

Coral reefs, a review

Roderick Stein-Rostaing

Sources of information mainly come from:

REEFS AT RISK: A Map-Based Indicator of Threats to the World's Coral Reefs

By Dirk Bryant, Laretta Burke, John McManus, Mark Spalding (1998)

World Resources Institute (WRI), International Center for Living Aquatic Resources Management (ICLARM),
World Conservation Monitoring Centre (WCMC), United Nations Environment Programme (UNEP)

The following is a review looking at the importance of coral reefs and what they do, and can provide for humanity. Also outlined are facts and figures on coral reef destruction and why this is occurring.

1. The coral reef as a source of wealth

1.1 The traditional sources of wealth

1.1.1 Fisheries

World wide there are 230,000km squared of shallow water coral reefs which occupy 0.2 % of the world's ocean. This ocean area provides habitation and breeding grounds for 25% of all marine fish species.

Coral reefs and their associated coastal ecosystems (e.g. mangrove forests) also provide habitation and breeding grounds for a large part of the commercial crustaceans and mollusc species. Damage to either associated ecosystem and the reduction to the overall fishing yield of all these fisheries will be swift and dramatic.

If properly managed a coral reef can provide 15 tons of fish and associated invertebrates per square kilometre, per year. On a global scale one fifth of all animal protein consumed by humans comes from the marine environment, which generates 50-100 billion dollars per year.

1.1.2 Coastal protection

Coral reefs provide extensive coastal protection from watershed erosion, which is important for maintaining coastal fish hatcheries. This protection has also provided storm protection to human habitation allowing the establishment of ports and towns.

About one sixth of the world's coastline is shielded by coral reefs. Loss of this protection will mean the loss of hatcheries for fish and crustaceans, and beaches for tourism and causing towns and ports to suffer from increased storm damage.

The main island of Mauritius, for example, has lost much of its coral reef protection ability and to achieve a man made alternative will cost the government \$30million for implementation alone, something the country's economy cannot afford. But the main areas that will pay the highest price by this loss of protection will be South and Southeast Asia. The coastal areas there are the most densely populated in the world so the loss of their reefs protection from the yearly typhoons will be measured in loss of human life rather than economic loss.

1.1.3. Building materials

Due to the composition of the coral substrate it is used by many tropical islanders as a source of limestone in the formation of cement. The living coral and the main coral substrate is removed by hand and crushed, giving limestone, which is added in the process of cement formation.

For example Mauritius islanders have extensively expanded their towns using mined coral in construction work. This has allowed the influx of tourists to the islands, which has helped their economy to expand.

1.2 The new sources of wealth

1.2.1 Tourism

Since the development of the personal scuba unit nearly 30 years ago, the number of westerners seeking tropical regions to undertake scuba diving activities has exploded. The influx of this new type of tourist has allowed many countries to derive a new mass of foreign income to their otherwise small economies. For example the Caribbean reef and beach industry was responsible for half the island's GNP, which in 1990 equated to \$8.9 billion. More than 100 countries could benefit from the recreational value of their reefs.

1.2.2 Aquariums

The use of tropical animals in private and public aquariums has expanded dramatically over the past 20 years growing from a \$30 million business in the early 1980s to a value of \$1.5 billion today. Since the early 1990s the industry has been growing at 12-25% per year and is the largest growing hobby in the world.

This has come about due to improvements in aquarium technology and transportation methods, which have subsequently caused an increase in accessibility to the private sector.

1.2.3 Partial sink for Green House Gases

A healthy coral reef will act as a sink for carbon dioxide, the green house gas produced in the largest quantity. The normal metabolic activities of corals lock up this carbon dioxide as calcium carbonate, which is used in growth. As long as the corals are alive and the reef is healthy, this carbon dioxide is kept within the coral's skeleton and not in the atmosphere where it would form clouds and add to global warming. Other fauna on the reef also lock up carbon dioxide during their metabolic activities.

1.2.4 Education through eco-tourism

The notion of eco-tourism has increased dramatically over the past 25-30 years due to increased public environmental awareness. Today non-scientifically trained people can go and help communities and environments in impoverished areas - a growing trend for the 21st century western tourist.

Eco-tourism not only helps the local economy of the host country, it also provides social and environmental help for the country's future generations.

1.2.5. Medicine

The wealth of new medicines that can be obtained from the ocean has only been acknowledged in the past 10 years. On coral reefs there is an estimated biodiversity of 900,000 species, and already the few corals, sponges, algae that have been studied for medical properties have provided new anti-cancer agents, anti-inflammatory agents and advanced UVC sun screens.

The potential for finding new antibiotics is huge as marine animals are exposed to over 3,000 more bacterial species than terrestrial animals.

