THE HARD CORAL COMMUNITY OF A SARGASSUM-TYPE REEF IN SINGAPORE

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INTRODUCTION

The coral reefs of Singapore have been classified by Chuang (1977) as being *Sargassum* reefs on the basis of the very slight gradient of the reef flat and the predominance of the marine brown algae *Sargassum spp.* on the flat. This algae grows throughout the year and peaks at heights of approximately 1 metre just before the north-east monsoon in December and January. Wave action during the monsoon period will break up the algae leaving stubbles to continue growing and repeat the cycle.

Studies on the scleractinian corals on the reefs of Singapore have so far been descriptive eg. Goh (1963), Poon (1963), Chuang (1973), Chan (1979). Reference collections of local corals have been made by Purchon (1956) and Chuang (1961). This investigation is aimed at describing quantitatively in terms of species diversity and zonation patterns, the hard coral community of Pulau Salu (1° 13'N, 103° 44'E), one of Singapore's southern off-shore island 12 km from the mainland (fig.1).

MATERIALS AND METHODS

The fringing reef at Pulau Salu surrounds the entire island and the reef flat is more extensive on the north-eastern part. Two vertical transects, A and B (fig.2) were established and the contiguous quadrat method (Maragos, 1974) was used. Each transect was marked by short iron rods driven into the sea bed at 10 metre intervals. A one-metre quadrat, subdivided into a grid of 100 equal-sized squares (each square being 10 cm^2 in area), was used in sampling along one side of the transect line beginning from the shore to the bottom of the reef slope.

For corals with flat, horizontal growth forms (eg. *Montipora, Acropora*), the surface area was estimated directly from the quadrat. For corals with massive globular growth forms (eg. *Diploastrea*) the depth was recorded to give a more accurate reading of surface area.

Results obtained from the transects were pooled and used for calculating the percentage cover of each coral species within a zone. The zone was named after the dominating coral species which constituted at least 25% of the total coral cover of that zone. In instances where there were two coral species exceeding the 25% limit, the zone was named after both. Since live coral coverage on the reef flat was very poor, every 20 metres was considered as a zone. At the reef edge and reef slope, the

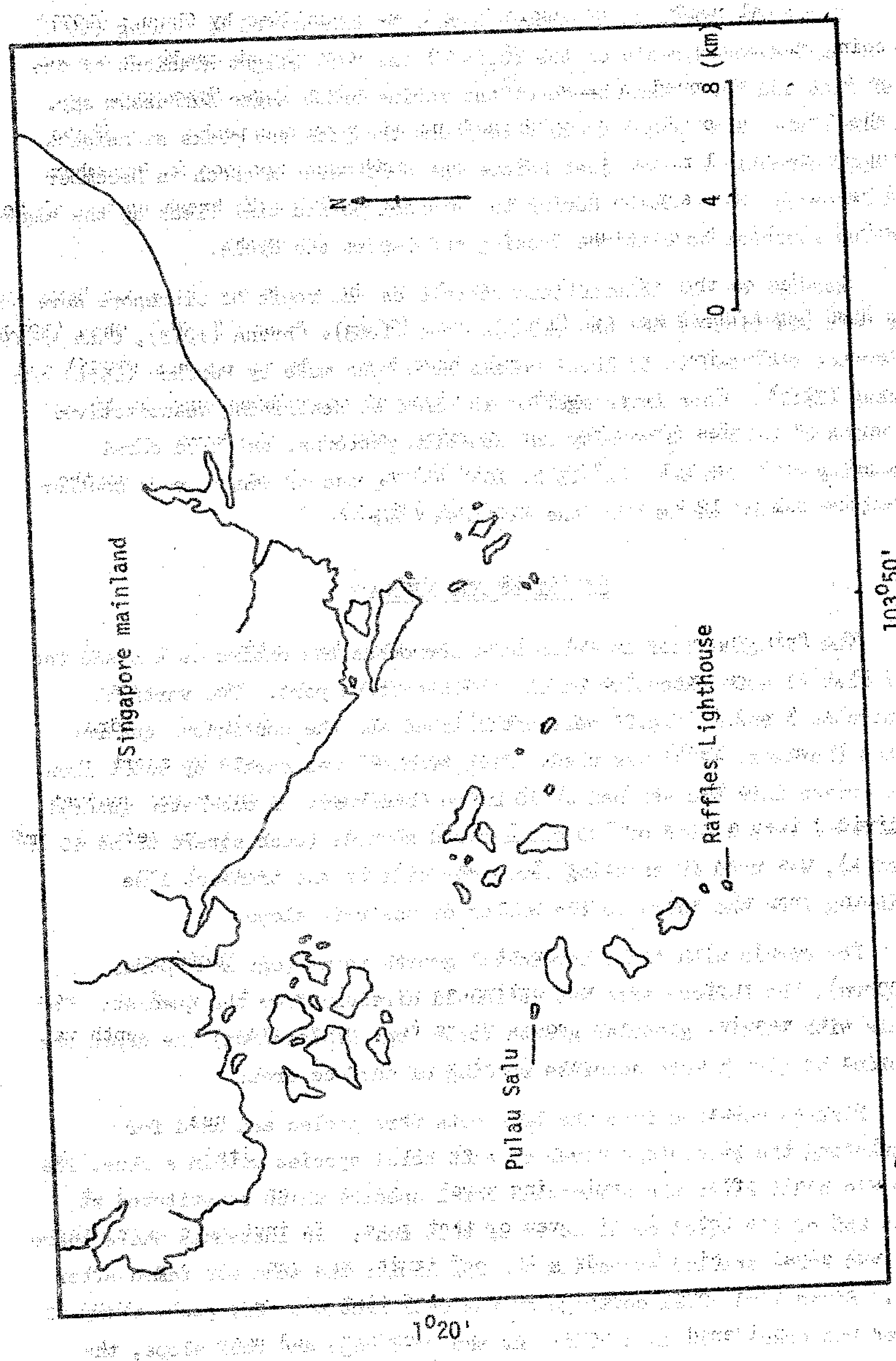

Fig.1. The southern islands of Singapore showing location of Pulau Salu.

