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Soft coral biodiversity and distribution in East Africa: Gradients, function and significance

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Abstract. Soft corals (Octocorallia: Alcyonacea) constitute important reef benthos in East Africa, yet relatively little is known of their distributional gradients, function or significance. Integrated results of published surveys manifest interesting gradients in their diversity, abundance and apparent function. Reef disturbance may result in them becoming dominant, eliciting an alternative stable state in some coral communities. While certain tropical taxa attenuate from north to south, others attain their highest abundance at high latitude; the latter appears to be related to their ability to tolerate sedimentation and more swell-driven turbulence. Once established, soft corals appear to be persistent and long-lived. A long-term monitoring study has nevertheless revealed that they appear to be vulnerable to climate change.

Keywords: Soft corals, Alcyonacea, western Indian Ocean, biodiversity gradients

Introduction

Soft corals (Octocorallia: Alyonacea) have been studied on East African reefs at several localities over the last 15 years, including Tanzania (Ofwegen and Benayahu 1992), Mozambique (Benayahu & Schleyer 1996; Benayahu et al. 2002) and South Africa (Benayahu 1993; Benayahu & Schleyer 1995, 1996; Ofwegen and Schleyer 1997; Williams 2000; Williams and Little 2001). These studies have shown that soft corals are abundant in these countries, include descriptions of several new species, and list numerous new zoogeographical records for Tanzania (7°S), Mozambique (12-21°S) and the KwaZulu-Natal coast in South Africa (27.5°S).

The East African coast possesses a full spectrum of reef types, from fringing reefs off the mainland and islands in Mozambique and Tanzania (Hamilton and Brakel 1984; Wells 1988; Obura et al. 2000; Rodrigues et al. 2000) to the high-latitude marginal reefs of southern Africa (Schleyer 2000). Consideration is given here to gradients in the diversity and distribution of the soft corals and their underlying causes, aspects of which have received specific attention (Riegl 1995; Schleyer and Celliers 2003a, b; Schleyer et al. 2008).

The East African coastline under consideration in this study forms the boundary of the western Indian Ocean (WIO) and lies within the influence of the South Equatorial Current (SEC) and its daughter currents. These are generated when the SEC deflects off the northern tip of Madagascar and, in turn, encounters Africa at approximately 10ºS. Lutjeharms (2007) provides the most recent review of their complexity, the deflected currents in question being the East Madagascan, East African and Mozambique Currents. Further complex interactions give rise to the Somali and Agulhas Currents at equatorial and higher southern latitudes respectively.

Materials and Methods

Species lists providing the distributional patterns considered in this paper were derived from material collected in Tanzania; Pemba, Mozambique Island and the Quirimbas, Segundas and Bazaruto Archipelagos in Mozambique; and reefs off Sodwana Bay and Durban in South Africa.

Results and Discussion

Soft coral genera most commonly recorded on East African reefs are listed in Table 1. Less common genera have been omitted for brevity (see publications cited in the introduction for the full record). While some genera proved cosmopolitan, others were found only in the north or south. Most notable was *Cespitularia*, a genus that was locally abundant on reefs recovering from the 1998 El Nino Southern Oscillation-related bleaching in northern Mozambique (MHS pers. obs.; Fig. 1). Its extensive cover in these areas appeared to be opportunistic.

Endemism was high amongst genera in the south, examples listed in Table 1 being *Efflatounaria*, *Eleutherobia* and *Leptophyton*, endemic species of which were narrowly restricted to the South African east coast. This is probably attributable to the transitional nature, from tropical to temperate, of the sea off this coast.

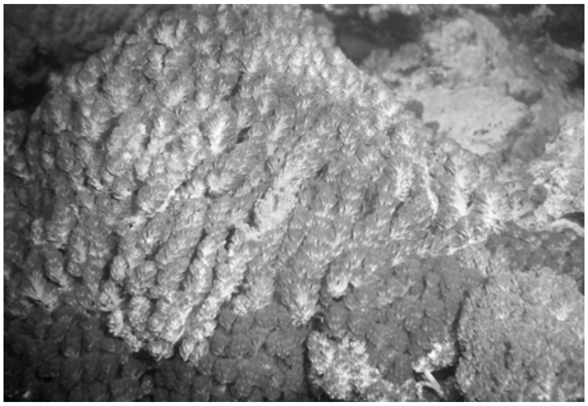

Figure 1. Bleached reef overgrown by extensive colonies of *Cespitularia*.

Table 1. Soft coral genera commonly recorded on East African reefs. TZ = Tanzania; MZ = Mozambique; ZA = South Africa. Grey shading denotes presence of genera and numerals the species, where known.

	TZ	N MZ	S MZ	ZA
FAMILY ALCYONIIDAE				
Cladiella Gray, 1869	5	8	3	3
Eleutherobia Pütter, 1900				2
Klyxum Alderslade, 2000	1			
Lobophytum Marenzeller, 1886	4	2	3	5
Rhytisma Alderslade, 2000		1		
Sarcophyton Lesson, 1834	9	3	5	6
Sinularia May, 1898	18	20	12	15
FAMILY XENIIDAE				
Anthelia Lamarck, 1816		1	1	1
Cespitularia M.-Edws. & Haime, 1850	1	3		
Efflatounaria Gohar, 1934				1
Heteroxenia Kölliker, 1874	2	1		1
Ovabunda Alderslade, 2001				
Sansibia Alderslade, 2000			1	1
Sympodium Ehrenberg, 1834				1
Xenia Lamarck, 1816		1	1	2
FAMILY NEPHTHEIDAE				
Dendronephthya Kükenthal, 1905				
Leptophyton Ofwegen & Schleyer, 1997				1
Lemnalia Gray, 1868	4	3		
Litophyton Forskål, 1775	1			
Stereonephthya Kükenthal, 1905				

Community data, when subjected to similarity analysis (Schleyer et al. in prep), revealed a gradient in abundance of soft corals, relative to the hard, from north to south (Table 2). The latter are dominant in the north but Alcyonacea become more successful in the south.

