Coral reef rehabilitation H6

Coral reef rehabilitation can be an expensive and labour-intensive activity, but there are occasions when it may be warranted in an MPA. This sheet provides general guidance on when it is appropriate, and on some of the methods that can be used.

Active rehabilitation can be used to aid recovery of damaged reefs by enhancing natural processes but is a controversial issue for three main reasons. Firstly, it can be expensive unless volunteer labour is available. Secondly, the activity may cause damage if coral colonies or fragments for transplantation are taken from healthy reefs, and finally, it has not yet proved effective on a large scale. Most attempts have been in areas of <100 m2, and have been experimental with little overall impact. Where rehabilitation is deemed necessary, the four approaches described below should be considered.

REMOVING NEGATIVE IMPACTS

This should always be the first priority, as it will encourage natural recovery. Many of the other theme sheets will help with this. More active techniques for reducing stresses include removing 'pest' or predatory species, such as sea urchins or crown of thorns starfish (see sheet H8).

INCREASING SUBSTRATE FOR SETTLEMENT

On a damaged reef, the availability of suitable substrate for larval settlement can rapidly decrease due to algal or soft coral overgrowth, and sedimentation. Minimising land-based sources of nutrient enrichment and maintaining algae-eating fish populations will help to reduce algae. Techniques for actively increasing suitable substrate, if essential, include:

Introducing artificial surfaces for larval settlement - concrete blocks, wrecks or other purpose-designed structures. Such artificial reefs may have an additional benefit for fisheries management (see sheet J8) but the cost may be prohibitive for large areas.

Encouraging natural surfaces - This can be done by stabilising or removing loose substrate material (such as coral fragments) and removing algae and other organisms that might inhibit larval settlement or damage young recruits. Certain substrates, e.g. *Goniastrea* skeletons, appear to induce settlement and larval metamorphosis. This approach should only be taken if expert scientific advice is available.

Creating new surfaces through electrolysis - This technique is not recommended, but has been tested in some WIO countries. Electrical currents are passed through a conductive material, such as chicken wire, causing calcium and magnesium minerals to precipitate from seawater to form a limestone framework. This requires considerable financial and human investment, and a source of permanent electrical current while the structure is being built. The long-term impact of the electrical current on marine life is not known.

TRANSPLANTING CORALS

Coral fragments or colonies can be removed from a reef and transplanted to natural substrate on a damaged reef, or to artificial substrates such as concrete blocks (provided these are secured to the seabed). Many species survive transplantation provided environmental factors are favourable, but it is expensive in terms of labour, unless volunteers can be used. Also transplanted fragments are highly vulnerable to dislodgement by waves and human disturbance, and are easily buried or smothered. The source of corals for transplantation must be chosen with care, to avoid damage to other reefs (preferably choose reefs that are likely to be lost from dredging or land reclamation). Transplantation has been carried out at several MPAs in Kenya (see case study) and Tanzania (Mafia Marine Park, Dar es Salaam Marine Reserves and at several sites in Zanzibar) with variable success. It is of greatest value in shallow, accessible sites that are important for tourism.

FARMING CORALS

Attempts have been made to farm corals, mainly in SE Asia. Coral fragments are transplanted to a protected site and 'grown out' to a certain size before being used for rehabilitation and for creating new fragments. The source

KEY POINTS FOR THE MPA

Rehabilitation should not be attempted if the damaging impacts are still present, and natural recovery may be a better solution. Managers must evaluate the potential success rates, cost-effectiveness and long-term viability of different methods and:

- **Identify the objectives of rehabilitation (e.g. biodiversity conservation, tourism, fishing, protection from coastal erosion) as these will help to determine methods.**
- **Determine the scale i.e. whether the area needing rehabilitation is small (e.g. anchor or boat grounding damage, dynamite crater), or large.**
- **Determine the cost in relation to available funding.**
- **Identify whether technical expertise and sufficient labour is readily available.**
- **Encourage active participation of those whose livelihoods depend on the reef.**

of fragments must be chosen with care, to avoid damage to other reefs. Coral farms potentially have an additional benefit as an attraction for snorkellers. Further investigation is required to reduce costs and increase success rates.

D. Obura

Transplanted colonies of *Porites* onto a larger dead colony in an MPA in Kenya.

Sources of further information

(see also sheet J7 Artificial reefs)

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van Treeck, P. & Schuhmacher, H. 1999. Artificial reefs created by electrolysis and coral transplantation: An approach ensuring the compatibility of environmental protection and diving tourism. *Estuarine Coastal and Shelf Science* **49** (suppl): 75-81. see also **http://www.uniessen.de/hyrdobiologie/e_framesite_meerdirect.htm**

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CORALations: bi-lingual field manual describing non-technical coral fragment planting and grow out methods for use by non-scientists in the Caribbean. **corals@prtc.net; www.coralations.org**

CASE STUDY

Reef rehabilitation initiatives in Kenyan MPAs

The 1998 El Niño-induced bleaching on reefs of Kenya resulted in very high coral mortality in many MPAs. The importance of these sites to tourism and fisheries replenishment provided a strong impetus to find methods that might accelerate reef recovery. With support from CORDIO, a comparison was therefore made between natural recovery processes and transplantation of coral fragments. Sites were selected in shallow reef lagoon areas in Mombasa and Kiunga Marine National Reserves and in Mombasa Marine National Park. All sites had been affected by the bleaching with 80-95% reduction in coral cover.

Small fragments of coral were taken from a source colony (seven species in Mombasa and four in Kiunga) and attached to cleared natural coral rock substrate with epoxy putty (in Mombasa) or to cement (in Kiunga). In Mombasa some transplants were also placed on tiles fixed to elevated racks. Over 100 fragments were transplanted at each site. The size of natural recruits, surviving colonies and transplants was measured every three months for one year in Kiunga and over a two year period in Mombasa. In Kiunga, the transplantation was carried out by fishers, KWS rangers, WWF staff and one scientist. One individual was designated to look after each site and visit it regularly to look for any problems, such as loss of transplants, signs of mortality or predation. In Mombasa the transplantation was carried out by scientists only.

The study found that recovery through recruitment and regrowth of surviving colonies was far greater than through transplantation. The growth rate of natural recruits was twice as fast as that of surviving colonies, while the lowest growth rates were those of the transplanted fragments. Average survivorship of natural corals, both recruits and surviving colonies, was over 80% whereas in transplants it was about 50%, dropping to under 30% after two years.

This study thus did not demonstrate a major value in transplantation, but rather that where natural recruitment is high or even moderate it is better to promote natural recovery. A further advantage of natural recovery is the much higher species diversity: in this study there were 31 genera among the natural recruits, but only nine species were involved in the transplantations.