ZONATION AND DISTURBANCE IN' CORAL COMMUNITIES ON FRINGING REEFS

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This meeting asks the question "what's different or special about fringing reefs ?" I hope to show you two things:

First, that being adjacent to an island or the mainland provides environments which result in the development of some biological communities which are distinctive yet superficially similar to those found on open water reefs. Here, I refer to the zonation patterns of hard and soft corals and algae as compared with those on open water reefs.

Second, I suggest that because natural frequencies of catastrophic physical and biological disturbance in sheltered sections of the shore are very low, coral structures with unusually long return times can develop. I refer in particular to the large size and old age reached by individual corals.

Zonation Patterns: There are hundreds of species of corals, soft corals algae and many other organisms which attach to and form part of the coral reef structure. These are divisible into 'communities' which are defined by different forms of plants and animals which live together in the same zone of the reef. Zonation schemes are used to summarize the distribution of communities on reefs but I know of no scheme for fringing reefs on the Great Barrier Reef.

A zonation scheme for open water reefs off Townsville is presented in Table 1. This scheme relates the distribution of communities to the degree of exposure to waves. Wave exposure varies with depth and aspect on any single reef, as well as across the continental shelf. It is a very low resolution scheme which serves to illustrate only very broad similarities ; each community type contains a great deal of variability at the level of genus and species and there is considerable overlap in the composition of the communities (Done 1982).(The organisms listed in parenthesis in Table 1 are present in communities dominated by corals and in some places, they are more abundant than corals, sometimes as a result of recent disturbance - see below).

These communities track wave exposure on reefs as shown in Fig.1. Note both the absence of communities 1 and 2 from nearshore reefs (reflecting their lack of oceanic swells) and the upward shift in the depth range of communities in backreefs (reflecting the shelter provided by the reef platform). These general trends have been described on coral reefs throughout the world (e.g. Barnes et al. 1972; Rosen 1975, Geister 1977, Done 1983 - review). Observations by the author on fringing reefs at Murray Islands (outer shelf), Lizard Is (mid-outer shelf), Palm Islands,

Whitsunday Islands((nearshore), Starke River, Cape Tribulation (mainland) suggest that, the same general trends apply to fringing. reefs as open water reefs.

The composition of the biological communities vary down reef slopes, across reef flats'and along the coast, tracking wave energy environments broadly in accordance with Table 1. For a given fringing reef system, the absolute wave energy levels and the extent of the exposure gradient (hence the local zonation 'patterns) depend 'on the location of the reef on the continental shelf, the depth of the sea floor, and the complexity of the coast line. Islands with the greatest gradients in exposure plus the most complex coastlines and hence the greatest variety of habitats., have the greatest variety of community types. Conversely, open mainland coast or small and simple islands without sheltered embayments and a limited exposure gradient have a greatly reduced diversity of community types.

Return times for disturbed coral communities:

While low resolution zonation schemes such as Table, 1 and Fig.1 describe gross trends in the distribution of communities, it is also important to consider potential and actual changes in biological communities, as they respond to local ecological factors and to externally imposed disturbances which occur from 'time to time .Disturbance by storms, increased siltation, pollution or mass predation of corals may cause widespread and sudden shifts from coral dominance to algal dominance (severe disturbance) or to a lesser dominance by corals (intermediate disturbance).

The coral communities of sheltered bays and coasts are of considerable interest because such locations are favoured by man as well as by corals. While corals can attain great size, very old age (to several centuries) and/or very high densities in many reef habitats, sheltered bays are frequently characterised by coral populations with all three of these characteristics simultaneously (Potts et al. 1985) . The development of such populations is an indication of the ability of individual corals to persist in conditions which, until recently, were presumed to be stressful for corals, namely, high sediment loads, poor illumination, high variability in salinity.

There are management implications in this observation' 'which are as yet unresolved. Should it be assumed that the coral species involved are tolerant to conditions which are deleterious to other corals, and by implication, capable of tolerating increased stresses imposed on the reefs by human usage or adjacent land practices? Or should we conclude that the conditions have not been stressful, that the present dense populations of large colonies have developed simply by the present colonies occupying space and pre-empting its occupation by other colonies or by more opportunistic species ? A rider to the second interpretation is that physical and biological disturbance of a type that kills corals episodically and opens up space for new settlement must have been rare. This carries the implication that additional stresses

and disturbances associated with human usage and adjacent land use practices might not readily be absorbed, and that widespread coral mortality may result.

The time for restoration of the previous adult-dominated coral populations is often measured in decades to centuries, depending on the extent of mortality, the coral species involved, and the population structure prior to the disturbance. Coral communities of fast-growing species such as Montipora and Acropora can displace dominance by the seasonal brown algae Sargassum in the space of a decade (Done and Navin, in prep.) whereas slow-growing corals such as Porites , where they are locally dominated by colonies which are centuries old, may have much longer replacement times, depending on the severity of the disturbance (Done in prep.). The issues for conservation and mahagement of these very old communities are comparable to those relating to rainforest trees as in both cases, the old individuals contribute significantly to the physical structure of the habitat, and individual replacement times far exceed human life spans.

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Table 1

Comparison of Fringing Reef and Open Water Reef Communities (Corals and Algae)

Broad Community Types of Open Water Reefs		Fringing Reefs
1. coralline *algae* dominant (+ algal turfs)	Exposed	1. not seen on gbr fringing reefs except with corals
2. robust Acropora dominant (+ algal turfs and various macro algae)	↓	2. mid-shelf fringing reefs, surf zones
3. mixed corals, high diversity, often dominated by more lightly structured forms, especially Acropora . massive corals present (+ various macro algae, alcyonarians (soft corals))	↓	3. a)mid-shelf fringing reefs,slopes b)nearshore fringing reefs frequently:- i) cohabitation with Sargassum ii) replacement by Sargassum
4. mixed corals, high diversity, low acropora, often high Porites (+ soft corals)	↓	4. a)mid-shelf fringing reef-leeward bays b)nearshore fringing reefs i) high densities,, -large sizes ii) mud adapted morphology and life histories
5. coral isolates and solitary corals on uncolidated sediment (usually sand)	Sheltered	5. a)mid-shelf - lagoon floors, sand -terraces b)nearshore fringing reefs - muddy sea floor

Figure 1.

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