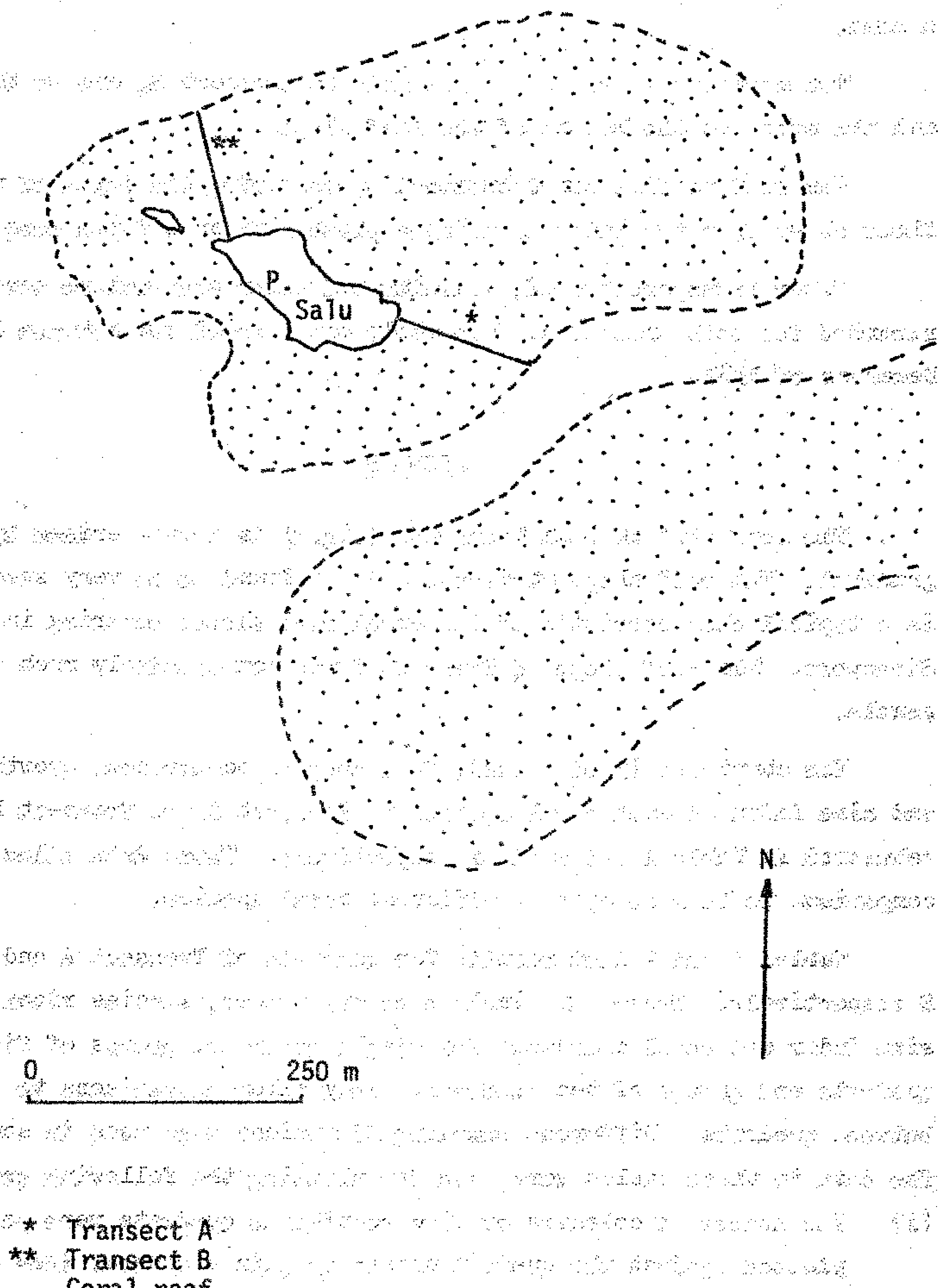

Fig.2. Figure showing coral reef around P. Salu and position of transects.

zone size was reduced depending on their lengths. For transect A, every 8 metres was considered a zone for both reef edge and reef slope. For transect B, the edge and slope were each considered separately as a zone.

Two horizontal transects were made at transect B, one at the top and the other at the bottom of the reef slope.

The reef profile was determined by measuring the depth of the sea floor at every metre interval using a plumb line or a depth guage.

Water transparency, pH, salinity and water temperature were recorded for both transects. The study was carried out between July and December of 1981.

RESULTS

The reef flat at both transects (fig.3) is characterised by a small gradient. The reef slope at Transect A was found to be very steep and is a typical characteristic of the coral reef slopes occuring in Singapore. The reef slope of Transect B was comparatively much more gentle.

The abundance (% of cover), frequency of occurrence, growth forms and size index of each coral species in Transect A and Transect B were tabulated in Table 1 and Table 2 respectively. These data allow comparison to be made between different coral species.

Tables 3 and 4 list results for quadrats of Transect A and Transect B respectively. These data include colony number, species richness, size index and coral abundance for single quadrats, groups of five quadrats and groups of ten quadrats. They allow comparisons to be made between quadrats. Different sampling dimensions were used in some cases. The data in these tables were used for plotting the following graphs:

(i) The number of colonies of five contiguous quadrats were pooled and plotted against the quadrat number to gain a general idea of the coral distribution on the reef in fig. 4.

(ii) The size index for quadrats were plotted against the transect location for comparing the colony size between quadrats (figs. 5 and 6).

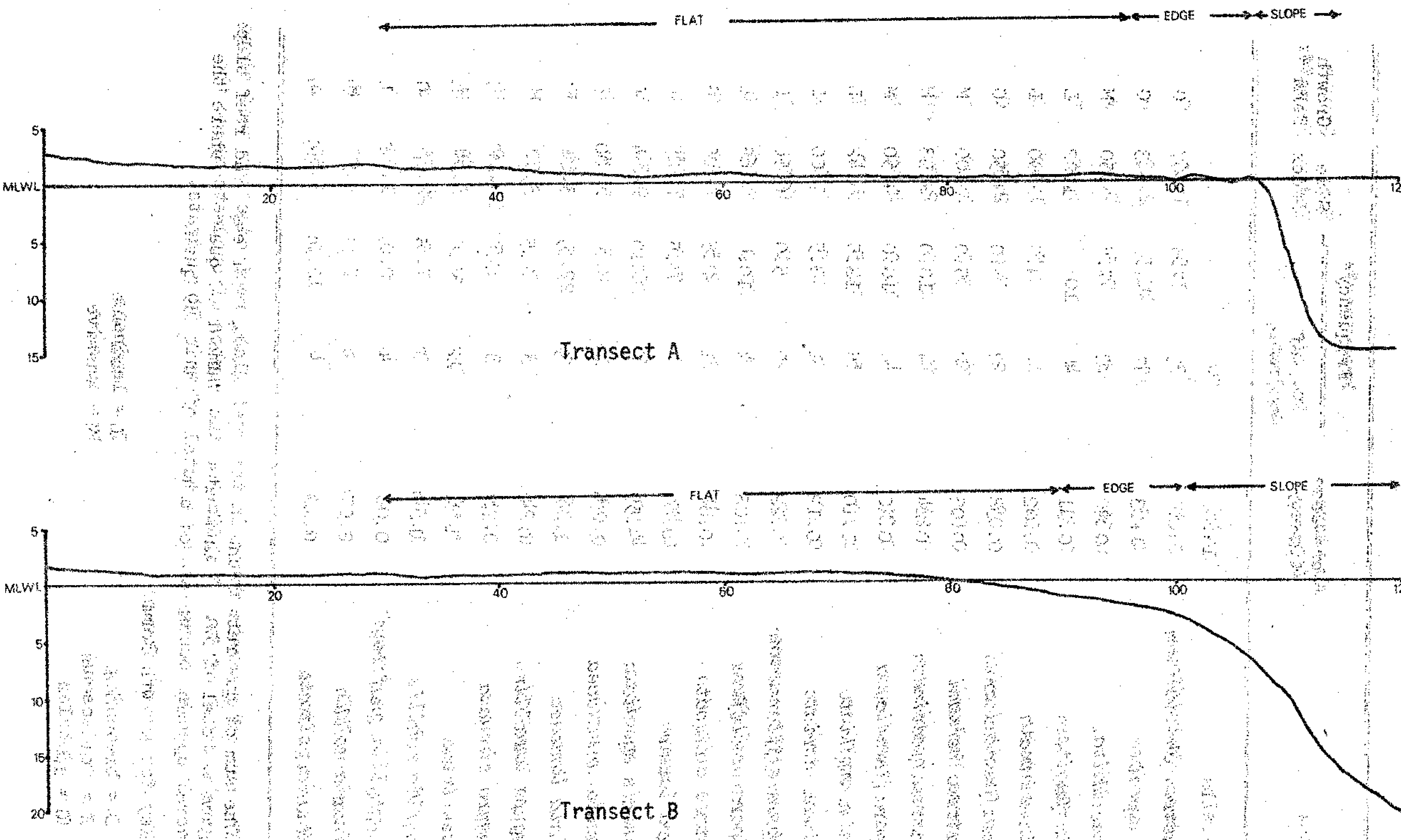

Fig.3. Reef profiles of transects.
(MLWL = mean low water level; all measurements in metres)

Table 1. Abundance, distribution, frequency and growth forms of corals at Transect A (Pulau Salu) July to December 1981.

Species	Abundance % Cover	Frequency* No. of Quadrats	Frequency* %	Size Index	Growth Forms**
All corals	15.48	40			
Cyphastrea chalcidicum	0.08	3	7.5	1.67	G
Favia speciosa	1.23	17	42.5	2.13	G
Favites abdita	0.30	3	7.5	4.50	M
Fungia fungites	0.31	4	10	1.02	L
Fungia echinata	0.02	1	2.5	1.00	L
Galaxea fascicularis	0.08	2	5.0	2.50	G
Goniastrea benhami	0.03	2	5.0	1.00	M
Goniastrea pectinata	0.24	4	10.0	2.33	M
Gonipora fructicosa	0.30	4	10.0	4.50	M
Merulina ampliata	1.10	5	12.5	5.42	L
Montipora striata	0.12	1	2.5	7.00	L
Montipora efflorescens	0.22	2	5.0	6.50	L
Montipora prolifera	1.03	4	10.0	7.63	L
Oulastrea crispata	0.04	1	2.5	1.25	G
Oxypora lacera	0.49	3	7.5	7.25	L
Pachyseris speciosa	4.59	6	15.0	9.34	L
Podabasia crestacea	0.08	1	2.5	5.00	L
Pectinia lactuca	0.86	9	22.5	3.64	F
Platygyra lamellina	0.24	3	7.5	3.50	M
Plerogyra sinuosa	0.71	3	7.5	14.00	M
Porites lutea	1.56	12	30.0	3.68	M
Symphyllia nobilis	1.54	3	7.5	22.75	G
Trachyphyllia geoffroyi	0.08	4	10.0	1.00	L
Turbinaria mollis	0.07	1	2.5	4.00	M
Turbinaria peltata	0.10	4	10.0	1.50	L

* The sum of quadrats found in the reef flat, reef edge and reef slope gave a total of 59. * indicates the number of quadrats where the coral species occur out of a total of this 59 quadrats.

