EXPEDITION TO PULAU LANGOR, ANAMBAS ISLANDS, INDONESIA

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Report presented to

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SUMMARY

An initial survey of the coral reefs of Pulau Langor (Anambas, Indonesia in May 1996 using the line-intercept-transect method, showed live coral cover ranging from 55.75% to 66.94%. Dead coral cover was low (7.42% to 9.92%), while abiotic cover occupied 23.35% to 31.75%. Cover of other faunal categories was minimal, with little or no algal cover. Reef profiles of the north, south, east and west slopes showed that the reef flat extended 60-125m, before descending to depths of 20m or more. Old blast-fishing scars, in the form of circular patches of rubble were evident. Other reef fauna observed included 4 nudibranch and 1 opisthobranch species and 58 species of reef fish, dominated by Pomacentridae (17 species) and Labridae (15 species). The data collected will be useful as baseline data for future studies in the area. In addition, other invertebrates and vertebrates encountered on land were also recorded.

INTRODUCTION

The Anambas Islands are situated in the southern part of the South China Sea, about 100 nautical miles west of Peninsular Malaysia between latitudes 2°15' and 3°35'N and longitudes 105°30' and 106°35'E (Fig. 1). They comprise 20 principal islands and more than 200 islets over a 9,200km^2 area. Early literature on the fauna of the islands concentrated on birds (Oberholser, 1917); no information was available on the coral reef fauna. The islands of Anambas were described as "high and rocky, formed chiefly of hard rocks and laterite, and with a fringe of coral reefs about their bases" (Oberholser, 1917). The coastline of most of the islands are irregular, forming many bays and inlets, many of which are still lined by mangrove forests. The largest island in the group is Pulau Jimaja, with a land area of 325km^2. Pulau Siantan is the second largest island with an area approximately 80km^2. Pulau Matak and Pulau Mubur, north of Pulau Siantan, are geophysically similar to Pulau Siantan. Human population, estimated between 3,000 to 4,000 by Oberholser in 1917, is presently more than 10,000. The principal village is still Terempa, on Pulau Siantan. Smaller villages are scattered throughout the islands. The main activity has been and still is fishing, with scattered nutmeg plantations on the slopes of some islands.

Pulau Langor is a small islet situated north of Pulau Mubur, coordinates 3°22.6'N, 106°13.8'E (Fig. 1). No previous coral or fish surveys had been conducted on this privately-owned island. The islet is uninhabited, but two simple, open-air huts have been built along its shore by the owner - one on the beach, and the other floating 30m offshore (both facing west). The island is rocky and densely vegetated. The reef surrounding the island is teardrop-shaped, longer on the northern side and shorter in the south. The eastern and western reef flats are similar in length, but the western flat is sandy, with patchy coral growth just before the crest 50m from shore. The nearest settlement (on the island of Mubur) was about 2km away. This data collected will be useful as a baseline for future studies in the area. In addition, reconnaissance of the island, and the waterfall at Teluk Baruk, Pulau Siantan were conducted.

MATERIALS AND METHOD

Line-intercept transects (English *et al.*, 1994) were conducted at three sites along the fringing reef between 28 to 30 May 1996. At each site, five 20m transects were laid at the crest (approximately 2m depth) of the northwestern, western and eastern slopes of the reef (Fig. 2). Benthos was categorised according to English *et al.* (1994). At each point where the benthic lifeform changed, the transition was recorded. These transitions were used to calculate percentage cover of the benthic lifeforms.

Perpendicular-to-shore profile transects of the reef were conducted along the north, east, south and west slopes (Fig. 2). A measuring tape was laid from the shore following the contour of the reef (this is the tape distance) and depth and lifeform transected at every metre along the tape was recorded. The east and west profiles were conducted up to the 20m depth, the north up to the 17m depth, and the south profile to the 15m depth (a sandy seabed was encountered at this depth). The tape distance between the transition points was converted to horizontal distance from shore using the formula:

$$\text{horizontal distance} = \cos\left[\sin^{-1}(y_2 - y_1)/\text{hypotenuse}\right]$$

where y_1 and y_2 are the depths of the previous transition point and the next transition point respectively, and the hypotenuse = 1 (ie. the tape distance between transition points).

Fish species observed during the dives were recorded, but no abundance data was collected due to time constraints. Incidental encounters of other marine and terrestrial organisms were also recorded. This included species observed from two land excursions, one at Teluk Baruk, Pulau Siantan and the other on Pulau Langor and animals captured by the villagers at Pulau Siantan and Pulau Mubur.

