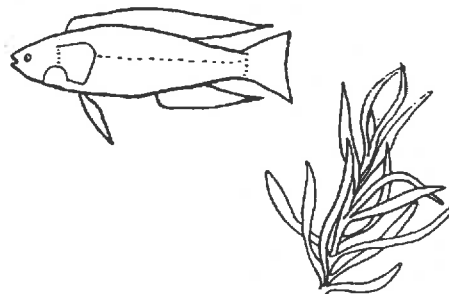


KAPITI ISLAND

SUBTIDAL ECOLOGICAL SURVEY



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Central Fishery Management Area

Internal Report No. 87/2

Ministry of Agriculture and Fisheries

Napier

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1. INTRODUCTION

Kapiti Island is situated about 50 km north of Wellington and about 5 km off Paraparaumu Beach. The island is about 9.5 km long and 2 km wide (Fig. 1). The present terrestrial flora is very diverse and the island is recognised as a regionally and nationally important area for the conservation of New Zealand's native bird fauna (Stephenson 1977). Kapiti Island is a land reserve administered by the Department of Conservation (formerly the Department of Lands and Survey).

The Kapiti region is very popular for recreational boating, sea fishing and diving, especially over the summer months (Baxter 1987). This popularity, together with public concern that the island's fish life has been depleted by commercial and recreational fishing, prompted recreational groups in the area to propose Kapiti Island as a site for a recreational "marine park."

The intertidal boulder beach and cliff face communities along the eastern and northern shores of Kapiti were surveyed in 1968 (see Appendix I). However, little information is available on the subtidal biology of the area. Although Rippon (1970) and Lahood (1984) briefly described Kapiti's underwater environment, most other information is limited to data from local spearfishing competitions (e.g. Rippon 1970, MAFFish unpublished data).

The aim of the present investigation was to describe the distribution, abundance, diversity and habitats of subtidal marine organisms around Kapiti Island. This information will provide a valuable biological base for the future management of Kapiti's waters, including any decisions regarding a marine reserve or park around the island.

Light penetration (which is a function of water depth and water clarity) and water movement appear to be two of the most important factors affecting the distribution and abundance of subtidal benthic species (Shepherd and Womersley 1970, 1971, 1976, Morton and Miller 1973, Grace 1983). The slope of rock surfaces and the degree of shading are also critical (Morton and Miller 1973). Biological factors, including settlement or recruitment patterns (Young and Chia 1982, Jones 1984a, b), behavioural patterns (Dix 1969, Leum and Choat 1980, Jones 1984c) competition (Thompson and Jones 1983, Fletcher and Creese 1985) and particularly predation (Vance 1979, Ayling 1981, Chapman 1981, Choat and Schiel 1982, Miller 1985) can also influence community structure. The interaction of all these biological and physical factors means that the distribution of many subtidal species can be very patchy. Hence subtidal zonation patterns are usually much less distinct than those found intertidally (Morton and Miller 1973).

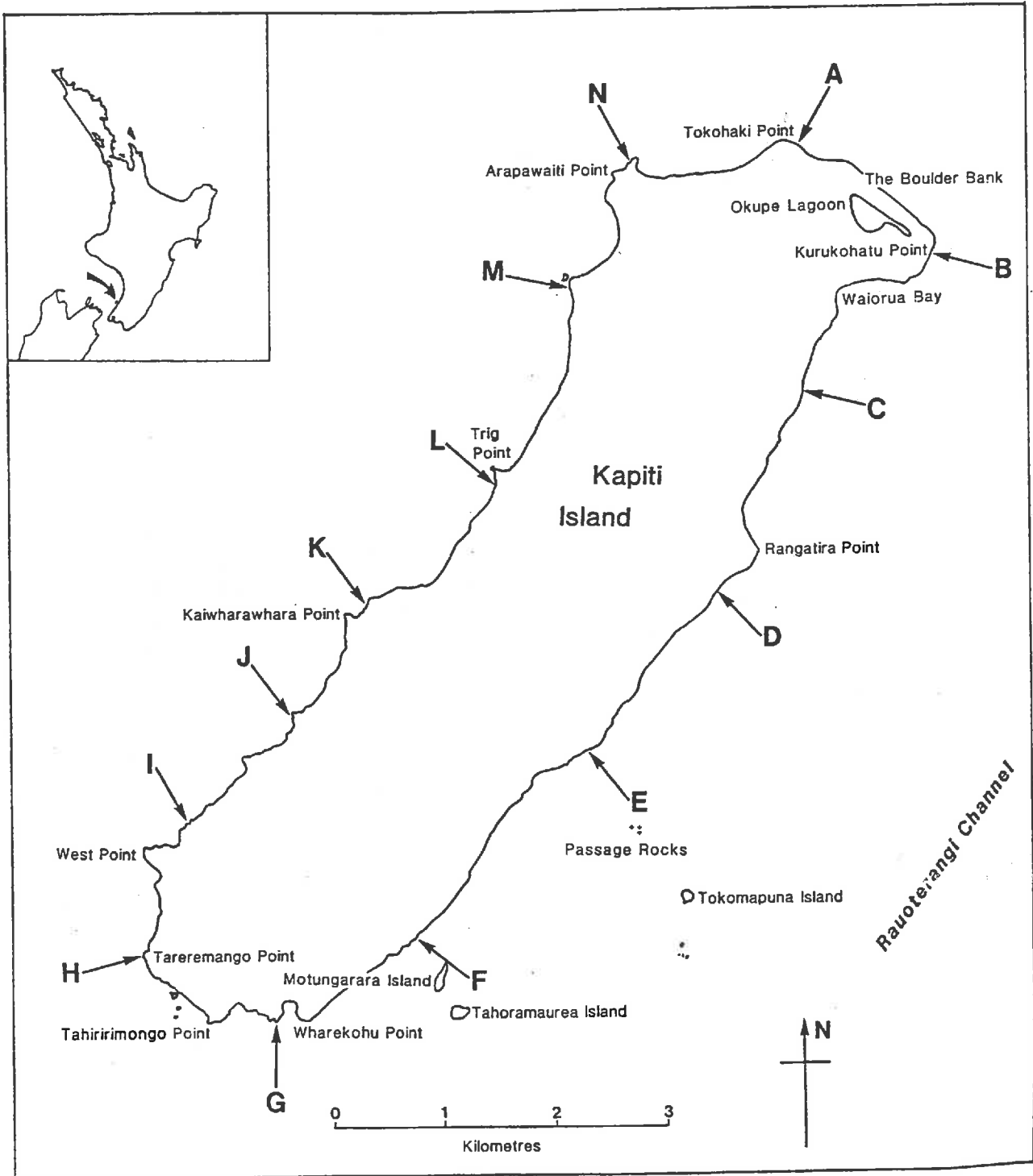


Fig. 1. Kapiti Island. Transects A-N and important geographical features are indicated.

2. METHODS

2.1 Benthic Survey

2.1.1 Transects

Underwater transects offer a convenient means of analysing the distribution of sublittoral organisms with depth. Fourteen transects were sited perpendicular to the shore at regular intervals around Kapiti Island (Fig 1) (the three small islands to the south-east of Kapiti were not surveyed). Fewer transects were established along the eastern side of Kapiti because of the lower habitat heterogeneity which occurs in this region compared with other areas around the island.

Each transect extended seawards from the high water mark to a maximum distance of 200 m. The subtidal zone between extreme low water springs and a depth of about 15 m (below chart datum) was surveyed. Water depths exceeding 15 m were not surveyed due to the need to survey at least two transects per day. Water turbulence usually prevented sampling close to the sublittoral fringe.

The transects were surveyed between 8 and 21 January 1986 (see Table 1 for individual survey dates). The decision as to which transect or transects to complete on any particular day depended largely on the sea and weather conditions, and the state of the tide. Many of the transects were sited in areas subject to strong tidal currents and could only be dived within 1½ hours either side of slack water. Transects along the western side of Kapiti were often inaccessible during moderate to strong on-shore winds.

Two divers recorded the following information along each transect -

- a. Water depth; recorded every 10 m using a calibrated depth gauge.
- b. Substrate type; noted every 20-30 m depending on the gradient of the sea floor (substrate was recorded more frequently on steeply sloping bottoms). Substrate type was defined by the approximate relative proportions of sand (particle size <2 mm diameter), gravels (2-60 mm), cobbles (60-260 mm), small boulders (260 mm - 1 m), large boulders (>1 m) and rock.
- c. Percentage cover of *Carpophyllum* spp. and laminarian algae (*Lessonia variegata* and *Ecklonia radiata* combined); recorded every 20-30 m depending on the gradient of the sea floor. Percentage cover at each station was roughly estimated by a visual appraisal of the sea floor.

- d. Abundance of major edible species. All paua (*Haliotis iris*), kina (*Evechinus chloroticus*) and rock lobster (*Jasus edwardsii*) within 1 m either side of the transect line were counted over each 10 m interval.

2.1.2 Quadrats

Sampling stations were positioned at set distances along each transect (except for transects D, F and I which could not be sampled because of insufficient time). The distance between each sampling station varied between transects, and also along some transects, depending on the gradient of the sea floor (stations were located more frequently on steeply sloping bottoms). Generally, sampling stations were 20-40 m apart.

Three 0.25 m² quadrats were censused at each sampling station to assess the diversity and abundance of marine organisms. Originally it was intended to census each quadrat by using underwater photography. However, poor water visibility on several sampling days meant that photography was used for only five transects (A, C, E, K and L). Quadrats along the remaining transects (B, G, H, J, M and N) were analysed *in situ* by recording data on waterproof acetate slates.

The photographic equipment comprised a Nikonus II camera with a 35 mm lens and underwater flash. Kodak 200 ASA colour slide film was used. This apparatus was attached to the top of a 1.25 m high aluminium frame with a 0.25 m² quadrat fixed at its base. The focal distance of 1.25 m ensured that the quadrat encompassed most of the area of each photograph. Before photographing a quadrat, any large macroalgae were noted and removed to present an unobstructed view of the understory biota.

All quadrats were analysed qualitatively by recording the presence/absence of the readily identifiable animals and plants. A number of species groups were not censused because of sampling difficulty or taxonomic uncertainty, including small red algae, bryozoans, hydroids and organisms living in sand. Large molluscs and crustacea (> 1.5 cm) and echinoderms were counted. Less conspicuous solitary species such as small gastropod molluscs, hermit crabs, coelenterates, brachiopods and solitary ascidians were only recorded as present or absent and only for the quadrats analysed in the field.

2.2 Fish Censuses

Methods for visually assessing fish abundance can be grouped broadly into those which use transects of a known length (Russell 1977, Willan *et al.* 1979, Leum and Choat 1980, Jones 1984a, b, c, Kimmel 1985) and those based on swimming time (Williams 1982, Russ 1984a, b, Kimmel 1985). In the present study, fish abundance was surveyed using a technique similar to that used by Williams (1982) and Russ (1984a, b).

An individual census comprised two divers swimming parallel to the shore for 20 minutes. The divers recorded separately the abundance of each fish species within a 10 m wide band using a log₃ abundance scale (Table

2). All fish except triplefins and juveniles less than about 5 cm overall length were counted. No attempt was made to flush out any fish hiding in the weed bed. Care was taken to avoid double counting. Although Russ (1984a, b) used a 30 minute swim, a shorter period was considered justified here since considerably fewer species were expected to be encountered at Kapiti than during Russ's study of the Great Barrier Reef. The 20 minute swim equated to a distance of approximately 300 m. Hence each census covered an area of approximately 3000 m².

Three habitats were surveyed -

- a. Eastern fringe habitat: Border of the boulder-rock reef and the outer sand bed; in 6-9 m of water along the eastern side of Kapiti Island. Weed covered reef, bare rock, and extensive areas of sand were present.
- b. Eastern reef habitat: Boulders and rock with a moderate covering of furoid and laminarian algae, interspersed with small patches of sand; in 3-5 m of water along the eastern side of the island.
- c. Western reef habitat: Boulders with a dense covering of furoid and laminarian algae; in 6-9 m of water along the western side of the island.

Six replicate censuses were completed for each habitat between 24 January and 4 February 1986. Censuses were conducted within one hour of high tide and only when water visibility allowed fish to be identified accurately at a horizontal distance of 10 m.

Table 1 Survey dates (1986) for Transects A to N

Transect	Date Surveyed
A	21 January
B	16 January
C	10 January
D	13 January
E	10 January
F	13 January
G	9 January
H	17 January
I	16 January
J	17 January
K	8 January
L	21 January
M	18 January
N	18 January

Table 2 Numbers of individual fish in each abundance category
(after Russ 1984a)

Abundance Category	Number of Individuals
1	1
2	2-3
3	4-9
4	10-27
5	28-81
6	82-243
7	244-729
8	730-2187

3. PHYSICAL DESCRIPTION

Beaches comprising cobbles and boulders or large boulders and broken rock dominate Kapiti's foreshore. In some localities, mainly on the eastern side of the island, small sand-gravel beaches have formed. Most shores are abutted by cliffs; the beaches at Kurukohatu Point and Rangatira Point are backed by the only significant expanses of level ground on the island. Vertical rock faces and large blocks of broken rock emerge directly from the sea at a number of locations around Kapiti Island, particularly along Kapiti's south coast and at various points and headlands along the western side of the island.

Depth profiles for Transects A to N, together with substrate types found along each transect, are illustrated in Figs 2-15. Water depths were converted to depth below chart datum.

Water depth increased relatively quickly around much of Kapiti Island, particularly around the island's southern and south-western shores (Transects G-I) and near Arapawaiti Point (Transect N) and Rangatira Point (Transect C). However, relatively shallow waters were found between Kapiti and the three smaller offshore islands (Transects E and F) and also directly off Kurukohatu Point (Transect B).

A bed of boulders and cobbles overlying a rocky base surrounded Kapiti. This bed was relatively narrow (30-70 m) along the eastern side of the island (Transects B-G) but was more extensive in other areas. Boulders were generally larger along the western side of the island; boulders over 2 m in diameter were found in some locations. Bed rock is quite common in some areas (e.g. Transects G, H, J and M).

Sands and gravels were found around the bases of boulders and cobbles at most transects. However, transects along the eastern side of Kapiti were noticeably sandier than most other transects and a layer of silt usually blanketed most bottom dwelling organisms in the vicinity (Transects C-G). Although Transect J was also relatively sandy, organisms in this area were free of silt.

A bed of sand and gravel generally began at a depth of 15-20 m along the western side of Kapiti. On the eastern side of the island, the transition from boulders to sand and gravel generally occurred at a shallower depth, usually between 7 and 10 m.

Broken rock was often found at the base of vertical rock faces. Just south of Arapawaiti Point (but not included in Transect N), large blocks of rock combined to create a very irregular underwater landscape with various archways, caves and tunnels formed between adjacent blocks. Boulders and cobbles replaced broken rock further out to sea.

Although no specific hydrological data were collected during the present survey, general observations on currents around Kapiti were made. Tidal currents generally flowed in a north-easterly direction on the flood tide and in a south-westerly direction on an ebb tide. A back eddy was observed between Kurukohatu Point and Rangatira Point on an outgoing tide. The strongest tidal flows were encountered around the boulder bank and along the eastern side of the island, particularly at Passage

Rocks. Relatively strong currents were also found off the various points and headlands along the western side of Kapiti Island.

The strong tidal currents and sandy conditions along the eastern side of Kapiti produced severe sand scouring. This eastern region was sheltered from the prevailing winds and water clarity was generally poorer than other areas around the island.

4. BIOLOGICAL DESCRIPTION

4.1 Benthic Biota

A total of 26 plant and 47 benthic animal species were recorded during the survey (Appendix II). These data do not include a large number of species omitted intentionally from the study (see section 2.1.2). Further, several sponges and algal species were recorded as unidentified.

Species were grouped into four biotic categories according to taxonomy and habit. These were -

- a. Algae
- b. Sponges and colonial ascidians
- c. Other sedentary animals (e.g. coelenterates, solitary ascidians and brachiopods).
- d. Mobile animal species (e.g. gastropods, chitons, echinoderms, and crabs).

The simplest measure for species diversity is species richness: the number of species (Krebs 1978). It has been argued (Green 1979) that this method is less ambiguous than, and often as informative as, more complex indices. Species richness was calculated as the mean number of organisms per 0.25 m² quadrat. These data have been summarised in Fig. 16 by grouping the data into two depth zones: a shallow zone for depths ≤ 7.5 m, and a deep zone for water depths > 7.5 m.

For most species, no estimate of abundance was made during the analysis of the subtidal quadrats. However, valuable information can still be gained by comparing the percentage of quadrats that a species was found in. Table 3 presents these percentage data for a selected range of algal and colonial animal species for the shallow and deep zones of each transect.

4.1.1 Algae

Noticeably fewer algal species were found at Transect E compared with other locations (Fig. 16). Here, sands and gravels, particularly beyond the 40 m mark (Fig. 6), reduced the number of algal species and an average of only 1.7 species per quadrat was recorded. Transects D and F were not surveyed. However a relatively impoverished subtidal flora would also be expected in the vicinity of these transects since they were very similar physically to Transect E. Algal species diversity was reduced towards the end of Transects C, L and M where sands and gravels were also prevalent.

Highest algal species diversity was found in very shallow water at Transects B and M; averages of 7 and 5.8 species/quadrat were recorded for the shallow depth zones of Transects B and M respectively (Fig. 16); however, diversity was lower at greater depth.

One of the most noticeable features of Kapiti's subtidal zone is the bed of macroalgae which extends seawards from the low water mark around the entire island. This weed bed is predominantly furoid algae of the genus *Carpophyllum* (*C. maschalocarpum* at or near the sublittoral fringe, and *C. flexuosum* in deeper water) and laminarian algae (primarily *Ecklonia radiata*, but also *Lessonia variegata* sparsely distributed in shallow water along the west coast of Kapiti). *Cystophora* sp. also occurs at some localities (Table 3).

The *Carpophyllum* and laminarian weed bed forms a dense canopy which, particularly along Kapiti's western and northern coasts, can completely conceal the bottom morphology and understory biota. Estimates of percentage cover for *Carpophyllum* spp. and laminarian algae along each transect are given in Figs. 2 to 15. Fig. 17 presents laminarian cover as a function of water depth for each transect. (Note: these percentage cover data were not determined by replicate sampling and are presented here as very rough estimates only).

The availability of boulders or rock for algal attachment determined the outer limit of the weed bed along most transects (B-G, L and M). For the remaining transects, *Carpophyllum* spp. or laminarian algae growing on either boulders or rock extended to the end of each transect. A brief dive in deep water off Transect K showed that the weed bed at this locality was restricted to depths of less than 20 m despite the presence of boulders or rock at greater depths.

The distribution and abundance of *Carpophyllum* and laminarian algae down the subtidal zone varied for different localities.

i. Transects A, H, I and N

Carpophyllum was relatively abundant in shallow water but declined with increased depth. The opposite trend was observed for laminarian algae.

ii. Transects J-M

Laminarian cover generally increased with water depth.

Carpophyllum cover showed a bimodal distribution. At Transects J and K, *Carpophyllum* was relatively abundant near the sublittoral fringe as well as in deeper waters, but was uncommon in depths around 3-5 m. *Carpophyllum* was also common in shallow water at Transects L and M but declined as laminarian cover increased with greater depth. *Carpophyllum* cover increased again at the outer fringe of the weed bed at Transects L and M as laminarian cover began to decline.

iii. Transects B-G

Laminarian algae along the eastern side of Kapiti was generally found in shallower water than elsewhere around the island (Fig. 17). At Transects C-F, a mixed weed bed comprising *Carpophyllum* spp. and laminarian algae in similar relative proportions was found down to the outer edge of the boulder reef. However, at Transect G, the reef extended further into deeper water and *Carpophyllum* was observed to increase in abundance beyond the laminarian dominated zone. At Transect B, *Carpophyllum* was relatively abundant in shallow water but declined as laminarian cover increased with greater depth.

