

THE REEFS OF THE GRANITIC ISLANDS OF THE SEYCHELLES

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INTRODUCTION

The status of coral reefs in the granitic islands of the Seychelles archipelago has been assessed by two independent surveys following the mass mortality caused by the 1997/98 bleaching event. Engelhardt (2000), working in collaboration with the Seychelles Department of Conservation surveyed 15 sites located mainly on the north west coast of Mahe during November and December 1999. During January 2000, Turner, Klaus, Hardman and West, working in collaboration with the Seychelles Marine Park Authority, surveyed 46 reef sites mainly to the east of Mahe, including Ste Anne, Ile Moyenne, Ile Cerf, Cousine, Praslin, Curieuse, La Digue, Grand Soeur and Felicite. Reefs around the granitic islands are shallow and rarely exceed 15 m depth. Both surveys aimed to assess reef structure over the full depth range, with corals identified to genus and species where possible, and assessed reef recovery by recording new colonies believed to have established since the bleaching event.

METHODS

Engelhardt surveyed 11 sites at a fine scale along the north west coast of Mahe, from Lighthouse to Baie Beau Vallon, with three additional sites at Conception Island, Moyenne Island, Beacon Island and Marianne Island to the east (Figure 3, open stars). Two 50 m x 5 m belt transects were employed at each site, at an oblique angle from a depth of 1-2 m to 15 m. Coral community structure was sampled in two 10 m x 1.2 m sub-transects by recording coral taxa in size classes 2-15 cm, 16-30 cm, 31-50 cm, 51-75 cm and >75 cm diameter. Coral cover was assigned to 10% range categories. Estimates of sea urchin densities within 250 m², level of sedimentation by a visual technique on disturbed sediment, and percentage cover of coralline algae were also recorded.

Turner, Klaus, Hardman and West used a rapid site assessment technique to assess reef composition and health over approximately one-hectare (100 m x 100 m) areas at 46 sites across the granitic islands (Figure 3, closed stars). It was not possible to survey northwestern exposed coasts during this period due to the monsoon. A two-tier approach was employed using a visual assessment of reef development and benthic cover combined with a taxonomic inventory. Sixty to 120 minutes were allowed for each survey, depending on whether snorkelling or S.C.U.B.A. was required. A team of four surveyors swam in a 'zigzag' pattern across the area, each with a specific: visual recording, video recording, and photography.

The visual recorder described the state of reef development as (a) reefs with extensive flats (b) reefs with moderate flats (c) reefs with no flats but with carbonate accretion (incipient reefs) (d) coral communities developed on non-reefal rock, sand or rubble. A six point index was used for percentage cover and abundance and was applied to live cover, substrate type and abundance of organisms (0 = Absent 0% 0 individuals; 1 = Rare <1% cover or 1 individual; 2 = Occasional 1-10% or 2-10 individuals; 3 = Frequent 11-30% or 11- 20 individuals; 4 = Common 31-50% or 21-50 individuals; 5 = Abundant 51-75% or 50-100 individuals; and 6 = Superabundant 76-100% or >100 individuals). Live cover was categorized as hard coral, dead standing coral, soft coral, turf algae, macro algae and other. Substratum categories used were hard substrate, continuous pavement, substratum in blocks >1 m, blocks <1 m, unconsolidated rubble, sand and silt. Organisms were identified to genus or species wherever possible. Coral colonies were classed by size into 1-10 cm, 11-25 cm, 26-50 cm, >50 cm classes, and the percentage of colonies damaged was recorded using the six-point scale. The number of coral recruits (colonies 1-10 cm in diameter or height) in the 100 m x 100 m area was recorded. Video records were made for archive and for cover analysis by random point counts, with frequent 360 degree scans to record reef development. Photography was used to confirm identification and record habitat structure.

PRELIMINARY RESULTS

Since the surveys have only recently been completed, preliminary results providing an overview are given, rather than site-specific information.

Living hard coral cover

Both surveys reported low percent cover of live hard corals. Engelhardt recorded 0% - 5% live coral cover at 80% of sites (n = 15) and a maximum of 0% - 10% at 20% of sites. Turner *et al.* recorded 1-10% living coral cover at 81% of the sites (n = 46) with a maximum of 31-50% at just two sites (Figure 4a). Many of the living corals displayed partial mortality. Dead standing coral was present at all sites with 100% cover at some (Figure 4b), and unconsolidated rubble was present at most, occasionally reaching 51% - 75% cover (Figure 4c). Live hard coral was mostly massive and sub-massive colonies of the coral genera *Porites*, *Acanthastrea*, *Goniopora*, *Diploastrea*, and *Physogyra*, usually occurring towards the bottom of the reef slopes. Branching and tabular *Acropora* and branching *Pocillopora* were either dead standing or reduced to rubble at most sites, especially along the upper reef slopes (Figure 5-6). The zoanthids *Zoanthus*, *Palythoa* and *Protopalythoa*, and corallimorpharian anemones grew on dead standing coral and consolidated rubble at the top of reef slopes and in lagoons, together with red and green calcareous algae. The soft corals *Sarcophyton*, *Lobophyton* and *Sinularia* grew on hard substrates on the lower reef slopes.