RESULTS

Live coral cover at the three sites was high, ranging from 55.75% to 66.94%, with the highest cover at the western transect and the lowest on the northwestern (Table 1). Dead coral cover (with and without algal growth) was low, ranging from 7.42% to 9.92%, while abiotic cover was between 23.35% and 31.75%. Cover of other fauna was minimal, with little or no algal cover. Branching corals (CB) dominated the east and northwest slopes (Table 2) while the west slope was dominated by branching *Acropora* (20.57% cover). Submassive corals (CS) were also prominent, ranging from 5.67% (northwest) to 14.99% (east). Foliose coral cover was low, ranging from 4.04% to 5.68%.

The reef flat west, south and east of the island extended 60m to 70m from the island, while the northern reef flat stretched 125m (Fig. 3). The slope here also extended well beyond the 20m depth, unlike the other sites, where the reef slope levelled off between 14m and 20m. A box plot (Fig. 4) showed that a majority of the living benthos occurred between 0m and 5m depth, although they were also recorded further down the reef slope. Foliose corals had the widest depth range, occurring from 0m to 15m, but were more common between 7m and 14m. The mushroom corals (CMR) also had a wide depth range, between 1m and 10m. The main non-living benthos was rubble, which occurred throughout the depth range. Bare rock was only observed nearer shore, with constant wave action keeping coral colonisation to a minimum. Some benthos categories could not be plotted as they were encountered only rarely (eg. zoanthids and sponges), and there was insufficient data for the box plot computation.

Circular areas of coral rubble, approximately 2.5m in diameter, were observed along the northwestern flat. These were thought to be the result of old dynamite-fishing activities. All showed colonisation by coral heads (mainly *Acropora* species), some of which were >30cm across, indicating recovery. There was no evidence of recent dynamite scars.

Fifty-eight reef fish species were observed (Table 3), dominated by Pomacentridae (17 species) and Labridae (15 species). While no abundance data were collected, *Amblyglyphidodon curacao*, *Neopomacentrus filamentosus*, *Dascyllus aruanus* and *D. melanurus* from Pomacentridae and

Halichoeres spp. from Labridae were observed to be dominant. Economically important species, such as groupers (Serranidae) and snappers (Lutjanidae) were conspicuously absent from the reef. Schools of tuna (*Thunnus* sp.) were observed swimming around the island, and a large eagle ray (*Aetobatus narinari*) was sighted just off the western beach of the island.

Other organisms observed (Table 4), included four nudibranch and one opisthobranch species, two species of turtles and one terrapin, a mouse deer, a civet cat and a school of dolphins.

DISCUSSION

The coral reefs at Pulau Langor did not appear to be affected by human activities. Its high coral cover compared favourably to other reefs in the region that are not affected by human intrusion (Table 5). At Pulau Layang-Layang, Malaysia, for example, high coral cover (>55%) was observed at sites away from the resort development. The site adjacent to the resort had the lowest cover (23.8%). Similarly, study sites in the Philippines and Thailand located away from any developments showed high coral cover. The low soft coral cover observed also supported the assumption that this reef has had little human impact (Alcala *et al.*, 1991). The clear, sediment-free waters (visibility was approximately 20m) allowed coral growth to extend to the deeper depths. Zonation patterns were apparent, with the fast-growing *Acropora* corals and other branching corals dominating the reef crest, while the lower reef slope was dominated by foliose corals, which are able to capture light more effectively than other growth forms at these depths (Veron, 1986). Variation of coral cover on the reef was largely determined by exposure to the monsoons (Yeemin *et al.*, 1994), accounting for the slightly lower percentage coral cover at the northwest slop compared the east and west. Previous dynamite fishing activities in this area may also have had an effect on coral cover.

No fair comparison of fish species diversity between Pulau Langor and other reefs in the region could be made, as observations for this trip was done on an ad hoc basis, and covered only a small area. More extensive surveys of the surrounding islands are needed to bring the fish species

list up to par. However, certain characteristics were evident: pomacentrids and labrids were the main families on the reefs, fishing pressure has resulted in the rarity of economically important fishes, such as groupers and snappers, and pelagics were rarely observed (Luchavez & Divinagracia, 1994). This was also the case at Pulau Langor, with pomcentrids and labrids making up 55% of the fish species observed. Up to five fishermen in dug-out boats were observed around the island daily, fishing and collecting invertebrates, such as spider conch and top shells, either for sale or for consumption. Fishing pressure elsewhere in the Anambas was also high, as the population depended on fishing for their livelihood and as their main source of protein. Pelagics were also rare around the island, but schools of tuna were sighted along the channels between the islands, and there were reports of larger fish at the small islands and reefs ringing the archipelago. This rich resource is also under threat from illegal trawlers, several of which were impounded at the naval outpost in Terempa.