A number of other algal species were found under and amongst the macroalgal weed bed, as well as in more open areas (Table 3, Appendix II). These included -

Encrustose coralline algae (e.g. *Lithothamnion* spp): very common along all transects, forming a pink crust over any spare rock or boulder surfaces. Included in this grouping is an ornate *Lithothamnion* - type species found on gravels at the end of Transect E.

Brown encrusting algae (including *Ralfsia verrucosa*): found at most transects. However, usually less abundant than coralline encrusting species.

Corallina spp: found at most transects but usually more common in shallower waters.

Zonaria turneriana: conspicuous member of the understory flora at most transects, in both deep and shallow water. Absent from the eastern side of Kapiti Island (Transects C and E).

Glossophora kunthii: found along Kapiti's northern and western shores. More abundant in shallower waters. Absent from Transects C, E, G, H and N.

Pterocladia lucida : locally common at some sites.

Ulva sp.: recorded from several transects but was most common off Kurukohatu Point (Transect B), particularly in the shallow depth zone.

Asparagopsis armata: common in gravel areas at Transects B and C. Also found in association with the boulder-rock reef at some localities.

Cladostephus verticillatus: only found in gravel areas along Transects B and C; common.

Sporochnus stylosus: common in gravel areas along Transect C and G.

Caulerpa brownii: common in gravel area along Transect C.
Also found along Transects G and K.

Tanarea carpophylli: calcareous species epiphytic on
Carpophyllum spp.; found only at Transect B.

4.1.2 Sponges and Colonial Ascidians

Only one species of colonial ascidian was recorded during the present survey. A total of 19 sponges were recognised; 10 of these were identified to genus or species level (Appendix II).

For convenience, sponges and colonial ascidians are referred to below as 'colonial species'.

Colonial species richness was high in relatively shallow water at Transect G (Fig. 16). Here, a vertical rock face about 30 m from the shore supported a rich colonial fauna. Colonial species diversity was also relatively high in other areas where rock was common; i.e. Transects H and M, and the end of Transect J. The irregular shape of rock surfaces in these areas formed many crevices, holes and overhangs suitable for colonisation.

The gaps and crevices formed under and between large boulders along Transects G, H and M were also occupied by colonial species. Large boulders were also common at Transect N and the end of Transect K, and colonial species diversity was relatively high (Fig. 16). However, despite large boulders being present at Transects A, L and the first 100 m of Transect K, relatively few colonial species were noted.

Colonial species diversity was also low along Transects B, C and E. The reef at Transect B was comprised predominantly of small boulders with few niches suitable for colonisation. Transects C and E were noted for their silty-sandy conditions (see section 3).

Didemnum candidum was the only colonial ascidian recorded. This species was found at most transects but was particularly common at Transects G (shallow water zone) and N (deep zone) (Table 3).

Of the sponges, the yellow-orange encrusting sponge *Cliona celata* was the most common. This species was frequently found amongst algal species on the upper surfaces of boulders and rock, as well as in more cryptic habitats (e.g. crevices, overhangs and vertical rock faces). *C. celata* occurred at all transects except C and E (Table 3). It was found in 50% or more of the quadrats sampled from the shallow water zone at Transect G and the deep zones at Transects A, H, J, K, M, and N. It is interesting to note that, although *C. celata* was a common member of the benthic fauna along Transect A, no other sponges were noted at this site and colonial species diversity was low (see above).

Other sponges (e.g. *Polymastia granulosa*, *Aplysilla sulfurea*, *Ancorina alata* and the golf ball sponges *Tethya* spp.) were more localised in their distributions, usually occurring in cryptic habitats free of algae. These species were generally more common at Transects G, M and N, but also occurred at a few other locations where suitable habitat was present.

The complex underwater environment located just south of Arapawaiti Point (see section 3) was not sampled. However, a brief observation dive revealed a diverse and luxuriant sponge community occupying the various archways, tunnels, caves and overhangs in the vicinity. Many large specimens were observed.

4.1.3 Other Sedentary Animals

This category includes coelenterates (e.g. sea anemones), solitary ascidians (sea squirts) and brachiopods. A total of 5 coelenterates, 2 solitary ascidians and 1 brachiopod were recorded (Appendix II). (Note: these species were only censused at Transects B, G, H, J, M and N).

Coelenterates, particularly sea anemones, were by far the most common species group within this faunal category. Hence, species richness data generally reflected the diversity of this group.

Diversity was generally highest in shallow water (Fig. 16) where wave action produces significant water movement. Diversity was also high in deep water at Transects B and N, areas noted for their strong tidal currents. Although strong currents also occur off Transect H, diversity at this site was relatively low.

The anemones *Corynactis haddoni* and *Actinothoe albocincta* were the most common coelenterates found at Kapiti Island. The other coelenterates recorded during the survey were -

The anemone *Isocradactis magna*: found only at Transect J in less than 1 m of water. This species was usually observed in sandy conditions around the base of boulders or rock.

Cup corals (*Flabellum rubrum*): found at Transects B, G and J, but in low numbers.

Zoanthids (*Parazoanthus* sp.): relatively uncommon; only observed at Transect N.

Two solitary ascidians were found: *Cnemidocarpa bicornuta* and *Asterocarpa coerulea*. These species were only found at Transects G and H; only one or two specimens were recorded from each transect.

The brachiopod *Terebratella inconspicua* was only recorded from Transects G and N. At these transects, *T. inconspicua* usually formed clumps of individuals in crevices, under overhangs or on vertical rock walls.

4.1.4 Mobile Animal Species

i. Paua, kina, rock lobster

The abundance of paua (*Haliotis iris*) and kina (*Evechinus chloroticus*) along each transect is depicted in Figs. 2 to 15.

Paua occurred around much of the island to a depth of about 5 m. Highest densities were generally found in the 0-3 m depth range.

Paua were particularly abundant at Transect J; approximately 500 paua were counted between the 20 and 30 m marks, equating to a density of 25/m². Relatively high paua densities also occurred at Transects A, K, L and M.

Although size frequency data were not collected for paua, general observations during the survey revealed few legal sized paua (≥ 125 mm shell length) around Kapiti Island.

Kina were also found around most of the island. However, few individuals were encountered along the northern and western sides of the island (Transects A and H-N). Kina were locally abundant elsewhere but showed no obvious preference for any particular depth range. Rather, large numbers of individuals were frequently seen aggregated on bare rock or boulders in areas with only a sparse cover of macroalgae. Within the dense weed bed, groups of kina were sometimes observed in areas denuded of macroalgae. However, such areas were small in size measuring less than about 10 m across.

Over 25 kina were counted in some 2m x 10m samples (Transects B, C, E, F and G). However, since patches of kina usually only covered a small area of each sample, these data give little indication of the density of individual patches.

Very few rock lobsters (*Jasus edwardsii*) were found. Three individuals were seen sheltering under boulders along Transect I. A single rock lobster was also observed at Transect K. All specimens observed were males.

ii. Subtidal quadrats

A total of 9 molluscs, 7 echinoderms and 2 crab species were recorded (Appendix II).

Small mobile animal species were not recorded for the photographed quadrats. Hence, species richness for this group was only estimated for Transects B, G, H, J, M and N (Fig. 16). Little can be deduced from these data about inter-site differences in species diversity.

Paua (see above) was the most conspicuous and one of the most numerous subtidal molluscs present. The small gastropod *Xymene traversi* was also very common; this species was found at all transects sampled and in places ranged from the low water mark

to the maximum depth sampled (abundance data were not collected for this species).

Other molluscan species were only present in very low numbers (see Table 4). However, observations made along the eastern side of Kapiti at various times during the survey suggested that the Cook's turban shell (*Cookia sulcata*) was more common in that region than indicated by the quadrat data. Although no circular saw shells (*Astraea heliotropium*) were recorded in the subtidal quadrats, several specimens were observed along the eastern side of the island.

Kina (see above) was the most conspicuous and probably the most numerous echinoderm found around Kapiti Island. The starfish *Patiriella regularis* was relatively common at Transects A and B but was rare in samples elsewhere (Table 4). Other starfish (*Pentagonaster pulchellus*, *Stegnaster inflatus* and *Stichaster australis*) as well as brittlestars (*Pectinura maculata*) were uncommon. Sea cucumbers (*Stichopus mollis*) were found at Transects B, G and J, usually in groups of 2-3 individuals.

Hermit crabs (*Pagurus* sp) were present along most transects (abundance data were not collected for this species). The only other crab observed was the red rock crab *Plagusia capensis*. *P. capensis* was frequently seen hiding amongst boulders, especially along the western side of the island. However, only two red rock crabs were sampled; one at Transect H and one at Transect K (Table 4):

4.2 Fish

A total of 20 fish species were recorded during the fish censuses at Kapiti Island (Appendix II). One species of squid was also recorded. For convenience, the data for squid are also presented in this section.

For each species, the two \log_3 abundance values recorded during a census were averaged. The abundance of a species at a particular sampling site was then estimated by averaging the data from the 6 replicate censuses. \log_3 abundance data are summarised in Table 5 and presented graphically in Figs. 18 and 19.

A conservative estimate of actual fish numbers is given in Table 6. The abundance of a species in a particular habitat was calculated as the mean minimum number of individuals (in an abundance category; see Table 2) per census (Russ 1984a,b).

Species richness (Table 5, Fig. 19) was calculated as the mean number of species per census.

One-way analysis of variance (ANOVA) was used to analyse the effect of habitat on species abundance and species richness. Abundance analyses were carried out for 18 selected species using the \log_3 abundance category data. The use of abundance categories is justified since it equates approximately to an ANOVA on

log-transformed count data (Russ 1984a,b). Homogeneity of variances was tested ($p = 0.05$) using Cochran's test (Winer 1971). This test is limited when only 1 of the variances is non-zero. In this case, the Cochran's test statistic will always equal 1, even if the non-zero variance is very small, and hence the variances will always be significantly heterogeneous. This occurred for 6 of the 18 fish species tested (Table 7); no significant departure from homogeneity of variances was detected for the remaining species nor for the species richness data. Nevertheless, ANOVA was carried out on the abundance category data for all species since a non-significant outcome of ANOVA will be a reliable result even when variances are significantly heterogeneous (Underwood 1981).

The results of Cochran's test and the analyses of variance are given in Table 7. Of the 6 species where variances were significantly heterogeneous, only butterfly perch and eagle ray yielded a significant ANOVA result. The results for these two species must therefore be regarded with caution.

For those species where ANOVA demonstrated a significant relationship between habitat and abundance, pairs of means were tested using the T - method (Tukey's honestly significant difference method; Sokal and Rohlf 1981) to isolate the contributing factor(s). The results of these analyses are outlined in Table 8.

There was no significant difference in species richness between habitats. However, differences in the abundance of various species were apparent. The distribution and abundance patterns for each species are outlined separately below (refer to Figs 18 and 19, and Tables 5-8 for data and results of analyses). It is important to note that this description relates to the sampling period only; seasonal changes were not investigated.

Banded Wrasse (*Pseudolabrus fucicola*)

Banded wrasse were common in all 3 habitats. They were normally seen swimming amongst the kelp fronds but were also observed over the weed bed. Abundance was not influenced significantly by habitat.

Blue cod (*Parapercis colias*)

Blue cod were very abundant along the outer margin of the weed bed to the east of Kapiti. Although significantly fewer blue cod were recorded from the western reef habitat, this species was still relatively common in this region. Lowest numbers were noted from the shallower eastern reef habitat. These data indicate a preference for relatively deep water, especially along the outer margin of the weed bed.

Blue moki (*Latridopsis ciliaris*)

Blue moki were found either singly or in small schools. They occurred in moderate to low numbers in all three habitats. Habitat type did not significantly affect fish abundance.

Butterfish (*Odax pullus*)

Butterfish occurred in all three habitats. Fish moved in over the weed bed with the incoming tide to feed on the macroalgae. Abundance appeared to be related to the extent of macroalgal cover; significantly more butterfish were found in the western reef habitat than either of the other localities sampled, and significantly more fish were recorded from the eastern reef habitat than the eastern fringe habitat.

Butterfly perch (*Caesioperca lepidoptera*)

Butterfly perch were found only in the western reef habitat, usually forming loose schools of individuals above the weed bed. Analysis of the data showed that the observed distribution pattern was statistically significant. However, since the sample variances were significantly heterogeneous, this result must be viewed with caution. Nevertheless, the observed trend is probably still significant biologically since

- a. the results of the statistical analyses are highly significant and
- b. throughout the entire survey, butterfly perch were only ever observed from reef areas to the north and west of Kapiti.

Eagle ray (*Myliobatis tenuicaudatus*)

Eagle rays were observed only in the eastern reef habitat, generally resting on patches of sand found amongst the boulders and rock. Although statistical analysis of the data showed that this trend was significant, this result may be dubious due to the heterogeneity of the sample variances. However, the result is probably still biologically significant since eagle rays were not observed elsewhere at anytime during the survey. Eagle rays also occur in shallow water around the three small islands to the south-east of Kapiti Island (pers. observ.).

Garfish (*Hyporhamphus ihi*)

Large schools of garfish were recorded during two censuses of the eastern reef habitat; this species was not observed elsewhere. Habitat type did not significantly affect fish abundance.

Goatfish (*Upeneichthys lineatus*)

This species was found only to the east of Kapiti, invariably over sand or close to sand. Abundance appeared to be related directly to the amount of sand present; significantly more goatfish were found in the eastern fringe habitat than either of the other

localities, and significantly more fish were recorded from the eastern reef habitat than the western reef habitat.

Jack mackerel (*Trachurus spp.*)

Large schools of jack mackerel were noted from both reef habitats. Differences in abundance between habitats, however, were not statistically significant.

Kahawai (*Arripis trutta*)

Kahawai abundance did not differ significantly between habitats. Only one school of kahawai, from the eastern reef habitat, was recorded during the fish censuses.

Kingfish (*Seriola grandis*)

Kingfish were recorded only from the western reef habitat where a single small-sized school was observed. Abundance differences between habitats were not statistically significant.

Leatherjacket (*Parika scaber*)

This species was found in all three habitats, but in relatively low numbers. Habitat did not significantly affect leatherjacket abundance.

Marble fish (*Aplodactylus arctidens*)

Marble fish is a highly cryptic species found in association with macroalgae in all three habitats. The abundance of marbled fish did not differ significantly between habitats and relatively low numbers were recorded.

Red moki (*Cheilodactylus spectabilis*)

Red moki were found in the eastern and western reef habitats. Individuals were normally observed swimming amongst the macroalgae or sheltering in caves or tunnels formed between adjacent boulders. Abundance appeared to be related directly to available cover; significantly more red moki were found in the western reef habitat than either of the other localities sampled, and significantly more fish were recorded from the eastern reef habitat than the eastern fringe habitat.

Scarlet wrasse (*Pseudolabrus miles*)

Although scarlet wrasse were observed over the weed beds on either side of the island, preference was shown for more open territory, especially around open rocky areas. Thus, significantly more fish were recorded from the eastern fringe habitat than the two weed-dominated reef habitats.

Spotty (*Pseudolabrus celidotus*)

Spotties were extremely numerous over and adjacent to reef in all three habitats. This species was by far the most abundant fish found around Kapiti Island.

Tarakihi (*Nemadactylus macropterus*)

Tarakihi were found in all three habitats but were significantly more abundant in the eastern fringe habitat where small schools of fish were frequently seen. Elsewhere, tarakihi were generally observed swimming individually.

Yellow-eyed mullet (*Aldrichetta forsteri*)

Yellow-eyed mullet were only recorded from the eastern reef habitat; two large schools were observed during separate censuses. Differences in abundance between habitats were not statistically significant.

Sand flounder (*Rhombosolea plebeia*)
Sweep (*Scorpiis aequipinnis*)
Broad squid (*Sepioteuthis bilineata*)

One specimen of each of these species was recorded during the fish censuses.

A number of other fish species were observed at various times during the study but were not censused during the fish survey. These are listed in Appendix II.

Table 3. Percentage of quadrats in which various algal, sponge and colonial ascidian species occurred for the shallow (≤ 7.5 m) and deep (≥ 7.5 m) zones of each transect

	TRANSECT																					
	SHALLOW ZONE							DEEP ZONE														
	A	B	C	E	G	H	J	K	L	M	N	A	B	C	E	G	H	J	K	L	M	N
ALGAE																						
Encrustose coralline algae (e.g. <i>Lithothamnion</i> spp.)	100	100	100	53	83	100	100	73	100	67	-	100	100	67	-	100	78	100	100	40	50	78
Brown encrusting algae (e.g. <i>Ralfsia verrucosa</i>)	83	67	100	33	0	0	56	36	67	11	-	80	50	11	-	0	22	17	83	20	0	22
<i>Corralina</i> spp.	33	92	33	20	0	67	22	18	33	44	-	20	83	0	-	0	0	0	0	40	0	78
<i>Zonaria turneriana</i>	75	8	0	0	67	100	67	45	92	78	-	80	0	0	-	0	89	100	33	40	50	78
<i>Glossophora kunthii</i>	50	33	0	0	0	0	22	36	25	11	-	20	0	0	-	0	0	17	0	0	0	0
<i>Pterocladia lucida</i>	0	0	0	0	0	0	44	9	25	11	-	0	0	0	-	0	0	0	0	0	33	0
<i>Ulva</i> spp.	25	92	0	0	17	0	0	18	0	0	-	0	50	0	-	0	11	0	0	20	0	0
<i>Asparagopsis armata</i>	0	42	0	20	17	67	0	0	0	0	-	0	50	100	-	33	78	0	0	0	0	33
<i>Cladostephus verticillatus</i>	0	0	0	0	0	0	0	0	0	0	-	0	83	50	-	0	0	0	0	0	0	0
<i>Sporochinus stylosus</i>	0	0	0	0	0	0	0	0	0	0	-	0	0	83	-	100	0	0	0	0	0	0
<i>Caulerpa brownii</i>	0	0	0	0	17	0	0	27	0	0	-	0	0	50	-	33	0	0	0	0	0	0
<i>Tanarea carpophylli</i>	0	25	0	0	0	0	0	0	0	0	-	0	0	0	-	0	0	0	0	0	0	0
<i>Cystophora</i> sp.	25	0	0	0	0	0	0	18	8	0	-	0	0	0	-	0	11	17	0	0	0	0
SPONGES AND COLONIAL ASCIDIANS																						
<i>Didemnum candidum</i>	0	8	33	7	66	33	22	0	0	44	-	0	0	0	-	0	11	33	33	0	17	78
<i>Cliona celata</i>	42	33	0	0	50	33	0	18	25	89	-	60	0	0	-	0	56	83	100	0	50	100
<i>Polymastia granulosa</i>	0	8	0	0	33	0	11	0	0	0	-	0	0	0	-	0	0	0	0	0	33	0
<i>Aplysilla sulfurea</i>	0	0	0	0	50	0	11	0	0	11	-	0	0	0	-	0	0	0	0	0	0	22
<i>Ancorina alata</i>	0	0	0	0	50	0	0	0	0	22	-	0	0	0	-	0	0	0	0	0	17	22
<i>Tethya</i> spp.	0	0	0	0	17	33	0	0	0	0	-	0	0	0	-	0	11	0	17	0	0	22
Number of quadrats	12	12	3	15	6	3	9	11	12	9	0	5	6	9	0	3	9	6	6	5	6	9

Table 4. Abundance (mean number per $0.25 \text{ m}^2 \pm \text{S.E.}$) of selected mobile animal species ($>1.5 \text{ cm}$) for the shallow and deep zones of each transect: Data for Haliotis iris and Evachinus chloroticus have not been included; these two species are discussed separately in section 4.1.4.

