Marine Pollution Bulletin 136 (2018) 491–507

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

What can South African reefs tell us about the future of high-latitude coral systems?

Michael H. Schleyer[a,*], Camilla Floros[a], Stuart C.S. Laing[a], Angus H.H. Macdonald[a,1], Phanor H. Montoya-Maya[a,2], Tamaryn Morris[a,b,3], Sean N. Porter[a], Mathieu G. Seré[a,4]

[a] Oceanographic Research Institute, PO Box 10712, Marine Parade, 4056 Durban, South Africa
[b] Bayworld Centre for Research and Education, PO Box 7296, Rogge Bay 8012, South Africa

ARTICLE INFO

Keywords:
Coral reefs
Coral diseases
Fish communities
Oceanography
Climate change
Marine sediments
Ecosystem services
Resource economics
Resource evaluation

ABSTRACT

Coral communities are found at high latitude on the East Coast subtropical reefs of South Africa. They are biodiverse, economically important, and afforded World Heritage Site status in the iSimangaliso Wetland Park where some are subjected to recreational use. While the Park's unique coral reefs have, to date, suffered little bleaching from climate change, they are susceptible to the phenomenon and provide a natural laboratory for the study of its effects at high latitude. This review covers recent advances in the regional oceanography; coral community dynamics and the underpinning reef processes, including minor bleaching events; the incidence of coral disease; and coral genetic connectivity. The effects of human activity (SCUBA diving, recreational fishing, pesticide use) were assessed, as well as the nursery benefits of *Acropora austera*, a coral which provides the reefs with much structure and is vulnerable to damage and climate change. The reefs were valued in terms of human use as well as services such as sediment generation and retention. The results have provided valuable information on relatively pristine, high-latitude reefs, their socio-economic benefits, and the anticipated effects of climate change.

1. Introduction

Coral communities in South Africa constitute the southernmost distribution of this fauna on the African coast and fall within the iSimangaliso Wetland Park, a World Heritage Site in the northern limits of the province of KwaZulu-Natal (Fig. 1). The region is also known as Maputaland and lies between neighbouring Swaziland and the coast, from Lake St Lucia to the Mozambican border. The reefs on which the coral communities are found are not true, accretive reefs since corals merely grow as a thin veneer on the limited Pleistocene sandstone substrata in the region (Ramsay and Mason, 1990; Ramsay, 1994, 1996; Cooper and Green, 2016). As coral reefs, they are thus marginal in nature and soft coral cover (~32%), comprising relatively few species (39), exceeds that of scleractinian cover (~27%; 93 species) over much of their surface (Schleyer, 2000; Celliers and Schleyer, 2008; Fig. 2). While not accretive, the coral communities nevertheless are rich in biodiversity at this latitude on the East African coast (Riegl, 1996a, b; Schleyer, 2000; Schleyer and Celliers, 2003a, Schleyer and Celliers, 2005; Celliers and Schleyer, 2008), comprising a mix of tropical and subtropical species (Fig. 3). They are located at the south–western limits of the large Indo-West Pacific Marine Province (the ocean between the study area, the Red Sea and the Andaman Islands; Spalding et al., 2007) and, at a smaller biogeographic scale, they occur in the Delagoa Bioregion, which extends from Inhaca Island in southern Mozambique to Leven Point in South Africa (Porter et al., 2013; Fig. 1).

While they were discovered in 1970, intensive research only commenced on the reefs in 1990 and, in the following fifteen years, yielded publications on the geology (Ramsay, 1996) and biodiversity of the reefs (Riegl et al., 1995; Celliers and Schleyer, 2001, 2008; Schleyer, 2000; Schleyer and Celliers, 2005; Porter et al., 2013), many of which have been surveyed, mapped and zoned for potential use. Fundamental research has been undertaken on matters such as the local oceanography (Morris, 2009), coral systematics, distribution, reproduction and settlement (Riegl, 1996a, b; Benayahu and Schleyer, 1995, 1998;

* Corresponding author.
E-mail address: schleyer@ori.org.za (M.H. Schleyer).
[1] Present address: University of KwaZulu-Natal (Westville Campus), School of Life Sciences, Private Bag X54001, 4000 Durban, South Africa.
[2] Present address: Corales de Paz, Calle 4 # 35A-51, Santiago de Cali, Colombia.
[3] Present address: South African Environmental Observation Network (Egagasini Node), Private Bag X2, Roggebaai, Cape Town 8012, South Africa.
[4] Present address: Institut de Recherche pour le Développement, CS 41095 - 2 rue Joseph Wetzell, 97495 Sainte Clotilde Cedex, Réunion.

https://doi.org/10.1016/j.marpolbul.2018.09.014
Received 9 May 2018; Received in revised form 5 September 2018; Accepted 9 September 2018

