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Coral Communities at Lizard Island, Great Barrier Reef, Australia

Korallengemeinschaften auf der Lizard Insel, Großes Barriere Riff, Australien

by

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Summary

In general, the reefs at Lizard Island are dominated by *Acropora*. In part of the lagoon, *Porites* becomes the commonest and probably most important reefbuilder. In spite of the overall dominance of *Acropora*, the massive genera probably contribute more to the frame building. Probably more of their carbonate production keeps in place, while that of *Acropora* will be broken down, turned into sediment, and shifted away.

Occurrence of certain genera can characterize Lizard reef localities: e.g., *Porites (Synaraea)* and *Heliopora* at a larger patch reef in the lagoon (RP lagoon); large *Diploastrea* colonies in steep reef walls, usually below 3 m, at more exposed sites (Site WM); common and large colonies of encrusting *Montipora* at a shallow slope (N Palfrey Is.) in about 3 m depth; and increased abundance of *Goniastrea* (Site C).

In the hierarchical cluster analysis of 33 transects, we find two main clusters in the coral distribution, one with >50 % *Acropora* of the live scleractinian cover, and one with <50 %. In an analysis, considering only *Acropora*, three clusters can be noted, of which one is characterized by *A. hyacinthus* group, another by the occurrence of *A. (Isopora)* group, and the third cluster combines all transects with few *Acropora*.

Zusammenfassung

Die Riffe um Lizard Island, GBR, werden von *Acropora*-Arten dominiert. In der Lagune können *Porites*-Arten bedeutender werden. Obgleich *Acropora* im allgemeinen vorherrscht, dürften doch die Korallen mit massiver Wuchsform mehr zum Gerüstaufbau der Riffe beitragen. Von ihrer Kalkproduktion wird mehr vor Ort erhalten bleiben als von *Acropora*-Arten, die leichter zerbrochen, zu Sediment umgeformt und verfrachtet werden.

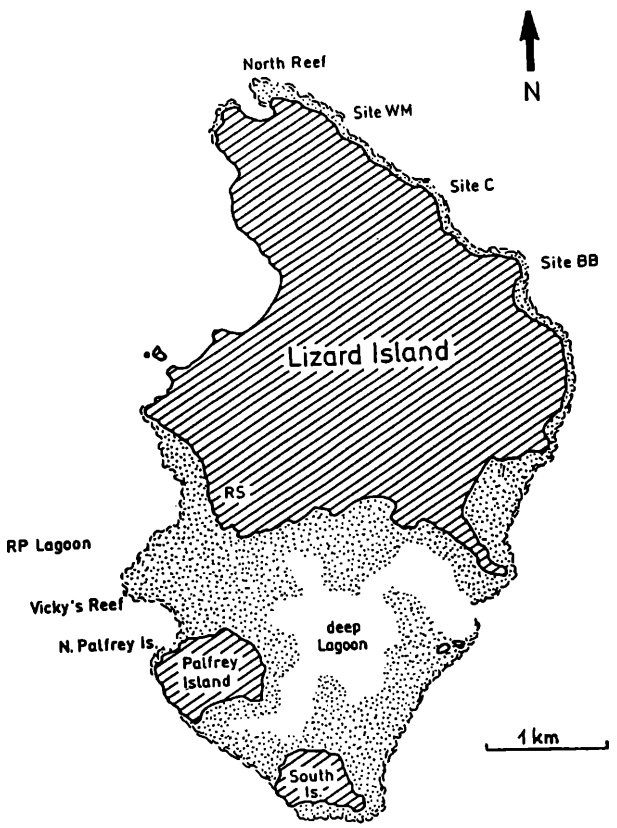

Figure 1. Scetch-map of Lizard Island group and transect sites.

Bestimmte Gattungen oder Arten können Riffbereiche bei Lizard durch ihr Vorkommen charakterisieren: *P. (Synaraea)* und *Heliopora* in der Lagune bei „Research Point"; sehr große *Diploastrea* Kolonien in der steilen Riffwand exponierter Stellen, unter 3 m Tiefe, bei „Washing Machine"; gehäuftes Vorkommen von *Goniastrea* bei „C"; häufige und großflächige Kolonien von *Montipora* im flachen Hang nördlich Palfrey I., in etwa 3 m Tiefe.

Eine hierarchische Clusteranalyse der 33 Transekte ergab zwei Hauptgruppen, die eine mit mehr und die andere mit weniger als 50 % Acropora des lebenden Korallenanteils. In einer Analyse, die nur *Acropora* berücksichtigt, ergeben sich drei Cluster, wobei einer durch die *A. hyacinthus* Gruppe charakterisiert ist und der zweite durch das Vorhandensein von *A. (Isopora)*.

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Der dritte Cluster vereinigt all jene Transekte mit geringem *Acropora* Vorkommen.

1. Introduction

The challenge of complexity and diversity of coral reefs and their biota has led to investigations from many disciplines and viewpoints to find ordered structures and other ways to deal with the vast system (CONNELL, 1973; BARNES, 1983; DUBINSKY,1990). There are attempts to analyze and generalize on a larger scale. DONE (1982) found patterns in the distribution of coral communities across the central Great Barrier Reef. Little further north, the present study was conducted in Nov./Dec. 1991 at Lizard Island, 14 40' S, 154 28' E, Cairns section of the Great Barrier Reef marine park. Lizard, with neighbouring Palfrey and South Island surrounding a lagoon (Fig. 1), lies about 19 km inside the outer barrier.

From site to site, coral comunities shift in their relative abundance and composition, due to a number of varying parameters such as light, water movement, etc. (DONE, 1983, 1992; NELSON, 1993). The aim of this study was to differentiate certain reef areas according to the coral community composition, dominance or presence of certain coral genera or species.

