
3 DAMAGE AND RECOVERY OF CORAL COMMUNITIES

The causes of damage to reef communities can be discussed under three categories: natural damage, man-induced changes, and damage caused by the crown-of-thorns starfish. The last was considered separately because of the lack of conclusive proof of the causes of population outbreaks.

3.1 NATURAL DAMAGE

The most frequent natural causes of reef damage are severe storms and cyclones, which produce physical damage from water movement, as well as fresh water run-off and high sediment load. Earthquakes, volcanic activity, red tide and unusually low tides and high temperatures are also known to damage reefs. On the Great Barrier Reef extensive bleaching of shallow water coral communities occurred in early 1982. This resulted in high mortality of hard corals, and may have been caused by an unusual combination of weather conditions.

Recovery of reefs from natural damage depends largely on the extent and type of damage. Below a certain level of damage, recovery may be relatively rapid. The recovery rate is also dependent on the species comprising the community e.g. a branching coral community may show extensive damage, but recover quickly as a result of regrowth of surviving fragments.

It has been proposed that where damage is so extensive that few adult colonies survive on a reef, recovery might be delayed by the lack of larval recruits that have to travel large distances from undamaged reefs. Recent evidence indicates that coral larvae may be capable of travelling large distances, and certainly larval periods of at least several days appear to be the rule rather than the exception.

We found in a comparative study of juvenile coral recruitment at Green Island and two nearby reefs that the number of juvenile corals was very much higher at Green Island (which had very low coral cover), than at the other reefs studied (Harriott and Fisk, 1988). This result gives some indication that recruitment of corals may not limit recovery of the coral community, provided the reef is 'downstream' from a source of coral larvae. Coral recruits may also come from corals in undamaged areas of the same reef, and for at least some species and reefs, this could be the dominant form of recruitment.

Extreme low tides have been documented to cause extensive mortality in Red Sea and Pacific Ocean reefs. The rate of recovery of reefs from damage was found at one site to be dependent on whether or not the reef was polluted by oil. On a polluted reef, recolonisation by coral planulae may be inhibited and recovery would proceed slowly.

3.2 MAN-INDUCED CHANGES

Damage to reefs may be acute (one sharply defined event) or chronic (occurring over an extended period), and the two types of damage will have different effects on the community. The period of recovery from an acute event will be similar to that following a natural disturbance, i.e. it will depend on the extent of the damage and the condition of the reef afterwards. Recovery from chronic damage will depend on whether the cause of the damage has ceased, and whether the changes in the environment are long lasting.

3.3 PREDATION BY CROWN-OF-THORNS STARFISH

The history of episodes of crown-of-thorns starfish outbreaks has been discussed many times but there has not been conclusive proof of their causes. Large numbers of the starfish were first reported on the Great Barrier Reef in the early 1960s at Green Island. Over 80% of the coral at Green Island was consumed by the starfish during that period. Starfish populations were subsequently reported on reefs generally to the south of Green Island, but by the late 1970s there were few large populations on the Great Barrier Reef.

A second major population outbreak occurred in the Green Island region in 1979/80. The starfish population was estimated to number several million, and an estimated 90% of the hard coral was killed at Green Island. In 1983/84 large numbers of starfish were present on reefs off Townsville.

The effects of crown-of-thorns starfish on hard corals and subsequent coral recolonisation is relatively well studied. The preferred corals of the adult crown-of-thorns starfish are the branching and plate *Acropora* corals, and to a lesser extent, the massive corals. Factors that affect the rate of recolonisation include the size of the patch damaged, the number of corals or coral fragments left alive after the starfish had left the area, and the availability of coral larvae. Estimates of recovery times (i.e. to coral cover levels the same as before the starfish) are generally in the order of 10 to 50 years.

The definition of recovery will greatly influence the interpretation of recovery times. For example, some species, including many of the plate and staghorn *Acropora* species, are fast growing and recruit rapidly. In a few years following damage a community rich in these species may have a high coral cover but may still lack many of the species present before the damage occurred.