The paucity of nudibranch and opisthobranch fauna was surprising and were but a fraction of the diversity thought to exist in Anambas (M. Willan, pers. comm.). The low abundance was probably due to seasonal variations in their density, and the fact that only one island was surveyed. More extensive studies on the distribution of nudibranchs is needed.

Among the many marine organisms harvested in the area are turtles. One licenced collector (a local businessman) has also started a turtle release programme, as part of his permit to collect turtle eggs. Most of the turtles that visit the islands are hawksbills (*Eretmochelys imbricata*), with a smaller representation of green turtles (*Chelonia mydas*). A percentage of the eggs collected are incubated, the hatchlings reared until a year old, before being released at the beach where the eggs were laid. There is no monitoring programme of released hatchlings. The incubation facilities were also primitive: the eggs were laid out on a trough in a wooden hut. This raises the possibility of rearing single-sex batches of turtles as temperature could not be properly regulated (Miller & Limpus, 1980; Wood & Wood, 1982).

Another resource that could be overexploited are the large land crabs (*Gecarcoidea* sp.) observed on Pulau Langor. These crabs are sold as pets in the United States of America and demand for them could threaten their existence in the future.

Rapid population growth in the area has increased pressure on the islands and the reefs - expansion of the towns and villages have caused damage to the coastline and nearby coral reefs. The dead or dying reefs near some of the settlements have high algal cover (observed while snorkelling), indicating an increase in the nutrient load of the water, probably from discharge of pollutants and human effluent. Further, these areas were semi-enclosed and water exchange with the open ocean was limited.

Pulau Langor is presently not threatened by pollution and sewage from the settlement 2 km away, as the island is located near the open ocean which continually flushes the system with clean seawater. Development on the island has so far been restricted to the construction of the two bamboo huts. However, fishing practices need to be monitored to prevent a recurrence of destructive practices (such as dynamite fishing) and over-fishing. In general, management of developments and their impacts on the reefs in the Anambas area does not appear strong. However, good management programmes, such as the designation of marine nature areas in biodiversity-rich reefs or islands, coupled with monitoring programmes and enforcement on the ban on dynamite, cyanide and trawler fishing, will ensure that these islands remain productive and avoid the depredations of development.

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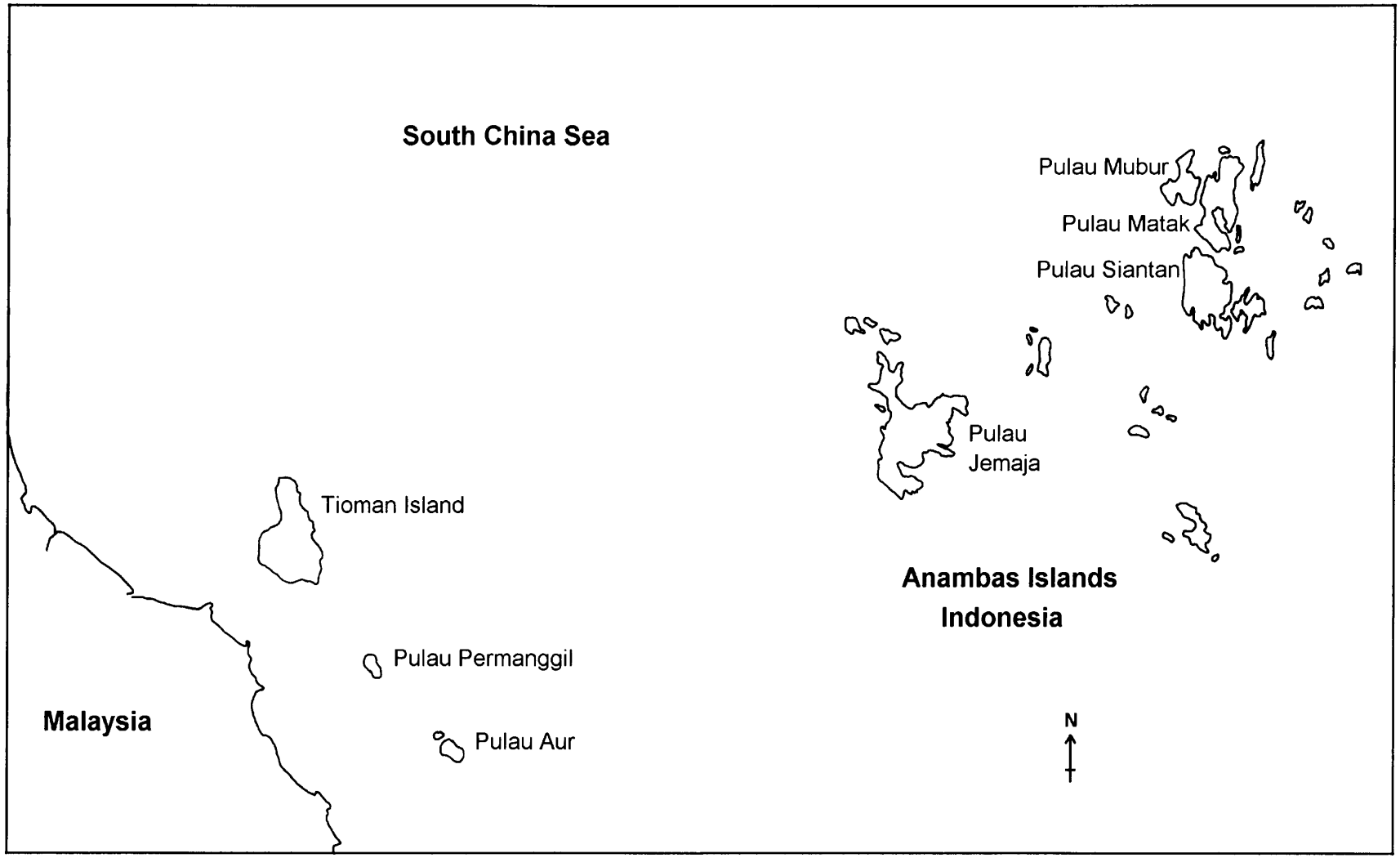