2. Methods

By SCUBA-diving regional coral assemblages were checked for peculiarities regarding community structure and species occurrence. Observations were noted on water-proof sheets on a turnable tube carried between elbow and fist. The usually 10m-line intercept technique (LIT), employed by SCHEER (1967), was used to quantitatively evaluate the most common genera or characteristic species at each locality. The LIT is a simple tool in coral reef surveys and is able to characterize reef areas (MONTEBON, 1992). The measurements were taken in a vertical view using a metal rod with 5 cm-scale. The rod was clipped to and moved foreward along the line in 1m intervals (Pl. 1/Fig. 1). Fair weather conditions allowed investigations on usually wave washed reef platforms, edges and uppermost slopes. Quantitative data were subjected to agglomerative hierarchical cluster analysis using Ward's method of linkage and squared Euclidian distance (DIGBY & KEMPTON, 1987). Corals were determined after VERON (1986), VERON & PICHON (1976, 1980, 1982), VERON & WALLACE (1984), and VERON et al. (1977).

3. Results

At Lizard Island, narrow, shallow-water fringing reefs, dominated by *Acropora*, are developed mainly along the NE and SE shores of the granitic islands. In between stretches a lagoon consisting of a deeper (>3 m) and a larger shallower (<3 m) part with various patch reefs scattered on the sandy bottom (Fig. 1). In general, reef slopes drop steeply to shallow fore reef areas (commencing at 6-8 m at North Reef (NR), 15–20 m at Site BB, and about 20 m along the ESE front of the island group).

From a total length of 330 m, 171.8 m (52 %) of the cover was free from live scleractinians (including dead stony corals, alcyonarians, gorgonians, zooantharians, bivalve *Tridacna*, coral rubble and sand). A length of 158.2 m (48 %) was covered by live stony coral (Tab. 1). In the present account, stony corals are understood as including scleractinians, fire coral *Millepora* and blue coral *Heliopora*.

From the total live stony coral cover, *Acropora* has a share of more than half (53.7 %). Adding the next two common genera, *Porites* (9.5 %) and *Montipora* (6.9 %), 70 % are occupied, leaving only 30 % for all remaining (Tab. 1):

Goniastrea 4.3 %, *Favia* 4.1 %, *Pocillopora* 4 %, *Diploastrea* 2.6 %, *Favites* 2.1 %, *Stylophora* 1.8 %, *Echinopora* 1.7 %, pooled *Leptoria* and *Platygyra* 1.6 %, *Seriatopora* 1.4 %, *Symphyllia* 1.3 %, less than 1 % have *Millepora*, *Hydnophora, Heliopora*, and *Cyphastrea*, less than 0.5 % have *Pavona*, fungiids, *Mycedium, Psammocora, Turbinaria, Galaxea*, less than 0.2 % have *Goniopora, Astreopora, Acanthastrea, Physogyra, Echinophyllia, Leptastrea*, and less than 0.1 % have *Lobophyllia* and *Pectinia*.

Considering individual transects (Tab. 1), *Acropora* dominates (>50 %) in 19 and has the largest share in further 5 transects. Its intercept ranges from 0.4 to 8.65 m. The second commonest coral, *Porites*, dominates 3 and is commonest in 1 further transect, intercept ranging from 1.2–3.5 m (transects 4, 6–8). *Diploastrea* is commonest in 2 transects with 1.5 and 2.6 m intercept: In no. 20, ahead of *Favia* and *Montipora*, in no. 21, ahead of *Montipora, Acropora*, and *Porites*. *Favia* leads in 2 transects. With 0.5 m narrowly ahead of *Acropora* and *Symphyllia* (no. 5), and with 0.65 m ahead of *Goniastrea* with 0.5 m (no. 24). *Montipora* leads with 0.9 m in transect no. 14 ahead of *Echinopora* with 0.65 m. In transects no. 1 and 2, in spite of an amount of 1.65 and 2.45 m, *Montipora* ranges second behind *Acropora* (Tab. 1).

N Palfrey Island (NPI): Rather sheltered, gentle slope down to about 10 m, covered by a thin coral carpet. Species of *Acropora* being dominant (>50 % of the live intercept), contribute up to 3 m intercept (Tab. 1). In the pooled transects no. 1–2, the amount of *A. hyacinthus* group, *A. (Isopora)*, and staghorn type are almost equal (Tab. 2). Both transects are yet characterized by large colonies of encrusting *Montipora*, intercept amounting up to 2.45 m (Tab. 1). Particularly at this site, various coral-bivalve associations are common. *Montipora* spp. are densely infested by *Lithophaga laevigata* (QUOY

Table 1. The 33 10 m-transects from Lizard, GBR, Australia, Live Stony Coral (LSC). Ac– *Acropora*, Ps–*Porites*, Mp–*Montipora*, Gs–*Goniastrea*, Fa–*Favia*, Pc–*Pocillopora*, Ds–*Diploastrea*, Fs–*Favites*, St–*Stylophora*, Ep–*Echinopora*, LP–*Leptoria* and *Platygyra*, Se–*Seriatopora*, Sm–*Symphyllia*, oc-other corals.