	SHALLOW ZONE												N	
	A	B	C	E	G	H	J	K	L	M	N			
MOLLUSCS														
<u>Cantharidus purpureus</u>	0	0	0	0	0	0	0	0	0	0	0	0	0.11 \pm 0.11	-
<u>Cookia sulcata</u>	0	0	0	0	0	0	0	0	0	0	0	0	0	-
<u>Eudoxochiton nobilis</u>	0	0	0	0	0	0	0.22 \pm 0.15	0	0	0	0	0	0	-
<u>Glossodoris aureomarginata</u>	0	0	0	0	0	0	0	0	0	0	0	0	0	-
<u>Maurea pellucida</u>	0	0	0	0	0	0	0	0	0	0	0	0	0	-
<u>Maurea punctulata</u>	0	0	0	0	0	0	0	0	0	0	0	0	0	-
<u>Turbo smaragdus</u>	0	0.08 \pm 0.08	0	0	0	0	0	0	0	0	0	0	0	-
ECHINODERMS														
<u>Pectinura maculata</u>	0	0	0	0.07 \pm 0.07	0	0	0	0	0	0	0	0	0	0
<u>Pentagonaster pulchellus</u>	0	0	0	0	0	0.33 \pm 0.33	0	0	0	0	0	0	0.08 \pm 0.08	-
<u>Patriella regularis</u>	0.42 \pm 0.19	0.33 \pm 0.19	0	0	0	0	0	0	0	0	0	0	0	-
<u>Stegnaster inflatus</u>	0	0	0	0	0.17 \pm 0.17	0	0	0	0	0	0	0	0	-
<u>Stichaster australis</u>	0	0	0	0	0	0	0	0	0	0	0	0	0	-
<u>Stichopus mollis</u>	0	0.17 \pm 0.17	0	0	0.51 \pm 0.34	0	0	0	0	0	0	0	0	-
DECAPODS														
<u>Plagusia capensis</u>	0	0	0	0	0	0	0	0	0	0	0	0	0	-
Number of quadrats	12	12	3	15	6	3	9	11	12	9	12	9	9	0
SHALLOW ZONE														
DEEP ZONE														
MOLLUSCS														
<u>Cantharidus purpureus</u>	0	0	0	-	0	0	0	0	0	0	0	0	0	0
<u>Cookia sulcata</u>	0	0.33 \pm 0.33	0	-	0	0	0	0	0	0	0	0	0	0
<u>Eudoxochiton nobilis</u>	0	0	0	-	0	0	0	0	0	0	0	0	0	0
<u>Glossodoris aureomarginata</u>	0	0	0	-	0	0.11 \pm 0.11	0	0	0	0	0	0	0	0
<u>Maurea pellucida</u>	0	0.17 \pm 0.17	0	-	0	0.11 \pm 0.11	0	0	0	0	0	0	0	0
<u>Maurea punctulata</u>	0	0.17 \pm 0.17	0	-	0	0	0	0	0	0	0	0	0	0
<u>Turbo smaragdus</u>	0	0	0	-	0	0	0	0	0	0	0	0	0	0
ECHINODERMS														
<u>Pectinura maculata</u>	0	0	0.22 \pm 0.22	-	0	0.11 \pm 0.11	0	0	0	0	0	0	0	0
<u>Pentagonaster pulchellus</u>	0	0	0	-	0	0.22 \pm 0.15	0	0	0	0	0	0	0	0
<u>Patriella regularis</u>	0	0.51 \pm 0.34	0	-	0	0	0.17 \pm 0.17	0.17 \pm 0.17	0	0	0	0	0	0
<u>Stegnaster inflatus</u>	0	0	0	-	0	0	0	0	0	0	0	0	0	0
<u>Stichaster australis</u>	0	0	0	-	0	0	0	0	0	0	0	0	0	0.11 \pm 0.11
<u>Stichopus mollis</u>	0	0	0	-	0	0	0	0	0	0.17 \pm 0.17	0	0	0	0
DECAPODS														
<u>Plagusia capensis</u>	0	0	0	-	0	0.11 \pm 0.11	0	0.17 \pm 0.17	0	0	0	0	0	0
Number of quadrats	5	6	9	0	3	9	6	6	5	6	6	6	6	9

Table 5. Mean \log_3 abundance of fish, and mean number of fish species per census (species richness), for each of the 3 habitats censused at Kapiti Island. SE = standard error. n = 6.

	HABITAT					
	EASTERN FRINGE		EASTERN REEF		WESTERN REEF	
	\bar{x}	S.E.	\bar{x}	S.E.	\bar{x}	S.E.
Banded wrasse	2.67	0.21	3.50	0.22	2.83	0.40
Blue cod	5.00	0	0.83	0.48	3.00	0.26
Blue moki	2.17	0.22	2.00	0.26	1.50	0.85
Butterfish	0.17	0.17	0.83	0.31	3.17	0.17
Butterfly perch	0	0	0	0	2.50	0.76
Eagle ray	0	0	0.67	0.33	0	0
Flounder	0.17	0.17	0	0	0	0
Garfish	0	0	2.00	1.29	0	0
Goatfish	3.67	0.21	0.33	0.21	0	0
Jack mackerel	0	0	1.00	1.00	3.50	1.59
Kahawai	0	0	0.67	0.67	0	0
Kingfish	0	0	0	0	0.67	0.67
Leatherjacket	1.17	0.48	1.33	0.42	1.50	0.43
Marblefish	0.17	0.17	0.67	0.21	0.33	0.21
Red moki	0	0	0.50	0.34	1.33	0.42
Scarlet wrasse	4.00	0	1.83	0.40	2.00	0.26
Spotty	8.00	0	8.00	0	8.00	0
Squid (broad)	0	0	0.17	0.17	0	0
Sweep	0	0	0.17	0.17	0	0
Tarakihi	4.33	0.56	1.33	0.42	0.33	0.33
Yellow eyed mullet	0	0	2.17	1.42	0	0
Species richness	8.00	0	9.33	0.76	9.17	0.40

Table 6. Mean minimum number of individuals per census for each fish species recorded during the fish censuses at Kapiti Island. SE = standard error. n = 6.

	HABITAT					
	EASTERN FRINGE		EASTERN REEF		WESTERN REEF	
	\bar{x}	S.E.	\bar{x}	S.E.	\bar{x}	S.E.
Banded wrasse	3.33	0.42	7.00	1.34	5.00	1.61
Blue cod	28.00	0	1.00	0.63	4.67	1.12
Blue moki	2.67	0.67	2.17	0.40	5.50	4.54
Butterfish	0.17	0.17	0.83	0.31	5.00	1.00
Butterfly perch	0	0	0	0	7.50	4.35
Eagle ray	0	0	0.67	0.33	0	0
Flounder	0.17	0.17	0	0	0	0
Garfish	0	0	45.33	40.00	0	0
Goatfish	8.00	1.26	0.33	0.21	0	0
Jack mackerel	0	0	13.67	13.67	176.00	117.37
Kahawai	0	0	1.67	1.67	0	0
Kingfish	0	0	0	0	1.67	1.67
Leatherjacket	1.33	0.61	1.50	0.56	1.67	0.56
Marblefish	0.17	0.17	0.67	0.21	0.33	0.21
Red moki	0	0	0.50	0.35	1.50	0.56
Scarlet wrasse	10.00	0	2.17	0.60	2.17	0.40
Spotty	730.00	0	730.00	0	730.00	0
Squid (broad)	0	0	0.17	0.17	0	0
Sweep	0	0	0.17	0.17	0	0
Tarakihi	26.67	11.87	1.50	0.56	0.33	0.33
Yellow eyed mullet	0	0	126.33	120.82	0	0

Table 7. Results of Cochran's test and Analyses of Variance (ANOVA) on fish species abundance and species richness data. Abundance and species richness data are presented in Figs. 18 and 19 and Tables 5 and 6.

†† = variances significantly heterogeneous, $p < 0.01$
 * = ANOVA significant, $p < 0.05$
 ** = ANOVA significant, $p < 0.01$
 *** = ANOVA significant, $p < 0.001$
 NS = not significant, $p < 0.05$

	Cochran's test for homogeneity of variances	ANOVA
Banded wrasse	NS	NS
Blue cod	NS	***
Blue moki	NS	NS
Butterfish	NS	***
Butterfly perch	††	***
Eagle ray	††	*
Garfish	††	NS
Goatfish	NS	***
Jack mackerel	NS	NS
Kahawai	††	NS
Kingfish	††	NS
Leatherjacket	NS	NS
Marble fish	NS	NS
Red moki	NS	*
Scarlet wrasse	NS	***
Spotty	Variances equal	NS (abundances equal)
Tarakihi	NS	***
Yellow-eyed mullet	††	NS
Number of species	NS	NS

Table 8 T - method results showing the effect of habitat on the abundance of selected fish species. Abundance data are presented in Figs. 18 and 19 and Tables 5 and 6.

** = significant difference, $p < 0.01$
 NS = not significant, $p < 0.05$

(NB: Critical values for $p < 0.001$ were not available)

Paired Tests

	Eastern fringe- Eastern reef	Eastern fringe- Western reef	Eastern reef - Western reef
Blue cod	**	**	**
Butterfish	**	**	**
Butterfly perch	NS	**	**
Eagle ray	**	NS	**
Goatfish	**	**	**
Red moki	**	**	**
Scarlet wrasse	**	**	NS
Tarakihi	**	**	NS

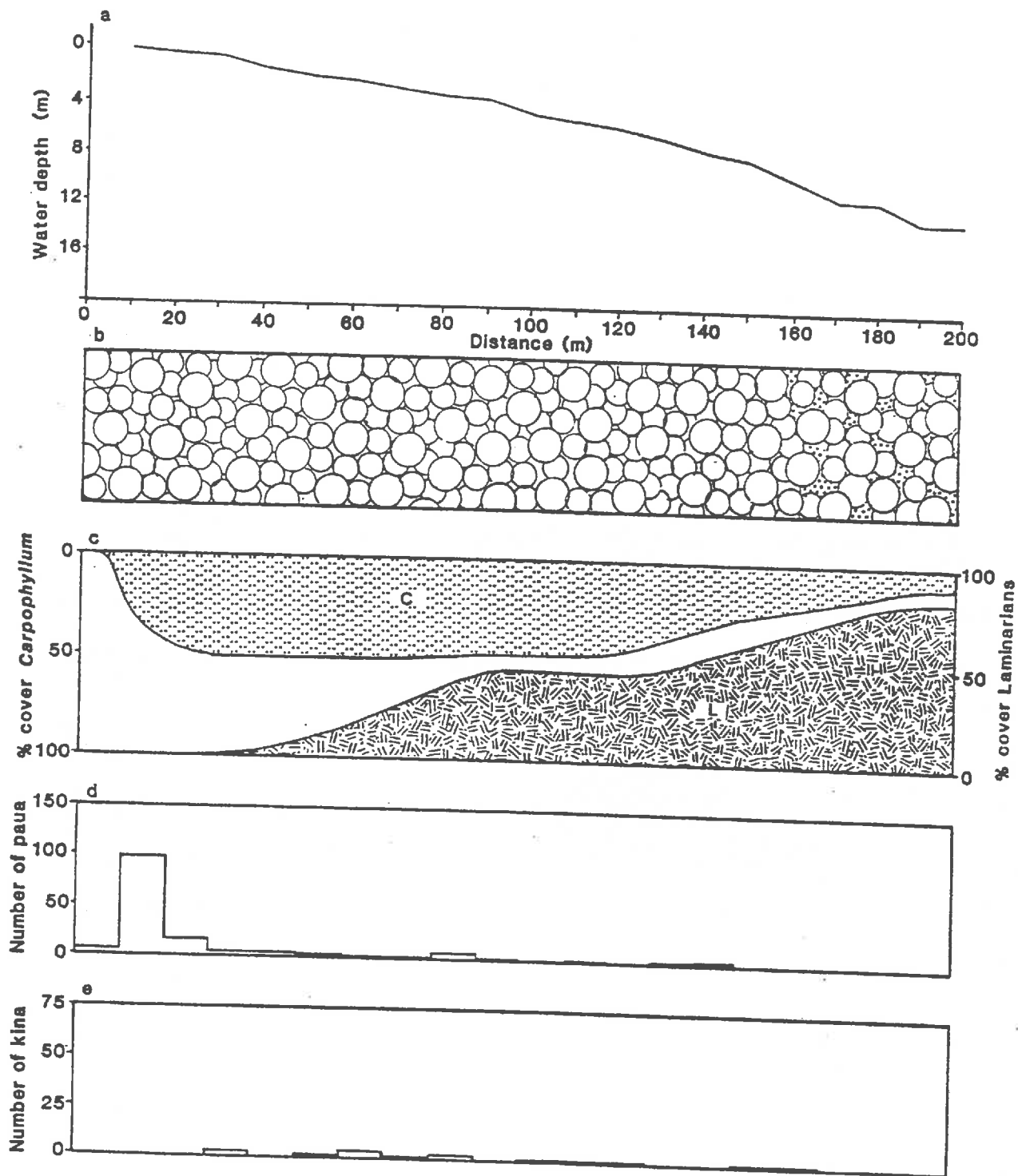








Fig. 2. Transect A.

a. Depth profile. Water depth = metres below chart datum.
Distance = metres from high water mark.

b. Substrate type

(Refer to text for substrate definitions)

-  = sand
-  = gravels
-  = cobbles
-  = small boulders
-  = large boulders
-  = rock

c. Percentage cover of *Carpophyllum* spp. (C) and laminarian algae (L).

d. Abundance of paua (*Haliotis iris*).

e. Abundance of kina (*Evechinus chloroticus*).

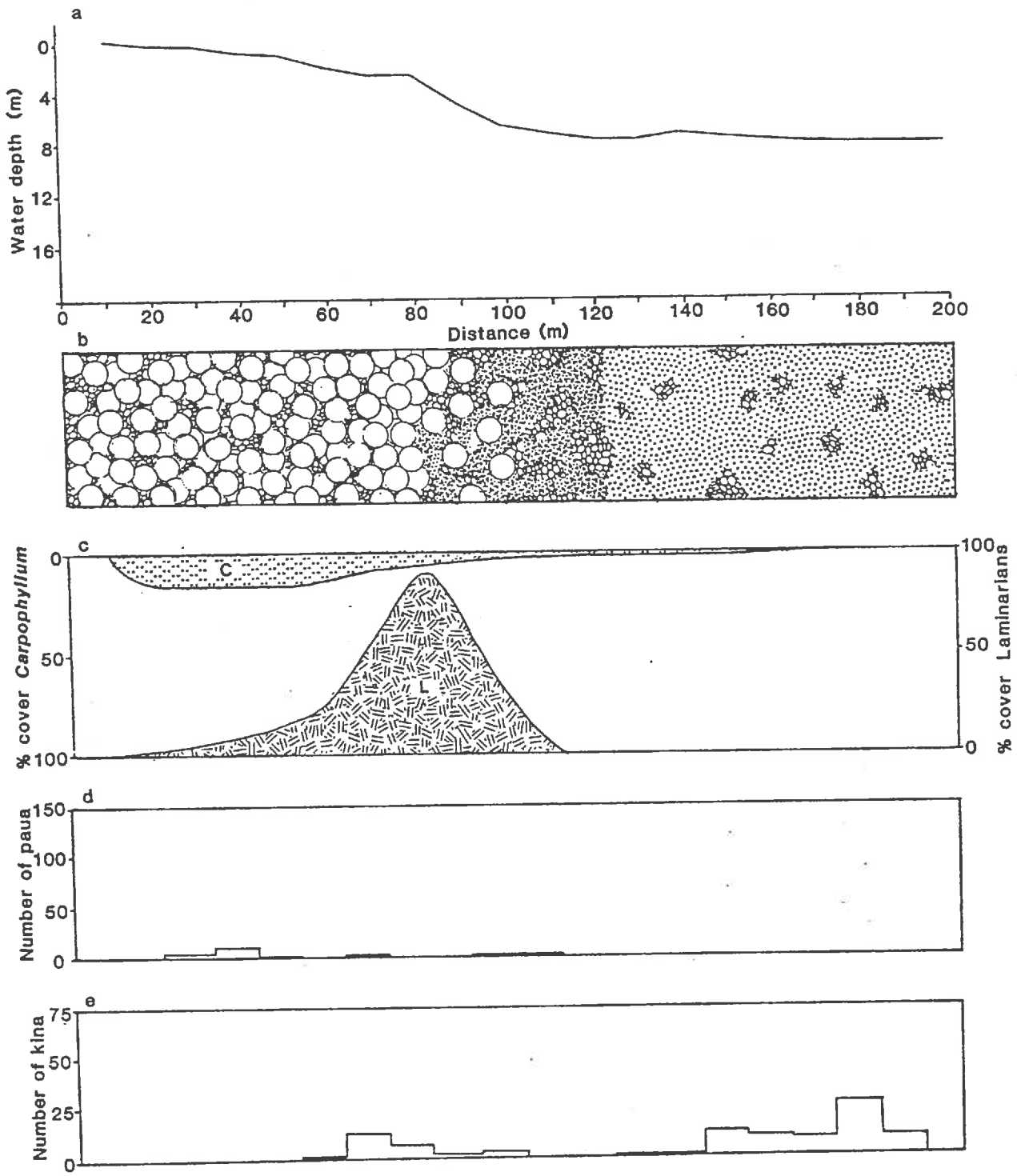


Fig. 3. Transect B. Refer to Fig. 2 for explanation.

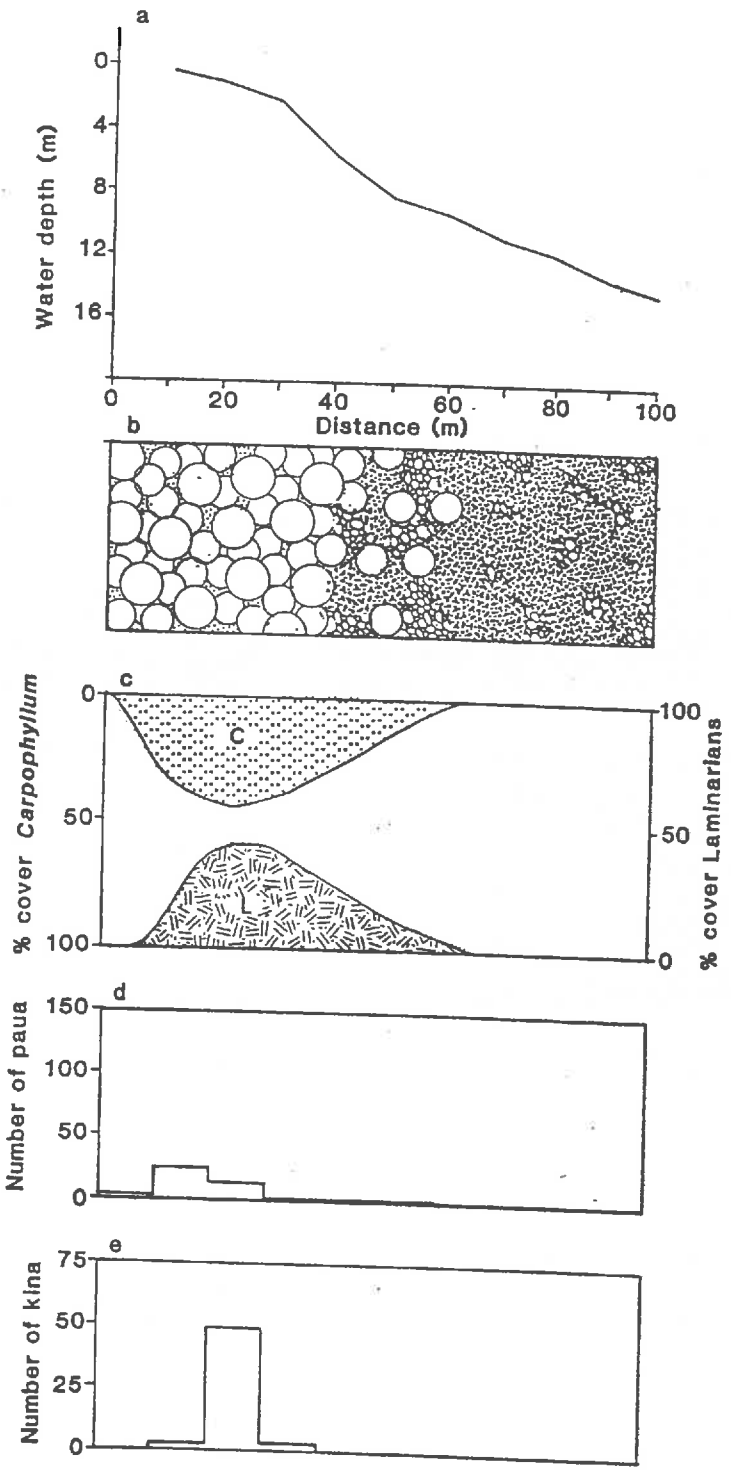


Fig. 4. Transect C. Refer to Fig. 2 for explanation.