Fig. 1. Location of the Anambas Islands, Indonesia, about 100 nautical miles from the east coast of West Malaysia (not to scale).

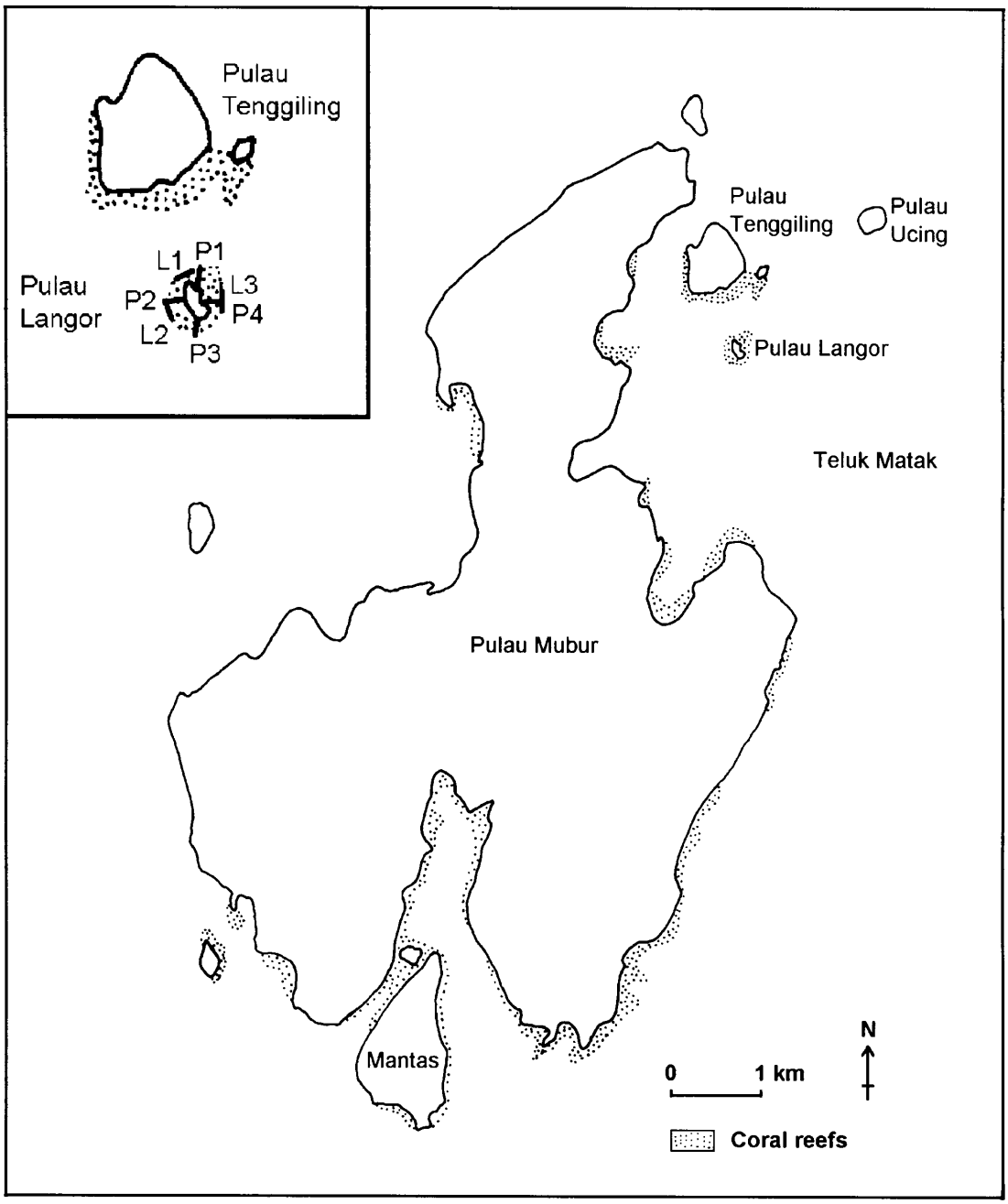

Fig. 2. Location of Pulau Langor, showing profile (P1: northern, P2: western, P3: southern, P4: eastern) and line intercept transects (L1: northwestern, L2: western, L3: eastern).

