Marine Resource Inventory of Pacific Rim National Park — 1976

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MARINE RESOURCE INVENTORY OF PACIFIC RIM NATIONAL PARK - 1976

by

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ABSTRACT

Lee, J. C., and N. Bourne. 1977. Marine resource inventory of Pacific Rim National Park - 1976. Fish. Mar. Serv. MS Rep. 1436: 375 p.

The 1976 marine resource study was the 2nd yr of a 5-yr program designed to provide information on marine organisms and their associated habitats for Park planning, interpretation, and management. Results of habitat type, fauna and flora, kelp and eelgrass, and recreational impact studies are discussed under the three Park sections, Long Beach, Broken Group Islands, and West Coast Trail.

Key words: marine park, marine resource inventory, British Columbia

RÉSUMÉ

Lee, J. C., and N. Bourne. 1977. Marine resource inventory of Pacific Rim National Park - 1976. Fish. Mar. Serv. MS. Rep. 1436: 375 p.

En 1976, l'étude des ressources marines en était à sa deuxième année des cinq années prévues pour la saisie d'informations sur les organismes marins et leur habitat en vue de la planification, de l'interprétation et de la gestion du parc. Les auteurs commentent les données recueillies sur les types d'habitat, la faune et la flore, le varech et le zostère, ainsi que les études d'incidence des loisirs dans les trois parties du parc: Long Beach, Broken Group Islands et West Coast Trail.

Mots clés: parc marin, inventaire des ressources marines, Colombie-Britannique.

INTRODUCTION

The marine resource study, begun in 1975 in Pacific Rim National Park (Lee and Bourne 1976) was continued in 1976 on behalf of Parks Canada, Western Region, by Fisheries and Marine Service (Nanaimo), Department of Fisheries and the Environment. The 1976 study was the second year of a 5-yr program which was designed to provide information on marine organisms and their associated habitats for Park planning, interpretation, and management. Investigations were undertaken in all three sections of the Park; studies begun in 1975 were continued in 1976 and in some cases expanded. In the present year, emphasis was placed on obtaining quantitative data in order to determine present levels of marine populations within the Park.

Major emphasis was again devoted to studies in the Long Beach Section because it is the area most frequently visited by tourists and receives the heaviest recreational pressure. Surveys for fauna and flora were continued and assessment of habitat types was completed. Recreational impact studies were continued and in some cases expanded. The razor clam (*Siliqua patula*) and littleneck clam (*Protothaca staminea*) studies were largely completed. Studies on the sea mussel (*Mytilus californianus*) were expanded to include a study of partial removal of mussels from a mussel bed. Investigations on the purple olive snails (*Olivella biplicata*) and starfish (*Pisaster ochraceus*) were expanded to more accurately assess populations and distribution. Work in this section of the Park included preliminary investigations of organisms in the subtidal area.

In the Broken Group Islands work was expanded in all areas. Fauna and flora surveys were continued and intertidal habitat type identifications completed. The bivalve population study was expanded and 44 sites were studied. A major undertaking was the commencement of a preliminary investigation of the subtidal habitat types and their associated fauna and flora.

Work in the West Coast Trail Section was expanded to include studies of habitat types and fauna and flora surveys along the entire length of the West Coast Lifesaving Trail.

The distribution and size of kelp and eelgrass beds were assessed in all three sections of the Park.

Terms of reference for this marine resource inventory are given in Appendix 1.

LONG BEACH SECTION

HABITAT TYPES

Major emphasis in 1976 was devoted to work in the Long Beach Section. Studies in the intertidal area were continued and completed. Preliminary studies were begun in the subtidal area of this section of the Park.

Habitat types - Intertidal

Criteria used to define habitats in the 1976 work and sampling procedures were essentially the same as used in the previous year (Lee and Bourne 1976). Most transects established in 1975 were resampled in 1976; additional sites were established at Radar Beaches (1), Grassy Island, Schooner Cove (2), and Half Moon Bay (4) (Fig. 1). On rocky shores, transects 1, 2, 4, 11, 12b, 13, and 14a were sampled. On sandy beaches, transects 5 and 8 were sampled and a mud beach, transect 16 was sampled. One difference was that substrates were reclassified according to particle size as shown in Table 1. Substrate and exposure to surf in the Long Beach Section are presented in Fig. 2 and 3. Results of fauna and flora studies are discussed in their related habitat types.

In 1976, numbers of organisms in a 1 m^2 sample were recorded from each biotic zone along the transect. (See Kozloff (1973) and Ricketts and Calvin (1968) for additional discussion of zonation.) Sponges, bryozoans, compound ascidians and some polychaete species were recorded as percent coverage within a m^2 area. A 25 X 25 cm grid was used when counting organisms smaller than 2 cm. Algal cover was recorded as percent coverage within a m^2 area.

Exposed habitats

Sandy beaches

Numbers of organisms found in the sand samples taken along vertical transects at Locations 5 and 8 are shown in Table 3.

The most abundant polychaete was the bloodworm, Euzonus mucronata, which was found in well demarcated bands parallel to the shore in the mid-tidal region. The band of Euzonus north of Lovekin Rock was between the 50 and 100 m levels throughout the year which agrees with 1975 observations. North of Quisitis Point the band of Euzonus remained fairly consistent at the

25-50 m level in both 1975 and 1976. Density of Euzonus (greater than 1 cm long) at the northern sample site fluctuated around 1,200/m^2 throughout the year, but at the southern transect ranged from 3,300-400/m^2 and no Euzonus were observed in September in this transect. Ruby and Fox (1976) reported that Euzonus was often the sole macroscopic organism found within its habitat and that populations commonly reached densities greater than 55,000/m^2 in southern California.

Euzonus measuring less than 1 cm in length and 1 mm in width were observed north of Lovekin Rock from August to November. Highest density of these smaller Euzonus was 4,700/m^2 in October. Smaller Euzonus were not found at the southern end of Long Beach in 1976 nor at either location in 1975.

Because of its large numbers, Euzonus is undoubtedly of importance in the physical and chemical turnover of organic matter on sandy beaches (McConnaughey and Fox 1949). It serves as a food for shore birds and crows which can be seen in flocks digging the worms during periods of low tides and leaving areas of the beach pitted and scarred in a characteristic manner.

Other polychaetes, Abarenicola pacifica and Nepthys californiensis, and several nemerteans (ribbon worms) were most frequently observed as solitary individuals but occasionally reached densities of 16/m^2. These species were not restricted to any particular zone of the intertidal beach.

Beach hoppers, Orchestia traskania and Orchestoidea californiana, and other arthropods such as mysids, isopods and some decapods were observed from the driftwood line to the low-water line. These arthropods usually occured in densities less than 10/m^2 but some pockets had densities which reached 100-200/m^2.

Rocky shores

Fauna and flora of exposed rocky shores were recorded from a vertical rock face at Green Point (Fig. 1) and numbers of organisms recorded are shown in Table 4. Biota along this shore occurred in four easily distinguishable zones (Lee and Bourne 1976).

Zone 1, splash or spray zone

Few organisms were recorded in the splash zone. Collisella digitalis was the dominant limpet in this zone, and occurred in densities as high as 80/m^2; Notoacmea persona and N. scutum were also common throughout the year, but in much lower numbers. Periwinkles, Littorina scutulata and L. sitkana, were common in cracks and crevices along rock faces. Density of these two species did not fluctuate throughout the year; L. sitkana was most abundant while fewer L. scutulata were observed. Acorn barnacles, Balanus glandula and Chthamalus dalli, occurred in the spray zone. B. glandula, the more conspicuous barnacle, was recorded at mean density, $56{,}000/m^2$ while C. dalli, a much smaller species, was observed at mean density, $2{,}000/m^2$.

Few plant species were observed in this zone. A lichen Verrucaria sp. formed a conspicuous horizontal black band with a coverage as high as $50\%/m^2$. The green alga Prasiola meridionalis occurred in a narrow 1 m band along the top of the rock face, at densities as high as 75% coverage/m^2 in June, but in October, coverage was much reduced.

Zone 2, high intertidal zone

Zone 2 was identified by the presence of two brown algae, rockweed, Fucus distichus, and Pelvetiopsis limitata; however, Fucus was small and gave coverage of $25\%/m^2$. Pelvetiopsis, found only in the upper zone on exposed rocky shores, was abundant with a coverage of $50\%/m^2$ in June which decreased slightly in October. Species of green and red algae were also present in Zone 2 but their densities were less than 5% coverage/m^2 throughout the year (Table 4).

Limpets, periwinkles and acorn barnacles, observed in Zone 1, were also recorded in Zone 2. Numbers of C. digitalis and C. dalli were less in Zone 2 than 1, while density of L. scutulata was greater. Populations of other species observed in both Zone 1 and 2 were not significantly different. The snail Thais emarginata was more common than T. lamellosa; the barnacle B. cariosus occurred at densities of $400/m^2$.

Zone 3, mid intertidal zone

Sea mussels, Mytilus californianus, goose barnacles, Pollicipes polymerus and the brown alga Hedophyllum sessile were the characteristic assemblage of the mid intertidal zone. M. californianus formed extensive beds in this zone, (up to $25{,}000/m^2$); however, these mussel beds could extend down to 30 cm or more in depth depending on surface configuration of the rock (discussed later, mussel study at Cox Point, page 15). Bay mussels M. edulis, more commonly associated with sheltered areas, were abundant in the upper parts of the mussel bed. P. polymerus, usually associated with sea mussels in exposed rocky habitats, occurred in solitary clumps at densities of $200/m^2$ but did not form a continuous cover as was observed for Balanus.

Other abundant or conspicuous fauna in this zone were anemones, *Anthopleura elegantissima* and *A. xanthogrammica*, limpets, *Thais*, acorn barnacles, sponges, bryozoans and compound ascidians. Numbers of *A. xanthogrammica* remained fairly constant throughout the year but the number of *A. elegantissima* increased during the same period. Only the limpets *C. pelta* and *N. scutum* were present in Zone 3 in moderate abundance. Numbers of two species of *Thais* recorded amongst the mussels were not significantly different from those observed in Zone 2. *B. cariosus* densities were similar to those in Zone 2 but the number of *B. glandula* were much lower, 14,600/m^2. Isolated individuals of acorn barnacles, *Balanus nubilus*[1] were also found. This species was conspicuous because of its large size; the white shell measured 5 cm in diameter and 8 cm in height and was usually covered with bryozoans. Sponges, bryozoans and compound ascidians were recorded at low densities of 5-10/m^2 but because of their bright colours, these species provided a sharp contrast to the drab grays and blacks of the surrounding area. Other species found in this zone are shown in Table 4.

Growth of the dominant alga *Hedophyllum sessile* increased throughout the spring and summer, up to a maximum of 50% coverage. *Hedophyllum* blades became very tattered in the fall and gradually coverage decreased. A similar pattern was also observed for the brown algae *Alaria marginata* and *Leathesia difformis*, and red algae *Halosaccion glandiforme* and *Porphyra* sp. although growth was not as extensive as *Hedophyllum* (Table 4).

Tidepools in Zone 3 had populations of sculpins *Oligocottus* sp. (6/m^2), anemones, shore crabs *Hemigrapsus nudus* (3/m^2), chitons *Katharina tunicata* and *Mopalia* spp. and the various species of algae recorded in this zone.

Zone 4, low intertidal zone

The low intertidal zone was marked by an abundance of brown and red algae. Numbers of organisms in this zone were reduced and their densities low (Table 4).

The pattern of seasonal growth observed in Zone 3 was also recorded in Zone 4. The two dominant brown algae were *Alaria marginata* and *Laminaria setchellii*; *A. marginata*

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[1]This species has been described as a distinct species, *Balanus altissimus* (Cornwall 1936) but because of its structural similarity to *B. nubilus* and the major criterion being a habitat distinction, it may be only an environmental variety of *B. nubilus* (Cornwall 1970).

was more abundant than L. setchellii in June, but both species decreased to similar densities in October when some plants were little more than a holdfast and stunted stalk. Small Postelsia palmaeformis were observed until June. This alga is characteristic of exposed rocky shores but is not always present throughout the year, nor does it occur in great numbers. The alga Gigartina exasperata had a coverage of 10%/m² throughout the year. Coralline red algae (Bosseilla sp., Calliarthron sp. and Corallina sp.) and the encrusting red alga (Lithothamion sp.) were observed in low densities amongst the holdfasts of the brown algae. Other algae present in this zone are given in Table 4.

Semi-exposed habitats

In the Long Beach Section sand and gravel beaches and rocky shores are found in semi-exposed areas (Fig. 2 and 3). In 1976, only semi-exposed rocky shores were studied. Locations and habitat descriptions are given in Table 2 and Fig. 1.

Rocky shores

Biota of semi-exposed rocky shores were recorded from a vertical rock face on the east side of Box Island (12b), and gently sloping rocky outcrops at Quisitis Point (14a), Half Moon Bay (4) and Radar Beaches (1) (Fig. 1). Numbers of organisms observed at these sites are given in Table 4. Zonation patterns observed in the fauna and flora of exposed rocky areas was continued in the semi-exposed sites.

Zone 1, splash or spray zone

Limpets, periwinkles, and acorn barnacles were the dominant animals in this zone. Densities of these organisms did not change significantly throughout the sampling period but differences were observed between sample sites (Table 4). The finger limpet, C. digitalis, was most abundant at Box Island and was found at other sites in lower densities; N. persona and N. scutum were present at varying densities but in lower abundance than C. digitalis. L. sitkana was the most numerous periwinkle; L. scutulata was present in much lower numbers. B. glandula was the dominant acorn barnacle at all sites with densities that ranged from 39,000 to 65,000/m²; C. dalli did not occur at Box Island and was found in lower numbers than B. glandula at Quisitis Point and Radar Beaches. Coverage by the black lichen, Verrucaria, was similar to that found in exposed habitats. The green alga Prasiola meridionalis provided a coverage of 30-50%/m² in June at Quisitis Point and Radar Beaches but by October had decreased to only a few scattered patches. Enteromorphora intestinalis, the only other alga observed in Zone 1 was present at Radar Beaches at 25% coverage/m^2.

Zone 2, high intertidal zone

Rockweed, Fucus distichus, formed a denser cover pattern in semi-exposed situations than was observed in exposed areas. Densities were highest in June and decreased throughout the remainder of the year. Pelvetiopsis occurred in sparse patches at Quisitis Point and Radar Beaches. Coverage by green and red algae at these sites was less than 10%/m^2 (Table 4) except for the red alga Porphyra sp. at Quisitis Point where coverage increased to 30%/m^2 in June and then gradually decreased until October when none was found.

Limpets C. digitalis, N. persona and N. scutum in Zone 2 showed densities similar to those observed in Zone 1. B. glandula was the most abundant barnacle at the four sites; B. cariosus occurred in smaller numbers and C. dalli varied considerably in numbers. Thais emarginata was found at all sites in high numbers (150/m^2) except at Box Island where numbers were low (0-16/m^2); T. lamellosa was not common at these sites. Bay mussels were present in isolated patches amongst Fucus at Box Island.

Zone 3, mid intertidal zone

M. californianus, and the brown alga Hedophyllum sessile were the dominant species of Zone 3 in semi-exposed areas. Pollicipes usually associated with M. californianus in exposed situations occurred in low numbers in these semi-exposed sites. Extensive mussel beds continued into the semi-exposed areas at surface densities of 28,000/m^2 except at Box Island where the numbers of sea mussels were low. Bay mussels, M. edulis, were common (1,700/m^2) except again at Box Island where this species was virtually absent. Density of Pollicipes varied considerably from site to site; maximum 50/m^2 at Quisitis Point. Three anemones, Anthopleura elegantissima, A. xanthogrammica and juvenile Metridium senile were common in the mid intertidal zone of semi-exposed sites. Numbers of limpets, Thais and acorn barnacles did not vary greatly from season to season but showed some variation from site to site (Table 4). The barnacle B. nubilus was present in low numbers at Box Island, Half Moon Bay and Radar Beaches. Sponges, bryozoans and compound ascidians were recorded at low densities. Purple sea urchins, Strongylocentrotus purpuratus, inhabited the scoured holes in the softer rock base at Half Moon Bay and Radar Beaches. S. franciscanus, red sea urchins, were also present but in low numbers. These sea urchins were not commonly distributed along the semi-exposed rocky shores in the Long Beach Section. Sea cucumbers, Cucumaria miniata, were found at Quisitis Point and at Half Moon Bay. Additional species that appeared irregularly or in low densities are shown in Table 4.

The growth pattern of the dominant brown and red algae (H. sessile, A. nana, A. marginata, H. glandiforme) observed in exposed areas was also recorded in semi-exposed locations; maximum growth in summer and then a decrease in coverage in fall and winter. Additional algal species of densities less than 5% coverage/m^2 are recorded in Table 4.

Tidepools in the mid intertidal area of semi-exposed rocky shores had sculpins Oligocottus sp. and Clinocottus sp., turban snails Tegula funebralis, shore crabs Hemigrapsus nudus and H. oregonensis, hermit crabs Pagurus sp., chitons K. tunicata and Mopalia spp., sea urchins S. purpuratus and S. franciscanus, and sea cucumber Cucumaria miniata.

Zone 4, low intertidal zone

Dominant species in the low intertidal zone of semi-exposed rocky shores were surf grass Phyllospadix scouleri, brown algae Alaria marginata, Egregia menziesii, Laminaria setchellii and Lessoniopsis littoralis and red algae Gigartina exasperata and Iridaea sp. These algal species were not evenly distributed throughout the semi-exposed area. A. marginata, E. menziesii, Iridaea sp. and P. scouleri were the dominant species at Box Island. L. setchellii, L. littoralis and G. exasperata were most abundant at Quisitis Point and Half Moon Bay. Each species showed the highest density in summer and decreased by winter as is seen in Table 4.

Sponges, bryozoans, anemones, polychaetes and the barnacle B. nubilus were present in the low intertidal zone. Their densities were much lower than observed in Zone 3. Species observed and their densities are shown in Table 4.

Sheltered habitats

Sheltered mudflats and rocky outcrops are located along the shores of Grice Bay (Fig. 2, 3). Locations and habitat descriptions are given in Table 2 and Fig. 1.

Mudflats

Organisms observed in samples dug in mudflats at Grice Bay (Fig. 1, Site 16) are given as numbers/m^2 in Table 5. Soft-shell clams, Mya arenaria, the clam locally referred to as "pink ears," Tellina carpentari and ghost shrimps Callianassa californiensis occurred in greatest densities at the 10 m sample site: Mya $142/m^2$; Tellina $50/m^2$; Callianassa $33/m^2$. Numbers of Mya decreased seaward along the transect but showed a slight increase at the lowest level sample. Numbers of T. carpentari decreased steadily seaward from the shore. Callianassa numbers also decreased down the intertidal area but seemed to stabilize between the 20 and 30 m samples at densities of $20/m^2$. Shore crabs Hemigrapsus oregonensis occurred in low numbers ($3/m^2$) at the first sample site; bent nose clams Macoma nasuta, and polychaetes Nepthys californiensis were recorded in low densities ($3/m^2$) lower down the beach.

The small clam Tellina carpentari found in the upper intertidal area of the Grice Bay mudflats at maximum densities of $50/m^2$, is potentially important as a recreational species. T. carpentari is collected by curio shop owners and tourists and commonly used in making souvenirs. No collecting of this population was observed in 1975 or 1976, but it could come under heavy exploitation in future by tourists and the nearby residents of Tofino.

Rocky shores

Fauna and flora of sheltered rocky shores was studied along the gently sloping rocky outcrop at Grice Bay (Fig. 1, Site 11). Numbers of organisms observed at this site are shown in Table 6. Zonation patterns in sheltered areas were similar to those observed in exposed and semi-exposed rocky shores; however, at Site 11 no splash zone (Zone 1) was found.

Zone 2, high intertidal zone

Fucus distichus formed a luxuriant growth in the upper intertidal zone. Highest density occurred in June ($80\%/m^2$) and decreased slightly by October. Numbers of limpets C. digitalis, N. persona and N. scutum showed little change throughout the sampling period; their densities were not significantly different from those observed in exposed or semi-exposed areas. Densities of periwinkles L. scutulata and L. sitkana (324 and $565/m^2$) were higher than observed in more exposed locations. Thais lamellosa were found in low numbers. No sea mussels were found in this habitat but bay mussels were moderately common ($148/m^2$). Acorn barnacles B. glandula and C. dalli were both abundant at this site, (4,900 and $2{,}100/m^2$).

Zone 3, mid intertidal zone

Bay mussels M. edulis ($316/m^2$), and red algae Halosaccion glandiforme and Gelidium sp. (60 and $30\%/m^2$) were the dominant species in the mid intertidal zone. Shore crabs H. oregonensis and hermit crabs Pagurus sp. were common; (20-25/m^2).

Zone 4, low intertidal zone

Eelgrass Zostera marina and the green alga Ulva sp. were the dominant species recorded in the lower intertidal zone. Growth of these species stabilized in June when coverage was as high as 75 & 50%/m^2 respectively. Algae present at lower densities (less than 5% coverage) included the brown alga Costaria costata and red algae Grateloupia doryphora, Iridaea sp. and Smithora naiadum. The brown alga Agarum finbriatum was observed below the water's edge but the percent cover was not determined. Pisaster ochraceus, purple starfish were found in low abundance (less than 1/m^2) at this site.

KELP AND EELGRASS STUDIES

The importance of these regions was pointed out in the previous report (Lee and Bourne 1976). In 1976 beds of kelp (Nereocystis luetkeana and Macrocystis integrifolia) and eelgrass (Zostera marina) were mapped for the Long Beach Section and are shown in Fig. 4.

These areas are important because they provide shelter for fish, gastropods, crustaceans and other marine organisms, as well as providing food for herbivores. No quantitative samples were taken but results of the 1976 work show that kelp beds occupy about 3.9 km^2 and eelgrass 17.6 km^2 within the Long Beach Section of the Park. These ecological zones are of great importance and studies should be undertaken to determine their specific importance to this area.

RECREATIONAL IMPACT STUDIES

The need for recreational impact studies and the necessity of their long term was discussed in the previous report (Lee and Bourne 1976). Most tourist and recreational pressure in Pacific Rim National Park will occur in the Long Beach Section and it is essential to know not only the general ecology of this area but also the resilience of the animal and plant populations when exposed to varying degrees of pressure in order that management policies may be formulated. Studies were begun in 1975 to assess current levels of some exploited populations in this section and the extent to which they can be further utilized. All studies begun in 1975 were continued in 1976; some were expanded.

Razor clam (*Siliqua patula*) study

Studies to assess adult populations, time of spawning, recruitment, and growth begun in 1975 were continued. Clam populations at the northern end of Long Beach were monitored in 1976 and a tagging census was carried out to refine the 1975 population estimate.

Assessment of adult population

The northern end of Long Beach was selected for population assessment because 1975 studies showed highest densities there. Population estimates were undertaken at Sites 3, 4, and 5 (Fig. 5). As in 1975, sample areas of 25 X 5 m were established, clams dug by point digging and shows counted in the intertidal zone below 1.5 m tide level. Another estimate of clam population was made, using a tagging census method, (Bourne 1969).

Three plots were marked off in the low intertidal zone below the 1.5 m tide level (Fig. 6). (Plots A and C were 0.4 km on either side of Incinerator Rock, plot B was parallel to the south side of Incinerator Rock.) Plots were staked out during a period of low tides in April; plot A measured 15 X 5 m and plots B and C were each 25 X 25 m. Clams were dug from the north side of Lovekin Rock and marked by etching a letter and number on the shell. All tagged clams were greater than 90 mm in length and care was taken to ensure they were not damaged during digging or marking. Fifty clams were planted in each plot on a flood tide to keep exposure time to a minimum. Clams in the plots were dug again in May, July, and September by point digging, and the number of tagged and untagged clams recorded.

Numbers of clams and shows counted in 125 m^2 sampling areas are given in Table 7. Mean density of adult razor clams at the northern end of Long Beach was $0.116/m^2$, slightly higher than the 1975 estimate of $0.104/m^2$.

Results of the tagging census are given in Tables 8 and 9. Numbers of tagged clams recovered were small which can lead to errors in calculating total population. The formula used to calculate the population is taken from Bourne (1969),

$$\hat{N} = \frac{M\ (C-R)}{R+1}$$

where $\hat{N}$ is the estimate of the original population in the transect, M the number of clams tagged, C the total catch, and R the number of recaptured marked clams in the total catch. Estimates of clam populations using this method were $0.34/m^2$ (Table 9), 3 times the density obtained from the digging and counting shows methods.

The point digging and counting shows methods of assessing intertidal razor clam populations depends on whether or not clams are showing. Numbers of shows produced fluctuate with tidal height and weather conditions. Bourne (1969) stated that it was unlikely all clams present would produce shows at one time and that any assessment relying on shows would always underestimate the population. Results from the tagging census at Long Beach illustrate that counting shows underestimated the population. It must be pointed out that returns of tagged clams was small and could lead to errors in population estimates. However, these studies have shown that the razor clam population at Long Beach is small, less than $0.34/m^2$. It is felt that further assessment of the adult population at Long Beach is unwarrented unless strong recruitment is observed in future years.

Growth

Razor clam growth studies were continued in 1976 using the same methods as in 1975. The beach screening site at Combers Beach was dropped in 1976 and a new site between Round and Little Islands established (Fig. 5).

Size frequency distribution shows that most of the intertidal clam population (95%) sampled by point digging was larger than 90 mm shell length. There was an increase of about 5 mm shell length in larger clams in 1976 compared to shell lengths in 1975, which can be attributed to growth (Fig. 7). Few small clams were found in 1976 and no distinct bands of shows which were found in September 1975 were observed in 1976.

Growth measurements (Table 10 and Fig. 8) in both 1975 and 1976 were similar. Age frequency distribution in both years is presented in Table 11 and Fig. 9. Numbers of the 0-yr class clams are similar in both years; 1-yr olds increased slightly; 2 and 3-yr olds decreased and numbers of 4 and 5-yr old classes were about the same.

As noted in previous studies (Bourne and Quayle 1970; Lee and Bourne 1976), populations of adult razor clams were sparse on Long Beach in 1976 and recruitment was low.

Time of spawning

Time of spawning was determined by examining microscopic sections of gonads (Lee and Bourne 1976) and results are shown in Table 12. Time of spawning in 1976 was similar to that observed in 1975; some spawning was recorded in July but major spawning occurred in August and September. No indication of a spring spawning was observed in either years.

Subtidal population

Accurate assessments of subtidal razor clam populations have not been undertaken, although there is evidence that such populations exist. Crab fishermen at Long Beach and Masset have reported catching razor clams in their traps set at depths to 18 m. Subtidal razor clams have been observed by SCUBA divers at Masset (Bourne 1969) and there is a small fishery on this population at Masset at the present time. Subtidal populations have been observed in Oregon (D. Demery, pers. comm.) and Nickerson (1975) attempted dredging for subtidal razor clams in Alaska.

Three 0.4 km transects were established subtidally at the northern end of Long Beach in depths ranging from 6 to 8 m (Fig. 6). Assessment of subtidal clam populations along these transects was made on two occassions, in September and in October. Two divers swam along the transects and examined the area 1 m on either side of the transect line for razor clam shows or siphons.

In October, ten samples of the substrate, each 0.5 m^2 in area and 15 cm in depth were taken along the transect to determine the population of subtidal juvenile clams. Samples were taken with a portable suction pump and the material washed through a 2 mm mesh bag attached to the end of the apparatus.

No shows or siphons were observed along these subtidal transects and no small clams were found in the 0.5 m^2 samples. Subtidal clam populations do exist off Long Beach since crab fishermen have found them in their traps. The fact that no clams were found in this assessment may be due in part to sparse populations and also to the fact that conditions were unfavourable for clams to produce shows or extend their siphons. The fact that no juvenile clams were found in the ten samples indicates recruitment has been low. Juvenile clams from the September spawnings may have been too small to be retained by the mesh.

Results of razor clam studies in 1975 and 1976 indicate recruitment in both years has been poor and the adult population is small. Growth rates and time of spawning agree with the data reported by Bourne and Quayle (1970). The razor clam population at Long Beach has not changed significantly over a 10 yr period and adult population assessments, growth rates and time of spawning studies will not be continued in the present study. Beach screening work will continue to determine strength of the in-coming year classes. If strong recruitment is found, adult population studies will be recommenced. Subtidal studies will continue to determine the significance of this population to the intertidal population.

Littleneck clam (*Protothaca staminea*) study

The littleneck clam study in Florencia Bay was continued in 1976 and expanded somewhat to study a small population at the southeast end of the Bay (Fig. 1). Sampling was undertaken in September using methods reported in Lee and Bourne (1976); in 1976 all samples were screened through a 2 mm mesh to assess the population of small clams.

The bed at the northwest end of the Bay (Fig. 10) was resampled in 1976 and the density was 392 clams/m^2 which is slightly above the density of 313 clams/m^2 found in 1975. Increase in density of the population is due mainly to the increased number of small clams found in the screening work.

Another smaller bed, 20 X 25 m was located at the southeast end of the Bay (Fig. 11). Clam densities here were 538/m^2. Total population in the two areas was 300,000-400,000 in the bed at the northwest end and 336,000 in the smaller bed.

Growth rates were calculated for clams from the two beds using the 1975 methods, and results are shown in Table 13 and Fig. 12. Growth rates of the two populations are similar and the same as recorded in 1975 (Lee & Bourne 1976).

Length and age frequency data are shown in Tables 13 &14 and Fig. 13-16. Population structure is different for the two beds. The bed at the northwest end has a bimodal structure with peaks at 2 and 5-yr old clams. The bed at the southeast end has a mode at 3-yr old clams. Smaller (younger) clams formed a high percentage of the population in the bed at the southeast end, 50% of the clams at the southeast end were 3 yr or younger compared to 35% in the other bed. The bed at the northwest end had a higher percentage of older clams (6 yr and older) than the bed at the southeast end. The two beds are separated by approximately 5 km and the variations in population structure is probably due to differences in the sporadic recruitment.

The littleneck clam population in Florencia Bay is small and rather unique in that this species usually inhabits beaches in quieter waters. The amount of habitat suitable for this clam is small and constantly changing. It is unlikely that the population will increase much over present levels, and the extent of the population will depend primarily on the regularity of recruitment. Surveillance studies of this population will be continued in 1977.

Sea mussel (*Mytilus californianus*) study

The sea mussel study to assess the re-establishment pattern and recovery time of a denuded mussel bed was continued in 1976. This study began in July, 1975, with the clearing of a 1 m^2 plot in a mussel bed on the semi-exposed north side of Cox Point (Lee and Bourne 1976). Organisms recolonizing the cleared plot since July 1975 were counted in September, October, and December 1975 and in June, September, and November 1976. Total numbers of organisms removed and numbers of organisms recolonizing the cleared 1 m^2 plot are given in Table 15.

Hewatt (1937) and Castenholz (1961) observed that a denuded rock was first covered with a film of algae, accompanied by a vanguard of limpets and littorines grazing it. Recolonization of the cleared mussel plot at Cox Point followed this sequence of events. In 1975, the limpets *Collisella digitalis* and *Notoacmea persona* were the dominant animals observed in the m^2 plot, although the area lacked visible algal cover. However, the rock surface had a slimy feel which indicates it was first recolonized by an algal film. The periwinkle *Littorina scutulata*, also a herbivore, was observed in decreasing numbers while numbers of limpets, *C. digitalis* and *N. persona*, increased. Numbers of *Thais emarginata* also decreased throughout the year. *Thais* preys on barnacles (Connell 1970; Dayton 1971) and the initial high number of this species may indicate their feeding on barnacles on the rocks below the mussel bed. The large size of the *Thais* showed they had moved into the cleared area and did not originate from a new year-class.

Northcraft (1948) and Castenholz (1961; 1967) reported the film of algae in cleared areas was usually followed by establishment of *Ulva* and/or *Enteromorpha*. This algal colonization was often accompanied by or shortly followed by sparse settlement of the original elements forming the mussel beds. Hewatt (1937) observed that barnacles were the major colonizing organisms following the first growth of algae. In 1976, recolonization of the cleared mussel plot at Cox Point had a noticeable algal coverage along with mussel and barnacle settlement and an increase in the numbers and species of limpets and periwinkles. Algal species were recorded as number of algal tufts per 20 X 20 cm plots in a m^2 (Lee and Bourne 1976). An algal tuft was defined as an alga covering an area 5 mm^2. Dominant species were the green alga *Ulva* sp. and the red algae

Endocladia muricata, Gigartina sp., Halosaccion glandiforme, and Petrocelis sp. A continual decrease in the amount of algal cover was observed throughout 1976. In June, large numbers of mussels M. californianus and M. edulis less than 1 cm were found in the m^2 plot. These small mussels were probably the 1975 year class. Numbers of mussels decreased throughout 1976; however, the higher number counted in November than September may be due to the decrease in algal cover exposing mussles previously settled in small crevices in the rock. Few barnacles settled in the cleared area. Because of the minute size of recently set barnacles, species were not identified. Barnacle settlement was accompanied by an influx of Thais emarginata; the number of Thais decreased markedly after June, which probably indicates the Thais were preying on newly settled barnacles. Four species of limpets Collisella digitalis, C. pelta, Notoacmea persona, and N. scutum and two species of periwinkle Littorina scutulata and L. sitkana were found in the m^2 plot. Although numbers of individual species fluctuated throughout the year, limpets and periwinkles were the dominant organisms recorded in the cleared area in 1976. Nemerteans were observed amongst the algal growth and often were seen stretching from crevices in the rock. However, they were difficult to remove intact and were recorded either as present or absent.

Figure 17a shows the m^2 plot in the mussel bed after the organisms were removed in July 1975; Fig. 17b shows the recolonization in November 1976. Although some recolonization was observed in the m^2 plot, there was little mussel recruitment. Similar studies along the Oregon coast showed that algal communities recuperated completely in approximately 2 yr, but there were still permanent swaths through mussel beds even after 8 yr although there had been considerable replacement of both Mytilus and Pollicipes (Castenholz 1967).

This study at Cox Point will continue through 1977.

Partial removal of sea mussel (M. californianus) study

Sea mussels will probably become more popular as a sea food and therefore populations of this species will receive increasing exploitation. A study was begun in 1976 to obtain some information on the effect of different exploitation rates on sea mussel beds.

A small exposed point adjacent to Location 14a (Fig. 1) at Quisitis Point was chosen for this study because it is not frequently visited by tourists. The sea mussel zone at this site was 4 m wide. Fourteen random 50 X 50 cm plots were established and marked in the bed (Fig. 18). Two plots were left undisturbed; three occasions, September, October, and

November, 20, 40, 60, 80, and 100 of the largest sea mussels (30 mm and larger) were removed from each of two plots. All mussels were removed from two plots in September.

Shell lengths of all mussels were recorded to the nearest millimeter and the animals grouped in 10 mm size-classes. Length frequency distributions are given in Table 16 and Fig. 19. (Length measurements are not finished for the completely cleared plots.) Lengths of the mussels varied from plot to plot but the modes of the largest mussles in most samples ranged from 50 to 70 mm.

After the November samples were removed, the plots were easily distinguished from the remainder of the bed because the outline of each plot was below the surface layer of the mussel bed and loose byssal threads showed that mussels had been ripped away from adjoining mussles. No other changes in the mussel bed were observed at that time.

This partial removal study will be continued to determine any long term effects to the mussel bed with prolonged exploitation.

Purple olive snail (*Olivella biplicata*) study

Studies begun in 1975 to assess intertidal populations and distribution of *Olivella* on Long Beach were continued in 1976. The 1976 sample locations were the same as in 1975 but one new location (5) was added between Round and Little Islands (Fig. 20). Quadrat sampling procedures followed those of 1975. In addition, a transect, 100 m long at right angles to the low tide line, was established between Round and Little Islands to estimate extent of intertidal movement. Two samples, each 0.25 m^2 X 8 cm deep and 1 m apart, were taken along the transect every 5 m from low water (0.5 m tide level or lower) up the beach until three consecutive sets of samples had no *Olivella*. These samples were washed through a 2.0 mm mesh screen.

The numbers of *Olivella* observed in monthly quadrat samples are given in Table 17. Intertidal distribution of *Olivella* was confined to the northern end of Long Beach and larger numbers were found in 1976 than in 1975. In May, the density was $4/m^2$, and increased to $8/m^2$ in June and August. Numbers decreased sharply in September to $1/m^2$ or less; in October and November, no *Olivella* were observed.

As the density of *Olivella* increased throughout the summer, their range up the intertidal beach also increased (Table 18). In May, all *Olivella* occurred in the 20 m intertidal zone closest to low water; by August this zone had increased to 45 m. No *Olivella* were found along the transect in September.

In 1975 lowest densities of *Olivella* ($1/m^2$ or less) in quadrat samples were observed north of Lovekin Rock. In 1976, densities had increased from $4/m^2$ to $8/m^2$. Low densities in 1975 may have been due to high recreational pressure. Until September 1975 this part of the beach was open to vehicle traffic and camping, but in 1976 it was closed for these purposes. The reduction of recreational pressure and cessation of vehicle traffic may be important in reducing mortality rates of this snail.

Disappearance of *Olivella* from the intertidal area of Long Beach coincided with a series of fall storms in both 1975 and 1976. Beach contours changed and freshwater flooded the beach during the heavy rains. As no windrows of *Olivella* were observed between storms to indicate extensive mortalities, and no live *Olivella* were observed at the low tide mark, *Olivella* may have moved down the beach to the subtidal area.

A brief subtidal survey (Fig. 1, Location C) was conducted in October 1976 using SCUBA. A transect was established at a depth of 10 m, parallel to the shore between Round and Little Islands. Ten quadrat samples, 0.5 m^2 X 15 cm deep, were taken randomly along the transect using a portable suction sampler (Fig. 21). Populations of *Olivella* in the subtidal samples ranged from 2 to $8/m^2$, mean $6/m^2$ and show that *Olivella* may migrate into the intertidal area in spring and then return to the subtidal zone in the fall.

As reported in the previous year, the intertidal *Olivella* population is abundant during the height of the tourist season, and these snails are collected in large numbers by the public. Reasons for possible vertical migrations of *Olivella* are not known, but people must be advised to resist collecting this species or serious reduction in the population may occur.

This *Olivella* study will continue in 1977.

Purple or ochre starfish (*Pisaster ochraceus*) study

Starfish are collected by tourists, the chief species being *Pisaster ochraceus*; but a few other species (*Pycnopodia helianthoides*, and *Dermasterias imbricata*) are also taken.

A study was begun in 1975 and continued in 1976 to determine seasonal changes in density of starfish populations at Box Island; in 1976 it was expanded to include two additional intertidal sites. The original sample site, 2.5 X 7.0 m, is described in Lee and Bourne (1976). The first additional sample area, 3.1 X 5.6 m, was established along a semi-exposed vertical rock face on the east side of Grassy Island in Schooner

Cove (Fig. 1, Site 2). It extended from the upper limit of the goose barnacle (Pollicipes polymerus) zone to the sand substrate at the base of the rock wall (Fig. 22). The second additional site, 1.6 X 8.4 m, was established along the exposed west side of Green Point (Fig. 1, Site 13), and extended from the lower limit of the Fucus zone to the sand substrate at the base of the rock (Fig. 23). Starfish were counted monthly from April to November, 1976, and results are given in Table 19.

As observed in 1975, numbers of Pisaster steadily decreased at Box Island throughout the summer of 1976 and this trend was also recorded at the Green Point site. Numbers did not significantly change at Grassy Island during the sampling period.

Decrease in the Pisaster population at the two sites is not thought to be due to removal by tourists, because no collecting was reported in these areas. Decreases may be due to migration of starfish into deeper water during the summer, since both sites have a western exposure and receive considerable direct afternoon sunlight. The Grassy Island site is protected from direct sunlight by an adjacent wall which would help prevent dessication of the animals. Increase in starfish numbers in winter at the two sites would occur because cooler overcast and wet weather would prevent dessication.

Populations of sunflower starfish were different in 1976 compared to those in 1975. In 1975 numbers of this species decreased during the summer until none was found in December. In 1976 the population increased until sampling ended in November. No explanation can be given for this reversal in population structure in the second year.

As reported in 1975, this study does not permit one to determine the effects of starfish removal in these areas, but Paine (1966; 1969) and Dayton (1971) have pointed out the ecological consequences of starfish removal. To prevent such ecological changes from occurring in the Park, the public should be encouraged to cause minimum disturbance to such areas. An ideal solution is a "look but do not remove" policy which has been presented to the public by the Interpretive Program in the Park through posters (Fig. 24), summer evening programs and intertidal beach walks. The "look but do not remove" policy should be intensified in the future as utilization of the Park increases.

The starfish project will continue in 1977 to determine seasonal and yearly changes in density at the three sample sites.

BROKEN GROUP ISLAND SECTION

HABITAT TYPES

Identification and mapping of habitats in the Broken Group Islands which was begun in 1975 was completed in 1976. Substrates and exposures to surf are shown in Fig. 25 and 26. Results of fauna and flora studies are discussed in their related habitat types.

Sampling semi-exposed and sheltered intertidal areas was continued in 1976 and expanded to include exposed habitats. Sampling subtidal habitats was begun in 1976 and included exposed, semi-exposed and sheltered sites. These subtidal studies were conducted during a 6-wk period from May to August.

In both the intertidal and subtidal work numbers of animals in 1 m^2 sample plots were recorded from each biotic zone along transects. Sponges, bryozoans, compound ascidians and some polychaete species were recorded as percent coverage within a m^2 area. Organisms smaller than 2 cm were counted in 25 X 25 cm subsamples. Algal cover was recorded as percent coverage within a m^2 area.

Habitat types - intertidal

Exposed habitats

Rock and boulder beaches

Sample locations and habitat descriptions of exposed rock and boulder beaches are given in Table 20 and Fig. 27. Fauna and flora were recorded from transects at Dempster (50), Howell (58 and 60), and Wouwer Islands (64), using criteria discussed in the Long Beach Section. Results are given in Table 21.

Zone 1, splash or spray zone

Organisms in this zone were similar to those in Zone 1 of the Long Beach Section.

The spray zone was dominated by limpets, periwinkles, acorn barnacles which occurred mainly in crevices, and black lichen, *Verrucaria* sp. which covered as much as 50% of the rock surfaces (Table 21).

Zone 2, high intertidal zone

Brown algae Fucus distichus and Pelvetiopsis limitata were the characteristic algae of the high intertidal zone and each covered up to 50% of the area. Limpets and acorn barnacles were abundant amongst and beneath the algae in maximum densities of 60 and 60,000/m² respectively. Periwinkles, usually abundant amongst algae, were recorded only at Wouwer Island (64). The anemone Anthopleura elegantissima, more common in lower zones, occurred at densities greater than 50/m² in crevices on Howell Island (58). Other fauna and flora recorded in this zone are given in Table 21.

Zone 3, mid intertidal zone

M. californianus and P. polymerus were the dominant fauna in the mid intertidal zone and occurred in maximum densities of 2,100 and 120/m², respectively. The brown alga Hedophyllum sessile dominant in this zone in the Long Beach Section, provided only 5-10% of the algal cover. Algal species with the highest densities varied from site to site and included Alaria nana, Gigartina exasperata, Iridaea sp., and surf grass P. scouleri. Other fauna and flora observed in this zone are recorded in Table 21.

Zone 4, low intertidal zone

The lower intertidal zone was characterized by brown and red algae - Alaria nana, Laminarina setchellii, Lessoniopsis littoralis, Gigartina exasperata, and Microcladia coulteri. Few animals occurred in this zone.

Semi-exposed habitats

Rocky shores, beaches with boulders-cobble-gravel-shell, and gravel-sand-shell beaches were studies in semi-exposed habitats in this section of the Park (Tables 20 and 21, Fig. 25 and 26).

Gravel, sand, and shell beaches

Semi-exposed gravel-sand-shell beaches were sampled on Nettle Island (Fig. 27, Sites 27-30). The beach is steep sloped and no intertidal fauna or flora were recorded on these four beaches. Because of the nature of the beach and its steep slope, the material is continually shifting and this may inhibit faunal populations on these beaches.

Boulder beaches and rocky shores

Boulder beaches were sampled at Turret (48), Gilbert (55), and Cooper Islands (56), and rocky beaches at Mullins (9), Turret (47 and 49), Gibraltar (52), Cooper (57), Wouwer (61), Camblain (62), and Dicebox Islands (63) (Table 20 and Fig. 27). Fauna and flora recorded from boulder beaches were not significantly different to those observed on rocky shores and will be discussed below. The four zonation patterns observed in other areas were also identified along these semi-exposed beaches.

Zone 1, splash and spray zone

The spray zone was recorded at only six of the sites sampled. The width of this zone in semi-exposed areas is less than in exposed sites because the exposure to surf is reduced. Limpets, periwinkles, acorn barnacles and lichens were the dominant species (Table 21). In the other five sites, _Fucus_ extended into the spray zone of rocky beaches.

Zone 2, high intertidal zone

Fucus distichus, the dominant alga in the high intertidal zone, formed a dense mat in most semi-exposed areas (maximum coverage was 80% at Cooper Island). Green and red algae were also present but at densities lower than $10\%/m^2$ (Table 21). Limpets, periwinkles and acorn barnacles were abundant amongst and beneath the algal layer and populations were generally denser than in exposed areas. Snails _Tegula funebralis_ and _Searlesia dira_ as well as _Thais_ spp. were common in semi-exposed areas. _Anthopleura elegantissima_ and _A. xanthogrammica_ were found in the high intertidal zone of several semi-exposed sites and densities (up to $160/m^2$) were higher than observed in exposed areas. Other organisms recorded in this zone are given in Table 21.

Zone 3, mid intertidal zone

At Cooper (57) and Camblain Islands (62), _M. californianus_ formed continuous beds and was the dominant organism (maximum density was $1{,}500/m^2$). At the other sites, sea mussels occurred in isolated clumps, and individual animals measured up to 18 cm in length. No goose barnacles and few bay mussels were found in association with _M. californianus_ in semi-exposed sites. _A. elegantissima_ was the most abundant anemone observed in this zone in numbers as high as $120/m^2$. Several species of starfish were recorded in these semi-exposed sites but densities were less than $1/m^2$ except for _Pisaster_ *ochraceus*, which had a mean density of $3/m^2$. Sea cucumbers *Cucumaria miniata*, conspicuous because of their bright orange colour, were found in densities greater than $1/m^2$ at Turret (48) and Cooper Islands (58). *Hedophyllum* was the dominant alga at Camblain (62) and Dicebox Islands (63) but was absent at other sites. Dominant alga at the other sites varied among five species, surf grass *Phyllospadix scouleri*, brown algae *Leathesia difformis* and *Sargassum muticum* and red algae *Gigartina exasperata* and *Halosaccion glandiforme*. Other algae present in lower densities are shown in Table 21.

Zone 4, low intertidal zone

Fauna and flora in the low intertidal zone were recorded from only five sites. As in other areas, this zone was predominantly occupied by brown and red algae - *A. marginata*, *L. setchellii*, *G. exasperata*, *Iridaea* sp. and surf grass *P. scouleri*. Additional algal species and animals recorded are shown in Table 21.

Sheltered habitats

Rock, boulder and cobble beaches, and gravel-sand-shell beaches, were studied in sheltered habitats. Sample locations and habitat descriptions are given in Table 20 and Fig. 27.

Shell and sand beaches

Sheltered shell beaches were studies at Gibraltar (10), Dodd (40), and Clarke Islands (45); sheltered sandy beaches were at Jaques (3), Gibraltar (11), and Nettle Islands (26) (Table 20 and Fig. 27). Little fauna and flora were observed at these sites and no zonation was evident. A few nemerteans, polychaetes, ghost shrimp burrows (*Callianassa californiensis* or *Upogebia pugettensis*), and bivalves were found at these sites (Table 22). Eelgrass *Zostera marina* was observed on sandy beaches but not on shell beaches.

Gravel, sand, and shell beaches

Sheltered beaches consisting of gravel, sand, and shell were studied at Jaques (1, 2), Keith (7), Nettle (16, 17, 21, 31), Walsh (32a-34), Willis (35-38), Hand (42), Effingham (53), and Camblain Islands (59) (Table 20 and Fig. 27).

Few species of fauna or flora were observed on these beaches (Table 22). The only zonation found at these sites was for bivalves which were the most abundant fauna. Butter clams *Saxidomus giganteus* were most abundant at the low tide mark; littleneck clams *Protothaca staminea* were often found amongst butter clams but their range extended into the mid intertidal area. Manila clams *Venerupis japonica* were occasonally recorded with littleneck clams but were usually found in separate bands above the littleneck clams. Nemerteans, polychaetes, ghost shrimp burrows, and bat stars *Patiria miniata* were common. Eelgrass *Z. marina*, and red alga *Gracilaria verrucosa* were the only flora recorded at these sites.

Cobble beaches

Sheltered cobble beaches were studied at Keith (6), Nettle (15, 20, 23), Clarke (44), Willis (35a), and Hand Islands (41) (Table 20 and Fig. 27). Fauna and flora recorded at these sites are presented in Table 23. Zonation was observed at these sites but no spray zone (Zone 1) was present.

Zone 2, high intertidal zone

Fucus distichus was the dominant alga observed in the upper intertidal zone and formed a coverage of up to 95%. Limpets *C. digitalis* (17/m^2), periwinkles *Littorina sitkana* (150/m^2), and *L. scutulata* (20/m^2) and acorn barnacles *B. glandula* (19,000/m^2), and *C. dalli* (100/m^2) were common.

Zone 3, mid intertidal zone

Mid intertidal zone was characterized by the snails *Searlesia dira* and *Tegula funebralis*, shore crabs *H. oregonensis* and *H. nudus*, eelgrass *Z. marina* and brown alga *Leathesia difformis* (Table 23). A few Pacific oysters *Crassostrea gigas* were observed at these sites but at low densities; *Ostrea lurida* was found only at Nettle Island (15) at a density of 20/m^2. Other fauna and flora observed on these beaches are given in Table 23.

Zone 4, low intertidal zone

Sargassum muticum, *Gigartina exasperata*, and a filamentous green alga were the dominant flora in the low intertidal area. Fauna were not abundant in this zone (Table 23); the most conspicuous were the red anemone *Tealia coriacea*, snail *Astraea gibberosa*, hermit crabs *Pagurus* sp. and bat star *P. miniata*.

Boulder beaches and rocky shores

Boulder beaches were studied at Mullins (8), Nettle (19, 20), Hand (43), and Gilbert Islands (54). Rocky outcrops were sampled at Keith (4, 5), Gibraltar (12, 13, 51), Nettle (18, 24, 25, 31a), Willis (39), and Clarke Islands (46) (Table 20 and Fig. 27). Similar fauna and flora were recorded in these two habitats and are presented together (Table 24).

No spray zone (Zone 1) was observed at these sites and Zone 4 (low intertidal area) could not be sampled.

Zone 2, high intertidal zone

Fauna and flora in this zone were similar to those observed in sheltered rocky shore habitats in the Long Beach Section. *Fucus distichus* formed a dense growth in the upper intertidal zone and provided a coverage of up to 80%. Additional algae present at less than 10%/m^2 are given in Table 24. Numbers of limpets *C. digitalis* and *N. persona* and periwinkles *Littorina sitkana* were comparable to those observed in exposed and semi-exposed areas. Acorn barnacles *B. glandula* were found at densities of 35,000/m^2, *B. cariosus* at 250/m^2, and *C. dalli* at 400/m^2. Shore crabs *Hemigrapsus*, hermit crabs *Pagurus* sp., and procelain crabs *Petrolisthes cinctipes* were common in this zone.

Zone 3, mid intertidal zone

M. edulis, eelgrass *Z. marina*, brown algae *Leathesia difformus* and *Sargassum muticum*, and red alga *Halosaccion glandiforme* were the predominant species observed in the mid intertidal zone. The snail *A. gibberosa* (densities up to 6/m^2), and bat star *P. miniata* (densities up to 10/m^2), species indicative of sheltered areas, were common in this zone. Other fauna and flora observed in this zone are given in Table 24.

Habitat types - subtidal

In 1976 a preliminary ecological subtidal investigation was begun in the Broken Group Islands which will form the basis for more detailed qualitative and quantitative studies to be carried out in future years. Results of this preliminary investigation are summarized here.

A total of 45 dives, using standard SCUBA were made at regular intervals during a 6-wk period from May to August 1976, in depths up to 12 m. Dive sites were selected from a grid drawn on a chart of the area, and were marked by placing wooden pegs well above the intertidal zone and taking compass bearings of the transects. A lead line marked in 1 m intervals was placed along each transect and was used as a distance reference point for recording ecological zones and associated communities. Each transect included a strip covering 5 m on either side of the marker and extended to a depth of 12 m where possible, or on gently sloping shores, to a distance of 100 m from shore.

Biotic zones were defined by observing the dominant organisms along each transect. Organisms in 1 m^2 plots in each biotic zone were counted in situ and recorded on underwater paper by the divers. No organisms were removed except for identification purposes. Only animals over 1 cm were counted. Algal cover was recorded as percent coverage per m^2 as in the intertidal sampling. Highly mobile species such as fish were noted as individuals or schools.

Six representative subtidal habitat types were defined using criteria of substrate type, exposure to surf, community composition and foreshore slope. Exposure to surf and substrate were the dominant physical factors influencing subtidal habitat types with foreshore slope of lesser importance. Substrate types usually changed with depth and such changes were usually accompanied by changes in associated biota. Substrates at most sites merge into mud at depths below 12 m which follows the observations reported by Carter (1972). As controlling parameters merge, habitat types become less easily distinguishable and these sites were placed in the most similar habitat type description. Depth profiles of individual dive sites are given in Appendix 2.

Exposed habitats

Rocky shores

This habitat is distinct and the most common one found in the Broken Group Islands. Representative sites facing west are: Dempster (15), Onion (26), Village Reef (29), Reeks (33), Wiebe (34), Cooper (38), Wouwer (39), Effingham (40), Faber Islets (41), Howell (42), Dicebox Islands(43), and Elbow Islet (46); and facing east are: Dodd (9), Benson (10), Willis (13, 14), Clarke (21), Owens (27), Hankin (35), Puffin Islet (36), and Camblain Islands (37) (Table 25 and Fig. 28). These habitats are characterized by steep rock faces with the exception of Weibe Island and Faber Islets where rock faces are moderately sloping.

The first zone adjacent to the intertidal area was an algal zone and included *Desmarestia ligulata*, *Costaria costata*, *A. marginata*, *Lithothamnion* sp. and *N. luetkeana*.

This zone did not occur in sites exposed to the strongest wave action, e.g., Benson, Puffin, Wouwer, Howell, and Effingham Islands. The second or lower zone was dominated by red sea urchins S. franciscanus, except on Benson Island where this species only occurred sporadically.

Other common species occurring throughout the area were cup coral Balanophyllia elegans, brooding anemone Epiactis prolifera, an encrusting polychaete Dodecaceria fewlogi, numerous species of sponges and ascidians, blood star Henricia leviuscula, a small fish Jordania zanope that appears to live under red urchins, and two species of algae Halicystis ovalis and Opuntiella californica (Table 26 and Fig. 29).

Semi-exposed habitats

Gravel and shell shores with isolated boulders

This habitat is represented by three sites Benson (11, 28), and Clarke Islands (22), which are in long shallow bays and have impoverished biota close to shore (Table 25 and Fig. 28). Farther out from shore, giant kelp M. intergrifolia occurred in patches and was the dominant species. In these beds a turban snail Tegula pulligo, sunflower stars P. helianthoides, and bull kelp N. luetkeana, occurred sporadically (Table 27 and Fig. 30).

Cobble, boulder and rock shores

This habitat is found at Erin (2), Jaques (3), Nettle (4), Keith (6), Gibraltar (7), Gilbert (17), Brabant (19), Jarvis (23), and Mullins Islands (25) (Table 25 and Fig. 28).

The dominant species were brown algae M. integrifolia, Eisenia arborea and Agarum fimbriatum, sea cucumber Cucumaria miniata, and burrowing anemone Pachycerianthus fimbriatus. A. fimbriatum and E. arborea occurred only at depths between 3 and 12 m, Cucumaria in crevices in the upper zones and Pachycerianthus on mud in the lower zones. Other common species were top snails A. gibberosa, polychaete Serpula, giant cucumbers Parastichopus californicus, northern abalone Haliotis kamtschatkana, and several starfish species. All species inhabited solid substrate (Table 28 and Fig. 31).

Two sites, Brabant and Mullins Islands, had no Agarum/Eisenia zone. Both sites are shallow guts between bodies of land.

Rocky shores

Hand Island (12) is the only representative of this habitat (Table 25 and Fig. 28). The bottom consists of extensive flat rock with sparse biota and no apparent zone differentiation.

Major species scattered throughout the site included the red alga _Gelidium robustum_, top snails _A. gibberosa_, giant cucumbers _P. californicus_, and various starfish species. An interesting species at this site was an unusually large anemone _Tealia crassicornis_ 30 cm in diameter (Table 28 and Fig. 32).

Sheltered habitats

Sand and mud flats

One site at Jaques Island (5) represents this habitat (Table 25 and Fig. 28). The extensive flat bottom is colonized by eelgrass _Z. marina_, red rock crabs _Cancer productus_, moon snails _Polinices lewisii_, bat stars _P. miniata_, nudibranch _Dendronotus_ sp. and burrowing anemone _P. fimbriatus_. Throughout the eelgrass zone scattered cobbles provided a habitat for sparse growth of brown algae _Laminaria saccharina_ and _Sargassum muticum_, a green alga _Bryopsis plumosa_, rock oysters _Pododesmus macroschisma_, and several species of barnacles, chitons and limpets. Extending alongside the mud is a rock reef providing a habitat for a brown alga _E. arborea_, top snails _A. gibberosa_, and small orange sea cucumber _C. miniata_ (Table 29 and Fig. 33).

Sand, mud, gravel, and shell slopes

Ten sites found in this habitat were Turtle (1), Turret (8), Gilbert (18), Hand (20), Jarvis (24), Willis (30), Jarvis/Jaques (31), Prideaux (32), Gibraltar (44), and Nettle Islands (45) (Table 25 and Fig. 28).

Dominant species were eelgrass _Z. marina_, bat stars _P. miniata_, horse clams _Tresus capax_, and a burrowing anemone _P. fimbriatus_. Other common species representative of this habitat included short-spined seastar _Pisaster brevispinus_, sunflower star _P. helianthoides_, red rock crab _C. productus_, moon snail _P. lewisii_, top snail _A. gibberosa_, giant sea cucumber _P. californicus_, giant nudibranch _Dendronotus_ sp., and the algae _G. robustum_, _Gracilaria verrucosa_, _Neoagardhiella baileyi_, _L. saccharina_ and _Smithora naiadum_ (epiphytic on eelgrass). These all occurred at varying depths with the exception of _Laminaria_ which was limited to depths between 3 and 12 m (Table 29 and Fig. 34).

Rock oysters *P. macroschisma*, a tube worm *Serpula vermicularis*, leather stars *Dermasterias imbricata*, a coralline red alga *Corallina* sp., Japanese weed *S. muticum*, and various species of barnacles and chitons were found on scattered cobbles.

KELP AND EELGRASS STUDIES

In 1976 mapping of kelp beds (*Nereocystis luetkeana* and *Macrocystis integrifolia*) and eelgrass (*Zostera marina*) was continued. Locations of beds are shown in Fig. 35. The total area of the kelp beds was 33.7 km^2 and eelgrass beds was 12.9 km^2; no quantitative data were taken.

RECREATIONAL IMPACT STUDIES

Bivalve population study

Initial studies to determine intertidal bivalve populations in the Broken Group Islands, begun in 1975, were expanded in 1976. When present restrictions on clam digging due to P.S.P. in this area are rescinded, bivalve populations could be subjected to heavy exploitation. This study is designed to provide information on the effect of exploitation on these populations and permit the formulation of management policies.

Forty-four semi-exposed and sheltered gravel-sand-shell beaches were sampled during May, June, and July (Table 20). Five samples, each 50 X 50 cm and of variable depth, were dug at each location from the low tide line to the high intertidal area. Each sample was dug to a depth until no clams were found or until a coarse cobble layer was encountered below the gravel. Numbers of all bivalves were recorded and shell lengths of littleneck clams (*Protothaca staminea*), butter clams (*Saxidomus giganteus*), and Manila clams (*Venerupis japonica*) were measured to the nearest millimeter.

Bivalve populations were found in 29 sample sites and results of the work are given in Table 30. Shell lengths have been grouped into 10 mm size classes for littleneck, butter, and Manila clams and are shown in Fig. 36.

Clams were found in pocket beaches at Nettle Island (17 and 31), in gravel accumulations between rocky outcrops at Keith (7) and Gilbert Islands (54), and in gravel bars between islets and islands at Willis (35, 38) and Clarke Islands (44, 45).

Beaches that supported the greatest combined populations of littleneck, Manila, and butter clams (density greater than $20/m^2$) were Jaques (1, 3), Keith (7), Gibraltar (11), Nettle (17, 20, 21, 23, 31), Walsh (32a, 34), Clarke (44, 45), and Gilbert Islands (54).

Largest populations of littleneck clams were found at Keith (7) and Nettle Islands (21) where densities were $355/m^2$ and $231/m^2$ respectively. At these two sites, large numbers of these clams were in the 0.0-9.9 mm size class, indicating a fairly strong 1975 year-class. This strong year-class was not found at other sites. Other substantial littleneck clam beds (density $20/m^2$ or greater) were found at Jaques (1, 3), Gibraltar (11), Nettle (17, 20, 23, 31), Walsh (32a, 34), Clarke (44, 45), and Gilbert Islands (54). Size distributions at these sites show that the overall number of legal-sized littleneck clams (38 mm) was low. However, sites with the greatest percentage of legal-sized clams (greater than 40%) were Jaques (1, 3), Nettle (17), Walsh (32a, 34), and Clarke Islands (44, 45).

The largest butter clam population was found on Nettle Island (21) where density was $244/m^2$; 82% of these clams were in the 0.0-9.9 mm size-class. As observed in littleneck clam populations at Nettle Island, a large proportion of the population was the result of recruitment of the 1975 year-class. Again this dominant year-class was not found at other sites. Densities of 20 butter clams/m^2 or greater were recorded only at Nettle (17, 23) and Clark Islands (44). The overall number of legal-sized butter clams (63 mm) was also low; Clarke Island (44) was the only site with a large percentage (75%) of legal-sized butter clams.

Manila clams were found at densities of $20/m^2$ or greater at Keith (7), Nettle (17, 20), and Hand Islands (42). The overall number of legal-sized Manila clams (38 mm) was extremely low; Nettle Island (20) was the only site with 25% of the Manila clams above 38 mm.

In general, populations of butter, littleneck and Manila clams in the beaches sampled are not extensive. Further, the wide spread of size-classes indicates that recruitment has been sporadic. Because of those two factors it is felt the clam populations will only support limited exploitations and management policies must be formulated to insure over exploitation does not occur.

Pacific oysters <u>Crassostrea gigas</u> were not found in large numbers in the Broken Group Islands; highest density was $4/m^2$ at Nettle Island (20). Isolated individuals (density $1/m^2$ or less) were found on gravel beaches at Keith (7), Walsh (32, 34), and Effingham Islands (53) and in the lower reaches of rocky outcrops at Mullins (9) and Nettle Islands (22). Native oysters Ostrea lurida were found at Walsh Island (34) at a density of $20/m^2$.

Other bivalve species recorded in gravel-sand-shell beaches during this survey were cockles Clinocardium nuttalli, bent-nose clams Macoma nasuta, soft-shell clams Mya arenaria, and horse clams Tresus capax (Table 30). Cockles occurred at densities less than $5/m^2$ and were occasionally found with butter and littleneck clams. Substantial populations of both Macoma and Tresus occurred at Keith Island (7) at densities of $195/m^2$ and $32/m^2$ respectively. Macoma and Mya were usually found in beaches with some mud accumulation, but Mya was restricted to the higher intertidal area; Macoma was generally distributed throughout clam beds. Tresus was found only in the low intertidal area.

One species that was not abundant in any area, but may become important as a souvenir species, was the sunset shell Gari californica (Table 30). Maximum density of this species was $2.4/m^2$ at Willis Island.

Bivalve species most commonly taken in the past in the Broken Group Islands were littleneck, butter and Manila clams, and Pacific oysters. Nine locations that support the largest populations of these bivalves, and the areas of beaches, are shown in Table 31 and Fig. 37. Bivalve populations at all these sites, except perhaps those on Nettle and Keith islands, have been moderately exploited in the past. However, as pointed out previously, past recruitment has been sporadic and unless future recruitment is heavier and more consistent, the clam populations will only support moderate exploitation.

To determine recruitment, as well as study existing populations and the effects of digging on the populations, the study will be continued in 1977.

Fish population studies

Records were kept of fish species (excluding salmonids) observed during the subtidal survey at Long Beach and in the Broken Group Islands during the summer of 1976. Numbers of species observed may be limited because maximum depth of dives was 12 m. Species and numbers of fish observed are given in Table 32; locations are given in Tables 26-29.

Two species of perch Embiotoca lateralis and Rhacochilus vacca were observed in the Broken Group Islands. Schools of these species were found in exposed and semi-exposed areas amongst rocks and brown algae.

Greenlings Hexagrammos decagrammus and Oxylebius pictus were recorded as solitary animals mainly in exposed rock areas, but Hexagrammos was also found amongst brown algae in semi-exposed and sheltered locations. Lingcod Ophiodon elongatus, a commercially important species, was infrequently encountered, but a few individuals were observed in exposed rocky sites.

Two rockfish species Sebastes caurinus and S. melanops were found mainly in exposed rocky locations but were also recorded in semi-exposed and sheltered sites amongst boulders and brown algae. Both these species are recorded as common in rocky reef areas in shallow water.

In the Broken Group Islands, sanddabs were found in sheltered areas with a mud-sand-gravel substrate; this species was also encountered subtidally along the exposed sand beach at the northern end of Long Beach.

Fish species encountered in sheltered mud, sand and gravel habitats amongst eelgrass and brown algae were black eyed goby Coryphopterus nicholsi, buffalo sculpin Enophyrys bison, and plainfin midshipman Porichthys notatus. Additional species observed in exposed rocky habitats were red irish lord Hemilepidotus hemilepidotus, longfin sculpin Jordania zanope, tube-snout Anlorhynchus flavidus, scalyhead sculpin Artedius harrington and smoothead sculpin A. lateralis, Pacific sand lance Ammodytes hexapterus, and spiny dogfish Squalus acanthias. A single school of Pacific herring Clupea herringus pallasi was seen amongst the eelgrass in a sheltered mud and sand habitat.

Incidental observations of fish species will be continued in the 1977 work. Undoubtedly fishing pressure (both angling and SCUBA spear-fishing) will increase in the Park in future years. A comprehensive study of fish populations suitable to recreational fishing needs is beyond the scope of this study, but such a study should be undertaken to ensure the public is well informed about the species involved. Comprehensive biological studies should be undertaken to ensure that sufficient information is available on resident fish species to form a sound basis for both educating the public, and establishing satisfactory management programs.

WEST COAST TRAIL SECTION

HABITAT TYPES

Habitat types - intertidal

West Coast Trail Section habitat studies and intertidal fauna and flora surveys were expanded in 1976 to include exposed sand-gravel-boulder beaches and sandstone benches in the area from Port Renfrew to Pachena Bay. Studies were made on those portions of the beach accessible from the trail. Habitats were examined and observations of macroscopic fauna and flora recorded during low tide periods of the last week in August and first week in September. Sample locations and habitat descriptions are given in Table 33 and Fig. 38.

