannon-Weaver (1949) measure (2.61 vs. 2.18), and Pielou's (1969) index of evenness (0.56 vs. *0.48).* Similar trends are shown for the macrophytes treated separately, but not for the macroinvertebrates in terms of the Shannon-Weaver index (2.30 vs. 2.48) and evenness index (0.59 vs. 0.65). During both the 1975-76 and 1976-77 sampling periods, the greatest number of taxa were recorded in February (114 and 103), although highest H′ and J′ values were obtained in both years during October. These diversity patterns basically reflect the seasonal and annual differences discussed in the floristic and faunistic section (1.1.9.4.1) of this report.

TABLE 1.1.9-17. ANNUAL MEAN DENSITY (NO./M2) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TICAL HEIGHT FOR TIDEPOOLS AT SANTA CRUZ ISLAND DURING 1976/1977, DATA REFLECT THE AVERAGES OF SEASONAL VALUES, BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT), 2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9
CYANOPLAX HARTWEGI I				3
TEGULA FUNEBRALIS				13
MYTILUS CALIFORNIANUS				22
NUTTALLINA FLUXA				26
NUTTALLINA CALIFORNICA				5
OCENEBRA CIRCUMTEXTA				6
LEPTASTERIAS HEXACTIS				2
LITTORINA SCUTULATA				77
NUCELLA (THAIS) EMARGINATA				2
EPITONIUM TINCTUM				7
PAGURUS SAMUELIS				2
LEPTASTERIAS PUSILLA				11
SEPTIFER BIFURCATUS AND BRACHIDONTES				5
ACMAEA (COLLISELLA) STRIGATELLA				13
MOPALIA MUSCOSA				2
LITTORINA PLANAXIS				2
ACMAEA (COLLISELLA) LIMATULA	141			97
ACMAEA (COLLISELLA) PELTA	30			58
PACHYGRAPSUS CRASSIPES	5			10
TETRACLITA SQUAMOSA RUBESCENS	66			28
ANTHOPLEURA ELEGANTISSIMA	96			02
FISSURELLA VOLCANO	17			15
HALIOTIS FULGENS	3			7
STRONGYLOCENTROTUS PURPURATUS	105			30

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.9-17. ANNUAL MEAN DENSITY ($NO./M_2$) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR TIDEPOOLS AT SANTA CRUZ ISLAND DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). 2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9
CHITHAMALUS FISSUS AND DALLI	2			10
ACMAEA (COLLISELLA) SCABRA	10			73
ACMAEA JUVENILE	68			255
PHRAGMATOPOMA CALIFORNICA	283			148
SPIROBRANCHUS SPINOSUS	26			173
SPIRORBIS SPP.	40			2010
DENDROPOMA LITUELLA	77			
DORIOPSILLA ALBOPUNCTATA	2			
SERPULORBIS SQUAMIGERUS	82			
HALIOTIS CRACHERODII	3			

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.9-18. SEASONAL AND ANNUAL DIVERSITY FOR SANTA CRUZ ISLAND.

GROUPS AND DATES	NO. TAXA	COVER (%) D'	COVER (%) H'	COVER (%) J'	DENSITY (NO./M2) D'	DENSITY (NO./M2) H'	DENSITY (NO./M2) J'
MACRO-INVERTEBRATES							
OCT. 1976	41	17.48	2.45	0.66	5.52	2.47	0.66
DEC. 1976	45	18.26	2.41	0.63	5.98	2.49	0.66
FEB. 1977	51	20.85	2.58	0.66	6.52	2.50	0.64
MAY 1977	43	16.71	2.48	0.66	5.26	2.19	0.58
MEAN	45	18.83	2.48	0.65	5.82	2.41	0.63
MACROPHYTES							
OCT. 1976	53	11.28	2.12	0.53	- -	- -	- -
DEC. 2976	46	10.25	1.87	0.48	- -	- -	- -
FEB. 1977 "	52	11.05	1.75	0.44	- -	- -	- -
MAY 1977	41	8.70	1.48	0.40	- -	- -	- -
MEAN	49	10.32	1.80	0.46			
COMBINED MACRO-INVERTEBRATES AND MACROPHYTES							
OCT. 1976	94	19.77	2.45	0.54	- -	- -	- -
DEC. 1976	93	19.60	2.25	0.50	- -	- -	- -
FEB. 1977	103	21.61	2.15	0*46	- -	- -	- -
MAY 1977	84	17. ?1	1.87	0.42	- -	- -	- -
MEAN	94	19.67	2.18	0.48			

1. 1.9.4:4.2 Species Assemblages

Cluster analyses were performed on the undisturbed quadrats from each of the quarterly visits. For purposes of comparison with the species assemblage determinations for 1975-76, the results of the cluster analysis, expressed as a dendrogram for December 1976 (Figure 1.1.9-17) will be detailed here. All quadrats, except for six, fell into a large cluster group above a correlation level of +0.70 in the dendrogram. For December 1975, all but four undisturbed quadrats were fairly evenly distributed among three large cluster groups. As a result, the general appearance of the dendrograms for December 1975 and 1976 was quite different. Within the large cluster grouping for 1976, five distinct cluster groups (labelled A to E) are evident. The individual quadrats comprising each cluster group are identified as belonging to a given cluster group or subgroup (e.g., AA, AB, AC, etc.) in Figure 1.1.9-18. The largest cluster group (A) defines an upper shore assemblage (Zone I), which ranges downward on each transect line to South 11 and North 9, which is the same distance down the shore to which Zone I extended in December 1975. There are, however, compositional changes that had taken place in Zone I in the one year period that had elapsed. In 1975, Zone I was divided into two subgroupings at South 5 and North 8. A similar subdivision is recognizable for 1976 at South 6 and North" 8. However, in 1975 Endocladia muricata contributed higher cover on the shore, and the dominants in the Zone I subgroups changed to blue-greens and Littorina planaxis, with E. muricata as a secondary species (in the upper subgroup), and blue-greens with Lithophyllum proboscideum and E. muricata describing the lower subzone of Zone I.

Zone 11 continued in December 1976 to represent a broad zone extending seaward to South 17 and North 16. In December 1975 this zone was reasonably homogeneous, being dominated by Pelvetia fastigiata, Mytilus californianus, Corallina officinalis var. chilensis, and C. vancouveriensis. In December 1976, Zone II included quadrats represented by several different cluster groups. After determining the dominant cover organisms in each quadrat and cluster group, the 'basic structure of the zone was seen to be essentially unchanged from December 1975. In the upper portion of the zone, Lithophyllum proboscideum and M. californianus were dominant cover organisms, belonging to cluster groups EA and B. Pelvetia fastigiata was of secondary importance in a number of 'quadrats in the zone, but was conspicuous in the middle of the zone at South 14 and North 13. In the lower portion of the zone, C. officinalis var. chilensis and L. proboscideum were the dominant 'cover species. Zone III, located immediately below Zone 11, comprised only three quadrats, in which C. officinalis var. chilensis and C. vancouveriensis dominated the cover. This zone was unchanged from December 1975, except for the loss of South 20 to Zone IV, due apparently to an increase in cover by Halidrys dioica and of South 17 to Zone II, due mainly to increased cover by L. proboscideum.

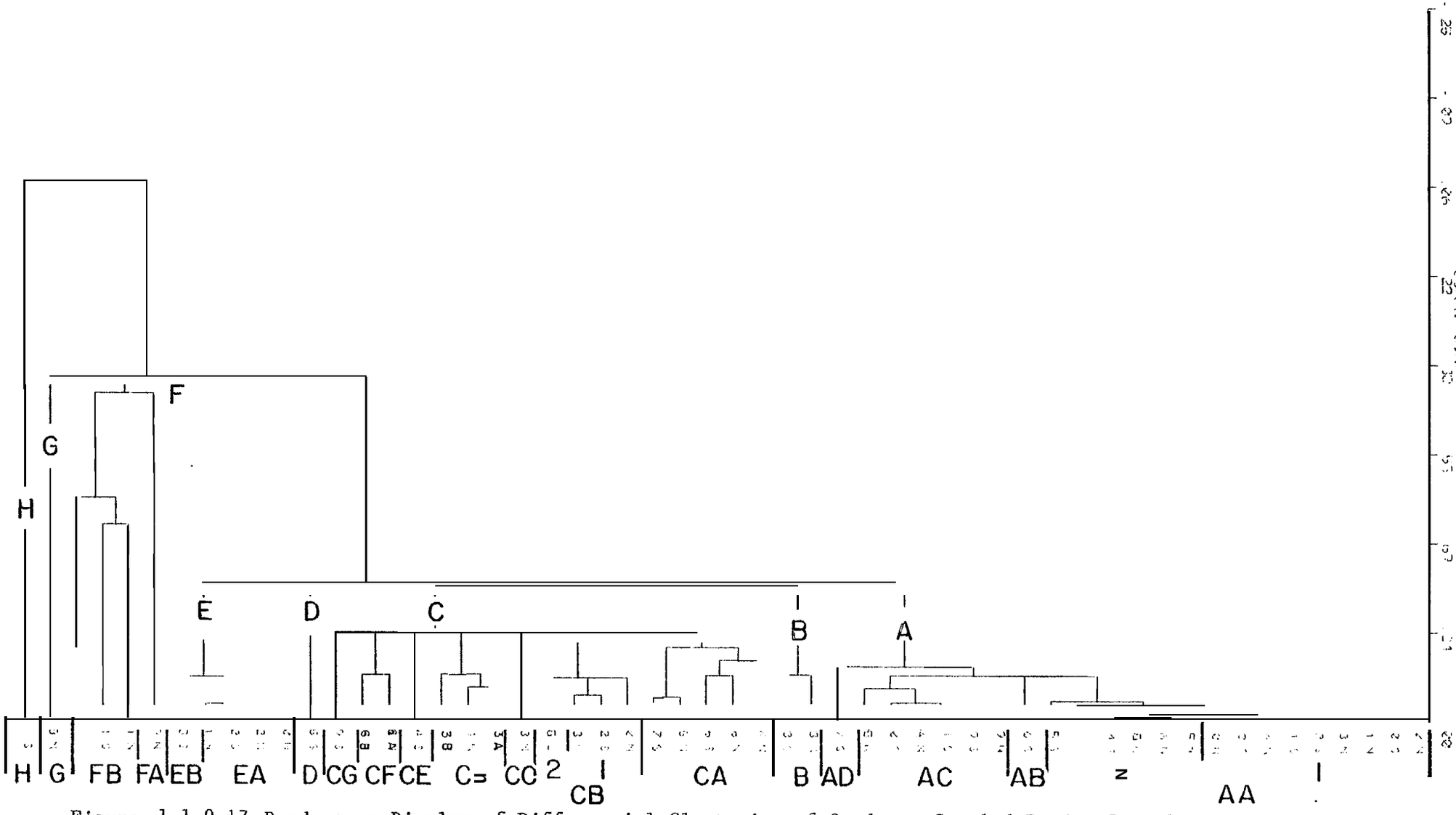
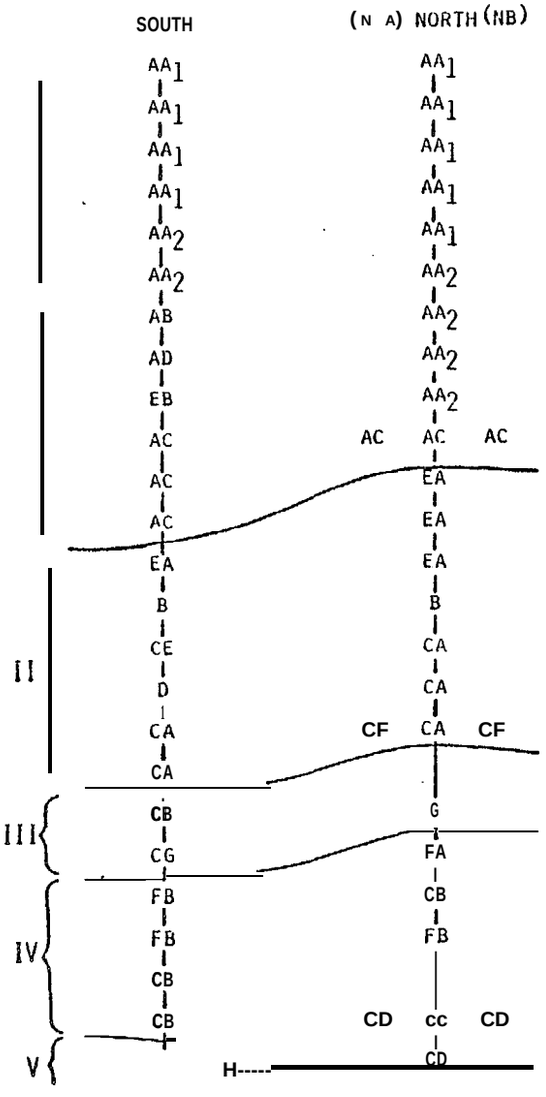


Figure 1.1.9-17. Dendrogram Display of Differential Clustering of Quadrats Sampled During December 1976 from Santa Cruz Island.



CLUSTERED GROUPS

- AA_1 · BLUE-GREEN* LITTORINA
- AA_2 · BLUE-GREEN ◦ LITTORINA • ENDOCLADIA
- AB · BLUE-GREEN • ENDOCLADIA • LITTORINA
- AC · BLUE-GREEN• ENDOCLADIA ● LITHOPHYLLUM
- AD · BLUE-GREEN ◦ LITHOPHYLLUM• ENDOCLADIA
- B_1 · LITHOPHYLLUM • MYTILUS
- B_2 · LITHOPHYLLUM ● PELVETIA
- CA · CORALLINA OFFICINALIS VAR. CHILENSIS • LITHOPHYLLUM
- CB · CORALLINA OFFICINALIS VAR. CHILENSIS • LITHOPHYLLUM ◦ ANTHOPLEURA
- CC - CORALLINA OFFICINALIS VAR. CHILENSIS • ANTHOPLEURA ◦ LITHOPHYLLUM
- CD · CORALLINA OFFICINALIS VAR. CHILENSIS • GIGARTINA CANALICULATA
- CE - CORALLINA OFFICINALIS VAR. CHILENSIS · LITHOPHYLLUM • PELVETIA
- CF · CORALLINA VANCOUVERIENSIS • CORALLINA OFFICINALIS VAR. CHILENSIS
- CG · CORALLINA VANCOUVERIENSIS ● CORALLINA OFFICINALIS VAR. CHILENSIS GIGARTINA CANALICULATA
- D - LITHOPHYLLUM • LITHOTHRIX
- EA - LITHOPHYLLUM • MYTILUS
- EB - LITHOPHYLLUM • ENDOCLADIA
- FA - CODIUM • CORALLINA CHILENSIS - LITHOPHYLLUM
- FB - CORALLINA OFFICINALIS VAR. CHILENSIS
- G - CORALLINA VANCOUVERIENSIS ● CORALLINA OFFICINALIS VAR. CHILENSIS
- H -PHYLLOSPADIX. GIGARTINA CANALICULATA • GIGARTINA SPINOSA

Figure 1.1.9-18. Distributional Patterns of Species Groups from Santa Cruz Island for December 1976 in Relation to Positions of Transects and Locations of Quadrats.

Zone IV included the remaining quadrats below Zone III, except South 24 which was unique in the dendrogram (cluster group H) and described a separate Zone (V). In December 1975, Corallina officinalis var. chilensis continued down the shore from Zone III as the dominant cover organism with three rhodophytes as secondary species. In December 1976, C. officinalis var. chilensis was still the dominant cover species, and several species were secondary in importance and were different from those in 1975, and were abundant in only one of the three quadrats. This observation accounts for the low similarity between the four quadrats comprising the F cluster group in the dendrogram (Figure 1.1.9-17). The secondary species in the FB group included Serpulorbis squamigerus, Lithophyllum proboscideum, Halidrys dioica, Herposiphonia littorals, Dictyota flabellata, and Anthopleura elegantissima. Group FA was dominated by Codium fragile, but its secondary species clearly aligned it with Zone IV. Lower in the zone, Gigartina canaliculata became a secondary dominant to C. officinalis var. chilensis quadrats, in which C. officinalis var. chilensis and C. vancouveriensis dominated the cover. This zone was unchanged from December 1975, except for the loss of South 20 to Zone IV, due apparently to an increase in cover by Halidrys dioica and of South 17 to Zone II, due mainly to increased cover by L. proboscideum.

Zone IV included the remaining quadrats below Zone 111, except South 24 which was unique in the dendrogram (cluster group H) and described a separate Zone (V). In December group CD) on the North transect 1 ine, while on the South transect line, L. proboscideum and A. elegantissima were the secondary species.

Zone V was represented by a single quadrat, South 24, as it was in December 1975, with Phyllospadix scouleri as the dominant cover species. In 1976, however, Gigartina canaliculata and G. spinosa increased in cover to become the dominant secondary species.

1.1.9.5 Discussion

The major difference between the 1976-77 and 1975-76 periods was the lack of a seasonal die-back during the February visit, when the macrophytes Endocladia muricata, 'Pelvetia fastigiata, Corallina officinalis var. chilensis, and C. vancouveriensis decreased markedly in per cent cover over their levels in December 1975 (Seapy and Littler, 1977). The die-back was attributed to unusually strong, hot and dry afternoon winds blowing down Willows Canyon, which coincided in time with periods of extreme low tides during the midday and afternoon hours. No such weather patterns were recorded during January and February 1977, and no dieback occurred. The result was that total mean cover by the macrophytes was higher than in 1975-76 and there was a lack of seasonal change in total cover.

In other respects, the two years were quite comparable. The basic community structure and zonation patterns were unchanged, although the algae Endocladia muricata and Pelvetia fastigiata were no longer dominant cover species in Zones I and II, respectively, having not recovered after the February die-back to their abundance levels of December 1975.

1. 1.9.6 Literature Cited

Littler, M. M., Spatial and Temporal Variations in the Distribution and Abundance of Rocky Intertidal and Tidepool Biotas in the Southern California Bight. Unpbl. Tech. Compt. Rept., U. S . Department of the Interior, Bureau of Land Management, (1977).

Margalef, R., "Perspectives in Ecological Theory," (Chicago, University of Chicago Press, 1968).

Pielou, E. C., "An Introduction to Mathematical Ecology, (New York, Wiley Interscience, 1969).

Seapy, R. R., and M. M. Littler, 1977. "Biological Features of Rocky Intertidal Communities Near Willows Anchorage, Santa Cruz Island, California,'t in M. M. Littler, cd., Spatial and Temporal Variations in the Distribution and Abundance of Rocky Intertidal and Tidepool Biotas in the Southern California Bight, Unpubl. Tech. Compl. Rep. U. S. Department of the Interior, Bureau of Land Management (1977).

Shannon, C. E., and W. Weaver. "The Mathematical Theory of Communication" , (Urbana University of Illinois Press, 1949).

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INTERTIDAL STUDY OF THE SOUTHERN CALIFORNIA BIGHT

1.1.10

VARIATIONS IN THE ROCKY INTERTIDAL BIOTA NEAR CUYLER HARBOR, SAN MIGUEL ISLAND , CALIFORNIA

VOLUME 111

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1.1.10 Variations in the Rocky Intertidal Biota Near Cuyler Harbor, San Miguel Island, California

1. 1.10.1 Abstract

Seasonal patterns of distribution and abundance of rocky intertidal organisms were measured during October 1976, December 1976, February 1977, and May 1977. The assessments consisted of both disturbed and undisturbed sampling with 0.15 m^2 and 1.0 m^2 samples totaling 406 quadrats. More taxa (yearly average of 16 more macrophytes and 8 macroinvertebrates) were found in the undisturbed samples than had been present the previous year, largely as a result of improved taxonomic capabilities. This study contributed 24 new macrophyte and 13 new macroinvertebrate records for San Miguel Island that were not found by us during 1975-76.

This report focuses on variations between data gathered in 1976-76 and that produced during the present study, utilizing only undisturbed data (our most powerful for comparative purposes); consequently, the numbers reported do not include cover, density,or frequency data produced by the disturbed sampling method used in 1975-76. As was the case the preceding year, few opportunistic species characteristic of perturbed intertidal habitats were of importance. The total substrate in the undisturbed samples covered by macrobiota increased over 1975-76 values by 15.3% (from 98.0% to 113.3%) and again showed very little seasonal variation. Macrophyte cover increased by 17.0% (from 73.1% to 90.1%) while macroinvertebrates decreased by 1.7% (from 24.9% to 23.2%).

Seasonal total cover of the prominent macrophytes fell into nearly the same order found in 1975-76. Gigartina canaliculata again had the greatest cover (16.4%; 16.5% in 1975-76) followed by blue-green algae with 14.6% (an increase of 4.6% over the preceding year) and Pelvetia fastigiata (decrease of 0.5%). The same patterns of seasonality were shown as for the preceding year's study; e.g., G. canaliculata decreased in December through February associated with desiccating conditions during the winter daytime low tide periods. Corallina vancouveriensis again followed the reverse pattern, increasing from 5.2% to 7.5% cover from October through December and February and then dropping *to* 5.7% in May. A slight decline of Phyllospadix scouleri and P. fastigiata was again noted in May. On the other hand, the lowest coverage Egregia menziesii occurred in February (as opposed to April in 1975-76), clearly following the desiccating, heating, and insulating conditions of the daytime low tides. The cover of epilithic blue-green algae was not notably depressed in October as it had been one year earlier. The most important space-occupying macroinvertebrates (i.e., Phragmatopoma californica, 7.2% cover; Dodecaceria fewkesi, 5.4%; Mytilus californianus, 3.5%; and Chthamalus fissus/dalli, 3.4%) occurred in the same order of abundance and showed slight decreases in cover over 1975-76 values, with the exception of a 1.2% increase in cover of D. fewkesi.

The combined macrophyte and macroinvertebrate Shannon-Weaver (H_e') diversity averaged 3.13 for cover, contrasted with 2.98 for the previous year. Compared to 1975-76 data, richness (D_e') was also higher (19.76 vs. 15.38) while evenness (J ') was slightly lower (0.67 vs. 0.70). When the array of undisturbed samples was examined seasonally by cluster analysis, 13 assemblages were recognized (2 more than in 1975-76). Virtually the same assemblages were found in 1976-77 as in the previous year with only a few shifts in grouping by several of the quadrats. All of the groupings remained constant throughout 1976-77 as they had the previous year, depicting a stable pattern of zonation similar to that found in 1975-76. The San Miguel Island site, therefore, was characterized by relatively high diversity, few opportunistic species, and the cover dominants tended to be the larger perennial species indicative of mature environmentally constant intertidal communities. Again, mobile carnivores aside from Anthopleura elegantissima were not abundant on the study site.

1.1.10.2 Study Area

1.1.10.2.1 General

See Littler and O'Brian (1977) for the location, physical characterization, and published literature concerning this study site.

1.1.10.2.2 Environmental Data

The long-term climatic records for this site have been summarized by Littler and O 'Brien (1977), largely from Kimura (1974), Strange (1973) , and the U. S. Naval Weather Service Command (1971), along with our own physical data gathered during 1975-76. Table 1.1.10-1 is a summary of environmental measurements collected from October 1976 through May 1977 of the present study.

1.1.10.3 Methods and Materials

The methods employed were identical to those of the previous year's study (see Littler and O'Brien, 1977) with the exceptions noted in the introductory chapter (Littler, Chapter 1.1.1, this report). The identical transects and quadrats assessed by undisturbed sampling during the above 1975-76 study were reoccupied October 1976, December 1976, February 1977, and May 1977 throughout the present investigation. However, disturbed sampling was performed only in October 1976 rather than quarterly as in 1975-76. A total of 406 quadrats (203 0.15 m^2 and 203 1.0 m^2) were assessed throughout the period of study. These included 382 undisturbed rocky, and 24 disturbed rocky shoreline samples. Tidepools did not occur within the permanent transect area and, consequently, no pool data were taken during this study. The thrust of this chapter will be to present the

Table 1.1.10-1. . Environmental Data Measured during the Period of Study for Cuyler Harbor, San Miguel Island.

	Water Temp. (°C)	Air Temp, (°C)	Cloud Cover (%)	Salinity (°/00)	Wave Ht. (ft)	Relative Humidity (%)	Velocity (knots)
22-25 October 1976							
Range	17.8-19.0	16.8-18.0	4-100	34.0	---	79-85	15-25
Mean	18.3	17.5	74	34.0	--	81	20
18-21 December 1976							
Range	16.0	15.0-15.8	0-15	33.5-35.0	--	68-80	0-10
Mean	16.0	15.4	5	34.5	--	75	7
16-18 February 1977							
Range	14.5-14.8	15.0-16.0	0-95	33.0-34.0	--	58-90	0-5
Mean	14.6	15.6	32	33.3	--	79	3
04-05 May 1977							
Range	13.0-14.2	12.6-14.6	0-2	33.0	1-4	62-82	10-25
Mean	13.4	13.4	1	33.0	2	72	16

1976-77 findings for Cuyler Harbor, San Miguel Island, and to contrast the salient variations in the biota with the high-resolution analysis presented (Littler and O'Brien, 1977) for 1975-76.

Our emphasis throughout all four quarters of 1976-77 was to focus on undisturbed sampling, which provides the most extensive and powerful information for assessing temporal changes. Therefore, to make the information comparable, only the undisturbed data from both years will be utilized (i.e., disturbed quadrat data deleted).

1.1. 10.4 Results

1.1.10.4.1 Floristics and Faunistics

During the 1976-77 sampling program, a total of 74 macrophytes (Table 1.1.10-2) was found in the quadrats. Fifty-one taxa were present in the disturbed samples and 69 occurred in the undisturbed samples. Five macrophytes were located only in the harvest samples while 23 were taken only in the undisturbed quadrats. An additional 12 macrophytes were collected outside the sample plots. The list of macrophytes found during 1976-77 (Table 1.1.10-2) includes 24 new entities recorded for Cuyler Harbor, San Miguel Island. As occurred the previous year, Rhodophyta (67) contributed the majority of taxa, followed by Chlorophyta (8) and Phaeophyta (7). Bacillariophyta were treated as a single taxon but an additional colonial form, as well as the crust form, of Cyanophyta was recognized. A total of 58 macroinvertebrates was recognized over the four sampling periods (Table 1.1.10-3), with 47 found in disturbed samples and 50 recorded from undisturbed quadrats.

Eleven macroinvertebrates were found only in the undisturbed samples and eight only occurred in the harvest plots. An additional 6 species were collected outside of the quadrats. Table 1.1.10-3 includes 13 new records of macroinvertebrate taxa for the San Miguel Island site. Seven phyla of macroinvertebrates were present in the quadrats. The most numerous taxa were members of the Mollusca (36), with 28 Gastropoda, 6 Bivalvia, and 2 Polyplacophora. In addition, the 1976-77 sample plots contained 13 Arthropoda, 5 Tunicata, 4 Cnidaria, 4 Porifera, 2 Annelida, and 2 Echinodermata.

1.1. 10.4.2 Standing Crop

1.1.10.4.2.1 Cover

The total substrate in the undisturbed samples covered by macrobiota on San Miguel Island increased by 15.3% (from 98.0% to 113.3%) during 1975-76 to 1976-77 and again showed little seasonal variation. Macrophytes increased by 17.0% (from 73.1% to 90.1%) while macroinvertebrates decreased by 1.7% (from 24.9% to 23.2%).

Table 1.1.10 -2 Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of Cuyler Harbor, San Miguel Island. Additional species collected in the study area (C) but not present in samples have also been listed.

Species and Taxa	Oct. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	u	u	U	C
Bacillariophyta						
Benthic diatoms					x	
Chlorophyta						
Bryopsis corticulans	x	x	x	x	x	
Cladophora columbiana	x			x	x	
Cladophoropsis fasciculatus	x	x		x		
Cladophora spp.		x	x	x	x	
Codium setchellii		x	x	x		
Ulva californica	x	x	x	x	x	
Ulva lobata						x
Cyanophyta						
Blue-green algae	x	x	x	x	x	
Blue-green colony				x	x	
Phaeophyta						
Cylindrocarpus rugosus	x	x	x	x	x	
Egregia menziesii	x	x	x	x	x	
Hesperophycus harveyanus						x
Laminaria dentigera					x	
Pelvetia fastigiata	x	x	x	x	x	
Ralfsiaceae	x	x	x	x	x	
Rhodophyta						
Ahnfeltia plicata						x
Anisocladella pacifica		x	x	x		
Bossiella orbigniana ssp. dichotoma	x	x	x	x	x	
Calliarthron tuberculosum						x
Callithamnion pikeanum				x	x	
Callithamnion rupicolum	x	x	x			

Table 1.1 .10-2. Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of Cuyler Harbor, San Miguel Island. Additional species collected in the study area (C) but not present in samples have also been listed. (Continued)

Species and Taxa	Ott. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	u	u	U	C
Callophyllis flabellulata					x	
Callophyllis violacea	x			x	x	
Centroceras clavulatum		x	x			
Ceramium spp.		x				
Ceramium eatonianum/ sinicola	x	x	x	x	x	
Chondria nidifica					x	
Corallina officinalis var. chilensis	x	x	x	x	x	
Corallina vancouveriensis	x	x	x	x	x	
Cryptopleura corallinara		x	x	x	x	
Cryptopleura crisps					x	
Cryptopleura lobulifera		x				
Cryptopleura violacea	x	x	x	x	x	
Endocladia muricata	x	x	x	x	x	
Gastroclonium coulteri	x	x	x	x	x	
Gelidium coulteri	x	x	x	x	x	
Gelidium pusillum	x	x	x	x	x	
Gelidium robustum	x			x	x	
Gigartina agardhii					x	
Gigartina canaliculata	x	x	x	x	x	
Gigartina corymbifera						x
Gigartina papillata	x	x	x	x	x	
Gigartina spinosa	x	x	x	x	x	
Gigartina leptorhynchos	x					
Gracilaria andersonii					x	
Gracilaria sp.		x	x	x	x	
Gracilaria verrucosa						x
Grateloupia doryphora			x			
Gymnogongrus leptophyllus						x
Herposiphonia plumula		x				
Hydrolithon decipiens	x	x	x	x	x	
Iridaea cordata var. cordata						x

Table 1.1.10-2 Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of Cuyler Harbor, San Miguel Island. Additional species collected in the study area (C) but not present in samples have also been listed. (Continued)

Species and Taxa	Oct. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	U	U	U	C
Iridaea cordata var. splendens	x	x	x	x,	x	
Iridaea flaccida				x	x	
Laurencia masonii		x				
Laurencia spectabilis	x	x	x		x	
Laurencia splendens						x
Lithophyllum proboscideum	x	x	x	x	x	
Melobesia mediocris	x		x		x	
Microcladia borealis	x	x	x	x	x	
Microcladia coulteri	x	x	x	x		
Nemalion helminthoides	x		x			
Neoagardhiella baileyi						x
Petrocelis franciscana	x	x	x	x	x	
Peyssonneliaceae/ Hildenbrandiaceae	x	x	x	x	x	
Pleonosporium squarrulosum						x
Plocamium cartilagineum	x	x	x	x	x	
Plocamium violaceum	x	x	x	x	x	
Polysiphonia spp.	x		x		x	
Polysiphonia hendryi var. hendryi	x		x	x	x	
Polysiphonia scopulorum var. villum		x		x	x	
Porphyra perforata	x	x	x	x	x	
Prionitis lanceolata	x	x	x	x	x	
Pterosiphonia baileyi	x	x	x	x	x	
Pterosiphonia dendroidea	x	x	x	x	x	
Rhodoglossum affine	x	x	x	x	x	
Rhodymenia californica var. californica	x					
Rhodymenia pacifica		x	x			
Smithora naiadum	x		x	x	x	
Stenogramme interrupts						x
Spermatophyte						
Phyllospadix scouleri	x		x	x	x	
86 Total Macrophytes						

Table 1.1.10-3 Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Cuyler Harbor, San Miguel Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column.

Species and Taxa	Oct. 1976		Dec. 1976	Feb. 1977	May 1977	
	U	D	U	U	U	C
Annelida						
Polychaeta						
Dodecaceria fewkesi	X	X	X	x	X	
Phragmatopoma californica	X	X	x	X	x	
Arthropoda						
Crustacea						
Balanus glandula	X	X	X	X	X	
Balanus tintinnabulum californicus		X	X			
Cancer antennarius			X			
Cancer jordani		X				
Chthamalus fissus/dalli	X	x	X	X	x	
Pachycheles rudis		x				
Pachygrapsus crassipes	X	X	x	X	X	
Pagurus hirsutiusculus	X	X	X	X	X	
Pagurus samuelis	X	x	x			
Pollicipes polymerus	X	X	x	X	X	
Pugettia products		X	X			
Tetraclita squamosa rubescens	X	X	X	x	X	
Chordata: Urochordata						
Ascidiacea						
Archidistoma psammion	X				X	
Archidistoma ritteri			X			
Distaplia occidentals					X	
Euherdmania claviformis						X
Ritterella aequalisiphonis			X		X	
Cnidaria						
Anthozoa						
Anthopleura elegantissima	x	X	X	X	X	
Corynactis californica			X		X	
Hydrozoa						
Aglaophenia sp.		X	X			
Syncoryne eximia			X			

Table 1.1.10-3. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Cuyler Harbor, San Miguel Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right--hand column. (Continued).

Species and Taxa	Oct. 1976		Dec. 1976	Feb.. 1977	May 1977	
	U	D	U	U	U	C
Echinodermata						
Asteroidea						
Pisaster ochraceus	.	x				
Echinoidea						
Strongylocentrotus purpura t us						x
Mo llusca						
Bivalvia						
Brachidontes adamsianus		x				
Hiatella arctica		X				
Modiolus capax		x	X			
Mytilus californianus	x	x	x	x	x	
Mytilus edulis			X		x	
Septifer bifurcates/ Brachidontes adamsianus	x		x	x	x	
Gastropoda						
Acanthina punctulata	X	x	x	x	X	
Acanthina spirata	X	X	x			
Acmaea (Collisella) asmi			x		x	
Acmaea (Collisella) digitalis	X	x	x	x	x	
Acmaea (Notoacmea) insessa	X	x		x		
Acmaea (Collisella) limatula	x	x	x		x	
Acmaea (Collisella) pelta	X	x	x	x	x	
Acmaea (Collisella) scabra	x	x	x	x	x	
Acmaea (Collisella) strigatella	x	x	x	x	x	
Amphissa versicolor		x				
Barleeia haliotiphila		X				
Calliostoma canaliculatum						X
Cerithiopsis carpenter		X				
Crepipatella lingulata		X				
Epitonium tincture		x	X	X		
Fissurella volcano						X
Haliotis cracherodii	x	X	X	X	X	

Tablel .1. IO-3. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Cuyler Harbor, San Miguel Island. Additional species collected at the study site (C), hut not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. Continued)

Species and Taxa	Oct. 1976 U	Oct. 1976 D	Dec. 1376 U	Feb. 1977 U	May 1977 U	C
Lacuna spp.	X	X				
Littorina planaxis	X	X	X	X	X	
Littorina scutulata	X	X	X	X	X	
Lottia gigantea	X	X	X	X	X	
Mitrella carinata	X	X	X			
Nucella (Thais) emarginata	X	X	X	X	X	
Ocenebra circumtexta		X	X			
Tegula funebralis	X	X	X	X	X	
Trimusculus reticulatus						X
Williamia peltoides						X
Polyplacophora						
Cyanoplax hartwegii	X	X	X	X	X	
Mopalia muscosa	X	X	X	X	X	
Porifera						
Demospongiae						
Axocielita originals	X					
Spheciospongia confoederata	X	X				
64 Total Macroinvertebrates						

Total macrophyte cover over the year was again very consistent (Table 1.1.10-4), ranging between 84.3% in December 1976 and 94.0% in May 1977. Macro phytes again occupied the most substrate on the lower shore where they had a mean seasonal cover of 130.9% from -1.0 to +3.0 ft. (-.3 to .9 m). Their cover averaged 90.8% in the mid-intertidal (+3.0 to +6.0 ft., .9 to 1.8 m) and 34.9% in the high intertidal (+6.0 to +9.0 ft., 1.8 to 2.7 m). This represents macrophyte gains in cover over 1975-76 values of 28.6%, 14.7%, and 4.2% in the low, mid, and high zones, respectively.

Total macroinvertebrate cover again was also quite stable (Table 1.1.10-5), remaining constant at about 24% throughout 1976-77. Macroinvertebrate cover was again highest in the mid-intertidal with 37.6% between +3.0 and +6.0 ft. (+.9 and +1.8 m); however, this represented a 9.7% decrease over the previous year's value. In the low intertidal (-1.0 to +3.0 ft., -.3 to +.9 m) and high intertidal (+6.0 to +9.0 ft., +1.8 to +2.7 m) macroinvertebrates covered 21.1% (gain of 4.1%) and 11.6% (decrease of 1.3%), respectively.

Seasonal total cover of the prominent macrophytes fell into nearly the same order found in 1975-76 as indicated in Table 1.1.10-6. Gigartina canaliculata had the greatest cover (16.4%; 16.5% in 1975-76) followed by blue-green algae with 14.6 (an increase of 4.6% over the preceding year) and Pelvetia fastigiata (decrease of 0.5%). The same patterns of seasonality were shown as for the preceding year's study; e.g. , G. canaliculata decreased in December through February associated with desiccating conditions during the winter daytime low tide periods. Corallina vancouveriensis again followed the reverse pattern, increasing from 5.3% to 7.5% cover from October through December and February and then dropping to 5.7% in May. A slight decline of Phyllospadix scouleri and P. fastigiata was again noted in May. On the other hand, the lowest-coverage of Egregia menziesii occurred in February (as opposed to April in 1975-76), clearly following the insulating, heating and desiccating conditions of the daytime low tides. The cover of epilithic blue-green algae was not notably depressed in October as it had been one year earlier. In 1975-76, we did not distinguish Hydrolithon decipiens adequately from Lithophyllum proboscideum, so the apparent decrease in L. proboscideum (from 3.5% to 1.0%) reflects this separation.

Yearly mean macrophyte cover distributions are shown in Figure 1. 1.10-1 and the patterns over each of the four quarters are indicated in Figures 1.1. 10-2 through 1.1.10-5. Macrophytes with the broadest yearly distributional ranges (MLLW to +9.0 ft., 2.7 m) were the same encrusting forms as recorded for 1975-76; i.e., Ralfsiaceae, blue-green algae , and Peyssonneliaceae/Hildenbrandiaceae (Figure 1.1.10-1). Other Major species that were again broadly distributed

TABLE 1.1.10-4. SEASONAL AND ANNUAL PATTERNS OF OVERALL MACROPHYTE COVER (%) AS A FUNCTION OF TIDAL HEIGHT FOR SAN MIGUEL ISLAND,

SEASON		TIDAL HEIGHT (FT). -1.0 TO -0.1	MLLW TO 0.9	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9
OCTOBER	1976	--	116.1	132.8	128.7	94.0	90.8	105.8	41.2	68.8	14.1
DECEMBER	1976	135.1	140.2	108.9	121.0	85.3	72.3	98.9	31.7	36.9	12.6
FEBRUARY	1977	127.5	148.6	110.4	116.6	88.1	73.6	110.7	38.6	48.8	23.1
MAY	1977	160.6	139.0	134.6	133.2	88.6	84.7	97.0	39.2	44.9	18.1
MEAN		141.1	136.0	121.7	124.9	89.0	80.4	103.1	37.7	49.9	17*0

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.10-5. SEASONAL AND ANNUAL PATTERNS OF OVERALL MACRO-INVERTEBRATE COVER (%) AS A FUNCTION OF TIDAL HEIGHT FOR SAN MIGUEL ISLAND.

SEASON		TIDAL HEIGHT (FT). -1.0 TO -0.1	MLLW TO 0.9	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7*9	8.0 TO 8.9
OCTOBER	1976	--	26.6	28.1	10.7	31.2	57.0	28.5	25.0	10,0	1.7
DECEMBER	1976	6,2	32.0	23.7	20.2	24.5	50.1	29.3	24.1	10.2	1.1
FEBRUARY	1977	5.7	27.4	33.9	14.8	39.4	55.2	30.5	21.5	9.4	1.8
MAY	1977	1.7	20.8	40.2	34.4	23.7	49.6	31.6	22.0	9.3	2.4
MEAN		4.5	28.8	31.5	20.0	29.7	53.0	30.0	23.2	9*8	1.6

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.10-6. QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN MIGUEL ISLAND (CONTINUED ON NEXT PAGE).

TAXA	COVER (%) OCT, 1976	DEC, 1976	FEB, 1977	MAY 1977	MEAN
GIGARTINA CANALICULATA	17,9	13,7	15,0	15,0	16,4
BLUE-GREEN ALGAE	16,6	12,1	17.1	12,3	14,6
PELVETIA FASTIGIATA	10,3	7,9	7,5	6,4	8,0
CORALLINA VANCOUVERIENSIS	5,3	7,5	7,5	5,7	6,5
PHYLLOSPADIX SCOULERI	6,0	5,0	5,6	3,7	5,1
CRYPTOPLEURA VIOLACEA	3,1	4,4	5,8	3,0	4,3
BOSSIELLA ORBIGNIANA SSP, DICHOTOMA	0,2	6,5	5,8	4,5	4,2
EGREGIA MENZIESII	3,1	3,2	1,9	8,0	4,0
PRIONITIS LANCEOLATA	3,6	3,7	4,3	4,2	4,0
GIGARTINA SPINOSA	1,9	0,6	1,4	4,4	2,2
PETROCELIS FRANCISCANA	2,0	2,1	1,6	2,0	1,9
SMITHORA NAIADUM	0,7	2,1	1.5	2,0	1,6
CORALLINE CRUSTS	1,9	1,9	1.2	1,3	1,6
HYDROLITHON DECIPIENS	2,0	1,3	1.6	0,9	1,5
RHODOGLOSSUM AFFINE	1,5	1,0	1,2	1,4	1,3
ENDOCLADIA MURICATA	1,1	0,9	1,2	1,7	1,2
GASTROCLONIUM COULTERI	1,2	0,6	1,4	1,4	1,2
GELIDIUM ROBUSTUM	1,4	1,0	1,0	1,0	1,1
LITHOPHYLLUM PROBOSCIDEUM	1.4	0,7	1,1	0,6	1,0
PLOCAMIUM CARTILAGINEUM	0,6	1,2	0,9	0,7	0,9
IRIDAEA CORDATA VAR, SPLENDENS	0,9	0,9	0,9	0,8	0,9
PORPHYRA PERFORATA	1,0	<0,1	<0,1	1,8	0,7
PEYSSONNELIACEAE/HILDENBRANDIACEAE	0,7	0,9	0.3	0,7	0,7
PTEROSIPHONIA BAILLYI	0,6	1,1	0,4	0,4	0,6
RALFSIACEAE	0,5	0,4	0.7	0,7	0,6
GELIDIUM COULTERI	0,5	0,2	0,4	0,4	0,4

NOTE; 1 FOOT = 0,3048 METERS

TABLE 1.1.10-6. QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN MIGUEL ISLAND (CONTINUATION).

TAXA	COVER (%) OCT, 1976	DEC, 1976	FEB, 1977	MAY 1977	MEAN
ULVA CALIFORNICA	0,4	0,3	0,3	0,6	0,4
IRIDAEA FLACCIDA	<0,1	<0,1	<0,1	0,8	0,2
PLOCAMIUM VIOLACEUM	0,3	0,2	0,2	<0,1	0,2
CORALLINA OFFICINALIS VAR, CHILENSIS	<0,1	0,2	0,4	<0,1	0,2
PTEROSIPHONIA PENDROIDEA	0,4	0,4	<0,1	<0,1	0,2
GIGARTINA PAPILLATA	0,2	<0,1	<0,1	0,3	0,2
AHNFELTIA PLICATA	0,0	0,0	0,0	0,6	0,2
GIGARTINA CANALICULATA BLEACHED	0,0	0,6	0,0	0,0	0,1
CRYPTOPLEURA CORALLINARA	0,0	0,3	<0,1	0,3	0,1
OTHER MACROPHYTES	0,4	1,4	0,4	1,0	
NUMBER OF OTHER TAXA	(20)	(29)	(21)	(31)	

NOTE: 1 FOOT = 0,3048 METERS

FIGURE 1.1.10-1. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN MIGUEL ISLAND (CONTINUED).

FIGURE 1.1.10-1. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN MIGUEL ISLAND (CONTINUED).

FIGURE 11.10-1.

MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN MIGUEL ISLAND (CONTINUED)

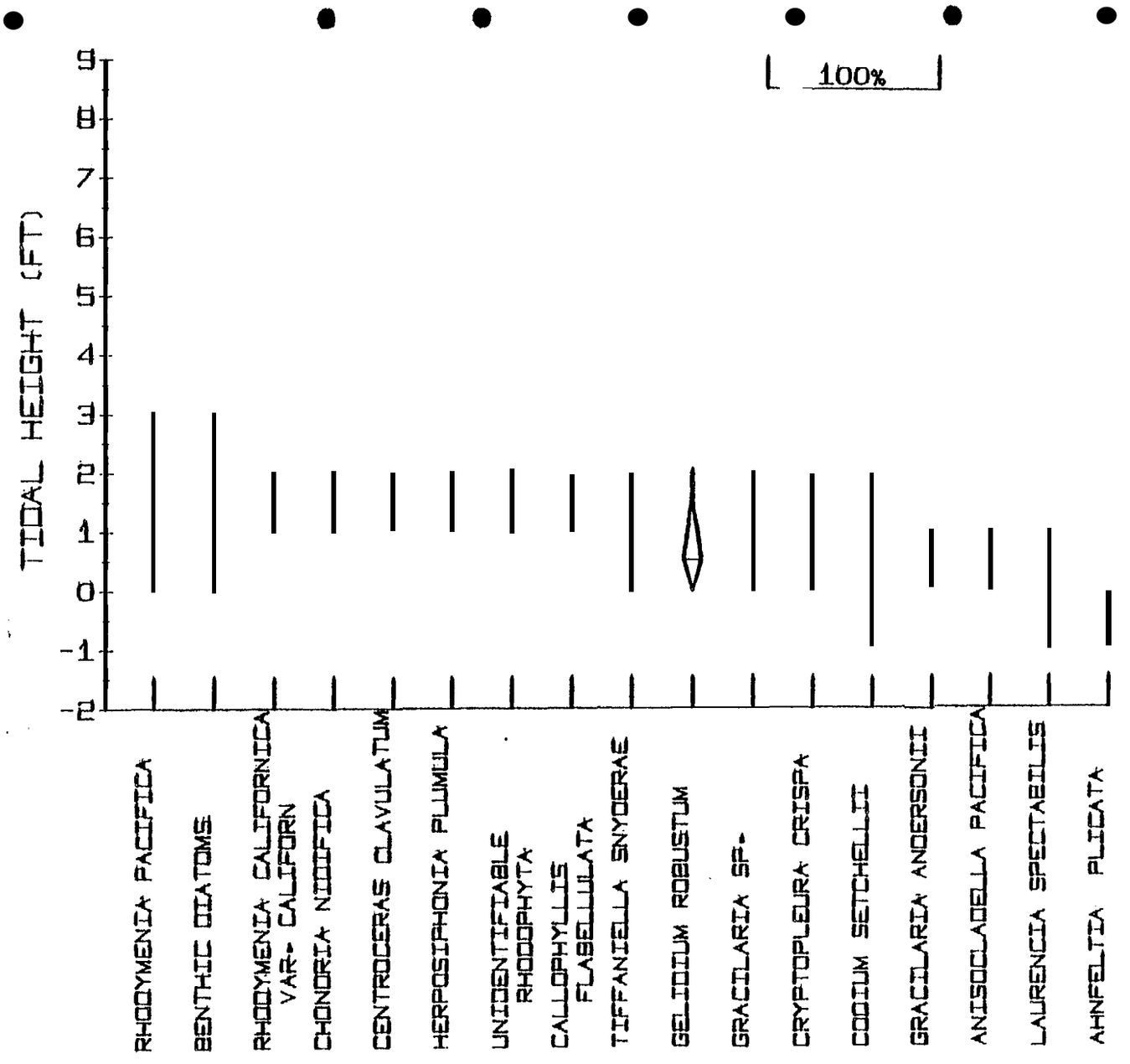

FIGURE 1.1.10-1. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN MIGUEL ISLAND (CONTINUATION).

FIGURE 1.1.10 -2. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN MIGUEL ISLAND (CONTINUED).

FIGURE 1.1.10-2. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN MIGUEL ISLAND (CONTINUED).

FIGURE 1.1.10-2. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN MIGUEL ISLAND (CONTINUATION).

FIGURE 1.1.10-3. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1975 AT SAN MIGUEL ISLAND (CONTINUED).

FIGURE 1.1.10-3. CHESTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DECEMBER 1976 AT SAN MIGUEL ISLAND

FIGURE 1.1.10-3. DISTRIBUTION OF DOMINAN MACROPHYTE OVER AS A FUNCTION OF TIDAL HEIGH FOR DECEMBER 197[illegible] A SAN MIGUEL [illegible] SLAND (CONTINUATION)

FIGURE 1.1.10-4, DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SAN MIGUEL ISLAND (CONTINUED).

FIGURE 1.1.10-4 DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SAN MIGUEL ISLAND (CONTINUED).

FIGURE 1.1.1-4. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SAN MIGUEL ISLAND (CONTINUATION).

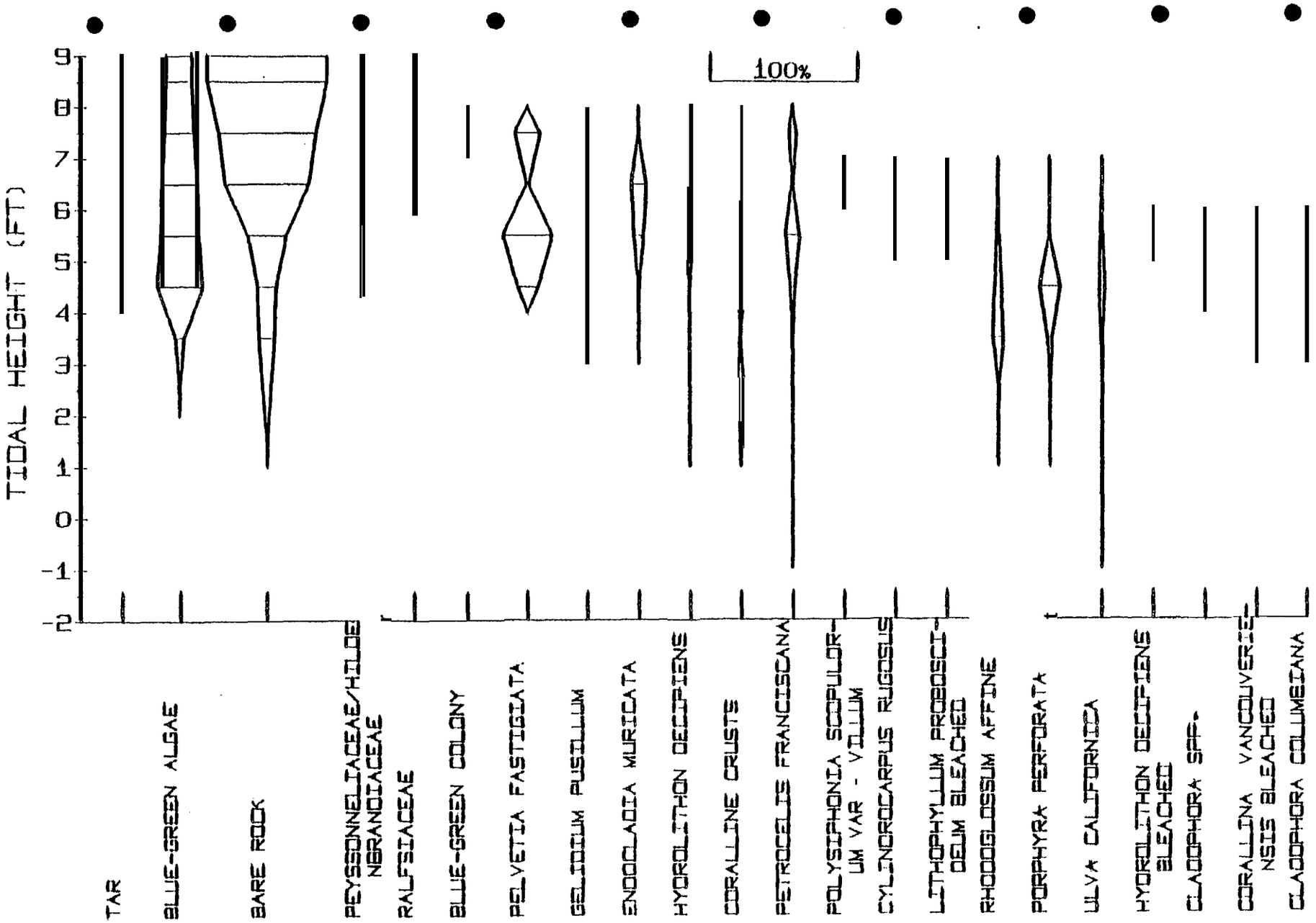

FIGURE 1.1.10-5. DISTRIBUTION OF DOMINAN MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SAN MIGUEL SLAND (CONTINUED).

FIGURE 1.1.10-5. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SAN MIGUEL ISLAND (CONTINUED).

FIGURE 1.1.10-5. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SAN MIGUEL ISLAND (CONTINUATION).

were Petrocelis franciscana and coralline algal crusts (-1.0 to +8.0 ft., -.3 to +2.4 m) along with Corallina vancouveriensis, Gigartina canaliculata, and Prionitis lanceolata (-1.0 to +6.0 ft., -.3 to +1.8 m).

Macrophytes that demonstrated conspicuous seasonality (i.e., Pelvetia fastigiata and Phyllospadix scouleri) during 1975-76 did not do so in 1976-77 (Figures 1.1.10-2 t-o-5). Also, Egregia menziesii, which reached its abundance peak in the +2.0 to +3.0 ft. (+.6 to +.9 m) interval during October, declined in December and February (particularly in its upper range of distribution) finally showing a dramatic increase in the lower intertidal (Figure 1.1.10-5) in May. This contrasted markedly with its performance the preceding year when Egregia cover declined markedly from February to April.

Seasonal total cover of the dominant macroinvertebrates appears in Table 1.1.10-7. The most important space-occupying macroinvertebrates (i.e., Phragmatopoma californica, 7.2%; Dodecaceria fewkesi, 5.4%; Mytilus californianus, 3.5%; and Chthamalus fissus/dalli, 3.4%) occurred in the same order of abundance and showed slight decreases in cover over 1975-76 values, with the exception of a 1.2% increase in cover of D. fewkesi.

Macroinvertebrate mean yearly patterns of cover are indicated in Figure 1.1.10-6, while the seasonal distributions are given separately in Figures 1.1. 10-7 through 1.1.10-10. Widely ranging dominant species were again Phragmatopoma californica (MLLW to +8.0 ft., +2.4 m), Anthopleura elegantissima (-1.0 to +7.0 ft., -.3 to +2.1 m), Chthamalus fissus/dalli, and Tegula funebralis (+2.0 to +9.0 ft., +.6 to -1-2.7 m). Very little seasonality in macroinvertebrate cover was apparent as was the case the previous year.

1.1. 10.4.2.2 Frequency

The percentages of samples containing the major macrophytes and macroinvertebrates are presented by season in Tables 1. 1.10-8 and 1.1.10-9. In general, most of the widespread macrophytes (blue-green algae, 74.5% frequency; Petrocelis franciscana, 60.1%; Corallina vancouveriensis, 59. 4%; Ralfsiaceae, 50.7%; Gigartina canaliculata, 46.6%) and macroinvertebrates (Anthopleura elegantissima, 59.9%; Chthamalus fissus/dalli, 48.8%; Phragmatopoma californica, 46.6%) also were among the dominants in terms of cover. The ranking from high to low mean seasonal frequency did not correspond precisely to the sequence of cover dominance (Table 1.1.10-6) because several species with high cover values were relatively restricted in range (e.g., Pelvetia fastigiata with 8.0% cover only occurred in 15.4% of the samples; and Phyllospadix scouleri had 5.1% cover but was found in only 10.6% of quadrats). Conversely, species often were broadly dispersed but were relatively low in cover (e.g., P. franciscana with only 1.9% cover was present in 60.1% of the samples taken).

TABLE 1.1.10-7. QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SAN MIGUEL ISLAND.

TAXA	COVER (%) OCT, 1976	DEC, 1976	FEB, 1977	MAY 1977	MEAN
PHRAGMATOPOMA CALIFORNICA	6.6	5.8	7.7	6.5	7.2
DODECACERIA FEWKESI	5.4	4.4	5.7	6.1	5.4
MYTILUS CALIFORNIANUS	4.0	3.3	3.5	3.1	3.5
CHTHAMALUS FISSUS AND DALLI	3.5	3.3	3.2	3.4	3.4
ANTHOPLEURA ELEGANTISSIMA	1.7	2.6	1.8	1.2	1.8
BALANUS GLANDULA	1.5	1.0	0.6	0.8	1.0
TEGULA FUNEBRALIS	0.3	0.4	0.3	0.3	0.3
DEMOSPONGIAE	0.3	0.6	<0.1	0.1	0.2
TETRACLITA SQUAMOSA RUBESCENS	0.1	<0.1	0.3	0.2	0.2
OTHER MACRO-INVERTEBRATES	0.9	0.8	0.6	0.7	
NUMBER OF OTHER TAXA	(24)	(36)	(23)	(24)	

NOTE: 1 FOOT = 0.3048 METERS

FIGURE 1.1.10-6. MEAN DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 SAN MIGUEL ISLAND (CONTINUED)

FIGURE .1.10-6.

MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 A-1 SAN M GUEL ISLAND (CONTINUED).

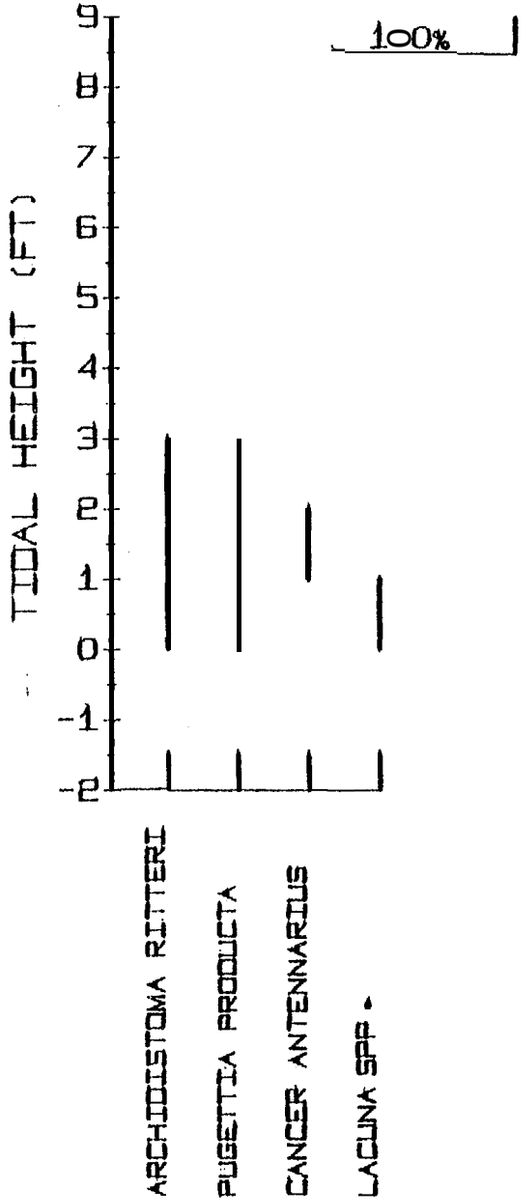

FIGURE 1.1.10-6. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRA E COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 A SAN MIGUEL ISLAND (CONTINUATIO).

FIGURE 1.1.10-7. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN MIGUEL ISLAND (CONTINUED).

FIGURE 1.1.10-7. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN MIGUEL ISLAND CONTINUATION.

FIGURE 1.1.10-8. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN MIGUEL ISLAND (CONTINUED)

FIGURE 1.1.10-8. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN MIGUEL ISLAND (CONTINUATION).

FIGURE .1.10-9. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SAN MIGUEL ISLAND (CONTINUED).

FIGURE 1.1.10-9. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SAN MIGUEL ISLAND (CONTINUATION).

FIGURE 1,1,10-1o. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SAN MIGUEL ISLAND CONTINUED.

FIGURE 1.1.10-10. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 A1 SAN MIGUEL ISLAND (CONTINUATION).

TABLE 1.1.10-8. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN MIGUEL ISLAND (CONTINUED ON NEXT PAGE).

TAXA	FREQUENCY (%) OCT, 1976	DEC, 1976	FEB, 1977	MAY 1977	MEAN
BLUE-GREEN ALGAE	77,6	82,0	77,3	61,1	74,5
PETROCELIS FRANCISCANA	56,6	64,3	58,8	60,5	60,1
CORALLINA VANCOUVERIENSIS	54,8	59,5	62,1	61,1	59,4
RALFSIACEAE	56,6	59,1	42,4	44,2	50,7
GIGARTINA CANALICULATA	45,1	50,6	43,1	47,5	46,6
CRYPTOPLEURA VIOLACEA	39,4	47,5	48,8	47,5	45,8
PEYSSONNELIACEAE/HILDENBRANDIACEAE	39,5	48,0	36,0	41,3	41,7
BOSSIELLA ORBIGNIANA SSP, DICHOTOMA	26,1	40,5	43,8	40,0	37,6
CORALLINE CRUSTS	33,5	52,1	28,3	33,7	36,9
RHODOGLOSSUM AFFINE	32,6	36,8	32,9	34,5	34,2
PRIONITIS LANCEOLATA	29,4	32,8	36,2	36,2	33,6
HYDROLITHON DECIPIENS	34,7	26,7	34,4	31,7	32,4
PTEROSIPHONIA BAILEYI	22,8	36,3	16,3	42,2	29,4
ULVA CALIFORNICA	17,6	19,8	27,1	52,7	29,3
IRIDAEA CORDATA VAR, SPLENDENS	30,7	27,8	23,6	23,8	26,5
EGREGIA MENZIESII	18,4	23,3	28,6	33,1	25,6
LITHOPHYLLUM PROBOSCIDEUM	22,7	24,0	21,5	24,4	23,1
PLOCAMIUM CARTILAGINEUM	20,6	24,3	16,5	29,0	23,1
GASTROCLONIUM COULTERI	14,1	24,3	24,8	26,5	22,4
GIGARTINA SPINOSA	19,6	15,7	13,2	31,5	20,0
CORALLINA OFFICINAL S VAR, CILENSIS	11,8	15,1	20,9	24,9	18,2
PORPHYRA PERFORATA	20,2	11,8	3,6	36,1	18,0
ENDOCLADIA MURICATA	19,4	17,4	15,9	16,4	17,8
PLOCAMIUM VIOLACEUM	16,1	22,0	17,8	10,3	16,6
PELVETIA FASTIGIATA	17,4	14,3	14,3	15,7	15,4
CERAMIUM EATONIANUM/SINICOL[a]	4,2	13,5	6,5	37,3	15,4

NOTE; 1 FOOT = 0,3048 METERS

TABLE 1.1.10-8. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN MIGUEL ISLAND (CONTINUED).

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
MICROCLADIA BOREALIS	18.9	10.8	8.3	21.1	14.8
GELIDIUM COULTERI	21.2	7.7	12.5	16.4	14.5
GELIDIUM PUSILLUM	6.3	17.0	13.4	18.5	13.8
GIGARTINA PAPILLATA	11.9	6.8	16.8	9.9	11.3
POLYSIPHONIA HENDRYI VAR HENDRYI	12.5	2.5	15.0	13.3	10.8
PHYLLOSPADIX SCOULERI	11.5	10.3	10.3	10.3	10.6
MICROCLADIA COULTERI	20.1	7.8	4.5	4.0	9.1
SMITHORA NAIADUM	9.3	8.3	7.8	10.3	8.9
CALLITHAMNION PIKEANUM	0.0	0.0	9.5	26.2	8.9
CRYPTOPLEURA CORALLINARA	0.0	13.7	3.4	10.7	6.9
PTEROSIPHONIA DENDROIDEA	5.9	13.2	2.5	5.0	6.6
POLYSIPHONIA SPP.	6.6	13.4	0.0	5.8	6.5
LAURENCIA SPECTABILIS	3.7	3.3	0.0	16.7	5.9
CALLOPHYLLIS VIOLACEA	0.0	0.0	4.5	15.3	5.0
CLADOPHORA COLUMBIANA	6.9	0.0	6.4	6.4	5.0
GELIDIUM ROBUSTUM	5.9	3.3	5.3	3.3	4.5
CALLITHAMNION RUPICOLUM	12.9	2.5	0.0	0.0	3.8
CODIUM SETCHELLII	0.0	3.3	2.0	10.0	3.8
IRIDAEA FLACCIDA	2.8	2.5	2.5	7.0	3.7
BRYOPSIS CORTICULANS	4.4	5.8	2.0	2.0	3.6
GIGARTINA CANALICULATA BLEACHED	0.0	12.5	0.0	0.0	3.1
GRACILARIA SP.	0.0	6.7	3.3	2.0	3.0
CORALLINA VANCOUVERIENSIS BLEACHED	0.0	3.8	2.5	5.4	2.9
BOSSIELLA ORBIGNIANA SSP. DICH B	0.0	11.3	0.0	0.0	2.8
CLADOPHORA SPP.	0.0	5.0	2.6	2.7	2.5
CORALLINE CRUST BLEACHED	0.0	3.8	1.3	5.2	2.5

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.10-8. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN MIGUEL ISLAND (CONTINUED).

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
AHNFELTIA PLICATA	0.0	0.0	0.0	10.0	2.5
HYDROLITHON DECIPIENS BLEACHED	3.7	0.0	2.0	4.3	2.5
POLYSIPHONIA SP.	0.0	9.8	0.0	0.0	2.4
MELOBESIA MEDIOCRIS	2.8	4.5	0.0	2.0	2.3
CYLINDROCARPUS RUGOSUS	1.4	2.7	1.3	2.9	2.0
BENTHIC DIATOMS	0.0	0.0	0.0	7.8	2.0
HEMALION HELMINTHOIDES	1.4	6.3	0.0	0.0	1.9
ARISCLADELLA PACIFICA	0.0	3.3	3.3	0.0	1.7
TIFFANIELLA SNYDERAE	5.9	0.0	0.0	0.0	1.5
RHODYMENIA PACIFICA	0.0	5.8	0.0	0.0	1.5
POLYSIPHONIA SCOPULORUM VAR. VILLUM	0.0	0.0	3.9	1.4	1.3
CRYPTOPLEURA CRISPA	0.0	0.0	0.0	5.3	1.3
CLADOPHOROPSIS FASCICULATUS	2.2	0.0	2.5	0.0	1.2
BLUE-GREEN COLONY	0.0	0.0	2.0	2.0	1.0
GRACILARIA ANDERSONII	0.0	0.0	0.0	3.3	0.8
LITHOPHYLLUM PROBOSCIDEUM BLEACHED	0.0	0.0	0.0	2.9	0.7
CALLOPHYLLIS SP.	2.8	0.0	0.0	0.0	0.7
PRIONITIS LANCEOLATA BLEACHED	0.0	2.5	0.0	0.0	0.6
LAMINARIA DENTIGERA	0.0	0.0	0.0	2.5	0.6
CRYPTOPLEURA VIOLACEA BLEACHED	0.0	2.5	0.0	0.0	0.6
MICROCLADIA BOREALIS BLEACHED	0.0	0.0	0.0	2.5	0.6
CORALLINA OFFICINALIS VAR. CH B	0.0	1.3	0.0	1.3	0.6
HERPOSIPHONIA PLUMULA	2.2	0.0	0.0	0.0	0.6
RHODYMENIA CALIFORNICA VAR. CALIFORN	2.2	0.0	0.0	0.0	0.6
CHONDRIA NIDIFICA	0.0	0.0	0.0	2.0	0.5
UNIDENTIFIABLE RHODOPHYTA	0.0	0.0	2.0	0.0	0.5

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.0-8. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN MIGUEL ISLAND (CONTINUATION).

TAXA	FREQUENCY (%) OCT, 1976	DEC, 1976	FEB, 1977	MAY 1977	MEAN
CALLOPHYLLIS FLABELLULATA	0.0	0.0	0.0	2.0	0.5
CENTROCERAS CLAVULATUM	0.0	2.0	0.0	0.0	0.5
GIGARTINA LEPTORHYNCHOS	1.6	0.0	0.0	0.0	0.4
RHODOGLOSSUM AFFINE BLEACHED	0.0	1.3	0.0	0.0	0.3
GRATELOUPIA DORYPHORA	0.0	1.3	0.0	0.0	0.3
PORPHYRA PERFORATA BLEACHED	0.0	1.3	0.0	0.0	0.3
ULVA CALIFORNICA BLEACHED	0.0	1.3	0.0	0.0	0.3
GIGARTINA AGARDHII	0.0	0.0	0.0	1.3	0.3

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.10-9. QUARTERLY AND ANNUAL MEAN FREQUENCY (% FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SAN MIGUEL ISLAND (CONTINUED ON NEXT PAGE).

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
ANTHOPLEURA ELEGANTISSIMA	54.2	64.2	61.7	59.3	59.8
CHTHAMALUS FISSUS AND DALLI	49.0	56.0	45.6	44.6	48.8
PHRAGMATOPOMA CALIFORNICA	40.9	49.8	44.6	51.2	46.6
TETRACLITA SQUAMOSA RUBESCENS	42.6	37.5	42.0	24.8	36.7
BALANUS G A DULA	39.0	36.0	33.6	36.0	36.1
LITTORI A LANAXIS	38.1	33.2	30.7	37.9	35.0
LITTORINA SCUTULATA	29.9	36.3	32.9	32.1	33.3
ACMAEA (COLLISELLA) SCABRA	40.8	37.2	31.8	20.2	32.5
TEGULA FUNEBRALIS	39.1	36.1	27.4	26.5	32.3
MYTILUS CALIFORNIANUS	34.7	28.6	29.3	27.5	30.0
ACMAEA (COLLISELLA) PELTA	26.8	30.9	11.1	16.1	21.2
DODECACERIA FEWKESI	22.8	23.0	16.0	16.0	20.4
ACMAEA (COLLISELLA) DIGITALIS	8.4	19.0	22.0	17.1	16.8
POLLICIPES POLYMERUS	10.1	19.0	19.6	16.5	16.3
DEMOSPONGIAE	10.9	16.3	11.8	16.7	14.9
ACANTHINA PUNCTULATA	11.9	13.4	13.2	14.8	13.3
HALIOTIS CRACHERODII	6.9	11.4	10.8	12.5	10.4
CYANOPLAX HARTWEGII	7.5	9.7	1.3	10.6	9.3
NUTTALLINA FLUXA/CALIFORNICA	9.7	8.8	6.3	8.9	8.4
LOTTIA GIGANTEA	10.1	7.7	7.7	7.7	8.3
NUCELLA (THAIS) EMARGINATA	16.5	9.1	2.5	5.0	8.3
ACMAEA (COLLISELLA) LIMATULA	6.2	3.9	0.0	16.5	6.6
PAGURUS HIRSUTIUSCULUS	7.4	11.0	5.2	2.5	6.5
PACHYGRAPSUS CRASSIPES	4.6	7.4	8.4	3.9	6.1
SEPTIFER BIFURCATUS AND BRACHIDONTES	4.6	2.7	9.9	6.4	5.9
ACMAEA (COLLISELLA) STRIGATELLA	1.4	3.9	11.6	3.4	5.1

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.10-9. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SAN MIGUEL ISLAND (CONTINUATION).

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
PAGURUS SAMUELIS	14.3	3.9	0.0	0.0	4.5
MOPALIA MUSCOSA	7.1	6.3	1.4	2.5	4.3
ARCHIDISTOMA RITTERI	0.0	9.2	0.0	6.5	3.9
ACMAEA JUVENILE	0.0	0.0	0.0	10.9	2.7
ACANTHINA SPIRATA	6.7	3.3	0.0	0.0	2.5
CORYNACTIS CALIFORNICA	0.0	5.8	0.0	2.5	2.1
RITTERELLA AEQUALISIPHONIS	0.0	5.0	0.0	2.5	1.9
ACMAEA (NOTOACMEA) INSESSA	2.8	0.0	4.5	0.0	1.8
DELHEBRA CIRCUMTEXTA	0.0	7.2	0.0	0.0	1.8
MITRELLA CARINATA	2.2	2.5	2.0	0.0	1.7
PUGETTIA PRODUCTA	0.0	5.8	0.0	0.0	1.5
EPITONIUM TINCTUM	0.0	1.3	4.5	0.0	1.4
ACMAEA (COLLISELLA) CONUS	0.0	4.1	0.0	0.0	1.0
ACMAEA (COLLISELLA) ASMI	0.0	1.4	0.0	2.5	1.0
MODIOLUS CAPAX	0.0	3.9	0.0	0.0	1.0
LACUNA SPP.	3.7	0.0	0.0	0.0	0.9
TUNICATES UNKNOWN	2.6	0.0	0.0	0.0	0.7
MYTILUS EDULIS	0.0	1.3	0.0	1.4	0.7
CREPIPATELLA LINGULATA	0.0	2.5	0.0	0.0	0.6
ARCHIDISTOMA PSAMMION	0.0	0.0	2.5	0.0	0.6
LEUCILLA NUTTINGI	0.0	2.5	0.0	0.0	0.6
AGLAOPHENIA SP.	0.0	2.5	0.0	0.0	0.6
CANCER ANTENNARIUS	0.0	2.0	0.0	0.0	0.5
BALANUS GLANDULA DEAD	0.0	0.0	2.0	0.0	0.5
CHTHAMALUS FISSUS & DALLI DEAD	0.0	0.0	1.4	0.0	0.4
HUTTALLINA CALIFORNICA	0.0	1.3	0.0	0.0	0.3

NOTE: 1 FOOT = 0.3048 METERS

The frequency values for the widespread species remained within 10% over the two years of study, except for increases during 1976-77 shown by Corallina vancouveriensis (increase of 30.3%), Petrocelis franciscana (25.1%), and Chthamalus fissus/dalli (15.2%). The apparent 37.9% decrease of Lithophyllum proboscideum from 1975-76 to 1976-77 is not real and reflects the fact that Hydrolithon decipiens (32.4% frequency) was distinguished taxonomically and separated from L. proboscideum in the present study. Porphyra perforata proliferated in the spring; from a frequency of 3.8% in February to 36.1% in May in a manner almost identical to that shown in 1975-76. The increased frequency of occurrence of bleached thalli of Gigartina canaliculata, C. vancouveriensis, coralline algal crusts, Prionitis lanceolata, Cryptopleura violacea, Rhodoglossum affine, P. perforata, and Ulva californica in December reflects the heat and desiccation stresses imposed by "Santa Aria" winds during the daytime low tides.

For the macroinvertebrates (Table 1.1.10-9), the ranking from high to low mean seasonal frequency did not repeat the sequence of cover dominance (Table 1.1.10-7) for the same reasons given above for macrophytes. However, most of the broadly distributed macroinvertebrates (Anthopleura elegantissima, 59.8% frequency; Chthamalus fissus/dalli, 48.8%; and Phragmatopoma californica, 46.6%) were among the dominants in terms of cover. The percentage of samples containing these taxa did not change in a major way from 1975-76 values.

The mean seasonal distributions of the macrophytes, with respect to percent occurrence in samples over their intertidal ranges, appear in Figure 1.1.10-11. In general, as during 1975-76, the distributional patterns of frequency as a function of tidal height mirrored the trends in cover (Figure 1.1.10-1). Similar relationships existed for the yearly frequency patterns shown by macroinvertebrates (cf. Figures 1. 1.10-6 and 1.1.10-12).

1.1.10.4.2.3 Density

The seasonal and yearly mean densities of the most numerous macroinvertebrates are presented in Table 1.1.10-10. Those macro invertebrates most abundant in 1975-76, remained predominant in 1976-77 with only slight changes in their numbers per square meter. However, yearly mean densities of the barnacles, Chthamalus fissus/dalli and Balanus glandula decreased by 365 and 155/m^2, respectively.

Changes in the seasonal distributions of density were readily apparent for several taxa (Table 1. 1.10-10). The seasonal patterns found during 1975-76 were, for the most part, not repeated in 1976-77. Two exceptions are (1) the recruitment of Tetraclita squamosa rubescens between October and December and a subsequent period of high mortality

FIGURE 1.1.10-11. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN MIGUEL ISLAND CONTINUED).

FIGURE 1.1.10-11. MEAN DISTRIBUTION OF DOMINAN MACROPHYTE FREQUENCY AS A FUNC ION OF TIDAL HEIGHT DURING 1976/1977 AT SAN MIGUEL ISLAND (CONTINUED).

FIGURE .1.10-11.

MEAN DISTRIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN MIGUEL ISLAND CONTINUED.

FIGURE 1.1.10-11.

MEAN DISTRIBUTION OF DOMINAN MACROPHYTE FREQUENCY AS A FUNC IO N OF TIDAL HEIGHT DURING 1976/1977 AT SAN MIGUEL ISLAND (CONTINUED).

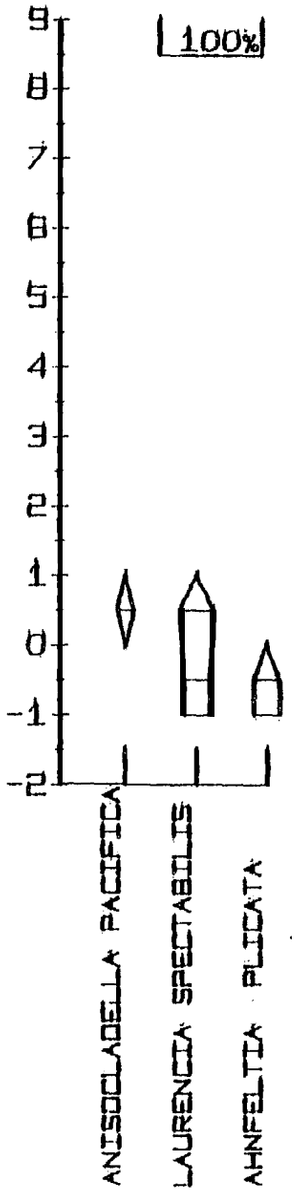

FIGURE 1.1.10-11. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN MIGUEL ISLAND (CONTINUATION).

FIGURE 1.1.10-12. DOMINANT MACRO-INVERTEBRATE ASSOCIATION OF TIDAL HEIGHT DURING 1976/1977 RIBLON SAN L ISLAND (CONTINUED).

FIGURE 1.1.1-12. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 A-1 SAN MIGUEL ISLAND (CONTINUED)

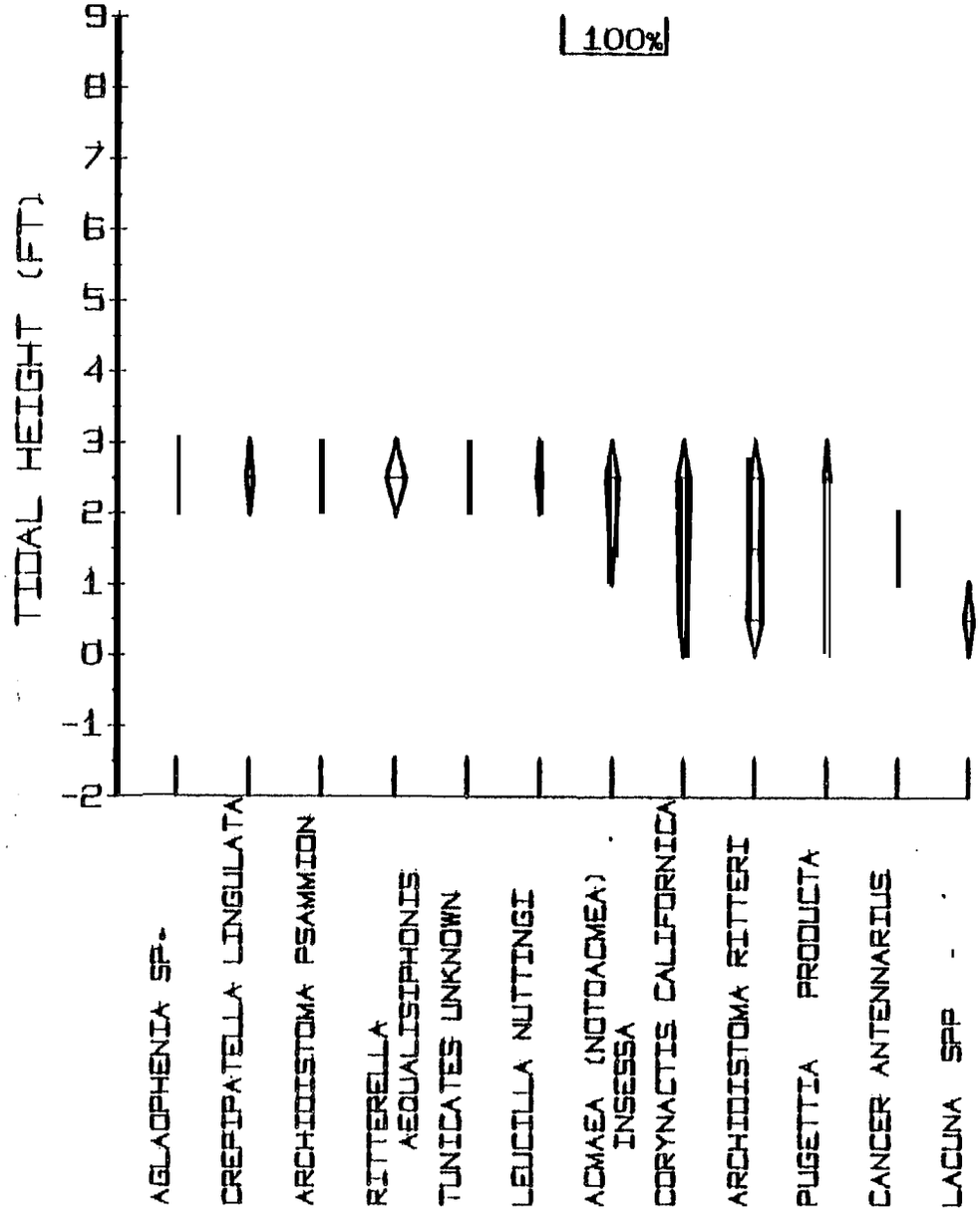

FIGURE 1.1.10-12. MEAN DISTRIBU ION OF DOMINANT MACRO-INVERTEBRATE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN MIGUEL ISLAND (CONTINUATION).

TABLE 1.1.10-10. QUARTERLY AND ANNUAL MEAN DENSITY (NO./M2) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SAN MIGUEL ISLAND.

TAXA	DENSITY (NO./M2) OCT. 1976	DEC. 1976	FEB. 1977	MAY 1977	MEAN
CHTHAMALUS FISSUS AND DALLI	1271	1164	1193	1219	1212
BALANUS GLANDULA	212	223	200	179	203
LITTORINA PLANAXIS	117	110	43	245	129
TETRACLITA SQUAMOSA RUBESCENS	83	90	74	52	75
ANTHOPLEURA ELEGANTISSIMA	60	72	66	47	61
MYTILUS CALIFORNIANUS	70	64	50	55	60
LITTORINA SCUTULATA	42	51	113	31	59
ACMAEA (COLLISELLA) SCABRA	23	36	11	9	20
TEGULA FUNEBRALIS	17	19	12	8	14
ACMAEA (COLLISELLA) PELTA	5	10	1	2	5
ACMAEA (COLLISELLA) DIGITALIS	2	5	7	3	4
POLLICIPES POLYMERUS	2	4	5	5	4
NUTTALLINA FLUXA/CALIFORNICA	2	1	1	1	1
LOTTIA GIGANTEA	2	1	1	1	1
ACANTHINA PUNCTULATA	1	<1	1	1	1
OTHER MACRO-INVERTEBRATES	7	10	4	9	
NUMBER OF OTHER TAXA	(14)	(23)	(11)	(13)	
TOTALS	1916	1863	1784	1865	

NOTE; 1 FOOT = 0.3048 METERS

through the winter and spring and , (2) the decline in Anthopleura elegantissima at the same time. Littorina scutulata appeared to recruit between December 1976 and February 1977, whereas no such pattern was evident the previous year.

Yearly density distributions on a compressed scale (Figure 1.1.10-13) and an expanded scale (Figure 1.1.10-14) were plotted to show patterns as a function of tidal height. Seasonal patterns are indicated similarly in Figures 1.1.10-15 through 1.1.10-22.

During 1975-76, Chthamalus fissus/dalli showed a large recruitment in the period February to April (from 3916 to 12038 individuals/m^2 between +6.0 and +7.0 ft., +1.8 and +2.1 m). A similar trend was evident during 1976-77 (Figures 1.1.10-15 to 1.1.10-22) but the increase was considerably less dramatic (5337 individuals/m^2 in December to 7253/m^2 in May). For Balanus glandula, the trend in 1976-77 was the reverse of that noted during the preceding year. In the +6.0 to +7.0 ft. (+1.8 to +2.1 m) interval, where B. glandula attained its maximum density, the 1975-76 pattern was an increase from 851/m^2 in October to 1904/m^2 in April. The 1976-77 trend was a decrease from 1174/m^2 to 967/m^2 over the same period and tidal height. In general, of the other seasonal trends in density recorded during 1976-77, none were repeated during the present study.

1. 1.10.4.2.4 Biomass

Wet and dry (organic) biomass of the major organisms from the Cuyler Harbor study area were estimated by combining disturbed samples from all five visits (October 1975-October 1976) to yield an overall representation of biomass as a function of tidal height (Tables 1.1.10-11 through 1.1.10-14).

The contribution of the October 1976 harvest samples was to considerably alter the grand means for biomass determined for the previous four quarters of 1975-76, particularly, in the case of the macroinvertebrates (Tables 1.1.10-12 and 1.1.10-14). The total wet biomass (WW) of 5834.0 g/m^2 (753.5 g/m^2 ODW) represented an increase of 2,446.1 g/m^2 over the average from the first four sampling periods (1975-76). This was comprised of 3223.3 g/m^2 WW (528.7 g/m^2 ODW) contributed by macro phytes (increase of 384.() g/m^2 WW) and 2610.7 g/m^2 WW (224.8 g/m^2 ODW) provided by macroinvertebrates (increase of 2063.1 g/m^2 WW).

The patterns of wet and organic dry biomass as a function of tidal height were also altered after inclusion of the September 1976 harvest. Again the same top four macrophytes (Gigartina canaliculata, 849.8 g/m^2; Pelvetia fastigiata, 637.5 g/m^2; Corallina vancouveriensis, 314.9 g/m^2; and Phyllospadix scouleri, 230.0 g/m^2) contributed the majority (63%) of the organic biomass.

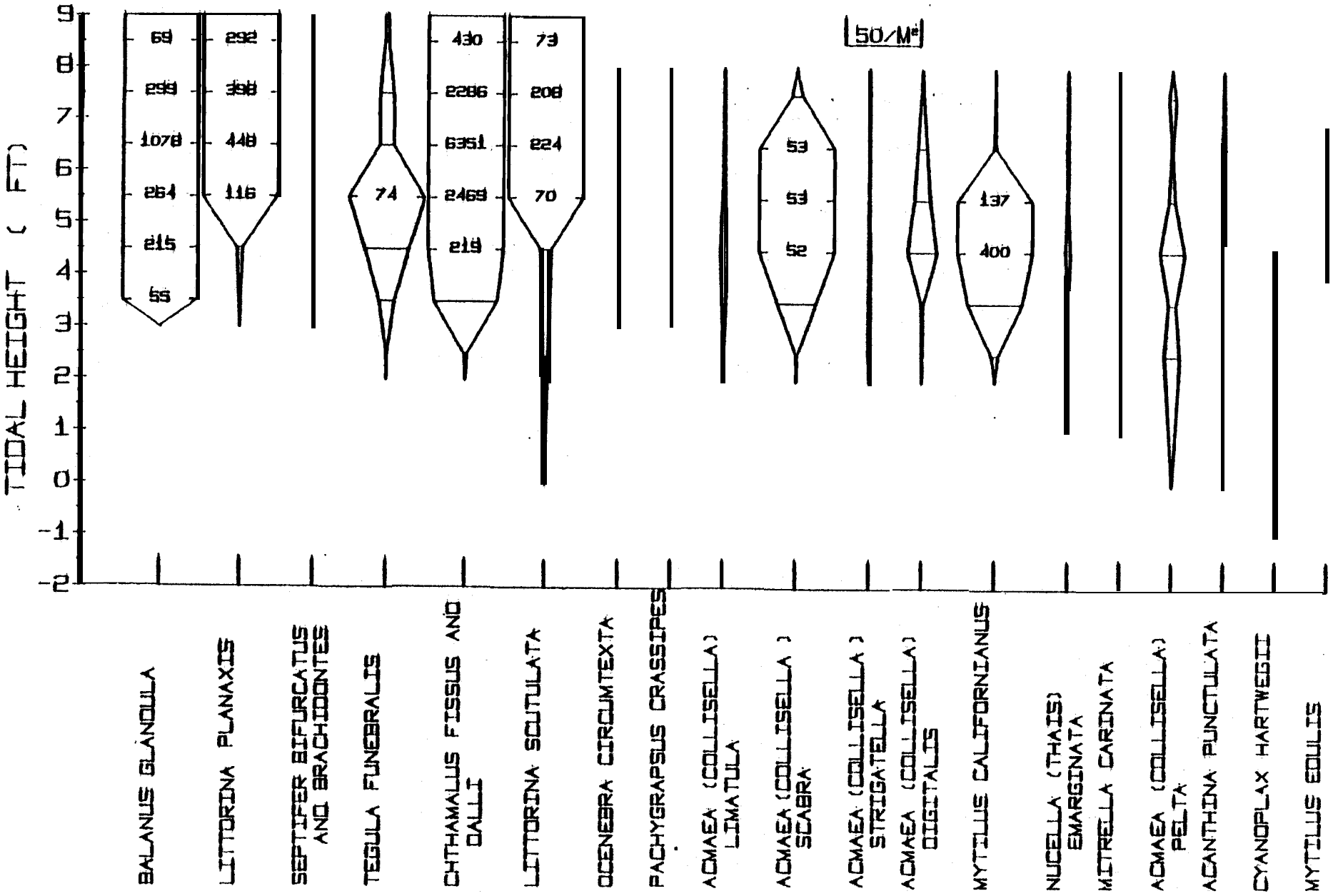

FIGURE 1.1.10-13. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN MIGUEL ISLAND (CONTINUED).