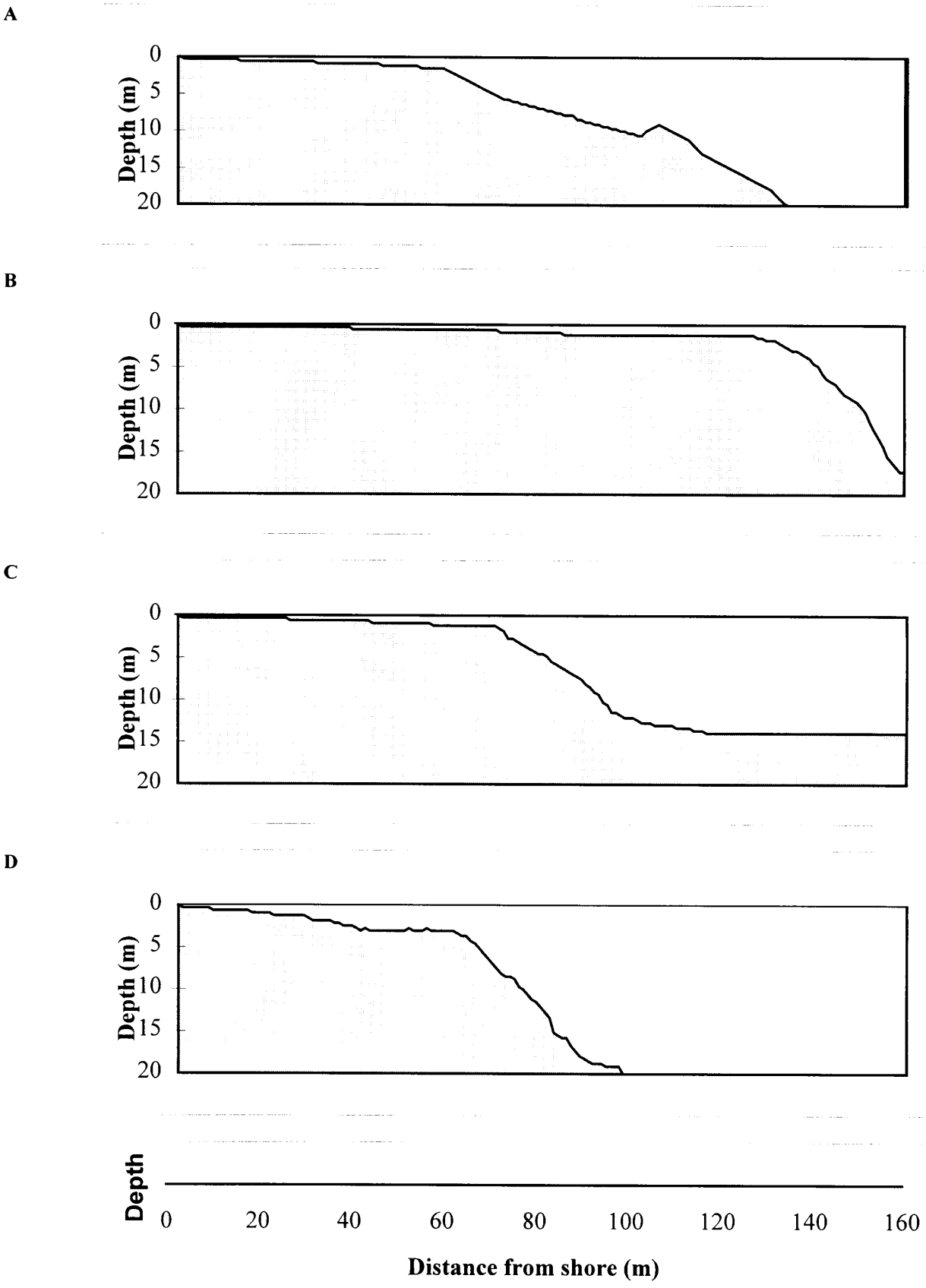

Fig. 3. Depth profiles in the north, east, south and west directions from the island. **A** West profile, 28 May 96; **B** North profile, 29 May 96; **C** South profile, 29 May 96; **D** East profile, 29 May 96.

