EPIBENTHIC COMMUNITIES ON THE ARTIFICIAL REEF WEST OF KOH LANTA, THAILAND

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ABSTRACT

Frame samples of epifauna organisms from 1 m^3 and 8 m^3 concrete modules showed no significant differences (ANOVA) with respect to proportions of barnacles and bivalves at two stations, and between vertical, upper, and under surfaces of the modules. A total dominance of *Balanus* spp. was probably due to high turbidity and shallow depth, 10 m. Barnacles constituted 98 % of the total dry weight per unit area. The fauna collected at the Koh Lanta reef is compared to a similar reef in clear water and greater depth.

INTRODUCTION

Artificial reefs serve as shelter, breeding area, and shoreline protection, leading to an increase in fishing grounds mainly for small scale fisheries. Thailand initiated an artificial reef construction programme in 1978, and 34 reef sets were constructed in the following 10 years in seven coastal provinces in the Gulf of Thailand and the Andaman Sea (White 1990).

Because enhancement of fisheries has been the main purpose of artificial reef constructions, most research has focused on their aggregating effect on fish (*i.e.*, Bortone *et al.* 1988; Campos & Gamboa 1989; Zahary & Hartman 1985; Bohnsack 1989). The benthic communities formed on the reef modules have been studied considerably less (Bohnsack & Sutherland 1985; Bohnsack *et al.* 1991; Ardizzone *et al.* 1989; Bailey-Brock 1989).

The composition of hard bottom communities on concrete reefs depends on the location with respect to depth (Moffitt *et al.* 1989), current speed and direction (Baynes & Szmant 1989), surrounding substrate (Bohnsack *et al.* 1991), and water conditions (Chang 1985). Besides, seasonal fluctuation of the composition of sedentary community has been recorded (Phongsuwan *et al.* 1994; Ardizzone *et al.* 1989).

It is essential to investigate hydrographic factors influencing the composition of sedentary species on the modules to find areas with optimum conditions before new reefs are constructed. The aim of this study is to estimate the distribution of benthic organisms on the artificial reef at Lanta Island to estimate the amount of food on the reef modules available to sea-farming of carnivorous gastropods.

MATERIALS AND METHODS

The artificial reef at Koh Lanta was installed in 1990 and consists of 2,160 concrete modules (1 x 1 x 1 m, referred to as small modules) and 720 modules (2 x 2 x 2 m, referred to as big modules). The reef modules were dumped randomly from a boat 8 km off the west coast of Koh Lanta in a 10 x 2 km area according to Andaman Fisheries Development Center, Phuket.

Two different aggregations of modules within that area were chosen: one station with small modules (N 7° 40.418' E 98° 58.151') at 9 m depth and one station with big modules (7° 40.599' E 98° 58.730') at 12 m depth. The two stations were located using satellite navigator (Tremple GPS).

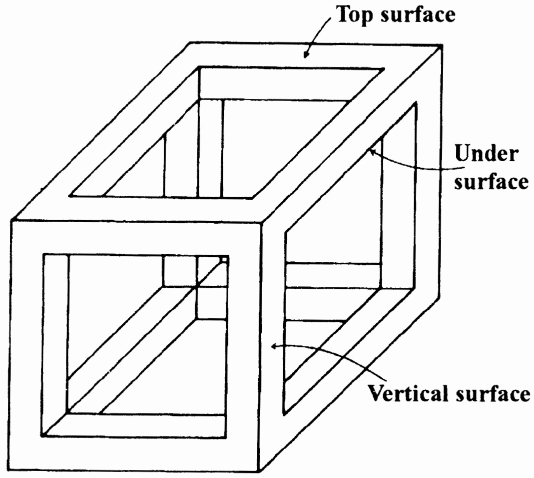

Figure 1. Diagram of a concrete module with the position of the sampling plots from top surface, under surface and vertical surface (Phongsuwan *et al.* 1994).

Samples were taken in March 1994. The sessile organisms inside frames of 20 x 20 cm (0.04 m^2) were scraped off with an axe and transferred to sampling net while SCUBA diving. Samples from the modules were of three categories: (1) top surface, (2) under surface, and (3) vertical surface (Fig. 1).
From each of the three kinds of surfaces, 5 samples were taken on small and big modules. The 5 samples from the vertical surface of the big modules were unfortunately lost due to rough weather. The other samples were preserved in 10 % formaldehyde. At Phuket Marine Biological Center, the samples were washed in a 2 mm sieve, sorted, identified, and dried for 24 hrs at 105 °C to obtain dry weight. One way ANOVA was used for statistical analysis (Sokal and Rohlf 1981).

RESULTS

Balanus spp. constitute approximately 98 % of the dry weight on the modules and no significant difference (ANOVA) between dry weight of barnacles or bivalves were found between the two stations. Statistical analysis (ANOVA) of the coverage of barnacles and bivalves on the three surfaces: top, vertical and under, did not show a significant difference, in part due to high variation among the samples and the massive cover of barnacles.
At station 1, the most dominant bivalves were *Saccostrea* spp. (34.8 g/m^2), *Barbatia fusca* (1.3 g/m^2) and *Modiolus philippinarum* (1.5 g/m^2). At station 2, the dominant bivalves were *Perna viridis* (18.2 g/m^2), *Saccostrea* spp. (14.4 g/m^2) and *Barbatia fusca* (1.3 g/m^2).