FIGURE .1.1o-13. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN MIGUEL IS. AND (CONTINUATION).

FIGURE 1.1.10-14. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN MIGUEL ISLAND (CONTINUED).

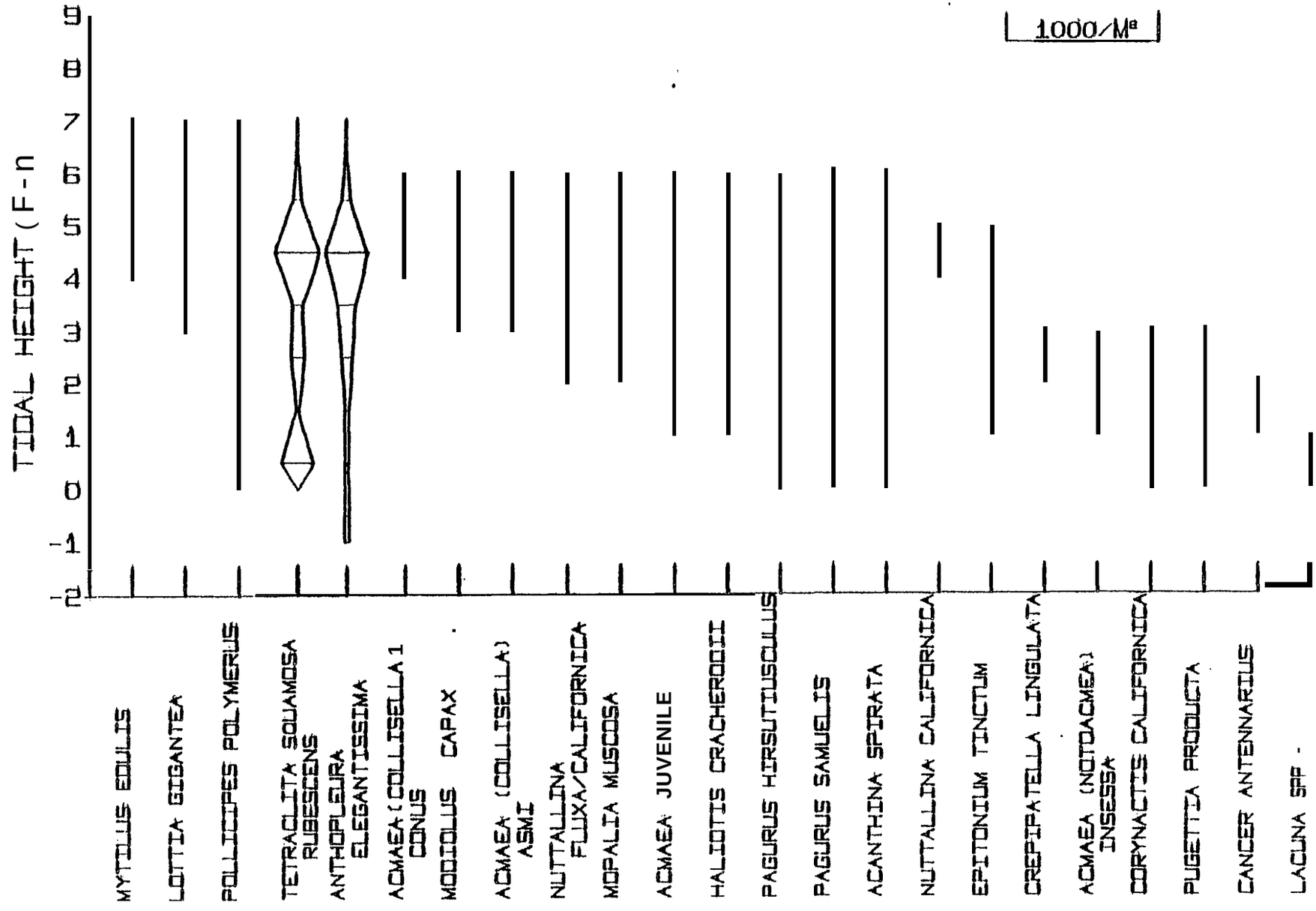

FIGURE 1.1.10-14. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN MIGUEL ISLAND (CONTINUATION).

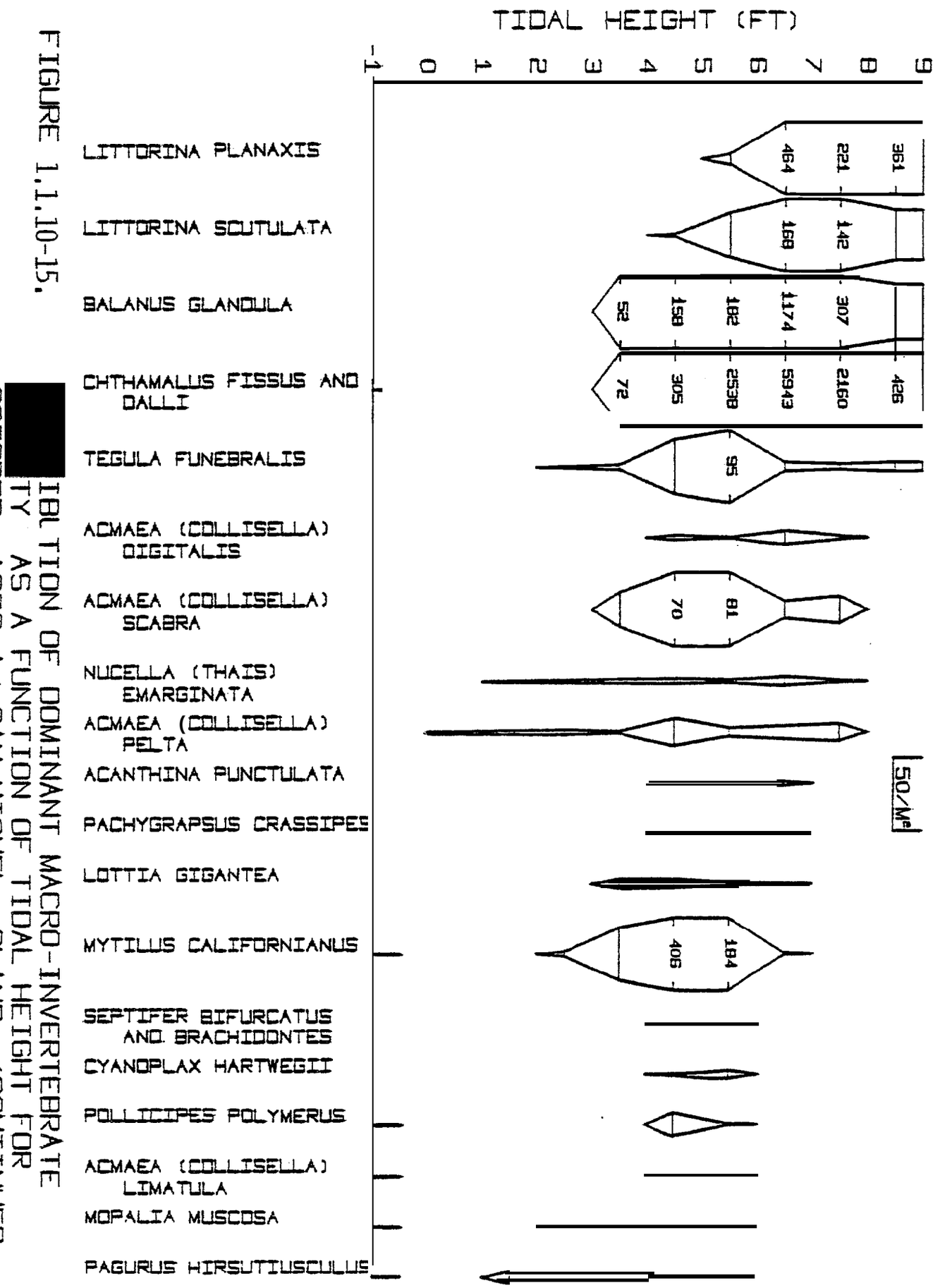

FIGURE 1.1.10-15. [redacted] IBL TION OF DOMINANT MACRO-INVERTEBRATE TY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 A-1 SAN MIGUEL ISLAND (CONTINUED).

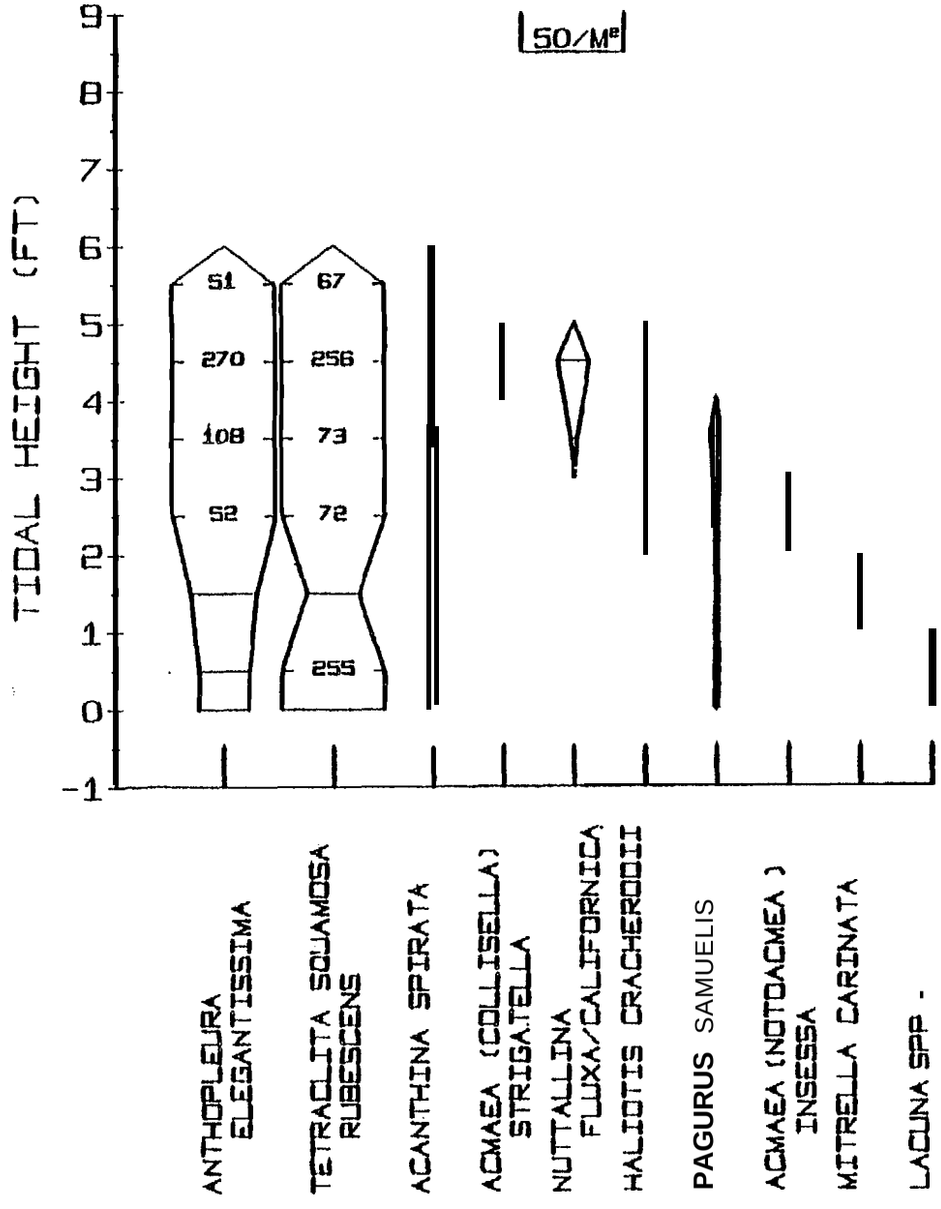

FIGURE 1.1.10-15. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN MIGUEL ISLAND (CONTINUATION

FIGURE 1.1.10-16.

DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN MIGUEL ISLAND (CONTINUED).

FIGURE .1.10-16. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN MIGUEL ISLAND (CONT=NUAT=ON).

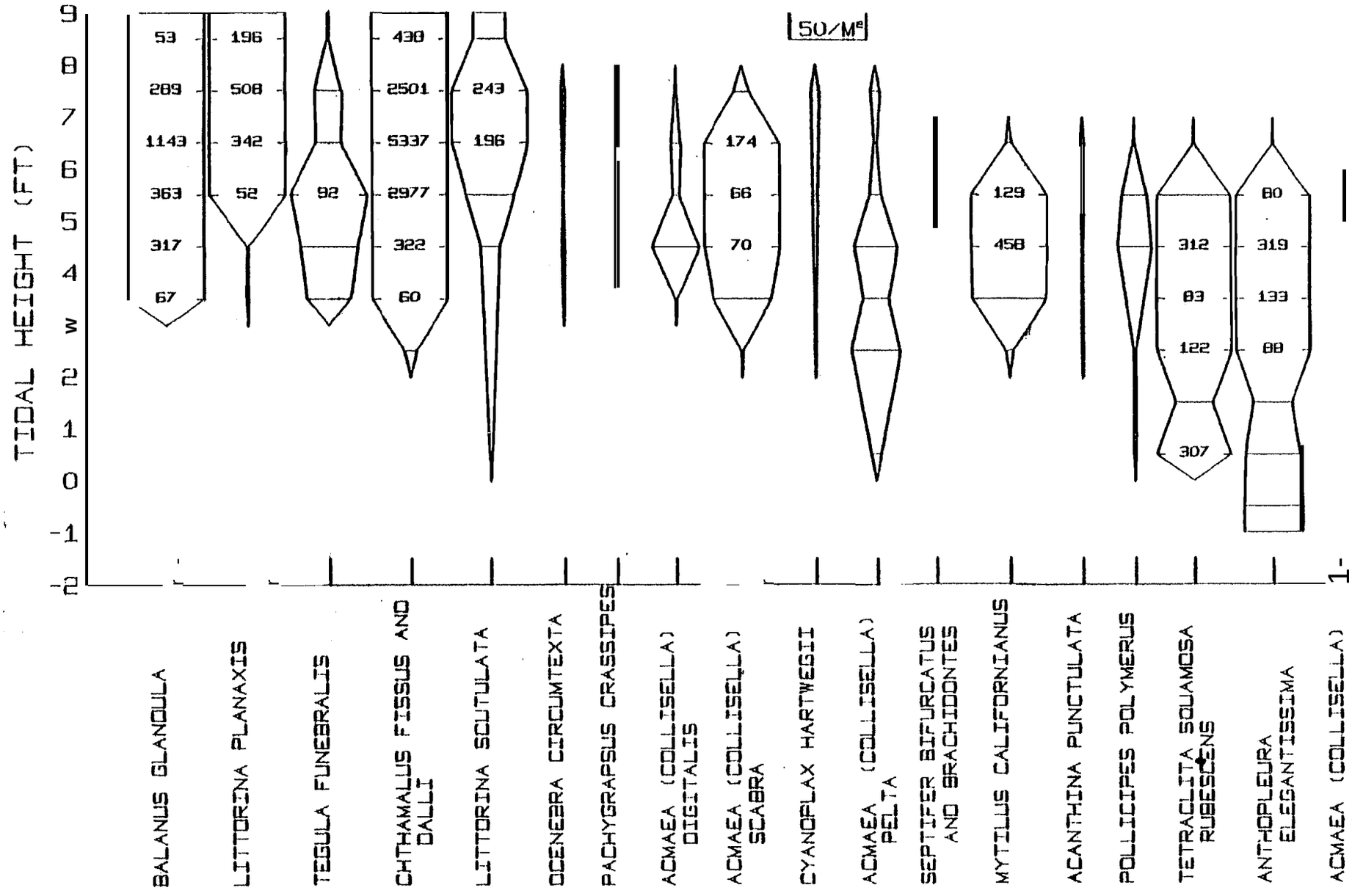

FIGURE 1.1.10-17. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGH FOR DECEMBER 1976 AT SAN MIGUEL ISLAND (CONTINUED

FIGURE 1.1.1-17. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN MIGUEL ISLAND (CONTINUATION).

FIGURE .1.10-18.

USS RIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNC ION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN MIGUEL ISLAND (CONTINUED)

FIGURE 1.1.10-18. OBSERVATION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN MIGUEL ISLAND (CONTINUATION).

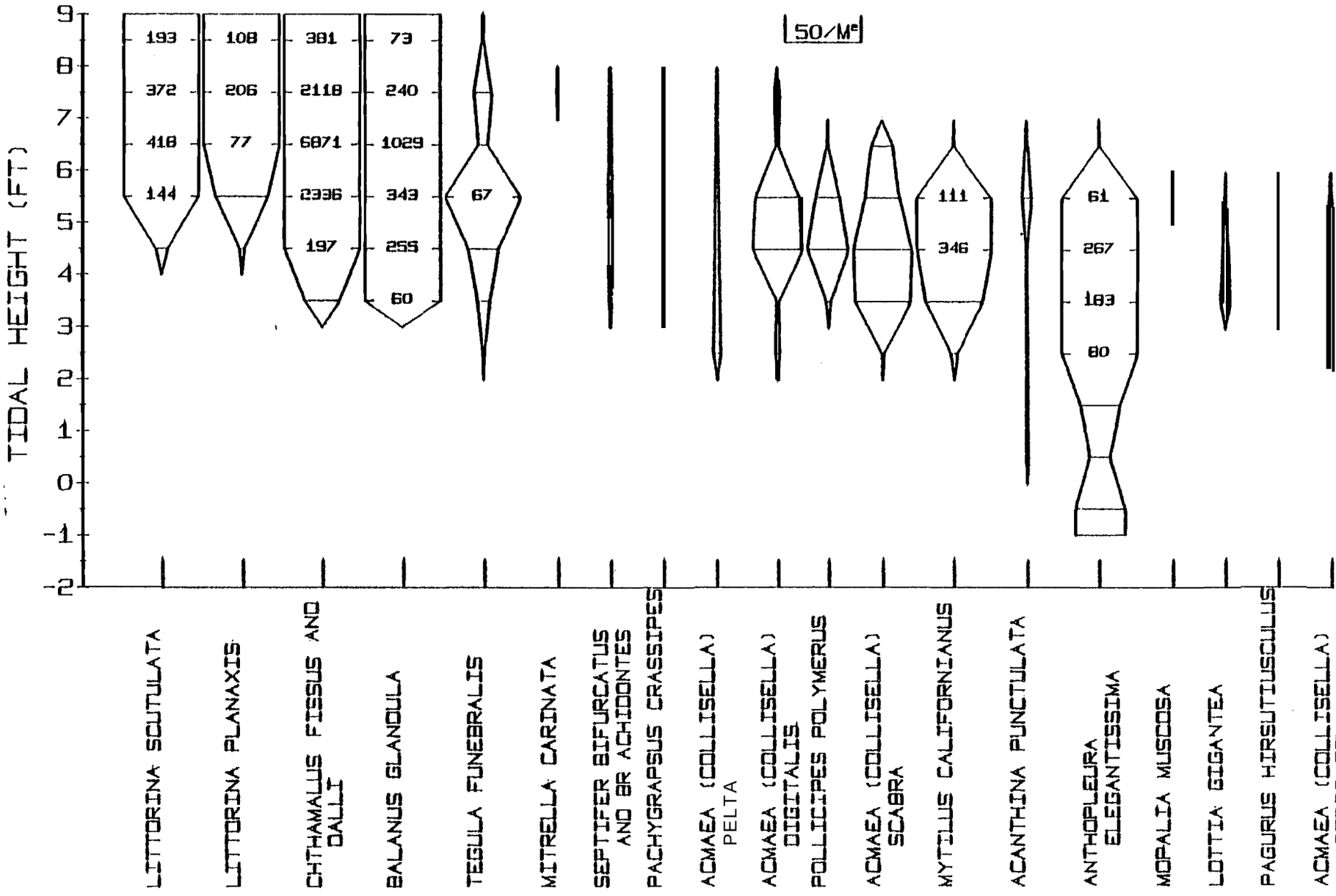

FIGURE 1.1.10-19. DISTRIBUTION OF DOMINAN MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF IDAL HEIGHT FOR FEBRUARY 1977 AT SAN MIGUEL ISLAND CONTINUED.

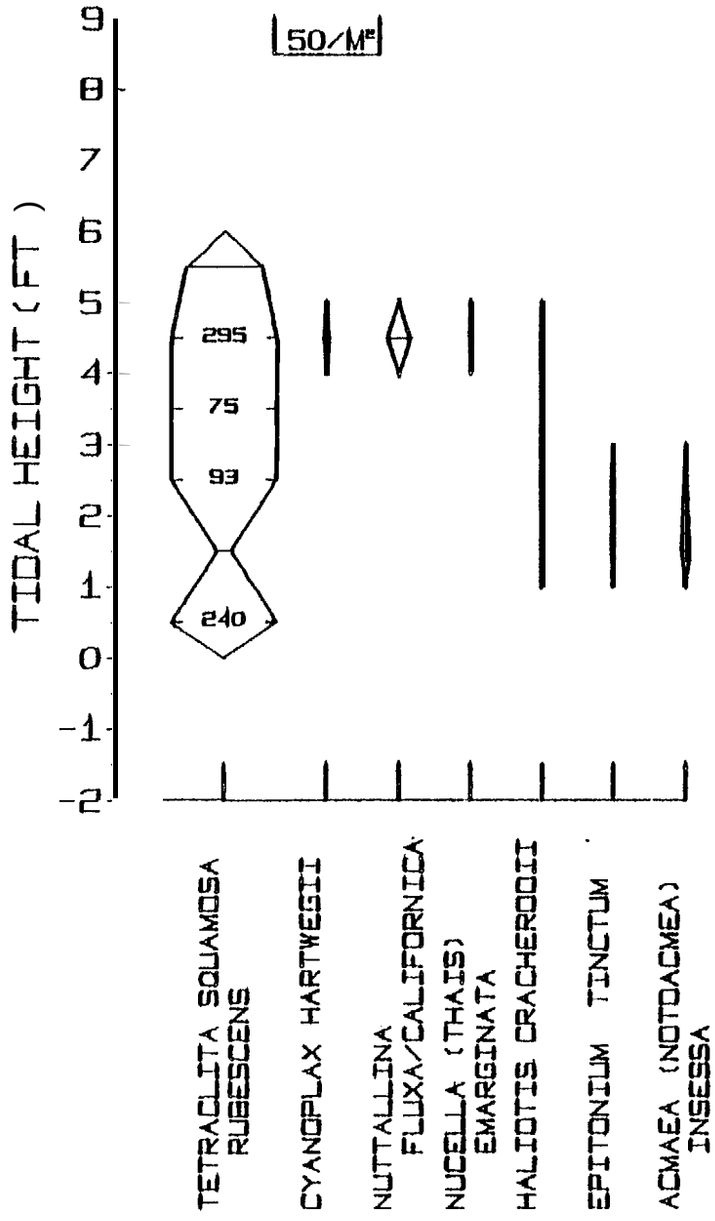

FIGURE 1.1.10-19. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SAN MIGUEL ISLAND (CONTINUATION).

FIGURE 1.1.10-20. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SAN MIGUEL ISLAND (CONTINUED).

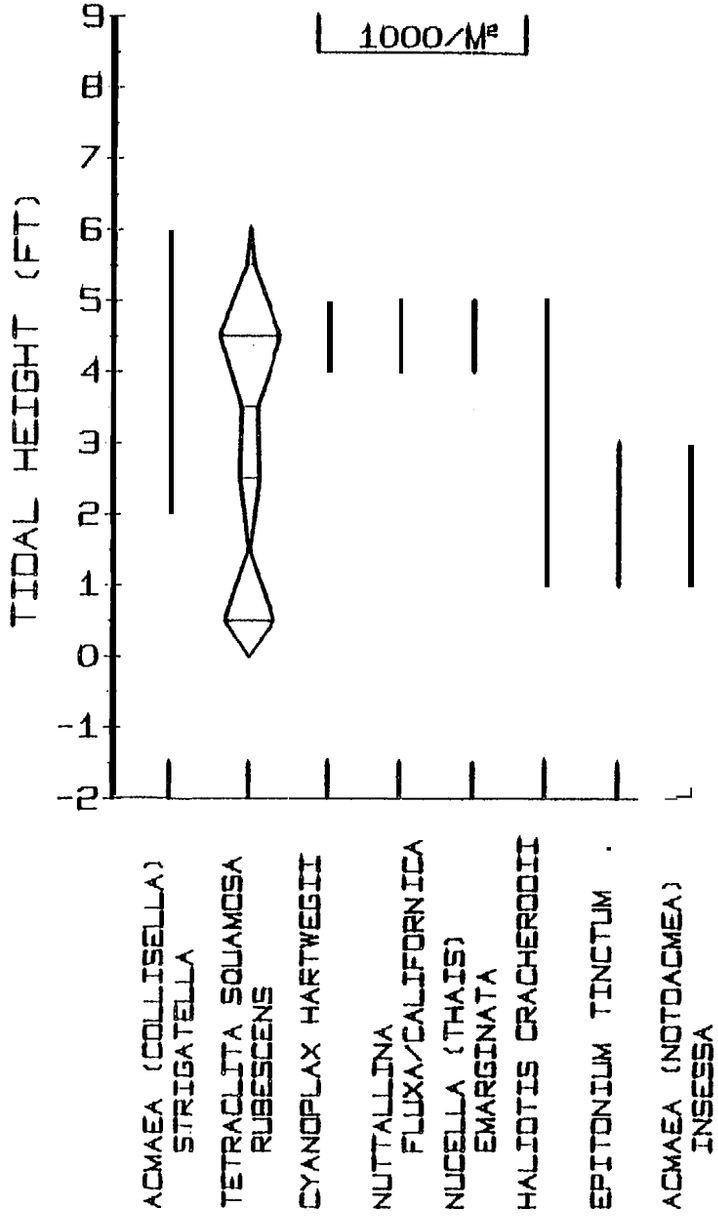

FIGURE 1.1.10-2. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR FEBRUARY 1977 AT SAN MIGUEL ISLAND (CONTINUATION).

FIGURE 1.1.10-21. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 A-1 SAN MIGUEL ISLAND (CONTINUED).

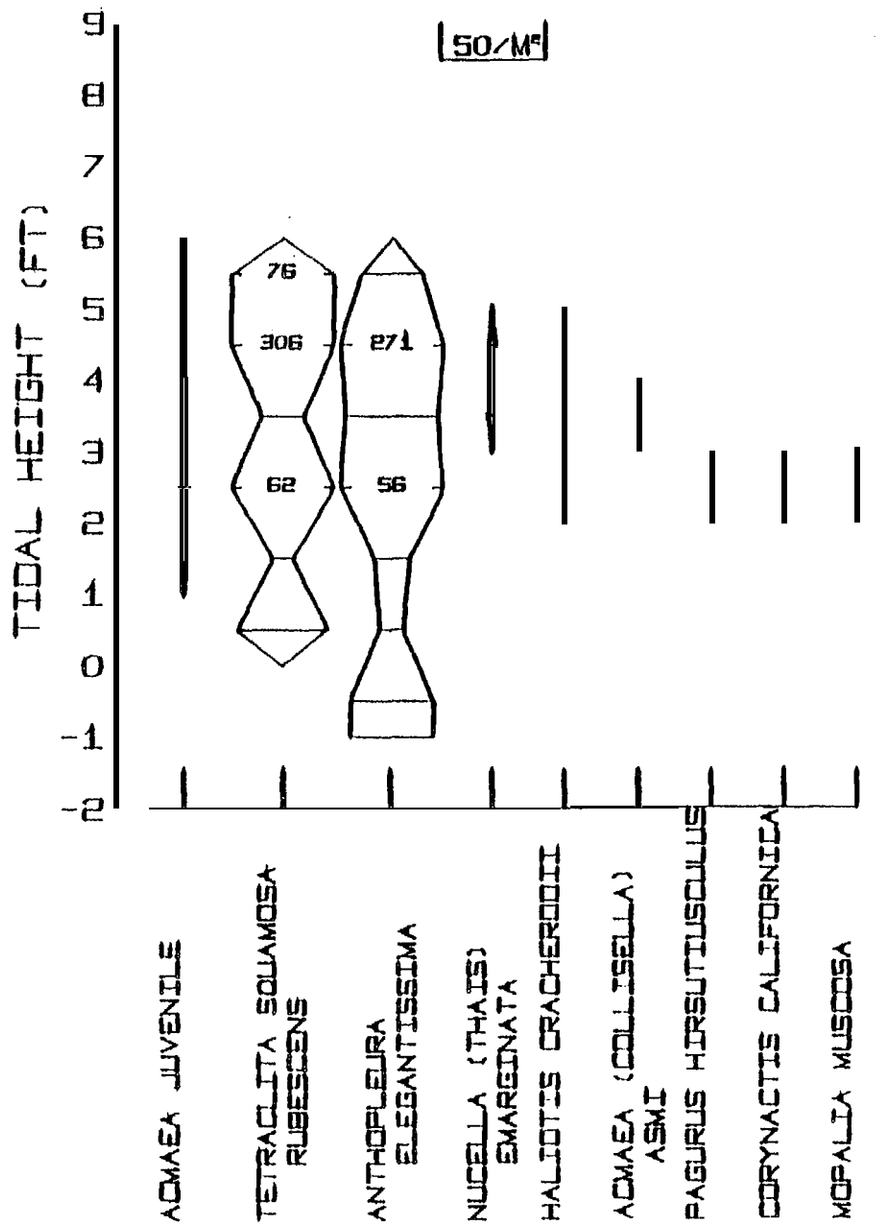

FIGURE 1.1.1-21. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SAN MIGUEL ISLAND (CONTINUATION).

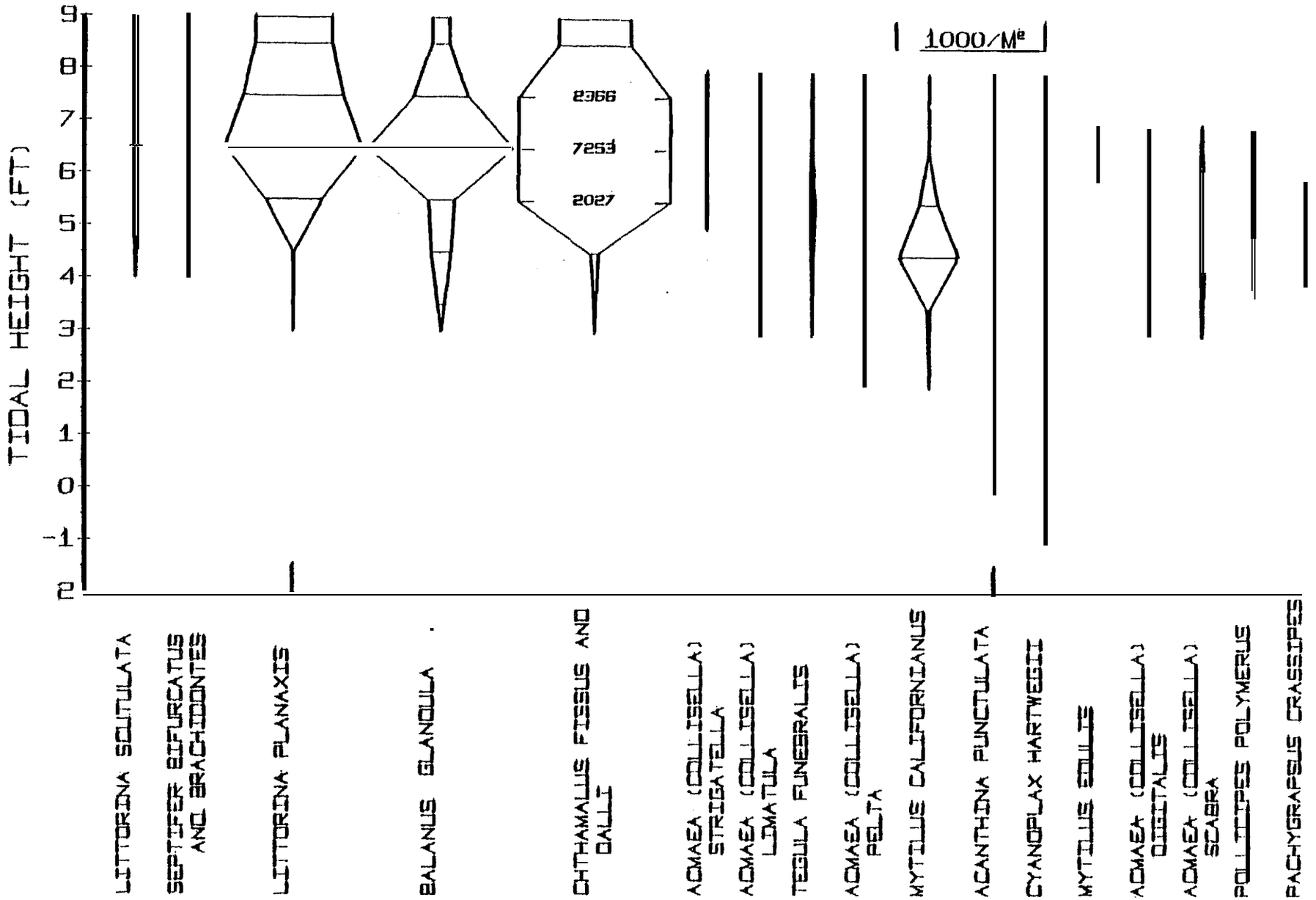

FIGURE 1.1.0-22. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SAN MIGUEL ISLAND (CONTINUED).

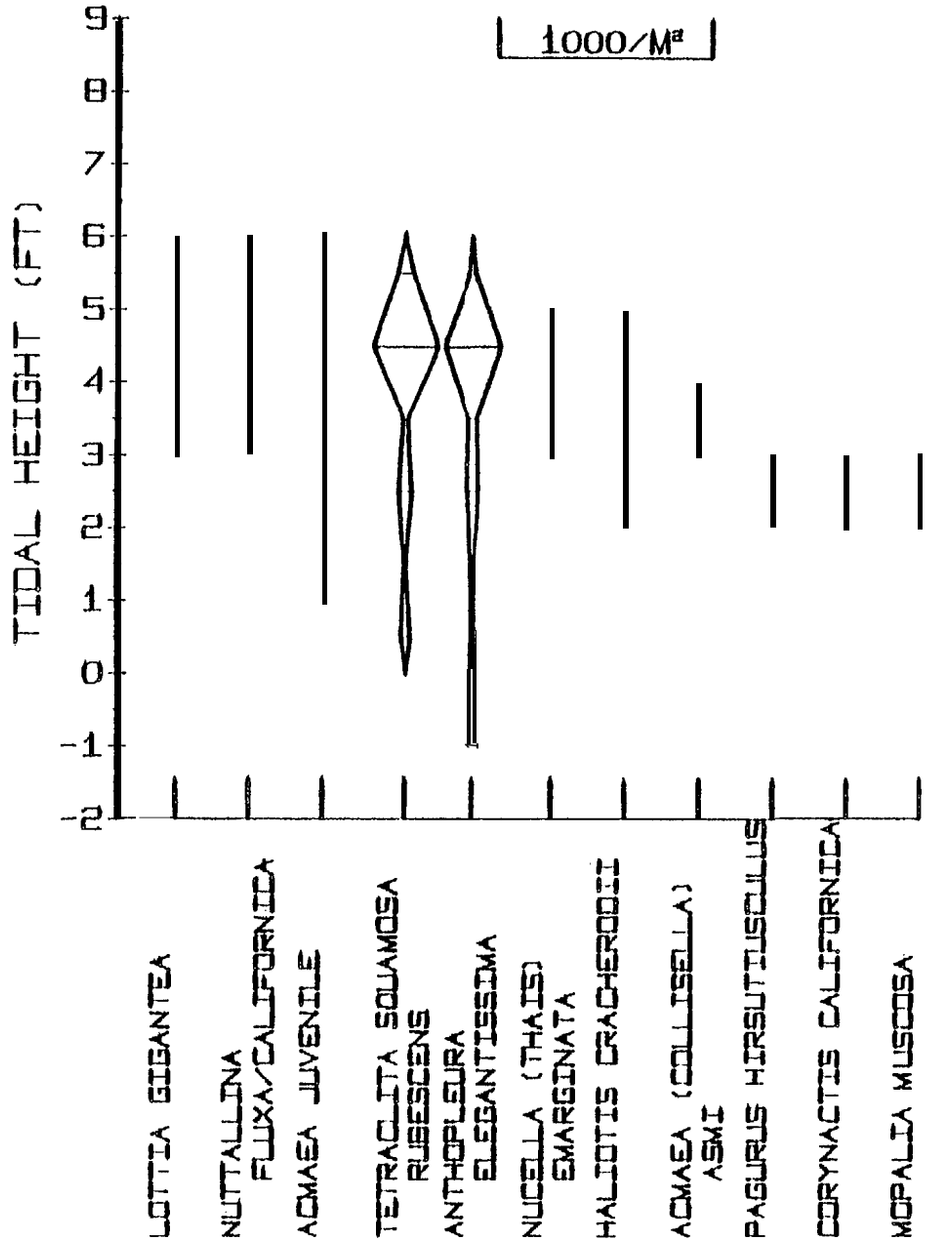

FIGURE .1.10-22. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MAY 1977 AT SAN MIGUEL ISLAND (CONTINUATION).

TABLE 11.0-11. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM CUYLER HARBOR, SAN MIGUEL ISLAND FROM OCTOBER 1975 TO OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT) MLLW TO 0.9 (N= 1)	1.0 TO 1.9 (N=10)	2.0 TO 2.9 (N=11)	3.0 TO 3.9 (N= 2)	4.0 TO 4.9 (N= 6)	5.0 TO 5.9 (N=10)	6.0 TO 6.9 (N= 9)	7.0 TO 7.9 (N= 1)	MEAN
PELVETIA FASTIGIATA					1506.0	3592.0	1.7		637.5
ENDOCLADIA MURICATA		<0.1		1.6	41.7	60.7	80.3		23.8
RHODOGLOSSUM AFFINE		4.9	73.1	185.2	61.2	23.3	0.7		45.6
ULVA CALIFORNICA		<0.1	13.0	3.1	<0.1	<0.1	0.1		2.1
CLADOPHORA COLUMBIANA			0.7	3.8	29.4	<0.1			4.2
PORPHYRA PERFORATA			7.5	52.2	24.5	28.6			14.1
GIGARTINA PAPILLATA		2.9	8.1	64.3	14.6	7.6			12.2
POLYSIPHONIA SPP.		0.2	5.1			<0.1			0.7
GELIDIUM COULTERI		65.3	23.9	189.1	2.3	3.8			35.6
PLOCAMIUM VIOLACEUM		62.1	23.1	65.8		<0.1			10.9
PRIONITIS LANCEOLATA	632.7	203.6	87.3			0.2			115.5
PTEROSIPHONIA DENDROIDEA	42.0	0.4	<0.1	6.0		<0.1			6.0
CORALLINA OFFICINALIS VAR. CHILENSIS	8.5	26.2	14.2	9.4	13.5	10.6			10.3
CORALLINA VANCOUVERIENSIS	492.1	565.6	462.3	779.5	159.1	20.5			314.9
GELIDIUM PUSILLUM	6.0				0.3	1.9			1.0
CRYPTOPLEURA CORALLINARA	7.7	100.3	138.3	46.9		0.2			36.7
GIGARTINA CANALICULATA	572.3	1779.3	2199.2	2237.6	0.8	8.6			849.8
GIGARTINA SPINOSA	219.7	68.7	54.6			0.3			42.9
IRIDAEA CORDATA VAR. SPLENDENS		88.7	65.4	462.1	0.1				94.5
MICROCLADIA BOREALIS		3.9	80.2	86.1	0.4				21.3
PTEROSIPHONIA BAILEYI	17.3	63.1	49.8	4.0	<0.1				16.8
PLOCAMIUM CARTILAGINEUM	222.9	13.4	26.3		<0.1				32.8

No L. 1 POD = 0.3048 METERS

TABLE .1.10-11. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM CUYLER HARBOR, SAN MIGUEL ISLAND FROM OCTOBER 1975 TO OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED).

TAXA	TIDAL HEIGHT (FT). MLLW TO 0.9 (N= 1)	1.0 TO 1.9 (N=10)	2.0 TO 2.9 N=11	3.0 TO 3.9 (N= 2)	4.0 TO 4.9 N= 6	5.0 TO 5.9 (N=16)	6.0 TO 6.9 (N= 9)	7.0 TO 7.9 (N= 1)	MEAN
CALLITHAMNION RUPICOLUM	8.3	10.1	4.1	15.3	<0.1				4.7
CRYPTOPLEURA VIOLACEA	9.6	15.7			0.9				5.3
CALLITHAMNION PIKEANUM		0.0	6.9	26.4					4.3
GASTROCLONIUM COULTERI	86.3	37.3	55.9	5.2					23.1
GOSSIELLA ORBIGNIANA SSP. DICHOTOMA	129.1	33.4	6.6	7.6					22.3
LAMINARIA CENTIGERA			14.9						1.9
RHODYMENIA CALIFORNICA VAR. CALIFORN			1.0						0.1
SMITHORA NAIADUM			72.6						9.1
PHYLLOSPADIX SCOULERI			1840.4						230.0
IPIDEA HETEROCARPA			3.3						0.4
GRATELOUPIA DORYPHORA			0.9						0.1
PHYCODRYS SETCHELLII			1.8						0.2
BENTHIC DIATOMS			3.0						0.4
CERAMIUM EATONIANUM/SINICOLA		1.7	2.5						0.5
BRYOPSIS CORTICULANS	0.4	0.5	0.3						0.1
EGREGIA MENZIESII	923.5	55.5	283.0						157.7
CHORDARIA DECIPIENS		1.9							0.2
MICROCLADIA COULTERI		11.2							1.4
RHODYMENIA PACIFICA	25.1	<0.1							3.1
LAURENCIA SPECTABILIS	32.9	2.6							4.4
ANISOCLADELLA PACIFICA	10.6	2.0							1.6
CERAMIUM SP.	0.9								0.1

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.10-11. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM CUYLER HARBOR, SAN MIGUEL ISLAND FROM OCTOBER 1975 TO OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT IN FEET								
	MLLW TO 0.9 (N= 1)	1.0 TO 1.9 (N=10)	2.0 TO 2.9 (N=11)	3.0 TO 3.9 (N= 2)	4.0 TO 4.9 (N= 6)	5.0 TO 5.9 (N=14)	6.0 TO 6.9 (N= 9)	7.0 TO 7.9 (N= 1)	MEAN
CRYPTOPLEURA LOBULIFERA	61.7								7.7
CODIUM SETCHELLII	65.9								8.2
OTHER MACROPHYTES (19)	0.2	0.4	0.2			0.6			
TOTAL WET WEIGHT IN G/M2	3575.8	3241.6	5771.4	4271.5	1858.1	3759.2	88.8		

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.10-12. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM CUYLER HARBOR, SAN MIGUEL ISLAND FROM OCTOBER 1975 TO OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). MLLW TO 0.9 (N= 1)	1.0 TO 1.9 (N=10)	2.0 TO 2.9 (N=11)	3.0 TO 3.9 (N= 2)	4.0 TO 4.9 (N= 6)	5.0 TO 5.9 (N=16)	6.0 TO 6.9 (N= 9)	7.0 TO 7.5 (N= 1)	MEAN
CHTHAMALUS FISSUS AND DALLI					1.2	92.5	169.6	0.4	33.0
LITTORINA PLANAXIS					1.1	4.7	19.1	19.5	5.6
LITTORINA SCUTULATA			<0.1		4.4	8.8	18.8	0.9	4.1
BALANUS GLANDULA					25.8	99.7	231.7		44.7
ACMAEA (COLLISELLA) DIGITALI					0.6	0.7	1.7		0.4
ACMAEA (COLLISELLA) SCABRA				1.5	16.5	7.7	1.3		3.4
BRACHIDONTES ADAMSIANUS		0.1	0.2	0.4	5.7	2.4	0.2		1.1
ACANTHINA PUNCTULATA		1.6	5.9	0.2	21.4	12.0	2.0		5.4
MYTILUS CALIFORNIANUS		23.4	57.2	313.7	661.8	163.3	1.6		777.6
TEGULA FUNEBRALIS		50.9	59.2	397.6	202.9	174.5	34.0		114.9
ACMAEA (COLLISELLA) PELTA	0.6	0.7	1.4	3.5	0.5	11.4	0.2		2.3
LOTTIA GIGANTEA					2.5	8.9			1.4
NUTTALLINA CALIFORNICA					10.5	2.0			1.6
NUTTALLINA FLUXA					17.8	1.8			2.5
ACMAEA (COLLISELLA) LIMATULA					0.5	2.9			0.4
NUCELLA (THAIS) EMARGINATA			2.2	2.4	36.3	8.6			6.2
POLLICIPES POLYMERUS			0.2		6.8	5.7			1.6
ACMAEA (COLLISELLA) STRIGATELLA			0.6		3.8	0.2			0.6
NUTTALLINA FLUXA/CALIFORNICA			0.9	15.7	4.3	3.1			3.0
PAGURUS SAMUELIS			1.5			<0.1			0.2
PACHYGRAPSUS CRASSIPES		3.4	46.5	136.7	16.9	1.9			25.7
PHRAGMATOPOMA CALIFORNICA		0.2			50.9	98.1			31.1

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.0-12. WE WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM CUYLER HARBOR, SAN MIGUEL ISLAND FROM OCTOBER 1975 TO OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED).

TAXA	TIDAL HEIGHT (FT). MLLW TO 0.9 (N= 1)	1.0 TO 1.9 (N=10)	2.0 TO 2.9 (N=1)	3.0 TO 3.9 (N= 2)	4.0 TO 4.9 (N= 6)	5.0 TO 5.9 (N=16)	6.0 TO 6.9 (N= 9)	7.0 TO 7.9 (N= 1)	MEAN
TETRACLITA SQUAMOSA RUBESCENS		4.6	41.9		44.1	6.2			12.1
MOPALIA MUSCOSA		26.5	12.8	6.8	0.7	1.2			5.3
CYANOPLAX HARTWEGII		0.1	<0.1	1.1	3.9	12.2			2.2
MODIOLUS CAPAX	1.3	1.2	8.4	13.0	19.4	2.7			5.8
PUGETTIA PRODUCTA	1.9	6.5	14.2			<0.1			2.8
ANTHOPLEURA ELEGANTISSIMA	400.7	332.1	224.9	172.3	93.5	20.9			155.6
SEPTIFER BIFURCATUS					34.8				4.3
PACHYCHELES RUDIS					6.4				0.8
HALIOTIS CRACHERODII			22.0		13.4				4.4
MITRELLA CARINATA	0.9	0.3			<0.1				0.2
PAGURUS HIRSUTIUSCULUS	1.4	0.7	2.0	0.2					1.7
BROWN SPONGE			274.6						34.3
MYTILUS EDULIS			5.2						0.6
TUNICATES UNKNOWN			6.5						0.8
ORANGE SPONGE		55.9	3.9						7.5
CANCER ANTENNARIUS		3.0	16.6						2.4
LACUNA UNIFASCIATA	3.	2.8	1.2						1.0
DEMOSPONGIAE		5.0							0.6
FISSURELLA VOLCANO		2.5							0.3
CANCER JORDANI		1.0							0.1
CREPIPATELLA LINGULATA		0.9							0.1
SPHECIOSPONGIA CONFOEDERATA		5.9							0.7

NOTE: 1 FOO = 0.3048 METERS

TABLE 1.1.10-12. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM CUYLER HARBOR SAN MIGUEL ISLAND OCTOBER 1975 TO OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). MLLW TO 0.9 (N= 1)	1.0 TO 1.9 (N=10)	2.0 TO 2.9 N=11	3.0 TO 3.9 (N= 2)	4.0 TO 4.9 (N= 6)	5.0 TO 5.9 (N=16)	6.0 TO 6.9 (N= 9)	7.0 TO 7.9 N= 1)	MEAN
ARCHIDISTOMA PSAMMION	333.7	3.4							42.1
DODECACERIA FEWKESI	5960.5	1404.9							930.7
OTHER MACRO-INVERTEBRATES (16)	0.1	0.5	1.3		0.3	0.4			
TOTAL WET WEIGHT IN G/M2	6713.9	2018.2	811.3	1067.0	6408.7	754.6	460.2	20.8	

NOTE: 1 FOOT = 0.3048 METERS

Table 1.1.10-13. Organic Dry Weight in g/m^2 for Dominant Macrophytes from Cuyler Harbor, San Miguel Island from October 1975 to October 1976. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros.

Taxa	Tidal Height (ft) MLLW to 0.9 (N=1)	1.0 to 1.9 (N=10)	2.0 to 2.9 (N=11)	3.0 to 3.9 (N=2)	4.0 to 4.9 (N=6)	5.0 to 5.9 (N=16)	6.0 to 6.9 (N=9)	7.0 to 7.9 (N=1)	Mean
Pelvetia fastigiata					445.2	894.6	0.4		167.5
Endocladia muricata		<0.1		0.3	6.3	11.0	18.2		4.5
Rhodoglossum affine		0.9	10.3	15.7	10.1	3.8	<0.1		5.1
Ulva californica		<0.1	1.6	0.2	<0.1	<0.1	<0.1		0.2
Cladophora columbiana			0.2	0.5	8.1	<0.1			1.1
Porphyra perforata			0.7	3.6	3.6	3.7			1.4
Gigartina papillata		0.4	2.0	7.8	3.5	2.0			2.0
Gelidium coulteri		14.2	5.7	32.3	0.5	1.2			6.7
Plocamium violaceum		9.0	2.9	6.=		<0.1			2.3
Prionitis lanceolata	127.5	48.5	22.3			<0.1			24.8
Pterosiphonia dendroidea	5.0	<0.1	<0.1	0.3		<0.1			0.7
Corallina officinalis var. chilensis*	0.4	2.1	1.1	0.4	1.0	0.7			0.7
Corallina vancouveriensis*	29.8	37.1	30.0	44.1	9.5	1.6			19.0
Gelidium pusillum	0.7				0.1	0.3			0.1
Cryptopleura corallinara	0.7	17.5	19.5	4.6		<0.1			5.3
Gigartina canaliculata	104.3	313.5	384.9	282.5	0.2	1.8			135.9
Gigartina spinosa	25.7	8.2	12.4			0.1			5.8
Iridaea cordata var. splendens		15.6	35.0	61.8	0.1				14.0
Microcladia borealis		0.7	11.1	8.6	0.1				2.6
Pterosiphonia baileyi	3.0	8.7	6.2	0.3	0.1				2.3
Plocamium cartilagineum	23.5	1.5	2.8		0.1				3.5
Callithamnion rupicolum	0.5	1.9	0.7	2.3	0.1				0.7

Table 1.1.10-13. Organic Dry Weight in g/m^2 for Dominant Macrophytes from Cuyler Harbor, San Miguel Island from October 1975 to October 1976. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros. (Continued).

Taxa	Tidal Height (ft) MLLW to 0.9 (N=1)	1.0 to 1.9 (N=10)	2.0 to 2.9 (N=11)	3.0 to 3.9 (N=2)	4.0 to 4.9 (N=6)	5.0 to 5.9 (N=16)	6.0 to 6.9 (N=9)	7.0 to 7.9 (N=1)	Mean
Cryptopleura violacea	1.8	2.0			0.1				0.5
Callithamnion pikeanum		0.1	0.9	2.2					0.4
Gastroclonium coulteri	11.1	5.0	6.0	0.3					2.8
Bossiella orbigniana ssp. dichotoma*	8.1	2.8	0.6	0.5					1.5
Laminaria dentigera			5.7						0.7
Smithora naiadum			5.4						0.7
Phyllospadix scouleri			578.0						72.2
Egregia menziesii	202.0	14.0	95.6						39.0
Microcladia coulteri		0.8							0.1
Rhodymenia pacifica	4.9	<0.1							0.6
Laurencia spectabilis	4.9	0.5							0.7
Anisocladella pacifica	1.4	0.3							0.2
Cryptopleura lobulifera	9.1								1.1
Codium setchellii	10.1								1.3
Other Macrophytes (29)	0.2	1.0	2.5			0.1			
Total Organic Dry Weight in g/m^2	574.7	506.7	1,244.2	475.0	488.8	921.5	18.7		528.7

Note: 1 foot = 0.3048 meters

Table 1.1.10-14. Organic Dry Weight in g/m^2 for Dominant Macroinvertebrates from Cuyler Harbor, San Miguel Island from October 1975 to October 1976. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros.

Taxa	Tidal Height (ft) MLLW to 0.9 (N=1)	1.0 to 1.9 (N=10)	2.0 to 2.9 (N=11)	3.0 to 3.9 (N=2)	4.0 to 4.9 (N=6)	5.0 to 5.9 (N=16)	6.0 to 6.9 (N=0)	7.0 to 7.9 (N=1)	Mean
Chthamalus fissus/dalli*					<0.1	3.3	6.2	<0.1	1.2
Littorina planaxis*					<0.1	0.2	1.1	1.2	0.3
Littorina scutulata*			<0.1		0.2	0.4	1.1	0.1	0.2
Balanus glandula*					1.6	5.6	15.1		2.8
Acmaea (Collisella) digitalis*					0.1	<0.1	<0.1		<0.1
Acmaea (Collisella) scabra*				0.1	1.3	0.5	0.1		0.2
Brachidontes adamsianus*		<0.1	<0.1	<0.1	0.6	0.2	<0.1		0.1
Acanthina punctulata*		0.1	0.4	<0.1	1.4	0.8	0.1		0.4
Mytilus californianus*		1.8	4.5	26.1	551.6	14.5	0.1		74.8
Tegula funebralis*		5.2	6.5	40.7	22.1	16.8	3.4		11.8
Acmaea (Collisella) pelta*	<0.1	0.1	0.1	0.3	<0.1	1.1	<0.1		0.2
Lottia gigantea*					0.2	0.9			0.1
Nuttallina californica*					1.5	0.3			0.2
Nuttallina fluxa*					2.2	0.3			0.3
Acmaea (Collisella) limatula*					0.1	0.3			<0.1
Nucella (Thais) emarginata*			0.2	0.2	2.8	0.7			0.5
Pollicipes polymerus*			<0.1		0.9	0.8			0.2
Acmaea (Collisella) strigatella*			<0.1		0.2	<0.1			<0.1
Nuttallina fluxa/californica*			0.1	1.9	0.6	0.4			0.4
Pachygrapsus crassipes*		0.7	9.1	24.2	2.8	0.4			4.6
Phragmatopoma californica*		<0.1			6.0	3.7			1.2
Tetraclita squamosa rubescens*		0.2	1.8		2.0	0.3			0.5

Table 1.1.10-14. Organic Dry Weight in g/m^2 for Dominant Macroinvertebrates from Cuyler Harbor, San Miguel Island from October 1975 to October 1976. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros. (Continued).

Taxa	Tidal Height (ft) MLLW to 0.9 (N=1)	1.0 to 1.9 (N=10)	2.0 to 2.9 (N=11)	3.0 to 3.9 (N=2)	4.0 to 4.9 (N=6)	5.0 to 5.9 (N=16)	6.0 to 6.9 (N=9)	7.0 to 7.9 (N=1)	Mean
Mopalia muscosa*		4.1	2.2	1.3	0.1	0.2			1.0
Cyanoplax hartwegii*		<0.1	<0.1	0.1	0.6	1.6			0.3
Modiolus capax*	0.1	0.1	0.7	1.1	1.9	0.3			0.5
Pugettia producta*	0.3	1.0	2.5			<0.1			0.5
Anthopleura elegantissima*	70.6	51.2	32.7	22.1	13.9	3.0			24.2
Septifer bifurcatus*					3.0				0.4
Pachycheles rudis*					1.2				0.2
Haliotis cracherodii*			5.3		2.2				0.9
Mitrella carinata*		<0.1			<0.1				<0.1
Pagurus hirsutiusculus*		0.1	0.2	<0.1					0.2
Brown sponge*			46.5						5.8
Mytilus edulis*			0.4						<0.1
Tunicates unknown			3.2						0.4
Orange sponge*		7.8	0.3						1.0
Cancer antennarius*		0.4	2.2						0.3
Lacuna unifasciata*	0.4	0.3	0.2						0.1
Fissurella volcano*		0.2							<0.1
Spheciospongia confoederata		1.1							0.1
Archidistoma psammion	145.0	1.7							18.3
Dodecaceria fewkesi*	347.6	89.1							54.6
Other Macroinvertebrates (20)	0.0	1.2	0.9		0.2	0.3			
Total Organic Dry Weight in g/m^2	565.4	166.8	120.5	118.4	621.8	57.2	27.5	1.4	209.9

Note; 1 foot = 0.3048 meters

Macroinvertebrate patterns of dominance changed dramatically because Dodecaceria fewkesi (930.7 g/m^2 WW) was not measured previously (1 975-76) and Mytilus calif ornianus was more heavily sampled (5661.8 g/m^2 WW) in the +4.0 to +5.0 ft. (+1.2 to +1.5 m) interval. However, Tegula funebralis (l14.0 g/m^2 WW) and Anthopleura elegantissima (115.6 g/m^2 WW) remained as prominent contributors to biomass.

1.1.10.4.3 Tidepools

1.1. 10.4.3.1 Standing Crop

Since there were no tidepools included by our undisturbed transect lines, no additional tidepool information was obtained beyond that sampled during 1975-76.

1.1.10.4.3.2 Tidepool Finfishes

In the present disturbed sampling program, tidepool finfish were collected during October 1976; of the two species taken throughout 1975-76 (i.e., Clinocottus recalvus and C. analis) only the former was present.

1.1.10.4.4 Community Analysis

1. 1.10.4.4.1 Species Diversity

Seasonal and yearly mean taxa number, Margalef's (1968), richness (D'), Shannon-Weaver (1949) diversity (H'), and Pielou's (1975) evenness (J') indices for macrophytes and macroinvertebrates are presented in Table 1.1.10-15. Combined macro phyte and macroinvertebrate H' diversity (which included aspects of both evenness and richness) averaged 3.13 for cover, contrasted with 2.98 for the previous year. Compared to 1975-76 data, D' was also higher (19.76 vs. 15.38) while J' was slightly lower (0.67 vs. 0.7'0). This trend, whereby D' increased markedly during 1976-77 while J' remained at about 1975-76 levels , held for both macro phytes and macro invertebrates considered separately, using cover and density data (Table 1. 1.10-15). This resulted in greatly increased Shannon-Weaver values over 1975-76 indices.

Because of the greater overall cover of macrophytes, their values had a greater influence on combined H' diversity than did macroinvertebrate cover. This resulted in peak combined H' values in December 1976 (3.22) and May 1977 (3.17) in association with the macrophyte peaks in those periods (H' = 2.89). Contrastingly, macroinvertebrate H' diversity (2.04) was highest during December 1976 but was minimal in May 1977 (1.80). The seasonal differences in H' diversity were reflective of the values for richness (which tracked total taxa present) while evenness remained remarkably constant; whereas, the reverse occurred during 1975-76. The patterns of

TABLE 1,1.10-15. SEASONAL AND ANNUAL DIVERSITY FOR SAN MIGUEL ISLAND.

GROUPS AND DATES	NO. TAXA	COVER (%) D'	COVER (%) H'	COVER (%) J'	DENSITY (NO./M2) D'	DENSITY (NO./M2) H'	DENSITY (NO./M2) J'
MACRO-INVERTEBRATES							
OCT. 1976	3s	10.03	1.97	0.56	4.23	1.31	0.37
DEC. 1976	45	14.20	2.04	0.54	5.84	1.44	0.38
FEB. 1977	32	9.76	1.84	*0.53*	4.14	1.28	0.37
MAY 1977	33	10.02	1.80	0.51	4.25	1.26	0.36
MEAN	36	11.00	1.91	0.54	4.62	1.32	0.37
MACROPHYTES							
OCT. 1976	52	11.39	2.70	0.68	- -	- -	- -
DEC. 1976	63	13.98	2.89	0.70	- -	- -	- -
FEB. 1977	54	11.82	2.72	0.68	- -	- -	- -
MAY 1977	*65*	14.09	2.89	0.69	- -	- -	- -
MEAN	59	12.82	2.80	0.69			
COMBINED MACRO-INVERTEBRATES AND MACROPHYTES							
OCT. 1976	85	17.79	3.07	0.69	- -	- -	- -
DEC. 1976	108	22.92	3.22	0.69	- -	- -	- -
FEB. 1577	86	16.00	3.05	0.69	- -	- -	- -
MAY 1977	98	20.32	3.17	0.69	- -	- -	- -
MEAN	94	19.76	3.13	0.69			

seasonality shown by all three indices did not repeat those noted in 1975-76; however, the San Miguel Island study site consistently exhibited only slight seasonality of its biota and the differences appeared to be relatively minor. More taxa (average of 17 more macrophytes and 6 macroinvertebrates) were found in our 1976-77 samples than the previous year, largely reflecting our greater ability to distinguish between species. This accounts in part for the increases in richness and Shannon-Weaver diversity.

1.1.10.4.4.2 Species Assemblages

As in 1975-76, the entire array of samples taken during each season was subjected to statistical cluster analysis using a correlation coefficient of similarity. This technique afforded objective seasonal comparisons by determining if the same samples clustered together consistently over the year.

A dendrogram display of the levels of correlation among the various samples obtained in February of 1977 is presented in Figure 1.1.10-23 to compare with that for the same period in 1976 (cf. Figure 1.1.10-12 in Littler and O'Brien, 1977). Virtually the same groupings were found in 1976-77 as in the previous year with only a few shifts in grouping by several of the quadrats. For example, the blue-green Mytilus group, the Gigartina canaliculata-Phragmatopoma group, and the Gelidium-Gigartina spinosa group of 1975-76 did not cluster; however, in the present study (Figure 1.1.10-23), five new groups appeared (i.e., the bare rock blue-green group, AD; the Gigartina canaliculata-Dodecaceria group, DB; the Gigartina canaliculata-Phyllospadix group, DC; the Prionitis group, F; and the Bossiella-Egregia group, G).

Figure 1.1.10-24 provides the distributional patterns of the various assemblages defined by the cluster analysis in respect to their various quadrat positions along the three transect lines. All of these groupings remained constant throughout 1976-77 as they had the previous year, depicting a stable pattern of zonation similar to that previously described (Littler and O'Brien, 1977). One exception appears to be in the lower intertidal where quadrats containing the Gigartina canaliculata-Dodecaceria group (DB) appear (Figure 1.1.10-24) in lieu of the Gigartina canaliculata-Corallina and Gigartina canaliculata-Phragmatopoma groups of the previous year. Also several of the south transect quadrats containing the blue green Mytilus group of 1975-76 were dominated by the Phragmatopoma-blue-green assemblage in 1976-77.

1.1.10.5 Discussion

As in 1975-76, the principle feature characterizing the biota of Cuyler Harbor, San Miguel Island, was the high degree of seasonal constancy. Only minor changes between the data gathered by the

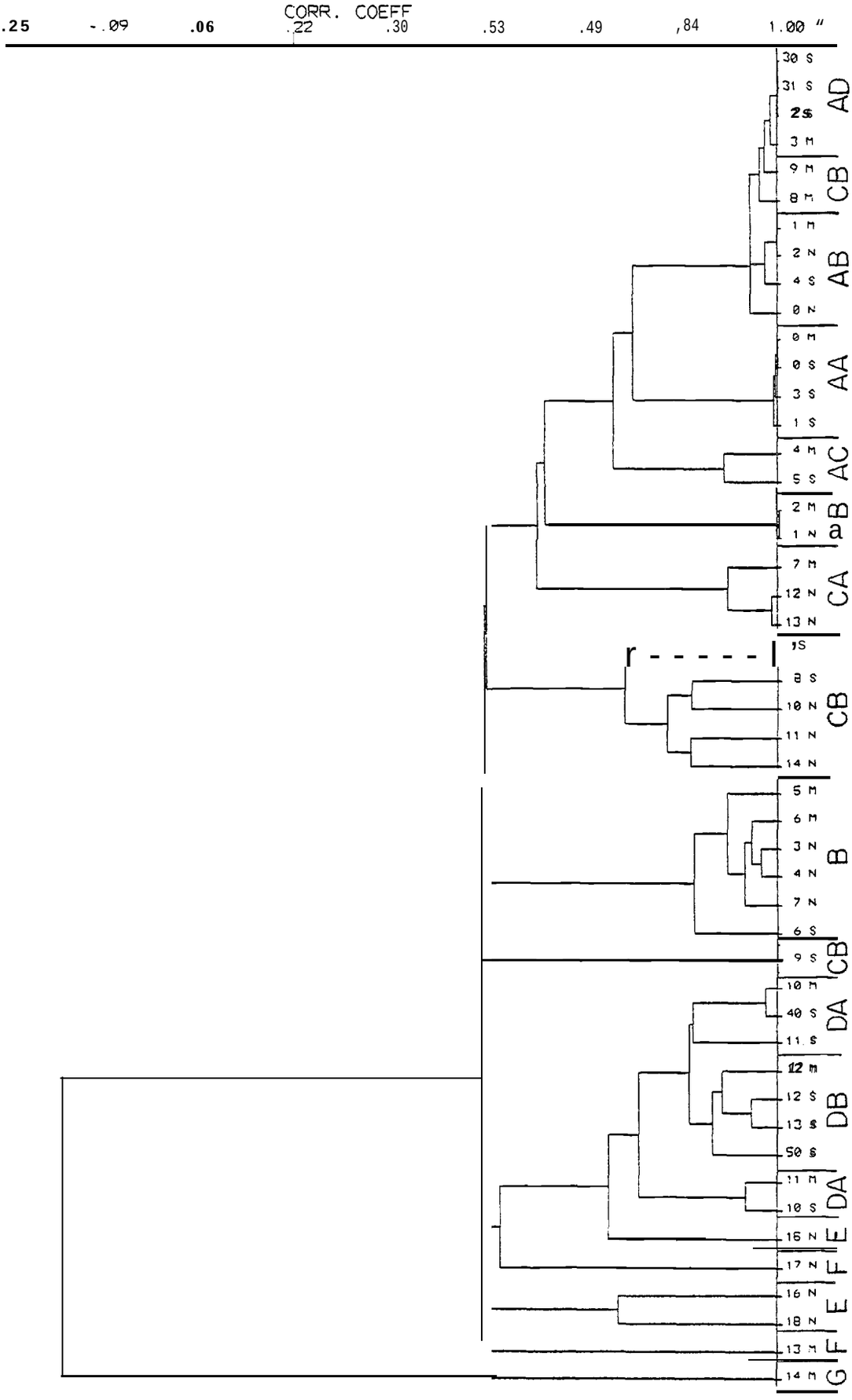

Figure 1.1.10-23 Dendrogram Display of Differential Clustering of Quadrats Sampled During February 1977 from San Miguel Island.

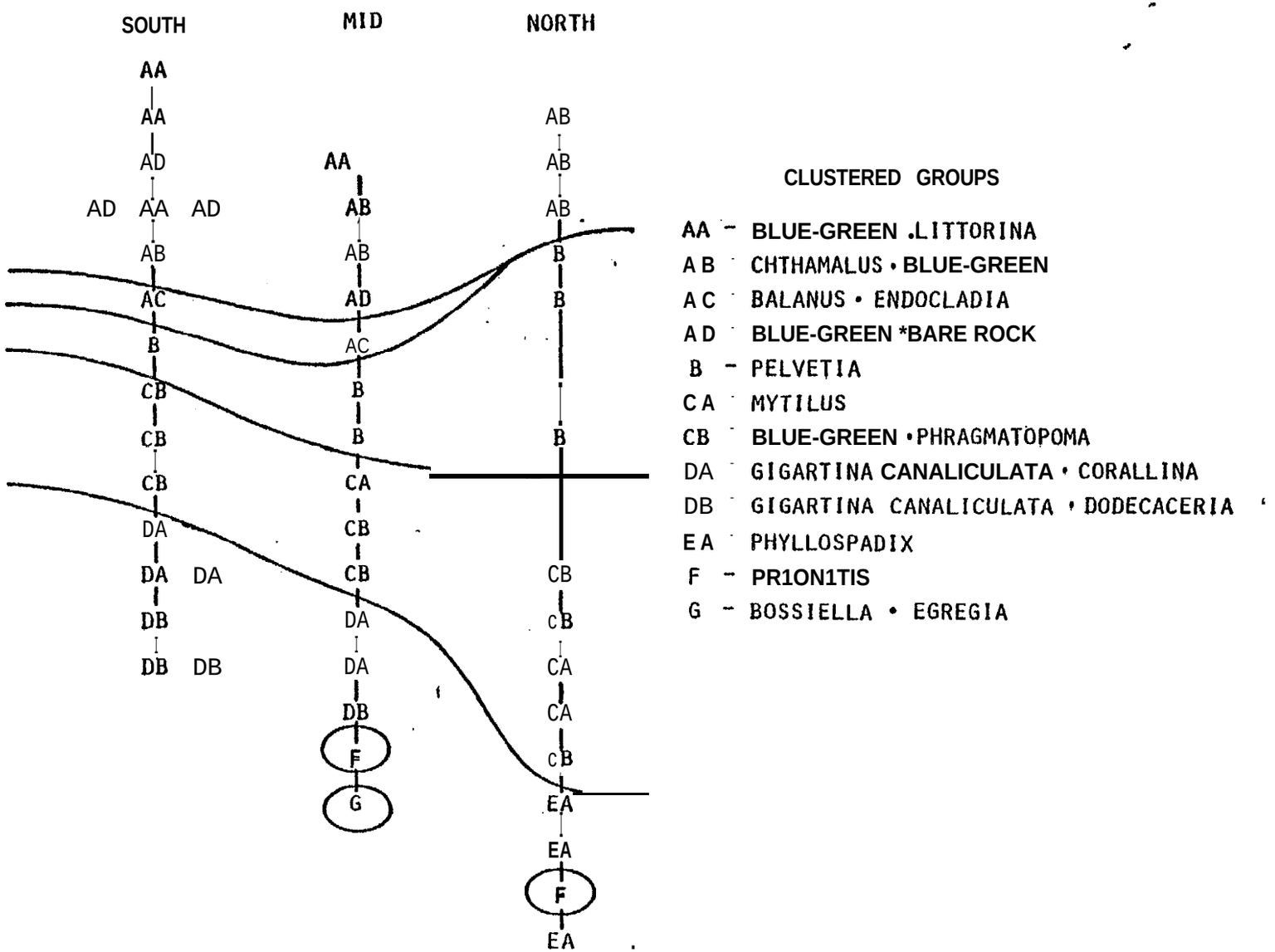

Figure 1.1.10-24 **Distributional Patterns** of **Species** Groups from **San Miguel** Island for February 1977 in Relation to Position of Transects and Locations of Quadrats.

present study and that of the preceding year were evident. Except for variations caused by seasonal species (e.g ., Porphyra perforata) much of the season ality seemed relatable to recruitment by several macro invertebrates (e. g., Littorina scutulata) and winter die-back of several macro phyte taxa (e .g. , Egregia menziesii) in association with daytime low tides and desiccating winds. As in the previous year, Shannon-Weaver (H′) diversity, richness (D′), and evenness (J′) did not change appreciably over the year for either macrophytes or macroinvertebrates , reflecting stable conditions. However, the J′ and H′ indices were considerably higher in 1976-77 than in 1975-76, probably as a reflection of the improved ability on our part to discern the various taxa. This site is characterized by relatively high mean H′ (3.13), J′ (0.69), and D′ (19.76) values, and few opportunistic species (Littler and Murray, 1975). The cover dominants tended to be the larger perennial species indicative of mature, environmentally constant intertidal communities. Again, mobile carnivores aside from Anthopleura elegantissima were not abundant on the study site. This current year's study has added 23 new records of macrophytes and 13 new records of macroinvertebrates for the Cuyler Harbor area.

1. 1.10.6 References

Kimura, J. C., "Climate, " pages 2-1 to 2-70 in, M. D. Dailey, B. Hill, and N. Lansing, eds., '*A Summary of Knowledge of the southern California Coastal Zone and Offshore Islands, " U. S. Department of the Interior, Bureau of Land Management (1974).

Littler, M. M., and P, Y. O'Brien, "Biological Features of Rocky Intertidal Communities near Cuyler Harbor, San Miguel Island. California," pages 795-883 in, M. M. Littler, cd., "Spatial and Temporal Variations in the Distribution and Abundance of Rocky Intertidal and Tidepool Biotas in the southern California Bight," Unpubl. Tech. Comp. Rept., U. S. Department of the Interior, Bureau of Land Management (1977).

Littler, M. M., and S. N. Murray, "'"Impact of Sewage on the Distribution, Abundance and Community Structure of Rocky Intertidal Macro-organisms, " Mar. Biol. 30, 277-291 (1975).

Margalef, R., "Perspectives in Ecological Theory," (Chicago, University of Chicago Press, 1968).

Pielou, E. C., "Ecological Diversity," (New York, John Wiley and Sons, 1975) .

Shannon, C. E., and W. Weaver, "'The Mathematical Theory of Communication ," (Urbana, University of Illinois Press, 1949) .

Strange, R. R., "A Climatological Survey of San Miguel, Anacapa, and Santa Barbara Islands, " Unpubl. , cited in, Kimura, 1974, not seen by authors, (1973).

u. s. Naval Weather Command, Fleet Weather Facility, San Diego, "Climatological Study Southern California Operating Area,"' (North Carolina: NWSED, 1971).

INTERTIDAL STUDY OF THE
SOUTHERN CALIFORNIA BIGHT

1.1.11

VARIATIONS IN THE ROCKY INTERTIDAL BIOTA ON LEEWARD, SAN CLEMENTE ISLAND, CALIFORNIA

VOLUME 111

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1.1.11 Variations in the Rocky Intertidal Biota on Leeward San Clemente Island, California

1.1.11.1 Abstract

The distribution, abundance, and community structure of the rocky inter tidal macr obi ota near Wilson Cove , leeward San Clemente Island, were studied from October 1976 to June 1977 in order to further describe annual and seasonal variations in standing stock. The study emphasized undisturbed sampling and analyses have been per formed to maximize data comparability with 1975-76 results. This included the reworking of the previous year's data to remove results attributable to disturbed sampling. Four quarterly biological assessments were per formed, during which a total of 431 quadrats were analyzed and 84 macrophy tes and 82 macr oinver tebrate taxa were sampled.

Overall biotic cover averaged 109.3% (102.6% macrophytes; 6. 7% macr oinver tebrates), a value highly comparable to that generated for 1975-76 undisturbed sampling (108.4%). Macr oinver tebrate cover again showed little variation over the year while macrophy tes ranged seasonally from 90. 7% for December to 112.1 % for June; macr ophy te cover during December was 10 wer than the previous year due mostly to reductions in brown algal standing stocks. Macrophy te and macr oinver tebr ate cover continued to be dominated by the same species established during 1975-76. The macrophy te with the greatest cover was again blue-green algae, while Pterocladia capillacea, Corallina of ficinalis var . chilensis, Egregia menziesii, Pseudolithoderma nigra, Gi gar tins canaliculata, and Halidrys dioica also had large standing stocks as during last year. The majority of macroinver tebrate cover was again contributed by Chthamalus 'fi ssus/dalli , Tetracli ta squamosa rubescens, and Acmaea (Collisella) scabra. Frequency data revealed similar relationships to 1975-76 patterns, with the greatest mean macrophy te frequencies being supplied by blue-green algae , P. nigra C. of ficinalis var . chilensis, and G. canali cula ta. Macr oinver tebrate frequencies were again led by A. (Collisella) scabra, C. fissus/dalli, and Littorina planaxis. Over all macr oinver tebrate density aver aged 2066/m^2 for the year compared to 1781 /m^2 based on 1975-76 undisturbed sampling. Unlike the previous year macr oinver tebr ates were least numer cus during De cember (1 539/m^2) and most abundant during June 2795/m^2). Chthamalus fissus/dalli had the greatest macroinvertebrate mean density, while A. (Collisella) scabra, T. squamosa rubescens, L. planaxis, and poma li tuella/rastrum all had densities greater than 100/m^2 as during 1975-76. Mean wet and organic dry biomass changed very li t tle fr om the previously reported values.

The number of taxa encountered in samples averaged 92 for the year , an increase of 22 over 1975-76. Most of the added species were obtained in low abundances. Richness (De') , Shannon-Weaver diver si ty (H_e'), and evenness (J_e') based on combined macr ophy te and macr oinver tebr ate cover measured 1 9.54, 2.50, and 0.55, respectively. Richness was

higher, while H_e' and J_e' values were lower than 1975-76. June showed high species richness as did the June 1975-76 undisturbed data, while for both years, December was the period of fewest species numbers. Shannon-Weaver diversity was relatively constant over the year although a slightly greater range (2.46 to 2.57) was found compared to 1975-76 (2.65 to 2.66).

The statistically-based determination of groups of quadrats (i.e., cluster analysis) revealed identical patterns to those established the previous year. The four major zones and dominant species groups continued to characterize the shoreline throughout the year, with seasonal variations in species abundances generally being insufficient to alter the clustering of quadrats.

Large seasonal variations in cover were shown by relatively few of the major taxa and overall community changes were not striking. Modest increases in standing stock again occurred during the spring and fall for several of the frondose algae sampled in association with the mid-intertidal coralline algal turf. These included Sargassum agardhianum, Colpomenia sinuosa, Gigartina canaliculata, Laurencia pacifica, and L. snyderae. Egregia menziesii continued to show a pattern of increased cover during the fall and summer and reductions in winter along with Halidrys dioica and Eisenia arborea on the lower shore. Pteocladia capillacea showed increases in cover during winter when the large brown algae were least abundant. Blue-green algae, which developed most extensively during the colder months during the 1975-76 program, failed to show a similar pattern in 1976-77.

This site remains characterized by large macrophyte standing stocks and low abundances of grazing snails (other than littorines), chitons, predatory molluscs, and starfish. Two years of research has revealed modest seasonality and relatively constant annual patterns of macrobiotic standing stocks.

1. 1.11.2 Study Area

1.1.11.2.1 General

The distribution, abundance, and community structure of the macro-organisms for the leeward San Clemente Island rocky intertidal site have been described and analyzed (Murray and Littler, 1977a) for four seasonal assessments during the 1975-76 program. That report included a review of the relevant literature. Since that date, much additional information (Littler and Murray, 1977a) has been published concerning the influence of domenstic wastes on the structure and energetic of intertidal communities near the Wilson Cove study site. No additional data are available for the leeward San Clemente Island site except an isolated report (Dorsey, 1977) of a new species of Rhynchospio, a polychaete inhabitant of intertidal and shallow subtidal coralline algal mats.

1.1.11.2.2 Environmental Data

A thorough description of the study site, including the prevailing wind and wave patterns, shoreline topography, substrate composition> and surface water temperatures and salinities has been presented in the previous report (Murray and Littler, 1977a). Seawater temperature and salinity, air temperatures, and wave height measured during lower low water for 1976-77 were highly comparable to data gathered during 1975-76 although water temperatures were higher for October (20.5 vs. 18.5°C) and December (16.7 vs. 13.8°C, Table 1.1.11-1). Salinity ranged from 33 to 34 °/oo, air temperature from 15.0 to 17.2°C, wave height from less than 0.1 m to 0.7 m; relative humidity readings (Table 1.1. 11-1) initiated during 1976-77 ranged from 79.0 to 81.6%.

1.1.11.3 Methods and Materials

The methods employed for 1976-77 study of the leeward San Clemente Island site were those described previously (Littler, 1977; Murray and Littler, 1977a) with the exceptions noted in the introductory chapter of this report (Chapter 1.1.1). For leeward San Clemente Island, this year's study emphasized undisturbed sampling, as disturbed sampling was performed only during the first quarter. Undisturbed assessments were performed along the three permanent transect lines during 22-27 October 1976, 17-23 December 1976, 16-21 March 1977, and 17-20 June 1977. The sampling strategy was identical to that employed during the 1975-76 program. During each assessment, transect lines were sampled down *to* the lowest emergent plots. The number of undisturbed 0.15 and 1. 0-m^2 samples taken during each visit averaged 102, with 107 for October, 102 for December, 96 for March, and 102 for June (Table 1.1.11-2). A total of 24 plots (12 0.15 and 12 1.0-m^2) were sampled by disturbed methods during October 1976. For San Clemente Island, the 1.0-m^2 plots were again employed to sample the larger macrophytes (i.e. Egregia menziesii, Eisenia arborea, Halidrys dioica, and Phyllospadix torreyi) and the larger mobile invertebrates (i.e., Haliotis cracherodii and Octopus bimaculatus); Megathura crenulata, a species encountered in 1.0-m^2 plots during 1975-76, was not obtained during 1976-77 sampling. All other biota were assessed using 0.15-m^2 plots.

The purpose of this report is to present the patterns of abundance of the macro-biota for 1976-77 and to contrast the main temporal variations with the 1975-76 study (Murray and Littler, 1977a). To facilitate comparisons, the 1975-76 data have been re-worked by removing the results from disturbed sampling. Therefore, salient seasonal and annual variations in macro-biotic standing stock have been analyzed by the most powerful means possible, i.e., seasonal comparisons have been made using data obtained from identical sets of sample plots.

Table 1.1.11-1. Air Temperature, Water Temperature, and Salinity for San Clemente Island Measured during 1976-77.

ENVIRONMENTAL FACTOR	DATE			
	Oct. 1976	Dec. 1976	Mar. 1977	June 1977
Air temperature (^{o}C)	***26.5***	***17.2***	***15.3***	***16.6***
Water temperature (^{o}C)	20.5	16.7	15.1	17.1
Salinity (ppt)	32.5	33.3	34.0	32.5
Relative Humidity (%)		80.0	79.0	81.6

Table 1.1.11-2. Number of Undisturbed and Disturbed 0.15-m^2 and 1.0-m^2 Samples Obtained during the Four Site Visits of 1976-77 to Wilson Cove, San Clemente Island.

	Oct. 1976		Dec. 1976		Mar. 1977		June 1977	
	0.15-m^2	1.0-m^2	0.15-m^2	1.0-m^2	0.15-m^2	1.0-m^2	0.15-m^2	1.0-m^2
Rocky Intertidal Samples								
Disturbed	12	12	--	--	--	--	--	--
Undisturbed	70	37	68	34	63	33	67	35
Total	82	49	68	34	63	33	67	35

1.1. 11.4 Results

1. 1.11.4.1 Floristics and Faunistics

A total of 163 taxa were sampled in undisturbed or disturbed quadrats or taken as vouchers from areas near the study site during 1976-77. Seventy-five macrophytes (Table 1.1.11-3) were sampled during the study, with 74 occurring in undisturbed and 30 in disturbed quadrats, while, of the 73 macroinvertebrates obtained (Table 1.1.11-4), 56 were sampled in undisturbed and 42 in disturbed plots. Fifteen taxa (7 macrophytes and 8 macroinvertebrates) did not occur in samples but were collected near the study area. A total of 55 taxa (22 macrophytes and 33 macroinvertebrates) were added to the floristic and faunistic lists generated during 1975-76, while 11 macrophytes and 23 macroinvertebrates which appeared previously were not encountered in quadrats during the 1976-77 program.

1.1.11.4.2 Standing Crop

1.1.11.4.2.1 Cover

Biotic cover averaged 109.3% for the year, a value highly comparable to the 108.4% recorded for 1975-76 undisturbed data (Table 1.1.11-5). Macrophyte (102.6% vs. 102.9%) and macroinvertebrate (6.7% vs. 5.5%) cover also showed little change. Patterns of overall biotic cover as a function of tidal interval remained highly comparable to those established during 1975-76. Cover remained greatest below +2.0 ft. (.6 m) where the larger, canopy-forming macrophytes were predominant, while minimal values were obtained above +7.0 ft. (2.1 m), a zone without frondose seaweeds (Table 1.1.11-6) Macroinvertebrate cover (Table 1.1.11-7) was again greatest between +2.0 and +5.0 ft. (.6 and 1.5 m) a zone dominated by barnacles.

Macrophyte cover ranged seasonally from 90.7% (Table 1.1.11-5) for December to 112.1% for June. Seasonal cover during 1976-77 showed little variation from that previously established, except for significantly lower values (90.7% vs. 108.1%) for December which were mostly due to reductions in the standing stocks of the larger brown algae. Macroinvertebrate cover again showed very little variation, ranging from 6.4% (December 1976) to 7.1% (March 1977).

Temporal variability in the cover of the dominant macrophytes species was again moderate during 1976-77, substantiating the pattern of constancy described for 1975-76. As shown in Table 1.1.11-8, the same seven macrophytes again accounted for more than 75% of the annual cover. Little variation in abundance and rank order occurred among these macrophyte dominants when 1975-76 data were compared with those for 1976-77. Blue-green algae again (37.1%) provided the greatest macrophyte cover (Table 1.1.11-8) followed by Pterocladia capillacea

Table 1.1.11-3 Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of Wilson Cove, San Clemente Island. Additional species collected in the study area (C) but not present in samples have also been listed.

Species and Taxa	Oct. 1976		Dec. 1976	Mar. 1977	June 1977	
	U	D	U	U	U	C
Bacillariophyta						
Benthic diatoms	x				x	
Chlorophyta						
Chaetomorpha linum	x		x	x	x	
Cladophora spp.	x		x	x	x	
Codium fragile						x
Enteromorpha sp.	x		x	x	x	
Enteromorpha clathrata						x
Ulva californica	x		x	x	x	
Cyanophyta						
Blue-green algae	x	x	x	x	x	
Blue-green colony	x		x	x	x	
Phaeophyta						
Coilodesme rigida		x		x		
Colpomenia sinuosa	x	x	x	x	x	
Cylindrocarpus rugosus	x		x	x	x	
Dictyota flabellata	x	x	x	x	x	
Ectocarpaceae	x		x	x	x	
Egregia menziesii	x	x	x	x	x	
Eisenia arborea	x	x	x	x	x	
Endarachne binghamiae						x
Halidrys dioica	x	x	x	x	x	
Hydroclathrus clathratus						x
Pachydictyon coriaceum					x	
Pelvetia fastigiata f. gracilis						x
Pseudolithoderma nigra	x		x	x	x	
Ralfsiaceae	x		x	x	x	
Sargassum agardhianum	x	x	x	x	x	
Sargassum muticum						x
Scytosiphon dotyi			x			
Scytosiphon lomentaria				x		
Sphacelaria californica						x

Table 1.1.11-3. Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of Wilson Cove, San Clemente Island. Additional species collected in the study area (C) but not present in samples have also been listed. (Continued)

Species and Taxa	Oct. 1976		Dec. 1976	Mar. 1977	June 1977	
	U	D	U	U	U	C
Zonaria farlowii	x				x	
Rhodophyta						
Acrosorium uncinatum	x			x		
Anisocladella pacifica	x				x	
Bossiella orbigniana ssp. dichotoma	x	x	x		x	
Callithamnion rupicolum			x	x	x	
Carpopeltis divaricata	x	x	x		x	
Centroceras clavulatum	x		x			
Ceramium eatonianum/sinicola	x		x	x	x	
Ceramium spp.				x	x	
Coeloseira compressa					x	
Corallina officinalis var. chilensis	x	x	x	x	x	
Corallina vancouveriensis	x	x	x	x	x	
Cryptopleura corallinara	x	x	x	x	x	
Gastroclonium coulteri				x		
Gelidium coulteri	x	x	x	x	x	
Gelidium purpurascens	x	x	x	x	x	
Gelidium pusillum	x		x	x	x	
Gelidium robustum					x	
Gigartina canaliculata	x	x	x	x	x	
Gigartina spinosa	x	x	x	x	x	
Haliptylon gracile	x	x	x	x	x	
Herposiphonia littorals	x					
Herposiphonia plumula	x	x	x	x	x	
Herposiphonia verticillata		x		x	x	
Heterosiphonia erects	x		x		x	
Hydrolithon decipiens			x	x	x	
Jania tenella				x	x	
Laurencia lajolla	x	x	x	x	x	
Laurencia masonii				x		
Laurencia pacifica	x	x	x	x	x	
Laurencia snyderae	x				x	
Laurencia spectabilis	x	x	x	x	x	
Lithophyllum proboscideum	x	x	x	x	x	
Lithothrix aspergillum	x	x	x	x	x	
Melobesia mediocris	x					

Table. 1.1.11-3. Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of Wilson Cove, San Clemente Island. Additional species collected in the study area (C) but not present in samples have also been listed. (Continued)

Species and Taxa	Oct. 1976		Dec. 1976	Mar. 1977	June 1977	
	U	D	U	U	U	C
Nienburgia andersoniana					x	
Peyssonneliaceae/ Hildenbrandiaceae	x		X	X	X	
Plocamium cartilagineum	x	x	X	x	X	
Polysiphonia acuminata					X	
Polysiphonia hendryi var. hendryi				x	x	
Polysiphonia scopulorum var. villum	x	x	x	X	X	
Polysiphonia spp.	X			X	X	
Porphyrella californica	x			x	X	
Pterocladia capillacea	X	X	x	X	X	
Pterosiphonia baileyi		X				
Pterosiphonia dendroidea	x		X	X	X	
Rhodoglossum affine	x	X	X	X	X	
Rhodymenia californica var. californica			X			
Schizymenia pacifica					X	
Tiffaniella synderae			X	X	X	
Spermatophyta						
Phyllospadix torreyi	X					
82 Total Macrophytes						

Table 1.1.11-4. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Wilson Cove, San Clemente Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column.

