

ICRI Resolution on Artificial Coral Reef Restoration and Rehabilitation

This Resolution was tabled and discussed at the ICRI General Meeting in Seychelles on Wednesday, 27 April 2005. It was approved after 14 days of further discussion on the ICRIForum.

Recognising that there is often an urgent need to restore and rehabilitate coral reef and associated ecosystems following major damage;

Agrees that artificial systems cannot replace a natural coral reef and do not function as effectively as a living reef;

Agrees that some artificial rehabilitation and restoration may be appropriate under particular environmental circumstances for small areas of coral reefs of particular economic value or following maritime accidents or natural disasters;

Noting that there is a proliferation of artificial rehabilitation techniques and ‘engineering’ solutions;

Concerned about the lack of adequate scientific evidence about the ecological and economic effectiveness of most of these techniques and solutions;

Concerned that the limited financial resources for coral reef conservation may be diverted away from the most urgent tasks of removing chronic stresses;

Advises governments, international organisations and NGOs to examine carefully claims promoting ‘engineering’ solutions for coral reef rehabilitation and restoration, and to seek advice from the ICRI Operational Networks and other independent experts, and;

Agrees to establish an Ad Hoc Committee on Artificial Restoration and Rehabilitation with the following Terms of Reference and present an initial report on to the next ICRI General Meeting in November 2005:

Terms of Reference

- a. Request the International Society for Reef Studies (ISRS), in consultation with the Coral Remediation Working Group of the Coral Reef Targeted Research and Capacity Building program (of the Global Environment Facility, World Bank, University of Queensland, Intergovernmental Oceanographic Commission of UNESCO, the US National Oceanic and Atmospheric Administration) and the CRISP (Coral Reef Initiative in the South Pacific) to prepare a discussion paper. This paper should focus on the scale of the problem facing coral reef countries and assess the scientific evidence for the effectiveness of proposed ‘engineering’ solutions for coral reef rehabilitation compared to natural recovery mechanisms. Questions to be addresses, inter alia, are appended to this Resolution (Appendix 1);
- b. Prepare guidance for ICRI members on the suitability and effectiveness of different proposed ‘engineering’ solutions and present this guidance to ICRI for consideration and lodge this on ICRIForum and/or the ‘coral list’; and

- c. Prepare guidance for proponents of coral reef restoration and rehabilitation techniques on developing the most suitable and effective techniques and avoiding engineering techniques that may exacerbate environmental damage. This guidance should be presented to ICRI for consideration.

Appendix 1: The use of engineered construction for coral reef rehabilitation

Many techniques involving some form of engineered construction have been proposed as coral reef rehabilitation techniques. These include:

- artificial reefs (sometimes called restoration modules) constructed of different materials and in various shapes;
- ‘electric’ reefs constructed of metal and including an electric power source;
- re-cemented reefs using glue, cement, plastic or other binding techniques; and
- transplantation using living corals (and other organisms) from other areas.

Following damage to coral reefs from natural disasters, such as coral bleaching, tropical storms and the recent tsunami, governments and private organizations have naturally sought to repair damaged coral reefs rapidly to improve amenity for tourists and ensure fisheries productivity. Some proponents of engineered construction have made claims unsupported by scientific evidence that these methods have the potential to rehabilitate and restore damaged coral reefs (often with an inference that the repair will be effective and permanent over large areas).

The proponents of this ICRI Resolution are in agreement that:

- Artificial reefs of any kind cannot replace a natural reef and do not function as effectively as a living coral reef;
- Coral reefs can usually repair themselves quickly if environmental conditions are suitable, and chronic disturbances are reduced;
- Artificial reefs may offer some solutions for rehabilitation of reefs damaged through shipping accidents or to construct specific displays within aquaria or at severely damaged sites used by tourist operators, however, the current technology has not advanced sufficiently to develop such artificial reefs that function as a natural coral reef;
- The applicable scale of these techniques is to repair damaged reef areas of a few square meters, but such methods may never be viable or feasible for larger-scale coral reef rehabilitation on the scale of square kilometres;
- Long-term, peer reviewed scientific and cost-benefit studies are generally lacking to document reef restoration success or failure. Additional research should be encouraged and supported;
- These techniques have the potential to cause environmental damage to coral reefs and associated ecosystems during construction and operation;
- Investments in coral reef conservation and preservation should therefore focus on removing the causes of coral reef decline and facilitating natural and long-term recovery.