2. The extinction of the coral reef

2.1 The fragility of the coral reef

2.1.1 Sources & causes of the dilapidation

The major threat to the world's coral reefs is the increase in human activities in and around tropical coastal areas. These activities include:

a) Coastal development and deforestation

Development of towns, houses, hotels and structures along the coastline, and inland deforestation activities mainly for agriculture and fuel causes an increase in sediment run-off and sediment in the water column.

This increase causes disruption to feeding, reproduction and settling mechanisms of the reef's fauna. The sediment increase can be tolerated up to a certain point after which the fauna is killed. Though the extent to which species can tolerate this increase does differ, any large construction project and / or large scale or prolonged deforestation will release sediment loads well above any species' tolerance level.

b) Inland pollution

Most coastal towns in developing countries have little or no sewage treatment facilities. This causes a release of high nutrient loads into a low nutrient environment, which causes algal blooms to occur regularly.

Along with sewage influx, coastal regions are subject to agricultural run-off, which can be huge in areas of cash crop growing. These fertiliser run-offs again cause algal blooms to occur and the pesticides and herbicides used are toxic to many reef organisms and can accumulate in the food chain causing severe illness and death to the local population.

c) Destructive fishing practices.

As the above effects reduce the reef's faunal assemblages the fish catches begin to decline rapidly. This forces local fisherman to resort to alternative fishing methods to increase their catch and reduce the effort required to get ahead of their rivals. These practices include cyanide fishing, dynamite fishing and hook fishing. All cause massive depletion to the remaining fish stocks as the methods are unselective and cause structural damage to the reef leading to loss of suitable habitation.

The decline in the fish populations will have negative feedback effects on the reef ecosystem allowing first algal, then more harmful seaweed species, to out-compete the other sessile fauna with greater efficiency.

d) Marine pollution

The two main sources of marine pollution are oil pollution from oil spills, oil drilling and everyday boat use, and heavy metal pollution from port dredging and ship dumping activities. Both cause long lasting disturbances to coastal ecosystems with heavy metal pollution having the greatest implication to the coastal population. The heavy metals, like pesticides, accumulate up the food chain and can get into the human population, causing severe illness, birth defects and infant deaths.

2.1.2. Irreversible nature of the destruction

Irreversible destruction will come about if all the above threats continue for a long period of time. These ongoing factors will cause the loss of feeding herbivorous fish species (about 50% of reef dwelling fish species), which will cause the smothering and loss of the coral and other sessile species, and eventually lead to a shift in the dominance of animals occurring on the reef's substrata.

The reef substrata then becomes dominated by algae and other non-reef building invertebrates like sponges which, over time, will degrade the reef substrata thus undermining the effectiveness of the reef for coastal protection, habitation for marine species, and therefore it will completely fail as a food provider for the local population.

Once this collapse and shift in the system has occurred (taking as little as a year), the commercial fishing trade too will eventually become economically unviable.

For the reef system to return to its original state naturally will take several hundred years if the human activities are reduced dramatically, or 50-100 years if stopped immediately.

2.1.3. Facts and figures

58% of the world's reefs are under some sort of threat from human activities. Of the reefs classified as threatened, 36% are threatened from overexploitation, 30% from coastal development, 22% from inland pollution and erosion and 12% from marine pollution.

The risk of damage (high, medium, low), from these threats to the 58% of coral reefs at risk is that 27% are at high risk, 31% are at medium risk and 42% are at low risk. This equates to reef areas of 67,900km squared having a high threat, 79,000km squared a medium threat and 108,400km squared with low risk.

2.1.4. The economic damage

The economic damage, which will occur from damage to a coral reef, will come about from the loss of tourism to the reefs, fisheries productivity and coastal protection.

For example, the Western Indian Ocean region, which comprises the east African countries and the islands of Madagascar, Seychelles, Mauritius, Comoros and Reunion, has seen its reefs heavily damaged by the 1998 bleaching event. The region's reefs comprise 36,100km squared and in the majority of this area the bleaching was severe. In the worst case scenario, in areas of heavy bleaching and with continued human pressures this will mean slow to non-existent recovery for the coral species and the reef system as a whole.

The long-term impacts of the destruction to the reefs will cost the fisheries \$1,361 million, tourism and recreation \$3,477 million, coastal protection \$2,152 million and other services \$1,200 million over the next 20 years. (Estimates based on valuation per sq km of reef with a 10% discount rate over the 20 years. Costanza et al. 1997)

Another example from averaged data for a global overview is a loss of 1km of reef will reap an economic loss of \$137,000 - \$1.2 million over a 25 year period.