Species and Taxa	Oct. 1976		Dec. 1976	Mar. 1977	June 1977	
	U	D	U	U	U	C
Annelida						
Polychaeta						
Dodecaceria fewkesi						X
Eupomatus gracilis			X			
Phragmatopoma californica	x	x	X	X	x	
Spirobranchus spinosus	X	X	X	X	X	
Spirorbis spp.	X		x	X	x	
Arthropoda						
Crustacea						
Balanus glandula	x	x	X			
Chthamalus fissus/dalli	X	X	X	X	X	
Lophopanopeus bellus		X				
Lophopanopeus leucomanus heathii	X					
Pachygrapsus crassipes	x	x	X	X	X	
Paraxanthias taylori		X				
Pollicipes polymerus					X	
Pugettia producta	X	X		X		
Pugettia richii		X	X		x	
Tetraclita squamosa rubescens	X		X	X	X	
Chordata: Urochordata						
Ascidiacea						
Unidentified tunicates					x	
Cnidaria						
Anthozoa						
Anthopleura elegantissima		x				
Corynactis californica			X		X	
Hydrozoa						
Sertularella sp.						X

Table 1.1.11-4. Presence of Macro invertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Wilson Cove, San Clemente Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued).

Species and Taxa	Oct. 1976		Dec. 1976	Mar. 1977	June 1977	
	U	D	U	U	U	C
Echinodermata						
Echinoidea						
Strongylocentrotus purpuratus		x				
Ectoprocta						
Encrusting bryozoans						
Mollusca						
Bivalvia						
Brachidontes adamsianus		x				
Modiolus capax		x				
Mytilus californianus		x				
Mytilus edulis						
Philobrya setosa	x	x				
Pseudochama exogyra			x			
Septifer bifurcates		x				
Septifer bifurcates/ Brachidontes adamsianus	x		x	x	x	
Cephalopoda						
Octopus bimaculatus					x	
Gastropoda						
Acmaea (Collisella) conus	x		x	x	x	
Acmaea (Collisella) digitalis				x		
Acmaea (Notoacmea) insessa	x					
Acmaea (Collisella) limatula	x		x	x	x	
Acmaea (Collisella) pelts	x		x	x	x	
Acmaea (Collisella) scabra	x	x	x	x	x	
Acmaea (Collisella) strigatella	x		x	x	x	
Amphithalamus tenuis		x				
Barleeia californica	x	x				
Barleeia haliotiphila		x				
Bittium interfossa						x
Cerithiopsis carpenter						x

Table 1.1.11 4Presence of Macroinvertebrates in Undisturbed (u) and Disturbed (D) Quadrats during the Quarterly Visits to Wilson Cove, San Clemente Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued).

Species and Taxa	Oct. 1976		Dec. 1976	Mar. 1977	June 1977	
	U	D	u	u	u	C
Chelidonura inermis						x
Cystiscus politulus		X				
Dendropoma lituella/rastrum	x		X	x	x	
Fissurella volcano	X	x	X	x	X	
Fusinus luteopictus		X				
Haliotis cracherodii	x					
Hipponix antiquates	X		X	x	x	
Hipponix tureens	x	X				
Homalopoma luridum		X				
Lacuna marmorata		X				
Littorina planaxis	x	X	x	x	X	
Littorina scutulata	X	X	X	x	x	
Lottia gigantea	X			x		
Macrarene cookeana		x				
Metaxia convexa		X				
Mitrella aurantiaca						x
Mitrella carinata		X				
Norrisia norrisi	x	x		x		
Ocenebra circumtexta						x
Ocenebra gracillima		x				
Parviturbo acuticostatus					x	
Petaloconchus montereyensis	x	x	X	X	x	
Serpulorbis squamigerus	X	x	X	X	x	
Tegula funebralis				X	X	
Tricolia pulloides		x				
Polyplacophora						
Cyanoplax dentiens					X	
Cyanoplax hartwegii	X	X	X	X	X	
Mopalia muscosa		X			x	
Nuttallina fluxa	X	X	x	X	X	
Porifera						
Calcarea						
White sponge	X	X	X	X	X	
Leucandra heathi						
Lucetta losangelensis						

Table 1.1.1,1-4. presence of Macro invertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Wilson Cove, San Clemente Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued).

Species and Taxa	Oct. 1976		Dec. 1976	Mar. 1977	June 1977	
	U	D	U	U	U	C
Demospongiae						
Haliclona sp.				x		
Hymeniacidon sp.					x	
Ophlitaspongia pennata	x		x	x	x	
Penares saccharis			x			
81 Total Macroinvertebrates						

Table 1.1.11-5. Seasonal and Annual Patterns of Overall Biotic Cover (%) for Wilson Cove, San Clemente Island.

Group	Cover (%) Oct. 1976	Dec. 1976	Mar. 1977	June 1977	Mean
Macroinvertebrates	7.0	6.4	7.1	6.5	6.7
Macrophytes	107.4	90.7	100.2	112.1	102.6
Totals	114.4	97.1	**107.3**	118.6	109.3

TABLE 1.1.1-6. SEASONAL AND ANNUAL ATTERNS OF OVERAL MACROPHYTE COVER % AS A FUNCTION OF TIDAL HEIGHT FOR SAN CLEMENTE ISLAND.

SEASON		TIDAL HEIGHT (FT.) -1.0 TO -0.1	MLLW TO 0.9	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9
OCTOBER	1976	180.5	176.9	168.7	99.7	74.8	80.8	82.6	68.0	50.6
DECEMBER	1976	151.7	152.0	140.7	95.9	74.1	59.3	66.8	61.7	38.6
MARCH	1977	170.4	183.5	145.1	89.9	66.2	70.2	76.9	70.0	52.1
JUNE	1977	176.9	216.4	174.6	90.2	77.6	69.8	78.2	71.6	60.5
MEAN		169.9	182.2	162.3	93.9	73.2	70.0	76.6	67.8	50.5

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.1 -7. SEASONAL AND ANNUAL PATTERNS OF OVERALL MACRO-INVERTEBRATE COVER (%) AS A FUNCTION OF TIDAL HEIGHT FOR SAN CLEMENTE ISLAND.

SEASON		TIDAL HEIGHT (FT)								
		-1.0 TO -0.1	MLLW TO 0.9	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9
OCTOBER	1976	0.9	3.8	4.8	18.8	15.1	13.9	3.2	2.0	0.2
DECEMBER	1976	1.0	1.1	6.5	16.2	14.3	14.0	2.2	1.9	0.4
MARCH	1977	0.5	1.0	6.7	19.3	17.8	12.9	3.8	1.4	0.5
JUNE	1977	0.9	2.1	5.4	19.5	15.3	11.4	2.2	1.5	0.1
MEAN		0.8	2.0	5.9	18.5	15.6	13.1	2.9	1.7	0.3

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.11-8. QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN CLEMENTE ISLAND (CONTINUED ON NEXT PAGE).

TAXA	COVER (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
BLUE-GREEN ALGAE	38.2	33*0	37.0	40.2	37.1
PTEROCLADIA CAPILLACEA	8.2	11.8	9.(I	8.2	9.3
CORALLINA OFFICINALIS VAR. CHILENSIS	10.3	7.9	8.5	4.4	7.8
PSEUDOLITHODERMA NIGRA	7.1	7*7	7.3	6.2	7.1
GIGARTINA CANALICULATA	5.9	3.9	4.7	6.8	5.8
UNIDENTIFIED	5.5	1.2	5*1	7.1	4.7
EGREGIA MENZIESII	7,6	2.0	2.4	4,6	4.1
LITHOPHYLLUM PROBOSCIDEUM	3.4	500	1.6	5.4	3.9
HALIDRYS DIOICA	2.5	4,2	4.7	3,5	3,7
UNIDENTIFIED	3,2	1.7	3.4	3,6	3.0
SARGASSUM AGARDHIANUM	1.6	1.5	1.8	3,5	2.1
CORALLINA VANCOUVERIENSIS	2,4	2,9	0.8	0.5	1.6
GELIDIUM PUSILLUM	1.2	1.1	1.5	0.5	1.1
LAURENCIA PACIFICA	1.2	0,5	0.5	1.4	0.9
UNIDENTIFIED	1.3	0.3	0.9	0.6	0.7
HYDROLITHON DECIPIENS	0.7	0.7	0.6	0.7	0.7
POLYSIPHONIA SCOPULORUM VAR. VILLUM	1,0	009	<0.1	<0.1	0.5
CORALLINA OFFICINALIS VAR. CH B	0.3	0*2	1.2	<O*1	0.4
COLPOMENIA SINUOSA	<0.1	<0*1	0.5	1.0	0.4
DICTYOTA FLABELLATA	<0,1	0.2	0.7	0,5	0.4
CRYPTOPLEURA CORALLINARA	<0,1	0.4	0.4	0,4	0.3
ENTEROMORPHA SP,	1.0	<0.1	0.2	<0.1	0.3
PEYSSONNELIACEAE/HILDENBRANDIACEAE	0.5	0*3	0.2	0.2	0.3
HALIPTYLON GRACILE	0.4	0.3	0.1	0.3	0.3
RHODOGLOSSUM AFFINE	<0.1	<0.1	0.2	0.8	0.3
HYDROLITHON DECIPIENS BLEACHED	0.0	0.1	0.3	0.6	0.3

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.11-8. QUARTERLY AND ANNUAL. MEAN COVER (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN CLEMENTE ISLAND (CONTINUATION) .

TAXA	COVER (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
GELIDIUM COULTERI	<0.1	<0.1	0.1	O*7	0.2
EISENIA ARBOREA	0.1	0,3	0.2	0.2	O*2
LITHOTHRIX ASPERGILLUM	0.2	0.2	0.2	(),2	0.2
TIFFANIELLA SNYDERAE	0.0	0,3	0.3	0.2	0.2
PTEROCLADIA CAPILLACEA BLEACHED	<0.1	<0,1	0.6	0,0	0.2
ULVA CALIFORNICA	0.1	<0,1	0.3	(),2	0.2
CLADOPHORA SPP.	<0.1	O*1	0.3	<0,1	0.1
LAURENCIA LAJOLLA	<0.1	<0,1	0.2	0.2	0.1
GELIDIUM PURPURASCENS	<0.1	O*2	0.3	<0,1	"0.1
PTEROSIPHONIA DENDROIDEA	<0.1	0.2	0.2	<0,1	0.1
OTHER MACROPHYTES	0.8	O*7	1.4	1,3	
NUMBER OF OTHER TAxA	(26)	(19)	(26)	(33)	

NOTE: 1 FOOT = 0,3048 METERS

(9.3%), Corallina officinalis var. chilensis (7.8%), Egregia menziesii (7.3%), Pseudolithoderma nigra (7.1%), Gigartina canaliculata (5.8%), and Halidrys dioica (5.4%). Blue-green algae increased by 10.4% from 975-76, as did P. capillacea (2.4% increase), E. menziesii (2.0%), and P. nigra (1.1%); a decrease in cover was observed for G. canaliculata (2.1%). Modest seasonal increases in abundance were again evident for the large canopy-forming brown algae and for the frondose algae which occurred as epiphytes on the mid-intertidal coralline algal turf. Generally, these species were more luxurious and abundant during the fall and summer visits. For June 1977, Sargassum agardhianum, Colomenia sinuosa, Laurencia pacifica and E. menziesii reached their greatest cover, substantiating the pattern apparent from 1975-76 data. However, G. canaliculata and blue-green algae showed greatest cover during the June assessment for 1976-77, while for both species, cover was maximal for December during 1975-76. Also, P. capillacea and Halidrys dioica had higher standing stocks and less seasonal variability in cover during 1976-77 when compared with 1975-76. These data support the seasonal trends in species abundances established previously (Murray and Littler, 1977a) for leeward San Clemente Island. However, certain dominant species appear to depict less obvious seasonality than previously indicated, suggesting that their abundances may be more closely tied to more subtle environmental variables.

Macrophyte cover as a function of tidal height has been averaged over the year to depict the prevailing patterns of abundance. (Figure 1.1.11-1); seasonal zonation has also been presented for each of the quarterly visitations (Figure 1. 1.11-2 through 1.1.11-5). Distributional data generally supported the cover patterns established for 1975-76 (Murray and Littler, 1977a). The most abundant macrophytes sampled above +3.0 ft. (.9 m) were again the blue-green and encrusting algae; the latter were most common on shaded vertical rocks and in crevices. Blue-green algae were more abundant above +4.0 ft. (1.2 m) during 1976-77, and continued to provide the dominant cover by far on the upper shoreline. Pseudolithoderma nigra was again the most abundant macrophyte other than blue-green algae between +3.0 and +4.0 ft. (.9 and 1.2 m). The dense coralline turf, and its associated epiphytic algae, remained the most conspicuous feature of the lower mid-intertidal zone. Corallina officinalis var. chilensis, the dominant turf component, supplied greatest cover between +1.0 and +2.0 ft. (.3 and .6 m) and was sampled at all tidal intervals below +5.0 ft. (1.5 m). Corallina vancouveriensis and Lithothrix aspergillum were also conspicuous in the coralline turf during 1976-77, although C. vancouveriensis showed slightly less abundance below +1.0 ft. (.3 m) during the current year.

The principal epiphytes on the coralline algal turf were again frondose algae, including Gigartina canaliculata, Colpomenia sinuosa, Laurencia pacifica, Sargassum agardhianum, and Pterocladia capillacea. These species were also frequently encountered as saxicolous thalli,

FIGURE 1.1.11-1 MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE III-1.1.11-1

MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN CLEMENTE ISLAND (CONTINUED)

TIDAL HEIGHT (FT)

-2 -1 0 1 2 3 4 5 6 7 8

100%

PTEROCLADIA CAPILLACEA

HALIORYS DIOICA

EISENIA ARBOREA

LAURENCIA LAJOLLA

LAURENCIA PACIFICA

CORALLINA VANCOUVERIENSIS

HERPOSIPHONIA VERTICILLATA

CORALLINA OFFICINALIS VAR. CH 8

LAURENCIA PACIFICA BLEACHED

GELIDIUM PUSILLUM BLEACHED

HERPOSIPHONIA LITTORALIS

COELOSEIRA COMPRESSA

LAURENCIA LAJOLLA BLEACHED

CENTROCERAS CLAVULATUM

LITHOPHYLLUM PROBOSCIDEUM BLEACHED

CERAMIUM SPP.

LAURENCIA SNYDERAE

CALLITHAMNION RUPICOLUM

ECTOCARPACEAE

UNIDENTIFIED

SARGASSUM AGARDHIANUM

CERAMIUM EATONIANUM/SINICOLA

GELIDIUM COULTERI

FIGURE 1.1.11-

MEAN DISTRIBUTION OF O MINAZT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT JUR NE 1976/1977 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-2 MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 A SAN CLEMENTE SLANE CONTINUATION

FIGURE 1.1.11-2 DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-2

DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 A SAN CLEMENTE ISLAND (CONTINUED).

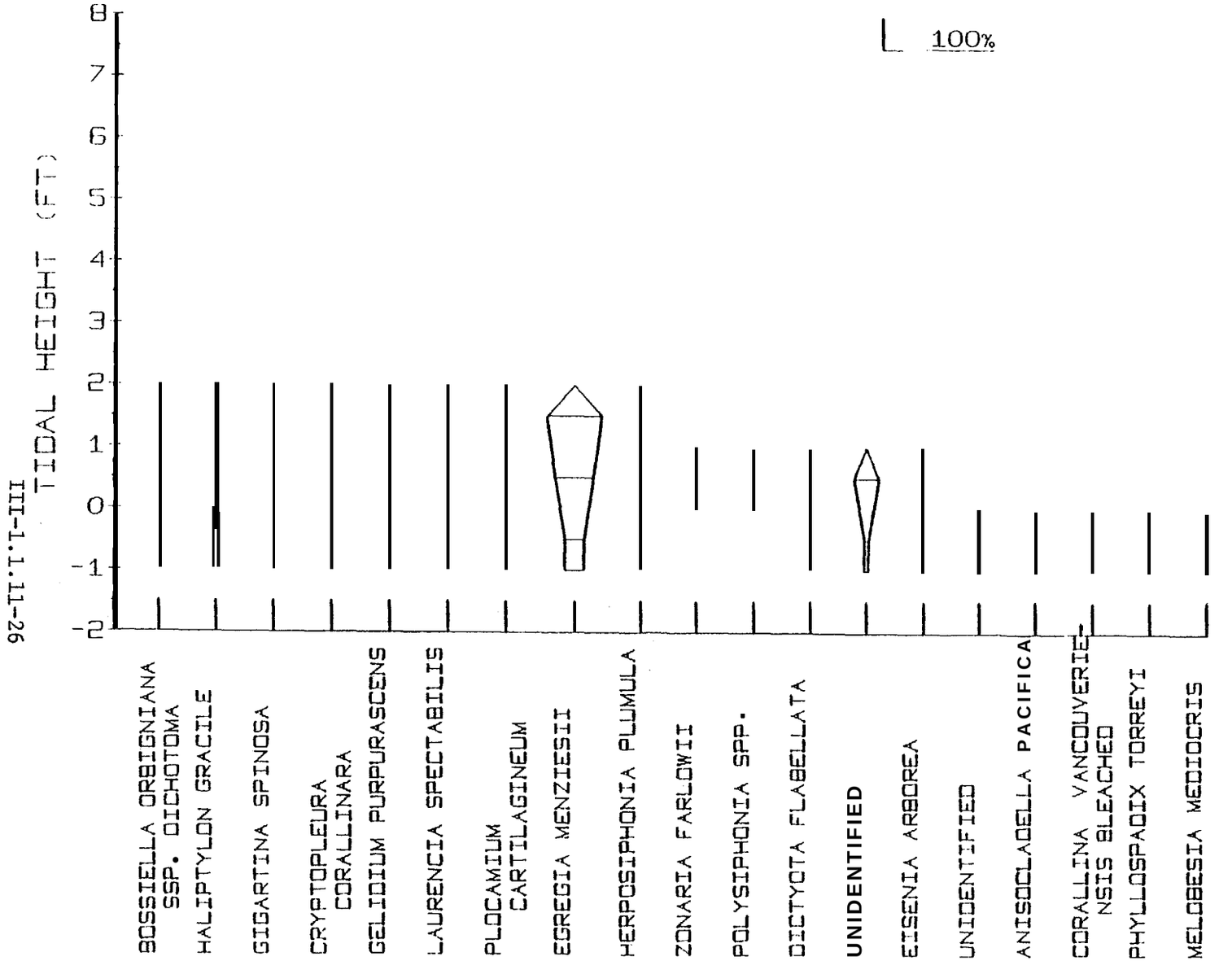

FIGURE 1.1.11-2 DISTRIBUTION OF DOMINAN MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN CLEMENTE IS AND (CONTINUATION).

FIGURE 1.1.11-3 DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-3 DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-3 DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN CLEMENTE ISLAND (CONTINUATION).

FIGURE 1.1.11-4 DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF HORIZONTAL TRANSECT FOR MARCH 1977 AT SAN CLEMENTE ISLAND (CONTINUED)

FIGURE 1.1.11-4

DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SAN CLEMENTE ISLAND (CONTINUED)

FIGURE 1.1.11-4

DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SAN CLEMENTE ISLAND (CONTINUED)

TIDAL HEIGHT (FT)

-2 -1 0 1 2 3 4 5 6 7 8

HERPOSIPHONIA PLUMULA

PTEROSIPHONIA DENDROIDEA

COILODESME RIGIDA

GIGARTINA SPINOSA

LAURENCIA SPECTABILIS

DICTYOTA FLABELLATA

ECTOCARPACEAE

ACROSORIUM UNCINATUM

CRYPTOPLEURA CORALLINARA

EISENIA ARBOREA

JANIA TENELLA

GELIDIUM PURPURASCENS

CERAMIUM SPP.

HALIPTYLON GRACILE

CHAETOMORPHA LINUM

TIFFANIELLA SNYDERAE

LAURENCIA MASONII

POLYSIPHONIA SCOPULORUM VAR. VILLUM

HERPOSIPHONIA VERTICILLATA

ENTEROMORPHA SP.

SCYTOSIPHON LOMENTARIA

100%

FIGURE 1.1.11-5

DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 AT SAN CLEMENTE ISLAND (COURTESY).

FIGURE 1.1.11-5

OBSERVED DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 A. SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-5 DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-5

DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 AT SAN CLEMENTE ISLAND (CONTINUATION).

particularly as larger plants. As was the case during 1975-76, G. canaliculata , L. pacifica, and S. agardhianum were maximally abundant between +1.0 and +2.0 ft. (.3 and .6 m), while P. capillacea provided greatest cover below +1.0 ft. (.3 m). Increased growths of P. capillacea were evident below MLLW during 1976-77.

The larger brown algae Halidrys dioica, Egregia menziesii, and Eisenia arborea continued to dominate the lower shoreline. Halidrys dioica and Eisenia arborea reached greatest abundance between MLLW and +1.0 ft. (.3 m) while E. menziesii cover was maximal below MLLW. All three species showed marked seasonal cover oscillations over their upper distributional limits (above MLLW, see Figures 1. 1.11-2 through 1.1.11-5). Lithophyllum proboscideum, the encrusting coralline alga, continued to occupy much of the primary substrate below +1.0 ft. (.3 m) beneath the brown algal canopies and showed a slight increase in abundance during 1976-77 below MLLW. A cover decline was also evident for Gelidium purpuascens on the lower shoreline during the current year.

The barnacles Chthamalus fissus/dalli (3.0%) and Tetraclita squamosa rubescens (1.3%) were again determined to be the most abundant macroinvertebrates during 1976-77 (Table 1.1.11-9). These animals, along with the limpet Acmaea (Collisella) scabra (1.2%), provided greater than 80% of the total macroinvertebrate cover. Dendropoma lituella/rastrum (0.4%) was also an abundant constituent of the fauna.

Seasonal patterns of macroinvertebrate standing stock were again not readily apparent from cover data due to the low abundances of most species. Macroinvertebrate cover as a function of tial height has been averaged over the year to depict the prevailing patterns of zonation (Figure 1.1.11-6); seasonal distributional data have also been plotted for each of the quarterly visits (Figures 1.1.11-7 through 1.1.11-10). The 1976-77 distributional data generally supported the relationships established for 1975-76 (see Murray and Littler, 1977a).

Littorina planaxis was again the most abundant macroinvertebrate above +7.0 ft. (2.1 m), while the shoreline between +3.0 and +7.0 ft. (.9 and 2.1 m) continued to be dominated by the small acorn barnacles Chtamalus fissus/dalli. The limpets Acmaea (Collisella) scabra, A. (Collisella) strigatella, A . (Collisella) limatula, and A. (Collisella) pelts were frequently obtained in samples. The most abundant limpet in terms of cover was by far A.(Collisella) scabra which was sampled throughout the entire intertidal zone as in 1975-76 between -1.0 and +8.0 ft. (-.3 and 2.4 m). Acmaea (Collisella) scabra again supplied greatest cover between +2.0 and +5.0 ft. (.6 and 1.5 m), while A. (Collisella) strigatella and A. (Collisella) limatula showed most abundance between about MLLW and +7.0 ft. (2.1 m). Acmaea (Collisella) limatula was determined to be much more abundant during 1976-77, although this may be due to its greater recognition by field taxonomists.

TABLE 1.1.11-9. QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACRO-INVERTEBRATES" OVER ALL TIDAL INTERVALS FROM SAN CLEMENTE ISLAND.

TAXA	COVER (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
CHTHAMALUS FISSUS AND DALLI	3.6	2.6	3.2	2.7	3.0
TETRACLITA SQUAMOSA RUBESCENS	0,9	1.3	1.5	1,5	1*3
ACMAEA (C OLLISELLA) SCABRA	1.2	1*3	1.2	1.1	1.2
DENDROPOMALITUELLA/RASTRUM	0.2	0.2	0.5	0.5	0.4
LITTORINA PLANAXIS	0,2	0.2	0.3	(.).1	0.2
SPIROBRANCHUS SPINOSUS	0.4	<O*1	<0.1	0.1	0.1
OTHER MACRO-INVERTEBRATES	0,6	0.8	0.4	0.5	
NUMBER OF OTHER TAXA	(28)	(23)	(24)	(32)	

NOTE: 1 FOOT = 0,3040 METERS

FIGURE 1.1.11-6

MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-6 MEAN DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 A SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-6

MEAN DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN CLEMENTE ISLAND (CONTINUATION).

FIGURE 1.1.11-7 DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-7 DISTRIBUTION OF DOMINAN MACRO-INVER EBRA E
COVER AS A FUNCTION OF TIDAL HEIGHT FOR
OCTOBER 1976 AT SAN CLEMEN E ISLAND
(CONTINU, I(N)

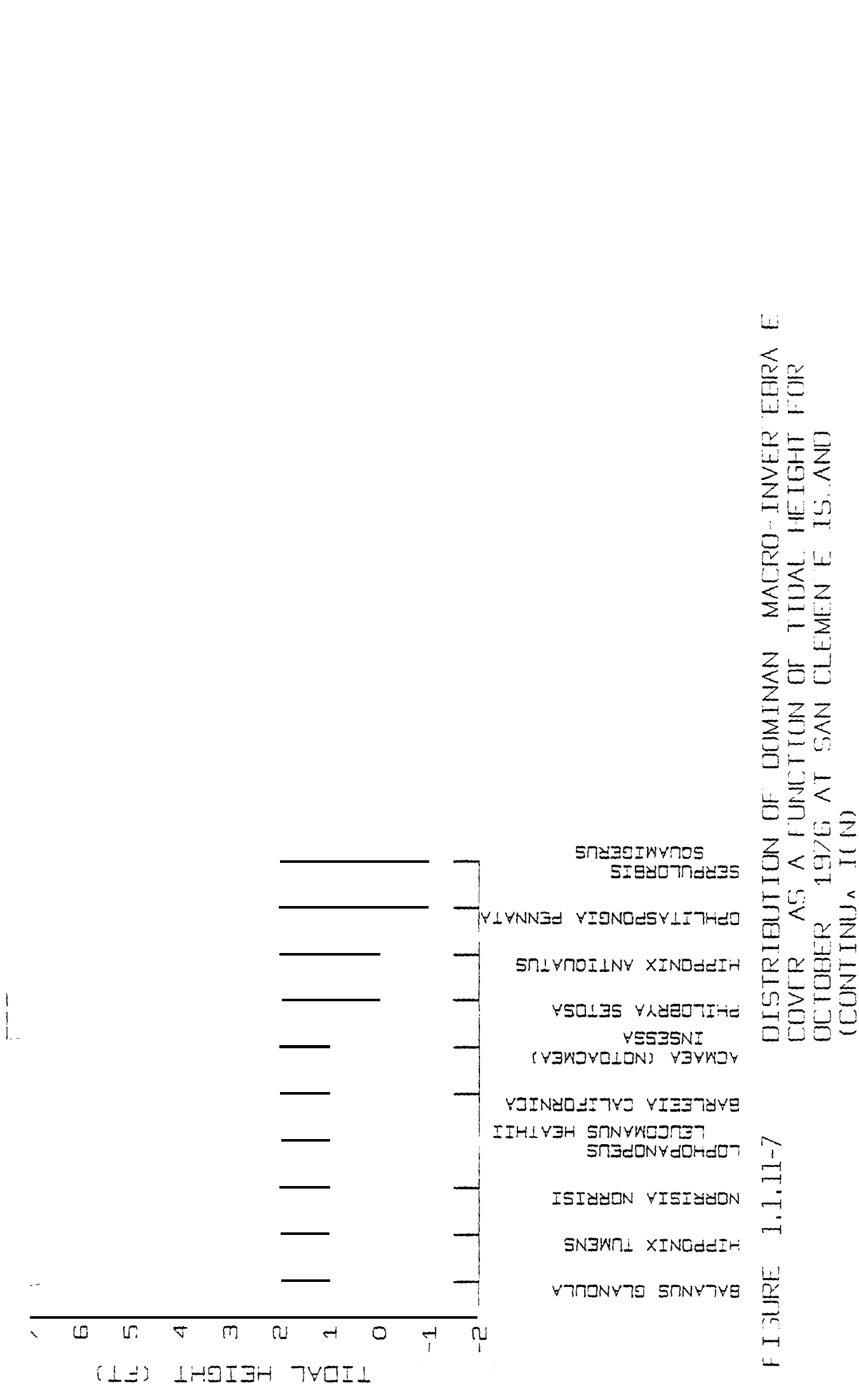

FIGURE 1.1.11-8 DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-8

DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN CLEMENTE ISLAND. CONTINUATION.

FIGURE 1.1.11-9 DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SAN CLEMENTE ISLAND (CONTINUED).

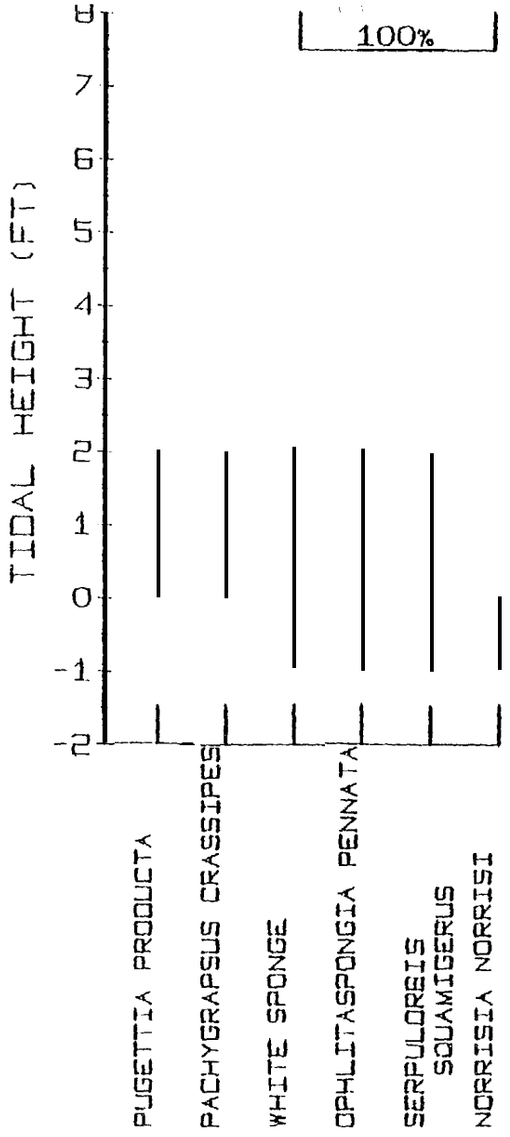

FIGURE 1.1.11 9 DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SAN CLEMENTE ISLAND (CONTINUATION).

FIGURE 1.1.11-10

HISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR -1 FOR NE 1977 A SA7 CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-10 DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT JUNE 1977 A SAN CLEMENTE ISLAND (CONTINUATION).

Tetraclita squamosa rubescens continued to dominate the macroinvertebrate cover between +1.0 and +3.0 ft. (.3 and .9 m) and maintained maximal abundance (7.5%) between +2.0 and +3.0 ft. (.6 and .9 m). The tube-forming macroinvertebrates Dendropoma lituella/rastrum, Petaloconchus montereyensis (a species not segregated from Dendropoma spp. during 1975-76), Spirobranchus spinosus, Serpulorbis squamigerus, and Phragmatopoma californica again provided the vast majority of macroinvertebrate cover below MLLW.

1.1.11.4.2.2 Frequency

The annual (Figure 1.1.11-11) patterns of macrophyte frequency mostly paralleled comparable relationships for cover. Fourteen macrophytes recorded mean frequencies greater than 25.0% for undisturbed samples based on annual averages (Table 1.1.11-10) compared to 10 taxa for 1975-76. The blue-green algae (84.4%) and encrusting forms, i.e., Pseudolithoderma nigra (57.5%), Peyssonneliaceae/Hildenbrandiaceae (40.2%), Hydrolithon decipiens (34.0%), and Lithophyllum proboscideum (33.6%), continued to rank among the most frequently sampled macrophytes along with the red algae Corallina officinalis var. chilensis (46.3%), Gigartina canaliculata (41.0%), and Pterocladia capillacea (39.0%). Increased mean frequencies were obtained for the large brown algae Halidrys dioica (35.2% vs. 12.3%), Egregia menziesii (33.0% vs. 12.3%), and Eisenia arborea (24.6% vs. 6.5%) for 1976-77, comparable to the increases in cover described previously (Table 1.1.11-8).

Macroinvertebrate frequency as a function of tidal interval has been averaged over the year to depict the prevailing distributional abundance relationships (Figure 2.1.11-12). Frequency patterns generally paralleled those derived for cover for macroinvertebrates as was the case during 1975-76. However, macroinvertebrate taxa generally showed higher mean frequencies during the current year, perhaps as a result of greater sampling efficiency resulting from familiarity with the study area. Macroinvertebrates sampled with greatest frequency were again the higher intertidal forms (barnacles, limpets, and littorines). Whereas, only nine macroinvertebrates showed mean frequencies greater than 10.0% during 1975-76, 17 did so in 1976-77. The rank order of macroinvertebrates showed negligible differences over the two years, as Acmaea (Collisella) scabra (55.2%), Chthamalus fissus/dalli (52.2%), and Littorina planaxis (51.2%) again represented the three most frequently encountered forms (Table 1.1.11-11).

1.1.11.4.2.3 Density

The annual densities and rank order of abundance for the dominant macroinvertebrates showed little variation between 1975-76 and 1976-77. Chthamalus fissus/dalli (1232/m^2) continued to supply the

FIGURE 1.1.11-11

MEAN DISTRIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 A SAN CLEMENTE ISLAND (CONTINUED)

FIGURE 1.1.11-11

MEAN DISTRIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-11 MEAN DISTRIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A UNIT OF TIDAL HEIGHT DURING 1976/1977 AT SAN CLEMENTE ISLAND (CONTINUED)

FIGURE 1.1.11-11

MEAN DISTRIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN CLEMENTE ISLAND (UNINUNDATION).

TABLE 1.1.11-10. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN CLEMENTE ISLAND (CONTINUED ON NEXT PAGE).

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
BLUE-GREEN ALGAE	91.4	94.8	78.7	72.8	84.4
PSEUDOLITHODERMA NIGRA	54.1	68.3	52.5	55.1	57.5
CORALLINA OFFICINALIS VAR. CHILENSIS	46.7	46.4	45.3	46.7	46.3
GIGARTINA CANALICULATA	35.6	42.0	43.2	43.0	41.0
PEYSSONNELLIACEAE/HILDENBRANDIACEAE	42.7	57.7	27.2	33.1	40.2
PTEROCLADIA CAPILLACEA	37.0	41.7	37.9	39.3	39.0
HYDROLITHON DECIPIENS	41.2	39.0	24.8	30.9	34.0
LITHOPHYLLUM PROBOSCIDEUM	29.6	36.8	36.5	31.5	33.6
GELIDIUM PUSILLUM	25.3	40.9	34.2	33.7	33.5
CORALLINA VANCOUVERIENSIS	24.7	43.0	25.4	26.8	30.0
ULVA CALIFORNICA	33.5	31.9	21.5	29.6	29.1
LAURENCIA PACIFICA	23.5	30.0	27.8	35.2	29.1
COLPOMENIA SINUOSA	16.0	16.0	28.1	32.8	23.3
LITHOTHRIX ASPERGILLUM	19.8	17.6	21.1	25.9	21.1
RHODOGLOSSUM AFFINE	6.8	27.5	20.1	25.8	20.0
UNIDENTIFIED	19.8	16.0	21.3	21.2	19.6
UNIDENTIFIED	18.5	14.8	20.1	19.9	18.3
CRYPTOPLEURA CORALLINARA	13.6	20.7	19.0	19.9	18.3
BLUE-GREEN COLONY	24.9	19.0	8.3	9.9	15.5
CLADOPHORA SPP.	5.6	17.6	15.1	22.3	15.2
UNIDENTIFIED	13.0	13.6	16.0	16.5	14.8
DICTYOTA FLABELLATA	5.6	14.5	19.0	19.0	14.5
SARGASSUM AGARDHIANUM	12.3	11.4	15.4	17.1	14.1
PTEROSIPHONIA DENDROIDEA	7.4	17.9	16.7	12.7	13.7
LAURENCIA LAJOLLA	11.7	13.3	17.7	11.7	13.6
PLOCAMIUM CARTILAGINEUM	9.9	11.4	16.4	14.0	13.4

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.11-10. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN CLEMENTE ISLAND (CONTINUED).

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
CORALLINA OFFICINALIS VAR. CH B	14.8	13.0	21.5	1.2	12.6
HALIDRYS DIOICA	8.0	14.0	11.6	16.9	12.6
POLYSIPHONIA SCOPULORUM VAR. VILLUM	17.7	20.5	3.7	7.6	12.4
CYLINDROCARPUS RUGOSUS	9.9	11.9	10.3	17.3	12.4
CERAMIUM EATONIANUM/SINICOLA	4.9	11.4	8.8	21.9	11.8
GIGARTINA SPINOSA	10.5	5.2	11.6	17.4	11.2
EGREGIA MENZIESII	10.5	12.3	9.3	10.6	10.7
HYDROLITHON DECIPIENS BLEACHED	0.0	5.7	10.8	23.8	10.1
LAURENCIA SPECTABILIS	6.8	10.8	8.8	13.4	9.9
HALIPTYLON GRACILE	10.5	13.9	7.4	7.8	9.9
ENTEROMORPHA SP.	13.7	6.5	3.7	8.1	8.0
GELIDIUM COULTERI	5.6	2.5	7.9	16.1	8.0
HERPOSIPHONIA PLUMULA	6.2	4.9	6.5	14.3	8.0
RALFSIACEAE	8.0	5.2	5.1	11.0	7.3
PTEROCLADIA CAPILLACEA BLEACHED	3.1	5.2	19.1	0.0	6.9
TIFFANIELLA SNYDERAE	0.0	9.6	11.1	6.8	6.9
ACROSORIUM UNCINATUM	6.8	0.0	17.6	0.0	6.1
EISENIA ARBOREA	3.7	6.9	3.7	9.7	6.0
CHAETOMORPHA LINUM	4.3	1.2	11.1	6.2	5.7
CARPOPELTIS DIVARICATA	13.6	1.9	0.0	3.5	4.7
GELIDIUM PURPURASCENS	3.1	7.4	3.7	2.2	4.1
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	6.8	5.6	0.0	3.5	4.0
POLYSIPHONIA SPP.	3.7	0.0	4.9	6.8	3.9
HERPOSIPHONIA VERTICILLATA	0.0	0.0	3.7	10.6	3.6
CORALLINE CRUSTS	1.2	5.4	0.0	4.0	2.7
ECTOCARPACEAE	3.1	1.2	5.1	1.2	2.7

NOTE: 1 FOOT = 0.3048 METERS

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
JANIA TENELLA	0.0	0.0	3.7	6.2	2.5
PORPHYRELLA CALIFORNICA	7.2	0.0	1.2	1.2	2.4
COILODESME RIGIDA	0.0	0.0	8.8	0.0	2.2
CORALLINA VANCOUVERIENSIS BLEACHED	1.9	5.6	1.4	0.0	2.2
LITHOPHYLLUM PROBOSCIDEUM BLEACHED	3.1	0.0	2.6	2.5	2.0
ANISOCLADELLA PACIFICA	1.9	0.0	0.0	6.2	2.0
LAURENCIA LAJOLLA BLEACHED	0.0	0.0	8.0	0.0	2.0
CALLITHAMNION RUPICOLUM	0.0	2.0	1.2	4.0	1.9
CERAMIUM SPP.	0.0	0.5	3.7	3.7	1.9
HETEROSIPHONIA ERECTA	1.2	1.0	0.0	4.9	1.9
SCYTOSIPHON LOMENTARIA	0.0	0.2	7.4	0.0	1.9
NIENBURGIA ANDERSONIANA	0.0	0.0	0.0	6.7	1.7
RHODYMENIA CALIFORNICA VAR. CALIFORN	0.0	6.0	0.0	0.0	1.6
CENTROCERAS CLAVULATUM	4.3	1.5	0.0	0.0	1.4
POLYSIPHONIA HENDRYI VAR HENDRYI	0.0	0.2	1.2	4.0	1.3
GASTROCLONIUM COULTERI	0.0	0.0	5.1	0.0	1.3
BENTHIC DIATOMS	2.2	0.0	0.0	2.5	1.2
ZONARIA FARLOWII	1.9	0.0	0.0	2.8	1.2
LAURENCIA SNYDERAE	3.1	0.0	0.0	1.2	1.1
COELOSEIRA COMPRESSA	0.0	0.0	0.0	3.7	0.9
UNIDENTIFIED	3.7	0.0	0.0	0.0	0.9
LAURENCIA MASONII	0.0	0.0	3.7	0.0	0.9
GELIDIUM ROBUSTUM	0.0	0.0	0.0	3.5	0.9
MELOBESIA MEDIOCRIS	1.9	0.0	0.0	0.0	0.5
PHYLLOSPADIX TORREYI	1.9	0.0	0.0	0.0	0.5
GIGARTINA CANALICULATA BLEACHED	0.0	0.0	1.4	0.0	0.3

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.11-10. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SAN CLEMENTE ISLAND (CONTINUATION).

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
HERPOSIPHONIA LITTORALIS	1.2	0.0	0.0	0.0	0.3
POLYSIPHONIA ACUMINATA	0.0	0.0	0.0	1.2	0.3
LAURENCIA PACIFICA BLEACHED	0.0	0.0	1.2	0.0	0.3
GELIDIUM PUSILLUM BLEACHED	0.0	0.0	1.2	0.0	0.3
CARPOPELTIS DIVARICATA BLEACHED	0.0	0.0	0.0	1.2	0.3
PACHYDICTYON CORIACEUM	0.0	0.0	0.0	1.2	0.3
SCHIZYMENIA PACIFICA	0.0	0.0	0.0	1.2	0.3
SCYTOSIPHON DOTYI	0.0	1.1	0.0	0.0	0.3

NOTE: 1 FOOT = 0.3048 METERS

FIGURE 1.1.11-12 MEAN DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 A SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-12

MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-12 MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 7-W 5/1977 AT SAN CLEMENTE ISLAND (CONTINUATION).

TABLE 1.1.11-.. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SAN CLEMENTE ISLAND (CONTINUED ON NEXT PAGE .

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
ACMAEA (COLLISELLA) SCABRA	54.9	54.2	54.1	57.5	55.2
CHTHAMALUS FISSUS AND DALLI	51.4	50.0	51.5	56.0	52.2
LITTORINA PLANAXIS	42.6	46.3	56.6	57.4	51.2
TETRACLITA SQUAMOSA RUBESCENS	37.9	41.9	35.3	39.7	38.7
ACMAEA (COLLISELLA) STRIGATELLA	35.2	42.1	27.6	33.1	34.5
DENDROPOMA LITUELLA/RASTRUM	28.9	27.1	33.4	35.9	31.3
LITTORINA SCUTULATA	20.1	36.3	36.9	28.3	30.9
SPIRORBIS SPP.	24.7	35.9	28.5	20.7	27.5
ACMAEA (COLLISELLA PELTA	20.5	18.0	30.8	26.6	24.0
FISSURELLA VOLCANO	16.7	23.1	31.6	18.4	22.5
SPIROBRANCHUS SPINOSUS	25.9	25.6	17.4	16.9	21.5
PACHYGRAPSUS CRASSIPES	23.6	16.3	6.5	23.3	17.4
SERPULORBIS SQUAMIGERUS	16.7	16.0	16.2	19.4	17.1
PETALOCONCHUS MONTEREYENSIS	19.8	10.8	16.8	17.6	16.7
PHRAGMATOPOMA CALIFORNICA	20.4	19.4	14.0	8.1	15.5
CYANOPLAX HARTWEGII	11.5	16.1	6.6	13.1	11.8
ACMAEA (COLLISELLA) LIMATULA	11.2	9.5	8.1	17.9	11.7
WHITE SPONGE	16.0	9.6	5.1	5.9	9.2
SEPTIFER BIFURCATUS AND BRACHIDONTES	10.9	7.4	1.2	12.1	7.9
NUTTALLINA FLUXA	14.8	2.5	2.5	6.4	7.0
OPHLITASPONGIA PENNATA	11.1	4.9	8.8	2.5	6.8
HIPPONIX ANTIQUATUS	4.3	5.2	1.2	1.2	3.0
LITTORINA JUVENILE	0.0	0.0	11.4	0.0	2.8
ACMAEA (COLLISELLA) CONUS	3.5	4.9	1.2	1.2	2.7
BRACHYURAN CRAB MEGALOPS	5.9	0.0	0.0	2.8	2.2
CORYNACTIS CALIFORNICA	0.0	5.2	0.0	3.5	2.2

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.11-11. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SAN CLEMENTE ISLAND (CONTINUED).

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
PUGETTIA PRODUCTA	3.1	0.0	5.1	0.0	2.0
BALANUS GLANDULA	1.2	6.5	0.0	0.0	1.9
SERPULA VERMICULARIS	0.0	4.0	0.0	1.2	1.3
NORRISIA NORRISI	1.2	0.0	3.7	0.0	1.2
TUNICATES UNKNOWN	0.0	0.0	0.0	4.7	1.2
PUGETTIA RICHII	0.0	1.2	0.0	3.5	1.2
PENARES SACCHARIS	0.0	4.6	0.0	0.0	1.2
PHILOBRYA SETOSA	4.3	0.0	0.0	0.0	1.1
HIPPONIX TUMENS	3.7	0.0	0.0	0.0	0.9
JUVENILE BARNACLES	0.0	0.0	0.0	3.5	0.9
TEGULA FUNEBRALIS	0.0	0.0	1.1	2.2	0.8
UNIDENTIFIED	0.0	0.0	0.0	2.8	0.7
LOTTIA GIGANTEA	1.2	0.0	1.4	0.0	0.7
PSEUDOCHAMA EXOGYRA	0.0	2.5	0.0	0.0	0.6
MOPALIA MUSCOSA	0.0	0.0	0.0	2.5	0.6
BARLEEIA CALIFORNICA	2.5	0.0	0.0	0.0	0.6
ENCRUSTING BRYOZOANS	0.0	0.0	0.0	2.2	0.6
HALICLONA SP.	0.0	0.0	1.4	0.0	0.3
CYANOPLAX DENTIENS	0.0	0.0	0.0	1.2	0.3
LOPHOPANOPEUS LEUCOMANUS HEATHII	1.2	0.0	0.0	0.0	0.3
HYMENIACIDON SP.	0.0	0.0	0.0	1.2	0.3
ACMAEA (COLLISELLA) DIGITALIS	0.0	0.0	1.2	0.0	0.3
ACMAEA (NOTOACMEA) INSESSA	1.2	0.0	0.0	0.0	0.3
PARVITURBO ACUTICOSTATUS	0.0	0.0	0.0	1.2	0.3
UNIDENTIFIED	1.2	0.0	0.0	0.0	0.3
OCTOPUS BIMACULATUS	0.0	0.0	0.0	1.2	0.3

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.11-11. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SAN CLEMENTE ISLAND (CONTINUATION).

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
POLLICIPES POLYMERUS	0.0	0.0	0.0	1.1	0.3

NOTE: 1 FOOT = 0.3048 METERS

vast majority approximately (60%) of macroinvertebrate individuals (Table 1.1. 11-12), followed by Acmaea (Collisella) scabra (261 /m^2), Tetraclita squamosa rubescens (187/m^2), Littorina planaxis (144/m^2), and Dendropoma lituella/rastrum (115/m^2). These five species furnished 94% of the annual macroinvertebrate densities during 1976-77, a figure highly comparable to the 97% contributed by this identical group during 1975-76.

Overall macroinvertebrate density averaged 2066/m^2 for the year and was greatest in June (2795/m^2) and least in December (1539/m^2). Comparable undisturbed data for 1975-76 revealed an overall density of 1781/m^2 with maximum numerical abundance of animals in December (2200/m^2), and minimum abundance in October (1494/m^2) during 1975-76. Overall patterns of macroinvertebrate density for both years closely paralleled those for Chthamalus fissus/dalli, by far the most abundant of the intertidal animals. Chthamalus fissus/dalli showed highly comparable annual mean densities from 1975-76 to 1976-77 (1259/m^2 vs. 1232/m^2, but substantial differences in seasonal averages (Table 1.1.11-12). During 1975-76, C. fissus/dalli was most abundant during December 1618/m^2), while that month provided the fewest numbers of animals (908/m^2) for 1976-77; additionally, greater densities were recorded for C. fissus/dalli during June 1977 than for the preceding year. The remainder of the macroinvertebrates showed relatively comparable densities over the two years with the exception of Littorina planaxis which experienced an overall four-fold increase from 1975-76.

Major patterns of density distribution along the shoreline were obtained from yearly (Figure 1.1.11-13 and 1.1.11-14) and seasonal (Figures 1.1.11-15 through 1.1.11-22) plots of numbers of macroinvertebrates as a function of tidal interval. Littorina planaxis continued to be the most numerous macroinvertebrate above +7.0 ft. (2.1 m) and supplied greater than 200 individuals/m^2 for all tidal intervals above +4.0 ft. (1.2 m). Littorina scutulata became the most abundant littorine below +4.0 ft. (1.2 m), similar to last year. Both littorine species showed two-to-three fold increases in their densities above +3.0 ft. (.9 m) when compared to 1975-76. Barnacles and limpets continued to furnish the greatest numbers of macroinvertebrate individuals from +1.0 to +7.0 ft. (.3 and 2.1 m) and showed similar distributional patterns to 1975-76. Chthamalus fissus/dalli was the most abundant macroinvertebrate between +2.0 and +7.0 ft. (.6 and 2.1 m) and reached greatest densities between +3.0 and +5.0 ft. (.9 and 1.5 m). Tetraclita squamosa rubenscens reached maximal abundance between +2.0 and 3.0 ft. (.6 and .9 m) and Acmaea (Collisella) scabra was most numerous between +2.0 and +4. O ft. (.6 and 1.2 m). Slight increases were recorded for the current year for A. (Collisella) scabra and T. squamosa rubescens in their zones of maximal density while a decrease was obtained for C. fissus/dalli. Dendropoma lituella/rastrum provided high density vales between +1.0 and +4.0 ft. (.3 and 1.2 m) similar to 1975-76. Dendropoma

TABLE 1.1.11-12. QUARTERLY AND ANNUAL MEAN DENSITY (NO./M2) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SAN CLEMENTE ISLAND.

TAXA	DENSITY (NO./M2) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
CHTHAMALUS FISSUS AND DALLI	1230	508	1176	1615	1232
ACMAEA (COLLISELLA) SCABRA	220	158	275	391	261
TEGULA SQUAMOSA RUBESCENS	135	151	193	269	187
LITTORINA PLANAXIS	94	131	203	148	144
DENDROPOMA LITUELLA/RASTRUM	42	66	156	194	115
SPIROBRANCHUS SPINOSUS	5(I	18	2	36	26
LITTORINA SCUTULATA	10	411	21	31	25
JUVENILE BARNACLES	0	0	0	50	13
ACMAEA (COLLISELLA) STRIGATELLA	15	14	4	16	12
ACMAEA (COLLISELLA) PELTA	11	8	11	11	10
PHRAGMATOPOMA CALIFORNICA	14	13	6	3	9
PETALOCHICHUS MONTEREYENSIS	11	4	11	2	7
SERPULORBIS SQUAMIGERUS	4	9	2	8	6
ACMAEA (COLLISELLA) LIMATULA	5	3	2	6	4
FISSURELLA VOLCANO	3	3	5	3	3
PACHYGRAPSUS CRASSIPES	2	1	<1	3	2
CYANOPLAX HARTWEGII	2	2	<1	1	1
BALANUS GLANDULA	<1	4	G	0	1
LITTORINA JUVENILE	n	0	4	o	1
SEPTIFER BIFURCATUS AND BRACHIDONTES	<1	<1	<1	2	1
OTHER MACRO-INVERTEBRATES	6	3	1	2	
NUMBER OF OTHER TAXA	(13)	(7)	(8)	(14)	
TOTALS	1853	1539	2076	2795	

NOTE: 1 FOOT = 0.3048 METERS

FIGURE 1.1.11-13

MEAN DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN ONOFRE AND SAN CLEMENTE ISLAND

MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE

FIGURE 1.1.11-13 % DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 19/6/1977 A SAN CLEMENTE ISLAND (CONTINUED).

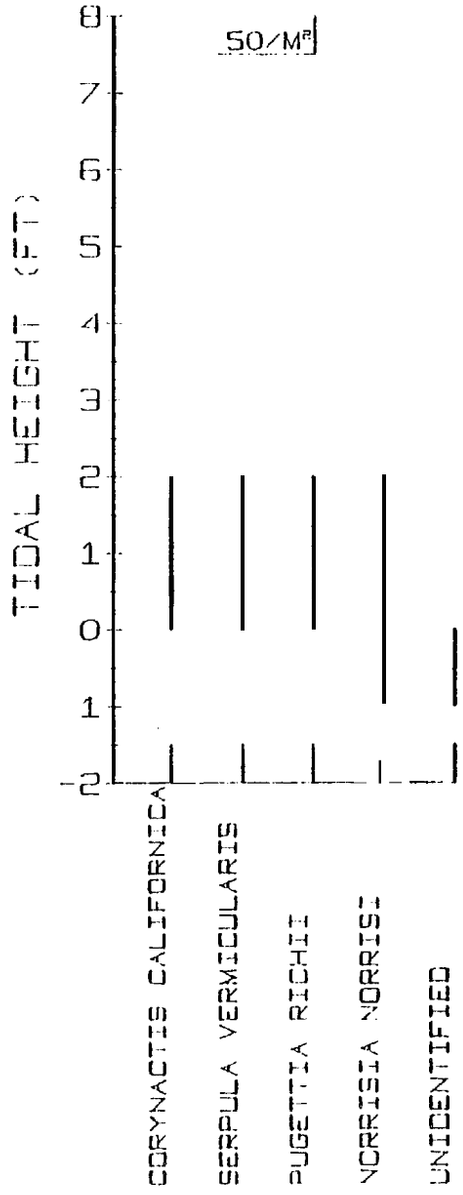

FIGURE 1.1.11-13 MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1973-1977 AT SAN CLEMENT. ISLAND (CONTINUATION).

FIGURE 1.1.11-14 MEAN DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-14 MEAN DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 A SAN CLEMENTE ISLAND (CONTINUED)

FIGURE 1.1.11-14 MEAN DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN CLEMENTE ISLAND (CONTINUATION).

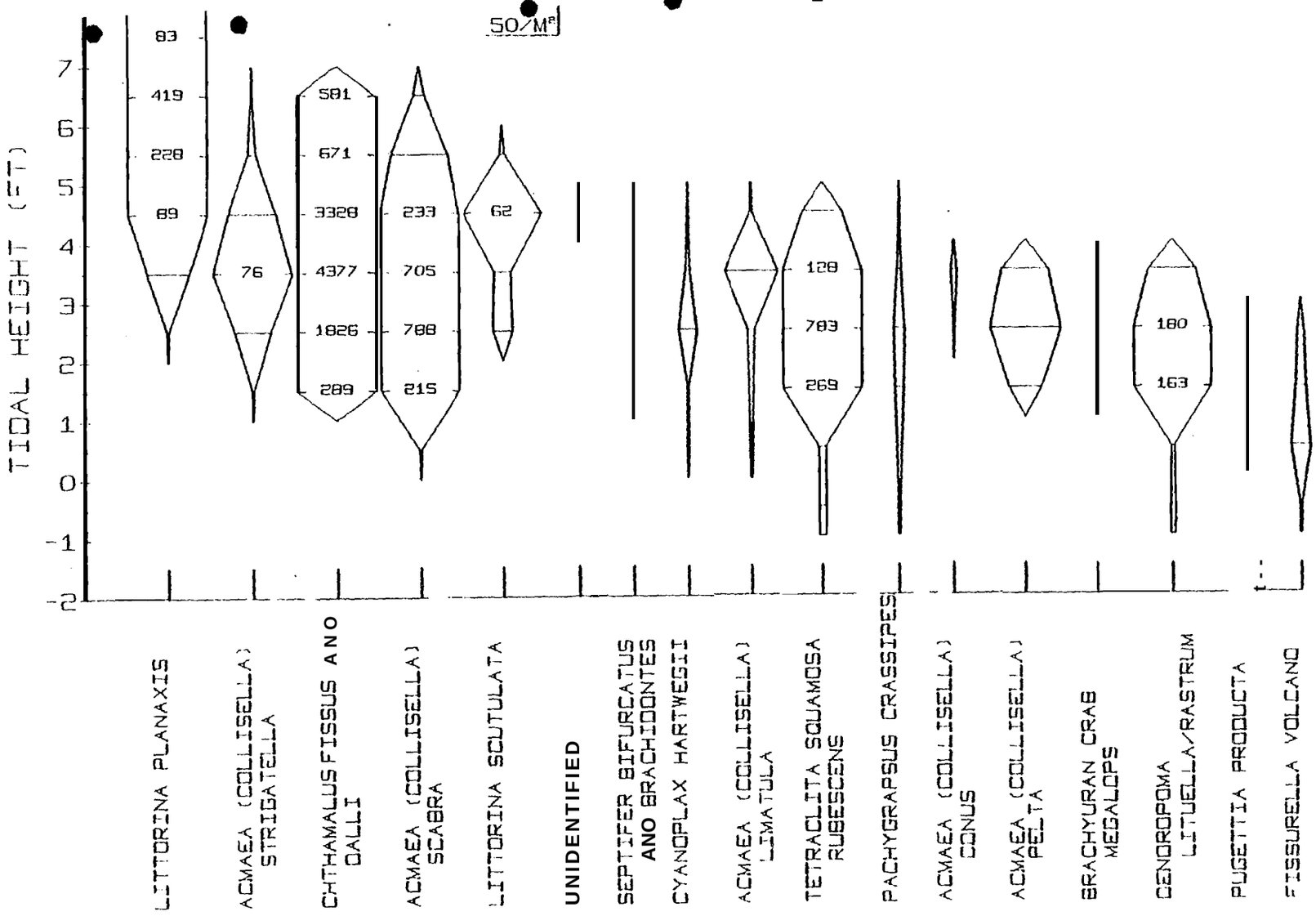

FIGURE 1.1.11-15 DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-15 DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN CLEMENTE ISLAND (CONTINUATION).

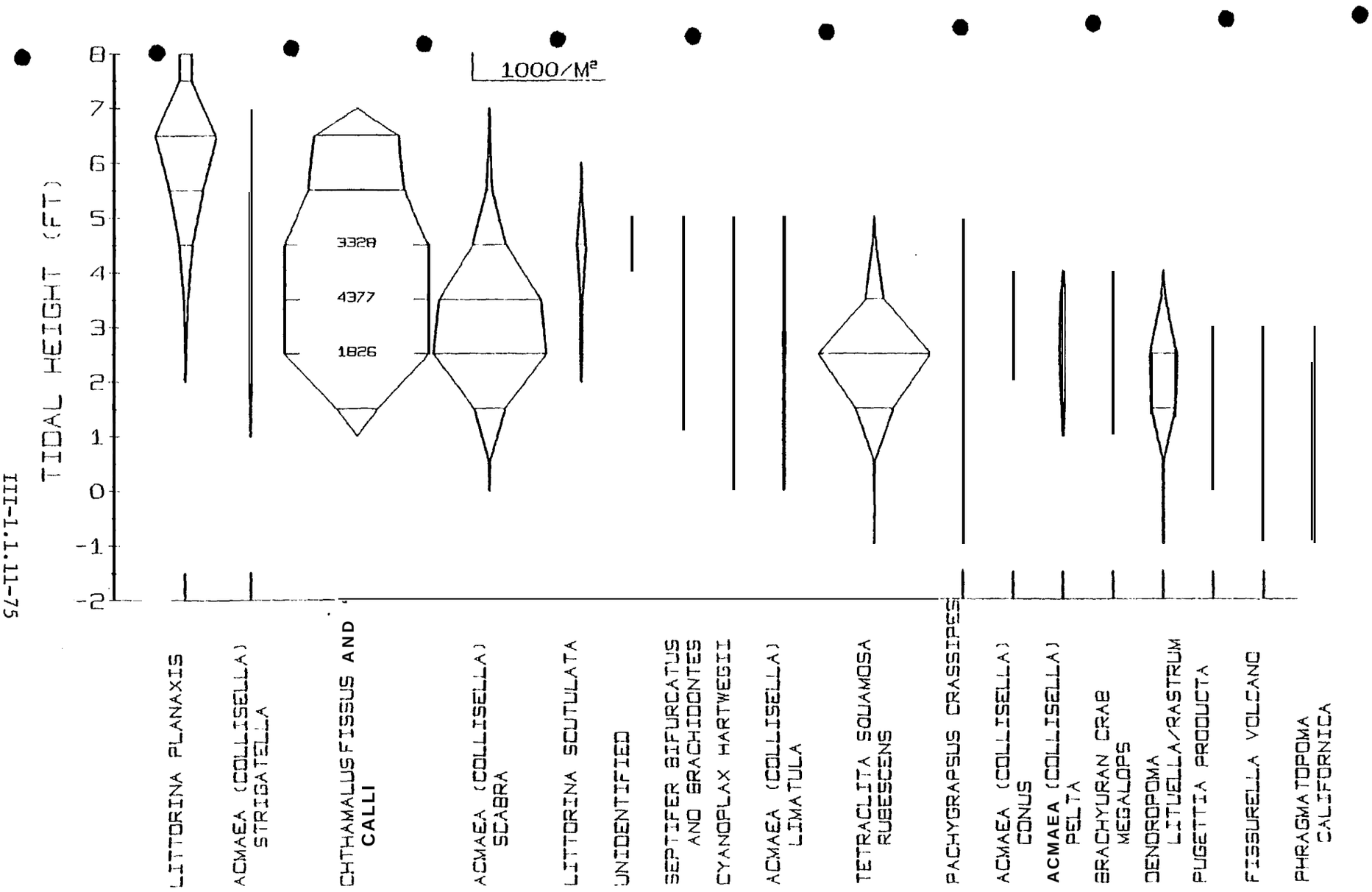

FIGURE 1.1.1 -16 DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-16 DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN CLEMENTE ISLAND (CONTINUATION).

FIGURE 1.1.11-17 ESTIMATION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1975 AT SAN CLEMENTE ISLAND (CZ INDEX).

FIGURE 1.1.11-17

DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1972 AT SAN CLEMENTE ISLAND (CONTINUATION).

FIGURE 1.1.11-18 DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDE HEIGHT FOR DECEMBER 1976 AT SAN CLEMENTE ISLAND (COZINE).

FIGURE 1.1.11-18 DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN CLEMENTE (SOUTH AND CONTINUATION).

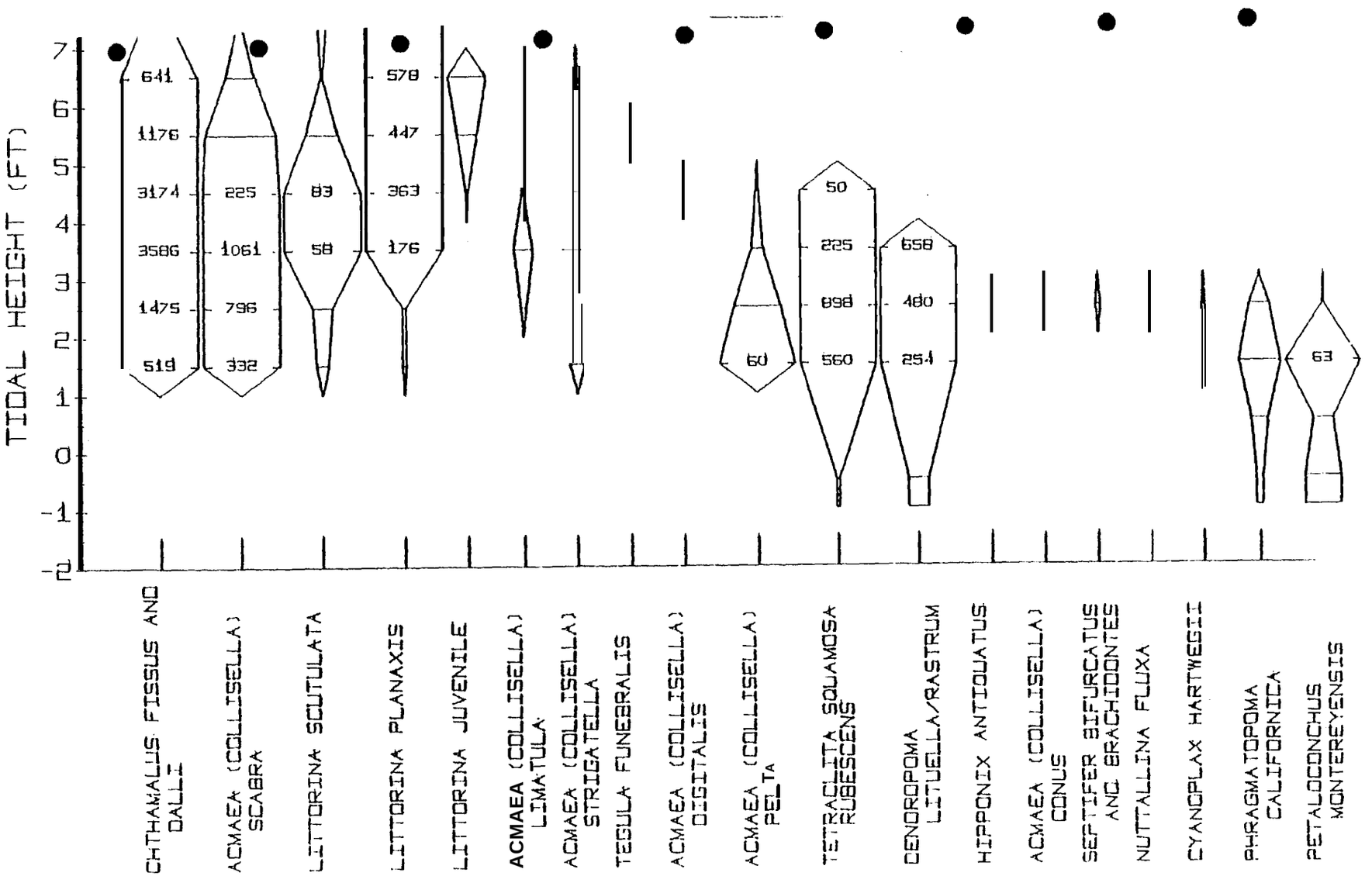

FIGURE 1.1.11-19 DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-19 DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SAN CLEMENTE ISLAND CONTINUATION

FIGURE 1.1.11-20 DISTRIBUTION OF COMMUNITY MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SAN CLEMENTE ISLAND (CONTINUED)

FIGURE 1.1.1-20 DISTRIBUTION OF DOMINAN MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGH FOR MARC 1977 AT SAN CLEMENTE I PA ND (CONTINUATION).

FIGURE 1.1.11-21 DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR JUNE, 1977 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-2 DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE III.1.11-22. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 AT SAN CLEMENTE ISLAND (CONTINUED).

FIGURE 1.1.11-22 DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 AT SAN CLEMENTE ISLAND (CONTINUATION).

lituella/rastrum and the other tube-forming animals, Spirobranchus spinosus, Serpulorbis squamigerus, and Petaloconchus montereyensis, continued to supply the majority of macroinvertebrate individuals below +1.0 ft., a habitat markedly influenced by large brown algal canopies .

1. 1.11.4.2.4 Biomass

The 24 (12 0.15-m^2 and 12 1.0-m^2) disturbed samples taken in October 1976 did not significantly alter species abundances or rank order when pooled with the previously treated (Murray and Littler, 1977a) 1975-76 samples. The mean wet biomass of 3406.6 g/m^2 consisted of 91.4% macrophytes (Table 1.1.11-13) and 8.6% macroinvertebrates (Table 1.1.11-14). Macrophyte organic dry weight averaged 493.3 g/m^2 (Table 1.1.11-15) and macroinvertebrates, 15.5 g/m^2 (Table 1.1.11-16) for a total of 508.8 g/m^2. Organic cry biomass tables have been prepared to include ash-free dry weights for selected species containing significant inorganic body parts; ash-free conversion factors have been included as Table 1.1.11-17. Biomass continued to be concentrated on the lower shoreline, and, with the exception of the -1.0 ft. (-.3 m) to MLLW tidal interval where we were restricted to a single sample, showed an increase with decreasing tidal height below +3.0 ft. (.9 m). Macrophytes furnished the vast majority of biomass throughout all tidal intervals below +3.0 ft. (.9 m), while macroinvertebrates were more abundant above +3.0 ft. (.9 m) where barnacles, limpets, and littorines predominated.

The previously established domination of macrophyte biomass by only a few species was repeated. The same 14 macrophytes listed in 1975-76 contributed over 98% of the wet weight (Table 1.1.11-13), led by Egregia menziesii (1129.3 g/m^2), Halidrys dioica (436.5 g/m^2), Corallina officinalis var. chilensis (380.0 g/m^2), and Sargassum agardhianum (36.74 g/m^2); the same four species that headed the previously reported list, see Murray and Littler (1977a). Similar species relationships to those based on wet weight were established for macrophytes for organic dry weight (Table 1.1.11-15) as during 1975-76, with articulated coralline algae (e.g., C. officinalis var. chilensis ranking lower due to the high percentage of biomass consisting of inorganic calcium carbonate. More than 99% of the organic dry biomass was contributed by the 14 most abundant taxa, led by E. menziezii (175.4 g/m^2). The brown algae H. dioica and S. agar-dhianum and the red alga Pterocladia capillacea also each supplied greater than 40 g/m^2 organic dry weight. The Phaeophyta, mostly due to the contributions of the large canopy-forming species, again supplied the majority of macrophyte wet and organic dry weight, followed by Rhodophyta and Spermatophyte; colonial blue-green (Cyanophyta) algae, Chlorophyta, and benthic diatoms (Bacillariophyta) supplied very little biomass.

TABLE 1.1.11-13. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM WILSON COVE, SAN CLEMENTE ISLAND FROM OCTOBER 1975 TO OCTOBER1976.BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 (N=19)	1.0 TO 1.9 (N=11)	2.0 TO 2.9 (N=10)	3.0 TO 3.9 (N= 9)	4.0 TO 4.9 (N= 5)	5.0 TO 5.9 (N= 4)	6.11 TO 6.9 (N= 1)	MEAN
BLUE-GREEN COLONY				<0.1	1.8	2.8			0.6
PELVETIA FASTIGIATA F. GRACILIS				144.5	192.5				42.1
CYLINDROCARPUS RUGOSUS				0.2	1.6				0.2
CERAMIUM EATONIANUM/SINICOLA			0.4	25.7	10.9				4.6
CELIDIUM PUSILLUM		<0.1	26.3	91.1	5.6				15.4
COLPOMENIA SINUOSA		0.9	27.3	20.2	<0.1				8.0
LAURENCIA PACIFICA		5.3	46.0	66.9	0.7				15.1
CORALLINA OFFICINALIS VAR. CHILENSIS	65.1	162.7	1158.9	1649.9	3.5				383.0
GIGARTINA CALIFICULATA	1.9	59.1	829.7	492.5	1.6				173.1
BENTHIC DIATOMS				1.1					0.1
POLYSIPHONIA SCOPULORUM VAR. VILLUM				1.0					0.1
PTILOTHAMNION GRACILE		7.9	<0.1	<0.1					1.0
CRYPTOPLEURA CORALLINARA		3.3	22.5	16.6					5.6
CELIDIUM COULTERI		3.0	17.3	64.8					10.6
LITHOTHRIX ASPERGILLUM		6.6	6.6	13.7					3.4
SARGASSUM AGARDHIANUM		1.0	2016.6	921.5					367.4
LAURENCIA SPECTABILIS		20.5	1.0	7.4					3.6
GASTROCLONIUM COULTERI		3.2	16.7	1.3					2.7
HERPOSIPHONIA VERTICILLATA		1.8	0.4	5.0					0.9
GIGARTINA SPINOSA		23.9	4.0	0.7					3.6
LAURENCIA LAJOLLA		0.4	0.2	9.7					1.3
CORALLINA VANCOUVERIENSIS	2.2	5.0	102.7	330.9					55.1

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.11-13. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM WILSON COVE, SAN CLEMENTE ISLAND FROM OCTOBER 1975 TO OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT.) -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 (N=19)	1.0 TO 1.9 (N=11)	2.0 TO 2.9 (N=10)	3.0 TO 3.9 (N= 9)	4.0 TO 4.9 (N= 5)	5.0 TO 5.9 (N= 4)	6.0 TO 6.9 (N= 1)	MEAN
RHODOGLOSSUM AFFINE	34.9	17.1	1.4	0.6					6.7
EGREGIA MENZIESII	3343.0	5616.4	71.3	1.6					1129.3
FISTULARIA CORNEA	8.1	637.2	6.9	2.8					82.1
MALIBUS DIGITA	53.7	3074.4	361.4	2.1					436.5
PTEROCLADIA CAPILLACEA	7.1	436.0	742.2	330.1					169.4
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA		17.7	4.1						2.7
CARPOPELTIS DIVARICATA		7.5							0.9
PELVETIA PURPURASCENS		7.5							0.9
PHODYMENIA CALIFORNICA VAR. CALIFORN		1.4							0.2
PHYLLOSPADIX TORREYI		1380.8							172.6
HEMOSIPHONIA BERMUDA		3.7							0.5
OTHER MACROPHYTES (26)	0.1	1.8	0.4	0.5	0.8	0.0			
TOTAL WET WEIGHT IN G/M2	3516.2	11508.6	5468.3	4204.5	219.1	2.8			

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.11- 4. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM WILSON COVE, SAN CLEMENTE ISLAND FROM OCTOBER 1975 TO OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT).								
	-1.0 TO -0.1 N= 1	MLLW TO 0.9 (N=19)	1.0 TO 1.9 (N=11)	2.0 TO 2.9 (N=10)	3.0 TO 3.9 (N= 9)	4.0 TO 4.9 (N= 5)	5.0 TO 5.9 (N= 4)	6.0 TO 6.9 (N= 1)	MEAN
LITTORINA PLANAXIS				<0.1	0.6	8.9	13.6	17.5	5.1
CRTHOMALUS FISSUS AND DALLI				3.5	260.7	265.6	69.3	2.1	73.9
CRTHOMALUS FISSUS						3.3	121.8		15.6
ACMAEA (COLLISELLA) SCABRA			0.6	21.1	141.5	37.8	16.4		27.2
BRACHIDONTES ADAMSIANUS		<0.1	7.5	29.6	1.1	0.2	0.3		4.6
PACHYCHAMUS CRASSIPES		0.1	0.5	1.5			<0.1		0.3
ACMAEA (COLLISELLA) STRIGATELLA					2.0	0.6			0.3
ACMAEA (COLLISELLA) PELTA				<0.1	1.4	<0.1			0.2
LITTORINA SCUTULATA			<0.1	<0.1	1.8	1.2			0.4
TEGULA SQUAMOSA RUBESCENS		2.7	30.6	195.3	958.6	10.1			149.7
FISSURELLA VOLCANO		1.5	1.2	0.3	<0.1				0.4
FISSURELLA FLUXA		<0.1	<0.1	2.3	0.2				0.3
LOPHOPANOPEUS BELLUS		0.3	<0.1	<0.1					0.2
CRASSOSTREA GIGAS		1.2	4.4	<0.1					0.6
MYTILUS CALIFORNICUS		10.2		0.4					1.3
SEPTIFER BIFURCATUS		<0.1	1.7	1.2					0.4
HIPPOLYX ANTIQUATUS		0.4	0.2	1.0					0.3
SPIROBRANCHUS SPINOSUS		14.5		0.4					1.9
BALANUS TINTINNABULUM CALIFORNICUS			1.0						0.1
ASTROPETIS SERTULIFERA		1.1							0.1
HALIOTIS CRACHERODII		22.7							2.8
PETALOCONCHUS MONTEREYENSIS		21.0							2.6

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.11-14. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM WILSON COVE, SAN CLEMENTE ISLAND FROM OCTOBER 1975 TO OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW To 0.9 (N=19)	1.0 TO 1.9 (N=11)	2.0 TO 2.9 (N=10)	3.0 TO 5.9 (N= 9)	4.11 TO 4.9 (N= 3)	5.0 TC 5.9 (N= 4)	0.0 TO 6.9 (N= 1)	MEAN
SERPULORBIS SQUAMIGERUS		19.7							2.5
OTHER MACRO-INVERTEBRATES (50)		3.7	1.7	1.6	0.1				
TOTAL WET WEIGHT IN G/M2		99.5	49.3	256.2	1357.9	327.8	221.7	19.5	

NOTE: 1 FOOT = 0.3048 METERS

'liable 1 .1 .11-15 . Organic Dry Weight in g/m^2 for Dominant Macrophytes from Wilson Cove, San Clemente Island, from October 1975 to October 1.976. Blank spaces indicate zeros.

Taxa	Tidal Height (ft) -1.0 to -0.1 (N=1)	MLLW to 0.9 (N=19)	1.0 to 1.9 (N=11)	2.0 to 2.9 . (N=10)	3.0 to 3.9 (N=9)	4.0 to 4.9 (N=5)	5.0 to 5.9 (N=4)	6.0 to 6.9 (N=1)	Mean
Blue-green colony				<0.1	0.6	1.0			0.2
Pelvetia fastigiata f. gracilis				**42.0**	52.2				11.8
Ceramium eatonianum/sinicola			**<0.1**	**3.0**	0.8				0.5
Gelidium pusillum		<0.1	4.7	**14.1**	0.3				2.4
Laurencia pacifica		0.7	4.5	**6.9**	<0.1				1,5
Colpomenia sinuosa		0.1	5.2	2.0	<0.1				0.9
Corallina officinalis var. chilensis[a]	2.9	11.2	89.4	120.2	<0.1				**28.0**
Gigartina canaliculata	0.4	9.8	171.1	92.9	0.5				**34.3**
Haliptylon gracile[a]		0.6	<0.1	<0.1					**0.1**
Cryptopleura corallinara		0.3	1.8	1.6					**0.4**
Gelidium coulteri		0.5	4.1	13.2					**2.2**
Lithothrix aspergillum[a]		0.5	0.5	0.8					**0.2**
Sargassum agardhianum		<0.1	297.5	154.4					**56.5**
Laurencia spectabilis		1.9	0.2	1.3					**0.4**
Gastroclonium coulteri		0.5	2.4	0.3					**0.4**
Herposiphonia verticillata		0,2	<0.1	0.7					**0.1**
Gigartina spinosa		3.5	1.7	<0.1					**0.7**
Corallina vancouveriensis[a]	0.2	0.5	9.1	28.7					**4.8**
Rhodoglossum affine	4.6	3.5	0.2	0.1					**1.0**

Table 1 .1. 1.1-15 . Organic Dry Weight g/m^2 for Dominant Macrophytes from Wilson Cove, San Clemente Island from October 1975 to October 1976. Blank spaces indicate zeros. (Continued).

Taxa	Tidal Height (ft) -1.0 to -0.1 (N= 1)	MLLW to 0.9 (N=19)	1.0 to 1.9 (N=11)	2.0 to 2.9 (N=10)	3.0 to 3.9 (N= 9)	4.0 to 4.9 (N= 5)	5.0 to 5.9 (N= 4)	6.0 to 6.9 (N= 1)	Mean
Egregia menziesii	495.9	896.7	10.6	0.2					**175.4**
Eisenia aborea	1.3	99.3	2.0	0.8					**12.9**
Halidrys dioica	9.1	509.0	57.2	0.4					**72.0**
Pterocladia capillacea	1.8	99.7	206.5	80.8					48.6
Bossiella orbigniana ssp dichotoma[a]		**1.3**	**0.3**						0.2
Carpopeltis divaricata		**1.6**							0.2
Gelidium purpurascens		**1.4**							0.2
Phyllospadix torreyi		297.5							**37.2**
Other Macrophytes (34)	**0.0**	**0.7**	**0.1**	**0.7**	0.4	0.0			0.2
Total Ash-Free Weight in g/m^2	516.2	1941.0	869.1	565.1	54.8	1.0			493.3

[a] Ash-Free Dry Weight; see Table 1.1.11.-17 for conversion factors.

Note: 1 foot = 0.3048 meters

Table 1.1.11-16. Organic Dry Weight in g/m^2 for Dominant Macroinvertebrates from Wilson Cove, San Clemente Island, from October 1975 to October 1976. Blank spaces indicate zeros.

Taxa	Tidal Height (ft) -1.0 to -0.1 (N=1)	MLLW to 0.9 (N=10)	1.0 to 1.9 (N=11)	2.0 to 2.9 (N=10)	3.0 to 3.9 (N=9)	4.0 to 4.9 (N=5)	5.0 to 5.9 (N=1)	6.0 to 6.9 (N=1)	Mean
Littorina planaxis[a]				<0.1	0.1	0	1.2	1.8	0.5
Chthamalus fissus/dalli[a]				0.1	12.1	14	10.3	0.1	4.6
Acmaea (Collisella) scabra[a]			0.1	1.3	11.3	3	1.4		2.2
Brachidontes adamsianus[a]		<0.1	0.6	2.4	0.1	<0	<0.1		0.4
Acmaea (Collisella) strigatella[a]					0.2	0			<0.1
Acmaea (Collisella) pelta[a]				<0.1	0.2	<0			<0.1
Littorina scutulata[a]			<0.1	<0.1	0.2	0			<0.1
Tetraclita squamosa rubescens[a]		0.1	1.2	7.5	37.7	0			5.9
Nuttallina fluxa[a]		<0.1	<0.1	0.3	<0.1				0.1
Fissurella volcano[a]		0.1	0.1	<0.1	<0.1				<0.1
Pseudochama exogyra[a]		<0.1	0.3	<0.1					<0.1
Septifer bifurcatus[a]		<0.1	0.1	0.1					<0.1
Spirobranchus spinosus[a]		0.5		<0.1					0.1
Phragmatopoma californica[a]		0.3		<0.1					0.1
Hipponix antiquatus[a]		<0.1	<0.1	0.1					<0.1
Haliotis cracherodii[a]		4.4							0.6
Petaloconchus montereyensis[a]		0.2							<0.1
Serpulorbis squamigerus[a]		1.1							0.1
Other Macroinvertebrates (54)	0.0	2.6	1.6	1.2	0.1	0	0.0	0	0.1
Total Ash-Free Weight in g/m^2	0.0	9.8	4.3	13.7	62.0	19.5	12.9	1.9	15.5

[a] Ash-Free Dry Weight; see Table .1.11-17 for conversion factors.

Note: 1 foot = 0.3048 meters

Table 1 .1. 11-17 . Mean Ratio of Ash-Free to Dry Biomass for Dominant Macrophytes and Macroinvertebrates with High Ash Content. All specimens were collected from the Wilson Cove, San Clemente Island study area except where noted otherwise.

Species	No. Replicates	Ash-Free Dry Weight (g)/Dry Weight (g) Mean	Standard Deviation
Macrophytes			
Bossiella orbigniana ssp. dichotoma	9	0.139	**0.025**
Corallina officinalis var. chilensis	9	0.144	**0.013**
Corallina vancouveriensis	8	0.198	**0.046**
Haliptylon gracile	6	0.221	**0.099**
Lithothrix aspergillum	11	0.198	**0.052**
Macroinvertebrates			
Acmaea (Collisella) digitalis	5	**0.148**	**0.037**
Acmaea (Collisella) pelta	5	**0.233**	**0.064**
Acmaea (Collisella) scabra	10	**0.135**	**0.013**
Acmaea (Collisella) strigatella	9	**0.212**	**0.046**
Anthopleura elegantissima[b]	3	**0.685**	--
Balanus tintinnabulum californicus[a]	7	**0.060**	**0.024**
Brachidontes adamsianus	7	**0.141**	**0.014**
Ceratostoma nuttalli[a]	7	**0.061**	**0.018**
Chthamalus fissus/dalli	10	**0,091**	**0.029**
Cyanoplax hartwegii	5	**0.319**	**0.161**
Fissurella volcano	9	**0.169**	**0.053**
Haliotis cracherodii[b]	4	**0.320**	--
Hipponix antiquates	6	**0.077**	0.033
Homalopoma luridum	2	0.096	--

Table 1.1.11-17. Mean Ratio of Ash-Free to Dry Biomass for Dominant Macrophytes and Macroinvertebrates with High Ash Content. All specimens were collected from the Wilson Cove, San Clemente Island study area except where noted otherwise. (Continued).

Species	No. Replicates	Ash-Free Dry Weight (g)/Dry Weight (g) Mean	Standard Deviation
Lithophaga plumula[a]	9	0.203	0.055
Littorina planaxis	7	0.167	0.089
Littorina scutulata	9	0.139	0.037
Mitrella aurantiaca and Mitrella carinata[a]	2	0.108	--
Mytilus edulis[a]	5	0.133	0.089
Nuttallina fluxa	7	0.288	0.076
Ocenebra circumtexta[a]	4	0.083	--
Pachygrapsus crassipes[b]	3	0.524	--
Petaloconchus montereyensis	1	0.126	--
Phragmatopoma californica[c]	1	0.050	--
Pseudochama exogyra[a]	9	0.093	0.045
Septifer bifurcates	3	0.095	--
Serpulorbis squamigerus[b]	3	0.080	--
Spirobranchus spinosus[c]		0.050	--
Strongylocentrotus purpuratus	3	0.113	--
Tetraclita squamosa rubescens	13	0.059	0.016

[a] Specimens obtained from Fisherman Cove, Santa Catalina Island.

[b] Values reported for Wilson Cove, San Clemente Island specimens in Murray and Littler (1977b).

[c] Values obtained from Seapy and Littler (in press) with conversion for Spirobranchus spinosus assumed to be identical to that for Phragmatopoma californica.

Macroinvertebrate wet biomass was almost entirely furnished by the barnacles Tetraclita squamosa rubescens (149.7 g/m^2) and Chthamalus fissus/dalli (89.5 g/m^2), and the limpet Acmaea (Collisella) scabra (27.2 g/m^2, Table 1.1.11-14). These taxa accounted for over 90% of overall macroinvertebrate wet weight. Similar relationships were evident for macroinvertebrates based on organic dry weight (Table 1.1.11-16, as during 1975-76. The barnacles and limpets continued to dominate macroinvertebrate organic dry weight, as T. squamosa rubenscens (5.9 g/m^2), C. fissus/dalli (4.6 g/m^2), A. (Collisella) scabra (2.2 g/m^2) furnished over 80% of the biomass. In terms of macroinvertebrate biomass, the Arthropoda (Crustacean), composed almost entirely of barnacles, were predominant followed by Mollusca (mostly Gastropoda); very little biomass was contributed by Echinodermata, Cnidaria, Porifera, or Ectoprocta.

