# STATUS OF THE CORAL REEFS OF MALDIVES AFTER THE BLEACHING EVENT IN 1998

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## INTRODUCTION

A pilot reef monitoring study was conducted in 1998 to assess the extent of coral bleaching in the Maldives. The aims of this monitoring exercise were:

1. To quantitatively document the post-bleaching status of the shallow-water coral communities on the reefs of the north, central and southern regions of Maldives.
2. To estimate bleaching-induced coral mortality by comparing data yielded by the pilot survey with data from previous surveys, especially those sites for which historical data are available.

## METHODS AND SURVEY LOCATIONS

### *Site Selection*

The reef area of Maldives is enormous and the resources available for monitoring it are small. Reefs that would provide a description of the current post-bleaching status of the coral communities throughout Maldives were selected. The sampling sites were chosen in the following region (Figure 1):

- *Haa Dhaal* (north and a regional development target)
- *Male* (east central with intensive tourism and other commercial activities)
- *Ari* (east central with intensive existing tourism development)
- *Vaavu* (south central with a community-based integrated island resource management project underway).
- *Addu-Gaaf Alif* (south and a regional development target)

In each of these regions three reefs were selected ensuring that reefs that had been surveyed in the recent past were included thus providing baseline data against which data obtained from this study could be compared.

Because virtually all of the previous studies were conducted on the reef top and for logistical efficiency, all of the quantitative surveys conducted in this pilot study were conducted on the reef top also. Surveys were also confined to inner reefs within the atolls because this is where past surveys had been conducted and also because the surge caused by oceanic swells ensures that working in shallow water on outer reefs is usually impossible.

## SURVEY METHOD

On each surveyed reef, data from three line intercept transects of 50 m (English *et al.*, 1997) were recorded in areas near the location of past survey sites and where physical conditions such as wave action permitted. Occasionally, when it was judged efficient to do so, a 50 m long line point insect transect was used. Surveys of the same sites were repeated in 1999 as part of an ongoing monitoring programme to assess the status of the reefs and to compare the results with those of the post bleaching study. It is anticipated that these sites will become permanent monitoring sites and will be surveyed annually to provide an insight to the processes of reef recovery especially after the bleaching in 1998.

**RESULTS**

A summary of post-bleaching data shows that the mean cover of live coral was 2.1% and ranged between 1.0% and 3.1% among the different atolls surveyed (Table 1) which is comparable to MRS Reef Check estimates of 1.7% (Table 2). This is in stark contrast with pre-bleaching levels of 46.5% (Table 2) and 37.4% (Table 3) (Figure 2). Although the cover of live coral is uniformly low, there is a suggestion of slight difference among atolls. Members of the family Acroporidae, excluding *Astreopora*, were rarely seen on the reef top, whereas poritids and agariciids, despite suffering high mortality, have survived best.

Results from the 1999 surveys show that the mean cover of live coral is 1.9% and ranges between 0.33% and 3.04% among the atolls surveyed (Table 4). These results are compared with those of the post bleaching study and are shown in figure 3.

**DISCUSSION**

The post bleaching study data show that only a small amount of live coral cover (~ 2%) remains on the reef tops surveyed. Qualitative observations made by many other people in other parts of the country are consistent with these quantitative surveys and lead to the conclusion that this is the general condition of reef tops throughout Maldives. Surveys conducted before and during the bleaching event indicate that live coral cover was approximately 20 times greater prior to the event. Although quantitative data describing the abundance of *Acropora* and *Pocillopora* prior to bleaching are unavailable, it is well known that they were common. Indeed, *Acropora* was often the dominant coral on many reefs.

Repeated surveys of the same sites six months later indicated the cover of live coral remained very low at all sites. Indeed, each site surveyed, with the exception of Ari Atoll and North / South Male, possessed less live coral one year after the bleaching event than it did immediately after indicating subsequent mortality of corals and negligible recovery. Furthermore, it is suspected that Ari and Haa Dhal Atolls were affected more than the other regions surveyed and the low level of coral cover was consistent with consecutive sampling.

Despite the grim picture painted by these data, the survey team has observed new coral recruits at all sites. Re-colonisation of fast growing branching growth forms were observed ten months after the bleaching event, indicating that reef recovery processes were already underway (Clark *et al.*, 1999). Several observations bode well for the recovery of these reefs. For example, many of the new recruits belonged to the genus *Acropora* which was the genus most seriously affected

by the bleaching in 1998 (Figure 4-5). In addition, on some reefs encrusting coralline algae are abundant (Figure 6) providing potential areas for coral settlement and recruitment and in some regions (e.g. Haa Dhaal) large *Acropora* tables that were believed to be dead are regenerating live tissue indicating prolonged recovery of some species of coral.

The impacts of the 1998 bleaching event will not be fully understood for some time. However, it is clear that reefs will be modified as a result of this bleaching event. In the short term (< 5 years), reefs formerly dominated by branching species will be dominated by non-living substrate supporting only a low percentage cover of living corals of which the majority will be massive species. The consequences of bleaching for the reef framework will largely depend on the transport and fate of calcium carbonate ($CaCO_3$) fragments. Where reef disturbance is severe, boring and grazing organisms may remove $CaCO_3$ faster than primary frame-builders can add to it (Figure 7). Such biogenic processes will determine whether the integrity of the reef structure will be compromised.

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