Coral diversity

Species diversity of hard corals was low at all reef sites surveyed across the granitic islands. Engelhardt recorded a maximum of 10 families and 15 genera of hard corals (at Lighthouse), while Turner *et al.*, recorded a maximum of 13 families, 30 genera, and 49 species (at Port Launay Marine National Park) and a median of 5 families, 8 genera and 10 species per site. Other marine National Parks fared less well, although Turner *et al.*, found 9 families, 21 genera and 31 species at Coral Gardens Curieuse, 10 families, 15 genera and 28 species at Baie Ternay,

and just 2 families 2 genera and 2 species living at Ile Coco Marine National Park. Some species were represented by just one colony in all surveys. Corals species recorded as dead standing, surviving, and recruiting are summarised in Figure 7.

Coral recruitment

Engelhardt and Turner *et al.*, observed variable levels of coral recruitment. Based on mean densities of size classes of corals, Engelhardt reported more small (2 cm - 15 cm) corals than larger corals at all sites. Highest densities of over 200 small corals per 24 m² area were recorded at two sites (Conception Island and Marianne Island), and low densities were recorded on the central reefs of the north west coast of Mahe (e.g. 6 small corals per 24 m²). Branching *Acropora* and *Pocillopora* recruits showed a more patchy distribution with none at 46% (7 of 15) of sites, 175 per 24 m² at Marianne Island and an average of <20 per 24 m² at other sites. Turner *et al.*, recorded no branching *Acropora* or *Pocillopora* recruits (classed as being 1-10 cm in size) at 35% (16 of 46) sites, and only 17% (8) of sites had >20 recruits per 100 m x 100 m area. Those sites with highest recruitment were the more sheltered sites, while exposed sites showed low or no recruitment (Figure 8). Recruits were observed settled on limestone pavement, dead standing coral and rubble. Many recruits exhibited damage and scars from abrasion, breakage, fish and urchin grazing (Figures 9-11).

DISCUSSION

The coral reefs of the Seychelles granitic islands have suffered severe degradation during the two-year period following the 1997/98 mass coral bleaching event, and signs of recovery are slight. Live coral cover has been reduced to less than 10% on most reefs around the inner islands, and partial mortality of colonies is high. Although hard coral cover was rarely 100% before mass mortality, this still represents a major reduction from the 35-80% hard coral cover typical of reef slopes e.g. Baie Ternay, (TMRU, 1996) and 25-40% hard coral cover typical of patch reefs e.g. Coral Garden, Curieuse (TMRU, 1997). In common with many other reefs throughout the Indian Ocean region, the massive and sub-massive corals survived the mass mortality, particularly *Porites*, *Goniopora*, *Acanthastrea* and *Diploastrea*. Branching and tabular *Acropora* and branching *Pocillopora* were mostly dead and are now either standing or reduced to rubble. However, care is required in assessing rubble, since broken *Acropora* is a common component of these reefs (Braithwaite, 1971; Rosen, 1971). There is no indication that reefs further away from the main islands of Mahe and Praslin fared any better, and conversely more remnant corals were recorded from lower reef slopes in turbid water, especially around the main island of Mahe (such as Beau Vallon Bay and adjacent to the harbour on Mahe). Dead standing coral is brittle and is reduced to rubble at exposed sites where it remains largely unconsolidated, becoming mobile in storm waves causing abrasion. Calcareous algae, zoanthids and corallimorpharians are binding rubble in shallow waters in sheltered sites.

A total of 109 species and 42 genera of scleractinian corals were recorded from granitic island sites during the January 2000 survey (although some species were represented by only one colony), compared to 143 species in 55 genera listed for the whole Seychelles archipelago (granitic and coralline islands combined, including deep sites) by Sheppard (1998). The 13 genera not found during the January 2000 survey were *Heteropsammia*, *Trachiphyllia*, *Euphyllia*, *Catalaphyllia*, *Seriatopora*, *Anacropora*, *Stylaraea*, *Anomastrea*, *Cosinarea*,

Pachyseris, *Mycedium*, *Cynarina*, and *Caulastrea*. The coral diversity for the granitics is comparable with those of surveys conducted prior to the mass mortality event. TMRU (1996) recorded 31 genera and 69 species from the Baie Ternay area of Mahe, and 36 genera and 84 species from Curieuse (TMRU, 1997). The Dutch Tyro expedition recorded 37 genera and 109 species from the Seychelles Plateau around Mahe (van der Land, 1994). Thus, the preliminary results presented here indicate that most species of corals have survived somewhere in the region, but that diversity at most sites is low (median 8 genera, 10 species). This finding has important implications on the probability of future recruitment from within the region.

To date, two years after the mass mortality event, recruitment to the degraded reefs is patchy and low, with 35% of the sites surveyed showing no recruitment. In particular, recruitment is low for fast growing *Acropora* and *Pocillopora* (<20 recruits per hectare at most sites) that used to dominate the reefs. Recruitment that has occurred is greatest on more sheltered reefs in bays and may be related to suitable consolidated substrate. Recruits are vulnerable to fish and urchin predation and to breakage, abrasion and removal during storms. There is an urgent requirement to monitor recruitment and survival and to protect surviving species that may be reproducing sexually and providing new sources of coral larvae.

The Seychelles granitic island reefs appear to have experienced one of the greater mass mortalities of corals in the Indian Ocean following the 1997/98 bleaching event, probably because they are mostly shallow (<15 m depth). Reef structure is breaking down, and this may expose island shores to erosion during storms, as has occurred at La Digue. The Marine National Parks of the Seychelles, once the most diverse reefs, have been badly degraded and will require even greater protection if they are to recover. Fishing gear, boat anchors and especially sedimentation and siltation from coastal development activities continue to place many of these recovering reefs at risk. There may need to be a reassessment of the management of Marine National Parks to afford greater protection to larger areas.

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