1.1.11.4.3 Community Analysis

1. 1.11.4.3.1 Species Diversity

The four methods of diversity assessment employed for 1975-76 were again used to facilitate seasonal and annual within-site comparisons. These were simple counts of taxa, Margaleg's (1968) quantitative richness (D') index, Shannon's H' index (Shannon and Weaver, 1949) and Pielou's (1969) J' evenness index. A mean yearly total of 132 taxa, including 74 macrophytes and 58 macroinvertebrates were obtained in undisturbed samples during 1976-77 (see Tables 1. 1.11-3 and 1.1.11-4) compared to 52 macrophytes and 40 macroinvertebrates sampled by similar methods during 1975-76. An average of 92 taxa (33 macroinvertebrates and 59 macrophytes) were encountered during each seasonal assessment for the current year, with a maximum of 103 for June, a period when macrophytes (65) and macroinvertebrates (39) also reached a Peak (Table 1.1.11-18). Richness (D') revealed a similar trend, averaging 19.54 per seasonal assessment and also reached highest values during June. The measurements of species richness (i.e. , counts of taxa and D') showed increases over 1975-76. Analyses of abundance data revealed that the increased numbers of species encountered in undisturbed samples for 1976-77 likely resulted from greater resolution on the part of the field taxonomists as significantly more rare (low abundance) macrophytes and macroinvertebrates were obtained. Whereas March was described as the 1975-76 sampling period of greatest richness based on combined undisturbed and disturbed sampling data (Murray and Littler, 1977a), an analysis of 1975-76 undisturbed samples only revealed that both March and June 1976 were comparable in richness. For 1976-77, June showed maximum species numbers followed closely by October and March (Table 1.1.11-15). December remained the period of lowest species richness comparable to our 1975-76 finding. These data for the two years of study suggest a Pattern of greater species numbers during the spring, summer and fall, and reduced numbers during the winter.

TABLE 1.1. 11-1S. SEASONAL AND ANNUAL DIVERSITY FOR SAN CLEMENTE ISLAND.

GROUPS AND DATES	NO. TAXA	COVER (%)			DENSITY (NO./M2)		
		D'	H'	J'	D'	H'	J'
MACRO-INVERTEBRATES							
OCT. 1976	35	17.52	1.69	0.47	4.52	1.29	0.36
DEC. 1976	31	16.14	1.81	0.53	4.09	1.50	0.44
MAR. 1977	32	15.81	1.64	0.47	4.06	1.43	0.41
JUNE 1977	39	20.31	1.72	0.47	4.79	1.47	0.40
MEAN	34	17.44	1.72	0.49	4.36	1.42	0.40
MACROPHYTES							
OCT. 1976	62	12.98	2.42	0.59	- -	- -	- -
DEC. 1976	56	12.12	2.40	0.60	- -	. .	- -
MAR. 1977	65	13.82	2.50	0.60	. .	. .	- -
JUNE 1977	69	14.39	2.45	0.58	- -	- -	- -
MEAN	63	13.32	2.44	C*59			
COMBINED MACRO-INVERTEBRATES AND MACROPHYTES							
OCT. 1976	97	20.11	2.60	0.57	- -	- -	- -
DEC. 1976	87	16.67	2.60	0.58	- -	. .	- -
MAR. 1977	97	20.43	2.68	0.59	. .	- -	- -
JUNE 1977	108	22.37	2.62	0.56	- -	- -	- -
MEAN	97	20.40	2.63	0.57			

An analysis of diversity measured by H' and J', indices that heavily emphasize the distribution of abundance among taxa, showed maximal overall diversity during March, the period of greatest macrophyte H' values . The H' average of 2.50 for combined macrophytes and macroinvertebrates compared favorably with the 2.66 value obtained for undisturbed sampling for 1975-76, considering the increased number of low-abundance species encountered this year. Evenness (J') also showed a decline (0.55 vs. 0.63). As during 1975-76, seasonal fluctuations in H' diversity for combined macroinvertebrates and macrophytes were very slight although a greater range was determined for 1976-77 (2.46 to 2.57) than for 1975-76 (2.65 to 2.66). These diversity data suggest a relatively constant intertidal biota, as measured by cover, with little seasonality in the abundance patterns of most of the dominant populations. Greater fluctuations in diversity were apparent for 1976-77 than for 1975-76 although these were very slight. Additionally, the increase in species numbers obtained during the current year probably resulted from increased sampling resolution.

1.1.11.4.3.2 Species Assemblages

To further analyze patterns of community structure, seasonal cover data for sample quadrats were subjected to statistical cluster analysis. The 4 major zones (A-D) established during 1975-76 (Murray and Littler, 1977a) again persisted over the 1976-77 sampling program. The seven species groups described for 1975-76 were also identified for the current year, although their association with specific sample plots varied slightly during the two years of study. These groups have been referred to as: blue-green algal group (AA), blue-green Chthamalus group (AB), blue-green - Chthamalus - Acmaea group (AC), Pseudolithoderma - Tetraclita group (B), Corallina - Gigartina group (CA), Corallina - Pterocladia group (CB), and Egregia group (D).

As during 1975, the biotic character of the individual Plots comprising the four major zones (A-D) was generally maintained, with seasonal variations in species abundances mostly being insufficient to alter the major group to which a plot was assigned. The cluster analysis for quadrats based on annual average percent covers for each species has been presented to provide a representative example of the zonational Patterns for the Wilson Cove, San Clemente Island site (Figure 1.1.11-23).

Detailed descriptions of the species assemblages characteristic of the quadrat groups for the leeward San Clemente Island study site have been presented previously (Murray and Littler, 1977a). The same species have mostly continued to provide the dominant cover in the well-established zones resulting in overall distributional patterns comparable to those established last year. A generalized depiction of these patterns in relation to positions of quadrats (Figure 1.1.11-24) has been prepared for this study site from interpretations of the cluster analysis data presented in Figure 1.1.11-23.

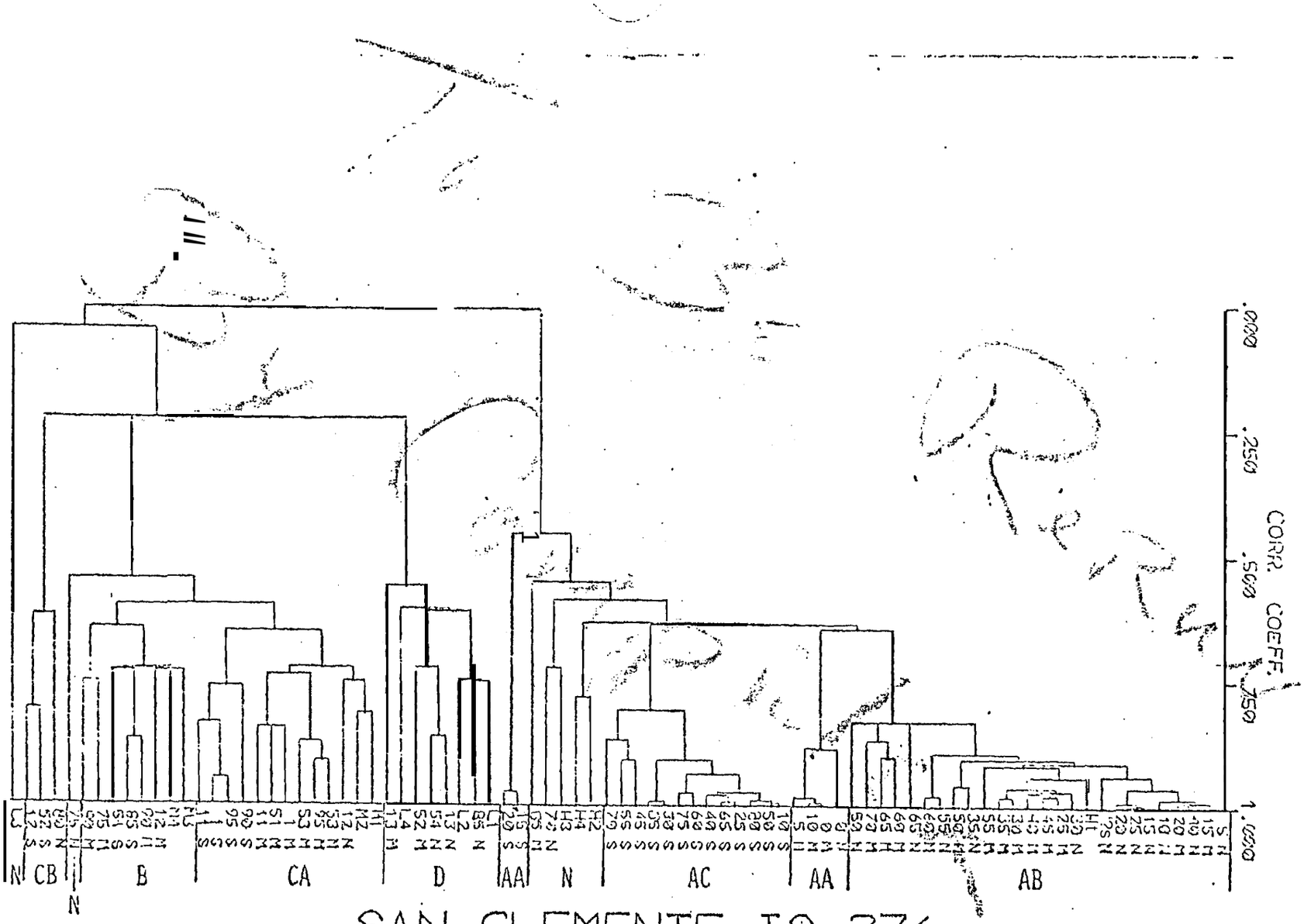

Figure 28. Dendrogram display of differential clustering of quadrats sampled during March 1976.

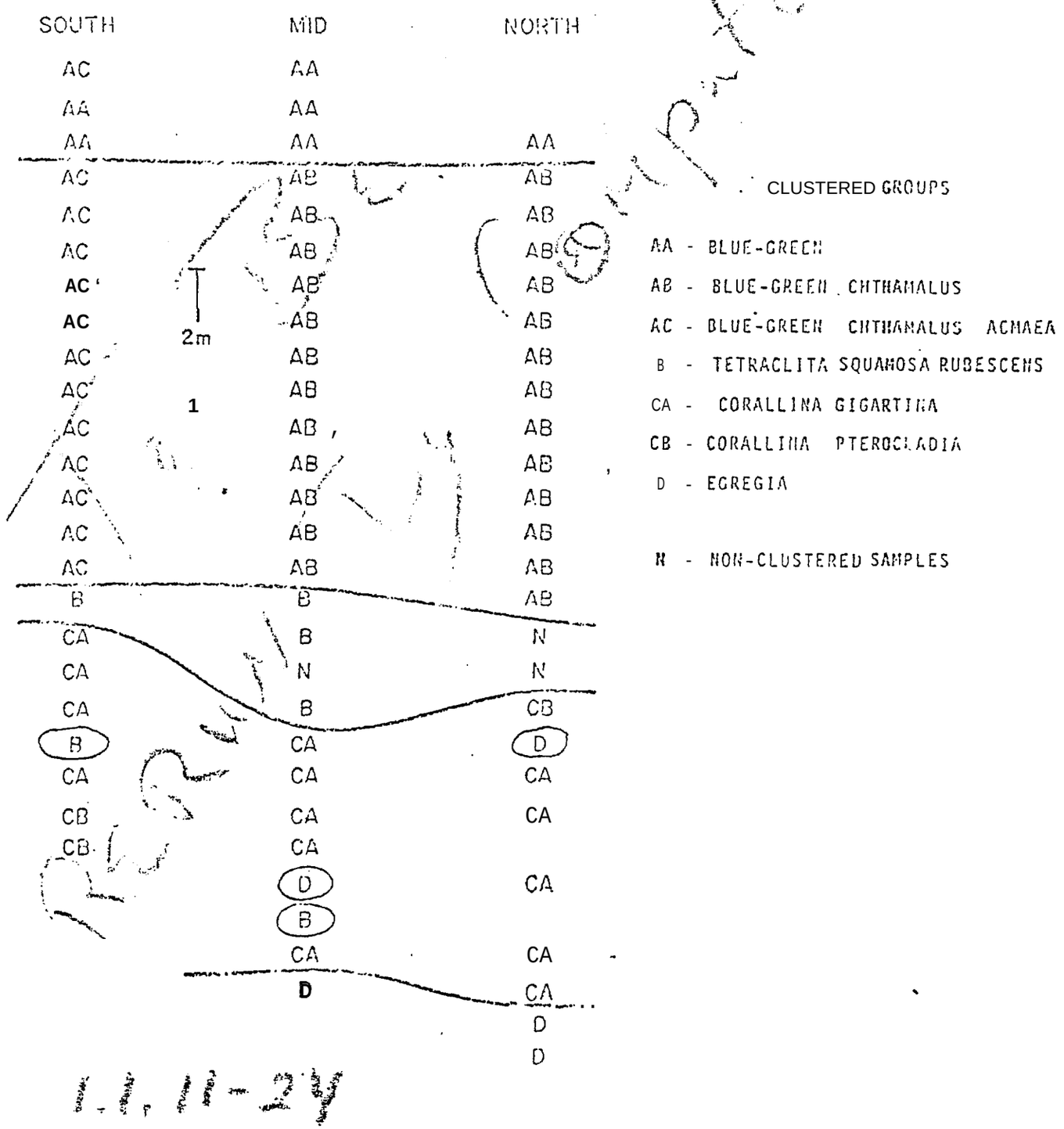

Figure 29. Distributional patterns of species groups for March 1976 in relation to positions of transects and locations of quadrats in which they occurred.

and Eisenia arborea, additional species of large brown algae that along with E. menziesii dominate the lower intertidal shoreline. Pterocladia capillacea, a species also found in abundance along the lower shoreline, revealed increased standing stocks during 1976-77, particularly when the large brown algae were most reduced. This seasonality may have resulted from increased light availability and reduced substrate disturbance from the lashing of large brown algal fronds. Blue-green algae, which developed most extensively during the colder months during the 1975-76 program, failed to show a similar pattern during 1976-77. Macrophytes continued to dominate macro-organism biomass near Wilson Cove, contributing over 91% of the total wet weight and 97% of the organic dry weight. The large brown algae were by far the dominant macrophytes as reported previously (Murray and Littler, 1977a). Macroinvertebrate biomass, however, was relatively low and dominated almost exclusively by barnacles and other suspension feeders, along with a few species of limpets. Grazing snails (other than littorines), chitons, and predatory molluscs, and starfish were notably found in very low numbers and furnished virtually negligible biomass. Only a few macroinvertebrates were conspicuous near the study site as most of the species encountered during the sampling program showed relatively low frequencies (Table 1.1.11-11). Additionally, many of the barnacles and limpets were found as large older individuals. The reasons for the low macroinvertebrate standing stocks and reduced numbers of grazers and predators remains in need of further study.

The cluster analyses revealed the same four major biological zones reported previously (Littler and Murray, 1975; Murray and Littler, 1977a). Additionally, cluster analyses did not reveal significant differences in quadrat groupings when compared to 1975-76 interpretations. Two years of research has characterized the rocky intertidal communities near Wilson Cove as showing modest seasonality and relatively constant annual patterns of macro-organism standing stocks.

1. 1.11.5 Discussion

This study has contributed to our knowledge of the biota inhabiting rocky intertidal habitats near Wilson Cove, San Clemente Island by add ing additional taxonomic records. The 1975-76 sampling program (Murray and Littler, 1977a) added 89 new taxonomic records (37 macrophytes and 52 macroinvertebrates) to the previous information (Seapy, 1974; Sims 1974) for leeward San Clemente Island, while the current study has added further entities to the list. Many of these species were also encountered by Murray and Littler (1977b) during their studies on the influence of the nearby sewage outfall on rocky intertidal communities adjacent to Wilson Cove.

The patterns of abundance of the dominant macrophyte and macroinvertebrate populations continued to agree closely with those reported since 1972 (Littler and Murray, 1975; Murray and Littler, 1977a, 1977b), further substantiating the view that the standing stocks of the macro-organisms near Wilson Cove show relatively little long-term variability.

This study also supports previous interpretations of only moderate seasonality in macro-organism standing stocks . Diversity of macro-organisms was highly constant throughout the year. The number of species sampled (Table 1.1.11-18) ranged from 81 in December to 103 in June indicating a pattern of increased richness during the summer; this was slightly different from 1975-76, when March (81 and June (79) were found to be the seasons of maximal species richness. Combined macroinvertebrate and macrophyte cover diversity (Table 1.1.11-18) as measured by Shannon's (H') index continued to be relatively constant although slightly greater ranges (2.46 to 2.57 vs. 2.65 to 2.66) and slightly lower (2.50 vs. 2.66) averages were determined. Seasonal variations in abundance during 1976-77 continued to be mostly resticted to the macrophytes, with conspicuous changes evident for only a few of the dominant taxa. Modest seasonal increases in cover again occurred for several of the frondose algae which were sampled in association with the mid-intertidal coralline turf. Generally, these species, including Sargassum agardhianum, Colpomenia sinuosa, Gigartina canaliculata, Laurencia pacifica, and L. snyderae, were more luxurious and provided greater cover during the fall and summer (Table 1.1,11-8). The large, canopy-forming brown algae also continued to show seasonal variations in their standing stocks. Egregia menziesii again showed a pattern of greater cover during the fall and summer. Egregia menziesii appeared to recruit juvenile sporophyte thalli at higher intertidal levels during the spring and early summer, as previously reported by Murray and Littler (1977b), and it then rapidly accumulated biomass through the fall. The winter of 1976-77 also revealed a large decrease in E. menziesii standing stock, presumably due to desiccation stresses imposed by afternoon low tides. Similar reductions in cover during winter were determined for Halidrys dioica

1. 1.11.6 References

Dorsey, J. H., "A New Species of Rhynchospio (Polychaeta: Spionidae) from San Clemente Island, California, "Bull. S. Calif. Acad. Sci. 76, 1-14 (1977).

Littler, M.M., "General Introduction, Methods and Materials," pages 1-26 in M. M. Littler, cd., Spatial and Temporal Variations in the Distribution and Abundance of Rocky Intertidal and °Tidepool Biotas in the Southern California Bight, Unpubl. Tech. Compl. Rept., U. S. Department of the Interior, Bureau of Land Mangement (1977).

Littler, M. M., and S. N. Murray, "Impact of Sewage on the Distribution , Abundance and Community Structure of Rocky Intertidal Macro-organisms," Mar. Biol. 30, 277-291 (1975).

Littler, M. M., and S. N. Murray, eds., "Influence of Domestic Wastes on the Structure and Energetic of Intertidal Communities Near Wilson Cove, San Clemente Island, California," Calif. Water Res. Ctr. Contr., No. 164 (1977a).

Littler, M. M., and S. N. Murray, "Analyses of Pathways of Energy Flow , " pages 47-56 in M. M. Littler and S. N. Murray, eds., Influence of Domestic Wastes on the Structure and Energetic of Intertidal Communities Near Wilson Cove, San Clemente Island, California. Calif. Water Res. *Ctr.* Contr., No. 164 (1977b).

Margalef, R., "Perspective in Ecological Theory." (Chicago, University of Chicago Press, 1968).

Murray, S. N. and M. M. Littler, "Biological Features of Rocky Intertidal Communities on Leeward San Clemente Island , California," pages 885-1049 in M. M. Littler, cd., Spatial and Temporal Variations in the Distribution and Abundance of Rocky Intertidal and Tidepool Biotas in the Southern California Bight, Unpubl. Tech. Compl. Rept., U.S. Department of the Interior, Bureau of Land Management (1977a).

Murray, S. N., and M. M. Littler, "Seasonal Analyses of Standing Stock and Community Structure of Macro-organisms." pages 7-32 in M. M. Littler and S. N. Murray, eds., Influence of Domestic Wastes on the Structure and Energetic of Intertidal Communities Near Wilson Cove, San Clemente Island, California, Calif. Water Res. Ctr. Contr. No. 164 (1977b).

PieLou, E. C. "An Introduction to Mathematical Ecology," (New York, Wiley-Interscience, 1969).

Seapy, R. R. , "Macroinvertebrates " pages 14-22 in S. N. Murray and M. M. Littler, eds. , Biological Features of Intertidal Communities Near the U. S. Navy Sewage Outfall, Wilson Cove, San Clemente Island, California, Naval Undersea Center, San Diego, California, TP 396 (1974).

Seapy, R. R., and M. M. Littler, '*Biological Features of Rocky Intertidal Communities Near Willows Anchorage, Santa Cruz Island, California, " pages 686a-794a in M. M. Littler, cd., Spatial and Temporal Variations in the Distribution and Abundance of Rocky Intertidal and Tidepool Biotas in the Southern California Bight. Unpubl. Tech. Compl. Rept., U.S. Department of the Interior, Bureau of Land Management (1977).

Shannon, C. E., and W. Weaver, "The Mathematical Theory of Communication. (Urbana, University of Illinois Press, 1949).

Sims, R. H., "Intertidal Macrophytes, "pages 13-17 in S. N. Murray and M. M. Littler, eds., Biological Features of Intertidal Communities Near the U. S. Navy Sewage Outfall, Wilson Cove, San Clemente Island, California. Naval Undersea Center, San Diego, California, TP 396 (1974).

INTERTIDAL STUDY OF THE SOUTHERN CALIFORNIA BIGHT

1.1.12

BIOLOGICAL FEATURES OF ROCKY INTERTIDAL COMMUNITIES AT GOVERNMENT POINT, SANTA BARBARA COUNTY , CALIFORNIA

VOLUME 111

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1,1.12 Biological Features of Rocky Intertidal Communities at Government Point, Santa Barbara County, California

1 .1.12.1 Abstract

The distribution and abundance patterns of rocky inter tidal organisms were measured seasonally from August 1976 through April 1977 by a combination of disturbed and undisturbed methods. Totals of 191 0.15 -m^2 and 191 1.0-m^2 disturbed samples in conjunction with 66 0.15-m^2 and 66 1. 0-m^2 disturbed samples were assessed during the study. Over the period of study , a total of 103 macrophytes and 79 macroinvertebrates were present in the samples , over a tidal range of -1.0 to +7.0 ft. (-.3 to +2.1 m). All 101 of the macr oinvertebrates in the samples and vouchers represented newly published records and 63 of the macrophy tes were newly documented for the Government Point area

Total biotic cover averaged 141. 1%, ranging from 129. 5% in January to 150.8% in August. The over all contribution of macrophy tes aver aged 112. 8% and macroinvertebrates 28. 3%. Maximal cover (1 86. 9%) occurred between +5.0 and +6.0 ft. (+1 .5 and +1.8 m) due to exceptionally high macr oinver tebrate cover in conjunction with moderately high macr ophy te cover , Macrophyte cover was greatest (155.4%) from MLLW to +1.0 ft. (+.3 m) and least (44.4%) from +6.0 to +7.0 ft. (+1.8 to +2.1 m). Macr oinver tebrate cover , however , was maximal (60.1%) from +5.0 to +6.0 ft. (+1.5 to +1.8 m) and least 2.9% from -1.0 ft. (-.3 m) to MLLW .

The seasonal peak for macr ophy te cover (124. 6%) was reached during August , and the seasonal low (100.2%) in January. Based on annual mean values , blue-green algae provided the most macrophy te cover (28.4%) , followed by Pelvetia fastigiata (1 6.1%), Laminaria sinclairii (15. 5%) , Phyllospadix torreyi (7.6%), Iridaea cordata var. splendens (4.6%) , and Gigartina canaliculata (4.4%). A common seasonal pattern in cover was indicated for L. sinclairii , P. torreyi, and I. cordata var . splendens. These spe cies, all prominent below +2.5 ft. (.8 m) , attained maximum cover in August and Apr i 1 and minimum cover in January suggesting a winter die-back associated with desiccator winds during the afternoon low tides. P. fastigiata and G. canaliculata, species found predominantly above +2. 5 ft. (+. 8 m) exhibi ted definite cover maxima in August but, in contrast to the above three species , showed shallow minima in April. Blue-green algal cover was at a minimum in November and a maximum in January. Several of the less abundant algal species, par titularly Gelidium coulteri , 1. f laccida, Ulva taeniata, and Crypt opleura violacea, also exhibited 'an apparent winter die-back, but the majority of macrophy tes presented no apparent seasonal patterns.

Macr oinver tebr ate cover changed little throughout the year but was slightly higher during the colder months. Chthamalus fissus/dalli , Anthopleura elegantisssima, and Phragmatopoma californica provided the

major portion of macr oinver tebr ate cover throughout the year and had annual mean cover values of 14.6%, 6.3%, and 3.8%, respectively. Eight of the nine predominant macroinvertebrate species exhibi ted seasonal cover minima in August, though no common seasonal pattern was apparent since the cover maxima were scattered among the other three sampling periods.

Sand cover was considerable between MLLW and +3.0 ft. (+.9 m) during all four sampling periods. However , sand coverage reached a distinct maximum and extended higher in the intertidal (+5.0 ft., +1.5 m) in January 1977.

Macrophyte taxa that occurred in the greatest proportion of samples based on annual mean values were blue-green algae (88.2%) , and Ralfsiaceae (54.9%). Bleached thalli were encountered most frequently in either November or January for Hydrolithon decipiens , Corallina of ficinalis var. chilensis, coralline crust, Bossiella orbigniana SSP dichotoma , Gigartina canaliculata, and Plocamium car tilagineum, consistent with the Pattern of algal die-back in relation to the desiccator condi tions of winter daytime low tides. Chthamalus fissus/dalli was the most frequently sampled macroinver tebrate (52. 7% frequency), followed closely by Anthopleura eleganti ssima (48. 5%) and Te gula funebralis (46.1%) based on annual mean values over all tidal intervals.

The annual over all mean density of Chthamalus fissus/dalli (581 O individuals/m^2) was far greater than any other taxon. The remaining taxa that were found in exceptionally high densities were Littorina planaxis (244/m^2), Anthopleura elegantissima (214/m^2) , Balanus glandula (1 51 /m^2). and Li ttorina scutulata (104/m^2). Mean densities of L. scutulata decreased strikingly from 361 /m^2 t o 36 /m^2 between August and November , primarily between +4.0 and +5.0 ft. (+1 .2 and +1.5 m). Two other species also exhibiting large decreases in numbers between August and November were Pollicipes polymerus (from 88/m^2 to 14/m^2) and Acmaea (Collisella) digitalis (from 50/m^2 to 20/m^2) to 20/m^2). Lacuna spp. increased sharply in density from 3 /m^2 in January to 60/m^2 in April.

The over all mean standing crop in wet biomass averaged over all tidal intervals was 5,563.5 g/m^2 (1 ,142.5 g/m^2 dry weight, ODW) , of which 4,548.9 g/m^2 (1,011.3 g/m^2 ODW) was contributed by macr ophy tes and 1,014.6 g/m^2 (131.2 g/m^2 ODW) by macr oinver tebra tes. Corresponding data for dry biomass (including hard parts) were 1 ,578.6 g/m^2 total DW , 1 ,052.0 g/m^2 DW for macrophytes , and 526.6 g/m^2 DW for macr oinver tebr ates. Macr ophy te biomass was maximal (9, 749.7 g/m^2 WW and 1 ,976.1 g/m^2 DW) in the interval from MLLW to +1.0 ft. (+.3 m). Macroinvertebrate wet biomass was greatest (1 ,608.8 g/m^2) from +1 .0 to +2.0 ft. (+.3 to +.6 m) and dry biomass was maximal (974.1 g/m^2) from +6.0 to +7.0 ft (+1.8 to +2.1 m). Pelvetia fastigiata, the most abundant alga in terms of biomass, contributed 40% (1 ,608.4 g/m^2 WW)

of the total annual mean wet weight. The next two most predominant species by biomass , Laminaria sinclairii (923.9 g/m^2 WW) and Phyllospadix torreyi (646.6 g/m^2 ww) , together represented 35% of the over all macrophyte wet weight. Anthopleura elegantissima, with an annual mean of 465.8 g/m^2 ww, accounted for 46% of the total wet macroinvertebrate biomass. The remaining dominant species were Tegula funebralis (186.2 g/m^2 WW), Dodecaceria fewkesi (143.9 g/m^2 WW), and Chthamalus fissus/dalli (101.4 g/m^2 WW).

In tidepools, total biotic cover averaged 107. 7%; 99. 8% was contributed by macrophytes and 7.2% by macroinvertebrates . Phyllospadix torreyi (48.3% mean cover) was the tidepool dominant from +1.0 to +4.0 ft. (+.3 to +1.2 m), whereas blue-green algae (29. 7% mean cover) exceeded all other macrophytes in the range from +4.0 to +6.0 ft. (1.2 to 1.8 m). Macroinvertebrate dominants in the tide pools were Tegula funebralis (2.0% cover) , Anthopleura elegantissima (1 .9%) , and Dodecaceria fewkesi (1 .1%). The most widespread of the tidepool macrophytes were Corallina officinalis Var . chilensis (82.5% frequency) and Phyllospadix torreyi (60.0%). Bleached forms of macrophytes were most prevalent in pools during November and January of the study and consisteal mainly of C. officinalis var . chilensis, Hydrolithon decipiens, and unidentified coralline crusts, all of which appeared following the stressful periods of the afternoon low tides in November . Macroinvertebrates attaining the highest densities in tidepools at Government Point were: Chthamalus fissus/dalli (mean of 183 individuals/m^2), T. funebralis (79/m^2), Lacuna spp. (40/m^2), and A. elegantissima (17/m^2). Tidepool biomass averaged 2,664.3 g/m^2 WW (675.4 g/m^2 DW) of which macrophytes contributed 2,240.7 g/m^2 WW (467.7 g/m^2 DW) and macroinvertebrates 423.6 g/m^2 WW (207.7 g/m^2 DW). By far , the macrophyte biomass dominants in pools were P. torreyi (mean biomass 1,128.9 g/m^2 WW) and Laminaria sinclairii (719.7 g/m^2 WW). The two dominant macroinvertebrates were A. elegantissima (219.8 g/m^2 WW) and T. funebralis (154.5 g/m^2 WW) . The six species of finfishes collected in tidepools during the sampling year were : Clinocottus analis , C. recalvus, Oligocottus snyderi , Gibbonsia elegans, Girella nigricans, and Xiphister atropurpureas

The He ' (Shannon-weaver) index for combined macrophytes and macroinvertebrates averaged 2.98, and ranged between 2.84 in August to 3.07 in April. The evenness (J_e') of the combined biota averaged 0.66 and only ranged from 0.64 in August to 0.68 in November . Combined richness (D_e') averaged 18.38 and ranged from 16.65 in January to 21.85 in April. Of the diversity indices (D_e', He' , and J_e') based on density of macroinvertebrates, values were lowest during January when sand inundation was most pronounced.

Seven major assemblages were found to persist throughout the year. The blue-green Chthamalus fissus/dalli group occupied upper intertidal levels. The bare rock Cyanophyta group dominated the two uppermost quadrats on the north transect and an assemblage dominated by Pelvetia

f astigiata Cyanophyta group occurred in the upper and mid-inter tidal leve 1s. Another assemblage consisting primarily o f P. f astigiata and Gi gar tina canaliculata was found at lower levels in the mid-inter tidal zone, and the two groups dominated by P. fastigiata were separated by a band almost exclusively containing the Anthopleura ele ganti ssima gr Oup A group constituted by a large number of taxa, particularly G. canaliculata, Gelidium coulteri, Coralli na of ficinalis var . chilensis, and Ulva taeniata, lay below the P elve ti a-Gi gar tina group and above an assemblage consisting principally of Rhodomela larix. Quadrats dominated by Phyllospadix torreyi formed a group immediately below the Rhodomela group, and the assemblage found at the lowest tidal levels consisted primarily of Laminaria sinclairii with lesser amounts of Iridaea cordata var . splendens. The assemblages remained reasonably constant over the year and only the influx of sand caused variations in their respective cluster groups at different sampling periods.

The Government Point site, while being moderate ly affected by sand accumulation and nearby oil seepage, contained populations unique to the Southern California Bight area. These populations were predominantly cold wa tar forms and in conjunction with the warm water forms comprised an ecological assemblage that remains pivotal to under standing the nor them and southern limits of many species of marine organisms.

1.1.12.2 Study Area

1 .1.12.2.1 General

The Government Point study site (34° 26 ' 35" N, 120° 27 ' 6" W) in Santa Barbara County is located approximately 0.4 km southeast of Point Conception along a stretch of coastline owned and controlled by the Bixby Ranch Corporation (Figure 1.1.12-1) .

The rocky intertidal portion of Government Point (Figure 1. 1.12-2) is relatively low-lying and consists of Monterey formation shale/ siltstone with extensive tidepools. The shoreline is about 200 m broad and extends seaward in a westerly direction for approximately 100 m from the base of a low bluff 10-15 m in height. The bluff and rocky inter tidal extend nor thward and westward fr om the study site to Point Conception and eastward and southward to a gully which marks the beginning of an extensive sandy beach.

Seasonal transport of sand is a moderately important physical par a-meter in the study region Generally the sand moves onshore and off shore of the gently sloping platform on the nor thwest mar gin. Sand was present throughout the year on the study site , but generally moved onshore mostly during the winter months of the study. According to Ricketts, et al. , (1 968), Point Conception, just 0.4 km away, receives wave shock as powerful as in any other par t of the nor them hemisphere. Gleason (1 958) has character zed this region as the "Cape

Horn of the Pacific" because of heavy northwesterly gales sweeping around the headland. As a consequence, this site has proven to be one of the most dangerous and difficult to sample on a consistent basis.

Historically, the Point Conception/Government Point area has been recogni zed for the nearby seeps and deposits of bituminous residues that accumulate on the rocky shoreline and nearby beaches. The sour ces of these residues are natural onshore and offshore seeps similar to others found throughout the Southern California Bight as well as in other regions of the world (Johnson, 1971) . Recent reviews by Ventura and Wintz (1 971), Johnson (1971), and Wilkinson (1 972) have described the seepage processes , mapped locations and discussed the historical implications of this natural phenomenon Wilkinson (1972) described the location of four offshore gas/oil seeps within 8 km of the study area. There is also a shoreline (upper inter tidal) seep with extensive surrounding deposits of bituminous asphalts just 0. 3 km toward Point Conception. Conclusions regarding the effects of exposure of intertidal organisms to oil seepage are difficult to draw from studies per formed following the Santa Barbara oil spills of 1969 (Nicolson and Cimberg, 1971; Foster , et al., 1971; Nicolson, 1972; Cimberg, et al., 1973). Two studies have been conducted on the intertidal–f lora of Government Point by Dawson (1 959) and Thorn (1 976) which demonstrated a relatively high number of algal species at this site.

1.1.12.2.2 Environmental Data

Government Point is bathed in the relatively cold waters of the southeasterly flowing California Current sy stem throughout most of the year . Wyllie and Lynn (1 971) report 1950-1969 temperature values at the 10-m deep offshore CalCOFI station to range from 11 °-16oC. Environmental data gathered by the U. S. Naval Weather Service Command are shown in Table 1.1.12-1. These data show the late winter and early spring to be characterized by the most severe winds, greatest wave shock, and coolest air and seawater temper atures Our own data (Table 1.1.12-2) recorded the highest winds, lowest air and seawater temper ature , highest humidity, and lowest salinity valuesin Apri I. 1977. The maximum wave height occurred in January 1977 when the relative humidi ty was at its measured lowest.

1 .1.12.3 Methods and Materials

Government Point was sampled 22-27 August 1976, 19-23 November 1976, 15–18 January 1977, and 5-8 April L 977 by a combination of disturbed and undisturbed methods. On the first visit, two par alle l transect lines were established which were 40 m and 42 m long and designated N and S, respectively. These lines were placed at right angles to the waterline and traversed the gently sloping bench (Figure 1 .1.12-2) over an intertidal range from -1.0 to +7.0 ft. (-.3 to +2.1 m). The location of each quadrat was permanently marked where possible to permit the precise relocation of the undisturbed samples.

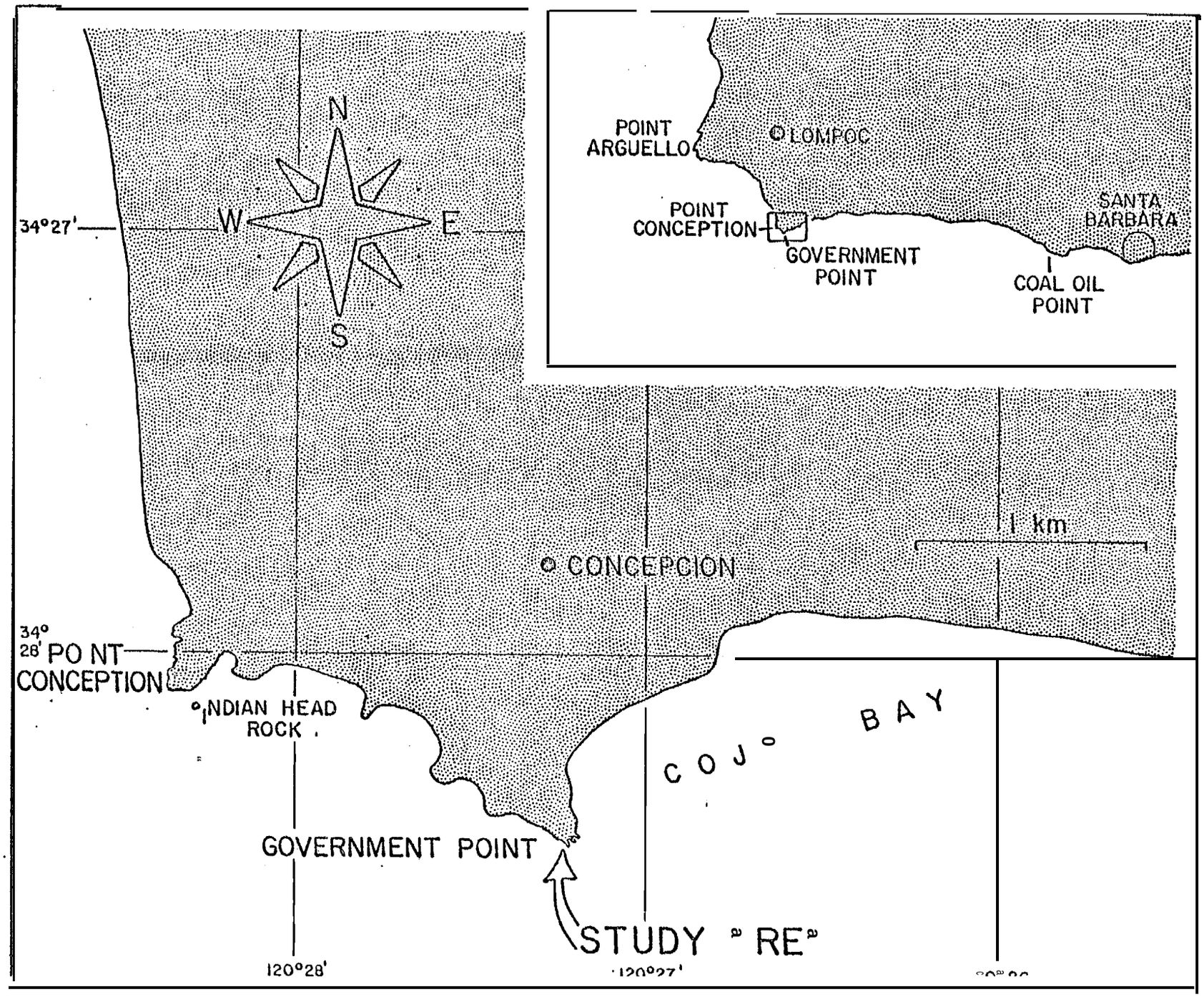

Figure 1.1.12-1 Location of the Governmen Point Study Site.

Figure 1.1.12--2. Intertidal platform sampled by north and south transect lines at Government Point.

Table 1.1.12-1. Environmental Data for Government Point.

Month	Wind Speed % Frequency 5.6–10.7 m/see (11-21 knots)	≤3.1 m/see (≤ 6 knots)	≥17.3 m/see (≥ 34 knots)	Mean Sea Temp. (°C)	Swell Height % Frequency >1.8 m	Mean Air Temp.
January	30	30	0.05	13.3	15	--
February	20-30	20-30	<1	12.8	20	12.8
March	40-50	20	1-2	13.3	30	13.3
April	40-50	10-20	2	12.8	40	13.3
May	40-50	10-20	2	13.3	20	13.3
June	40-50	20	1	14.4	10	15.0
July	40	20	1	15.6	10	15.6
August	40	20	<().()5	16.4	20-30	16.1
September	40	30	< 0.05	16.7	10	16.1
October	30	30-40	0.05	16.7	10	16.7
November	30	30-40	0.05-1	15.6	10	15.0
December	40	30	1	14.4	20	15.0

Source: Naval Weather Service Command

Naval Weather Service Command, Fleet Weather Facility, San Diego 1971. Climatological Study Southern California Operating Area. NWSED, Asheville, North Carolina. 240 pp.

Table 1.1.12-2. Environmental Data Measured during the Period of Study for Government Point, Santa Barbara County.

	Water Temp. (°C)	Air Temp. (°C)	Cloud Cover (%)	Salinity (°/oo)	Wave Ht. (ft)	Relative Humidity	Wind Velocity (knots)
23-26 August 1976							
Range	13.6-16.8	15.0-24.0	0-1oo	33.0-37.0	--	--	0-20
Mean	15.4	17.3	21	34.8	--	--	7
19-22 November 1976							
Range	**17.5-18.0**	15.5-19.0	0-80	34.0-34.5	2-3	72-83	0-10
Mean	**17.9**	17.1	25	34.1	2.5	77	4
15-18 January 1977							
Range	15.2-16.0	16.5-22.0	0-90	34.0-36.0	2-6	48-90	0-7
Mean	15.7	18.6	30	34.5	3.5	65	3
05-08 April 1977							
Range	11.3-12.0	10.8-15.0	0-99	33.0-33.8	0-3	72-92	0-25
Mean	11.6	12.4	32	33.3	1.5	82	6

On the 'August 1976 visit, undisturbed sampling was done gener ally at two-meter intervals along each line, resulting in a total of 40 0.15-m^2 and 40 1.0-m^2 samples (Table 1.1.12-3). On subsequent visits, the number of samples was increased to assure adequate statistical replication within each 1.0-ft. (,3-m) tidal interval. The numbers and types of the various samples are given in Table 1.1.12-3. Disturbed samples were positioned to obtain biomass estimates of each dominant zonal community in the intertidal. Generally, a row of four adjacent 1.0-m^2 quadrats was positioned perpendicular to the transect lines in the high, mid-, and low intertidal. Disturbed samples were not taken within 0.5 m of either transect so as to avoid perturbing the undisturbed permanent sample plots. A total of 66 disturbed samples was taken during the study, 18 of which were from tidepools (Table 1.1.12-3). The entire array of seasonal disturbed quadrats from the rocky shore was combined and analyzed by 1. O-ft. (. 3-m) tidal intervals; disturbed tidepool quadrats were similarly treated.

1.1.12.4 Results

1 .1.12.4.1 Floristics and Faunistics

Over the period of study, a total of 103 macrophytes (Table 1.1.12-4) was present in the samples. Ninety-three taxa occurred in the harvested samples and 80 were recorded in the undisturbed plots. Of these, 22 macrophy tes were found only in the disturbed samples while 11 occurred only in the undisturbed. An additional 19 taxa were collected in the area outside of the sample quadrats.

Of the six major groups of macrophytes represented (Table 1.1.12-4), the Rhodophyta contributed the most taxa in the samples (87) , followed by 19 Phaeophyta, 11 Chlorophyta, and 2 Spermatophy ta. The precise number of Bacillariophyta and Cyanophy ta was not determined and each was considered as a single taxon for statistical purposes .

A total of 79 macroinvertebrates was sampled over the four study periods (Table 1.1.12-5), with 75 taxa occurring in the disturbed samples and 50 taxa in the undisturbed quadr ats. Four macr oi river te-brates were located only in the undisturbed sampled and 29 taxa only occurred in the disturbed plots. Addi tinally, 22 taxa were collected outside the samples. The number of taxa in the undisturbed samples varied seasonally fr om 82 in January to 110 in April.

Eight macroinvertebrate phyla (Table 1.1. 12-5) were represented in the samples. The Mollusca with 52 taxa (37 Gastropoda, 9 Bivalvia, and 6 Polyp lacophor a) , provided the most taxa at Government Point. In addi ti on, the quadrats sampled contained 14 Arthropoda, 4 Cnidaria, 4 Annelida, 2 Chordata, 2 Echinodermata, and 2 Porifera.

Table 1.1.12-3. Number of Undisturbed and Disturbed 0.15-m^2 and 1.0-m^2 Samples Obtained during the Four Site Visits of 1976-77 to Government Point, Santa Barbara County.

	Aug. 1976	Nov. 1976	Jan. 1977	Apr. 1977
Rocky Intertidal Samples				
Disturbed	12	12	12	12
Undisturbed	40	43	41	42
Subtotal	52	55	53	54
Pool Samples				
Disturbed	3	7	3	5
Undisturbed	4	8	7	6
Total	55	62	56	59

Table 1.1.12-4. Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of Government Point, Santa Barbara County. Additional species collected in the study area (C) but not present in samples have also been listed.

Species and Taxa	Aug. 1976		Nov. 1976		Jan. 1977		Apr. 1977		
	U	D	U	D	U	D	U	D	C
Bacillariophyta									
Benthic diatoms	x	XP					X	X	
Chlorophyta									
Bryopsis corticulans						x^P			
Chaetomorpha linum			X	X	X	X	X	X	
Cladophora columbiana	X	X	X	X	X	X	X	X	
Cladophora spp.				X					
Codium fragile									X
Codium setchellii						X			
Enteromorpha clathrata	x				x		x		
Monostroma oxyspermum	X						X		
Ulva lobata	X	X		x^P		X	X	X	
Ulva taeniata	X	X	X	X	X	X	X	X	
Cyanophyta									
Blue-green algae	X	X	X	X	X	X	X	X	
Blue-green colony			x		x		X		
Phaeophyta									
Analipus japonicus									x
Colpomenia sinuosa	X	X					x		
Cylindrocarpus rugosus	X	X	x	x	X		X		
Desmarestia ligulata var. ligulata								X	
Ectocarpaceae			x		x		X	X	
Egregia menziesii	X	X	X	X	X		X	X	
Fucus distichus ssp. edentatus	X		X		X		X		
Halidrys dioica		X							
Haplogloia andersonii							X	x^P	
Hesperophycus harveyanus		X		X				X	
Laminaria sinclairii	X	X	X	X	X	X	X		
Pelvetia fastigiata	X	X	X	X	X	X	X	X	
Petalonia fascia							X	X	

Table 1.1.12-4. Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of Government Point, Santa Barbara County. Additional species collected in the study area (C) but not present in samples have also been listed. (Continued)

Species and Taxa	Aug. 1976		Nov. 1976		Jan. 1977		Apr. 1977		
	U	D	U	D	U	D	U	D	C
Ralfsiaceae	X	X	X	X	X	X	X	X	
Scytosiphon dotyi					X	X	X		
Scytosiphon lomentaria									x
Soranthera ulvoidea	X	X			X		X		
Rhodophyta									
Ahnfeltia gigartinoides									X
Anisocladella pacifica		X	x[P]	x		X	X	X	
Bossiella orbigniana ssp. dichotoma	X	X	X	X	X	X	X	X	
Botryoglossum farlowianum			X	X		X			
Calliarthron tuberculosum					X				
Callithamnion pikeanum						X	X	X	
Callithamnion rupicolum						X			
Callophyllis sp.				x					
Callophyllis violacea									X
Centroceras clavulatum	X		X	X	X	X	X	X	
Ceramium eatonianum/sinicola	X	X	X	X	X	X	X	X	
Chondria decipiens		X	X	X		X	X		
Chondria nidifica									X
Coeloseira compressa				X			X		
Corallina officinalis var. chilensis	X	X	X	X	X	X	X	X	
Corallina vancouveriensis	X		X	X	X	X	X	X	
Cryptopleura corallinara			X	X					
Cryptopleura crisps		X				X			
Cryptopleura violacea	X	X	X	X	X	X	X	X	
Cumagloia andersonii								x[P]	
Endocladia muricata	X	X	X	X	X	X	X	X	
Gastroclonium coulteri	X	X	X	X	X	X	X	X	
Gelidium coulteri	X	X	X	X	X	X	X	X	
Gelidium nudifrons									X
Gelidium pusillum	X	X	X	X	X		X	X	
Gelidium robustum		X	X			X			
Gigartina canaliculata	X	X	X	X	X	X	X	X	
Gigartina corymbifera									X
Gigartina exasperate									X
Gigartina harveyana									x
Gigartina leptorhynchos	X	X	X	X	X	X	X		
Gigartina papillata	X	X	X	X	X	X	X	X	

Table l. 1.12-4. Macrophytes Sampled by Undisturbed (U) and Disturbed (D). Methods for each Seasonal Assessment of Government Point, Santa Barbara County. Additional species collected in the study area (C) but not present in samples have also been listed. (Continued)

Species and	Aug. 1976		Nov. 1976		Jan. 1977		Apr. 1977		
	U	D	U	D	U	D	U	D	C
Gigartina spinosa			x						
Gigartina volans									X
Gloiosiphonia capillaries		X				X	x	x^p	
Gracilaria sjoestedtii			X	X			x^p		
Grateloupia doryphora		X					x	x	
Gymnogongrus leptophyllus				x^p				x^p	
Gymnogongrus platyphyllus									x
Haliptylon gracile			x						
Hydrolithon decipiens	X	X	X	X	X	X	X	X	
Iridaea cordata var. splendens	X	X	X	X	X	X	X	X	
Iridaea flaccida	X	X	X	X	X		X	X	
Iridaea heterocarpa							X		
Iridaea lineare						X		X	
Iridaea sp.									
Laurencia spectabilis	X	X	X	X		#		X	x
Laurencia splendens									x
Lithophyllum proboscideum		X	x^p	x	x^p	x^p	x	x	
Lithothrix aspergillum									X
Melobesia mediocris		x	X	x^p	X	X	X		
Microcladia borealis		X					X	X	
Microcladia coulteri	X	X						x^p	
Neoagardhiella baileyi			x^p	x^p	x^p		x	x^p	
Neoptilota californica				X					
Neoptilota densa							X		
Nienburgia andersoniana				x^p		X		X	
Ophidocladus simpliciusculus				X					
Petrocelis franciscana	x	X	X	X	x	x	X	X	
Peyssonneliaceae/ Hildenbrandiaceae	X	X	X	X	X	X	X	X	
Phycodrys setchellii				X					
Pikea californica								X	
Plocamium cartilagineum	x	x	x	x	X	X	X	X	
Plocamium violaceum	X	X	X		X	X	X	X	
Pogonophorella californica									X
Polyneura latissima							x	x	
Polysiphonia acuminata	X	x		X		x	x	x^p	
Polysiphonia hendryi var. hendryi	X	X	X	X	X		x		
Polysiphonia paniculata		X	X	X		x	x	x^p	

Table 1.1.12-4. Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of Government Point, Santa Barbara County. Additional species collected in the study area (C) but not present in samples have also been listed. (Continued)

Species and Taxa	Aug. 1976		Nov. 1976		Jan. 1977		Apr. 1977		
	U	D	U	D	U	D	U	D	C
Polysiphonia scopulorum var. villum						x			
Polysiphonia spp.					x	x	x	x	
Porphyra perforata	x	x	x		x		x	x	
Prionitis lanceolata	x		x	x		x[p]	x		
Pterocladia capillacea						x			
Pterosiphonia baileyi	x	x	x	x		x	x	x[p]	
Pterosiphonia bipinnata									x
Pterosiphonia dendroidea	x	x	x	x	x	x	x	x	
Pterosiphonia pennata									x
Ptilota filicina				x				x	
Rhodoglossum affine	x	x	x	x	x	x	x	x	
Rhodomela larix	x	x	x	x	x	x	x	x	
Rhodymenia californica var. californica				x[p]					
Rhodymenia pacifica			x	x	x	x	x		
Schizymenia pacifica							x		
Smithora naiadum	x	x	x		x	x	x	x	
Tiffaniella snyderae						x		x	
Spermatophyta									
Phyllospadix scouleri									x
Phyllospadix torreyi	x	x	x	x	x	x	x	x	
122 Total Macrophytes									

p Refers to those taxa only obtained in tidepools.

Table 1.1. 12-5. Presence of Macroinvertebrates 'in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Government Point, Santa Barbara County. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column.

Species and Taxa	Aug. 1976		Nov. 1976		Jan. 1977		Apr. 1977		
	U	D	U	D	U	D	U	D	C
Annelida Polychaeta									
Dodecaceria fewkesi	X	X	X	X	X	X	X		
Phragmatopoma californica	X	x	X	X	X	X	X	X	
Spirorbis spp.			X						
Arthropoda Crustacea									
Balanus glandula	X	X	X	X	X	X	X	X	
Cancer antennarius		X		X					
Cancer anthonyi									X
Cancer j ordani		X		X					
Chthamalus fissus/dalli	X	X	X	X	X	X	X	X	
Pachycheles rudis				X					
Pachygrapsus crassipes			X	X	x^P	x^P	X	X	
Pagurus hirsutiusculus	X	X	X	X	X	x^P			
Pagurus samuelis	X	X	x^P	X	x^P	x	x^P		
Pollicipes polymerus	x		x		X		X	X	
Pugettia gracilis				x^P					
Pugettia products	X	X	X	X	X	X		X	
Tetraclita squamosa rubescens	x		X	X	X		X	X	
Chordata: Urochordata Ascidiacea									
Aplidium californicum									X
Archidistoma psammion	X	X		X	X	X		X	
Distaplia occidentals									X
Ritterella aequalisiphonis	X								

Table" 1.1.12-5. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Government Point, Santa Barbara County. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued).

Species and Taxa	Aug. 1976		Nov. 1976		Jan. 1977		Apr. 1977		
	U	D	U	D	U	D	U	D	C
Cnidaria									
Anthozoa									
Anthopleura elegantissima	X	X	X	X	X	X	X	X	
Corynactis californica			X				x		
Hydrozoa									
Abietinaria sp.				X				X	
Aglaophenia sp.	X	X		X			X		
Sertularella sp.									X
Syncoryne eximia									X
Echinodermata									
Asteroidea									
Henricia leviuscula									X
Patiria miniata									X
Pisaster ochraceus	x	x	X	X	X		x		
Echinoidea									
Strongylocentrotus purpuratus						X	X	X	
Ectoprocta									
Flustrellidra corniculata									X
Tricellaria sp.									X
Mollusca									
Bivalvia									
Brachidontes adamsianus		X		x[p]				X	
Glans subquadrata								X	
Hiatella arctica				X		X		X	
Hinnites giganteus									X

Table 1.1.12-5. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Government Point, Santa Barbara County. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued) .

Species and Taxa	Aug. 1976		Nov. 1976		Jan. 1977		Apr. 1977		
	U	D	U	D	U	D	U	D	C
Lithophaga plumula						X			
Modiolus capax		X				X		X	
Modiolus carpenter								X	
Modiolus rectus									X
Mytilus californianus	X	X	X	X	X	X	X	X	
Mytilus edulis	x	X		x				X	
Septifer bifurcates		X		X		x		x	
Septifer bifurcates/ Brachidontes adamsianus	X						X		
Gastropoda									
Acanthina punctulata	x	x	X	X	X	X	X	X	
Acanthina spirata		X	X		X				
Acmaea (Collisella) asmi	X	X	X	X	X	x[P]	X	x[P]	
Acmaea (Collisella) digitalis	X	x[P]	X	X	X	X	X	X	
Acmaea (Notoacmea) fenestrata		x[P]				X		X	
Acmaea (Notoacmea) insessa				X					
Acmaea (Collisella) limatula	X	x[P]	X	x[P]		X		X	
Acmaea (Collisella) pelta	x	x	X	X	X	X	X	X	
Acmaea (Notoacmea) paleacea								x[P]	
Acmaea (Collisella) scabra	x	X	X	X	X	X	X	X	
Acmaea (Notoacmea) scutum									X
Acmaea (Collisella) strigatella		x		X				x	
Acmaea strigatella/fenestrata	x		X		x		X		
Alvinia sp.									x
Amphissa versicolor		X		X	X	X	X	X	
Aplysia californica						X			
Barleeia spp.		X		X		X		X	
Calliostoma canaliculatum									X
Cerithiopsis spp.				X		X		X	
Cerithiopsis cosmia									X
Conus californicus						X			

Table 1.1.12-5. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Government Point, Santa Barbara County. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued).

Species and Taxa	Aug. 1976		Nov. 1976		Jan. 1977		Apr. 1977		
	U	D	U	D	U	D	U	D	C
Epitonium tincture	X	X	X	X	X	X	X	X	
Haliotis cracherodii									x
Hermissenda crassicornis									X
Lacuna marmorata		X		X		X		X	
Lacuna spp.	X		X		X		X		
Lacuna unifasciata		X		X		X		X	
Littorina planaxis	X	X	x	x	X	X	X		
Littorina scutulata	X	X	X	X	x	x	X	X	
Lottia gigantea			x	x[P]	x				
Mitrella carinata		X		X	X	X		X	
Mitromorpha gracilior								X	
Nassarina penicillata						X		x	
Nucella (Thais) emarginata	X	X		X	X	X	X	X	
Ocenebra atropurpurea				X					
Ocenebra circumtexta	X	X		X		X	X		
Odostomia eucosmia						X			
Odostomia nota						X			
Opalia funiculata				X		X		X	
Tegula funebralis	X	X	X	X	X	X	X	X	
Tricolia pulloides		X		X		X		X	
Triphora catalinensis						X			
Triphora sp.									X
Turbonilla kelseyi				x		x			
Polyplacophora									
cryptochiton stelleri									X
Cyanoplax dentiens								x	
Cyanoplax hartwegii		X	X	X	x[P]	x	x[P]	x	
Mopalia ciliata						X		X	
Mopalia hindsii									X
Mopalia muscosa	X	X		X	x[P]	X	x[P]	X	
Mopalia porifera									X

Table 1.1.12-5. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to Government Point, Santa Barbara County. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued).

Species and Taxa	Aug. 1976		Nov. 1976		Jan. 1977		Apr. 1977		
	U	D	U	D	U	D	U	D	C
Nuttallina californica								X	
Nuttallina fluxa							x[P]	X	
Nuttallina fluxa/californica	X	X	X						
Porifera									
Demospongiae	X		X	X	X	X	X	X	
Calcarea									
Leucilla nuttingi									X
101 Total Macroinvertebrates									

P Refers to those taxa only obtained in tidepools.

1 .1.12.4.2 Standing Crop

1 .1.12.4.2.1 Cover

Total biotic cover averaged 141.1% (Tables 1.1. 12-6 and 1.1.12-7), ranging from 129.5% in January to 150.8% in August. The contribution of macrophytes averaged 112.8% and macroinvertebrates 28.3%. Maximal cover (186.9%) occurred between +5.0 and +6.0 ft. (+1.5 and +1.8 m) due to exceptionally high macroinvertebrate cover in conjunction with moderately high macrophyte cover . The minimum aver age cover (71. 5%) was located in the adjacent +6.0 to +7.0 ft. (+1 .8 to +2.1 m) interval. Biological cover was high (>1 15%) in all intervals below the +6.0 ft. (+1.8 m) level. Macrophyte cover was greatest (155.4%) from MLLW to +1.0 ft. (.3 m) and least (44.4%) from +6.0 to +7.0 ft. (+1.8 to +2.1 m). Macr oi river tebr ate cover , however , was maximal (60.1%) from +5.0 to +6.0 ft. (+1.5 to +1.8 m) and least (2.9%) from -1.0 ft. (-.3 m) to MLLW.

The seasonal peak for macr ophy te cover (124.6%) was reached during August, and the seasonal low (100.2%) in January. Macr oinver tebrate cover changed little throughout the year but was slightly higher during the colder months (Table 1.1.12-7).

Based on annual mean values (Table 1.1.12-8), blue-green algae provided the most macrophy te cover (28.4%) followed by Pelvetia fastigiata (16.1%) , Laminaria sinclairii (15. 5%) , Phyllospadix torreyi (7.6%) , Iridaea cordata var . splendens (4.6%), and Gigartina canali culata (4.4%). An additional five species each contributed 2. 0% or more cover .

A common seasonal pattern in cover was indicated for Laminaria sinclairii , Phyllospadix torreyi, and Iridaea cordata var . splendens (Table 1.1. 12-8). These species, all prominent below +2. 5 ft. (+. 8 m) , attained maximum cover in August and April and minimum cover in January (Figure 1.1.12-3) suggesting a winter die-back associated with desiccator winds during afternoon low tides. Pelvetia fastigiata and Gigartina canaliculata, species found predominantly above +2.5 ft. (.8 m), exhibi ted definite cover maxima in August but, in contrast to the above three species, showed shallow minima in April. Cover of blue-green algae was at a minimum in November and a maximum in January. Some of the less abundant algal species, par titularly Gelidium coulteri , 1. flaccida , Ulva taeniata , and Crypt opleura violacea, also exhibited an apparent winter die-back, but most of the macro phytes presented no discernible seasonal pattern.

Data related to patterns in macrophy te cover as a function of tidal interval averaged over the year are given in Table 1.1.12-9. Blue-green algae and Pelvetia fastigiata were found predominantly above +2.0 ft. (+.6 m) and increased in cover from lower to higher tidal levels. Phyllospadix torreyi occurred mainly between MLLW and i-3. 0

TABLE 1.1.12-6. SEASONAL AND ANNUAL PATTERNS OF OVERALL MACROPHYTE COVER (%) AS A FUNCTION OF TIDAL HEIGHT FOR GOVERNMENT POINT, SANTA BARBARA COUNTY.

SEASON		TIDAL HEIGHT (FT). -1.0 TO -0.1	MLLW TO 0.9	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9
AUGUST	1976	157.3	142.6	82.5	140.8	125.4	119.7	100.5	48.2
NOVEMBER	1976	150.8	145.4	76.3	141.1	121.9	87.2	104.3	43.6
JANUARY	1977	102.1	151.2	64.0	120.4	114.6	92.4	115.4	43.5
APRIL	1977	169.4	162.3	73.9	144.6	133.8	96.7	109.0	42.3
MEAN		141.9	155.4	74.2	136.6	123.9	99.0	126.8	44.4

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-7. SEASONAL AND ANNUAL PATTERNS OF OVERALL MACRO-INVERTEBRATE COVER (%) AS A FUNCTION OF TIDAL HEIGHT FOR GOVERNMENT POINT, SANTA BARBARA COUNTY.

SEASON		-1.0 TO -0.1	MLLW TO 0.9	.0 TO 1.9	TIDAL HEIGHT (FT). 2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9
AUGUST	1976	1.2	2.9	37.0	8.3	30.6	50.	39.6	34.5
NOVEMBER	1976	1.1	5.6	50.4	7.7	38.7	46.4	67.3	22.6
JANUAR	1977	9.1	3.7	40.2	14.0	26.8	47.5	69.1	23.9
APRIL	1977	0.1	4.9	44.6	8.4	29.9	47.4	64.2	25.3
MEAN		2.9	4.3	43.2	9.6	31.5	48.0	60.1	27.1

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-8. QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED ON NEXT PAGE).

TAXA	COVER (%) AUG. 1976	NOV. 1976	JAN. 1977	APR. 1977	MEAN
BLUE-GREEN ALGAE	27.0	25.7	30.7	30.3	28.4
PELVETIA FASTIGIATA	25*5	13.0	14.6	11.1	16.1
LAMINARIA SINCLAIRII	17.6	16.0	9.9	16.6	15.5
PHYLLOSPADIX TORREYI	9.5	6.5	6.0	8.4	7.6
IRIDAEA CORDATA VAR. SPLENDENS	5.0	3.8	1.8	8.0	4,6
GIGARTINA CANALICULATA	5.3	3,9	4.6	3.7	4,4
RHODOMELA LARIX	3,9	2.5	2.7	2.2	2.8
RALFSIACEAE	1.4	2.7	2.7	3.5	2.6
HYDROLITHON DECIPIENS	2,7	2.6	1.9	1.9	2.3
GELIDIUM COULTERI	4.7	1.0	1.1	1.8	2.2
PLOCAMIUM CARTILAGINEUM	2.3	2.7	2*CJ	1.6	2.1
SMITHORA NAIADUM	1.6	1,0	1.2	3.8	1.9
CORALLINA OFFICINALIS VAR. CHILENSIS	1.4	2.3	1.9	1.6	1.8
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	0.9	1.4	2.8	1.9	1.8
IRIDAEA FLACCIDA	2.3	2.9	0.4	0.7	1.6
ULVA TAENIATA	2.7	1.1	0.6	1.3	1.4
EGREGIA MENZIESII	1.2	1.7	().9	1.7	1.4
CRYPTOPLEURA VIOLACEA	2.1	O*5	0.7	1.7	1,2
RHODOGLOSSUM AFFINE	0.9	1.0	1.2	1.6	1.2
ENDOCLADIA MURICATA	0.8	0.8	1.0	1.5	1.0
CORALLINA VANCOUVERIENSIS	<0.1	0.9	0.9	2.0	1.0
CORALLINE CRUSTS	<0.1	0,5	2.2	0.8	0,9
PETROCELLIS FRANCISCANA	0.5	1.4	1.3	<0.1	0.8
GIGARTINA PAPILLATA	1.?	0.7	0.4	0.9	0.8
BLUE-GREEN COLONY	0.0	1.7	(J.?	0.8	0.8
RHODYMENIA PACIFICA	0.0	1.0	1.7	<0.1	0.7

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-8 QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION)

TAXA	COVER (%) AUG. 1976	NOV. 1976	JAN. 1977	APR. 1977	MEAN
PTEROSIPHONIA DENDROIDEA	<0.1	0.3	0.9	1.0	0.6
CYLINDROCARPUS RUGOSUS	0.5	0.6	0.3	0.5	0.5
CLADOPHORA COLUMBIANA	0.4	0.7	0.1	0.5	0.4
GASTROCLONIUM COULTERI	0.3	0.3	<0.1	0.9	0.4
PTEROSIPHONIA BAILEYI	0.3	0.6	0.0	0.5	0.4
CERAMIUM EATONIANUM/SINICOLA	0.3	0.4	0.2	0.4	0.3
POLYSIPHONIA PANICULATA	0.0	0.6	0.0	0.6	0.3
ECTOCARPACEAE	0.0	0.5	0.5	0.1	0.3
HYDROLITHON DECIPIENS BLEACHED	<0.1	0.5	<0.1	0.4	0.3
GELIDIUM PUSILLUM	0.4	0.2	0.2	0.2	0.2
POLYSIPHONIA HENDRYI VAR HENDRYI	0.7	0.1	<0.1	<0.1	0.2
CENTROCERAS CLAVULATUM	0.2	<0.1	0.5	0.1	0.2
GIGARTINA LEPTORHYNCHOS	<0.1	0.2	0.2	0.3	0.2
ULVA LOBATA	<0.1	0.0	0.0	0.7	0.2
PORPHYRA PERFORATA	0.2	<0.1	<0.1	0.4	0.2
POLYSIPHONIA SPP.	0.0	0.0	0.2	0.5	0.2
CORALLINA OFFICINALIS VAR. CHILOSA	0.2	0.4	0.1	<0.1	0.2
MELOBESIA MEDIOCRIS	0.0	<0.1	0.4	<0.1	0.1
GRATELOUPIA DORYPHORA	0.0	0.0	0.0	0.5	0.1
CORALLINE CRUST BLEACHED	0.0	0.2	<0.1	0.1	0.1
SCYTOSIPHON DOTYI	0.0	0.0	0.3	0.1	0.1
PRIONITIS LANCEOLATA	<0.1	0.1	0.0	0.3	0.1
OTHER MACROPHYTES	0.2	0.5	0.2	1.3	
NUMBER OF OTHER TAXA	(12)	(14)	(9)	(30)	

NOTE: 1 FOOT = 0.3048 METERS

FIGURE 1.1.12-3. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, SAN'A BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-3. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-3. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-3. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, MAN'S BARBARA COUNTY (CONTINUATION).

TABLE 1.1.12-9. ANNUAL MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR GOVERNMENT POINT, SANTA BARBARA COUNTY DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1	MLLW TO 0.9	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9
BLUE-GREEN COLONY							0.3	6.0
SCYTOSIPHON DOTYI						<0.1	0.6	0.2
PELVETIA FASTIGIATA			<0.1	28.0	36.0	19.1	44.8	0.5
BLUE-GREEN ALGAE	4.3	4.1	4.2	5.8	28.0	74.9	68.5	37.7
PORPHYRA PERFORATA				0.7	0.4	0.3	<0.1	
ENDOCLADIA MURICATA				1.1	0.2	3.6	3.1	
HYDROLITHON DECIPIENS BLEACHED				1.4	0.3	0.1	0.1	
CLADOPHORA COLUMBIANA			<0.1	0.4	2.9		<0.1	
CYLINDROCARPUS RUGOSUS			<0.1	0.1	3.5	<0.1	<0.1	
CORALLINA OFFICINALIS VAR. CH B			<0.1	0.2	1.0		<0.1	
PEYSSONNELIACEAE/HILDENBRANDIACEAE		<0.1	<0.1	<0.1	<0.1	<0.1	0.2	
RHODOGLOSSUM AFFINE		0.3		7.2	1.9		<0.1	
CORALLINA OFFICINALIS VAR. CHILENSIS	0.4	0.3	2.2	3.8	7.5		<0.1	
HYDROLITHON DECIPIENS	1.6	1.8	0.3	3.8	2.2	<0.1	8.5	
PALESIACEAE	1.3	0.7	0.8	7.5	9.7	0.4	0.2	
GIGARTINA PAPILLATA	<0.1		<0.1	4.7	1.0	0.5	0.3	
POLYSIPHONIA HENDRYI VAR HENDRYI			1.2	0.2	0.5	<0.1		
POLYSIPHONIA SPP.			0.8	0.4		<0.1		
GIGARTINA CANALICULATA		2.1	1.0	18.4	13.6	<0.1		
GIGARTINA LEPTORHYNCHOS				1.0	0.7			
CERAMIUM EATONIANUM/SINICOLA			1.3	0.8	0.5			
GELIDIUM PUSILLUM			0.5	1.1	0.4			
ECTOCARPACEAE			<0.1	0.3	2.0			
GASTROCLONIUM COULTERI		0.7	0.8	1.4	0.4			

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1,12-9. ANNUAL MEAN COVER (X) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR GOVERNMENT POINT, SANTA BARBARA COUNTY DURING 1976/1977. OATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUED).

TAXA	TIDAL HEIGHT (FT). -1.0 To -0,1	MLLW TO 0.9	1.0 TO 1.9	2,0 10 2.9	3.0 TO 3,9	4.0 To 4.9	5.0 TO 5.9	6.0 To 6.9
PHYLLOSPADIX TORREYI		32.4	15.5	11.6	1.3			
PTEROSIPHONIA BAILEYI		2.8	<0.1		<0.1			
CRYPTOPLEURA CORALLINARA		0.2	<0.1		<0.1			
ULVA LOBATA		0.5		0.7	0.3			
GELIDIUM COULTERI		0,4	5.3	10.9	0.7			
ULVA TAENIATA		0,3	6.5	3.6	1.0			
PRIONITIS LANCEOLATA	0.5	0.4	<0.1	<0.1	<0.1			
IRIDAEA FLACCIDA	3.7	O*3	1.6	.3.2	5.6			
BOSSIELLA ORBIGNIANA SSP, DICHOTOMA	4.7	7.5	1.4	0.5	<0.1			
CRYPTOPLEURA VIOLACEA	4.'3	3*9	0.6	0.4	0.4			
PTEROSIPHONIA DENDROIDEA	0.8	3*3	0.2	0.2	0.2			
CORALLINA VANCOUVERIENSIS	2.6	1.6	2.0	0.6	0.8			
EGREGIA MENZIESII	0,4	4,3	3.6	0.7	1.9			
PETROCELIS FRANCISCANA	0.3	<0.1	2.1	4.0	0.3			
CORALLINE CRUSTS	2,6	2,6	1.2	0.3	0.2			
IRIDAEA HETEROCARPA				0.5				
FUCUS DISTICHUS SSP. EDENTATUS				0.2				
CENTROCERAS CLAVULATUM			1.1	0.6				
POLYSIPHONIA PANICULATA			0.8	1.5				
SCRANTHERA ULVOIDEA			0.3	0.1				
POLYSIPHONIA ACUMINATA			0.5	<0.1				
RHODOMELA LARIX		14.3	7.8	0.6				
MELOBESIA MEDIOCRIS		0.8		0.1				
CORALLINE CRUST BLEACHED		0.3	0.4	0.3				

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-9. ANNUAL MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR GOVERNMENT POINT, SANTA BARBARA COUNTY DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES, BLANK SPACES INDICATE ZEROS (CONTINUATION).

	TIDAL HEIGHT (FT).							
TAXA	-1.0 TO -0.1	MLLW TO 0.9	1.0 To 1.9	2*O TO 2.9	3.0 To 3.9	U*O To 4.9	5.0 TO 5.9	6.0 TO 6.9
CHONDRIA DECIPIENS		<0.1		0.1				
SMITHORA NAIADUM		7.6	1.2	6.3				
MONOSTROMA OXYSPERMUM	0.3	<0.1		<0.1				
PLOCAMIUM CARTILAGINEUM	8.9	1.3		0.8				
GLOIOSIPHONIA CAPILLARIS			0.1					
GIGARTINA SPINOSA		001	<0.1					
GRATELOUPIA DORYPHORA	0.6	0.3	<0.1					
LAMINARIA SINCLAIRII	75.1	45.3	3.6					
IRIDAEA CORDATA VAR. SPLENDENS	24.3	7.9	5*O					
RHODYMENIA PACIFICA	4.7	0.7						
CALLIARTHRON TUBERCULOSUM	0.2							
PTILOTA DENSA	0.2							

NOTE: 1 FOOT = 0.3048 METERS

ft. (+.9 m) and Gigartina canaliculata, between +2.0 and +4.0 ft. (+.6 and +1.2 m). The vertical distributions of Laminaria sinclairii and Iridaea cordata var . splendens reached upper limits of +2.0 ft. (+.6 m) , and the cover of these species increased fr om higher to lower tidal levels. The greatest cover values of any species in a single tidal interval were due to sinclairii [75 .1% between -1.0 ft. (-. 3 m) and MLLW] and blue-green algae [74. 9% between +4.0 and +5.0 ft. (+1.2 and +1.5 m)].

Data concerning the distributions of macrophy te cover as a function of tidal interval for each of the four sampling periods are presented in Figures 1.1.12-4 through 1.1.12-7. Pelvetia fastigiata appeared to decrease in cover markedly at its upper extent between August and November [from 106.6% to 23.0% in the +5.0 to +6.0 ft. (+1.5 to +1.8 m) interval then changed little through January and Apri 1; however , this pattern resulted from the addition in November of three new quadrats in that interval which contained no P. f astigiata and was therefore artifactual. Cover of Laminaria sinclairii at the -1.0 ft. (-.3 m) to MLLW level decreased from 85.0% in November to 40.0% in January and then returned to 85.2% in April. Similarly, cover of I. cordata var . splendens at -1.0 ft. (-.3 m) to MLLW diminished from 35.0% in August to 14.2% in November to 4.8% in January then increased to 43.2% in April. The upper limit to the distribution of Phyllospadix torreyi varied from +4.0 ft. (+1 .2 m) in November to +2.0 ft. (.6 m) in January and returned to +4.0 ft. (1.2 m) in April. No clear pattern of change in the cover of P. torreyi was exhibited in the interval that mar ked the lower limit of distribution throughout the year, MLLW to +1.0 ft. (+.3 m).

Chthamalus fissus/dalli, Anthopleura elegantissima, and Phragmatopoma calif ornica provided the major portion of macr oinver tebrate cover throughout the year and had annual mean cover values of 14. 6%, 6. 3%, and 3.8%, respectively (Table 1.1.12-10). Eight of the nine predominant macroinver tebrate species exhibi ted seasonal cover minima in August, though no common seasonal pattern was apparent since the cover maxima were scat ter ed among the *other* three sampling periods (Table 1.1.12-10).

Chthamalus fissus/dalli was distinctly the predominant taxon with respect to cover above +4. 0 ft. (+1.2 m), averaging 38.8% across the three tidal intervals from +4.0 to +7.0 ft. (+1.2 to +2.1 m, Table 1.1.12-11 and Figure 1.1.12-8). From +3.0 to +4.0 ft. (+.9 to +1.2 M) the dominant species was Phragmatopoma californica (22.0% cover) . Phragmatopoma calif ornica (4.2%) and Anthopleura elegantissima (3.7%) contributed most of the macroinvertebrate cover from +2. 0 t o +3. 0 ft. (+.6 to +.9 m); and A. elegantissima (39.0%) was clearly the predominant species between +1 .0 and +2.0 ft. (+.3 and +.6 m) . Below +1.0 ft. (+.3 m), Demospongiae occupied the most substrate (2.0% aver age over the lowest t WO tidal intervals) . Data concerning macr oinvertebrate cover distributions as a function of tidal interval

FIGURE 1.1.12-4. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR AUGUST 1976 (1- GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-4. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR AUGUST 1976 AT GOVERNMENT POINT, SANTA BARBARA ISLAND (CONTINUED).

FIGURE 1. .12-4. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR AUGUST 1976 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION).

FIGURE 1.1.12-5. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR ZONE NOVEMBER 1976 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-5. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR NOVEMBER 1976 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-5. DISTRIBUTION OF DOMINANT MACROPHYTE ZONES AS A FUNCTION OF TIDAL HEIGHT FOR NOVEMBER 1976 A GOVERNMENT ISLAND, SANTA BARBARA COUNTY CONTINUATION.

FIGURE 1.1.12-6. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR JANUARY 1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY CONTINUED.

FIGURE 1. 12-6.

DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR JANUARY 1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY CONTINUED).

FIGURE 1.1.12-6. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR JANUARY 1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION).

FIGURE 1.1.12-7. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR APRIL 1977 AT GOVERNMENT POINT, SAN A BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-7. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR APRIL 1977 A GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-7. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR APRIL 1977 AT GOVERNMENT POINT, SAN ARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-7. DISTRIBUTION OF DOMINAN MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR APRIL 1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION).

TABLE 1.1.12-10. QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM GOVERNMENT POINT, SANTA BARBARA COUNTY.

TAXA	COVER (%) AUG. 1976	NOV. 1976	JAN. 1977	APR. 1977	MEAN
CHTHAMALUS FISSUS AND DALLI	14.0	14.8	14.6	15.1	14.6
ANTHOPLEURA ELEGANTISSIMA	5.9	6.8	6.1	6.4	6.3
PHRAGMATOPOMA CALIFORNICA	3.5	3.9	4.1	3.7	3.8
BALANUS GLANDULA	0.3	1.2	1.0	0.5	0.7
DEMOSPONGIAE	0.4	0.8	0.8	0.4	0.6
CHTHAMALUS FISSUS & DAL I DEAD	0.3	0.4	1.0	0.6	0.6
TEGULA FUNEBRALIS	0.6	0.8	0.5	0.3	0.6
CORALLINA VANCOUVERIENSIS	<0.1	0.8	0.5	0.4	0.4
POLLICIPES POLYMERUS	0.6	<0.1	<0.1	<0.1	0.2
OTHER MACRO-INVERTEBRATES	0.6	0.5	0.7	0.4	
NUMBER OF OTHER TAXA	(26)	(23)	(21)	(23)	

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-11. ANNUAL MEAN COVER (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR GOVERNMENT POINT, SANTA BARBARA COUNTY DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS.

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1	MLLW TO 0.9	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9
CHTHAMALUS FISSUS & DALLI DEAD						1.8	1.0	1.7
LITTORINA SCUTULATA						0.2	<0.1	<0.1
CHTHAMALUS FISSUS AND DALLI				0.2	0.3	39.9	51.6	24.8
LITTORINA PLANAXIS				<0.1		<0.1	<0.1	0.1
ACMAEA (COLLISELLA) DIGITALIS				<0.1	<0.1	0.4	0.3	<0.1
BALANUS GLANDULA				<0.1	<0.1	4.1	1.7	<0.1
TEGULA FUNEBRALIS		<0.1	0.1	0.8	2.4	0.8	0.2	<0.1
BALANUS GLANDULA DEAD						0.1	<0.1	
ACANTHINA PUNCTULATA					<0.1	0.2	0.1	
POLLICIPES POLYMERUS				<0.1	<0.1	<0.1	1.3	
MYTILUS CALIFORNIANUS		<0.1		<0.1	<0.1	<0.1	0.2	
PHRAGMATOMA CALIFORNICA		0.9	0.2	4.2	22.0		3.2	
ANTHOPLEURA ELEGANTISSIMA	0.9	0.4	39.0	3.7	6.1	0.2	<0.1	
STRONGYLOCENTROTUS PURPURATUS					0.1			
DODECACERIA FEWKESI			3.3	0.1				
DEMOSPONGIAE	1.3	2.6	0.6	0.3				
ARCHIDISTOMA PSAMMION	0.6	<0.1		<0.1				
AGLAOPHENIA SP.	<0.1	0.2						

NOTE: 1 FOOT = 0.3048 METERS

FIGURE 1.1.12-8. MEAN HISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-8. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION)[a]

for each of the four sampling periods are presented in Figures 1 .1.12-9 through 1.1.12-12. The lower limit to the vertical distribution of Phragmatopoma californica extended from +2.0 ft. (+. 6 m) in August to MLLW in November and remained at that leve 1 through April. No other notable change between sampling periods was observed.

Sand cover was consider able between MLLW and +3. O ft. (+. 9 m) during all four sampling periods (Figures 1.1 .12-4 through 1.1.12-7). However , sand cover age reached a distinct maximum and extended higher in the intertidal (+5.0 ft. , +1.5 m) in January 1977. Cover of sand increased from 3. 8% in November to 18.9% in January in the +2. O to +3. O-ft . (+.6 to +.9 m) tidal interval and from 18.6% to 40.0% during the same period between +i .0 and +2. O ft. (+.3 and +.6 m), the interval in which maximum sand cover was consistently attained.

1 .1.12.4.2.2 Frequency

The macr ophy te taxon that occurred in the greatest proportion of samples based on annual mean values (Table 1.1 .12-12) was blue-green algae (88. 2%) , followed by Ralfsiaceae (54. 9%) , Pelvetia fastigiata (42.1%) , Corallina of ficinalis var . chilensis (37.6%) , Hydrolithon decipiens (34. 9%) , Endocladia muricata (34. 5%), Gi gartina papillata (33.'6%) , Bos siella orbigniana ssp . dichotoma (31.8%) , Gigartina canaliculata (29. 3%) , and Ulva taeniata (26. 8%) . Seven other al-gal species were found in more than 20% of the quadrats.

Bleached thalli were observed in 11 algal taxa at some time during the year . For six of those taxa (i .e. , Hydr oli then decipiens , Corallina of ficinalis var . chilensis, coralline crust, Bossiella orbigni" ana ssp. dichotoma , Gigar tina canaliculata , and Plocamium cartilagineum) bleached thalli were encountered most frequently in either November or January . Similar ly , 7 of the 10 most frequently sampled algal taxa exhibited frequency minima in November or January. Both of these observations are consistent with the pattern of winter algal die-back described in relation to seasonal cover in the previous section.

Many of the algal taxa encountered with greatest frequency were not dominant with respect to cover . Hydrolithon decipiens, even though i t contributed only moderate cover , occurred consistently beneath Pelvetia fastigiata overstory throughout the broad range of the latter species and extended from +6.0 to -1.0 ft. (+1.8 to -.3 m. Figure 1.1.12-13; Table 1.1.12-13). Ralfsiaceae , Corallina of ficinalis var . chilensis, Gigartina papillata, Bossiella orbigni ana ssp. dichotoma, and Gi gar ti na canaliculata were found disper sed across most of the inter tidal bench. Endocladia muricata was found in nearly all quadrats between +4.0 and +6.0 ft. (+1.2 and +1.8 m) and extended down to +2.0 ft. (+.6 m).

Chthamalus fissus/dalli was the most frequently sampled macr oinver te-brate (52.7%), followed closely by Anthopleura elegantissima (48.5%) and Tegula funebralis (46. 1%) based on annual mean values over all

FIGURE 1.1.12-9. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR AUGUST 1976 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.1-9. DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR AUGUST 1976 AT GOVERNMENT POINT, SANTA BARBARA COUNTY CONTINUATION.

FIGURE 1.1.12-10. HISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR NOVEMBER 1976 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-10. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR NOVEMBER 1976 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION).

FIGURE 1.1.12-11. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR JANUARY 1977 AT GAVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-11. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR JANUARY 1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION).

FIGURE 1.1.12-12. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR APRIL 1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE . ,12-12.

DES RIBcTIOn OF DOMINANT MACRO INVERTEBRATE
nOVER AS A -n JNCTIOn OF TIDAL HEIGH FOR
APRIL 1977 AT GOVERNMENT POINT, SANTA BARBARA
Co JN Y (CONTINUATION .

TABLE 1.1.12- 2 QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED ON NEXT PAGE).

TAXA	FREQUENCY (%) AUG. 1976	NOV. 1976	JAN. 1977	APR. 1977	MEAN
BLUE-GREEN ALGAE	84.7	79.9	95.0	93.3	88.2
RALFSIACEAE	36.8	48.6	66.3	68.0	54.9
PELVETIA FASTIGIATA	48.6	36.5	42.2	41.3	42.1
CORALLINA OFFICINALIS VAR. CHILENSIS	45.1	30.2	30.9	44.0	37.6
HYDROLITHON DECIPIENS	46.2	39.6	24.4	29.6	34.9
ENDOCLADIA MURICATA	30.2	36.8	34.4	36.8	34.5
GIGARTINA PAPILLATA	52.1	27.1	26.6	28.8	33.6
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	30.6	37.8	35.3	23.7	31.8
GIGARTINA CANALICULATA	25.7	31.6	31.6	28.5	29.3
ULVA TAENIATA	24.7	24.3	26.1	30.2	26.8
CLADOPHORA COLUMBIANA	27.4	22.6	24.4	24.0	24.6
LAMINARIA SINCLAIRII	20.6	25.0	21.3	24.4	22.9
CRYPTOPLEURA VIOLACEA	30.9	15.3	9.4	34.8	22.6
CORALLINE CRUSTS	0.7	26.4	33.1	24.0	21.1
PLOCAMIUM CARTILAGINEUM	22.2	20.1	23.4	17.0	20.7
GELIDIUM COULTERI	23.6	19.1	12.5	27.2	20.6
IRIDAEA CORDATA VAR. SPLENDENS	16.7	18.8	21.3	24.4	20.3
PETROCELLIS FRANCISCANA	21.2	20.8	23.1	10.9	19.0
PLYSSONNELIACEAE/HILDENBRANDIACEAE	27.4	9.4	11.9	25.1	18.5
RHODOGLOSSUM AFFINE	11.5	14.6	18.8	28.5	18.3
PILROSIPHONIA DENDROIDEA	9.4	11.8	25.9	24.0	17.8
IRIDAEA FLACCIDA	18.8	21.5	20.3	9.0	17.4
EGREGIA MENZIESII	12.8	18.4	15.0	20.9	16.8
PORPHYRA PERFORATA	28.5	4.5	3.1	24.0	15.0
CORALLINA VANCOUVERIENSIS	3.1	13.5	15.9	21.7	13.6
PHYLLOSPADIX TORREYI	16.3	13.9	10.6	9.5	12.6

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-12. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINAN MACROPHY ES OVER ALL TIDAL INTERVALS FROM GOVERNMENT POIN., SANTA BARBARA COUNTY (CONTINUED).