The proponents of this ICRI Resolution suggest that the following basic questions should be answered prior to applying reef rehabilitation methods:

- Is a lack of colonisable habitat a limiting factor for coral settlement and reef development?

- What is the area of damaged reef that is targeted for rehabilitation?
- What are the chances for natural recovery of the reef? For example: are there available natural sources of coral larvae; are there stable habitats for settlement; and are environmental conditions favourable for reef growth?
- What is the cost per square meter of treatment to achieve a viable, functioning reef?
- How much will a proposed treatment cost to repair a substantial area of damaged reef?
- What are the potential economic or sociological returns if a reef is rehabilitated?
- What are the likely impacts on surviving reef areas used as a source of collected transplant colonies?
- What is the likelihood of survival to normal growth and reproduction of colonies transplanted onto artificial structures?
- Have the causative stresses that led to reef damage been addressed/removed?
- Will any added structures be stable in the long-term and not degrade, thereby creating a future problem?

A fundamental problem on many degraded reefs is the well-documented shift in ecological function from coral dominated to algal dominated communities due to some combination of overfishing and eutrophication and, in some situations, soil run-off from adjacent land. These changes have affected hundreds to thousands of square kilometres of coral reef around the world over the past 25 years. On such damaged reefs, there is usually abundant and potentially available hard substratum for new settlement of hard coral recruits. The problem is often that any new coral recruits are quickly out-competed by algae.

Such a fundamental ecological imbalance is unlikely to be solved by adding artificial reefs, whether 'electric' or concrete. Rather, efforts should be focused on removing the cause of the imbalance. These methods frequently involve transplanting adult colonies to the artificial reefs, however, the survival and growth of these transplants cannot be assured if environmental conditions are not favourable.

Adult coral transplantation has been applied for over 30 years to rehabilitate relatively small areas (10s of square meters) of coral reef. In special cases, such as a ship grounding or a damaged 'house reef' of a tourist resort, it may be cost-effective to attempt rehabilitation if the reef has a high economic value for tourism, education or an insurance claim. In addition, artificial reefs may be useful for preventing beach erosion, for creating interesting structures for divers to visit, and for increasing habitat for fishes. Prior to attempting artificial rehabilitation, it is essential to reduce or remove the original causes of coral loss e.g. due over-fishing, sedimentation and nutrient enrichment.

A symposium was held in Phuket to examine rehabilitation of reefs in 1998; www.ncl.ac.uk/tcmweb/rehab/workshop.htm. Little has changed since 1998 to alter the conclusions of this meeting and they remain applicable: rehabilitation of large areas of reef through transplantation and artificial reef construction will generally be too expensive to be practical on a large scale; newly transplanted corals will probably die if the fundamental environmental imbalances that caused reef corals to die have not been remedied.

Summary:

- the scale of recent damage to coral reefs is of the order of 100s of square kilometres. The use of artificial ‘electric’ or concrete reefs, and adult coral transplantation to restore large reef areas is neither feasible nor prudent;
- the effectiveness of artificial reef restoration is unproven, potentially very expensive, and any construction project on coral reefs can potentially cause environmental damage;
- there is a substantial risk of misdirection of a scarce coral conservation funds and effort if rehabilitation/ restoration techniques are not used wisely; and
- promotion of artificial reef restoration may encourage a view that any reef degradation can be repaired to return reefs to a ‘natural’ state.

Gregor Hodgson, Executive Director, Reef Check

Clive Wilkinson, Coordinator, GCRMN

Richard Kenchington, Board Chair, International Coral Reef Action Network

Kristian Teleki, Managing Director, International Coral Reef Action Network

Richard Dodge, Nova University, Florida