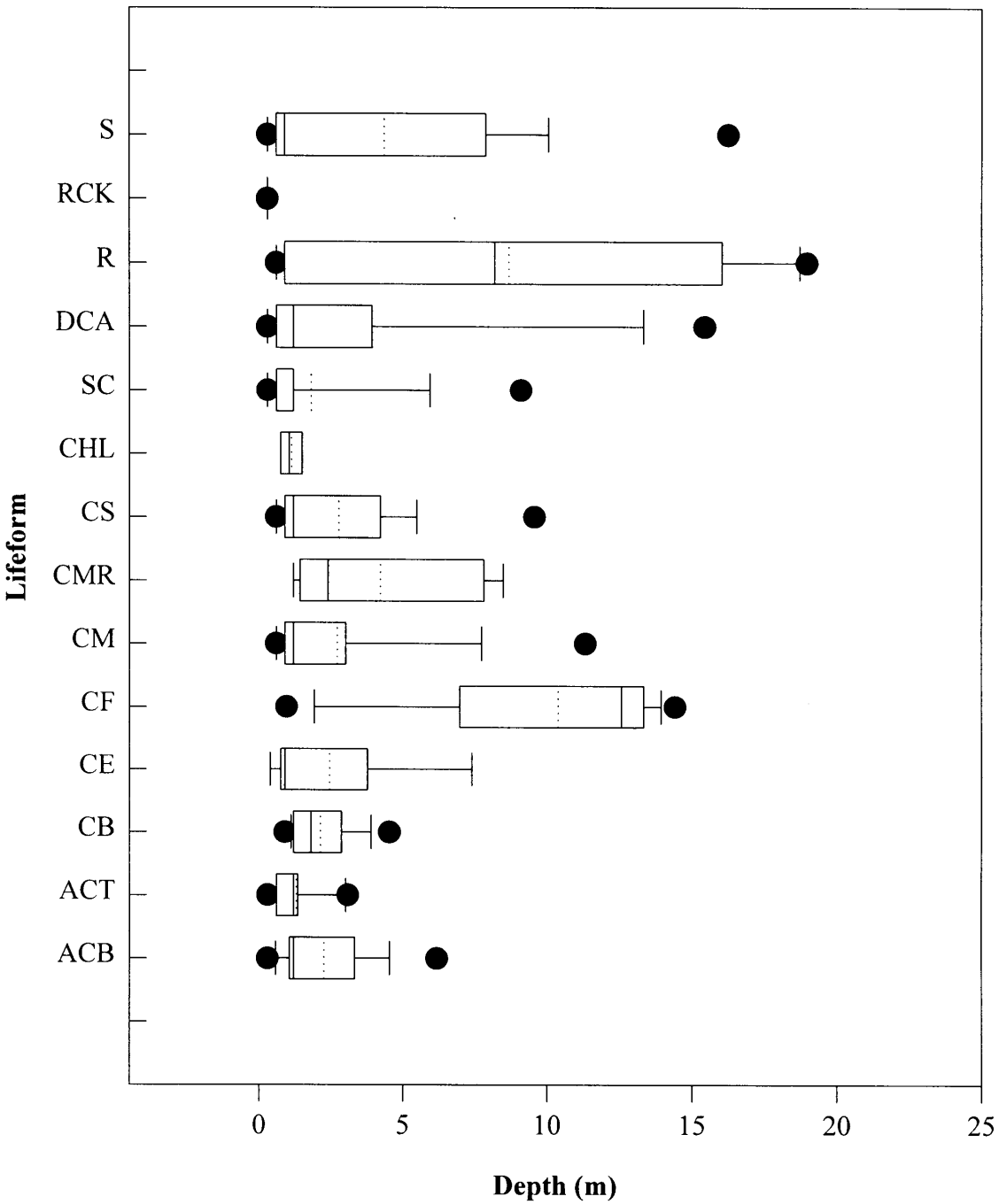

Fig. 4. Box plot showing distribution of lifeforms along profile transects. The box encompasses the 25th through 75th percentiles of the lifeform. The caps mark the 10th to 90th percentile points. The 5th and 95th percentiles are shown as the symbol (●). The median of the data is shown by the solid black line within the box, the mean by the dotted line. Lifeforms categories that have no symbols indicate insuffiecient data for percentile computation.

Table 1. Summary of line-intercept transects conducted at Pulau Langor, Anambas, Indonesia in May 1996.

Site	Live corals	Dead corals	Algae	Other fauna	Abiotic
Pulau Langor West	66.93	7.42	0.00	2.28	23.35
Pulau Langor East	64.26	8.42	0.07	0.31	26.94
Pulau Langor Northwest	55.75	9.92	0.60	1.98	31.75

Table 2. Hard coral lifeform percentage cover at Pulau Langor, Anambas, Indonesia in May 1996 (figures in parenthesis are no. of colonies, figures in bold indicate highest percentage coral cover).

Benthic lifeform	Code	West	East	Northwest
Acropora				
Branching	ACB	**20.57** (21)	5.11 (15)	0.57 (5)
Tabulate	ACT	0.00	1.14 (6)	0.00
Encrusting	ACE	0.00	0.00	0.00
Submassive	ACS	0.43 (3)	0.00	0.00
Digitate	ACD	0.00	0.28 (2)	0.00
Non-*Acropora*				
Branching	CB	13.87 (38)	**32.35** (83)	**35.91** (77)
Massive	CM	8.51 (27)	1.32 (3)	3.64 (16)
Encrusting	CE	1.65 (12)	4.21 (14)	4.71 (23)
Submassive	CS	14.12 (32)	14.99 (38)	5.67 (23)
Foliose	CF	5.68 (23)	4.78 (19)	4.04 (18)
Mushroom	CMR	1.04 (12)	0.08 (1)	1.21 (8)
Millepora	CME	0.00	0.00	0.00
Heliopora	CHL	1.08 (1)	0.00	0.00

Table 3. Fish species observed at Pulau Langor, Anambas, Indonesia in May 1996.