Transects were established at each sample location from the driftwood line to the low water mark. One m^2 samples were taken in sand and gravel beaches at Sites 1, 2, and 3. Numbers of organisms observed in each sample were recorded for each biotic zone along boulder beaches and sandstone benches at Sites 1, 4-15. A subsample, 25 X 25 cm, was taken to record numbers of organisms less than 2 cm long. Algal cover was recorded as percent cover/m^2.

Substrates and degree of exposure to surf identified in the West Coast Trail Section are shown in Fig. 39 and 40. The area northwest of Pachena Bay, along Cape Beale to Whittlestone Point, was not surveyed in 1976, and substrate and exposure information was compiled from Robilliard (1971), hydrographic charts, and observations provided by Park wardens.

Exposed habitats

Rocky outcrops with boulders, and sand-gravel-cobble beaches occur in exposed areas. Narrow, steep-sloped sand-gravel beaches occur from Walbran Creek north to Pachena Point. Many of these beaches are located at the back of sandstone benches. Small gravel-cobble beaches are found at the mouths of the major rivers and creeks. Exposed rocky shores are primarily sandstone benches and inaccessible vertical cliffs, interrupted by surge channels.

Sand and gravel beaches

Sand and gravel in these steeply sloping beaches is continually shifting and grinding under the force of waves. No organisms were found on these exposed beaches.

Gravel and cobble beaches

Small exposed gravel and cobble beaches were sampled at Camper Bay (2) and Cullite Cove (3) (Table 33 and Fig. 38). Marine life on these beaches was sparse (Table 34). No apparent zonation of fauna or flora was observed. Acorn barnacles Balanus glandula and B. cariosus were found on the upper surfaces of the cobble at maximum densities of 1,600/m² and 500/m², respectively. Unidentified species of amphipods and isopods were found amongst and under the cobble and gravel. Only a sparse growth of Ulva and Spongomorpha was found in these areas.

Rocky shores

Horizontal sandstone benches were the only exposed rocky shores sampled along the West Coast Trail. Although benches are found along many exposed headlands in the Park, sandstone benches in the West Coast Trail Section are more extensive. Fauna and flora at the front edge of the bench are typical of exposed areas, while species nearer the shore are similar to those found in semi-exposed or sheltered areas. Sample sites along sandstone benches were Sites 4-8 and 10-15 (Table 33 and Fig. 38), and results of sampling fauna and flora are presented in Table 35.

Three distinct zones were observed and classified according to the more conspicuous organisms and their relationship to the sandstone bench. The splash or spray zone was not evident along the sandstone benches. Zone 2 (high intertidal area) included the flat expanse of bench extending from the driftwood line down about 2/3 the width of the bench. Zone 3 (mid intertidal zone) extended from the lower margin of Zone 2 to the front edge of the bench. Zone 4 (low intertidal zone) was restricted to the very front edge of the bench.

Zone 2, high intertidal zone

The dominant fauna of the high intertidal area were periwinkles, limpets, and acorn barnacles. Periwinkles L. scutulata and L. sitkana were restricted to the upper intertidal region, and were observed amongst the luxuriant algal growth. Limpets C. digitalis, C. pelta, N. persona, and N. scutum were found under algae and in crevices in this zone. Except for N. scutum, these limpets were found at most sample sites; N. scutum occurred only at locations 7, 8, and 15. Three species of acorn barnacles B. glandula, B. cariosus and C. dalli were recorded in varying densities along sandstone benches in crevices and small depressions in the otherwise smooth surfaces (maximum densities were 19,100/m², 800/m², and 3,200/m² respectively). A species indicative of sheltered rocky shores, the turban snail *Tegula funebralis* was common at locations 10, 12, 13, and 14.

The dominant algal cover along the flat surface of the benches were rockweed *Fucus distichus*, and red algae *Rhodomela larix*, *Gigartina* spp. and *Porphyra* sp. *Fucus* was present at each sample site but in variable abundance (10-40%/m²). *Rhodomela* was the dominant alga at sites where *Fucus* was sparse (Table 35). The brown alga *Pelvetiopsis limitata* was found at locations 6, 8, 10, 11, and 13, in varying densities (10-60%/m²). Adjacent to the sample sites, these algae occurred in alternate vertical bands. In some sites *Rhodomela larix* was the dominant alga to the exclusion of any other algae for a 10 m vertical strip; in the immediate adjacent area it would be found between bands of *Gigartina* spp. and *Fucus distichus*. At Site 13 *P. scouleri* was the dominant flora between strips of *Rhodomela* and *Fucus*/*Gigartina*.

Tidepools in the high intertidal area of the benches were inhabited by floral and faunal species discussed above. In addition, anemones *Anthopleura elegantissima* and *A. xanthopleura*, shore crabs *Hemigrapsus nudus*, hermit crabs *Pagurus* sp., and tidepool sculpins *Oligocottus* spp. and *Clinocottus* spp. occurred in these pools. These species are more typical of semi-exposed mid to low intertidal tidepools. Sea mussels *M. californianus* and surf grass *P. scouleri*, characteristic of low intertidal areas, were also found in these high intertidal tidepools. Green algae *Cladophora* sp., *Enteromorpha* sp. and *Ulva* sp., red algae *Prionitis* sp., *Porphyra* sp., and coralline red algae also were found in these tidepools (Table 35).

Zone 3, mid intertidal zone

Mussels, goose barnacles, and purple sea urchins were the characteristic fauna of the mid intertidal area. Sea mussels *M. californianus* occurred in depressions and small cracks, usually a single layer deep at maximum densities of 2,700/m², but were not found in clearly demarcated areas as in the Long Beach or Broken Group Island Sections. Bay mussels *M. edulis* were present but in much lower numbers. Purple sea urchins *S. purpuratus* only occurred in tidepools in rows of holes scoured in the sandstone. Acorn barnacles and limpets observed in Zone 2 were also present in the mid intertidal region, but in much lower densities (Table 35). The goose barnacle *P. polymerus* commonly found in association with *M. californianus* on exposed rocky shores occurred in widely separated clumps along depressions and crevices. The dire whelk *Searlesia dira* usually associated with protected rocky shores was observed at Sites 5, 6, 8, 13, and 15. *Hedophyllum sessile*, the dominant alga, was found at all sample sites (25-80%/m²) except the "Cribbs" north of Carmanah Point (Site 10). Coralline red algae *Bossiella* sp., *Corallina* sp. and

Calliarthron sp. occurred more frequently than in Zone 2 but densities were usually less than 5%/m².

Tidepools in the mid intertidal area had purple sea urchins S. purpuratus, green anemone Anthopleura xanthogrammica, chiton Katharina tunicata, and limpet Acmaea mitra. Flora in these tidepools were P. scouleri, coralline red algae, and red algae Odonthalia floccosa, Prionitis sp., and Rhodomela larix. Any intervening spaces were covered by the encrusting red alga Lithothamnion sp. (Table 35).

Zone 4, low intertidal zone

M. californianus and P. polymerus were the dominant fauna at the front edge of the sandstone benches. Density of Mytilus was lower in Zone 4 than in Zone 3 but the mussels were larger (up to 20 cm in length). Density of Pollicipes was about twice that observed in Zone 3.

Few of the algal species observed in Zones 2 and 3 were found in Zone 4. Brown algae Alaria marginata, Egregia menziesii and Postelsia palmaeformis, and red algae Gigartina spp., Iridaea sp., Rhodoglossum sp. and coralline red algae were the characteristic flora of Zone 4 (Table 35). Nereocystis luetkeana occurred in regular beds offshore in most areas along the West Coast Trail.

Tidepools did not occur in this zone.

Semi-exposed habitats

Rocky shores and boulder beaches

Rocky shores and boulder beaches with cobble-gravel-sand at Thrasher Cove and sandstone benches with boulders at Carmanah Point were sampled in 1976 (Table 33 and Fig. 38). Fauna and flora observed at these sites are shown in Table 35. Similar fauna and flora and zonation patterns were found at both sites, and results are combined.

The zonation pattern found in exposed rocky areas was also observed in semi-exposed habitats.

Zone 2, high intertidal zone

Numbers of dominant fauna and flora of Zone 2 were similar to those found in exposed areas. However, no Pelvetiopsis limitata, coralline or encrusting red algae were found in semi-exposed sites (Table 35).

Zone 3, mid intertidal zone

M. californianus and Hedophyllum sessile were the major fauna and flora found in this zone and their densities were comparable to those in exposed areas (Table 35). No goose barnacles P. polymerus, sea urchins, limpets Acmaea mitra, coralline or encrusting red algae were found at these sample sites.

Zone 4, low intertidal zone

In semi-exposed areas, faunal species were reduced in Zone 4, and algae were the dominant species observed (Table 35). Alaria marginata and Gigartina sp. were the major species. No M. californianus, P. polymerus, Postelsia palmaeformis, coralline or encrusting red algae were observed in Zone 4.

Sheltered habitats

Few sheltered habitats are present along the West Coast Trail (Fig. 39, 40). The area around the tidal marker at the southeastern end of the trail, northwest shore of Pachena Bay and perhaps some areas around Cape Beale are the extent of protected areas in this section. None of these areas were sampled in 1976.

KELP AND EELGRASS STUDIES

In 1976 kelp beds Nereocystis luetkeana were mapped for the West Coast Trail Section and are shown in Fig. 38. Total area of the beds was 5.1 km^2 but no quantitative samples were taken. No eelgrass beds were found in this section in 1976.

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Table 1. Classification of substrate types according to particle size.

Substrate	Definition
MUD	very fine consolidated sediment, $<.05$ cm.
SAND	granular, .05-.5 cm.
SHELL	crushed shell
GRAVEL	.5-5.0 cm.
COBBLE	5.0-50.0 cm.
BOULDER	>50.0 cm.
ROCK	continuous or repeated strata

Table 2. Location and habitat description of intertidal fauna and flora survey sites, Long Beach Section (1976).

Sample No.	Location	Slope	Habitat: Substrate	Habitat: Exposure
1	Radar Beaches (1976)	15.4°	rock	semi-exposed
2	Grassy Island, Schooner Cove (1976)	90.0°	rock	semi-exposed
3	Between Round and Little Islands	1.3°	sand	semi-exposed
4	West side of Half Moon Bay (1976)	19.4°	rock	semi-exposed
5	Halfway between Incinerator and Shawd Rocks	1.1°	sand	exposed
8	0.8 km. north of Quisitis Point	1.8°	sand	exposed
9	Beach at northwest end of Florencia Bay	2.1°	sand, gravel	semi-exposed
10	North side of Cox Point	42.2°	rock	exposed
11	North end of gravel extension for Grice Bay Road	28.3°	rock	sheltered
12b	East side of Box Island	90.0°	rock	sheltered to semi-exposed
13	West side of Green Point	39.6°	rock	exposed
14a	North side of Quisitis Point; adjacent to Wickaninnish Inn	23.0 - 84.5°	rock	semi-exposed
15a	Outcrop north of Half Moon Bay	21.9°	rock	semi-exposed
16	East side of culvert on Grice Bay Road	2.4°	mud	sheltered

Table 3. Number of intertidal organisms recorded from sand samples taken at 25 m intervals along a vertical transect, Long Beach Section (1976).
(Numbers converted to No./m^2; number of *Euzonus* in brackets less than 1 cm in length)
Note: 0 m sample located at driftwood line.

Table 3.

Sample (m)	North of Lovekin Rock																	
	May						June						July					
	Amphipods	Mysids	Isopods	Polychaetes	*Euzonus*	Nemerteans	Amphipods	Mysids	Isopods	Polychaetes	*Euzonus*	Nemerteans	Amphipods	Mysids	Isopods	Polychaetes	*Euzonus*	Nemerteans
0	0	0	0	0	0 (0)	0	0	0	0	0	0 (0)	0	0	0	0	0	0 (0)	0
25	0	0	0	0	0 (0)	0	0	0	3	0	0 (0)	0	0	0	11	0	0 (0)	0
50	0	0	0	0	1028 (0)	0	0	0	33	0	14 (0)	0	0	0	53	0	28 (0)	0
75	0	0	0	11	50 (0)	0	0	0	3	0	361 (0)	0	0	0	119	0	1333 (0)	11
100	0	0	0	6	0 (0)	8	0	0	0	0	3177 (0)	0	0	0	0	0	917 (0)	0
125	0	0	0	3	0 (0)	6	0	0	0	3	0 (0)	0	3	0	0	0	0 (0)	11
150	0	3	0	0	0 (0)	3	0	0	0	3	0 (0)	8	3	6	0	0	0 (0)	6
175	0	3	0	0	0 (0)	6	0	0	0	3	0 (0)	6	0	3	0	3	0 (0)	3
200	0	0	0	0	0 (0)	0	0	0	0	6	0 (0)	3	-	-	-	-	-	-
225	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
275	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	0	6	0	20	1078 (0)	23	0	0	39	15	3552 (0)	17	6	9	183	3	2278 (0)	31

Table 3 cont'd

North of Lovekin Rock

Sample (m)	August						September						October					
	Amphipods	Mysids	Isopods	Polychaetes	*Euzonus*	Nemerteans	Amphipods	Mysids	Isopods	Polychaetes	*Euzonus*	Nemerteans	Amphipods	Mysids	Isopods	Polychaetes	*Euzonus*	Nemerteans
0	0	0	0	0	0 (0)	0	3	0	0	0	0 (0)	0	0	0	0	0	0 (0)	0
25	0	0	0	0	0 (0)	0	0	0	0	0	0 (0)	0	0	0	0	0	0 (0)	0
50	3	0	0	0	0 (0)	0	0	0	0	0	0 (0)	0	0	0	8	0	0 (0)	0
75	0	0	367	3	139 (500)	0	0	0	203	0	1306 (0)	0	0	0	206	0	1167 (0)	0
100	8	0	8	0	1139 (778)	0	3	0	0	3	1264 (1778)	6	0	0	0	3	375 (4697)	0
125	6	0	0	17	0 (167)	0	11	0	0	3	0 (0)	6	94	0	0	0	0 (0)	17
150	3	0	0	3	0 (0)	8	6	0	0	3	0 (0)	6	6	0	0	3	0 (0)	0
175	0	0	0	11	0 (0)	3	3	0	0	3	0 (0)	3	6	0	0	3	0 (0)	0
200	6	0	0	8	0 (0)	0	3	0	0	3	0 (0)	0	6	3	0	3	0 (0)	3
225	8	6	0	3	0 (0)	3	3	0	0	8	0 (0)	0	0	0	0	0	0 (0)	0
250	-	-	-	-	-	-	3	0	0	0	0 (0)	0	3	0	0	0	0 (0)	3
275	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	14	0 (0)	0
Total	34	6	375	45	1278 (1445)	14	35	0	203	23	2570 (1778)	21	115	3	214	26	1542 (4697)	23

Table 3 cont'd

Sample (m)	North of Lovekin Rock					
	November					
	Amphipods	Mysids	Isopods	Polychaetes	*Euzonus*	Nemerteans
0	0	0	0	0	0 (0)	0
25	0	0	0	0	0 (0)	0
50	0	0	3	0	625 (0)	0
75	0	0	8	0	97 (1389)	0
100	83	0	8	0	0 (0)	6
125	3	0	0	6	0 (0)	3
150	0	0	0	3	0 (0)	6
175	0	0	0	3	0 (0)	11
200	0	0	0	6	0 (0)	0
225	-	--	-	--	-	-
250	-	-	-	-	-	-
275	-	-	-	-	-	-
Total	86	0	19	18	722 (1389)	26

Table 3 cont'd

Sample (m)	North of Quisitis Point																	
	May						June						July					
	Amphipods	Mysids	Isopods	Polychaetes	*Euzonus*	Nemerteans	Amphipods	Mysids	Isopods	Polychaetes	*Euzonus*	Nemerteans	Amphipods	Mysids	Isopods	Polychaetes	*Euzonus*	Nemerteans
0	8	0	3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
25	0	0	0	0	2278	0	0	0	11	0	250	0	0	0	8	0	1167	0
50	8	0	6	11	3	3	0	0	0	3	1111	0	0	0	8	0	0	6
75	3	6	3	0	0	3	0	3	0	6	0	3	0	3	0	0	0	3
100	0	3	0	6	0	6	14	11	0	3	0	3	0	0	0	8	0	3
125	11	0	0	3	0	0	6	0	0	6	0	0	-	-	-	-	-	-
150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
175	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	30	8	11	20	2281	12	20	14	11	18	1361	6	3	3	16	8	1167	12

Table 3 cont'd

	North of Quisitis Point																	
	August						September						October					
Sample (m)	Amphipods	Mysids	Isopods	Polychaetes	*Euzonus*	Nemerteans	Amphipods	Mysids	Isopods	Polychaetes	*Euzonus*	Nemerteans	Amphipods	Mysids	Isopods	Polychaetes	*Euzonus*	Nemerteans
0	3	0	0	0	0	0	0	0	3	0	0	0	17	0	0	0	0	0
25	17	0	22	0	0	0	0	0	128	0	0	0	0	0	42	0	331	0
50	0	0	11	11	3306	0	3	0	22	14	0	14	0	0	0	0	375	3
75	0	0	0	14	6	0	14	0	0	3	0	6	0	3	6	0	0	8
100	0	0	0	6	0	11	3	0	0	8	0	0	8	3	0	6	0	0
125	0	0	0	6	0	3	0	0	0	3	0	0	0	0	0	0	0	0
150	0	0	0	3	0	0	3	0	0	0	0	0	6	0	0	0	0	0
175	6	0	0	3	0	0	0	0	0	0	0	0	11	0	0	0	0	0
200	0*	0	0	3	0	0	-	-	-	-	-	-	111	0	0	0	0	0
Total	25	0	33	46	3312	14	23	0	153	28	0	20	153	6	48	6	706	11

*One *Crangon* present

Table 3 cont'd

Sample (m)	North of Quisitis Point					
	November					
	Amphipods	Mysids	Isopods	Polychaetes	_Euzonus_	Nemerteans
0	0	0	3	0	0	0
25	8	0	33	0	1389	3
50	14	0	53	0	0	11
75	31	0	0	0	0	6
100	0	0	0	8	0	6
125	6	0	0	3	0	6
150	11	0	0	0	0	0
175	0	0	0	3	0	0
200	-	-	-	-	-	-
Total	70	0	89	14	1389	31

Table 4. Seasonal observations of fauna and flora on exposed and semi-exposed rocky shores, Long Beach Section (1976).
(Multiply No./m^2 of _B. glandula_ and _M. californianus_ by 100, and _C. dalli_ and _M. edulis_ by 10)

Table 4

Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches(1)
ZONE 1 width	6m			5m			10m			4m			5m
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
FAUNA													
PHYLUM Mollusca Class Gastropoda Subclass Prosobranchia													
Collisella digitalis (fingered limpet)	76	80	79	82	88	86	30	42	34	36	40	38	42
Littorina scutulata (checkered periwinkle)	42	36	40	21	19	18	32	36	30	42	31	37	21
L. sitkana (sitka periwinkle)	122	126	131	196	211	220	109	115	94	132	129	127	126
Notoacmea persona (mask limpet)	10	<1	3	14	25	20	21	27	23	6	9	8	21
N. scutum (plate limpet)	<1	0	<1	1	3	1	11	11	11	14	12	10	3
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia													
Balanus glandula	625	525	529	380	441	378	650	575	600	484	506	483	360
Chthamalus dalli	200	220	190	0	0	0	230	220	190	100	110	90	200

Table 4 cont'd

Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches (1)
ZONE 1													
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
FLORA													
Lichens													
Verrucaria sp.	50	50	50	40	50	50	50	50	50	60	60	60	40
PHYLUM Chlorophyta (green algae)													
Enteromorpha intestinalis		0	0	0	0	0	0	0	0	0	0	0	25
Prasiola meridionalis	30	75	10	0	0	0	10	30	<5	0	0	0	50

Table 4 cont'd

Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches (1)
ZONE 2 width	2m			3m			3m			2m			3m
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
FAUNA													
<u>PHYLUM</u> Mollusca <u>Class</u> Gastropoda Subclass Opisthobranchia													
<u>Onchidella borealis</u>	0	0	0	0	3	3	0	0	0	0	0	0	140
Subclass Prosobranchia													
<u>Collisella digitalis</u> (fingered limpet)	34	36	42	36	40	40	48	52	56	47	48	52	61
<u>Littorina scutulata</u> (checkered periwinkle)	89	98	102	95	121	120	82	82	103	58	61	60	125
<u>L. sitkana</u> (sitka periwinkle)	98	109	126	165	161	167	135	137	142	121	137	142	201
<u>Notoacmea persona</u> (mask limpet)	10	16	8	11	20	14	10	10	9	11	12	12	25
<u>N. scutum</u> (plate limpet)	0	3	1	1	4	3	4	5	2	9	12	10	14
<u>Thais emarginata</u> (short-spired purple)	119	120	122	0	16	0	146	152	140	154	160	162	148
<u>T. lamellosa</u> (wrinkled purple)	3	0	4	5	10	3	1	0	3	1	0	0	20
Class Bivalvia													
<u>Mytilus edulis</u>	0	0	0	10	10	10	0	0	0	0	0	0	0

Table 4 cont'd

Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches (1)
ZONE 2													
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
PHYLUM Arthorpoda Class Crustacea Subclass Cirripedia													
Balanus cariosus	400	500	300	300	300	300	400	300	400	200	300	200	400
B. glandula	624	575	600	420	441	440	550	575	546	484	475	468	462
Chthamalus dalli	94	92	94	10	12	11	91	87	89	0	0	0	98
FLORA													
PHYLUM Chlorophyta (green algae)													
Cladophora sp.	0	0	0	0	0	0	10	15	10	5	5	<5	0
Spongomorpha sp.	<5	<5	<5	5	10	10	0	0	0	0	0	0	0
Ulva sp.	<5	<5	<5	<5	<5	<5	<5	<5	<5	0	0	0	10
PHYLUM Phaeophyta (brown algae)													
Fucus distichus	20	25	15	20	30	10	30	40	25	40	60	40	50
Pelvetiopsis limitata	15	50	35	0	0	0	20	20	10	0	0	0	10

Table 4 cont'd

Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches (1)
ZONE 2													
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
PHYLUM Rhodophyta (red algae)													
Calliathamnion pikeanum	0	0	0	0	0	0	10	10	5	5	5	5	10
Endocladia muricata	<5	<5	10	0	0	0	0	0	0	10	10	5	<5
Odonthalia floccosa	<5	<5	<5	0	0	0	0	0	0	0	0	0	0
Petrocelis sp.	<5	<5	<5	0	0	0	0	0	0	0	0	0	0
Porphyra sp.	0	0	0	0	0	0	10	30	0	0	0	0	0
Rhodomela larix	<5	<5	<5	0	0	0	0	0	0	0	0	0	0

Table 4 cont'd

Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches (1)
ZONE 3 width	5m			5m			3m			14m			5m
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
FAUNA													
PHYLUM Porifera													
Haliclona permollis	0	0	0	10	10	20	5	5	5	5	5	5	5
Ophlitaspongia pennata	0	0	0	10	10	10	5	5	5	5	5	5	5
unidentified species	0	0	0	0	<5	<5	5	5	5	5	5	5	5
PHYLUM Cnidaria Class Anthozoa Order Actiniaria													
Anthopleura elegantissima	135	150	400	70	75	168	76	80	81	125	200	275	105
A. xanthogrammica (green anemone)	20	20	20	10	10	12	2	2	2	27	30	30	26
Metridium senile	0	0	0	10	10	15	0	0	0	<1	<1	<1	0
PHYLUM Annelida Class Polychaeta													
Eudistylia vancouveri	<5	<5	<5	<5	<5	<5	0	0	0	<5	<5	<5	0
Serpula vermicularis	5	5	5	10	10	10	5	5	5	5	5	5	0
PHYLUM Mollusca Class Amphineura													
Katharina tunicata	1	1	<1	3	4	2	4	3	5	3	4	4	8

Table 4 cont'd

Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches (1)
ZONE 3													
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
Class Amphineura cont'd													
Mopalia spp.	<1	3	<1	0	3	<1	<1	<1	<1	<1	3	0	1
Tonicella lineata	0	0	0	0	<1	3	<1	<1	<1	<1	<1	<1	0
Class Gastropoda Subclass Opistobranchia													
Aeolidida papillosa	0	0	0	0	0	0	0	0	0	6	3	<1	0
Archidoris montereyensis	0	0	0	1	0	0	<1	<1	0	5	3	<1	0
Dirona albolineata	0	0	0	0	0	0	<1	<1	0	0	0	0	0
Hermissenda crassicornis	0	0	0	0	0	0	<1	<1	<1	<1	<1	<1	0
Rostanga pulchra	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Subclass Prosobranchia													
Ceratostoma foliata (leafy hornmouth)	<1	0	0	0	0	0	<1	<1	0	0	<1	<1	0
Calliostoma ligatum	0	0	0	0	0	0	2	1	1	36	40	24	3
Collisella pelta	36	24	38	24	29	19	42	32	36	38	40	46	23
Diodora aspera	0	0	0	0	0	0	1	1	0	0	0	0	0
Notoacmea scutum (plate limpet)	10	8	5	3	2	1	17	15	25	11	12	14	8
Searlesia dira	0	0	0	0	0	0	5	3	4	0	0	0	12
Tegula funebralis	0	0	0	0	0	0	48	42	52	0	0	0	60
Thais emarginata	136	142	137	0	0	0	125	128	136	198	180	182	156
T. lamellosa	1	1	<1	5	10	3	5	0	4	2	3	0	28

Table 4 cont'd

Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches (1)
ZONE 3													
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
Class Bivalvia													
<u>Mytilus californianus</u>	240	256	255	.20	.23	.21	260	273	264	275	319	325	286
<u>M. edulis</u>	120	121	117	1.5	1.5	1.5	168	144	156	180	192	187	171
<u>Pododesmus macroschisma</u>	0	0	0	0	0	0	0	0	0	<1	<1	<1	6
<u>PHYLUM</u> Arthropoda Class Crustacea Subclass Cirripedia													
<u>Balanus cariosus</u>	420	360	400	270	240	210	150	140	140	160	150	160	360
<u>B. glandula</u>	140	168	132	108	110	96	54	48	56	228	209	171	252
<u>B. nubilus</u>	3	3	3	2	2	2	0	0	0	6	6	6	3
<u>Pollicipes polymerus</u> (goose barnacle)	200	200	200	0	0	0	50	56	52	25	31	26	30
Subclass Malacostraca Order Decapoda													
<u>Hemigrapsus nudus</u> (purple shore crab)	3	2	5	0	0	0	0	0	0	6	10	9	31
<u>H. oregonensis</u> (green shore crab)	0	0	0	0	0	0	0	0	0	4	2	1	20
<u>Oedignathus inermis</u>	0	0	0	<1	<1	<1	<1	<1	<1	<1	<1	<1	0
<u>Pagurus</u> sp. (hermit crab)	15	10	10	0	0	0	12	14	13	9	11	9	120
<u>Pugettia gracilis</u> (kelp crab)	0	0	0	0	<1	0	<1	<1	<1	<1	<1	0	0

Table 4 cont'd

Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches (1)
ZONE 3													
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
PHYLUM Bryozoa													
Dendrobaenia lichenoides	5	5	5	5	5	10	1	1	1	5	5	5	0
Frustrellidra corniculata	5	5	5	10	10	15	10	10	10	5	10	10	15
unidentified species	5	10	10	10	10	10	5	5	5	10	10	10	10
PHYLUM Echinodermata Class Asteroidea													
Evasterias troschellii	0	<1	0	0	<1	<1	<1	<1	0	<1	0	0	<1
Henricia leviuscula	0	0	0	0	0	<1	<1	<1	<1	<1	<1	<1	<1
Pisaster ochraceus (purple starfish)	0	0	0	0	0	0	1	2	1	14	26	17	2
Pycnopodia helianthoides (sunflower star)	0	0	0	0	0	0	0	0	0	1	<1	0	1
Class Echinoidea													
Strongylocentrotus purpuratus	1	<1	<1	0	0	0	0	0	0	36	40	42	48
S. franciscanus	<1	<1	0	0	0	0	<1	<1	<1	6	10	3	0
Class Holothuroidea													
Cucumaria miniata	0	0	0	0	0	0	<1	<1	<1	4	4	4	0
Eupentacta pseudoquinquesemita	0	0	0	0	0	0	0	0	0	<1	<1	<1	0

Table 4 cont'd

Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches(1)
ZONE 3													
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
PHYLUM Chordata Subphylum Urochordata Class Ascidiacea													
Clavelina huntsmani	0	0	0	0	0	0	<1	<1	<1	<1	<1	<1	0
Styela montereyensis	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	1	1	0
unidentified species	5	5	5	15	20	20	0	0	0	10	10	10	0
Subphylum Craniata Class Osteichthys													
Clinocottus sp. OR *Oligocottus* sp.	7	6	4	0	0	0	17	20	19	6	7	6	0
FLORA													
PHYLUM Spermatophyta													
Phyllospadix scouleri (surf grass)	10	10	5	0	0	0	10	10	10	<5	<5	<5	10
PHYLUM Chlorophyta (green algae)													
Cladophora sp.	0	0	0	10	10	<5	<5	<5	<5	0	0	0	10
Codium fragile	0	0	0	0	0	0	<5	<5	<5	<5	<5	<5	0
Ulva sp.	0	0	0	20	20	<5	<5	<5	<5	<5	<5	<5	<5

Table 4 cont'd

Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches (1)
ZONE 3													
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
PHYLUM Phaeophyta (brown algae)													
Alaria marginata	5	10	5	0	0	0	5	15	0	10	10	<5	<5
A. nana	0	0	0	0	0	0	0	0	0	20	50	10	0
Egregria menziesii	<5	<5	<5	10	10	<5	0	0	0	25	25	10	0
Hedophyllum sessile	20	50	20	25	40	<5	40	40	30	50	75	45	35
Leathesia difformis	10	10	<5	5	5	<5	<5	<5	<5	<5	<5	<5	10
PHYLUM Rhodophyta (red algae)													
Bossiella sp.	0	0	0	0	0	0	<5	<5	<5	<5	<5	<5	<5
Calliarthron sp.	0	0	0	0	0	0	<5	<5	<5	<5	<5	<5	<5
Callithamnion pikeanum	0	0	0	0	0	0	0	0	0	5	5	5	0
Corallina sp.	<5	<5	<5	0	0	0	<5	<5	<5	<5	<5	<5	<5
Endocladia muricata	5	5	5	0	0	0	<5	<5	<5	10	10	10	10
Gigartina exasperata	0	0	0	0	0	0	10	15	5	0	0	0	5
Gigartina sp.	<5	<5	<5	0	0	0	0	0	0	10	10	10	0
Halosaccion glandiforme	5	5	5	10	30	30	<5	<5	<5	10	15	5	20
Iridaea sp.	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Larensia spectabilis	0	0	0	<5	<5	<5	0	0	0	0	0	0	0
Microcladia borealis	0	0	0	0	0	0	0	0	0	20	20	20	<5
Odonthalia floccosa	5	5	5	20	20	<5	<5	<5	<5	30	30	30	10
Lithothamnion sp.	0	0	0	0	0	0	0	0	0	<5	<5	<5	0

Table 4 cont'd

Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches (1)
ZONE 3													
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
Petrocelis sp.	5	5	5	<5	<5	<5	0	0	0	<5	<5	<5	<5
Porphyra sp.	<5	<5	0	<5	<5	0	5	5	0	5	5	0	<5
Prionitis sp.	<5	<5	<5	0	0	0	10	10	10	10	15	15	10
Rhodomela larix	0	0	0	20	20	10	<5	5	5	5	5	5	<5

Table 4 cont'd Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches (1)
ZONE 4 width	2m			2m			1m			2m			2m
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
FAUNA													
PHYLUM Porifera													
Haliclona permollis	<5	<5	<5	5	10	10	5	5	5	5	5	5	5
Ophlitaspongia pennata	<5	<5	<5	5	10	10	5	5	5	5	5	5	10
unidentified species	<5	<5	<5	<5	<5	<5	5	5	5	10	20	20	5
PHYLUM Cnidaria Class Anthozoa Order Actiniaria													
Anthopleura elegantissima	75	100	200	30	30	42	30	35	42	0	0	0	10
A. xanthogrammica	0	5	0	2	2	2	0	4	0	0	19	0	5
Epiactus prolifera	0	0	0	0	0	0	0	0	0	2	2	2	0
Tealia coriacea	0	0	0	0	0	0	<1	<1	<1	<1	<1	<1	0
T. crassicornis	0	0	0	<1	<1	<1	<1	<1	<1	0	0	0	0
PHYLUM Annelida Class Polychaeta													
Serpula vermicularis	0	0	0	10	10	10	5	5	5	10	10	10	0

Table 4 cont'd

Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches (1)
ZONE 4													
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
<u>PHYLUM</u> Mollusca Class Amphineura													
<u>Tonicella</u> <u>lineata</u>	0	0	0	<1	<1	<1	0	0	0	<1	<1	<1	<1
Class Gastropoda Subclass Opisthobranchia													
<u>Triopha</u> <u>carpenteri</u>	0	0	0	0	0	0	0	0	0	0	<1	0	0
Subclass Prosobranchia													
<u>Acmaea</u> <u>mitra</u> (whitecap limpet)	0	0	0	0	0	0	0	0	0	<1	<1	<1	0
<u>Ceratostoma</u> <u>foliata</u> <u>(leafy hornmouth)</u>	0	0	0	0	<1	0	<1	<1	<1	<1	<1	<1	0
<u>Megatabennus</u> <u>bimaculatus</u>	0	0	0	0	0	0	0	0	0	<1	<1	<1	0
<u>PHYLUM</u> Arthopoda Class Crustacea Subclass Cirripedia													
<u>Balanus</u> <u>nubilus</u>	4	4	4	1	1	1	<1	<1	<1	8	8	8	2
<u>Pollicipes</u> <u>polymerus</u>	125	125	125	0	0	0	48	52	49	0	0	0	+
PHYLUM Bryozoa													
<u>Flustrellidra</u> <u>corniculata</u>	0	0	0	<5	<5	<5	0	0	0	10	10	10	5
unidentified species	10	10	10	15	15	15	0	0	0	10	10	10	10

Table 4 cont'd

Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches (1)
ZONE 4													
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
PHYLUM Echinodermata Class Asteroidea													
Dermasterias imbricata	<1	<1	0	0	0	0	0	<1	0	<1	<1	<1	0
Pisaster ochraceus	0	0	0	0	0	0	3	3	4	4	5	5	0
Pycnopodia helianthoides	0	0	0	0	0	0	<1	<1	0	0	0	0	0
Solaster dawsoni	0	0	0	0	0	0	0	<1	0	0	0	0	0
PHYLUM Chordata Subphylum Urochordata Class Ascidiacea													
Styela montereyensis	0	0	0	<1	<1	<1	0	0	0	<1	<1	<1	<1
FLORA													
PHYLUM Spermatophyta													
Phyllospadix scouleri (surf grass)	10	10	5	40	60	40	20	25	10	10	10	10	10
PHYLUM Phaeophyta (brown algae)													
Alaria marginata	20	30	5	20	20	10	5	15	0	0	0	0	10
Desmarestia sp.	<5	<5	<5	0	0	0	0	0	0	0	0	0	<5
Egregria menziesii	<5	<5	<5	20	20	5	<5	<5	<5	10	10	10	10

Table 4 cont'd

Location	Green Point (13)			Box Island (12b)			Quisitis Point (14a)			Half Moon Bay (4)			Radar Beaches (1)
ZONE 4													
Date	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	Apr.	June	Oct.	June
PHYLUM Phaeophyta cont'd													
Laminaria setchellii	10	10	5	0	0	0	20	25	25	10	10	10	20
Lessoniopsis littoralis	0	0	0	0	0	0	20	25	0	50	50	25	5
Nereocystis luetkeana	<5	<5	<5	0	0	0	<5	<5	<5	5	5	5	5
Postelsia palmaeformis	<5	<5	0	0	0	0	0	0	0	0	0	0	0
PHYLUM Rhodophyta (red algae)													
Bossiella sp.	<5	<5	<5	0	0	0	<5	<5	<5	<5	<5	<5	<5
Calliarthron sp.	<5	<5	<5	0	0	0	<5	<5	<5	<5	<5	<5	<5
Constantinia simplex	0	0	0	0	0	0	0	0	0	<5	<5	<5	0
Corallina sp.	<5	<5	<5	0	0	0	<5	<5	<5	<5	<5	<5	<5
Gigartina exasperata	10	10	10	0	0	0	10	15	5	40	50	25	10
Gigartina sp.	<5	<5	<5	0	0	0	<5	<5	<5	<5	<5	<5	<5
Iridaea sp.	0	0	0	10	10	5	<5	<5	<5	25	25	25	10
Lithothamnion sp.	<5	<5	<5	0	0	0	<5	<5	<5	<5	<5	<5	0
Porphyra sp.	<5	<5	<5	0	0	0	<5	<5	<5	0	0	0	10

Table 5. Numbers of intertidal invertebrates recorded at 10 m intervals in a 3 m wide transect in the mudflats, Grice Bay, Long Beach Section (1976). (Numbers recorded as no./m^2.)

Sample (m)	*Mya arenaria*	*Macoma nasuta*	*Tellina carpenteri*	*Callianassa californiensis*	*Nepthys californiensis*	*Hemigrapsus oregonensis*
10	141.7	0	50.0	33.3	0	2.8
20	5.5	0	13.8	16.7	2.8	0
30	25.0	2.8	8.3	19.4	2.8	0

Table 6. Seasonal observations of fauna and flora on sheltered rocky shores, Long Beach Section (1976).

Location	Grice Bay (11)		
No ZONE 1			
ZONE 2 Width - 3 m			
Date	April	June	October
FAUNA			
PHYLUM Mollusca Class Gastropoda Subclass Prosobranchia			
Collisella digitalis (Fingered limpet)	20	34	26
Littorina scutulata (Checkered periwinkle)	324	312	336
L. sitkana (Sitka periwinkle)	524	568	604
Notoacmea personna	10	15	13
N. scutum	6	4	7
Thais lamellosa (Wrinkled purple)	1	4	2
Class Bivalvia			
Mytilus edulis (Bay mussel)	140	156	148
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia			
Balanus glandula (Acorn barnacle)	4900	4800	5000
Chthamalus dalli	2000	2300	2100
FLORA			
PHYLUM Phaeophyta			
Fucus distichus	50	80	50

Table 6 cont'd

ZONE 3 Width - 2 m	April	June	October
FAUNA			
PHYLUM Mollusca Class Bivalvia			
Mytilus edulis	300	316	332
PHYLUM Arthropoda Class Crustacea Subclass Malacostraca			
Hemigrapsus oregonensis (Green shore crab)	28	26	28
Pagurus sp. (Hermit crab)	20	23	21
FLORA			
PHYLUM Phaeophyta (brown algae)			
Leathesia difformis	<1	<1	<1
PHYLUM Rhodophyta (red algae)			
Halosaccion glandiforme	40	60	55
Gelidium sp.	20	30	15

Table 6 cont'd

ZONE 4 Width - 3 m			
Date	April	June	October
FAUNA			
PHYLUM Echinodermata			
Pisaster ochraceus (Purple starfish)	<1	<1	<1
FLORA			
PHYLUM Spermatophyta			
Zostera marina (Eel grass)	70	75	75
PHYLUM Chlorophyta (green algae)			
Ulva sp.	40	50	50
PHYLUM Phaeophyta (brown algae)			
Agarum fimbriatum	* we	we	we
Costaria costata	<5	<5	<5
PHYLUM Rhodophyta (red algae)			
Grateloupia doryphora	<5	<5	<5
Iridaea sp.	<5	<5	<5
Smithora naiadum	<5	<5	<5

* **we = water's edge**

Table 7. Intertidal distribution of adult razor clams, Long Beach Section (1976). The number of clams or clams and shows counted in 125 m^2 sampling areas.

Area	Sample	Numbers of adult razor clams					
		Apr. 14-16	May 12-14	June 10-11	Aug. 8	Sept. 25	Yearly Mean
2	3	11	10	13	12	13	11.8
	4	17	15	18	17	15	16.4
	5	13	15	14	18	16	15.2
Mean (mm)		13.7	13.3	15.0	15.7	14.67	14.47
Standard Deviation		3.1	2.9	2.6	3.2	1.5	2.4

Table 8. Number of tagged and untagged clams dug in plots at Long Beach (1976).

Plot	Area (m^2)	May 12 - 14		June 7 - 8		Sept. 24 - 25		Total	
		tagged	untagged	tagged	untagged	tagged	untagged	tagged	untagged
A	75	0	1	0	1	1	0	1	2
B	625	0	9	1	0	0	3	1	12
C	625	0	0	0	2	0	0	0	2

Table 9. Razor clam populations in plots at Long Beach (1976). (Population estimated by tagging census method.)

Plot	Estimated clam Population	Area (m^2)	Estimated clam density (clams/m^2)
A	50	75	0.67
B	300	625	0.48
C	100	625	0.16
Total	450	1325	0.34

Table 10. Mean shell length at winter checks of razor clams collected at Long Beach (1975 and 1976).

1975 Winter checks	1	2	3	4	5	6
Mean length (mm)	33.6	90.7	115.5	125.2	130.3	133.9
Standard deviation (mm)	10.5	10.3	6.5	6.3	5.8	5.4
Range (mm)	13.3-61.8	53.9-113.2	90.9-131.2	105.3-143.0	115.8-143.0	122.2-141.2
Number of clams measured	186.0	183.0	181.0	154.0	96.0	38.0

1976 Winter checks	1	2	3	4	5	6
Mean length (mm)	24.4	86.7	114.7	124.5	131.0	135.6
Standard deviation (mm)	9.0	11.6	7.4	6.2	6.0	5.4
Range (mm)	6.2-56.4	54.8-123.6	96.3-136.4	106.4-145.5	111.9-149.4	121.0-147.5
Number of clams measured	221.0	212.0	187.0	174.0	129.0	51.0

Table 11. Age frequency distribution of razor clams, Long Beach Section.

1975 Month	Apr	May	Jun	Jul	Aug	Sept	Oct	Dec	Total No.	Percent of Total No.
Age (yrs.)										
0	0	1	0	0	0	1	2	0	4	2.1
1	0	1	0	0	0	0	0	1	2	1.1
2	3	8	3	5	3	3	0	2	27	14.4
3	6	10	6	9	7	10	6	4	58	31.0
4	15	3	8	6	7	4	6	9	58	31.0
5	1	1	9	4	5	4	6	8	38	20.3
Total No.	25	24	26	24	22	22	20	24	187	99.9

1976 Month	May	Jun	Jul	Aug	Sept	Oct	Nov	Total No.	Percent of Total No.
Age (yrs.)									
0	0	0	0	4	0	1	4	9	4.1
1	0	1	13	1	10	0	0	25	11.4
2	3	1	2	2	0	1	3	12	5.5
3	11	6	12	1	4	3	8	45	20.5
4	18	15	1	13	8	16	7	78	35.5
5	10	5	6	11	3	10	6	51	23.2
Total No.	42	28	34	32	25	31	28	220	100.2

Table 12. Stage of gonadal development of razor clams collected at Long Beach (1976).

Date	Inactive Phase	Active Phase	Ripe Phase	Partially Spent Phase	Spent Phase	Total No. of clams
April 14 - 16		14♂ 12♀				26
May 14		14♂ 10♀				24
June 11		7♀	9♂ 10♀			26
July 8		5♀	9♂ 9♀	2♂ 1♀		26
Aug. 8			2♂ 2♀	6♂ 5♀	7♂ 7♀	29
Sept. 25				6♂ 2♀	7♂ 9♀	24
Oct. 23				7♂ 1♀	9♂ 6♀	23
Nov. 22				1♂ 1♀	12♂ 9♀	23

Table 13. Mean shell length at winter checks of littleneck clams collected at A) northwest end and B) southeast end of Florencia Bay (1976).

A)

Winter checks	1	2	3	4	5	6	7	8
Mean length (mm)	8.1	17.7	27.2	34.0	38.0	41.7	45.8	48.5
Standard deviation (mm)	2.8	4.5	5.0	5.2	6.7	6.8	6.1	9.5
Range (mm)	3.7-16.4	9.2-32.0	15.6-42.3	23.6-48.8	27.5-53.7	30.3-56.4	33.4-58.9	38.3-61.5
Number of clams measured	245	221	165	150	129	100	58	33

B)

Winter checks	1	2	3	4	5	6	7	8
Mean length (mm)	7.9	15.9	23.9	30.5	35.3	40.9	46.0	50.6
Standard deviation (mm)	2.5	4.2	5.0	6.5	6.7	7.5	7.4	6.4
Range (mm)	3.0-16.0	13.5-27.4	15.0-37.1	19.1-48.4	21.6-51.5	25.3-55.3	28.0-59.6	38.1-62.3
Number of clams measured	333	311	244	168	112	63	42	32

Talbe 14. Age frequency distribution of littleneck clams collected at A) northwest end and B) southeast end of Florencia Bay (1976).

A)

Age	1	2	3	4	5	6	7	8	8+	Total No.
Quadrat										
1	0	9	4	4	8	7	5	0	6	43
2	0	4	3	5	3	6	5	4	3	33
3	12	10	0	0	1	0	1	0	0	24
4	3	1	0	1	2	2	2	0	0	11
5	2	18	2	5	6	9	4	2	1	49
6	2	9	3	0	0	0	0	0	0	14
7	2	2	2	4	2	11	2	3	3	31
8	1	0	0	1	3	3	3	4	0	15
9	2	3	0	1	4	3	2	4	3	22
10	0	0	0	1	0	1	1	0	0	3
Total	24	56	14	22	29	42	25	17	16	245

B)

Age	1	2	3	4	5	6	7	8	8+	Total No.
Quadrat										
1	1	0	0	1	0	0	0	0	0	2
2	0	0	0	0	0	0	0	0	0	0
3	0	2	1	1	2	7	4	5	4	26
4	0	1	1	4	5	1	0	2	2	16
5	0	0	0	0	2	0	1	1	0	4
6	0	0	0	2	3	0	0	1	4	10
7	0	0	0	1	2	1	1	0	1	6
8	5	6	16	21	5	2	0	2	1	58
9	15	53	58	25	30	9	4	3	6	203
10	1	5	0	1	0	1	0	0	0	8
Total	22	67	76	56	49	21	10	14	18	333

Table 15. Total number of organisms removed and number of organisms re-colonizing cleared one m^2 plot of mussel bed, Cox Point (1975 and 1976).

Table 15

Species	1975				1976		
	July	Sept.	Oct.	Dec.	June	Sept.	Nov.
PHYLUM Cnidaria Class Anthozoa Order Actiniaria							
Anthopleura elegantissima	91	3	3	3	2	9	6
A. xanthogrammica	0	0	0	0	8	7	0
PHYLUM Annelida Class Polychaeta							
Polychaetes	341	0	0	0	0	0	0
Nereis vexillosa	5	0	0	0	0	0	0
PHYLUM Nemertea							
Nemerteans	286	0	0	0	+	+	+
PHYLUM Platyhelminthes Class Turbellaria							
Flatworms	264	0	0	0	0	0	0
PHYLUM Sipuncula Family Phascolosomatidae							
Phascolosoma agassizii	3	0	0	0	0	0	0
PHYLUM Echinodermata Class Holothuroidea							
Cucumaria pseudocurata	4,833	0	0	0	0	0	0
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia							
Balanus cariosus	1,021	0	0	0			
B. glandula	14,345	0	0	0	+	+	+
Chthamalus dalli	2,676	0	0	0			
Pollicipes polymerus	35	0	0	2	5	1	0

Table 15 cont'd

Species	1975 July	1975 Sept.	1975 Oct.	1975 Dec.	1976 June	1976 Sept.	1976 Nov.
Subclass Malacostraca Division Eucarida Order Decapoda Suborder Reptantia Section Brachyura							
Hemigrapsus nudus	30	0	0	0	2	0	0
H. oregonensis	62	0	0	0	0	0	0
Section Anomura							
Pagurus sp.	2	0	0	0	0	0	0
Petrolisthes eriomerus	849	0	0	0	0	0	0
Division Peracarida Order Amphipoda							
Amphipods	33	0	0	0	0	1	0
Order Isopoda							
Isopods	12	0	0	0	0	1	0
PHYLUM Mollusca Class Amphineura							
Cyanoplax dentiens & *Tonicella* sp.	168	0	0	0	0	0	0
Mopalia sp.	0	0	0	0	2	0	0
Class Gastropoda Subclass Prosobranchia							
Collisella digitalis	450	223	252	447	366	307	167
C. pelta	94	0	0	0	95	52	53
C. strigatella	11	0	0	0	0	0	0
Lacuna marmorata	2	0	0	0	0	0	0
Littorina scutulata	5	210	53	21	343	34	15
L. sitkana	42	0	0	0	259	564	364
Notoacmea persona	578	0	27	230	0	46	0

Table 15 cont'd

Species	1975 July	1975 Sept.	1975 Oct.	1975 Dec.	1976 June	1976 Sept.	1976 Nov.
N. scutum	7	0	0	0	212	705	308
Tegula brunnea	1	0	0	0	0	0	0
T. funebralis	0	0	0	0	0	1	0
Thais canaliculata &							
T. emarginata	327	279	0	4	235	22	6
T. lamellosa	1	0	0	0	0	0	0
Class Gastropoda Subclass Opistobranchia							
Onchidella borealis	43	0	0	0	0	0	0
Class Bivalvia							
Hiatella arctica	1	0	0	0	0	0	0
Mytilus californianus &							
M. edulis ≥1.0 cm	4,578	0	28	21	1	26	35
<1.0 cm	94,380	0	0	0	644	261	391
Petricola sp.	2	0	0	0	0	0	0
Protothaca staminea							
≥1.0 cm	63	0	0	0	0	0	0
<1.0 cm	62,082	0	0	0	0	0	0
PHYLUM (Division) Chlorophyta							
Cladophora sp.	0	0	0	0	0	1	0
Spongomorpha sp.	0	0	0	0	1	0	0
Ulva sp.	0	0	0	0	8	7	4
unidentified filamentous alga	0	0	0	0	0	1	0
PHYLUM (Division) Phaeophyta							
Fucus sp.	0	0	0	0	1	0	0
Leathesia difformis	0	0	0	0	0	1	0
Ralfsia sp.	0	0	0	0	0	3	0

Table 15 cont'd

Species	1975 July	1975 Sept.	1975 Oct.	1975 Dec.	1976 June	1976 Sept.	1976 Nov.
PHYLUM (Division) Rhodophyta							
Endocladia muricata	0	0	0	0	10	7	16
Gigartina sp.	0	0	0	0	11	11	3
Halosaccion glandiforme	0	0	0	0	18	10	2
Hildenbrandia sp.	0	0	0	0	0	0	1
Microcladia borealis	0	0	0	0	0	1	1
Petrocelis sp.	0	0	0	0	11	12	4
Porphyra sp.	0	0	0	0	1	0	0
Prionitis sp.	0	0	0	0	0	2	0
Pterosiphonia bipinnata	0	0	0	0	0	9	1
unidentified red algae	0	0	0	0	12	0	0

Table 16. Total and monthly length frequency distributions of sea mussels removed from plots at Quisitis Point, Long Beach Section (1976). (Measurements in 10 mm size classes)

Location	A - 20				B - 20			
Date	Sept.	Oct.	Nov.	Total	Sept.	Oct.	Nov.	Total
Size class								
40.0 - 49.9	0	2	0	2	0	1	1	2
50.0 - 59.9	3	11	8	22	2	8	10	20
60.0 - 69.9	10	7	9	26	6	8	7	21
70.0 - 79.9	6	0	3	9	7	2	2	11
80.0 - 89.9	1	0	0	1	4	1	0	5
90.0 - 99.9	0	0	0	0	1	0	0	1
100.0 - 109.9	0	0	0	0	0	0	0	0
Total	20	20	20	60	20	20	20	60

Location	A - 40				B - 40			
Date	Sept.	Oct.	Nov.	Total	Sept.	Oct.	Nov.	Total
Size class								
30.0 - 39.9	0	3	0	3	0	1	0	1
40.0 - 49.9	4	17	8	29	0	2	0	2
50.0 - 59.9	23	14	19	56	5	11	6	22
60.0 - 69.9	10	6	11	27	16	14	23	53
70.0 - 79.9	3	0	2	5	12	6	10	28
80.0 - 89.9	0	0	0	0	6	5	1	12
90.0 - 99.9	0	0	0	0	1	1	0	2
100.0 - 109.9	0	0	0	0	0	0	0	0
Total	40	40	40	120	40	40	40	120

Table 16 cont'd

Location	A - 60				B - 60			
Date	Sept.	Oct.	Nov.	Total	Sept.	Oct.	Nov.	Total
Size class								
40.0 - 49.9	1	4	0	5	0	2	0	2
50.0 - 59.9	25	23	10	58	3	12	6	21
60.0 - 69.9	22	23	27	72	9	18	20	47
70.0 - 79.9	12	8	16	36	27	14	17	58
80.0 - 89.9	0	2	5	7	17	11	11	39
90.0 - 99.9	0	0	2	2	4	2	5	11
100.0 - 109.9	0	0	0	0	0	1	1	2
Total	60	60	60	180	60	60	60	180

Location	A - 80				B - 80			
Date	Sept.	Oct.	Nov.	Total	Sept.	Oct.	Nov.	Total
Size class								
30.0 - 39.9	0	2	0	2	0	17	2	19
40.0 - 49.9	0	10	7	17	19	49	49	117
50.0 - 59.9	8	33	45	86	45	13	27	85
60.0 - 69.9	41	30	19	90	15	1	2	18
70.0 - 79.9	30	5	7	42	1	0	0	1
80.0 - 89.9	1	0	2	3	0	0	0	0
90.0 - 99.9	0	0	0	0	0	0	0	0
100.0 - 109.9	0	0	0	0	0	0	0	0
Total	80	80	80	240	80	80	80	240

Table 16 cont'd

Location	A - 100				B - 100			
Date	Sept.	Oct.	Nov.	Total	Sept.	Oct.	Nov.	Total
Size class								
30.0 - 39.9	0	1	0	1	0	1	2	3
40.0 - 49.9	0	3	2	5	2	27	43	72
50.0 - 59.9	0	36	27	63	35	50	43	128
60.0 - 69.9	9	33	35	77	50	20	9	79
70.0 - 79.9	35	20	21	76	11	1	3	15
80.0 - 89.9	27	6	10	43	2	1	0	3
90.0 - 99.9	16	1	2	19	0	0	0	0
100.0 - 109.9	11	0	3	14	0	0	0	0
110.0 - 119.9	1	0	0	1	0	0	0	0
120.0 - 129.9	1	0	0	1	0	0	0	0

Table 17. Number of *Olivella biplicata* observed in 10 quadrats, each 3 x 3 m, Long Beach Section (1976).

Location	4				5			
Date	May	June	Aug.	Sept.	May	June	Aug.	Sept.
Sample No.								
1	0	43	62	0	42	76	80	1
2	0	34	74	0	36	79	72	0
3	0	32	83	0	44	80	68	2
4	0	45	72	0	52	78	74	3
5	0	43	86	0	41	84	81	4
6	0	23	76	0	42	73	79	1
7	0	45	69	0	53	74	87	2
8	0	22	83	0	35	86	64	1
9	0	36	91	0	42	68	76	3
10	0	41	86	0	52	73	88	1
Total	0	364	782	0	439	771	769	18
Mean	0	36.4	78.2	0	43.9	77.1	76.9	1.8
No./m^2	0	4.04	8.69	0	4.88	8.57	8.54	0.20

Table 18. Number of <u>Olivella biplicata</u> collected at 5 m intervals along a transect between Round and Little Islands (1976). (No./m^2)

Date		May	June	Aug.	Sept.
Sample (m)					
Water's edge	0 a	0	4	0	0
	b	4	4	8	0
	5 a	16	0	0	0
	b	0	8	0	0
	10 a	0	4	0	0
	b	16	4	0	0
	15 a	4	0	8	0
	b	8	0	12	0
	20 a	4	4	0	-
	b	0	0	0	-
	25 a	0	4	0	-
	b	0	8	8	-
	30 a	0	4	0	-
	b	0	0	8	-
	35 a	0	0	4	-
	b	0	0	4	
	40 a	-	0	0	-
	b	-	0	0	-
	45 a	-	0	8	-
	b	-	0	4	-
	50 a	-	-	0	-
	b	-	-	0 *	-

(*plus two consecutive sets of samples with no <u>Olivella</u>)

Table 19. Number of starfish recorded from three sample sites, Long Beach Section.

Sample site	Box Island						Schooner Cove		Green Point	
Year	1975			1976			1976		1976	
Species	*Pisaster*		*Pycnopodia*	*Pisaster*		*Pycnopodia*	*Pisaster*		*Pisaster*	
Date	Total No.	No./m^2	Total No.	Total No.	No./m^2	Total No.	Total No.	No./m^2	Total No.	No./m^2
April	-	-	-	150	8.6	0	92	5.3	40	3.0
May	-	-	-	124	7.1	0	100	5.7	29	2.2
June	-	-	-	98	5.6	2	101	5.8	21	1.6
July	87	5.0	6	101	5.8	4	70	4.0	15	1.1
Aug.	50	2.9	5	65	3.7	4	93	5.4	19	1.4
Sept.	34	1.9	4	49	2.8	0	85	4.9	16	1.2
	-	-	-	33	1.9	8	-	-	-	-
Oct.	-	-	-	19	1.1	13	79	4.5	13	1.0
Nov.	-	-	-	63	3.6	10	62	3.6	29	2.2
Dec.	108	6.2	0	-	-	-	-	-	-	-

Table 20. Location and habitat description of intertidal fauna and flora survey sites, Broken Group Islands Section, (1976).

Sample No.	Location	Slope	Habitat	
			Substrate	Exposure
1	Pocket beach on west side of the southeastern peninsula of Jacques Island	3.7°	boulder to mud	sheltered
2	Pocket beach on southeast side of Jacques Island	3.7°	boulder to mud	sheltered
3	Pocket beach on southeast side of Jacques Island	3.7°	sand, mud	sheltered
4	West side of Keith Island	9.6°	bedrock, cobble	sheltered
5	West side of Keith Island	9.6°	bedrock, cobble	sheltered
6	West side of Keith Island	9.6°	cobble, gravel, sand	sheltered
7	South side of Keith Island	1.0°	gravel, sand	sheltered
8	West side of Mullins Island	6.2°	boulder, cobble	sheltered
9	West side of Mullins Island	6.2°	bedrock	semi-exposed
10	Bay on south side of Gibraltar Island	3.3°	shell	sheltered
11	Bay on south side of Gibraltar Island	3.3°	sand, shell	sheltered
12	Bay on south side of Gibraltar Island	9.6°	bedrock, cobble	sheltered
13	North side of Gibraltar Island	9.6°	bedrock	sheltered
14	Adjacent to rocky out - crop on north side of Gibraltar Island (Sample 9/1975)	3.4°	coarse sand	sheltered

Table 20 cont'd

Sample No.	Location	Slope	Habitat	
			Substrate	Exposure
15	Pocket beach on south-west side of southern peninsula of Nettle Island	9.4°	cobble, gravel	sheltered
16	Pocket beach on south-west side of southern peninsula of Nettle Island	3.2°	gravel	sheltered
17	Beach behind small islet on west side of southern peninsula of Nettle Island	2.9°	gravel, sand, shell	sheltered
18	South side of Nettle Island	6.1°	bedrock to gravel	sheltered
19	Beach on southeast side of small islet on south side of Nettle Island	4.2°	boulder to gravel	sheltered
20	Beach on southwest side of small islet on south side of Nettle Island	4.1°	cobble, gravel	sheltered
21	East side of Nettle Island	5.7°	gravel, sand	sheltered
22	East side of Nettle Island	5.2°	boulder to mud	sheltered
23	Beach behind small islet on east side of Nettle Island	4.2°	cobble	sheltered
24	Beach behind small islet on east side of Nettle Island	9.2°	bedrock	sheltered
25	Beach behind small islet on northeast side of Nettle Island	9.6°	bedrock to cobble	sheltered
26	Beach behind small islet on northeast side of Nettle Island	2.9°	sand	sheltered
27	Northwest side of rocky outcrop on northeast side of Nettle Island	17.1°	gravel, sand	semi-exposed

Table 20 cont'd

Sample No.	Location	Slope	Habitat	
			Substrate	Exposure
28	Northwest side of rocky outcrop on northeast side of Nettle Island (Sample 24/1975)	17.1°	gravel, sand	semi-exposed
29	Northwest side of rocky outcrop on northeast side of Nettle Island (Sample 23/1975)	17.1°	gravel, sand	semi-exposed
30	Northwest side of rocky outcrop on northeast side of Nettle Island (Sample 22/1975)	17.1°	gravel, sand	semi-exposed
31	Pocket beach on west end of Nettle Island (Sample 21/1975)	6.6°	gravel, sand	sheltered
31a	Pocket beach on west end of Nettle Island	9.6°	bedrock	sheltered
32a	East side of Walsh Island	3.6°	gravel	sheltered
32	East side of Walsh Island	3.2°	gravel, sand, shell	sheltered
33	Beach on east side of small islet on south-east side of Walsh Island (Sample 2/1975)	5.1°	gravel, sand, shell	sheltered
34	Beach on west side of small islet on southeast side of Walsh Island	5.1°	gravel, sand, shell, mud	sheltered
35	Gravel bar at north end of Willis Island (Sample 6/1975)	4.5°	gravel, sand, shell	sheltered
35a	Gravel bar at north end of Willis Island	4.5°	cobble, gravel, sand	sheltered
36	Gravel bar at north end of Willis Island	4.0°	gravel, sand	sheltered
37	Gravel bar at north end of Willis Island	4.0°	sand, shell	sheltered

Table 20 cont'd

Sample No.	Location	Slope	Habitat	
			Substrate	Exposure
38	Gravel bar at north end of Willis Island	4.0°	gravel, shell	sheltered
39	Beach adjacent to gravel bar at north end of Willis Island	14.2°	bedrock	sheltered
40	Inlet on southwest side of Dodd Island (Sample 5/1975)	3.1°	shell	sheltered
41	East side of Hand Island (Sample 25/1975)	2.8°	cobble, gravel	sheltered
42	East side of small island adjacent to northeast end of Hand Island (Sample 26/1975)	2.1°	gravel, sand, shell	sheltered
43	Beach between two islands at northeast end of Hand Island	2.7°	boulder, cobble, gravel, shell	sheltered
44	North side of bar at northwest end of Clarke Island	1.0°	cobble, gravel, sand, shell	sheltered
45	Beach on west side of Clarke Island	2.7°	shell	sheltered
46	Beach on northeast side of Clarke Island	15.5°	bedrock	sheltered
47	Beach on east side of Turret Island	15.3°	bedrock, cobble	semi-exposed
48	Beach on east side of Turret Island	15.3°	boulder, cobble	semi-exposed
49	Reef on east side of Turret Island	20.9°	bedrock	semi-exposed
50	Pocket beach on east side of Dempster Island	90.0°	bedrock	exposed
51	Southwest side of Gibraltar Island	90.0°	bedrock	sheltered

Table 20 cont'd

Sample No.	Location	Slope	Habitat	
			Substrate	Exposure
52	Reef at northeast end of Gibraltar Island	90.0°	bedrock	semi-exposed
53	Small beach on south side of Effingham Bay (Sample 44/1975)	4.3°	gravel, sand, shell	sheltered
54	East end of Gilbert Island (Sample 47/1975)	3.3°	boulder, cobble, sand, shell	sheltered
55	Beach on northwest side of Gilbert Island	11.4°	boulder, cobble, gravel, shell	semi-exposed
56	Northeast end of Cooper Island (Sample 49/1975)	5.2°	boulder to shell	semi-exposed
57	Northeast end of Cooper Island	14.5°	bedrock	semi-exposed
58	South side of small beach on west side of Howell Island	15.5°	boulder	exposed
59a	East side of bar between north side of Camblain Island and small island (Sample 52/1975)	4.9°	gravel, sand, shell	sheltered
59b	West side of bar between north side of Camblain Island and small island	4.9°	gravel, sand, shell	sheltered
60	Northeast side of east tip of Howell Island	90.0°	bedrock	exposed
61	Beach on northeast tip of Wouwer Island	19.5°	bedrock, boulder	semi-exposed
62	Beach on west side of Camblain Island	8.5°	bedrock, boulder	semi-exposed
63	Beach on west end of Dicebox Island	17.1°	bedrock	semi-exposed
64	Beach on south side of Wouwer Island	12.0°	bedrock	exposed

Table 21. Fauna and flora observed at exposed and semi-exposed rock and boulder beaches, Broken Group Island (1976).

(Multiply No./m^2 of *B. glandula* by 100; *C. dalli* and *M. californianus* by 10; we indicates samples taken at water's edge.)

