EXECUTIVE SUMMARY

Coral reefs can be extensively damaged by natural phenomena such as cyclones, man-induced changes such as tourist developments, reefwalking, strandings, and pollution, or by the crown-of-thorns starfish. Estimates of the time required for the natural recovery of severely damaged coral reef systems varies from about five years to greater than 20 years. Management of damaged reef systems may require consideration of options to accelerate the rate at which recovery of the reefs naturally proceeds.

The objectives of the present study were:

- to test, in a field situation, procedures that would accelerate the re-establishment of hard corals in a damaged reef system;
- to compare the rate of natural coral recolonisation to the rate of accelerated coral recolonisation;
- to revise the handbook of methods for accelerated regeneration of corals produced in an earlier study with reference to the field results.

The following report is intended as a manual for those contemplating the regeneration of an area of reef for either management or financial reasons. It is not written as a scientific paper and experimental results upon which the manual is based are confined to technical appendices.

Techniques were developed and evaluated at Green Island Reef which had been affected several years earlier by the crown-of-thorns starfish. A project monitoring the natural regeneration at Green Island was undertaken concurrently and is reported separately, though the results contained therein are referred to where relevant.

The studies showed that the most practical way to accelerate regrowth is by the transplantation of large (>30 cm diameter) coral pieces. The use of large numbers of small fragments of coral (<10 cm length) scattered over the reef to 'reseed' the coral is not feasible because of their high rate of mortality. Large staghorn *Acropora* corals survive transplantation well, grow rapidly, occupy a large amount of space in relation to their weight, and look attractive. Their use for transplants is recommended. Pocilloporid (including 'brown-stem') and faviid (massive or brain-type) corals also survived well and are suitable for transplantation. Branching poritii corals were unsuitable mainly for aesthetic reasons.

Three-dimensional fragments of branching corals (i.e. with plentiful side-branches) survived better than straight pieces because they are raised off the sandy bottom and are more stable. There was little difference in the survival rates of coral pieces that were either attached to the substrate, or were carefully or randomly scattered, under normal conditions. However, in very shallow water or under storm conditions, attached colonies would almost certainly have increased survival prospects.

To minimise environmental stress it is advisable to transplant corals from sites which have a similar depth and degree of exposure to the transplant site. Corals survived for periods of several hours when transported out of water, but shaded. For travel periods longer than two hours, transport in water is recommended.

The effect on the collection site of removal of corals for transplantation was found to be small because relatively few corals are suitable for transplantation. Damage could be minimised by spreading the collection effort over the widest possible area.

Experienced divers, under conditions similar to those encountered during the study, could collect and distribute sufficient coral to cover an area of 10 m^2 with coral cover of 30% in one work hour (excluding travelling time). When costs of labour, boat charter, equipment expenses and travel time are included, coral transplantation can be very expensive.

Conclusions

Transplantation of large numbers of small coral fragments would bypass the initial slow process of recruitment and early growth, but is not considered feasible because of their very high mortality rates.

Transplantation of medium to large colonies or fragments is feasible and corals had a good survival rate. The costs however are very high.

The collecting effort for transplanted corals should be spread out over as wide an area as possible to minimise the impact, and at least 50% of a large branching colony should be left intact at the collection site to regrow.

In most reefs which have a supply of coral larval recruits, natural regeneration of damaged corals should be well advanced in 5 to 10 years after the damage.

Accelerated coral recolonisation is biologically feasible, and when it should be recommended remains an economic and management decision.