Family/No. of species	Species	Common name
Myliobatididae (1)	*Aetobatus narinari*	Spotted eagle ray
Apogonidae (2)	*Apogon compressus*	Split-banded cardinalfish
	Cheilodipterus quinquilinetus	Sharp-toothed cardinalfish
Blennidae (2)	*Atrosalarias fuscus*	Dusky blenny
	Cirripectes stigmaticus	Ember blenny
Caesionidae (1)	*Caesio teres*	Beautiful fusilier
Carangidae (2)	*Elegastis bipinnulata*	Rainbow runner
	Thunnus sp.	
Chaetodontidae (3)	*Chaetodon baronnesa*	Triangular butterflyfish
	Chatodon octofasciatus	Eight-striped butterflyfish
	Heniochus varius	Humphead bannerfish
Gobiesocidae (1)	*Diademichthys lineatus*	Yellowstripe clingfish
Gobiidae (1)	*Signigobius biocellatus*	Two-spot goby
Labridae (15)	*Cheilinus fasciatus*	Red-breasted Maori wrasse
	Diproctocanthus xanthurus	Yellow-tailed cleaner
	Epibulus insidator	Slingjaw wrasse
	Gomphosus varius	Bird wrasse
	Halichoeres hoeveni	Yellow-lined wrasse
	Halichoeres sp.	
	Halichoeres chloropterus	Green wrasse
	Halichoeres vrolikii	Vrolik's wrasse
	Labrichthys unilineatus	Tubelip wrasse
	Labroides dimidiatus	Bluestreak cleaner wrasse
	Macropharyngodon sp.	
	Pseudocheilinus hexataenia	Sixstripe wrasse
	Thalassoma amblycephalus	Rainbow wrasse
	Thalassoma hardwickii	Sixbar wrasse
	Thalassoma lunare	Moon wrasse
Lutjanidae (1)	*Lutjanus decussatus*	Checkered snapper
Mullidae (1)	*Parupeneus barberinus*	Dash-dot goatfish
Nemipteridae (1)	*Scolopsis bimaculatus*	Double-blotch spinecheek
Pinguipeidae (1)	*Parapercis hexophthalma*	Sharp-nosed weever
Pomacanthidae (2)	*Centropyge vrolikii*	Pearl-scaled angelfish
	Pygoplites diacanthus	Regal angelfish
Pomacentridae (17)	*Abudefduf sexfasciatus*	Stripe-tail damsel
	Amblyglyphidodon aureus	Golden damsel
	Amblyglyphidodon curacao	Staghorn damsel
	Amblyglyphidodon leucogaster	White-belly damsel
	Chromis viridis	Blue-green reeffish
	Dascyllus aruanus	White-tailed humbug
	Dascyllus melanurus	Blacktail humbug
	Dascyllus reticulatus	Reticulated damselfish
	Dascyllus trimaculatus	Threespot damselfish
	Dischistidus melanotus	Black-backed damsel
	Dischistodus perspicilatus	White damsel
	Neoglyphidodon oxyodon	Javanese damsel
	Neoglyphidodon melas	Black damsel