Table 21

Site	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
ZONE 1	5m	4m	4m	4m	2m	2m	0	2m	1m	0	0	3m	0	0	1m
FAUNA															
<u>PHYLUM</u> Mollusca <u>Class</u> Gastropoda Subclass Prosobranchia															
<u>Collisella digitalis</u> (fingered limpet)	48	40	0	44	36	54	–	14	24	–	–	60	–	–	20
<u>Littorina scutulata</u> (checkered periwinkle)	0	0	0	36	52	84	–	0	80	–	–	40	–	–	40
<u>L. sitkana</u> (sitka periwinkle)	144	160	0	80	125	224	–	0	120	–	–	44	–	–	60
<u>Notoacmea persona</u> (mask limpet)	0	8	0	0	3	1	–	3	1	–	–	0	–	–	12
<u>N. scutum</u> (plate limpet)	0	0	0	0	0	0	–	0	1	–	–	1	–	–	24
<u>Tegula funebralis</u>	0	<1	0	0	0	0	–	0	0	–	–	0	–	–	0
<u>Thais emarginata</u>	0	24	0	0	0	0	–	0	0	–	–	0	–	–	20
<u>PHYLUM</u> Arthropoda Class Crustacea Subclass Cirripedia															
<u>Balanus glandula</u>	3	4	2	2	5	4	–	11	15	–	–	12	–	–	3
<u>Chthamalus dalli</u>	10	10	0	0	0	5	–	50	100	–	–	52	–	–	10
<u>Pollicipes polymerus</u>	0	5	0	0	0	0	–	0	0	–	–	10	–	–	0

Table 21 cont'd

Site	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
ZONE 1															
FLORA															
Lichens															
Verrucaria sp.	30	20	40	40	50	80	–	50	40	–	–	50	–	–	40
PHYLUM Chlorophyta (green algae)															
Enteromorpha intestinalis	0	0	0	0	10	0	–	0	0	–	–	0	–	–	0
Prasiola meridionalis	0	0	0	0	0	<5	–	0	0	–	–	0	–	–	0
PHYLUM Phaeophyta (brown algae)															
Fucus distichus	0	0	0	0	0	0	–	0	0	–	–	0	–	–	<5
Pelvetiopsis limitata	0	0	<5	0	0	0	–	0	0	–	–	0	–	–	0

Table 21 cont'd

Site	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
ZONE 2	2m	7m	1m	3m	2m	5m	2m	1m	7m	3m	5m	5m	1m	2m	4m
FAUNA															
PHYLUM Porifera															
Haliclona permollis	0	<5	0	0	0	0	0	0	0	0	10	10	0	0	<5
PHYLUM Cnidaria Class Anthozoa Order Actiniaria															
Anthopleura elegantissima	0	34	0	0	32	0	0	0	80	0	120	160	0	0	0
A. xanthogrammica (green anemone)	0	24	0	0	1	1	0	0	20	0	24	2	0	0	0
PHYLUM Mollusca Class Amphineura															
Katharina tunicata	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Class Gastropoda Subclass Prosobranchia															
Collisella digitalis (fingered limpet)	10	0	40	60	80	16	56	20	0	20	28	140	120	84	4
Littorina scutulata (checkered periwinkle)	0	0	0	44	48	40	80	0	40	100	28	60	24	48	0
L. sitkana (sitka periwinkle)	0	0	0	120	164	240	256	0	160	120	120	80	84	100	0
Notoacmea persona (mask limpet)	0	0	0	0	3	12	3	1	12	0	12	0	0	3	0

Table 21 cont'd

Site	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
Subclass Prosobranchia cont'd															
N. scutum (plate limpet)	0	48	0	0	27	4	0	1	10	8	0	12	1	14	8
Tegula funebralis	0	0	0	0	0	100	0	0	0	4	3	200	0	0	12
Thais emarginata (short-spired purple)	0	0	0	0	17	0	0	0	40	0	0	36	0	0	8
T. lamellosa (wrinkled purple)	0	0	0	0	0	0	0	0	16	0	0	0	0	0	4
Searlesia dira	0	0	0	0	0	40	0	0	0	0	1	0	0	0	0
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia															
Balanus cariosus	0	0	0	164	200	700	150	425	300	200	110	275	0	25	100
B. glandula	440	400	600	525	500	625	550	725	700	500	625	460	520	480	525
Chthamalus dalli	0	0	20	0	0	75	0	70	5	0	10	22	32	30	10
Subclass Malacostraca Order Decapoda															
Hemigrapsus nudus	0	0	0	0	0	80	0	0	0	0	0	0	0	0	0
H. oregonensis (green shore crab)	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0
Pagurus sp.	0	0	0	0	0	60	0	0	0	0	0	10	0	0	0
Petrolisthes cinctipes (porcelain crab)	0	40	0	0	0	40	0	0	0	0	0	0	0	0	12

Table 21 cont'd

Site	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
PHYLUM Echinodermata Class Asteroidea															
Leptasterias hexactis	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0
Pisaster ochraceus	0	3	0	0	0	<1	0	0	2	0	2	3	0	0	<1
PHYLUM Chordata Subphylum Craniata Class Osteichthys															
Clinocottus sp. OR *Oligocottus* sp.	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0
FLORA															
PHYLUM Chlorophyta (green algae)															
Cladophora sp.	0	0	0	0	0	<5	0	<5	0	0	<5	0	<5	0	0
Entromorpha intestinalis	0	<5	0	0	10	<5	0	0	0	0	0	0	0	0	<5
Spongomorpha sp.	0	<5	0	0	0	0	0	0	0	0	<5	0	0	<5	0
Ulva sp.	10	<5	0	0	10	0	<5	<5	0	0	<5	<5	<5	<5	<5
PHYLUM Phaeophyta (brown algae)															
Fucus distichus	40	50	30	40	60	70	50	20	80	60	40	60	40	35	80
Pelvetiopsis limitata	0	0	50	45	0	0	0	0	0	0	0	0	0	0	0

Table 21 cont'd

	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
PHYLUM Rhodophyta (red algae)															
Corallina sp.	0	0	0	<5	0	0	0	10	0	0	0	<5	<5	<5	0
Endocladia muricata	<5	<5	<5	0	<5	0	10	<5	0	0	<5	20	0	<5	<5
Gigartina spp.	0	5	0	0	0	0	0	0	0	0	20	0	0	0	0
Hildenbrandia sp.	0	0	0	<5	0	0	0	0	0	0	<5	0	0	0	<5
Odonthalia floccosa	0	0	0	0	<5	0	0	0	0	0	<5	0	<5	0	0
Petrocelis sp.	<5	<5	0	0	<5	10	<5	<5	10	0	<5	<5	<5	<5	<5
Porphyra sp.	0	<5	0	<5	0	<5	0	0	0	0	<5	<5	0	0	0
Prionitis sp.	0	0	0	<5	0	0	0	0	0	0	<5	0	0	0	0
Rhodomela larix	0	0	0	0	0	0	0	0	0	0	<5	0	0	0	<5

Table 21 cont'd

	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
ZONE 3	6m	4m	2m	5m	4m	10m	5m	1m	6m	2m	7m	6m	5m	6m	4m
FAUNA															
PHYLUM Porifera															
Haliclona permollis	0	0	10	0	0	0	0	0	<5	0	<5	0	0	0	0
Ophlitaspongia pennata	0	0	0	0	0	0	0	0	0	0	<5	<5	0	0	0
unidentified species	0	0	10	10	0	10	0	<5	0	0	<5	0	0	0	0
PHYLUM Cnidaria Class Anthozoa Order Actinaria															
Anthopleura elegantissima	120	0	100	40	40	0	80	120	0	60	120	0	76	120	0
A. xanthogrammica (green anemone)	0	0	12	5	3	0	4	0	20	8	20	0	0	0	<1
Metridium senile	0	0	0	0	0	0	0	20	0	0	0	3	0	0	0
Tealia coriacea	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	<1
T. lofotensis	0	0	0	0	0	0	0	0	<1	<1	0	<1	0	0	0
PHYLUM Annelida Class Polychaeta															
Eudistylia vancouveri	0	0	0	0	0	0	0	0	20	0	0	15	25	10	0
Serpula vermicularis	20	5	50	<1	0	100	0	0	50	0	0	25	15	0	0
Spirobis sp.	0	0	0	0	0	500	0	0	0	0	0	100	0	0	600

Table 21 cont'd

Site	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
PHYLUM Mollusca Class Amphineura															
Cryptochiton stelleri	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0
Ischnochiton sp.	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0
Katharina tunicata	0	0	4	3	0	0	0	10	<1	3	<1	0	4	2	0
Mopalia sp.	0	0	0	<1	0	0	0	0	0	0	0	0	3	0	0
Tonicella lineata	0	<1	0	0	0	<1	0	0	0	0	<1	<1	2	0	0
Class Gastropoda Subclass Opisthobranchia															
Archidoris montereyensis	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0
Subclass Prosobranchia															
Cerastostoma foliata (leafy hornmouth)	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0
Calliostoma ligatum	0	0	0	0	0	0	0	0	0	0	0	<1	1	0	0
Collisella digitalis	0	0	0	120	12	0	0	0	41	0	0	0	44	64	0
C. pelta	0	0	0	16	44	0	0	0	0	0	0	24	0	0	4
Diodora aspera	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0
Notoacmea scutum (plate limpet)	0	0	0	0	14	12	0	0	12	0	0	10	0	0	8
Searlesia dira	0	0	0	0	0	0	40	0	0	0	0	0	0	0	20
Tegula funebralis	0	0	0	0	0	0	0	0	0	0	0	0	0	120	0
Thais emarginata	0	0	0	40	21	0	0	0	0	0	0	0	0	0	0
T. lamellosa	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0

Table 21 cont'd

Site	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
Class Bivalvia															
Mytilus californianus	96	16*	130	210	4*	5*	4*	6*	110	10	150	97	4*	2*	6*
M. edulis	0	0	0	160	0	0	0	0	0	0	100	0	0	0	0
Pododesmus macroschisma (jingle shell)	0	0	0	0	0	3	2	0	2	0	4	0	0	0	0
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia															
Balanus cariosus	110	0	120	150	250	0	0	0	600	0	410	0	0	425	0
B. glandula	180	120	300	150	325	200	190	270	300	250	170	220	240	230	500
B. nubilus	0	<1	0	<1	0	0	0	3	0	0	0	<1	0	0	0
Pollicipes polymerus (goose barnacle)	0	0	100	120	0	0	0	0	0	0	0	0	0	0	0
Subclass Malacostraca Order Decapoda															
Cancer productus	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0
Pagurus sp. (hermit crab)	0	0	0	0	10	0	0	0	20	25	0	15	27	41	60
Petrolisthes eriomerus (porcelain crab)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40
Pugettia gracilis (kelp crab)	0	0	0	0	0	<1	0	0	0	0	0	<1	0	0	0

* $\simeq$ 18 cm long; found in clumps

Table 21 cont'd

Site	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
PHYLUM Bryozoa															
Flustrellidra corniculata	0	0	0	0	0	0	0	0	0	0	0	5	5	10	0
unidentified species	0	0	0	<5	0	<5	0	<5	<5	0	5	10	5	5	0
PHYLUM Echinodermata Class Asteroidea															
Evasterias troschellii	0	0	0	0	1	0	<1	0	0	0	0	0	<1	0	0
Dermasterias imbricata	0	0	0	0	0	<1	<1	0	<1	<1	0	<1	<1	0	<1
Leptasterias hexactis	0	<1	0	<1	0	0	0	0	0	0	0	0	0	0	0
Patiria miniata	0	0	0	0	0	<1	3	0	0	0	0	0	8	0	6
Pisaster ochraceus (purple starfish)	10	0	1	3	4	0	6	0	1	2	3	3	3	0	<1
Pycnopodia helianthoides	0	0	0	0	0	<1	0	0	0	0	0	<1	0	0	<1
Class Echinoidea															
Stronglylocentrotus purpuratus	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0
Class Holothuroidea															
Cucumaria miniata	0	0	0	0	<1	0	0	0	0	0	0	0	4	2	0
PHYLUM Chordata Subphylum Urochordata Class Ascidiacea															
Styela montereyensis	0	0	0	0	0	0	0	0	0	0	1	<1	<1	<1	0
unidentified compound ascidians	0	5	0	0	0	0	0	0	0	0	5	10	0	0	0

Table 21 cont'd

Site	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
Subphylum Craniata Class Osteichthys															
<u>Anoplarchus</u> <u>purpurescens</u> (blenny)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
<u>Gobiesox</u> <u>meanaricus</u> (clinger fish)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
FLORA															
<u>PHYLUM</u> Spermatophyta															
<u>Phyllospadix</u> <u>scouleri</u> (surf grass)	0	0	0	30	0	40	0	0	50	0	0	0	40	0	0
<u>PHYLUM</u> Chlorophyta (green algae)															
<u>Cladophora</u> sp.	0	0	0	0	0	0	0	0	<5	0	0	0	0	0	0
<u>Codium</u> <u>fragile</u>	<5	0	0	0	0	0	<5	<5	<5	0	<5	<5	30	<5	<5
<u>C.</u> <u>setchellii</u>	0	0	0	0	0	0	0	0	0	0	<5	<5	0	0	0
<u>Enteromorpha</u> <u>intestinalis</u>	0	0	0	0	0	<5	0	0	<5	0	0	0	0	0	0
<u>Ulva</u> sp.	0	0	20	0	<5	0	<5	0	<5	<5	0	<5	0	20	20
<u>PHYLUM</u> Phaeophyta (brown algae)															
<u>A.</u> <u>nana</u>	0	50	0	50	0	0	<5	0	0	0	0	<5	0	0	0
<u>Analipus</u> <u>japonica</u>	10	0	0	0	0	0	<5	0	0	0	0	0	0	<5	<5

Table 21 cont'd

Site	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
PHYLUM Phaeophyta cont'd															
Egregia menziesii	0	<5	0	0	0	0	0	0	<5	<5	0	0	0	0	<5
Hedophyllum sessile	10	<5	<5	5	0	0	0	0	0	0	50	40	0	0	10
Leathesia difformis	10	0	0	0	0	20	50	40	10	30	0	0	0	<5	10
Sargassum muticum	0	0	0	0	50	0	0	0	0	0	0	0	30	0	<5
PHYLUM Rhodophyta (red algae)															
Bossiella sp.	10	0	0	10	0	0	0	0	0	0	0	0	0	0	0
Calliarthron sp.	10	0	0	10	0	0	0	0	0	0	0	0	0	0	0
Callithamnion pikeanum	0	0	0	0	0	0	0	0	0	0	0	<5	0	0	0
Ceramium sp.	0	0	0	0	0	0	<5	0	<5	0	0	0	0	0	0
Corallina sp.	10	20	10	10	10	0	0	0	<0	0	20	0	<5	<5	10
Cryptosiphonia woodii	0	0	0	0	0	0	0	0	5	0	0	0	0	<5	0
Endocladia muricata	0	0	10	<5	0	0	<5	0	0	<5	<5	0	<5	<5	0
Erythrophyllum delesserioides	0	0	0	<5	0	0	0	0	0	0	0	0	0	0	0
Gastroclonium coulteri	0	0	0	0	0	10	0	0	20	10	0	0	<5	20	60
Gelidium sp.	<5	0	0	0	0	10	0	0	<5	0	0	0	0	0	<5
Gigartina exasperata	40	0	0	0	0	0	0	0	20	0	0	50	40	0	40
Gigartina sp.	0	<5	0	0	0	0	<5	0	0	0	<5	0	<5	<5	<5
Halosaccion glandiforme	<5	<5	20	0	<5	0	35	10	10	40	<5	<5	<5	<5	10
Hildenbrandia sp.	0	0	0	0	0	0	0	0	<5	0	<5	0	0	<5	<5
Iridaea sp.	10	30	0	<5	0	0	0	0	0	0	20	0	0	0	<5

Table 21 cont'd

Site	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
<u>PHYLUM</u> Rhodophyta cont'd															
<u>Microcladia borealis</u>	0	0	0	<5	0	0	0	0	0	0	0	<5	0	0	<5
<u>M. coulteri</u> (epiphytic)	60	0	0	0	0	0	0	0	0	0	0	<5	0	0	<5
<u>Lithothamnion</u> sp.	<5	0	0	<5	10	0	0	0	10	0	0	10	<5	<5	<5
<u>Petrocelis</u> sp.	0	<5	<5	0	10	0	0	0	<5	0	<5	<5	<5	<5	<5
<u>Prionitis</u> sp.	<5	0	0	<5	0	0	<5	0	0	0	0	<5	0	0	<5
<u>Pterosiphonia bipinnata</u>	0	0	<5	<5	0	0	0	0	0	0	0	0	0	0	0
<u>Rhodomela larix</u>	0	<5	0	0	0	15	0	0	<5	0	0	0	0	<5	0

Table 21 cont'd

Site	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
ZONE 4	we	2m	1m	we	*	*	we	we	*	5m	2m	1m	*	*	*
FAUNA															
PHYLUM Porifera															
Haliclona permollis	0	10	0	0	-	-	0	0	-	0	0	<5	-	-	-
Ophlitaspongia pennata	0	10	0	0	-	-	0	0	-	0	10	<5	-	-	-
unidentified species	0	10	0	0	-	-	0	0	-	0	20	<5	-	-	-
PHYLUM Cnidaria Class Anthozoa Order Actiniaria															
Tealia lofotensis	0	0	0	0	-	-	0	0	-	0	<1	0	-	-	-
PHYLUM Annelida Class Polychaeta															
Eudistylia vancouveri	0	0	0	0	-	-	0	0	-	0	10	0	-	-	-
Serpula vermicularis	0	0	0	0	-	-	0	0	-	0	0	0	-	-	-
Spirorbis sp.	0	0	0	0	-	-	0	0	-	0	20	0	-	-	-
PHYLUM Mollusca Class Amphineura															
Katharina tunicata	0	0	1	0	-	-	0	0	-	0	0	0	-	-	-
Tonicella lineata	0	<1	<1	0	-	-	0	0	-	0	<1	0	-	-	-
Crytochiton stelleri	0	0	<1	0	-	-	0	0	-	0	0	0	-	-	-

* not able to sample ZONE 4

Table 21 cont'd

Site	Exposed				Semi-exposed										
	50	58	60	64	9	27	29	52	57	61	62	63	48	56	55
Class Gastropoda Subclass Prosobranchia															
<u>Ceratostoma foliata</u> (leafy hornmouth)	0	0	<1	0	–	–	0	0	–	2	0	0	–	–	–
<u>Diodora aspera</u>	0	0	<1	0	–	–	0	0	–	0	0	0	–	–	–
<u>Tegula pulligo</u>	0	0	0	0	–	–	0	0	–	8	0	0	–	–	–
<u>PHYLUM</u> Arthropoda Class Crustacea Subclass Cirripedia															
<u>Balanus nubilus</u>	0	0	<1	0	–	–	0	0	–	0	<1	0	–	–	–
<u>PHYLUM</u> Bryozoa															
<u>Flustrellidra corniculata</u>	0	0	0	0	–	–	0	0	–	0	5	0	–	–	–
unidentified species	0	10	5	0	–	–	0	0	–	5	5	0	–	–	–
<u>PHYLUM</u> Echinodermata Class Asteroidea															
<u>Dermasterias</u>	<1	<1	<1	0	–	–	0	0	–	0	<1	0	–	–	–
<u>Henricia</u>	<1	0	<1	0	–	–	0	0	–	0	0	0	–	–	–
<u>Pycnopodia</u>	0	0	<1	0	–	–	0	0	–	0	0	0	–	–	–
Class Echinoidea															
<u>Patiria miniata</u>	0	0	0	0	–	–	0	0	–	0	<1	0	–	–	–
<u>Strongylocentrotus droebachiensis</u>	0	0	<1	0	–	–	0	0	–	0	0	0	–	–	–

Table 21 cont'd

Site	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
Class Echinoidea cont'd															
S. franciscanus	0	0	6	0	–	–	0	0	–	0	0	10	–	–	–
S. purpuratus	0	3	0	0	–	–	0	0	–	0	0	2	–	–	–
Class Holothuroidea															
Cucumaria miniata	0	3	0	0	–	–	0	0	–	0	5	0	–	–	–
PHYLUM Chordata Subphylum Urochordata Class Ascidiacea															
Styela montereyensis	0	3	6	0	–	–	0	0	–	0	2	0	–	–	–
unidentified compound ascidians	0	10	0	10	–	–	0	0	–	0	50	0	–	–	–
FLORA															
PHYLUM Spermatophyta															
Phyllospadix scouleri (surf grass)	0	<5	<5	0	–	–	0	0	–	0	50	0	–	–	–
PHYLUM Chlorophyta															
Cladophora sp.	0	0	0	0	–	–	0	0	–	0	<5	0	–	–	–
Codium fragile	0	<5	<5	0	–	–	0	0	–	<5	0	0	–	–	–
C. setchellii	0	<5	<5	0	–	–	0	0	–	0	0	0	–	–	–
Ulva sp.	0	0	<5	0	–	–	0	0	–	5	0	0	–	–	–

Table 21 cont'd

Site	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
PHYLUM Phaeophyta (brown algae)															
Alaria marginata	0	0	0	0	–	–	0	30	–	0	10	0	–	–	–
A. nana	10	0	0	0	–	–	0	0	–	0	0	0	–	–	–
Desmarestia sp.	10	<5	0	0	–	–	0	0	–	0	<5	10	–	–	–
Costaria costata	0	<5	0	0	–	–	0	<5	–	0	<5	<5	–	–	–
Egregia menziesii	<5	<5	<5	0	–	–	0	0	–	0	<5	10	–	–	–
Hedophyllum sessile	0	0	<5	0	–	–	0	0	–	0	0	0	–	–	–
Laminaria setchellii	0	0	60	30	–	–	0	60	–	0	<5	5	–	–	–
L. groenlandica	0	<5	0	0	–	–	0	0	–	0	0	0	–	–	–
Lessoniopsis littoralis	0	0	5	40	–	–	0	0	–	0	0	0	–	–	–
Macrocytis integrifolia	0	0	0	0	–	–	0	0	–	0	<5	0	–	–	–
Odonthalia floccosa	0	0	0	0	–	–	0	0	–	0	<5	0	–	–	–
PHYLUM Rhodophyta (red algae)															
Bossiella sp.	0	0	<5	10	–	–	0	0	–	0	0	0	–	–	–
Calliarthron sp.	0	0	<5	10	–	–	0	0	–	0	<5	0	–	–	–
Corallina sp.	0	0	0	10	–	–	0	0	–	<5	<5	0	–	–	–
Gigartina exasperata	0	60	30	0	–	–	50	0	–	50	20	10	–	–	–
Gigartina sp.	0	0	<5	0	–	–	0	0	–	<5	0	0	–	–	–
Iridaea sp.	0	0	<5	0	–	–	0	0	–	0	0	30	–	–	–
Lithothamnion sp.	0	<5	<5	0	–	–	0	0	–	10	<5	<5	–	–	–
Microcladia coulteri	0	40	50	0	–	–	0	0	–	0	<5	0	–	–	–

Table 21 cont'd

Site	Exposed				Semi-exposed										
	50	58	60	64	9	47	49	52	57	61	62	63	48	56	55
PHYLUM Rhodophyta cont'd															
Nemalion elminthoides	0	0	0	0	–	–	0	<5	–	0	<5	0	–	–	–
Petrocelis sp.	0	0	<5	0	–	–	0	0	–	0	0	0	–	–	–
Porphyra sp.	0	0	<5	0	–	–	0	0	–	0	<5	0	–	–	–
Prionitis sp.	0	<5	0	0	–	–	0	0	–	10	<5	0	–	–	–
Smithora naiadum	0	0	<5	0	–	–	0	0	–	0	0	0	–	–	–

Table 22. Fauna and flora observed at sheltered beaches composed of gravel, sand and shell mixture and sand and shell beaches, Broken Group Islands Section (1976).

Site	1	2	7	16	17	21	31	32a	32	33	34	35	36	37	38	42	53	59a	59b	3	11	26	10	40	45
FAUNA																									
<u>PHYLUM</u> Cnidaria Class Anthozoa Order Actinaria																									
<u>Metridium sessile</u>	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Tealia coriacea</u>	<1	<1	0	0	0	0	<1	0	<1	0	<1	1	0	0	0	0	0	0	0	<1	0	0	0	0	0
<u>PHYLUM</u> Nemertea																									
unidentified species	0	0	0	10	25	30	0	0	0	0	0	0	0	0	0	25	50	0	0	50	0	0	15	0	0
<u>PHYLUM</u> Annelida																									
unidentified species	3	0	0	1	0	2	0	0	0	3	0	0	0	0	0	0	4	0	0	10	0	0	0	0	0
<u>PHYLUM</u> Mollusca Class Gastropoda Subclass Prosobranchia																									
<u>Astraea gibberosa</u>	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Polinices lewisii</u>	<1	0	0	0	0	0	0	0	0	0	0	<1	1	0	0	0	0	<1	0	0	0	0	0	0	0
<u>Tegula funebralis</u>	0	0	0	0	0	0	0	0	0	52	0	0	24	80	0	0	40	0	0	0	0	0	0	0	0
Class Bivalvia																									
<u>Clinocardium nuttallii</u>	2	0	0	0	2	1	0	0	0	0	0	0	0	1	3	0	1	0	0	2	0	0	0	0	2

Table 22 cont'd

Site	1	2	7	16	17	21	31	32a	32	33	34	35	36	37	38	42	53	59a	59b	3	11	26	10	40	45
Class Bivalvia cont'd																									
<u>Crassostrea gigas</u>	0	0	<1	0	0	0	0	0	1	0	<1	0	0	0	0	0	<1	0	0	0	0	0	0	0	0
<u>Gari californica</u>	0	0	0	1	0	1	0	0	0	1	0	1	0	2	0	0	0	0	0	0	0	0	0	0	2
<u>Macoma nasuta</u>	2	0	195	0	1	0	0	2	0	0	0	0	0	0	0	2	1	0	0	12	0	0	0	0	1
<u>Mya arenaria</u>	4	0	0	0	33	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	1	0
<u>Ostrea lurida</u>	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	19	2	0	0	0	0	0	0	0	0
<u>Protothaca staminea</u>	35	0	355	6	48	231	45	20	0	10	20	0	0	1	3	6	16	0	0	33	25	4	0	0	22
<u>Saxidomus giganteus</u>	12	0	16	0	26	244	3	6	0	8	3	0	0	0	0	0	14	2	2	4	2	0	0	0	7
<u>Tresus</u> sp.	7	0	32	0	0	0	0	4	0	0	0	0	2	0	0	0	2	6	6	0	1	1	0	1	6
<u>Venerupis japonica</u>	0	0	54	0	35	1	6	0	1	0	0	0	0	0	0	28	20	0	0	2	0	1	0	0	0
<u>PHYLUM</u> Arthropoda																									
*<u>Callianassa californiensis</u> (ghost shrimp)	4	0	b	3	b	b	0	b	b	b	b	0	b	b	0	0	0	0	0	0	b	0	b	0	0
<u>Hemigrapsus nudus</u>	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>H. oregonensis</u>	0	0	0	0	3	0	0	0	0	0	20	0	0	0	0	24	4	0	0	0	0	0	0	0	0
<u>Pagurus</u> sp.	0	0	0	0	0	0	0	0	0	0	0	0	28	0	0	0	4	0	0	0	0	0	0	0	0
*<u>Upogebia pugettensis</u> (ghost shrimp)	0	0	b	0	b	b	3	b	b	b	b	0	b	b	0	3	0	0	0	0	b	0	b	0	0

*b = burrows

Table 22 cont'd

Site	1	2	7	16	17	21	31	32a	32	33	34	35	36	37	38	42	53	59a	59b	3	11	26	10	40	45
PHYLUM Echinodermata Class Echinoidea																									
Patiria miniata	12	0	0	0	4	0	9	7	7	0	0	10	7	0	0	0	7	10	0	3	0	0	0	0	0
Pisaster brevispinus	<1	0	0	0	<1	0	<1	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P. ochraceus	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class Holothuroidea																									
Cucumaria miniata	0	8	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Leptosynapta clarki	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	2	0	0	0	0	0	<1	0	0
FLORA																									
PHYLUM Spermatophyta																									
Zostera marina	0	90	0	0	50	0	0	0	0	0	0	80	0	0	0	0	50	0	0	60	0	40	0	0	0
PHYLUM Rhodophyta																									
Gracilaria verrucosa	0	0	0	0	0	0	0	0	0	75	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0

Table 23. Fauna and flora observed at sheltered cobble beaches, Broken Group Islands (1976). (Multiply No./m^2 of *B. glandula* by 100)

Table 23

Site	6	15	20	23	35a	41	44
ZONE 2	3m	4m	2m	2m	3m	10m	10m
FAUNA							
PHYLUM Mollusca Class Gastropoda Subclass Prosobranchia							
Collisella digitalis (fingered limpet)	7	16	10	5	16	12	17
Littorina scutulata (checkered periwinkle)	4	0	0	0	20	0	3
L. sitkana (sitka periwinkle)	104	120	150	100	150	120	114
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia							
Balanus glandula	120	140	15	170	190	160	140
Chthamalus dalli	102	100	100	75	0	0	0
FLORA							
PHYLUM Chlorophyta (green algae)							
Enteromorpha intestinalis	<5	<5	10	10	0	<5	<5
PHYLUM Phaeophyta (brown algae)							
Fucus distichus	50	60	75	75	95	0	90

Table 23 cont'd

Site	6	15	20	23	35a	41	44
ZONE 3	3m	6m	4m	6m	10m	30m	10m
FAUNA							
PHYLUM Nemertea							
unidentified species	50	0	0	75	0	100	75
PHYLUM Annelida Class Polychaeta							
unidentified species	3	0	0	15	0	20	0
PHYLUM Mollusca Class Gastropoda Subclass Prosobranchia							
Searlesia dira	45	25	8	0	0	40	0
Tegula funebralis	0	40	15	0	20	0	40
Class Bivalvia							
Crassostrea gigas	<1	0	4	1	0	0	0
Ostrea lurida	0	20	0	0	0	0	0
Pododesmus macroschisma	<1	1	1	0	1	0	0
PHYLUM Arthropoda Subclass Malacostraca Order Decapoda							
Hemigrapsus nudus	15	25	18	15	0	24	0
H. oregonensis (shore crab)	28	30	25	3	0	24	0
PHYLUM Echinodermata Class Holothuroidea							
Leptosynapta clarki	0	0	0	6	0	4	2

Table 23 cont'd

Site	6	15	20	23	35a	41	44
PHYLUM Chordata Subphylum Craniata Class Osteichthys							
Anoplarchus purpurescens (blenny)	1	0	0	0	4	0	0
Clinocottus sp. OR *Oligocottus* sp. (sculpins)	12	0	0	0	20	0	10
FLORA							
PHYLUM Spermatophyta							
Zostera marina (eelgrass)	25	0	0	40	70	50	<5
PHYLUM Phaeophyta (brown algae)							
Leathesia difformis	10	20	60	10	5	0	<5
Sargassum muticum	15	10	<5	10	20	0	0
PHYLUM Rhodophyta (red algae)							
Rhodomela larix	<5	10	<5	<5	5	0	30

Table 23 cont'd

Site	6	15	20	23	35a	41	44
ZONE 4	3m	2m	1m	3m	2m	7m	3m
FAUNA							
PHYLUM Cnidaria Class Anthozoa Order Actiniaria							
Tealia coriacea	0	1	1	1	0	<1	0
PHYLUM Annelida Class Polychaeta							
Serpula vermicularis	0	250	75	0	0	300	0
PHYLUM Mollusca Subclass Prosobranchia							
Astraea gibberosa	4	0	1	<1	<1	0	0
Ceratostoma foliata	1	0	0	0	0	2	0
Collisella pelta	15	20	7	5	0	12	10
Notoacmea scutum	10	10	3	0	0	28	0
Class Bivalvia							
Pododesmus macroschisma	0	1	1	<1	0	<1	0
PHYLUM Arthropoda Subclass Malacostraca							
Pagurus sp.	34	14	10	10	28	0	11
PHYLUM Echinodermata Class Asteroidea							
Dermasterias imbricata	<1	<1	0	<1	0	<1	0
Patiria miniata	8	3	0	0	7	<1	<1
Pisaster ochraceus	3	1	0	0	0	0	<1
Pycnopodia helianthoides	0	4	0	0	0	0	0

Table 23 cont'd

Site	6	15	20	23	35a	41	44
PHYLUM Chordata Subphylum Craniata Class Osteichythus							
Anoplarchus purpurescens	0	0	0	0	0	< 1	0
FLORA							
PHYLUM Chlorophyta (green algae)							
unidentified filamentous alga	0	0	< 5	0	0	50	10
PHYLUM Phaeophyta (brown algae)							
Sargassum muticum	25	20	10	10	0	30	40
PHYLUM Rhodophyta (red algae)							
Gigartina exasperata	10	20	< 5	10	10	5	< 5
Lithothamnion sp.	< 5	< 5	< 5	0	0	5	0

Table 24. Fauna and flora observed at sheltered rock and boulder habitats, Broken Group Islands (1976). (Multiply No./m^2 of *B. glandula* by 100, and *M. edulis* by 10)

Table 24

	Sheltered Rock											Sheltered Boulders				
Site	4	5	12	13	18	24	25	31a	39	46	51	8	19	22	43	54
ZONE 2	4m	5m	5m	3m	2m	3m	4m	2m	10m	5m	3m	3m	5m	2m	10m	4m
FAUNA																
PHYLUM Mollusca Class Gastropoda Subclass Prosobranchia																
<u>Collisella digitalis</u> (fingered limpet)	48	36	52	48	36	60	84	48	40	24	32	20	64	52	60	12
<u>Littorina scutulata</u> (checkered periwinkle)	52	48	16	64	56	66	92	64	100	92	60	62	108	56	12	60
<u>L. sitkana</u> (sitka periwinkle)	120	100	120	156	132	128	148	124	40	140	142	116	216	128	64	180
<u>Notoacmea persona</u>	10	3	5	3	2	4	12	3	20	1	5	2	20	11	3	1
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia																
<u>Balanus cariosus</u>	100	80	120	140	150	240	325	225	0	425	275	250	175	125	275	0
<u>B. glandula</u>	500	360	390	420	510	370	360	350	380	400	360	270	310	340	260	320
<u>Chthamalus dalli</u>	0	0	400	350	160	375	400	425	0	0	0	0	0	0	425	275
Subclass Malacostraca Order Decapoda																
<u>Hemigrapsus nudus</u>	28	12	0	10	24	64	82	96	40	20	15	28	60	52	120	12
<u>H. oregonensis</u>	20	8	14	15	0	20	24	12	60	0	0	8	20	24	60	0
<u>Pagurus</u> sp.	0	24	54	40	24	72	88	60	0	24	0	0	32	16	48	40
<u>Petrolisthes cinctipes</u> (porcelain crab)	0	0	164	0	108	124	0	0	0	0	0	140	124	120	0	0

Table 24 cont'd

Site	Sheltered Rock											Sheltered Boulder				
	4	5	12	13	18	24	25	31a	39	46	51	8	19	22	43	54
FLORA																
PHYLUM Chlorophyta (green algae)																
Cladophora sp.	<5	<5	10	0	0	<5	<5	<5	0	0	0	0	0	<5	0	0
Enteromorpha sp.	10	10	0	10	0	0	<5	0	0	0	5	10	10	0	<5	<5
Spongomorpha sp.	10	<5	10	0	0	<5	10	<5	<5	<5	<5	0	0	<5	0	0
Ulva sp.	<5	<5	<5	<5	<5	10	<5	10	<5	<5	5	0	0	<5	<5	<5
PHYLUM Phaeophyta (brown algae)																
Fucus distichus	60	75	50	70	75	60	50	60	80	75	75	60	75	50	5	50
PHYLUM Rhodophyta (red algae)																
Endocladia muricata	0	<5	0	0	<5	<5	10	<5	0	<5	0	<5	0	<5	0	<5
Gigartina sp.	0	0	<5	0	0	<5	<5	0	0	0	0	0	0	0	0	<5
Odonthalia floccosa	0	0	<5	0	0	0	10	0	0	0	0	0	0	0	0	0
Petrocelis sp.	0	10	10	<5	0	10	<5	<5	0	<5	<5	<5	0	<5	0	<5

Table 24 cont'd

Site	Sheltered Rock											Sheltered Boulder				
	4	5	12	13	18	24	25	31a	39	46	51	8	19	22	43	54
ZONE 3	5m	6m	7m	6m	5m	6m	8m	2m	6m	9m	3m	6m	5m	5m	12m	6m
FAUNA																
PHYLUM Cnidaria Class Anthozoa Order Actiniaria																
Anthopleura xanthogrammica	0	0	4	7	0	0	0	0	0	<1	0	0	0	0	0	0
Tealia coriacea	0	0	0	0	0	0	0	<1	<1	0	0	0	0	0	<1	0
PHYLUM Annelida Class Polychaeta																
Serpula vermicularis	120	100	150	80	164	0	240	325	0	0	150	250	200	220	250	0
Spirobis	0	0	0	0	0	0	200	0	0	0	0	0	0	0	0	0
PHYLUM Mollusca Class Amphineura																
Cryptochiton **stelleri**	<1	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0
Mopalia sp.	0	0	<1	1	<1	0	0	4	0	0	0	0	1	0	1	0
Tonicella lineata	0	0	<1	<1	0	0	0	<1	<1	<1	<1	0	0	0	0	0
Class Gastropoda Subclass Opisthobranchia																
Diaulula sandiegensis	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0
Dirona albolineata	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0

Table 24 cont'd

	Sheltered Rock											Sheltered Boulder				
Site	4	5	12	13	18	24	25	31a	39	46	51	8	19	22	43	54
Subclass Prosobranchia																
Astraea gibberosa	4	3	0	5	6	0	0	1	0	0	0	0	0	<1	0	0
Ceratostoma foliata	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	8	0
Collisella digitalis	10	24	0	16	0	0	24	0	16	12	20	0	64	48	24	0
C. pelta	14	12	24	28	0	16	12	12	0	0	4	24	0	16	3	0
Diodora aspera	0	0	<1	0	0	0	0	0	0	0	0	0	<1	0	0	0
Polinices lewisii	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0
Searlesia dira	42	52	0	64	0	0	92	40	0	0	0	120	32	0	20	0
Tegula funebralis	50	62	200	24	164	184	128	0	24	20	12	82	64	0	120	0
Thais emarginata	0	0	100	48	0	0	0	0	0	0	28	0	120	0	4	0
T. lamellosa	3	0	5	0	0	0	0	0	0	0	0	0	0	5	0	0
Notoacmea persona	11	3	4	12	10	0	14	0	0	0	6	12	6	0	13	0
N. scutum	0	0	10	0	3	0	8	0	0	0	0	0	3	0	0	0
Class Bivalvia																
Crassostrea gigas	0	<1	<1	<1	0	0	0	<1	0	0	0	0	0	<1	0	0
Mytilus edulis	97	120	110	130	15	52	120	130	160	140	130	52	40	120	47	75
Pododesmus machroschisma	0	0	<1	1	<1	0	<1	<1	<1	0	0	0	1	0	<1	0

Table 24 cont'd

Site	Sheltered Rock											Sheltered Boulder				
	4	5	12	13	18	24	25	31a	39	46	51	8	19	22	43	54
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia																
Balanus cariosus	120	100	0	140	200	375	250	0	200	325	250	200	325	0	0	225
B. glandula	420	230	360	390	380	350	370	360	340	380	350	250	310	340	320	310
Subclass Malacostraca Order Decapoda																
Cancer productus	0	0	0	0	0	0	0	0	<1	0	0	0	0	<1	<1	0
Lophopanopeus bellus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	160	0
Pagurus sp.	0	10	0	20	64	80	92	60	28	80	0	0	16	0	120	24
Petrolisthes eriomerus	112	120	0	0	144	208	232	0	40	0	0	0	60	0	80	0
Pugettia gracilis	0	0	0	0	0	0	<1	0	0	<1	0	0	0	0	<1	0
PHYLUM Echinodermata Class Asteroidea																
Dermasterias imbricata	<1	0	<1	<1	<1	0	<1	0	0	0	<1	<1	<1	<1	0	<1
Evasterias troschelii	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Patiria miniata	9	3	5	4	10	0	5	9	0	0	7	5	6	0	0	10
Pisaster ochraceus	1	2	0	1	0	3	0	0	0	<1	2	0	0	0	2	2
* *P. brevispinis*	<1	0	0	0	<1	0	0	<1	0	0	0	0	0	<1	0	<1
Pycnopodia helianthoides	<1	0	0	<1	<1	0	0	<1	0	0	0	3	0	0	0	<1
Orthasterias koehleri	0	0	0	1	0	0	<1	0	0	0	<1	0	0	0	0	<1

* below water's edge

Table 24 cont'd

Site	Sheltered Rock											Sheltered Boulder				
	4	5	12	13	18	24	25	31a	39	46	51	8	19	22	43	54
Class Holothuroidea																
Cucumaria miniata	12	8	4	9	5	0	10	0	0	0	15	0	0	0	0	8
* *Parastichopus californicus*	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0
PHYLUM Chordata Subphylum Craniata Class Osteichthys																
Anoplarchus purpurescens (blenny)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Clinocottus sp. OR *Oligocottus* sp. (sculpins)	0	0	20	11	0	0	8	<1	0	0	0	0	0	0	0	0
* *Coryphopterus nickelsi*	0	0	0	0	0	0	0	0	0	0	0	0	4	<1	0	0
Xerepes fucorum (blenny)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
FLORA																
PHYLUM Spermatophyta																
Zostera marina (eelgrass)	10	5	20	0	50	10	20	0	50	10	0	0	10	20	30	0

* below low water

Table 24 cont'd

Site	Sheltered Rock											Sheltered Boulder				
Site	4	5	12	13	18	24	25	31a	39	46	51	8	19	22	43	54
PHYLUM Chlorophyta (green algae)																
<u>Cladophora</u> sp.	<5	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Codium fragile</u>	<5	0	0	0	0	<5	0	0	0	0	0	0	0	0	0	<5
<u>Enteromorpha intestinalis</u>	<5	<5	0	0	0	0	0	10	0	<5	0	<5	0	0	<5	0
<u>Ulva</u> sp.	<5	10	<5	<5	<5	10	<5	<5	0	<5	10	0	10	<5	<5	<5
PHYLUM Phaeophyta (brown algae)																
<u>Leathesia difformis</u>	30	5	5	25	0	30	30	30	10	10	40	40	60	<5	10	10
<u>Sargassum muticum</u>	0	20	10	20	10	10	10	0	20	20	0	0	0	20	40	0
<u>Scytosiphon lomentaria</u>	<5	0	5	<5	0	0	<5	0	0	<5	0	0	0	<5	0	0
PHYLUM Rhodophyta (red algae)																
<u>Endocladia muricata</u>	0	0	0	<5	0	0	0	0	0	<5	0	0	0	0	0	0
<u>Gigartina exasperata</u>	10	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0
•<u>Halosaccion glandiforme</u>	25	10	<5	30	0	20	20	0	0	0	<5	25	0	0	0	15
<u>Rhodomela larix</u>	0	60	0	0	0	0	10	0	<5	10	0	0	0	0	0	0
*<u>Gigartina</u> sp.	<5	<5	<5	<5	<5	<5	<5	0	0	<5	0	0	0	<5	0	15

Table 25. Location and habitat description of subtidal fauna and flora survey sites, Broken Group Islands Section (1976).

Sample No.	Location	Bearing from peg	Habitat	
			Substrate	Exposure
1	North side of east Turtle Island	05°	gravel, sand, shell mud	sheltered
2	Southwest Erin Island	255°	cobble, boulder, rock	semi-exposed
3	Southeast Jacques Island	125°	cobble, boulder, rock	semi-exposed
4	Reef in centre of bay on south Nettle Island	150°	cobble, boulder, rock	semi-exposed
5	Bay on southeast Jacques Island	220°	sand, mud flats	sheltered
6	Southeast Keith Island	180°	cobble, boulder, rock	semi-exposed
7	North side of west Gibraltar Island	325°	cobble, boulder, rock	semi-exposed
8	Off the campsite on the south side of west Turret Island	165°	gravel, sand, shell, mud	sheltered
9	Island off the western tip of Dodd Island	240°	rock	exposed
10	South side of west Benson Island	190°	rock	exposed
11	Bay on northeast Benson Island	60°	gravel, shell, boulder	semi-exposed
12	Reef off northeast tip of Hand Island	310°	rock	semi-exposed
13	West end of Willis Island	275°	rock	exposed
14	North side of west end of Willis Island	285°	rock	exposed

Table 25 cont'd

Sample No.	Location	Bearing from peg	Habitat	
			Substrate	Exposure
15	Northeast tip of Dempster Island	95°	rock	exposed
16	"Valene" on a reef off southeast Austin Island		shipwreck	exposed
17	Off the centre of north Gilbert Island	325°	cobble, boulder, rock	semi-exposed
18	Off the campsite on northeast Gilbert Island	45°	gravel, sand, shell, mud	sheltered
19	In the gut between the two most westerly Brabant Islands	330°	cobble, boulder, rock	semi-exposed
20	Bay on the northern side of east Hand Island	90°	gravel, sand, shell, mud	sheltered
21	Off an island west of Clarke Island	270°	rock	exposed
22	In the bay on north Clarke Island	30°	gravel, shell, boulder	semi-exposed
23	Northwest Jarvis Island	355°	cobble, boulder, rock	semi-exposed
24	In the gut between Jarvis Island and a small island to the east	300°	gravel, sand, shell, mud	sheltered
25	In the gut between Mullins Island and a small island to the southeast	290°	cobble, boulder, rock	semi-exposed
26	Southeast Onion Island	185°	rock	exposed
27	West end of north Owens Island	15°	rock	exposed
28	Bay on west end of north Benson Island	10°	gravel, shell, boulder	semi-exposed

Table 25 cont'd

Sample No.	Location	Bearing from peg	Habitat	
			Substrate	Exposure
29	East end of Village Reef	28°	rock	exposed
30	West end of small island east of Willis Island	320°	gravel, sand, shell, mud	sheltered
31	Southeast side of largest island between Jarvis and Jacques Islands	142°	gravel, sand, shell, mud	sheltered
32	East side of south Prideaux Island	14°	gravel, sand, shell, mud	sheltered
33	South end of east Reeks Island	145°	rock	exposed
34	South side of east Wiebe Island	210°	rock	exposed
35	Centre of north side of Hankin Island	310°	rock	exposed
36	West end of Puffin Islet	250°	rock	exposed
37	West end of Camblain Island	145°	rock	exposed
38	Southeast Cooper Island	140°	rock	exposed
39	North side of island south of Wouwer Island	40°	rock	exposed
40	East tip of Effingham Island	120°	rock	exposed
41	East end of Faber Islets	180°	rock	exposed
42	South side of east Howell Island	130°	rock	exposed
43	East end of Dicebox Island	120°	rock	exposed
44	Bay on southwest side of Gibraltar Island	220°	gravel, sand, shell, mud	sheltered

Table 25 cont'd

Sample No.	Location	Bearing from peg	Habitat	
			Substrate	Exposure
45	South end of bay on southeast Nettle Island	90°	gravel, sand, shell, mud	sheltered
46	East side of Elbow Islet	80°	rock	exposed

Table 26. Fauna and flora observed at subtidal exposed rock habitats in Broken Group Islands Section (1976). (sch indicates school of fish)

ZONE 1	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
PHYLUM Porifera																					
Sponges (unidentified)	>5	0	0	0	<5	<5	0	0	0	0	0	<5	<5	<5	<5	>5	<5	0	<5	0	<5
PHYLUM Cnidaria Class Hydrozoa																					
Aequorea aequorea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	<1
Class Anthozoa																					
Anthopleura elegantissima	0	0	<1	<1	<1	0	0	<1	0	0	0	0	0	0	<1	0	0	0	0	0	0
A. xanthogrammica	<1	<1	<1	<1	<1	<1	0	<1	<1	0	0	0	<1	0	0	<1	<1	0	0	0	<1
Balanophyllia elegans	<1	<1	<1	0	<1	<1	0	<1	0	<1	0	0	<1	0	0	<1	<1	0	20	0	0
Epiactis prolifera	<1	<1	0	0	<1	0	0	0	0	0	0	<1	<1	<1	0	10	<1	0	15	5	<1
Metridium senile	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	<1	<1	0	0	0	0
Pachycerianthus fimbriatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ptilosarcus gurneyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tealia sp.	0	0	<1	<1	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T. coriacea	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0
T. crassicornis	0	<1	0	0	0	0	0	0	0	0	0	0	<1	<1	<1	0	0	0	0	0	0
T. lofotensis	<1	<1	0	0	<1	0	<1	0	0	<1	0	0	<1	0	0	0	<1	<1	0	0	<1
unidentified staromedusa	0	<1	0	0	0	0	0	0	0	0	0	<1	<1	0	0	0	<1	0	0	0	0

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
PHYLUM Annelida Class Polychaeta																					
Dodecaceria fewkesi	0	0	0	0	<5	0	<5	0	0	0	<5	30	<5	0	0	0	<5	<5	0	<5	<5
Eudistylia vancouveri	<1	<1	<1	0	<1	<1	<1	<1	0	0	<1	<1	<1	<1	0	<1	0	0	<1	<1	<1
Serpula vermicularis	<5	<5	<5	0	<5	<5	0	0	0	<5	0	<5	<5	<5	0	<5	<5	0	<5	<5	<5
Spirorbis sp.	0	0	<1	<1	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0
PHYLUM Mollusca Class Amphineura																					
Cryptochiton stelleri	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Katharina tunicata	0	0	0	0	<1	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0
Placiphorella velata	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	<1	<1	0	0	<1
Tonicella sp.	<1	<1	0	<1	<1	<1	<1	0	<1	0	<1	<1	<1	<1	0	0	<1	<1	0	<1	<1
Class Gastropoda Subclass Prosobranchia																					
Acmaea mitra	<1	<1	0	<1	<1	<1	<1	0	0	0	<1	0	<1	<1	0	<1	<1	<1	0	<1	0
Astraea gibberosa	<1	<1	<1	<1	0	<1	0	0	0	0	<1	0	<1	<1	<1	0	0	0	0	0	0
Calliostoma ligatum	<1	<1	0	0	<1	0	0	0	0	0	0	<1	<1	0	0	0	<1	<1	0	<1	0
Ceratostoma foliata	<1	0	<1	<1	<1	0	<1	<1	0	0	<1	<1	<1	<1	0	0	<1	<1	<1	0	0
Crepidula adunca	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diodora aspera	0	<1	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	<1	<1	<1	0	0

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
Class Gastropoda Subclass Prosobranchia (cont'd)																					
<u>Haliotis</u> <u>kamtschatkana</u>	<1	<1	<1	<1	<1	0	0	0	<1	0	0	0	<1	<1	0	0	<1	<1	0	0	0
<u>Lacuna</u> <u>variegata</u>	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0
<u>Notoacmea</u> <u>scutum</u>	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Tegula</u> sp.	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>T.</u> <u>funebralis</u>	0	0	<1	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0
<u>T.</u> <u>pulligo</u>	<1	<1	0	0	<1	0	<1	0	0	0	<1	<1	0	<1	<1	0	<1	0	0	<1	0
Class Opisthobranchia																					
*<u>Cadlina</u> <u>luteomarginata</u>	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Diaulula</u> <u>sandiegensis</u>	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0
<u>Dirona</u> <u>albolineata</u>	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0
<u>D.</u> <u>aurantia</u>	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	<1	0	0	0	0
<u>Hermissenda</u> <u>crassicornis</u>	<1	<1	<1	<1	<1	0	<1	0	0	0	0	0	<1	<1	0	0	<1	0	0	0	0
<u>Tochuina</u> <u>tetraquetra</u>	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Triopha</u> <u>carpenteri</u>	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Tritonia</u> <u>festiva</u>	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0
<u>Rostanga</u> <u>pulchra</u>	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*<u>Archidoris</u> <u>odhneri</u>	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
Class Bivalvia																					
Chlamys sp.	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0
Hinnites giganteus	0	<1	0	0	<1	0	0	0	0	<1	0	0	<1	<1	<1	<1	<1	0	<1	0	0
Mytilus californianus	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pododesmus macroschisma	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia																					
Balanus cariosus	0	0	0	0	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. glandula	<5	0	0	0	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. nubilus	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	<1	0	0	<1	<1
Subclass Malacostraca Order Decapoda Suborder Reptantia Section Anomura																					
Pagurus sp.	<1	<1	0	0	<1	0	0	0	0	0	0	<1	0	0	0	<1	<1	0	0	0	0
Petrolisthes sp.	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Section Brachyura																					
Cancer productus	<1	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0
Oregonia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
PHYLUM Ectoprocta																					
bryozoans	0	0	<5	<5	<5	<5	<5	0	<5	<5	0	<5	0	<5	<5	<5	<5	<5	<5	<5	<5
PHYLUM Echinodermata Class Holothuroidea																					
Cucumaria miniata	<1	0	<1	<1	<1	0	0	0	0	0	0	0	<1	5	<1	0	<1	<1	0	0	0
Eupentacta quinquesemita	0	<1	0	0	<1	0	<1	0	0	0	0	0	<1	0	0	0	<1	0	0	0	0
Parastichopus californicus	0	0	0	0	0	0	0	0	0	0	0	0	<1	<1	0	<1	0	0	0	0	0
Class Ophiuroidea																					
Ophiopholis sp.	<1	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	<1	0	0	0	0
Class Asteroidea																					
Dermasterias imbricata	<1	<1	<1	0	<1	0	<1	0	0	0	0	<1	<1	<1	<1	0	<1	<1	<1	<1	<1
Evasterias troschelii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Henricia leviuscula	0	<1	<1	0	<1	0	0	0	<1	0	0	0	<1	<1	<1	<1	<1	<1	<1	0	<1
Leptasterias hexactis	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Orthasterias koehleri	<1	<1	<1	0	<1	0	0	0	0	0	0	0	<1	<1	0	<1	<1	<1	0	0	0
Patiria miniata	<1	0	0	<1	0	0	<1	0	<1	<1	0	0	0	0	0	0	0	0	0	0	0
Pisaster brevispinus	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
Class Asteroidea cont'd																					
P. ochraceus	0	<1	<1	0	<1	<1	0	<1	<1	0	0	0	0	0	0	0	0	0	0	0	0
Pycnopodia helianthoides	<1	<1	<1	0	<1	<1	<1	0	<1	0	0	0	<1	<1	0	<1	<1	0	<1	0	0
Solaster stimpsoni	<1	0	0	<1	<1	0	0	0	0	0	0	0	<1	<1	0	0	0	0	<1	0	0
Class Echinoidea																					
Strongylocentrotus droebachiensis	0	<1	0	0	<1	0	<1	0	0	0	0	0	0	0	0	0	<1	0	0	0	0
S. franciscanus	<1	<1	<1	0	0	0	0	0	0	0	0	0	3	10	0	4	3	0	20	0	0
S. purpuratus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0
PHYLUM Chordata Subphylum Urochordata																					
Compound ascidians (unidentified)	0	<5	0	0	<5	<5	<5	0	<5	0	0	0	<5	<5	<5	<5	<5	<5	<5	<5	<5
red tunicates (unidentified)	<1	0	0	0	<1	0	0	0	0	0	0	<1	0	<1	0	0	<1	0	0	0	0
Styela montereyensis	<1	0	0	0	<1	<1	0	0	0	<1	0	<1	<1	<1	0	<1	0	0	<1	0	<1
Subphylum Craniata Class Osteichthyes																					
Artedius harringtoni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0
A. lateralis	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
Class Osteichthyes cont'd																					
Coryphopterus nicholsi	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Embiotoca lateralis	0	0	<1	0	0	0	0	0	0	sch	0	0	0	0	0	0	0	0	0	0	sch
Hemilepidotus hemilepidotus	0	0	0	0	<1	0	<1	0	<1	0	0	0	0	<1	0	0	0	0	0	0	0
Hexagrammos decagrammus	<1	<1	0	<1	<1	0	<1	0	<1	0	0	0	<1	<1	0	<1	<1	0	<1	0	<1
Jordania zanope	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	<1	<1	0	0	0	0
Loxorhynchus crispatus	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0
Ophiodon elongatus	0	0	0	0	0	0	0	0	0	0	0	0	<1	<1	0	0	0	0	0	0	0
Rhacochilus vacca	0	0	<1	sch	0	0	0	0	0	0	0	0	sch	0	0	0	0	0	0	0	0
Sebastes caurinus	0	<1	0	0	0	0	0	0	0	0	0	0	0	<1	0	<1	0	0	<1	0	0
S. melanops	0	sch	<1	0	0	0	sch	0	0	0	0	0	sch	sch	0	sch	sch	0	sch	0	sch
PHYLUM Spermatophyta																					
Phyllospadix sp.	0	0	0	<5	<5	<5	0	30	<5	10	0	0	0	0	<5	0	0	0	0	0	0
PHYLUM Chlorophyta																					
Codium fragile	<5	0	0	<5	0	0	<5	<5	<5	0	0	0	0	0	0	0	0	0	0	0	0
C. setchellii	0	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	<5	<5	0	0	0	0

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
PHYLUM Chlorophyta cont'd																					
Halicystus ovalis	<5	<5	0	0	<5	0	0	0	0	0	<5	0	<5	0	0	0	<5	0	0	0	0
Ulva sp.	0	0	0	<5	0	0	<5	0	0	0	0	0	0	0	<5	0	0	0	0	0	0
PHYLUM Phaeophyta																					
Alaria marginata	0	0	>5	>5	40	0	0	10	80	0	0	<5	0	0	0	0	<5	0	0	0	<5
Costaria costata	<5	0	>5	<5	<5	0	50	0	10	0	<5	<5	0	0	<5	0	<5	0	0	0	<5
Desmarestia ligulata	40	0	>5	>5	<5	15	50	<5	<5	30	35	95	0	<5	30	0	50	0	0	30	95
Egregia menziesii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<5	0	0	0	0	0	0
Laminaria setchellii	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lessoniopsis littoralis	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Macrocystis integrifolia	0	0	0	0	0	0	25	0	0	0	0	0	0	0	70	0	0	0	0	0	0
Nereocystis luetkeana	<5	<5	<5	0	<5	<5	25	0	50	60	40	20	<5	40	<5	<5	30	0	<5	60	40
PHYLUM Rhodophyta																					
Bossiella sp.	<5	<5	<5	0	<5	40	<5	0	0	<5	0	0	<5	0	0	<5	0	0	0	0	<5
Calliarthron sp.	<5	0	0	0	0	0	<5	0	0	0	0	<5	0	0	0	0	0	0	<5	0	0
Callophyllis sp.	0	0	0	0	0	0	0	0	0	0	0	0	<5	0	0	<5	<5	0	0	0	0
Constantinea simplex	0	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	<5	<5	0	0	0	0
Corallina sp.	<5	0	<5	0	0	40	<5	0	0	<5	<5	<5	0	0	<5	<5	0	0	0	0	0

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
PHYLUM Rhodophyta cont'd																					
Fauchea sp.	0	0	0	0	0	0	0	0	0	0	0	0	<5	<5	0	<5	<5	0	0	0	0
Gelidium robustum	0	0	<5	<5	0	0	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gigartina sp.	<5	0	<5	<5	<5	<5	<5	0	0	<5	0	0	<5	0	<5	0	0	0	0	0	0
Hymenema sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<5	0	0	0	0
Iridaea sp.	<5	<5	0	0	<5	0	0	<5	<5	0	0	0	<5	<5	<5	<5	0	0	0	0	<5
Laurencia spectabilis	0	<5	0	0	0	0	0	<5	0	0	0	0	0	0	0	0	0	0	0	0	0
Lithothamnion sp.	<5	<5	0	<5	<5	0	<5	45	<5	<5	50	10	40	40	25	40	70	<5	<5	80	20
Microcladia coulteri	0	0	0	0	0	<5	<5	0	0	<5	0	0	<5	0	<5	0	0	0	0	0	0
Micronema sp.	0	0	0	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Opuntiella californicus	0	0	0	0	0	0	0	<5	0	<5	0	0	0	0	0	<5	<5	0	<5	0	0
Polyneura latissima	0	0	0	0	0	0	0	0	0	0	0	0	<5	0	0	0	0	0	0	0	0
Polysiphonia sp.	0	0	<5	0	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prionitis sp.	0	0	0	<5	0	0	0	<5	0	0	0	0	0	0	<5	0	0	0	0	0	0
Ptilota sp.	0	0	0	0	0	0	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodoglossum sp.	0	0	0	0	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodomela sp.	0	0	0	0	0	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodomenia sp.	0	0	0	0	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smithora naiadum	0	0	0	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 26 cont'd

ZONE 2	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
PHYLUM Porifera																					
Sponges (unidentified)	<5	0	<5	0	<5	0	0	0	<5	<5	0	0	0	0	<5	0	0	0	0	0	<5
PHYLUM Cnidaria Class Anthozoa																					
Anthopleura xanthogrammica	0	0	0	0	<1	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	<1
Balanophyllia elegans	0	0	<1	0	<1	0	<1	0	<1	10	<1	<1	0	0	0	0	0	0	0	<1	<1
Epiactis prolifera	<1	0	0	0	<1	<1	0	0	<1	<1	<1	<1	0	0	0	0	0	0	0	<1	<1
Metridium senile	0	0	0	0	0	0	<1	0	<1	0	<1	<1	0	0	0	0	0	0	0	<1	0
Pachycerianthus fimbriatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Tealia lofotensis	<1	0	0	0	0	0	0	0	<1	<1	0	<1	0	0	0	0	0	0	0	<1	<1
T. coriacea	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0
T. crassicornis	0	0	0	0	0	0	<1	0	<1	0	0	<1	0	0	<1	0	0	<1	0	<1	<1
unidentified staromedusa	<1	0	0	0	0	<1	0	<1	0	0	<1	0	0	0	0	0	0	0	0	<1	<1
Tealia sp.	0	0	<1	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
PHYLUM Annelida Class Polychaeta																					
Dodecaceria fewkesi	0	0	0	0	<5	0	0	0	<5	<5	<5	<5	0	0	0	0	0	<5	0	<5	<5
Eudistylia vancouveri	0	0	<1	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	<1	0
Serpula vermicularis	<5	0	0	0	<5	0	0	0	<5	<5	<5	<5	0	0	0	0	0	<5	0	<5	<5
Spirorbis sp.	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYLUM Mollusca Class Amphineura																					
Cryptochiton stelleri	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0
Katharina tunicata	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0
Placiphorella velata	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0
Tonicella sp.	0	0	<1	<1	<1	0	<1	<1	<1	<1	<1	<1	0	0	0	0	0	<1	0	<1	<1
Class Gastropoda Subclass Prosobranchia																					
Acmaea mitra	<1	0	<1	0	<1	0	<1	0	<1	<1	<1	<1	0	0	<1	0	0	<1	0	<1	<1
Astraea gibberosa	<1	0	<1	<1	0	<1	<1	0	<1	<1	<1	<1	0	0	<1	0	0	<1	0	<1	<1
Calliostoma ligatum	0	0	0	0	0	0	0	0	<1	<1	<1	<1	0	0	0	0	0	<1	0	<1	<1
Ceratostoma foliata	<1	0	<1	0	0	<1	<1	0	<1	<1	0	<1	0	0	<1	0	0	<1	0	<1	<1
Diodora aspera	0	0	0	0	<1	<1	0	0	0	0	<1	0	0	0	0	0	0	0	0	<1	<1
Haliotis kamtschatkana	<1	0	<1	<1	<1	0	0	0	<1	<1	<1	<1	0	0	0	0	0	<1	0	<1	<1

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
Class Gastropoda Subclass Prosobranchia cont'd																					
<u>Searlesia dira</u>	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0
<u>Tegula pulligo</u>	<1	0	0	0	0	0	<1	<1	<1	<1	<1	<1	0	0	<1	0	0	<1	0	<1	0
Subclass Opisthobranchia																					
<u>Anisodoris nobilis</u>	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Archidoris montereyensis</u>	<1	0	0	0	0	0	<1	0	0	0	<1	0	0	0	0	0	0	0	0	0	0
<u>A. odhneri</u>	<1	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Cadlina luteomarginata</u>	<1	0	0	0	0	0	0	0	<1	<1	0	0	0	0	0	0	0	0	0	0	0
<u>Dirona albolineata</u>	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Hermissenda crassicornis</u>	<1	0	0	0	0	<1	<1	<1	<1	<1	<1	<1	0	0	0	0	0	0	0	<1	<1
<u>Tochuina tetraquetra</u>	<1	0	0	0	0	0	0	0	0	<1	<1	0	0	0	0	0	0	0	0	0	<1
<u>Triopha carpenteri</u>	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Tritonia festiva</u>	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class Bivalvia																					
<u>Hinnites giganteus</u>	0	0	0	0	0	0	<1	0	<1	<1	0	<1	0	0	<1	0	0	0	0	<1	<1
<u>Mytilus californianus</u>	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0
<u>Pododesmus macroschisma</u>	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia																					
Balanus nubilus	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	<1	0	<1	0
Subclass Malacostraca Order Decapoda Suborder Reptantia Section Anomura																					
Pagurus sp.	0	0	0	0	0	0	0	0	<1	<1	0	<1	0	0	0	0	0	<1	0	<1	0
Oedignathus inermis	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0
Section Brachyura																					
Cancer productus	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Pugettia sp.	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oregonia sp.	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYLUM Ectoprocta																					
bryozoans	0	0	0	0	<5	0	0	0	<5	<5	<5	<5	0	0	<5	0	0	<5	0	<5	<5

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
PHYLUM Echinodermata Class Holothuroidea																					
Cucumaria miniata	<1	0	<1	<1	<1	0	<1	0	<1	<1	0	<1	0	0	<1	0	0	<1	0	<1	0
Eupentacta quinquesemita	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	<1	0
Parastichopus californicus	<1	0	<1	0	0	0	1	0	<1	0	<1	<1	0	0	<1	0	0	<1	0	<1	<1
Class Ophiuroidea																					
Ophiopholis sp.	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	<1
Class Asteroidea																					
Crossaster papposus	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	<1
Dermasterias imbricata	0	0	0	<1	0	<1	<1	0	0	<1	<1	<1	0	0	0	0	0	<1	0	<1	<1
Evasterias troschelii	0	0	0	0	0	0	0	0	0	<1	<1	0	0	0	0	0	0	0	0	0	<1
Henricia leviuscula	<1	0	<1	<1	<1	<1	0	0	<1	<1	0	<1	0	0	0	0	0	<1	0	<1	<1
Mediaster aequalis	<1	0	0	0	0	0	0	0	0	0	<1	<1	0	0	<1	0	0	0	0	0	0
Orthasterias koehleri	<1	0	0	0	<1	0	<1	0	<1	<1	<1	<1	0	0	0	0	0	<1	0	<1	<1
Pisaster brevispinus	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	<1	0	0	0	0	0	0
P. ochraceus	0	0	0	0	0	<1	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0
Pycnopodia helianthoides	<1	0	0	<1	<1	<1	<1	0	<1	<1	<1	0	0	0	<1	0	0	<1	0	<1	<1
Solaster dawsoni	<1	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0
S. stimpsoni	<1	0	0	<1	0	0	0	0	0	0	<1	<1	0	0	0	0	0	<1	0	<1	<1

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
Class Echinoidea																					
Strongylocentrotus droebachiensis	<1	0	0	0	0	0	0	0	<1	<1	<1	0	0	0	0	0	0	<1	0	<1	<1
S. franciscanus	3	0	>1	>1	3	5	3	2	10	5	2	5	0	0	5	0	0	5	0	2	3
S. purpuratus	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0
PHYLUM Chordata Subphylum Urochordata																					
Compound ascidians (unidentified)	<5	0	<5	0	<5	0	0	0	<5	<5	<5	<5	0	0	<5	0	0	<5	0	0	<5
red tunicates (unidentified)	<1	0	0	0	0	0	0	0	0	<1	<1	<1	0	0	0	0	0	<1	0	<1	<1
Styela montereyensis	0	0	0	0	<1	0	0	0	<1	<1	0	<1	0	0	<1	0	0	0	0	0	<1
Subphylum Craniata Class Chondrichthyes																					
Squalus acanthias	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Class Osteichthyes																					
Ammodytes hexapterus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0
Artedius harringtoni	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	<1	0	<1	0
A. lateralis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Aulorhynchus flavidus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	<1	0	0	0

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
Class Osteichthyes cont'd																					
<u>Embiotoca lateralis</u>	0	0	0	0	0	0	0	0	0	sch	0	0	0	0	0	0	0	0	0	0	0
<u>Enophrys bison</u>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0
<u>Hemilepidotus hemilepidotus</u>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0
<u>Hexagrammos decagrammos</u>	<1	0	<1	<1	<1	<1	0	0	<1	<1	<1	0	0	0	<1	0	0	<1	0	<1	<1
<u>Jordania zanope</u>	0	0	0	0	<1	<1	0	0	0	0	0	0	0	0	<1	0	0	<1	0	<1	<1
<u>Ophiodon elongatus</u>	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	<1	0	0	0	0	0	0
<u>Oxylebius pictus</u>	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
<u>Sebastes caurinus</u>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0
<u>S. melanops</u>	0	0	0	0	0	sch	0	0	0	sch	sch	0	0	0	sch	0	0	sch	0	sch	sch
PHYLUM Spermatophyta																					
<u>Phyllospadix</u> sp.	0	0	0	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<5	0
PHYLUM Chlorophyta																					
<u>Codium setchellii</u>	0	0	0	0	0	0	0	0	0	<5	0	0	0	0	0	0	0	0	0	0	0
<u>Halicystus ovalis</u>	<5	0	0	0	0	0	0	0	0	0	0	<5	0	0	0	0	0	0	0	<5	0

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
PHYLUM Phaeophyta																					
Colpomenia sinuosa	0	0	0	0	0	0	0	0	<5	0	<5	0	0	0	0	0	0	0	0	0	0
Costaria costata	0	0	0	0	0	0	0	60	0	0	0	0	0	0	0	0	0	0	0	0	0
Desmarestia ligulata	<5	0	0	0	0	0	0	30	<5	0	0	<5	0	0	0	0	0	0	0	<5	0
Egregia menziesii	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Macrocystis integrifolia	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0
Nereocystis luetkeana	0	0	0	0	0	90	0	80	<5	<5	0	0	0	0	0	0	0	0	0	0	0
PHYLUM Rhodophyta																					
Bossiella sp.	<5	0	0	0	0	0	0	0	<5	<5	0	<5	0	0	0	0	0	0	0	<5	0
Botryoglossum sp.	0	0	0	0	0	0	0	0	0	<5	0	<5	0	0	0	0	0	0	0	0	0
Calliarthron sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<5	0	0	0
Corallina sp.	0	0	0	0	0	<5	0	0	<5	0	0	0	0	0	0	0	0	0	0	0	0
Fauchea sp.	0	0	0	0	0	0	0	0	0	<5	0	0	0	0	0	0	0	<5	0	0	0
Gigartina sp.	0	0	0	0	0	0	0	<5	0	0	0	0	0	0	0	0	0	0	0	<5	0
Iridaea sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<5	0
Lithothamnion sp.	<5	0	0	<5	<5	35	0	15	80	50	60	60	0	0	40	0	0	<5	0	<5	<5
Microcladia coulteri	0	0	0	0	0	0	0	<5	0	0	0	0	0	0	0	0	0	0	0	<5	0
Micronema sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<5	0
Opuntiella californica	0	0	0	0	0	0	0	0	0	<5	0	0	0	0	0	0	0	0	0	<5	0
Polysiphonia sp.	0	0	<5	<5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 26 cont'd

Site	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
PHYLUM Rhodophyta cont'd																					
Polyneura latissima	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<5
Prionitis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<5	0
ZONE 3																					
PHYLUM Arthropoda Class Crustacea Subclass Malacostraca Order Decapoda Suborder Reptantia Section Brachyura																					
Cancer productus	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYLUM Echinodermata Class Asteroidea																					
Pycnopodia helianthoides	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 26 cont'd

	9	10	13	14	15	21	26	27	29	33	34	35	36	37	38	39	40	41	42	43	46
PHYLUM Phaeophyta																					
Desmarestia ligulata	0	0	0	0	0	0	0	0	0	0	<5	0	0	0	0	0	0	0	0	0	0
Nereocystis luetkeana	0	0	0	0	0	0	0	0	0	0	<5	0	0	0	0	0	0	0	0	0	0

Table 27. Fauna and flora observed at subtidal semi-exposed gravel, shell and boulder habitats in Broken Group Islands Section (1976). (sch indicates school of fish)

Table 27

Site	11	22	28
ZONE 1			
FAUNA			
PHYLUM Mollusca Class Amphineura			
Tonicella sp.	0	0	< 1
Class Gastropoda Subclass Prosobranchia			
Collisella pelta	0	0	<1
Crepidula adunca	<1	0	0
Notoacmea persona	0	0	<1
Polinices lewisii	<1	0	0
Searlesia dira	<1	0	0
Tegula pulligo	<1	3	<1
Thais lamellosa	<1	0	0
Subclass Opisthobranchia			
Dirona albolineata	0	<1	0
Class Bivalvia			
Tresus capax	<1	0	0
PHYLUM Arthropoda Class Crustacea Subclass Malacostraca Order Decapoda Suborder Reptantia Section Brachyura			
Cancer productus	0	<1	0
Pugettia sp.	0	<1	0

Table 27 cont'd

Site	11	22	28
PHYLUM Echinodermata Class Asteroidea			
Dermasterias imbricata	0	<1	0
Henricia leviuscula	<1	0	0
Patiria miniata	0	1	0
Pisaster ochraceus	<1	0	0
Pycnopodia helianthoides	<1	<1	0
PHYLUM Chordata Subphylum Urochordata			
Compound ascidians (unidentified)	0	<5%	0
Subphylum Craniata Class Osteichthyes			
Ammodytes hexapterus	0	<1	0
Coryphopterus nicholsi	0	0	<1
Enophrys bison	0	<1	0
Hexagrammos decagrammus	<1	0	0
FLORA			
PHYLUM Spermatophyta			
Phyllospadix sp.	0	0	20
Zostera marina	0	<5	0
PHYLUM Chlorophyta			
Codium fragile	<5	<5	<5
Ulva sp.	<5	<5	<0

Table 27 cont'd

Site	11	22	28
PHYLUM Phaeophyta			
Desmarestia sp.	0	<5	0
Macrocystis integrifolia	<5	0	0
Nereocystis luetkeana	<5	0	0
Pterygophora californica	<5	0	0
Sargassum muticum	0	0	20
Scytosiphon lomentaria	<5	0	0
PHYLUM Rhodophyta			
Iridaea sp.	<5	0	<5
Lithothamnion sp.	0	<5	0
Microcladia coulteri	0	0	<5
Neoagardhiella baileyi	10	0	0
Prionitis sp.	0	<5	0
ZONE 2			
FAUNA			
PHYLUM Mollusca Class Gastropoda Subclass Prosobranchia			
Haliotis kamtschatkana	0	<1	0
Tegula pulligo	0	<1	<1
PHYLUM Arthropoda Class Crustacea Subclass Malacostraca Order Decapoda Suborder Reptantia Section Brachyura			
Cancer productus	0	<1	0

Table 27 cont'd

Site	11	22	28
PHYLUM Echinodermata Class Holothuroidea			
Cucumaria miniata	0	<1	0
Class Asteroidea			
Dermasterias imbricata	0	<1	0
Pycnopodia helianthoides	0	<1	0
Subphylum Craniata Class Osteichthyes			
Coryphopterus nicholsi	0	0	<1
Sebastes melanops	0	0	sch
FLORA			
PHYLUM Phaeophyta			
Costaria costata	0	0	60
Desmarestia ligulata	0	0	<5
Macrocystis integrifolia	0	40	80
Nereocystis luetkeana	0	0	20
PHYLUM Rhodophyta			
Lithothamnion sp.	0	<5	20

Table 28. Fauna and flora observed at subtidal semi-exposed cobble, boulder and rock habitats with moderate slope and semi-exposed flat rock habitat (12) in Broken Group Islands Section (1976).

