TRANSPLANTATION OF CORAL FRAGMENTS

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INTRODUCTION

Coral reefs globally are increasingly under threat from environmental and anthropogenic factors, particularly the recent widespread bleaching and mortality of corals due to the temperature anomaly recorded during the 1997/98 El Niño. The active rehabilitation of reefs maybe necessary in some locations. Different rehabilitation methods require development for use in different conditions according to the constraints of area, availability of funding and reasons for rehabilitation. A number of studies have involved transplantation of parts of adult corals at a variety of technical, financial and spatial scales. Methods have included placement of loose staghorn *Acropora* branches (Bowden-Kirby, 1997; Lindahl, 1998) on suitable substrates, cementing corals to natural substrates using cement or epoxy-type glues, and cementing corals to movable bases (Obura, unpublished data). Transplantation can be used for management purposes in the rehabilitation of reefs (Harriott, 1988), and in conjunction with transplants of wider reef communities (e.g. Muñoz-Chagin, 1997).

The primary objective of this study is to investigate the capacity of coral transplants, covering a range of genera with different growth and life history strategies, in the repair and rehabilitation of degraded reefs. A secondary objective is to develop a suitable (efficient, economical and practical) methodology for the transplant procedure. Higher level objectives can be investigated in the long term, including three-dimensional complexity and diversity in the vicinity of the transplants. The study is conducted in the Mombasa Marine National Park, Kenya.

METHODS

Coral species used were *Porites lutea*, *Pavona cactus*, *Montipora spongodes*, *Echinopora gemmacea*, *Acropora* sp. (cf. *corymbose*), *Hydnopora microconos* and *Goniopora* sp. Small fragments were broken off parent colonies and immediately fixed using an epoxy "Quickset putty" as the cementing agent to a) natural reef substrate cleaned by scraping with a wire brush and b) small conical cement bases to enable movement of the fragments, held in place on the reef in holes on an elevated rubber rack (Figure 1). Coral fragments were left for >2 days to acclimatize to the manipulation. Size was measured at approximately 30 day intervals, recording height and base diameter for branching species, and maximum and a perpendicular diameter to compute projection are for sub-massive species. Losses and mortality were recorded and sample sizes made up by addition of new fragments. The results of three and four intervals of growth are reported here (number of intervals are varied due to the time of starting different species).

RESULTS

Positive growth was recorded only for *Echinopora*, *Hydnopora* and *Porites* on the racks, and for *Acropora* and *Montipora* on natural substrate (Figure 2). Negative growth was recorded in the remaining instances, with *Pavona* and *Goniopora* displaying negative growth rates for

transplants on both natural substrate and on the racks. Therefore, transplants of branching corals appear to do better on natural substrates and transplants of submassive corals grow better on the racks, with the exception of *Goniopora* and *Pavona*. Growth of the corals, particularly on natural substrate, was better during rough water conditions, decreasing during the calm transition between monsoons in November-December. During this time large amounts of fine silt accumulate on reef surfaces and are likely to stress benthic organisms.

Survivorship was high (> 80%) for all transplants except for *Acropora* on both racks and natural substrate and *Echinopora* on natural substrate. *Porites* suffered no losses or mortality on either the racks or natural substrate. *Echinopora* on the racks and *Hydnopora* on the substrate also exhibited a 100% survival rate. The lowest survival value was for *Acropora* on the racks, caused by predation by *Drupella* during the first interval. Replacement fragments survived at close to 90% for the remaining intervals presented here. *Acropora* and *Echinopora* showed significant long-term decline of substrate transplants.

DISCUSSION

The primary objective for this study was to investigate the capacity of transplants of different species of corals in the rehabilitation and repair of degraded reefs. One of the main findings so far was that sub-massive corals tend to fare better on elevated racks while branching species tend to do better when transplanted onto natural substrates. The difference is most likely due to algal competition and the accumulation of sediment in algae adjacent to the coral tissue margin (especially in calm conditions) and overgrowth of the coral by algae, that suppresses growth of non-erect corals. However, why branching corals should fare less well on racks is not clear. Future investigation will include the use of larger sized fragments to determine if the large amount of negative growth is a function of size.

Higher level objectives can be derived with the continued monitoring of transplants over the long term. The response of transplants to manipulations and transplanting to reefs with different environmental conditions enables research into species-specific differences in growth and survival. One possible outcome could be the development of a coral bio-assay in which the health and environmental conditions of varied reef systems could be assessed through the use of transplants of a species with a known and predictable response profile under well defined environmental conditions.

The two methods used for the study are relatively low cost with the following estimates per transplant (underwater materials only): approximately 6.50 Kshs (US$ 0.10) per coral fragment (on natural substrate), and 25-30 KShs (US$ 0.35-0.40) per coral fragment (on racks). However, further studies have to be performed before transplantation of corals by these methods can be considered a feasible rehabilitative technique for degraded reefs. Different transplant methodologies such as the use of cement will also be considered for evaluating the strengths and weaknesses of specific methods under different contexts, including economic.

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