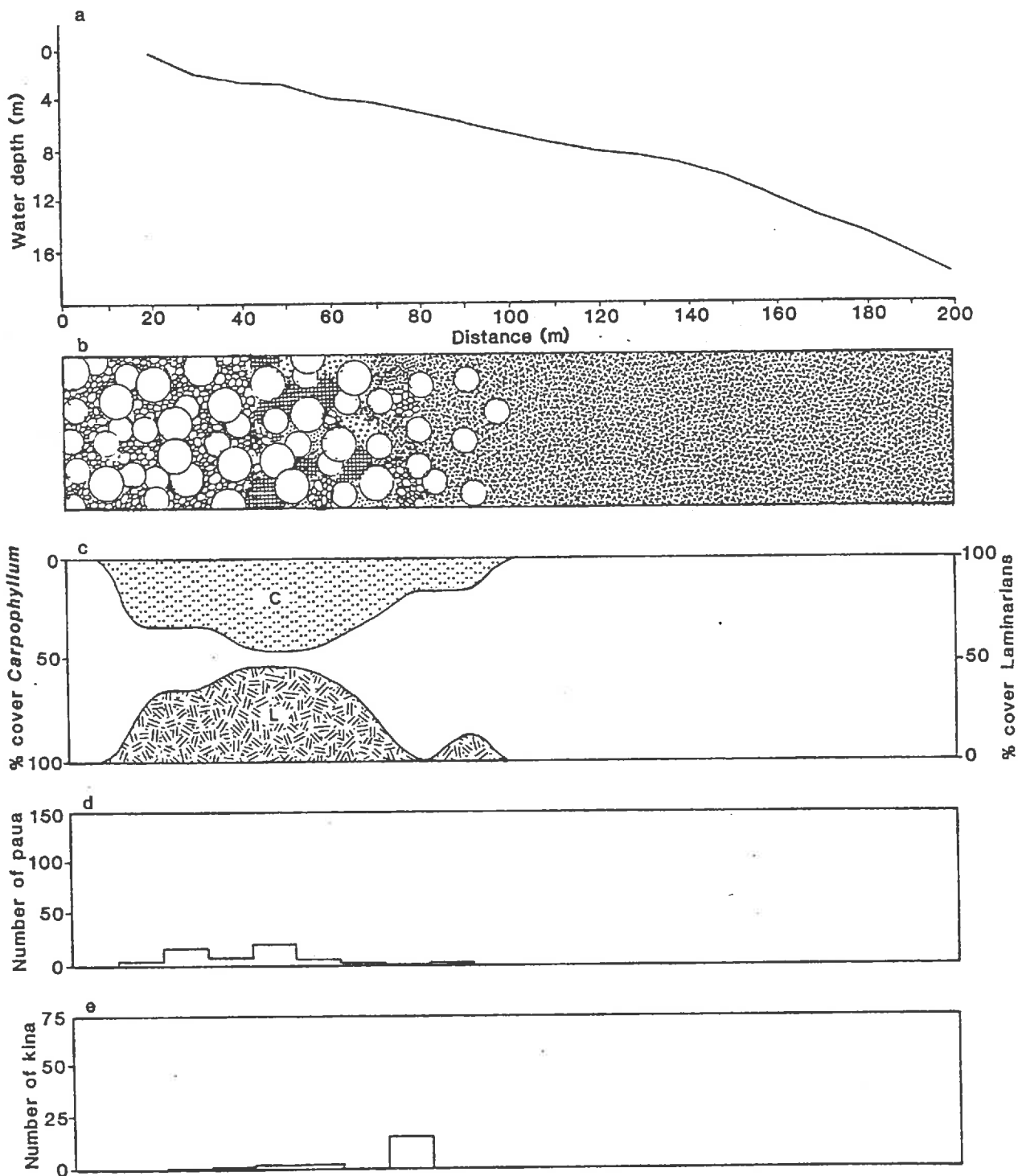


Fig. 5. Transect D. Refer to Fig. 2 for explanation.

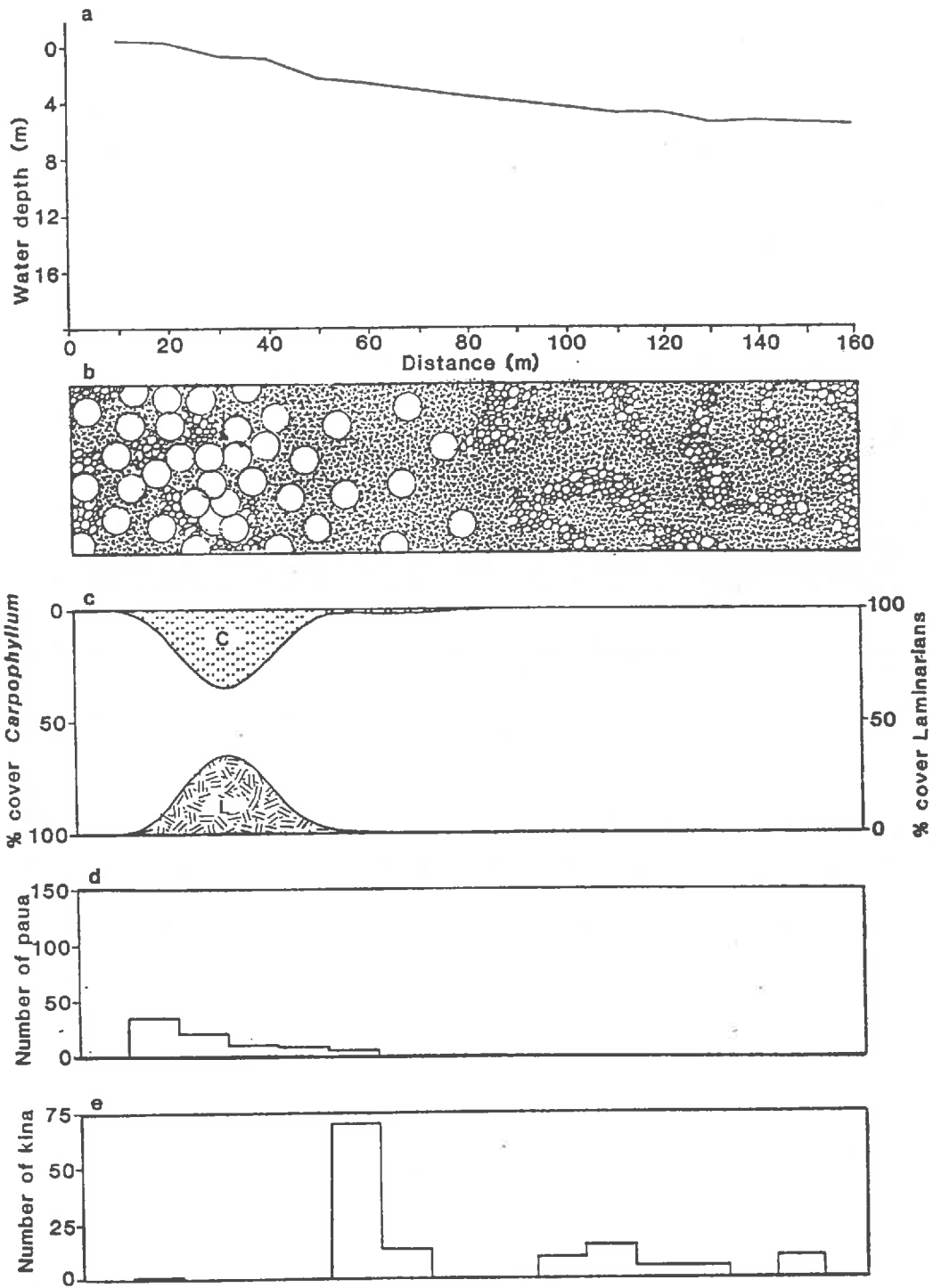


Fig. 6. Transect E. Refer to Fig. 2 for explanation.

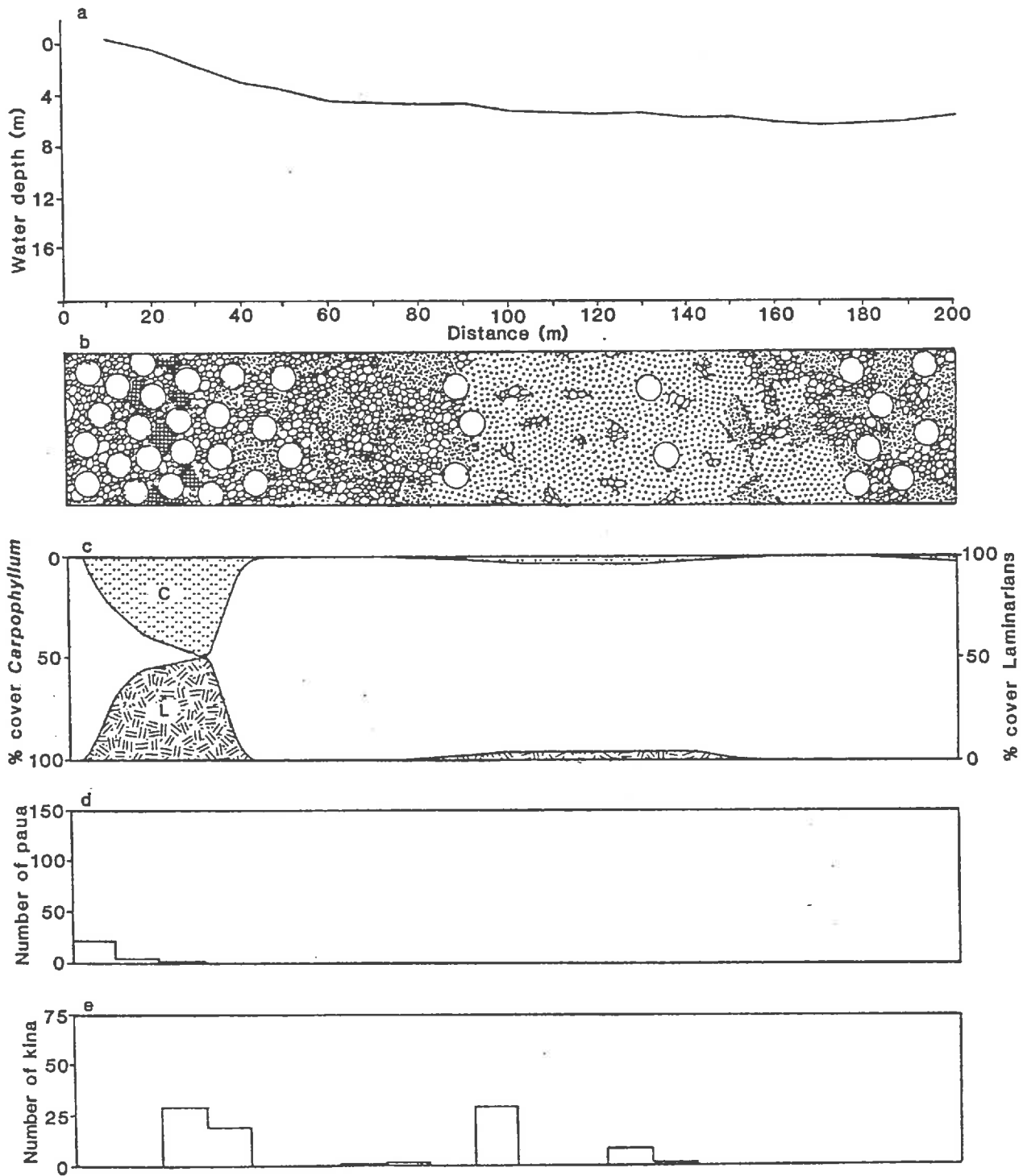


Fig. 7. Transect P. Refer to Fig. 2 for explanation.

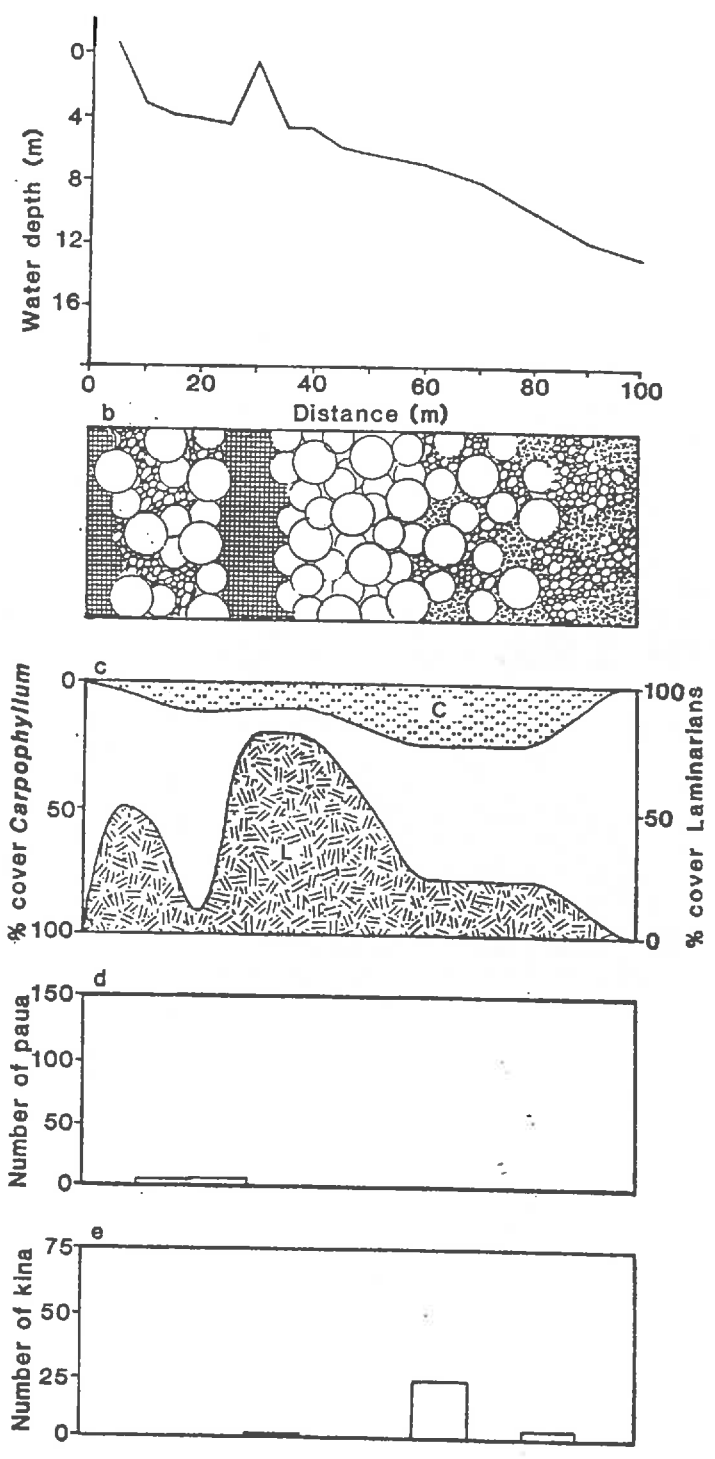


Fig. 8. Transect G. Refer to Fig. 2 for explanation.

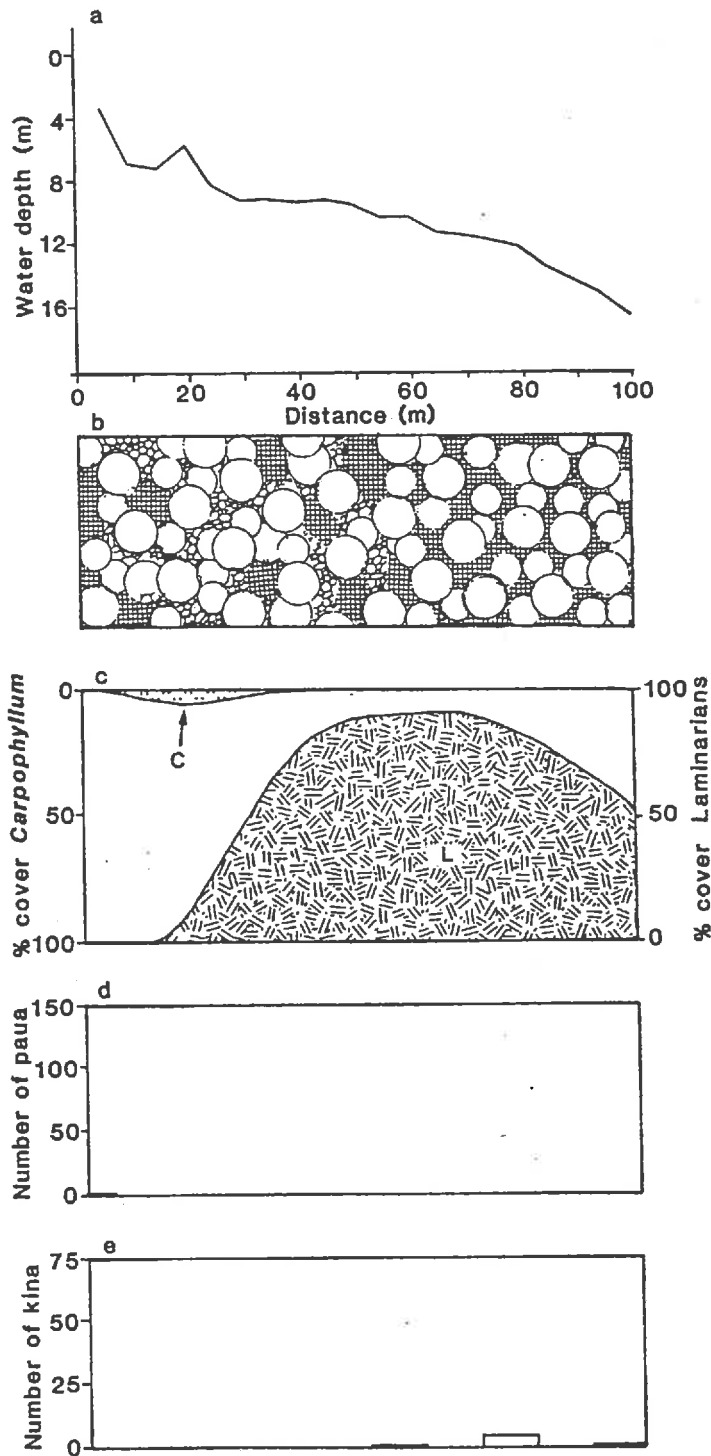


Fig. 9. Transect H. Refer to Fig. 2 for explanation.