(sch indicates school of fish)

Table 28

Site	2	3	4	6	7	17	19	23	25	12
ZONE 1										
FAUNA										
PHYLUM Cnidaria Class Hydrozoa										
Aequorea aequorea	0	0	<1	0	0	0	0	0	0	0
Class Anthozoa										
Anthopleura xanthogrammica	0	0	0	0	0	0	<1	0	0	0
Balanophyllia elegans	0	0	0	0	0	<1	<1	0	0	0
Tealia coriacea	0	0	0	0	0	0	0	0	0	<1
T. crassicornis	0	0	0	0	0	0	<1	0	0	<1
PHYLUM Annelida Class Polychaeta										
Serpula vermicularis	0	0	<5%	<5%	<5%	0	<5%	<5%	<5%	<5%
PHYLUM Mollusca Class Amphineura										
Mopalia sp.	0	0	0	0	0	0	0	0	0	<1
Tonicella sp.	0	0	<1	0	<1	<1	0	0	0	0
Class Gastropoda Subclass Prosobranchia										
Acmaea mitra	<1	0	<1	0	<1	<1	<1	0	0	<1
Astraea gibberosa	<1	<1	<1	<1	<1	<1	5	0	10	2
Ceratostoma foliata	0	0	0	0	0	<1	0	0	0	0

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
Class Gastropoda Subclass Prosobranchia cont'd										
Diodora aspera	0	0	0	0	<1	0	0	0	0	0
Notoacmea persona	0	0	0	0	<1	0	0	0	0	0
N. scutum	0	0	0	0	<1	0	0	0	0	0
Searlesia dira	0	0	0	0	<1	0	0	0	0	0
Tegula pulligo	0	0	0	0	<1	<1	0	0	0	0
Subclass Opisthobranchia										
Anisodoris nobilis	0	0	0	0	0	0	0	<1	0	0
Cadlina luteomarginata	<1	0	0	0	0	0	0	0	0	0
Dirona albolineata	0	0	0	0	0	0	0	0	0	<1
Hermissenda crassicornis	0	0	0	0	0	0	0	0	0	<1
Class Bivalvia										
Crassostrea gigas	0	0	0	<1	0	0	0	0	0	0
Pododesmus macroschisma	<1	0	<1	0	<1	0	0	0	0	<1
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia										
Balanus cariosus	0	0	<5%	<5%	<5%	0	0	0	0	0
B. glandula	0	<5%	<5%	<5%	<5%	0	0	0	<5%	<5%

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
Subclass Malacostraca Order Decapoda Suborder Reptantia Section Anomura										
<u>Pagurus</u> sp.	0	0	0	0	<1	0	<1	0	0	0
<u>Petrolisthes</u> sp.	0	0	0	0	<1	0	0	0	0	<1
Section Brachyura										
<u>Cancer productus</u>	0	<1	<1	0	0	0	<1	0	0	<1
<u>PHYLUM</u> Ectoprocta										
unidentified bryozoans	<5%	0	<5%	0	<5%	<5%	<5%	<5%	<5%	0
<u>PHYLUM</u> Echinodermata Class Holothuroidea										
<u>Cucumaria miniata</u>	<1	2	<1	<1	6	10	15	<1	<1	<1
<u>Eupentacta quinquesemita</u>	0	0	<1	0	<1	0	<1	0	0	0
<u>Parastichopus californicus</u>	0	0	<1	0	<1	0	<1	0	0	<1
Class Asteroidea										
<u>Dermasterias imbricata</u>	<1	0	<1	0	<1	0	0	<1	0	<1
<u>Evasterias troschelii</u>	0	0	<1	0	0	0	0	0	0	<1
<u>Henricia leviuscula</u>	0	0	0	0	<1	<1	0	0	0	0
<u>Leptasterias hexactis</u>	0	0	0	0	0	<1	0	<1	0	0
<u>Orthasterias koehleri</u>	0	0	<1	0	<1	<1	<1	0	0	<1
<u>Patiria miniata</u>	0	3	0	5	<1	0	10	3	2	<1

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
Class Asteroidea cont'd										
Pisaster brevispinus	0	0	0	<1	0	0	0	0	0	<1
P. ochraceus	0	0	0	<1	0	0	0	<1	0	0
Pyncopodia helianthoides	<1	<1	0	0	<1	<1	<1	<1	<1	<1
Solaster stimpsoni	0	0	0	0	<1	0	0	0	0	0
Class Echinoidea										
Strongylocentrotus franciscanus	0	0	0	0	0	0	1	0	0	0
PHYLUM Chordata Subphylum Urochordata										
compound ascidians (unidentified)	0	0	<5%	0	<5%	<5%	0	0	0	0
red tunicates (unidentified)	0	0	<1	0	0	0	0	0	0	0
Styela montereyensis	0	0	0	0	0	<1	0	0	0	0
Subphylum Craniata Class Osteichthyes										
Aulorhynchus flavidus	0	0	0	0	0	<1	0	0	0	0
Coryphopterus nicholsi	<1	<1	<1	0	<1	<1	<1	<1	<1	<1
Embiotoca lateralis	0	sch	0	0	0	0	0	sch	0	0
Gobiesox maeandricus	0	0	0	0	<1	0	0	0	0	0
Rhacochilus vacca	0	sch	0	0	0	sch	sch	sch	0	0

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
FLORA										
PHYLUM Spermatophyta										
Zostera marina	0	0	0	<5	0	0	0	0	0	<5
PHYLUM Chlorophyta										
Bryopsis plumosa	<5	0	<5	0	0	0	0	0	0	0
Codium fragile	0	0	0	0	0	0	0	<5	0	0
Ulva sp.	0	30	0	<5	0	<5	<5	10	<5	0
PHYLUM Phaeophyta										
Desmarestia ligulata	0	0	0	0	0	20	<5	0	0	0
Eisenia arborea	0	0	0	0	<5	0	0	0	0	0
Fucus sp.	0	0	0	<5	0	0	0	0	0	0
Gastroclonium coulteri	0	0	0	0	0	0	0	<5	0	0
Leathesia difformis	<5	10	<5	0	<5	0	0	0	0	0
Macrocystis integrifolia	0	0	0	0	<5	85	0	0	0	<5
Sargassum muticum	25	0	50	<5	<5	0	0	0	0	0
Scytosiphon lomentaria	0	0	0	0	<5	0	0	0	0	0

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
PHYLUM Rhodophyta										
Bossiella sp.	0	0	0	0	0	<5	0	0	0	0
Ceramium sp.	0	0	0	0	0	0	0	<5	0	0
Corallina sp.	0	<5	80	0	<5	<5	0	0	0	0
Gelidium robustum	0	30	0	0	0	0	40	20	40	30
Gigartina sp.	0	<5	0	<5	0	<5	0	20	0	<5
Lithothamnion sp.	0	0	<5	0	<5	<5	30	0	<5	<5
Microcladia coulteri	0	0	0	0	0	<5	0	0	0	0
Smithora naiadum	0	0	0	0	0	0	0	0	0	<5

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
ZONE 2										
FAUNA										
PHYLUM Cnidaria Class Hydrozoa										
Obelia sp.	0	0	0	0	0	0	0	0	<1	0
Class Anthozoa										
Balanophyllia elegans	<1	0	<1	0	0	0	<1	<1	0	0
Epiactis prolifera	0	0	<1	0	0	0	0	0	0	0
Metridium senile	0	0	<1	0	0	0	0	0	0	0
Pachycerianthus fimbriatus	0	0	0	<1	0	0	0	<1	0	0
PHYLUM Annelida Class Polychaeta										
Serpula vermicularis	0	<5%	<5%	0	<5%	<5%	0	<5%	0	0
Spirobis sp.	0	0	0	0	<1	0	0	0	0	0
PHYLUM Mollusca Class Amphineura										
Tonicella sp.	<1	0	<1	0	0	<1	0	<1	0	0
Class Gastropoda Subclass Prosobranchia										
Acmaea mitra	<1	0	0	0	<1	<1	<1	0	0	0
Astraea gibberosa	<1	0	<1	<1	<1	0	<1	<1	<1	0

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
Class Gastropoda Subclass Prosobranchia cont'd										
Ceratostoma foliata	0	0	0	0	<1	<1	0	0	0	0
Haliotis ramtschatkana	0	0	0	0	0	0	0	<1	0	0
Puncterella multistriata	0	0	<1	0	0	0	0	0	0	0
Tegula funebralis	0	<1	0	0	0	0	0	0	0	0
T. pulligo	0	0	0	0	<1	0	<1	0	<1	0
Subclass Opisthobranchia										
Anisodoris nobilis	0	0	0	<1	0	0	0	0	0	0
Cadlina luteomarginata	<1	0	<1	0	0	0	0	<1	0	0
Diaulula sandiegensis	0	0	0	0	<1	0	0	0	0	0
Dirona albolineata	0	0	0	0	<1	0	0	0	0	0
D. aurantia	0	0	0	0	<1	0	0	0	0	0
Hermissenda crassicornis	0	0	0	<1	0	0	0	0	0	0
Polycera tricolor	0	0	<1	0	0	0	0	0	0	0
Triopha carpenteri	0	0	0	0	<1	0	0	0	0	0
Class Bivalvia										
Pododesmus macroschisma	0	0	0	0	<1	0	0	0	0	0
Saxidomus giganteus	0	0	0	0	0	0	<1	0	0	0

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
PHYLUM Arthropoda Class Crustacea Subclass Malacostraca Order Decapoda Suborder Reptantia Section Anomura										
Pagurus sp.	0	0	0	<1	0	0	0	0	0	0
Section Brachyura										
Cancer magister	0	0	0	<1	0	0	0	0	0	0
C. productus	0	0	<1	0	<1	0	0	0	0	0
Pugettia sp.	<1	0	<1	0	0	0	0	0	0	0
PHYLUM Ectoprocta										
bryozoans	<5%	<5%	<5%	0	0	0	0	<5%	<5%	0
PHYLUM Echinodermata Class Holothuroidea										
Cucumaria miniata	<1	4	<1	<1	0	<1	0	<1	<1	0
Eupentacta quinquesemita	0	<1	<1	<1	<1	0	0	<1	0	0
Parastichopus californicus	<1	0	0	<1	0	0	<1	<1	<1	0
Psolus chitonoides	0	0	<1	0	0	0	0	0	0	0
Class Asteroidea										
Dermasterias imbricata	0	<1	<1	<1	0	0	0	0	0	0
Evasterias troschelii	0	0	<1	0	0	0	0	0	0	0
Henricia leviuscula	0	0	0	0	<1	<1	0	0	0	0

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
Class Asteroidea cont'd										
Orthasterias koehleri	<1	<1	<1	<1	<1	<1	0	<1	0	0
Patiria miniata	0	0	0	0	0	0	5	<1	0	0
Pisaster brevispinis	0	0	0	0	<1	0	0	0	0	0
Pteraster tesselatus	0	0	<1	0	0	0	0	0	0	0
Pycnopodia helianthoides	0	<1	<1	<1	0	0	<1	<1	0	0
Solaster stimpsoni	0	0	<1	0	0	0	0	0	0	0
PHYLUM Chordata Subphylum Urochordata										
Ascidia paratropa	0	0	<1	0	0	0	0	0	0	0
Compound ascidians (unidentified)	0	0	0	0	0	<5%	0	0	0	0
red tunicates (unidentified)	<1	0	<1	0	0	0	0	<1	0	0
Styela montereyensis	0	0	<1	<1	0	0	0	0	0	0
Subphylum Craniata Class Osteichthyes										
Coryphopterus nicholsi	0	0	<1	<1	<1	<1	0	<1	<1	0
Embiotoca lateralis	0	0	sch	0	0	0	0	0	0	0
Hexagrammos decagrammos	0	0	0	0	0	0	<1	<1	0	0
Sebastes caurinus	0	0	0	<1	0	0	0	<1	0	0
S. melanops	<1	<1	0	0	0	0	0	sch	0	0

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
FLORA										
PHYLUM Chlorophyta										
Ulva sp.	0	<5	0	0	0	0	0	0	0	0
PHYLUM Phaeophyta										
Agarum fimbriatum	0	0	50	0	30	30	0	60	0	0
Costaria costata	0	<5	0	0	0	0	0	0	0	0
Desmarestia ligulata	0	<5	0	0	0	0	<5	<5	0	0
D. viridis	0	<5	0	0	0	0	0	0	0	0
Eisenia arborea	<5	0	50	0	30	10	0	0	0	0
Macrocystis integrifolia	90	25	0	50	0	0	0	20	100	0
Nereocystis luetkeana	0	<5	0	0	0	0	0	0	0	0
PHYLUM Rhodophyta										
Bossiella sp.	0	40	0	<5	<5	0	0	0	0	0
Botryocladia pseudodichotoma	0	0	<5	0	0	0	0	0	0	0
Corallina sp.	0	0	30	<5	0	<5	0	0	0	0
Gelidium robustum	0	0	0	0	0	0	<5	0	0	0
Laurencia spectabilis	0	0	0	0	0	0	0	<5	0	0
Lithothamnion sp.	0	0	0	0	<5	<5	30	<5	<5	0

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
ZONE 3										
FAUNA										
Phylum Porifera										
Sponges (unidentified)	0	0	0	<5%	0	0	0	0	0	0
PHYLUM Cnidaria Class Hydrozoa										
Aequorea aequorea	<1	0	0	0	0	0	0	0	0	0
Class Anthozoa										
Balanophyllia elegans	<1	0	0	0	0	0	<1	<1	0	0
Pachycerianthus fimbriatus	>1	0	0	.0	0	0	0	<1	1	0
Ptilosarcus gurneyi	0	0	0	<1	0	0	0	0	0	0
Tealia lofotensis	0	0	0	0	0	0	<1	0	0	0
PHYLUM Nemertea										
Tubulanus polymorphus	0	0	0	0	0	0	0	0	<1	0
PHYLUM Annelida Class Polychaeta										
Serpula vermicularis	<5%	0	0	0	0	0	0	0	0	0
PHYLUM Mollusca Class Amphineura										
Mopalia sp.	0	0	0	0	0	0	0	<1	0	0

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
Class Amphineura cont'd										
Tonicella sp.	<1	0	0	0	0	0	0	0	0	0
Class Ecphalopoda										
Octopus sp.	0	0	0	0	0	0	<1	0	0	0
Class Gastropoda Subclass Prosobranchia										
Astraea gibberosa	<1	0	0	<1	0	0	<1	0	1	0
Ceratostoma foliata	<1	0	0	0	0	0	0	0	0	0
Haliotis kamtschatkana	0	0	0	<1	0	0	0	0	0	0
Polinices lewisii	0	0	0	0	0	0	0	0	<1	0
Tegula funebralis	0	<1	0	<1	0	0	0	0	0	0
Subclass Opisthobranchia										
Cadlina luteomarginata	0	0	0	0	0	0	0	<1	0	0
Dendronotus sp.	0	0	0	<1	0	0	0	0	0	0
Triopha carpenteri	<1	0	0	0	0	0	0	<1	0	0
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia										
Balanus glandula	0	0	0	0	0	0	<5%	0	75%	0

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
Subclass Malacostraca Order Decapoda Suborder Reptantia Section Anomura										
Pagurus sp.	0	0	0	0	0	0	0	0	<1	0
Section Brachyura										
Cancer productus	0	0	0	0	0	0	0	0	<1	0
PHYLUM Ectoprocta										
bryozoans (unidentified)	0	0	0	<1	0	0	0	<5%	0	0
PHYLUM Echinodermata Class Holothuroidea										
Cucumaria miniata	<1	0	0	0	0	0	<1	<1	0	0
Eupentacta quinquesemita	<1	0	0	0	0	0	0	<1	0	0
Parastichopus californicus	<1	1	0	0	0	0	<1	<1	<1	0
Class Asteroidea										
Dermasterias imbricata	<1	<1	0	0	0	0	<1	0	0	0
Evasterias troschelii	0	0	0	0	0	0	0	0	<1	0
Patiria miniata	0	0	0	0	0	0	0	0	5	0
Pisaster brevispinus	<1	<1	0	<1	0	0	0	0	<1	0
Pycnopodia helianthoides	<1	0	0	0	0	0	<1	<1	<1	0
Solaster dawsoni	<1	0	0	0	0	0	0	0	0	0
S. stimpsoni	0	0	0	0	0	0	0	<1	0	0

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
Class Echinoidea										
Strongylocentrotus franciscanus	0	0	0	0	0	0	<1	0	0	0
PHYLUM Chordata										
Subphylum Urochordata										
Compound ascidians (unidentified)	0	<5%	0	0	0	0	0	<5%	0	0
Styela montereyensis	0	0	0	0	0	0	0	0	<1	0
Subphylum Craniata										
Class Chondrichthyes										
Squalus acanthias	0	0	0	<1	0	0	0	0	0	0
Class Osteichthyes										
Artedius harringtoni	0	<1	0	0	0	0	0	0	0	0
Coryphopterus nicholsi	<1	0	0	0	0	0	0	<1	0	0
Hexagrammos decagramm s	0	<1	0	<1	0	0	0	0	0	0
Loxorhynchus crispatus	0	<1	0	0	0	0	0	0	0	0
Pholis sp.	0	0	0	<1	0	0	0	0	0	0

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
FLORA										
PHYLUM Chlorophyta										
Codium fragile	0	0	0	0	0	0	<5	0	0	0
Ulva sp.	0	0	0	0	0	0	0	0	<5	0
PHYLUM Phaeophyta										
Agarum fimbriatum	75	20	0	75	0	0	0	0	0	0
Desmarestia ligulata	0	0	0	0	0	0	<5	0	0	0
Eisenia arborea	<5	35	75	0	0	0	0	50	0	0
Pleurophycus gardneri	0	0	0	0	0	0	0	<5	0	0
PHYLUM Rhodophyta										
Bossiella sp.	0	0	0	0	0	0	0	<5	0	0
Calliarthron sp.	0	<5	0	0	0	0	0	0	0	0
Gelidium robustum	0	0	0	0	0	0	40	0	<5	0
Gigartina sp.	0	0	0	0	0	0	<5	0	0	0
Lithothamnion sp.	<5	0	0	0	0	0	20	0	<5	0
Neoagardhiella baileyi	0	0	0	0	0	0	<5	0	0	0
Rhodoglossum affine	0	<5	0	0	0	0	0	0	0	0

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
ZONE 4										
FAUNA										
PHYLUM Cnidaria Class Anthozoa										
Metridium senile	0	0	0	0	0	0	0	0	<1	0
Pachycerianthus fimbriatus	0	0	0	0	> 1	0	0	0	0	0
PHYLUM Annelida Class Polychaeta										
Serpula vermicularis	0	0	0	0	0	0	0	0	<5%	0
PHYLUM Mollusca Class Amphineura										
Mopalia sp.	0	0	0	0	0	0	0	0	<1	0
Class Gastropoda Subclass Prosobranchia										
Astraea gibberosa	0	0	0	0	0	0	0	0	<1	0
Class Bivalvia										
Pododesmus macroschisma	0	0	0	0	0	0	0	0	<1	0
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia										
Balanus glandula	0	0	0	0	0	0	0	0	<5%	0

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
PHYLUM Ectoprocta										
bryozoans (unidentified)	0	0	0	0	0	0	0	0	<5%	0
PHYLUM Echinodermata Class Holothuroidea										
Cucumaria miniata	0	0	0	0	0	0	0	0	<1	0
Parastichopus californicus	0	0	0	0	<1	0	0	0	0	0
Class Asteroidea										
Patiria miniata	0	0	0	0	0	0	0	0	<1	0
Pisaster brevispinus	0	0	0	0	<1	0	0	0	0	0
Pycnopodia helianthoides	0	0	0	0	<1	0	0	0	<1	0
PHYLUM Chordata Subphylum Urochordata										
red tunicates (unidentified)	0	0	0	0	0	0	0	0	<1	0
Subphylum Craniata Class Osteichthyes										
Coryphopterus nicholsi	0	0	0	0	0	0	0	0	<1	0

Table 28 cont'd

Site	2	3	4	6	7	17	19	23	25	12
FLORA										
PHYLUM Chlorophyta										
Ulva sp.	0	0	0	0	0	0	0	0	<5	0
PHYLUM Phaeophyta										
Macrocystis integrifolia	0	0	0	0	0	0	0	0	60	0
PHYLUM Rhodophyta										
Gelidium robustum	0	0	0	0	0	0	0	0	30	0
Lithothamnion sp.	0	0	0	0	0	0	0	0	<5	0

Table 29. Fauna and flora observed at subtidal sheltered gravel, sand, shell and mud habitats with moderate slope and sheltered sand and mud flats (5), Broken Group Islands Section (1976). (sch indicates school of fish)

Table 29

Site	1	8	18	20	24	30	31	32	44	45	5
ZONE 1											
FAUNA											
PHYLUM Cnidaria Class Anthozoa											
Metridium senile	0	0	0	0	0	0	0	0	<1	0	0
Pachycerianthus fimbriatus	0	0	0	0	1	<1	<1	2	0	1	<1
Tealia coriacea	0	0	0	0	<1	<1	0	0	0	0	<1
PHYLUM Annelida Class Polychaeta											
Serpula vermicularis	<5%	0	0	0	<5%	<5%	<5%	0	<5%	<5%	<5%
PHYLUM Mollusca Class Amphineura											
Mopalia sp.	<1	0	0	0	0	0	0	0	0	<1	<1
Class Gastropoda Subclass Prosobranchia											
Astraea gibberosa	0	0	0	0	5	0	0	2	3	<1	<1
Collisella pelta	0	0	0	0	0	0	0	0	0	0	<1
Polinices lewisii	0	<1	0	0	<1	0	0	<1	0	<1	<1
Searlesia dira	0	0	0	0	<1	0	0	0	0	<1	0
Tegula pulligo	0	0	0	0	<1	0	0	0	0	0	0

Table 29 cont'd

Site	1	8	18	20	24	30	31	32	44	45	5
Subclass Opisthobranchia											
Dendronotus sp.	0	0	0	0	0	0	0	0	0	0	<1
Phyllaplysia taylori	<1	0	0	0	0	0	<1	0	0	0	0
Class Bivalvia											
Clinocardium nuttalli	0	0	0	<1	0	0	0	0	0	0	0
Hinnites giganteus	0	0	0	0	0	<1	0	0	0	0	0
Pododesmus macroschisma	0	0	0	0	<1	<1	<1	0	0	<1	<1
Tresus capax	0	4	5	2	<1	0	1	0	0	<1	0
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia											
Balanus cariosus	0	0	0	0	0	0	<5%	0	0	0	0
B. glandula	0	0	<5%	0	<5%	<5%	0	0	<5%	<5%	<5%
Subclass Malacostraca Order Decapoda Suborder Reptantia Section Brachyura											
Cancer productus	0	<1	<1	0	<1	<1	0	<1	0	0	<1
Pugettia sp.	0	<1	0	0	0	0	0	<1	0	0	<1
PHYLUM Ectoprocta											
bryozoans (unidentified)	0	0	0	0	0	0	0	0	<5%	0	<5%

Table 29 cont'd

Site	1	8	18	20	24	30	31	32	44	45	5
PHYLUM Echinodermata Class Holothuroidea											
Cucumaria miniata	0	0	<1	0	0	0	0	0	<1	0	0
Parastichopus californicus	0	0	0	0	0	0	0	0	<1	<1	0
Class Ophiuroidea											
Ophiopholis sp.	0	0	0	0	0	0	0	0	<1	0	0
Class Asteroidea											
Dermasterias imbricata	0	0	<1	0	0	<1	0	<1	<1	0	<1
Evasterias troschelii	<1	<1	<1	0	0	<1	0	0	0	0	0
Henricia leviuscula	0	0	0	0	0	0	0	<1	0	0	0
Orthasterias koehleri	0	0	<1	0	<1	0	0	<1	0	0	0
Patiria miniata	<1	<1	5	0	5	2	3	4	2	1	<1
Pisaster brevispinus	0	<1	<1	0	0	<1	<1	0	0	<1	<1
P. ochraceus	0	0	0	0	<1	0	<1	0	0	0	0
Pycnopodia helianthoides	0	<1	<1	0	<1	0	0	<1	<1	<1	0
PHYLUM Chordata Subphylum Urochordata											
red tunicates (unidentified)	0	0	0	0	0	0	0	0	<1	0	0

Table 29 cont'd

Site	1	8	18	20	24	30	31	32	44	45	5
Subphylum Craniata Class Osteichthyes											
<u>Clupea herrengus pallasii</u>	0	0	0	0	0	0	0	0	0	0	sch
<u>Cymatogaster aggregata</u>	0	0	0	0	0	0	0	0	0	0	<1
<u>Embiotoca lateralis</u>	0	0	0	0	0	0	sch	0	0	0	sch
<u>Enophrys bison</u>	0	0	<1	0	0	0	0	0	0	0	0
<u>Hexagrammos decagrammus</u>	0	<1	0	0	0	0	<1	<1	0	0	0
<u>Porichthys notatus</u>	0	0	0	0	0	<1	0	0	0	0	0
<u>Rhacochilus vacca</u>	0	0	0	0	0	0	0	0	0	0	sch
<u>Sebastes caurinus</u>	0	0	0	0	0	0	0	0	<1	0	0
<u>S. melanops</u>	0	0	0	0	0	0	0	0	sch	0	0
sandab (unidentified)	0	<1	<1	0	0	0	0	0	0	0	0
blenny (unidentified)	0	<1	0	0	0	0	0	0	0	0	0
<u>Coryphopterus nicholsi</u>	0	0	<1	0	0	<1	0	<1	<1	<1	0
FLORA											
<u>PHYLUM</u> Spermatophyta											
<u>Zostera marina</u>	90	80	0	80	0	0	10	<5	0	0	95
<u>PHYLUM</u> Chlorophyta											
<u>Bryopsis plumosa</u>	0	0	0	0	0	0	0	0	0	0	<5
<u>Codium fragile</u>	0	<5	<5	0	0	0	0	0	0	0	0
<u>Enteromorpha</u> sp.	0	0	<5	0	0	0	<5	0	0	<5	0
<u>Ulva</u> sp.	0	<5	<5	0	<5	0	0	0	0	0	<5

Table 29 cont'd

Site	1	8	18	20	24	30	31	32	44	45	5
PHYLUM Phaeophyta											
Alaria marginata	0	<5	0	0	0	0	0	0	0	0	0
Desmarestia ligulata	0	<5	0	0	0	0	0	0	0	<5	0
Laminaria saccharina	0	0	0	0	0	0	0	0	0	<5	<5
Sargassum muticum	0	<5	0	0	0	0	0	<5	0	0	<5
PHYLUM Rhodophyta											
Ceramium sp.	0	0	0	0	0	<5	0	0	<5	<5	0
Corallina sp.	0	<5	<5	0	0	0	0	0	0	0	0
Gelidium robustum	0	0	<5	0	<5	20	<5	<5	60	<5	0
Gigartina sp.	<5	<5	0	0	0	0	<5	0	0	0	0
Gracilaria verrucosa	0	0	0	0	0	<5	<5	<5	0	<5	0
Lithothamnion sp.	0	<5	0	0	<5	0	0	0	<5	<5	<5
Neoagardhiella baileyi	0	0	<5	0	0	0	0	0	0	0	0
Smithora naiadum	0	<5	0	0	0	0	0	0	0	0	<5

Table 29 cont'd

Site	1	8	18	20	24	30	31	32	44	45	5
ZONE 2											
FAUNA											
<u>PHYLUM</u> Porifera											
Sponges (unidentified)	0	0	0	0	0	0	0	0	0	0	<5%
<u>PHYLUM</u> Cnidaria <u>Class</u> Hydrozoa											
Aequorea aequorea	<1	0	0	0	0	0	0	0	0	0	<1
Class Anthozoa											
Pachycerianthus fimbriatus	>1	0	0	0	0	0	0	0	1	0	0
Tealia coriacea	0	0	0	0	0	0	0	0	<1	0	0
<u>PHYLUM</u> Nemertea											
Tubulanus polymorphus	0	0	0	0	0	0	0	0	0	0	<1
<u>PHYLUM</u> Annelida Class Polychaeta											
Serpula vermicularis	<5%	0	0	0	0	0	0	0	0	0	<5%
<u>PHYLUM</u> Mollusca Class Amphineura											
Tonicella sp.	0	0	0	0	0	0	0	0	0	0	<1

Table 29 cont'd

Site	1	8	18	20	24	30	31	32	44	45	5
Class Cephalopoda											
Octopus sp.	0	0	0	0	0	0	0	0	0	0	<1
Class Gastropoda Subclass Prosobranchia											
Acmaea mitra	0	0	0	0	0	0	0	0	0	0	<1
Astraea gibberosa	0	<1	0	0	0	0	0	0	<1	0	<1
Ceratostoma foliata	0	0	0	0	0	0	0	0	0	0	<1
Polinices lewisii	0	0	0	0	0	0	0	0	<1	0	0
Tegula funebralis	0	0	0	0	0	0	0	0	<1	0	0
Subclass Opisthobranchia											
Anisodoris nobilis	0	0	0	0	0	0	0	0	0	0	<1
Dendronotus sp.	0	0	0	0	0	0	0	0	<1	0	<1
Dirona albolineata	0	<1	0	0	0	0	0	0	0	0	0
Hermissenda crassicornis	0	0	0	0	0	0	0	0	0	0	<1
Class Bivalvia											
Hinnites giganteus	0	0	0	0	0	0	0	0	0	0	<1
Pododesmus macroschisma	<1	0	0	0	0	0	0	0	0	0	<1
Tresus capax	<1	2	0	2	0	0	0	0	0	0	0
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia											
Balanus glandula	<5%	0	0	0	0	0	0	0	0	0	0

Table 29 cont'd

Site	1	8	18	20	24	30	31	32	44	45	5
Subclass Malacostraca Order Decapoda Suborder Reptantia Section Anomura											
Pagurus sp.	0	0	0	0	0	0	0	0	0	0	<1
Petrolisthes sp.	0	0	0	0	0	0	0	0	0	0	<1
Section Brachyura											
Cancer productus	0	<1	0	0	0	0	0	0	<1	0	<1
PHYLUM Ectoprocta											
bryozoans (unidentified)	<1	0	0	0	0	0	0	0	0	0	0
PHYLUM Echinodermata Class Holothuroidea											
Cucumaria miniata	0	0	0	0	0	0	0	0	0	0	<1
Eupentacta quinquesemita	0	0	0	0	0	0	0	0	0	0	<1
Parastichopus californicus	0	0	0	0	0	0	0	0	0	0	<1
Class Asteroidea											
Dermasterias imbricata	<1	0	0	0	0	0	0	0	0	0	<1
Evasterias troschelii	0	0	0	0	0	0	0	0	0	0	<1
Orthasterias koehleri	0	0	0	0	0	0	0	0	<1	0	0
Patiria miniata	6	0	0	0	0	0	0	0	<1	0	<1
Pisaster brevispinus	<1	0	0	0	0	0	0	0	<1	0	0
Pycnopodia helianthoides	<1	0	0	0	0	0	0	0	<1	0	<1

Table 29 cont'd

Site	1	8	18	20	24	30	31	32	44	45	5
Class Asteroidea cont'd											
Solaster stimpsoni	0	0	0	0	0	0	0	0	0	0	<1
Stylasterias forreri	0	0	0	0	0	0	0	0	0	0	<1
PHYLUM Chordata Subphylum Urochordata											
compound ascidians (unidentified)	0	0	0	0	0	0	0	0	0	0	<5%
red tunicates (unidentified)	0	0	0	0	0	0	0	0	0	0	<1
Styela montereyensis	0	0	0	0	0	0	0	0	0	0	<1
Subphylum Craniata Class Osteichthyes											
blenny (unidentified)	<1	0	0	0	0	0	0	0	0	0	0
Coryphopterus nicholsi	0	0	0	0	0	0	0	0	0	0	<1
Hexagrammos decagrammus	0	0	0	0	0	0	0	0	<1	0	<1
sanddab (unidentified)	0	0	0	0	0	0	0	0	<1	0	0
Sebastes melanops	0	0	0	0	0	0	0	0	sch	0	0

Table 29 cont'd

Site	1	8	18	20	24	30	31	32	44	45	5
FLORA											
PHYLUM Spermatophyta											
Zostera marina	0	0	0	0	0	0	0	0	<5	0	0
PHYLUM Chlorophyta											
Enteromorpha sp.	0	<5	0	0	0	0	0	0	0	0	0
PHYLUM Phaeophyta											
Agarum fimbriatum	0	0	0	0	0	0	0	0	0	0	<5
Costaria costata	0	0	0	0	0	0	0	0	0	0	<5
Desmarestia ligulata	0	<5	0	0	0	0	0	0	<5	0	0
Eisenia arborea	0	0	0	0	0	0	0	0	0	0	40
Laminaria saccharina	0	0	0	0	0	0	0	0	<5	0	0
Sargassum muticum	0	0	0	10	0	0	0	0	0	0	0
PHYLUM Rhodophyta											
Ceramium sp.	0	0	0	0	0	0	0	0	<5	0	0
Corallina sp.	0	<5	0	0	0	0	0	0	0	0	<5
Gelidium robustum	0	0	0	0	0	0	0	0	<5	0	0
Gigartina sp.	0	<5	0	0	0	0	0	0	0	0	0
Gracilaria verrucosa	0	0	0	0	0	0	0	0	<5	0	0
Lithothamnion sp.	0	0	0	0	0	0	0	0	0	0	<5
Microcladia coulteri	0	0	0	0	0	0	0	0	<5	0	0
Neoagardhiella baileyi	30	0	0	0	0	0	0	0	<5	0	0
Polysiphonis sp.	0	0	0	0	0	0	0	0	<5	0	0

Table 29 cont'd

Site	1	8	18	20	24	30	31	32	44	45	5
ZONE 3											
FAUNA											
PHYLUM Cnidaria Class Anthozoa											
Pachycerianthus fimbriatus	4	0	0	1	0	0	0	0	0	0	0
Tealia coriacea	0	0	0	<1	0	0	0	0	0	0	0
PHYLUM Nemertea											
Tubulanus polymorphus	0	0	0	<1	0	0	0	0	0	0	0
PHYLUM Annelida Class Polychaeta											
Spirorbis sp.	<1	0	0	0	0	0	0	0	0	0	0
PHYLUM Mollusca Class Gastropoda Subclass Prosobranchia											
Polinices lewisii	0	0	0	<1	0	0	0	0	0	0	0
Subclass Opisthobranchia											
Dendronotus sp.	<1	0	0	<1	0	0	0	0	0	0	0
Hermissenda crassicornis	<1	0	0	0	0	0	0	0	0	0	0
Class Bivalvia											
Tresus capax	0	0	0	<1	0	0	0	0	0	0	0

Table 29 cont'd

Site	1	8	18	20	24	30	31	32	44	45	5
PHYLUM Arthropoda Class Crustacea Subclass Malacostraca Order Decapoda Suborder Reptantia Section Brachyura											
Pugettia sp.	<1	0	0	<1	0	0	0	0	0	0	0
PHYLUM Echinodermata Class Holothuroidea											
Parastichopus californicus	0	0	0	<1	0	0	0	0	0	0	0
Class Asteroidea											
Dermasterias imbricata	0	0	0	<1	0	0	0	0	0	0	0
Patiria miniata	0	0	0	1	0	0	0	0	0	0	0
Pycnopodia helianthoides	<1	0	0	0	0	0	0	0	0	0	0
Stylasterias forreri	<1	0	0	0	0	0	0	0	0	0	0
PHYLUM Chordata Subphylum Urochordata											
compound ascidians (unidentified)	<5%	0	0	0	0	0	0	0	0	0	0
Subphylum Craniata Class Osteichthyes											
Porichthys notatus	0	0	0	<1	0	0	0	0	0	0	0

Table 29 cont'd

Site	1	8	18	20	24	30	31	32	44	45	5
FLORA											
PHYLUM Chlorophyta											
Ulva sp.	0	0	0	<5	0	0	0	0	0	0	0
PHYLUM Phaeophyta											
Laminaria saccharina	100	0	0	0	0	0	0	0	0	0	0
PHYLUM Rhodophyta											
Neoagardhiella baileyi	0	0	0	40	0	0	0	0	0	0	0

Table 29 cont'd

Site	1	8	18	20	24	30	31	32	44	45	5
ZONE 4											
FAUNA											
PHYLUM Cnidaria Class Anthozoa											
Pachycerianthus fimbriatus	0	0	0	<1	0	0	0	0	0	0	0
PHYLUM Mollusca Class Gastropoda Subclass Opisthobranchia											
Dendronotus sp.	0	0	0	<1	0	0	0	0	0	0	0
PHYLUM Echinodermata Class Holothuroidea											
Parastichopus californicus	0	0	0	<1	0	0	0	0	0	0	0
Class Asteroidea											
Pteraster tesselatus	0	0	0	<1	0	0	0	0	0	0	0
FLORA											
PHYLUM Spermatophyta											
Zostera marina	0	0	0	60	0	0	0	0	0	0	0

Table 30. Total number and number/m² of clams found in semi-exposed and sheltered gravel, sand and shell beaches, Broken Group Islands Section (1976).

Location	Jaques Is. (1)		Jaques Is. (3)		Keith Is. (7)		Gibraltar Is. (11)		Gibraltar Is. (14)		Nettle Is. (16)	
Bivalve species	Total No.	No./m²	Total No.	No./m²	Total No.	No./m²	Total No.	No./m²	Total No.	No./m²	Total No.	No./m²
Clinocardium nuttallii	3	1.5	2	1.6	0	0	0	0	3	2.4	0	0
Crassostrea gigas	0	0	0	0	-	<1	0	0	0	0	0	0
Diplodonta orbellus	0	0	0	0	0	0	0	0	0	0	0	0
Gari californica	0	0	0	0	0	0	0	0	2	1.6	1	0.8
Macoma nasuta	6	2.4	15	12.0	61	195.2	0	0	0	0	0	0
Mya arenaria	9	3.6	0	0	0	0	0	0	0	0	0	0
Protothaca staminea	88	35.2	42	33.6	111	355.2	31	24.8	9	7.2	7	5.6
Saxidomus giganteus	30	12.0	5	4.0	5	16.0	2	1.6	13	10.4	0	0
Tresus capax	17	6.8	0	0	10	32.0	1	0.8	15	12.0	0	0
Venerupis japonica	0	0	2	1.6	17	54.4	0	0	2	1.6	0	0

Table 30 cont'd

Location	Nettle Is. (17)		Nettle Is. (20)		Nettle Is. (21)		Nettle Is. (23)		Nettle Is. (26)		Nettle Is. (31)	
Bivalve species	Total No.	No./m²	Total No.	No./m²	Total No.	No./m²	Total No.	No./m²	Total No.	No./m²	Total No.	No./m²
Clinocardium nuttallii	3	2.0	0	0	2	1.3	0	0	0	0	0	0
Crassostrea gigas	0	0	-	4	0	0	0	0	0	0	0	0
Diplodonta orbellus	0	0	0	0	16	10.7	3	2.4	0	0	0	0
Gari californica	0	0	0	0	1	0.7	0	0	0	0	0	0
Macoma nasuta	2	1.3	0	0	0	0	0	0	0	0	0	0
Mya arenaria	49	32.8	2	1.6	0	0	0	0	16	12.8	0	0
Protothaca staminea	72	48.2	32	25.6	345	231.2	60	48.0	5	4.0	14	44.8
Saxidomus giganteus	38	25.5	2	1.6	364	243.9	69	55.2	0	0	1	3.2
Tresus capax	0	0	0	0	0	0	0	0	1	0.8	0	0
Venerupis japonica	52	34.8	47	37.6	1	0.7	0	0	1	0.8	2	6.4

Table 30 cont'd

Location	Walsh Is. (32)		Walsh Is. (32a)		Walsh Is. (33)		Walsh Is. (34)		Willis Is. (35)		Willis Is. (35a)	
Bivalve species	Total No.	No./m²	Total No.	No./m²	Total No.	No./m²	Total No.	No./m²	Total No.	No./m²	Toal No.	No./m²
Clinocardium nuttallii	0	0	0	0	0	0	0	0	0	0	0	0
Crassostrea gigas	-	1	0	0	0	0	-	<1	0	0	0	0
Diplodonta orbellus	0	0	0	0	0	0	0	0	0	0	0	0
Gari californica	0	0	0	0	1	0.8	0	0	1	0.8	1	0.8
Macoma nasuta	0	0	2	1.6	0	0	0	0	0	0	0	0
Mya arenaria	0	0	1	0.8	0	0	0	0	0	0	0	0
Protothaca staminea	0	0	25	20.0	13	10.4	25	20.0	0	0	0	0
Saxidomus giganteus	0	0	7	5.6	10	8.0	4	3.2	0	0	0	0
Tresus capax	0	0	5	4.0	0	0	0	0	0	0	0	0
Venerupis japonica	1	0.8	0	0	0	0	0	0	0	0	0	0

Table 30 cont'd

Location	Willis Is. (36)		Willis Is. (37)		Willis Is. (38)		Dodd Is. (40)		Dodd Is. (41)		Hand Is. (42)	
Bivalve species	Total No.	No./m^2	Total No.	No./m^2	Total No.	No./m^2	Total No	No./m^2	Total No.	No./m^2	Total No	No./m^2
Clinocardium nuttallii	0	0	1	0.8	4	3.2	0	0	0	0	0	0
Crassostrea gigas	0	0	0	0	0	0	0	0	0	0	0	0
Diplodonta orbellus	0	0	0	0	0	0	0	0	0	0	0	0
Gari californica	0	0	3	2.4	0	0	0	0	0	0	0	0
Macoma nasuta	0	0	0	0	0	0	0	0	11	6.3	3	1.7
Mya arenaria	0	0	0	0	0	0	1	0.8	39	22.2	33	18.8
Protothaca staminea	1	0.7	0	0	4	3.2	0	0	26	14.8	10	5.7
Saxidomus giganteus	0	0	0	0	0	0	0	0	6	3.4	0	0
Tresus capax	3	2.0	0	0	0	0	1	0.8	0	0	0	0
Venerupis japonica	0	0	0	0	0	0	0	0	5	2.9	49	27.9

Table 30 cont'd

Location / Bivalve species	Clarke Is. (44)		Clarke Is. (45)		Effingham Is. (53)		Gilbert Is. (54)		Camblain Is. (59)	
	Total No.	No./m^2	Total No.	No./m^2	Total No.	No./m^2	Total No.	No./m^2	Total No.	No./m^2
Clinocardium nuttallii	3	2.4	2	1.6	1	0.7	0	0	0	0
Crassostrea gigas	0	0	0	0	-	<1	0	0	0	0
Diplodonta orbellus	0	0	0	0	0	0	0	0	0	0
Gari californica	0	0	2	1.6	0	0	0	0	0	0
Macoma nasuta	9	7.2	1	0.8	2	1.3	0	0	0	00
Mya arenaria	1	0.8	0	0	1	1.7	0	0	0	0
Protothaca staminea	37	29.6	27	21.6	24	16.1	53	35.5	0	0
Saxidomus giganteus	69	52.2	9	7.2	21	14.1	2	1.3	3	1.7
Tresus capax	9	7.2	8	6.4	3	2.0	0	0	11	6.3
Venerupis japonica	0	0	0	0	3	2.0	3	2.0	0	0

Table 31. Area of the nine beaches that support the largest clam populations, Broken Group Islands Section (1976).

Location	Area of beach (Hectares)
1. Clarke Island	3.6
2. Trickett-Turret Islands	1.2
3. Willis Island	1.6
4. Hand Island	3.0
5. Nettle Island	1.0
6. Nettle Island	1.2
7. Gibraltar Island	0.4
8. Keith Island	0.2
9. Gilbert Island	0.3

Table 32. Species and numbers of fish observed during subtidal survey, Broken Group Islands Section (1976).

Species of fish	No. observed	
Greenling and Lingcod		
Hexagrammos decagrammus (kelp greenling)	32	
Oxylebius pictus (painted greeniling)	1	
Ophiodon elongatus (lingcod)	4	
Perch		
Embiotoca lateralis (striped seaperch)	8 1	schools individual
Rhacochilus vacca (pile perch)	7 1	schools individual
Rockfish		
Sebastes caurinus (copper rockfish)	8	
S. melanops (black rockfish)	19 3	schools individuals
Sanddab		
Citharichthys sp.	3	
Additional species		
Ammodytes hexapterus (pacific sand lance)	1	
Artedius harringtoni (scalyhead sculpin)	4	
A. lateralis (smoothead sculpin)	2	

Table 32 cont'd

Species of fish	No. observed
Additional species cont'd	
Aulorhynchus flavidus (tube-snout)	3
Clupea herringus pallasi (pacific herring)	1 school
Coryphoterus nicholsi (blackeye goby)	26
Enophyrys bison (buffalo sculpin)	3
Hemilepidotus hemilepidotus (red irish lord)	5
Jordania zanope (longfin sculpin)	8
Porichthys notatus (plainfin midshipman)	2
Squalus acanthias (spiny dogfish)	1
unidentified blenny	2

Table 33. Location and habitat description of intertidal fauna and flora survey sites, West Coast Trail Section (1976).

Sample No.	Location	Slope	Habitat	
			Substrate	Exposure
1	Southwest beach at Thrasher Cove, Hobbs Creek	4.3°	boulder to sand	semi-exposed
2	Beach on east side of Camper Creek mouth	10.7°	cobble, gravel	exposed
3	Beach on east side of Cullite Creek mouth	10.7°	cobble, gravel	exposed
4	Bench on east side of Logan Creek mouth	1.3°	sandstone	exposed
5	Bench on northwest side of Carmanah Point	0.0°	sandstone with few boulders	exposed
6	Bench on southeast side of Carmanah Point (50 m southwest of Sample 8)	0.0°	sandstone, boulders	exposed
7	Bench on south point of Carmanah Point (directly below fog horn)	3.1°	sandstone	exposed
8	South side of small point on southeast side of Carmanah Point (Sample 4/1975)	1.3°	sandstone and conglomerate rock	exposed
9	North side of small point on southeast side of Carmanah Point (Sample 5/1975)	2.1°	sandstone, boulders	semi-exposed
10	Natural breakwater 2 miles northwest of Carmanah Point	33.2° - 90.0°	sandstone	exposed
11	Bench 0.5 mile northwest of natural breakwater	0.0°	sandstone	exposed
12	Bench 0.25 mile northwest of Klanawa River	3.1°	sandstone	exposed
13	Bench 1 mile northwest of Klanawa River	1.3°	sandstone	exposed

Table 33 cont'd

Sample No.	Location	Slope	Habitat	
			Substrate	Exposure
14	Bench 2.5 miles northwest of Klanawa River	2.3°	sandstone	exposed
15	Bench on west side of Darling River mouth	3.1°	sandstone	exposed

Table 34. Fauna and flora observed on exposed gravel and cobble beaches, West Coast Trail Section (1976).

Site	2	3
FAUNA		
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia		
Balanus glandula	1620	1070
B. cariosus	425	492
Subclass Malacostraca Order Isopoda		
unidentified specimens	284	295
Order Amphipoda		
unidentified specimens	345	420
FLORA		
PHYLUM (DIVISION) Chlorophyta (green algae)		
Spongomorpha coalita	20	10
Ulva sp.	25	25

Table 35. Fauna and flora observed on semi-exposed boulder beaches (1) and exposed and semi-exposed sandstone benches (4-15), West Coast Trail Section (1976). (Multiply No./m^2 of *L. sitkana*, *C. dalli*, *P. polymerus* and *M. californianus* by 10; *B. glandula* by 100)

Table 35

Site	1	4	5	6	7	8	9	10	11	12	13	14	15
ZONE 2 width (m)	25	50	30	20	40	8	75	10	30	25	25	50	50
FAUNA													
PHYLUM Cnidaria Class Anthozoa Order Actiniaria													
Anthopleura elegantissima	0	25	0	0	160	0	160	0	0	0	0	90	200
A. xanthogrammica (green anemone)	1	5	0	0	48	0	0	0	0	0	0	0	0
PHYLUM Mollusca Class Amphineura													
Katharina tunicata	0	0	0	0	0	2	0	0	0	0	0	0	0
Mopalia sp.	0	0	0	0	<1	0	0	0	0	1	0	0	0
Class Gastropoda Subclass Prosobranchia													
Collisella digitalis (fingered limpet)	360	460	320	420	320	240	430	100	240	490	240	240	320
C. pelta (shield limpet)	32	26	1	20	20	0	25	30	0	112	0	0	64
Diodora aspera (rough keyhole limpet)	0	0	1	0	0	0	0	0	0	0	0	0	0
Littorina scutulata (checkered periwinkle)	80	320	290	450	420	410	390	50	224	120	256	208	232
L. sitkana (sitka periwinkle)	64	160	156	110	150	144	110	22	116	111	104	108	112
Notoacmea persona	160	0	0	92	73	50	60	30	40	160	0	0	30
N. scutum	64	72	0	0	60	90	10	0	0	0	0	0	20

Table 35 cont'd

Site	1	4	5	6	7	8	9	10	11	12	13	14	15
Subclass Prosobranchia cont'd													
Tegula funebralis (black top shell)	0	0	0	0	0	0	0	80	0	96	160	0	160
Thais emarginata (short-spired purple)	1	320	32	0	0	210	50	0	0	32	0	80	0
T. lamellosa (wrinkled purple)	<1	0	0	0	0	0	2	0	0	0	0	0	0
Class Bivalvia													
Mytilus californianus (sea mussel)	270	0	0	0	192	200	50	0	0	0	64	0	0
M. edulis (bay mussel)	25	0	0	0	0	15	5	0	0	0	11	0	0
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia													
Balanus cariosus	800	640	736	576	0	720	688	624	0	0	0	800	752
B. glandula	150	132	147	151	191	176	183	167	149	153	161	181	173
Chthamalus dalli	240	121	320	190	0	140	0	0	0	120	0	130	170
Subclass Malacostraca													
Hemigrapsus nudus (purple shore crab)	0	1	1	<1	0	0	<1	0	1	2	0	1	1
Pagurus sp. (hermit crab)	32	14	48	51	13	50	35	27	16	11	28	32	14

Table 35 cont'd

Site	1	4	5	6	7	8	9	10	11	12	13	14	15
PHYLUM Echinodermata Class Asteroidea													
Leptasterias hexactis (six-rayed starfish)	0	0	0	0	<1	0	0	0	0	0	0	0	0
Pisaster ochraceus (purple star)	0	0	0	0	0	1	0	0	0	0	0	0	0
PHYLUM Chordata Subphylum Craniata													
tidepool sculpins (cottidae)	20	0	34	16	10	0	0	13	0	20	11	0	10
blenny (Stichaeidae)	0	0	0	0	0	0	0	0	0	0	0	0	<1
FLORA													
PHYLUM (DIVISION) Spermatophyta													
Phyllospadix scouleri (surf grass)	<5	0	<5	0	0	0	10	0	0	0	60	0	0
PHYLUM (DIVISION) Chorophyta (green algae)													
Cladophora sp.	0	<5	0	<5	<5	<5	0	10	10	<5	<5	10	<5
Enteromorpha sp.	<5	0	0	0	<5	0	40	0	<5	0	<5	<5	<5
Prasiola meridionalis	0	0	0	25	0	0	0	0	0	0	0	0	0
Spongomorpha sp.	0	0	<5	<5	0	0	<5	0	20	<5	<5	0	<5
Ulva sp.	<5	10	<5	30	0	<5	<5	0	<5	10	10	0	<5

Table 35 cont'd

Site	1	4	5	6	7	8	9	10	11	12	13	14	15
PHYLUM (DIVISION) Phaeophyta (brown algae)													
Analipus japonicus	<5	0	0	0	<5	0	0	0	0	0	0	0	0
Fucus distichus	40	30	40	20	20	30	30	10	10	10	20	30	40
Leathesia difformis	<5	0	0	0	<5	0	0	<5	0	0	<5	0	0
Pelvetiopsis limitata	0	0	0	20	0	60	0	25	40	0	10	0	0
Ralfsia sp.	0	0	<5	0	<5	0	0	<5	0	<5	<5	0	0
Scytosiphon lomentaria	0	0	0	0	<5	0	0	0	0	0	0	0	0
Soranthera ulvoidea	0	0	0	0	0	0	30	0	10	10	10	0	0
PHYLUM (DIVISION) Rhodophyta (red algae)													
Bangia sp.	0	0	0	0	<5	0	0	0	0	0	0	0	0
Corallina sp.	0	0	0	<5	0	0	0	0	0	0	0	0	0
Endocladia muricata	0	<5	<5	0	0	<5	0	<5	0	<5	<5	<5	<5
Gigartina spp.	<5	20	20	0	20	<5	<5	<5	0	10	<5	0	20
Halosaccion glandiforme	0	<5	0	0	0	<5	0	0	<5	0	0	0	0
Hildenbrandia sp.	0	<5	0	<5	0	<5	0	0	0	<5	0	0	0
Lithothamnion sp.	0	0	0	<5	0	<5	<5	0	0	<5	0	0	0
Petrocelis sp.	10	20	<5	0	<5	0	<5	0	<5	<5	0	0	0
Porphyra sp.	10	10	10	30	0	<5	10	10	<5	20	0	0	<5
Prionitis sp.	0	<5	0	10	0	<5	0	0	<5	0	0	<5	0
Pterosiphonia bipinnata	<5	0	0	0	0	<5	0	0	0	0	0	0	0
Rhodomela larix	30	20	0	0	10	0	50	70	70	50	0	0	10
Smithora naiadum	<5	0	<5	0	0	0	0	0	0	0	0	0	<5

Table 35 cont'd

Site	1	4	5	6	7	8	9	10	11	12	13	14	15
ZONE 3 width (m)	15	20	10	20	15	25	10	5	15	10	10	15	20
FAUNA													
PHYLUM Porifera (sponges)													
Haliclona permollis	0	0	10	10	0	10	0	0	0	0	0	0	0
Ophlitaspongia pennata	0	0	0	10	0	<5	0	0	0	0	0	0	0
unidentified species	0	0	0	0	0	10	0	0	0	<5	<5	0	0
PHYLUM Cnidaria Class Anthozoa Order Actiniaria													
Anthopleura elegantissima	0	25	400	640	0	0	20	300	0	0	0	160	80
A. xanthogrammica (green anemone)	1	3	3	15	20	5	0	10	0	10	2	6	2
Tealia lofotensis	0	0	0	0	0	<1	0	0	0	0	0	0	0
PHYLUM Annelida Class Polychaeta													
Serpula vermicularis	0	0	20	0	20	0	0	0	0	0	0	0	0
PHYLUM Mollusca Class Amphineura													
Katharina tunicata	1	0	3	0	4	3	0	0	0	0	16	3	6
Mopalia sp.	0	0	1	0	0	0	0	0	0	0	0	1	0
Tonicella lineata	0	0	1	0	0	4	0	0	0	0	0	0	1

Table 35 cont'd

Site	1	4	5	6	7	8	9	10	11	12	13	14	15
Class Gastropoda Subclass Opistobranchia													
Cadlina luteomarginata	0	0	0	0	0	<1	0	0	0	0	0	0	0
Rostanga pulchra	0	0	0	1	0	<1	0	0	0	0	0	0	0
Subclass Prosobranchia													
Acmaea mitra	0	0	19	13	10	0	0	0	0	0	40	0	0
Calliostoma ligatum	0	0	1	0	2	2	0	0	0	0	1	0	0
Ceratostoma foliata (leafy hornmouth)	1	0	1	0	0	0	0	0	0	0	0	0	0
Collisella digitalis (fingered limpet)	45	120	220	310	0	80	220	40	120	240	272	160	112
C. pelta (shield limpet)	0	20	32	25	0	32	10	0	15	20	48	32	21
Diodora aspera (rough keyhole limpet)	1	0	6	0	1	2	0	0	0	0	0	0	0
Notoacmea persona	35	0	60	50	75	21	50	60	28	73	24	22	54
N. scutum	0	22	14	10	0	0	0	0	0	0	0	0	0
Searlesia dira	0	0	96	64	0	3	0	0	0	0	2	0	3
Thais emarginata (short-spired purple)	3	20	12	0	0	53	61	0	64	24	32	27	16
T. lamellosa (wrinkled purple)	<1	0	2	1	0	0	2	0	0	0	0	0	0
Class Bivalvia													
Mytilus californianus (sea mussel)	270	80	200	110	28	142	32	37	20	65	250	230	91
M. edulis (bay mussel)	320	160	272	304	48	180	240	52	48	224	36	256	192

Table 35 cont'd

Site	1	4	5	6	7	8	9	10	11	12	13	14	15
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia													
Balanus cariosus	160	0	0	128	0	240	112	144	96	0	0	176	224
B. glandula	0	60	41	25	32	24	29	47	36	43	37	24	34
Chthamalus dalli	0	0	0	210	0	0	0	0	0	190	170	146	136
Pollicipes polymerus	0	0	0	0	0	130	0	0	0	0	81	94	78
Subclass Malacostraca													
Cancer oregonensis	0	0	<1	<1	0	0	0	0	0	0	0	0	<1
Hemigrapsus nudus (purple shore crab)	0	0	0	0	<1	0	0	0	0	0	0	0	0
Oedignathus inermis	0	0	0	0	0	0	0	0	0	0	0	0	2
Pagurus sp. (hermit crab)	0	0	80	0	0	0	0	0	0	96	80	0	112
PHYLUM Echinodermata Class Asteroidea													
Henricia leviuscula	0	0	<1	<1	<1	<1	0	0	0	0	0	0	0
Pisaster ochraceus (purple star)	0	0	6	2	1	3	0	1	0	0	1	0	3
Class Echinoidea													
Strongylocentrotus droebachiensis (green urchin)	0	0	0	0	0	<1	0	0	0	0	0	0	<1
S. franciscanus (red urchin)	0	0	0	0	<1	0	0	0	0	0	0	<1	0
S. purpuratus (purple urchin)	0	60	80	0	50	20	0	0	0	0	20	80	30

Table 35 cont'd

Site	1	4	5	6	7	8	9	10	11	12	13	14	15
FLORA													
PHYLUM (DIVISION) Spermatophyta													
Phyllospadix scouleri	<5	<5	<5	<5	<5	<5	<5	0	<5	10	<5	<5	0
PHYLUM (DIVISION) Chlorophyta (green algae)													
Codium fragile	0	0	0	0	0	0	0	0	0	0	<5	0	0
Spongomorpha sp.	<5	0	0	0	0	0	0	0	<5	0	0	0	0
Ulva sp.	<5	0	<5	<5	0	10	15	0	<5	0	0	0	<5
PHYLUM (DIVISION) Phaeophyta (brown algae)													
Egregia menziesii	0	0	10	0	0	0	0	0	0	0	0	0	0
Hedophyllum sessile	30	40	80	25	75	50	40	0	50	40	40	70	50
Leathesia difformis	0	<5	<5	<5	0	<5	<5	<5	<5	0	0	<5	0
Soranthera ulvoidea	0	0	<5	0	0	0	<5	10	10	0	0	0	0

Table 35 cont'd

Site	1	4	5	6	7	8	9	10	11	12	13	14	15
PHYLUM (DIVISION) Rhodophyta (red algae)													
Bossiella sp.	0	0	0	0	0	<5	0	0	<5	<5	<5	0	10
Corallina sp.	0	40	<5	20	<5	<5	0	0	<5	<5	<5	0	10
Calliarthron sp.	0	0	0	0	0	<5	0	0	0	0	<5	0	10
Endocladia muricata	0	0	0	0	0	<5	<5	10	<5	20	<5	<5	<5
Gigartina spp.	<5	20	<5	<5	0	<5	<5	0	<5	0	<5	<5	0
Halosaccion glandiforme	<5	0	<5	25	0	20	10	0	0	<5	20	20	0
Hildenbrandia sp.	0	0	0	<5	0	0	0	0	0	0	0	0	0
Lithothamnion sp.	0	0	<5	0	<5	20	0	0	0	30	0	0	<5
Microcladia borealis	<5	0	<5	0	<5	10	0	0	0	0	0	0	0
Odonthalia floccosa	0	0	<5	25	0	<5	<5	0	0	0	0	0	0
Petrocelis sp.	0	0	0	10	0	10	0	0	0	30	0	10	<5
Prionitis spp.	<5	0	0	0	0	<5	0	0	0	<5	10	0	0
Rhodomela larix	<5	20	<5	25	0	0	10	40	25	<5	10	<5	<5
Smithora naiadum	0	0	0	0	0	<5	<5	0	0	0	0	0	0

Table 35 cont'd

Site	1	4	5	6	7	8	9	10	11	12	13	14	15
ZONE 4 width (m)	15	2	1	10	5	5	2	1	5	5	10	5	5
FAUNA													
PHYLUM Porifera (sponges)													
Haliclona permollis	0	0	10	0	0	0	0	0	10	<5	<5	<0	0
Ophlitaspongia pennata	10	0	0	0	0	<5	0	0	0	0	0	0	0
unidentified species	10	0	0	0	0	0	0	10	<5	10	10	10	0
PHYLUM Mollusca Class Amphineura													
Cryptochiton stelleri	0	0	<1	0	<1	0	0	0	0	0	0	0	<1
Katharina tunicata	0	0	0	0	0	2	0	0	0	0	0	0	0
Class Bivalvia													
Mytilus californianus	0	25	0	0	32	0	0	30	27	24	33	35	0
PHYLUM Arthropoda Class Crustacea Subclass Cirripedia													
Balanus glandula	0	4	0	0	0	0	0	0	0	0	0	0	0
Pollicipes polymerus	0	160	0	0	192	0	0	0	176	0	192	194	0
PHYLUM Echinodermata Class Asteroidea													
Pisaster ochraceus	10	0	0	0	0	0	0	0	0	0	0	0	0

Table 35 cont'd

Site	1	4	5	6	7	8	9	10	11	12	13	14	15
Class Echinoidea													
Strongylocentrotus purpuratus	10	20	0	0	0	0	0	0	0	0	0	0	0
FLORA													
PHYLUM (DIVISION) Spermatophyta													
Phyllospadix scouleri (surf grass)	0	10	40	20	0	<5	<5	0	0	0	0	10	10
PHYLUM (DIVISION) Chlorophyta (green algae)													
Codium fragile	0	0	0	<5	0	0	0	0	0	0	0	0	0
Ulva sp.	0	0	0	<5	0	<5	<5	0	0	0	0	0	0
PHYLUM (DIVISION) Phaeophyta (brown algae)													
Alaria marginata	50	30	40	25	0	40	40	0	30	10	30	30	40
Costaria costata	0	0	0	0	<5	0	0	0	0	0	<5	0	0
Egregia menziesii	0	0	0	0	0	20	20	0	0	10	20	20	<5
Laminaria setchellii	0	<5	0	0	<5	0	0	0	<5	0	<5	10	10
Lessoniopsis littoralis	0	20	0	0	50	0	0	0	0	0	0	0	0
Nereocystis luetkeana	40	20	20	40	20	40	0	0	30	30	30	20	30
Postelsia palmaeformis	0	10	10	0	20	0	0	30	0	0	0	30	0

Table 35 cont'd

Site	1	4	5	6	7	8	9	10	11	12	13	14	15
PHYLUM (DIVISION) Rhodophyta (red algae)													
Bossiella sp.	0	0	10	10	<5	<5	0	0	10	10	10	<5	10
Corallina sp.	0	0	0	10	<5	<5	0	0	<5	<5	10	<5	10
Calliarthron sp.	0	0	0	10	<5	0	0	0	<5	<5	10	<5	10
Ceramium sp.	<5	0	0	<5	0	0	0	0	0	0	0	0	0
Constantinea simplex	0	0	0	0	<5	0	0	0	0	0	0	0	0
Gigartina exasperata	0	0	0	0	0	<5	0	0	0	0	0	0	0
Gigartina spp.	10	0	0	<5	0	<5	10	0	<5	<5	<5	<5	<5
Iridaea sp.	0	0	10	25	0	20	10	0	10	10	0	10	20
Lithothamnion sp.	0	<5	0	<5	<5	10	0	10	<5	10	10	10	10
Odonthalia floccosa	0	0	<5	25	0	0	<5	0	0	0	0	<5	10
Rhodomela larix	0	0	0	20	<5	<5	<5	0	0	0	<5	0	<5
Rhodoptilum plumosum	0	0	<5	25	0	0	0	0	0	0	0	0	0
Rhodoglossum sp.	0	10	<5	25	<5	0	0	0	10	20	0	<5	<5

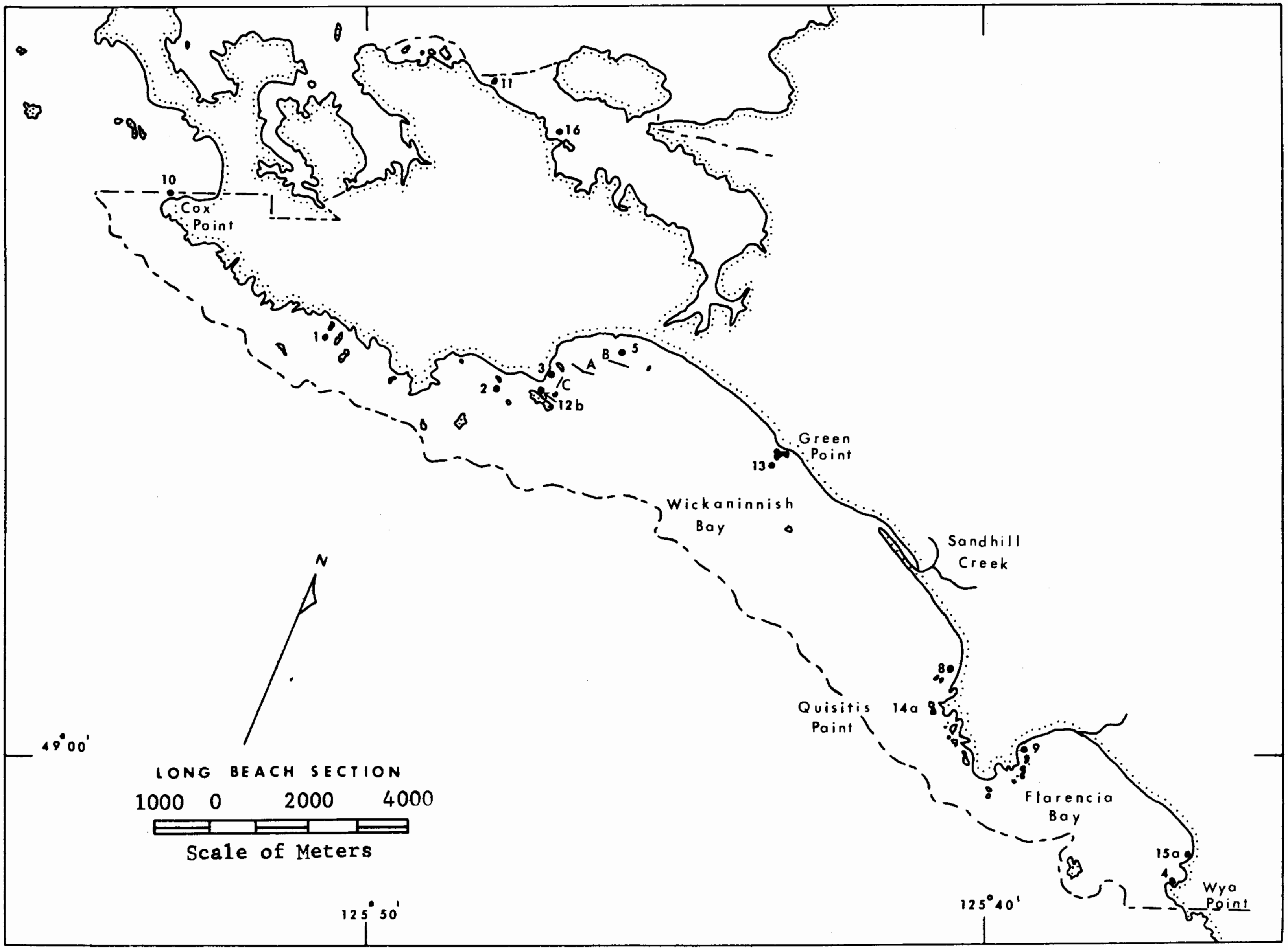


Figure 1. Location of intertidal fauna and flora survey sites, Long Beach Section (1976).

