

THE CHALLENGE OF CONSERVING AND MANAGING CORAL REEF ECOSYSTEMS

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ABSTRACT

Coral reef ecosystems are noted for their diversity and complexity. While they demonstrate a certain resilience under natural conditions, they have proven highly vulnerable and easily degraded under man's influence.

The integrated nature of many reef ecosystems and their interaction with terrestrial and oceanic influences limits the possibilities for resource management. The inadequate scientific understanding of the ecosystem also hampers the development of management strategies. The traditional resource management techniques of Pacific Island cultures may prove to be the best guide to methods of sustainable resource use on coral reefs.

A start has been made in conserving coral reefs in several South Pacific countries, using a variety of approaches. Unfortunately, local means have not permitted any study of the effectiveness of these efforts, and the protection of the region's reef resources is still far from adequate. Regional initiatives such as the South Pacific Regional Environment Programme are helping to advance coral reef resource management and conservation in the region.

The coral reef ecosystem occurs commonly along the coastlines and around the islands of tropical developing countries, where it is an important resource for subsistence, coastal protection, and economic development. The increasing use and misuse of resources throughout the world presents man with the challenge of conserving and managing coral reefs so that they can continue to provide benefits on into the future.

The conservation and management of coral reef ecosystems is a particularly difficult task for a number of reasons: the inherent characteristics of the ecosystem itself; its vulnerability under man's influence; and the inadequacy of the present scientific understanding of the ecosystem and how it functions.

The coral reef ecosystem is well known for its complexity and diversity, with perhaps more species within a small area than any other ecosystem known. Its long evolutionary history has allowed it to develop high levels of interaction between its components in both space and time, and on small and large scales. The result is an ecosystem noted for its high productivity even in a resource-poor environment, and for its efficiency in the utilization and recycling of energy and nutrients. There is increasing evidence of the dynamism and resilience of coral reefs under natural conditions, with a successional development of reef structures, a relative stability of reef ecosystems at large scales, and a large capacity for regeneration after damaging extremes at smaller scales.

It was long assumed that these characteristics in an ecosystem would make it more resistant and thus easier to manage, but the tropical environment of coral reefs has been one of the most stable over geological time, and when man pushes environmental factors beyond accustomed limits, or introduces new ones, the coral reef ecosystem has proven particularly vulnerable.

The direct destruction of coral reefs by dredging, construction or other activities can have effects far beyond the immediate area concerned. For instance, the migration routes of

fish and other organisms can be upset; damage to reproduction areas can reduce populations far beyond; food chains and the transfer of detritus can be interfered with; nutrient cycles can be interrupted; and the balance of construction and erosion of the reef framework can be altered.

The breaking or removal of corals is a serious problem in some areas. The effect is equivalent to cutting the trees in a forest; only a depauperate community is left behind.

Human activities frequently alter the water quality in coastal waters and affect reef-land interactions. As land is developed, terrestrial runoff changes, often with drastic effects on the turbidity, salinity, temperature, and sedimentation in the waters surrounding coral reefs.

Man also alters the chemical environment of coral reefs. Pesticide spills and the drainage of pesticide residues can have catastrophic or chronic effects. Nutrient inputs from fertilizers and urban wastes can upset delicate population balances, as can inputs of organic materials.

Fishermen find it hard to resist "just one more" or to grab at any opportunity that presents itself, and improved transport has reduced the number of areas protected by their inaccessibility, leading to increasing problems of overfishing on all coral reefs near significant population centers. Human ingenuity combined with modern technology have greatly increased the number of ways of killing fish, many of which (explosives and poisons in particular) are also highly destructive of other coral reef resources.

Furthermore, it is difficult or impossible to isolate a coral reef, as one might a park or reserve on land. Traditional park and reserve concepts and conservation approaches do not work as well in the sea, where the reef ecosystem is still subject to, and perhaps dependent on, oceanic and terrestrial influences.

The management of coral reef resources is further handicapped by the present inadequate scientific understanding of such complex systems. Johannes (1981) doubted that the scientific management of coral reef fisheries would be possible in this century. Predicting reef behavior under human stresses, or planning the restoration of a damaged area, are still well beyond current knowledge.

Unfortunately, with the present rapid rate of reef degradation, actions for the conservation and management of coral reef ecosystems cannot wait for adequate scientific knowledge to accumulate. A pragmatic approach based on educated guesses and common sense extrapolations from present understanding will have to serve until more information is available. Management guidelines will have to be worked out on a trial and error basis.

Efforts to conserve significant coral reef areas in the South Pacific have already begun. Early marine reserves in the region include the Ngerukewid (Seventy) Islands reserve in Palau (1958), the Yves Merlet Marine Reserve in New Caledonia (1970), Scilly Lagoon (1971) and Taiaro Atoll (1972) in French Polynesia, and Rose Atoll in American Samoa (1973). More recently, five coral reef reserves have been created in Tonga (1979), as well as the Palolo Deep Marine Reserve in Western Samoa (1979), Suvarrow Atoll Marine Park in the Cook Islands (1978), and Horseshoe Reef Park in Papua New Guinea (1981). New Caledonia has also recently created a rotating marine reserve on three major sections of barrier reef. Unfortunately, the enforcement of these reserves is often difficult, and the scientific resources in the region are too limited to study the effectiveness of these approaches to marine conservation.

Some regional efforts at coral reef management have started under the Regional Seas Action Plans. The South Pacific Regional Environment Programme (SPREP) has considered approaches to mapping coastal resources to permit more effective siting of developments and reserve areas. It is also planning guidelines for the management of coral reefs, following up on its earlier Coral Reef Monitoring Handbook (Dahl, 1981). In addition, it is supporting a project to strengthen the local management of coral reefs and other resources in rural areas by the users themselves.

In the absence of a strong scientific foundation for reef management, it is possible to look for guidelines in the traditional resource management techniques developed over generations by various Pacific Island cultures. Proper management of limited resources was

essential to these peoples' survival, and they developed many approaches of proven effectiveness. The following general guidelines are derived from these practices.

Access to a particular reef fishery or area should be limited to the number of fishermen able to fish the area efficiently on a sustainable basis.

The widest range of reef fishery resources (fish, shellfish, invertebrates, algae, etc.) should be used, rather than just the most desirable species. A broad but light pressure on resources will better preserve the balance of species.

There should be some permanent reserves, and other areas periodically closed to permit the regeneration of resources.

Resource use should be adjusted to protect the breeding cycle or capacity of each species, including limits on the consumption of rare resources. Such information is often part of local traditional knowledge.

Management of a coral reef can often be undertaken best by local people who have the most complete local knowledge of the status of the resource and its evolution over time.

Commercial fisheries development should be limited to areas where subsistence use leaves sustainable resources untapped. Too often in the past, commercial reef fisheries development has been at the expense of subsistence users, who in many cases already make full sustainable use of available resources.

The above approach to coral reef fisheries management, together with the better control of terrestrial influences (particularly those affecting critical habitats) and more integrated planning in the coastal zone, will help to meet the challenge of conserving and managing coral reef ecosystems in the years immediately ahead.

REFERENCES

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