TAXA	FREQUENCY (%) AUG. 1976	NOV. 1976	JAN. 1977	APR. 1977	MEAN
GIGAR. NA LEPTORHYNCHOS	4.5	13.2	10.9	17.7	11.6
HYDROLITHON DECIPIENS BLEACHED	0.7	22.6	6.3	13.5	10.8
CORALLINA OFFICINALIS VAR. CH B	6.9	13.5	13.4	9.0	10.7
GASTROCLONIUM COUL ERI	14.9	9.0	7.2	10.9	10.5
GELIDIUM PUSILLUM	8.0	11.8	9.4	12.2	10.3
CYLINDROCARPUS RUGOSUS	9.4	10.4	10.3	10.8	10.2
PTIONI IS LANCEOLATA	13.2	9.4	0.0	15.0	9.4
BLUE-GREEN COLONY	0.0	18.8	9.4	9.4	9.4
RHODOMELA LAR .	13.2	7.6	8.1	8.1	9.3
RHODYMENIA PACIFICA	0.0	6.3	18.8	6.3	7.8
CERAMIUM EATONIANUM/SINICOLA	8.0	6.3	4.1	10.9	7.3
CENTROCERAS CLAVULATUM	4.2	3.1	13.1	7.8	7.0
SCYTOSIP ION DUTYI	0.0	0.0	18.8	9.4	7.0
POLYSIPHONIA HENDRYI VAR HENDRYI	12.2	4.5	6.3	4.5	6.9
CORALLINE CRUST BLEACHED	0.0	11.8	11.3	3.1	6.5
ENTEROMORPHA CLATHRATA	13.2	0.0	1.6	9.0	5.9
GRATELOUPIA DORYPHORA	0.0	0.0	0.0	23.8	5.9
PTEROSIPHONIA BAILLYI	6.3	3.1	0.0	11.9	5.3
LAURENCIA SPEC ABILIS	1.4	12.2	0.0	7.0	5.1
PLOCAMIUM VIOLACEUM	4.2	5.9	3.1	7.0	5.1
SM THORA NAIADUM	6.3	4.5	3.1	4.5	4.6
ECTOCARPACEAE	0.0	4.5	4.7	8.4	4.4
' LYSI PHO IA SPP.	0.0	0.0	4.1	13.4	4.4
ULVA LOBA A	0.7	0.0	0.0	14.9	3.9
CALLIARTHRON TUBERCULOSUM	0.0	0.0	12.5	0.0	3.1
BENTHIC DIATOMS	0.7	0.0	0.0	11.5	3.1

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-12. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

TAXA	FREQUENCY (%) AUG. 1976	NOV. 1976	JAN. 1977	APR. 1977	MEAN
MELOBESIA MEDIOCRIS	0.0	4.5	3.1	4.5	3.0
SORANTHERA ULVOIDEA	6.9	0.0	2.5	2.5	3.0
CHAETOMORPHA LINUM	0.0	3.1	3.1	5.6	3.0
POLYSIPHONIA PANICULATA	0.0	4.5	0.0	6.7	2.8
BOSSIELLA ORBIGNIANA SSP. DICH B	0.0	1.4	4.7	4.5	2.6
MONOSTROMA OXYSPERMUM	0.7	0.0	0.0	9.4	2.5
CRYPTOPLEURA CORALLINARA	0.0	9.4	0.0	0.0	2.3
PTILOTA DENSA	0.0	0.0	0.0	6.3	1.6
BOTRYOGLOSSUM FARLOWIANUM	0.0	6.3	0.0	0.0	1.6
GIGARTINA SPINOSA	0.0	6.3	0.0	0.0	1.6
ANISOCLADELLA PACIFICA	0.0	0.0	0.0	6.3	1.6
CORALLINA VANCOUVERIENSIS BLEACHED	0.0	0.0	0.0	5.9	1.5
CHONDRIA DECIPIENS	0.0	4.5	0.0	1.4	1.5
COLPOMENIA SINUOSA	3.1	0.0	0.0	2.5	1.4
PETALONIA FASCIA	0.0	0.0	0.0	5.6	1.4
MICROCLADIA BOREALIS	0.0	0.0	0.0	5.6	1.4
CALLITHAMNION PIKEANUM	0.0	0.0	0.0	5.6	1.4
FUCUS DISTICHUS SSP. EDENTATUS	0.7	1.4	1.6	1.4	1.3
POLYSIPHONIA ACUMINATA	0.7	0.0	0.0	3.9	1.1
GIGARTINA CANALICULATA BLEACHED	0.0	4.5	0.0	0.0	1.1
GELIDIUM ROBUSTUM	0.0	4.5	0.0	0.0	1.1
IRIDAEA HETEROCARPA	0.0	0.0	0.0	4.2	1.0
CRYPTOPLEURA VIOLACEA BLEACHED	0.0	0.0	0.0	3.1	0.8
COLLOSERIRA COMPRESSA	0.0	0.0	0.0	3.1	0.8
ENDOCLADIA MURICATA BLEACHED	0.0	0.0	0.0	3.1	0.8
HALIPTYLON GRACILE	0.0	3.1	0.0	0.0	0.8

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-12. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION).

TAXA	FREQUENCY (%) AUG. 1976	NOV. 1976	JAN. 1977	APR. 1977	MEAN
SCHIZYMENIA SP.	0.0	0.0	0.0	3.1	0.8
CLADOPHORA COLUMBIANA BLEACHED	0.0	0.0	0.0	3.1	0.8
GRACILARIA SJOESTEDTII	0.0	3.1	0.0	0.0	0.8
LITHOPHYLLUM PROBOSCIDEUM	0.0	0.0	0.0	3.1	0.8
NEOAGARDHIELLA BAILEYI	0.0	0.0	0.0	3.1	0.8
GLOIOSIPHONIA CAPILLARIS	0.0	0.0	0.0	2.5	0.6
HAPLOGLOIA ANDERSONII	0.0	0.0	0.0	2.5	0.6
MICROCLADIA COULTERI	2.1	0.0	0.0	0.0	0.5
PLOCAMIUM CARTILAGINEUM BLEACHED	0.0	0.0	1.6	0.0	0.4
POLYNEURA LATISSIMA	0.0	0.0	0.0	1.4	0.3
LAURENCIA SPECTABILIS BLEACHED	0.7	0.0	0.0	0.0	0.2

NOTE: 1 FOOT = 0.3048 METERS

FIGURE 1.1.12-13. MEAN DISTRIBUTION OF DOMINAN MACROPHYTE FREQUENCY AS A FUNCTION O[illegible] TIDAL HEIGHT DURING 1976/1977 A[illegible] GOVERNMENT POINT, SAN[illegible]A BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-13. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, SAN A BARBARA COUNTY CONTINUED).

TIDAL HEIGHT (FT)

-2 -1 0 1 2 3 4 5 6 7

ULVA TAENIATA

PRIONITIS LANCEOLATA

IRIDAEA FLACCIDA

BOSSIELLA ORBIGNIANA SSP. DICHOTOMA

CRYPTOPLEURA VIOLACEA

PTEROSIPHONIA DENDROIDEA

CORALLINA VANCOUVERIENSIS

EGREGIA MENZIESII

PETROCELIS FRANCISCANA

CORALLINE CRUSTS

IRIDAEA HETEROCARPA

PLOCAMIUM CARTILAGINEUM BLEACHED

POLYNEURA LATISSIMA

FUCUS DISTICHUS SSP. EDENTATUS

LAURENCIA SPECTABILIS BLEACHED

CALLITHAMNION PIKEANUM

GELIDIUM ROBUSTUM

CENTROCERAS CLAVULATUM

POLYSIPHONIA PANICULATA

SORANTHERA ULVOIDEA

POLYSIPHONIA ACUMINATA

PLOCAMIUM VIOLACEUM

1%

MEAN CLIS RIB ION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY CONTINUED).

CORE 1.1.12-3.

FIGURE 1.1.12-13.

MEAN DISTRIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-13. MEAN CHS RIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION).

TABLE 1.1.2- 3. ANNUAL MEAN FREQUENCY (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR GOVERNMENT POINT, SANTA BARBARA COUNTY DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1	MLLW TO 0.9	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9
BLUE-GREEN COLONY							18.8	56.3
SCYTOSIPHON DOTYI						6.3	18.8	31.3
PELVETIA FASTIGIATA			4.2	64.2	100.0	81.3	68.8	18.8
BLUE-GREEN ALGAE	87.5	87.5	51.7	79.2	100.0	100.0	100.0	100.0
CLADOPHORA COLUMBIANA BLEACHED							6.3	
ENDOCLADIA MURICATA BLEACHED							6.3	
ENTEROMORPHA CLATHRATA				10.1	12.5		25.0	
PORPHYRA PERFORATA				26.4	25.0	3.3	37.5	
ENDOCLADIA MURICATA				38.9	37.5	100.0	100.0	
HYDROLITHON DECIPIENS BLEACHED				29.9	25.0	18.8	12.5	
CLADOPHORA COLUMBIANA			5.0	54.2	81.3		56.3	
CYLINDROCARPUS RUGOSUS			5.0	26.7	31.3	6.3	12.5	
CORALLINA OFFICINALIS VAR. CH B			5.0	24.7	50.0		6.3	
PEYSSONNELIACEAE/HILDENBRANDIACEAE		14.6	15.0	5.6	43.8	6.3	62.5	
RHODOGLOSSUM AFFINE		18.8		71.5	50.0		6.3	
CORALLINA OFFICINALIS VAR. CHILENSIS	37.5	12.5	63.3	74.7	100.0		12.5	
HYDROLITHON DECIPIENS	62.5	20.8	10.0	61.1	62.5	18.8	43.8	
RALFSIACEAE	37.5	43.8	56.7	88.9	100.0	43.8	68.8	
GIGARTINA PAPILLATA	25.		4.2	58.7	43.8	81.3	56.3	
LITHOPHYLLUM PROBOSCIDEUM						6.3		
POLYSIPHONIA HENDRYI VAR HENDRYI			12.5	11.1	25.0	6.3		
POLYSIPHONIA SPP.			20.0	8.7		6.3		
GIGARTINA CANALICULATA		39.6	24.6	83.0	81.3	6.3		
HALIPTYLON GRACILE					6.3			

NOTE: 1 FOOT = 0.3048 METERS

TABLE .1.12-13. ANNUAL MEAN FREQUENCY (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR GOVERNMENT POINT, SANTA BARBARA COUNTY DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUED).

TAXA	TIDAL HEIGHT (FT). -1.0 TO 0.1	MLLW TO 0.9	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9
GIGARTINA CANALICULATA BLEACHED				2.6	6.3			
CORALLINA VANCOUVERIENSIS BLEACHED				5.6	6.3			
GIGARTINA LEPTORHYNCHOS				49.0	43.8			
CHAETOMORPHA LINUM			5.0		18.6			
CERAMIUM EATONIANUM/SINICOLA			25.4	14.2	18.8			
GELIDIUM PUSILLUM			4.2	34.7	43.8			
ECTOCARPACEAE			5.0	11.5	18.8			
COLPOMENIA SINUOSA			5.0		6.3			
BENTHIC DIATOMS			5.0	6.9	12.5			
PETALONIA FASCIA			5.0		6.3			
GASTROCLONIUM COULTERI		22.9	25.4	17.0	18.8			
PHYLLOSPADIX TORREYI		27.1	50.0	11.1	12.5			
LAURENCIA SPECTABILIS		12.5	11.3	11.1	6.3			
PTEROSIPHONIA BAILEYI		27.1	9.2		6.3			
CRYPTOPLEURA CORALLINARA		6.3	6.3		6.3			
ULVA LOBATA		6.3		12.5	12.5			
GELIDIUM COULTERI		12.5	22.5	79.9	50.0			
ULVA TAENIATA		25.0	93.8	58.3	37.5			
PRIONITIS LANCEOLATA	37.5	18.8	11.3	1.4	6.3			
IRIDAEA FLACCIDA	37.5	6.3	10.4	35.1	50.0			
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	87.5	81.3	20.4	53.1	12.5			
CRYPTOPLEURA VIOLACEA	50.0	66.7	15.4	23.6	25.0			
PTEROSIPHONIA DENDROIDEA	37.5	52.1	16.3	24.0	12.5			
CORALLINA VANCOUVERIENSIS	12.5	18.8	26.3	19.8	31.3			

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-13. ANNUAL MEAN FREQUENCY (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR GOVERNMENT POINT, SANTA BARBARA COUNTY DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUED).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1	MLLW TO 0.9	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9
EGREGIA MENZIESII	12.5	60.4	16.3	20.1	25.0			
PETROCELIS FRANCISCANA	25.0	6.3	37.5	52.1	31.3			
CORALLINE CRUSTS	50.0	56.3	27.5	16.0	18.8			
IRIDAEA HETEROCARPA				8.3				
PLOCAMIUM CARTILAGINEUM BLEACHED				3.1				
POLYNEURA LATISSIMA				2.8				
FUCUS DISTICHUS SSP. EDENTATUS				10.1				
LAURENCIA SPECTABILIS BLEACHED				1.4				
CALLITHAMNION PIKEANUM				11.1				
GELIDIUM ROBUSTUM			6.3	2.8				
CENTROCERAS CLAVULATUM			44.6	11.8				
POLYSIPHONIA PANICULATA			11.3	11.1				
SORANTHERA ULVOIDEA			18.3	5.6				
POLYSIPHONIA ACUMINATA			5.0	4.2				
PLOCAMIUM VIOLACEUM		12.5	15.4	12.5				
RHODOMELA LARIX		27.1	34.6	12.5				
POSSIELLA ORBIGNIANA SSP. DICH B		12.5		8.7				
MELOBESIA MEDIOCRIS		18.8		5.6				
CORALLINE CRUST BLEACHED		12.5	22.5	17.4				
CHONDRIA DECIPIENS		6.3		5.6				
SMITHORA NAIADUM		18.8	8.3	9.7				
MONOSTROMA OXYSPERMUM	12.5	6.3		1.4				
PLOCAMIUM CARTILAGINEUM	87.5	66.7		11.5				
GRACILARIA SJOESTEDTII			6.3					

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-13. ANNUAL MEAN FREQUENCY (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR GOVERNMENT POINT, SANTA BARBARA COUNTY DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUATION).

	TIDAL HEIGHT (FT.)							
TAXA	-1.0 TO -0.1	MLLW TO 0.9	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9
HAPLOGLOIA ANDERSONII			5.0					
MICROCLADIA COULTERI			4.2					
GLOIOSIPHONIA CAPILLARIS			5.0					
GIGARTINA SPINOSA		6.3	6.3					
MICROCLADIA BOREALIS		6.3	5.0					
GRATELOUPIA DORYPHORA	25.0	12.5	10.0					
LAMINARIA SINCLAIRII	100.0	66.7	16.3					
IRIDAEA CORDATA VAR. SPLENDENS	87.5	58.3	16.3					
NEOAGARDHIELLA BAILEYI		6.3						
CRYPTOPLEURA VIOLACEA BLEACHED		6.3						
SCHIZYMENIA SP.		6.3						
ANISOCLADELLA PACIFICA		12.5						
COELOSEIRA COMPRESSA		6.3						
RHODYMENIA PACIFICA	50.0	12.5						
CALLIARTHRON TUBERCULOSUM	25.0							
BOTRYOGLOSSUM FARLOWIANUM	12.5							
PTILOTA DENSA	12.5							

NOTE: 1 FOOT = 0.3048 METERS

tidal intervals (Table 1. 1.12-14). Other inver tebr ate taxa found in high frequency were Littorina planaxis (29.4%), Phragmatopoma californica (29.2%), Balanus glandula (27.9%), Acmaea (Collisella) digitalis (25.9%), and Littorina scutulata (25.0%). Seven other taxa occurred in at least 10% of the quadrat samples. Frequency data generally paralleled data for invertebrate cover (Table 1.1.12-15, Figure 1.1.12-14); in particular, 8 of the 15 most widespread taxa exhibited frequency minima in August. A major difference is the frequency dominance of T. funebralis, despite its low cover .

1.1.12 .4.2.3 Density

The annual mean density over all tidal intervals of Chthamalus fissus/dalli (5, 810 individuals/m^2) was far greater than any other taxon (Table 1.1.12-16). The remaining taxa that were found in exceptionally high densities were Littorina planaxis (244/m^2), Anthopleura elegantissima (21 4/m^2), Balanus glandula (151 /m^2), and L. scutulata (104/m^2). Three of the five numerically dominant taxa exhibited density minima in August, reflecting the pattern of change observed in macroinvertebrate cover. However, the pattern seen in cover data was not generally reflected by density data and only 5 of the 15 most numerous taxa reached minimum density in August.

Annual mean density as a function of tidal interval is presented in Table 1.1.12-17 and Figures 1.1.12-15 and 1.1.12-16. Chthamalus fissus/dalli attained maximum density (21 , 849/m^2) from +5. 0 to +6. 0 ft. (+1.5 to +1.8 m), and Littorina planaxis was most numerous (935/m^2) in the highest interval sampled , +6.0 to +7.0 ft. (+1.8 to +2.1 m). Anthopleura elegantissima, the only species of the five numerical dominants that occurred below +2.0 ft. (+.6 m), reached a maximum density (1413/m^2) between +1 .0 and +2.0 ft. (+. 3 and +.6 m) . Both Balanus glandula and L. scutulata were found in maximum density (806 and 647/m^2) between +1.0 and +2.0 ft. (+.3 and +.6 m). Both Balanus glandula and L. scutulata were found in maximum density (806 and 647 /m^2, respectively) in the +4.0 to +5.0 ft. (+1.2 to +1.5 m) interval.

The quarterly mean density of Littorina scutulata decreased strikingly from 361 /m^2 to 36 /m^2 between August and November , (Table 1.1.12-16) primarily between +4.0 and +5.0 ft. (+1 .2 and +1.5 m) as shown in Figures 1.1.12-17 through 1.1.12-20. Two other species also exhibiting large decreases in numbers between August and November were Pollicipes polymerus (from 88 to 14/m^2) and Acmaea (Collisella) digitalis (from 50 to 20/m^2). Lacuna spp . increased sharply in density from 3 /m^2 in January to 60/m^2 in April.

Density data as a function of tidal height for each of the four sampling periods (Figures 1.1.12-17 through 1.1.12-24) showed an increase in Chthamalus fissus/dalli density at +3. 0 to +4.0 ft. (+.9 to +1.2 m) from 385/m^2 to 995/m^2 and at +4.0 to +5. 0 ft. (+1.2 to +1. 5 m) from 10,157/m^2 to 15,168/m2 between January and April, an average

TABLE 1.1.12-14. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED ON NEXT PAGE).

TAXA	FREQUENCY (%) AUG, 1976	Nov. 1976	JAN. 1977	APR. 1977	MEAN
CHTHAMALUS FISSUS AND DALLI	49.7	55.6	51.6	54.2	52.7
ANTHOPLEURA ELEGANTISSIMA	45,1	44.1	56.3	48.6	48.5
TEGULA FUNEBRALIS	52.1	4140	56.9	34.6	46.1
LITTORINA PLANAXIS	19.4	34.4	31;3	32.6	29.4
PHRAGMATOPOMA CALIFORNICA	30.6	28.5	29.7	28.2	29.2
BALANUS GLANDULA	17*7	28.1	28.1	37.5	27.9
ACMAEA (COLLISELLA) DIGITALIS	20.8	25,0	34.4	23.3	25.9
LITTORINA SCUTULATA	37.5	28.1	15.6	18.8	25.0
ACMAEA (COLLISELLA) SCABRA	5.9	36.0	23.4	27.8	23.5
CHTHAMALUS FISSUS & DALLI DEAD	12.5	25.0	31.3	25.0	23.4
DEMOSPONGIAE	18.8	23.3	21.3	16.4	19.9
MYTILUS CALIFORNIANUS	26.7	9.4	9.4	10.8	14.1
POLLICIPES POLYMERUS	20.1	9.4	9.4	9.4	12.1
PISASTER OCHRACEUS	8.0	12.5	7.8	13.9	10.5
ACMAEA (COLLISELLA) PELTA	5.2	1409	10.9	9.0	10.0
ACANTHINA PUNCTULATA	1506	12.5	3.1	3.1	8.6
LACUNA SPP.	2.1	4.5	14.7	8.8	7.5
ARCHIDISTOMA PSAMMION	13.2	0.0	15.6	0.0	7.2
PAGURUS HIRSUTIUSCULUS	2.1	3.1	22.2	0.0	6.8
AGLAOPHENIA SP.	16.7	0.0	0.0	3.1	4.9
TETRACLITA SQUAMOSA RUBESCENS	1.4	4.2	6.3	7.3	4.8
BUCELLA (THAIS) EMARGINATA	12.5	0.0	3.1	3.1	4.7
ACMAEA STRIGATELLA/FENESTRATA	6.6	4.5	0.0	7.6	4.7
PACHYGRAPSUS CRASSIPES	060	7.6	0.0	9.4	4.3
BALANUS GLANDULA DEAD	0.0	0*0*	3.1	12.5	3.9
EPITONIUM TINCTUM	5.2	1.4	1.6	5.6	3.4

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-5. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION).

TAXA	FREQUENCY (%) AUG. 1976	NOV. 1976	JAN. 1977	APR. 1977	MEAN
MOPALIA MUSCOSA	12.5	0.0	0.0	0.0	3.1
DODECACERIA FEWKESI	1.4	4.5	2.5	3.9	3.1
ACMAEA (COLLISELLA) LIMATULA	8.3	3.1	0.0	0.0	2.9
ACMAEA (COLLISELLA) ASMI	0.7	4.5	4.7	1.4	2.8
ACANTHINA SPIRATA	0.0	4.5	4.7	0.0	2.3
PUGETTIA PRODUCTA	6.3	1.4	1.6	0.0	2.3
ACMAEA JUVENILE	0.0	0.0	0.0	8.8	2.2
NUTTALLINA FLUXA/CALIFORNICA	4.2	3.1	0.0	0.0	1.8
LOTTIA GIGANTEA	0.0	3.1	3.1	0.0	1.6
CORYNACTIS CALIFORNICA	0.0	3.1	0.0	3.1	1.6
AMPHISSA VERSICOLOR	0.0	0.0	2.5	3.1	1.4
SEPTIFER BIFURCATUS AND BRACHIDONTES	0.7	0.0	0.0	4.5	1.3
OCENEBRA CIRCUMTEXTA	0.7	0.0	0.0	4.5	1.3
STRONGYLOCENTROTUS PURPURATUS	0.0	0.0	0.0	3.1	0.8
PAGURUS SAMUELIS	3.1	0.0	0.0	0.0	0.8
MITRELLA CARINATA	0.0	0.0	1.6	0.0	0.4
CYANOPLAX HARTWEGII	0.0	1.4	0.0	0.0	0.3
SPIROBIS SPP.	0.0	1.4	0.0	0.0	0.3
MYTILUS EDULIS	0.7	0.0	0.0	0.0	0.2
RITTERELLA AEQUALISIPHONIS	0.7	0.0	0.0	0.0	0.2

NOTE: 1 FOOT = 0.3048 METERS

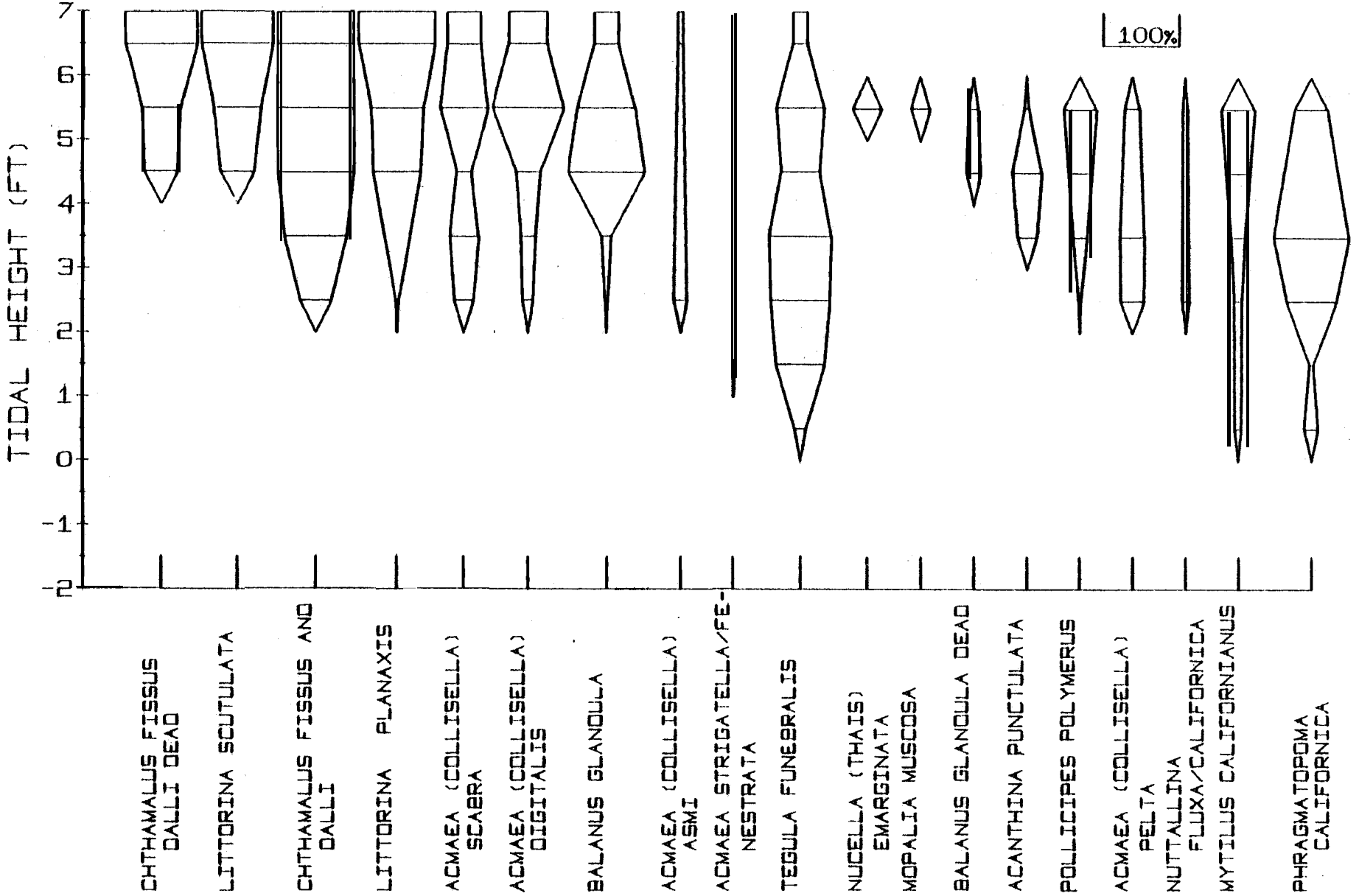

FIGURE 1.1.12-14. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-14. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-14

MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, SAN TA BARBARA COUNTY CONTINUATION).

TABLE 1.1.12-15. ANNUAL MEAN FREQUENCY (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR GOVERNMENT POINT, SANTA BARBARA COUNTY DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1	MLLW TO 0.9	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9
CHTHAMALUS FISSUS & DALLI DEAD						43.8	50.0	93.8
LITTORINA SCUTULATA						43.8	62.5	93.8
CHTHAMALUS FISSUS AND DALLI				40.6	8 .3	100.0	100.0	100.0
LITTORINA PLANAXIS				4.2		62.5	68.8	100.0
ACMAEA (COLLISELLA) SCABRA				25.3	37.5	18.8	62.5	43.8
ACMAEA (COLLISELLA) DIGITAL				13.2	18.8	31.3	93.8	50.0
BALANUS GLANDULA				4.2	12.5	100.0	75.0	31.3
ACMAEA (COLLISELLA) ASMI				16.3				6.3
ACMAEA STHIGATELLA/FENESTRATA			4.2	6.3	18.8			6.3
TEGULA FUNEBRALIS		14.6	64.2	77.8	81.3	50.0	62.5	18.8
NUCELLA (THAIS) EMARGINATA							37.5	
NOPALIA NOSCOSA							25.0	
BALANUS GLANDULA DEAD						18.8	12.5	
ACANTHINA PUNCTULATA					25.0	37.5	6.3	
POLLICIPES POLYMERUS				2.8	18 8	31.3	43.8	
ACMAEA (COLLISELLA) PELTA				30.2	31 3		19.8	
MUTTALLIA FLUXA/CALIFORNICA				8.3			6.3	
MYTILUS CALIFORNIANUS		8.3		10.4	18 8	31.3	43.8	
PHRAGMATOPOMA CALIFORNICA		18.8	5.0	66.3	100 0		43.8	
ANTHOPLEURA ELEGANTISSIMA	37.5	45,8	100.0	86.1	68 8	18.8	31.3	
SEPTIFER BIFURCATUS AND BRACHIDONTES				4.2		6.3		
ACANTHINA SPIRATA		6.3		5.9		6.3		
PAGURUS SAMUELIS					6 3			
STRONGYLOCENTROTUS PURPURATUS					6 3			

NOTE; 1 FOOT = 0.3048 METERS

ABLE 1.1.12-15. ANNUAL MEAN FREQUENCY (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR GOVERNMENT POINT, SANTA BARBARA COUNTY DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1	MLLW TO 0.9	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9
LOTTIA GIGANTEA					12.5			
OCENEBRA CIRCUMTEXTA				4.2	6.3			
PACHYGRAPSUS CRASSIPES				2.8	31.3			
TETRACLITA SQUAMOSA RUBESCENS				25.7	12.5			
ACMAEA (COLLISELLA) LIMATULA				4.2	18.8			
EPITONIUM TINCTUM			5.0	10.1	12.5			
AMPHISSA VERSICOLOR			5.0		6.3			
PISASTER OCHRACEUS	25.0	33.3		7.3	18.8			
PAGURUS HIRSUTIUSCULUS	25.0	6.3	10.0	7.3	6.3			
SPIROBIS SPP.				2.6				
RITTERELLA AEQUALISIPHONIS				1.4				
MYTILUS EDULIS				1.4				
CYANOPLAX HARTWEGII				2.8				
MITRELLA CARINATA				3.1				
DODECACERIA FEWKESI			16.3	8.3				
LACUNA SPP.		12.5	35.4	12.2				
PUGETTIA PRODUCTA		8.3		10.1				
DEMOSPONGIAE	87.5	45.8	16.3	9.7				
ARCHIDISTOMA PSAMMION	50.0	6.3		1.4				
ACMAEA JUVENILE		12.5	5.0					
CORYNACTIS CALIFORNICA		12.5						
AGLAOPHENIA SP.	25.0	14.6						

NOTE: 1 FOOT = 0.3048 METERS

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TABLE 1.1.12-16. QUARTERLY AND ANNUAL MEAN DENSITY (NO./M2) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM GOVERNMENT POINT, SANTA BARBARA COUNTY.

TAXA	DENSITY(NO./M2) AUG. 1976	NOV. 1976	JAN. 1977	APR. 1977	MEAN
CHTHAMALUS FISSUS AND DALLI	5206	6521	5791	5721	5810
LITTORINA PLANAXIS	150	204	262	358	244
ANTHOPLEURA ELEGANTISSIMA	189	260	210	198	214
BALANUS GLANDULA	126	196	122	161	151
LITTORINA SCUTULATA	361	36	9	10	104
TEGULA FUNEBRALIS	40	37	32	29	34
POLLICIPES POLYMERUS	88	14	5	6	28
ACMAEA (COLLISELLA) DIGITALIS	50	20	17	16	26
LACUNA SPP.	10	10	3	60	21
ACMAEA (COLLISELLA) SCABRA	4	14	4	7	7
MYTILUS CALIFORNIANUS	6	3	3	2	3
TETRACLITA SQUAMOSA RUBESCENS	<1	2	4	5	3
ACANTHINA PUNCTULATA	3	3	<1	<1	2
NUCELLA (THAIS) EMARGINATA	3	0	3	<1	1
ACMAEA (COLLISELLA) PELTA	<1	2	1	<1	1
OTHER MACRO-INVERTEBRATES	5	3	3	5	
NUMBER OF OTHER TAXA	(13)	(13)	(9)	(11)	
TOTALS	6242	7322	6468	6580	

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-17. ANNUAL MEAN DENSITY (NO./M²) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR GOVERNMENT POINT, SANTA BARBARA COUNTY DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS.

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1	MLLW TO 0.9	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9
LITTORINA SCUTULATA						647	53	131
CHTHAMALUS FISSUS AND DALLI				37a	512	13604	21849	10135
LITTORINA PLANAXIS				<1		212	862	935
ACMAEA(COLLISELLA) DIGITALIS				2	2	126	62	12
BALANUS GLANDULA				2	2	806	386	14
ACMAEA (COLLISELLA) SCABRA				5	14	4	15	22
ACMAEA STRIGATELLA/FENESTRATA			<1	1	1			<L
TEGULA FUNEBRALIS		1	9	58	141	32	32	1
KOPALIA MUSCOSA							2	
NUCELLA (THAIS) EMARGINATA							12	
ACANTHINA PUNCTULATA					4	5	4	
ACMAEA(COLLISELLA) PELTA				4	4		2	
POLLICIPES POLYMERUS				<1	2	14	210	
MYTILUS CALIFORNIANUS		1		<1	2	11	13	
ANTHOPLEURA ELEGANTISSIMA	4	6	1413	85	200	2	2	
STRONGYLOCENTROTUS PURPURATUS					1			
TETRACLITA SQUAMOSA RUBESCENS				19	2			
ACMAEA (COLLISELLA) LIMATULA				<1	2			
PACHYGRAPSUS CRASSIPES				<1	2			
EPITONIUM TINCTUM			<1	1	<1			
PAGURUS HIRSUTIUSCULUS	2	<1	<1	<1	<1			
LACUNA SPP.		92	71	4				
ACMAEA JUVENILE		1	<1					
CORYNACTIS CALIFORNICA		2						

NOTE: 1 FOOT = 0.3048 METERS

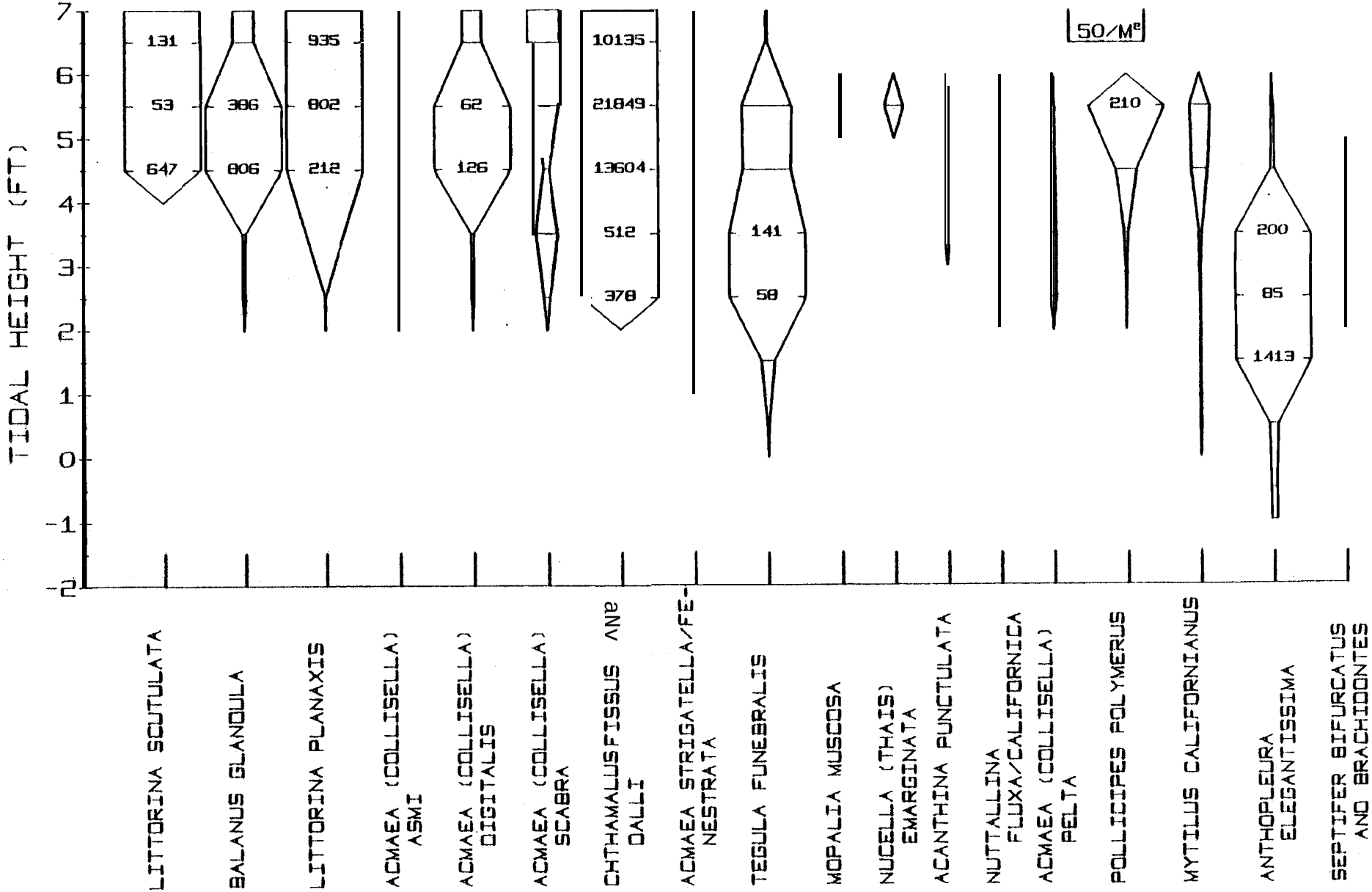

FIGURE 1.1.12-15. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-15. MEAN DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 A GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION).

FIGURE 1.1.12-16. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-16.

MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION).

FIGURE 1. .12-17. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR AUGUST 1976 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12 .7. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR AUGUST 1976 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION).

FIGURE 1.1.12-18. DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR AUGUST 1976 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED)

FIGURE 1.1.12-18. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR AUGUST 1972 AT GAVIOTA POINT, SANTA BARBARA COUNTY (CONTINUATION).

FIGURE 1.1.12-19. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR NOVEMBER 1976 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-19. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR NOVEMBER 1976 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION).

FIGURE 1.1.12-20. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR NOVEMBER 1976 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-20. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR NOVEMBER 1976 AT GOVERNMENT POINT, SANTA BARBARA COUNTY CONTINUA TION.

FIGURE 1.1.12-21. HISTOGRAM OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR CANUARY 1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 3.1.12-21.

DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR JANUARY 1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY CONTINUATION.

FIGURE 1.1.12-22. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR JANUARY 1977 AT GOVERNMENT 702, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1.1.12-22. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR JANUARY 1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION).

FIGURE 1.1.12-2w.

DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR APRIL 1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED)

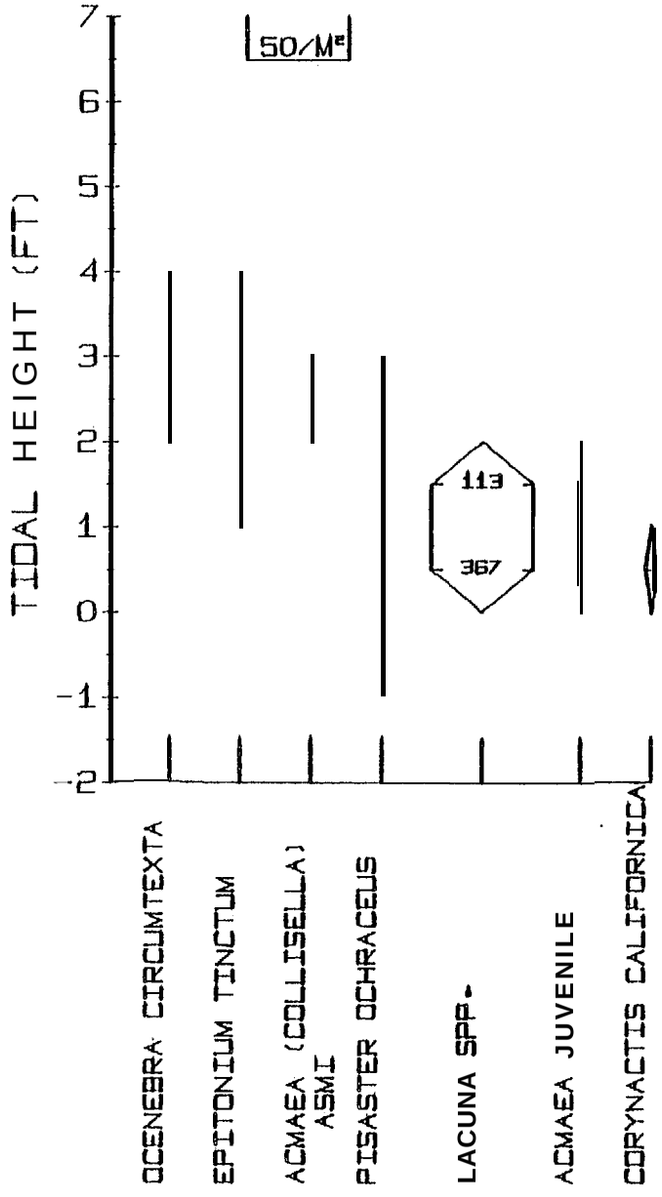

FIGURE 1.1.12-23. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR APRIL 1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION).

FIGURE 1. 12-24. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR APRIL 1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUED).

FIGURE 1. 12-24. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR APRIL 1977 AT GOVERNMENT POINT, SANTA BARBARA COUNTY (CONTINUATION).

increase of 53% at that tidal level. Although little net change in C. fissus/dalli density over all tidal heights occurred because of compensatory decreases at higher tidal levels, an obvious increase in cover of C. fissus/dalli as a function of tidal interval was observed between January and April (Figures 1.1.12-11 and 1.1.12-12). The only notable shift in vertical distribution was exhibited by Littorina planaxis. The lower distributional extreme of this species retreated from +2.0 ft. (+.6 m) in August to +4.0 ft. (+1.2 m) in November, while its density between +4.0 and +5.0 ft. (+1.2 and +1.5 m) decreased from 547 to 18/m^2.

1.1.12 .4.2.4 Biomass

The annual mean standing crop in wet biomass averaged over all tidal intervals was 5,563.5 g/m^2, of which 4,548.9 g/m^2 was contributed by macrophytes and 1 ,014.6 g/m^2 by macroinvertebrates (Tables 1.1.12-18 and 1.1.12-19). The corresponding data for dry biomass (hard parts) were 1, 578. g/m^2 (ODW) for macrophytes, and 526.6 g/m^2 (131.2 g/m^2 ODW) for macrophytes, and 526.6 g/m^2 (131 .2 g/m ODW) for macroinvertebrates (Tables 1.1.12-20 through 1.1.12-23).

Macrophyte biomass was maximal (9,7449.7 wet g/m^2 and 1 ,976.1 dry g/m^2) in the interval from MLLW to 1.0 ft. (.3 m) (Tables 1.1.12-18 and 1.1.12-20). Wet macrophyte biomass was minimal (1 ,389.0 g/m^2) between +1.0 and +2.0 ft. (+.3 and +.6 m), and dry biomass reached the lowest values in the +3.0 to +4. 0-ft. (+.9 to +1.2-m) and +1.0 to +2. o- ft. (+.3 to +.6-m) intervals (260.0 and 260.6 g/m^2, respectively) . Macroinvertebrate biomass was lowest (79.8 wet g/m^2 and 24.4 dry g/m^2) in the -1.0 ft. (-.3 m) to MLLW tidal interval, wet biomass was greastest (1 ,608.8 g/m^2) from +1.0 to +2.0 ft. (+.3 to +.6 m) , and &y biomass was maximal (974.1 g/m^2) from +6.0 to +7.0 ft. (+1.8 to +2.1 m, Tables 1.1.12-19 and 1.1.12-22).

Pelvetia fastigiata, the most abundant alga in terms of biomass, contributed 40% (1. 608.4 g/m^2) of the total annual mean wet biomass . The next two most" predominant species Laminaria sinclairii (923.9 g/m^2) and Phyllospadix torreyi (646.6 g/m^2), together represented 35% of macrophyte wet weight. Other dominant species based on biomass were Rhodomela larix (215.7 g/m^2 wet weight) , Gigartina canaliculata (127.7 g/m^2 WW). ,and Smithora naiadum (98.1 g/m^2 WW). Wet biomass of P. fastigiata generally increased at successively higher tidal intervals reaching a maximum (1 ,890.4 g/m^2 WW) in the +6.0 to +7.0 ft. (+1.8 to +2.1 m) interval, while L. sinclairii and P. torreyi decreased in wet biomass through ascending levels. Laminaria sinclairii exhibited a maximum (1,214.4 g/m^2 WW) from -1.0 (-.3 m) to MLLW, and P. torreyi, a maximum (1 ,020.9 g/m^2 WW) from MLLW to +1.0 ft. (+.3 m).

TABLE 1.1.12-18. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM GOVERNMENT POINT, SANTA BARBARA COUNTY FROM AUGUS 1976 TO APRIL 1977. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 (N=15)	1.0 TO 1.9 (N= 2)	2.0 TO 2.9 (N=10)	3.0 TO 3.9 (N= 1)	4.0 TO 4.9 (N=10)	5.0 TO 5.9 (N= 7)	6.0 TO 6.9 (N= 2)	MEAN
CORALLINA VANCOUVERIENSIS		5.		105.3					27.6
HESPEROPHYCUS HARVEYANUS						142.2	<0.1	118.0	32.5
HELVETIA FASTIGIATA				987.8		4336.7	2527.5	8620.0	1809.4
GIGARTINA PAPILLATA				36.6		87.2	3.2	41.1	21.0
ENDOCLADIA MURICATA				17.5		46.1	13.7	19.2	12.1
CLADOPHORA COLUMBIANA		<0.1		12.9		0.5	25.9	4.4	5.2
POLYSIPHONIA SCOPULORUM VAR. VILLUM				<0.1			1.6		0.2
GELIDIUM PUSILLUM			<0.1	1.3		6.0	13.5		2.5
ULVA TAENIATA		12.1	102.7	50.3	517.7	33.7	<0.1		89.6
CORALLINA OFFICINALIS VAR. CHILENSIS		16.5	216.6	97.4	311.6	19.5	11.0		83.3
GIGARTINA LEPTORHYNCHOS		<0.1		3.4		14.0	2.6		2.5
PTEROSIPHONIA DENDROIDEA	9.1	20.4	40.2	43.1	8.7	1.2	0.3		15.4
GOSSILELA ORBIGNIANA SSP. DICHOTOMA	110.4	56.9	0.2	4.2	1.3	0.2	<0.1		21.7
GELIDIUM COULTERI	0.2	13.7	6.5	138.2	70.2	86.7	2.3		39.7
COLPOMENIA SINUOSA						1.4			0.2
SCHIZYMENIA DUBYI					66.1	1.1			10.9
POLYSIPHONIA ACUMINATA			2.6	6.6	44.1	12.6			6.3
CHONDRIA DECIPIENS			9.8	6.4	5.5	1.3			2.9
POLYSIPHONIA PANICULATA		10.4	39.5	0.4		7.4			7.2
POLYSIPHONIA HENDRYI VAR HENDRYI		<0.1			16.7	20.5			4.7
IRIDAEA FLACCIDA		75.4		5.9		106.7			23.5
ULVA LOBATA		1.6		186.8	159.5	0.3			43.5

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-18. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM GOVERNMENT POINT, SANTA BARBARA COUNTY FROM AUGUST 1976 TO APRIL 1977. BLANK SPACES INDICATE ZEROS (CONTINUED).

TAXA	-1.0 TO -0.1 (N= 1)	0.0 TO 0.9 (N=15)	TIDAL HEIGHT (FT). 1.0 TO 1.9 (N= 2)	2.0 TO 2.9 (N=16)	3.0 TO 3.9 (N= 1)	4.0 TO 4.9 (N=10)	5.0 TO 5.9 (N= 7)	6.0 TO 6.9 (N= 2)	MEAN
CERAMIUM EATONIANUM/SIN =OLA		<0.1		8.3	52.1	25.1			10.7
GASTROCLONIUM COULTERI		31.6	148.7	534.5	1.9	7.2			90.5
RHODOMELA LARIX		135.4	641.1	468.4	472.5	8.4			215.7
ANISOCLADELLA PACIFICA		3.0				<0.1			0.4
PLOCAMIUM VIOLACEUM		0.4	1.8	12.5	0.9	<0.1			1.9
RHODOGLOSSUM AFFINE		0.3		15.0		46.2			7.7
GIGARTINA CANALICULATA		4.5	30.9	727.8		256.8			127.7
GLOIOSIPHONIA CAPILLARIS				6.5	40.3				5.9
PTEROSIPHONIA BAILEYI		1.3	1.8	<0.1	1.9				0.6
CRYPTOPLEURA VIOLACEA	0.4	31.1	4.9	86.3	57.1				25.2
PETALONIA FASCIA				2.5					0.3
CALLITHAMNION PIKEANUM				7.7					1.0
BENTHIC DIATOMS				0.9					0.1
POLYSIPHONIA, SPP.				13.4					1.7
CENTROCERAS CLAVULATUM			18.8	6.7					3.2
IRIDAEA CORDATA VAR. SPLENDENS		145.9		0.2					18.3
EGREGIA MENZIESII		594.7		7.2					75.2
PORPHYRA PERFORATA		<0.1		1.8					0.2
CALLOPHYLLIS SP.		2.5		0.6					0.4
ECTOCARPACEAE		3.8		0.1					0.5
MICROCLADIA BOREALIS		0.2		0.8					0.1
LAURENCIA SPECTABILIS		2.7	0.1	2.4					0.7

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-18. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM GOVERNMENT POINT, SANTA BARBARA COUNTY FROM AUGUST 1976 TO APRIL 1977. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 (N=15)	1.0 TO 1.9 (N= 2)	2.0 TO 2.9 (N=10)	3.0 TO 3.9 (N= 1)	4.0 TO 4.9 (N=10)	5.0 TO 5.9 (N= 7)	6.0 TO 6.9 (N= 2)	MEAN
PLOCAMIUM CARTILAGINEUM	46.8	172.9	4.0	3.5					28.4
CLADOPHORA SPP.			5.7						0.7
OPHIOCLADUS SIMPLICIUSCULUS			2.6						0.3
PHYLLOSPADIX TORREYI		5062.4	110.3						646.6
SMITHORA NAIADUM		764.9							98.1
BOTRYOGLOSSUM FARLOWIANUM		6.2							0.8
TIFFANIELLA SNYDERAE		3.0							0.4
GRATELOUPIA DORYPHORA		0.9							0.1
GELIDIUM ROBUSTUM		9.3							1.2
PTEROCLADIA CAPILLACEA		0.9							0.1
MICROCLADIA BORGESENII		3.0							0.4
IRIDAEA LINEARE		7.6							1.0
RHODYMENIA PACIFICA	44.4	9.2							6.7
LAMINARIA SINCLAIRII	4666.8	524.8							923.9
CODIUM SETCHELLII	4.6								0.6
OTHER MACROPHYTES (29		1.1	0.0	0.3		0.1	0.3		
TOTAL WET WEIGHT IN G/M2	5082.6	9749.7	1389.0	3634.0	1848.0	5273.0	2600.1	6803.5	

NOTE: 1 FOOT = 0.3048 METERS

TABLE .1.12-19. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM GOVERNMENT POINT, SANTA BARBARA COUNTY FROM AUGUST 1976 TO APRIL 1977. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	BELW TO 0.9 (N=15)	1.0 TO 1.9 (N= 2	2.0 TO 2.9 (N=10)	3.0 TO 3.9 (N= 1)	4.0 TO 4.9 (N=10	5.0 TO 5.9 (N= 7	6.0 6TO .9 N= 2	MEAN
LITTORINA PLANAXIS							3.5	0.4	1.1
ACMAEA (COLLISELLA) DIGITALIS						1.5	2.8	<0.1	0.5
CANTHINA PUNCTULATA						20.7	5.5	35.2	7.7
ACMAEA (COLLISELLA) SCABRA				0.5		6.4	3.7	0.3	0.6
PAGURUS SAMUELIS				0.1		0.4	<0.1	15.6	2.0
ACMAEA (COLLISELLA) ASMI				<0.1			0.5	2.4	0.4
NUCELLA (THAIS) EMARGINATA				0.1		3.4	12.0	2.1	2.8
ACMAEA (COLLISELLA) STRIGATELLA				<0.1		0.1	1.1	0.3	0.2
TEGULA FUNEBRALIS			35.5	102.4	40.1	285.1	133.7	892.5	166.2
CHTHAMALUS FISSUS AND DALLI			<0.1	4.7		86.8	464.0	256.1	101.4
EPITONIUM TINCTUM		<0.1	0.4	0.7	0.6	0.1		1.2	0.4
BALANUS GLANDULA		<0.1	0.8			25.0	166.8	3.5	27.3
LITTORINA SCUTULATA		<0.1		<0.1		6.4	15.9	21.9	5.5
ACMAEA (COLLISELLA) PELTA		<0.1		1.7		0.6	2.7	<0.1	0.7
MITRELLA TA	2.1	1.1	2.9	1.1	0.2			0.1	0.9
ATHOPLEURA ELEGANTISSIMA	17.2	13.0	552.4	417.2	1138.1	386.3	16.9	185.4	465.6
APACHIDONTES ALASSIANUS						0.3	1.1		0.2
ACMAEA (COLLISELLA) LIMATULA						1.2	1.0		0.3
STRONGYLOCENTROTUS PURPURATUS				1.0			10.3		1.4
MYTILUS EDULIS		0.4		2.9			36.3		4.5
SEPTIFER BIFURCATUS		0.9	0.6	0.7		1.9	10.6		1.3
PISASTER OCHRACEUS		12.3					10.2		2.8

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-19. WET WEIGHT IN G/M$_2$ FOR DOMINANT MACRO-INVERTEBRATES FROM GOVERNMENT POINT, SANTA BARBARA COUNTY FROM AUGUST 1976 TO APRIL 1977. BLANK SPACES INDICATE ZEROS (CONTINUED).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 (N=45)	1.0 TO 1.9 (N= 2)	2.0 TO 2.9 (N=10)	3.0 TO 3.9 (N= 1)	4.0 TO 4.9 (N=10)	5.0 TO 5.9 (N= 7)	6.0 TO 6.9 (N= 2)	MEAN
PERAGMATOPOMA CALIFORNICA		24.9		77.9		1.1	9.4		14.2
CYANOPLAX HARTWEGII		<0.1		0.6		3.5	7.7		1.5
MYTILUS CALIFORNIANUS		1.1	2.6	4.4	0.1	3.1	22.8		4.3
TETRACLITA SQUAMOSA RUBESCENS				0.6		0.5			0.1
COLEOCACERIA FEWKESI				546.5		604.5			143.9
CANCER ANTENNARIUS		1.6				<0.1			0.2
PAGURUS HIRSUTIUSCULUS		0.1			2.3	0.4			0.4
AMPHISSA VERSICOLOR		0.4	0.6	<0.1		<0.1			0.1
NOPALIA MUSCOSA		0.7	2.7	41.5	0.7	8.5			6.6
LACUNA UNIFASCIATA		0.2	<0.1	0.1	6.6	0.4			0.9
CANCER JORDANI		0.3			<0.1	1.2			0.2
PUGETTIA PRODUCTA		42.6	<0.1	0.6	9.3	0.9			6.7
LACUNA MARMORATA	3.3	4.8	8.0	11.2	<0.1	<0.1			3.4
BALCLLIA SPP.	0.1	0.1	1.4	1.4	1.2	0.1			0.5
TRICOLIA PULLO DES	0.2	<0.1	0.3	0.3	0.7	<0.1			0.2
MODIOLUS CAPAX				0.9	2.4				0.4
NUTTALLINA FLUXA				2.1					0.3
NUTTALLINA CALIFORNICA				1.0					0.1
APLYSIA CALIFORNICA				0.8					0.1
HIATELLA ARCTICA		0.4		0.4					0.1
PACHYCHELES RUDIS		1.5							0.2
ARCHIDISTOMA PSAMMION	5.8	54.7							7.6

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-19. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM GOVERNMENT POINT, SANTA BARBARA COUNTY FROM AUGUST 1976 TO APRIL 1977. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 (N=15)	1.0 TO 1.9 (N= 2)	.0 TO 2.9 (N=10)	3.0 TO 3.9 (N= 1)	4.0 TO 4.9 (N=10)	5.0 TO 5.9 N= 7	6.0 TO 6.9 N= 2	MEAN
DEMOSPONGIAE	51.1	3.7							6.9
OTHER MACRO-INVERTEBRATES (27)	0.1	0.6	0.5	1.7	0.8	0.1	0.5		
TOTAL WET WEIGHT IN G/M2	79.8	166.0	1608.8	1225.2	1203.2	1450.1	966.2	1417.2	

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-20. DRY WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM GOVERNMENT POINT, SANTA BARBARA COUNTY FROM AUGUST 1976 TO APRIL 1977. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 N= 1	MLLW TO 0.9 (N=15	1.0 TO 1.9 (N= 2)	2.0 TO 2.9 (N=10)	3.0 TO 3.9 (N= 1)	4.0 TO 4.9 N=10	5.0 TO 5.9 (N= 7)	6.0 TO 6.9 (N= 2)	MEAN
CORALLINA VANCOUVERIENSIS		1.5		34.3					8.7
HESPEROPHYCUS HARVEYANUS						34.5	<0.1	28.5	7.9
FELVETIA FASTIGIATA				267.3		197.2	728.9	1690.4	510.5
GIGARTINA PAPILLATA				10.1		16.7	0.7	9.0	4.6
ENDOCLADIA MURICATA				4.2		14.0	2.6	2.6	2.9
CLADOPHORA COLUMBIANA		<0.1		2.0		<0.1	3.5	0.7	0.8
GELIDIUM PUSILLUM			<0.1	0.2		0.9	3.1		0.5
CORALLINA OFFICINALIS VAR. CHILENSIS		4.5	121.9	42.7	126.7	7.1	3.7		38.3
ULVA TAENIATA		1.4	9.9	4.2	26.7	3.8	<0.1		5.7
GIGARTINA LEPTORHYNCHOS		<0.1		0.5		1.8	0.3		0.3
GELIDIUM COULTERI	<0.1	1.7	0.6	21.2	10.4	15.9	0.3		6.0
FOSSIELLA ORBIGNIANA SSP. DICHOTOMA	6.3	29.9	<0.1	1.3	0.7	0.1	<0.1		4.8
PTEROSIPHONIA DENDROIDEA	0.6	1.4	4.0	9.1	1.3	0.2	<0.1		2.1
SORANTHERA ULVOIDEA					6.2	0.1			0.8
POLYSIPHONIA ACUMINATA			0.2	0.4	2.2	0.6			0.4
CHONDRIA DECIPIENS			0.7	0.5	0.3	0.2			0.2
POLYSIPHONIA PANICULATA		1.9	5.8	<0.1		0.3			1.0
POLYSIPHONIA HENDRYI VAR HENDRYI		<0.1			1.3	2.6			0.5
CERAMIUM EATONIANUM/SINICOLA		<0.1		1.0	3.5	2.5			0.9
GASTROCLONIUM COULTERI		3.3	14.5	37.7	<0.1	0.7			7.0
IRIDAEA FLACCIDA		10.3		0.9		17.5			3.6
ULVA LOBATA		<0.1		18.0	9.9	<0.1			3.5

NOTE: 1 FOOT = 0.3048 METERS

TABLE .1.12 2o. DRY WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM GOVERNMENT POINT, BARBARA COUNTY FROM AUGUST 1976 TO APRIL 1977. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 (N=15)	1.0 TO 1.9 (N= 2)	2.0 TO 2.9 (N=10)	3.0 TO 3.9 (N= 1)	4.0 TO 4.9 (N=10)	5.0 TO 5.9 (N= 7)	6.0 TO 6.9 (N= 2)	MEAN
GIGARTINA CANALICULATA		0.6	4.7	114.2		48.3			20.0
PLOCAMIUM VIOLACEUM		<0.1	0.1	0.7	<0.1	<0.1			0.1
RHODOMELA LARIX		19.9	77.7	55.4	68.8	6.7			26.9
RHODOGLOSSUM AFFINE		<0.1		2.8		5.8			1.1
GLOIOSIPHONIA CAPILLARIS				0.5	3.4				0.5
CRYPTOPLEURA VIOLACEA	<0.1	4.2	0.4	14.4	3.3				2.8
POLYSIPHONIA SPP.				1.1					0.1
CENTROCERAS CLAVULATUM			2.3	0.9					0.4
EGREGIA MENZIESII		155.5		0.6					19.5
IRIDAEA CORDATA VAR. SPLENDENS		31.0		<0.1					3.9
PLOCAMIUM CARTILAGINEUM	4.6	16.0	0.3	0.2					2.6
CLADOPHORA SPP.			1.1						0.1
PHYLLOSPADIX TORREY		1020.9	15.5						129.6
SMITHORA NAIADUM		66.8							8.4
GELIDIUM ROBUSTUM		1.9							0.2
BOTRYOGLOSSUM FARLOWIANUM		0.8							0.1
IRIDAEA LINEARE		2.8							0.3
RHODYMENIA PACIFICA	6.9	1.4							1.0
LAMINARIA SINCLAIRII	1214.4	595.9							226.3
OTHER MACROPHYTES (47)	0.4	2.5	0.8	1.5	0.1	0.1	0.3		
TOTAL DRY WEIGHT IN G/M2	1233.1	1976.1	260.6	646.1	260.0	1361.8	743.5	1931.4	

NOTE: 1 FOOT = 0.3048 METERS

Table 1.1.2-21. Organic Dry Weight in g/m^2 for Dominant Macrophytes from Government Point, Santa Barbara County from August 1976 to April 1977. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros.

Taxa	Tidal Height (ft) -1.0 to -0.1 (N= 1)	MLLW to 0.9 (N=15)	1.0 to 1.9 (N= 2	2.0 to 2.9 (N=10)	3.0 to 3.9 (N= 1)	4.0 to 4.9 (N=10)	5.0 to 5.9 (N= 7)	6.0 to 6.9 (N= 2)	Mean
Corallina vancouveriensis*		0.3		6.4					0.8
Hesperophycus harvevanus						34.5	<0.1	28.5	7.9
Pelvetia fastigiata				267.3		1197.2	728.9	1890.4	510.5
Gigartina papillata				10.1		16.7	0.7	9.0	4.6
Endocladia muricata				4.2		14.0	2.6	2.8	2.9
Cladophora columbiana		<0.1		2.0		<0.1	3.5	0.7	0.8
Gelidium pusillum			<0.1	0.2		0.9	3.1		0.5
Corallina officinalis var. chilensis*		0.7	18.3	6.4	19.0	1.1	0.6		5.8
Ulva taeniata		1.4	9.9	4.2	26.7	3.8	<0.1		5.7
Gigartina leptorhynchos		<0.1		0.5		1.8	0.3		0.3
Gelidium coulteri	<0.1	1.7	0.6	21.2	10.4	13.9	0.3		6.0
Bossiella orbigniana ssp. dichotoma*	0.9	4.2	<0.1	0.2	<0.1	<0.1	<0.1		0.7
Pterosiphonia dendroidea	0.6	1.4	4.0	9.1	1.3	0.2	<0.1		2.1
Soranthera ulvoidea					6.2	0.1			0.8
Polysiphonia acuminata			0.2	0.4	2.2	0.6			0.4
Chondria decipiens			0.7	0.5	0.3	0.2			0.2
Polysiphonia paniculata		1.9	5.8	<0.1		0.3			1.0
Polysiphonia hendryi var. hendryi		<0.1			1.3	2.6			0.5
Ceramium eatonianum/sinicola		<0.1		.0	3.5	2.5			0.9
Gastroclonium coulteri		3.3	.4.5	3.7	<0.1	0.7			7.0
Iridaea flaccida		10.3		0.9		17.5			3.6
Ulva lobata		<0.1		1.0		<0.1			3.5

Table 1.1.12-21. Organic Dry Weight in g/m^2 for Dominant Macrophytes from Government Point, Santa Barbara County from August 1976 to April 1977. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros. (Continued).

Taxa	Tidal Height (ft) -1.0 to -0.1 (N=1)	MLLW to 0.9 (N=15)	1.0 to 1.9 (N= 2)	2.0 to 2.9 (N=10)	3.0 to 3.9 (N= 1)	4.0 to 4.9 (N=10)	5.0 to 5.9 (N= 1)	6.0 to 6.9 (N= 2)	Mean
Gigartina canaliculata		0.6	4.7	114.2		40.3			20.0
Plocamium violaceum		<0.1	0.1	0.7	<0.1	<0.1			0.1
Rhodomela larix		19.9	77.7	53.4	63.8	0.7			26.9
Rhodoglossum affine		<0.1		2.8		5.8			1.1
Gloiosiphonia capillaris				0.5	3.4				0.5
Cryptopleura violacea	<0.1	4.2	0.4	14.4	3.3				2.8
Polysiphonia spp.				1.1					0.1
Centroceras clavulatum			2.3	0.9					0.4
Egregia menziesii		155.5		0.6					19.5
Iridaea cordata var. splendens		31.0		<0.1					3.9
Plocamium cartilagineum	4.6	16.0	0.3	0.2					2.6
Cladophora spp.			1.1						0.1
Phyllospadix torreyi		1020.9	15.5						129.6
Smithora naiadum		66.8							8.4
Gelidium robustum		1.9							0.2
Botryoglossum farlowianum		0.8							0.1
Iridaea lineare		2.8							0.3
Rhodymenia pacifica	6.9	1.4							1.0
Laminaria sinclairii	1214.4	595.9							226.3
Other Macrophytes (47)	0.3	2.5	0.8	1.5	0.1	0.1	0.3		
Total Organic Dry Weight in g/m^2	1227.7	1945.4	157.0	580.8	151.7	1355.8	740.4	1931.4	1011.3

Note: 1 foot = 0.3048 meters

TABLE 1.1.12-22. DRY WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM GOVERNMEN POINT, SANTA BARBARA COUNTY FROM AUGUST 1976 TO APRIL 1977. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 N=15)	1.0 TO 1.9 (N= 2)	2.0 TO 2.9 N=10)	3.0 TO 3.9 (N= 1)	4.0 TO 4.9 (N=10)	5.0 TO 5.9 N= 7	6.0 TO 6.9 (N= 2	MEAN
LITTORINA PLANAXIS							6.4	0.3	0.6
ACMAEA (COLLISELLA) DIGITALIS						1.0	1.9	<0.1	0.4
ACANTHINA PUNCTULATA						7.8	4.7	26.1	6.1
ACMAEA (COLLISELLA) SCABRA				0.3		0.2	2.4	0.2	0.4
ACMAEA (COLLISELLA) ASPI				<0.1			0.4	1.6	0.3
PAGURUS SAMUELIS				<0.1		<0.1	<0.1	4.0	0.5
NUCELLA (THAIS) EMARGINATA				0.1		6.9	9.7	1.3	2.2
TEGULA FUNEBRALIS			32.6	88.7	3.0	233.2	113.5	715.7	151.8
CRYPTOMALUS FISSUS AND DALLI			<0.1	5.1		50.5	516.4	168.7	67.6
EPITONIUM TINCTUM		<0.1	0.2	0.4	0.3	<0.1		0.6	0.2
BALANUS GLANDULA		<0.1	0.4			16.1	131.0	1.7	16.6
ACMAEA (COLLISELLA) PELTA		<0.1		0.9		0.6	2.0	<0.1	0.4
LITTORINA SCUTULATA		<0.1		<0.1		4.1	11.7	12.9	3.6
ANTHOPLEURA ELEGANTISSIMA	3.5	2.9	430.7	109.2	279.2	99.3	3.6	48.7	121.1
MITRELLA CARINATA	1.2	0.6	1.7	0.7	<0.1			<0.1	0.5
BRACHIDONTES ADAMSIANUS						0.2	0.7		0.1
ACMAEA (COLLISELLA) LIMATULA						0.9	0.8		0.2
STRONGYLOCENTROTUS PURPURATUS				0.4			3.4		0.5
PISASTER OCHRACEUS		5.2					4.3		1.2
MYTILUS EDULIS		0.2		1.4			20.9		2.8
SEPTIFER BIFURCATUS		0.5	0.3	0.4		1.2	7.6		1.3
CYANOPLAX HARTWEGII		<0.1		0.3		2.0	4.4		0.8

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-22. DRY WEIGHT IN G/M$_2$ FOR DOMINANT MACRO-INVERTEBRATES FROM GOVERNMENT POIN , BARBARA COUN Y FROM AUGUST 1976 TO APRIL 1977. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 1)	MLLW TO 0.9 (N=15)	1.0 TO 1.9 (N= 2)	2.0 TO 2.9 (N=10)	3.0 TO 3.9 (N= 1)	4.0 TO 4.9 (N=10)	5.0 TO 5.9 (N= 7)	6.0 TO 6.9 (N= 2)	MEAN
PHRAGMATOPOMA CALIFORNICA		17.7		83.8		0.8	6.6		13.6
MYTILUS CALIFORNIANUS		0.7	1.4	2.3	<0.1	2.0	15.4		2.7
DODECACERIA FEWKESI				449.2		464.0			114.2
HOPALIA MUSCOSA		0.3	1.4	18.1	0.2	4.1			3.0
LACUNA UNIFASCIATA		0.1	<0.1	<0.1	2.9	0.3			0.4
PODETIA PRODUCTA		12.0	<0.1	0.1	1.9	0.2			1.8
BARLEEIA SPP.	<0.1	<0.1	1.1	0.8	0.9	0.1			0.4
LACUNA MARMORATA	1.6	2.5	3.6	5.6	<0.1	<0.1			1.7
TRICOLIA PULLOIDES	<0.1	<0.1	0.2	0.2	0.5	<0.1			0.1
MODIOLUS CAPAX				0.4	1.1				0.2
NUTTALLINA FLUXA				1.1					0.1
ARCHIDISTOMA PSAMMION	2.8	28.1							3.9
DENDROPONGIAE	15.0	0.8							2.0
OTHER MACRO-INVERTEBRATES 37	0.0	1.6	0.5	2.0	1.3	4.0	0.4	0.2	
TOTAL DRY WEIGHT IN G/M2	24.4	73.3	474.1	769.7	29.4	907.5	670.5	974.1	

NOTE: 1 FOOT = 0.3048 METERS

Table 3.1.12-23. Organic Dry Weight in g/m^2 for Dominant Macroinvertebrates from Government Point, Barbara County from August 1976 to April 1977. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros.

Taxa	Tidal Height (ft) -1.0 to -0.1 (N= 1)	MLLW to 0.9 (N=15)	1.0 to 1.9 (N= 2	2.0 to 2.9 (N=10)	3.0 to 3.9 (N= 1)	4.0 to 4.9 (N=10)	5.0 to 5.9 (N= 7)	6.0 to 6.9 (N= 2	Mean
Littorina planaxis*							.8	<0.1	.1
Acmaea (Collisella) digitalis*						0.1	.3	<0.1	.1
Acanthina punctulata*						1.4	.4	2.0	0.5
Acmaea (Collisella) scabra*				<0.1		<0.1	.3	<0.1	0.1
Acmaea (Collisella) asmi*				<0.1			<.1	0.2	<0.1
Pagurus samuelis*				<0.1		<0.1	<.1	2.0	0.3
Nucella (Thais) emarginata*				<0.1		0.7	1.0	0.1	0.2
Tegula funebralis*			3.9	10.6	3.7	28.0	13.6	85.9	18.2
Chthamalus fissus and dalli*			0.1	0.3		5.0	31.8	16.9	6.8
Epitonium tinctum*		<0.1	<0.1	<0.1	<0.1	<0.1		0.1	0.1
Balanus glandula*		<0.1	<0.1			1.4	11.8	0.2	1.3
Acmaea (Collisella) pelta*		<0.1		0.1		0.1	0.3	<0.1	0.1
Littorina scutulata*		<0.1		0.1		0.4	1.2	1.3	0.4
Anthopleura elegantissima*	2.4	2.0	295.0	74.8	91.3	68.0	2.5	27.9	83.0
Mitrella carinata*	0.1	0.1	0.[illegible]	0.1	<0.1			<0.1	0.1
Brachidontes adamsianus*						<0.1	0.1		<0.1
Acmaea (Collisella) limatula*						0.1	0.1		<0.1
Strongylocentrotus purpuratus*				[illegible]			0.5		0.1
Pisaster ochraceus*		1.7		[illegible]			1.4		0.4
Mytilus edulis*		<0.1		[illegible]			2.5		0.4
Septifer bifurcatus*		0.1	<0.1	.1		.2	1.0		0.2
Cyanoplax hartwegii		<0.1		.1		.5	1.1		0.2

Table 1.1 12-23. Organic Dry Weight in g/m^2 for Dominant Macroinvertebrates from Government Point, Santa Barbara County from August 1976 to April 1977. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros. (Continued).

Taxa	Tidal Height (ft) ♀ to -0.1 (N= 1)	MLLW to 0.9 (N=15)	1.0 to 1.9 (N= 2)	2.0 to 2.9 (N=10)	3.0 to 3.9 (N= 1)	4.0 to 4.9 (N=10)	5.0 to 5.9 (N= 7	6.0 to 6.9 (N= 2	Mean
Phragmatopoma californica*		0.9		4.2		<0.1	0.3		0.7
Mytilus californianus*		0.1	0.1	0.2	<0.1	0.2	1.5		0.3
Dodecaceria fewkesi*				38.2		39.5			9.7
Mopalia muscosa*		0.1	0.3	4.3	<0.1	1.0			0.7
Lacuna unifasciata*		<0.1	<0.1	<0.1	0.5	0.1			0.1
Pugettia producta*		6.4	<0.1	0.1	1.0	0.1			1.0
Barleeia spp.*	<0.1	<0.1	0.2	0.1	0.1	<0.1			0.1
Lacuna marmorata*	0.3	0.4	0.6	1.0	<0.1	<0.1			0.3
Tricolia pulliodes*	<0.1	<0.1	<0.1	<0.1	0.1	<0.1			0.1
Modiolus capax*				0.1	0.2				<0.1
Nuttallina fluxa*				0.3					<0.1
Archidistoma psammion	2.8	28.1							3.9
Demospongiae*	4.7	0.2							0.6
Other Macroinvertebrates (37)	0.0	1.6	0.5	2.9	1.3	1.0	0.4	0.2	
Total Organic Dry Weight in g/m^2	10.5	42.6	301.5	137.7	198.7	148.6	72.7	137.3	131.2

Note: foot = 0.3048 meters

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TABLE 1.1.12-24. SEASONAL AND ANNUAL PATTERNS OF OVERALL MACROPHYTE COVER (%) AS A FUNCTION OF TIDAL HEIGHT FOR TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY.

SEASON		TIDAL HEIGHT (FT). 1.0 To 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4*9	5.0 TO 5.9
AUGUST	1976	190.6	97.7	151.7	--	85.6
NOVEMBER	1976	109.0	51.6	152.1	85.5	9?.3
JANUARY	1977	36.1	113.3	92.4	94.7	100.0
APRIL	1977	119.6	4.0	--	91.5	100.3
MEAN		113.8	66.6	132.1	90.6	95.8

NOTE: 1 FOOT = 0.3046 METERS

TABLE 1.1.12-25. SEASONAL AND ANNUAL PATTERNS OF OVERALL MACRO-INVERTEBRATE COVER (%) AS A FUNCTION OF TIDAL HEIGHT FOR TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY.

SEASON		TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.3	3.0 TO 3.9	4.0 TO 4.5	5.0 TO 5.9
AUGUST	1976	0.0	1.2	2.0	--	2.9
NOVEMBER	1976	3.0	0.5	2.1	23.5	6.0
JANUARY	1977	0.2	22.7	14.7	14.6	5.1
APRIL	1977	0.1	0.1	--	14.3	5.9
MEAN		0.8	6.1	6.3	17.5	5.5

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-26. ANNUAL MEAN COVER %) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9
PELVETIA FASTIGIATA					5.9
LITHOPHYLLUM PROBOSCIDEUM				0.3	0.2
GELIDIUM PUSILLUM				0.5	<0.1
RALFSIACEAE				3.4	12.5
GIGARTINA LEPTORHYNCHOS				<0.1	1.2
CLADOPHORA COLUMBIANA				0.2	8.1
CHAETOMORPHA LINUM				0.5	1.8
HYDROLITHON DECIPIENS		0.7			1.1
BLUE-GREEN ALGAE	8.7	8.0	13.8	53.2	51.6
CORALLINA OFFICINALIS VAR. CHILENSIS	1.3	3.1	0.5	6.3	9.6
CORALLINE CRUSTS	0.3				0.3
CORALLINA OFFICINALIS VAR. CHILENSIS	<0.1	1.3		2.7	3.4
PYLLOSPADIX ORBEYI	84.7	42.9	84.5	0.4	
POLYSIPHONIA PANICULATA	0.9			<0.1	
CORALLINE CRUST BLEACHED	0.1			<0.1	
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA		2.2	0.3		
MELOBESIA MEDIOCRIS	<0.1	3.1	<0.1		
PLOCAMIUM CARTILAGINEUM		1.8			
CRYPTOPLEURA VIOLACEA		0.9			
CORALLINA VANCOUVERIENSIS	0.4	0.4			
SMITHORA NAIADUM	7.8	2.4			
ULVA ALFIATA	4.4				
NEOAGARDHIELLA BAILEYI	4.3				
PETROCELIS FRANCISCANA	0.3				

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12- 26. ANNUAL MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1*9	2.0 TO 2,9	3*CJ TO 3.9	4,0 TO 4,9	5,0 TO 5.9
PTEROSIPHONIA BAILEYI	0,4				
RHODOMELA LARIX	0,2				
GRACILARIA SJOESTEDTII	0,1				

NOTE; 1 FOOT = 0~3U% METERS

The order of macrophyte dominance with respect to dry biomass was very similar to the wet biomass ranking (Tables 1.1.12-18 and 1.1.12-20). Notable differences were associated with Corallina of ficinalis var . chilensis and Egregia menziesii which ranked higher in dry biomass than wet biomass. Those differ ences probably resulted from the relatively high structural content of these species as indicated by the similar po si ti ons of C. of ficinalis var . chilensis in the wet weight and organic dry weight rankings (Tables 1.1.12-18 and 1.1.18-21).

Anthopleura ele ganti ssima, with an annual mean of 465.8 g/m^2 WW, accounted for 46% of the total macr oinver tebr ate wet biomass (Table 1.1.12-19). The remaining dominant species wer e Te gula funebralis (1 86.2 g/m^2 WW) , Dodecaceria fewkesi (143.9 g/m^2 WW) , and Chthamalus fissus/dalli (101.4 g/m^2 WW). Anthopleura ele gantissima wet biomass peaked (1,552.4 g/m^2) in the mid-intertidal interval of +1.0 to +2.0 ft. (+. 3 to +.6 m) just as total macroinver tebrate biomass did , while the other three biomass dominants all reached maxima above +4. O ft. (1.2 m). Data for dry-weight invertebrate biomass generally agreed with that for wet biomass, except that T. funebr alis (151. 8 mean g/m^2 DW, 18.2 g/m^{2}ODW) , with a heavy structural component Contributed by shell , displaced A. elegantissima (121.1 mean dry g/m^2) in the dry biomass ranking. (Table 1.1.12-22 and 1.1.12 -23).-

1.1.12.4.3 Tidepools

1.1.12 .4.3.1 Standing Crop

All tidepool undisturbed samples were combined in one ar r ay irrespective of season to generate a broad representation of biotic cover and macr oinver tebrate densities in pools as a function of the five 1. O-ft. (3.-m) tidal intervals in which they occurred. The disturbed tidepool samples were elso combined to yield an overall pattern of biomass over the seven 1.O-ft. (.3-m) tidal intervals sampled.

Total biotic cover throughout the undisturbed pools averaged 107. 7%; 99. 8% was contributed by macrophytes and 7.2% by macroinver tebrates (Tables 1.1.12-24 and 1.1.12-25). Macrophy te cover was extensive (66.6% to 132.1%) in pools sampled at every tidal height with the maximum at +3.0 to +4.0 ft. (+.9 to +1.2 m). The cover maximum for macroinvertebrates (1 7.5%) occurred from +4.0 to +5. O ft. (+1 .2 to +1 .5 m) and the minimum (0.8%) at the lowest interval sampled (+1 .0 to +2. o ft. , .3 to .6 m). Phyllospadix torreyi (48.3% mean cover) was the tidepool dominant from +1.0 to +4.0 ft. (+.3 to +1 .2 m) , whereas blue-green algae (29. 7% mean cover) exceeded all other macrophy tes in the range from +4.0 to +6.0 ft. (+1.2 to +1.8 m) (Table 1.1.12-26). Macr oinver tebr ate dominates in the tide pools wer e Tegula funebralis (2.0% cover), Anthopleura elegantissima (1 .9%) , and Dodecaceria

fewkesi (1.1%); the first two reached peaks in the +4.0 to +5.0-ft. (+1.2 to +1.5 m) interval, while D. f ewke si was present only in the +2.0 to +3.0-ft. (+.6 to +.9 m) interval (Table 1.1.12-27).

The most widespread of the tidepool macrophytes (Table 1.1.12-28) were Cor allina of fi cinalis var . chilensis (82.5% frequency) and Phyllospadix torreyi (60.0%). Bleached forms of macrophy tes were most prevalent in pools during November and January of the study and included C. of ficinalis var . chilensis, Hydrolithon decipiens, and unidentified coralline crusts , all of which appeared during the stressful periods of the afternoon low tides in November. Paralled with the cover data, T. funebralis and A. elegantissima were the most frequent macroinver tebrates (Table 1.1. 17-29).

Macroinver tebrates attaining the highest densities in tidepools at Government Point (Table 1. 1.12-30) were: Chthamalus fissus/dalli [mean of 183 individuals/m^2, mainly between +4.0 and +6.0 ft. (+1.2 to +1 .8 m)] , Lacuna spp , [40/m2, present only in the lowest interval sampled (+1 .0 to +2.0 ft. , +.3 to +.6 m)], and Anthopleur a elegantissima [17/m2, mainly from +3.0 to +6.0 ft. (+.9 to +1. $ m)].

Tidepool biomass (Tables 1.1.12-31 through 1.1.12-34) averaged 2,664.3 g/m^2 WW of which macrophytes contributed 2,240.7 g/m^2 WW and macro-invertebrates 423.6 g/m^2 WW. By far , the macrophy te biomass dominants were Phyllospadix torreyi [mean biomass of 1 ,1-28.9 g/m^2 WW, abundant in all intervals except +4.0 to +5.0 ft. (+1.2 to +1 .5 m)] and Laminaria sinclairii (mean biomass of 719.7 g/m^2 WW) , present only between -1.0 ft. (-.3 m) to MLLW (Tables 1.1.12-31 and 1.1.12-32). The two dominant macroinvertebrates (Tables 1.1.12-33 and 1. 1.12-34) were Anthopleura elegantissima (219.8 g/m^2 WW and Te gula funebr alis (154.5 g/m^2 WW); the former reached its maximum in the +4. 0 to +5.0 ft. (+1. 2 to +1.5 m) interval and the latter in the interval from +5.0 to +6.0 ft. (+1.5 to +1.8 m).

1 .1.12.4.3.2 Tidepool Finfishes

The following six species of finfishes were collected in tidepools during the sampling year : Clinocottus analis , C. recalvus , Oligocottus snyderi , Gibbonsia elegans, Girella ni gricans, and Xiphister atropurpur eus.

1 .1.12.4.4 Community Analysis

1.1.12 .4.4.1 Species Diversity

Seasonal and year ly/mean taxa numbers, richness (D ') , Shannon-Weaver (H'), and evenness (J') indices for macrobiota are presented in Table 1.1.12-35. The H' index for combined macrophy tes and macroinver tebrates averaged 2.98, and ranged between 2.84 in August to 3.07 in April. Macroinvertebrates were quite low in H' diversity (yearly mean

TABLE 1.1.12-27. ANNUAL MEAN COVER (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS.

	TIDAL HEIGHT (FT).				
TAXA	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9
CHTHAMALUS FISSUS & DALLI DEAD					<0.1
CHTHAMALUS FISSUS AND DALLI				2.2	<0.1
MYTILUS CALIFORNIANUS				<0.1	0.5
ACMAEA (COLLISELLA) PELTA				<0.1	0.2
PHRAGMATOPOMA CALIFORNICA				1.0	1.0
PAGURUS SAMUELLIS	<0.1		0.1	0.4	<0.1
ANTHOPLEURA ELEGANTISSIMA	0.7		1.9	5.9	0.2
TEGULA FUNEBRALIS	<0.1	0.4	2.7	3.2	3.1
DEMOSPONGIAE		0.2			
DODECACERIA FEWKESI		5.5			

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-28. ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY, FROM AUGUST 1976 TO APRIL 1977 (CONTINUED ON NEXT PAGE).

TAXA	MEAN FREQUENCY (%)
CORALLINA OFFICINALIS VAR. CHILENSIS	82.5
BLUE-GREEN ALGAE	67.5
PHYLLOSPADIX TORREYI	60.0
RALFSIACEAE	38.8
CORALLINA OFFICINALIS VAR. CH B	27.5
GIGARTINA LEPTORHYNCHOS	25.6
LITHOPHYLLUM PROBOSCIDEUM	21.3
CLADOPHORA COLUMBIANA	20.0
HYDROLITHON DECIPIENS	16.9
ULVA TAENIATA	16.3
SMITHORA NAIADUM	15.0
PELVETIA FASTIGIATA	14.4
GELIDIUM PUSILLUM	13.8
NEOAGARDHIELLA BAILEYI	13.8
POLYSIPHONIA PANICULATA	11.9
CHAETOMORPHA LINUM	10.6
MELOBESIA MEDIOCRIS	10.0
PTEROSIPHONIA BAILEYI	8.8
PTEROSIPHONIA DENDROIDEA	8.8
PEYSSONNELIACEAE/HILDENBRANDIACEAE	8.8
CORALLINE CRUSTS	8.1
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	7.5
CORALLINE CRUST BLEACHED	7.5
CENTROCERAS CLAVULATUM	6.3
GRACILARIA SUBSTECTII	6.3
GELIDIUM COULTERI	5.6

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-28. ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY, FROM AUGUST 1976 TO APRIL 1977 (CONTINUATION).

TAXA	MEAN FREQUENCY (%)
CORALLINA VANCOUVERIENSIS	5.0
PETROCELLIS FRANCISCANA	5.0
ENDOCLADIA MURICATA	5*II
GIGARTINA CANALICULATA	3.1
CYLINDROCARPUS RUGOSUS	3.1
ULVA LOBATA	3.1
ANISOCLADELLA PACIFICA	2.5
RHODOMELA LARIX	2.5
CRYPTOPLEURA VIOLACEA	2.5
PLOCAMIUM CARTILAGINEUM	2.5
HYDROLITHON DECIPIENS BLEACHED	2.5

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-29. ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY, FROM AUGUST 1976 TO APRIL 1977.

TAXA	MEAN FREQUENCY (%)
TEGULA FUNEBRALIS	68.8
ANTHOPLEURA ELEGANTISSIMA	49.4
PAGURUS SAMUELIS	31.3
CHTHAMALUS FISSUS AND DALLI	27.5
ACANTHINA PUNCTULATA	23.1
MYTILUS CALIFORNIANUS	22.5
PHRAGMATOPOMA CALIFORNICA	21.9
ACMAEA (COLLISELLA) PELTA	18.1
ACMAEA STRIGATELLA/FENESTRATA	13.1
PAGURUS HIRSUTIUSCULUS	12.5
ACMAEA (COLLISELLA) SCABRA	11.3
LACUNA SPP.	11.3
LITTORINA PLANAXIS	10.6
DEMOSPONGIAE	8.8
MOPALIA MUSCOSA	8.1
NUTTALLINA FLUXA/CALIFORNICA	6.3
CYANOPLAX HARTWEGII	5.6
CHTHAMALUS FISSUS & DALLI DEAD	3.1
NUTTALLINA FLUXA	3.1
BALANUS GLANDULA	2.5
PACHYGRAPSUS CRASSIPES	2.5
DODECACERIA FEWKESI	2.5

NOTE: 1 FOOT = 0.3048 METERS

Macro invertebrates attaining the highest densities in tidepools at Government Point (Table 1.1.12-30) 'were: Chthamalus fissus/dalli [mean of 183 individuals/m^2, mainly between +4.0 and +6.0 ft. (1.2 to 1.8 m)], Lacuna SPP, [40/m2, present only in the lowest interval sampled (+1.0 to +2.0 ft., .3 to .6 m)], and Anthopleura elegantissima [17/m2, mainly from +3.0 to +6.0 ft. (.9 to 1.8 m)].

Tidepool biomass (Tables 1.1.12-31 through 1.1.12-34) averaged 2,664.3 g/m^2 WW of which macrophytes contributed 2,240.7 g/m^2 WW and macroinvertebrates 423.6 g/m^2 WW. By far, the macrophyte biomass dominants were Phyllospadix torreyi [mean biomass of 1,1-28.9 g/m^2 WW, abundant in all intervals except +4.o to +5.0 ft. (1.2 to 1.5 m)] and Laminaria sinclairii (mean biomass of 719.7 g/m^2 WW), present only between -1.0 ft. (-.3 m) to MLLW (Tables 1.1.12-31 and 1.1.12-32). The two dominant macroinvertebrates (Tables 1.1.12-33 and 1.1.12-34) were Anthopleura elegantissima (219.8 g/m^2 WW and Tegula funebralis (154.5 g/m^2 WW); the former reached its maximum in the +4.0 to +5.0 ft. (1.2 to 1.5 m) interval and the latter in the interval from +5.0 to +6.0 ft. (1.5 to 1.8 m).

1.1.12.4.3.2 Tidepool Finfishes

The following six species of finfishes were collected in tidepools during the sampling year: Clinocottus _, C. recalvus, Oligocottus snyderi, Gibbonsia elegans, Girella nigricans, and Xiphister atropurpureus .

1.1.12.4.4 Community Analysis

1.1.12.4.4.1 Species Diversity

Seasonal and yearly/ mean *taxa* numbers, richness (D^f), Shannon-Weaver (H'), and evenness (J') indices for macrobiota are presented in Table 1.1.12-35. The H' index for combined macrophytes and macroinvertebrates averaged 2.98, and ranged between 2.84 in August to 3.07 in April. Macroinvertebrates were quite low in H' diversity (yearly mean = 1.47) compared to macrophytes (2.73), with a direct relationship between combined and macrophyte H' diversity, indicating a controlling influence of macrophyte cover on combined diversity. Macroinvertebrate cover diversity was lowest in April (H' = 1.38) when macrophyte diversity was highest (2.87).