** Key for growth forms:

B = branching
F = foliaceous
G = globular
L = laminate
M = massive

Table 2. Abundance, distribution, frequency and growth forms of corals at Transect B (Pulau Salu) July to December 1981.

Species	Abundance % Cover	Frequency No. of Quadrats	Frequency %	Size Index	Growth Forms
All corals	6.48	47	57.3		
Acropora concina	0.02	1	1.2	1.5	B
Diploastrea heliopora	0.40	1	1.2	33.0	M
Cyphastrea chalcidicum	0.06	3	3.7	1.8	G
Favia speciosa	0.45	17	20.7	1.8	G
Favites abdita	0.08	9	11.0	0.6	M
Fungia fungites	0.05	2	2.4	0.7	L
Galaxea fascicularis	0.01	1	1.2	0.5	G
Goniathea benhami	0.02	1	1.2	2.0	M
Goniaetrea pectinata	0.18	3	3.7	5.0	M
Gonipora fructicosa	0.30	9	11.0	1.9	M
Gonipora lobata	0.04	2	2.4	0.9	M
Memlina ampliata	0.35	5	6.1	4.1	L
Montipora lavis	0.04	1	1.2	3.0	B
Montipora prolifera	0.32	6	7.3	3.3	L
Oulastrea crispata	0.12	3	3.7	2.0	G
Oxypora lacera	0.07	2	2.4	2.8	L
Pavona frondifera	0.35	3	3.7	7.1	L
Pachyseris speciosa	1.76	7	8.5	12.0	L
Podabasia crestacea	0.44	2	2.4	12.0	L
Pectinia lactuca	0.18	6	7.3	0.8	F
Platygyra lamellina	0.08	4	4.9	0.8	M
Plerogyra sinuosa	0.09	1	1.2	7.0	M
Polyphyllia talpina	0.01	1	1.2	0.5	M
Porites lutea	0.78	21	25.6	2.0	M
Porites negrescens	0.09	1	1.2	7.0	B
Psamocora contigua	0.15	8	9.8	1.1	F
Turbinaria mollis	0.06	2	2.4	2.5	M

Table 3. Tabulated Data of Transect A.
Colony number, Species richness, Size index and Coral abundance for single quadrats, groups of five quadrats and groups of ten quadrats; together with Shannon-Weaver Diversity Index and Evenness Index (Pielou) for groups of ten quadrats, are as follows:

Quadrat No.	Colony No.		Species Richness			Size Index	Coral Abundance % cover	D.I.*		E.I.**	
	1q.	5q.	1q.	5q.	10q.			5q.	10q.	5q.	10q.
56	1		1			2.0			0.04		0.06
57	1		1			1.0					
58	0	2	0	2	2***	0	0.6				
59	0		0			0					
60	0		0			0					
61	0		0			0					
62	0		0			0					
63	1	1	1	1	1	1.0	0.2			@	
64	0		0			0					
65	0		0		3	0			0.08		0.07
66	0		0			0					
67	2		1			4.0					
68	1	4	1	2		14.0	4.6				
69	1		1			1.0					
70	0		0			0					
71	1		1			2.0					
72	2		2			1.5					
73	1	4	1	2		3.0	1.6				
74	0		0			0					
75	0		0		3	0			0.11		0.1
76	0		0			0					
77	0		0			0					
78	2	2	1	1		11.5	4.6			@	
79	0		0			0					
80	0		0			0					
81	3		1			1.2					
82	2		1			2.0					
83	0	5	0	2		0	1.1	0.06		0.08	
84	0		0			0					
85	0		0		5	0			0.11		0.07

Table 3. (cont'd).

Quadrat No.	Colony No.		Species Richness			Size Index	Coral Abundance % cover	D.I.*		E.I.**	
	1q.	5q.	1q.	5q.	10q.			5q.	10q.	5q.	10q.
86	3		1			1.3					
87	1		1			2.0					
88	2	10	1	4		1.5	3.2	0.15		0.11	
89	1		1			2.0					
90	3		3			1.7					
91	1		1			1.0					
92	0		0			0					
93	3	4	2	3		2.0	1.4	0.07		0.06	
94	0		0			0					
95	0		0		6	0			0.14		0.08
96	1		1			1.0					
97	3		1			1.3					
98	3	14	1	6		1.3	4.8	0.21		0.12	
99	2		2			1.0					
100	5		4			2.6					
101	5		4			3.6					
102	7		4			2.2					
103	6	42	4	15		3.2	21.5	0.94		0.35	
104	14		6			3.9					
105	10		5		25	2.1			1.44		0.45
106	5		4			17.4					
107	9		6			7.0					
108	15		7	13		7.4	76.3	1.94		0.75	
109	13		6			4.7					
110	19		8			3.4					
111	20		5			5.1					
112	10		1			8.3					
113	11		7			2.4					
114	11		4			7.0					

* D.I. = Shannon-Weaver Diversity Index
** E.I. = Evenness Index (Pielou)
@ No data is given because when there is only one single species in the sample E.I. equal to infinity.
*** Reef flat starts from quadrat number 51, thus this value is calculated from quadrats number 51 to 60.

Table 4. Tabulated Data of Transect B.
Colony number, Species richness, Size index and Coral abundance for single quadrats, groups of five quadrats and groups of ten quadrats; together with Shannon-Weaver Diversity Index and Evenness Index (Pielou) for groups of ten quadrats, are as follows:

Quadrat No.	Colony No.		Species Richness			Size Index	Coral Abundance % Cover	D.I.*		E.I.**	
	1q.	5q.	1q.	5q.	10q.			5q.	10q.	5q.	10q.
31	9		4			1.2					
32	4		2			0.9					
33	0	17	0	6		0	3.5	0.17		0.078	
34	3		2			0.8					
35	1		1			0.5			0.15		0.07
36	0		0		8	0					
37	4	3				1.1					
38	5	12	3	6		1.1	2.2	0.12		0.067	
39	3		2			0.5					
40	0		0			0					
41	0		0			0					
42	0		0			0					
43	0	3	0	2		0	0.6	0.03		0.043	
44	2		1			1					
45	1		1		3	1			0.03		0.03
46	0		0			0					
47	0		0			0					
48	0	2	0	1		0	0.2	0.01			
49	0		0			0					
50	2		1			0.5					
51	2		2			0.7					
52	3		3			1.2					
53	2	10	2	7		0.8	1.5	0.09		0.046	
54	1		1			0.2					
55	2		2			0.5			0.05		0.03
56	1		1		7	0.5					
57	0		0			0					
58	0	1	0	1		0	0.1	0.01			
59	0		0			0					
60	0		0			0					
61	1		1			0.5					
62	0		0			0					
63	0	3	0	1		0	0.3	0.02			
64	0		0			0					
65	2		1			0.5			0.07		0.06
66	0		0		3	0					
67	4		2			1.6					
68	1	8	1	3		1	2.6	0.12		0.109	
69	1		1			1					
70	2		2			2.3					
71	0		0			0					
72	0		0			0					
73	0	1	0	1		0	0.1	0.01			
74	1		1			0.5					

Table 4. (cont'd).

Quadrat No.	Colony No. 1q.	Colony No. 5q.	Species Richness 1q.	Species Richness 5q.	Species Richness 10q.	Size Index	Coral Abundance % Cover	D.I.* 5q.	D.I.* 10q.	E.I.** 5q.	E.I.** 10q.
75	0		0			0			0.01		0.01
76	2		2		3	0.2					
77	0		0			0					
78	0	2	0	3		0		0.013		0.012	
79	0		0			0	0.2				
80	1		1			0.5					
81	0		0			0					
82	0		0			0					
83	4	7	3	4		0.65		0.05		0.036	
84	0		0			0	0.8				
85	3		2			0.5			0.03		0.02
86	0		0		4	0					
87	0		0			0					
88	1	1	1			0.9		0.01			
89	0		0			0	0.2				
90	0		0			0					
91	0		0			0					
92	0		0			0					
93	2		2			0.8	2.6	0.12		0.067	
94	3	10	2	6		2.0					
95	5		4		11	1.1			0.16		0.07
96	0		0			0					
97	1		1	8		6.0					
98	2	9	2			1.5	3.7	0.19		0.091	
99	2		2			1.0					
100	4		4			1.9					
101	4		3			12.0					
102	2		1			6.5					
103	7	30	7	15		5.0	30.8	1.04		0.384	
104	7		6			4.4					
105	10		7		20	2.7					
106	8		4			4.4			1.12		0.37
107	8		5			6.2					
108	11	40	7	13		2.1	45.5	1.19		0.464	
109	6		3			11.5					
110	7		4			2.1					
111	10		7			4.3					
112	5		3			2.8					

