

## Distribution of holothurians in the shallow lagoons of two marine parks of Mauritius

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### Abstract

Several studies have recently been carried out on the abundance and diversity of holothurians in the shallow lagoons of Mauritius. This paper presents data gathered on holothurians during two biodiversity inventories carried out in the two marine parks, namely Balaclava (surveyed in 2009) and Blue Bay (surveyed in 2012). Seventeen species were observed or photographed in Blue Bay Marine Park, with the most frequent and abundant species being *Holothuria atra*. Balaclava Marine Park has a lower diversity of habitats and only 10 species were recorded, mostly on the reef slopes and reef flat habitats. The data from the two marine parks were combined with those of a previous study, which found 20 species, to present an overview of the distribution of holothurians on the main island of Mauritius. We also present the first occurrence in Mauritius of the following four species: *Holothuria flavomaculata*, *H. impatiens*, *H. notabilis* and surprisingly *Thelenota ananas*.

### Introduction

Holothurians, or sea cucumbers, are particularly vulnerable to overexploitation, and have been under pressure in Mauritius since the start of the sea cucumber fishery in the mid-2000s. Consequently, the Ministry of Fisheries imposed a two-year moratorium on the collection of sea cucumbers from 2009, which was later extended for another period of four years (2012–2016) to prevent the collapse of the fishery.

Previous studies on the holothurians of Mauritius include inventories and/or ecological surveys conducted at different sites by Müller (1998), Luchmun et al. (2001), Mrowicki (2006) and Rowe and Richmond (2004) for Rodrigues. The most recent studies on the abundance and diversity of holothurians in Mauritius were made by Lampe (2013) and Lampe-Ramdoo et al. (2014) at several sites in the shallow lagoons of the south and west coasts, and on the northern and eastern coasts. Short syntheses have also been presented in other documents by Conand (2008), Conand et al. (2013), FAO (2013), Mohit (2013) and Eriksson et al. (2015).

The Balaclava Marine Park is located in the north-west of Mauritius, and covers an area of 485 ha (Fig. 1). Marine biologists from ARVAM-Pareto (Réunion) were contracted in 2009 to carry out a biological inventory of the marine park under the project “Marine protected areas network of the Indian Ocean countries”. This project aimed at promoting sustainable use and equitable sharing of benefits from marine protected areas throughout the Republic of Mauritius with the participation of all stakeholders (Nicet et al. 2009).

The Blue Bay Marine Park, designated in 1997, is located in the southeast of the island and covers an area of 353 ha (Fig. 1). The Fisheries and Marine Resources (Marine Protected Areas) Regulations



**Figure 1.** The main island of Mauritius, showing the location of Blue Bay and Balaclava marine parks.

Source: Google Earth 7.1.5.1557 (accessed 20/05/2015), Mauritius (<http://www.earth.google.com>).

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were amended in 2007 to provide for a zoning system to control permissible activities in the marine park. In January 2008, the Blue Bay Marine Park was officially nominated as the second Ramsar site (Wetland of International Importance) for Mauritius. It was studied in 2012 by marine biologists from Réunion, in cooperation with Albion Fisheries Research Centre counterparts, under the United Nations Development Programme/Global Environment Facility/Government of Mauritius-funded project “Partnerships for marine protected areas in Mauritius and Rodrigues” (Simian et al. 2012).

The specific objective of the surveys in 2009 (Balaclava Marine Park) and 2012 (Blue Bay Marine Park) was to study the biodiversity of the sites in order to develop effective management measures in these protected areas. The holothurians (Echinodermata) are one of the taxonomic groups that was inventoried. This paper is based on the data obtained on holothurians during the studies.

## Materials and methods

The collection of in situ data on target species was done using a rapid assessment protocol (McKenna and Allen 2005). Each survey was carried out over seven days. Underwater sampling was carried out either by diving or snorkelling depending on the station depth. The sites were grouped into general habitat categories – six for Blue Bay Marine Park (Fig. 2) and four for Balaclava Marine Park (Fig. 3). Sampling was standardised for one hour at each site to obtain a uniform sampling effort.