The evenness (J') of the combined biota averaged 0.66 (Table 1.1.12-35) and only ranged from 0.64 in August to 0.68 in November. Macrophyte evenness was consistently higher than that for the macroinvertebrates (mean yearly J = 0.67 vs. 0.43), with both reaching their greatest evenness in November and January. Combined richness (D') averaged 18.38 (Table 1.1.12-35) and ranged from 16.65 in January to 21.85 in April. With the exception of August, when the most macro-

TABLE 1.1.12-30. ANNUAL MEAN DENSITY (NO./M2) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS.

TAXA	TIDAL HEIGHT (FT). 1*0 To 1.9	2.0 To 2.9	3.0 To 3.9	4,0 To 4.9	5.0 TO 5.9
NUTTALLINA FLUXA/CALIFORNICA					2
BALANUS GLANDULA					23
ACANTHINA PUNCTULATA				3	5
CHTHAMALUS FISSUS AND DALLI				692	186
MYTILUS CALIFORNIANUS				2	21
ACMAEA STRIGATELLA/FENESTRATA				2	11
LITTORINA PLANAXIS				<1	6
ACMAEA (COLLISELLA) PELTA ,				4	8
ACMAEA (COLLISELLA) SCABRA				3	<1
MOPALIA MUSCOSA				<1	2
TEGULA FUNEBRALIS	9	17	113	122	112
ANTHOPLEURA ELEGANTISSIMA	4		10	61	6
PAGURUS SAMUELIS	2		2	9	3
CYANOPLAX HARTWEGII				2	
PAGURUS HIRSUTIUSCULUS	<1			7	
LACUNA SPP.	170				

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-31. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY FROM AUGUST 1976 TO APRIL 1977. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1.0 To -0.1 (N= 3)	MLLW TO 0.9 (N= 1)	1.0 TO 1.9 (N= 5)	2.0 Tu 2,9 (N= 1)	3.0 To 3.9 (N= 3)	4.0 To 4.9 (N= 2)	5.0 To 5.9 (N= 3)	MEAN
GIGARTINA LEPTORHYNCHOS							41.4	5.9
CLADOPHORA COLUMBIANA							9.1	1.3
CERAMIUM EATONIANUM/SINICOLA						0.3	<0.1	0.1
CHAETOMORPHA LINUM			<0.1				36.3	5.2
CORALLINA OFFICINALIS VAR. CHILENSIS		3.6	161.4	196.5	106.5	157.4	279.3	129.2
PTEROSIPHONIA DENDROIDEA	0.7	3.7	5.5	2.8	0.3		0.1	1.9
GELIDIUM COULTERI	<0.1		5.8	0.4	0.1		0.4	1.0
PHYLLOSPADIX TORREYI	1045.4	30.9	1433.3	2247.3	2995.7		100.0	1129.9
PTEROSIPHONIA BAILEYI	6,3		2.3			< 0.1		1.2
GIGARTINA CANALICULATA	1,0		0*1	20.0		0.4		3.1
BENTHIC DIATOMS			0.4		1.1			0.2
POLYSIPHONIA PANICULATA			14.3		<0.1			2.0
POLYSIPHONIA ACUMINATA			3.2		<0.1			0.5
ULVA TAENIATA		35.1	104.6		36.0			25.1
SMITHORA NAIADUM		27.5	25.0		41.8			13.5
BRYOPSIS CORTICULANS				0.8				0.1
CRYPTOPLEURA VIOLACEA			<0.1	10.9				1.6
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	47.3		4.8	121.9				24.9
PLOCAMIUM CARTILAGINEUM	12.4	42.3	22.0	228.3				45.6
LAURENCIA SPECTABILIS	0.7	1.0		46.0				6.6
PRODOMELA LARIX			15.1					2.2
POLYSIPHONIA HENDRYI VAR HENDRYI			23.4					3.3

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-31. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY FROM AUGUST 1976 TO APRIL 1977. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 3)	MLLW TO 0.5 (N= 1)	1.0 TO 1.9 (N= 5)	2.0 TO 2.9 (N= 1)	3.0 TO 3.9 (N= 3)	4.0 TO 4.5 (N= 2)	5.(I TO 5.9 (N= 3)	MEAN
MIELBURGIA ANDERSONIANA			1.4					0.2
CHONDRIA DECIPIENS			6.3					0.9
ENTEROMORPHA CLATHRATA			0.7					0.1
ULVA LOBATA		104.1	2.6					15.3
GRATELOUPIA DORYPHORA		368.1	<0.1					52.0
NEOAGARDHIELLA BAILEYI		26.5	43.7					10.0
AHNFELTIA PACIFICA	0.5	59.0	<al					8.6
IRIDAEA CORDATA VAR. SPLENDENS	0.7	0.6	<0.1					0.2
FGREGIA MENZIESII		77.7						11.1
ECTOCARPACEAE		34.3						4.9
CUMAGLOIA ANDERSONII		2.2						0.3
GYMNOGONGRUS LEPTOPHYLLUS	0.8	<0.1						0.1
PRIONITIS LANCEOLATA	25.4							3.6
BOTRYOGLOSSUM FARLOWIANUM	20.8							3.0
RHODYMENIA PACIFICA	43.6							6.2
RHODYMENIA CALIFORNICA VAR. CALIFORN	4.5							0.6
CALLOPHYLLIS SP.	9.5							1.4
LAMINARIA SINCLAIRII	5038.0							719.7
OTHER MACROPHYTES (20)	0.6		1.7				0.1	
TOTAL WET WEIGHT IN G/M2	6256.2	867.3	1877.6	2874.7	3191.6	158.6	466.8	

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-32. D R Y WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY FROM AUGUST 1976 TO APRIL 1977, B L A N K SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1.0 To -0.1 (N= 3)	MLLW TO 0.9 (N= 1)	1.0 TO 1.9 (N= 5)	2.0 TO 2.9 (N= 1)	3.0 TO 3.9 (N= 3)	4*0 TO 4.9 (N= 2)	5.0 TO 5.9 (N= 3)	MEAN
CIGARTINA LEPTORHYNCHOS							7.2	1.0
CLADOPHORA COLUMBIANA							1.4	0.2
CHAETOMORPHA LINUM			<0.1				3.6	0.5
CORALLINA OFFICINALIS VAR. CHILENSIS		0,9	67.6	85.0	46.4	78.4	134.6	59.0
PTEROSIPHONIA DENDROIDEA	0,1	0.2	0.5	0.2	<0.1		<0.1	0.2
GELIDIUM COULTERI	<0,1		1.7	<0.1	<0.1		<0.1	0.3
PHYLLOSPADIX TORREYI	175.3	16.7	262.7	427.4	481.0		20.2	200.5
PTEROSIPHONIA BAILEYI	0.6		0.4			<0*1		0.1
GIGARTINA CANALICULATA	0.3		<0.1	2.5		<0.1		0.4
POLYSIPHONIA PANICULATA			1.1		<0.1			0.2
ULVA TAENIATA		2.6	7*3		2.1			1.7
SMITHORA NAIADUM		1.3	1.8		4.7			1.1
CRYPTOPLEURA VIOLACEA			<al	0,9				0.1
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	3.3		3.5	61.5				9.8
FLOCAMIUM CARTILAGINEUM	1.1	3,5	2.1	24.7				4.5
LAURENCIA SPECTABILIS	0,1	<0.1		3.3				0.5
RHODOMELA LARIX			1.9					0.3
POLYSIPHONIA HENDRYI VAR HENDRYI			2.6					0.4
ULVA LOBATA		7.7	0.2					1.1
GRATELOUPIA DORYPHORA		29.0	<0.1					4.1
NEOAGARDHIELLA BAILEYI		1.6	5.7					1.1
ANISOCLADELLA PACIFICA	<0,1	5.8	<0.1					0.8

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-32. DRY WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY FROM AUGUST 1976 TO APRIL 1977, BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 3)	MLLW TO 0.9 (N= 1)	1.0 TO 1.9 (N= 5)	2.0 TO 2.9 (N= 1)	3.0 TO 3.9 (N= 3)	4.0 TO 4.9 (N= 2)	5.0 TO 5.9 (N= 3)	MEAN
EGREGIA MENZIESII		6.5						0.9
ECTOCARPACEAE		3.4						0.5
PRIONITIS LANCEOLATA	8*7							1.2
POTRYOGLOSSUM FARLOWIANUM	3,1							0.4
RHODYMENIA PACIFICA	9,4							1.3
RHODYMENIA CALIFORNICA VAR. CALIFORN	1*1							0.2
CALLOPHYLLIS SP.	2,0							0.3
LAMINARIA SINCLAIRII	122.3,0							174.7
OTHER MACROPHYTES (30)	0.4	0.1	1.4	0.0	0.0	0.1	0.1	
TOTAL DRY WEIGHT IN G/M2	1428.7	79.4	380.5	603.7	536.3	78.5	167.1	

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1. 2-33. WET WEIGHT IN G/M2 FOR DOMINANT MACRO- NVERTEBRATES FROM TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY FROM AUGUST 1976 TO APRIL 1977. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 3)	MLLW TO 0.9 (N= 1)	1.0 TO 1.9 (N= 5)	2.0 TO 2.9 (N= 1)	3.0 TO 3.9 NF 3	4.0 TO 4.9 (N= 2	5.0 TO 5.9 N= 3)	MEAN
NUCELLA (THAIS) EMARGINATA							5.8	0.8
ACMAEA (COLLISELLA) SCABRA							7.7	1.1
CYANOPLAX PARTNEGII							2.1	0.3
ACMAEA (COLLISELLA) STRIGATELLA						1.0	5.2	0.9
ACANTHINA PUNCTULATA						8.2	9.1	2.5
BRACHIDONTES ADAMSIANUS						1.2	0.4	0.2
MOPALIA MUSCOSA						7.6	62.3	10.0
CHTHAMALUS FISSUS AND DALLI					<0.1	18.9	2.1	3.0
LITTORINA SCUTULATA					0.3	0.2	1.8	0.3
ACMAEA (COLLISELLA) ASMI					0.8	0.2	2.1	0.4
PAGURUS SAMUELIS			0.5			20.9	2.4	3.4
TEGULA FUNEBRALIS			7.6	3.2	300.8	126.1	644.1	154.5
ANTHOPLEURA ELEGANTISSIMA	169.6		141.6	396.7	72.2	607.3	151.1	219.8
PAGURUS HIRSUTIUSCULUS	0.9		24.1	0.6	0.5		0.3	3.8
LACUNA MARMORATA	0.8	1.5	5.6	17.4	<0.1		<0.1	3.6
EPITONIUM TINCTUM	<0.1	<0.1	0.1	0.1	<0.1	0.4		0.1
AGLAOPHENIA SP.	1.0					0.2		0.2
EARLEKIA SPP.	<0.1	<0.1	1.6	0.1	<0.1			0.3
MITRELLA CARINATA	1.0		0.5	8.1	<0.1			1.4
TRICOLIA PULLOIDES			0.3	0.3				0.2
PUGETTIA PRODUCTA	0.7	<0.1	1.3	8.1				2.3
DEMOSPONGIAE	31.1			1.3				4.6

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12- 33. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY FROM AUGUST 1976 TO APRIL 1977. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 3)	MLLW TO 0.9 (N= 1)	1.0 TO 1.9 (N= 5)	2.0 TO 2.9 (N= 1)	3.0 TO 3.9 (N= 3)	4.0 TO 4.9 (N= 2)	5.0 TO 5.9 (N= 3)	MEAN
MYTILUS CALIFORNIANUS	1.5		0.2					0.2
ARCHIDISTOMA PSAMMION	9.6							1.4
PISASTER OCHRACEUS	52.4							7.5
AMPHISSA VERSICOLOR	0.9							0.1
OTHER MACRO-INVERTEBRATES (19)	0.4	0.6	0.1	0.5	0.2	0.6	2.6	
TOTAL WET WEIGHT IN G/M2	269.9	2.1	189.7	436.7	375.1	792.7	698.9	

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12- 34, DRY % WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM TIDEPOOLS AT GOVERNMENT POINT, SANTA BARBARA COUNTY FROM AUGUST 1976 TO APRIL 1977. BLANK SPACES INDICATE ZEROS.

TAXA	TIDAL HEIGHT (FT). -1.0 TO -0.1 (N= 3)	MLLW TO 0.9 (N= 1)	1.0 TO 1.9 (N= 5)	2.0 TO 2.9 (N= 1)	3.0 To 3.9 (N= 3)	4.0 TO 4.9 (N= 2)	5.0 TO 5.9 (N= 3)	MEAN
NUCELLA (THAIS) EMARGINATA							4.7	0.7
ACMAEA (COLLISELLA) SCABRA							5.4	0.8
CYANOPLAx HARTWEGII							1.2	0.2
ACMAEA (COLLISELLA) STRIGATELLA						O*7	3.8	0.6
ACANTHINA PUNCTULATA						7.8	7.9	2.2
BRACHIDONTES ADAMSIANUS						0.6	0.5	0.1
MOPALIA MUSCOSA						4.0	30.6	4.9
CHTHAMALUS FISSUS AND DALLI					<0.1	11*1	1.7	1.8
LITTORINA SCUTULATA					0.2	C*2	1.2	0.2
ACMAEA (COLLISELLA) ASMI					0.5	<0.1	1.5	0.3
PAGURUS SAMUELIS			<0.1			11.0	0.8	1.7
TEGULA FUNEBRALIS			5.9	2.6	235.9	102*2	541.5	126.9
ANTHOPLEURA ELEGANTISSIMA	43.3		33.6	109.7	15.5	149.9	37.2	55.6
PAGURUS HIRSUTIUSCULUS	0.2		19.7	0.1	0.1		<0.1	2.5
LACUNA MARMORATA	0.4	0.8	2.9	6.0	<0.1		<0.1	1.7
BARLEEIA SPP.	<0.1	<0.1	0.9	<1.1	<0.1			0.1
MITRELLA CARINATA	0.6		0.3	4.2	<0.1			0.7
PUGETTIA PRODUCTA	0.3	<6.1	1.5	1.3				0.5
CERASPONGIAE	6.5			0.2				1.0
MYTILUS CALIFORNIANUS	0.9		<0.1					0.1
ARCHIDISTOMA PSAMMION	4.6							0.7
PISASTER OCHRACEUS	23.8							3.4
OTHER MACRO-INVERTEBRATES (23)	1.0	0.3	0.2	0.8	0.1	0,6	1.5	
TOTAL DRY WEIGHT IN G/M2	81.6	1.1	65.0	127.0	252.4	287.7	639.3	

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.12-35. SEASONAL AND ANNUAL DIVERSITY FOR GOVERNMENT POINT, SANTA BARBARA COUNTY.

GROUPS AND DATES	NO. TAXA	COVER (%) D'	COVER (%) H'	COVER (%) J'	DENSITY (NO./M2) D'	DENSITY (NO./M2) H'	DENSITY (NO./M2) J'
MACRO-INVERTEBRATES							
AUG. 1976	35	10.41	1.43	0.40	3.89	0.76	0.21
NOV. 1976	32	9.12	L*54	0 *44	3.46	0.53	0.15
JAN. 1977	30	8.59	1.56	0.46	3.30	0.50	0.15
APR. 1977	32	9.32	1.38	0.40	3.53	0.60	0.17
MEAN	32	9.36	1.47	0.43	3.55	0.60	0.17
MACROPHYTES							
AUG. 1976	51	10.36	2.57	0.65	- -	- -	- -
NOV. 1976	58	12.19	2.80	0.69	- -	- -	- -
JAN. 1977	52	11.07	2.67	0.68	- -	- -	- -
APR. 1977	78	16.11	2.87	0.66		- -	- -
MEAN	60	12.43	2.73	0.67			
COMBINED MACRO-INVERTEBRATES AND MACROPHYTES							
AUG. 1976	86	16.95	2.84	0.64	- -	- -	- -
NOV. 1976	90	18.08	3.05	0.68	- -	- -	- -
JAN. 1977	82	16.65	2.95	0.67	- -	- -	- -
APR. 1977	110	21.85	3.07	0.65	- -	- -	- -
MEAN	92	18.38	2.98	0.66			

= 1.47), compared to macrophytes (2.73), with a direct relationship between combined and macrophyte H' diversity, indicating a controlling influence of macrophyte cover on combined diversity. Macroinvertebrate cover diversity was lowest in April (H' = 1.38) when macrophyte diversity was highest (2.87).

The evenness (J') of the combined biota averaged 0.66 (Table 1.1.12-35) and only ranged from 0.64 in August to 0.68 in November. Macrophyte evenness was consistently higher than that for the macroinvertebrates (mean yearly J = 0.67 vs. 0.43), with both reaching their greatest evenness in November and January. Combined richness (D') averaged 18.38 (Table 1.1.12-35) and ranged from 16.65 in January to 21.85 in April. With the exception of August, when the most macroinvertebrate taxa (35) were present and their richness (1 0.41) peaked, the macrophytes were richer than macroinvertebrates (mean D' = 12.43 VS. 9.36). The lowest macrophyte richness was recorded in August (10.36) and the highest occurred during April (16.11). There was a consistent correspondence between the numbers of taxa in the samples and the D' richness index based on cover data for macrophytes, macroinvertebrates, and combined biota (Table 1.1.12-35).

The Shannon-Weaver index, while considering both the richness and evenness components of species diversity, emphasizes evenness. Consequently, the seasonal sequence of H' values would be expected to more closely parallel the sequence of J' values than did the D' values. This was the case for the macroinvertebrate indices considered alone. However, the macrophyte H' sequence most closely paralleled that of D', while J' did not change much with season. The H' for combined biota also paralleled D' illustrating the dominant affect of macrophyte cover on overall community diversity.

For macroinvertebrates, when density was incorporated as the evenness component (Table 1.1.12-33), the seasonal sequence agreed with the cover-determined sequence only in the case of richness. The macroinvertebrate J' and H' values were highest in November and January, using cover, but when individuals/^{2} were employed, J' and H' were both highest in August and April. All of the diversity indices (D', H', and J') based on density were lowest during January when sand inundation was most pronounced.

1.1.12.4.4.2 Structural Complexity

Structural complexity appeared to be a moderately important attribute of the intertidal community sampled at Government Point as indicated by the occurrence of greater than 115% annual mean biotic cover in seven of the eight tidal intervals sampled (Tables 1.1.12-6 and 1.1.12-7). Structural complexity was most pronounced below +1.0 ft. (+.3 m) where an overstory of Laminaria sinclairii, Iridaea cordata var. splendens and, to a lesser extent, Egregia menziesii was underlain by Bossiella orbigniana Ssp. dichotoma, Corallina

of ficinalis var . chilensis, Cryptopleura violacea, Plocamium car ti-lagineum, C. vancouveriensts , Gr ateloupia dory phora, Demos pongiae, and, less frequently, Gelidium coulteri and Gigartina canaliculata. Phy llospadix torreyi provided a canopy , primarily between MLLW and +1.0 ft (+.3 m), for several species including P. car ti lagineum, P ter osiphonia dendr oidea, C. of ficinalis var . chilensis, and Rhodomela larix. Epiphytes were relatively rare in the low zone with the exception of Smithora naiadum, an epiphy te on P. torreyi , which attained consider able cover values.

Between +2.0 and +6.0 ft. (i-. 6 and +1 .8 m) Pelvetia fastigiata was generally found with an under story of Ralfsiaceae , Hydrolithon decipiens, Gigar tina canaliculata, Gelidium pusillum, porphyra perforate, Corallina of ficinalis var . chilensis , Rhodoglossum affine, Gi gar tins leptorhynchos, and less frequently, C. vancouveriensis, Iridaea heterocarpa, Endocladia muricata, Petrocelis franciscana, and Gelidium coulteri. Ralfsiaceae, H. decipiens, P. franciscana, and Phragmatopoma calif ornica were often over grown by—other species. No prominent beds of My tilus calif ornianus were present at the study site to provide extensive secondary substrate . Epiphytes , primarily Ceramium eatonianum/sini cola, Polysiphonia paniculata, var . hendryi, and Centroceras clavulatum, were moderately abundant in the mid-inter tidal zone and were found mainly on G. canaliculata and G. coulteri . Articulated coralline algae bore relatively little epiphy tic growth at this site. At higher tidal levels P. fastigiata was associated generally with a sparse under story consisting predominantly of H. decipiens and Ralfsiaceae and occasionally with high densities of Tegula funebr alis. In the upper intertidal, blue- green algae extensively utilized the secondary sub str ate provided by Chthamalus fissus/dalli .

1.1.12 .4.4.3 Species Assemblages

Quadrat samples from each sampling period were sub jetted to cluster analysis using a weighted pair correlation coefficient of similarity and the data for relative cover. The results for November 1976 and April 1977 (presented as dendrograms in Figures 1.1.12-25 and 1.1.12-26) were chosen as representative of the sampled communi ty and the variation that was observed between sampling periods. A diagram i llustr sting the actual arrangement of permanent, undisturbed, rocky substrate quadrats is presented in Figure 1.1.12-27 With quadrats labelled according to a composite representation of the spe cies assemblages inferred from the four , single season clus ter analy ses. Tidepool samples , which were excluded from analysis , are also illustrated in the diagram (Figure 1.1.12-27) .

Seven major assemblages were found to persist throughout the year (Figures 1.1.12-25 through 1.1.12-27). The groups labelled AA and AB were dominated by Cyanophy ta and Chthamalus fi ssus/dalli and consi stently character zed the upper intertidal levels. The two upper

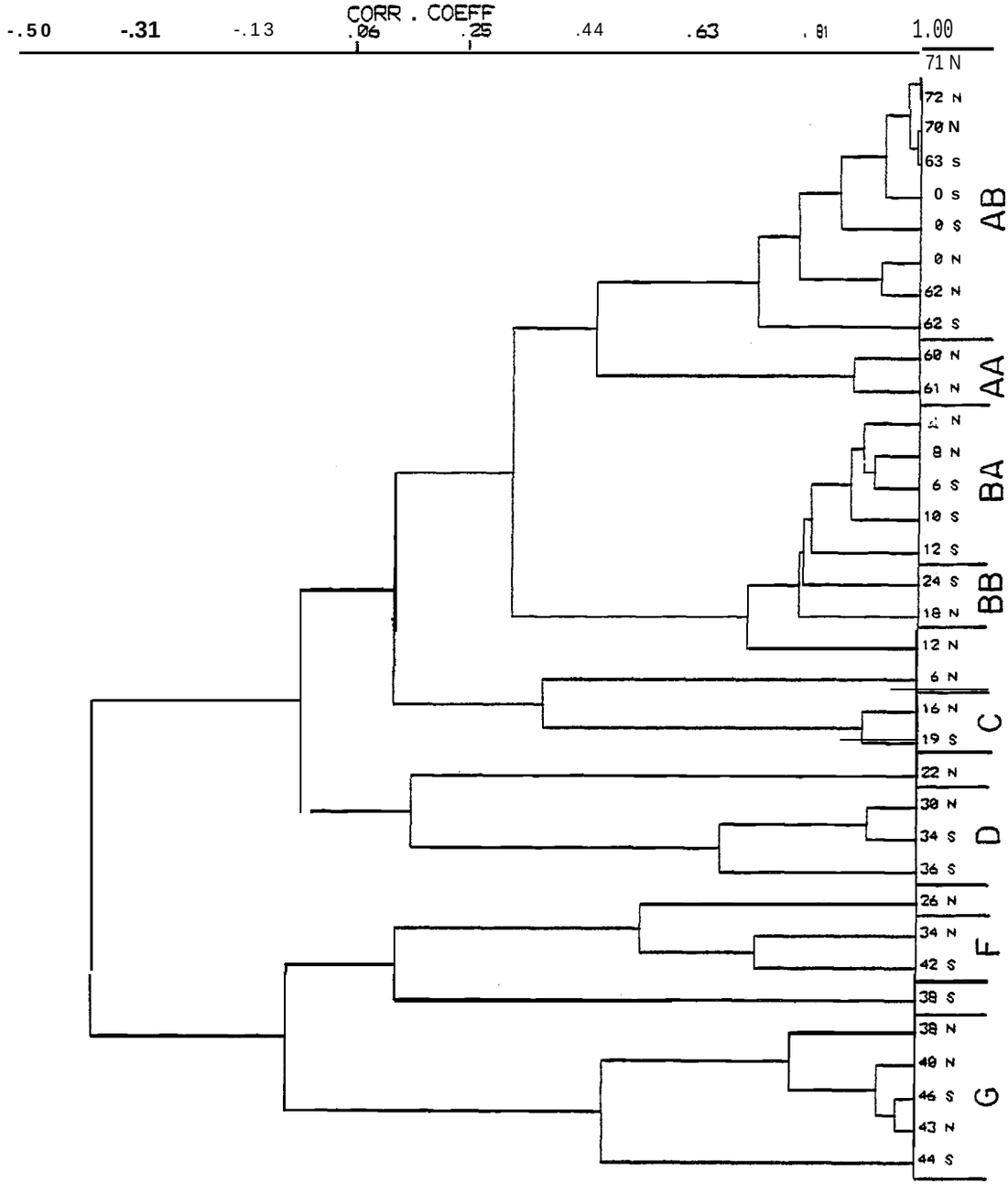


Figure 1.1.12-25 Dendrogram Display of Differential Clustering of Quadrats Sampled During November 1976 from Government Point.

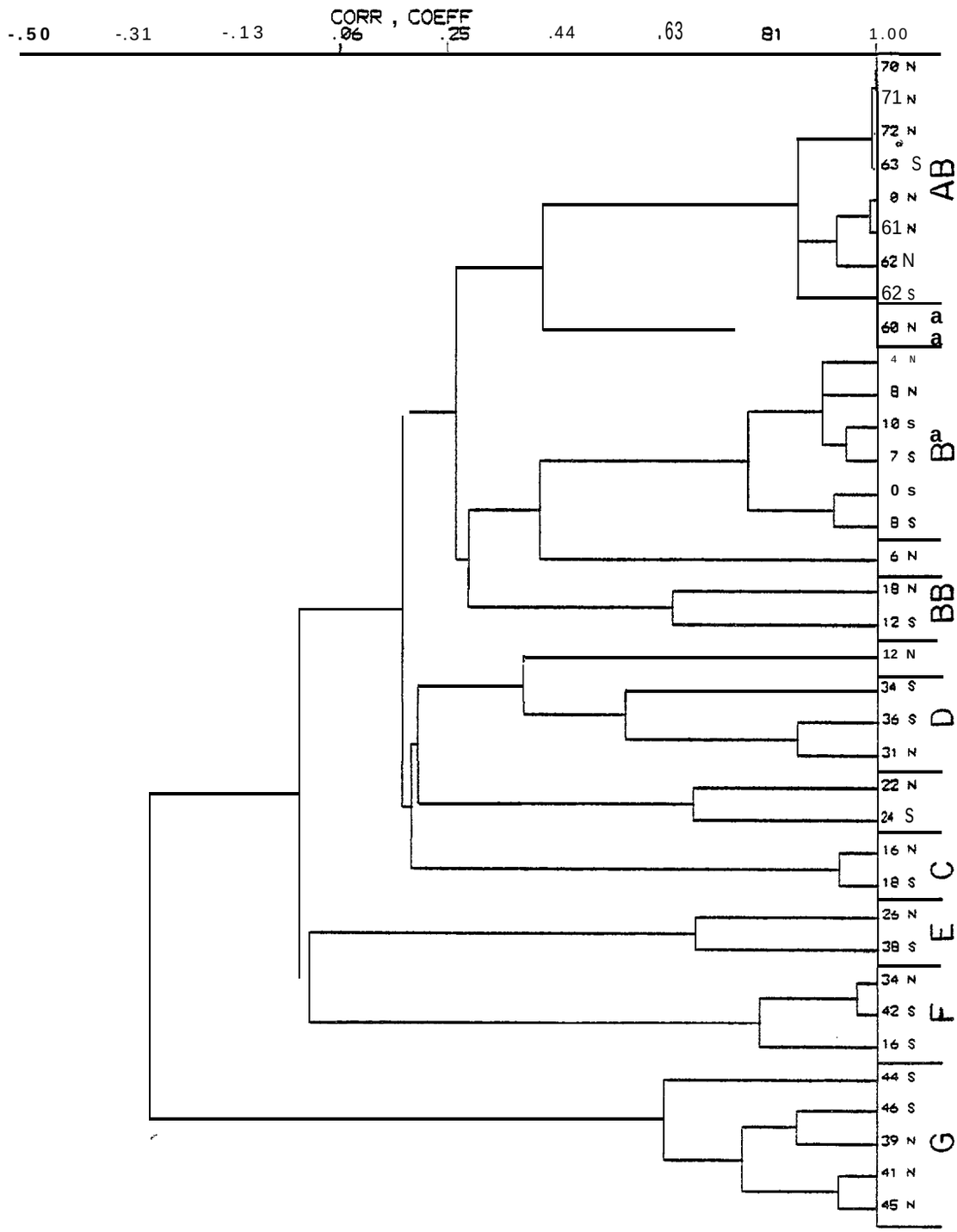
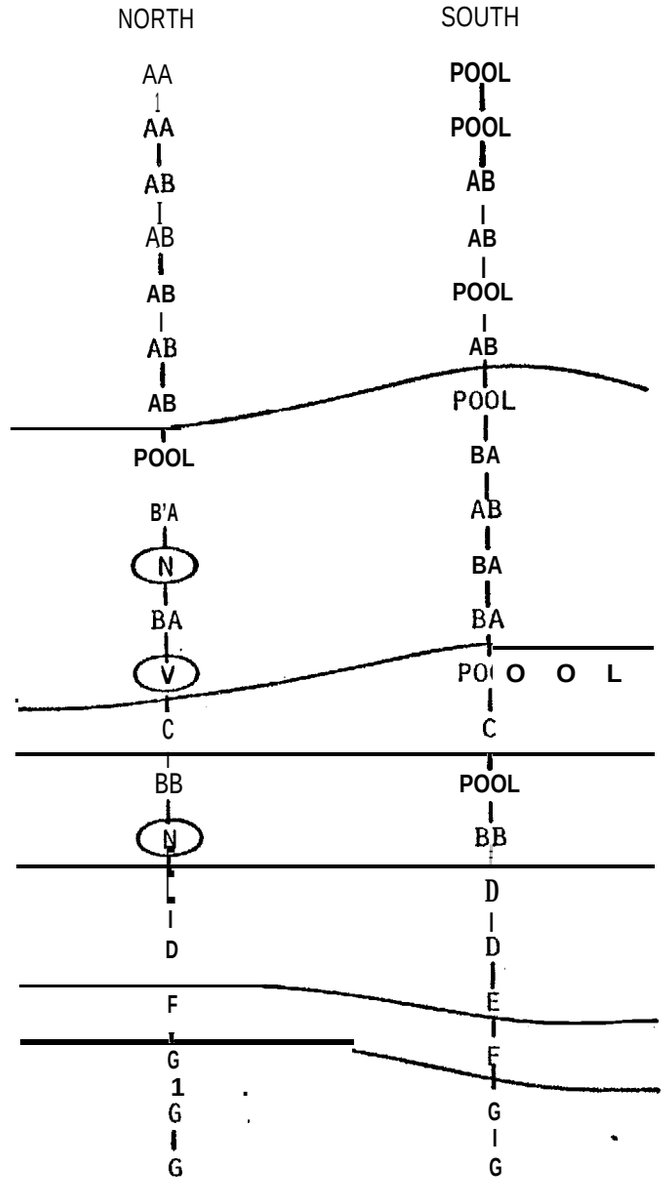


Figure 1.1.12-26. Dendrogram Display of Differential Clustering of Quadrats Sampled During April 1977 from Government Point.



CLUSTERED GROUPS

AA - BARE ROCK • CYANOPHYTA

AB - CYANOPHYTA • CHTHAMALUS

BA - PELVETIA • CYANOPHYTA

BB - PELVETIA • GIGARTINA

C - ANTHOPLEURA

D - GIGARTINA ● GELIDIUM

E - RHODOMELA

F - PHYLLOSPADIX

G - LAMINARIA

V - VARIABLY CORRELATED

N - NON-CLUSTERED SAMPLES

Figure 1.1.12-27. Combined Distributional Patterns of Species Groups from Government Point for November 1976 and April 1977 in Relation to Position of Transects and Locations of Quadrats.

most quadrats one north transect line, the bare rock-Cyanophyta group (AA), contained considerably more bare rock and blue-green colonies and less non-colonial Cyanophy ta and C. fissus/dalli than the quadrats grouped as Cyanophyta-Chthamalus (AB), which formed a di stinct zone immediately below. An assemblage dominated by Pelvetia fastigiata and Cyanophyta (BA) occurred in the upper and midintertidal levels. The occurrence of an AB-group quadrat among those of the BA cluster was very probably related to the location of one particular quadrat on the upturned edge of a rock shelf approximately 1.0 ft. (.3 m) higher and exposed to different water and sand flux than the surrounding quadrats. Another assemblage (BB) consisting primarily of P. f asti giata but also Gigartina canaliculata, G. papillata, and Rhodoglossum affine in relatively high proportions was found at lower levels in the mid-inter tidal zone. The two groups dominated by P. fastigiata were separated by a narrow band (C) nearly exclusively containing Anthopleura elegantissima. A group (D) constituted by a large number of taxa, particularly G. canaliculata, Gelidium coulteri , Corallina of ficinalis var . chilensis , and Ulva taeni ata, lay below the Pelvetia-Gigartina strip and above an assemblage (E) consisting principally o f Rhodomela larix. The order of the D and E assemblages on the north transect was not anomalous because the quadrat belonging to the E group was at a lower tidal elevation (+1.8 ft. , +.5 m) than the adjacent D-group quadrat (+2. 6 ft. , +.8 m). Quadrats dominated by the Phy llospadix torreyi group (E) formed a narrow zone immediately below the Rhodomela band. The assemblage found at the lowest tidal levels (G) consisted primarily of Laminaria sinclairii and secondarily of Iridaea cordata var . splendens, Bossiella or bigniana ssp. dichotoma, and Rhodymenia paci fi ca.

The upper quadrat of those designated as uncorrelated (U) and as well as the variably correlated quadrat (V) on the north transect (Figure 1.1. 12-27) were located in unique topographical situations and were exposed to sharp changes in sand cover that apparently caused those samples to be relatively unique and variable. Sand cover in the upper uncorrelated quadrat increased from an immeasurable amount in t o 71. 9% during January. That quadrat usually contained Anthopleura ele gantissima , Phragmatopoma californica , Corallina of ficinalis var . chilensis, Cladophora columbiana, Cy lindrocarpus rugosus, and several minor taxa in varying proportions without any forms becoming dominant. The variably correlated quadrat (clustered with the BB group in November and the C group in January , and uncorr e lated during the other two quarters) contained negligible sand during November and 51.9% sand cover in January . The principle taxa found in that quadrat were Gelidium coulteri, A. elegantissima, Gigartina canaliculata and, in highly varying proportions , Pelvetia fastigiata. The lower uncorr e-lated quadr at exhibi ted much less change in sand cover and contained varying proportions of Rhodoglossum affine , G. canaliculata , G. papillata, Polysiphonia paniculata, and Ulva taeniata throughout the year .

Two additional irregularities deserve elaboration. First, the Rhodome la group quadr ats were not correlated in November because marked increases in Phyllospadix torreyi cover took place at that location on the north transect and relatively high cover of Egregia menziesii was present in the other quadrat. Second, the quadr at on the nor th transect that generally clustered in the BB group was placed in the Ant hop leur a group in January, even though i t was clearly not dominated by A. eleganti ssima, apparently because of a dramatic influx of sand in January (0. 0% cover in November , 48. 2% in January ,, and 2. 6% in April).

1 .1.12.5 Discussion

Floristic sampling has been carried out near the Government Point site by Dawson (1 959; 1965) and Thorn (1 976). There were more cold-water algal forms at this site than any other recorded for the Southern California Bight (see Littler , 1977) and numerous macrophytes are reported to reach either their southernmost or northernmost limits in the Government Point/Point Conception area (see Abbott and Hollenber g, 1976). Although our goal was to pr educe a quantitative baseline, and not to locate species, the present study adds 71 new records of macr o-phyte species (41 additional genera) not listed by Dawson (1 959; 1965) and 63 species (31 additional genera) not found by Thorn (1 976) for the Government Point region. There were eight macrophy te species found by Dawson (1 959; 1965) but not by us, and 22 recorded by Thorn (1 976) that we did not observe. Virtually all of the macroinver tebr ate taxa recorded by the present study represent new records for Government Point area. Throughout all four sampling periods of the present study, sand cover was considerable between MLLW and +3. O ft. (+.9 m).

However , sand coverage reached a distinct maximum and extended higher in the intertidal during January 1977. This had a pronounced effect on the distribute on and abundance of certain populations as did the other ecologi tally important parameters, the heat and desiccation stress as during the winter months due to low tides occurring in the day time. Total biotic cover averaged 141.1 %, ranging from 129.5% in January to 150.8% in August. The contribution of macrophy tes aver aged 11 2.8% and macroinvertebrates 28.3%. Maximal cover (186. 9%) occurred between +5.0 and +6.0 ft. (+1 .5 and +1.8 m) due to exceptionally high macr oinver tebr ate cover in conjunction with moderately high macrophy te cover. The minimum aver age cover (71 .5%) was located in the adjacent interval (+6.0 to +7.0 ft. , +1.8 to +2.1 m). Macrophy te cover was maximal (155.4%) from MLLW to +1.0 ft. (i-.3 m) and least (44.4%) from +6.0 to +7.0 ft. (+1.8 to +2.1 m). Macr oi river tebr ate cover , however , was maximal (60.1%) from +5.0 to +6.0 ft. (+1.5 to +1.8 m) and least (2.9%) from -1.0 ft. (-.3 m) to MLLW. The seasonal peak for macro-pbyte cover (1 24. 6%) was reached during August, and the seasonal low (100.2%) in January. Macr oinver tebr ate cover changed little throughout the year but was slightly big her during the colder months.

Based on annual mean values, blue-green algae provided the most macrophyte cover (28.4%) followed by Pelvetia fastigiata (1 6.1%) , and the cold water species Laminaria sinclairii (15. 5%) , Iridaea cordata var , splendens (4.6%) , and two other macrophy tes (Phyllospadix torreyi, 7. 6%; arid Gigartina canaliculata, 4.4%). This represents a considerably higher standing crop of cold water macrophy tes than was reported for 10 other sites wi thin the Southern California Bight during 1975-76 study summarized by Littler (1 977).

A common seasonal patter n in cover was indicated for Laminaria sinclairii , Phy llospadix torreyi , and Iridaea cordata var . splendens, all of which showed a winter die-back associated with desiccator winds during afternoon low tides. Less abundant algal species, particularly Gelidium coulteri, I. flaccida, Ulva taeniata, and Cryptopleura vi olacea, also exhibi ted a winter die-back. Cover of the cold water species L. sinclairii at the -1.0 ft. (-.3 m) to MLLW level decreased from 85.0% in November to 40.0% in January and then returned to 85.2% in April. Similar ly , cover of I. cordata var. sp lendens in the same level diminished from 35.0% in August to 14.2% in November to 4.8% in January and then increased to 43.2% in April. Bleached thalli were most frequently encountered in the samples in either November or January, consistent wi th the pattern of winter algal die-back described in relation to late fall day time low tides in the report edi ted by Littler (1 977). Species showing the highest frequency of bleached thalli during the winter at Government Point were Hydroli then deci - piens, Corallina of ficinalis var . chilensis, coralline crust, Bossiella orbigniana spp . dichotoma , Gigartina canaliculata, and Plocamium cartilagineim. Bleached forms of macrophytes were most prevalent in tide pools also during November and January of the study and included C. of ficinalis Var . chilensis, H. decipiens and an unidentified coralline must, all of which appear ed following the stressful periods of the afternoon low tides in November .

1 .1.12.6 Literature Cited

Abbott, I. A., and G. J. Hollenberg, "Marine Algae of California," (Stanford, California, Stanford University Press, 1976) .

Cimberg, R. , S. Mann, and D. Straughan, "A Reinvestigation of Southern California Rocky Intertidal Beaches Three and One-helf Years after the 1969 Santa Ana, Hancock Foundation, University of Southern California (1 971).

Ricketts, F. R., J. Calvin, and J. W. Hedgepeth, "Between Pacific Tides, " (Stanford, California, Stanford University Press, 1968).

Thorn, R. M. , "Changes in the Inter tidal Flora of the Southern Cali f-ornia Mainland, " M. A. Thesis, California State University, Long . Beach (1976).

Ventura, C. , and J. Wintz, "Natural Oil Seeps: Historical Back-ground, " pp 11-16 in D. Straughan, ed. , Biological and Oceano-graphical Survey of the Santa Barbara Channel Oi 1 Spill 1969-1970. Vol. 1, Allen Hancock Foundation, Univer si ty of Sou ther n California (1 971).

Wilkinson, E. R. , "California Offshore Oil and Gas Seeps ," Calif. Div. Oil and Gas TR08, Sacramento, California (1 972).

Wyllie, J. G. and R. J. Lynn, "Distribution of Temperature and Salinity at 10 meters, 1960-1969, and Mean Temperature, Salinity , and Oxygen at 150 meters, 1959-1968 in the California Current, " CalCOFI Atlas No. 15 (1 971).

INTERTIDAL STUDY OF THE SOUTHERN CALIFORNIA BIGHT

1.1.13

BIOLOGICAL FEATURES OF ROCKY INTERTIDAL COMMUNITIES AT JOHNSON'S LEE SANTA ROSA ISLAND, CALIFORNIA

VOLUME III "

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1.1.13 · Biological Features of Rocky Intertidal Communities at Johnson's Lee, Santa Rosa Island, California

1 .1.13.1 Abstract

Seasonal patterns of distribution and abundance of rocky inter tidal organisms were evaluated at Johnson's Lee (near South Point), Santa Rosa Island from October 1976 to June 1977. Both undisturbed and disturbed sampling techniques were employed; totals of 184 0. 15-m2 and 184 1. 0-m^2 undisturbed samples and 48 0.15-m2 and 48 1.0-m^2 disturbed samples were ob tained during the four quar terly visits. The number of macrophytes in undisturbed samples ranged from 50 in December to 56 in June, while macroinvertebrate taxa varied from 48 in October to 63 in June. Total macrobiotic cover averaged 128. 6% with a macr ophy te component of 98.9% as well as 29.7% macroinver tebrates. Total macrobiotic cover was relatively constant throughout the year , although appreciable seasonali ty occurred among those macrophy tes and macroinver tebrates below the +4. 0-f t. (1 . 2-m) tidal level.

Macrophy tes with the greatest annual mean cover were blue-green algae (65.6%) and Phyllospadix scouleri (1 3.6%). The macr oinvertebrates with the highest annual mean cover were Mytilus californianus (11 . 6%>, Phragmatopoma californica (9.1%) , Chthamalus fissus/dalli (4.2%) , and Balanus glandula (2. 5%). The macrophy tes occurring in the greatest proportion of samples were blue-green algae (92.0% frequency) , Endoplura aurea (39.3%), Ulva lobata (38.6%), and Ralfsiaceae (33. 8%). The highest macr oinver tebr ate frequencies were recorded for C. fissus/dalli (60.1%), Littorina planaxis (55.1%), B. glandula (45.4%), and M. californianus (41.7%). The most numerous macr oinver tebrates were P. californica (34 individuals/m^2) , C. fissus/dalli (1980/m2) , B. glandula (1219/m^2) , L. planaxis (882/m^2) and M. calif orni anus (296/m^2). Seasonali ty was apparent through decreased macr ophy te cover , decreased macr oinver tebr ate density , arid increased frequency of bleached macr ophtyes and encrusting forms during the daytime low tide periods of the winter months.

Macrophyte standing crop averaged 650.6 g/m^2 organic dry weight , while macr oinver tebrates average d 370.2 g/m^2 or gani c dry weight. Three species contributed over 90%. of the macrophy te standing crop, Phy llospadix scouleri (569.3 g/m^2 ODW) , Endocladia muri cata (1 3. 9 g/m^2 ODW) , and Gigartina canaliculata (12.7 g/m^2 ODW) . Mytilus calif ornianus (31 2.8 g/m^2 ODW) and Balanus glandula (12.7 g/m^2 ODW) contributed over 90% of macroinver tebrate organic dry biomass .

Shannon-Weaver (H ') diversity of combined macrophy tes and macr oi river tebr at es r anged from 1. 9"1 in March to 2.14 in October , while combined richness (D_e) averaged 18.54. Five major species assemblages with correlation coefficients greater than 0.69 were distinguished. Seasonal vsriati on among these groups occurred primarily because of decreased cover of Endocladia muricata during the winter .

1.1.13.2 Study Area

1.1.13.2.1 General

The South Point study site on Santa Rosa Island (3S° 53 ' 31 " N, 120° 6 ' 31 " W) is located approximately 200 m south of the U. S. Navy-built pier (Figure 1.1.13-1) in Johnson's Lee. Santa Rosa, a member of the Northern Channe 1 Islands group, is part of an anti clinal uplift which represents a seaward extension of the Santa Monica Mountains (Weaver , Doerner , and Nolf, 1969). The island is approximately 21 km in length by 13 km in breadth with its long axis oriented in an east-west direction. The Island' s highest point is 466 m above sea level (SCCWRP, 1973).

The study site occupies a large bench of marine sandstone which is typical of the Johnson's Lee shoreline (Figures 1.1.13-2a and 1.1.13 - 2b . It is exposed to easterly and southeasterly weather, but sheltered from the prevailing northwesterly weather by the bulk of the island. The intertidal bench consists of relatively compact sandstone with few crevices or pools and has an average slope of approximately 22°. Sand movement in the vicinity of the study site was notably extensive, although sand deposition was not a major factor on the site proper . The accumulation of considerable quantities of sand during October may have influenced the lower intertidal biota. There are no known offshore oil or gas seeps near Johnson' s Lee although there are seeps near the adjacent islands of San Miguel and Santa Cruz (Wilkinson, 1972). Prevailing currents make it unlikely that oil from either of these sources would influence the study site. Bituminous deposits along the shoreline were minimal.

1.1.13.2.2 Environmental Data

Environmental data for the South Point area was obtained from a U. S. Navy weather station (Table 1.1.13-1) and from the Naval Weather Service Command (Table 1.1.13-2), both of which tend to overestimate the severity of conditions prevalent at the study site, since swell height and wind speed from both sources reflect northwesterly weather which does not dir ectly impact the site.

In general there was an increase in the frequency of high winds (217.3 m/see) between February and June , the season of northwesterly storms (Table 1.1.13-2). Winds indicative of a " Santa Aria" condition occurred between November and January (Table 1 .1.13-1) . The sheltered position of the study site would be expected to ameliorate these high wind conditions somewhat, although we have noted " Santa Aria" winds blowing severely at Johnson' s Lee.

Mean monthly air temperature ranged from a minimum of 13. 3°C in March and April to a maximum of 17. 2°C in September and October . Mean sea temperature ranged from 13. 3°C to 18. O°C (Table 1.1. 13-2). The months with the greatest frequency of rain were December , January , and February (Table 1.1.13-1).

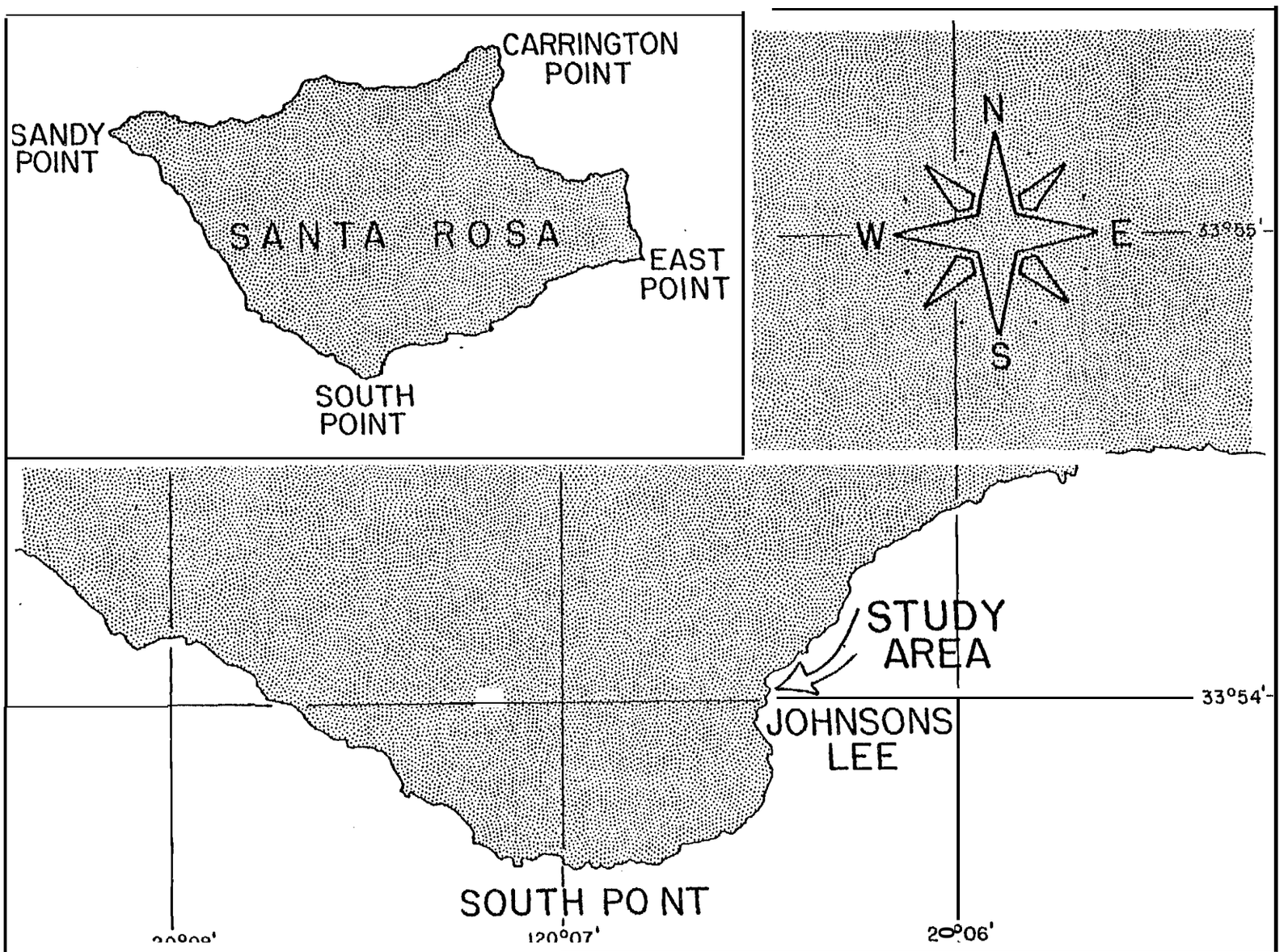

Figure 1.1.13-1. Location of the Santa Rosa Island Study Site

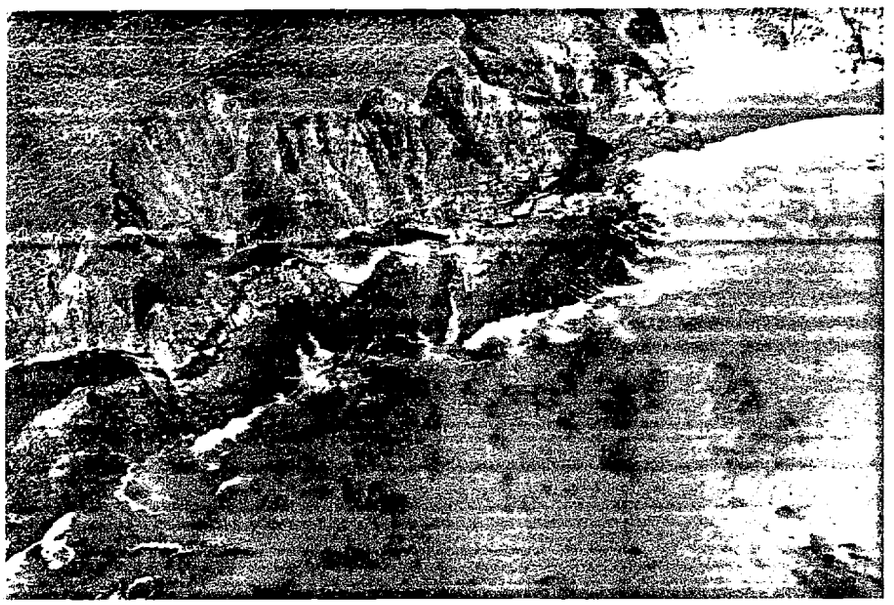

Figure 1.1.13-2a. Aerial Photograph Showing the Study Site.

Figure 1.1.13-2b. Intertidal Platform Sampled by North and South Transect Lines.

Table 1.1.13-1. Environmental Data from U.S. Navy Weather Station (elev. 456 m) on Santa Rosa Island.*

	Santa Ana**	Wind Speed % Frequency			Average wind speed (knots)	% Observ. with rain
		0.9-2.7 knots (l-3 mph)	3.6-10.7 knots (4-12 mph)	>11.6 knots (>13 mph)		
January	1.7	5.0	**34.7**	**60.3**	15.0	9.1
February	0.3	2.0	**33.7**	64.3	17.0	10.3
March	--	--	--		- -	--
April	--	--	--	--	--	--
May	--	--	--	--	--	--
June	0.0	1.7	22.5	75.8	**21.9**	0.0
July	0.0	8.6	47.1	44.3	**12.9**	2.0
August	0.0	10.2	46.4	43.4	**12.9**	2.0
September	0.0	9.4	41*O	49.6	**13.4**	0.7,
October	0.0	7.8	45.4	46.8	**14.3**	3.2
November	2.6	7.6	45.3	47.1	12.8	2.4
December	6.5	3.4	28.3	68.3	17.3	12.2

* Note: Data gathered between June 1943 and February 1944. These are not average figures.

** Santa Ana conditions are defined as East to Northeast winds greater than 25 mph (22 knots).

Table 1.1.13-2. Environmental Data for Santa Rosa Island.

Month	Wind Speed % Frequency 5.6-10.7 m/see (11-21 knots)	<3.1 m/see (≤ 6 knots)	>17.3 m/see (≥34 knots)	Mean Sea Temp. (°C)	Swell Height % Frequency >1.8 m	Mean Air Temp. (°C)
January	**20-30**	30	<0.05	13.9	10-20	- -
February	30-40	20-30	2-3	13.9	30-40	13.9
March	30-40	10-20	1	13.3	20-30	13.3
April	40	20	3	13.3	40-50	13.3
May	40-50	20	3-4	13.9	<10	13.9
June	40	20-30	1	**15.3**	10-20	15.0
July	40	30	0.05	16.7	20	16.1
August	40	20	0.05	17.2	20	16.7
September	40	30	0.05-1	18.0	20	17.2
October	30	30	<0.05	17.2	20	17.2
November	20-30	30-40	1	16.1	10-20	16.2
December	20-30	30-40	1-2	15.0	30	14.7

Source: U.S. Naval Weather Service Command

Environmental data recorded during the 1976-77 study period are presented in Table 1.1.13-3. *Sea* temper ature ranged from 13. O*C in March to 21 .0°C in October . The corr e spending minimum and maximum air temperatures of 13.0°C and 25.0°C occurred during the same respective months. Cloud cover and relative humidity were highly variable, while ocean salinity ranged from 32.0 °/oo to 35.0°/oo. Wave height was minimal during March and June and reached a maximum of 4.0 ft. in December. Wind velocity ranged from O to 15 knots but averaged only 4 knots throughout the year .

1 .1.13.3 Methods and Materials

The study site at Johnson' s Lee , Santa Rosa Island was sampled on 20-25 October 1976, 18-23 December 1976, 2-6 March 1977, and 30 May through 3 June 1977 using disturbed and undisturbed techniques. General methods are presented in Chapter 1.1.1 (this report) and only site specific modif i cations and details are presented here. Two parallel transect lines , 90° from magnetic north, were established, extending from the upper level of occurrence of inter tidal organisms to the lower limit imposed by the water level at low tide. The transects, designated N and S, were, respectively, 21 m and 16 m in length and approximately 25 m apart.

In general, the sub strate traversed by the transect lines was of a uniform 22° slope uninterrupted by cracks, crevices or pools. A slightly elevated ridge between meters 11 and 12 on the north and south line created a zone of nearly horizontal substrate which contained several tidepools, none of which were directly sampled. Few additional tidepools occurred in the vicinity of the transect lines and none were sampled b by undisturbed techniques. The total number of .0.15 m^2 and 1.0 m^2 undisturbed samples collected during each of the four visits was 92 (Table 1.1.13-4].

Disturbed samples were located between or adjacent to the established transect lines and were distributed throughout all tidal intervals. The disturbed samples obtained during the four quarter ly visits were lumped together to provide a representative picture of community biomass as a function of tidal height. A total of 48 0.15-m^2 and 48 I. O-m^2 disturbed samples were obtained during the period of the study (Table 1.1.13.4). The 1.0 m^2 samples were used strictly for sampling the larger or less common biota not adequately sampled by the O.^ 15-m^2 plots.

Tidepool finfishes were sampled from several pools at a variety of tidal heights to assure that a representative collection was made . A combination of netting, bailing and narcotizing with quinaldine was used to sample tidepool fish.

Table 1.1.13-3. Environmental Data Measured during the Period of Study for South Point, Santa Rosa Island.

	Water Temp. (°C)	Air Temp. (°C)	Cloud Cover (%)	Salinity (°/00)	Wave Ht (ft i	Relative Humidity (%)	Wind Velocity (knots)
21-24 October 1976							
Range	20.0-21.0	23.0-25.0	5-1oo	34.0-35.0	1-2	62-69	0-5
Mean	20.7	23.8	40	34.3	1.5	66	3
19-22 December 1976							
Range	18.0-18.5	20.0-24.0	0-50	34.0	1-4	38-70	2-5
Mean	18.4	21.6	13	34.0	2	60	4
02-05 March 1977							
Range	13.0-13.5	13.0-19.0	0-30	33.0-34.5	0-3	42-75	0-15
Mean	13.1	16.5	14	33.6	1	61	6
01-02 June 1977							
Range	15.0-16.0	15.0-18.8	0-1oo	32.0-34.0	0-1.5	56-89	0-8
Mean	15.5	16.9	33	33.3	1	68	4

Table 1. 1.13-4 . Numbers of Undisturbed and Disturbed 0.15-m^2 and 1.0-m^2 Samples Obtained Quarterly at South Point, Santa Rosa Island.

	Tidal Height (ft)										
	1.0 To 1.9	2.0 To 2.9	3.0 To 3,9	4.0 To 4.9	5.0 To 5 9	6.0 To 6.9	7.0 To 7.9	*O To 8.9	9.0 To 9.9	10.0 To 10.9	Total
Rocky Intertidal Samples											
'Disturbed											
October	3	1			2	"1	1	2	2		12
December		3	1		2	2			1	3	12
March	2	2		4				4			12
June			4			1	3		2	2	12
Total	5	6	5	4	4	4	4	6	5	5	48
Undisturbed											
October	1	5	6	4	5	7	4	6	3	5	46
December	1	5	6	4	5	7	4	6	3	5	46
March	1	5	6	4	5	7	4	6	3	5	46
June	1	5	6	4	5	7	4	6	3	5	46

At this site, the encrusting Phaeophyta, Ralfsia spp. and Pseudolithoderma nigra, were indistinguishable and have been lumped as Ralfsiaceae. Similarly, the two species of Ceramium, C. eatonianum and C. sinicola, typically co-occurred and were difficult to distinguish, therefore, they were treated as a single taxon. Also, unidentified coralline crusts and several species of bleached algae were included in our assessments.

Densities of Phragmatopoma californica were, in all cases, determined by multiplying per cent cover by the average ratio of 40 individuals/1 percent cover. This factor was determined by averaging the data from 10 randomly-selected quadrats.

1.1.13.4 Results

1.1.13.4.1 Floristics and Faunistics

The presence of macrophytes taxa in disturbed and undisturbed samples during the four quarterly assessments at Johnson's Lee, Santa Rosa Island is reported in Table 1.1.13-5. A total of 74 macrophytes was sampled over the entire study period, of which 61 occurred in disturbed samples and 64 in undisturbed samples. Thirteen taxa were found only in the undisturbed samples, and ten were unique to the disturbed samples. Twelve other macrophytes were collected in the vicinity of the study site but were not found among disturbed or undisturbed samples. Considering all samples, the range in total number of taxa was from 50 in December to 56 in June. Eleven species occurred only once in the samples, with single species occurrences equally distributed between quarters.

Phylogenetically, Rhodophyta were predominant with 53 taxa sampled, along with 12 Phaeophyta, 7 Chlorophyta, and 1 Spermatophyta. The presence of Bacillariophyta and Cyanophyta was noted although species determinations were not carried out.

The presence of macroinvertebrates in undisturbed and disturbed samples is indicated in Table 1.1.13-6. A total of 86 taxa was sampled, of which 53 occurred in undisturbed quadrats and 73 occurred in disturbed quadrats. An additional 20 were vouchered but not sampled. Thirteen taxa were unique to undisturbed samples and 33 were unique to disturbed samples. The number of taxa sampled ranged from 48 in October to 63 in June.

By taxa, 61 Mollusca, 16 Arthropoda, 7 Echinodermata, 7 Porifera, 5 Cnidaria, 5 Chordata, and 5 Annelida were sampled or vouchered.

Table 1.1.13-5. Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of South Point, Santa Rosa Island. Additional species collected in the study area (C) but not present in samples have also been listed.

Species and Taxa	Oct. 1976		Dec. 1976		Mar. 1977		June 1977		
	U	D	U	D	U	D	U	D	C
Bacillariophyta									
Benthic diatoms					X			X	
Chlorophyta									
Chaetomorpha linum	X		X		X		X		
Cladophora columbiana	X	X	X	X	X	X	X	X	
Cladophora spp.	X		X		X		X	X	
Codium fragile	X		X		X			X	
Enteromorpha sp.	X						X		
Ulva lobata	X	X	X	X	X	X	X	X	
Cyanophyta									
Blue-green algae	X	X	X	X	X	X	X	X	
Blue-green colony									X
Phaeophyta									
Colpomenia sinuosa	X	X	X		X	X	X		
Cylindrocarpus rugosus	X	X	X	X	X	X			
Desmarestia ligulata var. ligulata									X
Egregia menziesii	X	X	X	X	X	X	X		
Endarachne binghamiae		X			X				
Endoplura aurea	X	X	X	X	X	X	X	X	
Halidrys dioica		X			X		X		
Hesperophycus harveyanus									X
Macrocystis pyrifera	X								
Pelvetia fastigiata									X
Ralfsiaceae	X	X	X	X	X	X	X	X	
Scytosiphon dotyi			X		X				
Taonia lennebackerae				X					
Rhodophyta									
Bossiella orbigniana var. dichotoma	X	X	X	X	X	X	X	X	

Table 1.1.13 -5. Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of South Point, Santa Rosa Island. Additional species collected in the study area (C) but not present in samples have also been listed. (Continued)

Species and Taxa	Oct. 1976		Dec. 1976		Mar. 1977		June 1977		
	U	D	U	D	U	D	U	D	C
Calliarthron tuberculosum				X					
Callithamnion pikeanum					X	X	X	X	
Callithamnion rupicolum	X		X	X	X	X	X		
Callophyllis firma				X					
Callophyllis violacea	X	X	X					X	
Centroceras clavulatum					X			X	
Ceramium eatonianum/sinicola	X	X	X	X	X	X	X		
Ceramium pacificum	X		X		X		X		
Ceramium spp.	X	X	X	X	X		X	X	
Corallina officinalis var. chilensis	X	X	X	X	X	X	X	X	
Corallina vancouveriensis	X	X	X	X	X	X	X	X	
Cryptopleura crisps									X
Cryptopleura lobulifera		X		X		X		X	
Cryptopleura violacea	X		X		X		X	X	
Endocladia muricata	X	X	X	X	X	X	X	X	
Gastroclonium coulteri	X	X	X	X	X	X	X		
Gelidium coulteri	X	X	X	X	X	X	X	X	
Gelidium purpurascens	X								
Gelidium robustum									X
Gigartina canaliculata	X	X	X	X	X	X	X	X	
Gigartina leptorhynchos	X		X						
Gigartina papillata							X		
Gigartina spinosa	X		X	X	X		X	X	
Gracilaria sp.								-	X
Grateloupia doryphora	X	X					X		
Herposiphonia plumula	X		X	X	X			X	
Herposiphonia verticillata					X		X		
Hydrolithon decipiens	X	X	X	X	X	X	X		
Iridaea cordata var. splendens	X		X	X	X	X	X		
Iridaea heterocarpa		X	X	X		X	X		
Laurencia lajolla	X	X	X	X	X		X		
Laurencia spectabilis	X		X		X		X		
Lithophyllum proboscideum	X		X	X	X	X	X	X	
Lithothrix aspergillum	X			X	X			X	
Melobesia mediocris	X	X	X	X	X	X	X		

Table 1.1.13-5. Macrophytes Sampled by Undisturbed (U) and Disturbed (D) Methods for each Seasonal Assessment of South Point, Santa Rosa Island. Additional species collected in the study area (C) but not present in samples have also been listed. (Continued)

Species and Taxa	Ott. 1976		Dec. 1976		Mar. 1977		June 1977		
	U	D	U	D	U	D	U	D	C
Microcladia coulteri									X
Nemalion helminthoides	X	x					X	X	
Neoptilota californica									X
Neoptilota hypnoides									X
Petroglossum pacificum			X		X		X		
Phycodrys setchellii								X	
Plocamium cartilagineum		x				x		X	
Plocamium violaceum									X
Pogonophorella californica		X							
Polysiphonia hendryi var. hendryi	X	X	X	X	X	X	X	X	
Polysiphonia spp.	X		X		X	X			
Porphyra perforata	"x		x		X	X	X	X	
Prionitis cornea		X		X		x			
Prionitis lanceolata			X		X		X		
Pterocladia capillacea						X		X	
Pterosiphonia baileyi							X	X	
Pterosiphonia dendroidea		X		X		X	X	X	
Rhodoglossum affine	X	X	X	X	X	X	X	X	
Rhodymenia californica var. californica	X	X						X	
Schizymenia pacifica							X		
Smithora naiadum	X	X	X	X	X	X	X		
Tiffaniella snyderae						X			
Spermatophyte									
Phyllospadix scouleri	X	X	X	X	X	X	X		
Phyllospadix torreyi									X
86 Total Macrophytes									

Table 1.1. 13-62 resence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to South Point, Santa Rosa Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column.

Species and Taxa	Ott. 1976		Dec. 1976		Mar. 1977		June 1977		
	U	D	U	D	U	D	U	D	C
Annelida									
Polychaeta									
Dodecaceria fewkesi					X				
Phragmatopoma californica	X	X	X	X	X	X	X	X	
Spirobranchus spinosus			x		x		X		
Spirorbis spp.			x		x				
Arthropoda									
Crustacea									
Balanus glandula	X	X	X	X	X	X	X	X	
Balanus tintinnabulum californicus		X	x						
Cancer antennarius						X			
Chthamalus fissus/dalli	X	X	X	X	X	X	X	X	
Pachycheles rudis	X		X	X		X		X	
Pachygrapsus crassipes	X	X	X	X	X	X	X	X	
Pagurus granosimanus									X
Pagurus hirsutiusculus						X			
Pagurus samuelis						x	X	X	
Paraxanthias taylori				X					
Petrolisthes cabrilloi		X		X				X	
Pollicipes polymerus	X	x	x	x	X	X	X	X	
Pugettia gracilis									X
Pugettia products				X		X'		X	
Tetraclita squamosa rubescens	X	X	X	X	X	X	X	X	
Chordata: Urochordata									
Ascidiacea									
Aplidium californicum									X

Table 1.1.13-6. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to South Point, Santa Rosa Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued).

Species and Taxa	Ott. 1976		Dec. 1976		Mar. 1977		June 1977		
	U	D	U	D	U	D	U	D	C
Archidistoma psammion									X
Distaplia occidentalis									X
Euherdmania claviformis									X
Mogula regularis									X
Cnidaria									
Anthozoa									
Anthopleura elegantissima	X	X	X	X	X	X	X	X	
Anthopleura xanthogrammica				X					
Hydrozoa									
Abietinaria Sp.								X	
Aglaophenia Sp.				X				X	
Sertularella sp.									X
Echinodermata									
Asteroidea									
Henricia leviuscula		X							
Leptasterias hexactis									X
Leptasterias pusilla	X	X	X	X	X	X		X	
Patiria miniata	X		X						
Pisaster giganteus									X
Pisaster ochraceus	X		X		X		X		
Echinoidea									
Strongylocentrotus purpuratus	X	X	X	X	X	X	X		

Table 1.1.13-6. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to South Point, Santa Rosa Island. Additional species collected at the study site (C) , but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued).

Species and Taxa	Oct. 1976		Dec. 1976		Mar. 1977		June 1977		
	U	D	U	D	U	D	U	D	C
Mollusca									
Bivalvia									
Brachidontes adamsianus		X		X		X		X	
Hiatella arctica	x					X			
Lasaea subviridis		X		X		x	X	X	
Modiolus capax		X				X			
Modiolus carpenter.								X	
Mytilus californianus	X	X	X	X	X	X	X	X	
Mytilus edulis		X						X	
Semele rupicola		X		X					
Septifer bifurcates		X		X		X		X	
Septifer bifurcates/ Brachidontes adamsianus	X		X		X		X		
Gastropoda									
Acanthina punctulata	X								
Acanthina spirata								X	
Acteocina harpa								X	
Acmaea (Collisella) asmi									X
Acmaea (Collisella) digitalis	X	X	X	X	X	X	X	X	
Acmaea (Notoacmea) insessa	X		X						
Acmaea (Collisella) limatula	X	X	X		X	X	X	X	
Acmaea (Acmaea) mitra									X
Acmaea (Notoacmea) paleacea							X		
Acmaea (Collisella) pelts	X	X	X	X	X	X	X	X	
Acmaea (Collisella) scabra	X	X	X	X	X	X	X	X	
Acmaea (Collisella) strigatella	X	X	X		X		X		
Acmaea (Notoacmea) scutum							X		
Amphissa versicolor					X	X		X	
Amphithalamus spp.						X		X	
Barleeia spp.		X		X		X		X	
Cerithiopsis carpenter				X		X		X	

Table 1.1.13-6. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to South Point, Santa Rosa Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed quadrats, are indicated in the right-hand column. (Continued).

Species and Taxa	Oct. 1976		Dec. 1976		Mar. 1977		June 1977		
	U	D	U	D	U	D	U	D	C
Cerithiopsis cosmia								X	
Conus californicus						X		X	
Doriopsilla albopunctata									X
Epitonium tincture			X	X		X		x	
Fissurella volcano	X	X	X	X	X	X	X	X	
Haliotis cracherodii	X		X		X		X	X	
Homalopoma luridum				X		X		X	
Lacuna marmorata		X				X		X	
Lacuna porrecta								X	
Lacuna unifasciata			X	X		X		x	
Littorina planaxis	X	X	X	X	X	X	X	X	
Littorina scutulata	X	X	X	X	X	X	X	X	
Lottia gigantea	X	X	X	X	X	X	x	X	
Mitrella carinata			X	X		X		X	
Mitromorpha gracilior						X			
Nucella (Thais) emarginata	X	X	X		X	X	X	x	
Ocenebra atropurpurea						X			
Ocenebra circumtexta		X	X				X	X	
Olivella biplicata		X	X						
Opalia funiculata						X		X	
Seila montereyensis								X	
Serpulorbis squamigerus	X		X						
Tegula funebralis	X		X		X		X	X	
Tricolia pulloides				X				X	
Triphora pedroana						X		X	
Turbonilla kelseyi						X			
Polyplacophora									
Cyanoplax dentiens									X
Cyanoplax hartwegii	X	X	X	X	X	X	X	X	
Mopalia ciliata									X

Table 1.1.13-6. Presence of Macroinvertebrates in Undisturbed (U) and Disturbed (D) Quadrats during the Quarterly Visits to South Point, Santa Rosa Island. Additional species collected at the study site (C), but not present in undisturbed or disturbed! quadrats, are indicated in the right-hand column. (Continued).

Species and Taxa	Ott. 1976		Dec. 1976		Mar. 1977		June 1977		
	U	D	U	D	U	D	U	D	C
Mopalia muscosa			X	X		X	X	X	
Nuttallina californica		X		X		X		X	
Nuttallina fluxa		X		X		X		X	
Nuttallina fluxa/californica	X		X		X		X		
Tonicella lineata									X
Porifera									
Calcarea									
Lucetta losangelensis									
Demospongiae									
Axocielita originalis									X
Cliona sp.									X
Lissodendoryx firma									X
Plocamia karykina					X				
Suberites ficus									X
Tethya aurantia var. californiana		X							
106 Total Macroinvertebrates									

1.1.13.4.2 Standing crop

1.1.13 .4.2.1 Cover

Total macrobiotic cover averaged 128.6% with a macrophyte component of 98.9% and a macroinvertebrate component of 29. 7% (Tables 1.1.13-7 and 1.1.13-8). Macrobiotic cover ranged from a maximum of 132. O% in October to a minimum of 124.1% during March.

Total macrophy te cover ranged between 97. 7% in Decmeber and 100.4% in October (Table 1.1 .13-7). Macrophyte cover was 82. 9% at +10.0 to +11.0 ft. (3.0 to 3.3 m) and increased rather uniformly with decreasing tidal height to 111.0% at the +1.0 to +2. O-ft. (.3 m to .6-m) interval.

Total macroinvertebrate cover varied from 26. 2% in March to 31 .6% in October and followed a seasonal pattern of variation which is similar to that for the macrophytes (Table 1.1. 13-8). There were two tidal levels ion which peaks of macr oinver tebr ate cover were r cached; the intervals from +2.0 to +6.0 ft. (.6 m to 1.8 m) averaged 60.0% and the isolated interval from +7.0 to +8.0 ft . (2.1 to 2.4 m) averaged 34.6%.

Total macrophyte cover within intervals (Tables 1.1. 13-7) did not vary appreciably between seasons with the exception of the +2.0 to +3. O- ft. (.6 to 1.8-m) interval which ranged from a minimum of 100.9% in December to a maximum of 11 8.3% in October . Seasonal variation in both macrophy te and macroinver tebrate cover for the +1 .0 to +2. O-f t. (.3 m to . 6-m) interval is questi enable because only one sample was contained in the interval. Total macr oinver tebr ate cover within intervals displayed much greater seasonal variability. Macroinvertebrate cover between +2.0 and +6. O ft. (.6 and 1.8 m) indicates a general trend towards minimal values in March and maximal values in October or June. Cover at the +5.0 to +6. O-ft. (1.5 m to 1. 8-m) level, for example, ranged from 44.3% in March to 51.8% in October . The minimal macr oinver tebr ate cover for the +3. O to +4. O-f t. (-.9 m to 1.2-m) interval during March was partially a reflection of an inadver tent removal of My tilus calif ornianus by mussel collectors which took place prior to that visit.

Seasonal total cover of dominant macrophy tes is repor ted in Table 1.1.13-9. Blue-green algae and Phyllospadix scouleri had the greatest annual mean cover , with 65.6% and 13.6%, respectively. The remaining taxa all averaged less than 4.0%. Cumulatively , the first seven taxa (blue-green algae , P. scouleri , Endoplura aurea, Corallina vancouveriensis , Endocladia muricata , Gigar tina canaliculata , Ulva lobata, and C. of ficinalis vsr . chilensis) averaged 90% cover . A total of 48 other macrophytes comprised the remaining 10% cover .

TABLE 1.1.13-7. SEASONAL AND ANNUAL PATTERNS OF OVERALL MACROPHYTE COVER(%) AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND.

SEASON		TIDAL HEIGHT(FT). 1.0 To 1.9	2,0 TO 2.9	3.0 TO 3.9	4.0 To 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.3	9.0 TO 9.9	10.0 TO 10.9
OCTOBER	1976	120.5	118.3	104.1	98.5	96.3	96.6	99.0	93.2	94.9	63.0
DECEMBER	1976	106.9	100.9	104.0	97.7	98.9	97*9	98*5	93.3	94.3	83.0
MARCH	1977	107,5	102.6	102.7	99,9	100.3	96,7	97.7	93.4	96,0	a2.7
JUNE	1977	107.2	112.2	102*1	101.2	99,9	98.4	99.6	96.0	36.0	83.0
MEAN		111.0	108.5	103.2	99.3	98.8	97.4	56.7	94.0	55.3	82.9

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-8. SEASONAL AND ANNUAL PATTERNS OF OVERALL MACRO-INVERTEBRATE COVER (%) AS A FUNCTION O TICAL HEIGHT FOR SANTA ROSA ISLAND.

SEASON		TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 To 19.9
OCTOBER	1976	14.6	68.7	52.4	69.9	51.8	13.6	39.5	4.2	1.1	0.1
DECEMBER	1976	0.2	67.5	47.5	78.1	49.1	13.3	33*3	3.9	1.8	0.6
MARCH	1977	0.1	64.8	30.9	70.2	44.3	12.4	34.7	3.8	0.5	0.1
JUNE	1977	0.1	88.1	46.0	80.0	50.8	13.7	30.9	3.4	0.6	0.1
MEAN		3.7	72.3	44.2	74.5	49.0	13.3	34.6	3.8	1.0	0.2

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-9. QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SANTA ROSA ISLAND.

TAXA	COVER (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
BLUE-GREEN ALGAE	61.0	65.8	67.4	66.0	65.6
PHYLLOSPADIX SCOULERI	15.7	13.3	12.6	12.7	13.6
ENDOPLURA AUREA	3.1	3.7	3.2	3.6	3.4
CORALLINA VANCOUVERIENSIS	2.4	3.2	2.6	2.0	2.6
ENDOCLADIA MURICATA	3.6	2.4	1.9	1.8	2.4
GIGARTINA CANALICULATA	1*7	1.1	1.1	1.9	1.4
ULVA LOBATA	2.1	1.2	1.1	1.2	1.4
CORALLINA OFFICINALIS VAR. CHILENSIS	0.8	1.0	1.9	0.7	1.1
RALFSIACEAE	0.7	1.1	0.6	0.6	0.7
CERAMIUM EATONIANUM/SINICOLA	2.4	<0.1	0.2	0.1	0.7
RHODOGLOSSUM AFFINE	0.7	0.5	0.6	0.7	0.6
SMITHORA NAIADUM	0.7	0.5	0.3	0,9	0.6
HYDROLITHON DECIPIENS	0.4	0.7	0.5	0.4	0.5
EGREGIA MENZIESII	1.2	0.3	0.2	0.2	0.5
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	0.5	0.5	0.6	0,2	0.5
GELIDIUM COULTERI	0.5	0.3	0.2	0.8	0.4
PORPHYRA PERFORATA	<0.1	<O*1	<0.1	1.4	0.3
LITHOPHYLLUM PROBOSCIDEUM	0,3	0.3	0.4	0.3	0.3
CLADOPHORA COLUMBIANA	0,4	0"2	0.3	0.3	0.3
CORALLINE CRUSTS	0.3	0.3	0.2	<0,1	0.2
PHYLLOSPADIX SCOULERI BLEACHED	0 , 0	<0.1	0.6	0.3	0.2
CRYPTOPLEURA VIOLACEA	0.5	<0.1	0.1	<0.1	0,2
LAURENCIA SPECTABILIS	<0.1	0.2	0.3	0.2	0.2
HYDROLITHON DECIPIENS BLEACHED	0,0	0.2	0.3	<0.1	4.1
GRATELOUPIA DORYPHORA	0.5	0.0	0*CI	<0,1	0.1
OTHER MACROPHYTES	0.8	1.0	0.7	1.1	
NUMBER OF OTHER TAXA	(26)	(29)	(33)	(25)	

NOTE: 1 FOOT = 0.3048 METERS

Seasonal changes in mean macrophyte cover were not consistent; however , the majority showed cover minima occurring during March. Cover of blue-green algae varied from a minimum of 61. 0% in October to a maximum of 68.0% in June. Phy llospadix scouleri , the other dominant, reached a minimum cover of 12. 6% in March and a maximum of 15. 7% in October .

Seasonal and annual total cover for macroinver tebr ates is indicated in Table 1.1.13-1o. Four taxa occupied 90% of the total macr oinver tebr ate cover (29.8%); they were: Mytilus californianus with an annual mean cover of 11. 6%; Phragmatopoma californica, 9.1 %; Chthamalus fissus/dalli, 4. 2%; and Balanus glandula, 2. 5%. A total of 34 other macroinvertebrate taxa comprised the remaining cover (2.4%) . Seasonal variations in cover of the dominant macroinvertebrates indicate a preponder ante of minimal values during March, with maximal values distributed evenly between the other three seasons. Extreme seasonal variation in cover did not occur among the dominant macr oinver tebr ates.

Seasonal and total macrophy te cover distributions (as a function of tidal interval) are presented in Figures 1.1.13-3 through 1.1.13-7 and Table 1.1.13-11. The corresponding data for macr oinver tebrates are presented in Figures 1.1.13-8 through 1.1.13-12 and Table 1.1.13-12. There was no obvious seasonal trend with respect to tidal ranges. The modal macrophyte range was +1.0 ft. (.3 m). The macrophy tes with the widest mean range were blue-green algae [+1 .0 to +11 .0 ft. (.3 m to 3.3 m)] and Ralfsiaceae [+2.0 to +9.0 ft. (.6 m to 2.7 m)]. Macroinvertebrates also did not indicate a clear seasonal trend in tidal height ranges. The modal macr oinver tebr ate range was also 1.0 ft. (.3 m). The macroinver tebr ates with the widest mean range were Littorina planaxis [+3.0 to +11.0 ft. (.9 to 3.3 m)] , Chthamalus fissus/dalli [+3.0 to +11.0 ft. (.9 to 3.3 m)], L. scutulata [+2.0 to +10.0 ft. (.6 to -3.0 m)] and Acmaea (Collisella) digitalis [+2.0 to +10.0 ft. (.6 m to-3. 0 m)].

Above +7.0 ft. **(2.1 m)** the dominant macr ophy te was blue-green algae. Blue-green algae were pr eminent throughout all intervals except from +1.0 to +2.0 ft. (.3 to .6 m) and showed little seasonal variability (Tables 1.1.13-13 through 1.1.13-16).

The only pr eminent macr oinver tebr ate above +7. 0 ft. (2.1 m) was Chthamalus fissus/dalli (Tables 1.1.13-17 through 1. 1.13-20), which reached maximum cover in the +7.0 to +8.0 ft. (2.1 to 2.4 m) interval. **The** cover of C. fissus/dalli varied seasonally from a minimum of 27.5% in June to a 'maximum of 35.0% in October within the +7.0 to +8. 0-ft. (2.1 to 2.4-m) interval.

Between +5.0 and +7.0 ft. (1 .5 and 2.1 m), the macrophytes with the greatest cover were Ralfsiaceae , Endocladia muricata, and Endoplura aurea. Ralfsiaceae reached a maximum cover between +5. 0 and +6. 0 ft.

TABLE 1.1.13-10. QUARTERLY AND ANNUAL MEAN COVER (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SANTA ROSA ISLAND.

TAXA	COVER (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
MYTILUS CALIFORNIANUS	12.5	12.2	i n . t l	11.0	11.6
PHRAGMATOPOMA CALIFORNICA	10.0	7.9	7.6	10.8	9.1
CHTHAMALUS FISSUS AND DALLI	4.8	3.9	4.2	3.8	4.2
BALANUS GLANDULA	2.3	2.4	1.7	3.6	2.5
LITTORINA PLANAXIS	0.3	0.7	0.2	0.3	0.4
ANTHOPLEURA ELEGANTISSIMA	0.2	0.5	0.3	0.2	0.3
LOTTIA GIGANTEA	0.2	0.3	0.2	0.2	0.2
POLLICIPES POLYMERUS	0.2	0.2	0.2	0.2	0.2
CHTHAMALUS FISSUS & DALLI DEAD	0.2	0.2	0.2	0.2	0.2
TETRACLITA SQUAMOSA RUBESCENS	0.1	0.1	0.1	0*2	0.1
ACMAEA (COLLISELLA) SCABRA	<0,1	0*1	<G* I	0.1	0.1
SEPTIFER BIFURCATUS AND BRACHIDONTES	<0.1	0.1	<0.1	0.2	0.1
BALANUS GLANDULA DEAD	0.2	<0.1	O*1	<0.1	0.1
LITTORINA SCUTULATA	<0.1	0,2	<0.1	<0.1	0.1
OTHER MACRO-INVERTEBRATES	0.4	0.7	0.4	0,4	
NUMBER OF OTHER TAXA	(21)	(26)	(23)	(23)	

NOTE: 1 FOOT = 0.3048 METERS

FIGURE 1.1.13-w. MEAN DISTRIBUTION OF DOMINANT $ GROUP HYTE COVER AS A FUNCTION OF TIDAL HEIGHT -1 DURING 1976/1977 A SAN A ROSA ISLAND (CONTINUED).

FIGURE 1.1.13-3. MEAN CHARACTERIZATION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SANTA ROSA (CONTINUED).

FIGURE 1.1.13-3. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SANTA ROSA ISLAND (CONTINUED).

FIGURE 1.1.13-3. MEAN ±STANDARD DEVIATION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF -1 TIDAL HEIGHT DURING 1976/1977 AT SANTA ROSA ISLAND (CONTINUATION).

FIGURE 1.1.13-4. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA ROSA ISLAND (CONTINUED).

FIGURE 1.1.13-4. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA ROSA ISLAND (CONTINUED).

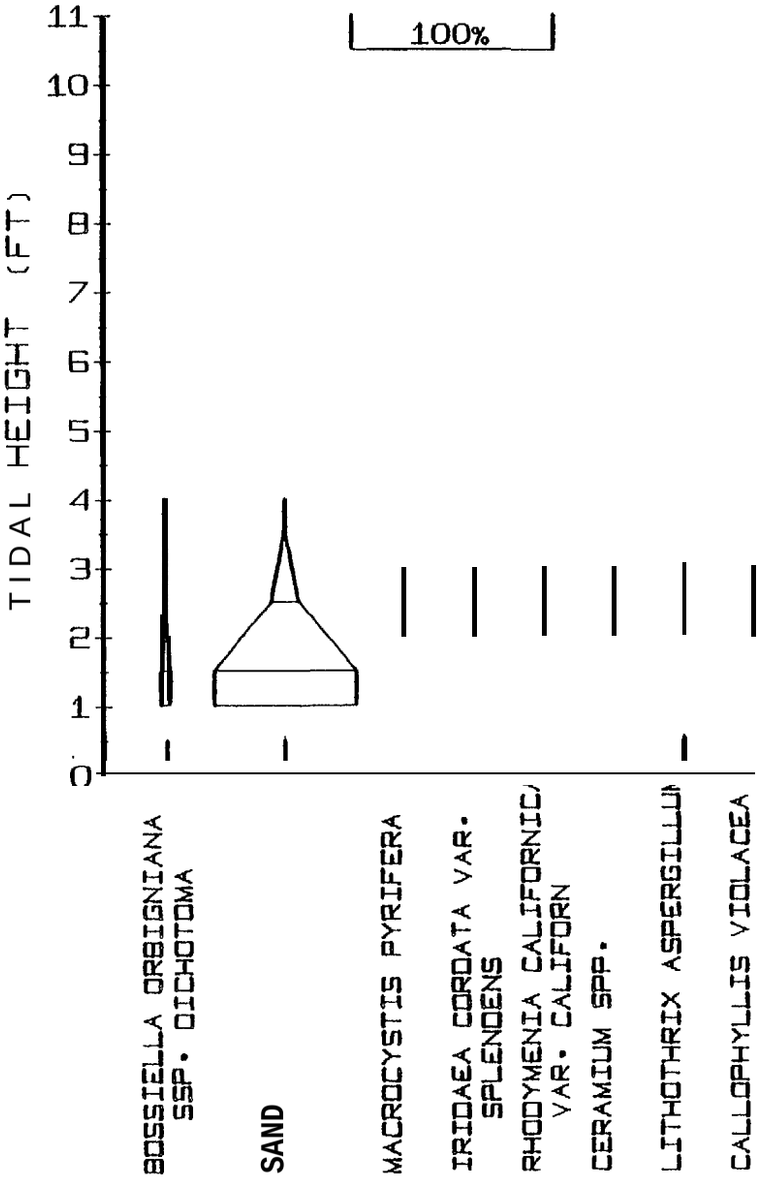

FIGURE 1. . "-4. DISTRIBUTION OF DOMINAN MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA ROSA ISLAND (CONTINUATION).

FIGURE 1.1-5. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN ROSA ISLAND (CONTINUED).

FIGURE 1.1.W-5. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA ROSA ISLAND (CONTINUED).