Locality	depth	non-lsc	lsc	Ac		Ps		Mp		Gs		Fa		Pc		Ds		Fs		St		Ep		LP		Se		Sm		oc	
	m	cm	cm	cm	%	cm	%	cm	%	cm	%	cm	%	cm	%	cm	%	cm	%	cm	%	cm	%	cm	%	cm	%	cm	%	cm	%
13, North Reef	3	405	595	485	81.5	20	3.4	10	1.7	10	1.7	10	1.7	45	7.6	0	0	5	0.8	0	0	0	0	0	0	0	0	0	0	10	1.7
22, Site C	1	405	595	485	81.5	5	0.8	0	0	20	3.4	5	0.8	60	10.1	0	0	15	2.5	0	0	0	0	5	0.8	0	0	0	0	0	0
9, North Reef	1	395	605	495	81.8	0	0	45	7.4	10	1.7	40	6.6	10	1.7	0	0	0	0	0	0	0	0	0	0	0	0	5	0.8	0	0
29, Site BB	1	440	560	400	71.4	40	7.1	20	3.6	5	0.9	10	1.8	40	7.1	0	0	5	0.9	25	4.5	0	0	0	0	0	0	0	0	15	2.7
30, Site BB	2	370	630	445	70.6	10	1.6	5	0.8	5	0.8	15	2.4	65	10.3	0	0	0	0	5	0.8	0	0	20	3.2	0	0	5	0.8	55	8.7
1, N Palfrey I	3	540	460	235	51.1	15	3.3	165	35.9	5	1.1	0	0	5	1.1	0	0	10	2.2	0	0	0	0	0	0	0	0	5	1.1	20	4.3
2, N Palfrey I	3	430	570	300	52.6	0	0	245	42.3	10	1.8	0	0	0	0	0	0	0	0	0	0	0	0	5	0.9	0	0	0	0	10	1.8
3, Vicky's Reef	2	535	465	265	57.0	70	15.1	25	5.4	5	1.1	40	8.6	0	0	0	0	0	0	0	0	25	5.4	25	5.4	0	0	0	0	10	2.2
27, Site C	3	375	625	310	49.6	40	6.4	75	12.0	30	4.8	55	8.8	10	1.6	0	0	30	4.8	0	0	0	0	25	4.0	0	0	5	0.8	45	7.2
18, Site WM	1	625	375	270	72.0	5	1.3	10	2.7	40	10.7	5	1.3	20	5.3	0	0	20	5.3	5	1.3	0	0	0	0	0	0	0	0	0	0
19, Site WM	2	545	455	245	53.9	40	8.8	20	4.4	55	12.1	20	4.4	30	6.7	0	0	15	3.3	10	2.2	0	0	15	3.3	0	0	5	1.1	0	0
16, Site WM	1	590	410	300	73.2	30	7.3	0	0	10	2.4	15	3.7	20	4.9	0	0	10	2.4	0	0	15	3.7	0	0	0	0	0	0	10	2.4
31, Site BB	2	570	430	290	67.4	10	2.3	10	2.3	5	1.2	20	4.7	30	7.0	0	0	0	0	25	5.8	0	0	10	2.3	0	0	5	1.2	25	5.8
17, Site WM	1	535	465	335	72.0	5	1.1	0	0	5	1.1	40	8.6	5	1.1	0	0	35	7.5	0	0	15	3.2	25	5.4	0	0	0	0	0	0
32, Site BB	3	475	525	295	56.2	10	1.9	5	1.0	10	1.9	25	4.8	5	1.0	0	0	40	7.6	25	4.8	45	8.6	10	1.9	20	3.8	0	0	35	6.7
10, North Reef	1	305	695	600	86.3	0	0	0	0	10	1.4	0	0	85	12.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11, North Reef	2	220	780	680	87.2	10	1.3	20	2.6	0	0	0	0	35	4.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	4.5
12, North Reef	2	130	870	865	99.4	0	0	0	0	0	0	0	0	5	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6, RP Lagoon	1	590	410	45	11.0	350	85.1	0	0	0	0	0	0	5	1.2	0	0	10	2.4	0	0	0	0	0	0	0	0	0	0	0	0
8, RP Lagoon	2	515	485	65	13.4	280	57.5	25	5.2	5	1.0	5	1.0	0	0	0	0	0	0	15	3.1	0	0	0	0	65	13.4	0	0	25	5.2
4, RP Lagoon	1	730	270	15	5.6	120	44.4	5	1.9	60	22.2	0	0	0	0	0	0	0	0	0	0	20	7.4	0	0	35	13.0	0	0	15	5.6
7, RP Lagoon	1	585	415	0	0	225	54.2	20	4.8	0	0	0	0	0	0	0	0	10	2.4	0	0	30	7.2	0	0	35	8.4	0	0	95	22.9
20, Site WM	4	485	515	50	9.7	35	6.8	60	11.7	15	2.9	75	14.6	0	0	150	29.1	10	1.9	20	3.9	0	0	15	2.9	10	1.9	15	2.9	60	11.7
21, Site WM	5	390	610	60	9.8	60	9.8	65	10.7	0	0	35	5.7	10	1.6	260	42.6	20	3.3	0	0	10	1.6	0	0	0	0	0	0	0	0
5, RP Lagoon	1	775	225	45	20.0	10	4.4	10	4.4	10	4.4	50	22.2	10	4.4	0	0	35	15.6	0	0	0	0	0	0	5	2.2	45	20.0	5	2.2
15, North Reef	8	890	110	40	36.4	15	23.6	10	9.1	0	0	5	4.5	0	0	0	0	0	0	5	4.5	10	9.1	0	0	0	0	0	0	25	22.7
24, Site C	1	760	240	20	8.3	10	4.2	15	6.3	50	20.8	65	27.1	10	4.2	0	0	0	0	5	2.1	0	0	20	4.2	0	0	0	0	45	18.8
14, North Reef	6	690	310	10	3.2	5	1.6	90	29.0	5	1.6	10	3.2	20	6.5	0	0	10	3.2	30	9.7	65	21.0	0	0	0	0	0	0	65	21.0
23, Site C	1	680	320	165	51.6	0	0	0	0	10	3.1	15	4.7	20	6.3	0	0	10	3.1	65	20.3	0	0	25	7.8	0	0	5	1.6	5	1.6
33, Site BB	4	475	525	225	42.9	15	2.9	40	7.6	20	3.8	35	6.7	10	1.9	0	0	25	4.8	50	9.5	20	3.8	5	1.0	0	0	20	3.8	60	11.4
25, Site C	2	665	335	135	40.3	5	1.5	35	10.5	80	23.9	5	1.5	25	7.5	0	0	0	0	0	0	0	0	0	0	20	6.0	10	3.0	20	6.0
26, Site C	2	570	430	160	37.2	25	5.8	30	7.0	50	11.6	10	2.3	50	11.6	0	0	10	2.3	5	1.2	0	0	15	3.5	15	3.5	35	8.1	25	5.8
28, Site C	3	490	510	155	30.4	40	7.8	30	5.8	130	25.5	40	7.8	5	1.0	0	0	5	1.0	0	0	20	3.9	35	6.9	0	0	30	5.9	20	3.9
Total		17180	15820	8490		1505		1090		680		650		635		410		330		290		275		255		225		200		785	
Live stony coral cover (lscc %)			100.0		53.7		9.5		6.9		4.3		4.1		4.0		2.6		2.1		1.8		1.7		1.6		1.4		1.3		5.0