Table 2. Relative abundance (% cover) of soft and hard corals on East African reefs. TZ = Tanzania; MZ = Mozambique; ZA = South Africa.

Group	N MZ & STZ	S MZ	ZA
N (reefs)	7	3	8
Alcyonacea	6.6	18.7	31.3
Scleractinia	46.6	23.6	25.6

Fabricius (1995) described the slow-growing tenacity of the family Alcyoniidae, in contrast to faster-growing "fugitives" such as the Xeniidae and Nephtheidae. While the opportunistic nature of *Cespitularia* in East Africa has already been mentioned, *Lemnalia* and *Litophyton* were also evident in the north. Persistent alcyoniids, on the other hand, are notably abundant on South African reefs (Schleyer 2000; Schleyer and Celliers 2005; Celliers and Schleyer 2007; Schleyer et al. 2008) where *Sinularia* and *Lobophytum* form extensive carpets, particularly on surge-swept reef crests. This appears attributable to the frequency of large storm waves in the south (Fig. 2).

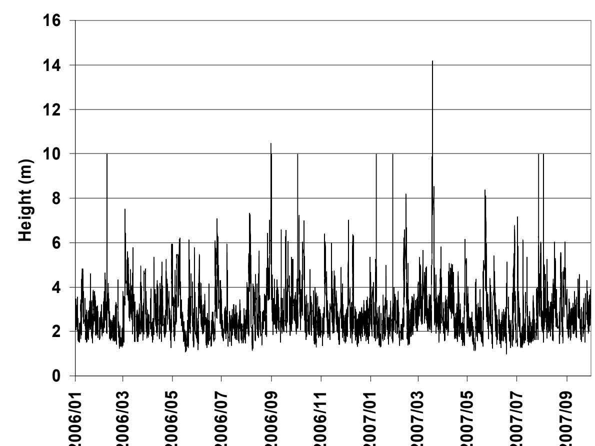

Figure 2. Maximum wave heights (m) recorded between January 2004 and December 2006, 100 km south of the South African coral reefs, portraying the frequency of storm waves in the area.
(Data courtesy of National Ports Authority – Richards Bay)

Persistent alcyonids gained a further competitive advantage during a spot outbreak of crown-of-thorns starfish (*Acanthaster planci*) where infested reef suffered a reduction in hard corals (Celliers and Schleyer 2006, 2007). Persistent soft corals became dominant in these areas, suggesting that their long-term dominance causes the coral community to enter an alternative stable state.

High turbulence in the south mobilises sediment and a differential abundance of sediment-tolerant soft corals has been recorded on reef tops relative to the reef-sediment interface in South African coral communities (Table 3; Schleyer and Celliers 2003a). Their disposal of sediment is dependent on the turbulence that initially deposits it (Riegl 1995; Schleyer and Celliers 2003a).

Table 3. Relative abundance (% cover) of soft and hard corals in South African coral communities on reef tops relative to the reef-sediment interface (from Schleyer & Celliers 2003a).

	Reef-sediment interface	Reef tops
Alcyonacea	34.6 ± 3.8	31.3
Scleractinia	14.2 ± 4.0	25.6

Factors limiting coral reef development have been assessed by Kleypas et al. (1999), light and aragonite saturation being deemed constraining at high latitudes in the WIO. The resultant reduction of scleractinian competition would further account for the greater success of Alcyonacea in the south. The effects of climate change are anticipated to influence this (Schleyer and Celliers 2003b) and monitoring has revealed that the Alcyonacea have diminished in favour of the hard (Figure 3; Schleyer et al. 2008).

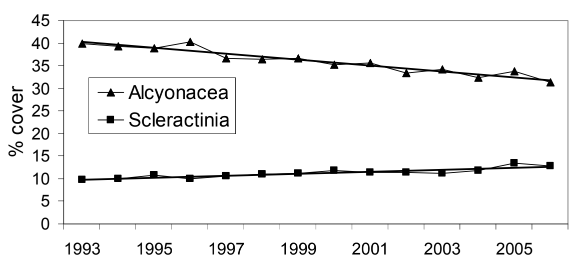

Figure 3. Overall changes in soft and hard coral cover measured at a long-term monitoring site in KwaZulu-Natal 1993-2006.

In conclusion, a number of parameters influence soft coral distribution on the East African coast. Some genera are limited to tropical or more temperate latitudes, with greater endemism at higher latitudes. Opportunism enables fast-growing pioneers to recolonise reef space in the tropics or, conversely, persistent slow-growers to attain dominance in the south. Reduced competition from Scleractinia due to climatic and environmental factors also facilitates the latter. Their proliferation is further promoted by the prevalence of heavy seas at higher latitudes as they are well-adapted to cope with the concomitant turbulence and sedimentation.

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