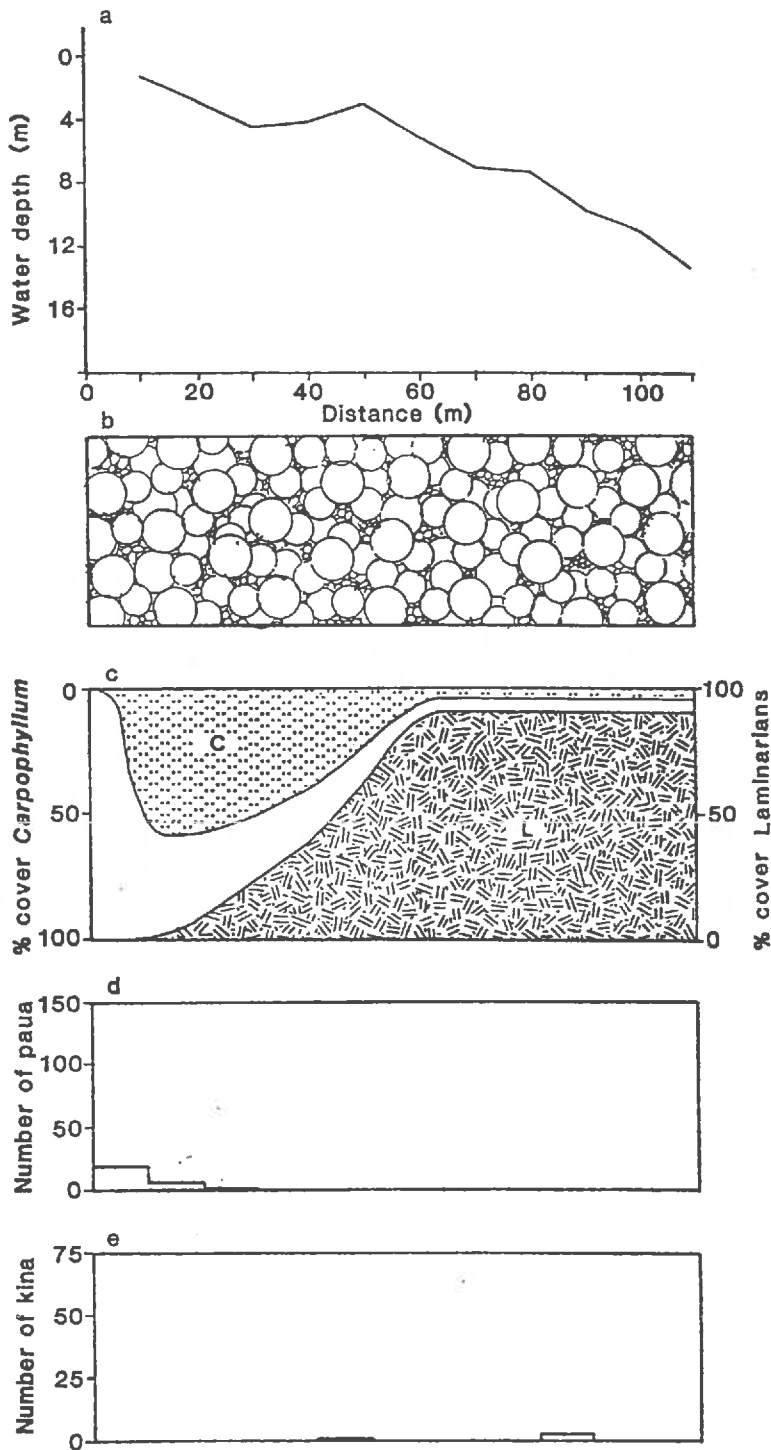


Fig. 10. Transect I. Refer to Fig. 2 for explanation.

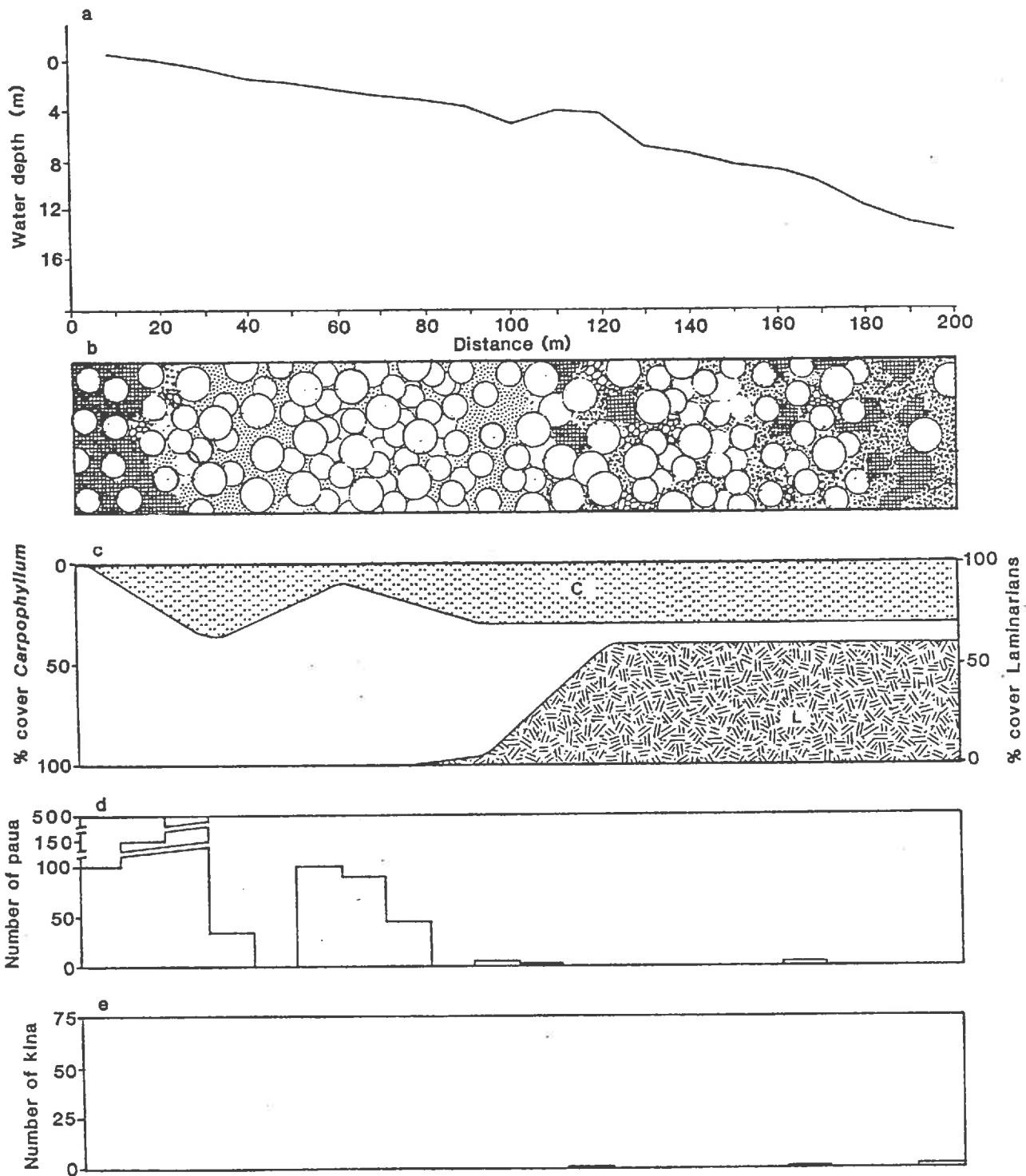


Fig. 11. Transect J. Refer to Fig. 2 for explanation.

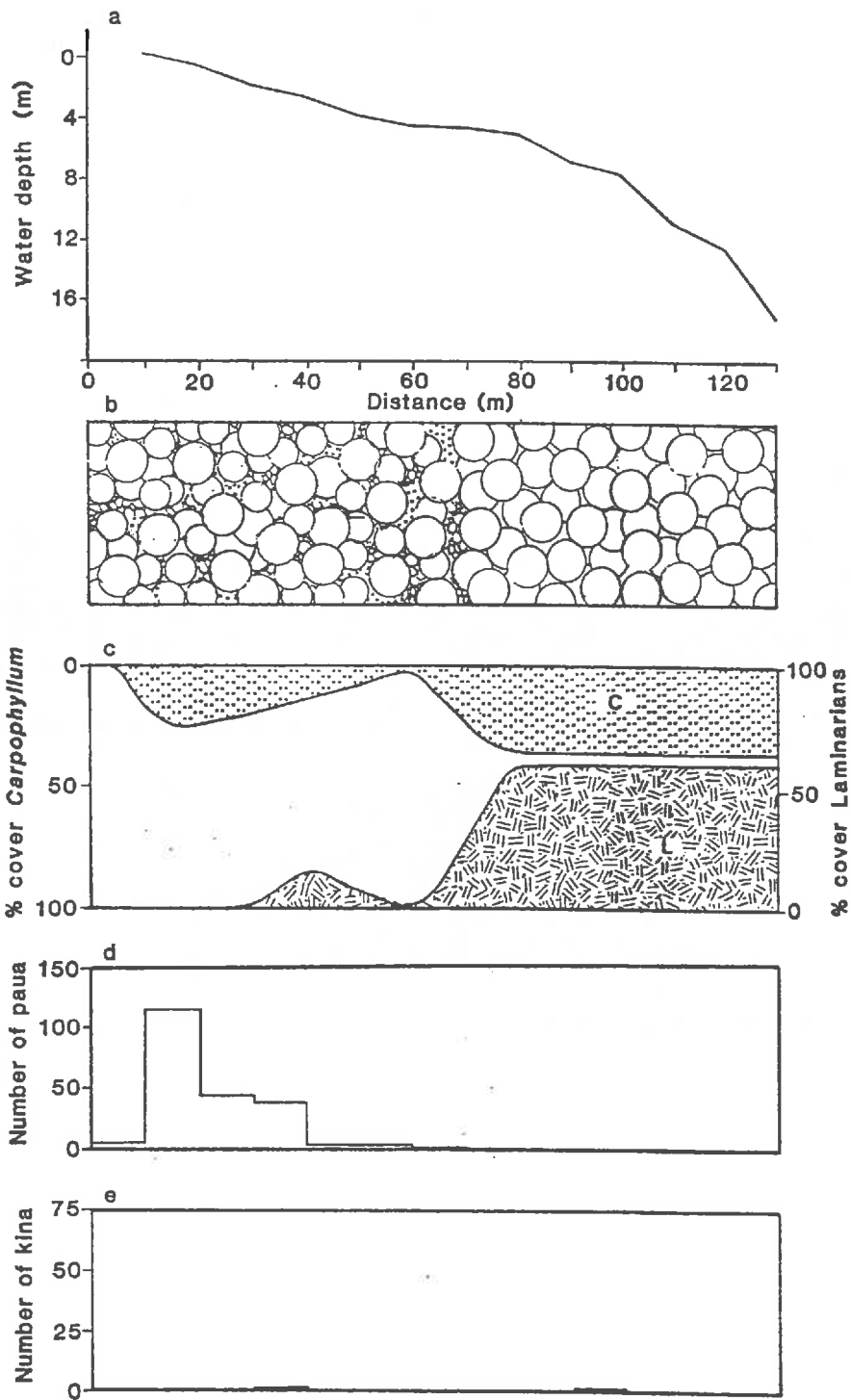


Fig. 12. Transect K. Refer to Fig. 2 for explanation.

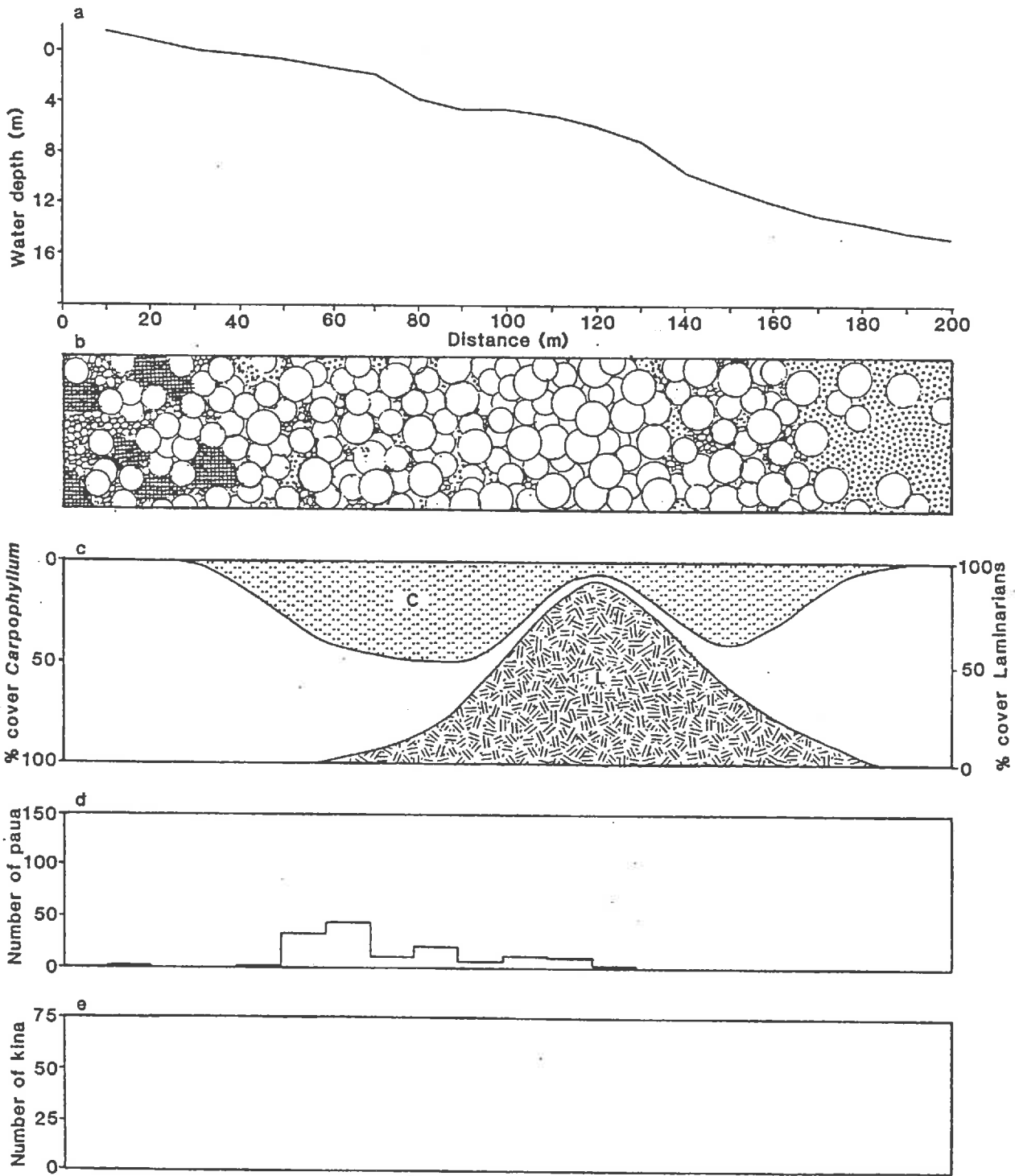


Fig. 13. Transect L. Refer to Fig. 2 for explanation.

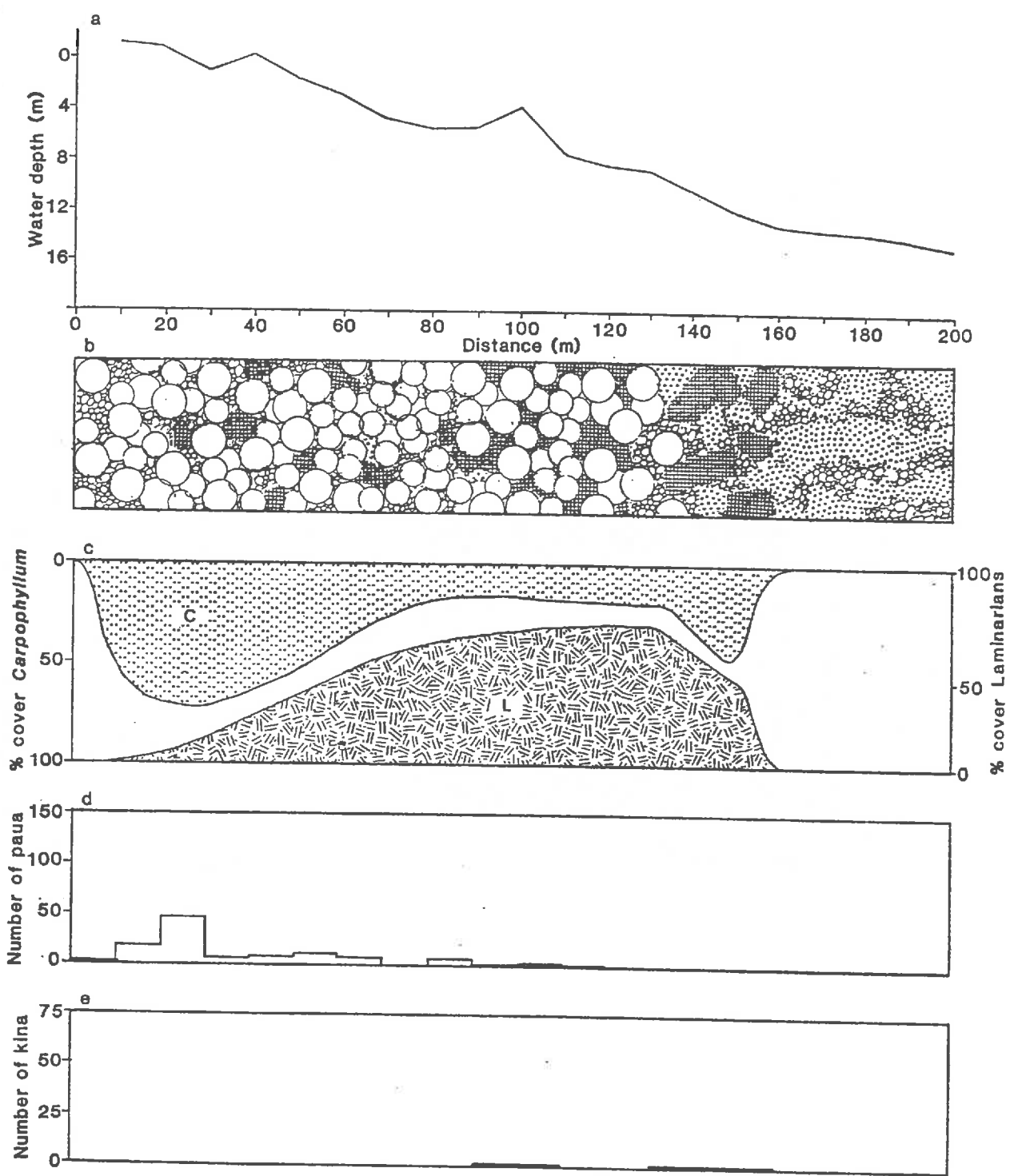


Fig. 14. Transect M. Refer to Fig. 2 for explanation.