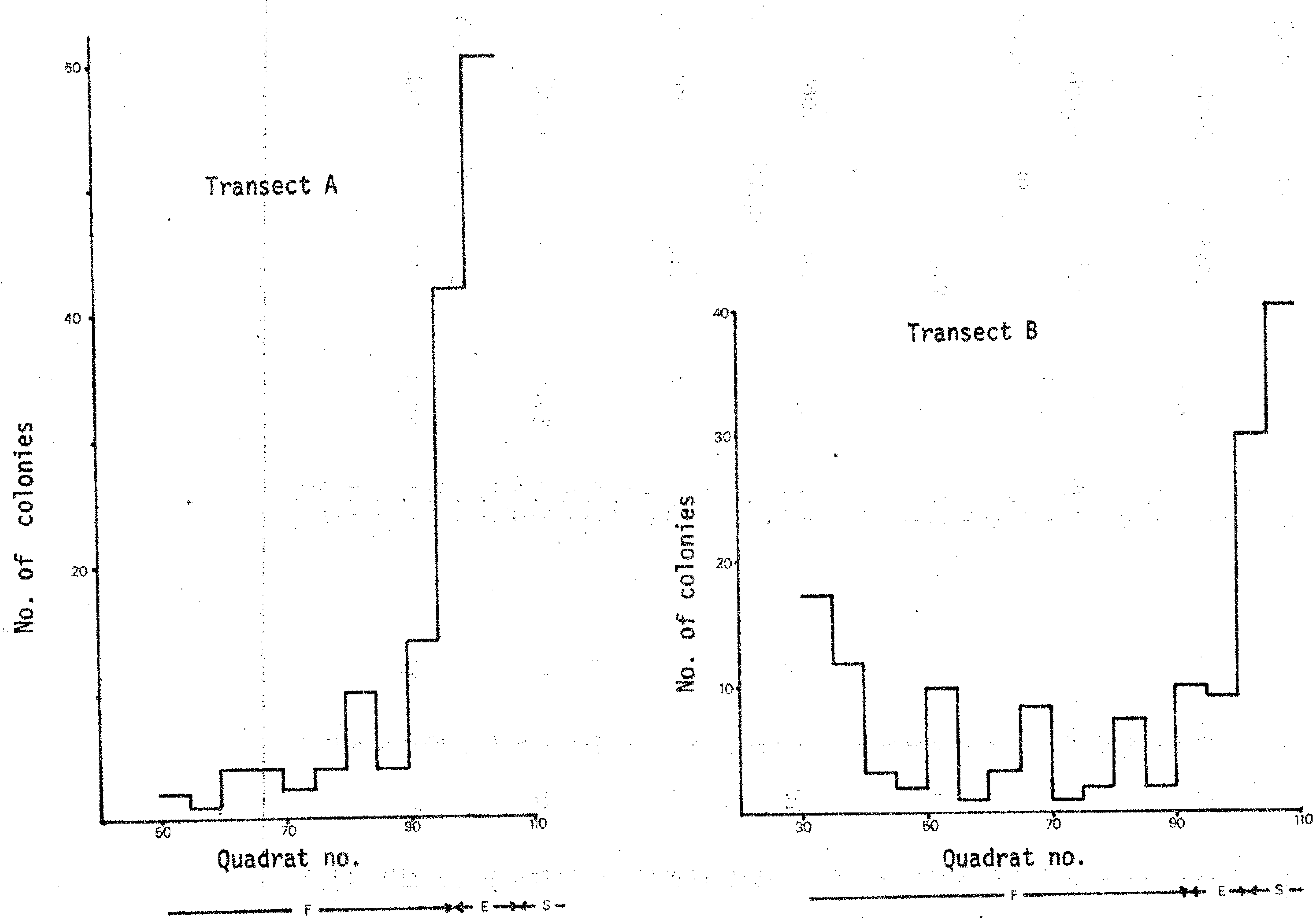

Fig.4. Number of colonies at 5 metre intervals along transects.
(F = flat, E = edge, S = slope)

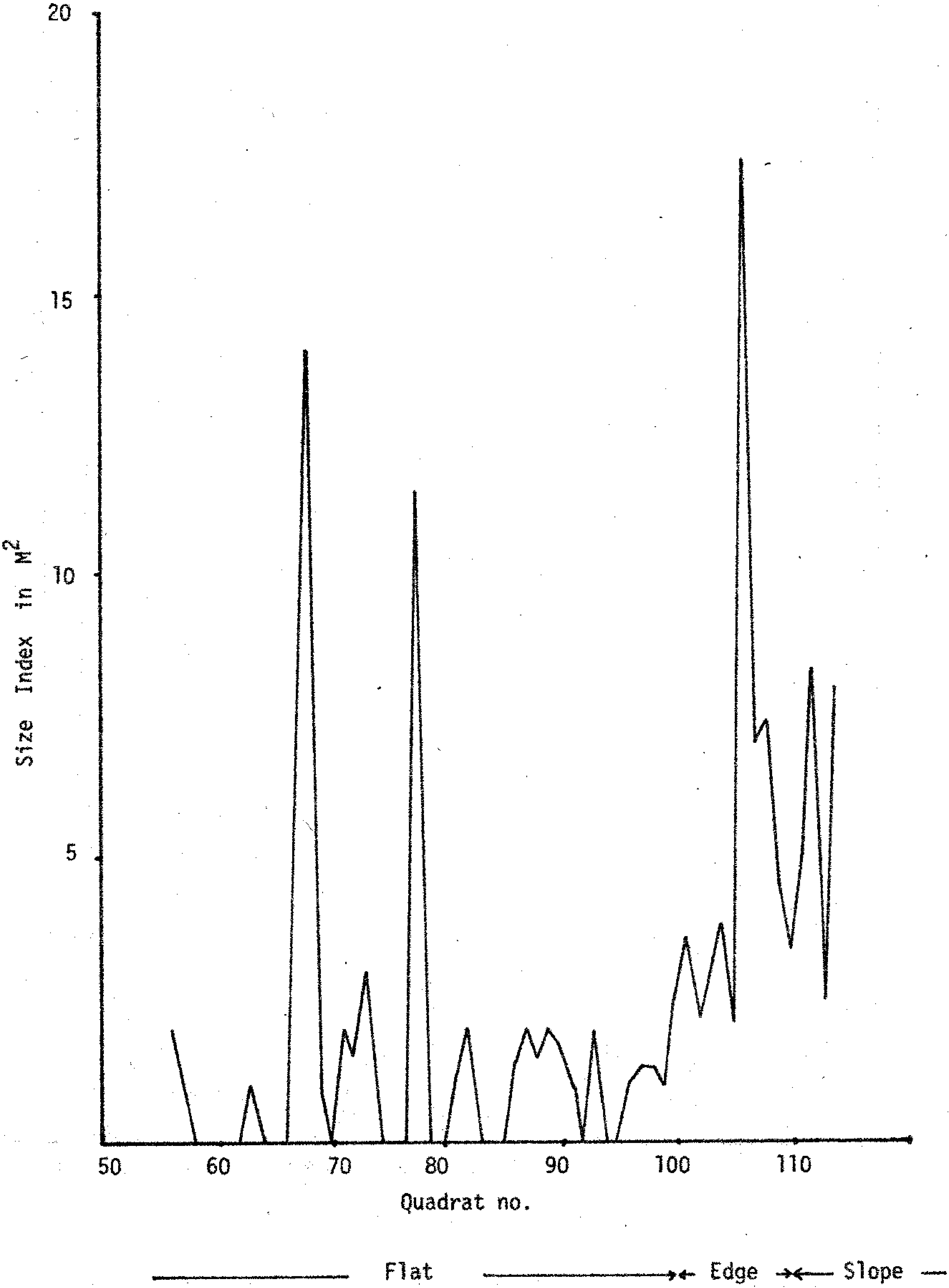

Fig.5. An estimate of average colony area (Size Index) plotted as a function of transect location (Transect A).