Table 2. The share of *Acropora* spp., *A.hyacinthus* group, *A. (Isopora)*, and „staghorn" *Acropora*. (a) in the 33 transects at Lizard Island, GBR, and (b) according to locations

(a)

Transect	*Acropora* spp		*A. hyacinthus* group		*A. (Isopora)*		*A.* "staghorn"	
	cm	n	cm	n	cm	n	cm	n
1	235	15	0	0	50	4	25	2
2	300	17	55	3	0	0	20	2
3	265	15	105	4	0	0	0	0
4	15	2	0	0	0	0	0	0
5	45	4	0	0	0	0	0	0
6	45	1	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	65	2	0	0	0	0	0	0
9	465	24	345	15	0	0	0	0
10	600	23	390	10	0	0	0	0
11	680	30	380	14	0	0	85	2
12	865	26	765	20	0	0	0	0
13	485	18	260	8	0	0	0	0
14	10	1	0	0	0	0	0	0
15	40	2	0	0	0	0	0	0
16	300	18	175	9	5	1	0	0
17	335	25	130	7	10	1	45	4
18	270	23	10	1	45	4	0	0
19	245	18	150	7	15	2	0	0
20	50	3	0	0	0	0	0	0
21	60	4	40	1	0	0	0	0
22	485	27	280	10	0	0	0	0
23	165	13	0	0	30	2	0	0
24	20	3	0	0	0	0	0	0
25	135	10	10	1	20	1	0	0
26	160	14	20	1	35	4	0	0
27	310	18	145	5	15	1	30	1
28	155	15	0	0	35	2	0	0
29	400	28	35	2	10	1	0	0
30	445	26	175	5	0	0	0	0
31	290	25	35	2	0	0	0	0
32	295	15	205	8	0	0	0	0
33	225	15	90	5	0	0	0	0
Total	8490	480	3800	138	270	23	205	11
	100%		44.80%		3.20%		2.50%	

(b)

Location	*Acropora* spp.		*A. hyacinthus* group		*A. (Isopora)*		*A.* "staghorn"	
	cm	mean	cm	%	cm	%	cm	%
NPI	535	267.5	55	10.3	50	9.3	45	8.4
Vicky's R	265	265.0	105	39.6	0	0	0	0
RPL	170	34.0	0	0	0	0	0	0
NR	3175	453.6	2140	67.0	0	0	85	2.7
WM	1260	210.0	505	40.1	75	6.0	45	3.6
C	1430	204.3	455	31.8	135	9.4	30	2.1
BB	1655	331.0	540	32.6	10	0.6	0	0
Total	8490		3800		270		205	
	100%		44.80%		3.20%		2.50%	

& GAIMARD, 1835), *Favia* spp. are commonly hosts of *L. simplex* IREDALE, 1939, and branching *A. (Isopora) brueggemanni* (BROOK, 1893) of *L. kuehnelti* (KLEEMANN, 1977) (KLEEMANN, 1995).

Vicky's Reef: Patch reef inside the shallow lagoon, N of Palfrey Is. Transect. no. 3, in 2 m. Live intercept <50 %, *Acropora* dominating with 2.65 m, *A. hyacinthus* group contributing almost 40 % (Tabs. 1–2).

Research Point Lagoon (RP Lagoon): Elongated patch reef inside the shallow lagoon, close to the shore at Research Point. Most of it's flat top is dead coral (>70 % in transects nos. 4–5, Tab. 1), mainly covered by soft coral, particularly *Sarcophyton*. At the reef edge, facing Lizard Is., live surface increases but remains < 50 % (transects nos. 6–8), dominated by large *Porites* and *P. (Synaraea)* colonies, pooled intercept up to 3.5 m (Tab. 1). Here, the share of *Acropora* is low (max. 20 %), *A. hyacinthus* group being not represented (Tab. 2). The mean intercept of *Seriatopora* has here its maximum with 28 cm (Tab. 3). One big branching *Montipora*