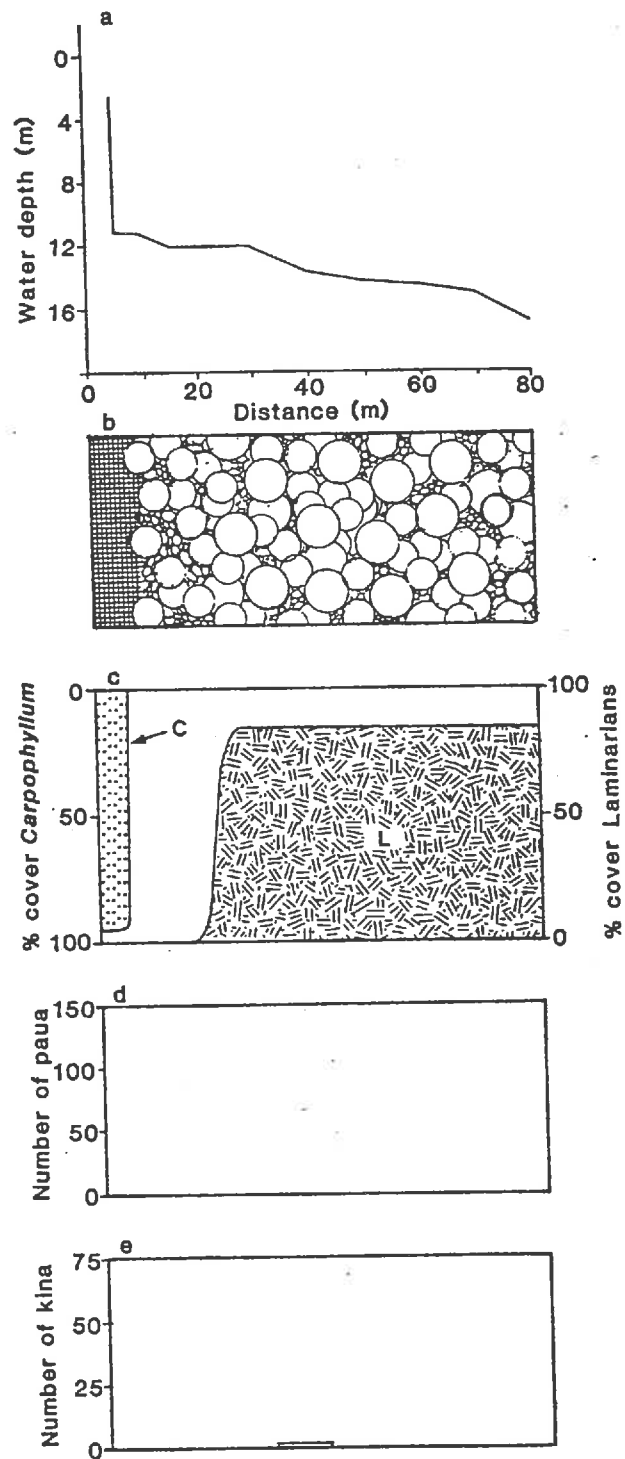


Fig. 15. Transect N. Refer to Fig. 2 for explanation.

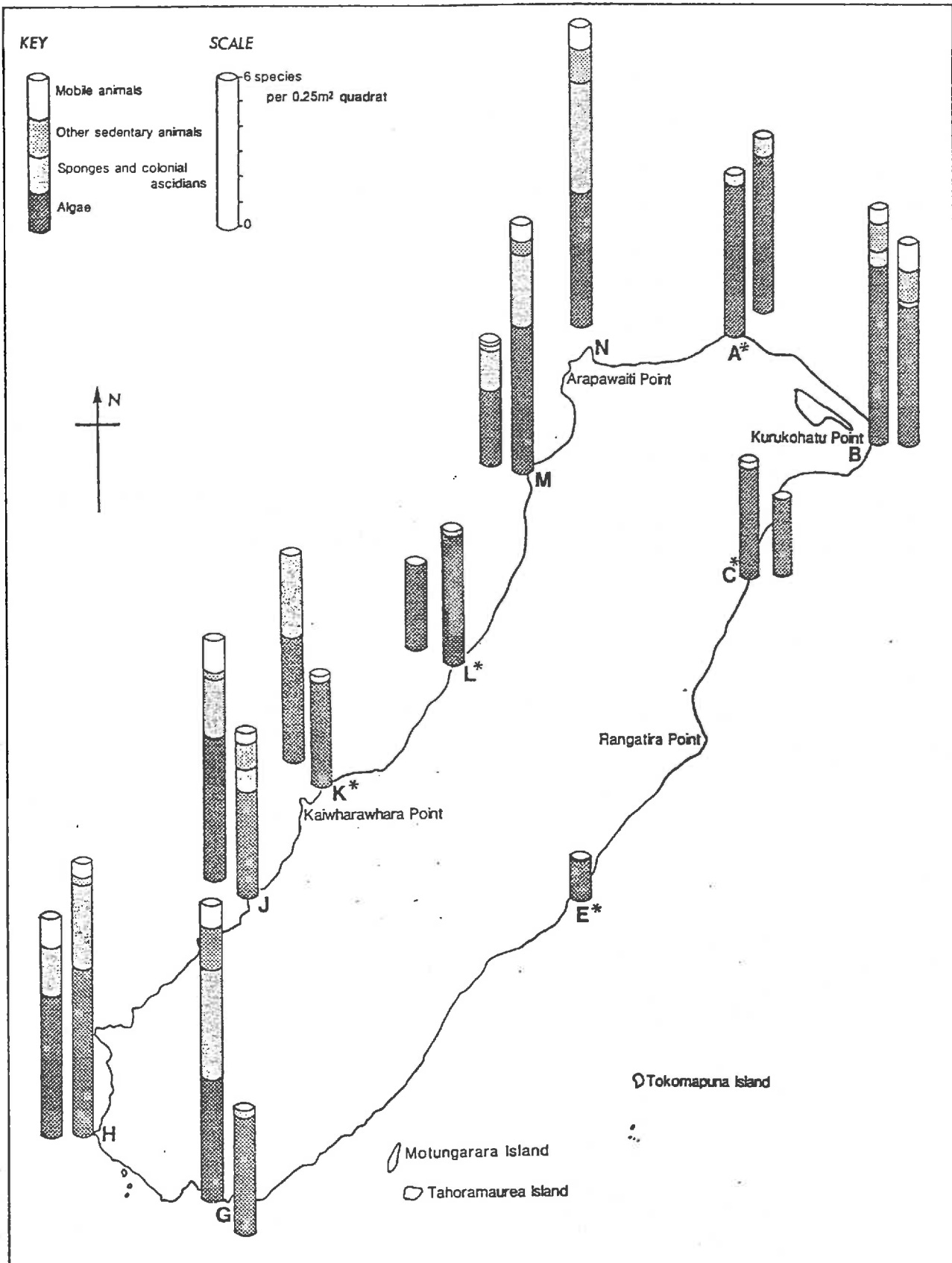


Fig. 16. Species diversity (mean number of organisms per 0.25 m² quadrat) for the shallow (inner) and deep (outer) zones. * indicates that diversity indices for other sedentary animals and mobile animal species were not determined. Transects D and F were not sampled.

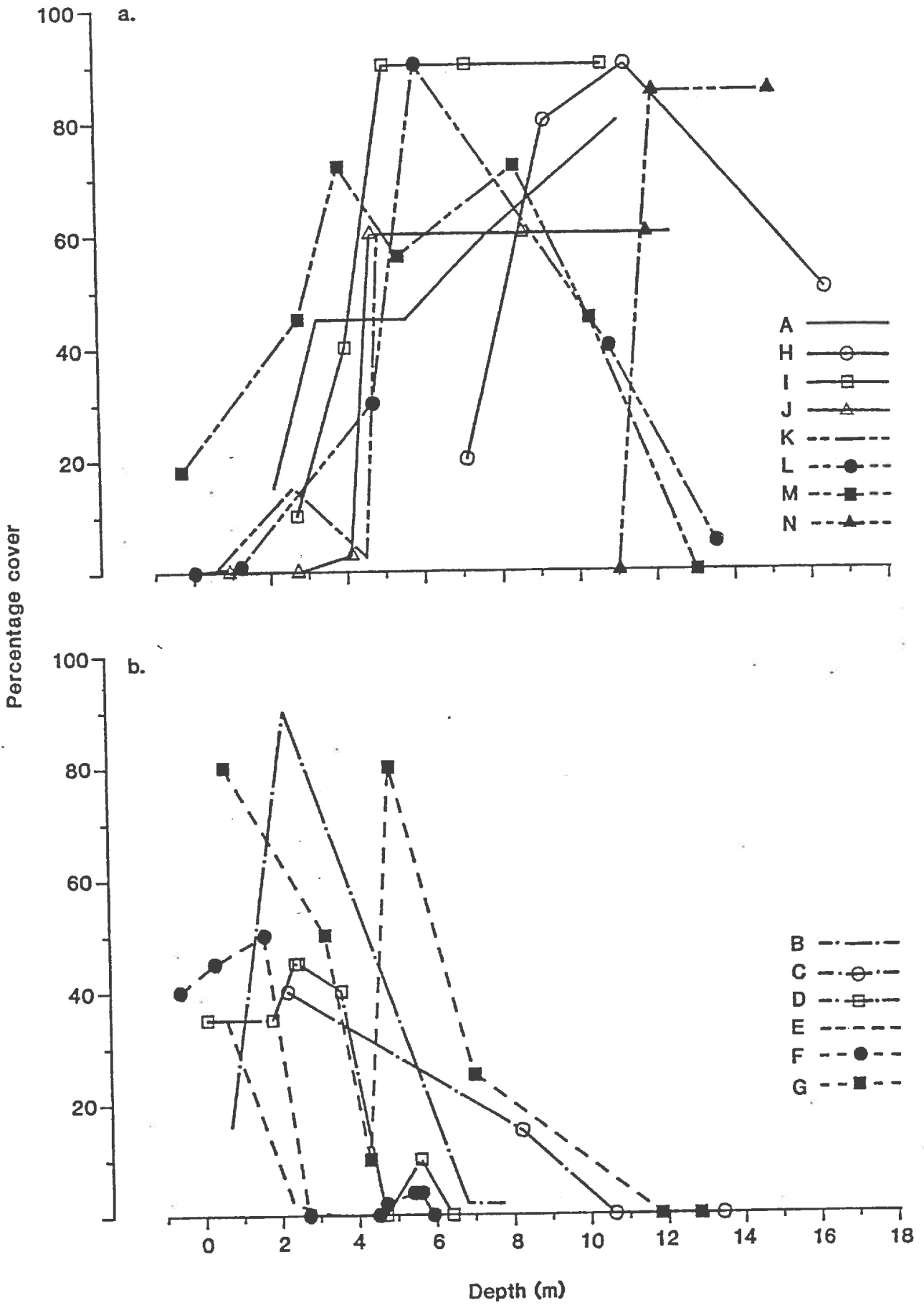


Fig. 17. Percentage cover of laminarian algae with respect to depth.
 a. Transects A and H-N. b. Transects B-G.

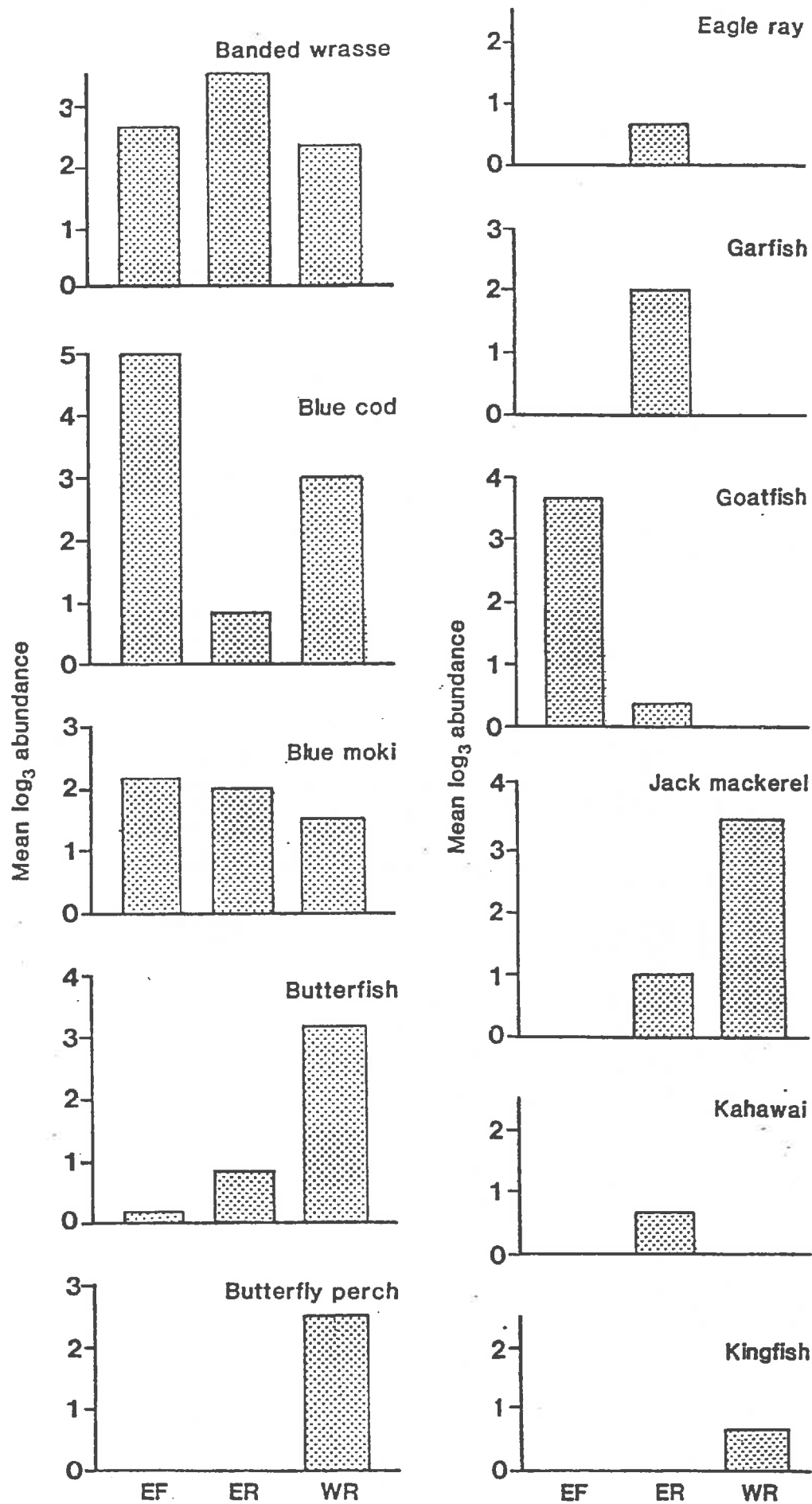


Fig. 18. Between habitat differences in mean log₃ abundance for various fish species. The numbers of individual fish in each abundance category are given in Table 2. Refer to Table 5 for standard error data. Results of statistical analyses are summarised in Tables 7 and 8.

EF = eastern fringe habitat
 ER = eastern reef habitat
 WR = western reef habitat

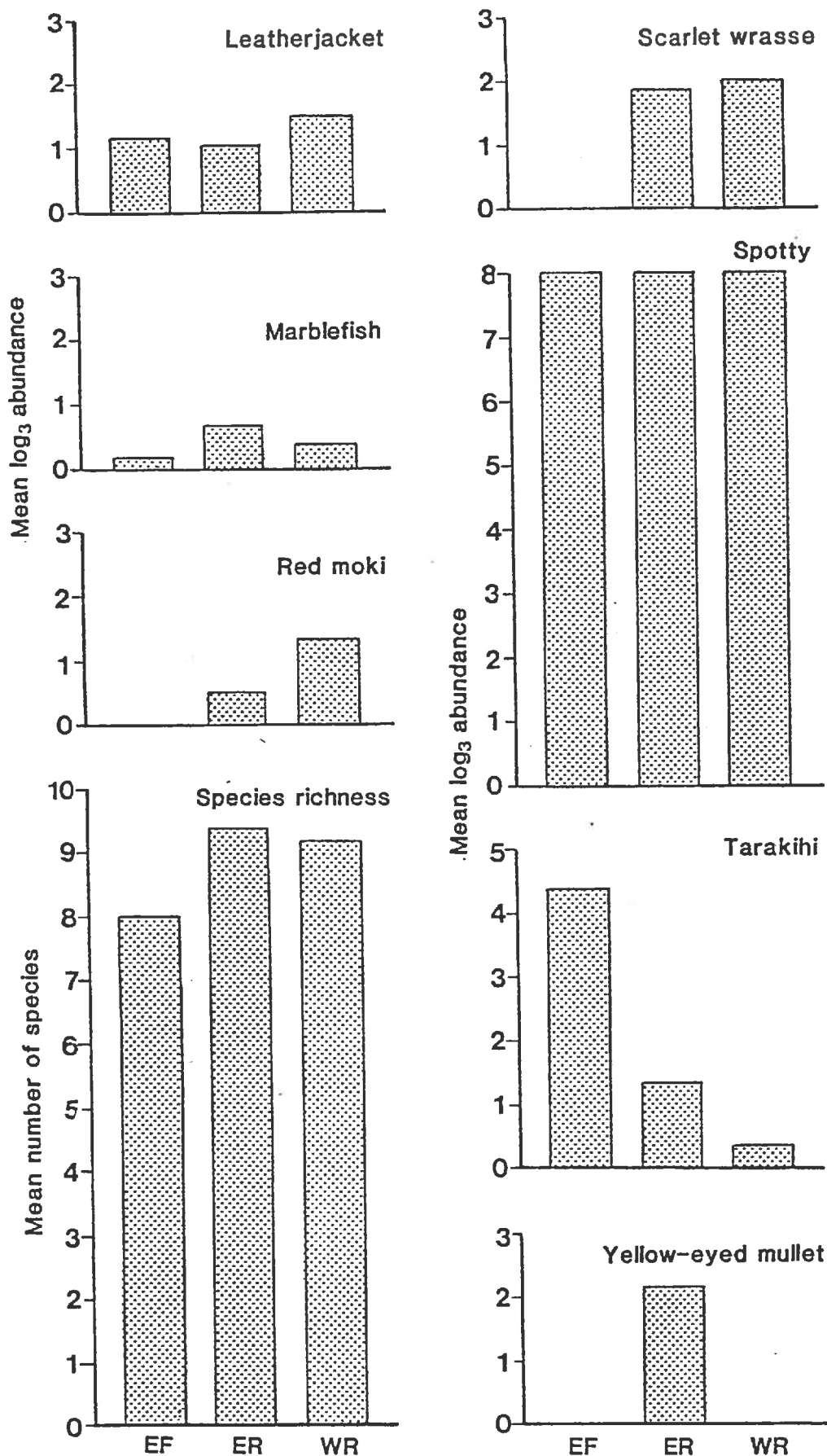


Fig. 19. Between habitat differences in mean log₃ abundance for various fish species, and mean number of fish species per census (species richness). For further explanation, see Fig. 20.

5. DISCUSSION

This study of Kapiti Island's marine biota was only carried out at one time of the year. The results therefore only present a static "picture" of the species assemblages found; seasonal differences were not investigated.

5.1 Benthic Biota

The survey revealed a subtidal community dominated by algal species. Algae occupied most of the available non-shaded free space over the subtidal reefs. Kapiti's subtidal flora closely resembles that found along Wellington's west coast (Marine Consultants Ltd. 1975).

Light penetration is a critical factor in determining the distribution and abundance of algal species (Shepherd and Womersley 1970, 1971, 1976, Grace 1972, 1983, Morton and Miller 1973). Poorer water clarity along the eastern side of Kapiti may explain the relatively impoverished subtidal flora in this region. Sand scour and sedimentation to the east of the island would also contribute to this pattern. Shepherd and Womersley (1976) also described a decline in algal cover in sediment affected areas.

Two subtidal zones were recognised along Kapiti Island's northern and western coasts : a shallow *Carpophyllum maschalocarpum* - *Lessonia variegata* - *Ecklonia radiata* zone, and a deeper *Ecklonia radiata* - *Carpophyllum flexuosum* zone. These zones probably equate to the upper sublittoral and mid sublittoral zones of Shepherd and Womersley (1970) and Grace (1972). Along the eastern side of Kapiti Island, the mid-littoral zone was compressed into the upper zone and only a single 'mixed' zone was recognised.

The mid-littoral zone (or 'mixed' zone) at Kapiti Island either extended to the limits of the boulder-rock reef or to the end of each transect. Hence, a lower sublittoral zone of red algae as described by Shepherd and Womersley (1970) was not surveyed at Kapiti. However, a brief dive in deep water off Transect K did reveal a zone of boulders and rock covered in red algae beyond the weed bed. A similar lower sublittoral zone probably also exists elsewhere around Kapiti Island where reef occurs at sufficient depth. Although red algae were common in some gravel areas off Kapiti's eastern coast, these areas were relatively shallow and small brown and green algae also occurred. These gravel areas are therefore not considered to be part of the true lower sublittoral zone.