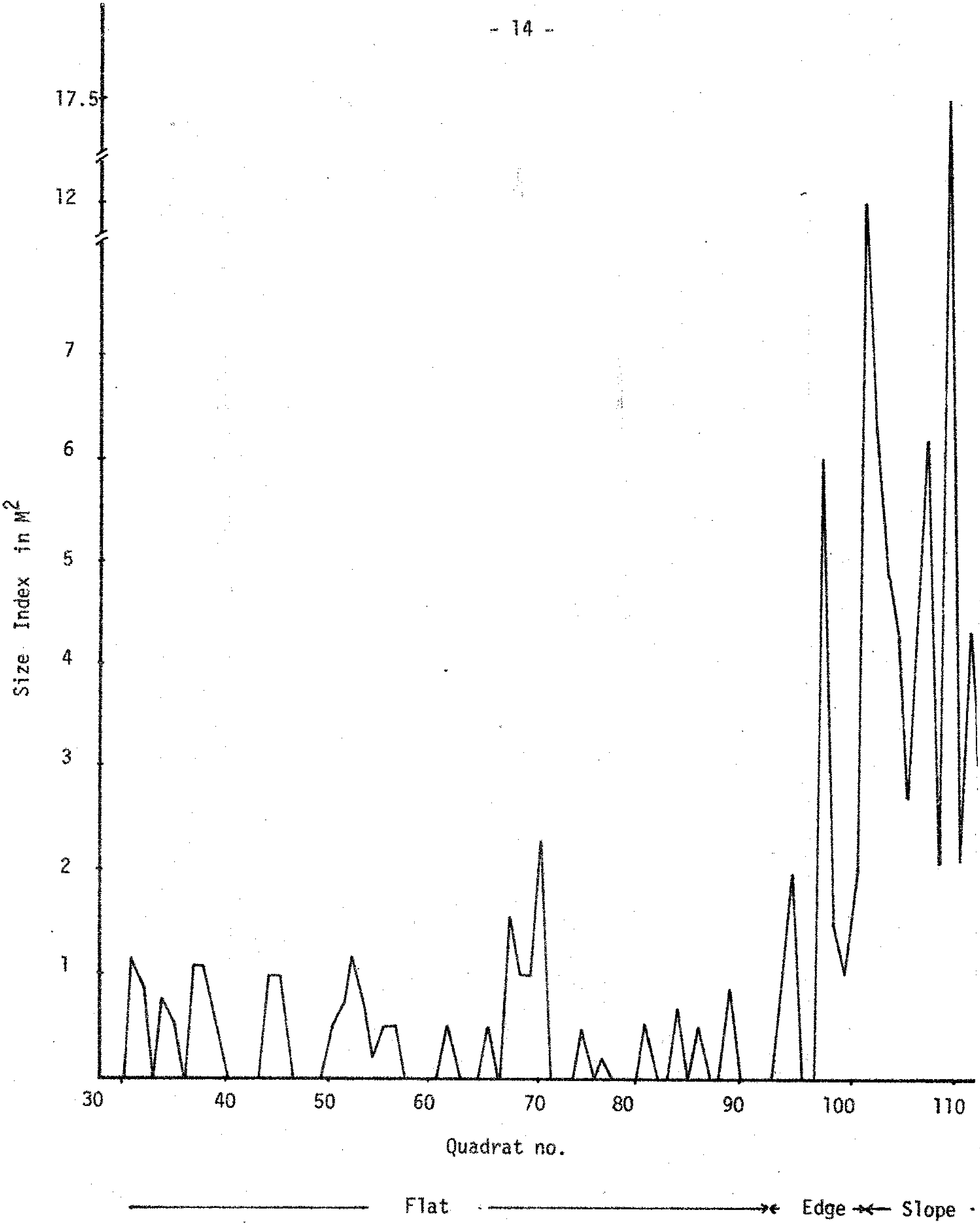

Fig.6. An estimate of average colony area (Size Index) plotted as a function of transect location (Transect B).

(iii) Species richness was plotted as a function of transect location for single quadrats, groups of five and groups of ten quadrats to indicate coral diversity (figs. 7 and 8).

(iv) The Shannon-Weaver diversity index together with the coral abundance (% cover of corals in the quadrat irrespective of species composition) were computed in groups of five quadrats and then plotted as a function of transect location in the same graph (figs. 9 and 10).

(v) Evenness Index (Pielou, 1966) plotted as a function of transect location for groups of ten quadrats for both transects is shown in fig.11.

Zonation models of Transect A and Transect B were constructed and shown in figs. 12 and 13 respectively.

From our observations of the reef slopes, it was concluded that in general, the average coral colony size is smaller at the bottom of the reef slope as compared to those at the top. To test this assumption, data obtained from the horizontal transects were used for statistical analysis using the 1-tailed t-Test. The null hypothesis is that there is no significant difference between the average size of a particular coral species inhabiting the bottom of the slope and those at the top of the slope. The alternative hypothesis is that the average colony size of a coral species at the bottom of the reef slope is indeed smaller than those at the top. The results of the t-Test are tabulated in Table 5.

DISCUSSION

Forty-two species of corals were found to be present on Pulau Salu reef. Twenty-five species (42.4%) were present on the 59 metre belt of Transect A and twenty-seven species (45.8%) were present on the 82 metre belt of Transect B. Nineteen coral species were common to both Transects A and B. Live coral coverage on both transects were low, being 15.4% on Transect A and 6.48% on Transect B. When compared with the live coral coverage of 32.9% obtained by Goh and Sasekumar (1980) at Cape Rachado, Malaysia, these results are indeed poor. When the live coral coverage for the reef flat, reef edge and the reef slope were compared, the figures were found to increase progressively from the landward reef flat to the seaward reef slope (Table 6). Live coral cover on the reef flat

Fig.7. Species richness plotted as function of transect location (Transect A) for single quadrats, for groups of five and ten quadrats.

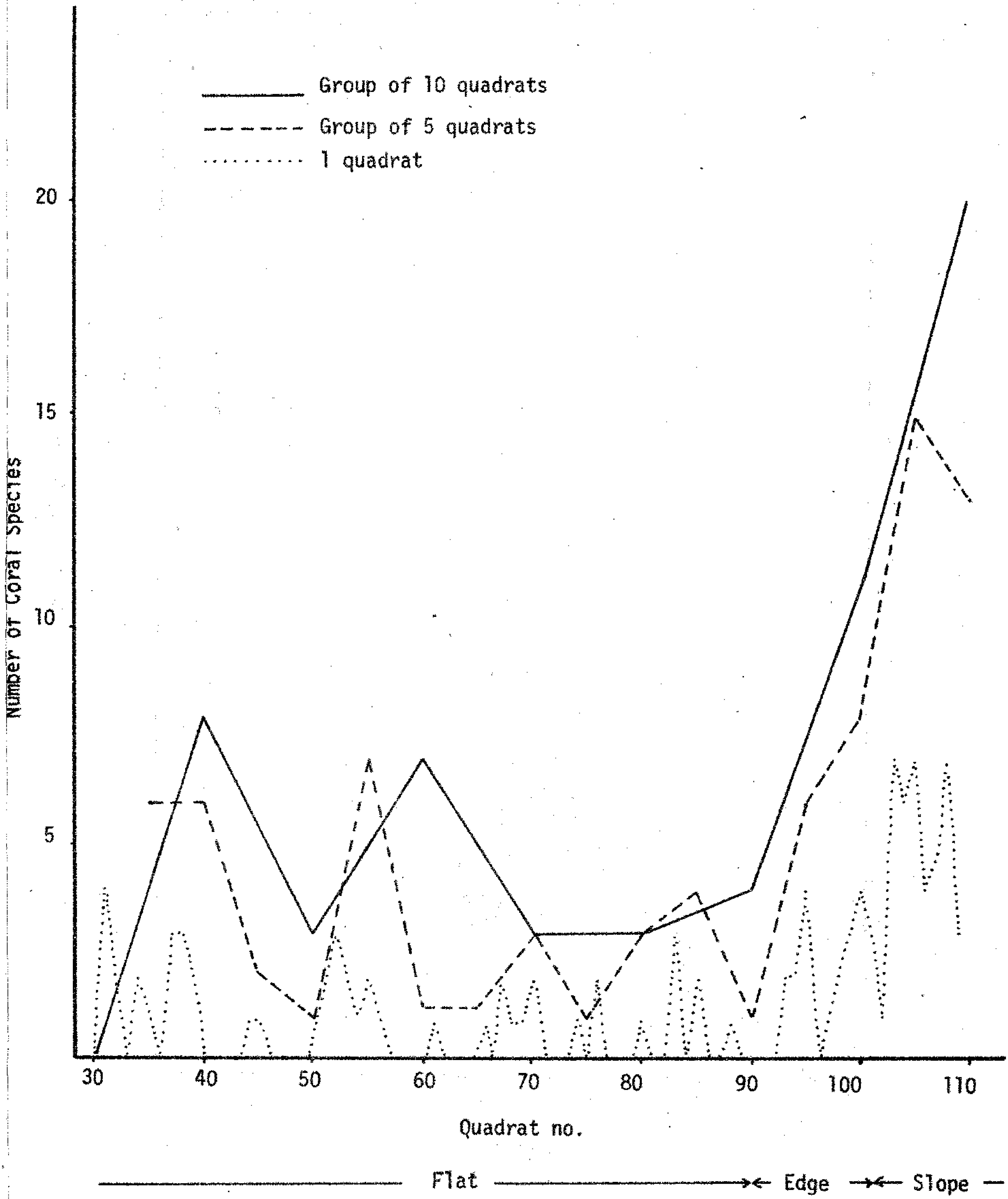

Fig.8. Species richness plotted as function of transect location (Transect B) for single quadrats, for groups of five and ten quadrats.