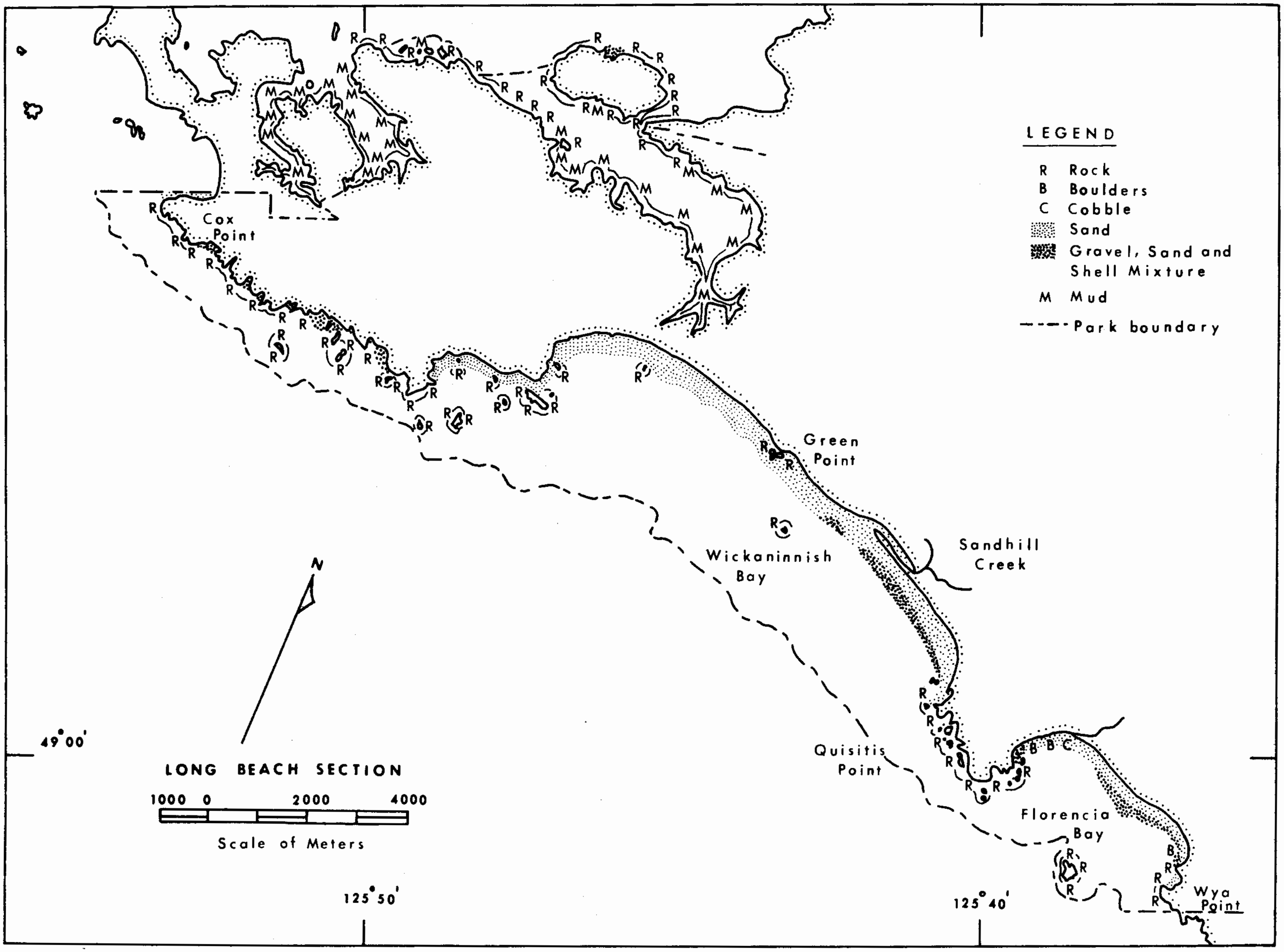


Figure 2. Distribution of general intertidal substrate types, Long Beach Section (1976).

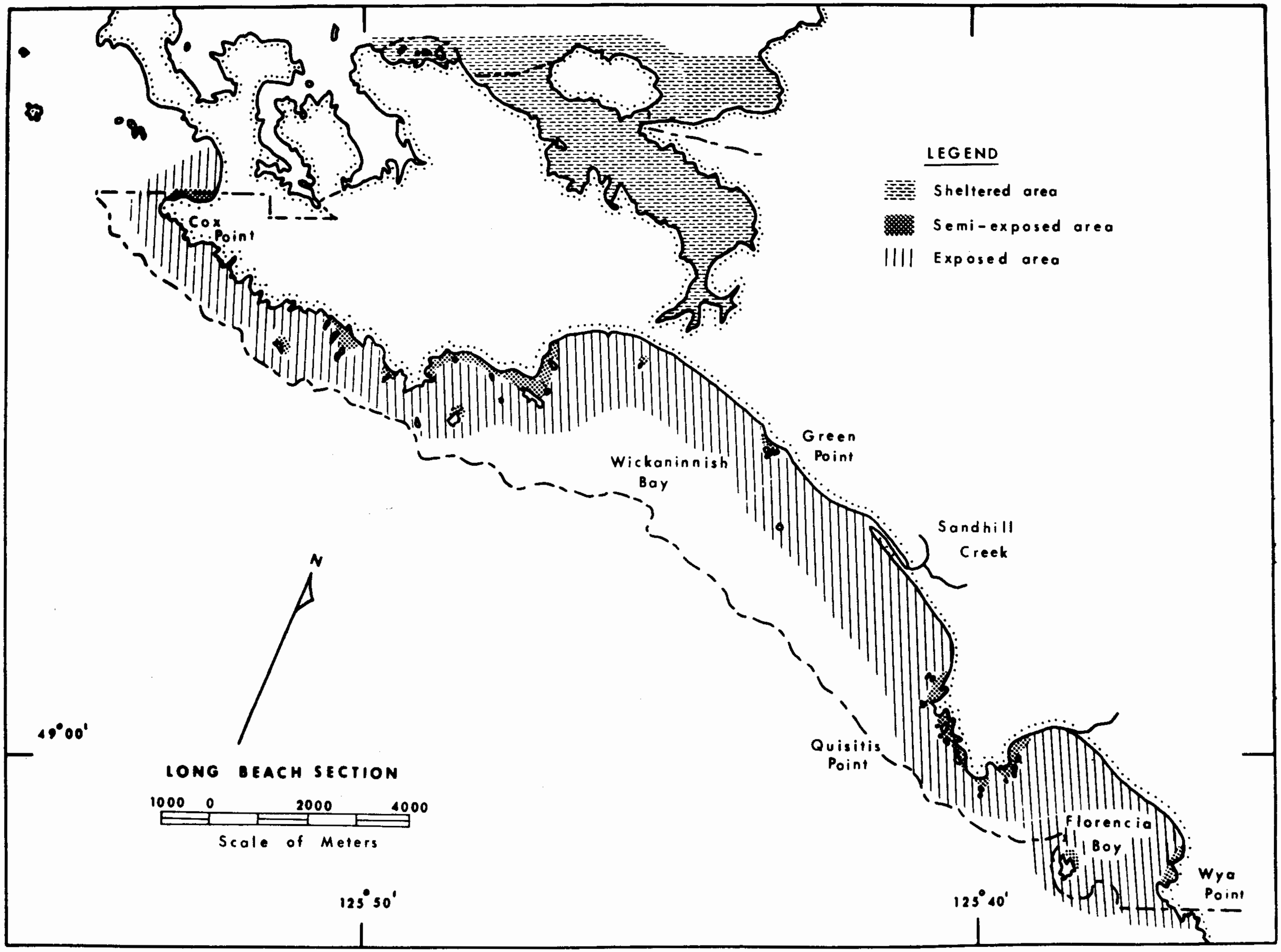


Figure 3. Distribution of intertidal exposures, Long Beach Section (1976).

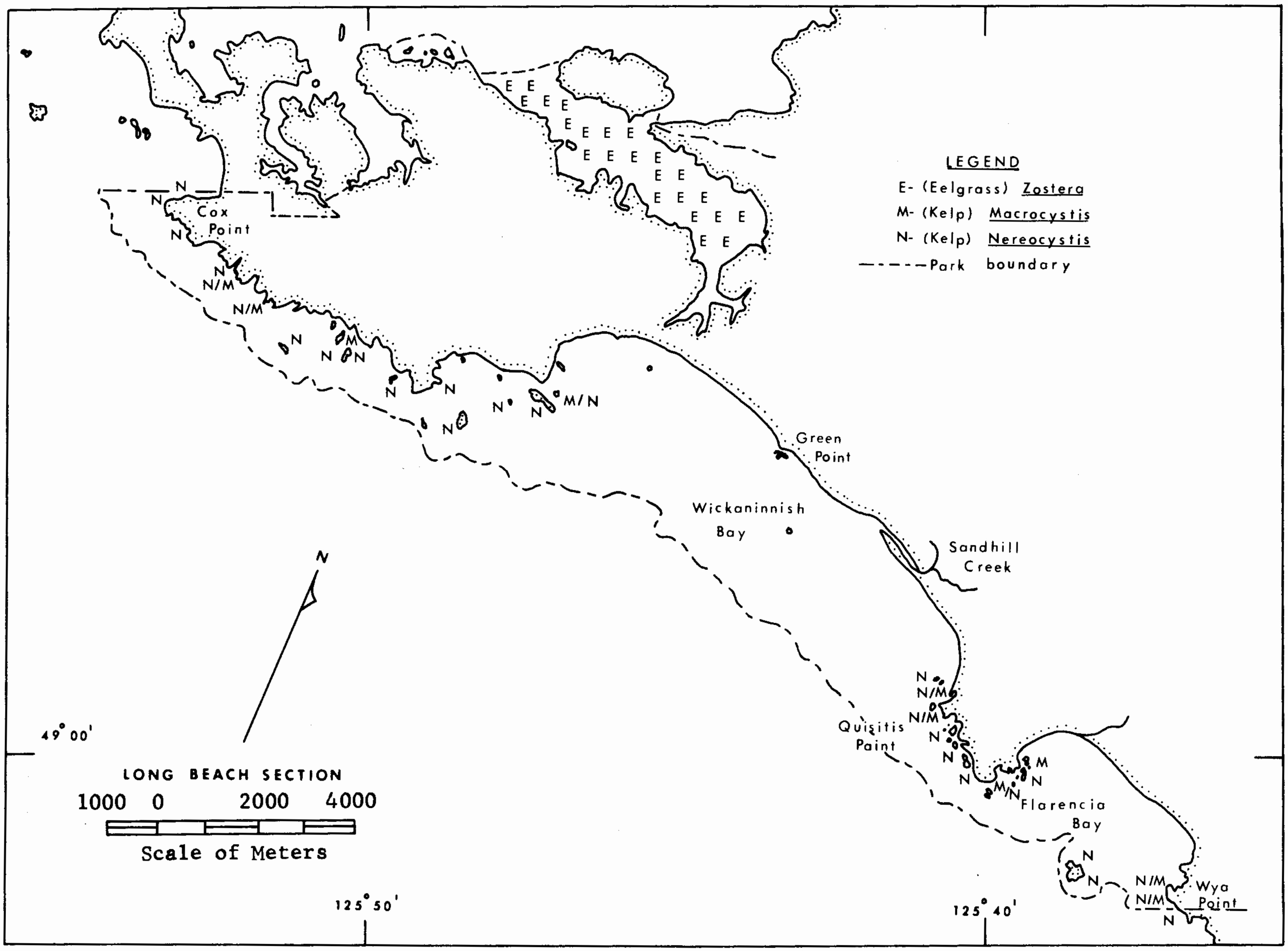


Figure 4. Distribution of kelp and eelgrass beds, Long Beach Section (1976).

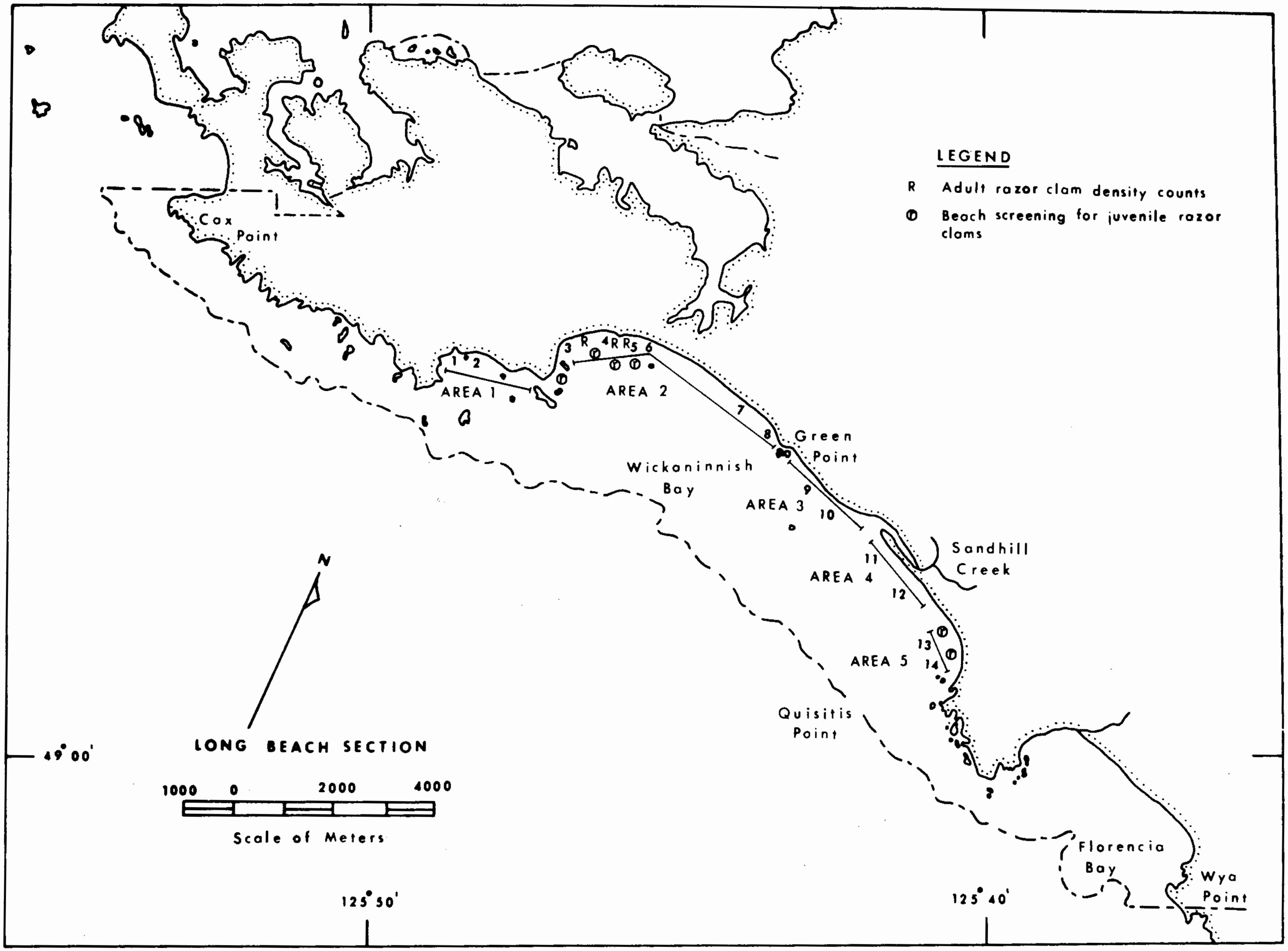


Figure 5. Locations of adult and juvenile razor clam sampling, Long Beach Section (1976).

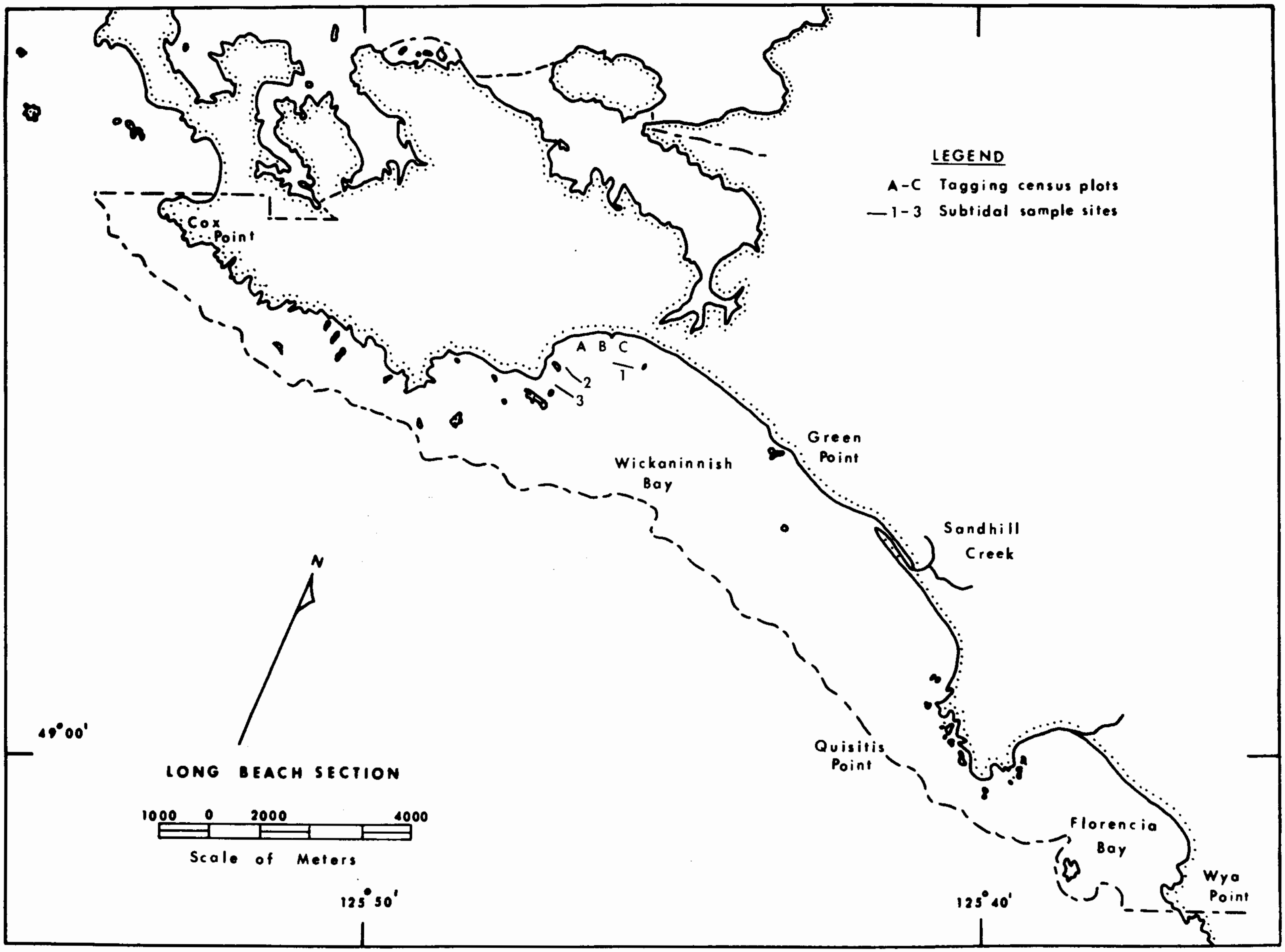


Figure 6. Locations of adult tagging census plots and subtidal sample sites, Long Beach Section (1976).

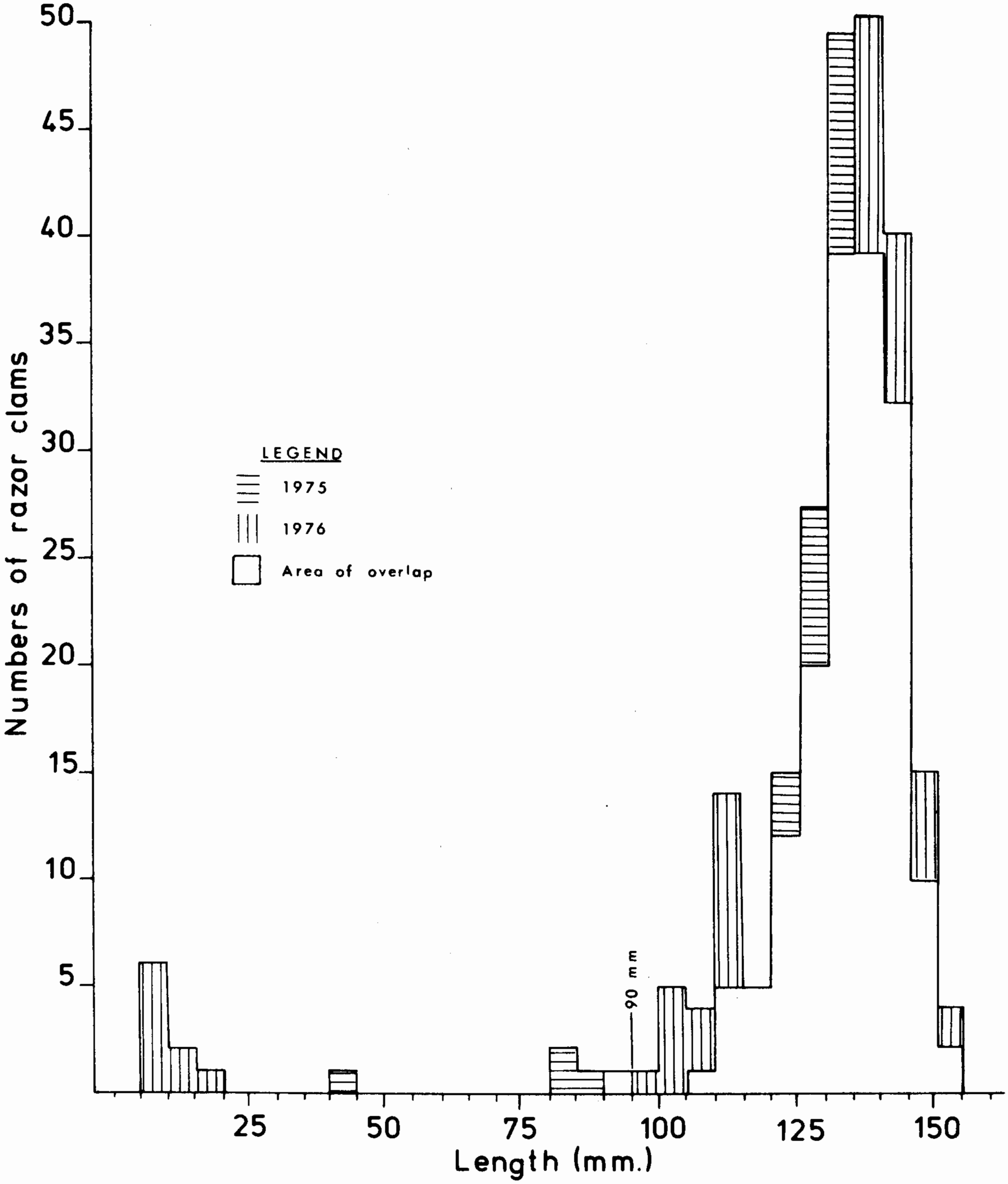


Figure 7. Length frequency distribution of razor clams, Long Beach Section. (Total number of clams in 1975 n=187 and in 1976 n=219.)

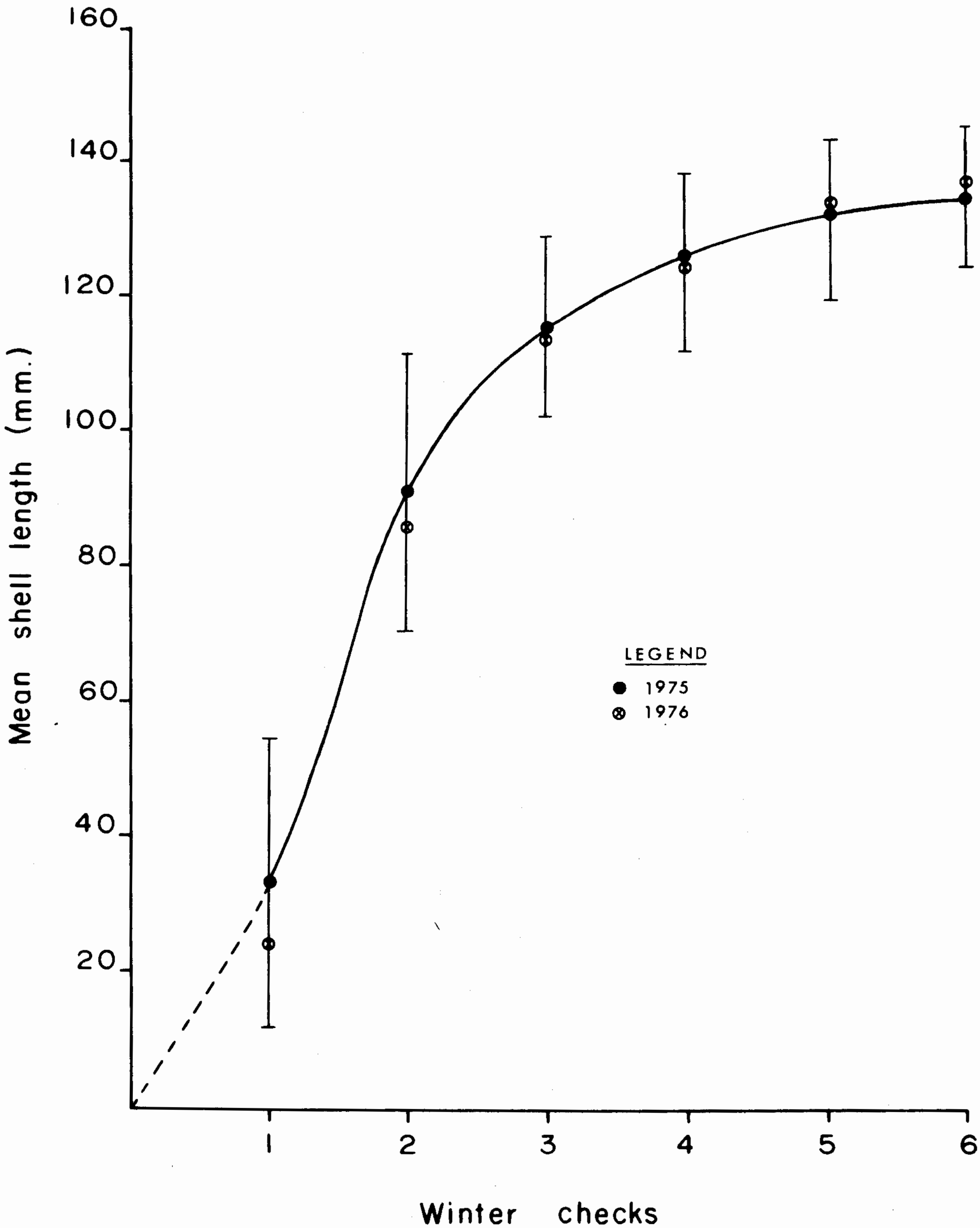


Figure 8. Annual growth rate of razor clams at Long Beach. (Vertical bars indicate two standard deviations about the mean.)

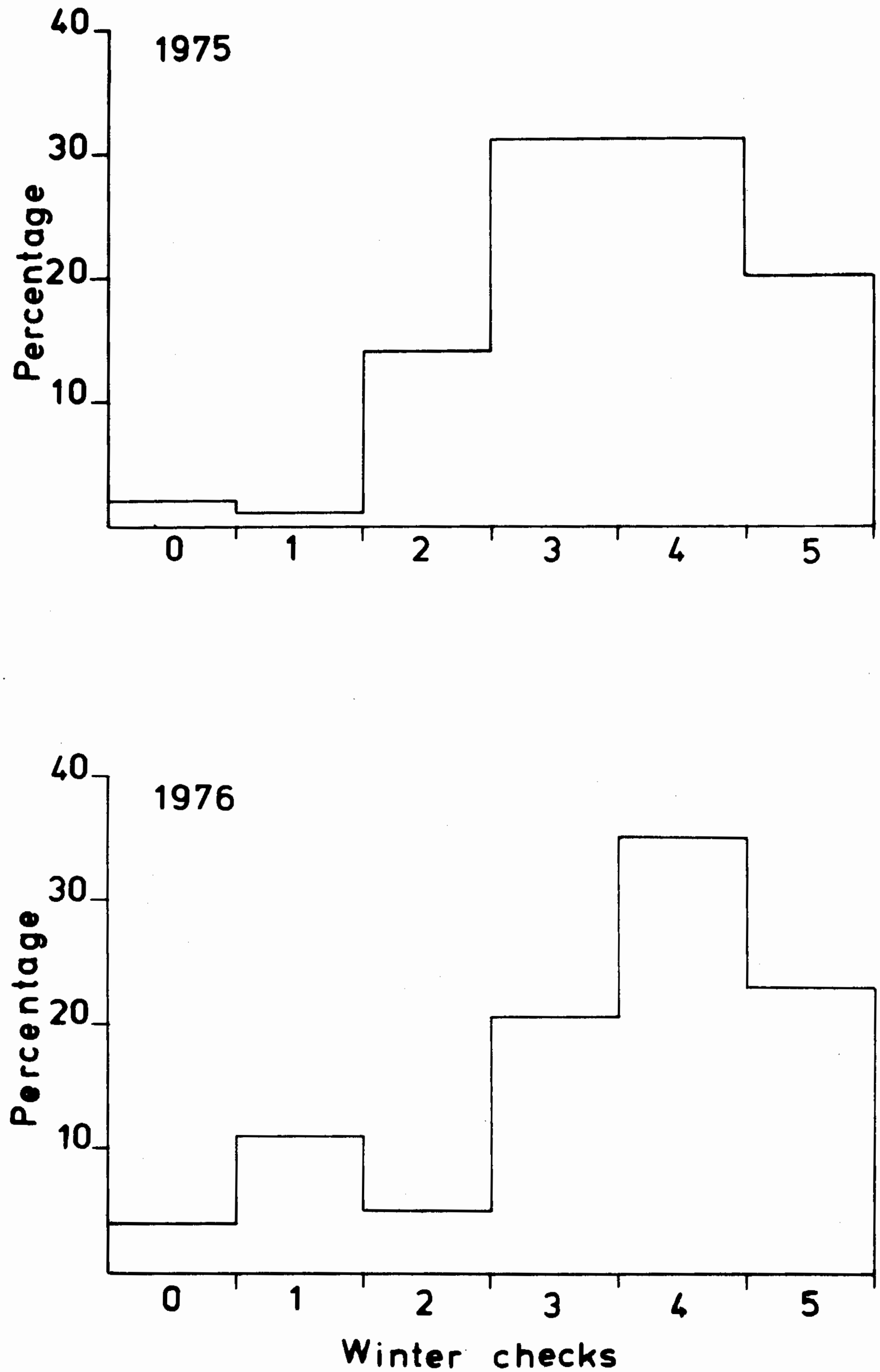


Figure 9. Age frequency distribution of razor clams as percentage of total number, Long Beach Section.

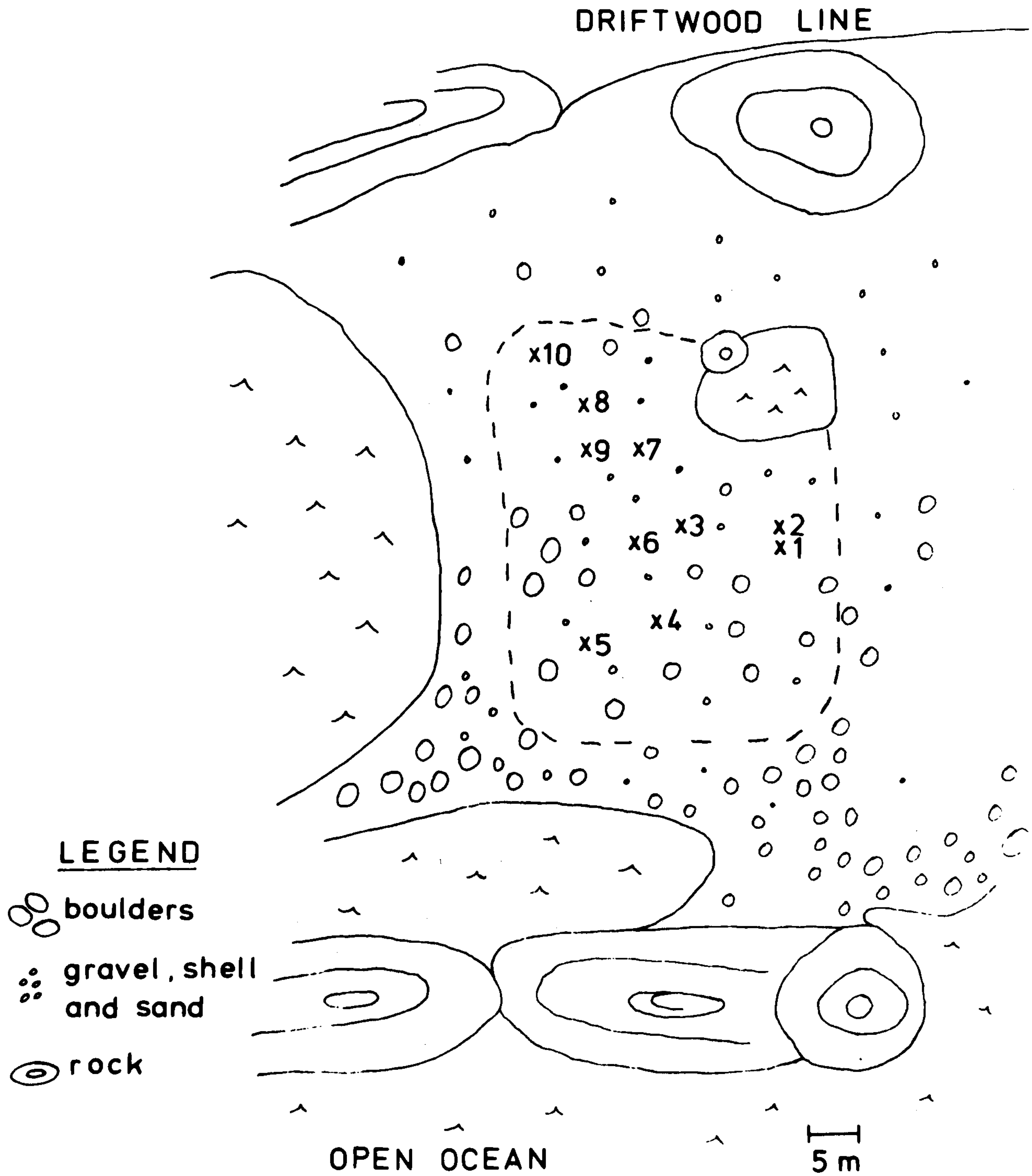


Figure 10. Littleneck clam bed at northwest end of Florencia Bay, Long Beach Section (1976). (Sample area drawn to scale.)

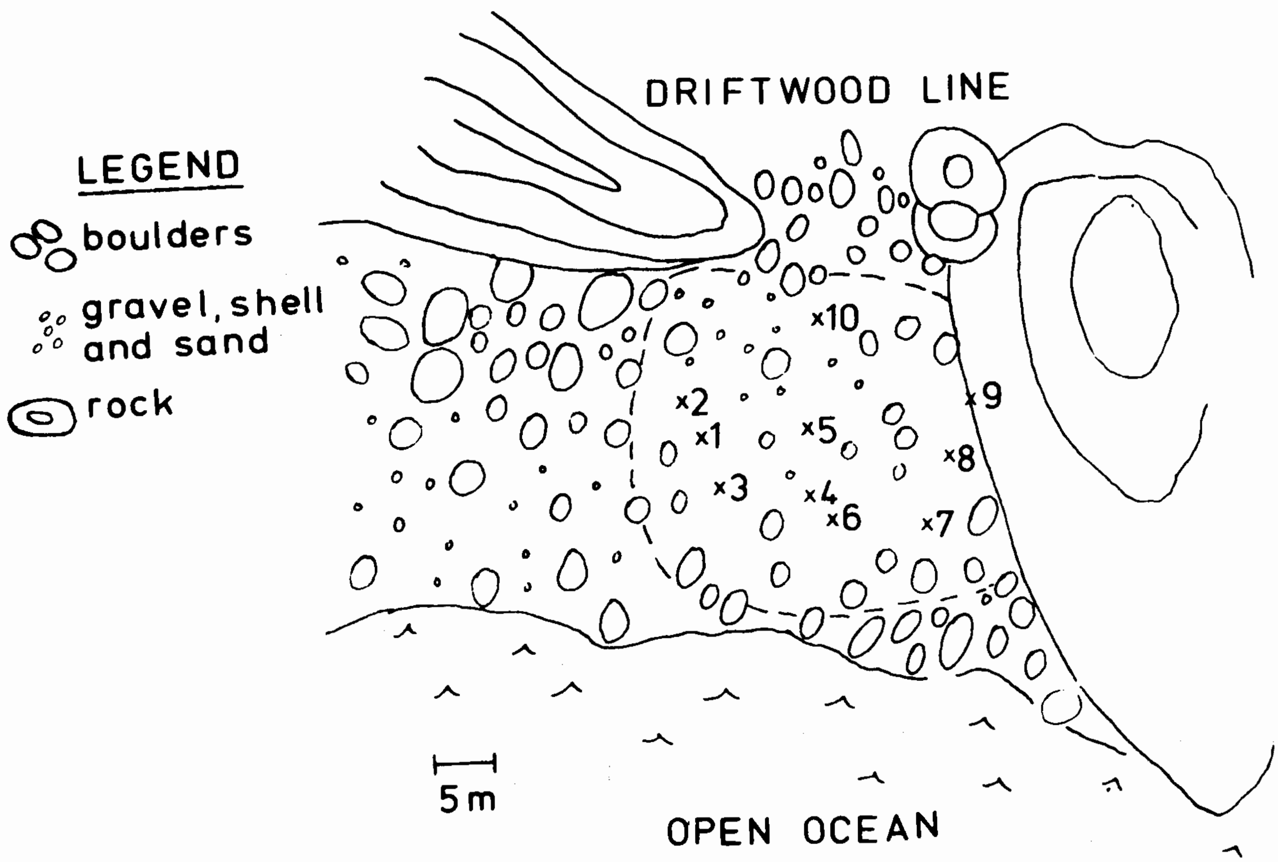


Figure 11. Littleneck clam bed at southeast end of Florencia Bay, Long Beach Section (1976). (Sample area drawn to scale.)

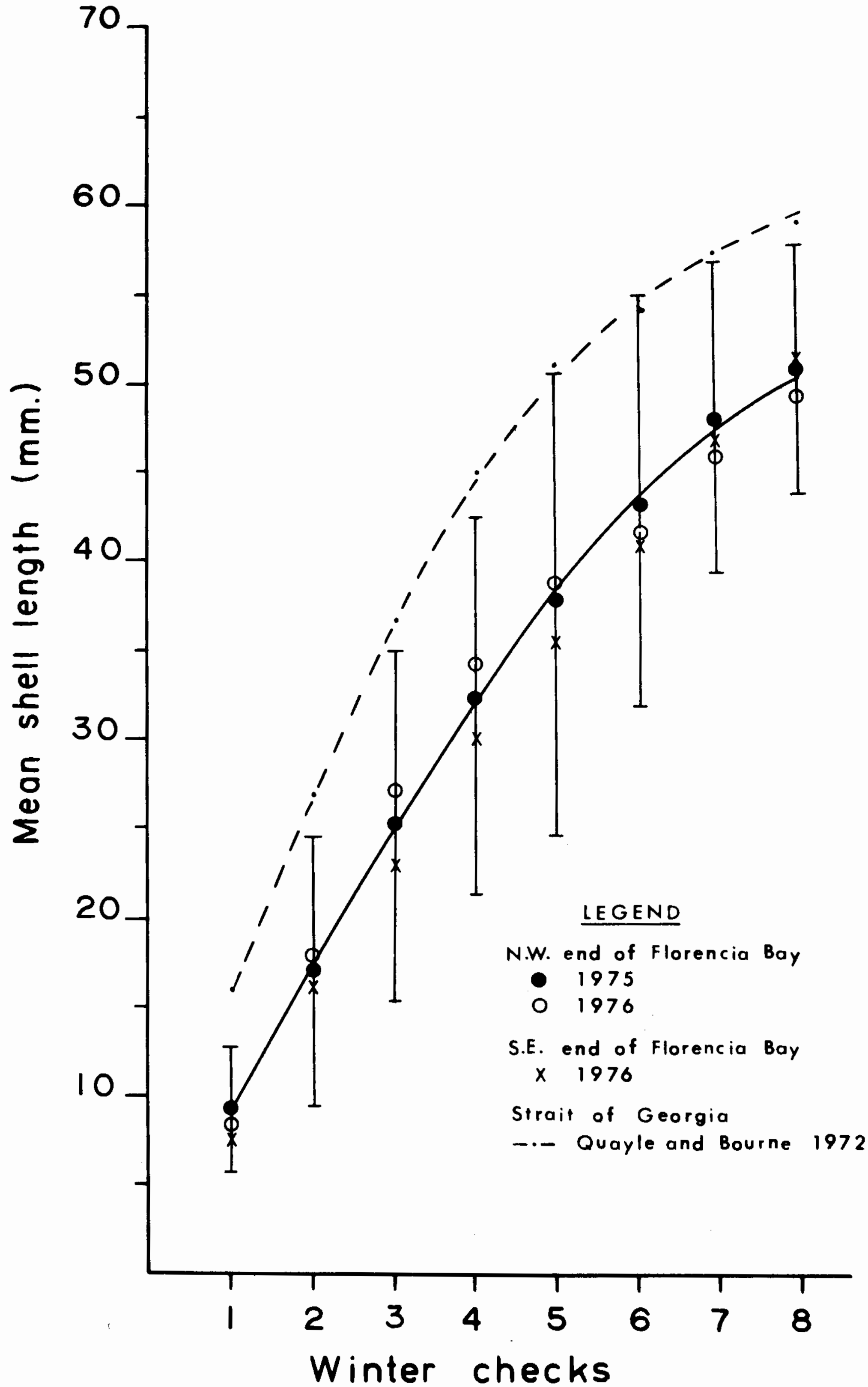


Figure 12. Annual growth rates of littleneck clams, Florencia Bay, Long Beach Section. (Vertical bars show two standard deviations about the mean.)

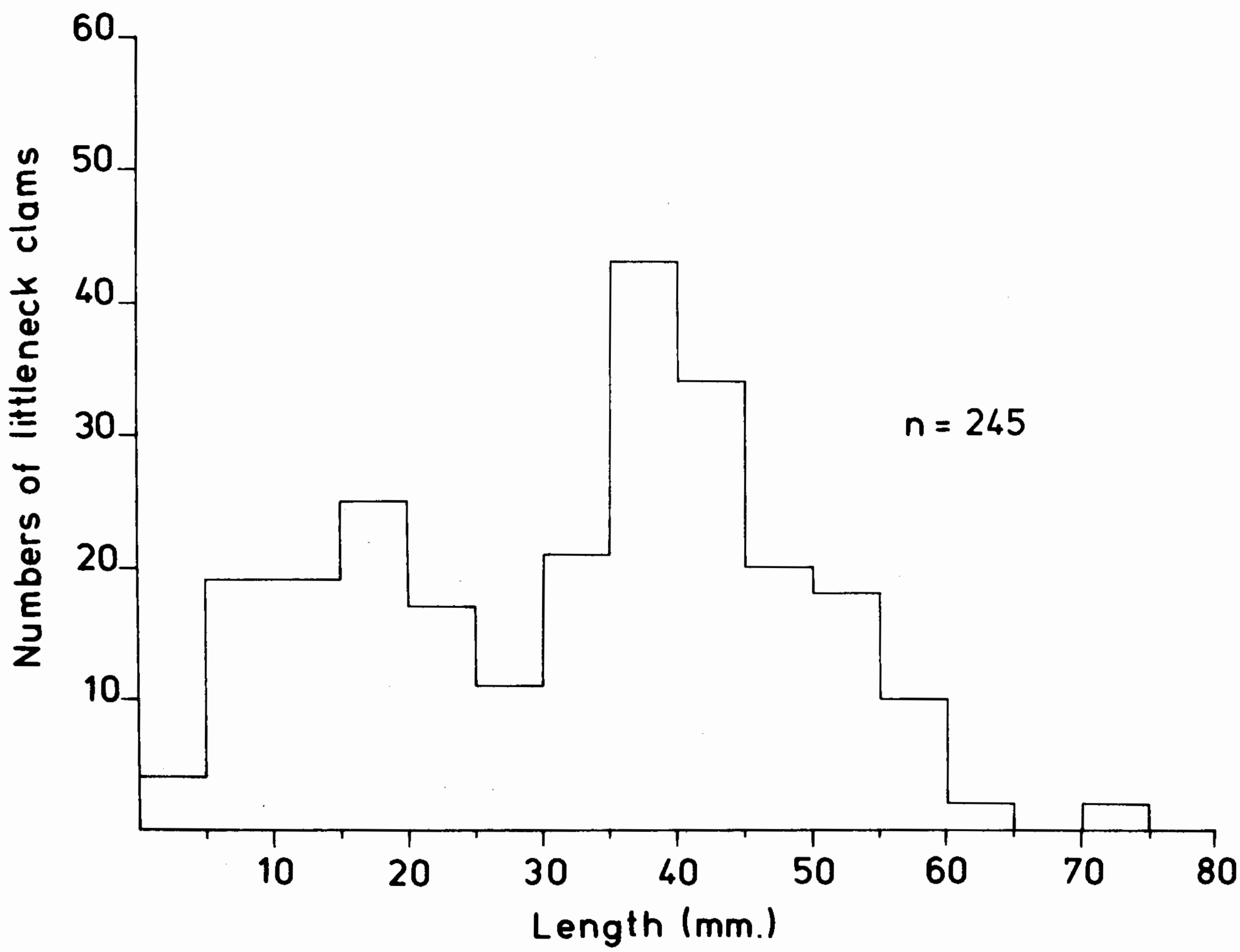


Figure 13. Length frequency distribution of littleneck clams from Northwest Florencia Bay, Long Beach Section (1976).

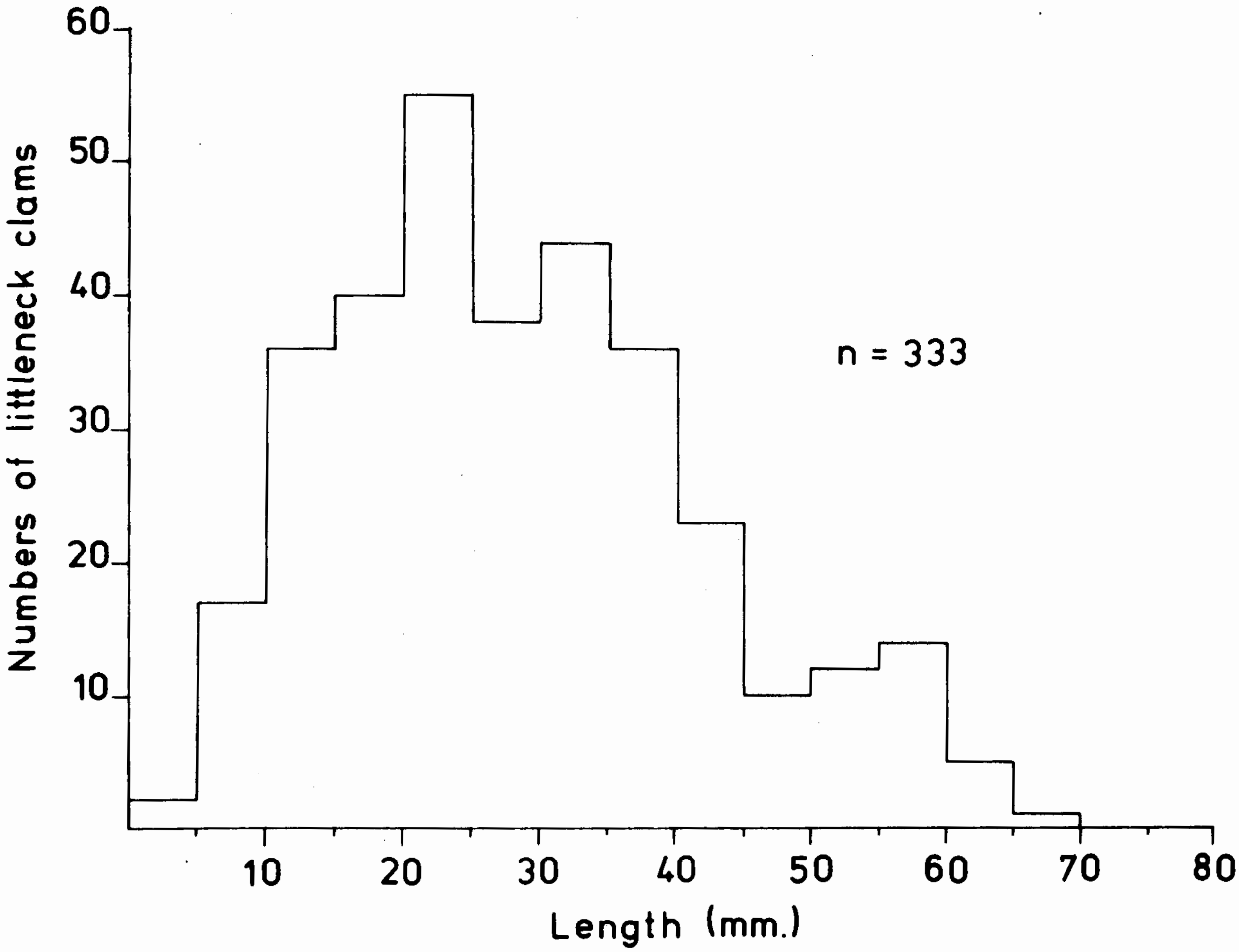


Figure 14. Length frequency distribution of littleneck clams from Southeast Florencia Bay, Long Beach Section (1976).

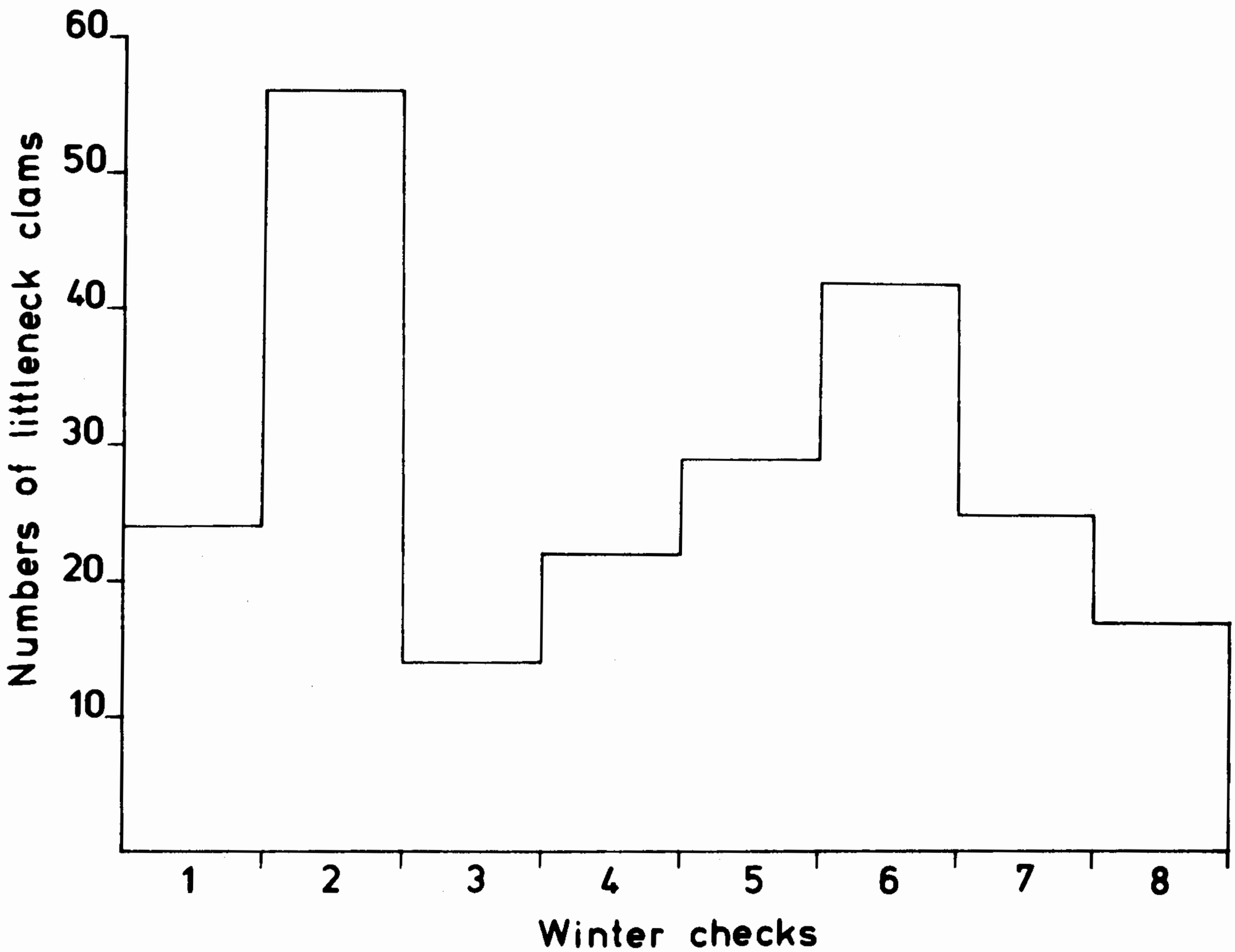


Figure 15. Age frequency distribution of littleneck clams collected at the northwest end of Florencia Bay, Long Beach Section (1976).

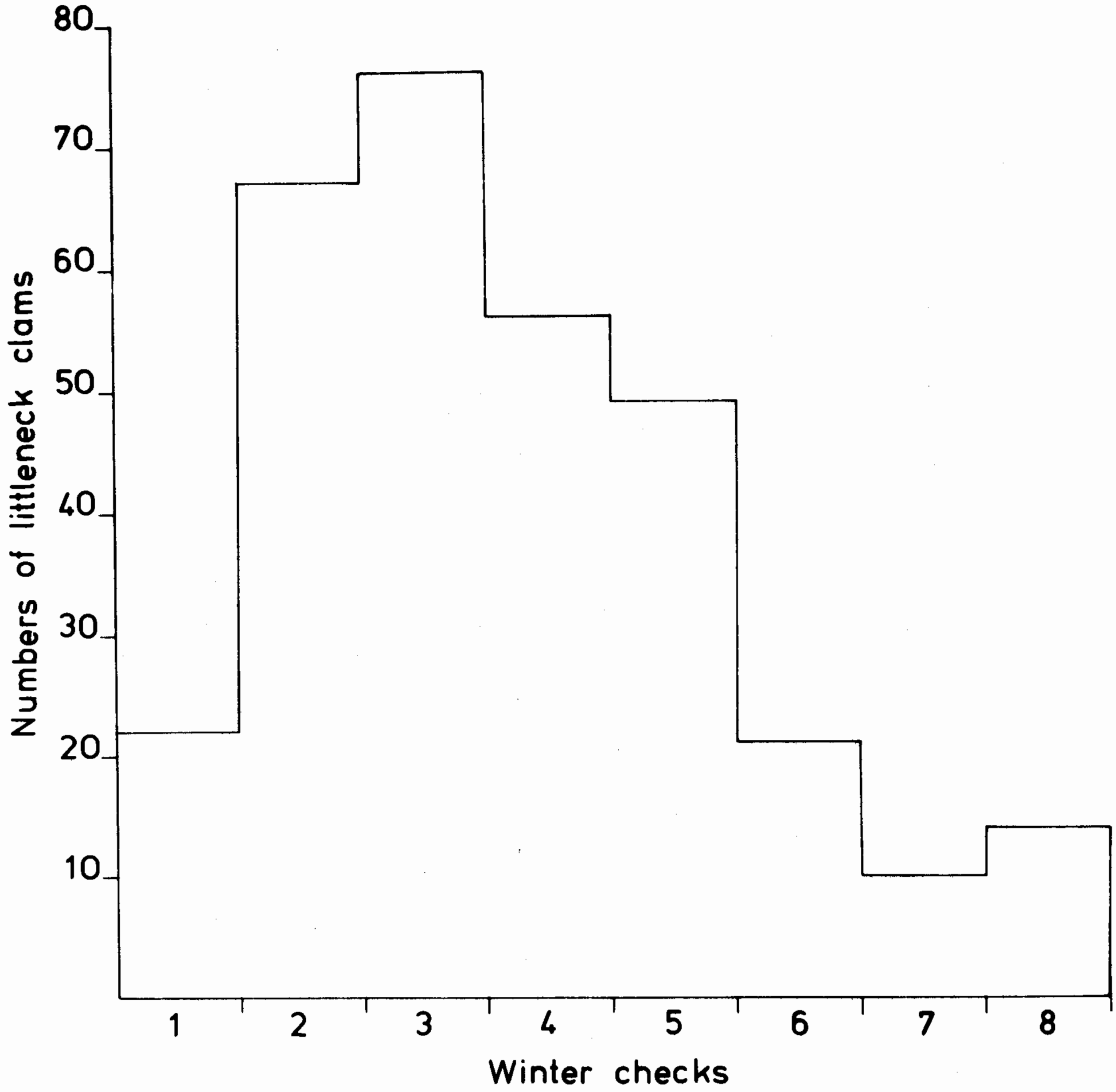


Figure 16. Age frequency distribution of littleneck clams collected at the southeast end of Florencia Bay, Long Beach Section (1976).

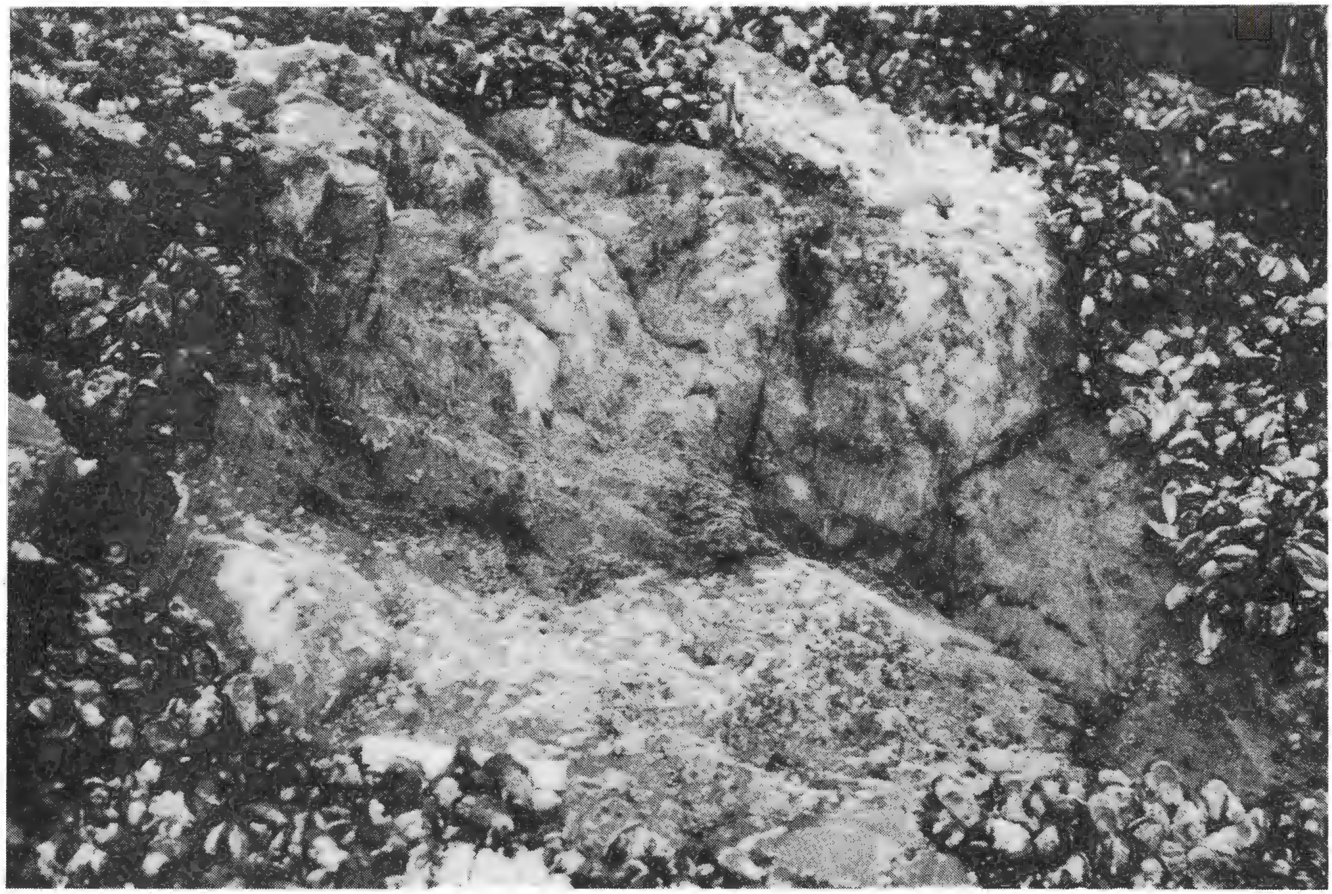


Figure 17a. One m^2 plot in a mussel bed that was cleared on the semi-exposed side of Cox Point, Long Beach Section (July, 1975).

Figure 17b. Re-colonization of a cleared one m^2 plot at Cox Point, Long Beach Section(November, 1976).