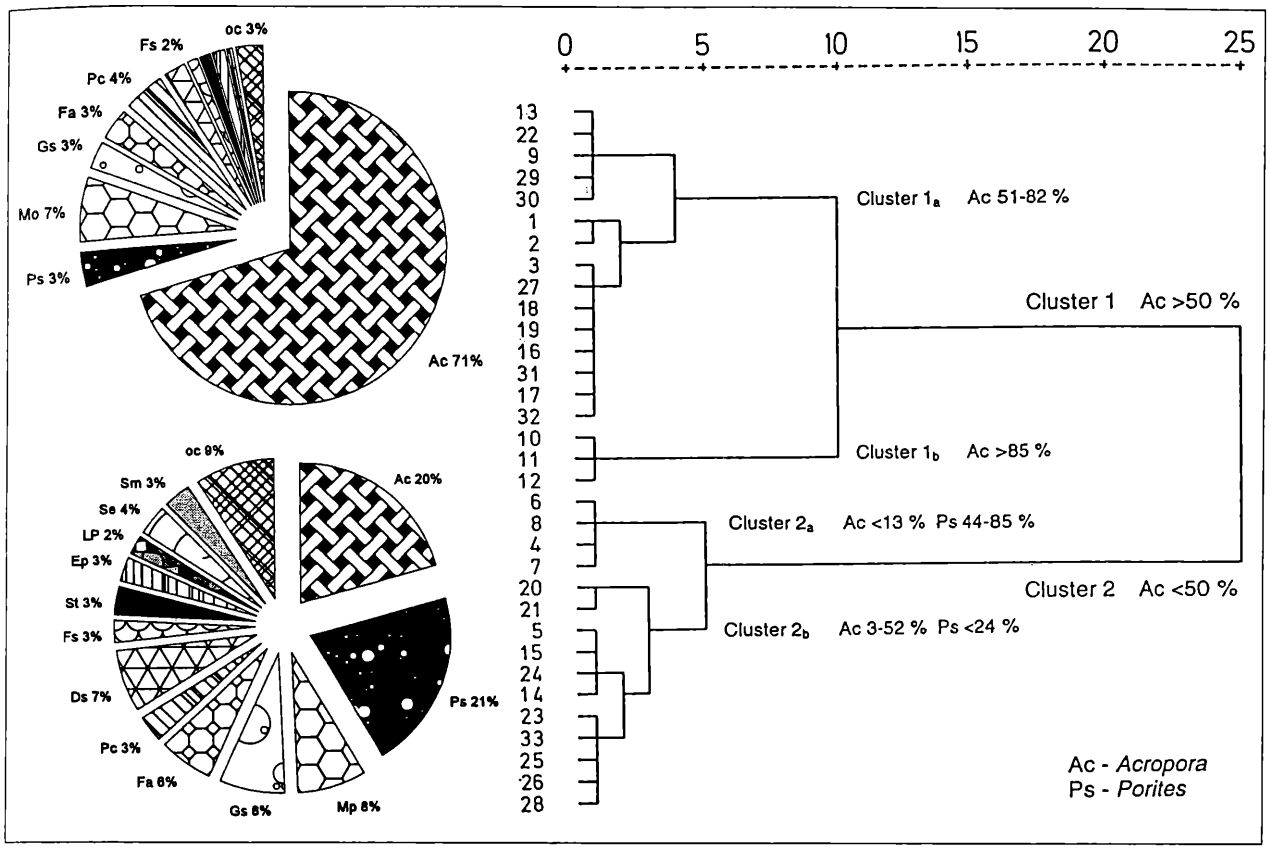


Figure 2. Hierarchical cluster analysis of the 33 transects from Lizard Island, GBR, yielding two main clusters. The abundance of coral genera is figured in the graphs below the dendrogram. Ac– *Acropora*, Ps–*Porites*, Mp–*Montipora*, Gs–*Goniastrea*, Fa–*Favia*, Pc–*Pocillopora*, Ds–*Diploastrea*, Fs–*Favites*, St–*Stylophora*, Ep–*Echinopora*, LP–*Leptoria* and *Platygyra*, Se–*Seriatopora*, Sm–*Symphyllia*, oc-other corals.

colony of about 1.5 m in diameter was observed off the transect lines. Non-scleractinian blue coral *Heliopora* is relatively common. Massive dead coral, mainly *Porites*, may be extensively bored, particularly by *L. obesa* (PHILIPPI, 1847). Bivalve specimens reaching 10 cm in length, occur in densities of up to 2–3/100 cm² (Pl. 1/Fig. 2).

North Reef (NR): Semi-sheltered fringing reef, platform relatively broad, with flourishing edges and a patch reef in front. There, highest live scleractinian cover was observed in transects nos. 9–13, 1–3 m deep, and dominated by *Acropora*, particularly *A. hyacinthus* group (Tabs. 1–2, Pl. 1/Fig. 3). In transects nos. 14–15, in 6 and 8 m respectively, live scleractinian cover decreases to 31 % and 11 %. They are situated at the foot of the steep slope and, in 4 m distance, in the sandy fore reef. In no. 14, *Montipora* occupies 0.9 m, more than other genera (Tab. 1).

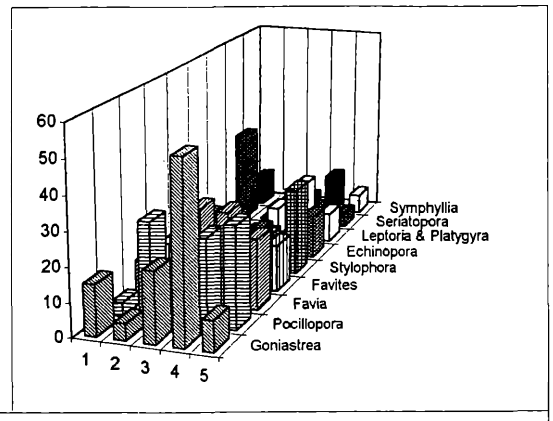
Site **WM**: Fringing reef, between NR and Site C, at the wave exposed NE shore (Fig. 1). Rather narrow, small platform and steep slope with narrow canyons and undercuts. In 1–2 m deep transects near the edge (nos. 16–19), *Acropora* contributes up to 3.35 m and 73 % of the live intercept. From *Acropora, A. hyacinthus* group amounts 40 % (Tab. 2), colony size being smaller than at NR. Large *Diploastrea heliopora* (LAMARCK, 1816) colonies, in the reef wall below 3 m, characterize the 4–5 m deep transects, nos. 20–21 (Pl. 1/Fig. 4). Their intercept share amounts 1.5 and 2.6 m respectively, while that of *Acropora* only 0.5 and 0.6 m (Tab. 1). Faviids are common. The mean intercept maximum of *Favia* and *Favites* amounts 28.3 and 18.3 cm respectively (Tab. 3).