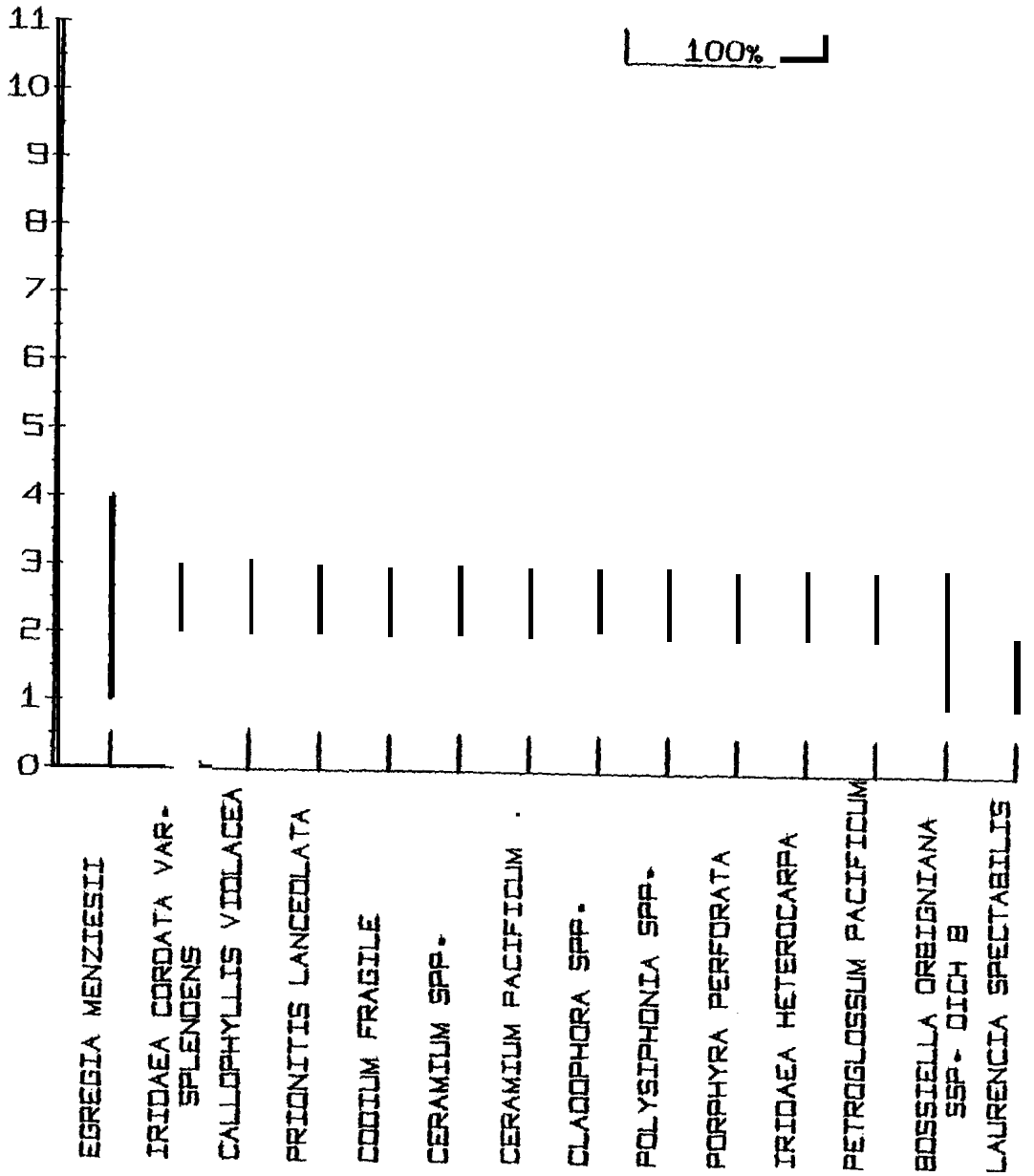

FIGURE .1.13-5. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA ROSA ISLAND (CONTINUATION).

FIGURE 1.1.13-6. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SANTA ROSA ISLAND (CONTINUED).

FIGURE 1.1.13-6. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SANTA ROSA ISLAND (CONTINUED)

FIGURE 1.1.13-6. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SANTA ROSA ISLAND (CONTINUATION).

FIGURE 1.1.1-7. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 AT SANTA ROSA ISLAND (CONTINUED).

FIGURE 1.1.13-7.

DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 AT SANTA ROSA ISLAND (CONTINUED).

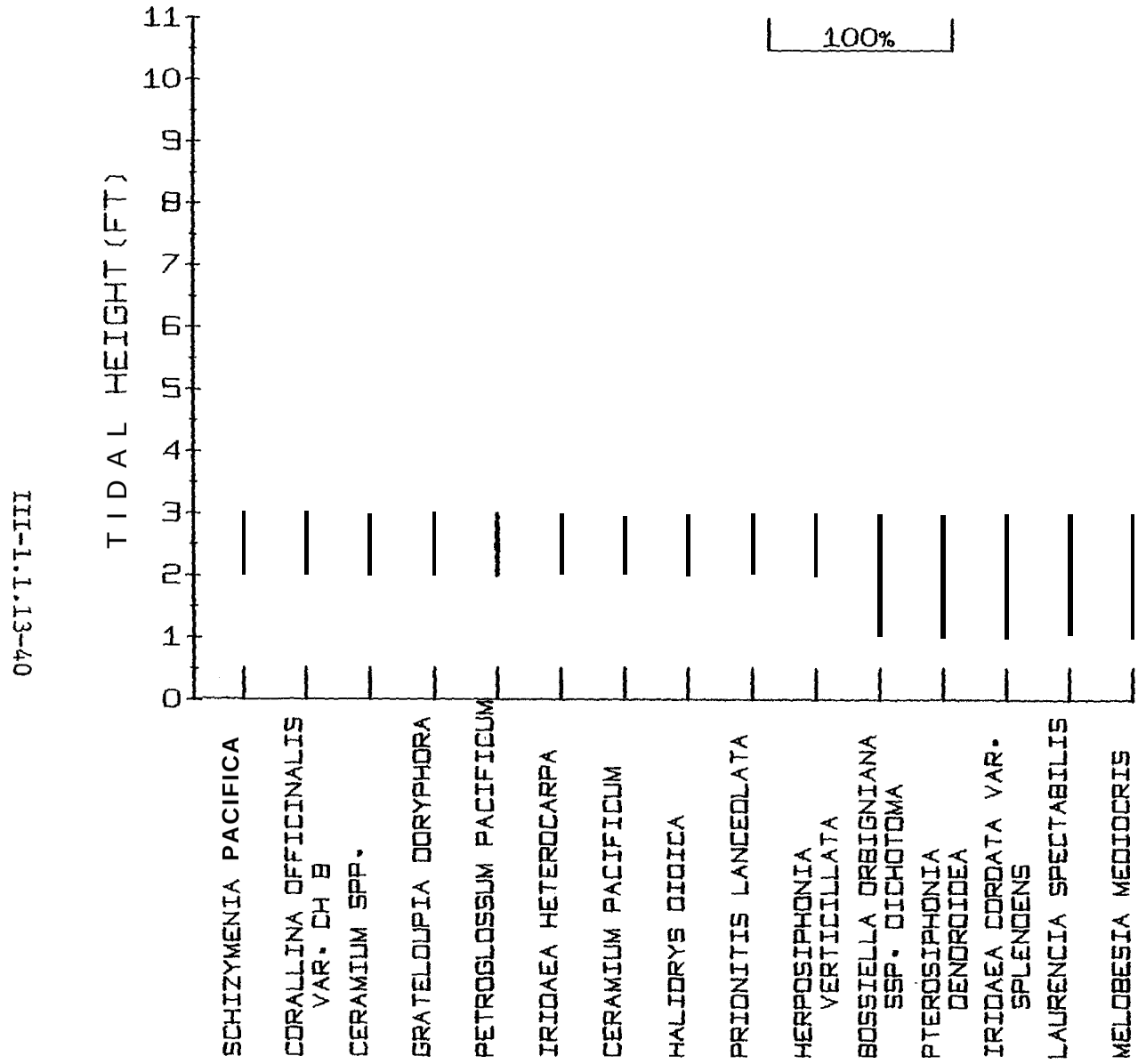

FIGURE 1.1.13-7. DISTRIBUTION OF DOMINANT MACROPHYTE COVER AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 AT SANTA ROSA ISLAND (CONTINUATION).

ABLE 1.1. 3-11. ANNUAL MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING 1976/1977, DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS CONTINUED ON NEXT PAGE).

	TIDAL HEIGHT (FT).									
AXA	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
BLUE-GREEN ALGAE	1.0	22.7	35.8	76.4	77.0	75.3	95.2	94.0	95.3	82.9
RALFSIACEAE		<0.1	2.0	1.1	3.8	0.3	0.1	<0.1		
ENDOCLADIA MURICATA			<0.1	2.1	6.3	15.5	0.4			
HYDROLITHON DECIPIENS			<0.1	0.6	2.3	0.9	1.2			
HYDROLITHON DECIPIENS BLEACHED			<0.1	<0.1	1.2	<0.1	<0.1			
CHAETOMORPHA LINUM			<0.1		<0.1	0.4	<0.1			
CERAMIUM EATONIANUM/SINICOLA		0.4	5.3	0.9	0.2	0.2	<0.1			
POLYSIPHONIA HENDRYI VAR HENDRYI		0.3	0.2				<0.1			
ENDOPLURA AUREA		<0.1	14.7	13.6	3.3	0.5	1.6			
ENDOCLADIA MURICATA BLEACHED					<0.1	0.3				
CYLINDROCARPUS RUGOSUS			0.1	0.2	<0.1	<0.1				
CLADOPHORA COLUMBIANA		0.4	0.5		0.2	2.0				
COPALLINE CRUSTS		<0.1	1.2	0.9	0.2	<0.1				
CLADOPHORA SPP.		0.2	<0.1			<0.1				
PORPHYRA PERFORATA		0.2	1.4	0.6	1.2	<0.1				
RHODOGLOSSUM AFFINE		4.1	1.6	0.1	0.5	<0.1				
ULVA LOBATA	<0.1	6.5	4.0	0.2	1.7	1.8				
CORALLINA OFFICINALIS VAR. CHILENSIS	0.3	5.0	4.7	0.7	<0.1	<0.1				
GIGARTINA CANALICULATA	1.5	7.0	6.0		<0.1	<0.1				
ENTEROMORPHA SP.			0.2	<0.1	<0.1					
GELIDIUM COULTERI		1.3	3.0	0.2	<0.1					
LITHOPHYLLUM PROBOSCIDEUM BLEACHED		<0.1	0.3	<0.1	<0.1					
GIGARTINA SPINOSA	<0.1	0.3	<0.1	<0.1	<0.1					
LITHOPHYLLUM PROBOSCIDEUM	<0.1	0.4	0.9	1.3	0.6					

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-11. ANNUAL MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING 1976/1977, DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUATION).

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	TIDAL HEIGHT (FT.)									
AXA	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
GASTROCLONIUM COULTERI		0.2	<0.1	<0.1						
LAURENCIA LAJOLLA		0.3	0.2	<0.1						
CERAMIUM SPP.		0.4	<0.1							
HERPOSIPHONIA PLUMULA		0.1	<0.1							
GRATELOUPIA CORYPHORA		1.3	<0.1							
PHYLLOSPADIX SCOULERI BLEACHED		0.4	1.8							
PHYLLOSPADIX SCOULERI	92.1	31.9	11.7							
SMITHORA NAIADUM	4.1	1.6	0.3							
MELOBESIA MEMBRANACEA	0.3	0.3	0.1							
CORALLINA VANCOUVERIENSIS	3.0	17.5	5.1							
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	3.6	0.6	0.3							
EGREGIA MENZIESII	2.1	1.8	0.6							
CRYPTOPLEURA VIOLACEA	0.8	0.7	0.3							
LAURENCIA SPECTABILIS	1.5	<0.1	<0.1							
PETROGLOSSUM PACIFICUM		0.3								
IRIDAEA HETEROCARPA		0.2								
MACROCYSTIS PYRIFERA		0.2								
PTEROSIPHONIA DENDROIDEA	0.3	<0.1								
IRIDAEA CORDATA VAR. SPLENDENS	<0.1	0.4								

NOTE: 1 FOOT = 0.3048 METERS

FIGURE 1.1.13-8. MEAN DISTRIBUTION OF MACRO-INVERTEBRATE COVER AS A FUNCTION OF HEIGHT DURING 1976/1977 ROSA ISLAND (CONTINUED).

FIGURE 1.1.13-8. MEAN DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SANTA ROSA ISLAND (CONTINUED).

FIGURE 1.1.13-8. MEAN DISTRIBUTION OF DOMINANT MACROINVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SANTA ROSA ISLAND (CINCINNATUS ON).

FIGURE 1.1.13-9. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA ROSA ISLAND (CONTINUED).

FIGURE 1.1.13-9.

DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT MAN'A ROSA ISLAND (CONTINUATION).

FIGURE 1.1.13-10. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA ROSA ISLAND (CONTINUED).

FIGURE .1.13-10. U.S. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA ROSA ISLAND (NOAA INUATION).

FIGURE 1.1.13-11. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SANTA ROSA ISLAND (CONCLUDED).

FIGURE 1.1.13-11. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SAN IA ROSA ISLAND (NOAA STATION).

FIGURE 1.1.13-12. DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 AT SANTA ROSA (S-6) (CONTINUED).

FIGURE 1.1.13-12.

DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE COVER AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 AT MANTA ROSA ISLAND CONTINUOUS

TABLE 1.1.13-12. ANNUAL MEAN COVER (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING 1976-1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS.

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
LITTORINA PLANAXIS			<0.1	<0.1	0.2	0.2	1.7	0.6	0.8	0.2
CHTHAMALUS FISSUS AND DALLI			<0.1	0.1	0.2	0.1	30.4	2.9	0.1	<0.1
LITTORINA SCUTULATA		<0.1	<0.1	<0.1	0.2	0.4	0.3	<0.1	<0.1	
ACMAEA (COLLISELLA) DIGITALIS		<0.1	<0.1	0.2	0.2	0.2	0.2	<0.1	<0.1	
CHTHAMALUS FISSUS & DALLI DEAD					<0.1	0.5	1.1	<0.1		
ACMAEA (COLLISELLA) SCABRA		<0.1	0.2	0.3	0.4	0.1	<0.1	<0.1		
SEPTIFER BIFURCATUS AND BRACHIDONTES		<0.1	<0.1	<0.1	<0.1	0.6	<0.1	<0.1		
BALANUS GLANDULA		<0.1	5.8	13.1	3.7	1.4	0.8	<0.1		
BALANUS GLANDULA DEAD			0.3	0.3	0.2	0.2	<0.1			
MYTILUS CALIFORNIANUS		0.5	17.4	55.8	41.2	1.1	<0.1			
LOTTIA GIGANTEA			0.6	1.3	0.4	<0.1				
NUTTALLINA FLUXA/CALIFORNICA		<0.1	<0.1	<0.1	0.2	<0.1				
TETRACLITA SQUAMOSA RUBESCENS		<0.1	0.7	0.5	0.2	<0.1				
POLLICIPES POLYMERUS		<0.1	1.2	0.5	0.2	<0.1				
ACMAEA (COLLISELLA) PELTA		<0.1	<0.1	0.1	<0.1	<0.1				
HALIOTIS CRACHERODII		0.2	<0.1		<0.1					
ANTHOPLEURA ELEGANTISSIMA	<0.1	0.7	0.7	1.1	0.3					
PHRAGMATOPOMA CALIFORNICA	3.6	69.6	16.3	0.5	0.6					
STRONGYLOCENTROTUS PURPURATUS		0.6	<0.1	<0.1						
PISASTER OCHRACEUS		0.3	0.5							

NOTE: 1 FOOT = 0.3048 METERS

ABLE 1.1.13-13. MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING OCTOBER 197[illegible], BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

	TIDAL HEIGHT (F								
AXA	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
BLUE-GREEN ALGAE		.1	28.7	72.5	73.6	62.6	94.9	93.2	94.9	85.0
ENDOCLADIA MURICATA				2.3	8.4	24.8	0.2			
RALFSIACEAE			1.2	1.5	4.0	0.3	<0.1			
ENDOPLURA AUREA			12.7	13.2	2.6	0.2	2.2			
HYDROLITHON DECIPIENS			<0.1	<0.1	1.7	6.7	1.7			
CERAMIUM EATONIANUM/SINICOLA		1.0	18.3	3.7	0.6	0.6	<0.1			
ENDOCLADIA MURICATA BLEACHED						<0.1				
POLYSIPHONIA SPP.						<0.1				
CHAETOMORPHA LINUM						0.7				
CLADOPHORA SPP.						<0.1				
CLADOPHORA COLUMBIANA		<0.1	<0.1		0.4	3.2				
CORALLINA OFFICINALIS VAR. CHILENSIS		4.5	3.1	0.4	<0.1	<0.1				
ULVA LOBATA		12.4	2.5	0.6	3.0	2.9				
PRODOBLOSSUM AFFINE		4.1	1.8	<0.1	1.0	0.2				
CORALLINE CRUSTS		<0.1	0.6	1.9	0.4	<0.1				
GIGARTINA CANALICULA A	2.5	8.9	5.7			<0.1				
PORPHYRA PERFORATA					<0.1					
GIGARTINA LEPTORHYNCHOS					<0.1					
HEMALION HELMINTHOIDES					<0.1					
HETEROSIPHONIA SP.				<0.1	<0.1					
CYLINDROCARPUS RUGOSUS			0.4	0.6	<0.1					
GIGARTINA SPINOSA		<0.1	<0.1		<0.1					
LITHOPHYLLUM PROBOSCIDEUM		0.2	1.0	1.4	0.3					
CODIUM FRAGILE				<0.1						

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13- 3. MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
GASTROCLONIUM COULTERI		<0.1		<0.1						
LAURENCIA LAJOLLA		0.2	0.2	<0.1						
GELIDIUM COULTERI		2.5	2.7	0.2						
CALLITHAMNION RUPICOLUM			<0.1							
GELIDIUM PURPURASCENS			0.3							
CORALLINE CRUST BLEACHED			0.1							
POLYSIPHONIA HENDRYI VAR HENDRYI			<0.1							
LAURENCIA SPECTABILIS			<0.1							
COLPOMENIA SINUOSA		0.2	<0.1							
GRATELOUPIA DORYPHORA		5.1	0.2							
CERAMIUM PACIFICUM		6.2	<0.1							
HERPOSIPHONIA PLUMULA		<0.1	<0.1							
CRYPTOPLEURA VIOLACEA	3.0	1.3	0.3							
MELOBESIA MEDIOCRIS	1.0	0.5	0.4							
PHYLLOSPADIX SCOULERI	97.0	43.0	16.9							
SMITHORA NAIADUM	4.0	2.6	0.8							
EGREGIA MENZIESII	5.0	4.9	1.8							
CORALLINE VANCOUVERIENSIS	3.5	16.4	3.8							
POSSIELLA ORBIGNIANA SSP. DICHOTOMA	4.5	0.7	0.2							
MACROCYSTIS PYRIFERA		0.8								
IRIDAEA CORDATA VAR. SPLENDENS		0.9								
RHODYMENIA CALIFORNICA VAR. CALIFORN		0.3								
CERAMIUM SPP.		0.4								
LITHOTHRIX ASPERGILLUM		<0.1								

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-13. MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED).

	TIDAL HEIGHT (FT),									
^^A	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
CALLOPHYLLIS VIOLACEA		< .1								

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-14. MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING DECEMBER 1976, BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT), 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
BLUE-GREEN ALGAE		24.0	43.4	4.7	76.6	74.6	94.0	93.3	94.3	83.0
RHODOCLADIA MURICATA				2.5	5.9	15.4	0.6			
RALFSIACEAE			3.0	1.2	5.5	0.6	0.4			
ENDOPLURA AUREA			15.7	5.3	3.4	0.8	1.6			
HYDROLITHON DECIPIENS			<0.1	0.7	2.9	1.6	1.7			
POLYSIPHONIA HENDRYI VAR HENDRYI			<0.1				0.3			
CHAETOPTERA LIMUM			<0.1			0.5	<0.1			
RHODOCLADIA MURICATA BLEACHED					<0.1	1.2				
HYDROLITHON DECIPIENS BLEACHED			<0.1	<0.1	1.6	<0.1				
CYLINDROCARPUS RUGOSUS			0.1	0.3		<0.1				
CORALLINA OFFICINALIS VAR. CHILENSIS		3.5	5.0	1.1	0.1	<0.1				
CLADOPHORA COLUMBIANA		<0.1	0.2		0.2	1.3				
ULVA LOBATA		6.6	1.8	<0.1	1.4	1.8				
RHODOGLOSSUM AFFINE		3.5	0.6	0.3	0.4	0.2				
ULVA LOBATA BLEACHED					<0.1					
LITHOPHYLLUM PROBOSCIDEUM		0.5	0.6	1.5	0.4					
LITHOPHYLLUM PROBOSCIDEUM BLEACHED		<0.1	0.6	<0.1	<0.1					
GELIDIUM COULTERI		0.2	2.4		<0.1					
SCYTOSIPHON LOMENTARIA				<0.1						
CORALLINE CRUSTS		<0.1	3.2	0.3						
CERAMIUM EATONIANUM/SINICOLA			0.6							
HERPOSIPHONIA PLUMULA			<0.1							
CALLITHAMNION RUPICOLUM			<0.1							
PHYLLOSPADIX SCOULERI BLEACHED			<0.1							

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-14. MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING DECEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3*O TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9*O TO 9.9	10.0 TO 10.9
GIGARTINA LEPTORHYNCHOS			0.2							
CORALLINE CRUST BLEACHED			<0.1							
CORALLINA OFFICINALIS VAR, CH B		<0.1	0.2							
EASTROCLONIUM COULTERI		0.3	<0.1							
COLPOMENIA SINUOSA		<0.1	<0.1							
LAURENCIA LAJOLLA		0.6	0.2							
CORALLINA VANCOUVERIENSIS BLEACHED		0.4	0.2							
GIGARTINA SPINOSA	0.8	0.3	<0.1							
CRYPTOPLEURA VIOLACEA	<0.1	0.6	<0.1							
CORALLINA VANCOUVERIENSIS	3.5	21.8	6.3							
EGREGIA MENZIESII	1.0	1.3	0.8							
BOSSIELLA CROCKIANA SSP, DICHOTOMA	3.3	0.7	0.6							
GIGARTINA CANALICULATA	3.3	4.0	3.6							
PHYLLOSPADIX SCOULERI	90.3	28.9	14.3							
MELOBESIA MEDIOCRIS	<0.1	0.1	<0.1							
SPITHORA NAIADUM	5.0	< C I	<0.1							
IRIDAEA CORDATA VAR, SPLENDENS		A*5								
PTILOTIS LANCEOLATA		<0.1								
PORPHYRA PERFORATA		<0.1								
CODIUM FRAGILE		<0.1								
CERAMIUM SPP.		0.4								
CERAMIUM PACIFICUM		<0.1								
CLADOPHORA SPP.		<0.1								
POLYSIPHONIA SPP.		0.2								

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1. 3-15. MEAN COVER %) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING DECEMBER 1976, BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT), 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
PETROGLOSSUM PACIFICUM		0.4								
IRIDAEA PETEROCARPA		0.5								
CALLOPHYLLIS VIOLACEA		0.2								
BOSSIELLA ORBIGNIANA SSP. DICH B	<0.1	<0.1								
LAURENCIA SPECTABILIS	1.6									

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-15. MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING MARCH 1977. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
BLUE-GREEN ALGAE	4.0	22.0	38.9	82.1	79.7	80.4	94.5	93.3	96.0	82.7
RALFSIACEAE		<0.1	1.4	0.8	3.0	0.2	0.1	<0.1		
SCYTOSIPHON LOMENTARIA							<0.1			
POLYSIPHONIA SPP.							0.3			
HYDROLITHON DECIPIENS			0.2	0.3	2.9	0.8	1.0			
ENDOCLADIA MURICATA			0.2	1.5	5.4	11.4	0.2			
ENDOCLURA FUREA		<0.1	15.0	11.4	3.1	0.5	1.6			
ENDOCLADIA MURICATA BLEACHED					<0.1	<0.1				
HYDROLITHON DECIPIENS BLEACHED				0.2	3.0	0.2				
CHAETOMORPHA LIGNUM			<0.1		0.1	0.3				
CLADOPHORA COLUMBIANA		1.1	1.1		<0.1	1.2				
CLADOPHORA COLUMBIANA BLEACHED		<0.1				<0.1				
RHODOGLOSSUM AFFINE		5.2	1.0	<0.1	0.2	<0.1				
ULVA LOBATA		3.8	4.4	<0.1	1.6	1.5				
CORALLINA OFFICINALIS VAR. CHILENSIS	.0	7.7	9.1	1.2	0.1	<0.1				
ULVA LOBATA BLEACHED					<0.1					
CYLINDROCARPUS RUGOSUS			<0.1		0.1					
LITHOPHYLLUM PROBOSCIDEUM		0.9	1.0	1.2	0.8					
GIGARTINA CANALICULATA		5.9	4.8		<0.1					
CORALLINE CRUSTS		<0.1	0.9	0.6	0.2					
LITHOPHYLLUM PROBOSCIDEUM BLEACHED		<0.1	0.4	<0.1						
GELIDIUM COULTERI		0.3	1.9	<0.1						
ENDARACHNE BINGHAMIAE			<0.1							
CALLITHAMNION RUPICOLUM			<0.1							

NOTE: 1 FOOT = 0.3048 METERS

ABLE 1.1.13- 5. MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING MARCH 1977. BLANK SPACES INDICATE ZEROS (CONTINUED).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
CORALLINA VANCOUVERIENSIS BLEACHED		<0.1	<0.1							
PHYLLOSPADIX SCOULERI BLEACHED		1.5	4.4							
CERAMIUM EATONIANUM/SINICOLA		0.6	1.0							
CODIUM FRAGILE		<0.1	<0.1							
BENTHIC DIATOMS		<0.1	<0.1							
LAURENCIA LAJOLLA		<0.1	0.2							
CERAMIUM SPP.		0.4	<0.1							
COLPOMENIA SINUOSA		0.1	<0.1							
PORPHYRA PERFORATA		<0.1	<0.1							
SMITHORA NAIADUM	2.0	1.0	<0.1							
CORALLINA VANCOUVERIENSIS	2.0	10.8	6.9							
BOSSIELLA ORBIGNIANA SSP. DICH B	<0.1	<0.1	0.2							
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	5.0	0.5	0.3							
PHYLLOSPADIX SCOULERI	89.6	28.0	8.2							
CRYPTOPLEURA VIOLACEA	<0.1	0.3	0.8							
CORALLINA OFFICINALIS VAR. CH B	<0.1		<0.1							
EGREGIA MENZIESII	1.0	0.8	<0.1							
PRIONITIS LANCEOLATA		<0.1								
LITHOTHRIX ASPERGILLUM		<0.1								
CALLITHAMNION PIKEANUM		<0.1								
POLYSIPHONIA HENDRYI VAR HENDRYI		0.8								
CENTROCERAS CLAVULATUM		<0.1								
HERPOSIPHONIA PLUMULA		0.5								
CLADOPHORA SPP.		0.8								

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.13-15. MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING MARCH 1977. BLANK SPACES INDICATE ZEROS (CONTINUATION).

AXA	TIDAL HEIGHT (FT), 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
CERAMIUM PACIFICUM		<0.1								
GASTROCLONIUM COULTERI		<0.1								
GIGARTINA SPINOSA		0.5								
IRIDAEA CORDATA VAR. SPLENDENS		<0.1								
PETROGLOSSUM PACIFICUM		0.4								
HALICRYS DIOICA		<0.1								
NEMASTOMA VERTICILLATA		<0.1								
MELOBESIA PEDIOCRIS	<0.1	<0.1								
LAURENCIA SPECTABILIS	2.5									

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-16. MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING JUNE 1977. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT), 1.0 TO 1.9	2.0 TO 2.9	3.0 To 3.9	4.0 To 4.9	5.0 To 5.9	6.0 To 6.9	7.0 To 7.9	8.0 To 8.9	9.0 To 9.9	10.0 To 10.9
BLUE-GREEN ALGAE		37.8	32.4	76.1	78.2	85.5	97.3	96.0	96.0	83.0
HYDROLITHON DECIPIENS BLEACHED					0.4	0.2	<0.1			
ENDOCLADIA MURICATA				1.8	5.6	10.2	0.7			
PALFSIACEAE			2.3	0.9	2.6	<0.1	<0.1			
HYDROLITHON DECIPIENS			<0.1	1.3	1.6	O*3	0.6			
ENDOPLURA AUREA		<0.1	15.3	15.3	4.2	0.6	1.0			
ENDOCLADIA MURICATA BLEACHED						<0.1				
CHAETOMORPHA LINUM					0 . 2	0.2				
CORALLINE CRUSTS			<0.1,	0,6	<0.1	<0.1				
CLADOPHORA COLUMBIANA		0,3	U*5			2.3				
PORPHYRA PERFORATA		0.7	5.6	2.5	4.6	<0.1				
GIGARTINA CANALICULATA		9.1	9.8			<0.1				
ULVA LOBATA	<0,1	3.4	7.1	0.2	0.4	1.0				
GIGARTINA PAPILLATA			<0.1	<0.1	<0.1					
LITHOPHYLLUM PROBOSCIDEUM BLEACHED		<0,1	0.3	<0.1	0,3					
GELIDIUM COULTERI		2,0	4.9	0.0	<0.1					
RHODOGLOSSUM AFFINE		3.8	3.1	0.2	O*3					
LITHOPHYLLUM PROBOSCIDEUM	<0,1	<0.1	1.0	1.4	1.0					
HEMALION HELMINTHOIDES			<0.1	<0.1						
CERAMIUM EATONIANUM/SINICULA		<0.1	1*2	<0.1						
CORALLINA OFFICINALIS VAR. CHILENSIS		4.6	1.7	0,3						
GIGARTINA SPINOSA		O*3		<0.1						
ENTEROMORPHA SP.			1.0							
PTEROSIPHONIA BAILEYI			<0,1							

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-16. MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING JUNE 1977. BLANK SPACES INDICATE ZEROS (CONTINUED).

	TIDAL HEIGHT (FT),									
TAXA	1.0 TO 1.9	2*LJ TO 2.9	3,0 TO 3,9	4.0 TO 4.9	5.0 TO 5,9	6.0 TO 6.9	7.0 TO 10	8.0 TO 8,9	9.0 TO 9.9	10.0 TO 10.9
C(1R(ALJ-1IE CRUSTOBLEACHED			<0.1							
CORALLINA VANCOUVERIENSIS BLEACHED			<0,1							
CLADOPHORA SPP.			0,1							
GASTROCLONIUM COULTERI		0,6	<0,1							
LAURENCIA LAJOLLA		0,4	0.2							
COLPOMENIA SINUOSA		<0,1	<0.1							
PHYLLOSPADIX SCOULERI BLEACHED		<0,1	2,8							
POLYSIPHONIA HENDRYI VAR HENDRYI		0.9	0.7							
CORALLINA VANCOUVERIENSIS	3.1	13.0	3.4							
CALLITHAMNION PIKEANUM	<0,1	6,2	0,3							
EGREGIA FENZILSII	1,4	0.4	<0,1							
CRYPTOPLEURA VIOLACEA	<O*1	0.6	0,2							
SPITHORA MAIADUM	5.5	2.6	0.2							
CALLITHAMNION RUPICOLUM	<0,1	<0.1	0.2							
PHYLLOSPADIX SCOULERI	91.8	27.8	7,3							
SCHIZYMENIA PACIFICA		0,2								
HALIDRYS DIOICA		0.1								
CERAMIUM SPP.		0.2								
CERAMIUM PACIFICUM		<0.1								
GRATELOUPIA DORYPHORA		<0.1								
IRIDAEA HETEROCARPA		0.5								
PETROGLOSSUM PACIFICUM		0,4								
HERPOSIPHONIA VERTICILLATA		<0.1								
CORALLINA OFFICINALIS VAR, CH B		<0.1								

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-16. MEAN COVER (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING JUNE 1977. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
PRIONITIS LANCEOLATA		<0.1								
LAURENCIA SPECTABILIS	2.0	<0.1								
IRIDAEA CORDATA VAR. SPLENDENS	<0.1	1.0								
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	1.7	0.5								
MELOBESIA MEDIOCRIS	<0.1	0.6								
PTEROSIPHONIA DENDROIDEA	1.0	<0.1								

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1. .13-17. MEAN COVER (% OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (F									
	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
LITTORINA PLANAXIS				<0.1	0.1	<0.1	1.0	1.1	0.8	<0.1
CHTHAMALUS FISSUS AND DALLI			<0.1	<0.1	0.5	9.0	55.1	3.0	0.2	
LITTORINA SCUTULATA		<0.1		<0.1	<0.1	<0.1	0.6		<0.1	
CHTHAMALUS FISSUS & DALLI DEAD					<0.1	0.4	1.1	<0.1		
ACMAEA (COLLISELLA) SCABRA			0.2	0.2	0.5	<0.1	<0.1	<0.1		
SEPTIFER BIFURCATUS AND BRACHIDONTES		<0.1	<0.1		<0.1	0.3		<0.1		
ACMAEA (COLLISELLA) DIGITALIS			<0.1	0.5	0.2	0.2	0.3			
ACMAEA (COLLISELLA) STRIGATELLA			<0.1	<0.1	<0.1	<0.1	<0.1			
BALANUS GLANDULA			4.0	11.6	4.2	1.6	1.2			
BALANUS GLANDULA DEAD			0.9	0.2	0.2	0.4	<0.1			
MYTILUS CALIFORNIANUS		2.0	22.8	54.5	44.4	1.2	0.3			
PACHYGRAPSUS CRASSIPES				<0.1	<0.1	<0.1				
TEGULA FUNEBRALIS				<0.1	<0.1	<0.1				
NUTTALLINA FLUXA/CALIFORNICA			<0.1	<0.1	0.2	<0.1				
LOTTIA GIGANTEA			1.0	1.0	0.4	<0.1				
TETRAKLITA SQUAMOSA RUBESCENS DEAD			<0.1	<0.1	<0.1	<0.1				
ACMAEA (COLLISELLA) PELTA		<0.1	<0.1	<0.1	<0.1	<0.1				
FISSURELLA VOLCANO		<0.1	<0.1			<0.1				
TETRAKLITA SQUAMOSA RUBESCENS		<0.1	0.8	0.4	<0.1	<0.1				
SERPULORBIS SQUAMIGERUS					<0.1					
CYANOPLAX HARTWEGII					<0.1					
ACMAEA (COLLISELLA) LIMATULA					<0.1					
NUCELLA (THAIS) EMARGINATA				<0.1	<0.1					
HALIOTIS CRACHERODII		0.2			0.2					

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-17. MEAN COVER (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING OCTOBER 1976, BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT), 1.0 To 1.9	2.0 TO 2,9	3.0 TO 3.9	4.0 TO 4.9	5.0 To 5.9	6.0 TO 6.9	7.0 TO 7,9	8.0 TO 8.9	9.0 To 9.9	10.0 T o 10.9
POLLICIPES POLYMERUS		<0.1	1.2	0.5	0.1					
ANTHOPLEURA ELEGANTISSIMA	<0.1	0.4	0.6	0.4	0.1					
ACANTHINA PUNCTULATA				<0.1						
MIATELLA ARCTICA				<0.1						
PISASTER OCHRACEUS			0.6							
STRONGYLOCENTROTUS PURPURATUS		0.4	<0.1							
PHRAGMATOPOMA CALIFORNICA	14.5	65,2	20,0							
ACMAEA (COLLISELLA) INSESSA		<0.1								
PATIRIA MINIATA		0.2								
LEPTASTERIAS PUSILLA		<0.1								
PACHYCHELES RUDIS		<0*1								

NOTE: 1 FOOT = 0,3048 METERS

TABLE 1.1.13-18. MEAN COVER (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING DECEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT.) 1.0 To 1.9	2.0 To 2.9	3.0 To 3.9	4.0 To 4.9	5.0 To 5.9	6.0 To 6.9	7.0 To 7.9	8.0 To 8.9	9.0 To 9.9	10.0 To 10.9
LITTORINA PLANAXIS					<0.1	<0.1	3.1	1.3	1.7	0.6
CHTHAMALUS FISSUS AND DALLI			0.1	<0.1	0.2	8.6	27.9	2.	<0.1	
CHTHAMALUS FISSUS & DALLI DEAD					<0.1	0.5	1.1	<0.		
SEPTIFER BIFURCATUS AND BRACHIDONTES		0.3	<0.1		<0.1	0.7	<0.1	<0.		
LITTORINA SCUTULATA			<0.1	<0.1	0.4	0.9	0.2			
BALANUS GLANDULA DEAD			0.1	<0.1	0.2	0.1	<0.1			
BALANUS GLANDULA		<0.1	7.1	11.5	3.8	1.0	0.7			
ACMAEA (COLLISELLA) DIGITALIS		<0.1	0.1	<0.1	0.4	0.3	0.2			
MYTILUS CALIFORNIANUS		<0.1	20.5	59.7	40.8	0.7	<0.1			
CYANOPLAX HARTWEGII					<0.1	<0.1				
TEGULA FUNEBRALIS				<0.1	<0.1	<0.1				
LOTTIA GIGANTEA			0.7	1.4	0.6	<0.1				
ACMAEA (COLLISELLA) SCABRA			0.3	0.4	0.4	0.2				
TETRACLITA SQUAMOSA RUBESCENS DEAD			<0.1	<0.1	0.2	<0.1				
ACMAEA (COLLISELLA) STRIGATELLA		<0.1	<0.1	<0.1	<0.1	<0.1				
PACHYGRAPSUS CRASSIPES		<0.1	<0.1	<0.1	<0.1	<0.1				
TETRACLITA SQUAMOSA RUBESCENS		<0.1	0.4	0.5	<0.1	<0.1				
MUTTALLINA FLUXA/CALIFORNICA		<0.1	<0.1	0.2	0.4	<0.1				
ACMAEA (COLLISELLA) PELTA		<0.1	<0.1	<0.	<0.1	<0.1				
NUCELLA (THAIS) EMARGINATA				<0.	<0.1					
CERITHIDEA CINCUMTEXTA				<0.	<0.1					
ACMAEA (COLLISELLA) LIMATULA			<0.1	<0.	<0.1					
FISSURELLA VOLCANO		<0.1		<0.	0.2					
POLLICIPES POLYMERUS		<0.1	1.3	0.	0.3					

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-18. MEAN COVER (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING DECEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4*9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO -1.?	8.0 TO b.9	9.0 TO 9.9	10.0 TO 10.9
PHRAGMATOPOMA CALIFORNICA		64.0	13.7	1.0	<0.1					
BALANUS TINTINNABULUM CALIFORNICUS		< G * 1			<0.1					
MOPALIA MUSCOSA		<0,1	<0.1		<al					
ANTHOPLEURA ELEGANTISSIMA	<0.1	1.2	1.4	1.8	0.5					
OLIVELLA BIPLICATA			< C I							
SPIROBRANCHUS SPINOSUS			<0.1							
PATIRIA MINIATA			<0,1							
SERPULORBIS SQUAMIGERUS			<0.1							
HALIOTIS CRACHERODII		<0,1	<0.1							
STRONGYLOCENTROTUS PURPURATUS		0.6	<0.1							
PISASTER OCHRACEUS		0.9	1.0							
ACMAEA (TOTACMEA) INSESSA		<0.1								
EPITONIUM TINCTUM		<0.1								
LEPTASTERIAS PUSILLA		<0.1								
SPIROBIS SPP.		<0.1								
PACHYCHELES RUDIS		<0.1								
LACUNA UNIFASCIATA		<0.1								
MITRELLA CARINATA	<0.1	<0.1								

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-19. MEAN COVER (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING MARCH 1977. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
LITTORINA PLANAXIS			<0.1	<0.1	<0.1	0.2	1.3	0.3	0.4	<0.1
CHTHAMALUS FISSUS AND DALLI			<0.1	0.2	0.3	7.5	51.2	3.2	<0.1	
CHTHAMALUS FISSUS & DALLI DEAD					<0.1	0.5	1.1	<0.1		
SEPTIFER BIFURCATUS AND BRACHIO S		<0.1	<0.1		<0.1	0.6	<0.1	<0.1		
ACMAEA JUVENILE							<0.1			
LITTORINA SCUTULATA			<0.1	<0.1	0.2	0.4	0.3			
BALANUS GLANDULA			2.3	9.9	2.2	1.6	0.6			
ACMAEA (COLLISELLA) DIGITAL S			<0.1	<0.1	0.2	0.2	<0.1			
BALANUS GLANDULA DEAD			0.2	0.8	0.3	0.1	<0.1			
MYTILUS CALIFORNIANUS		<0.1	14.2	54.5	38.1	1.0	<0.1			
ACMAEA (COLLISELLA) SCABRA		<0.1	<0.1	0.2	<0.1	0.1	<0.1			
LITTORINA JUVENILE						<0.1				
ACMAEA (COLLISELLA) STRIGATELLA				<0.1	<0.1	<0.1				
LOTTIA GIGANTEA			0.5	1.4	0.2	<0.1				
JUVENILE BARNACLES			0.2	<0.1	<0.1	0.2				
TETRACLITA SQUAMOSA RUBESCENS DEAD			<0.1	<0.1	<0.1	<0.1				
ACMAEA (COLLISELLA) PELTA		<0.1	<0.1	<0.1	0.2	<0.1				
TETRACLITA SQUAMOSA RUBESCENS		<0.1	0.7	0.3	<0.1	<0.1				
ACMAEA (COLLISELLA) LIMATULA		<0.1				<0.1				
NUCELLA (THAIS) EMARGINATA				<0.1	<0.1					
PLOCAMIA KARYKINA				<0.1	<0.1					
NUTTALLINA FLUXA/CALIFORNICA			<0.1	<0.1	0.1					
TEGULA FUNEBRALIS			<0.1	0.2	<0.1					
CYANOPLAX HARTWEGII		<0.1			<0.1					

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-19. MEAN COVER (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING MARCH 1977. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	9.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
PHRAGMATOPOMA CALIFORNICA		63.0	10.5	0.6	1.5					
POLLICIPES POLYMERUS		<0.1	1.0	0.2	0.3					
PACHYGRAPSUS CRASSIPES		<0.1		<0.1	<0.1					
ANTHOPLEURA ELEGANTISSIMA	<0.1	0.6	0.4	1.3	0.2					
AMPHISSA VERSICOLOR				<0.1						
SPIROBIS SPP.				<0.1						
LEPTASTERIAS PUSILLA		<0.1		<0.1						
STRONGYLOCENTROTUS PURPURATUS		0.6		<0.1						
SPIROBRANCHUS SPINOSUS			<O*1							
PISASTER OCHRACEUS			0.4							
FISSURELLA VOLCANO		<U*1	<0.1							
HALIOTIS CRACHERODII		O*2								
DODECACERIA FEWKESI		<0.1								

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13. MEAN COVER (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING JUNE 1977. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

	TIDAL HEIGHT (FT).									
AXA	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
LITTORINA PLANAXIS				<0.1	0.5	0.4	1.4	0.4	0.1	<0.1
CHTHAMALUS FISSUS AND DALLI			<0.1	<0.1	<0.1	7.4	27.5	2.7	0.2	<0.1
ACMAEA (COLLISELLA) DIGITALIS				<0.1	0.3	<0.1	<0.1	<0.1	<0.1	
CHTHAMALUS FISSUS & DALLI DEAD					<0.1	0.5	1.1	<0.1		
SEPTIFER BIFURCATUS AND BRACHIDONTES				<0.1	<0.1	1.4	0.1	0.2		
LITTORINA SCUTULATA			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
BALANUS GLANDULA		<0.1	9.6	19.6	4.6	1.6	0.6	<0.1		
BALANUS GLANDULA DEAD			<0.1	<0.1	<0.1	<0.1	<0.1			
MYTILUS CALIFORNIANUS		<0.1	12.0	54.5	41.5	1.4	<0.1			
LASAEA SUBVIRIDIS						<0.1				
ACMAEA (NOTOACMEA) SCUTUM						<0.1				
OCENEBRA CIRCUMTEXTA					<0.1	<0.1				
TEGULA FUNEBRALIS					<0.1	<0.1				
CYANOPLAX PARTHEGII				<0.1		<0.1				
LOTTIA GIGANTEA			0.3	1.7	0.4	<0.1				
ACMAEA (COLLISELLA) STRIGATELLA			<0.1	<0.1	<0.1	<0.1				
ACMAEA (COLLISELLA) LIMATULA			<0.1	<0.1	<0.1	<0.1				
TETRACLITA SQUAMOSA RUBESCENS DEAD			<0.1	<0.1	<0.1	<0.1				
TETRACLITA SQUAMOSA RUBESCENS			0.7	0.6	0.5	0.2				
ACMAEA JUVENILE			<0.1		0.2	<0.1				
MOPALIA MUSCOSA			<0.1			<0.1				
ACMAEA (COLLISELLA) SCABRA		<0.1	0.2	0.5	0.7	0.1				
POLLICIPES POLYMERUS		<0.1	0.2	0.9	0.2	<0.1				
NUTTALLINA FLUXA/CALIFORNICA		<0.1	<0.1	<0.1	<0.1	<0.1				

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-20. MEAN COVER (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING JUNE 1977. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT) 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
ACMAEA (COLLISELLA) PELTA		<0.1	0.2	0.2	<0.1	<0.1				
PHRAGMATOPOMA CALIFORNICA		86.2	20.8	0.4	1.0					
PACHYGRAPSUS CRASSIPES		<0.1	<0.1	<0.1	<0.1					
ANTHOPLEURA ELEGANTISSIMA		0.6	0.6	0.7	0.2					
SPIROBRANCHUS SPINOSUS				<0.1						
PAGURUS SAMUELIS				<0.1						
NUCELLA (THAIS) EMARGINATA			<0.1	<0.1						
STRONGYLOCENTROTUS PURPURATUS		0.5	<0.1							
FISSURELLA VOLCANO		<0.1	<0.1							
HALIOTIS CRACHERODII		0.2								
PISASTER OCHRACEUS		0.1								
LUCETTA LOSANGELENSIS		<0.1								
ACMAEA (NOTOACMEA) PALEACEA	<0.1									

NOTE: 1 FOOT = 0.3048 METERS

(1.5 and 1.8 m) and varied from 2.6% in June to 5.5% in December within that interval. E. muricata reached maximum cover between +6. O to +7.0 ft. (1.8 and 2.1 m) and ranged from 10.2% in June to 24.8% in October . Maximal values and variation in E. aurea were greatest below +5.0 ft. (1.5 m). Porphyra per forata incr-eased in cover between +5.0 and +6.0 ft (1.5 and 1.8 m) from <0.1% during March to 4.6% during June, indicating a spring bloom.

Between +5. O and +7. O ft. (1 .5 and 2.1 m) , the dominant macroinvertebrates were Balanus glandula and My tilus calif ornianus , both of which reached maximum cover below +5.0 ft. (1 .5 m) and are reported below.

From +3.0 to +5.0 ft. (.9 to 1.5 m) the macrophytes Endoplura aurea, Ceramium eatonianum/ sinicola , Ulva lobata , Corallina of ficinalis var. chilensis, and Gi gar tina canali culata were pr eminent. Endoplura aurea reached maximal cover in the +3.0 to +4.0 ft. (.9 to 1.2 m) and +4.0 to +5.0 ft. (1.2 to 1.5 m) intervals, averaging 14.7% and 13.8%, respectively. There was little seasonal variation in the cover of E. aurea. Ho-waver , C. eatonianum/sini cola varied from O. 6% cover in December and March to 18.3% in October between +3. O and +4.0 ft. (.9 m and 1.2 m). Between +3.0 and +4.0 ft. (.99 and 1.2 m), U. lobata ranged from 1.8% to 7.1%, C. of ficinalis var . chilensis from 1.7% to 9.1%, and G. canaliculata from 3. 6% to 9.8%. Both U. lobata and G. canaliculata reached maximum cover in June.

Between +3.0 and +6.0 ft. (.9 and 1.8 m), the macr oi nver tebr ates My ti lus calif orni anus and Balanus glandula were pr eminent. Balanus glandula reached a maximum mean cover of 13.2% between +3. O and +4. O ft. (.9 and 1.2 m) and ranged from a minimum of 9.9% in March to a maximum of 19. 6% in June. Mytilus californianus was prominent between +4.0 and +5. O ft. (1.2 end 1.5 m) and between +5.0 and +6.0 ft. (1.5 and 1.8 m) with mean cover of 55.8% and 41 .2%, respectively. Seasonal variation in the cover o f M. calif ornianus was not pr onounced.

Between +1.0 and +3.0 ft. (.3 and .9 m) , the macrophy te Phy llospadix scouleri was predominant, with lesser amounts of its epiphyte Smithora naiadum, Corallina vancouveriensis, and Bossiella orbigniana ssp . dichotoma. Phyllospadix scouleri averaged 92.1% and 31 .9% in the +1.0 to +2. O-ft. (.3 to .6-m) and +2.0 to +3. O-ft. (.6 to .9-m) intervals, respectively . Seasonal cover of P. scouleri varied only slightly between +1.0 and +2.0 ft. (.3 and . 6-m) , but ranged from 27.8% in June to 43.0% in October between +2.0 and +3.0 ft. (.6 and .9 m) . Smithora naiadum varied from 2. O% in March to 5. 5% in June between +1 .0 and +2. O ft. (.3 and .6 m), while B. orbigniana ssp . dichotoma covered from 1. 7% in June to 5. O% in March at the same level. Corallina vancouveriensis ranged from 13.0% in June to 21 .8% in December between +2.0 and +3.0 ft. (.6 and .9 m). There were no obvious seasonal trends in macrophyte cover at this level.

From +1.0 to +3.0 ft. (.3 to .9 m), Phragmatopoma californica was the only macroinvertebrate to provide extensive cover. Phragmatopoma californica covered from 63.0% in March to 86.0% in June between +2.0 and +3.0 ft. (.6 and .9 m).

The inter tidal distribution of rock and sand was highly polarized, with the greatest exposure of rock being above +7.0 ft . (2.1 m) and the concentration of sand being below +3.0 ft. (.9 m). The seasonal cover of bare rock was relatively constant, while cover of sand between +2.0 and +3.0 ft. (.6 and .9 m) varied from a maximum of 13.7% in October to a minimum of 0.3% in March.

1.1.13 .4.2.2 Frequency

Quarterly and annual mean frequency for dominant macrophytes and macroinvertebrates is presented in Tables 1.1.13-21 and 1.1.13-22. The distributions of macrophytes with respect to frequency over their intertidal ranges are presented in Figures 1.1.13-13 and Table 1.1.13-23. The corresponding distributions for macr oinver tebr ates are presented in Figure 1.1.13-14 and Table 1.1.13-24. The frequency distributions generally approximated cover patterns primarily because those species with high cover within a given interval were typically present in most of the samples of that interval. However , because of their small size several species did not dominate cover in spite of occurring in a high percentage of samples [e. g., Rhodoglossum af fine, Ulva lobata, Cryptopleura violacea, Littorina planaxis, and Acmaea (Collisella) scabra].

The macrophytes occurring in the greatest proportions of samples were blue-green algae (92.0%) , Endoplura aurea (39.3%) , Ulva lobata (38.6%). , and Ralfsiaceae (33.8%). Numerous par allels between cover and frequency were apparent for highly seasonal macr ophy tes. For Ceramium eatonianum/sini cola, the maximum (35. 4%) and minimum (2. O%) frequencies occurred in October and December , respectively , and corresponded with seasons of maximum and minimum cover The apparent blooms during June of U. lobata and Porphyra per forata (cf. Tables 1.1.13-13 through 1.1.13-16 were paralleled by frequency increases from 35.3% to 49.8% and 6.0% to 29.4%, respectively.

For those macr ophy tes with an annual mean frequency greater than 15. O% there was an apparent trend for encrusting forms (e .g. , blue-green algae, Endoplura aurea, Ralfsiaceae) to reach maximum frequency in Mar ch, whereas fleshy species (e .g. , Gi gartina canaliculata , Egregia menziesii, Gelidium coulteri) reached maximum frequency in October or June. Occurrence of various species of bleached algae generally r cached maximum frequency in December or March.

The macr oinver tebr ates present in the greatest pr opor tion of samples were Chthamalus fissus/dalli (60.1%) , Littorina planaxis (55.1%) , Balanus glandula (45.4%), Mytilus californianus (41.7%), Acmaea

TABLE 1.1.13-21. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SANTA ROSA ISLAND (CONTINUED ON NEXT PAGE).

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
BLUE-GREEN ALGAE	88.0	90.0	100.0	90.0	92.0
ENDOPLURA AUREA	37.3	37.3	43.3	39.3	39.3
ULVA LOBATA	36.9	30.4	35.3	49.6	38.6
RALFSIACEAE	29.4	34.6	36.5	34.4	33.8
CORALLINA OFFICINALIS VAR. CHILENSIS	30.9	26.4	44.9	27.5	32.9
ENDOCLADIA MURICATA	32.5	33.0	35.0	31.0	32.9
HYDROLITHON DECIPIENS	29.4	34.7	34.7	29.3	32.0
RHODOGLOSSUM AFFINE	32.4	27.4	31.9	34.0	31.4
LITHOPHYLLUM PROBOSCIDEUM	28.0	26.0	32.0	36.0	31.0
CORALLINA VANCOUVERIENSIS	24.0	24.0	24.0	24.0	24.0
GIGARTINA CANALICULATA	27.4	26.0	18.0	17.4	22.2
EGREGIA MENZIESII	26.0	22.0	18.0	16.0	20.5
GELIDIUM COULTERI	15.0	12.0	23.0	25.5	18.9
CRYPTOPLEURA VIOLACEA	16.0	18.0	22.0	18.0	18.5
PHYLLOSPADIX SCOULERI	19.0	18.0	18.0	16.0	18.0
CORALLINE CRUSTS	23.4	13.0	22.0	12.4	17.7
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	20.0	18.0	18.0	14.0	17.5
SMITHORA NAIADUM	18.0	16.0	18.0	18.0	17.5
CLADOPHORA COLUMBIANA	18.3	13.4	19.4	16.9	17.0
MELOBESIA MEDIOCRIS	16.0	16.0	14.0	12.0	15.0
CERANIUM EATONIANUM/SINICOLA	35.4	2.0	12.0	10.5	15.0
PORPHYRA PERFORATA	4.0	4.0	6.0	29.4	10.9
GIGARTINA SPINOSA	10.0	22.0	2.0	6.5	10.6
HYDROLITHON DECIPIENS BLEACHED	0.0	15.4	13.4	11.4	10.0
COLPOMENIA SINUOSA	12.0	6.0	12.0	6.0	9.5
LAURENCIA LAJOLLA	10.5	12.0	6.0	8.0	9.1

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-21. Q UARTERLY AND ANNUAL MEAN FR EQUENCY (%) FOR DOMINANT MACROPHYT ES OVER ALL TIDAL IN TERV AL S FROM SANT A ROSA ISLAND (CON TINUED).

TAXA	FREQUENC Y (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
LITHOPHYLLUM PROBOSCIDEUM BLEACHED	0.0	14.5	6.5	14.5	8.9
CYLINDROCARPUS RUGOSUS	17.0	10.4	8.0	0.0	8.9
LAURENCIA SPECTABILIS	2,0	10.0	10.0	12,0	8.5
IRIDAEA CORDATA VAR. SPLENDENS	6.0	6.0	2.0	14.0	7.5
BOSSIELLA ORBIGNIANA SSP. DICH B	O*O	14.0	14.0	(.1,0	7.0
ENDOCLADIA MURICATA BLEACHED	2.9	12.6	6.3	2.9	6.1
GASTROCLONIUM COULTERI	6,5	6,0	4.0	6,0	5.6
POLYSIPHONIA HENDRYI VAR HENDRYI	2.0	4*5	4.0	10.0	5.1
CALLITHAMNION PIKEANUM	0.0	0.0	4.0	16,0	5.0
CORALLINA OFFICINALIS VAR. CH B	0,0	6.0	12. (I	2.0	5.0
CALLITHAMNION RUPICOLUM	2.0	2*CI	2.6	14.0	5.0
CHAETOMORPHA LINUM	1.4	5.9	5.4	3,4	4.1
CERAMIUM PACIFICUM	4*O	2,0	6.0	4*O	4.0
CERAMIUM SPP.	2.0	4.0	4.0	4.(J	3.5
GRATELOUPIA DORYPHORA	12.0	0.0	0.0	2.0	3.5
PTEROSIPHONIA DENDROIDEA	0.0	0.0	0.0	12, (I	3.0
HERPOSIPHONIA PLUMULA	4.0	2.0	6.u	0.0	3.0
CORALLINA VANCOUVERIENSIS BLEACHED	0.0	6.(I	4.0	2.0	3.0
NEMALION HELMINTHOIDES	2.0	0,0	0.(.)	9 . 0	2.8
CODIUM FRAGILE	2.5	2.0	6.0	0.0	2.6
PHYLLOSPADIX SCOULERI BLEACHED	0.0	2.0	4.0	4.0	2.5
GIGARTINA PAPILLATA	0.0	0,0	0.0	6.5	2.1
ENTEROMORPHA SP.	4.5	O*O	0.0	4.0	2.1
CLADOPHORA SPP.	1.4	2,0	2.0	2.0	1.9
CORALLINE CRUST BLEACHED	2.0	2.0	0.0	2.0	1*5
HERPOSIPHONIA VERTICILLATA	0.0	000	4.0	2.0	1.5

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-21. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACROPHYTES OVER ALL TIDAL INTERVALS FROM SANTA ROSA ISLAND (CONTINUATION)

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
PRIONITIS LANCEOLATA	0.0	2.0	2.0	2.0	1.5
PETROGLOSSUM PACIFICUM	0.0	2.0	2.0	2.0	1.5
IRIDAEA HETEROCARPA	0.0	2.0	0.0	4.0	1.5
POLYSIPHONIA SPP.	1.4	2.0	2.5	0.0	1.5
SCYTOSIPHON DOTYI	0.0	2.5	2.5	0.0	1.3
HALIDRYS DIOICA	0.0	0.0	2.0	2.0	1.0
LITHOTHRIX ASPERGILLUM	2.0	0.0	2.0	0.0	1.0
ULVA LOBATA BLEACHED	0.0	2.0	2.0	0.0	1.0
BENTHIC DIATOMS	0.0	0.0	4.0	0.0	1.0
GIGARTINA LEPTORHYNCHOS	2.0	2.0	0.0	0.0	1.0
MACROCYSTIS PYRIFERA	4.0	0.0	0.0	0.0	1.0
CALLOPHYLLIS VIOLACEA	2.0	2.0	0.0	0.0	1.0
GELIDIUM PURPURASCENS	4.0	0.0	0.0	0.0	1.0
CLADOPHORA COLUMBIANA BLEACHED	0.0	0.0	3.4	0.0	0.9
RHODYMENIA CALIFORNICA VAR. CALIFORN	2.0	0.0	0.0	0.0	0.5
CENTROCERAS CLAVULATUM	0.0	0.0	2.0	0.0	0.5
ENDARACHNE BINGHAMIAE	0.0	0.0	2.0	0.0	0.5
PTEROSIPHONIA BAILEYI	0.0	0.0	0.0	2.0	0.5
SCHIZYMENIA PACIFICA	0.0	0.0	0.0	2.0	0.5

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-22. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SANTA ROSA ISLAND (CONTINUED ON NEXT PAGE).

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
CHTHAMALUS FISSUS AND DALLI	56.2	62.7	60.7	60.9	60.1
LITTORINA PLANAXIS	57.6	52.0	56.5	54.5	55.1
BALANUS GLANDULA	43.0	47.0	43.0	46.7	45.4
MYTILUS CALIFORNIANUS	39.4	44.8	41.4	41.4	41.7
ACMAEA (COLLISELLA) DIGITALIS	36.6	46.0	41.5	38.6	41.2
LITTORINA SCUTULATA	42.8	42.0	37.0	42.3	41.0
ACMAEA (COLLISELLA) SCABRA	42.2	37.1	41.1	36.6	39.7
ANTHOPLEURA ELEGANTISSIMA	40.0	42.0	40.0	28.0	37.5
BALANUS GLANDULA DEAD	33.6	38.1	36.7	34.7	35.8
ACMAEA (COLLISELLA) PELTA	29.8	30.9	36.9	34.9	33.1
TETRACLITA SQUAMOSA RUBESCENS	26.9	30.9	38.9	26.9	31.4
PHRAGMATOPOMA CALIFORNICA	26.0	27.5	31.5	33.5	29.6
POLLICIPES POLYMERUS	24.0	30.0	28.0	33.4	28.9
CHTHAMALUS FISSUS & DALLI DEAD	26.7	27.0	23.0	26.7	26.4
LOTTIA GIGANTEA	26.9	26.9	25.4	24.9	26.0
SEPTIFER BIFURCATUS AND BRACHIDONTES	16.8	26.7	24.7	24.3	23.2
ACMAEA (COLLISELLA) STRIGATELLA	32.2	15.6	7.4	23.3	19.6
PACHYGRAPSUS CRASSIPES	7.9	24.4	15.5	19.0	16.7
NUTTALLINA FLUXA/CALIFORNICA	9.9	18.4	17.0	17.9	15.8
TETRACLITA SQUAMOSA RUBESCENS DEAD	9.9	9.9	9.9	9.9	9.9
NUCELLA (THAIS) EMARGINATA	8.5	15.5	9.0	4.5	9.4
ACMAEA (COLLISELLA) LIMATULA	2.0	13.5	3.4	17.4	9.1
FISSURELLA VOLCANO	5.4	8.5	4.0	16.0	8.5
TEGULA FUNEBRALIS	7.4	5.9	9.0	5.4	6.9
JUVENILE BARNACLES	0.0	0.0	26.9	0.0	6.7
STRONGYLOCENTROTUS PURPURATUS	4.0	8.0	9.0	4.0	6.3

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-22. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SANTA ROSA ISLAND (CONTINUED).

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
ACMAEA JUVENILE	0.0	0.0	2.5	12.9	3.8
HALIOTIS CRACHERODII	4.0	400	2*O	4.0	3.5
CYANOPLAX HARTWEGII	2.0	3.4	4.0	3,9	3.3
PISASTER OCHRACEUS	4.0	4.0	2.0	2.0	3.0
MITRELLA CARINATA	0.0	12,0	0.0	0.0	3.0
OCENEBRA CIRCUMTEXTA	O.(J	7.(I	0.0	3.4	2.6
ACMAEA (NOTOACMEA) PALEACEA	0.0	0.0	0.0	10*O	2.5
MOPALIA MUSCOSA	0.0	6.0	0.0	3.4	2.4
LEPTASTERIAS PUSILLA	2.0	2.0	4.5	0.0	2.1
SPIROBRANCHUS SPINOSUS	O*C	2.0	2.0	2,5	1.6
PLOCAMIA KARYKINA	0.0	0.0	4.5	0,0	1.1
SPIRORBIS SPP.	0.0	2.0	2.5	0.0	1.1
PATIRIA MINIATA	2.0	2.0	0.0	0.0	1.0
ACMAEA (NOTOACMEA) INSESSA	2.0	2.0	0.0	0.0	1.0
SERPULORBIS SQUAMIGERUS	2.0	2.0	0.0	0.0	1.0
PACHYCHELES RUDIS	2.0	2.0	0.0	0"0	1.0
BALANUS TINTINNABULUM CALIFORNICUS	0.0	4.0	0.0	0,0	1.0
AMPHISSA VERSICOLOR	0.0	0.0	2.5	0.0	0.6
PAGURUS SAMUELIS	0.0	0.0	O.(J	2.5	0.6
HIATELLA ARCTICA	2.5	0.0	0.0	0.0	0.6
ACANTHINA PUNCTULATA	2.5	0,0	0.0	0.0	0.6
LACUNA UNIFASCIATA	0.0	2,0	0.0	0.0	0.5
DODECACERIA FEWKESI	0,0	0.0	2.0	0.0	0.5
EPITONIUM TINCTUM	0.0	2,0	0.0	0.0	0.5
LUCETTA LOSANGELENSIS	0.0	0.0	0.0	2.0	0.5
OLIVELLA BIPLICATA	0.0	2.0	0.0	(1o	0.5

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-22. QUARTERLY AND ANNUAL MEAN FREQUENCY (%) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SANTA ROSA ISLAND (CONTINUATION).

TAXA	FREQUENCY (%) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
LASAEA SUBVIRIDIS	0.0	0.0	0.0	1.4	0.4
ALMAEA (NOTOACMEA) SCUTUM	0.0	0.0	0.0	1.4	0.4
LITTORINA JUVENILE	0.0	0.0	1.4	0.0	0.4

NOTE; 1 FOOT = 0.3048 METERS

FIGURE 1.1.13-13.

FIGURE 1.1.13-13.

FIGURE 1.1.13-13. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SANTA ROSA ISLAND (CONTINUED).

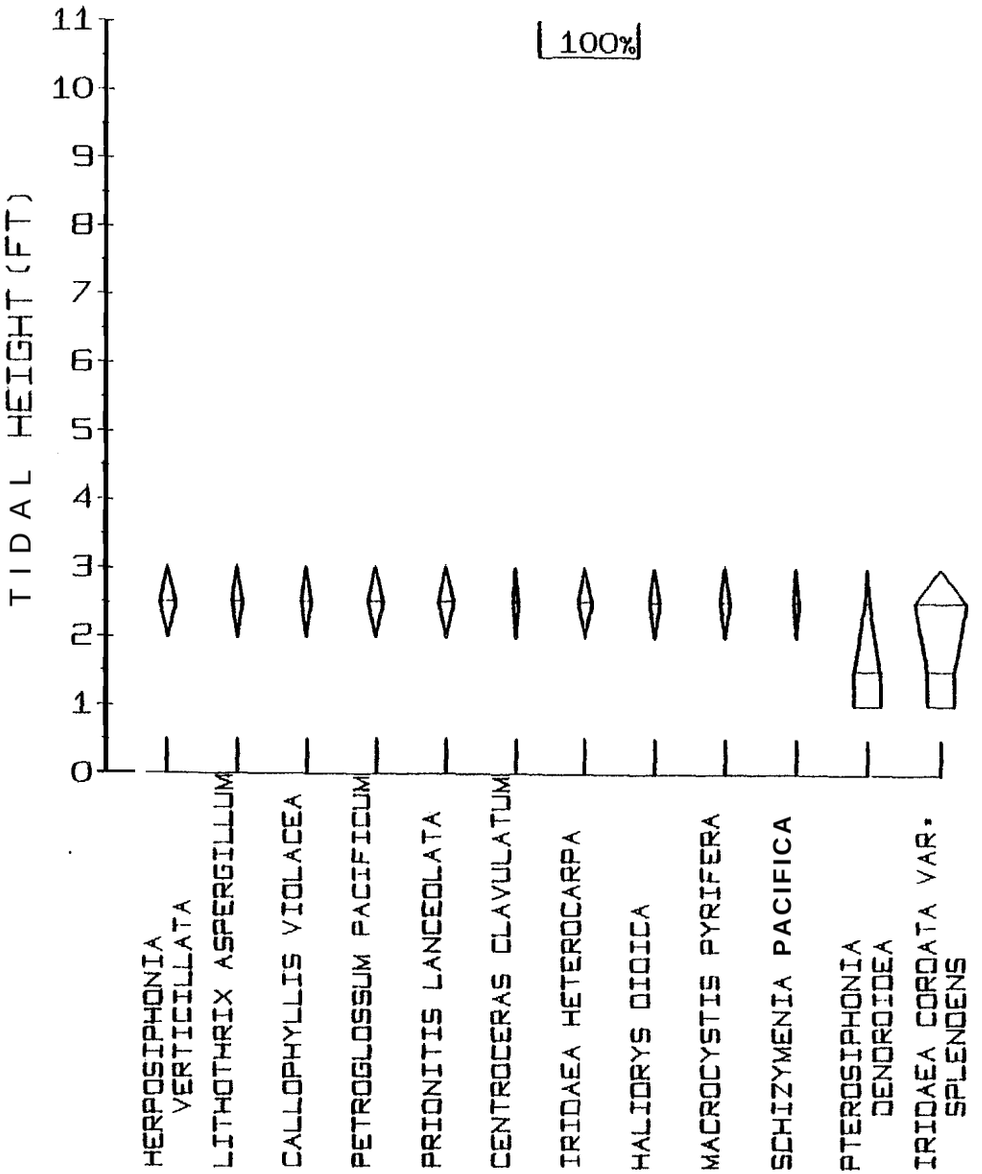

FIGURE 1.1.13-13. MEAN DISTRIBUTION OF DOMINANT MACROPHYTE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SANTA ROSA ISLAND (CONTINUATION).

TABLE 1.1.13-23. ANNUAL MEAN FREQUENCY (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT): 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
BLUE-GREEN ALGAE	25.0	95.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
RALFSIACEAE		5.0	75.0	75.0	50.0	32.1	56.3	4.2		
SCYTOSIPHON DOTYI				6.3			6.3			
ENDOCLADIA MURICATA			5.0	87.5	69.0	100.0	56.3			
HYDROLITHON DECIPIENS			35.0	93.8	95.0	46.4	50.0			
HYDROLITHON DECIPIENS BLEACHED			5.0	12.5	55.0	21.4	6.3			
CHAETOMORPHA LINUM			10.0		10.0	14.3	6.3			
CERAMIUM CATENIFORME/SINICOLA		45.0	50.0	31.3	10.0	7.1	6.3			
POLYSIPHONIA HENDRYI VAR HENDRYI		25.0	20.0				6.3			
ENDOPLURA AUREA		15.0	85.0	100.0	100.0	42.9	50.0			
POLYSIPHONIA SPP.		5.0				3.6	6.3			
ENDOCLADIA MURICATA BLEACHED					15.0	46.4				
CYLINDROCARPUS RUGOSUS			40.0	25.0	20.0	3.6				
CLADOPHORA COLUMBIANA		40.0	75.0		30.0	25.0				
CLADOPHORA COLUMBIANA BLEACHED		5.0				3.6				
CORALLINE CRUSTS		15.0	60.0	75.0	20.0	7.1				
CLADOPHORA SPP.		10.0	5.0			3.6				
PORPHYRA PERFORATA		20.0	30.0	25.0	30.0	3.6				
RHODOGLOSSUM AFFINE		90.0	60.0	50.0	80.0	14.3				
ULVA LOBATA	25.0	90.0	90.0	68.8	80.0	32.1				
CORALLINA OFFICINALIS VAR. CHILENSIS	25.0	90.0	100.0	68.8	35.0	10.7				
GIGARTINA CANALICULATA	50.0	85.0	75.0		5.0	7.1				
ULVA LOBATA BLEACHED					10.0					
ENTEROMORPHA SP.			10.0	6.3	5.0					

NOTE: 1 FOOT = 0.3048 METERS

ABLE 1.1.13-23. ANNUAL MEAN FREQUENCY (%) OF DOMINANT MACROPHYTES AS A UNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING 1976/1977, DATA REFLECT THE AVERAGES OF SEASONAL VALUES, BLANK SPACES INDICATE ZEROS (CONTINUED).

TAXA	TIDAL HEIGHT (FT), 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
GIGARTINA PAPILLATA			10.0	6.3	5.0					
HEMALION HELMINTHOIDES			10.0	12.5	5.0					
GIGARTINA LEPTORHYNCHOS			5.0		5.0					
GELIDIUM COULTERI		55.0	80.0	43.8	10.0					
LITHOPHYLLUM PROBOSCIDEUM BLEACHED		20.0	25.0	18.8	25.0					
GIGARTINA SPINOSA	25.0	45.0	25.0	6.3	5.0					
LITHOPHYLLUM PROBOSCIDEUM	25.0	35.0	50.0	100.0	100.0					
GASTROCLONIUM COULTERI		40.0	10.0	6.3						
CODIUM FRAGILE		10.0	10.0	6.3						
LAURENCIA LAJOLLA		50.0	35.0	6.3						
ENDARACHNE BINGHAMIAE			5.0							
GELIDIUM PURPURASCENS			10.0							
PTEROSIPHONIA BAILEYI			5.0							
CORALLINE CRUST BLEACHED			15.0							
CORALLINA VANCOUVERIENSIS BLEACHED		15.0	15.0							
CERAMIUM SPP.		30.0	5.0							
COLPOMENIA SINUOSA		60.0	35.0							
BENTHIC DIATOMS		5.0	5.0							
CERAMIUM PACIFICUM		35.0	5.0							
HERPOSIPHONIA PLUMULA		20.0	10.0							
GRATELOUPIA DORYPHORA		25.0	10.0							
PHYLLOSPADIX SCOULERI BLEACHED		10.0	15.0							
PHYLLOSPADIX SCOULERI	100.0	60.0	20.0							
CALLITHAMNION RUPICOLUM	25.0	5.0	20.0							

NOTE; 1 FOOT = 0.3048 METERS

TABLE 1.1.13-23. ANNUAL MEAN FREQUENCY (%) OF DOMINANT MACROPHYTES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). .0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
SPITHORA HAIADUM	100.0	55.0	20.0							
MELOBESIA MEDIOCRIS	100.0	40.0	10.0							
CORALLINA VANCOUVERIENSIS	100.0	100.0	40.0							
CORALLINA OFFICINALIS VAR, CH B	25.0	15.0	10.0							
BOSSIELLA ORBIGNIANA SSP, DICH B	50.0	15.0	5.0							
BOSSIELLA ORBIGNIANA SSP, DICHOTOMA	100.0	60.0	15.0							
EGREGIA MENZIESII	100.0	75.0	30.0							
CALLITHAMNION PIKEANUM	25.0	20.0	5.0							
CRYPTOPLEURA VIOLACEA	100.0	60.0	25.0							
LAURENCIA SPECTABILIS	75.0	5.0	5.0							
RHODYMENIA CALIFORNICA VAR, CALIFORN		5.0								
HERPOSIPHONIA VERTICILLATA		15.0								
LITHOTHRIX ASPERGILLUM		10.0								
CALLOPHYLLIS VIOLACEA		10.0								
PETROGLOSSUM PACIFICUM		15.0								
FRIOMITIS LANCEOLATA		15.0								
CENTROCERAS CLAVULATUM		5.0								
IRIDAEA HETEROCARPA		15.0								
HALIDRYS DIOICA		10.0								
MACROCYSTIS PYRIFERA		10.0								
SCHIZYMENIA PACIFICA		5.0								
PTEROSIPHONIA DENDROIDEA	25.0	5.0								
IRIDAEA CORDATA VAR, SPLENDENS	25.0	50.0								

NOTE: 1 FOOT = 0.3048 METERS

FIGURE 1.1.13-14. MEAN DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SANTA ROSA HS-1 AND HS-1 (CONTINUED).

FIGURE 1.1.13-14.

MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SANTA ROSA ISLAND (CONTINUED).

FIGURE 1.1.13-14.

MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE FREQUENCY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SANTA ROSA ISLAND (CONTINUED).

TABLE 1.1. 3-24. ANNUAL MEAN FREQUENCY (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

	TIDAL HEIGHT (FT).									
A*A	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
LITTORINA PLANAXIS			5.0	25.0	30.0	96.4	100.0	100.0	100.0	95.0
CHTHAMALUS FISSUS AND DALLI			35.0	93.8	100.0	96.4	100.0	95.8	75.0	5.0
LITTORINA SCUTULATA		5.0	20.0	93.8	100.0	100.0	75.0	8.3	8.3	
ACMAEA (COLLISELLA) DIGITALIS		5.0	35.0	100.0	95.0	89.3	75.0	4.2	8.3	
CHTHAMALUS FISSUS & DALLI DEAD					65.0	57.1	100.0	41.7		
ACMAEA (COLLISELLA) SCABRA		10.0	85.0	100.0	100.0	85.7	12.5	4.2		
SEPTIFER BIFURCATUS AND BRACHIDON =S		15.0	20.0	6.3	65.0	85.7	18.8	20.8		
BALANUS GLANDULA		20.0	80.0	100.0	100.0	100.0	50.0	4.2		
BALANUS GLANDULA DEAD			60.0	100.0	90.0	64.3	43.8			
ACMAEA JUVENILE			5.0		20.0	7.1	6.3			
ACMAEA (COLLISELLA) STRIGATELLA		5.0	35.0	43.8	50.0	50.0	12.5			
MYTILUS CALIFORNIANUS		65.0	95.0	100.0	100.0	32.1	25.0			
ACMAEA (NOTOACMEA) SCUTUM						3.6				
LITTORINA JUVENILE						3.6				
LASAEA SUBVIRIDIS						3.6				
CCELOPA CIRCUMTEX *				12.5	10.0	3.6				
LOTT A G GAN EA			55.0	100.0	60.0	25.0				
JUVENILE BARNACLES			15.0	25.0	20.0	7.1				
TETRACLITA SQUAMOSA RUBESCENS DEAD			40.0	25.0	20.0	14.3				
TEGULA FUNEBRALIS			5.0	25.0	25.0	14.3				
PACHYGRAPSUS CRASSIPES		25.0	20.0	56.3	55.0	10.7				
FISSURELLA VOLCANO		45.0	25.0	6.3	5.0	3.6				
NUTTALLINA FLUXA/CALIFORNICA		10.0	60.0	37.5	40.0	10.7				
ACMAEA (COLLISELLA) LIMATULA		5.0	10.0	43.8	25.0	7.1				

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-24. ANNUAL MEAN FREQUENCY (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING 1976/1977, DATA REFLECT THE AVERAGES OF SEASONAL VALUES, BLANK SPACES INDICATE ZEROS (CONTINUED).

	TIDAL HEIGHT (FT):								
TAXA	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO >.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
KOPALIA FUSCOSA		5.0	10.0		5.0	3.6				
TETRACLITA SQUAMOSA RUBESCENS		30.0	85.0	100.0	70.0	28.6				
POLLICIPES POLYMERUS		40.0	70.0	100.0	75.0	3.6				
ACMAEA (COLLISELLA) PELTA		45.0	80.0	93.8	80.0	32.1				
CYANOPLAX HARTWEGII		5.0		6.3	15.0	7.1				
PLOCAMIA KARYKINA				6.3	5.0					
NUCELLA (THAIS) EMARGINATA			5.0	43.8	45.0					
SERPULORBIS SQUAMIGERUS			5.0		5.0					
HALIOTIS CRACHERODII		25.0	5.0		5.0					
BALANUS TINTINNABULUM CALIFORNICUS		5.0			5.0					
ANTHOPLEURA ELEGANTISSIMA	75.0	60.0	80.0	100.0	60.0					
PHRAGMATOPOMA CALIFORNICA	25.0	100.0	70.0	56.3	45.0					
AMPHISSA VERSICOLOR				6.3						
ACANTHINA PUNCTULATA				6.3						
PAGURUS SAMUELIS				6.3						
HIATELLA ARCTICA				6.3						
SPINORBANCHUS SPINOSUS			10.0	6.3						
SPIROBIS SPP.		5.0		6.3						
STRONGYLOCENTROTUS PURPURATUS		35.0	15.0	12.5						
LEPTASTERIAS PUSILLA		15.0		6.3						
OLIVELLA BIPLICATA			5.0							
PATIRIA MINIATA		5.0	5.0							
PISASTER OCHRACEUS		10.0	20.0							
LUCETTA LOSANGELENSIS		5.0								

NOTE: 1 FOOT = 0.3048 METERS

ABLE 1.1.13-24. ANNUAL MEAN FREQUENCY (%) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HE GHT FOR SANTA ROSA ISLAND DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUATION).

	TIDAL HEIGHT (FT).									
TAXA	1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
EPITONIUM TINCTUM		5.0								
PACHYCHELLS RUDIS		10.0								
LACUNA DIFASCIATA		5.0								
ACMAEA (NOTOACMEA) INSESSA		10.0								
DODECACERIA FEWKESI		5.0								
MITRELLA CARINATA	25.0	5.0								
ACMAEA (NOTOACMEA PALEACEA	25.0									

NOTE; 1 FOOT = 0.3048 METERS

(Collisella) digitalis (41.2%), L. scutulata (41.0%) and A. (Collisella) scabra (39. 7%). Seasonally, most of the macroinvertbrate frequencies minima occurred during October , although seasonal variation was not pronounced for most species.

1.1.13.4.2.3 Density

Quarterly and annual mean densities of dominant macroinvertebrates are presented in Table 1.1.13-25. Annual mean densities of dominant macroinvertebrates as a function of tidal height are presented in Table 1.1.13-26 and Figures 1.1.13-15 and 1.1.13-16, with seasonal patterns shown in Figures 1.1.13-17 through 1.1.13-24.

The most numerous taxa were Phragmatopoma californica (with 2384 individuals/m^2), Chthamalus fissus/dalli (1 980/m^2), Balanus glandula (1219/m^2), Littorina planaxis (882/m) and Mytilus californianus (296/m^2). All of the above, except L. planaxis, were cover dominants as well.

Maximum and minimum macroinvertebrate densities were evenly distributed between quarters, indicating no overall consistent seasonal trend. There was a recruitment of juvenile barnacles in March (240 individuals/m) and a recruitment of juvenile acmaeids during both March and June (maximum density 13/m^2).

Quarterly mean densities of dominant macroinvertebrates as a function of tidal height are presented in Tables 1.1.13-27 through 1.1.13-30. Numeri cally, the dominant macroinvertebrates above +7.0 ft. (2.1 m) were Littorina planaxis which reached a maximum annual mean density of 4768 individuals/m between +7.0 and +8.0 ft. (2.1 and +2.4 m), and 14,350/m^2 Chthamalus fissus/dalli in the same interval (Table 1.1.13-26). Both taxa had minimum densities in March, L. planaxis ranged from 4186 individuals/m^2 to 5335/m , and C. fissus/dalli from 13,713/m to 14,635/m^2. Both L. planaxis and C. fissus/dalli were also prominent below +7.0 ft. (2.1 m).

In the i-5. 0 to +6. 0-ft. (1.5 to 1.8-m) interval, Balanus glandula with 2558 individuals/m^2 and Mytilus californianus with 1422/m^2 reached maximum densities (Table 1. 1.13-26). Balanus glandula recrui ted between March and June, increasing from 1852/m to 5217/m . Mytilus californianus reached a minimum of 1334/m^2 in March and a maximum of 1488 /m^2 in December (Tables 1.1.13-28 and 1.1.13-29). Both B. glandula and M. californianus were important numerically throughout the tidal range of +2.0 to +7.0 ft. (.6 to 2.1 m). Littorina scutulata also reached high density between +5.0 and +6.0 ft. (1.5 and 1.8 m), averaging 494/m^2 with a minimum (300/m) in March and a maximum (936/m^2) in June.

The limpet Acmaea (Collisella) scabra had an average density of 272 individuals/m^2 between +5.0 and +6. 0 ft. (1.5 and 1.8 m) and recruited seasonally from 58/m in March to 88/m in June (Table 1.1.13-25).

TABLE 1.1.13-25. QUARTERLY AND ANNUAL MEAN DENSITY (NO./M2) FOR DOMINANT MACRO-INVERTEBRATES OVER ALL TIDAL INTERVALS FROM SANTA ROSA ISLAND.

TAXA	DENSITY (NO./M2) OCT. 1976	DEC. 1976	MAR. 1977	JUNE 1977	MEAN
PHRAGMATOPOMA CALIFORNICA	2659	2057	1966	2856	2384
CHTHAMALUS FISSUS AND DALLI	1925	2092	1987	1916	1980
BALANUS GLANDULA	886	859	821	2309	1219
LITTORINA PLANAXIS	1042	936	782	768	882
MYTILUS CALIFORNIANUS	311	306	285	283	296
LITTORINA SCUTULATA	154	208	141	157	165
ACMAEA (COLLISELLA) SCABRA	50	65	58	68	65
JUVENILE BARNACLES	0	0	240	0	60
TETRACLITA SQUAMOSA RUBESCENS	26	30	34	31	30
ACMAEA (COLLISELLA) DIGITALIS	32	34	24	31	30
POLLICIPES POLYMERUS	18	30	41	25	29
ACMAEA (COLLISELLA) PELTA	12	14	33	42	25
SKENEIDAE BIFURCATUS AND BRACHIDONTES	13	15	17	19	16
ANTHOPLEURA ELEGANTISSIMA	12	20	14	13	15
LOTTIA GIGANTEA	8	7	8	9	8
ACMAEA JUVENILE	0	0	4	13	4
ACMAEA (COLLISELLA) STRIGATELLA	5	2	<1	4	3
NUTTALLINA FLUXA/CALIFORNICA	1	2	3	3	2
STRONGYLOCENTROTUS PURPURATUS	2	3	2	<1	2
PACHYGRAPSUS CRASSIPES	<1	3	1	2	2
NUCELLA (THAIS) EMARGINATA	<1	3	2	<1	1
MITRELLA CARINATA	0	5	0	0	1
ACMAEA (COLLISELLA) LIMATULA	<1	1	<1	3	1
OTHER MACRO-INVERTEBRATES	3	4	5	5	
NUMBER OF OTHER TAXA	(12)	(18)	(10)	(12)	
TOTALS	7160	6698	6468	8577	

NOTE: 1 FOOT = 0.3048 METERS

ABLE 1.1.13-26. ANNUAL MEAN DENSITY (NO./M$_2$) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
LITTORINA PLANAXIS			<1	7	39	804	4768	1496	1470	233
CITHAMALUS FISSUS AND DALLI			51	245	330	2546	14350	2091	148	<1
LITTORINA SCUTULATA		<1	9	61	494	676	184	2	3	
ACMAEA (COLLISELLA) DIGITALIS		<1	12	79	66	83	61	<1	1	
ACMAEA (COLLISELLA) SCABRA		<1	101	269	272	70	<1	<1		
SEPTIFER BIFURCATUS AND BRACHIDONTES		6	3	<1	29	113	2	5		
BALANUS GLANDULA		70	2978	6113	2558	331	138	<1		
ACMAEA JUVENILE			7		23	2	10			
ACMAEA (COLLISELLA) STRIGATELLA		<1	8	4	7	8	3			
MYTILUS CALIFORNIANUS		18	280	1216	1422	25	2			
LITTORINA JUVENILE						9				
LOTTIA GIGANTEA			15	42	21	1				
JUVENILE BARNACLES			237	139	166	38				
TEGULA FUNEBRALIS			<1	2	2	2				
FISSURELLA VOLCANO		3	3	<1	<1	<1				
PACHYGRAPSUS CRASSIPES		2	2	7	8	<1				
ACMAEA (COLLISELLA) PELTA		20	95	82	50	5				
NUTTALLINA FLUXA/CALIFORNICA		<1	11	3	6	1				
ACMAEA (COLLISELLA) LIMATULA		<1	2	6	3	<1				
TETRACLITA SQUAMOSA RUBESCENS		44	163	75	18	5				
POLLICIPES POLYMERUS		32	95	113	45	<1				
CYANOPLAX HARTWEGII		<1		<1	<1	1				
NUCELLA (THAIS) EMARGINATA			<1	9	4					
ARTHROPLEURA ELEGANTISSIMA	10	15	24	75	22					

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-26. ANNUAL MEAN DENSITY (NO./M²) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING 1976/1977. DATA REFLECT THE AVERAGES OF SEASONAL VALUES. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
PHRAGMATOPOMA CALIFORNICA	967	18557	4274	16	28					
SPIROBRACHUS SPINOSUS			<1	1						
STRONGYLOCENTROTUS PURPURATUS		17	<1	1						
LEPTASTERIAS PUSILLA		1		<1						
NITRELLA CARINATA	13	<A								
ACMAEA (NOTOACMEA) PALEACEA	2									

NOTE: 1 FOOT = 0.3048 METERS

FIGURE 1.1.13-15. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SANTA ROSA ISLAND (CONTINUED).

FIGURE 1.13-15. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SANTA ROSA ISLAND (CONTINUED).

FIGURE 1.1.13-15. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SANTA ROSA ISLAND (CONTINUATION).