	Neoglyphidodon nigroris	Yellowfin damsel
	Pomacentrus alexanderae	Alexander's damsel
	Pomacentrus amboinensis	Ambon damsel
	Pomacentrus moluccensis	Molucca damsel
	Neopomacentrus filamentosus	Brown damoiselle
Scaridae (1)	*Scarus sordidus*	Garnet red parrotfish
Serranidae (4)	*Cephalopholis argus*	Argus grouper
	Cephalopholis sp.	
	Labracinus cyclopthalmus	Spottysail dottyback
	Plectropomus sp.	
	Siganus virgatus	Double-barred foxface
Tetraodontidae (1)	*Arothron stellatus*	Star-eyed puffer
Zanclidae (1)	*Zanclus cornatus*	Moorish idol

Table 4. Other marine and terrestrial invertebrate and vertebrate species recorded from the Anambas, Indonesia in May 1996.

Family	Species	Remarks
Platyhelminthes		
	Bipalium sp.	Land planarian
Nudibranchia		
Chromodoridae	*Ardeadoris egretta*	Found at 10m depth, Pulau Langor
Chromodoridae	*Chromodoris colemani*	Found at 8m depth, Pulau Langor
Chromodoridae	*Cadlinella ornatissima*	Found at 10m depth, Pulau Langor
Phyllidiidae	*Phyllidia coelestis*	Found at 10m depth, Pulau Langor
Opistobranchia		
Elysiidae	*Thuridilla* sp.	Found at 11m depth, Pulau Langor
Crustecea		
	Gecarcoidea sp.	Land crabs, Pulau Langor
Amphibia		
Rhacophridae	*Polypedates leucomystax*	Four-lined tree frog, Tanjong Baruk
Ranidae	*Rana chalconata*	Copper-cheek frog, Tanjong Baruk
Reptilia		
Cheloniidae	*Eretmochelys imbricata*	Hawksbill turtle
Cheloniidae	*Chelonia mydas*	Green turtle
Trionychidae	*Pelodiscus* (=*Trionyx*) sp.	Soft-shelled turtle, Tanjaong Baruk
Dermochelyidae	*Ophiophagus hannah*	King cobra, Pulau Siantan
Mammalia		
Cetacea	*Sousa chinensis*	Indo-Pacific dolphin
Tragulidae	*Tragulus javanicus*	Mouse deer
Viveridae	*Paradoxurus haemophroditus*	Civet cat
Pteropodidae	*Teropus vampyrus*	Flying fox, Tanjong Baruk

Table 5. Range of percentage coral cover at <5m depths of other reefs in the region ([1]Alcala *et al.*, 1994; [2]Mohd. Ibrahim *et al.*, 1994; [3]Yeemin *et al.*, 1994).

Reef name	Country	% coral cover (range)
Campuyo Reef, North Bais Bay[1]	Philippines	50.2
Pulau Layang-Layang[2]	Malaysia	23.8-65.8
Chalok Bankao Bay, Tao Island[3]	Thailand	15.0-35.0
Nang-Yuan Island[3]	Thailand	60.0-95.0