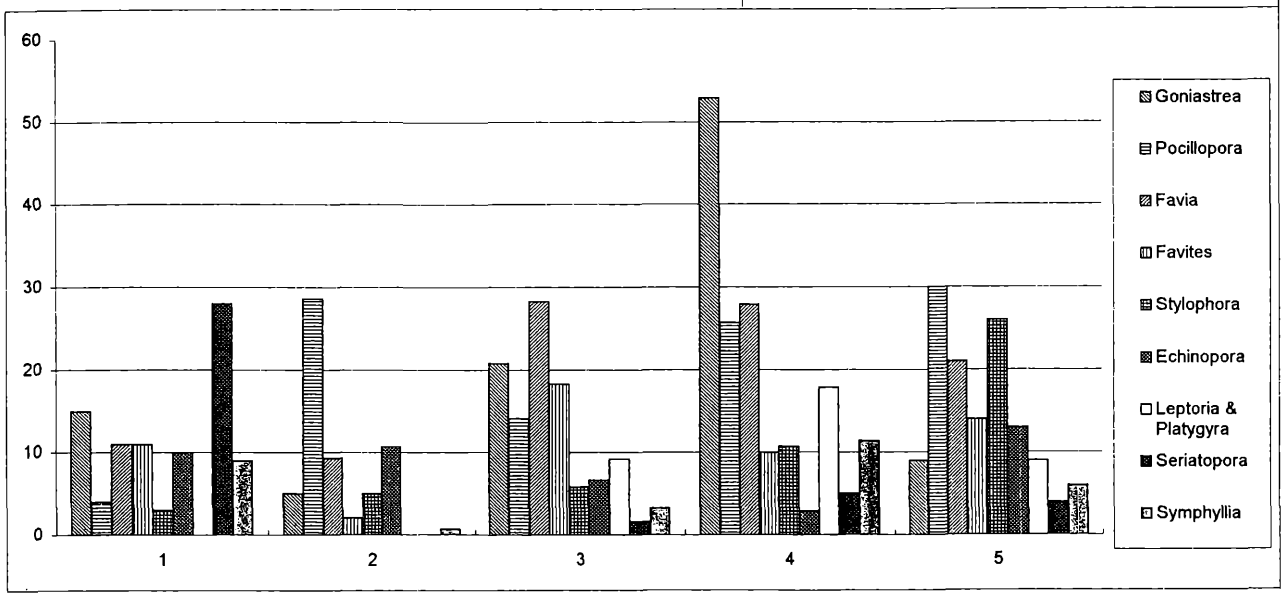
Site C: Fringing reef about midway of the NE shore of Lizard (Fig. 1). Platform dimensions very similar to Site WM, but reef slope less steep. High *Acropora* diversity, percentage of *A. hyacinthus* group low (Tab. 2). Live scleractinian cover, particularly that of *Acropora*, decreasing rapidly with increasing distance from the reef edge (Tab. 1, nos. 22–24). Spherical *Goniastrea* as well as *Leptoria* and *Platygyra* heads much more common than in other places (Tab. 1, nos. 26-28, Pl. 2/Fig.1). Mean intercept maximum of *Goniastrea* amounts 52.9 cm, of *Leptoria* and *Platygyra* 17.9 cm, and that of *Symphyllia* 11.4 cm (Tab. 3).

Site BB: Fringing reef at the southern end of the NE coast. Thus, the most exposed of the investigated sites. Five transects, nos. 29–33, from the edge to 4 m on the slope. Live scleractinian cover 43–63 % and *Acropora* clearly dominating with up to 4.45 m, being 70 % of the live scleractinian cover (Pl. 2/Fig. 2). *A. hyacinthus* group is much less common than at NR (Tab. 2). *Stylophora* is more often and regularly represented in the transects than elsewhere, mean intercept maxi-

Table 3: Mean coral intercept in 10m-transects at 5 sites at Lizard Island GBR of Australia (see text and Fig. 1, values in cm)

Coral	Sites (Numbers refer to diagram) RPL (1)	NR (2)	WM (3)	C (4)	BB (5)
Goniastrea	15	5	20,8	52,9	9
Pocillopora	4	28,6	14,1	25,7	30
Favia	11	9,3	28,3	27,9	21
Favites	11	2,1	18,3	10	14
Stylophora	3	5	5,8	10,7	26
Echinopora	10	10,7	6,6	2,9	13
Leptoria & Platygyra	0	0	9,2	17,9	9
Seriatopora	28	0	1,6	5	4
Symphyllia	9	0,7	3,3	11,4	6





mum 26 cm. That of *Pocillopora* and *Echinopora* amounts 30 and 13 cm respectively (Tabs. 1, 3).

A hierarchical cluster analysis of the 33 transects was carried out using live scleractinian cover values of all genera, neglecting the dead intercept. At a rescaled distance of 25, it yielded two main clusters: one with *Acropora* (Ac) >50 % of the live scleractinian cover, and another with <50 % respectively. Cluster 1 can be divided into 1a, with Ac 51–81 %, and 1b, with Ac >85 % (rescaled distance 10). Cluster 2, at distance 5, splits into 2a, where *Porites* has a share of 44–85 % (Tab. 1, nos. 4, 6–8), and 2b, where it is of minor importance and many coral genera are present (Fig. 2).