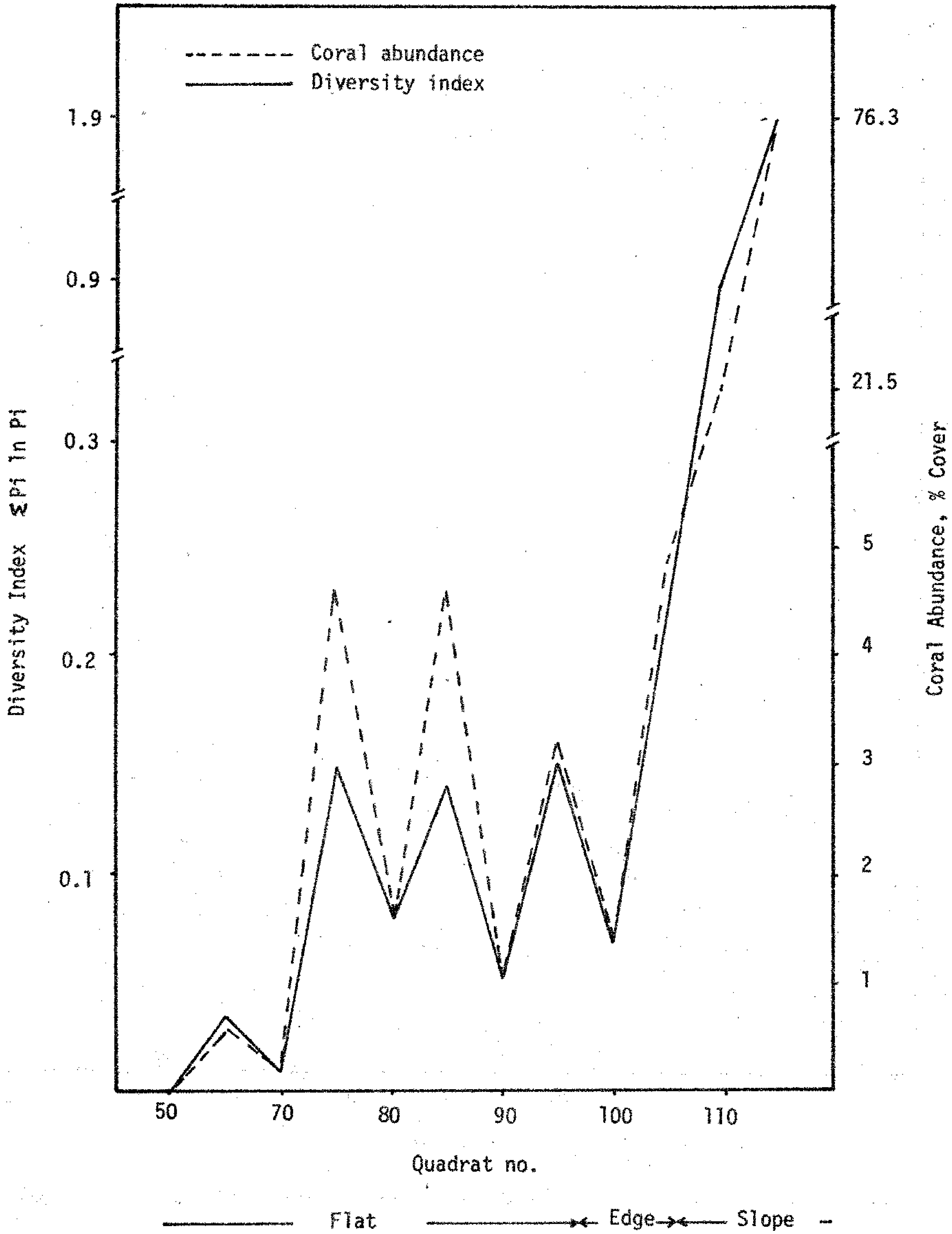

Fig.9. Coral abundance and the Shannon-Weaver Diversity Index plotted as a function of transect location (Transect A) with values based on pooling of contiguous groups of five quadrats.

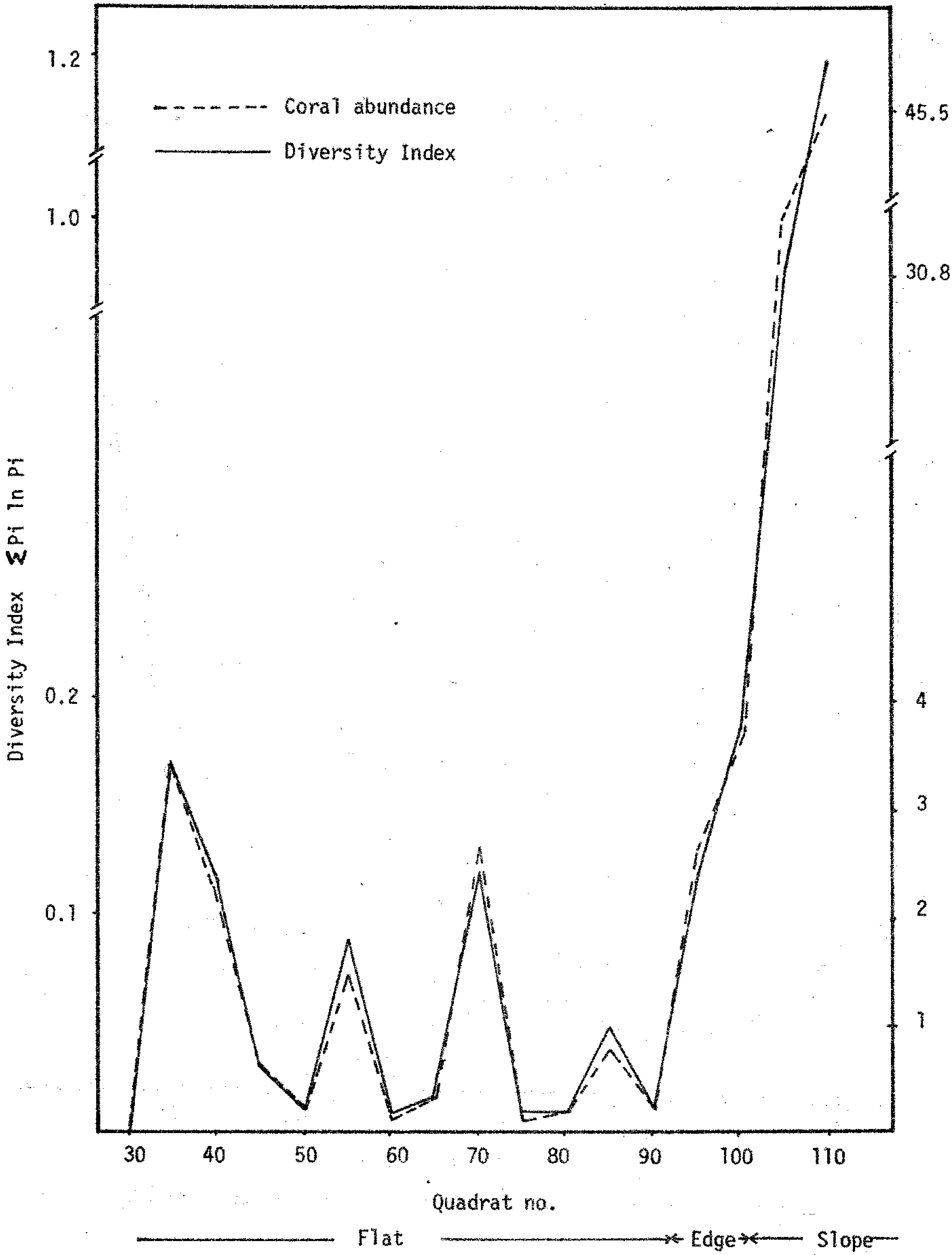

Fig.10. Coral abundance and the Shannon-Weaver Diversity Index plotted as a function of transect location (Transect B) with values based on pooling of contiguous groups of five quadrats.