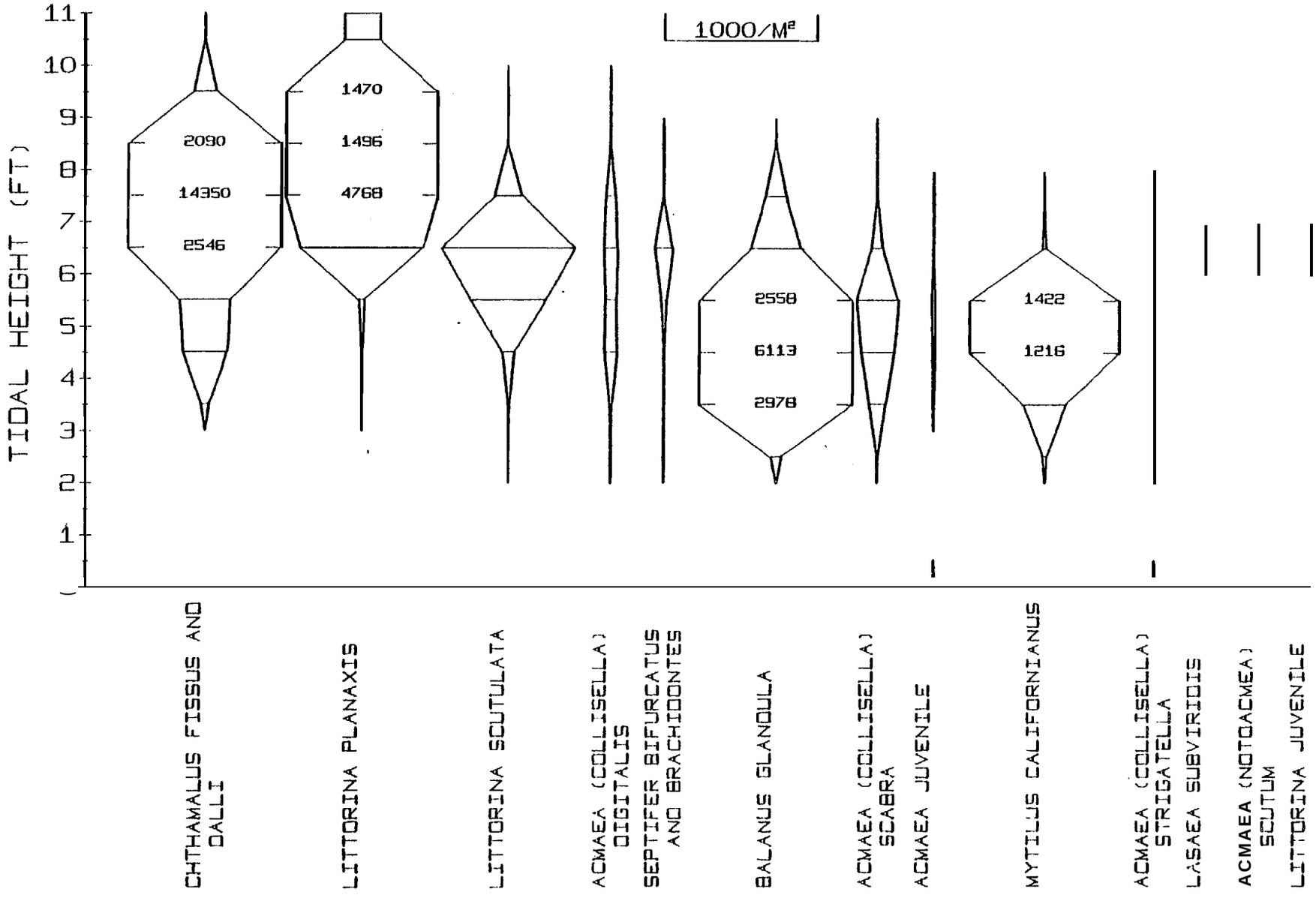

FIGURE 1.1.13-16. MEAN DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGH DURING 1976/1977 AT SANTA ROSA ISLAND (CONTINJED).

FIGURE 1.1.13-16. MEAN U.S. RIBBON OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN ONOFRE (CONTINUED).

FIGURE 1.1.13-16. MEAN DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT DURING 1976/1977 AT SAN ONOFRE (CONTINUATION).

FIGURE 1.1.13-17. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA ROSA ISLAND (CONTINUED).

FIGURE 1.1.3-17.

OISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA ROSA ISLAND CONTINUATION).

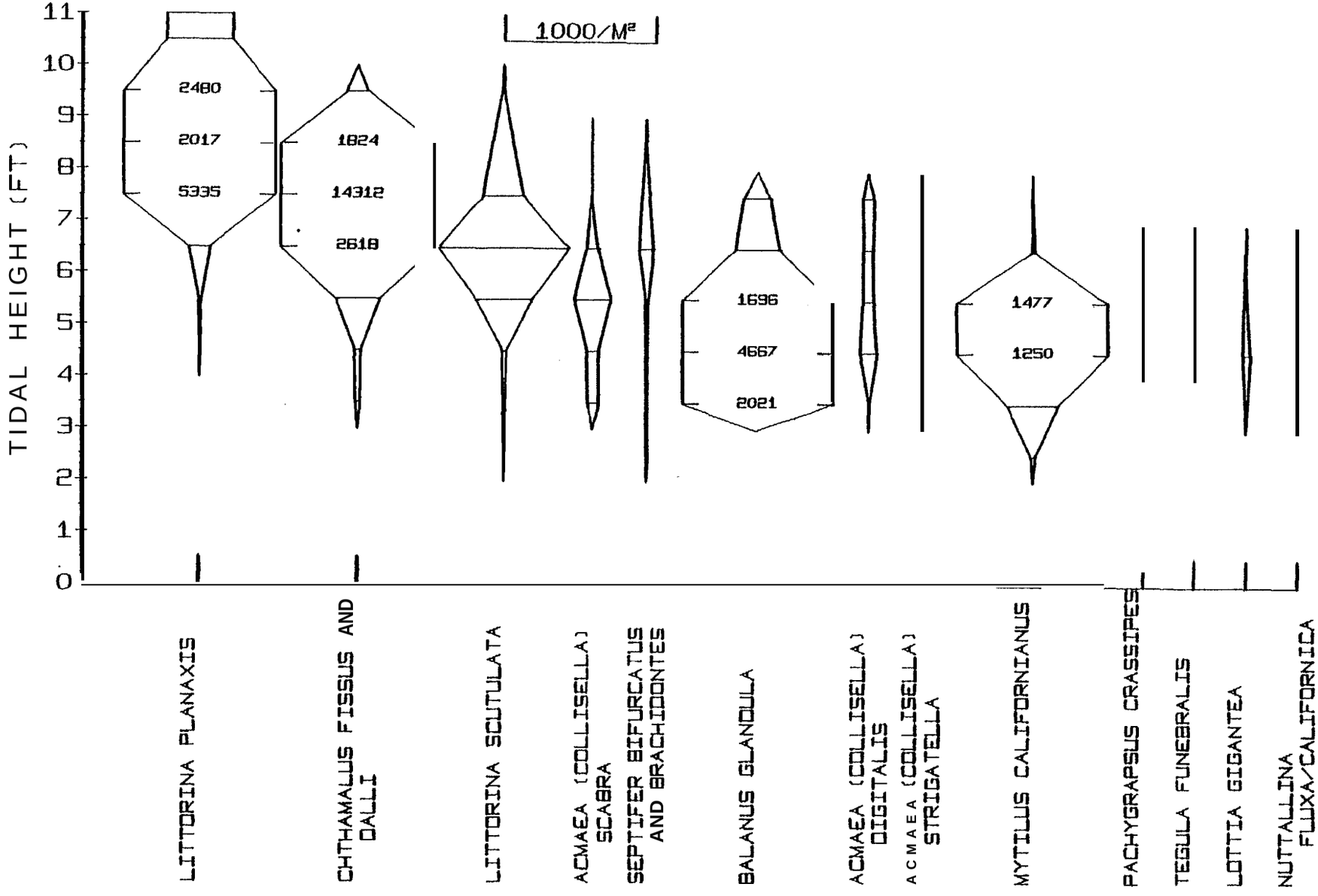

FIGURE 1.1.13-18. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SAN A ROSA ISLAND (CONTINUED).

FIGURE 1.1.13-18.

DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR OCTOBER 1976 AT SANTA ROSA ISLAND (CONTINUATION).

FIGURE .1.13-19. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA ROSA ISLAND (CONTINUED).

FIGURE 1.1.13-19. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA ROSA ISLAND CONTINUED.

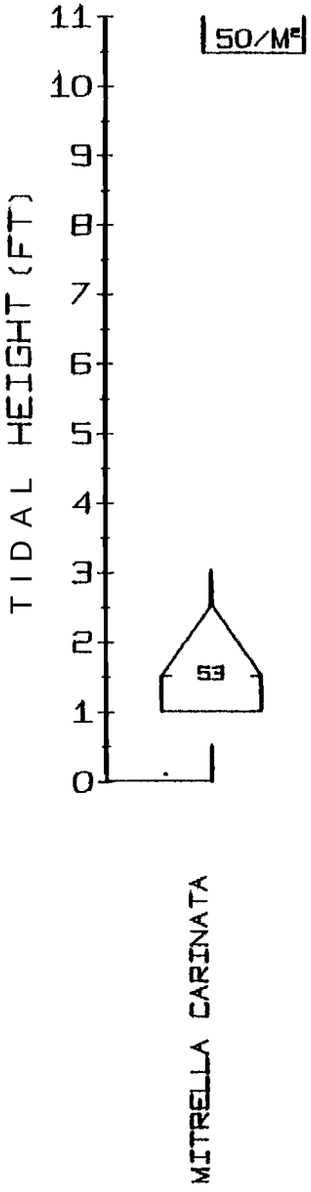

FIGURE 1.1.13-19. DISTRIBUTION OF DOMINAN MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA ROSA ISLAND (CONTINUATION).

FIGURE 1.1.13-20. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA ROSA ISLAND CONTINUED.

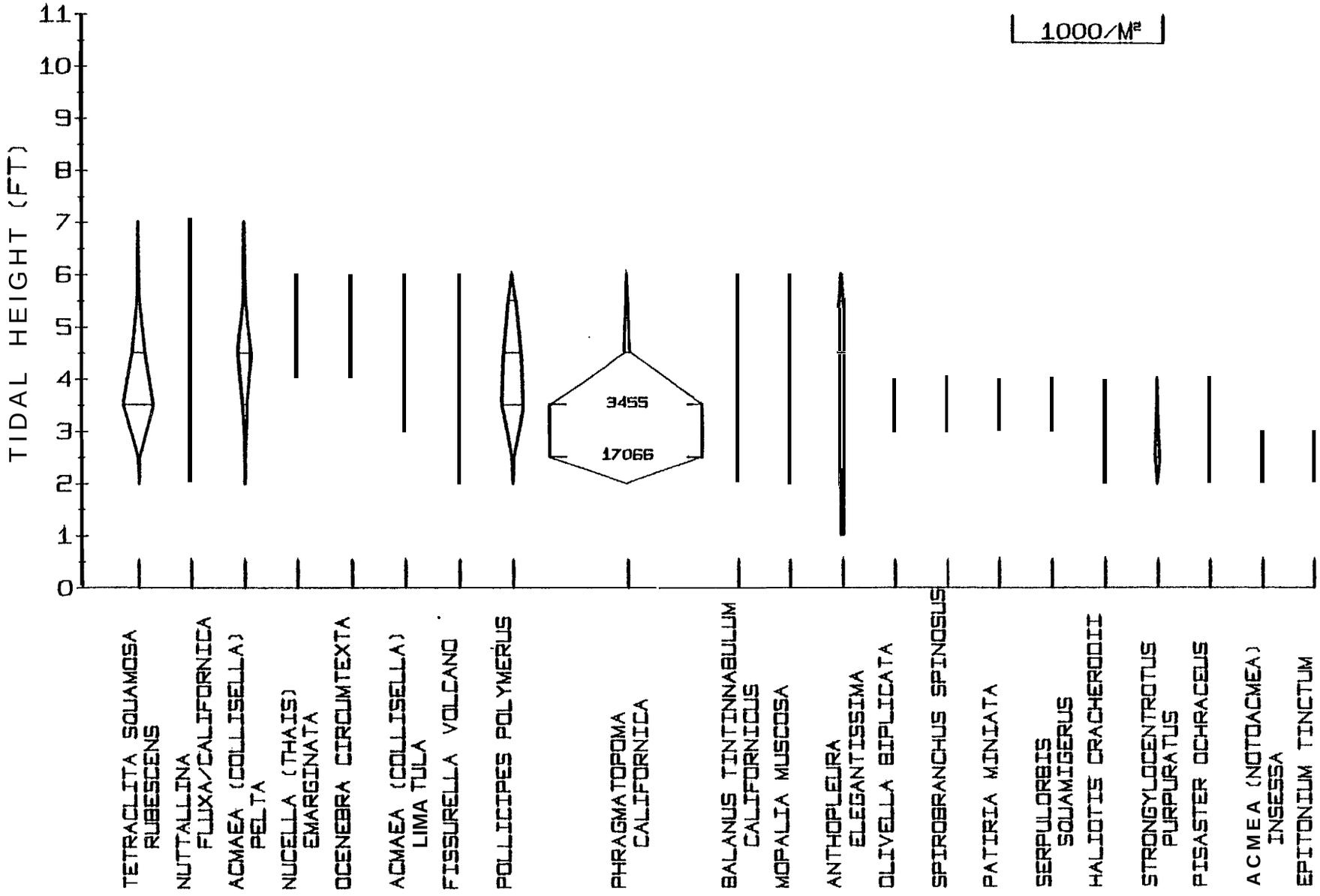

FIGURE 1.1.13-20. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SAN ROSA ISLAND (CONTINUED).

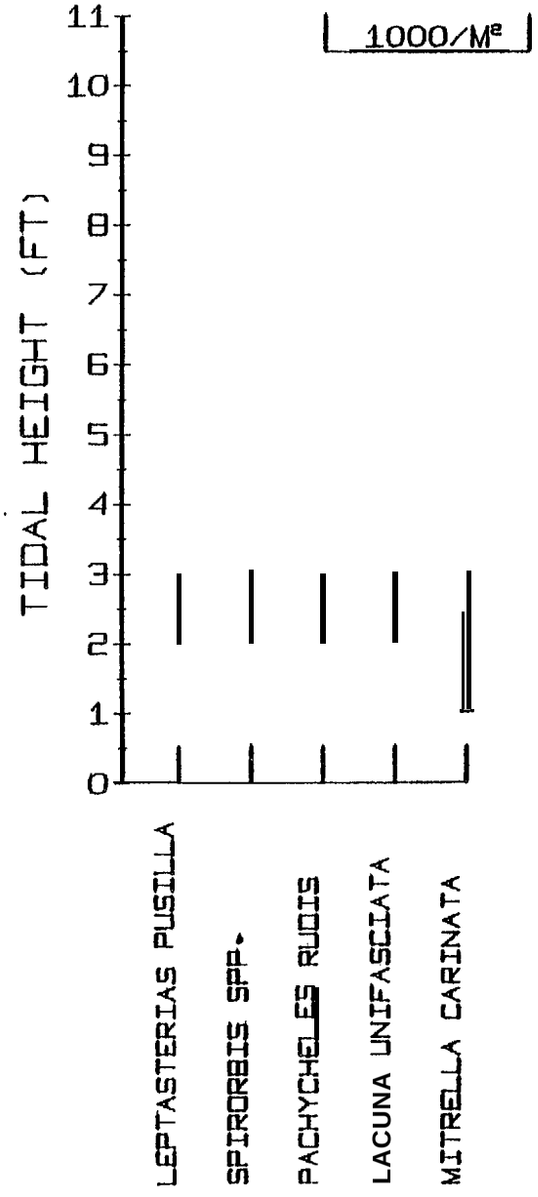

FIGURE 1.1.13-20. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR DECEMBER 1976 AT SANTA ROSA ISLAND (CONTINUATION).

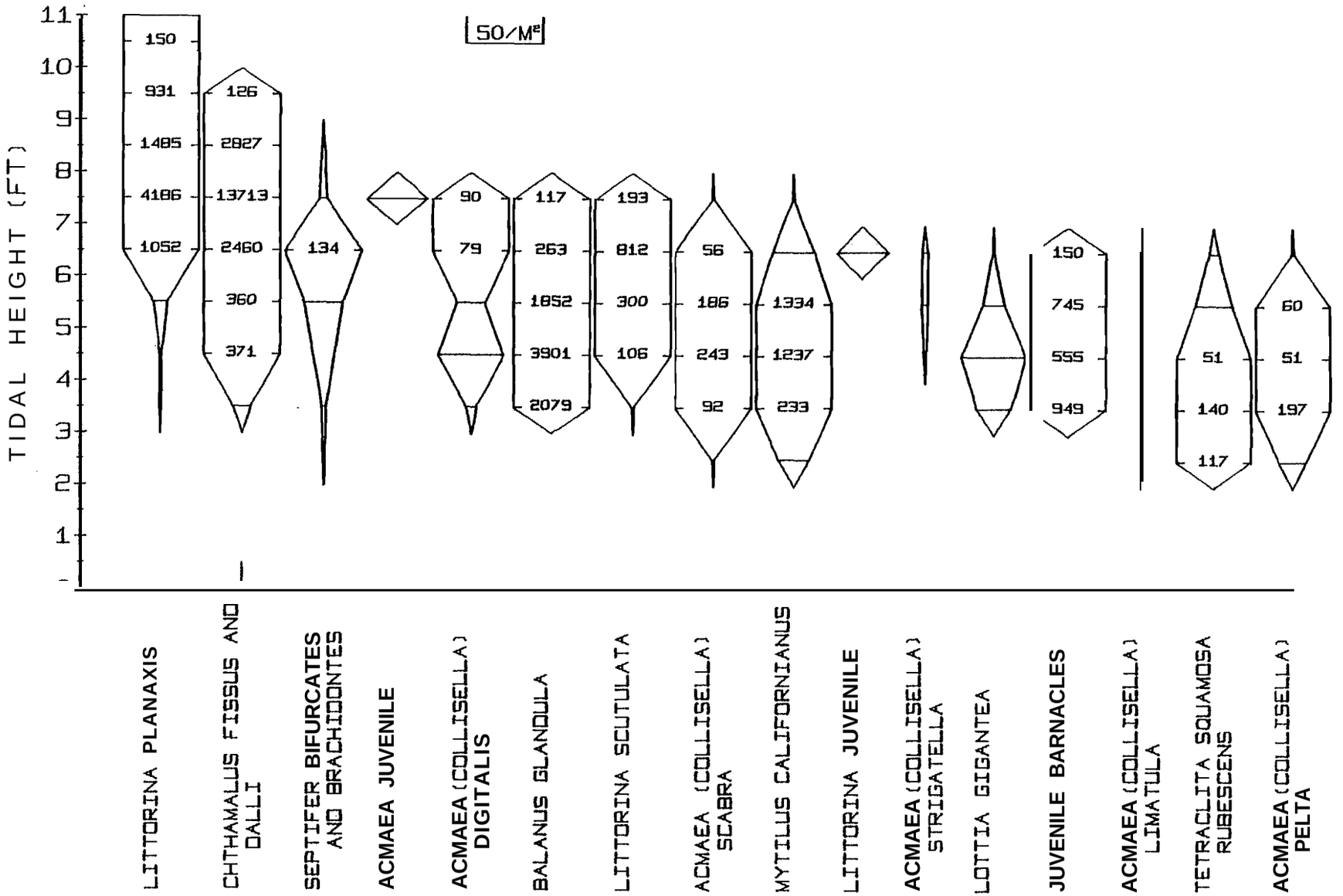

FIGURE 1.1.13-21. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SANTA ROSA ISLAND (CONTINUED).

FIGURE 1.1.13-21. DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SANTA ROSA ISLAND (CONTINUATION).

FIGURE 1.1.13-22. DISTRIBUTION OF DOMINANT MACRO INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SANTA ROSA ISLAND (CONTINUED).

FIGURE

DISTRIBUTION AND ABUNDANCE OF COMMON MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SANTA ROSA ISLAND (CONTINUED).

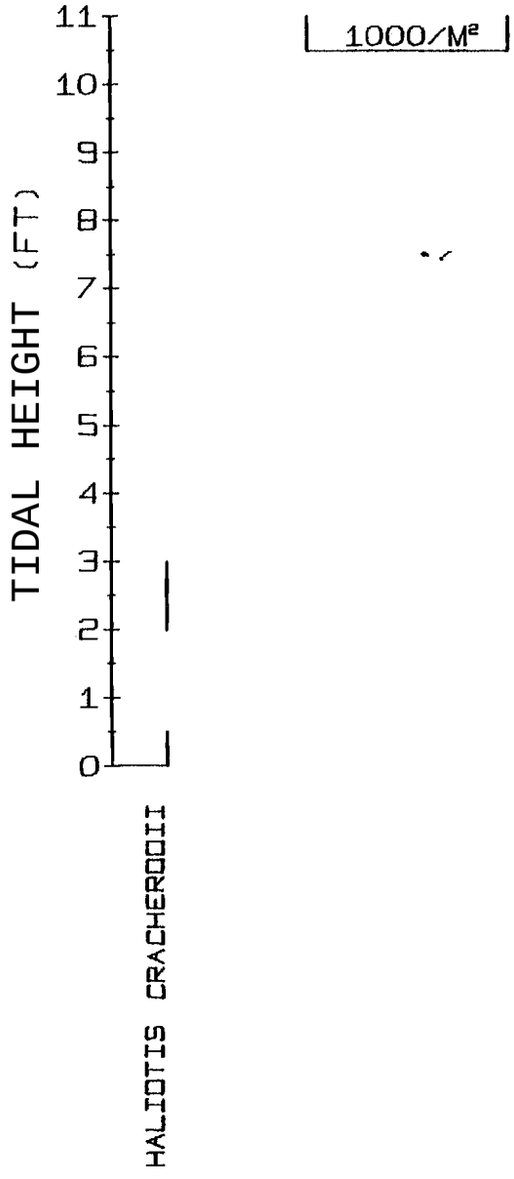

FIGURE 1.1.13-22. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR MARCH 1977 AT SANTA ROSA ISLAND CONTINUATION.

FIGURE 1.1.13-23. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 AT SANTA ROSA ISLAND (CONTINUED)

FIGURE 1.1.1w-23. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 AT SANTA ROSA ISLAND (CONTINUATION).

FIGURE .1.13-24. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 AT SANTA ROSA ISLAND (CONTINUED).

FIGURE 1.1.13-24. DISTRIBUTION OF DOMINANT MACRO-INVERTEBRATE DENSITY AS A FUNCTION OF TIDAL HEIGHT FOR JUNE 1977 AT SANTA ROSA ISLAND (CONTINUATION).

ABLE 1.1.13-27. MEAN DENSITY (NO./M2) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING OCTOBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT): 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
LITTORINA PLANAXIS				3	13	141	5335	2017	2460	436
CHTHAMALUS FISSUS AND DALLI			31	35	269	2618	14312	1824	147	
LITTORINA SCUTULATA		1		20	372	660	275		13	
ACMAEA (COLLISELLA) SCABRA			81	85	250	62	2	<1		
SEPTIFER BIFURCATUS AND BRACHIDONTES		9	4		16	92		8		
CHTHAMALUS FISSUS & DALLI DEAD										
ACMAEA (COLLISELLA) DIGITALIS			1	115	66	60	75			
ACMAEA (COLLISELLA) STRIGATELLA			16	5	13	6	10			
BALANUS GLANDULA			2021	4667	1696	297	180			
MYTILUS CALIFORNIANUS		24	330	1256	1477	22	3			
TEGULA FUNEBRALIS				2	1	6				
PACHYGRAPSUS CRASSIPES				3	5	<1				
MUTTALLINA FLUXA/CALIFORNICA			5	2	4	<1				
LOTTIA GIGANTEA			16	48	17	2				
TETRACLITA SQUAMOSA RUBESCENS		53	157	45	5	5				
BALANUS GLANDULA DEAD										
ACMAEA (COLLISELLA) PELTA		5	44	53	10	5				
FISSURELLA VOLCANO		1	3			2				
ACMAEA (COLLISELLA) LIMATULA					1					
SERPULORBIS SQUAMIGERUS					3					
CYANOPLAX HARTWEGII					1					
NUCELLA (THAIS) EMARGINATA				2	4					
HALIOTIS CRACHERODII		<1			<1					
POLLICIPES POLYMERUS		20	81	46	33					

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-27. MEAN DENSITY (NO./M2) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING OCTOBER 1976, BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT), 1.0 TO 1.9	2.0 TO 2.9	3.11 TO 3,9	4.0 TO 4,9	5.0 TO 5.9	6.0 TO 6.9	7,0 TO 7,9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
ARTHROPLEURA ELEGANTISSIMA	6	12	20	62	19					
ACANTHINA PUNCTULATA				<						
HIATELLA ARCTICA				<						
TETRACLITA SQUAMOSA RUBESCENS DEAD										
PISASTER OCHRACEUS			<1							
STRONGYLOCENTROTUS PURPURATUS		16	1							
PHRAGMATOPOMA CALIFORNICA	3866	17386	5333							
ACMAEA (NOTOACMEA) INSESSA		1								
PATIRIA MINIATA		<1								
LEPTASTERIAS PUSILLA		3								
PACHYCHELES RUDIS		1								

NOTE; 1 FOOT = 0,3048 METERS

TABLE 1.1.13-28. MEAN DENSITY (NO./M2) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING DECEMBER 1976. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.5
LITTORINA PLANAXIS					3	598	4965	1746	1935	297
CHTHAMALUS FISSUS AND DALLI			133	475	518	2626	14635	1976	155	
CHTHAMALUS FISSUS & DALLI DEAD										
SEPTIFER BIFURCATUS AND BRACHIDONTES		12	6		28	97	2	2		
LITTORINA SCUTULATA			1	46	369	1408	258			
BALANUS GLANDULA DEAD										
BALANUS GLANDULA		112	2321	4276	1469	269	148			
ACMAEA (COLLISELLA) DIGITALIS		1	38	70	97	64	55			
MYTILUS CALIFORNIANUS		8	312	1223	1486	30	2			
CYANOPLAX HARTWEGII					1	2				
TEGULA FUNEBRALIS				3	4	<1				
LOTTIA GIGANTEA			9	36	17	2				
ACMAEA (COLLISELLA) SCABRA			108	220	274	52				
ACMAEA (COLLISELLA) STRIGATELLA		3	1	2	3	13				
PACHYGRAPSUS CRASSIPES		3	5	13	9	2				
ACMAEA (COLLISELLA) TELTA		2	33	68	16	5				
TETRACLITA SQUAMOSA RUBESCENS		7	197	85	13	4				
NUTTALLINA FLUXA/CALIFORNICA		1	8	5	5	<1				
TETRACLITA SQUAMOSA RUBESCENS DEAD										
NUCELLA (THAIS) EMARGINATA				16	12					
CCENEBRA CIRCUMTEXTA				3	1					
ACMAEA (COLLISELLA) LIMATULA			1	11	2					
FISSURELLA VOLCANO		4		2	1					
POLLICIPES POLYMERUS		10	139	110	46					

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-28. MEAN DENSITY (NO./M2) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING DECEMBER 1976, BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT), 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
PHRAGMATOPOMA CALIFORNICA		17066	3455	38	1					
BALANUS TINTINNABULUM CALIFORNICUS		3			1					
MOPALIA MUSCOSA		1	1		1					
ANTHOPLEURA ELEGANTISSIMA	20	24	42	86	23					
OLIVELLA BIPLICATA			1							
SPIROBRANCHUS SPINOSUS			1							
PATIRIA MINIATA			<1							
SERPULORBIS SQUAMIGERUS			1							
HALIOTIS CRACHERODII		<1	<1							
STRONGYLOCENTROTUS PURPURATUS		30	1							
PISASTER OCHRACEUS		<1	<1							
ACMAEA (HOTOACMEA) INSESSA		1								
EPITONIUM TINCTUM		1								
LEPTASTERIAS PUSILLA		1								
SPIROBIS SPP.		1								
PACHYCHELES RUDIS		1								
LACUNA UNIFASCIATA		3								
MITRELLA CARINATA	53	1								

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-29. MEAN DENSITY (NO./M2) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING MARCH 1977, BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT), 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
LITTORINA PLANAXIS			1	2	9	1652	4186	1485	931	150
CHTHAMALUS FISSUS AND DALLI			12	371	360	2460	13713	2827	126	
CHTHAMALUS FISSUS & DALLI DEAD										
SEPTIFER BIFURCATUS AND BRACHIDONTES		1	3		25	134	5	2		
ACMAEA JUVENILE							40			
LITTORINA SCUTULATA			1	166	300	612	193			
BALANUS GLANDULA			2079	3961	1652	263	117			
ACMAEA (COLLISELLA) DIGITALIS			6	42	18	79	90			
ACMAEA (COLLISELLA) SCABRA		1	92	243	186	56	2			
MYTILUS CALIFORNIANUS		20	233	1237	1334	27	2			
BALANUS GLANDULA DEAD										
LITTORINA JUVENILE						34				
ACMAEA (COLLISELLA) STRIGATELLA				2	4	4				
LOTTIA GIGANTEA			22	43	14	<1				
JUVENILE BARNACLES			949	555	745	150				
ACMAEA (COLLISELLA) PELTA		18	197	51	60	2				
TETRACLITA SQUAMOSA RUBESCENS		117	140	51	25	7				
TETRACLITA SQUAMOSA RUBESCENS DEAD										
ACMAEA (COLLISELLA) LIMATULA		3				2				
NUCELLA (THAIS) EMARGINATA				13	2					
PLOCAMIA KARYKINA										
NUTTALLINA FLUXA/CALIFORNICA			21	5	8					
TEGULA FUNEBRALIS			1	3	1					
CYANOPLAX HARTWEGII		1			1					

NOTE: 1 FOOT = 0.3048 METERS

ABLE 1.1. 3-29. MEAN DENSITY (NO./M2) OF DOMINANT MACRO- INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING MARCH 1977. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT), 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
PHRAGMATOPOMA CALIFORNICA		16789	2805	16	45					
POLLICIPES POLYMERUS		83	101	72	52					
PACHYGRAPSUS CRASSIPES		1		5	5					
ANTHOPLEURA ELEGANTISSIMA	13	14	13	75	22					
AMPHISSA VERSICOLOR				2						
SPIRORBIS SPP.				2						
LEPTASTERIAS PUSILLA		1		2						
STRONGYLOCENTROTUS PURPURATUS		13		5						
SPIROBRANCHUS SPINOSUS			1							
PISASTER OCHRACEUS			<1							
FISSURELLA VOLCANO		1	1							
DODECACERIA FEWKESI										
HALIOTIS CRACHERODI		<1								

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-30. MEAN DENSITY (NO./M2) OF DOMINANT MACRO-INVERTEBRATES AS A FUNCTION OF TIDAL HEIGHT FOR SANTA ROSA ISLAND DURING JUNE 1977, BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
LITTORINA PLANAXIS				23	129	1027	4568	743	535	49
CHTHAMALUS FISSUS AND DALLI			29	256	154	2280	14542	1734	164	3
ACMAEA (COLLISELLA) DIGITALIS				88	82	107	23	<1	4	
SEPTIFER BIFURCATUS AND BRACHIDONTES				2	46	131	3	6		
LITTORINA SCUTULATA			33	166	936	424	8	8		
BALANUS GLANDULA		66	5492	11615	5217	494	107	<1		
CHTHAMALUS FISSUS & DALLI DEAD										
BALANUS GLANDULA DEAD										
MYTILUS CALIFORNIANUS		21	245	1155	1390	20	2			
LASAEA SUBVIRIDIS						4				
ACMAEA (NOTOACMEA) SCUTUM						<1				
OCENEBRA CIRCUMTEXTA					1	<1				
TEGULA FUNEBRALIS					2	3				
CYANOPLAX HARTWEGII				2		3				
LOTTIA GIGANTEA			12	36	34	2				
ACMAEA (COLLISELLA) STRIGATELLA			13	8	9	8				
ACMAEA (COLLISELLA) LIMATULA			7	13	6	<1				
ACMAEA JUVENILE			26		90	7				
TETRACLITA SQUAMOSA RUBESCENS			158	120	28	5				
HEPALIA FUSCOSA			1			<1				
NUTTALLINA FLUXA/CALIFORNICA		3	12	2	9	3				
ACMAEA (COLLISELLA) SCABRA		1	124	290	376	90				
POLLICIPES POLYMERUS		16	61	123	48	<1				
ACMAEA (COLLISELLA) PELTA		53	107	135	113	9				

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-30. MEAN DENSITY (NO./M2) OF DOMINANT MACRO-INVERTEBRATES AS A FUNC ON OF IDAL HEIGHT FOR SANTA ROSA ISLAND DURING JUNE 1977, BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT) 1.0 TO 1.9	2.0 TO 2.9	3.0 TO 3.9	4.0 TO 4.9	5.0 TO 5.9	6.0 TO 6.9	7.0 TO 7.9	8.0 TO 8.9	9.0 TO 9.9	10.0 TO 10.9
TETRACLITA SQUAMOSA RUBESCENS DEAD										
PHRAGMATOPOMA CALIFORNICA		22986	5504	10	54					
PACHYGRAPSUS CRASSIPES		4	1	7	11					
ANTHOPLEURA ELEGANTISSIMA		11	22	76	25					
SPIROBRANCHUS SPINOSUS				5						
PAGURUS SAMUELIS				2						
NUCELLA (THAIS) EMARGINATA			1	5						
STRONGYLOCENTROTUS PURPURATUS		8	1							
LUCETTA LOSANGELENSIS										
FISSURELLA VOLCANO		6	9							
PISASTER OCHRACEUS		<1								
HALIOTIS CRACHERODII		<1								
ACMAEA (NOTOACMEA) PALEACEA	6									

NOTE: 1 FOOT = 0.3048 METERS

Density of A. (Collisella) scabra, between +5.0 and +6.0 ft. (1.5 and 1.8 m), increased from 186/m² to 376/m² from March to June (Tables 1.1.13-29 and 1.1.13-30).

From +3.0 and +4.0 ft. (.9 and 1.2 m), the barnacle Tetraclita squamosa rubescens reached maximum density. The seasonal range in density for T. squamosa rubescens in this interval was from 157 individuals/m² in October to 197/m² in December and March.

Below +3.0 ft. (.9 m) Phragmatopoma californica became dominant. It reached a minimum density of 16,789 individuals/m² during March and a maximum density of 22,986/m² during June between +2.0 and +3.0 ft. (.6 and .9 m). Pollicipes polymerus and Acmaea (Collisella) pelta had annual mean densities of 32/m² and 20/m², respectively, between +2.0 and +3.0 ft. (.6 and .9 m).

1 .1.13.4.2.4 Biomass

Wet weight (wW), dry weight (DW) and organic dry weight (ODW) of dominant macrophytes are presented in Tables 1.1.13-31 through 1.1.13-33. Macr oinver tebr ate wet, dry , and organic dry weights are presented in Tables 1.1.13-34 through 1.1.13-36. The total array of quarter ly disturbed samples was lumped to provide more meaningful assessments of total biomass.

Total macr ophy te biomass averaged 722.4 g/m² dry and 2438.7 g/m² we t weight. Macrophyte biomass was minimal above +4. O ft. (1.2 m), averaging 57.3 g/m² DW with the exception of the +5.0 to +6.0 ft. (1. 5 to 1.8 m) interval which had an average dry weight of 280.1 g/m² (1133.9 g/m² WW). Below +4.0 ft. (1.2 m), macrophyte dry biomass increased dr amati tally to a maximum of 3194.3 g/m² between +2. O and +3.0 ft. (.6 and .9 m). Five species contributed over 90% of total macrophyte dry standing stock, Phyllospadix scouleri with 569.3 g/m² DW , Corallina vancouveriensis with 56.3 g/m² DW (9.6 g/m² ODW) , C. off i cinalis var . chilensis with 21.1 g/m² DW (3.2 g/m² ODW) , Endocladia muricata with 13.9 g/m² DW, and Gigartina canaliculata with 12.7 g/m² DW.

Total macroinvertebrate dry standing stock averaged 3543.5 g/m² (4854.5 g/m² WW). Most of the macroinvertebrate dry biomass was concentrated between +3.0 and +8.0 ft. (.9 and 2.4 m) , with less than 3% of the dry biomass being found in the remaining intervals. Over 90% of the dry biomass was contributed by two species, My tilus calif ornianus with 3127.7 g/m² DW (31 2,8 g/m² ODW) and Balanus glandula with 140.6 g/m² DW (12. 7 g/m² ODW) . Other pr eminent macr oinver tebrates were Lottia gi gantea wit h 74.1 g/m² DW, Chthamalus fissus/dalli with 62.8 g/m² DW, and Haliotis cracherodii with 26.3 g/m² DW. It should be noted that the biomass of the abundant Phragmatopoma californica could not be assessed because of lack of suitable methodology .

TABLE 1.1. 13-31. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM SOUTH POINT, SANTA R O S A ISLAND FROM OCTOBER 1976 TO JUNE 1977. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9 (N= 5)	2.0 TO 2.9 (N= 6)	3.0 TO 3.9 (N= 5)	4.0 TO 4.9 (N= 4)	5.0 To 5.9 (N= 4)	6.0 TO 6.9 (N= 4)	7*O TO 7.9 (N= 4)	8.0 TO 8.9 (N= 6)	9.0 TO 9.9 (N= 5)	10.0 To 10.9 (N= 5)	MEAN
ENDOCLADIA MURICATA			0,5	<0.1	248.4	256.9	55.7	81.4	*40.5*		72.3
COLPOMENIA SINUOSA	<0.1	0.2						*0.9*	*0.6*		0.2
POLYSIPHONIA HENDRYI VAR HENDRYI		0.6	6.2		12.1	5.9	*<0.1*				2,5
CLADOPHORA COLUMBIANA		0.8	9.1	0.3	13.7	9.8	*<0.1*				2.6
ULVA LOBATA	3.4	23.4	12.2	1.0	122.9	10.2	1.2				17.4
RHODOGLOSSUM AFFINE		2.5	124.1	2.4	69.1	1.6					22.0
GELIDIUM COULTERI	<0.1	34.5	305.6	36.9	62.5	<0.1					44.2
CERAMIUM EATONIANUM/SINICOLA		0.6			1.5						0.2
LAURENCIA LAJOLLA		7*2	2.1		19.8						2.9
CERAMIUM SPP.		<0.1	0.4		0.7						0.1
ENDARACHNE BINGHAMIAE		0.1			2.7						0.3
PTEROSIPHONIA DENDROIDEA	13.5	4.6	0.2		<0.1						1.9
CORALLINA OFFICINALIS VAR. CHILENSIS	14.9	174.4	110.4	2.4	116.4						41.8
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	59.4	96.4	4.2		<0.1						16.0
CORALLINA VANCOUVERIENSIS	91.3	469.0	350.7	40.0	191.6						114.3
GIGARTINA CANALICULATA	18.3	206.0	296.6	<0.1	260.6						78.3
CALLITHAMNION RUPICOLUM	1.3	2.8	1.1		<0.1						0.5
PORPHYRA PERFORATA			44.9	0.1							4.3
CRYPTOPLEURA VIOLACEA			1.8								0.2
IRIDAEA CORDATA VAR. SPLENDENS		17.9	0.9								1.9
GIGARTINA SPINOSA		0.6	10.7								1.1
CALLIARTHRON TUBERCULOSUM		1.2	0.2								0.1

NOTE: 1 FOOT = 0,3048METERS

TABLE 1.1.13-3. WET WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM SOUTH POINT, SANTA ROSA ISLAND FROM OCTOBER 1976 TO JUNE 1977. BLANK SPACES INDICATE ZEROS (CONTINUATION).

	TIDAL HEIGHT (FT).										
AXA	1.0 TO 1.9 (N= 5)	2.0 TO 2.9 N= 6)	3.0 TO 3.9 N= 5)	4.0 TO 4.9 (N= 4)	5.0 TO 5.9 (N= 4)	6.0 TO 6.9 (N= 4)	7.0 TO 7.9 N= 4)	8.0 TO 8.9 (N= 6	9.0 TO 9.9 (N= 5	10.0 TO 10.9 (N= 5)	MEAN
CRYPTOPLEURA LOBULIFERA	13.2	90.1	75.9								17.9
EGREGIA MENZIESII	81.1	251.8	91.4								42.4
PHYLLOSPADIX SCOULERI	10388.7	6367.6	241.0								1899.7
IRIDAEA HETEROCARPA	0.5	14.6									1.5
PRIONITIS CORDEA	153.3	18.2									17.1
SMITHORA NAIADUM	117.2	24.8									14.2
GRATELOUPIA DORYPHORA	4.6	7.6									1.2
GASTROCLONIUM COULTERI	<0.1	1.6									0.2
HALIDRYS DIOICA	187.6										18.8
OTHER MACROPHYTES (34	0.1	0.2	3.0	0.7	0.0	0.0	0.0				
TOTAL WET WEIGHT IN G/M2	11148.4	9819.4	1695.2	85.6	1133.9	324.4	56.9	82.3	40.9		

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-32. DRY WEIGHT IN G/M² FOR DOMINANT MACROPHYTES FROM SOUTH POINT, SANTA ROSA ISLAND FROM OCTOBER 1976 TO JUNE 1977. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). 1.0 To 1.9 (N= 5)	2*(J TO 2.9 (N= 6)	3.0 TO 3.9 (N= 5)	4.0 To 4.9 (N= 4)	5.0 TO 5.9 (N= 4)	6.G TO 6.9 (N= 4)	7.0 To 7.9 (N= 4)	8.0 To 8.9 (N= 6)	9.0 TO 9.9 (N= 5)	10.0 To 10.9 (N= 5)	MEAN
ENDOCLADIA MURICATA			<0.1	<0.1	56.5	53.6	8.5	19*5	6.6		13.9
POLYSIPHONIA HENDRYI VAR HENDRYI		0.1	0.6		2.2	0.7	<0.1				0.4
CLADOPHORA COLUMBIANA		0*2	1.8	<0.1	0.6	0.9	<0.1				0.4
ULVA LOBATA	0.2	2.2	1,5	0.3	20.4	0.9	<0.1				2.6
RHODOGLOSSUM AFFINE		0*5	11.3	0.5	10.3	0.2					2.3
GELIDIUM COULTERI	<0.1	8.8	67.6	8.5	13.1	<0.1					9.8
LAURENCIA LAJOLLA		11.6	6.1		1*3						0.2
PTEROSIPHONIA DENDROIDEA.	1.6	0.4	<0.1		<0.1						0.2
GIGARTINA CANALICULATA	3.(I	30.6	51.6	<G. i	%1.9						12.7
CORALLINA OFFICINALIS VAR. CHILENSIS	8.2	90.1	55.5	1.1	55.5						21.1
BOSSIELLA ORBIGNIANA SSP. DICHOTOMA	34.1	51.2	2.3		<0.1						8.8
CORALLINA VANCOUVERIENSIS	44.6	230.5	184.9	19.1	63.6						56.3
PORPHYRA PERFORATA			7.4	<0*1							0.7
IRIDAEA CORDATA VAR. SPLENDENS		3.3	<0.1								0.3
GIGARTINA SPINOSA		0*1	1.6								0.2
CALLIARTHRON TUBERCULOSUM		1,0	0.2								0.1
CRYPTOPLEURA LOBULIFERA	1.9	14.2	12.4								2.9
EGREGIA MENZIESII	22.2	70.1	23.3								11.6
PHYLLOSPADIX SCOULERI "	2950.5	2678.8	64.0								569.3
IRIDAEA HETEROCARPA	0.1	3.4									0.4
PRIONITIS COMEA	35.4	4.5									4.0
SMITHORA NAIADUM	8.6	2.0									1.1

NOTE: 1 FOOT = 0.3048 METERS

TABLE **1.1.13-32.** DRY WEIGHT IN G/M2 FOR DOMINANT MACROPHYTES FROM SOUTH POINT, SANTA ROSA ISLAND FROM OCTOBER 1976 TO JUNE 1977. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9 (N= 5)	2.0 To 2.9 (N= 6)	3.0 TO 3.9 (N= 5)	4.0 To 4.9 (N= 4)	5.0 TO 5.9 (N= 4)	6.11 TO 6.9 (N= 4)	7*11 To 7,9 (N= 4)	8.0 To 8.9 (N= 6)	9.0 To 9.9 (N= 5)	10.0 To 10.9 (N= 5)	MEAN
GRATELOUPIA DORYPHORA	0,7	1.1									O*2
HALIDRYS DIGITA	29.4										2.9
OTHER MACROPHYTES (41)	0.2	0.5	1.1	0.0	0.7	0.0	0.0	0.1	0.1		
TOTAL DRY WEIGHT IN G/M2	3141.5	3194.3	487.3	29.6	280.1	56.4	8.6	19.7	6.6		

NOTE; 1 FOOT = 0.3048 METERS

Table 1.1.13-33. Organic Dry Weight in g/m^2 for Dominant Macrophytes from, South Point, Santa Rosa Island from October 1976 to June 1977. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros,

Taxa	Tidal Height (ft) 1.0 to 1.9 (N= 5)	2.0 to 2.9 (N= 6)	3.0 to 3.9 (N= 5)	4,0 to 4.9 (N= 4)	5.0 to 5.9 (N= 4)	6.0 to 6.9 (N= 4)	7.0 to 7.9 (N= 4)	8.0 to 8.9 (N= 6)	9.0 to 9.9 (N= 5)	10.0 to 10.9 (N= 5)	Mean
Endocladia muricata			<0.1	<0.1	50.5	53.8	8.5	19.5	6.8		13.9
Polysiphonia hendryi var. hendryi		0.1	0.6		2.2	0.7	<0.1				0.4
Cladophora columbiana		0.2	1.8	<0.1	0.6	0.9	<0.1				0.4
Ulva lobata	0.2	2.2	1.5	0.3	20.4	0.9	<0.1				2.6
Rhodoglossum affine		0.5	11.3	0.5	10.3	0.2					2.3
Gelidium coulteri	<0.1	8.8	67.6	8.5	13.1	<0.1					9.8
Laurencia lajolla		0.6	0.1		1.3						0.2
Pterosiphonia dendroidea	1.6	0.4	<0.1		<0.1						0.2
Gigartina canaliculata	3.0	30.6	51.6	<0.1	41.9						12.7
Corallina officinalis var. chilensis*	1,3	13.5	8.3	0.2	8.3						3.2
Bossiella orbigniana ssp. dichotoma*	6.1	9.2	0.4		<0.1						1.6
Corallina vancouveriensis*	7.6	39.2	31.4	3.2	14.2						9.6
Porphyra perforata			7*4	<0.1							0.7
Iridaea cordata var. splendens		3.3	<0.1								0.3
Gigartina spinosa		0.1	1.6								0.2
Calliarthron tuberculosum*		0.2	<0.1								<0.1
Cryptopleura lobulifera	1*9	14.2	12.4								2.9

Table 1.1.13-33. Organic Dry Weight in g/m^2 for Dominant Macrophytes from South Point, Santa Rosa Island from October 1976 to June 1977. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros. (Continued).

Taxa	Tidal Height (ft) 1.0 to 1.9 (N= 5)	2.0 to 2.9 (N= 6)	3.0 to 3.9 (N= 5)	4.0 to 4.9 (N= 4)	5.0 to 5.9 (N= 4)	6.0 to 6.9 (N= 4)	7.0 to 7.9 (N= 4)	8.0 to 8.9 (N= 6)	9.0 to 9.9 (N= 5)	10.0 to 10.9 (N= 5)	Mean
Egregia menziesii	22.2	70.1	23.3								11.6
Phyllospadix scouleri	2950.5	2678,8	64.0								569.3
Iridaea heterocarpa	0.1	3*4									0.4
Prionitis cornea	35.4	4.5									4.0
Smithora naiadum	8.6	2.0									1.1
Grateloupia doryphora	0.7.	1.1									0.2
Halidrys dioica	29.4										2.9
Other Macrophytes (41)	0.2	0,5	,1.1	0.0	' 0.7	0.0	0.0	0,1	0.1		
Total Organic Dry Weight in g/m^2	3068.9	2883.5	284,8	13.1	163.7	56.4	8.6	19.7	6.8		650.6

Note: 1 foot = 0.3048 meters

TABLE 1.1.13-34. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM SOUTH POINT, SANTA R O S A ISLAND FROM OCTOBER 1976 TO JUNE 1977. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9 (N= 5)	2.0 TO 2.9 (N= 6)	3.0 TO 3.9 (N= 5)	4.0 TO 4.9 (N= 4)	5.0 TO 5.9 (N= 4)	6.0 TO 6.9 (N= 4)	7.0 TO 7.9 (N= 4)	8.0 TO 8.9 (N= 6)	9.0 TO 9.9 (N= 5)	10.0 TO 10.9 (N= 5)	MEAN
LITTORINA PLANAXIS		0*1	<0.1		1.4	11.7	56.2	42.9	28.3	16.5	13.7
CHTHAMALUS FISSUS AND DALLI			11.5	29.2	0.6	0.7	214.8	515.9	238.3		101.IJ
ACMAEA (COLLISELLA) DIGITALIS			10.7	4.9	5.1	17.5	3.0	0.9	0.9		4.6
LASAEA SUBVIRIDIS		<0.1		<0.1	0.1	1.0	3.8	0.3	0.1		0.5
ACMAEA (COLLISELLA) SCABRA		0.2	16.2	10.1	5.7	8.7	17.7	0.3	1.2		6.0
PACHYGRAPSUS CRASSIPES		<0.1	14.3	4.1	1.5	0.2	<0,1		<0.1		2*IJ
ACMAEA JUVENILE		<0.1	2.1	1*-1		0.2	<0.1		<d.l		0.4
SEPTIFER BIFURCATUS	0.6	1.1	28.8	137.3	27.6	71.1	27.8		1.0		29.5
LITTORINA SCUTULATA	<0.1	0.2	8.2	1.4	20.0	22.1	4.9	11.0	9.1		7.7
BALANUS GLANDULA	0.7	0.3	1369.6	455.7	264.4	44.8	4.1	9.7	88.2		223.6
BRACHIDONTES ADAMSIANUS		<0.1	<0.1	0.5	2.3	65.8	11.5	ii.2			8.0
BARLEEIA SPP.		<0.1	1.0	<0.1				<0"1			0.1
MYTILUS EDULIS			1.3			13.8	0.2				1.5
ACMAEA (COLLISELLA) LIMATULA			1.7	0.8			0.2				0.3
LOTTIA GIGANTEA			186.7	657.9	34.4	49.7	124.7				105.3
NUTTALLINA FLUXA		1.4	13.7	4.8	1.3	0.4	2.1				2.3
ACMAEA (COLLISELLA) PELTA		1.3	43.0	12.0	5.1	8.6	1.8				7.6
TETRACLITA SQUAMOSA RUBESCENS		<0.1	162.8	104.0	60.1	17.2	13.4				35.7
POLLICIPES POLYMERUS		2*0	272.2	136.6	27.2	52.6	0.0				49.1
NUTTALLINA CALIFORNICA		0.8	16.7	5.7	34.7		11.9				7.0
MYTILUS CALIFORNIANUS	6.1	39*8	18228.6	10353.2	6057.3	6743.5	317.3				4172.8
NUCELLA (THAIS) EMARGINATA			0.3	3*,5		12.9					4.8

NOTE: 1 FOOT =0.3048METERS

TABLE 1.1.13-34. WET WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM SOUTH POINT, SANTA ROSA ISLAND FROM OCTOBER 1976 TO JUNE 1977. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT). 1.0 To 1.9 (N= 5)	2.0 To 2.9 (N= 6)	3.0 To 3.9 (N= 5)	4.0 To 4.9 (N= 4)	5.0 To 5.9 (N= 4)	6.0 To 6.9 (N= 4)	7.0 To 7.9 (N= 4)	8.0 To 8.9 (N= 6)	9.0 To 9.9 (N= 5)	10.0 To 10.9 (N= 5)	MEAN
CYANOPLAX HARTWEGII		<0.1	1.3	0.?)	0.2	0.4					0..2
ANTHOPLEURA ELEGANTISSIMA		7.4	155.2	12.3	8.5	0.5					18.4
LEPTASTERIAS PUSILLA		1.0	0.9	1.6	3.5						0.7
PETROLISTHES CABRILLOI		<0.1	17.7		0.9						1.9
STRONGYLOCENTROTUS PURPURATUS	O*2	28.3	0.3		10.9						4.0
FISSURELLA VOLCANO	<0.1	1.2	6.5	<0.1	1.4						0.9
AMPHISSA VERSICOLOR			O*9	0.2							0.1
TEGULA JUVENILE			3.0	0.3							0.3
HOMALOPOMA LURIDUM		<0*1	0.7	1.1							0.2
CPALIA FUNICULATA	<0.1		3.4	<0.1							0.4
TEGULA FUNEBRALIS			8.3								0.8
HALIOTIS CRACHERODII			368.2								36.8
PARAXANTHIAS TAYLORI			1.3								0.1
PACHYCHELES RUDIS		4.5	2.8								0.7
OCPALIA MUSCOSA	2.2	16.8	<0.1								1.9
MITRELLA CARINATA	1.2	0.6	1.4								0,3
PUGETTIA PRODUCTA	1.5	1.5	0.3								0.3
ANTHOPLEURA XANTHOGRAMMICA		19.5									2.0
CANCER ANTENNARIUS	1.4										0.1
OTHER MACRO-INVERTEBRATES (34)	0.4	1.1	2.6	0.2	1.1	0.1	0.0	Gil	0.0		
TOTAL WET WEIGHT IN G/M2	14.6	129.5	20964.3	11977.7	6555.1	7143.7	795.1	581,2	367.2	16.5	

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1.1.13-35. DRY WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM SOUTH POINT, SANTA ROSA ISLAND FROM OCTOBER 1976 TO JUNE 1977. BLANK SPACES INDICATE ZEROS (CONTINUED ON NEXT PAGE).

TAXA	TIDAL HEIGHT (FT). 1.0 TO 1.9 (N= 5)	2.0 TO 2.9 (N= 6)	3.0 To 3.9 (N= 5)	4.0 TO 4.9 (N= 4)	5.0 TO 5.9 (N= 4)	6.0 TO 6.9 (N= 4)	7.0 TO 7.9 (N= 4)	8*U TO 8.9 (N= 6)	9.0 TO 9.9 (N= 5)	10.0 TO 10.9 (N= 51	MEAN
LITTORINA PLANAXIS		0.1	<0.1		1.1	6.9	18.5	24.0	17.7	11*3	8.0
CHTHAMALUS FISSUS AND DALLI			5.5	13.5	0.4	0.5	148.5	313.1	146.9		62.0
ACMAEA(COLLISELLA) DIGITALIS			5.5	5.1	3.6	11.5	1.9	0.5	0.1		2.9
PACHYGRAPSUS CRASSIPES		<0.1	4.5	1.2	0.4	<0.1	<0.1		<0.1		0.6
ACMAEA (COLLISELLA) SCABRA		0.1	9,1	7.0	4.1	4.9	11.6	0.2	0.6		3.8
ACMAEA JUVENILE		<0.1	0.5	1.6		<0.1	<0,1		<0,1		0.2
LASAEA SUBVIRIDIS		<0.1		<0.1	<0.1	0.3	1.4	<0.1	<0.1		0.2
LITTORINA SCUTULATA	<0.1	0.1	5,3	1.2	14.7	14.5	3*2	6.8	5,7		5.2
SEPTIFER BIFURCATUS	0.6	0.2	19.0	86.5	22.7	47.4	19.1		0.6		19.6
BALANUS GLANDULA	0.6	0.2	609.5	292.8	204.6	31.6	3.1	5.7	58.4		140.6
BRACHIDONTES ADAMSIANUS		<0.1	<1).1	0.4	1.4	37.0	6.5	0,1			4.5
LOTTIA GIGANTEA			120.5	491.3	24.3	31.7	72.7				74.1
ACMAEA (COLLISELLA) LIMATULA			0.5	0.-/			0.1				0.1
MYTILUS EDULIS			0.6			7.0	0,1				0.8
NUTTALLINA FLUXA		0.6	6,6	2.6	0.7	0.3	1.1				1.2
TETRACLITA SQUAMOSA RUBESCENS		<0.1	107.2	"5.6	47.7	11.3	8.2				24.0
POLLICIPES POLYMERUS		0.8	93.4	56.5	9.6	23.6	0.2				18.6
NUTTALLINA CALIFORNICA		0.4	8.0	3.3	15.5		6.3				3.3
ACMAEA (COLLISELLA) PELTA		1.0	25.2	10.5	3.6	5.8	1.0				4.5
MYTILUS CALIFORNIANUS	4.8	24.0	14107.4	6946.2	4668.4	5273.5	231.0				3127.7
NUCELLA (THAIS) EMARGINATA			0.1	26.3		8.1					3.5
CYANOPLAX HARTWEGII		<0.1	0.6	0.2	0.1	0.2					0.1

NOTE: 1 FOOT = 0.3048 METERS

TABLE 1. . 3-35. DRY WEIGHT IN G/M2 FOR DOMINANT MACRO-INVERTEBRATES FROM SOUTH POINT, SANTA ROSA ISLAND FROM 1976 TO JUNE 19'7. BLANK SPACES INDICATE ZEROS (CONTINUATION).

TAXA	TIDAL HEIGHT (FT.) 1.0 TO 1.9 (N= 5)	2.0 TO 2.9 (N= 6)	3.0 TO 3.9 (N= 5)	4.0 TO 4.9 (N= 4)	5.0 TO 5.9 (N= 4)	6.0 TO 6.9 (N= 4)	7.0 TO 7.9 (N= 4)	8.0 TO 8.9 N= 6	9.0 TO 9.9 (N= 5	10.0 TO 10.9 (N= 5)	MEAN
ANTHOPLEURA ELEGANTISSIMA		1.9	31.0	2.8	2.1	°.2					3.8
LEPTASTERIAS PUSILLA		0.5	0.4	0.7	1.5						0.3
PETROLISTHES CABRILLOI		<0.1	4.8		0.2						0.5
STRONGYLOCENTROTUS PURPURATUS	°.1	12.6	0.2		5.6						1.8
FISSURELLA VOLCANO	<0 1	0.7	3.3	<0.1	0.8						0.5
TEGULA JUVENILE	.		1.7	0.1							0.2
HOMALOPOMA LURIDUM		<0.1	0.6	0.9							0.2
OPALIA FUNICULATA	<0·1		2.3	<0.1							0.2
TEGULA FUNEBRALIS			6.6								0.7
HELICTIS CRACHERODII			262.6								26.3
PACHYCHELES RUDIS		1.7	0.6								0.2
MOPALIA MUSCOSA	1.0	8.0	<0.1								0.9
VITRELLA CARINATA	0 9	0.5	1.1								0.3
ANTHOPLEURA XANTHOGRAMMICA	.	6.4									0.6
OTHER MACRO-INVERTEBRATES 39	0·9	1.3	5.3	0.3	0.8	0.0	0.0	0.0	0.0		
TOTAL DRY WEIGHT IN G/M2	9.0	61.8	15646.3	8020.3	5054.1	5516.0	534.3	351.4	230.9	11.3	

NOTE: 1 FOOT = 0.3048 METERS

Table 1.1.13-36. Organic Dry Weight in g/m^2 for Dominant Macroinvertebrates from South Point, Santa Rosa Island from October 1976 to June 1977. Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros.

Taxa	Tidal Height (ft) 1.0 to 1.9 (N= 5)	2.0 to 2.9 (N= 6)	3.0 to 3.9 (N= 5)	4.0 to 4.9 (N= 4)	5.0 to 5.9 (N= 4)	6.0 to 6.9 (N= 4)	7.0 to 7.9 (N= 4)	8.0 to 8.9 (N= 6)	9,0 to 9.9 (N= 5)	10,0 to 10.9 (N= 5)	Mean
Littorina planaxis*		0.1	<0.1		0.1	0.8	2.2	3.0	2.1	1.4	1.0
Chthamalus fissus and dalli*			0.6	1.3	<0.1	0.1	14.8	31.3	14.7		6.3
Acmaea (Collisella) digitalis*			0.8	0.7	0.5	1.6	0.3	0.1	0.1		0.4
Pachygrapsus crassipes*		<0.1	2.4	0.6	0.2	<0.1	<0.1		<0.1		0.4
Acmaea (Collisella) scabra*		<0.1	1.3	1.0	0.6	0.7	1,6	<0.1	0.1		0.6
Acmaea juvenile*		<0.1	0.1	0.2		<0.1	<0.1		<0.1		0.1
Lasaea subviridis		<0.1		<0.1	<0.1	<0.1	0.2	<0.1	0.1		"0.1
Littorina scutulata*	<0.1	<0.1	0.5	0.1	1.5	1.4	*0.3*	0.7	0.6		0.5
Septifer bifurcates*	0.1	<0.1	2.5	11.1	3.0	*6.2*	2.5		0.1		2.6
Balanus glandula*	0.1	<0.1	72.9	26.4	18.4	2.8	*0.3*	0.5	5.3		12.7
Brachidontes adamsianus*		<0.1	<0.1	0.1	0.2	*5.6*	1.0	<0.1			0 . 7
Lottia gigantea*			16.9	68.8	3.4	4.4	10.2				10.4
Acmaea (Collisella) limatula*			0.1	0.1			<0.1				<0.1
Mytilus edulis*			0.1			0.8	<0.1				0.1
Nuttallina fluxa*		0.2	1.7	0.7	0.2	0.1	0.3				0.3
Tetraclita squamosa rubescens*		<0.1	6.4	"3.9	2.9	0.7.	0.5				1.4
Pollicipes polymerus*		0.2	23.4	14.6	2.4	.5.9	<0.1				4.7
Nuttallina californica*		0.1	2.1	0.9	4.0		1.6				0.9
Acmaea (Collisella) pelta*		0.2	3.5	1.6	0.5	0.9	0.2				0.7

Table 1.1.13-36. Organic Dry Weight in g/m^2 for Dominant Macroinvertebrates from South Point, Santa Roes Island from October 1976 to June 1977, Species with ash-free dry weights are indicated by an asterisk (*). Blank spaces indicate zeros. (Continued).

Taxa	Tidal Height (ft) 1.0 to 1.9 (N= 5)	2.0 to 2.9 (N= 6)	3.0 to 3.9 (N= 5)	4.0 to 4.9 (N= 4)	5.0 to 5.9 (N= 4)	6.0 to 6.9 (N= 4)	7.0 to 7.9 (N= 4)	8.0 to 8.9 (N= 6)	9.0 to 9.9 (N= 5)	10.0 to 10.9 (N= 5)	Mean
Mytilus californianus*	0.5	2.4	1410.7	694.8	468.8	527.3	23.1				312.8
Nucella (Thais) emarginata*			<0.1	2.6		0.8					0.4
Cyanoplax hartwegii*		<0.1	0.2	<0.1	<0.1	<0.1					0.1
Anthopleura elegantissima*		1.3	21.2	1.9	1.4	0.1					2.6
Leptasterias pusilla*		0.2	0.1	0.2	0.5						0.1
Petrolisthes cabrilloi*		<0.1	2.5		0.1						0.3
Strongylocentrotus purpuratus*	<0.1	1.8	<0.1		0.8						0.3
Fissurella volcano*	<0.1	0.1	0.5	<0.1	0.l						0.1
Tegula juvenile*			0.2	<0.1							<0.1
Homalopoma luridum*		<0.1	0.1	0.1							<0.1
Opalia funiculata*	<0.1		0.2	<0.1							<0.1
Tegula funebralis*			0.8								0.1
Haliotis cracherodii*			84.0								8.4
Pachycheles rudis*		0.9	0.3								0.1
Mopalia muscosa*	0.2	1.9	<0.1								0.2
Mitrella carinata*	O*1	0.1	0.1								0.1
Anthopleura xanthogrammica*		4.4									0.4
Other Macroinvertebrates (39)	0.9	1.3	3.3	0.3	0.8	0.0	0.0	0.0	0.0		
Total Organic Dry Weight in g/m^2	2.3	16.4	1659.1	832.5	510.6	560.6	59.6	35.9	23.3	1.4	370.2

Note: 1 foot = 0.3048 meters

Above +6.0 ft. (1.8 m), the macrophyte with the greatest dry biomass was Endocladia muricata which reached a maximum of 53.8 g/m^2 DW (296.9 g/m^2 WW) between +6.0 and +7.0 ft. (1.8 and 2.1 m). Between +4.0 and +6.0 ft. (1.2 and 1.8 m) the dominant macrophytes were Corallina vancouveriensis with 83.6 g/m^2 DW (14.2 g/m^2 ODW), C. officinalis var. chilensis with 55.5 g/m^2 DW (8.3 g/m^2 ODW), and Gigartina canaliculata with 41.9 g/m^2 DW, all between +5.0 and +6.0 ft. (1.5 and 1.8 m). Below +4.0 ft. (1.2 m), six macrophytes were predominant. Of these, four species reached maximum dry biomass between +2.0 and +3.0 ft. (.6 and .9 m): Corallina vancouveriensis (230.5 g/m^2), C. officinalis var. chilensis (90.1 g/m^2), Egregia menziesii (70.1 g/m^2), and Bossiella or bigniana ssp. dichotoma (51.2 g/m^2). Gigartina canaliculata reached a maximum dry weight of 51.6 g/m^2 between +3.0 and +4.0 ft. (.9 and 1.2 m), and Phyllospadix scouleri reached a maximum of 2950.5 g/m^2 DW between +1.0 and +2.0 ft. (.3 and .6 m).

Above +8.0 *ft. (2.4* m), which was the limit of dominance by Mytilus californianus and Balanus glandula, Chthamalus fissus/dalli was primary. Chthamalus fissus/dalli reached a maximum dry weight of 313.1 g/m^2 (31.3 g/m2 ODW) between +8.0 and +9.0 ft. (2.4 and 2.7 m). Between +3.0 and +8.0 ft. (.9 and 2.4 m), Lottia gigantea with a maximum dry weight of 491.3 g/m^2 [+4.0 to +5.0 ft. (1,2 to 1,5 m)] and Haliotis cracherodii with a maximum dry weight of 262.6 g/m^2 [+3.0 to +4.0 ft. (.9 to 1.2 m)] were dominant along with the aforementioned M. californianus and B. glandula. Below +3.0 ft. (1.2 m), the macroinvertebrates Strongylocentrotus purpuratus, Mopalia muscosa, and Anthopleura xanthogrammica were primary, with respective maximum dry weights of 12.6 g/m^2, 8.0 g/m^2 and 6.4 g/m^2 [+2.0 to +3.0 ft. (.6 to .9 m)].

1.1.13.4.3 Tidepool Finfishes

The following tidepool fish were collected: Clinocottus analis, C. recalvus, Oligocottus snyderi, Xiphister atropurpureus, and Gobiesox rhessodon.

1.1.13.4.4 Community Analysis

1.1.13.4.4.1 Species Diversity

Seasonal Shannon-Weaver (H'), evenness (J'), and richness (D') diversity indices for macrophytes, macroinvertebrates and combined taxa are presented in Table 1.1.13-37. Combined macrophyte and macroinvertebrate H' diversity averaged 2.00, ranging from a minimum of 1.91 in March to a maximum of 2.14 in October. Macroinvertebrate H' diversity averaged 1.62, while that of macrophytes averaged 1.42. Both macroinvertebrates and macrophytes experienced a season of substantially higher diversity, macroinvertebrates reaching a maximum

TABLE *1.1.13-37.* SEASONAL AND ANNUAL DIVERSITY FOR SANTA ROSA ISLAND,

GROUPS AND DATES	NO. TAXA	COVER (%) D'	COVER (%) H'	COVER (%) J?	DENSITY (NO./M2) D'	DENSITY (NO./M2) H'	DENSITY (NO./M2) J'
MACRO-INVERTEBRATES							
OCT. 1976	35	9.85	1.56	0.44	3.83	1.63	0.46
DEC. 1976	42	12.11	1.71	0.46	4.65	1.71	0.46
MAR. 1977	37	11.03	1*59	0.44	4.10	1.79	0.50
JUNE 1977	37	10.45	1.61	0.45	3.97	1.64	0.46
MEAN	38	10.86	1.62	0.45	4.14	1.70	0.47
MACROPHYTES							
OCT. 1976	49	10.41	1.59	0.41	- -	. .	- -
DEC. 1976	55	11.35	1.37	0.35	- -	- -	- -
MAR. 1977	57	12.21	1.34	0.33	- -	- -	- -
JUNE 1977	54	11.52	1.38	0.35	- -	. .	- -
MEAN	53	11.37	1.42	0.36			
COMBINED MACRO-INVERTEBRATES AND MACROPHYTES							
OCT. 1976	84	17.00	2.14	0.48	- -	- -	- -
DEC. 1976	95	19.40	1.99	0.44	- -	- -	- -
MAR. 1977	94	19.29	1.91	0.42	- -	- -	- -
JUNE 1977	91	18.46	1.98	0.44	- -	- -	. -
MEAN	91	18.54	2.00	0.44			

H′ of 1,.71 in December , and macrophytes reaching a maximum H' of 1.59 in October . Between October and Mar ch, macr ophyte H' diversity decreased from 1.59 to 1.34.

Combined macr oinver tebrate and macr ophy te evenness (J ′) averaged 0.44 and showed Ii t tle seasonal variation. Macr oinver tebr ate evenness ranged from O. 44 in October and March to O. 46 in December , indicating minimal seasonal change. Macr ophyte evenness, however , ranged from 0.33 in March to 0.41 in October , averaging 0.36. Thus , mini mum evenness of macr oinver tebrates , macr ophy tes , and combined taxa occurred during March. Shannon-Weaver (H′) diversity and evenness (J′) showed parallel trends.

Combined richness (D ′) averaged 18.54 and indicated little quarterly variation. Macroinvertebrate and macrophyte richness averaged 10.86 and 11.37, respectively , and neither showed excessive seasonal variation. Minimum richness for macr oinver tebr ates , macrophytes, and combined taxa occurred in October. Richness values paralleled closely the numbers of species recorded quarterly from undisturbed samples.

Mean Shannon-Weaver (H′) diversity and evenness (J′) as determined by density for macroinvertebrates were 1.70 and 0.47, respectively. Quarterly variation in both indices contradicts the numbers obtained using cover values; in particular the maximum density indices occurred during March, the time of near minimum Shannon-Weaver (H′) diversity and evenness as determined by cover. Diver sity (H′) reached a minimum of 1.63 in October and a maximum of 1.79 in March, a difference which was significant at the $p<0.05$ level (see HutchesOn, 1970). High mortality among several of the most abundant macr oinver tebrates during March apparently contributed to increased evenness (J′) and, consequent ly, increased Shannon-Weaver (H′) diver si ty.

1.1.13 .4.4.2 Structural Complexity

A great deal of structural complexity as evidenced by total biotic cover over 100 %, was evident for all tidal intervals below +8. O ft. (2.4 m); however, the inclusion of two-dimensional microscopic blue-green algae cover was responsible for elevating total values over 100% for all tidal levels except those below +4.0 ft. (1 .2 m).

Below +4.0 ft. (1. 2 m), a complex community became extensively developed , with Phyllospadix scouleri and its epiphyte Smi thora naiadum creating an over story canopy and the cor allines Bossiella or bigniana ssp . dichotoma and Corallina vancouveriensis growing beneath. The macr oinver tebr ate Phr a gmatopoma californica cccupied extensive sub str ate beneath the P. scouleri.

Throughout the range of Mytilus californianus [+2.0 to +8.0 ft. (.6 to 2.4 m)] , epibiotic organisms utilized mussel shells as secondary sub str ate. The macr oinver tebr ates Chthamalus fissus/dalli, Balanus

glandula, and several species of Acmaeidae frequently occupied this habitat as well as the macrophytes Gelidium coulteri and Ceramium eatonianum/sinicola. Epibiotic above +4.0 ft. (1.2 m) and the macroinvertebrates occurring sparsely throughout the range. Total biotic cover, exclusive of blue-green algae, did not exceed 100% above +4.0 ft. (1.2 m).

1.1.13.4.4.3 Species Assemblages

Figure 1.1.13-25 indicates the clustering of quadrats during 1976-77 at Santa Rosa Island as determined by a correlation coefficient index of similarity (using cover data). The dendrogram derived from lumped seasonal data was presented as representative because seasonal variation in species assemblages at this site was minimal. The distributional patterns of the various groups are diagrammed in Figure 1.1.13-26.

Five major species assemblages with correlation coefficients greater than 0.69 were apparent throughout the year. Above +6.0 ft. (1.8 m), the blue-green-bare rock group was ubiquitous. Between +3.0 and +6.0 ft. (.9 and 1.8 m), two groups were apparent with highly skewed distributions, the blue-green-Mytilus group predominating on the North transect line, while the blue-green-Phragmatopoma group was found exclusively on the South Line. Below +3.0 ft. (.9 m), both lines bisected the Phyllospadix-Phragmatopoma group.

The blue-green-bare rock group above +6.0 ft. (1.8 m) was characterized by extensive exposed substrate. Aside from the dominant blue-green algae, only Endocladia muricata reached appreciable cover at this level. The invertebrates Chthamalus fissus/dalli, Balanus glandula, Littorina planaxis and L. scutulata, and Acmaea (Collisella) digitalis were abundant but contributed little cover. Quarterly variation in species assemblages was concentrated almost exclusively in the blue-green-bare rock group. The variable quadrats at this level were all located on the North transect line and all experienced altered clustering because of abrupt reductions in cover of E. muricata during December and March (Figures 1.1.13-14 and 1.1.13-15). Endocladia muricata cover was not as great along the South line and its reduction in cover did not influence clustering. Several species listed by Glynn (1966) as being associated with E. muricata had distributions which were skewed from north to south-also, including Littorina scutulata, Acmaea (Collisella) scabra, and Chthamalus fissus/dalli. The density of L. scutulata paralleled the seasonal cover fluctuations of E. muricata (Tables 1.1.13-27 through 1.1.13-30).

The blue-green-Mytilus group was found predominantly on the North transect line with only three quadrats over a narrow tidal range [+4.2 to +4.8 ft. (1.3 to 1.4 m)] along the South line clustering with this group. Of the prominent species listed by Ricketts, Calvin, and Hedgepeth (1968) as being components of the "Mytilus-Pollicipes-

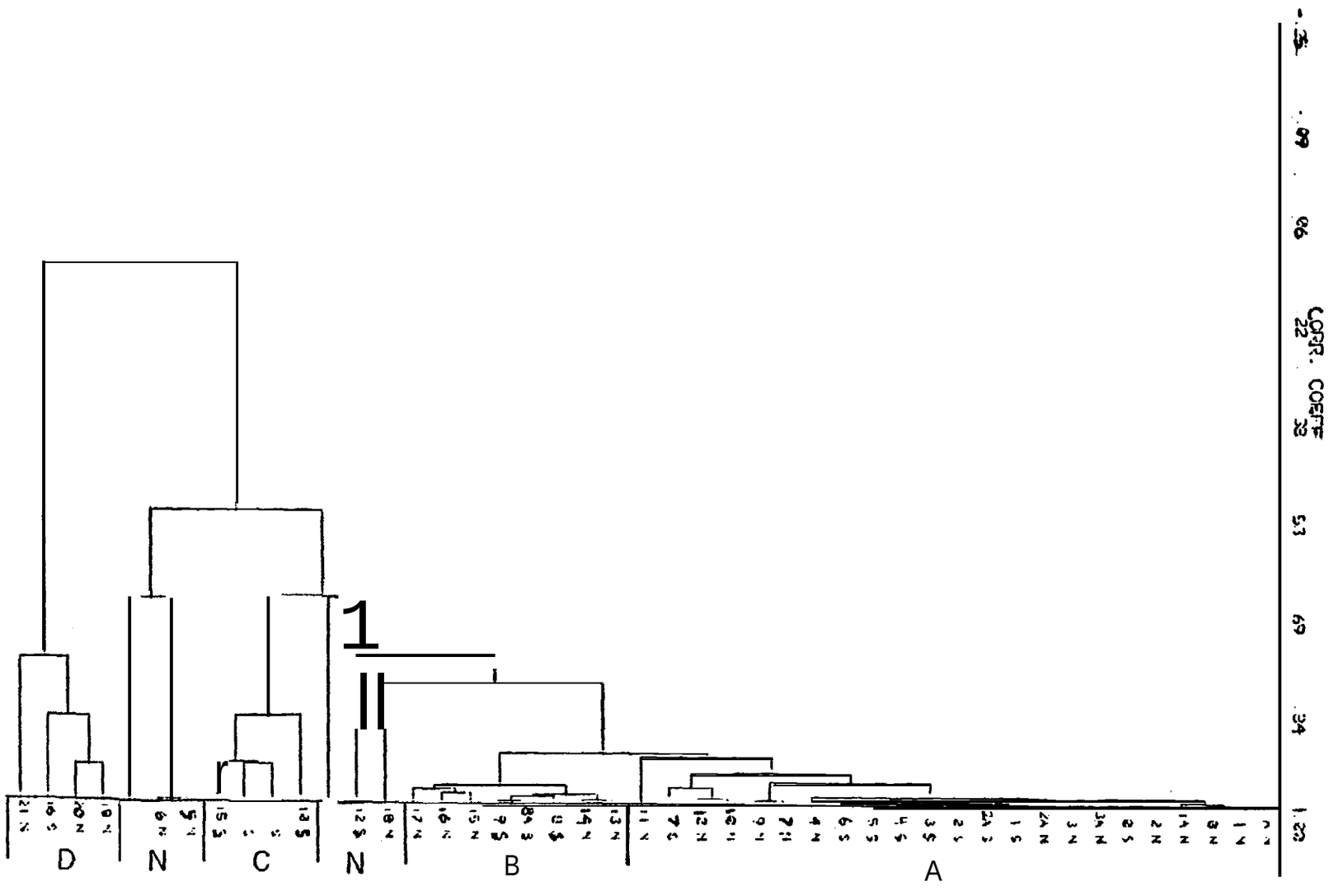

Figure 1. 1.13-25 Dendrogram Display of Differential Clustering Based on a Yearly Average of the Quadrats Sampled from Santa Rosa Island.

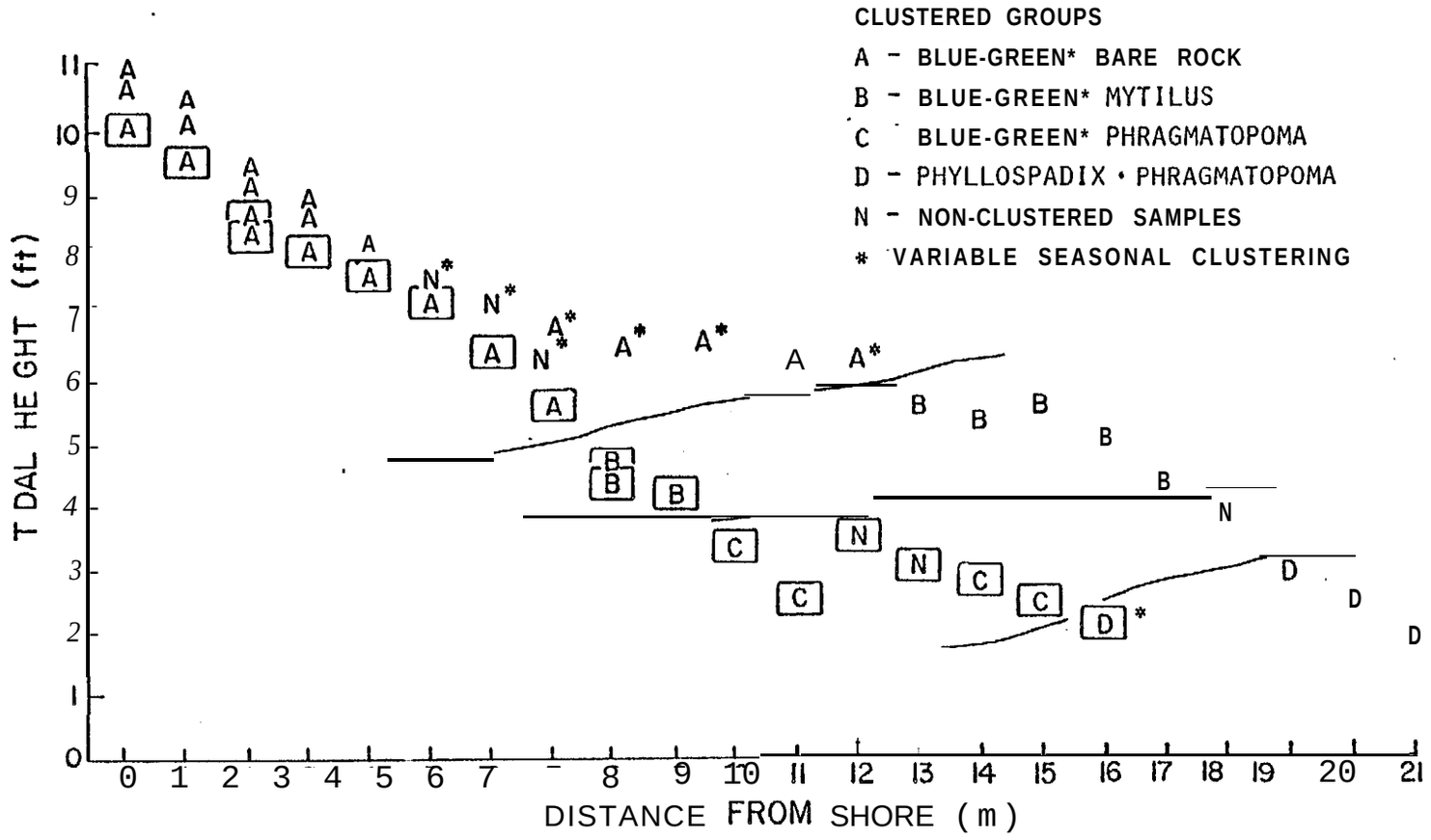

Figure 1.1.13-26 Distributional Patterns of Species Groups from San Miguel Island in Relation to Tidal Height and Distance from Shore.

Pisaster association" opposite to that of M. californianus, had similarly skewed distributions, indi eating that they were the major components defining the blue-green-My tilus group. Notably , several other members of this association (see Ricketts, et al. , had distributions skewed in a manner opposite to that of M. californianus, particularly Pollicipes polymerus, Tetraclita squamosa rubescens , Acmaea (Collisella) digitalis, and Acmaea (Collisella) pelts. The macrophytes Endoplura aurea and Endocladia muricata were components of the blue-green-My tilus group as well as the macroinvertebrates Lottia gigantea, A. (Collisella) scabra, P. polymerus, and T. squamosa rubescens. 'No seasonal variation was noted.

The blue- green-Phragreat opoma group was characterized by variable cover of Gigartina canaliculata, Rhodoglossum affine , Phyllospadix scouleri , Gelidium coulteri, and Ceramium eatonianum/ sinicola as well as the domi nants. The macr oinvertebrates S trongylocentrotus purpuratus and Anthopleur a ele ganti ssima were present at low densities. Seasonal variation was insignificant.

The Phy llospadix-Phragmatopoma group had variable cover of Egregia menziesii , Smithora naiadum, Bossiella orbigniana var . dichotoma, Corallina vancouveriensis, and sand as well as the dominants. Seasonal variation was of low magnitude and did not greatly af feet clustering.

Apparently an increase in exposure to wave action and surge along the south transect were ultimately responsible for the skewed distributions of the major species assemblages. This condition may also have been responsible for the lack of Endocladia muricata seasonality along the south transect.

1. 1.13.5 Discussion

Previous studies of macr ophy te flora from Santa Rosa Island have been limited primarily to subtidal sampling (Nicholson and Cimberg, 1971) and records of new or unusual species (see Murray, 1974). In total, 47 species were previously recorded, 38 Rhodophy ta, 5 Phaeophy ta, and 3 Chlorophyta (Murray, 1974). Twenty -three of these species were not collected by this study ; however , the 47 species sampled by Nicholson and Cimberg (1 971) were collected sub tidally and do not necessarily range into the inter tidal. Our study has recorded 48 species of macr ophy tes not previously documented, of which 38 were Rhodophy ta, 7 Phaeophyta, and 3 Chlorophyta.

In general, the community structure at Johnson' s Lee , Santa Rosa Island was similar to previously described patterns of zonation (see Rickets, et al. , 1968) . Conspicuous seasonal variation did occur, however, and three components of this variability were distinguished: 1) a general decrease in biotic cover during the winter months of December and March; 2) a series of macrophyte blooms

and macr oinver tebrate recruitments whi ch occurred primsri ly in June , and 3) 'a highly variable zone below +3.0 ft. (.9 m) which appeared to be affected by sand deposition.

The decrease in total biotic cover during the winter months was composed of decreased macrophyte cover (Table 1 .1.13-7). and decreased macroinvertebrate cover (Table 1 .1.13-8) and paralleled by decreased over all macr oinver tebr ate density (Table 1.1.13-21), and correspondingly increased frequency of bleached macrophy tes and encrusting forms (Table 1.1.13-21). In particular the decline of Endocladia muricata (Table 1.1.13-15) altered quadrat clustering during the tinter months (Figure 1.1.13-26). Shannon-Weaver (H') diversity and evenness (J') as assessed by cover of macroinvertebrates and macr ophy tes also reached minimum values during March (Table 1. 1.13-35). This general winter die-back was presumably due to a combination of environmental conditions including increased exposure to desiccator conditions brought about by daytime low tides. A similar winter die-off was noted by Seapy and Littler (1 977) for the inter tidal site of adjacent Santa Cruz Island.

The second component of seasonal variability , the macrophyte blooms and macr oinver tebr ate recruitments, was quite note-worthy . During June we recorded blooms of Ulva lobata and Porphyra perforata (Tables 1.1.13-15 and 1.1.13-16) and recruitment of, among others , Balanus glandu la, Littorina scutulata, Acmaea (Collisella) digitalis, A. (Collisella) scabra, and A. (Collisella) pelts (Tables 1.1.13-29 and 1.1.13-30). Chthamalus fissus/dalli apparently recruited previous to our December sampling period (Table-s 1.1.13-27 and 1.1.13-28). Proliferation of P. perforata during the spring has been recorded by Littler and O 'Brien (1 977) at nearby Cuyler Harbor , San Miguel Island. The settlement of the barnacles B. balanoides and c. stellatus (which are similar to our species) was noted by Connell (1 961a; 1961b) to occur during the spring and fall, respectively. High variability in recruitment of B. balanoides has been noted by Barnes (1 956) and recruitment of B. glandula may be annually variable as well. The vulnerability of planktonic larval stages to changes in nutrient content, temper atur e , current direction, and other factors , makes it unlikely that recrui tment patterns of barnacles and limpets at Johnson's Lee would be precisely repeated from year to year .

The third component of seasonality was conspicuous below +3. O ft. (.9 m) where high variability in cover was recorded for the dominant species Phyllospadix scouleri and Phragmatopoma californica (Table 1.1.13-13 through 1.1.13-20). The cause of this variability was not clear , although the cover of P. scouleri between +2.0 and +3.0 ft. (.6 and .9 m) correlated with the amount of sand present. Nor was i t clear what caused the influx of sand between +2. O and +3. O ft. (.6 and .9 m) during October . Annually , great variation was noted in the quantities of sand on beaches adjacent to the study site, but overall trends in sand flow were not distinct.

1 .1.13.6 References

Barnes, H., "Balanus balanoides (L.) in the Firth of Clyde: The Development and Annual Variation of the Larval Population, and Causative Factors," J. Anim. Ecol. 25, 72-84 (1956).

Connell, J. H., "The Effects of Competition, Predation by Thais lapillus, and other Factors on Natural Populations of the Barnacle. Balanus balanoides." Ecol. Mon. 31, 61-104 (1961a).

Connell, J. H., "The Influence of Interspecific Competition and other Factors one Distribution of the Barnacle Chthamalus stellatus," Ecol. *42, 710-723* (1961b).

Glynn, P. W., "Community Composition, Structure and Interrelationships in the Marine Intertidal Endocladia muricata-Balanus glandula Association in Monterey Bay, California," Beaufortia 12, 1-198 (1 966).

Hutcheson, K., "A Test for Comparing Diversities Based on the Shannon Formula,"' J. Theoret. Biol. 29, 151-154 (1970).

Littler, M. M., and P. Y. O'Brien, "Biological Features of Rocky Intertidal Communities near Cuyler Harbor, San Miguel Island, California, pages 795-883 M. M. Littler, cd., "Spatial and Temporal Variation in the Distribution and Abundance of Rocky Intertidal and Tidepool Biotas in the Southern California Bight," Unpubl. Tech. Compl. Rept., U. S. Department of Interior, Bureau of Land Management (1977).

Murray, S. N., "Benthic Algae and Grasses," pages 9-1 to 9-61 M. D. Dailey, B. Hill, and N. Lansing, eds., "A Summary of Knowledge of the Southern California coastal zone and offshore areas," U S. Department of the Interim, Bureau of Land Management (1974),

Nicholson, N. L., and R. L. Cimberg, "The Santa Barbara Oil Spills of 1969: A Post Spill Survey of the Rocky Intertidal," pages 325-399 D. Straughan, cd., "Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill 1969-1970, Vol. 1," Allan Hancock Foundation, Univer sity of Southern California (1 971).

Ricketts, E. F., J. Calvin, and J. W. Hedgepeth, "Between pacific Tides ," (Stanford: Stanford University Press, 1968).

Seapy, R. R., and M. M. Littler , "Biological Features of Rocky Inter tidal Communities near Willows Anchor_age, Santa Cruz Island, California, " pages *686-794* M. M. Littler , ed. , "Spatial and Temporal Variation in the Distribution and Abundance of Rocky

Inter tidal and Tidepool Biotas in the Southern California Bight, " Unpubl. Tech. Comp. Rept., U. S. Department of the Interior , Bureau of Land Management (1 977).

Southern California Coastal Water Fes.earth Project, "The Ecology of the Southern California Bight: Implications for Water Quality Management ," SCCWRP TR 104, 531 pp.

u, s. Naval Weather Ser vice Command , Fleet Weather Faci li ty , San Diego, "Climatology ca1 Study Southern California Operating Area, " NWSED, 240 pp.

Weaver , D. W. , D. P. Doerner , and B. Nolf, "Geology of the Northen Channel Islands ," Am. Assoc. Petro. Geol. Sot. Econ. Paleo. Miner alog. , Pac. Sec. Spec. Pub. 200 pp. (1969).

Wilkinson, E. R. , "California Offshore Oil and Gas Seeps ," Calif. Div. Oil and Gas, TR08, Sacramento, California, 9 pp . (1 972) .