Fucoid algae of the genus *Carpophyllum*, and laminarian algae (*Lessonia variegata* and particularly *Ecklonia radiata*) are important members of the subtidal community in many North Island localities (Adams 1972, Grace 1972, 1983, Marine Consultants Ltd. 1975, Ayling 1978, Choat and Schiel 1982, Schiel 1984). *E. radiata* is also one of the dominant macroalgal species in South Australian waters (Shepherd and Womersley 1970, 1971, 1976). At Kapiti Island, fucoid and laminarian algae formed a dense weed bed over the boulder-rock reefs surrounding the island. The relative proportions and abundance of each weed bed species varied depending on location and depth. Similar "kelp forests" have been

described by Ayling (1978), Choat and Schiel (1982) and Grace (1983) for north-eastern New Zealand where *Ecklonia radiata* is the dominant macroalgal species. Although *E. radiata* is also common at Owhiro Bay, Wellington, the plants are small and no canopy is formed (Choat and Schiel 1982).

Choat and Schiel (1982) also found dense stands of *Lessonia variegata* at Owhiro Bay. However, this species was only sparsely distributed in shallow water at Kapiti Island. Marine Consultants Ltd. (1975) also noted little *L. variegata* along Wellington's west coast.

Carpophyllum maschalocarpum and *C. flexuosum* were not differentiated in the results of the present survey. Nevertheless, it was observed that *C. maschalocarpum* generally occurred at or just below the sublittoral fringe, while *C. flexuosum* was more abundant in deeper waters. This is the typical zonation pattern for these two species (Adams 1972, Grace 1972, 1983, Morton and Miller 1973, Choat and Schiel 1982, Schiel 1984) and may account for the bimodal depth distribution of *Carpophyllum* at Transects J and K.

Competitive interactions between algae have been demonstrated by Lubchenco (1980). The increase in *Carpophyllum* cover as laminarian abundance declined towards the end of Transects G, L and M suggests that *Carpophyllum* and *Ecklonia radiata* may be competing for available space. However, further experimental work would be required to confirm this hypothesis and determine what factors, if any, influence competition between these species.

Grace (1972, 1983) found that *Ecklonia radiata* occurred at greater depths in clearer waters and concluded that zonation was dependent on light penetration. Shepherd and Womersley (1970) argued that the depth range of *E. radiata* is also related to water movement, with plants extending into deeper water in rougher conditions. The results of the present survey at Kapiti Island support these findings. Laminarian algae (principally *E. radiata*) generally occurred in shallower water along the eastern side of Kapiti Island. This area was noted for its relative shelter and high water turbidity.

Factors determining the upper limit of *Ecklonia radiata* are less obvious. Competition with other algae, low tolerance to high wave action, photosynthetic inhibition and grazing pressure have all been postulated (Chapman 1966, Choat and Schiel 1982).

Grazing by sea urchins has been shown to have a major impact on community structure in New Zealand waters (Dromgoole 1964, Ayling 1978, 1981, Choat and Schiel 1982, Grace 1983, Schiel 1984) as well as overseas (Vance 1979, Chapman 1981, Miller 1985). In north-eastern New Zealand, large areas of reef devoid of macroalgae occur due to intensive grazing by kina (*Evechinus chloroticus*). These cleared coralline flat areas usually define the upper boundary of deep water *Ecklonia radiata* forests (Choat and Schiel 1982, Grace 1983). Although kina were locally abundant at some sites around Kapiti Island, numbers were low compared with north-eastern New Zealand (see Choat and Schiel 1982) and only a few small areas of reef cleared by kina grazing occurred. Choat and Schiel (1982) also noted few kina at Owhiro Bay, Wellington, and found no reef areas denuded of large macroalgae.

Subtidally, adult kina are generally conspicuous (Dix 1970), preferring open territory to the more confined kelp forest habitat (Ayling 1978, Choat and Schiel 1982, Grace 1983). The distribution of kina around Kapiti Island conforms with this pattern; kina were most abundant along the eastern side of the island, a region noted for its relatively sparse weed bed.

Although few rock lobsters (*Jasus edwardsii*) were encountered during this survey, they are taken frequently from Kapiti's waters by amateur divers. Rock lobsters are known to occur throughout the year around the island but are most abundant inshore over late summer and autumn (S. Heyward, Kapiti Boating Club, pers. comm.).

The high densities of paua (*Haliotis iris*) which occur around Kapiti Island are typical of a rocky coastline in the Wellington region (MAFFish unpublished data). However, unlike the paua beds closer to Wellington, few specimens observed at Kapiti Island exceeded the minimum legal size of 125mm shell length. The abundance of paua at Kapiti island emphasises the ecological importance of this grazing mollusc in the subtidal zone.

Other grazing molluscs were rare at Kapiti Island. Choat and Schiel (1982) also found very few grazing gastropods at Owhiro Bay, Wellington. These Kapiti Island and Owhiro Bay data contrast with the high numbers of gastropod grazers that occur off north-eastern New Zealand, particularly over open coralline flats (Ayling 1981, Choat and Schiel 1982). The absence of a similar coralline flat habitat at Kapiti Island may contribute to the lower numbers of grazing molluscs (except paua) found around the island.

Coelenterates are sedentary carnivores and therefore rely on water movements to deliver their prey. An increase in water movement should increase the frequency of prey capture. This may help account for the greater abundance of coelenterates in areas subjected to strong tidal currents or to wave turbulence.

Most sponges and ascidians are usually found in rocky habitats which are free of algae. Hence, they are usually abundant in deep waters where light intensities are insufficient to support a dominant algal community. Off North Taranaki, high water turbidity suppresses algal growth even in relatively shallow water and a diverse sponge fauna is found (Taranaki Catchment Commission 1985, Sugar Loaf Islands Steering Committee 1986). This Kapiti Island study was restricted to depths less than 15 m and therefore any deep water communities that may exist beyond the algae dominated zone were not surveyed.

Highly shaded reef habitats, for example vertical rock faces, overhangs, archways and caves, usually support a prolific and diverse community of colonial animal species. However, such areas were limited in their extent at Kapiti and algae generally dominated the boulder-rock reefs. *Cliona celata* was the only sponge to occur regularly over the upper reef surfaces at Kapiti Island. This species is known from a wide variety of habitats throughout New Zealand (Morton and Miller 1973, Pritchard and Ward 1984).

5.2 Fish

Fish abundance is often very difficult to estimate because of fish mobility and behavioural factors such as schooling, territoriality and habitat preferences (Kimmel 1985). Visual census techniques are frequently used to investigate fish abundance in coastal reef habitats (Russell 1977, Willan *et al.* 1979, Leum and Choat 1980, Jones 1984a, b, c), particularly coral reefs (Sale and Douglas 1981, Williams 1982, Russ 1984a, b, Kimmel 1985). However, these methods rarely sample all fish at a site since many of the cryptic or nocturnal species are overlooked (Sale and Douglas 1981, Kimmel 1985). Further, visual techniques may also produce erroneous results for many schooling or transient species because schools can be large and the occurrence of these fish in a sample will often be infrequent and largely dependent on chance. Nevertheless, as long as these limitations are recognised and the results interpreted accordingly, visual census methods can yield valuable information on the distribution and abundance of fish species.

The species of fish found at Kapiti Island were similar to those noted by Marine Consultants Ltd. (1975) for the west coast of Wellington. The major exceptions were that goatfish, eagle rays and pelagic species were not recorded during the Wellington study while kelpfish (*Chironemus marmoratus*) were not seen at Kapiti.

Several pelagic schooling species were noted at Kapiti Island. Garfish, jack mackerel, kahawai, kingfish and yellow-eyed mullet were seen only occasionally, though in large schools for most of these species. The results for these species must therefore be viewed with caution. Kahawai were only censused from the eastern reef habitat. However, at various times throughout the study and at a number of locations around Kapiti Island, several large schools of kahawai were observed from the surface. Further, although only one small school of kingfish was recorded, kingfish are known to occur in large numbers all around the island, particularly over the boulder bank (K. Michael, MAFFish pers. comm.). The occurrence of garfish and yellow-eyed mullet along the sheltered eastern side of Kapiti may be related to these species' preference for sheltered coastal waters (Ayling and Cox 1982, Paul 1986).

Butterfly perch, tarakihi and blue moki were also seen in schools. However, these species were encountered regularly and schools were generally small. Tarakihi and blue moki were also observed swimming individually. The results from the fish censuses are therefore probably a fair indication of the distribution and abundance of these species at Kapiti Island.

Marblefish, banded wrasse and red moki are cryptic species and it is likely that many individuals were therefore overlooked during the fish censuses. Hence, the data presented here probably underestimate the true densities of these species, particularly along the western side of the island where the weed bed is thickest.

Marblefish feed exclusively on algae (Russell 1983) and are generally most common in areas where algal growth is most profuse (Ayling and Cox 1982). Banded wrasse is also a weed dwelling fish. At Kapiti Island,

highest densities of these species would therefore be expected along the western side of the island. The absence of any significant relationship between habitat type and the abundance of these two species may have been caused by fish hiding amongst the dense weed bed and not being seen by the divers.

Leum and Choat (1980) found that red moki abundance increased with topographic complexity. This is understandable considering the cryptic habits of this species. The abundance data presented here for the three habitat types at Kapiti support the findings of Leum and Choat (1980).

Scarlet wrasse are less secretive than banded wrasse and generally occur over open rock reefs beyond the weed bed zone (Ayling and Cox 1982). The distribution of scarlet wrasse at Kapiti Island conforms with this pattern although numbers may have been slightly underestimated in the two weed bed (reef) habitats.

Butterfish is a common reef fish in the Wellington region (Ritchie 1969, Marine Consultants Ltd. 1975). At Kapiti Island, the butterfish diet of large brown algae (Ritchie 1969, Russell 1983) is reflected in this species' preference for areas of dense macroalgal cover. Butterfish densities were probably slightly underestimated in the two reef habitats since it is likely that some fish foraging within the weed bed would have been overlooked.

Ayling and Cox (1982) consider that the spotty is probably the most abundant of New Zealand's larger reef fish. Jones (1984b) determined spotty abundance at a large number of locations around the North Island. Although he found densities as high as 315/500 m² over shallow algal forest at Takatu Peninsula, north-eastern New Zealand, estimates at most other sites were less than 50/500 m². Densities at Kapiti Island exceeded 121/500 m² (assuming each fish census covered an area of 3000 m²; see section 2.2). Therefore, spotties are very abundant at Kapiti compared with most other North Island areas. It is interesting to note that the habitat type at Takatu Peninsula (very dense bed of *Carpophyllum flexuosum* and *Ecklonia radiata* in shallow water) closely resembles that found at Kapiti Island.

Blue cod were also found in relatively high densities at Kapiti. However, this species is attracted to divers and double counting may have occurred. Hence, abundance was probably slightly overestimated. Nevertheless, blue cod was clearly the second most abundant of the larger reef fish at Kapiti Island. Rapson (1956) cites Kapiti Island as having the greatest densities of blue cod north of Cook Strait. The observed distribution of blue cod at Kapiti is typical for this species (Ayling and Cox 1982, Paul 1986).

The distribution of goatfish at Kapiti reflected the feeding habits of this species. Goatfish forage over sandy bottoms adjacent to reef areas for small invertebrates, primarily crustacea (Russell 1983). The distribution of eagle ray may also be feeding related. One of its preferred prey species, the Cook's turban shell (Russell 1983), was present along the eastern side of the island. Further, small patches of sand were common within the eastern reef habitat; eagle rays are known to return to such areas to consume their prey (Ayling and Cox 1982).

5.3 Preliminary Classification of Kapiti Island's Subtidal Zone

The subtidal environment around Kapiti Island can be broadly grouped into three major regions on the basis of habitat type and the distribution and abundance of marine life. The features which distinguish each of these regions are detailed below. This classification is based solely on the results of the present study and therefore only relates to waters shallower than about 15 m.

i. Eastern Region

Location: from Kurukohatu Point to Tahiririmongo Point

Distinguishing features:

- a. Physical
 - narrow boulder-rock reef, interspersed with small sand patches
 - sand and silt prevalent
 - sand-gravel bed below about 7-10 m
 - strong tidal currents, particularly in the vicinity of Passage Rocks
 - sand scour ubiquitous
 - water clarity relatively low
 - sheltered.
- b. Biological
 - moderate covering of macroalgae (fucoid and laminarian algae) on the boulder-rock reef
 - benthic species diversity generally low
 - spotties very abundant; eagle rays common in shallow water; goatfish, scarlet wrasse, blue cod and tarakihi abundant along the margin of the weed bed.

ii. Boulder Bank

Location: Kurukohatu Point to Tokahaki Point

Distinguishing features:

- a. Physical
 - extensive reef of rounded boulders
 - little sand
 - strong tidal currents
 - water clarity high
 - semi-exposed.
- b. Biological
 - area dominated by very dense bed of macroalgae over the boulder reef.
 - algal species diversity relatively high
 - sponges uncommon.
 - (fish species were not censused in this region, but fish assemblages would be expected to be similar to those found to the west of Kapiti; kingfish are known to be common.)

iii. Western Region

Location: from Tokahaki Point, along the western side of Kapiti to Tahiririmongo Point.

Distinguishing features:

- a. Physical
 - extensive reef of boulders (often very large) and rock
 - little sand

- sand-gravel bed below about 15-20 m
- areas dominated by large blocks of rock occur off points and headlands, particularly Arapawaiti Point and to the south-west of Kapiti
- relatively strong tidal currents off points and headlands
- water clarity high, especially towards the north of the region
- exposed.

b. Biological

- area dominated by very dense bed of macroalgae over the boulder-rock reef
- algal species diversity relatively high
- sponges abundant in localised areas, particularly where topography is complex
- spotties very abundant; butterfly, butterfly perch and red moki relatively common.

(7)

(7)

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APPENDIX 1 : Intertidal survey

In 1968, J. McKoy, D. Cross, G. Byers, and K. Nairn from Victoria University carried out a brief survey of the intertidal zone at Kapiti Island. The results of this study were documented in an unpublished report (McKoy 1968) and are summarised here with permission from the author.

Five transects were surveyed around the north-eastern end of the island, usually down to extreme low water springs (Fig. 1). A one metre wide strip along each transect was inspected for species present.

Two broad habitat types were studied;

1. Rock faces (Figs 2a-c)

Transect 1

Transect 1 had a slightly more northerly aspect than the other two rockface transects. The bushline was approximately 20 metres above sea level. The upper parts of the rock face were covered with grass, mosses, and lower down, lichens.

Transect 2

Transect 2 was perhaps less exposed than transect 1 because of sheltering rocks and shallower water at the base of the rock face. The bushline was 6-7 metres above sea level, and freshwater seepage was apparent. Nests of the small blue penguin (*Eudyptula minor*) were found.

Transect 3

This transect was similar to transect 2. A large freshwater outlet had a noticeable effect on the distribution and abundance of some organisms.

2. Boulder beaches (Figs. 3a, b).

Transect 4

This transect was over a beach of large boulders at the north-eastern end of the island. Tidal pools occurred towards the bottom of the transect.

Transect 5

Transect 5 was over a beach comprising small boulders, gravels, and coarse sand. Outcrops of rock occurred below mean high water springs.

The species found along each transect are listed below -

	COMMON NAME (where known)	TRANSECT				
		1	2	3	4	5
PHYLUM PHYCOPHAETA						
Division Chlorophyta						
	Green algae					
	<i>Codium adhaerens</i>					*
	<i>Ulva</i> sp.	*	*	*		
Division Phaeophyta						
	Brown algae					
	Flapjack	*		*	*	
	<i>Cystophora scalaris</i>					*
	<i>Cystophora torulosa</i>	*	*	*	*	*
	<i>Ecklonia radiata</i>	*				
	<i>Hormosira banksii</i>	*	*	*	*	*
	<i>Scytothamnus australis</i>	*	*	*	*	
	<i>Splachnidium rugosum</i>	*	*	*	*	
	<i>Zonaria angustata</i>					*
Division Rhodophyta						
	Red algae					
	<i>Cheilosporum</i> sp.					*
	<i>Corallina</i> encrustation	*		*	*	
	<i>Corallina officianalis</i>	*	*	*	*	*
	<i>Gelidium</i> sp.	*	*	*		
	<i>Lophurella caespitosa</i>		*			
	<i>Porphyra columbina</i>	*				
PHYLUM COELENTERATA						
Class Anthozoa						
	Anemones					
	Olive beadlet anemone			*	*	*
	Red waratah	*	*	*		*
	Disguised sea anemone; Kotoretore					*
	<i>Isoparactis ferax</i>					*
	Orange anemone (unidentified)	*			*	
	<i>Phlyctenactis tuberculosa</i>					*
PHYLUM ANNELIDA						
Class Polychaeta						
	Bristle-worms					
	<i>Eulalia microphylla</i>			*		*
	<i>Nereis ambiodonta</i>					*
	<i>Perinereis</i> sp.					*
	<i>Phascolosoma annulatum</i>					*
	<i>Pomatoceros caeruleus</i>	*	*	*	*	*
	<i>Spirorbis australis</i>				*	
	Unidentified eunicid					*
	Unidentified syllids			*		*
PHYLUM NEMERTINEA						
	Orange nemertine					*

	COMMON NAME (where known)	TRANSECT				
		1	2	3	4	5
PHYLLUM MOLLUSCA						
Class Amphineura						
Chitons						
<i>Acanthochitona zelandica</i>	Tufted or bristle chiton	*				
<i>Amaurochiton glaucus</i>	Green chiton			*	*	
<i>Ischnochiton maorianus</i>	Variable or active chiton	*		*		
<i>Ischnochiton</i> sp.					*	
<i>Chiton pelliserpentis</i>	Snakeskin chiton		*	*	*	
Unidentified chitons				*		
Class Gastropoda						
Univalves (snails and slugs)						
Subclass Prosobranchia						
Shelled marine gastropods						
<i>Anisodiloma lugubris</i>				*	*	
<i>Atalacmea fragilis</i>	Fragile limpet			*	*	
<i>Cantharidus purpuratus</i>		*				
<i>Cellana denticulata</i>		*	*	*	*	
<i>Cellana ornata</i>	Ornate limpet; mitimiti	*	*	*		
<i>Cellana radians</i>	Radiate limpet; mitimiti		*	*	*	
<i>Cookia sulcata</i>	Cook's turban shell; pupu	*				
<i>Estea simplicata</i>					*	
<i>Estea zosterophila</i>					*	
<i>Haliotis australis</i>	Yellowfoot paua	*		*		
<i>Haliotis iris</i>	Paua	*		*	*	
<i>Haustrum haustorium</i>	Dark rockshell; pupu			*	*	
<i>Lepsiella scobina</i>	Oyster borer	*	*	*	*	
<i>Melagraphia aethiops</i>	Spotted topshell			*	*	
<i>Littorina cincta</i>		*	*	*	*	
<i>Littorina unifasciata</i>		*	*	*	*	
<i>Micrelenchus dilantatus</i>					*	
<i>Neothais scalaris</i>		*	*	*	*	
<i>Notoacmea daedala</i>				*	*	
<i>Patelloidea</i> sp.		*				
<i>Risellopsis varia</i>			*	*	*	
<i>Rissoina chathamensis</i>					*	
<i>Trochus viridis</i>		*				
<i>Turbo smaragdus</i>	catseye			*	*	
<i>Zediloma atrovirens</i>				*	*	
Subclass Opisthobranchia						
Sea slugs						
<i>Onchidella nigricans</i>		*		*		
Subclass Pulmonata						
<i>Benhamina obliquata</i>				*		
<i>Hiatella australis</i>					*	
<i>Leucanopsis obsoleta</i>				*		
<i>Marinula filholi</i>				*	*	
<i>Siphonaria zelandica</i>	Siphon limpet	*	*	*	*	

	COMMON NAME (where known)	TRANSECT				
		1	2	3	4	5
Class Bivalvia	Bivalves		*			
<i>Aulacomya maoriana</i>		*	*	*	*	
<i>Modiolus neozelanicus</i>		*	*	*		
<i>Perna canaliculus</i>	Green lipped mussel; okutai; kuku	*	*	*		
PHYLUM ARTHROPODA						
Class Arachnida	Spiders, mites etc.				*	*
<i>Amaurobiodes maritima</i>					*	*
<i>Microtrombium</i> sp.		*				
Class Insecta	Insects					*
Ground beetle (unidentified)						*
Class Crustacea						
Subclass Cirrepedia	Barnacles					
<i>Chamaesipho brunnea</i>		*	*	*	*	
<i>Chamaesipho columna</i>	Columnar barnacle	*	*	*	*	
<i>Elminius plicatus</i>	Plicate barnacle	*	*	*		
<i>Tetraclita purpurascens</i>						*
Subclass Malacostraca	Shrimps, crabs, etc.					
Order Amphipoda						
Orange amphipod (unidentified)						*
<i>Talorchestia</i> sp.						*
White amphipod (unidentified)						*
Order Isopoda						
<i>Cirolana arcuata</i>						*
<i>Ligia novaezelandiae</i>						*
Order Decapoda						
<i>Alope spinifrons</i>						*
<i>Halicarcinus innominatus</i>	Pill box crab	*				
<i>Hemigrapsus edwardsii</i>	Common rock crab; papaka				*	*
<i>Heterozius rotundifrons</i>	Bighanded crab					*
<i>Ozius truncatus</i>	Black-finger crab					*
<i>Petrolisthes elongatus</i>	Half crab	*				*
PHYLUM ECHINODERMATA						
Class Asteroidea	Starfish					
<i>Allostichaster polyplax</i>	Dividing star					*
<i>Patiriella regularis</i>	Cushion star	*			*	

REFERENCES

- McKoy, J. 1968: A survey of three rocky shores on Kapiti Island - Easter 1968. Unpublished report, Zoology Department, Victoria University, Wellington.