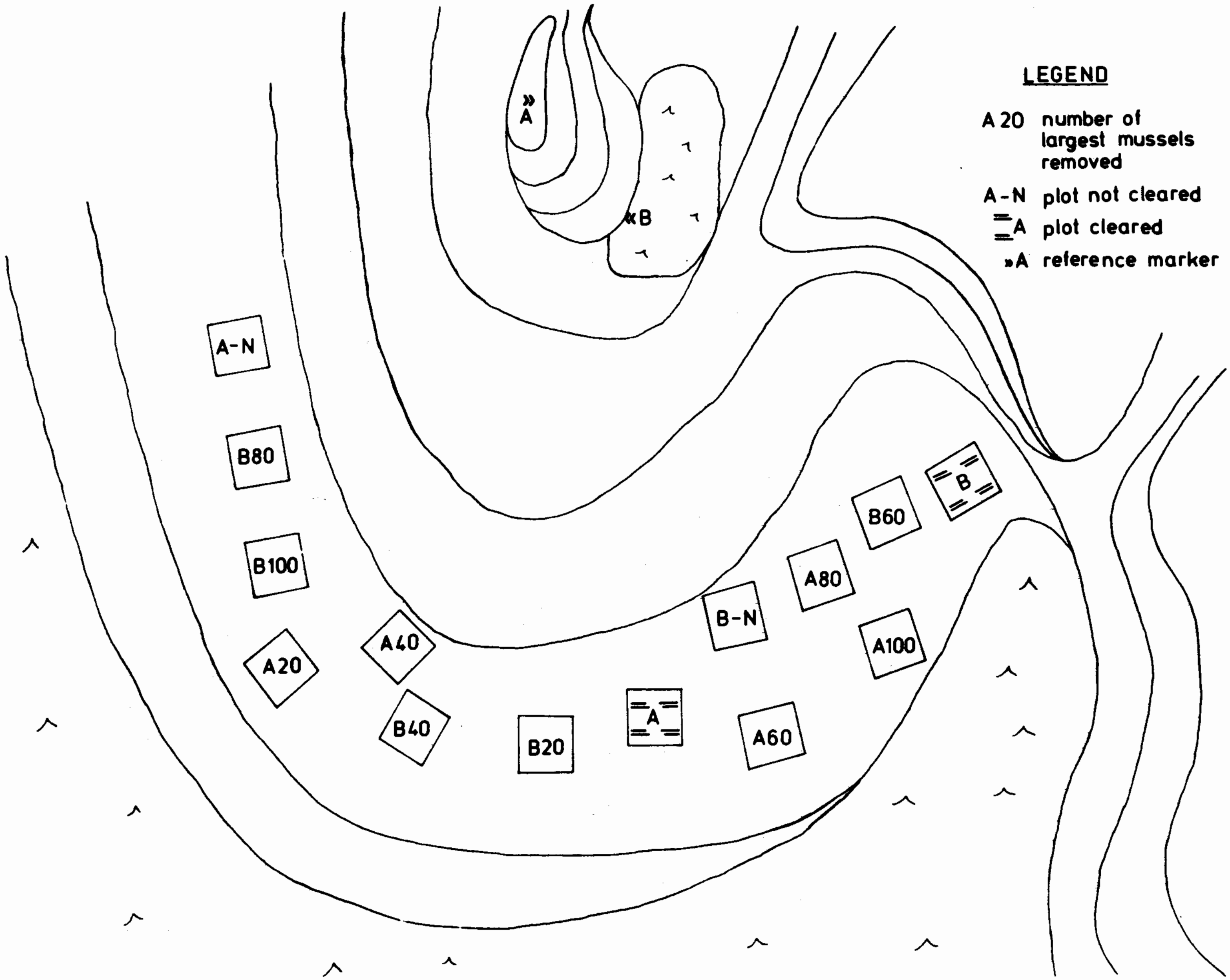


Figure 18. Schematic diagram of sea mussel partial removal plots at Quisitis Point, Long Beach Section (1976).

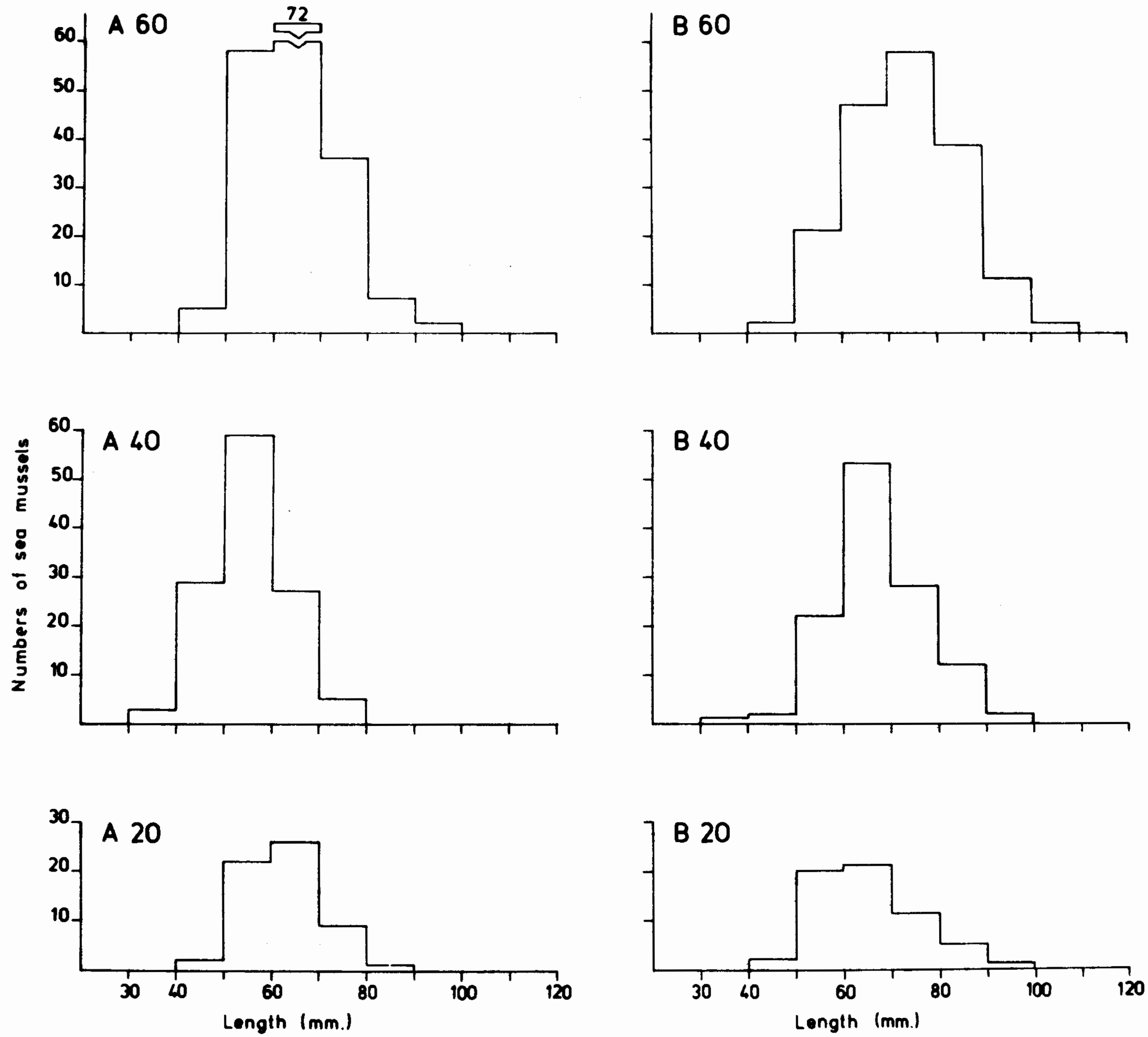


Figure 19. Total length frequency distribution of sea mussels removed from plots at Quisitis Point, Long Beach Section (1976).(Measurements grouped into 10 mm size classes.)

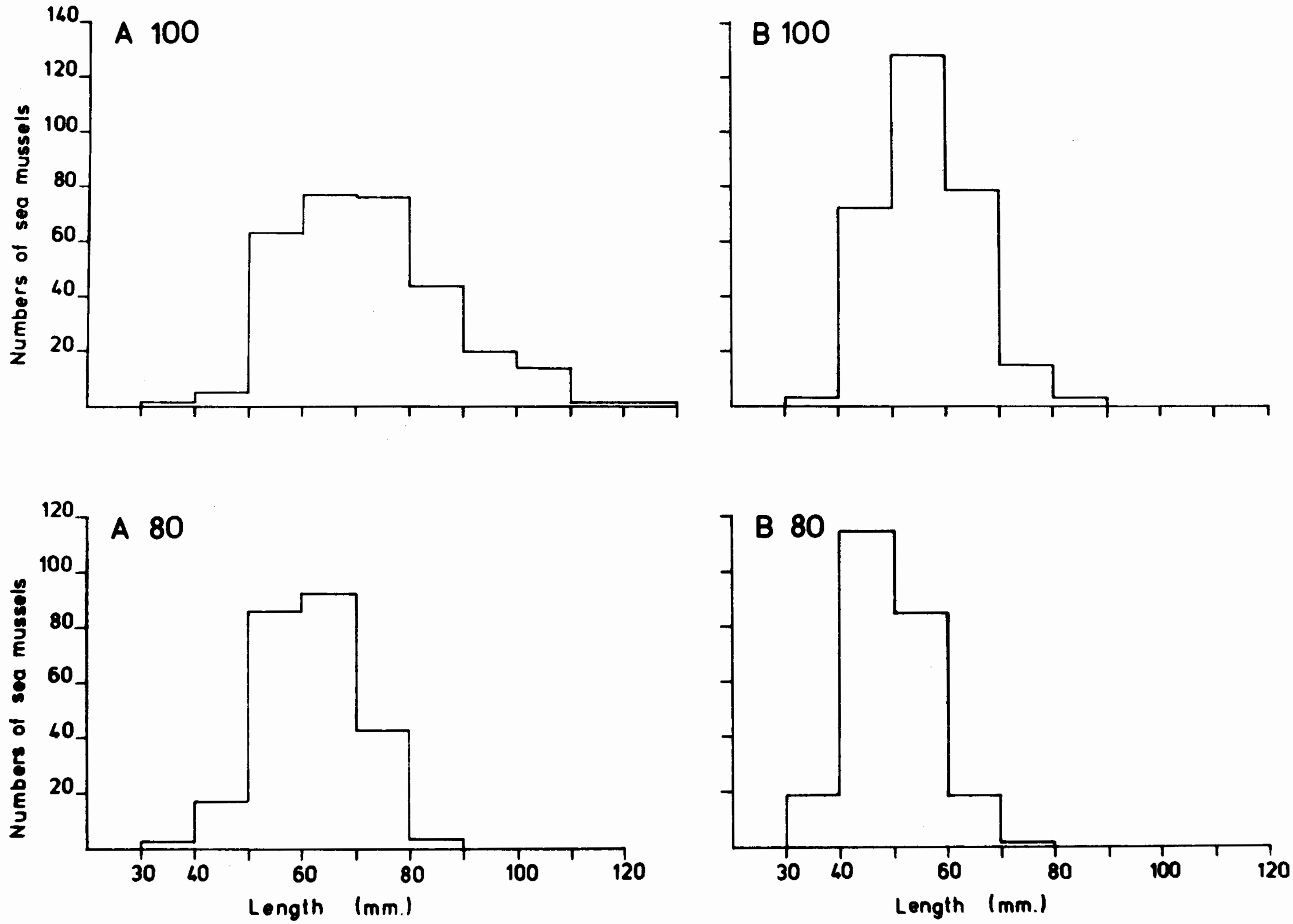


Figure 19. Continued

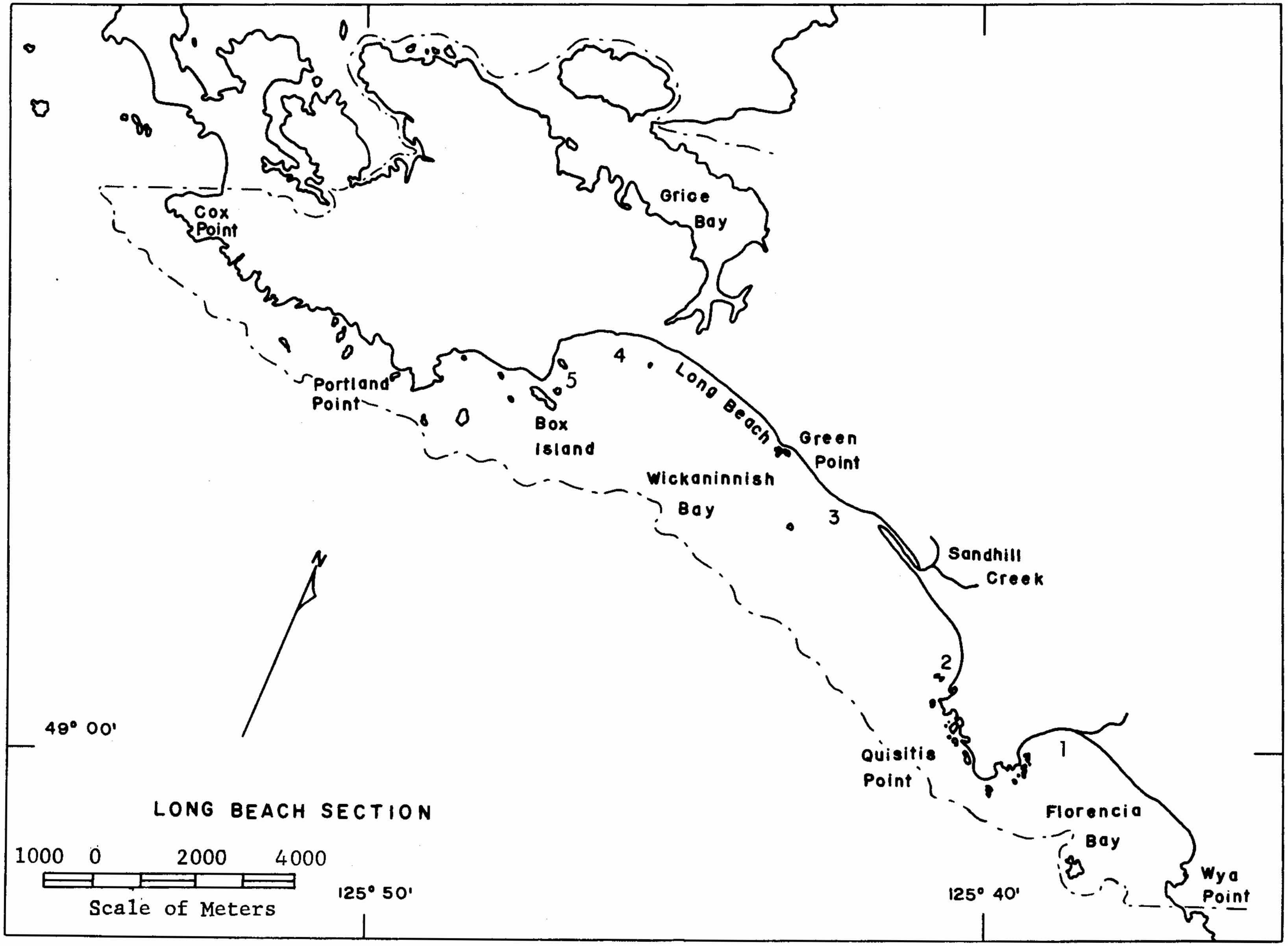


Figure 20. Locations sampled to determine density of <u>Olivella</u>, Long Beach Section (1976).

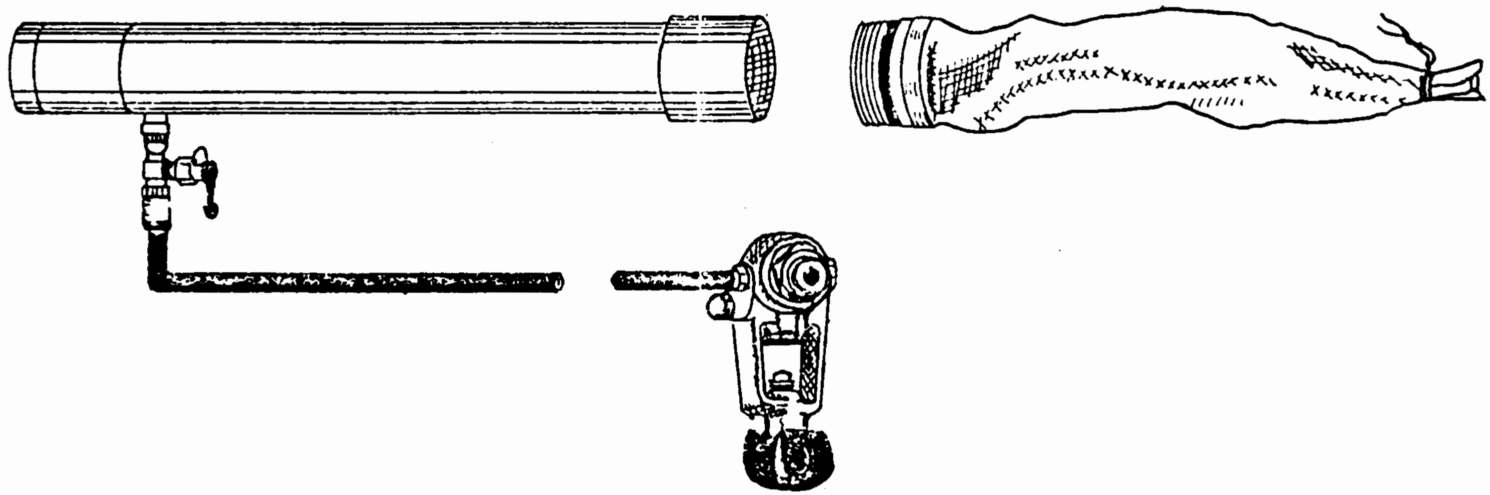


Figure 21. Portable suction sampler. (Courtesy of Dr. R.E. Foreman,Dept. of Botany,UBC.)

Figure 22. Pisaster study area, along a semi-exposed vertical rock face on the east side of Grassy Island, Schooner Cove.

Figure 23. <u>Pisaster</u> study area, along an exposed west side of Green Point.

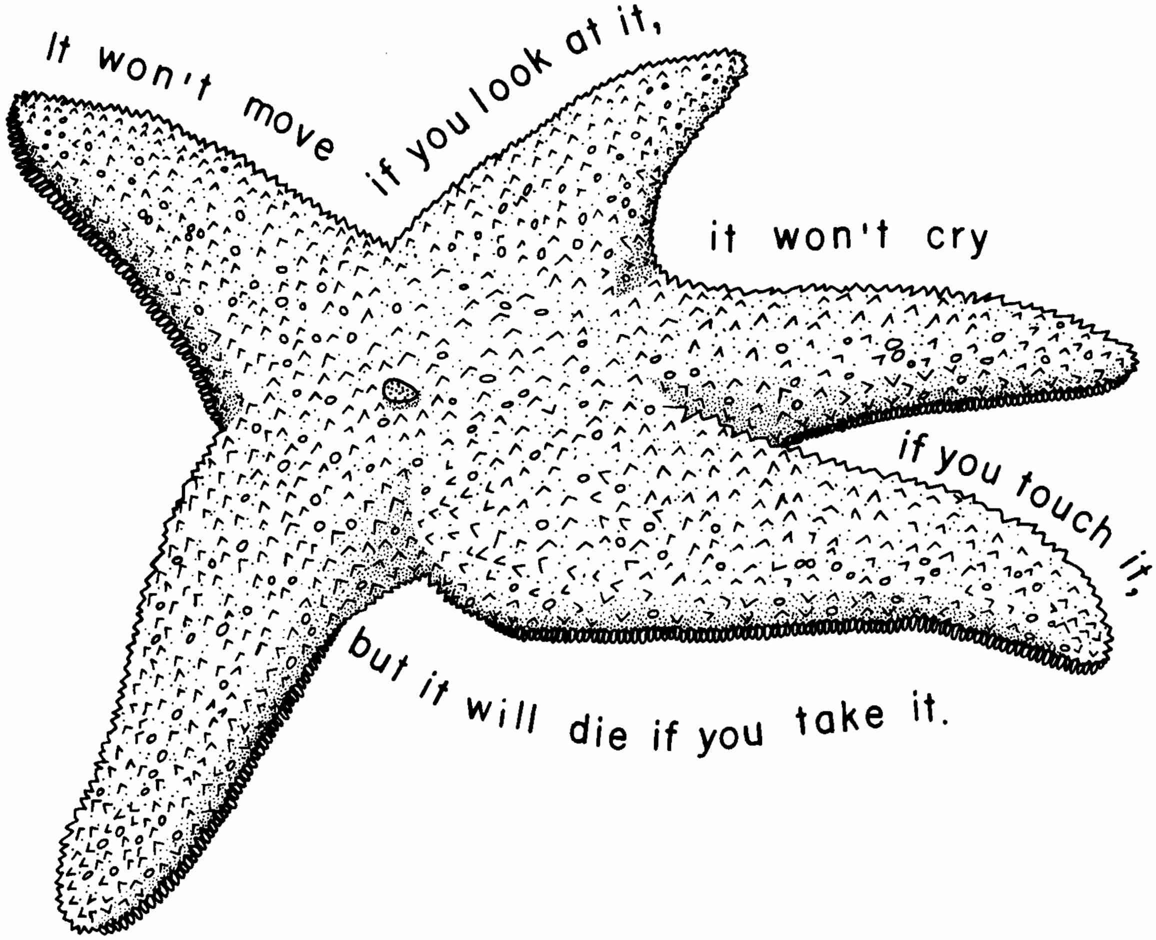


Figure 24. Poster of <u>Pisaster</u> "look but do not remove" policy taken from Interpretive Program 1974 pamphlet. (Redrawn by Barbara Adkins.)

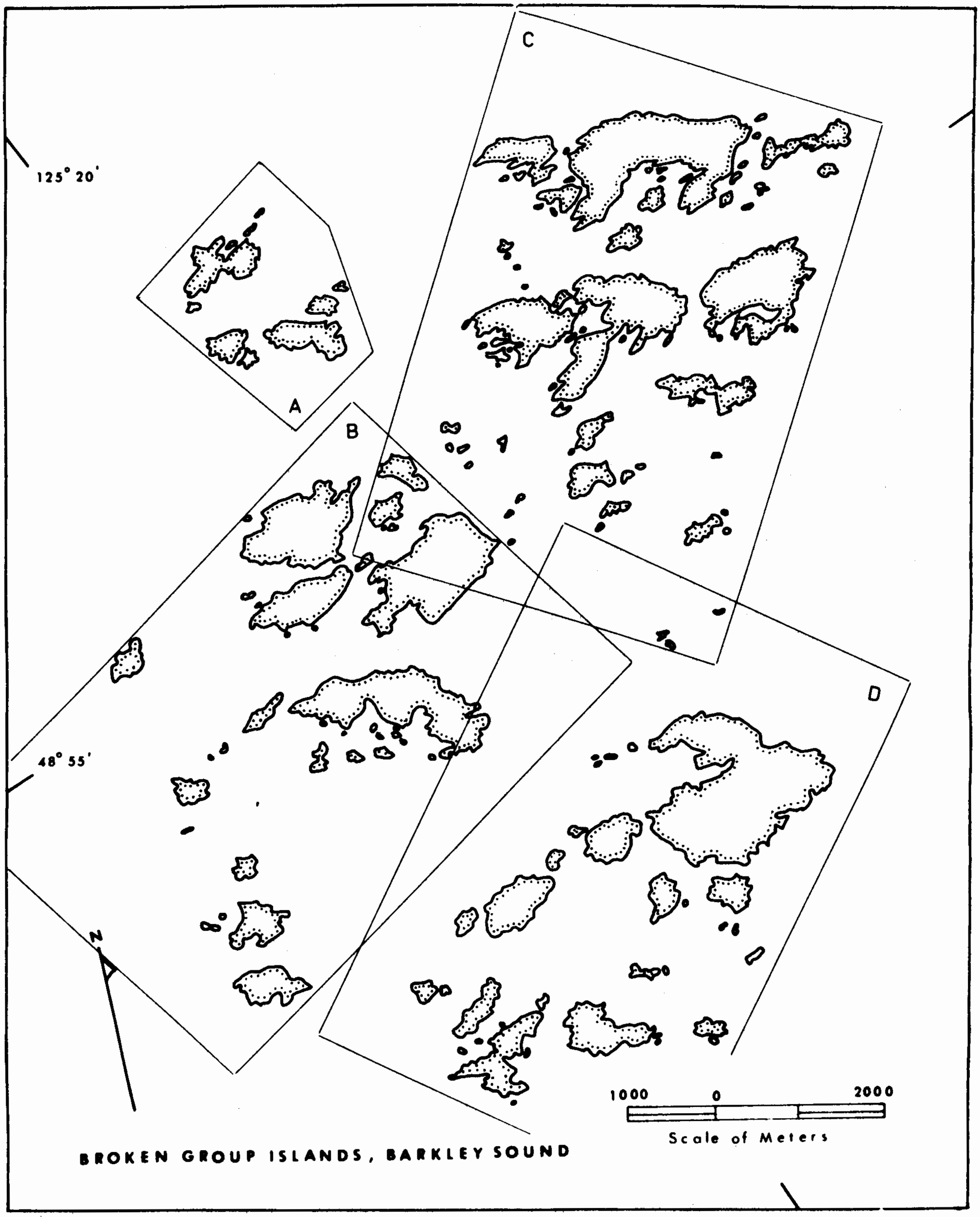


Figure 25. Sectional map for distribution of general intertidal substrate types and exposures, Broken Group Islands Section.

Figure 25. Continued. Distribution of general intertidal substrate types, Broken Group Islands Section (1976).

LEGEND

R Rock

B Boulders

C Cobble

Sand

Gravel, Sand and Shell Mixture

M Mud

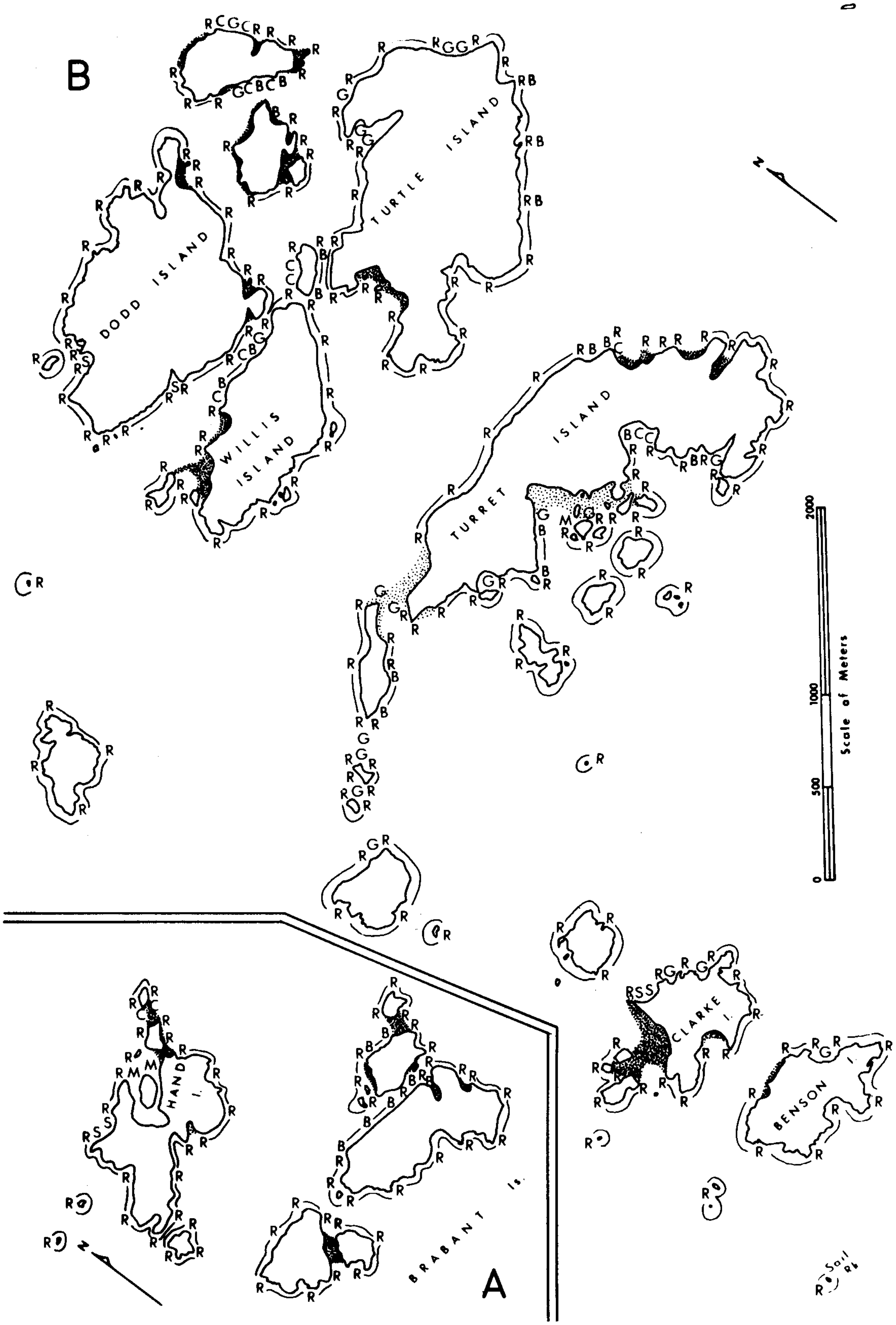


Figure 25. Continued

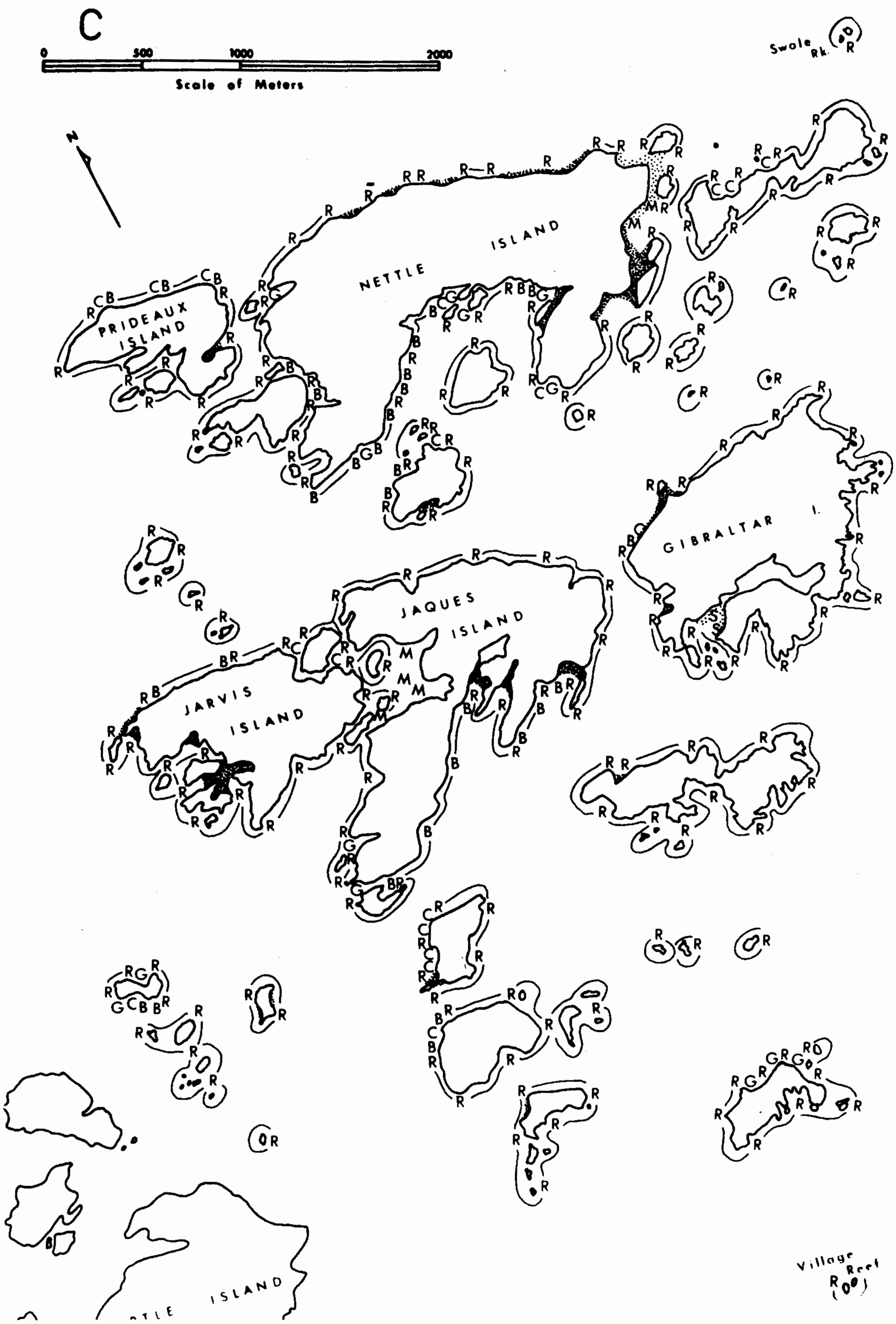


Figure 25. Continued

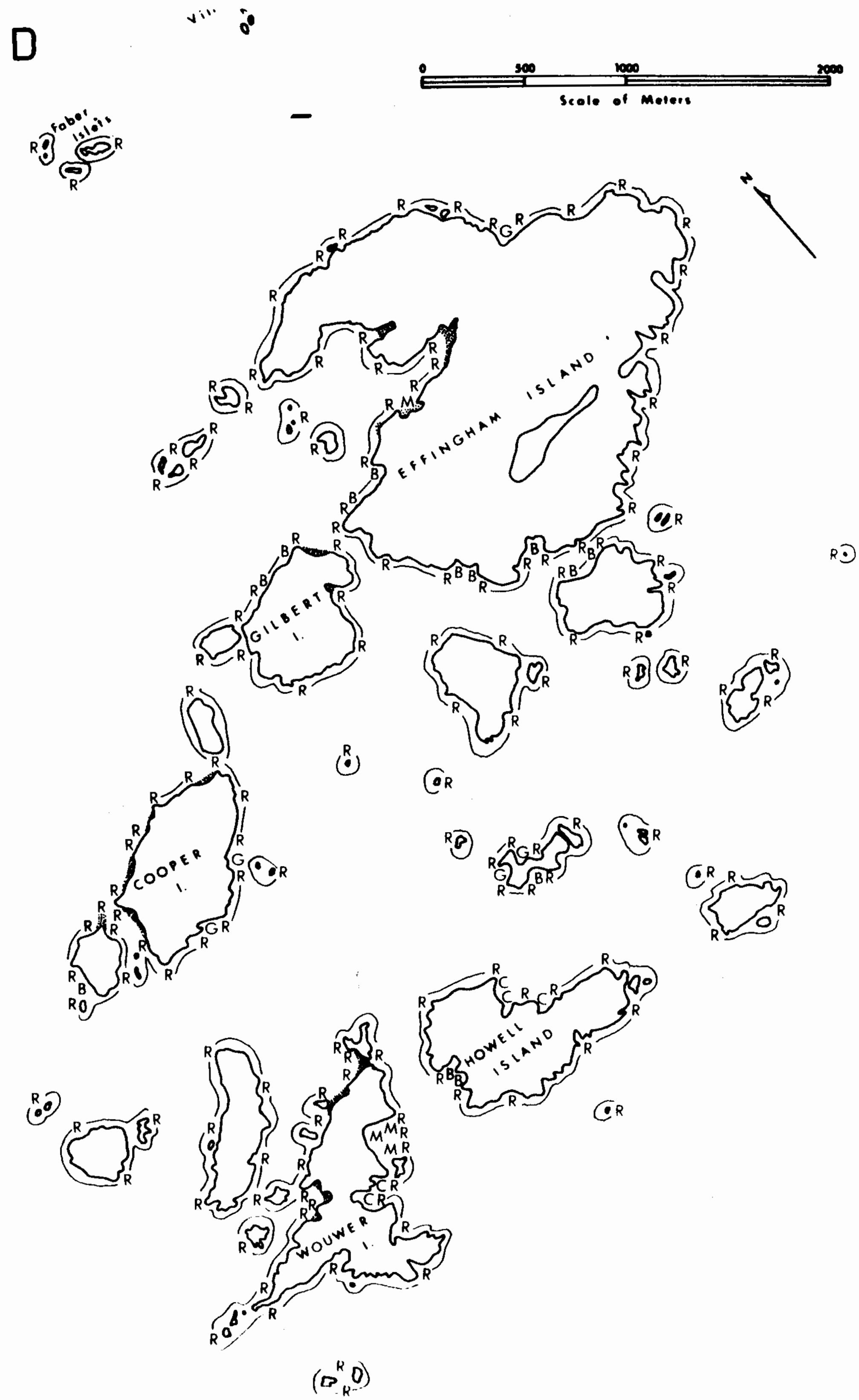


Figure 25. Continued

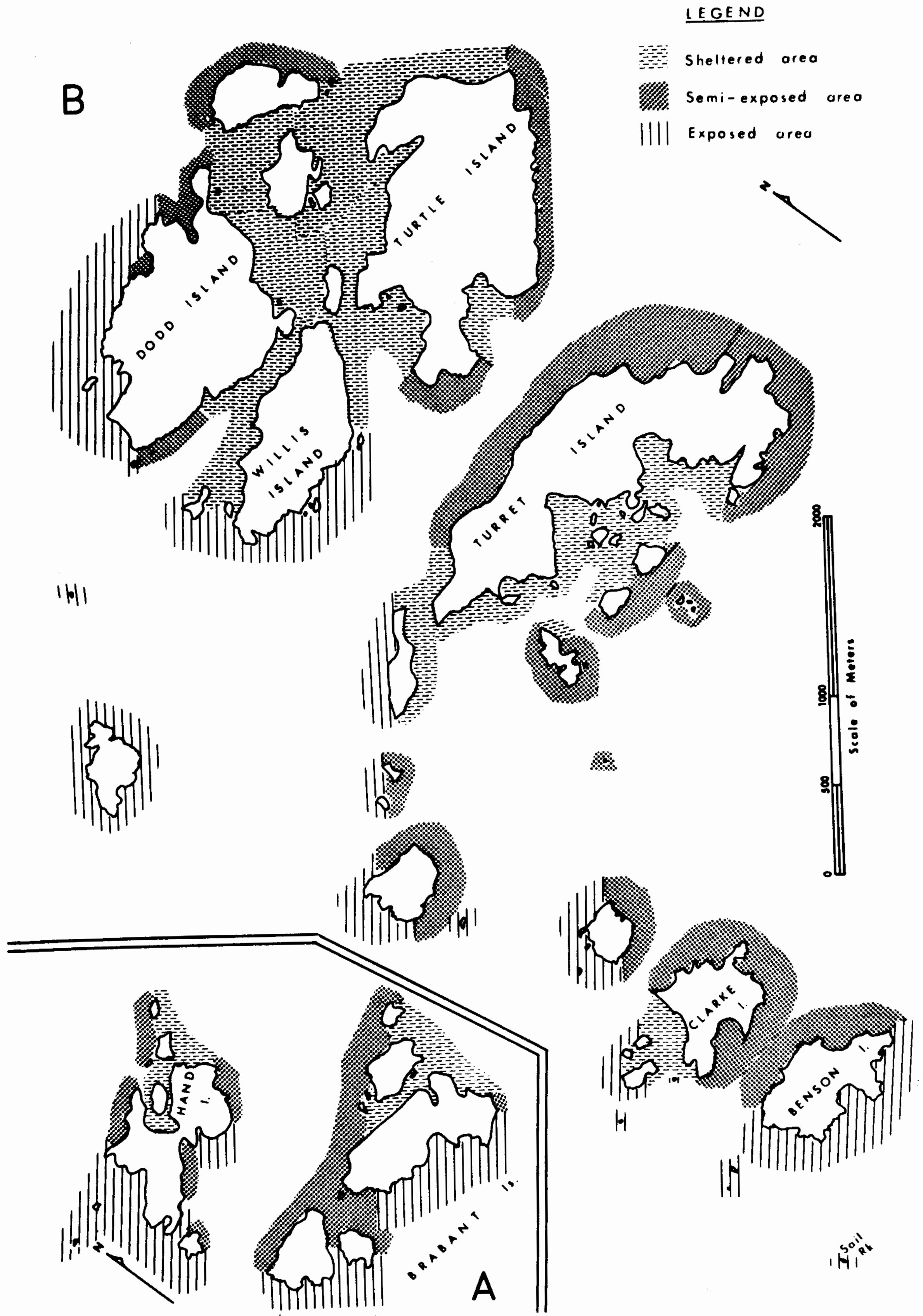


Figure 26. Distribution of intertidal exposures, Broken Group Islands Section (1976).

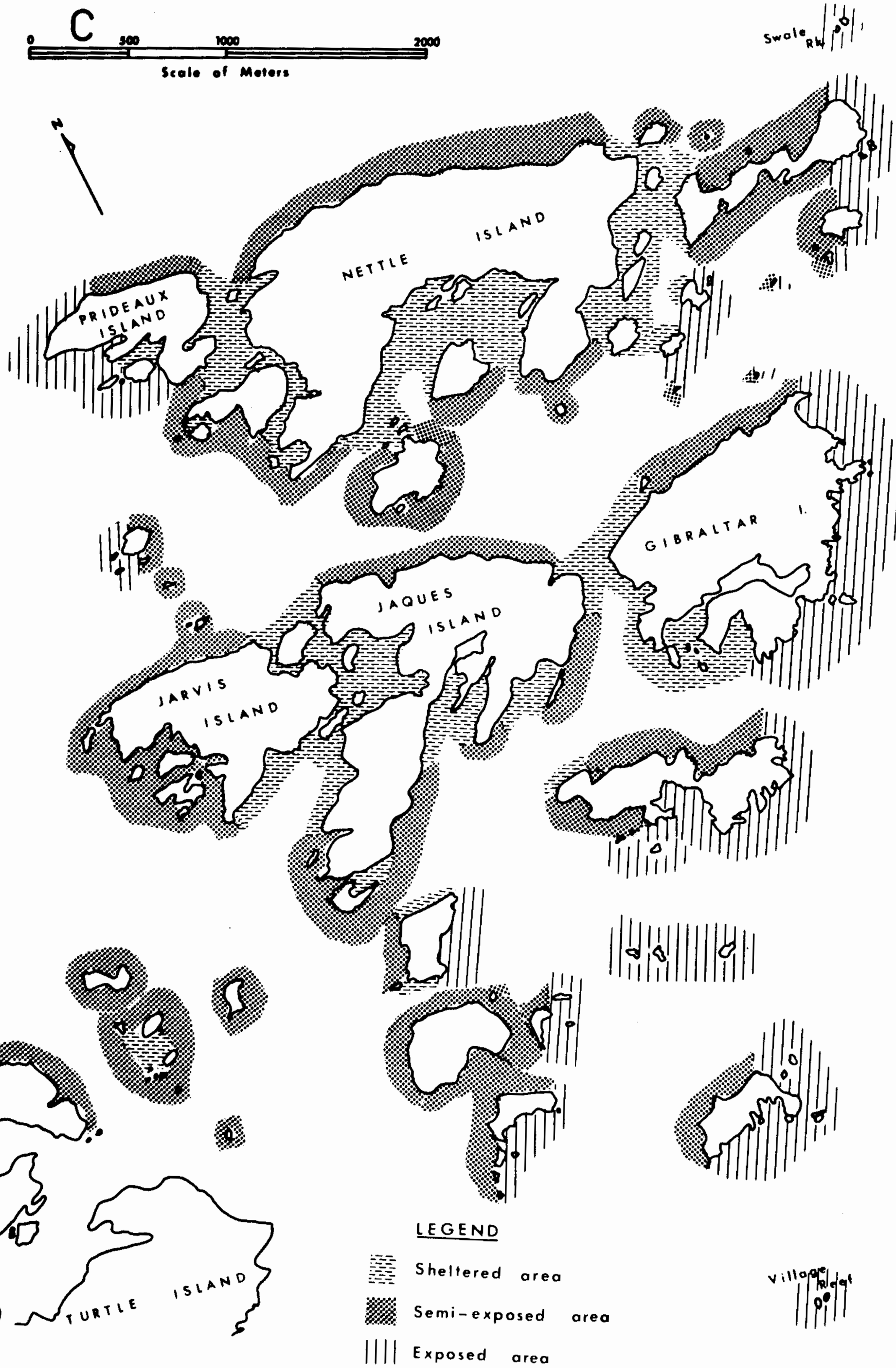


Figure 26. Continued

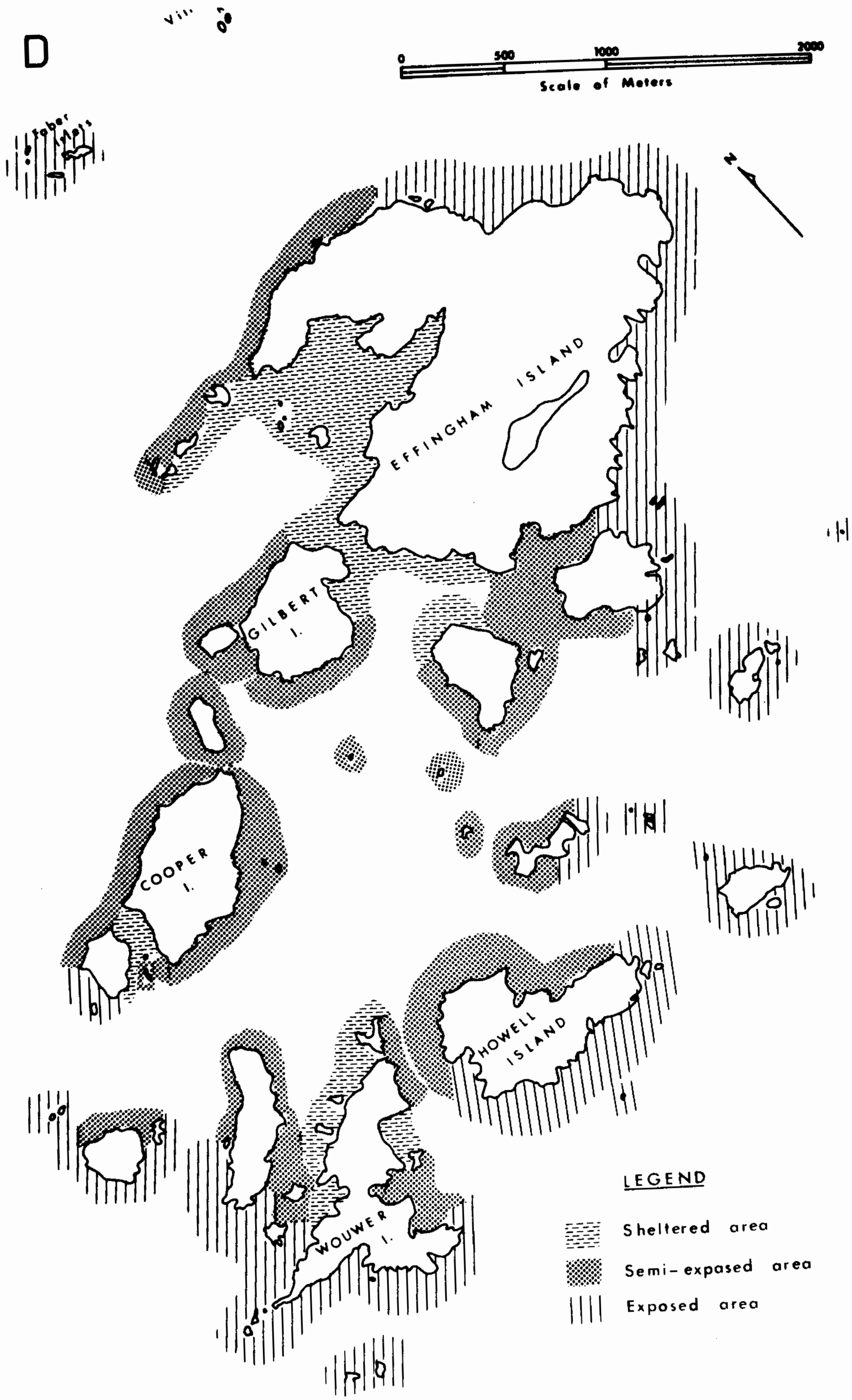


Figure 26. Continued

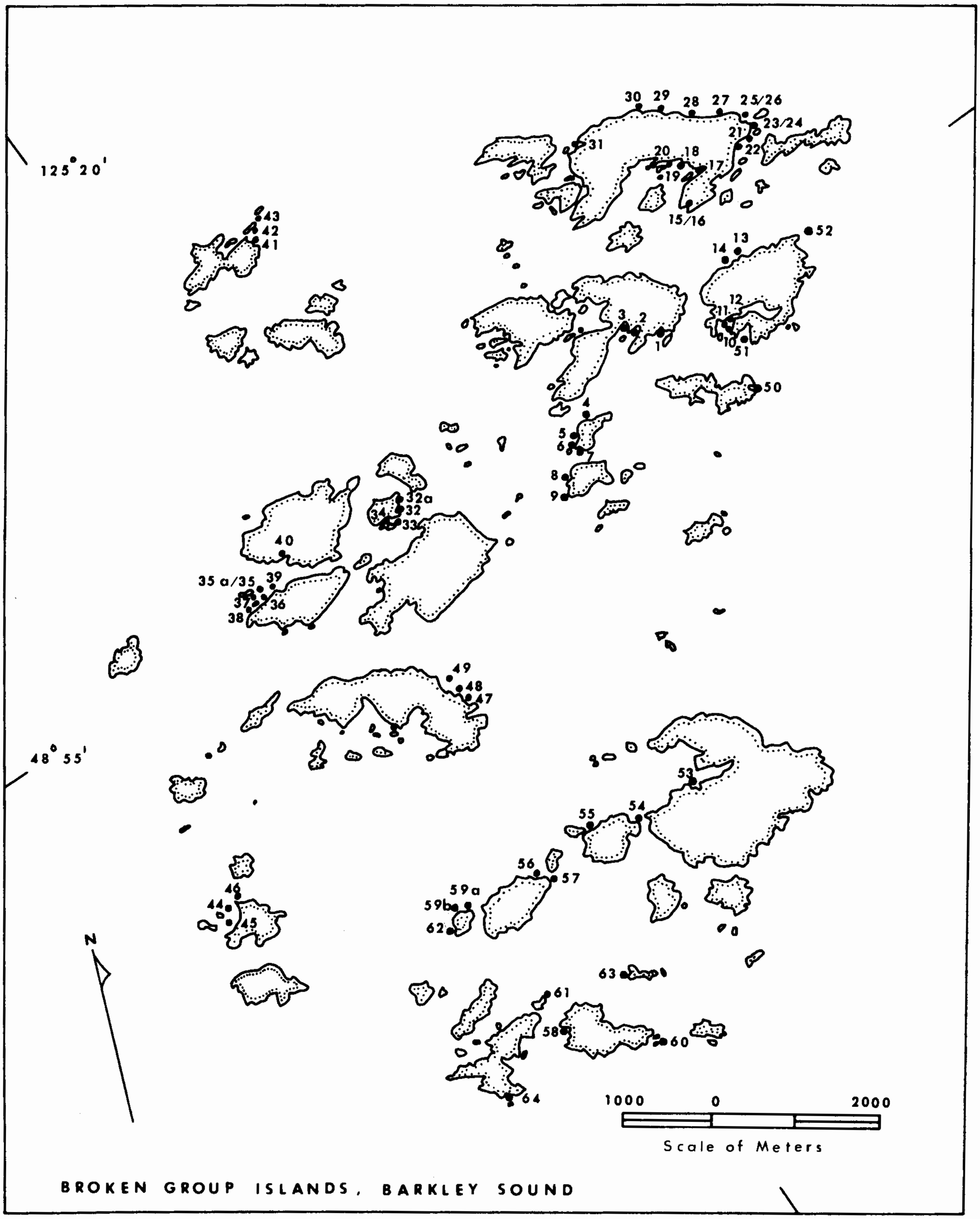


Figure 27. Location of intertidal fauna and flora survey sites, Broken Group Islands Section (1976).

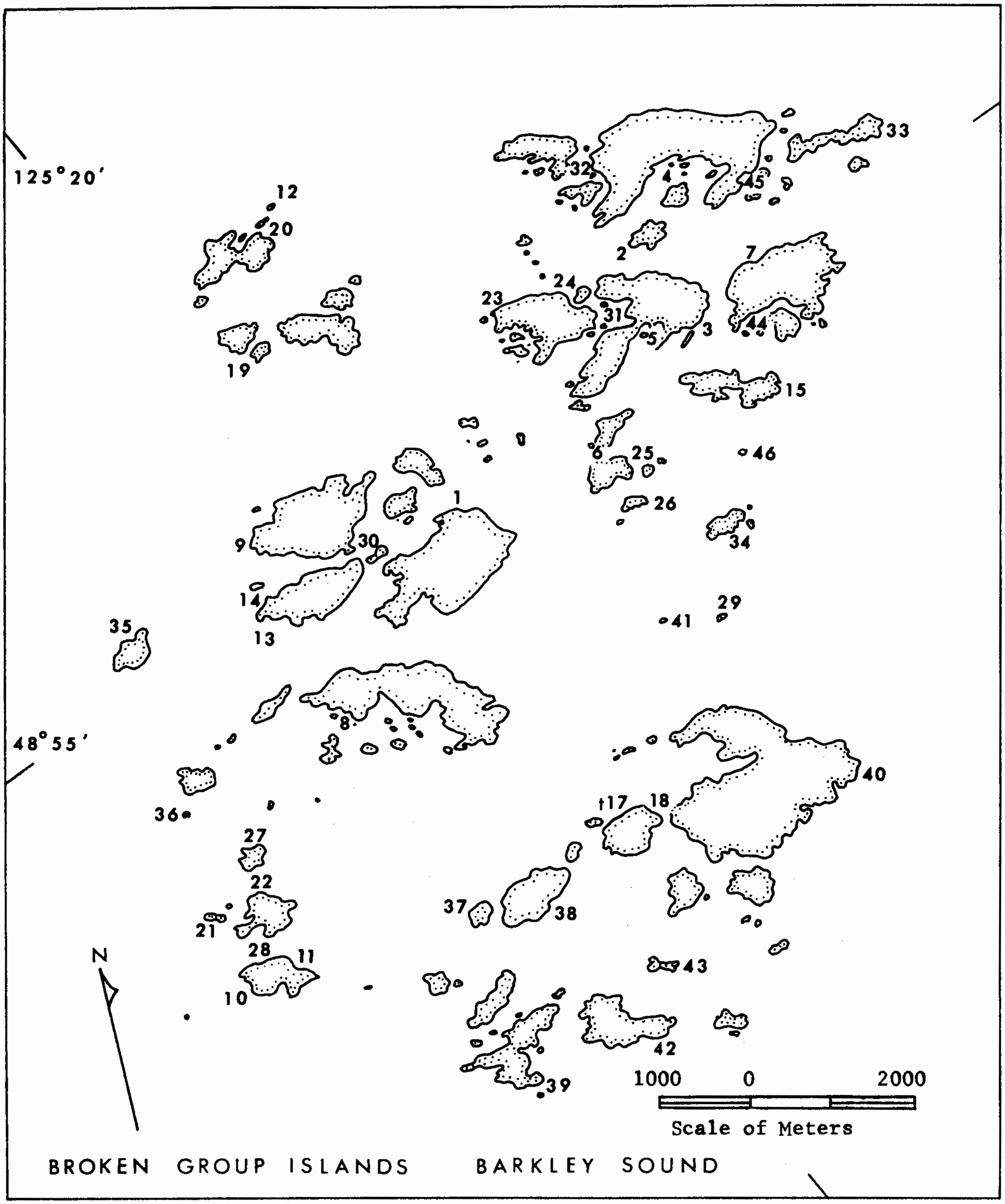


Figure 28. Location of subtidal fauna and flora survey sites, Broken Group Islands Section (1976).

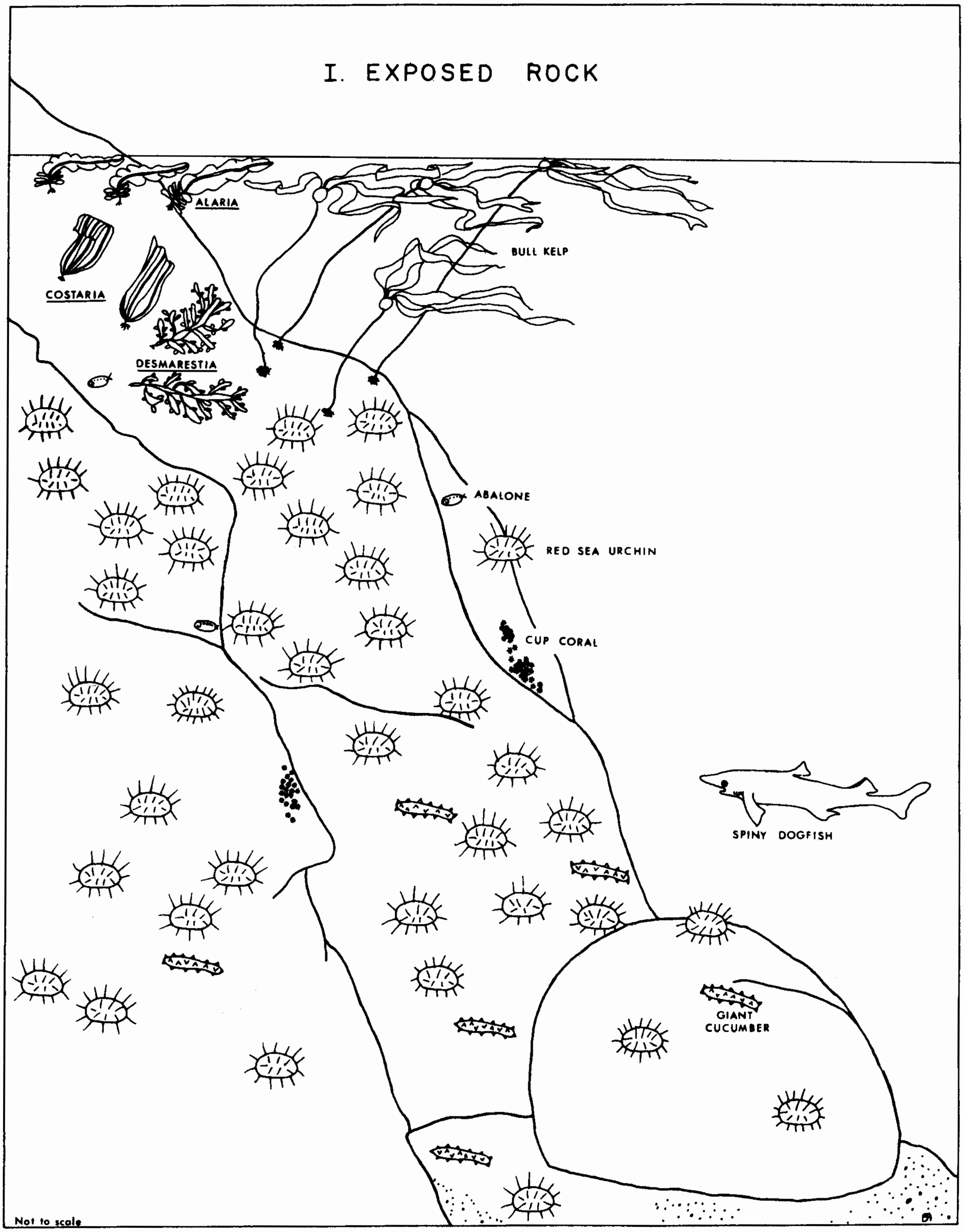


Figure 29. Schematic diagram of subtidal exposed rocky shore habitat type, Broken Group Islands Section (1976).

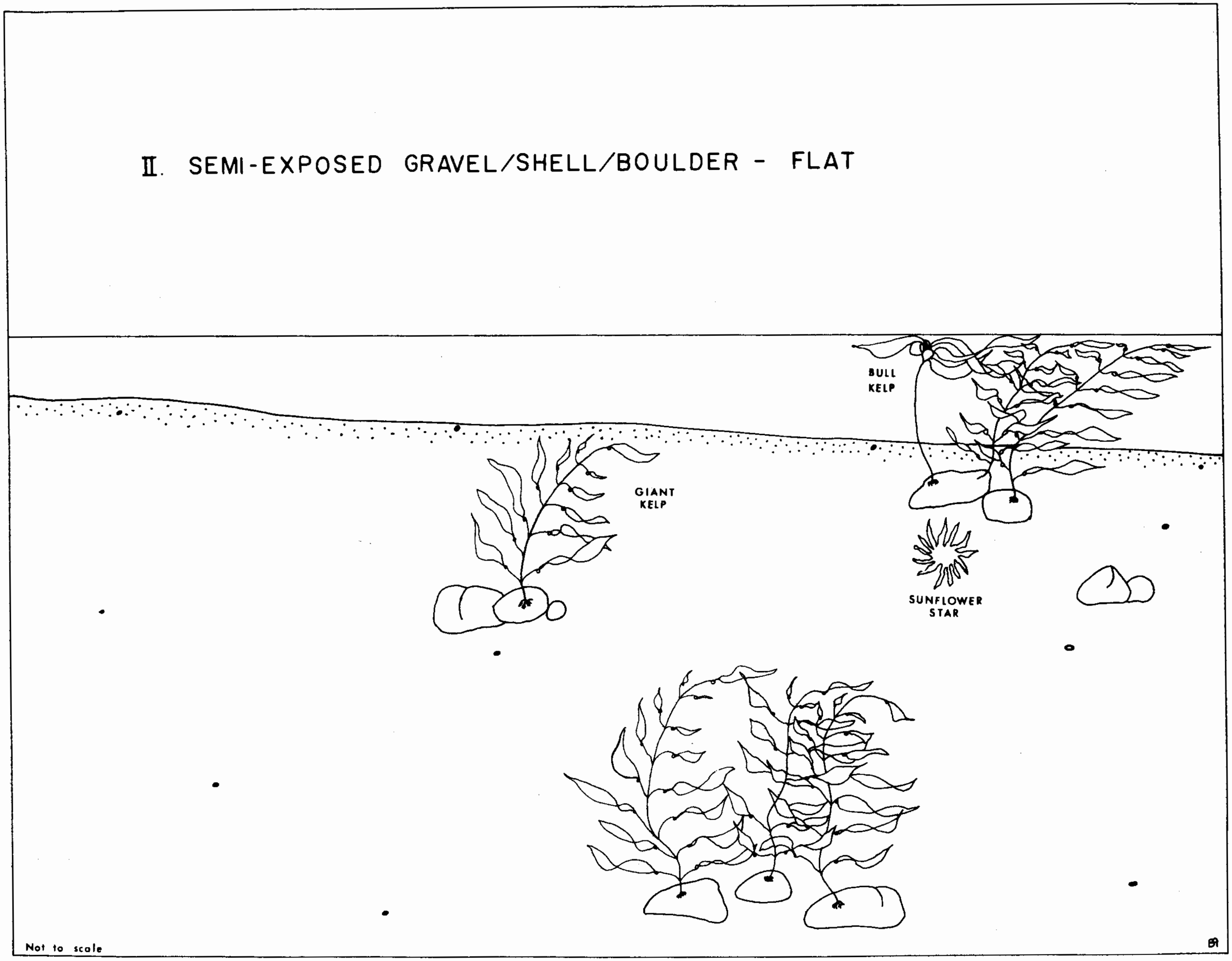


Figure 30. Schematic diagram of subtidal semi-exposed gravel, shell with isolated boulders habitat type, Broken Group Islands Section (1976).

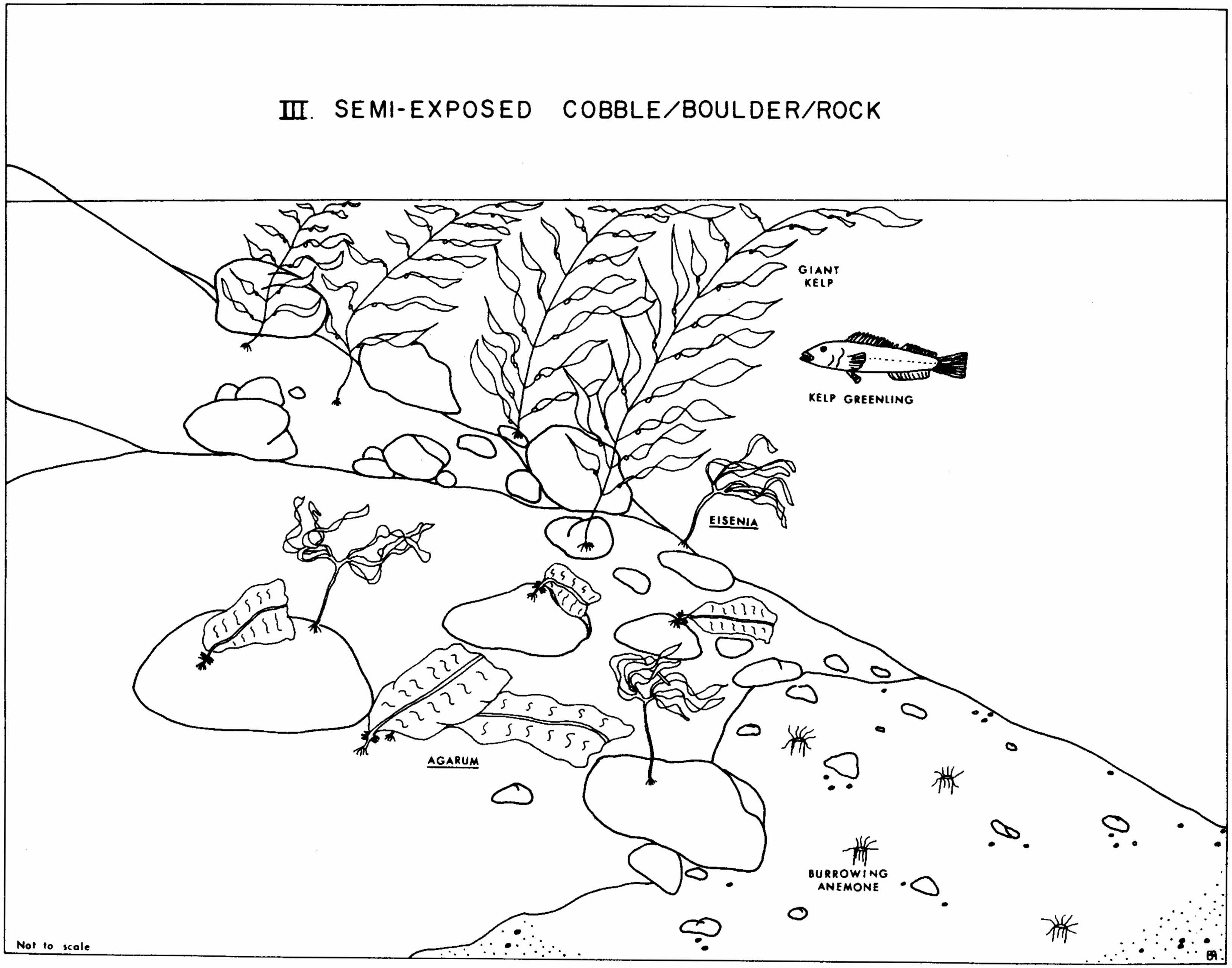


Figure 31. Schematic diagram of subtidal semi-exposed cobble, boulder and rock habitat type, Broken Group Islands Section (1976).