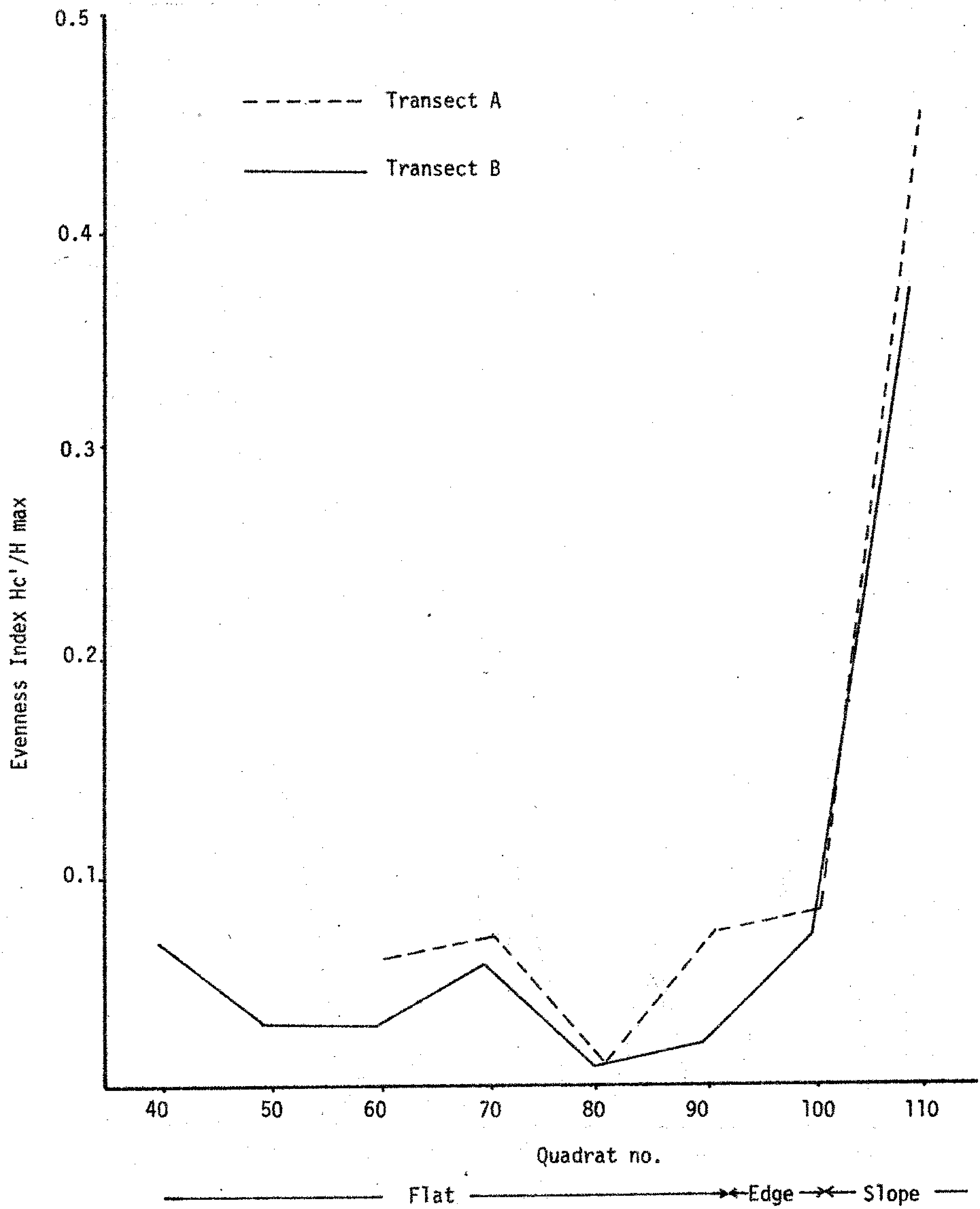

Fig.11. Evenness Index (Hc'/H max) plotted as a function of transect location for groups of ten quadrats.

Fig.12. Zonation model of coral reef transect at Pulau Salu (Transect A).

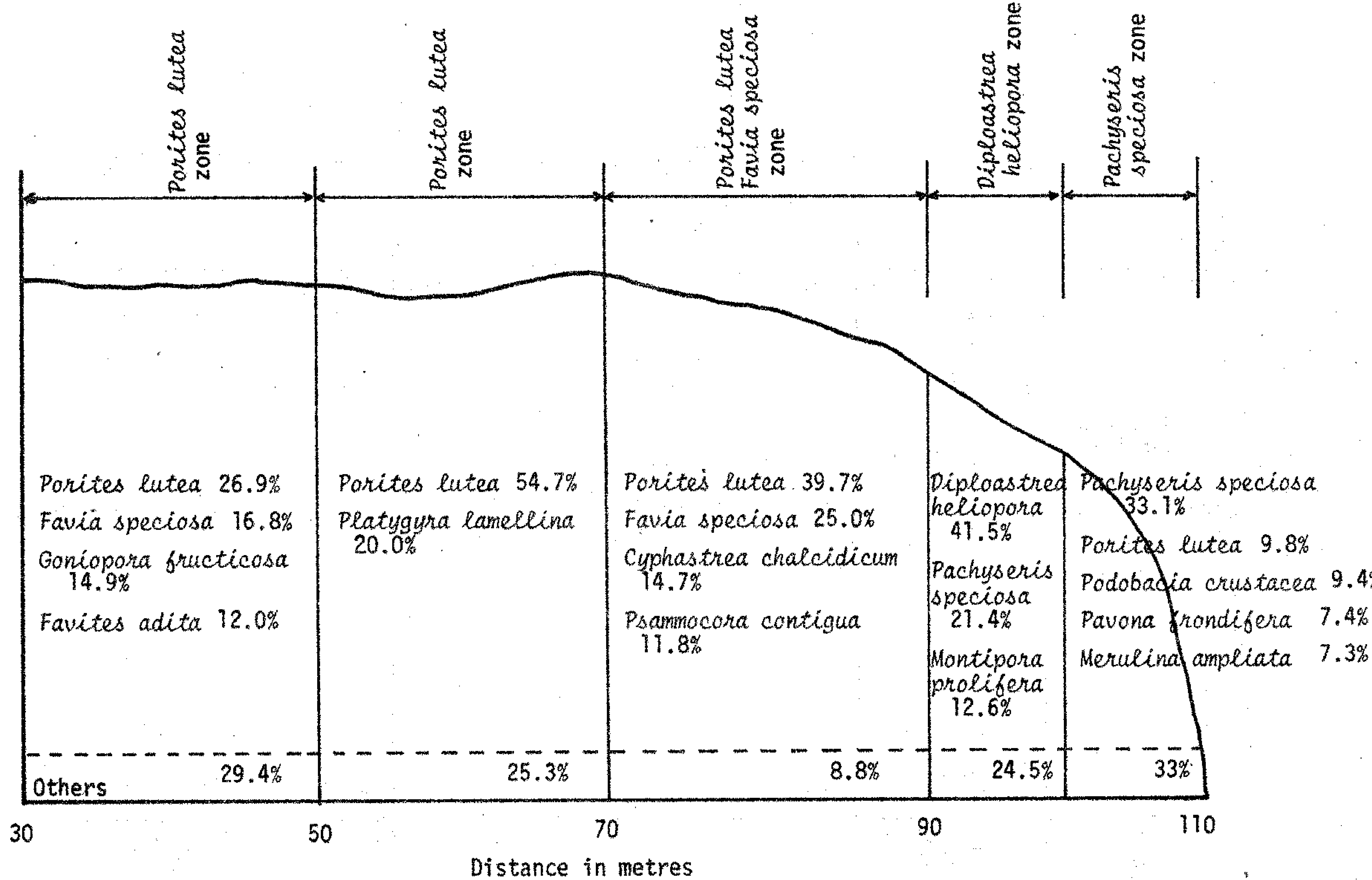

Fig.13. Zonation model of coral reef transect at Pulau Salu (Transect B).

Table 5. Summary of results for the various coral species at the two horizontal transects using the 1-tailed t-Test.

Coral species	Sample size n_1	Sample size n_2	Mean $\bar{x}_1$	Mean $\bar{x}_2$	Standard deviation of sample S_1	Standard deviation of sample S_2	Calculated t value	t value from one-tail t table
Favia speciosa	4	5	2.50	1.40	1.00	0.55	1.97*	1.895
Fungia fungites	2	6	1.00	0.58	0.00	0.20	5.14*	1.943
Gonipora fructicosa	3	2	3.70	1.25	2.08	1.06	1.22 ns	2.353
Montipora protifera	5	2	3.20	0.50	2.17	0.00	2.62*	2.015

* significant at P 0.05

ns not significant

Table 6. Comparison of live coral cover (%) between Transect A and Transect B of Pulau Salu.