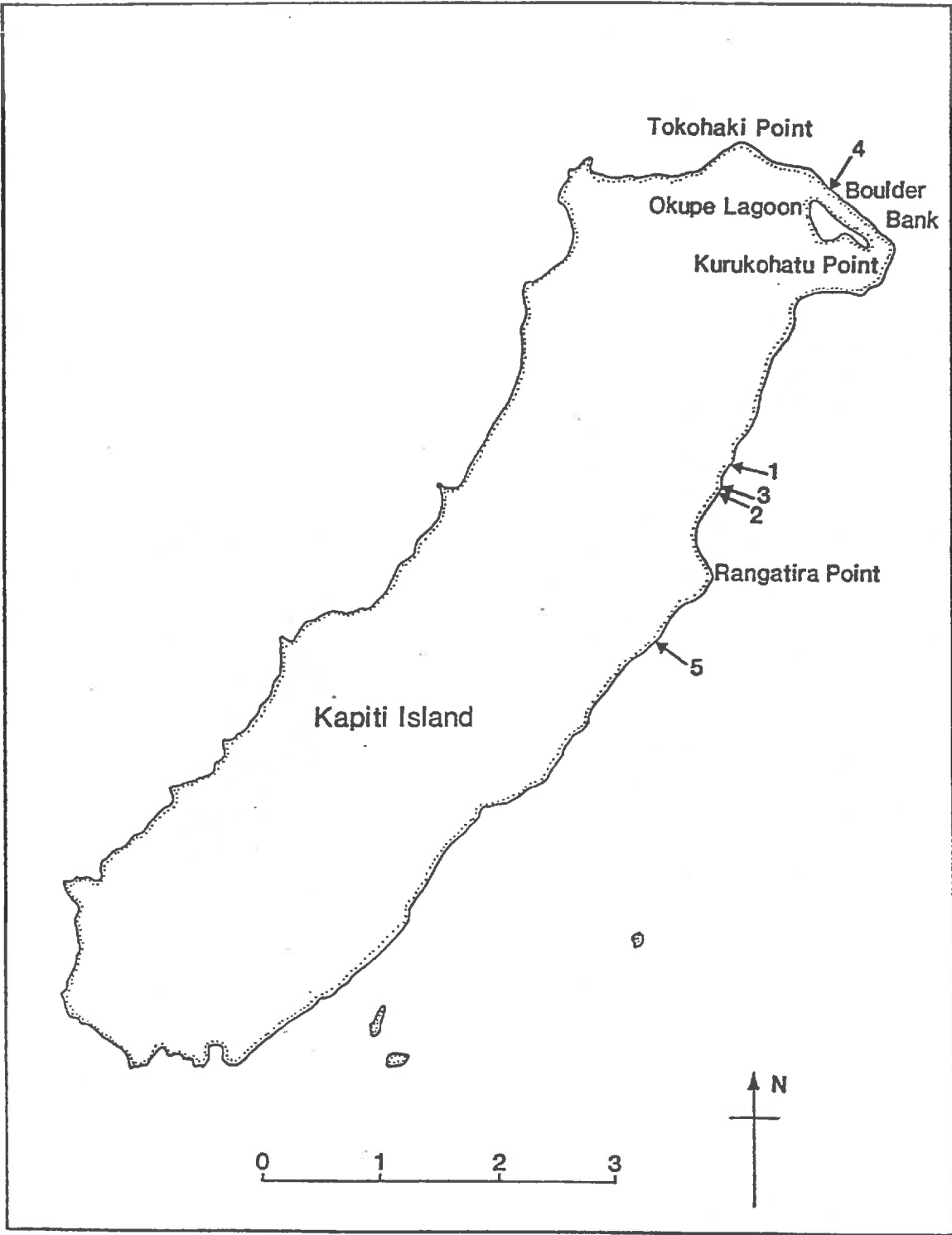


Fig. 1. Location of intertidal transects at Kapiti Island.

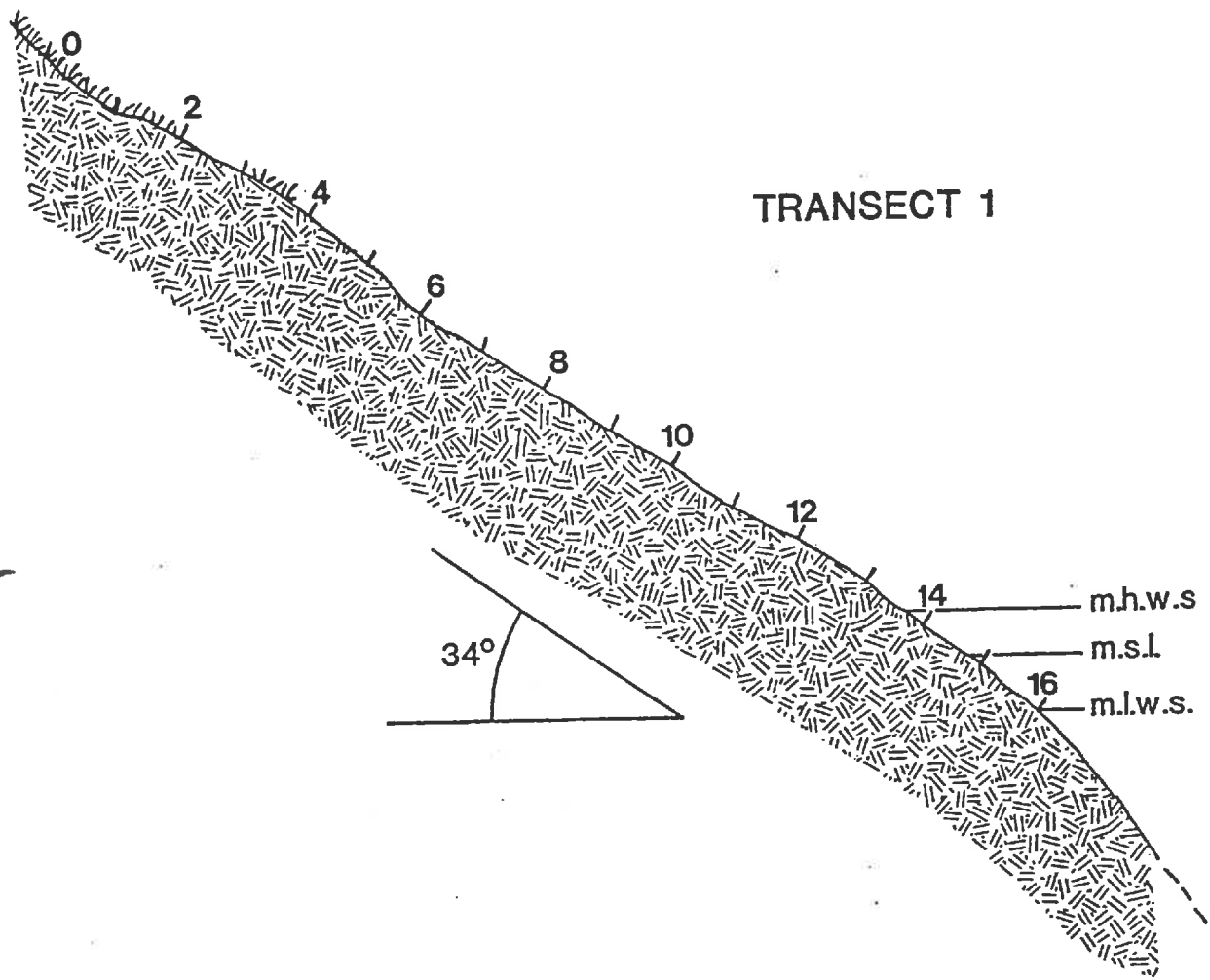


Fig. 2. Shore profile for Transect 1.

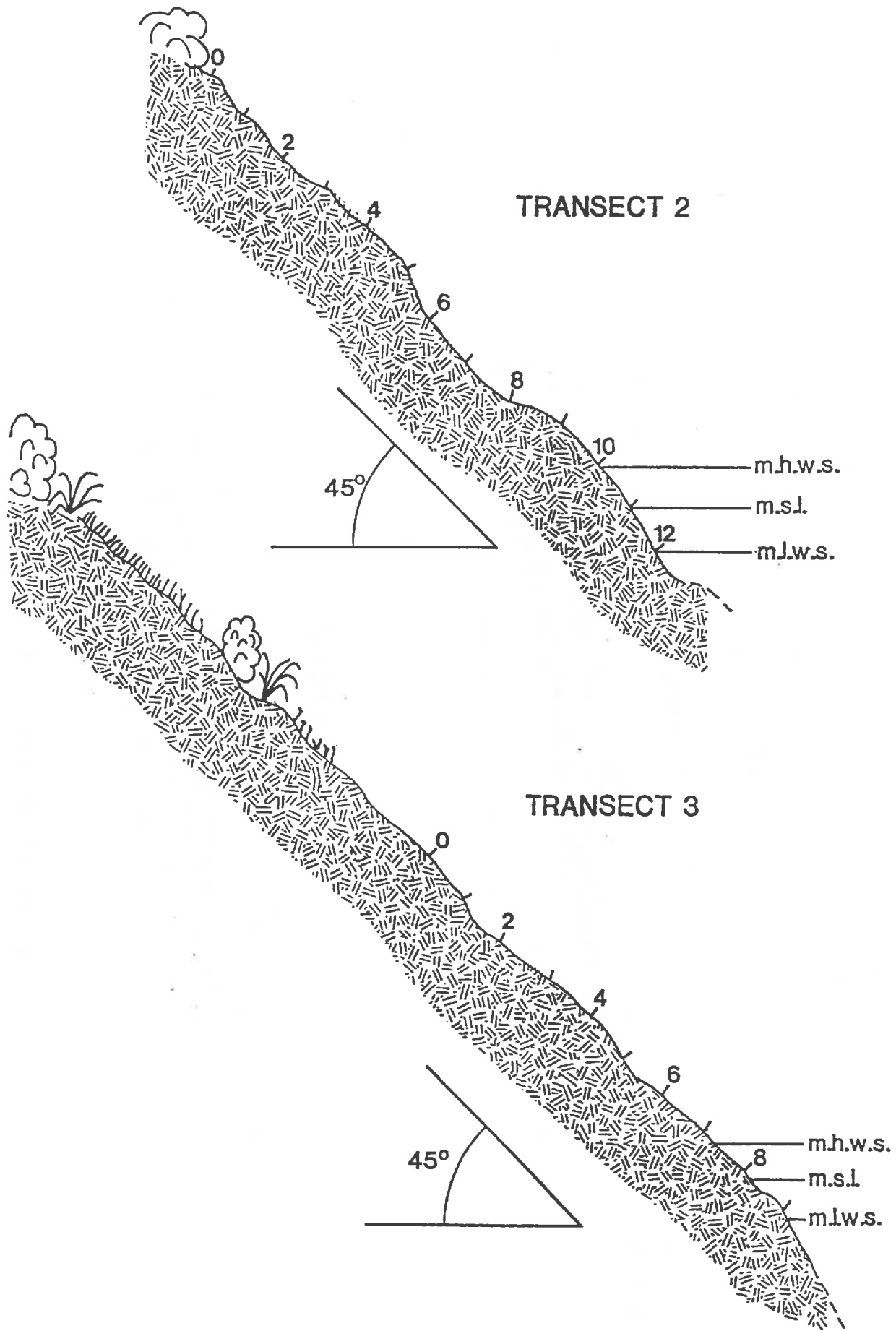


Fig. 3. Shore profiles for Transects 2 and 3.

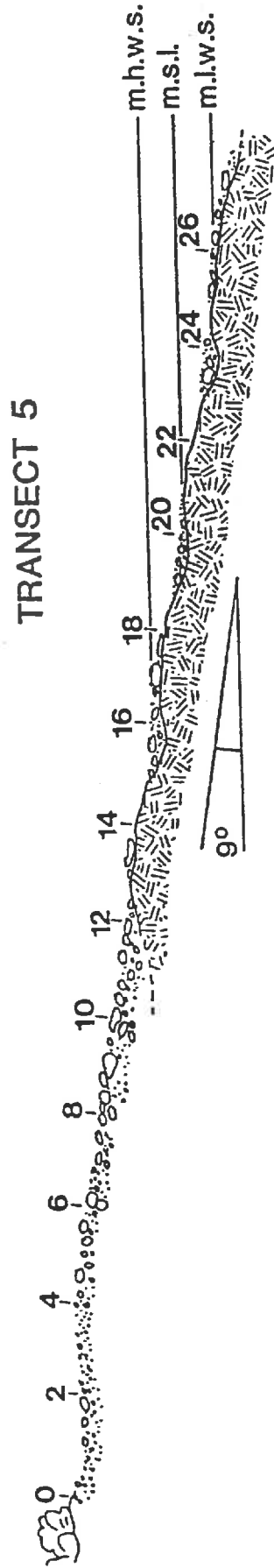
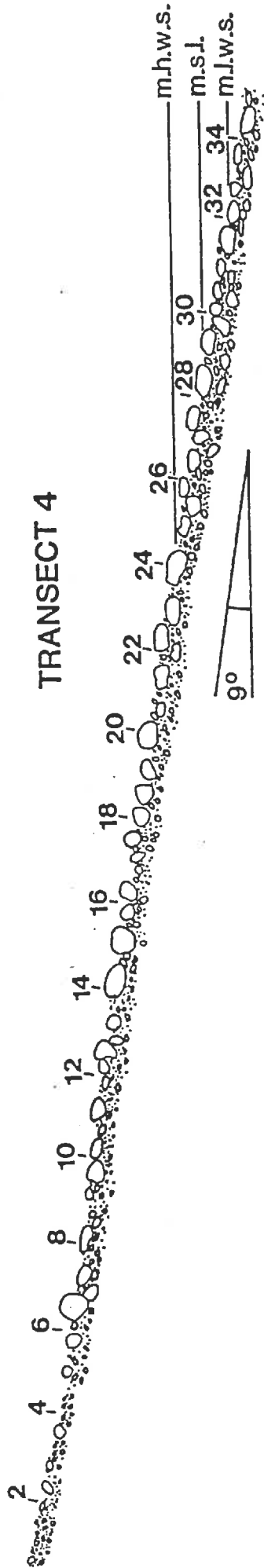


Fig. 4. Shore profiles for Transects 4 and 5.

SCIENTIFIC NAME

COMMON NAME

PHYLUM COELENTERATA

* Class Hydrozoa

Class Anthozoa

Actinothoe albocincta
Corynactis haddoni
Flabellum rubrum
Isocradactis magna
Parazoanthus sp.

Hydroids

Sea anemones, corals

Jewel anemone

Cup coral

Disguised sea anemone; kotoretore

PHYLUM MOLLUSCA

Class Amphineura

Eudoxochiton nobilis

Chitons

Noble chiton

Class Gastropoda

Subclass Prosobranchia

+ *Astraea heliotropium*
Cantharidus purpureus
Cookia sulcata
Haliotis iris
Maurea pellucida
Maurea punctulata
 † *Turbo granosus*
Turbo smaragdus
Xymene traversi

Univalves (snails and slugs)

Shelled marine gastropods

Circular saw shell

Cook's turban shell

Paua

Subclass Opisthobranchia

Glossodoris aureomarginata

Sea slugs

Class Cephalopoda

Sepioteuthis bilineata

Squid, octopi etc.

Broad squid

PHYLUM ARTHROPODA

Class Crustacea

Jasus edwardsii
Pagurus sp.
Plagusia capensis

Rock lobster

Hermit crabs

Red rock crab; papaka

*PHYLUM BRYOZOA

Bryozoans

PHYLUM BRACHIOPODA

Terebratella inconspicua

PHYLUM ECHINODERMATA

Class Holothuroidea

Stichopus mollis

Sea cucumbers

Sea cucumber

Class Echinoidea

Evechinus chloroticus

Sea urchins

Sea egg; kina

SCIENTIFIC NAME

COMMON NAME

PHYLUM ECHINODERMATA ctd.

Class Asteroidea

Patiriella regularis
Pentagonaster pulchellus
Stegnaster inflatus
Stichaster australis

Starfish
 Cushion star
 Jewel star
 Inflated cushion star
 Large reef star

Class Ophuroidea

Pectinura maculata

Brittle stars and snake stars
 Snake tail star

PHYLUM CHORDATA

Subphylum Urochordata

Class Ascidacea

Asterocarpa coerulea
Cnemidocarpa bicornuta
Didemnum candidum

Sea squirts

Subphylum Craniata

Aldrichetta forsteri
Aplodactylus arctidens
Arripis trutta
Caesioperca lepidoptera
Cheilodactylus spectabilis
 † *Chrysophrys auratus*
 † *Conger verreauxi*
 † *Forsterygion capito*
 † *Forsterygion varium*
 † *Forsterygion sp.*
 † *Forsterygion sp.*
 † *Gilloblennius decemdigitatus*
Helicolenus percoides
Hyporhamphus ihi
Latridopsis ciliaris
 † *Lotella rhacinus*
Myliobatis tenuicaudatus
Nemadactylus macropterus
Odax pullus
 † *Optivus elongatus*
Parapercis colias
Parika scaber
Pseudolabrus celidotus
Pseudolabrus fucicola
Pseudolabrus miles
Rhombosolea plebeia
Scorpius aequipinnis
Seriola lalandi
Trachurus spp.
Upeneichthys porosus

Higher cordates (e.g. fish)
 Yellow eyed mullet
 Marblefish
 Kahawai
 Butterfly perch
 Red moki
 Snapper
 Conger eel
 Common triplefin
 Variable triplefin
 Mottled triplefin
 Oblique swimming triplefin
 Long-finned triplefin
 Scarpee; jock stewart; sea perch
 Garfish
 Blue moki
 Rock cod
 Eagle ray
 Tarakihi
 Butterfish
 Slender roughy
 Blue cod
 Leatherjacket
 Spotty
 Banded wrasse
 Scarlet wrasse
 Sand flounder
 Sweep
 Kingfish
 Jack mackerel
 Goatfish