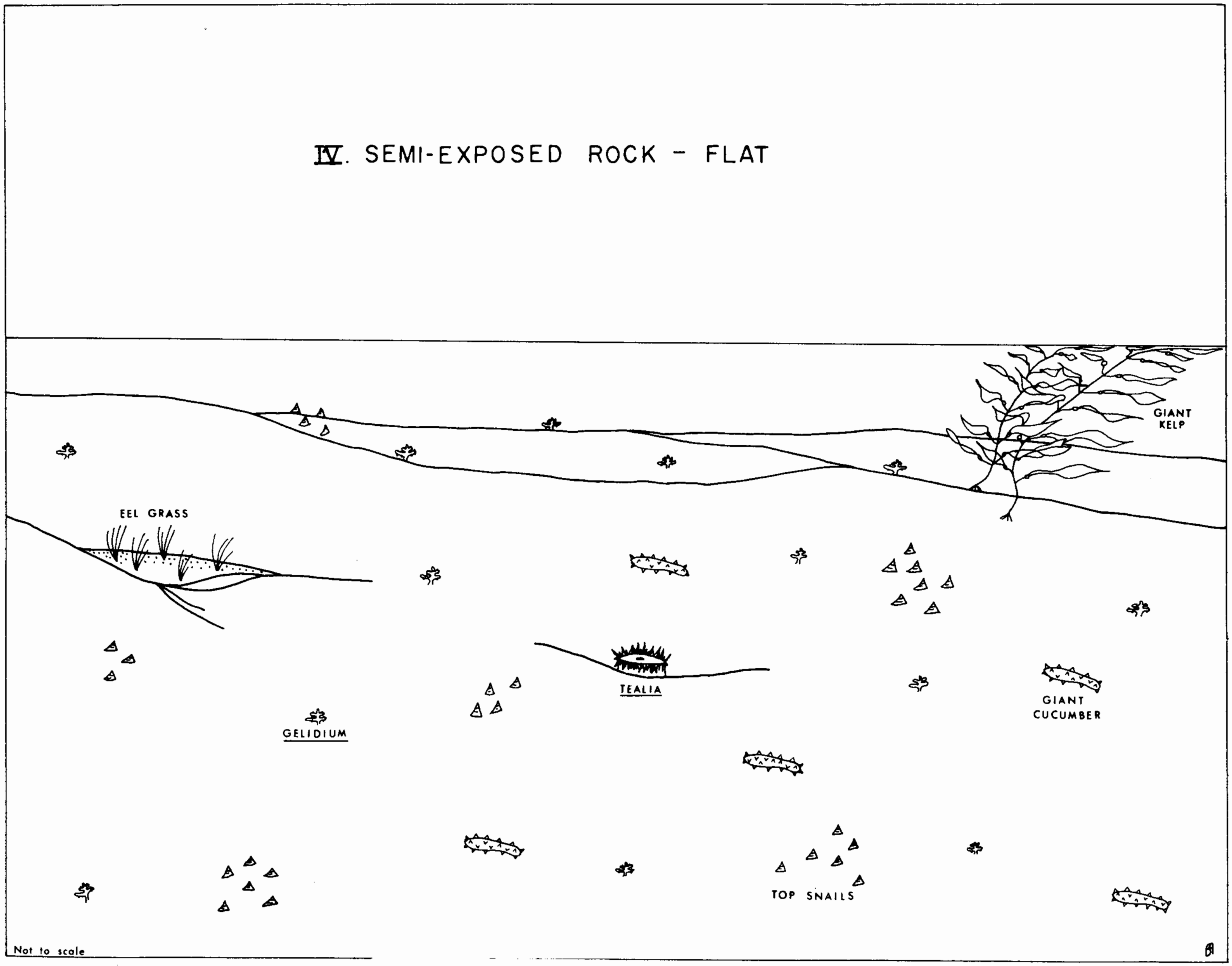


Figure 32. Schematic diagram of subtidal semi-exposed flat rock habitat type, Broken Group Islands Section (1976).

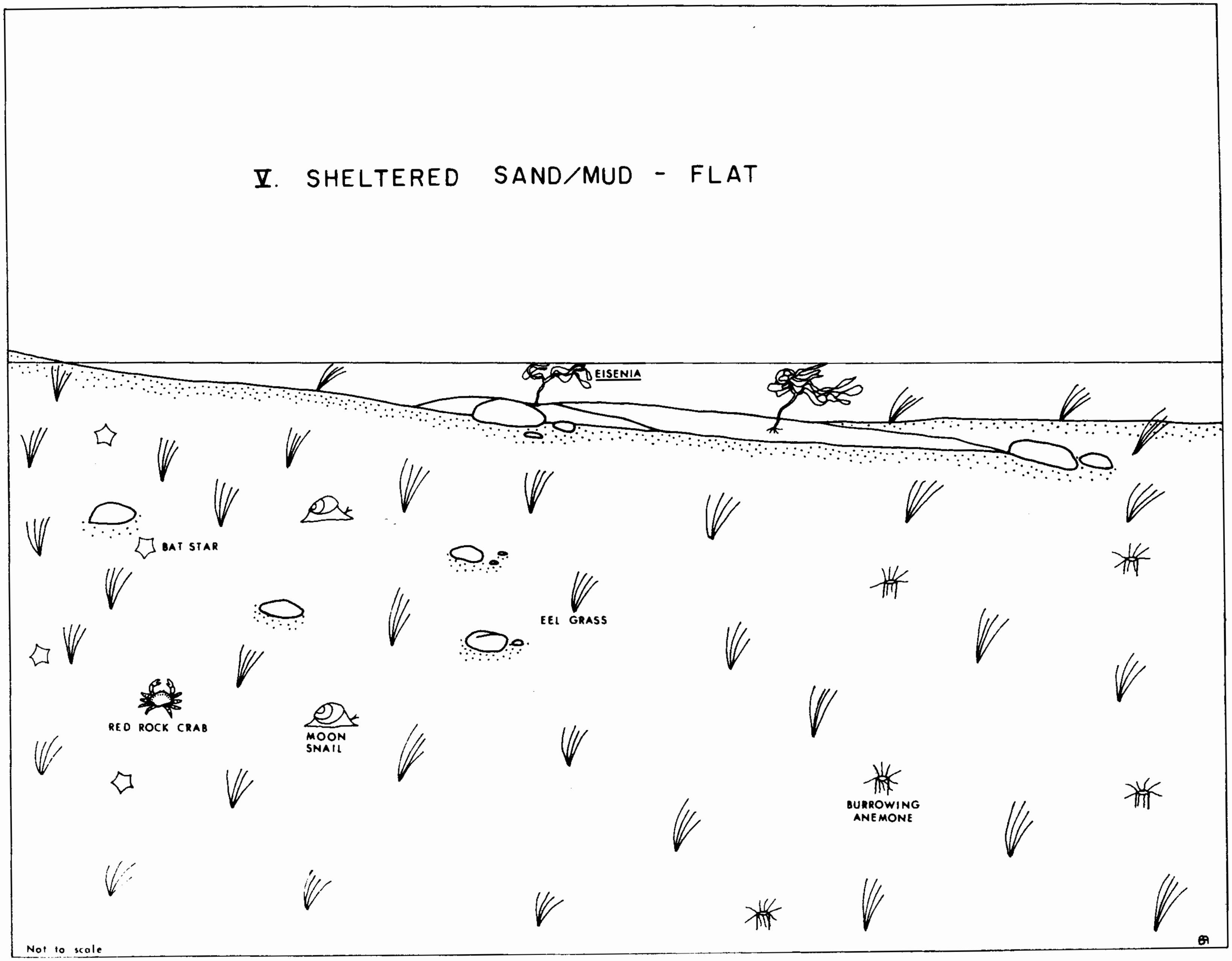


Figure 33. Schematic diagram of subtidal sheltered sand and mud flats, Broken Group Islands Section (1976).

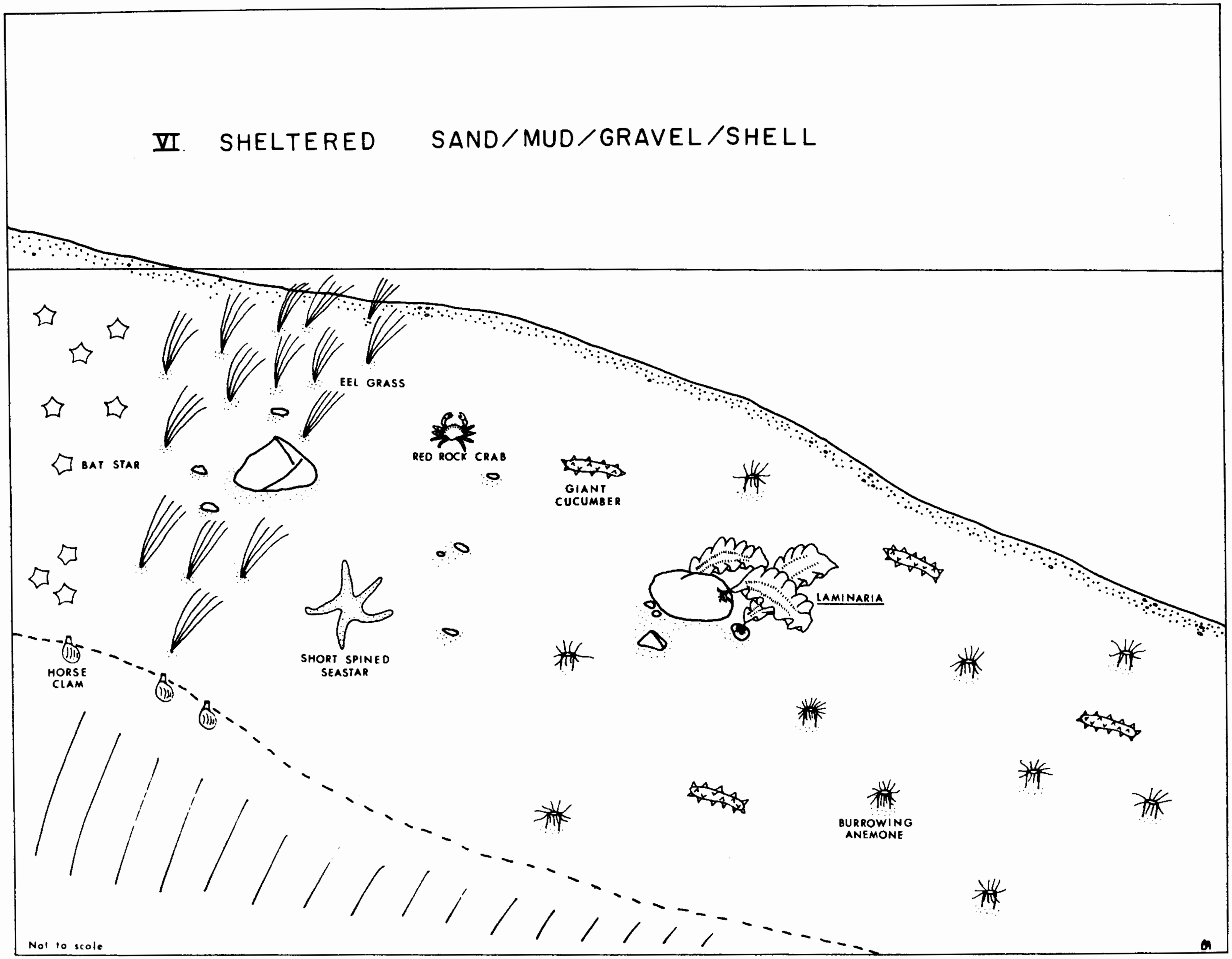


Figure 34. Schematic diagram of subtidal sheltered sand, mud, gravel and shell habitat type, Broken Group Islands Section (1976).

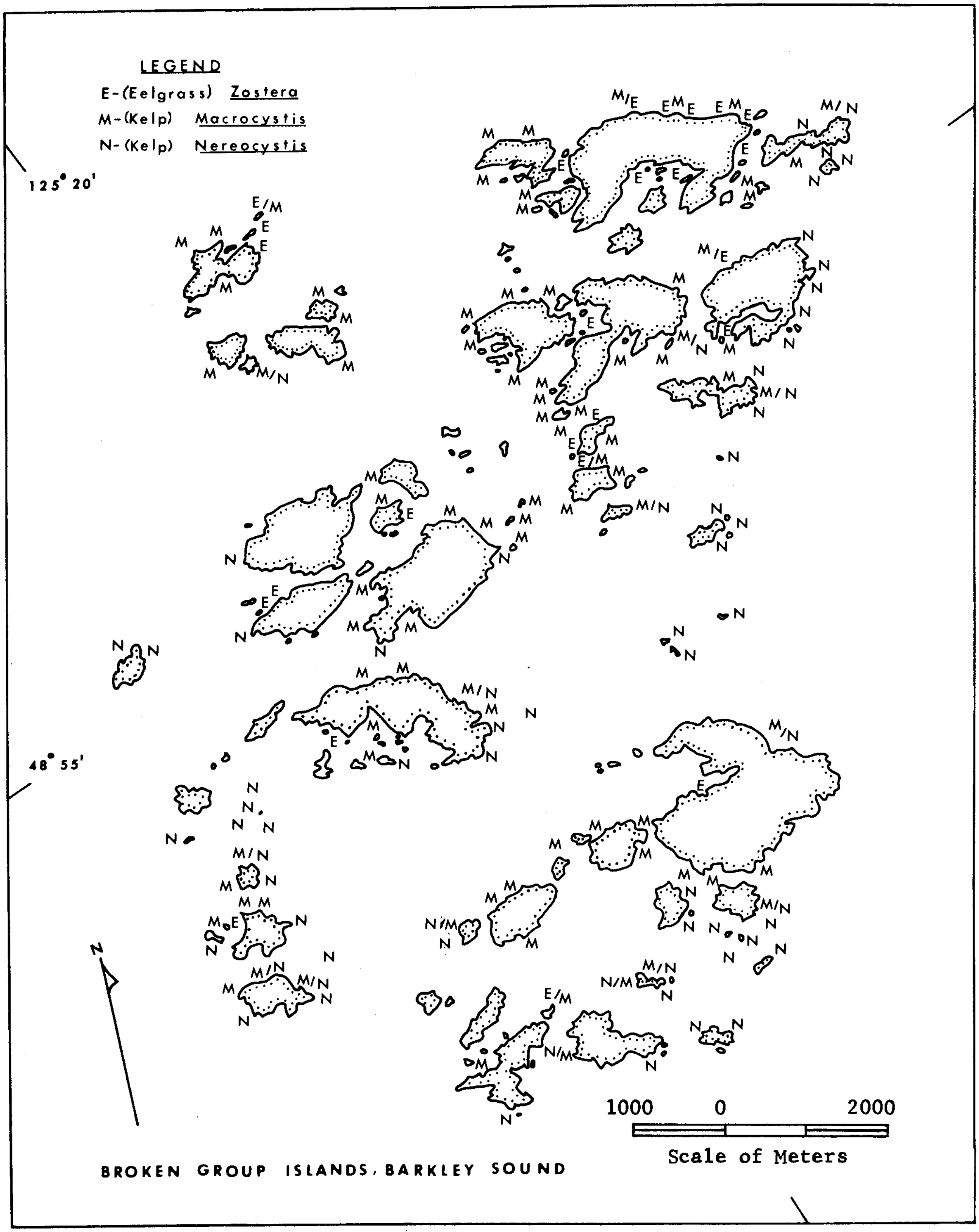


Figure 35. Distribution of kelp and eelgrass beds, Broken Group Islands Section (1976).

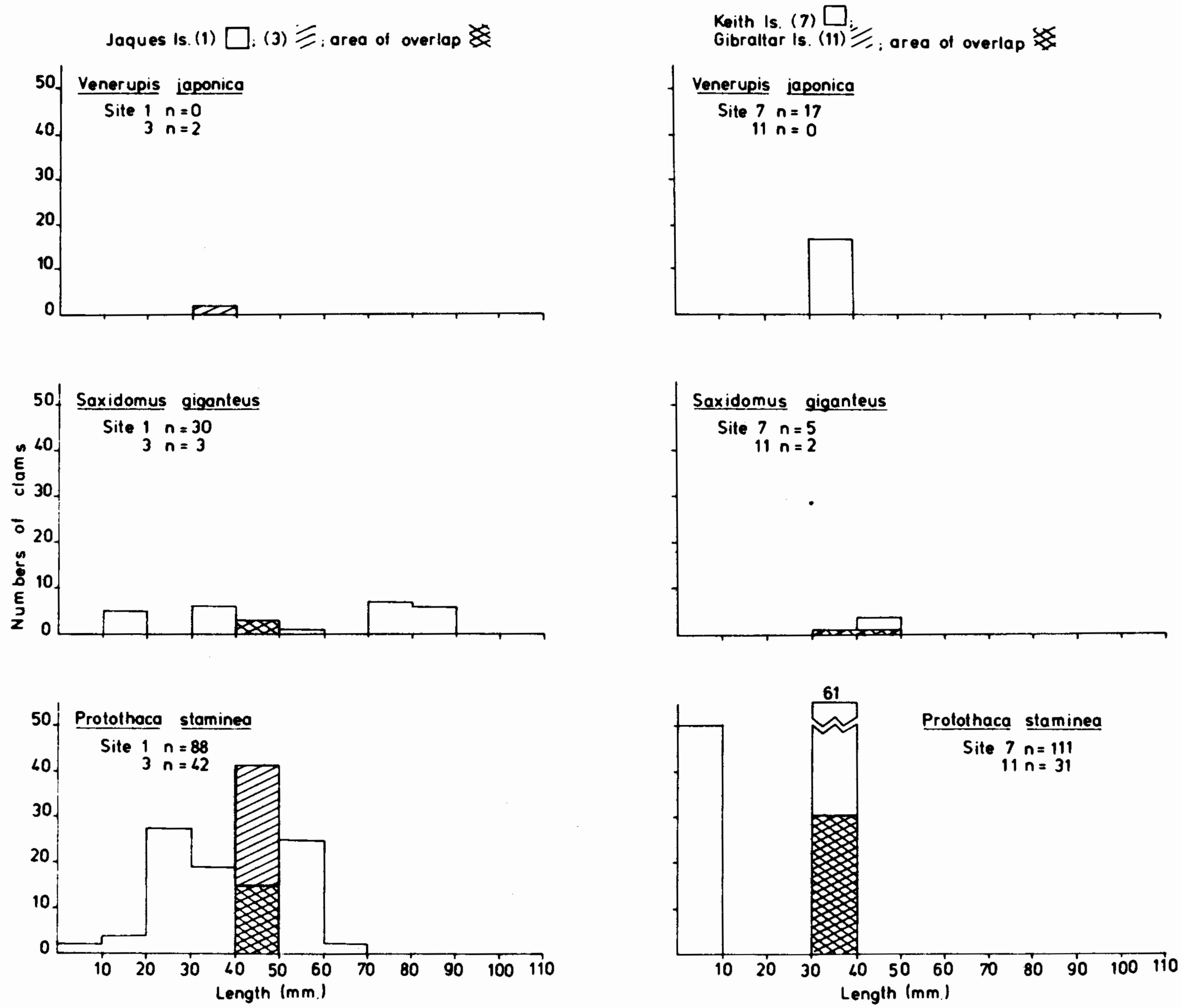


Figure 36. Total length frequency distribution of littleneck clams (*Protothaca staminea*), butter clams (*Saxidomus giganteus*), and Manila clams (*Venerupis japonica*) collected from sites in the Broken Group Islands (1976).

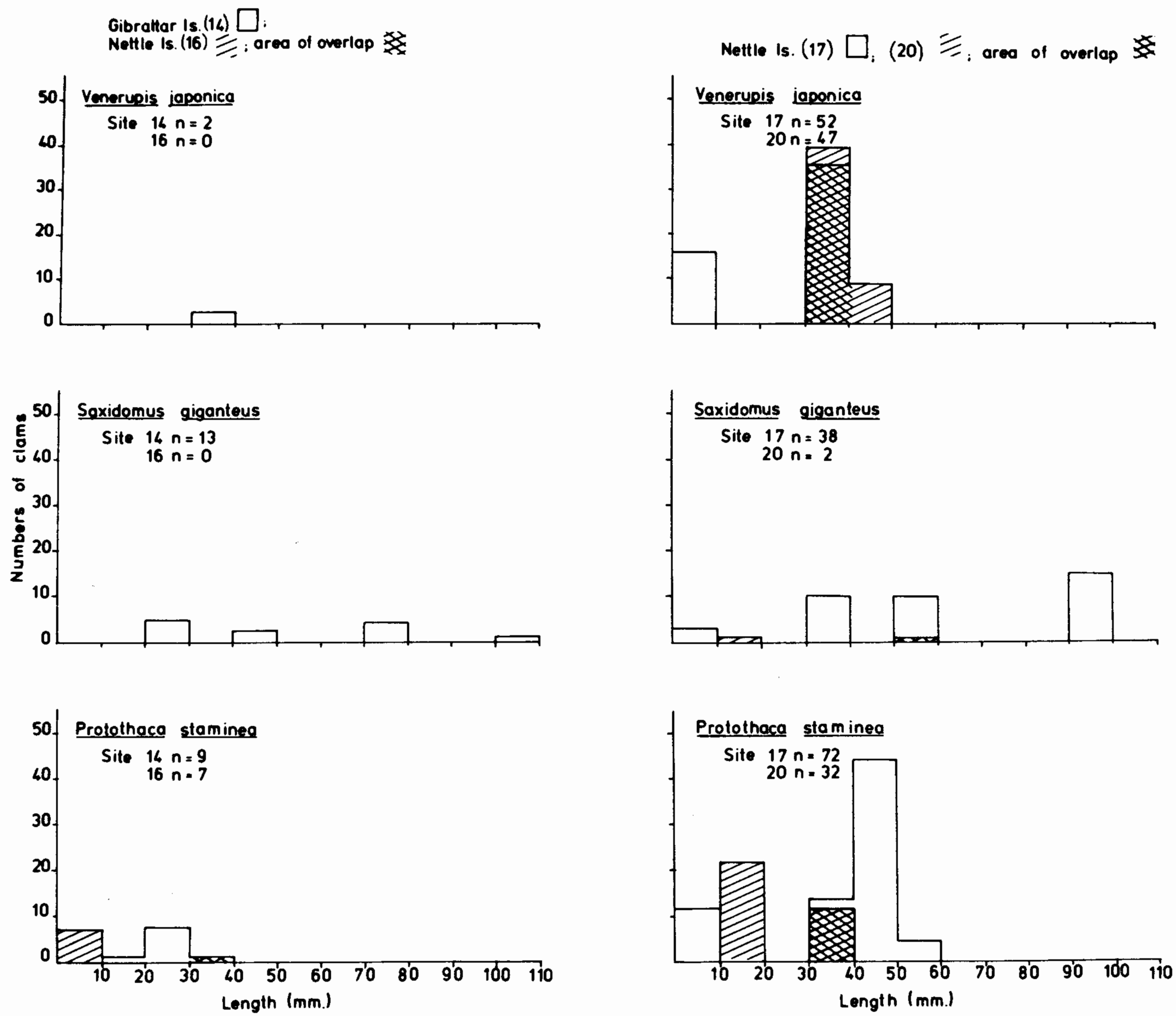


Figure 36. Continued

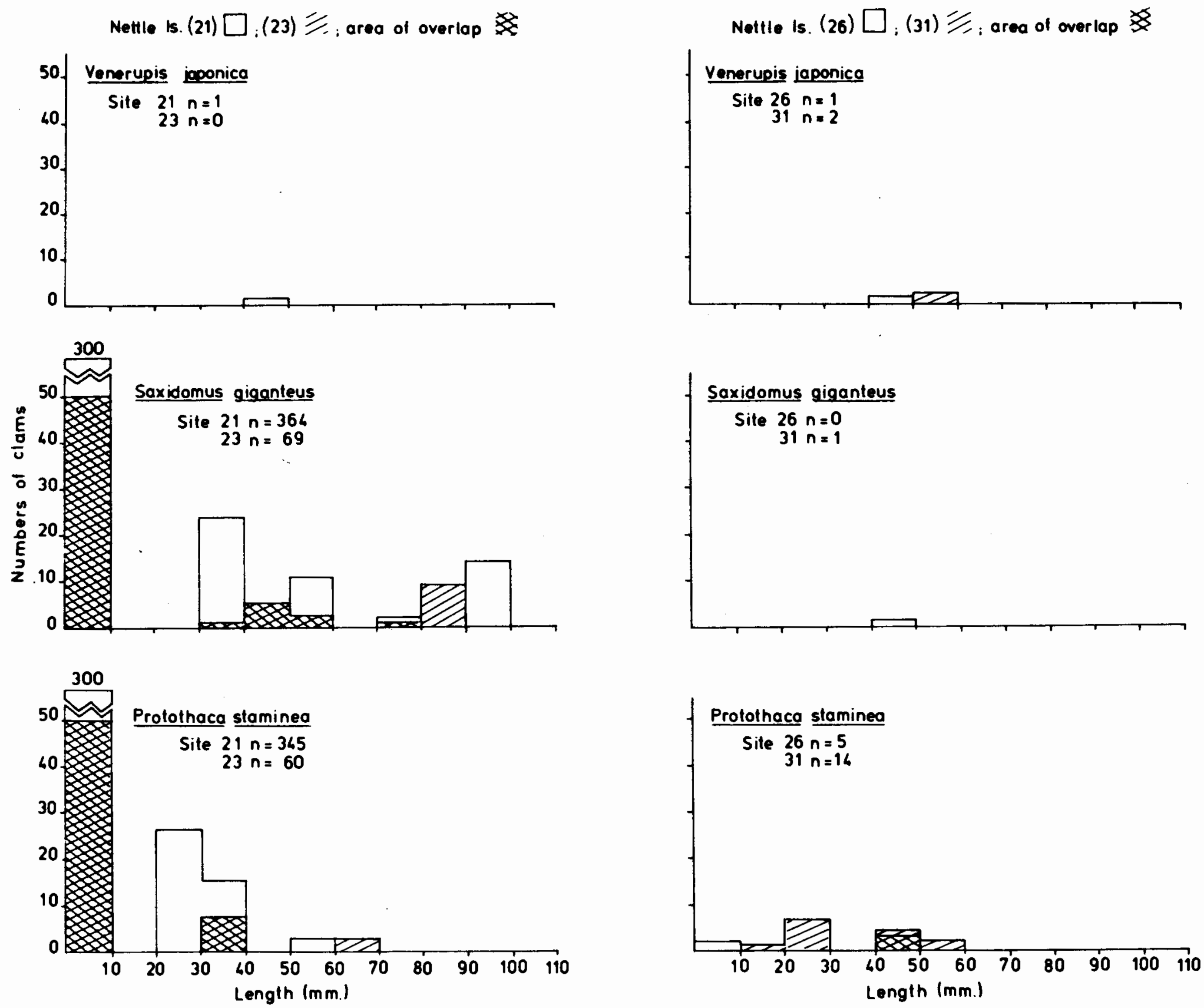


Figure 36. Continued

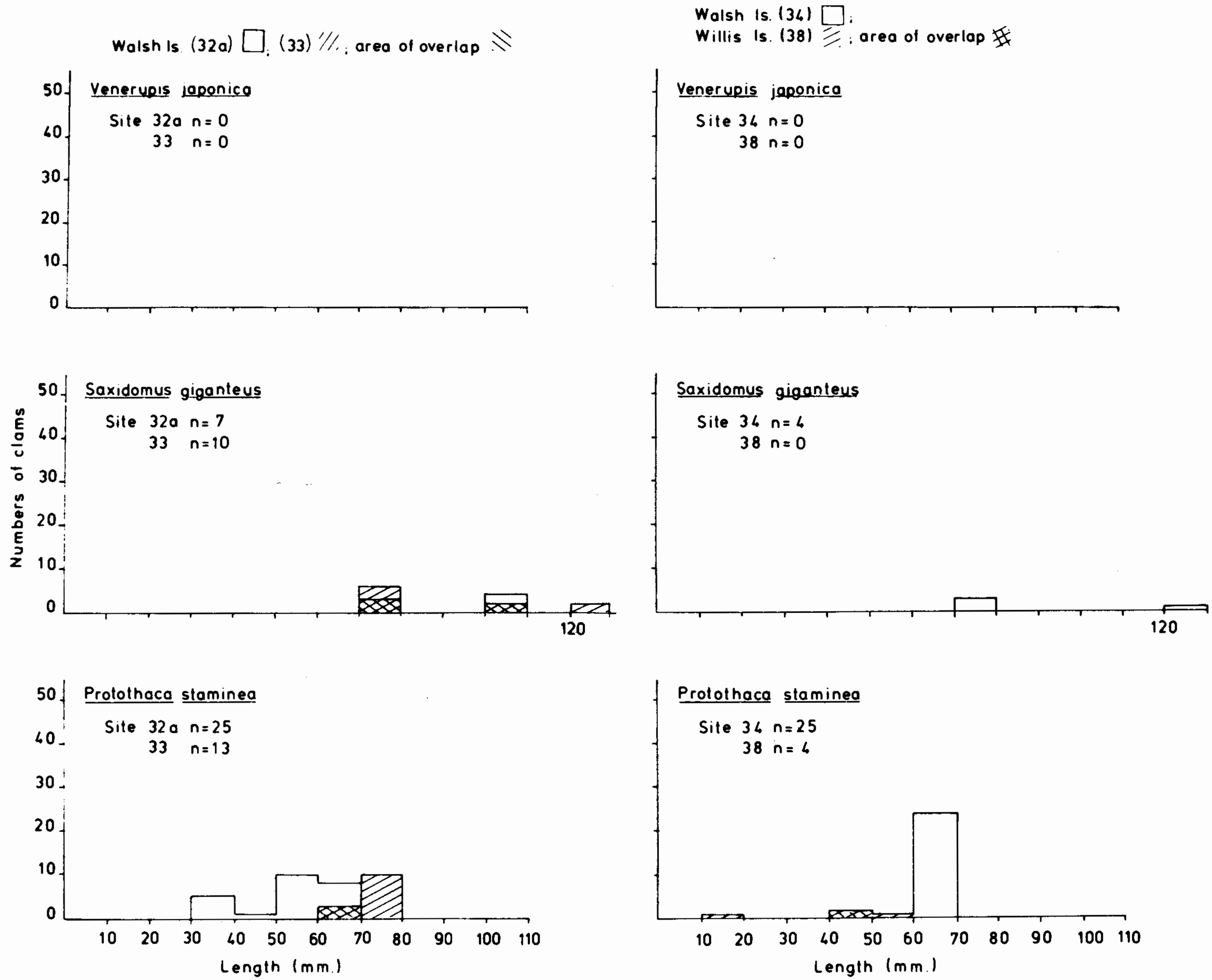


Figure 36. Continued

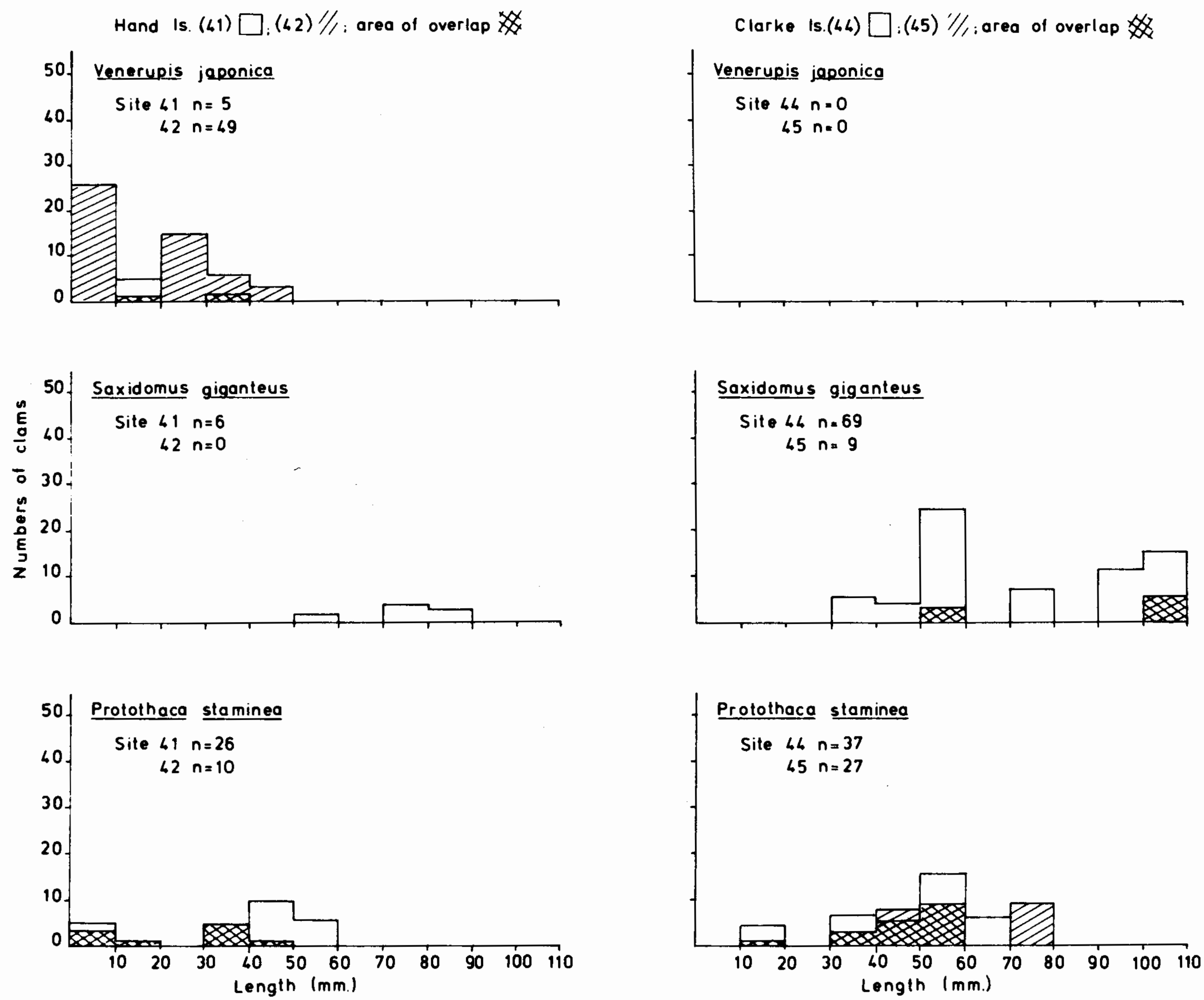


Figure 36. Continued

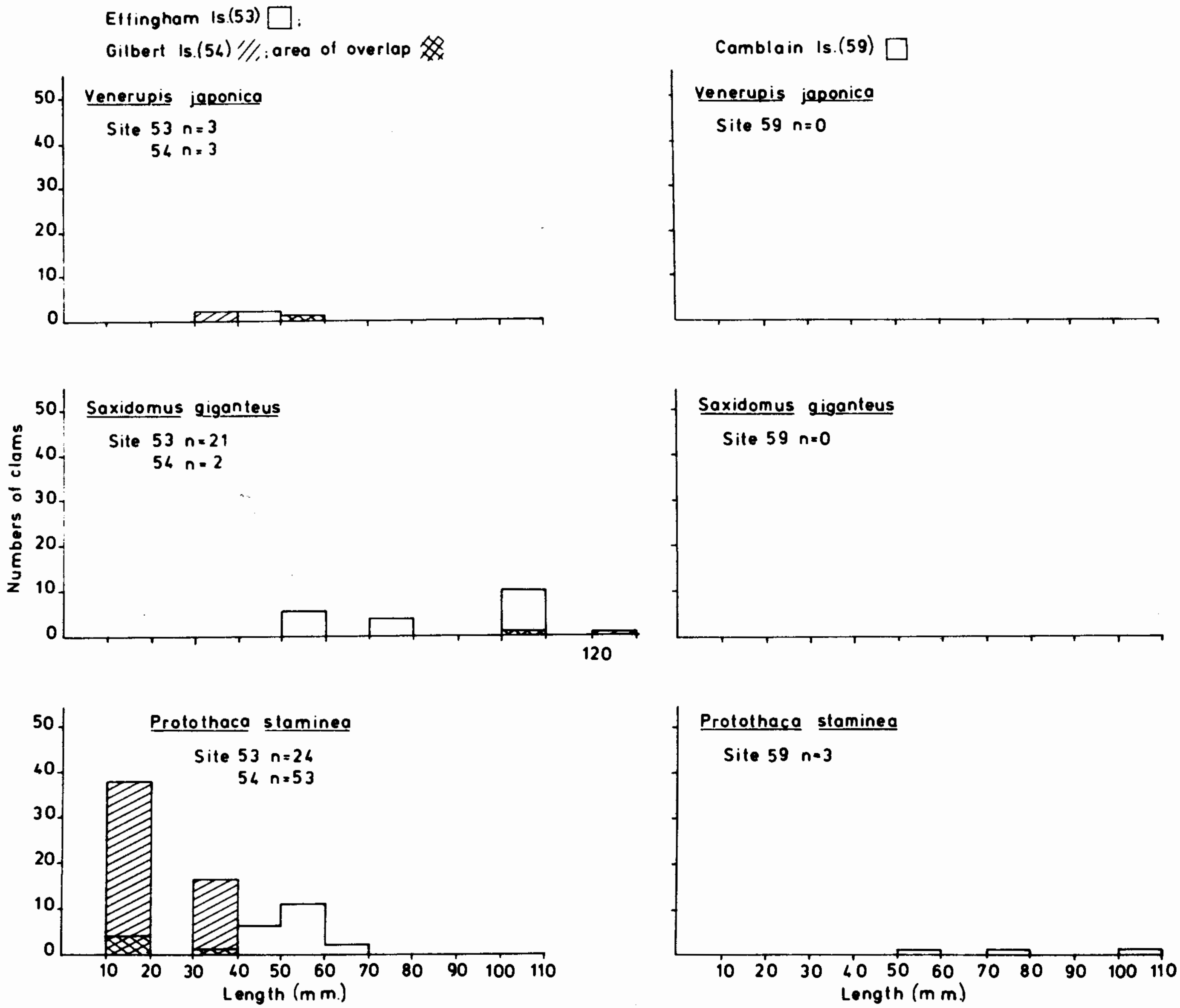


Figure 36. Continued

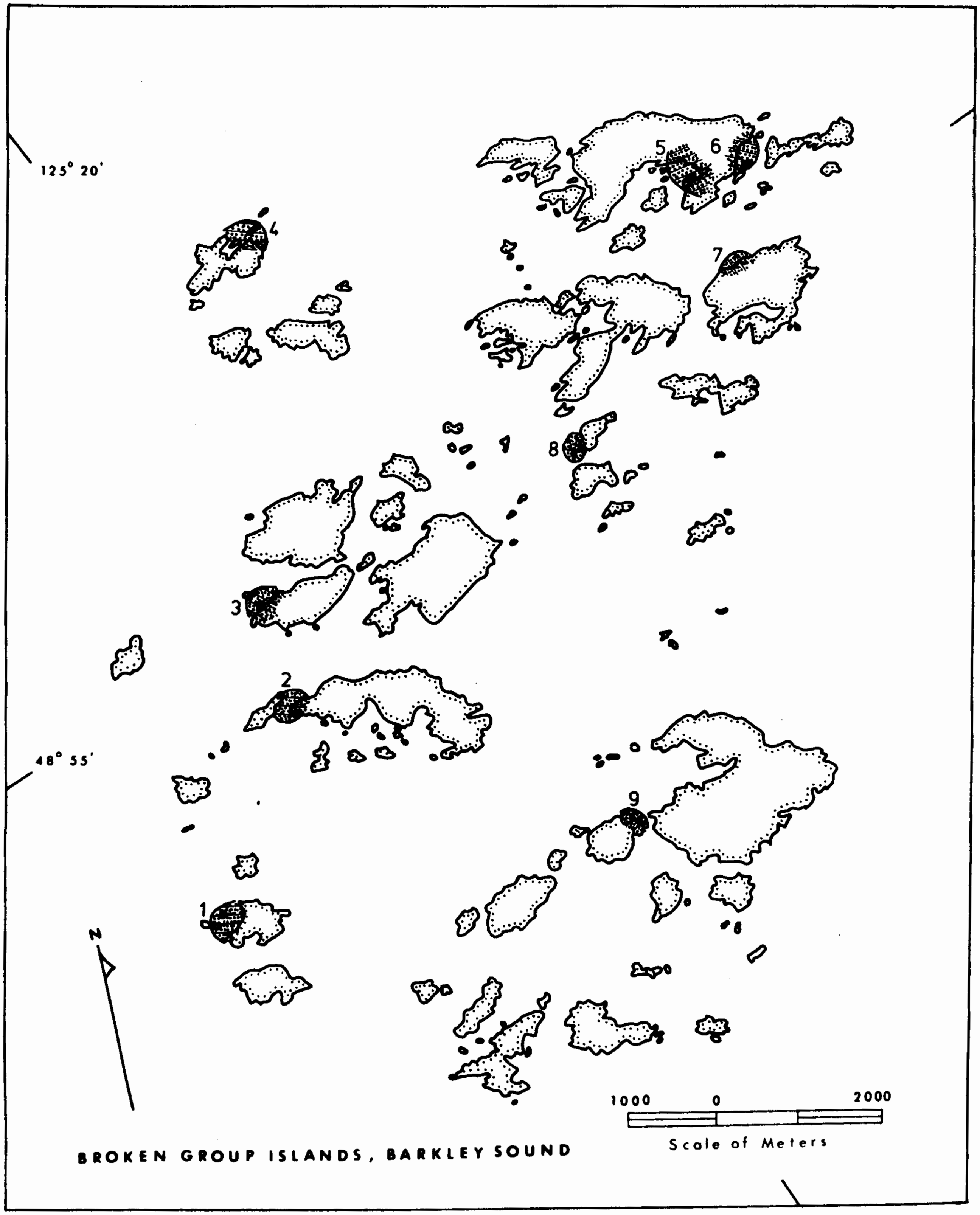


Figure 37. Sites of major bivalve populations, Broken Group Islands Section (1976).

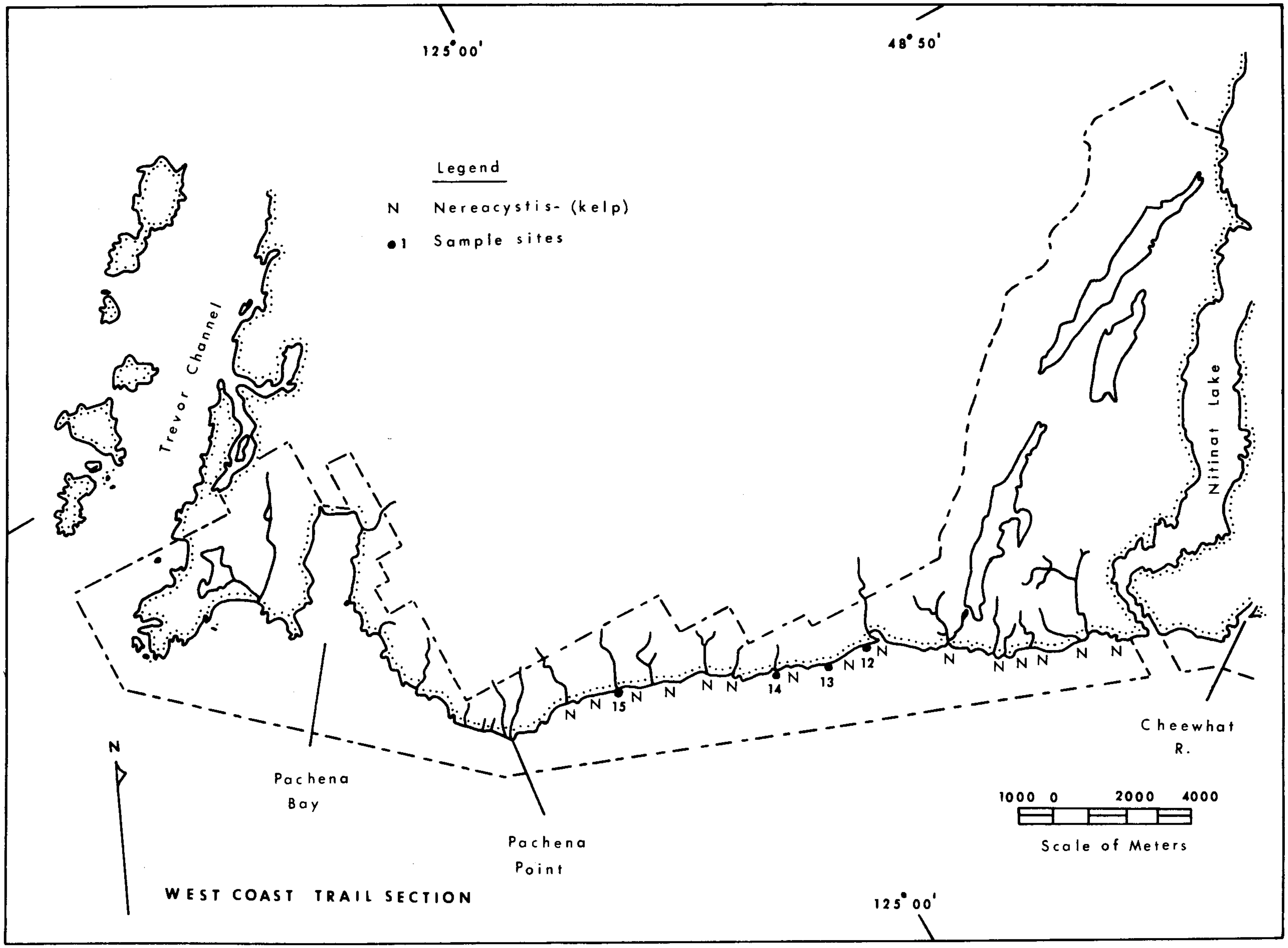


Figure 38. Location of intertidal fauna and flora survey sites and distribution of kelp beds, West Coast Trail Section (1976). (Pachena Bay to Cheewhat River.)

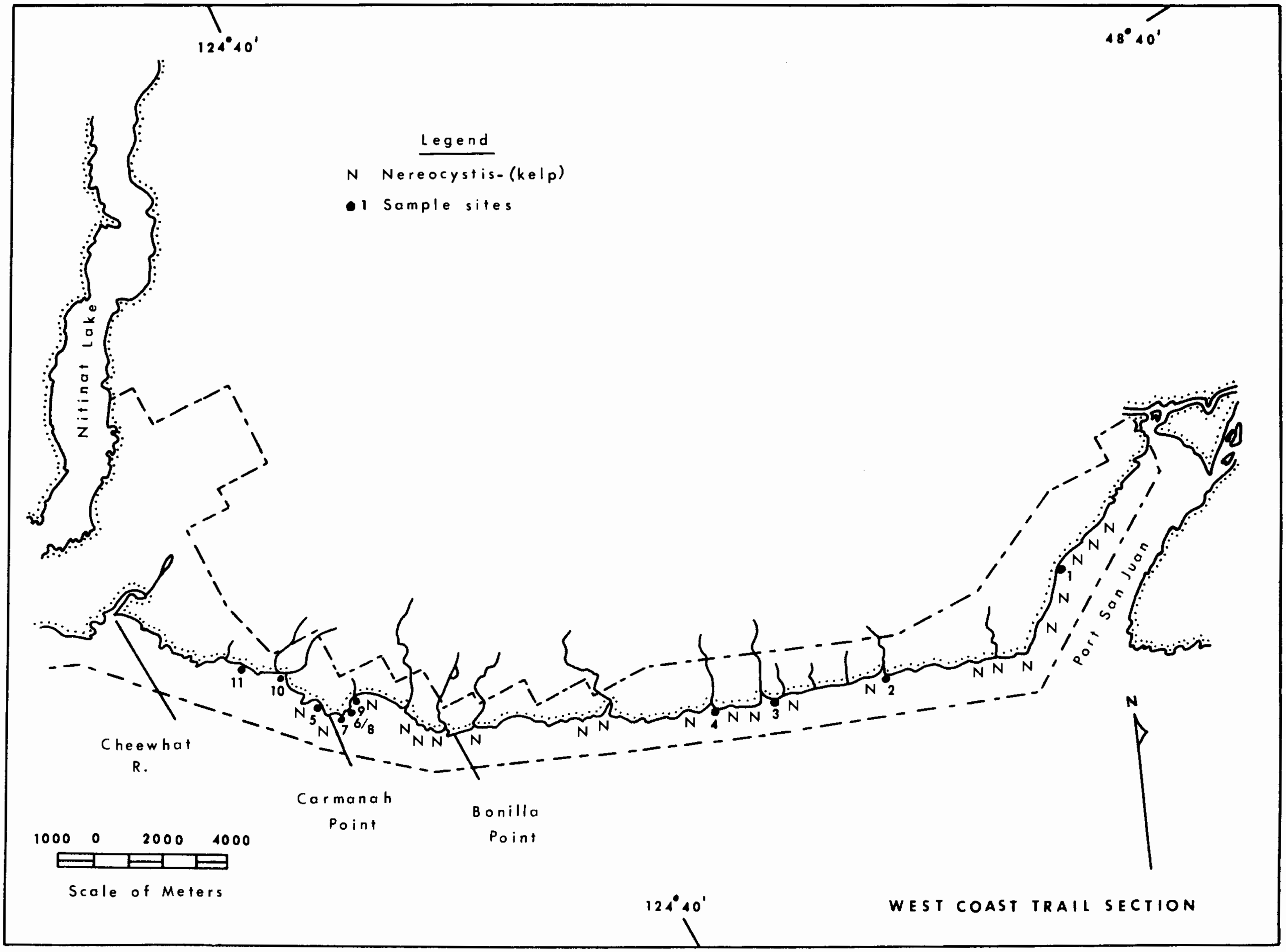


Figure 38. Continued
(Cheewhat River to Port San Juan.)

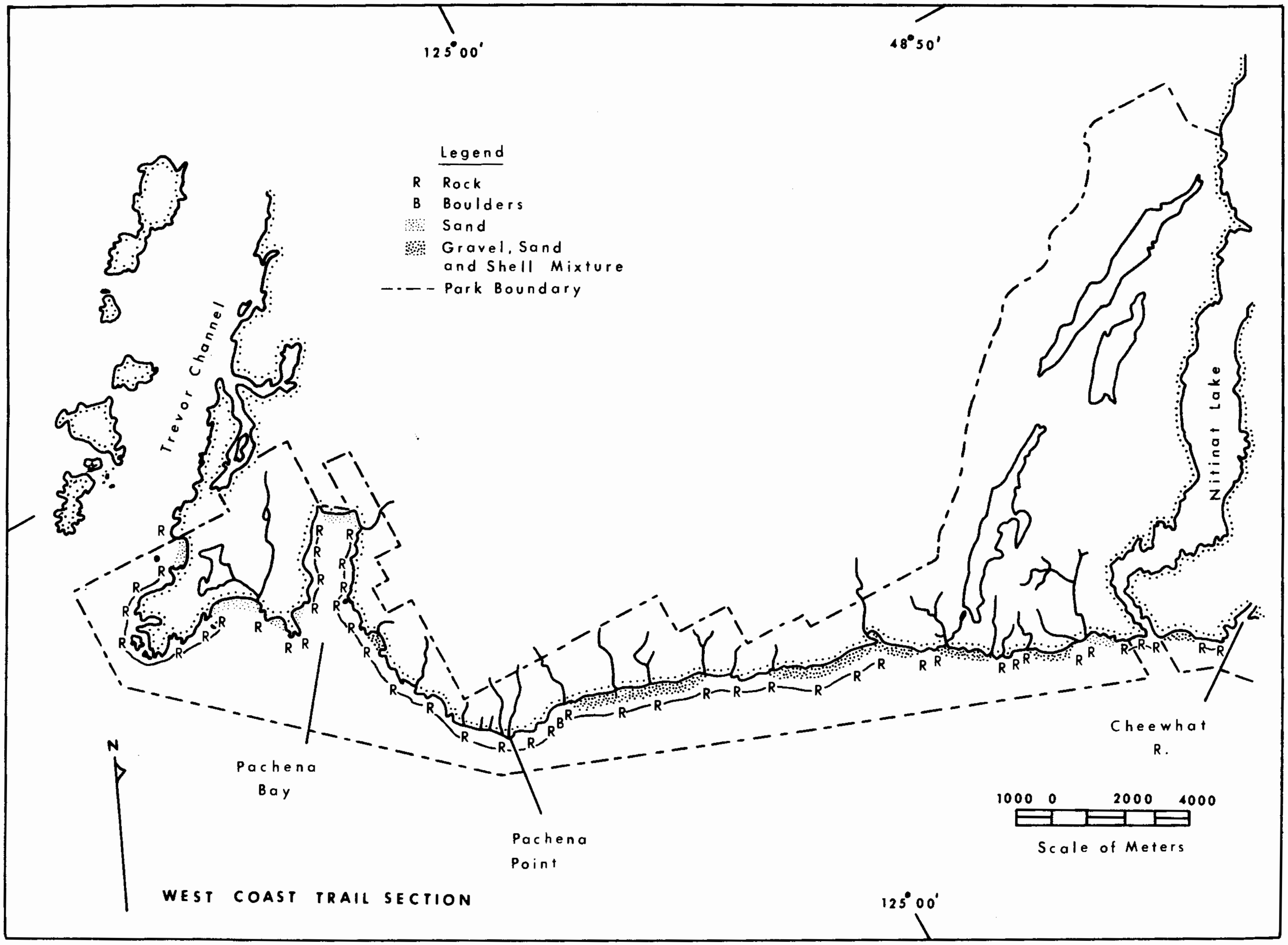


Figure 39. Distribution of general intertidal substrate types, West Coast Trail Section (1976). (Pachena Bay to Cheewhat River.)

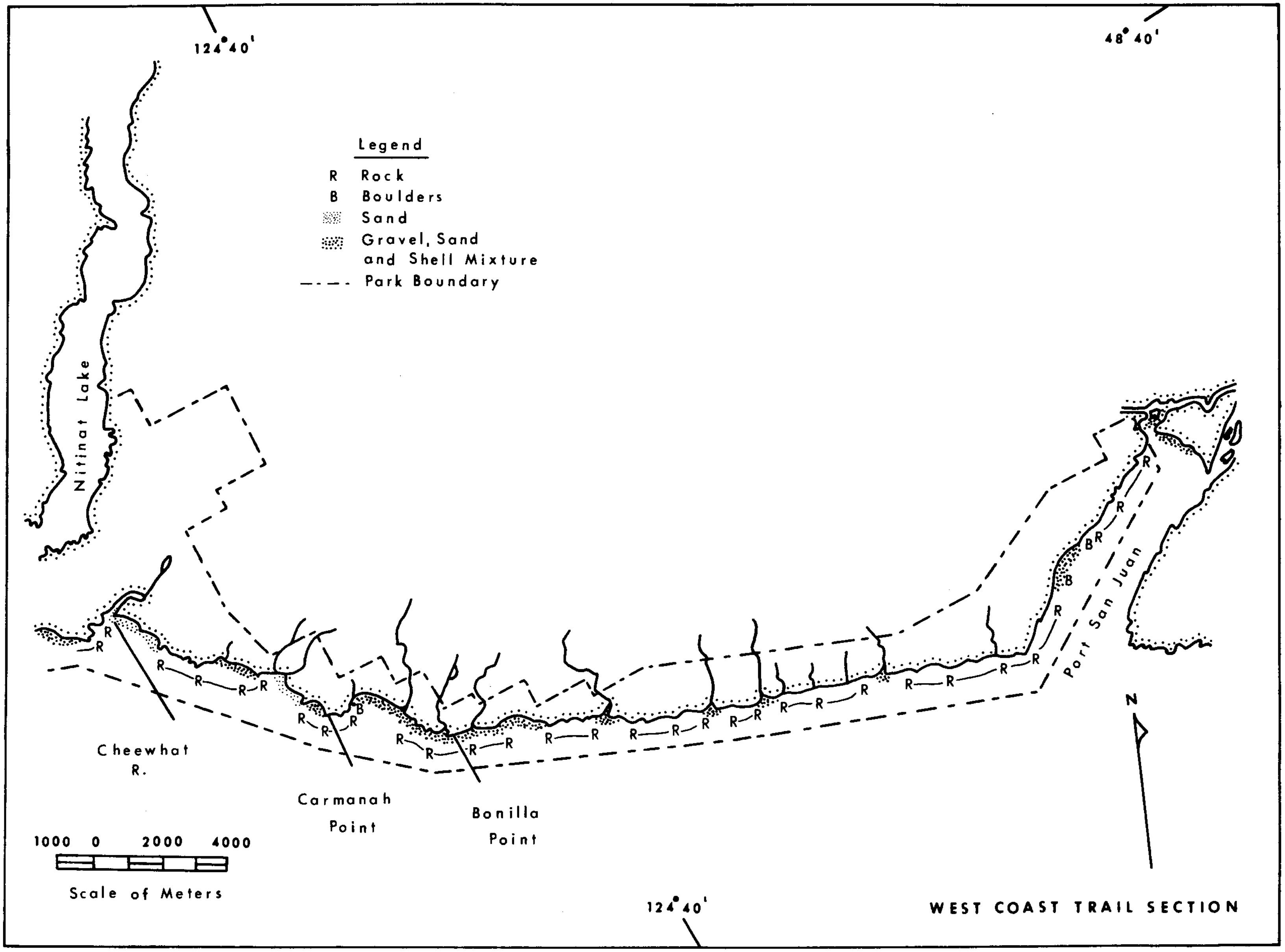


Figure 39. Continued
(Cheewhat River to Port San Juan.)

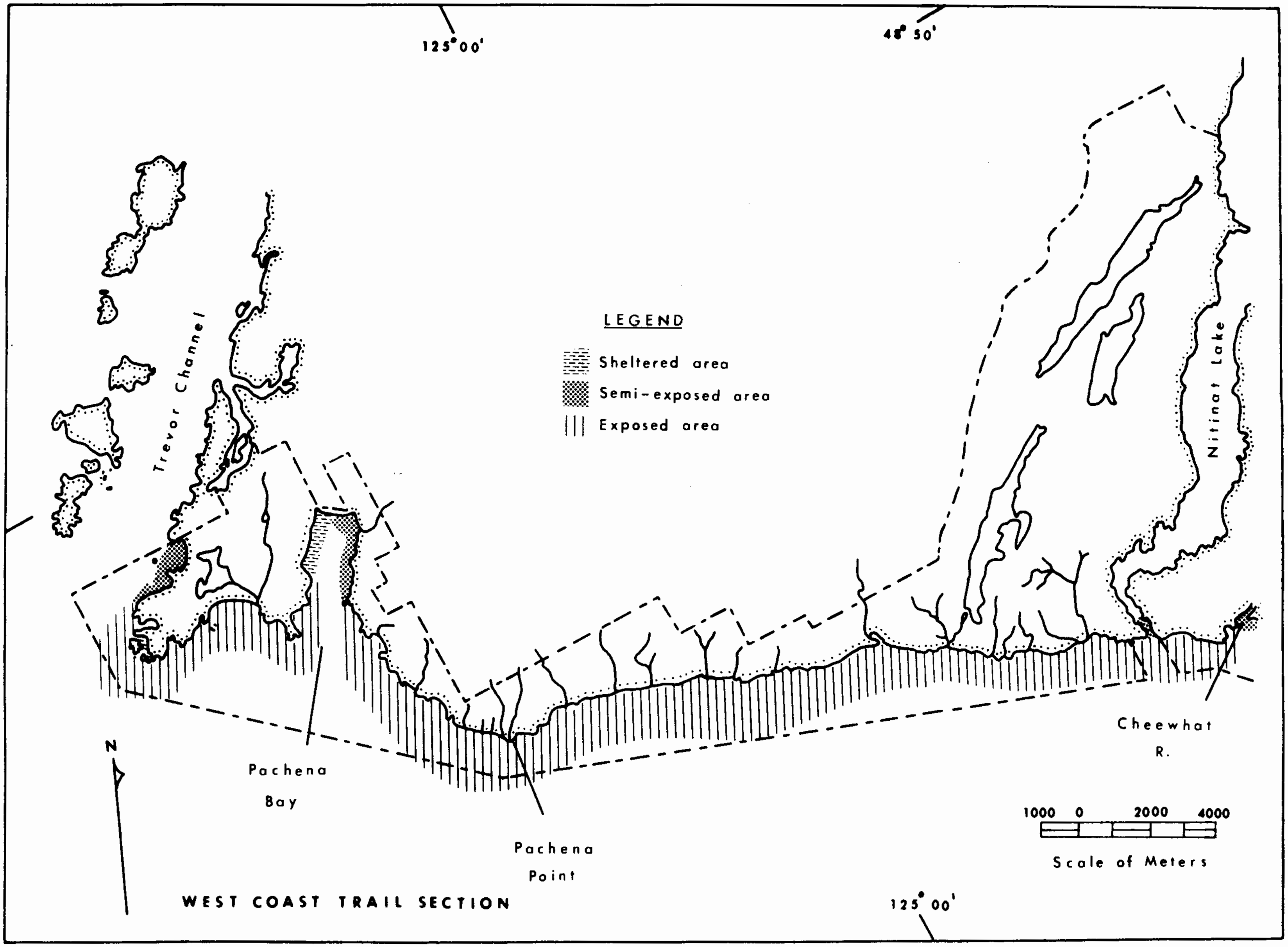


Figure 40. Distribution of intertidal exposures, West Coast Trail Section (1976). (Pachena Bay to Cheewhat River.)

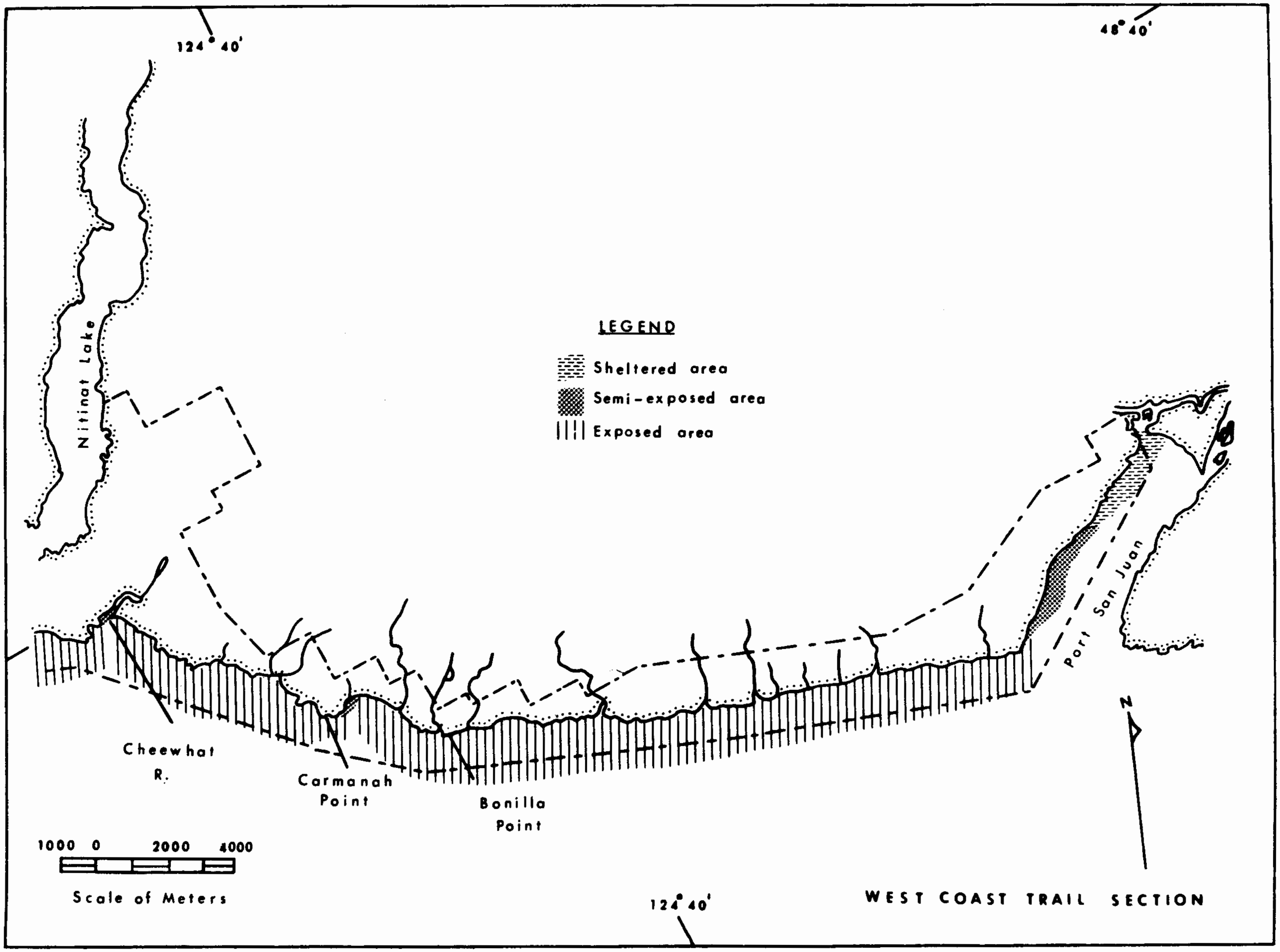


Figure 40. Continued
(Cheewhat River to Port San Juan.)

APPENDIX 1

Terms of Reference

PARKS CANADA - FISHERIES AND MARINE SERVICES

TERMS OF REFERENCE

MARINE RESOURCE INVENTORY - PACIFIC RIM NATIONAL PARK

INTRODUCTION

The following terms of reference were initially prepared by Miss Charlene Lee and Dr. N. Bourne, Fisheries and Marine Services (February, 1975) and subsequently modified by Mr. Zinkan, Assistant Resource Studies Manager, Parks Canada (March, 1975) to satisfy Parks Canada's format requirements. The terms of reference were again modified, as follows, on February 18, 1976, as a result of a review meeting held at the Park on February 11, 1976.

1. Purpose

The principal aim of this project is to undertake a biophysical resource inventory of the marine flora and fauna of the Pacific Rim National Park. The study will include:

1) a qualitative assessment of the marine flora and fauna within the Park borders;
2) a quantitative assessment of these organisms;
3) a description of their habitat types;
4) an evaluation of the effect of recreational pressure and human encroachment.

The study will be conducted on behalf of Parks Canada by the Fisheries and Marine Service, D.O.E., and will be under the direction of Dr. N. Bourne. Funding will be transferred from Parks Canada, Western Region to the Pacific Biological Station.

This information is required to ensure effective Park planning, interpretation and management and is an integral part of the Resource Inventory program for Pacific Rim National Park.

2. Project Area

Studies will be undertaken concurrently in all three phases of Pacific Rim National Park. In the initial year emphasis will be placed on the Long Beach Section because:

1) easy access;
2) acute recreation pressure;
3) relatively few habitat types are present in this area.

   Studies will be initiated in all three phases of the Park during the first year and emphasis will increase in Phases 2 and 3 after the initial year.

The boundaries of the study area will extend from the high-tide to a subtidal depth of 60' (10 fathoms).

3. Project Requirements

Major emphasis in the studies will be on the invertebrate populations within the Park. However, attention will also be given to the fish populations.

Because the lower limit of the photosynthetic zone and of most diving is 50', data requirements for depths greater than 50' will be extrapolated from sampling etc. done at shallower depths where possible.

More specifically but without limiting the generality of the foregoing, the project requirements include:

3.1. Update of Fisheries Research Board of Canada Manuscript Report No. 1276; Marine Bibliographical and Review Study of Pacific Rim National Park. This report was undertaken under contract to Parks Canada in 1973. Specifically information concerning species habitat lists and references acquired after 1973 shall be gathered and the status of all work listed under "Current Research Projects" in MS Rept. No. 1976 in addition to other recent projects and data collections shall be ascertained and documented.