	Reef flat	Reef edge	Reef slope
Transect A	2.2	26.8	73.3
Transect B	0.6	8.8	41.3

of Pulau Salu was 2.2% on Transect A and 0.6% on Transect B. Compared to that of 26.5% at Cape Rachado these results are extremely low. A 41.3% coral cover on the reef slope of Transect B was also considered low compared to the 60% obtained by Maragos (1974) at Fanning Island. The 73.3% coral cover on the slope of Transect A, however, proved to be higher than the 60% obtained from Fanning Island (Maragos, 1974).

Regardless of the fact that the coral growth at Transect A was better than that at Transect B, the results obtained from both transects show the following trends:-

(1) Coral colonies distribution measured by the numerical abundance of corals, without taking into consideration the number of species or the proportion of each species (fig.4) showed that the number of colonies at five-metre intervals along the transect was greatest on the reef slope, intermediate on the reef edge and lowest on the reef flat.

(2) Size index for quadrats, or an estimate of average colony area, which takes into account the number of colonies as well as the colony size was plotted as a function of transect location (figs.5 and 6). The results indicated that the average size of coral colony was larger on the reef slope than that on the reef flat.

(3) Species richness, plotted as a function of transect location for single quadrats, groups of five quadrats and groups of ten quadrats (figs. 7 and 8), showed that the number of species fluctuated along the reef flat but increased towards the reef edge and reached a peak on the reef slope. Regardless of the different sampling dimensions, the results obtained were similar.

(4) Coral abundance (percentage of coral cover with respect to the sampling dimension) and the Shannon-Weaver Diversity Index (a measure of both the number of species and the proportion of these species in a sample) were plotted as a function of transect location (figs. 9 and 10). By pooling contiguous groups of five quadrats, the data showed that percentage coral cover and diversity index were highest on the reef slope but lowest on the reef flat. Thus, these two parameters tend to fluctuate in the same direction indicating that the high percentage coral cover resulted from a greater number of species and a higher proportion of coral cover by each species on the reef slope.

(5) When the Evenness Index was plotted as a function of transect location for groups of ten quadrats (fig.11), it was found that this index was very low on the reef flat but approached a value of 0.5 on the reef slope. This implies that the distribution of corals along the reef flat is very uneven but it assumes a more even distribution on the reef slope. As the value of the Evenness Index is to be between zero and one, with an Evenness Index of one indicating the most even distribution, different sampling dimensions smaller than ten quadrats were not possible. This was due to the extremely uneven coral distribution at the reef flat which would have given index values of infinity.

From these parameters it can be concluded that the coral population is extremely low on the Salu reef flat, improving on the reef edge and reaching a maximum on the reef slope.

To account for the extremely low live coral coverage on the reef flat, several factors affecting coral growth will be examined. The factors to be considered include that of light penetration, sediment deposition rates, dessication and changes in salinity.

The amount of light penetration was measured with a Secchi disc at Pulau Salu. On a sunny day when the water is calm with a low sedimentation load, the Secchi disc reading was 4.5 metres. However, on an overcast day when the water is rough with a high sedimentation load, the Secchi disc reading was 1.5 metres. When compared to the Secchi disc readings of 7 metres (for a calm, sunny day) and 2 metres (for an overcast day) at Cape Rachado (Goh and Sasekumar, 1980) or a 50 metre reading at Fanning Island (Maragos, 1974), the sedimentation load at Pulau Salu was indeed very high.

Turbidity is positively correlated to sedimentation load. In a turbid environment the substratum would be coated with sediment and this reduces the possibility of coral larvae settling on it (Roy and Smith, 1971). From our observations, it was found that even the *Sargassum* were heavily coated with sediment. Furthermore, the proliferate growth of *Sargassum* would greatly reduce the area of substratum available for coral larvae settlement.

Apart from this effect, a high sedimentation load also causes smothering of the corals (Roy and Smith, 1971). The depth of light penetration is also reduced.

Loya (1972) found that three out of the four most abundant species in the high sedimentation rate areas on the coral reef at Eilat were branching corals. Our results, however, do not indicate a similar conclusion. Despite the fact that Pulau Salu has a very high sedimentation load, branching corals are exceptionally rare. Of the forty-two species on the Salu reef only three species of branching corals were found, namely *Acropora concina*, *Porites negrescens* and *Montipora lavis*. None of these three occurred on the reef flat or the reef edge and though they occurred on the reef slope their frequency of occurrences were very low (Table 2).

Coral species inhabiting the reef flats on both transects were the massive forms like *Favia speciosa*, *Porites lutea*, *Goniastrea pectinata*, *Favites abdita* etc. From our observations and the reef profile plotted, the Salu reef was often partially exposed for two to three hours at low spring tides. During this period, coral colonies will be subjected to dessication. Hence, species that can resist dessication will have a better chance of survival. Our findings therefore support the conclusion drawn by Fishelson (1973) at Eilat that massive brain corals which possess large and deep corallites are more resistant to dessication than the delicate branching forms which possess very shallow and small corallites.

It has frequently been observed that large boulders of the massive faviid corals on the reef flat have a dead top and that some even have *Sargassum* growing on the horizontal plane where the coral polyps had died. But polyps encrusted on the vertical plane of the boulders are still alive. Goh and Sasekumar (1980) also observed this pehnomenon at Cape Rachado. They suggested that the horizontal plane allows sediment to settle thereby smothering the coral polyps. However, we conclude that a combination of factors may be involved as the top of these big coral boulders are subjected to a number of ecological stresses. Other than the smothering effect of settling sediment, the coral colonies on the boulder top has a higher chance of exposure during a low spring tide and therefore subjected to direct sunlight resulting in severe dessication. Apart from the sunlight these boulder tops would also be subjected to direct rainfall, hence, there is the possibility of a sudden change in salinity causing death.

The factors considered above may account for the extremely low live coral coverage, species diversity and richness on the reef flat.

In contrast to the findings of the reef flat, it has been observed that the coral growth on the reef edge and the reef slope is much better. This can be attributed to the elimination of certain limiting factors at the seaward side of the reef. There is no danger of dessication or of sudden changes in salinity due to direct rainfall because reef slopes are permanently submerged, thus corals on the reef edge and the reef slope are not exposed during low tides. Current flows near the reef slope also decrease the chances for sediment to settle besides bringing an increased food supply of zooplankton for the coral polyps to feed on. The absence of *Sargassum* growth on the reef slope and the relatively rare *Sargassum* growth on the reef edge increase the chances for the coral larvae to settle and develop.

The zonation models constructed show that the distribution patterns of the scleractinian corals on both Transects A and B are quite similar even though the two transects are different in their profile.

Porites lutea was found to be the most dominant coral species on the reef flats. *Favia speciosa* was the next dominant species. Of the three zones in each transect, two are named after *Porites lutea* but the third is named after both *P. lutea* and *F. speciosa*. With only two coral species dominating the reef flats, the Diversity Index and Evenness Index of the two reef flats are very small. Environmental factors on the reef flats often limit the growth and development of corals. In addition, *Porites lutea* and *Favis speciosa* are found on all three zones of the reef. These two observations suggest that both corals are indeed very hardy species. *Porites lutea* and *Favia speciosa* also have the highest frequency of occurrences and, apart from *Pachyseris speciosa*, they are the species with the greatest abundance (Tables 1 and 2).

Symphyllia nobilis is the most dominant coral species at the reef edge of Transect A. For Transect B, *Diploastrea heliopora* is the most dominant species. Both species have massive growth forms achieving a size of greater than one square metre in surface area. Their huge size could, therefore, account for the larger size index and higher coral abundance at the reef edge.

Pachyseris speciosa is the most dominant coral species at the reef slope of both transects. This coral has a plate-like growth form and could grow to a diameter of 60 cms. Like other coral species that have a plate-like growth form, this species was only found on the reef slope and the deeper parts of the reef edge. This could be due to their fragile structure which tend to be more vulnerable to wave action at the reef flat when the tide changes. Although this species has a very narrow range of distribution, it has the highest percentage of cover throughout the reef when compared to other corals. This may be attributed to its hugh size and abundance at the reef slope.

From the statistical analysis of the data obtained for the horizontal transects (Table 5), it was found that three of the four coral species common to the two horizontal transects were significantly different in size. Thus, the average colony size of a particular coral species at the bottom of the reef slope is indeed smaller than those at the top. This could be accounted by the explanation advanced by Roy and Smith (1971). Light is important for the survival of photosynthetic zooxanthellae. A direct consequence of such a symbiotic relationship with madreporarian reef-building corals is that such hermatypic corals are limited to depths where there is sufficient light for photosynthesis to take place. Reduction of light will lead to the fast disappearance of the zooxanthellae which are responsible for the removal of waste materials in the coral polyps. The ultimate consequence is unhealthy growth, loss of colour or even death in some cases. The fall in light intensity at greater depths would, therefore, account for the smaller size index at the bottom of the reef slope or even a total absence of coral growth beyond certain critical depths.

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