Another analysis, considering only *Acropora*, delivered three clusters at a rescaled distance of 15. The first cluster combines all transects with a small amount of *Acropora* intercept. The second is characterized by *A. hyacinthus* group, and the third by the occurrence of *A. (Isopora)*.

A further analysis was carried out neglecting the data of *Acropora*, *Porites* and „oc", the pooled very rare coral genera (Tab. 1). It delivered five clusters at a rescaled distance of 5. One of which combined transects with a larger intercept of *Goniastrea*, mainly from site C. A second and third cluster is characterized by a large amount of *Montipora* and *Diploastrea* respectively. Another cluster pooles transects with a generally greater variety of coral genera than in the last. A subcluster of the latter combines transects with a larger share of *Pocillopora*.

From the data in Tabs. 1 and 3, it can be seen, that *Montipora* was most common at NPI, *Goniastrea* at site C, *Favia* at WM and almost equally at C, *Pocillopora* at BB, also well represented at NR, *Favites* at WM, *Stylophora* and *Echinopora* both at BB, *Leptoria* and *Platygyra* at C, *Seriatopora* at RPL, and *Symphyllia* at C. The mean measurements of coral intercept are shown in Tab. 3.

4. Discussion

DONE (1982), obtained from subjective estimates along traverses, noted 17 types of coral communities in the central GBR. They are grouped in wave exposed, semi-sheltered and sheltered habitats. Nine types are named after *Acropora* species-groups or growth forms. In the present paper, all *Acropora*, including *A. (Isopora)*, are pooled. Its dominance at Lizard is attributed to the generally wave exposed situation of the reefs, knowing that „staghorn" growth forms, including *A. (Isopora) brueggemanni* from NPI, prefer sheltered habitats (GEISTER, 1975; ROSEN, 1975). Comparing the 1–2

m deep transects at the reef edge along the NE shore (Tab. 1, nos. 9–12, 16–19, 22–26, 29–31) with those from the lagoon (nos. 3–8), the correlation to wave exposure becomes evident. Live scleractinian cover, distinctly that of *Acropora*, decreases in the lagoon and fore reef areas (Tab. 1). Also, cover by *Acropora*, below 2 m, decreases with increasing depth (nos. 14–15, 20–21, 28, 33), and on the flat, with increasing distance from the edge.

At sites WM and C, three transects each were taken on the reef flat (1 m). Those from WM, nos. 16–18, are aproximately the same distance (1 m) from the reef edge, those from C, nos. 22–24, increase in distance (1, 3, 5 m). At WM, the share of dead versus live scleractinian cover is similar in all three transects, while it changes at C towards a decreasing live scleractinian cover with increasing distance from the reef edge. NELSON (1993) found similar results for stony corals of various growth form at Lizard.

As for *Acropora*, an equivalent correlation to wave exposure in their distributional pattern and frequency show *Pocillopora* and *Stylophora*. They occur mainly in exposed reef edges and uppermost slopes, decreasing with depth. Due to a general lower abundance in *Stylophora*, the similarity is less obvious. The regular occurrence of *Stylophora* in all transects, nos. 29–33, of site BB, the most exposed of all considered, fits well to the other indications of this situation. Colonies of *Porites* range second in the distribution at Lizard, occupying almost 10 % of the total live scleractinian cover (Fig. 2). Occurring in 28 transects, it characterizes 4 in the lagoon (Tab. 1). Huge colonies of *Porites* and *Diploastrea*, demonstrate not only the longevity of certain colonies but also the size range of frame builders (Pl.1/ Fig. 4).

Comparing the width of fringing reef platforms at Lizard Island sites, NR is wider than reefs at sites WM, C, and BB. NR appears exposed enough for a lot of the developing sediment being shifted away, and shelterd enough from severe damage by heavy waves. This, together with a shallower sea bottom there, allowed a more rapid reef development at NR. There, on the reef flat and slope near the edge, colony size of *A. hyacinthus* group was generally larger than at other sites (Pl. 1/Fig. 1, 3, Pl. 2). Probably due to less disturbance by heavy waves. Storm events brake away more of the fragil, branching, and table-shaped corals than semi-spherical and encrusting ones. Thus, coral genera with a massive growth are presumably contributing more to the reef frame work at Lizard Island.

In Fig. 2, all shallow NR transects are found in cluster 1, and cluster 1b combines three of them, showing the highest live scleractinian cover and dominance of *Acropora hyacinthus* group. Similarly, cluster 2a combines only RPL transects, characterized by *Porites*. Cluster 2b combines mainly deeper transects together with shallow ones with low live scleractinian cover due to increased distance from the reef edge (nos. 5, 23–24). In cluster 1a, three further subclusters are shown, of wich the middle one combines the two transects from NPI, where *Montipora* is contributing about 40 % of the live scleractinian cover. The other subclusters combine transects from locations and depths which are very similar and where distinguishable differences probably turn out only by taking many more transects into consideration.

In a cluster analysis, with only *Acropora* values considered, three clusters are gained. Cluster one consists of transects where *Acropora* intercept is low. This may be due to various reasons such as decrease in wave exposure and light. Thus, we find the deepest and all lagoonal (RPL) transects in here. In cluster 2 we find all transects with a considerable to high amount of *A. hyacinthus* group. These transects are from a depth of 1–3 m, indicating rather wave exposed sites except in transect 2 from NR, with only a considerable share of *A. hyacinthus*. Cluster three combines the transects with *A. (Isopora)* presence. These include sites of rather wave exposed as well as sheltered localities. At the exposed sites, sub-massive *A. (Isopora) cuneata* is noted, and at the shelterd sites staghorn type *A. (Isopora) brueggemanni*. Both growth forms are infested by the associated mytilid bivalve, *Lithophaga kuehnelti* (KLEEMANN, 1995).