3.2 Studies will be undertaken concurrently in all three phases of the Park under the following general schedule.

3.2.1. Baseline Studies

From systematic and distributional studies qualitative data will be gathered to:

(i) Correct and broaden information on habitat types, zonation and species lists.

(ii) Determine areas of uniqueness (e.g., habitat types and/or species populations).

(iii) Establish control and recreational pressure study sites for each habitat type.

3.2.2. Long-Term Studies

Ecology and community structures will be continuously studied seasonally and yearly in intertidal and subtidal (where possible) areas using transect and random sampling procedures. Quantitative data obtained will be required to:

(i) Determine populations of marine organisms and monitor fluctuations in these populations.

(ii) Assess adult populations and recruitment of marine organisms particularly in areas where recreational pressure is greatest, i.e., are populations in danger of being seriously depleted?

(iii) Determine if any populations will require further protection.

(iv) Identify potential locations for intertidal and subtidal trails where collection of specimens is permitted and where collection is not permitted.

(v) Determine recruitment and mortality rates and whether bag limits are needed for species which will be taken in the recreational fisheries: clams, fish, oysters, abalone, etc.

3.3. <u>Description of Habitat types</u>

The marine ecological parameters and habitat types within the project area will be identified, mapped and described. The descriptive format shall allow easy comparison of one habitat type to another. All criteria used in habitat identification shall be defined.

3.4. Sampling will be confined primarily to the period March to December. During the remainder of the time, samples will be identified, data analyzed and reports prepared. A tentative sampling schedule is outlined for each year.

4. Submission Requirements

Yearly reports, similar to Manuscript Report No. 1276, will be submitted. A final report at the end of the 5-year study which will summarize all work will also be prepared.

The annual report will include all results of work outlined in Section 3. Future submission requirements will be based on review of the first annual report. The annual reports will be submitted in twenty-five (25) copies.

5. Project Cost

24.0/1976-77

6. Completion Schedule

At present the project is planned to be conducted over a 5-year period, 1975/76-1979/80 inclusive.

7. Material Supply

The contractor shall provide all material and equipment required for the completion of the study with the exception of:

7.1. Chronaflex base maps, transparencies, and/or paper prints of the area at a scale of 1:12,500, 1:25,000, and 1:50,000 for final mapping.

7.2 The contractor shall be allowed access to reports in the Research and Resource Inventory collection which pertain to the project, and where necessary, may be provided pertinent information from Branch files. Such material is located at Branch Headquarters, Regional Office, and Park Offices and shall be utilized at these places.

7.3. For the field season 1976/77 to 1979/80 inclusive Parks Canada will make available 1 zodiac boat (Grandrapid III) with 20hp motor and a smaller 7hp backup motor. Parks Canada will also attempt to provide cabin facilities in the Broken Islands Group and will encourage staff assistance in diving when staff time permits.

8. <u>Special Conditions</u>

8.1. The contractor agrees not to transfer the responsibility to a third party without the consent of the department.

8.2. The contract price includes all expenses which may be incurred by the contractor in connection with the work.

8.3. The contractor shall supply all equipment and materials required for the study, except where otherwise specifically noted in this contract, and shall provide all necessary assistance and pay all incidental expenses.

8.4. All reports shall be sent to:

Director,
Western Region - Parks Canada,
Department of Indian & Northern Affairs,
134 - 11th Avenue S.E.,
Calgary, Alberta,
T2G 0X5.

Attention: Resources Studies Manager

8.5. The final report will be professionally adequate in content, presentation and terminology, and of a quality such that it could, at the discretion of the Director, Parks Canada, be published.

The reports paid for under this contract are the property of the Government of Canada.

8.5.1. The contractor or principal assistant with the approval of the contractor may, subject to consultation with and approval of the Director or his designated representative, publish the report in whole or in part under his own name as a thesis, scientific or professional paper or other form of publication which is acceptable to the

Director. However, the foregoing in no way limits the rights of the Government of Canada to publish the report.

8.6. Collection of specimens will be strictly limited to those specified by the contract or to those which are made necessary by the terms of the contract. The contractor and his designated assistants shall comply with the following requirements when collecting specimens under the contract agreement:

8.6.1. Carry the collecting permit supplied by the Parks Canada Branch at all times when engaged in collecting activities or when in possession of specimens and present it upon request of National Parks staff or R.C.M.P. officers.

8.6.2. Obtain any permits that may be required by other agencies relating to collection of certain species or types of specimens.

8.6.3. Comply with conditions specified on the permit.

8.6.4. Provide the Park Superintendent with a list of specimens collected, and, at his request, present the specimens for inspection prior to removing them from the Park.

8.7. The contract field supervisor shall be the Park Superintendent at Pacific Rim National Park.

8.8.1. The contractor shall inform the field supervisor in advance of his plans for field work in the Park and shall make arrangements so that the field supervisor is kept informed of progress.

8.8.2. At the start of the field work in the Park each season, the contractor or his authorized representative shall meet with the field supervisor and such Park staff as he designates to review his plans for the season.

8.8.3. Prior to leaving the Park for the season, the contractor or his designated representative shall meet with the field supervisor to review progress and inform him of any important results to date.

8.9. The contractor shall maintain a close liaison with the Resource Studies Manager, Western Regional Office, and shall arrange for the work to be reviewed at critical points in the project.

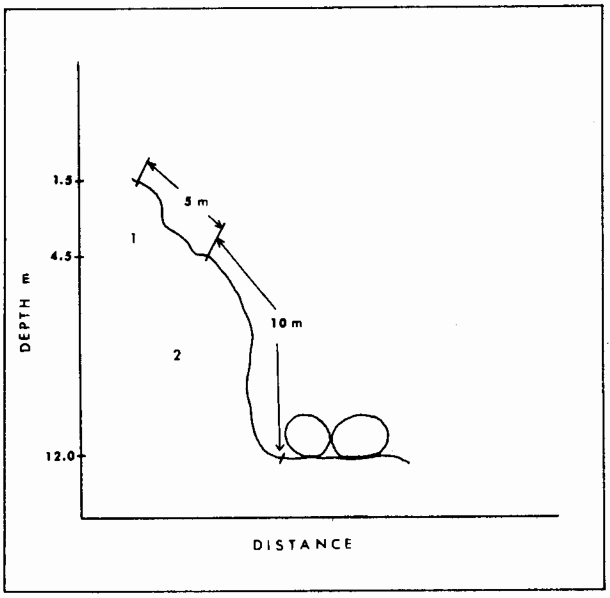
8.10. Before leaving the Park, upon completion of the field season and upon presentation of the final report, the contractor should be prepared to give a seminar on his research to provide all interested Park personnel with a better understanding of the results, purpose, and methodology of this study.

APPENDIX 2

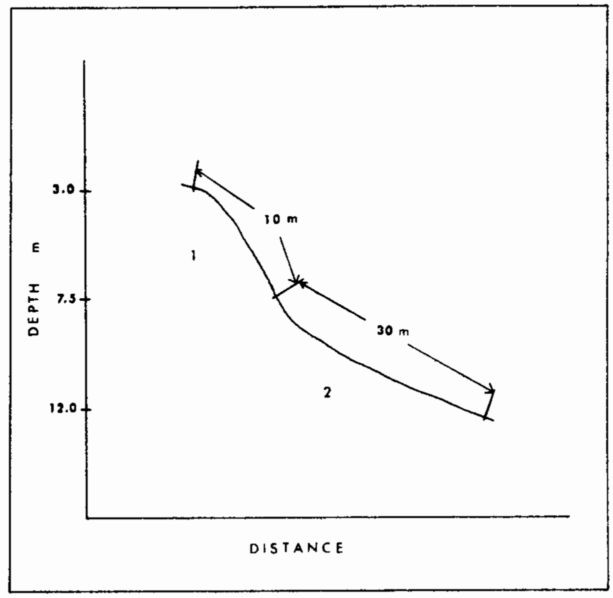
Depth profiles of individual dive sites, Broken Group Islands Section (1976).

EXPOSED ROCKY SHORES

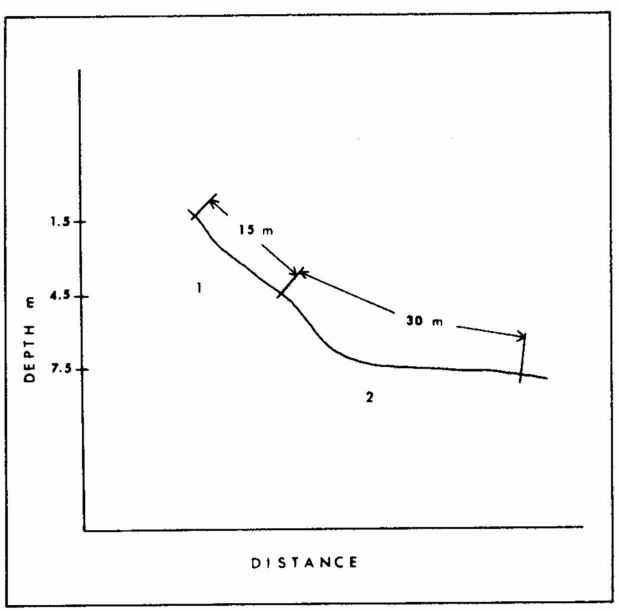
A) FACING WEST



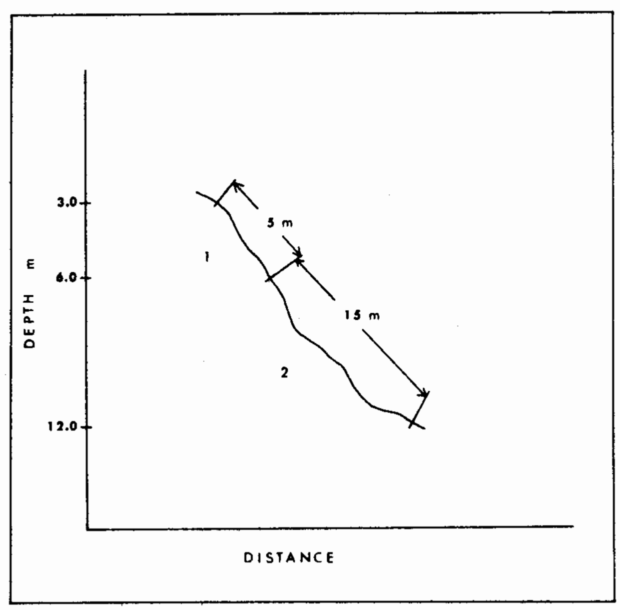
Dempster Is. 15



Onion Is. 26



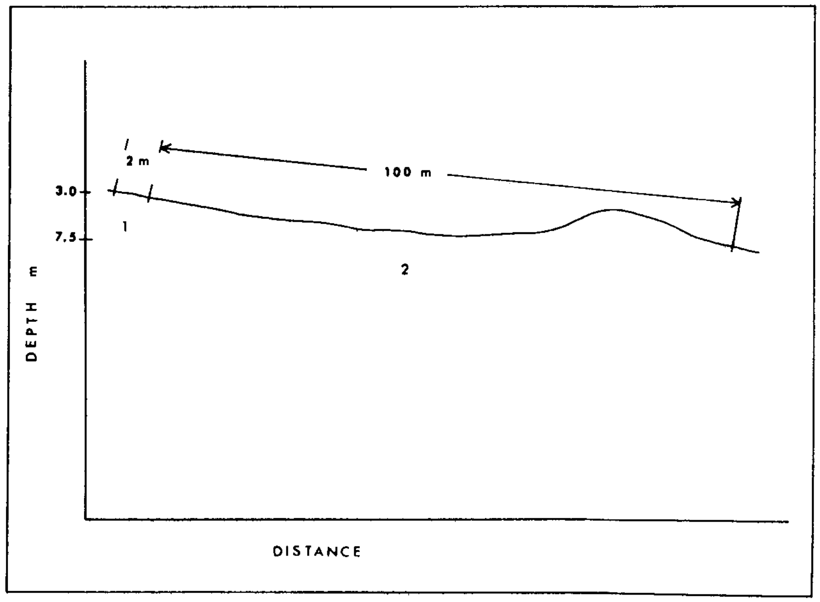
Village Reef 29



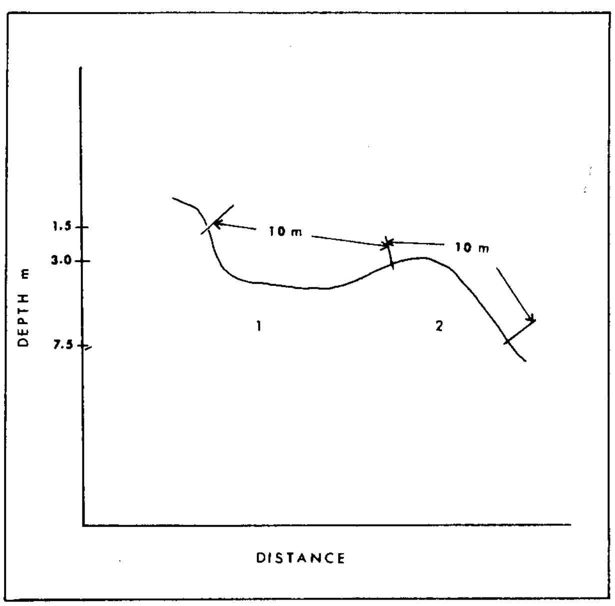
Reeks Is. 33

EXPOSED ROCKY SHORES

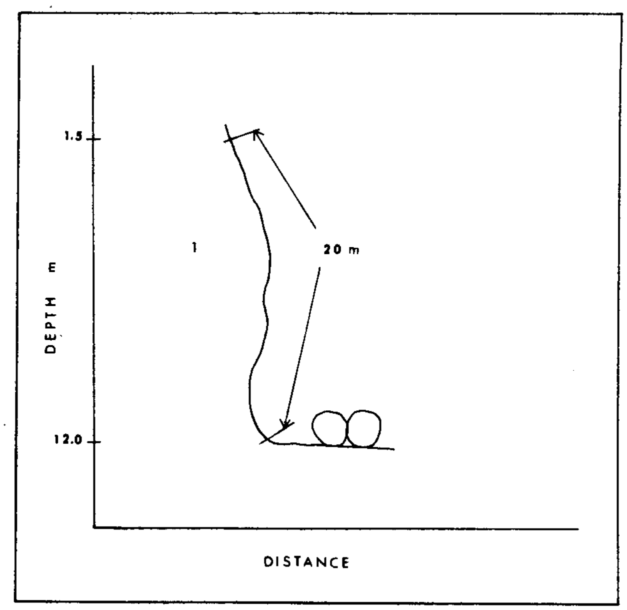
A) FACING WEST



Wiebe Is. 34



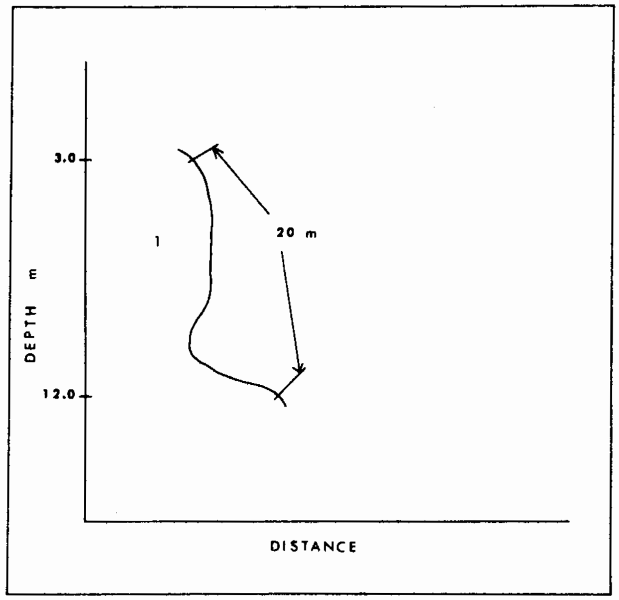
Cooper Is. 38



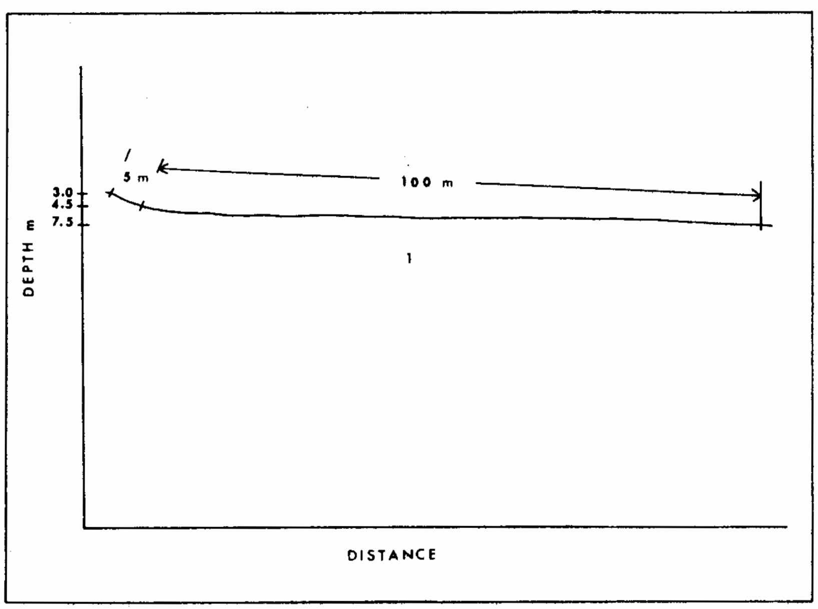
Wouwer Is. 39

EXPOSED ROCKY SHORES

A) FACING WEST



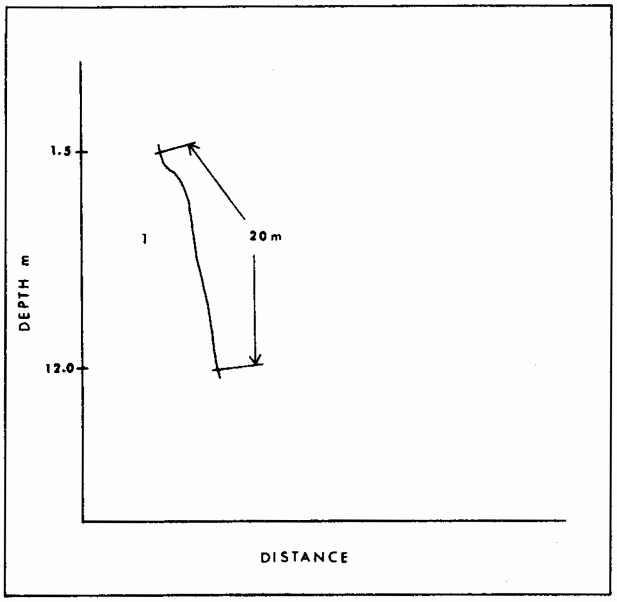
Effingham Is. 40



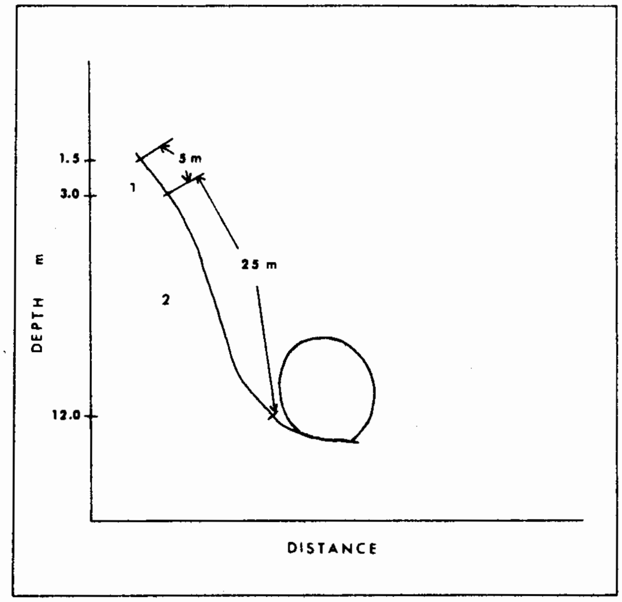
Faber Is. 41

EXPOSED ROCKY SHORES

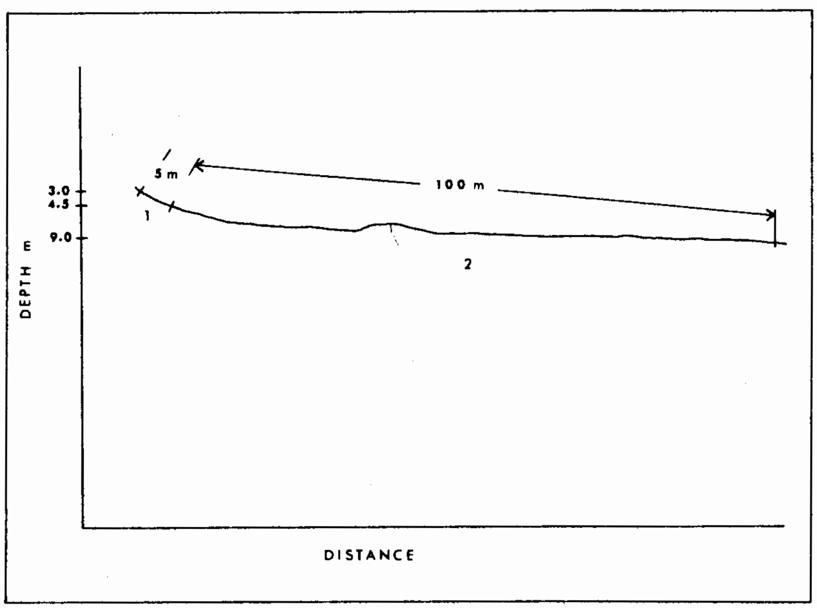
A) FACING WEST



Howell Is. 42



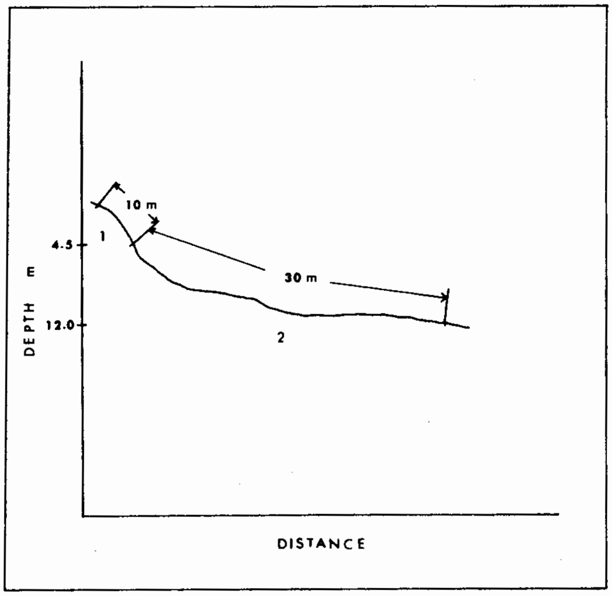
Elbow Islet 46



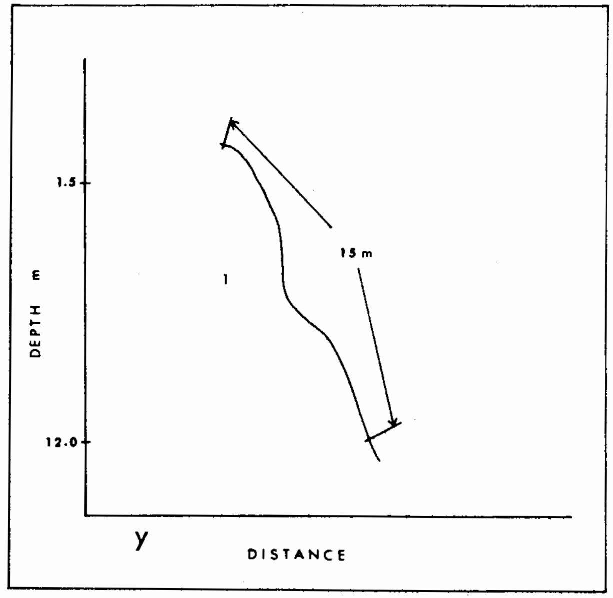
Dicebox Is. 43

EXPOSED ROCKY SHORES

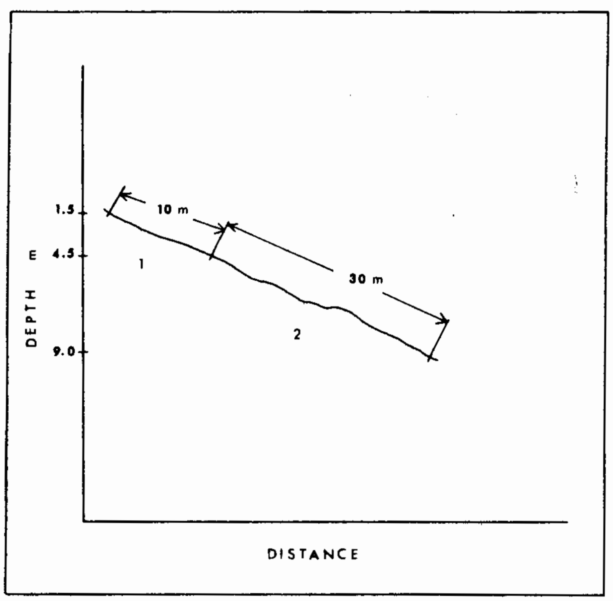
B) FACING EAST



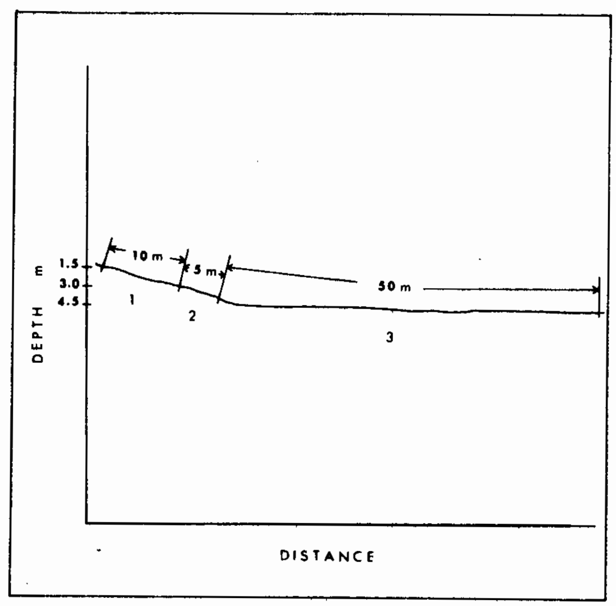
Dodd Is. 9



Benson Is. 10



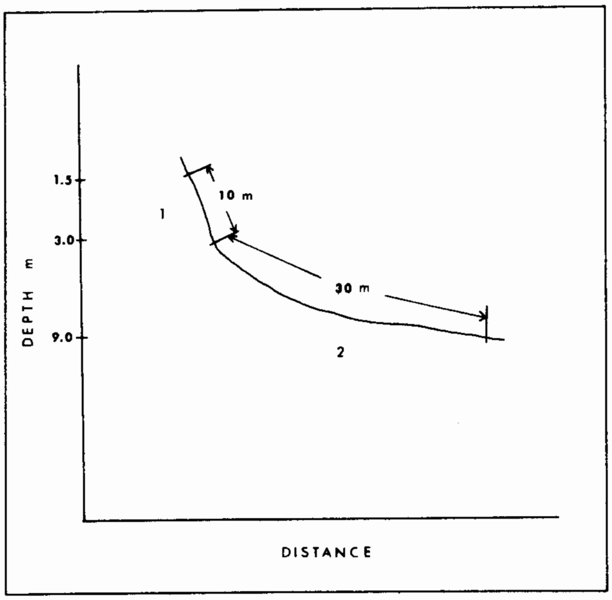
Willis Is. 13



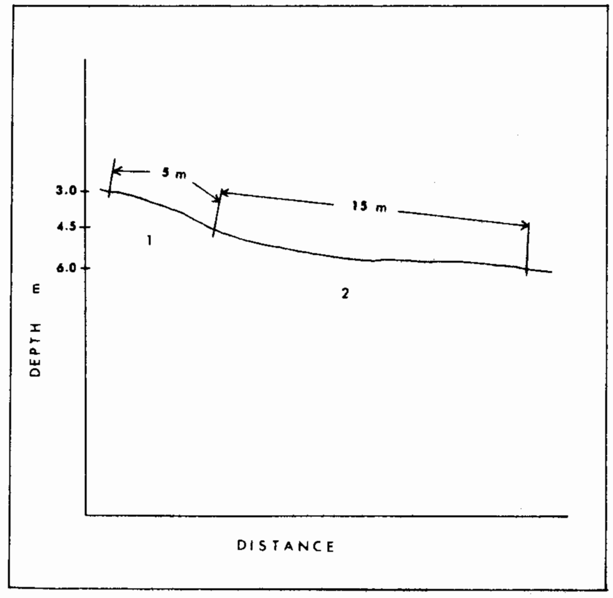
Willis Is. 14

EXPOSED ROCKY SHORES

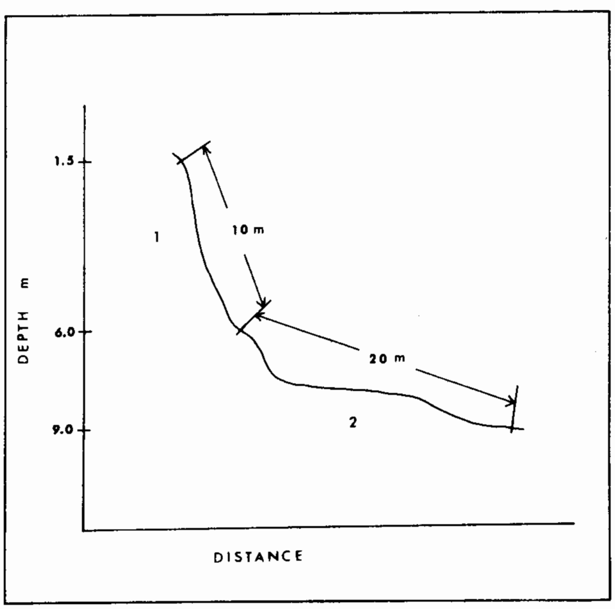
B) FACING EAST



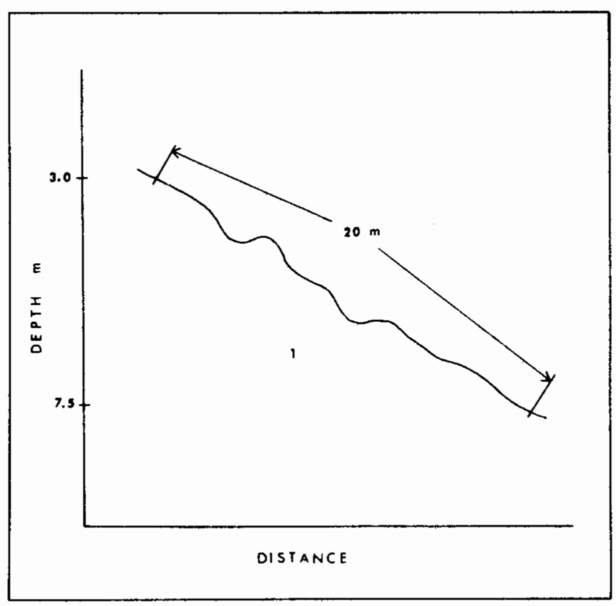
Clarke Is. 21



Owens Is. 27



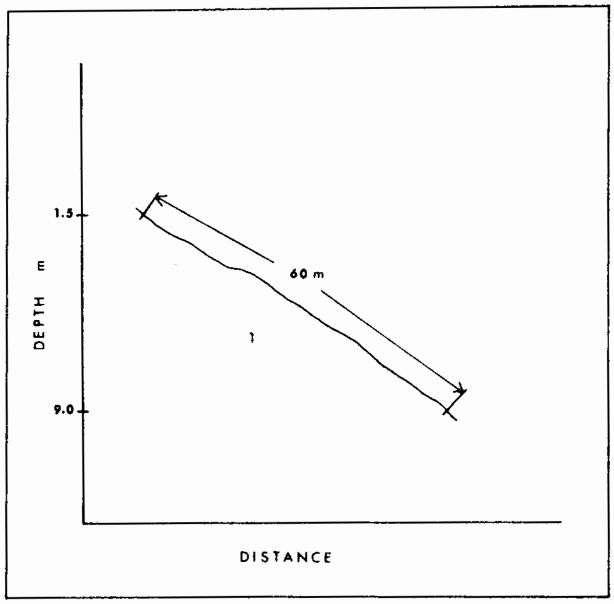
Hankin Is. 35



Puffin Islet 36

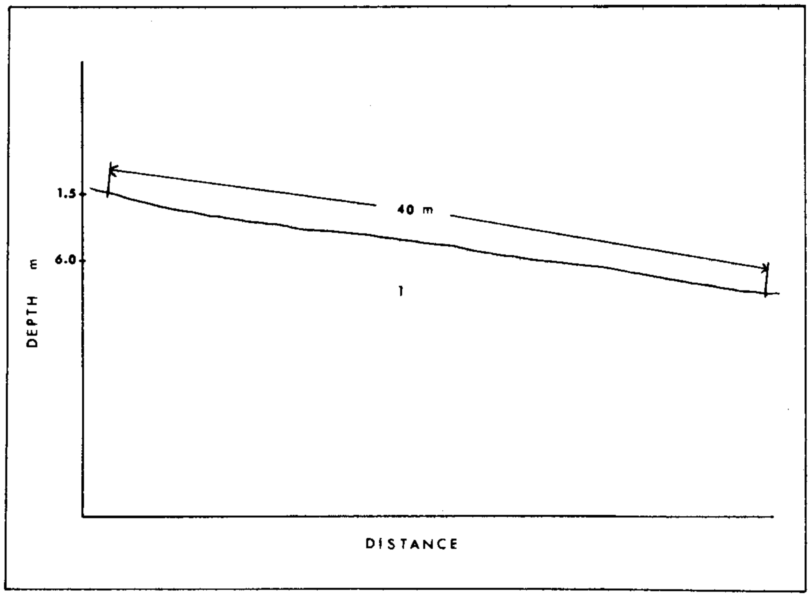
EXPOSED ROCKY SHORES

B) FACING EAST

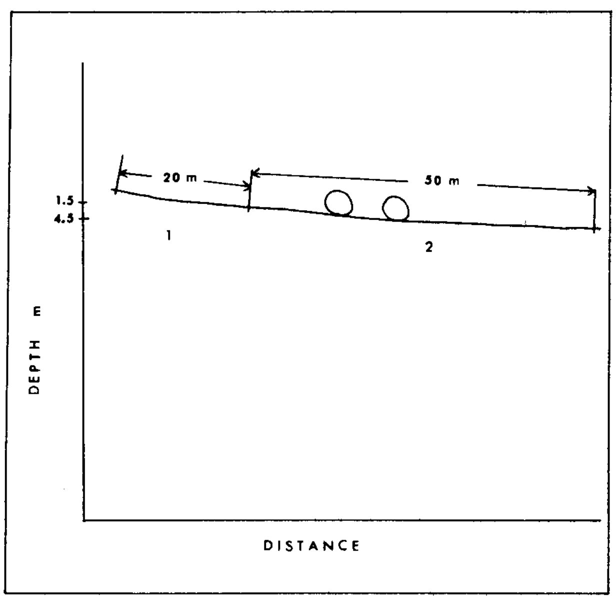


Camblain Is. 37

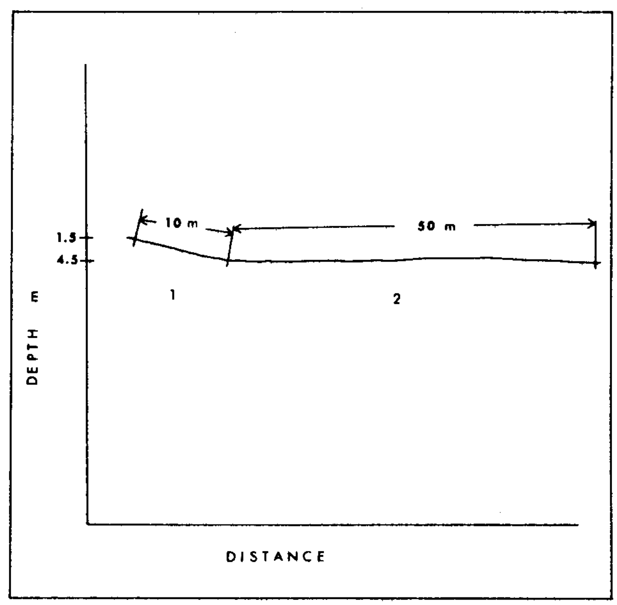
SEMI-EXPOSED GRAVEL AND SHELL SHORES
WITH ISOLATED BOULDERS



Benson Is. 11

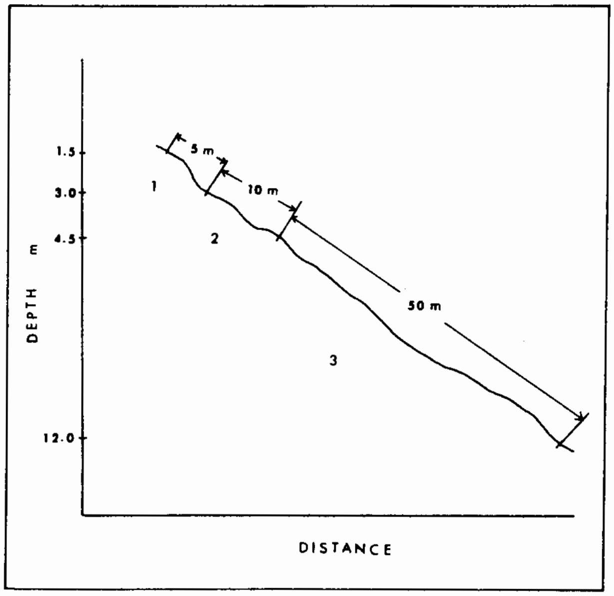


Clarke Is. 22

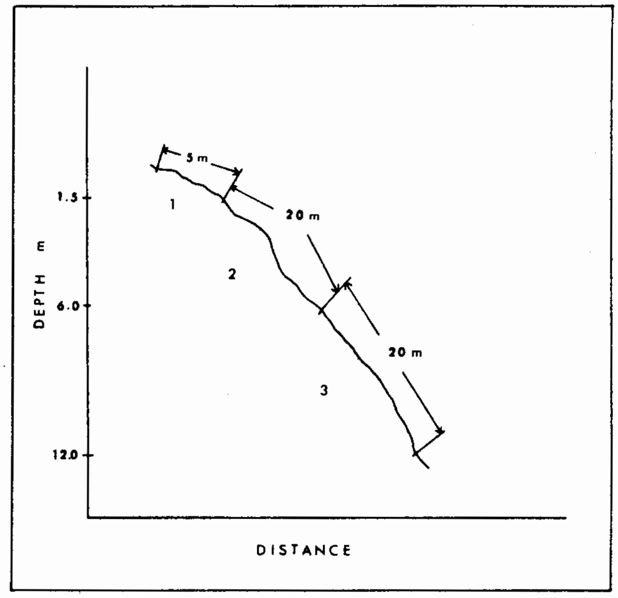


Benson Is. 28

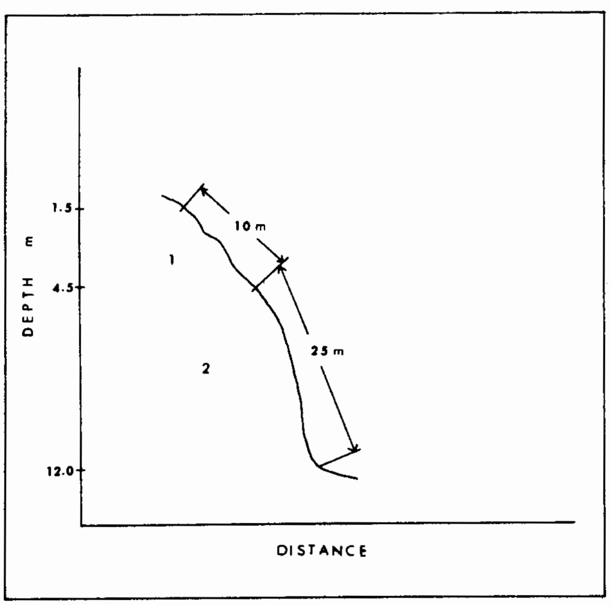
SEMI-EXPOSED COBBLE, BOULDER AND ROCK SHORES



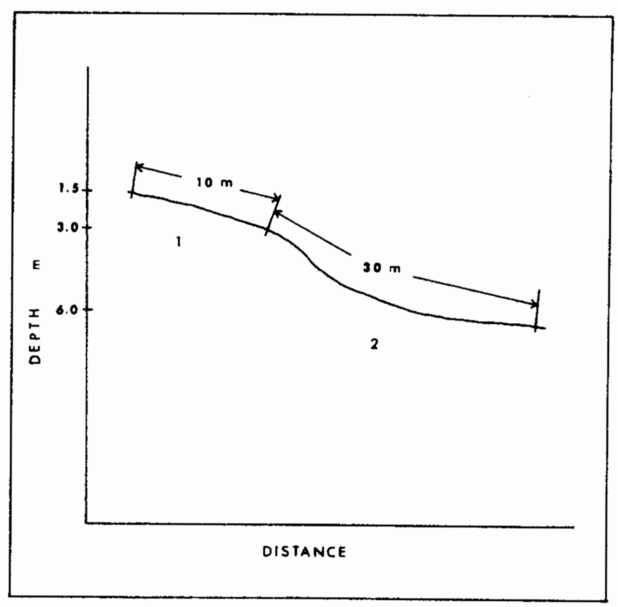
Erin Is. 2



Jaques Is. 3

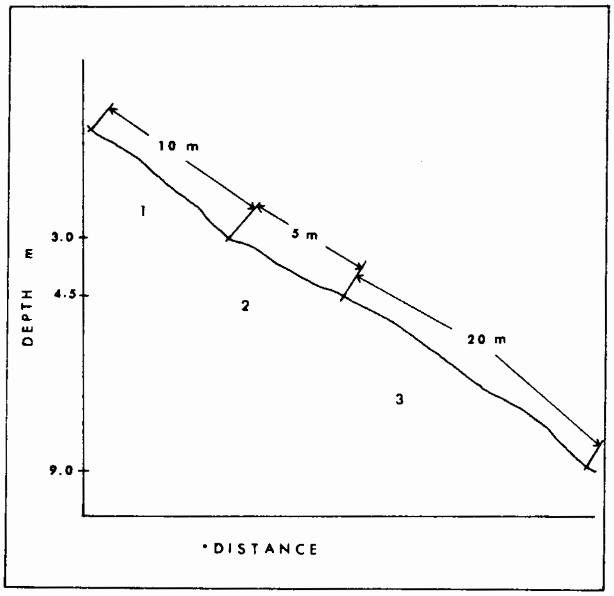


Nettle Is. 4

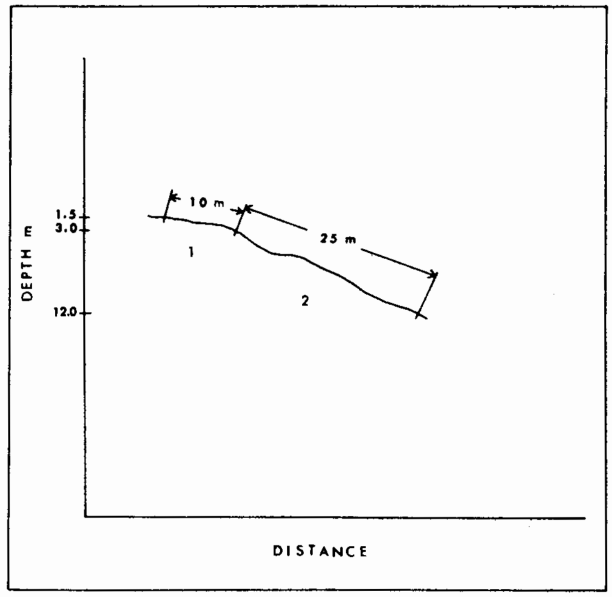


Keith Is. 6

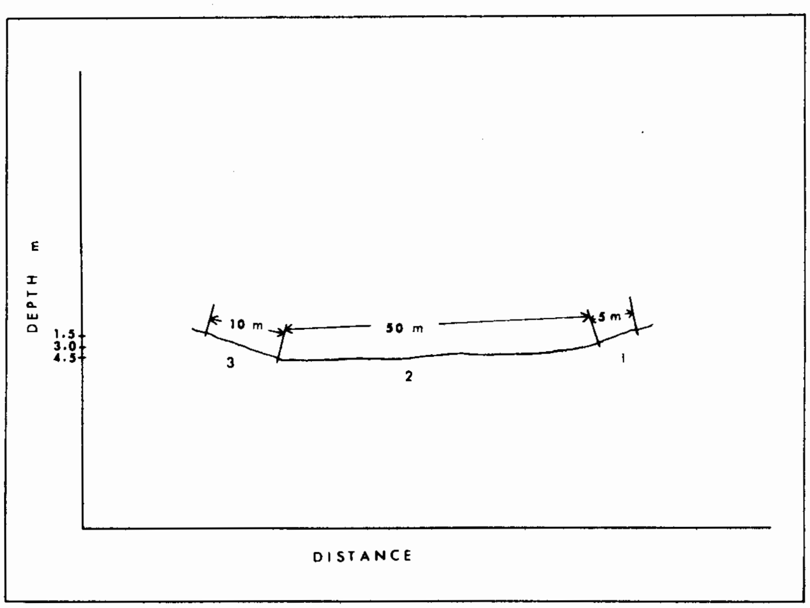
SEMI-EXPOSED COBBLE, BOULDER AND ROCK SHORES



Gibraltar Is. 7

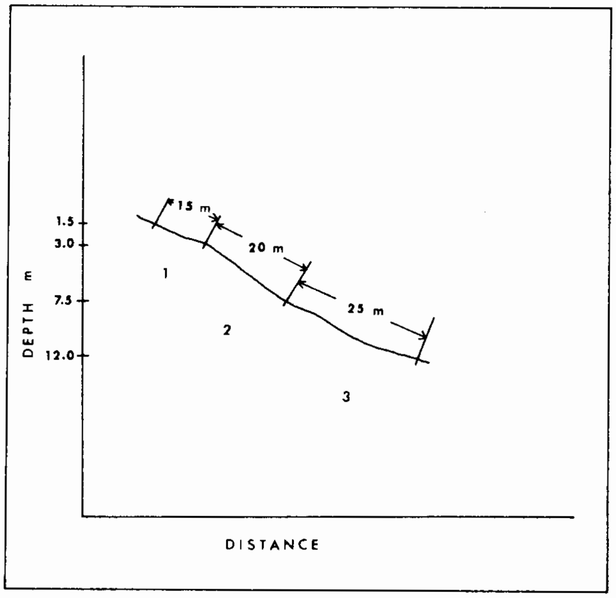


Gilbert Is. 17

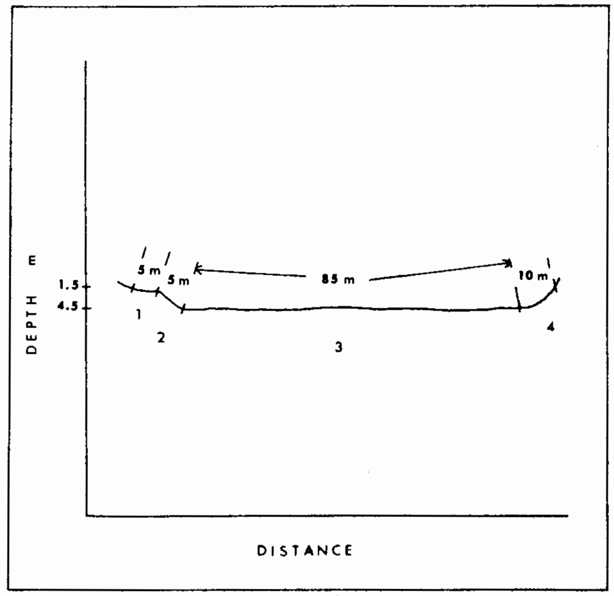


Brabant Is. 19

SEMI-EXPOSED COBBLE, BOULDER AND ROCK SHORES

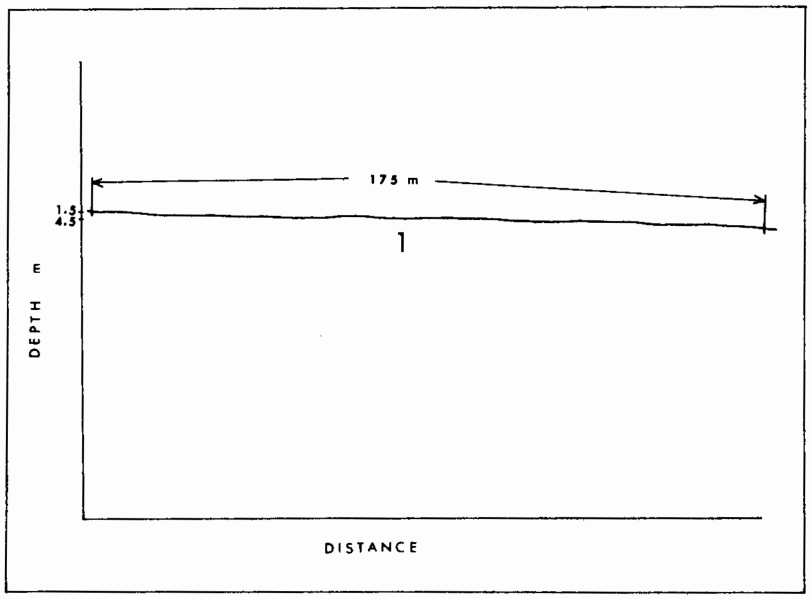


Jarvis Is. 23



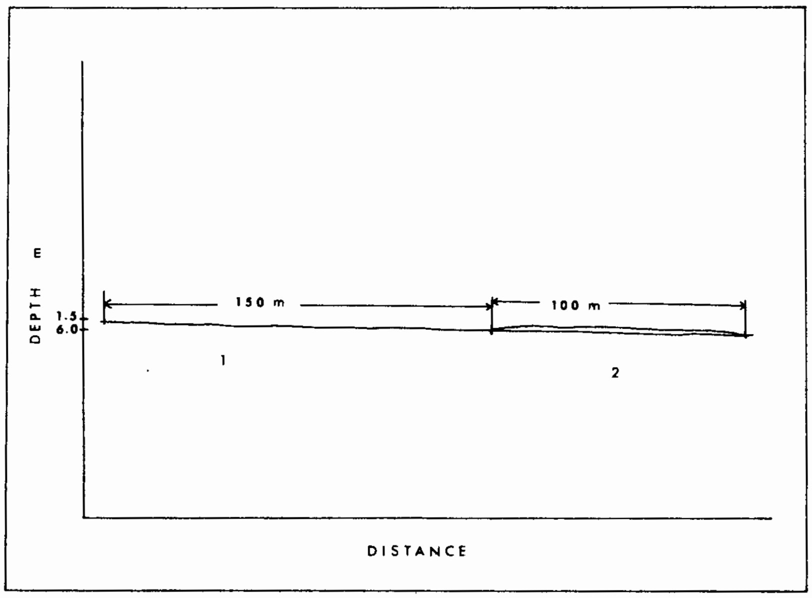
Mullins Is. 25

SEMI-EXPOSED ROCK SHORES



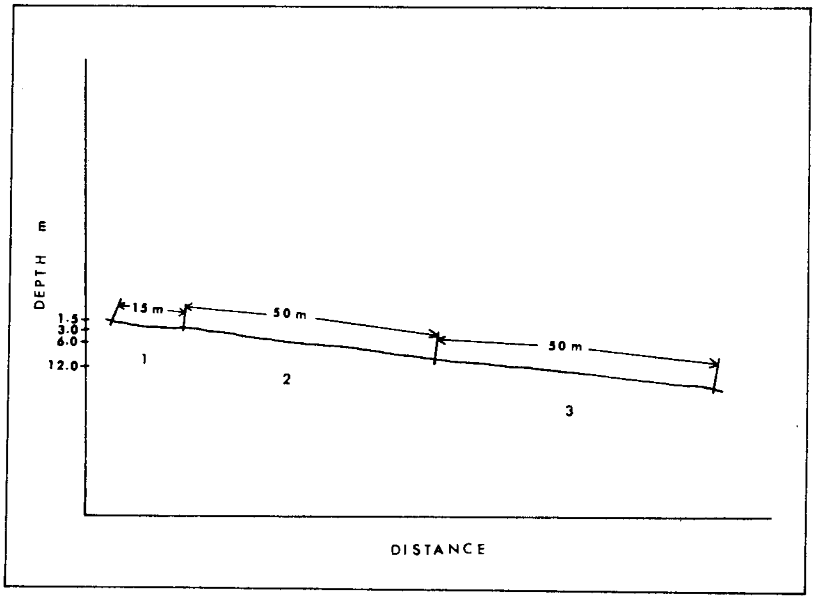
Hand Is. 12

SHELTERED SAND AND MUD FLATS

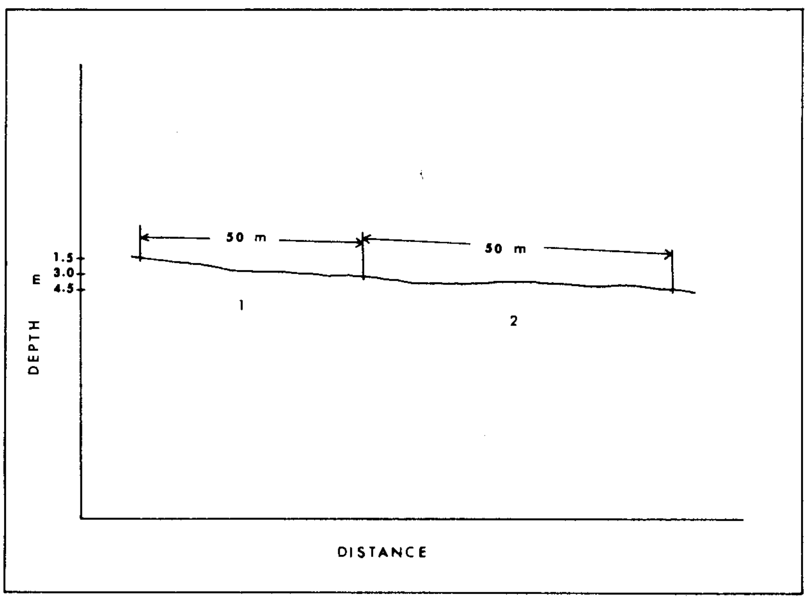


Jaques Is. 5

SHELTERED SAND, MUD, GRAVEL AND SHELL SLOPES

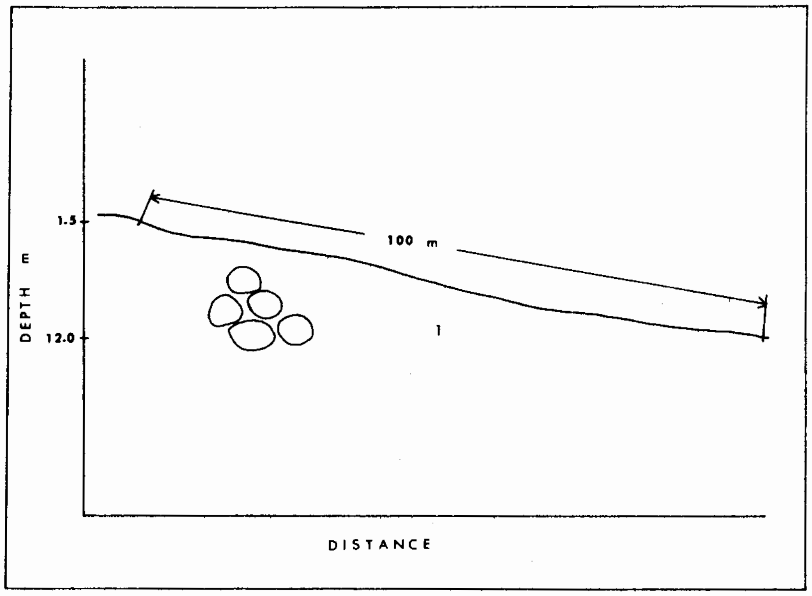


Turtle Is. 1

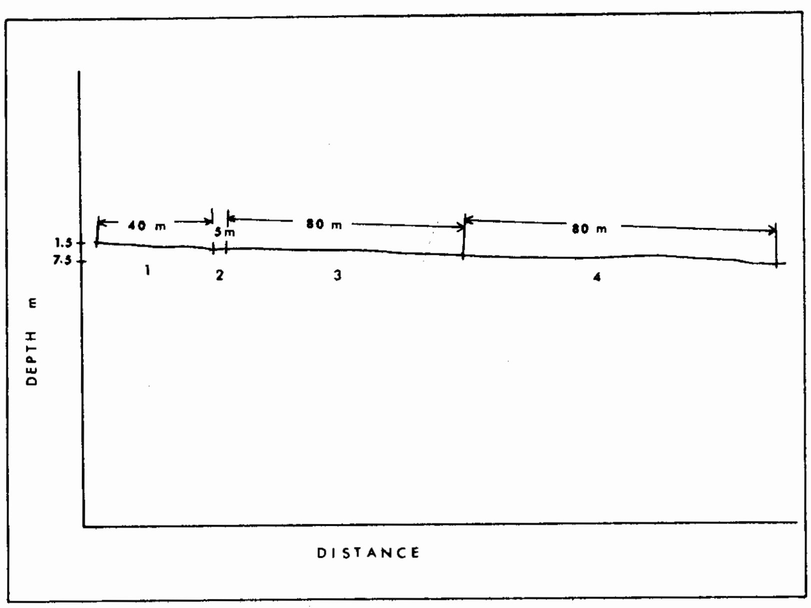


Turret Is. 8

SHELTERED SAND, MUD, GRAVEL AND SHELL SLOPES

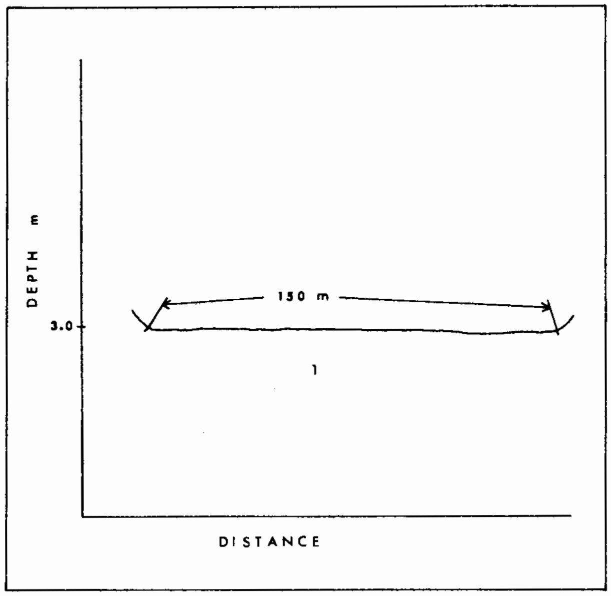


Gilbert Is. 18

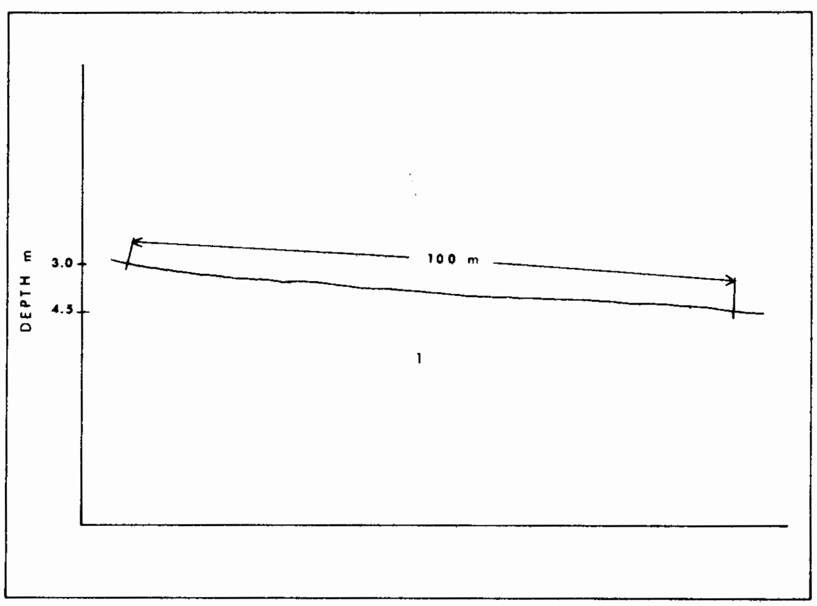


Hand Is. 20

SHELTERED SAND, MUD, GRAVEL AND SHELL SLOPES

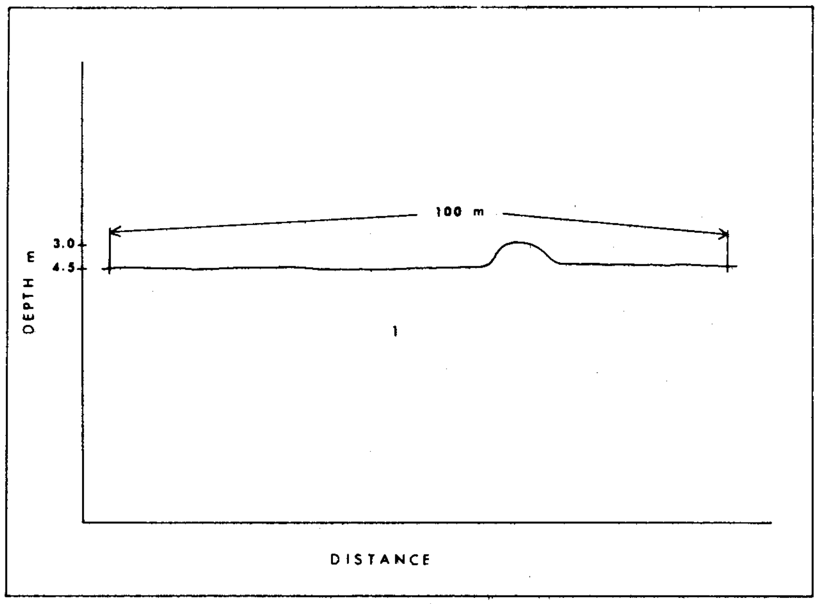


Jarvis Is. 24

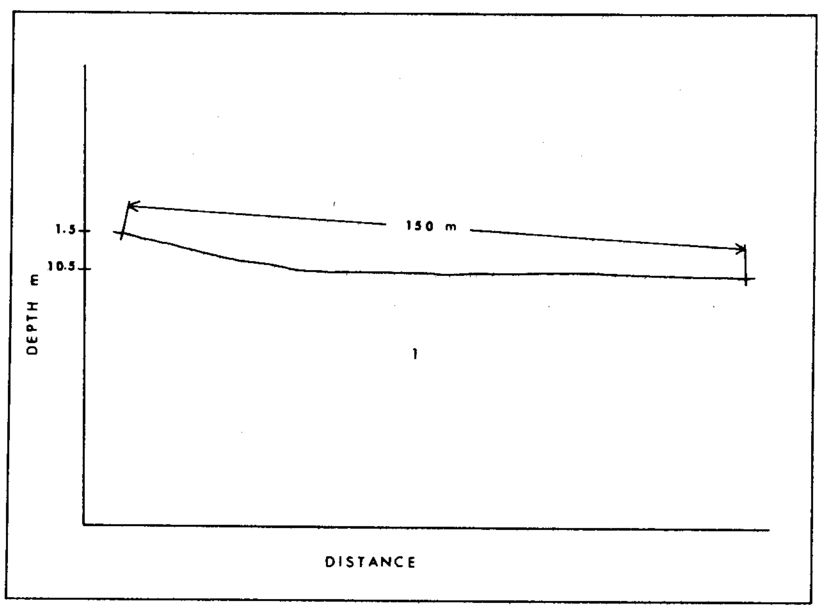


Willis Is. 30

SHELTERED SAND, MUD, GRAVEL AND SHELL SLOPES

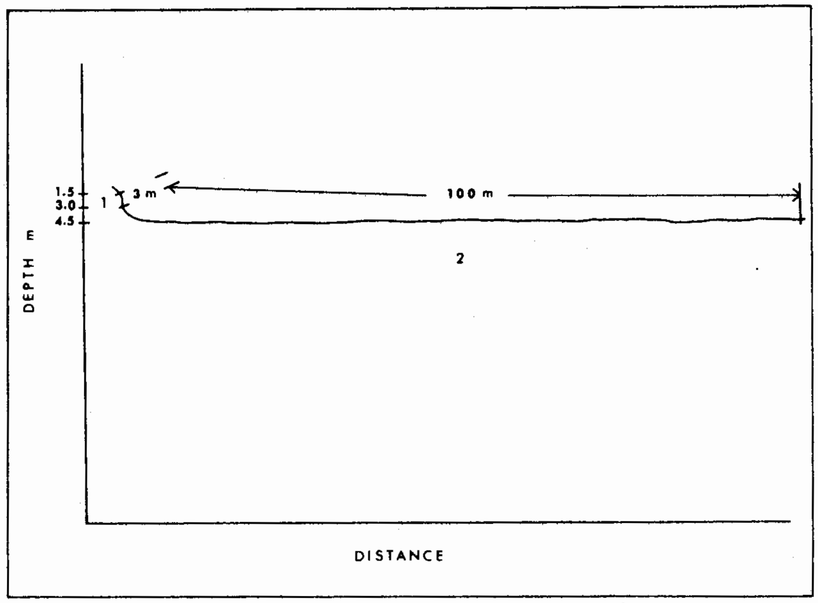


Jarvis / Jaques Is. 31

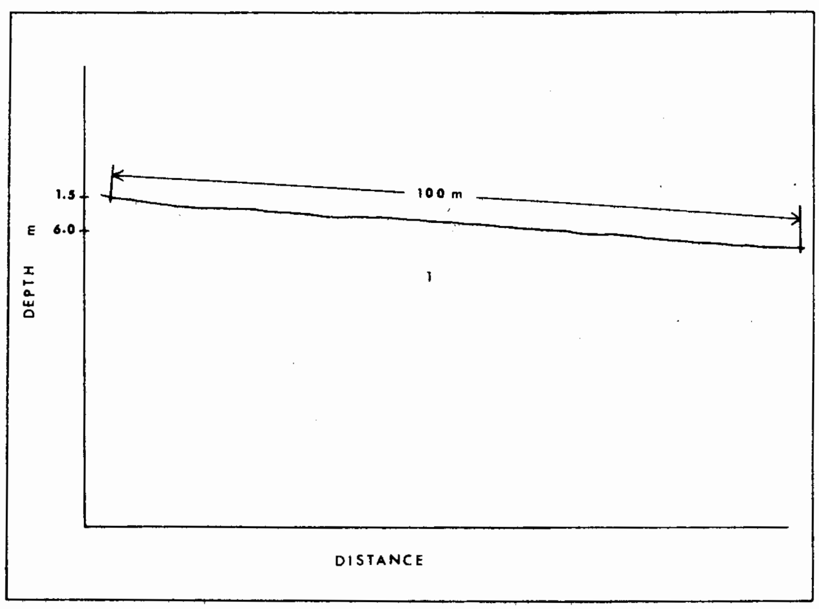


Prideaux Is. 32

SHELTERED SAND, MUD,GRAVEL AND SHELL SLOPES



Gibraltar Is. 44



Nettle Is. 45