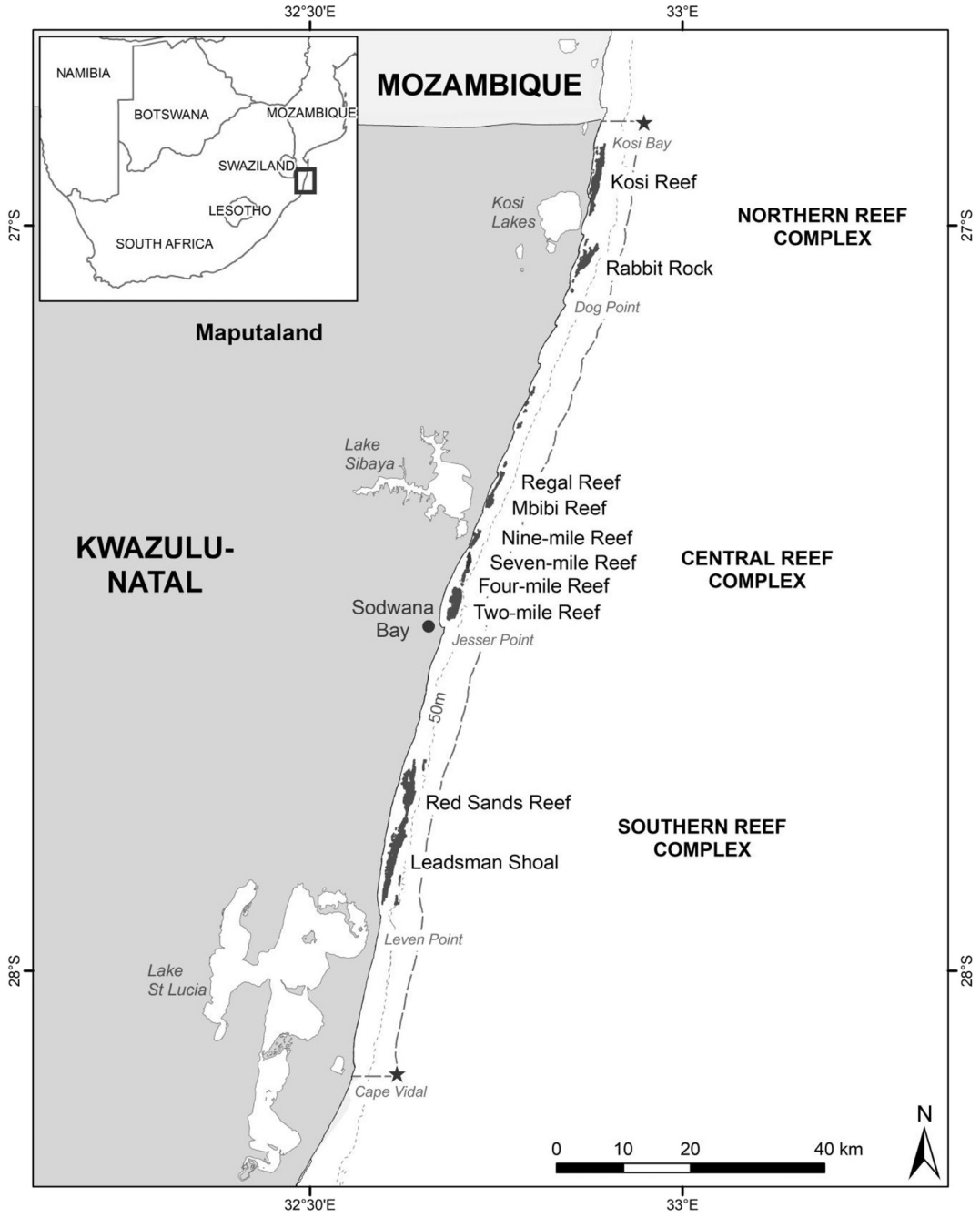

Fig. 1. Map of the Maputaland coast showing the major South African coral reefs within the marine boundaries (★) of the iSimangaliso Wetland Park.

Glassom et al., 2006; Monniot et al., 2001; Ofwegen and Schleyer, 1997; Kruger and Schleyer 1998; Kruger et al., 1998; Schleyer et al., 1997, 2003, 2004; Hart, 2018). Integrated monitoring was initiated early in the programme and yielded valuable information on coral community dynamics, climate-related bleaching and reef oceanography (Celliers and Schleyer, 2002; Morris, 2009; Schleyer and Celliers, 2003a, 2003b; Schleyer et al., 2005, 2008). Responses to factors such as crown-of-thorns starfish predation (Schleyer, 1998; Celliers and Schleyer, 2006), sedimentation (Riegl, 1995; Riegl and Branch, 1995; Schleyer and Celliers, 2003b) and recreational diving (Schleyer and Tomalin, 2000) were assessed, and studies on coral genetics (Macdonald, 2004) were initiated.

Comprehensive systematic studies have been published on the macro-algae in the iSimangaliso Wetland Park by the Universities of Cape Town and Ghent (104 species; Anderson et al., 2005) and limited work has been undertaken on the taxonomy of the sponges (96 species; Schleyer and Celliers, 2003a, 2005; Samaai et al., 2010) and ascidians (30 species; Monniot et al., 2001; Schleyer and Celliers, 2003a). Mobile organisms are diverse and at least 314 invertebrate (Milne and Griffiths, 2014) and 399 fish species (Chater et al., 1993; Floros et al., 2012) have been recorded on the reefs. The deeper reefs and canyon margins have not been sampled as intensively but support distinct and diverse invertebrate communities and provide habitat for the coelacanth (Sink et al., 2006).

The above research has yielded background and baseline information on the reefs, their extent and condition. Climate change-related coral bleaching emerged globally as the greatest threat to coral reefs in the late 1990s but fortunately has not affected the Maputaland reefs to any great extent (Celliers and Schleyer, 2002; Schleyer and Celliers, 2003a; Porter et al., 2018). The potential of the Maputaland reefs to