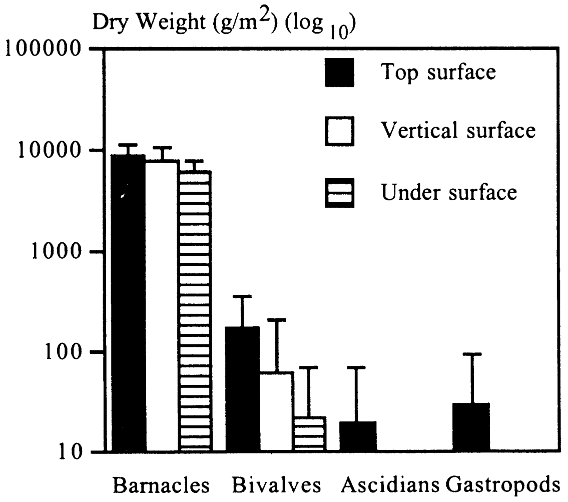

Figure 2. Distribution of epifauna and associated organisms at station 1.

During my observation of the artificial reef at Koh Lanta a qualitative study was made of common molluscs on the modules and in the vicinity of the modules. *Thais rugosa* and its egg capsules were found directly on the blocks. The bottom fauna in the vicinity of the modules seems to have a much higher species diversity of gastropods than found on the surrounding sand flats. Around the reef the following gastropods were found: *Melo melo* (often found spawning), *Murex* sp., *Fusinus colus*, *Conus* spp., *Strombus decorus decorus*, *Strombus vittatus vittatus*, *Turritella terebra* and *Tonna olearium*. Common bivalves on the modules not included in the quantitative samples were *Pteria penguin* and *Pinctada radiata*. Around the blocks mainly *Pinna bicolor* and *Paphia undulata* were found.

Table 1. The cryptic fauna on the modules from station 1 and station 2.

Major groups	Average number /m^2	Standard deviation
Gastropods	15.3	± 6.3
Crabs	311.5	± 54.4
Shrimps	49.5	± 3.6
Polychaetes	21.5	± 7.1
Brittlestars	97.5	± 31.8

DISCUSSION

Fauna in relation to turbidity. As stated in the introduction, biotic and abiotic factors may influence the composition of sedentary organisms on an artificial reef, making it difficult to explain why *Balanus* spp. are so dominant at Ko Lanta. However, available literature suggests that a key factor could be turbidity. Chang (1985) found that artificial reefs located in turbid water (visibility less than 1 m) were dominated by barnacles whereas artificial reefs located in clear water were not. Baynes and Szmant (1989) observed that areas with strong currents and low sedimentation support high species diversity, besides high coverage.
In Ranong Province, 200 km north of my study site, a concrete reef has been investigated extensively (Phongsuwan *et al.* 1994). The benthic faunal compo-

sition on the artificial reef at Ranong and the reef at Ko Lanta shows great differences. The Ko Lanta reef is dominated by barnacles while the reef at Ranong is dominated by *Saccostrea* spp. The Ranong reef is located at 17 m depth, exposed to strong currents and low sedimentation. Limpsaichol (1994) measured 8.55 m transparency, and total seston content of less than 7 mg/l. At my station west of Koh Lanta, Somkiat Khokiattiwong (pers. comm.) measured 3.2 m transparency, and the total seston content was 24,2 mg/l at the bottom. The Ranong reef has higher species diversity, and barnacles constitute only about one third of the total biomass depending on the season (Phongsuwan *et al.* 1994).

The reefs at Koh Lanta are located at 9-12 m depth, and the water is very turbid because of suspended mud from the nearby mangroves. In accordance with Chang (1985), I suggest that part of the explanation why *Balanus* spp. dominate the reefs at Koh Lanta is the high turbidity and the shallow water.

Competition for space. Space is often the most important limiting factor in a marine hard substratum environment (Jackson 1977) and a concrete reef is a space limited habitat providing an excellent substrate for sedentary organisms such as barnacles and oysters. According to Cornell (1972), species which contribute most to the structure of the mature hard bottom community are large, long-lived, and relatively slow growing, such as barnacles. Once the modules are covered by *Balanus* spp. living under good conditions, they constitute very space-competitive organisms. Generally, colonial animals outcompete solitary forms in space-limited habitats due to their reproductive pattern and the nature of their skeletons (Jackson 1977). The absolute dominance of barnacles is also related to their gregarious settling behaviour (Gabbott & Larman, 1987). But, a long term experiment is needed to identify the factors involved in this dominance by barnacles.

Sea-farming potential. Barnacles have been used successfully as food for *Chicoreus ramosus* in culture (Steenfeldt 1992). The artificial reefs at Koh Lanta constitute an excellent habitat for sea-farming of *C. ramosus* because of the large amount of food. Furthermore, the sediment of the surrounding sand flats is muddy and without cover, which is disliked by *C. ramosus* (Bech 1993). The snails are not encouraged to emigrate. Therefore, 2000 tagged juvenile *C. ramosus* were released on 20 different concrete modules at Koh Lanta. The results of that work will be given at the sixth workshop in 1995. It is possible that sea-farming of *C. ramosus* on artificial reefs could alter the dominance of barnacles. If space limitation is the most important cause for the dominant barnacles: then predation on them by *C. ramosus* could enhance settling of other organisms.

A dominance of oysters instead of barnacles on artificial reefs would be preferred from a commercial point of view, both to maintain the production of larvae to areas of oyster culture and to support harvest directly from the reefs.

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