In an attempt to exclude the influence of the dominating *Acropora* and *Porites*, their data and those of "oc" (Tab. 1) were neglected in analysis. Thus, it was tried to test whether common but not dominating coral could be indicative for certain reef areas. To a certain extent it worked, grouping transects with a larger share of *Goniastrea* to one cluster and another subcluster was characterized by *Pocillopora*.

Although the subjective semi-quantitative assessment during dives delivered in part more detailed information, e.g, the relative common occurrence of *Heliopora* at RPL, being not represented in the transects, the LIT-method, even with relatively few transects available, appears suitable to distinguish local reef sites.

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PLATE 1

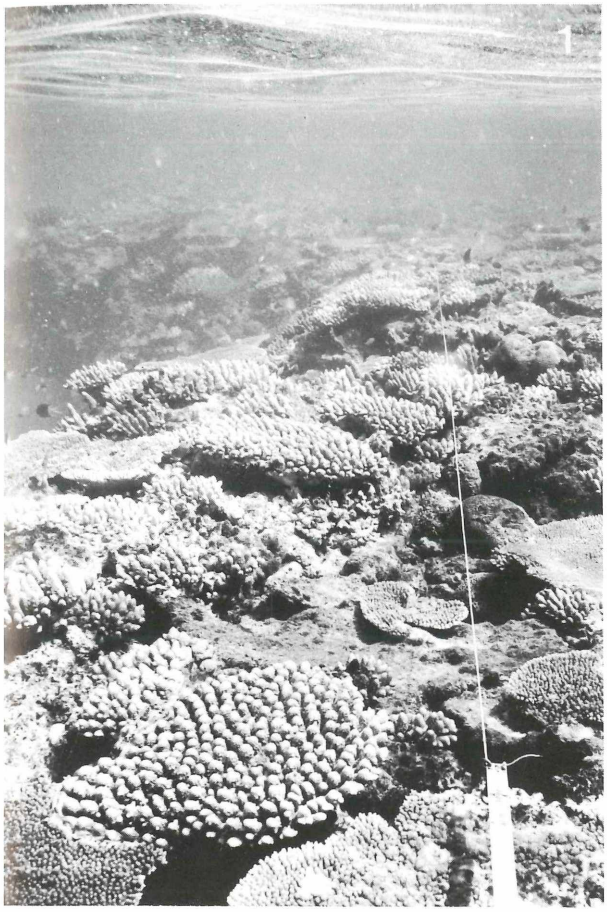
Fig. 1. Fringing reef at site WM at Lizard Island, GBR, dominated by *Acropora* spp., *A. hyacinthus* group important but less in comparison with NR (Fig. 3). Note transect line (no. 17 in Tabs. 1–2).

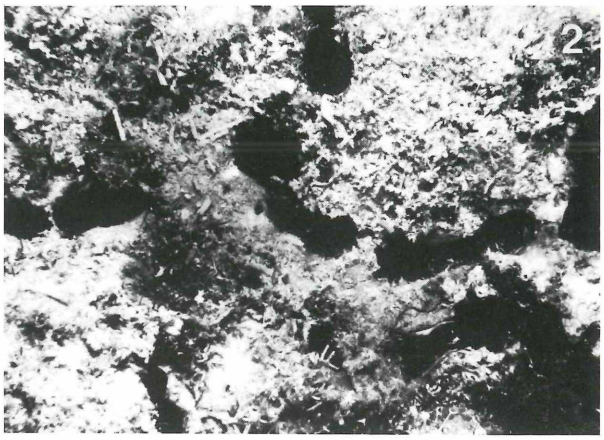
Fig. 2. Dead coral *Porites* from RPL at Lizard Island, GBR, densely infested by *Lithophaga obesa* (PHILIPPI, 1847) as demonstrated by the large figure-of-eight borehole orifices. Frame of print about 20 x 15 cm.

Fig. 3. Platform near edge of NR, Lizard Island, GBR, dominated by *A. hyacinthus* group. There, the highest cover with live scleractinians was observed.

Fig. 4. Reef slope at site WM, Lizard Island, GBR, with huge *Diploastrea* in the foreground (Tab. 1, nos. 20–21).

PLATE 1





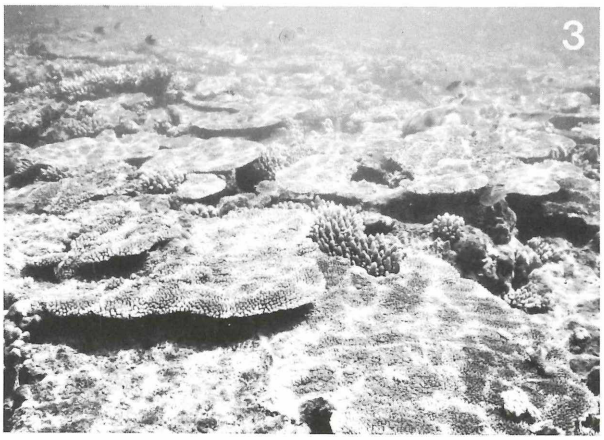


PLATE 2

Fig. 1. Reef platform near edge at site C, Lizard Island, GBR. Note the amount of spherical coral colonies, mainly *Goniastrea*.

Fig. 2. Reef edge and shallow slope at site BB, Lizard Island, GBR. Note the abundance and variety of dominating *Acropora* spp.

PLATE 2