Data on the holothurians include notes and photos and these have been used for preliminary identification of the families, genera and species, wherever possible.

## Results

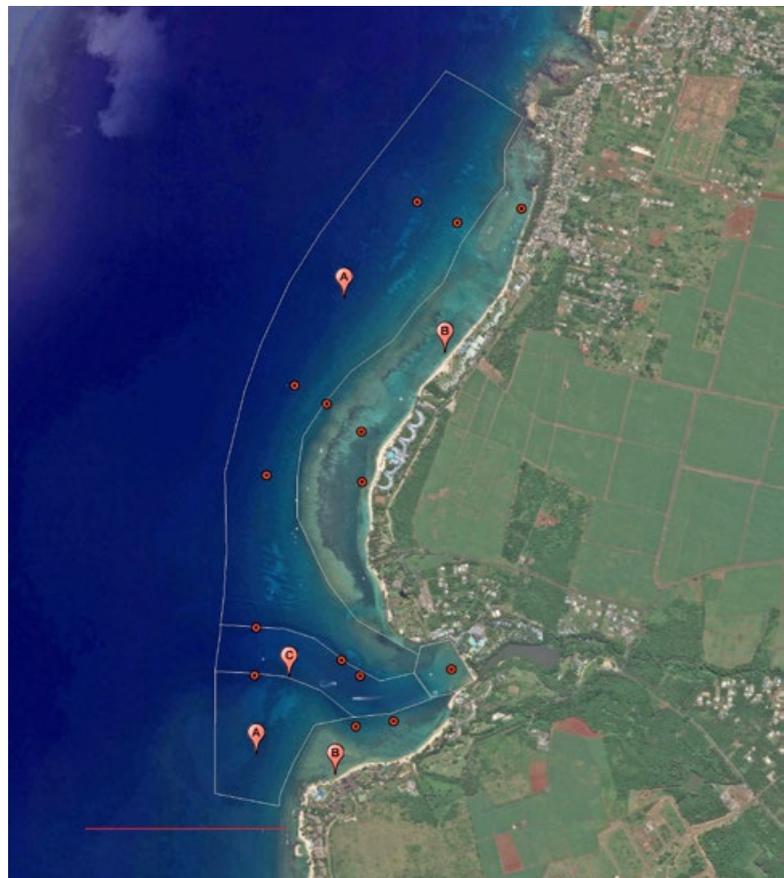
### Blue Bay Marine Park

Blue Bay Marine Park has a high diversity of habitats (Fig. 2), which were grouped as follows (Simian et al. 2012): outer slopes (fringing and barrier reefs; A); lagoon (shallow and deep terraces; B); pass (C); bay (D); barrier reef flat (E); and fringing reef flat (F). The area is subject to local threats (e.g. the effects of land-based agriculture and tourism-related activities) and global threats (e.g. climate change). The species richness of the different taxa sampled was generally high, considering the small size of the site (Simian et al. 2012).

Holothurian diversity is presented by habitat in Table 1. Seventeen species were observed or photographed. The most frequent and abundant species



**Figure 2.** Blue Bay Marine Park sampling sites. A: outer slope; B: lagoon; C: pass; D: bay; E: barrier reef flat; F: fringing reef flat. Source: Google Earth.



**Figure 3.** Balaclava Marine Park sampling sites. A: outer slope; B: lagoon; C: pass; D: bay. Source: Google Earth.

in several habitats is *Holothuria atra*. The lagoon terraces host several species, including the commercial teatfish *H. nobilis*, several *Bohadschia* species and *Pearsonothuria graeffei*. The barrier reef flat has the highest diversity of holothurians, while the fringing reef flat has only the two common species *H. atra* and *Stichopus chloronotus*.

### Balaclava Marine Park

Balaclava Marine Park has a lower diversity of habitats, as it is limited by fringing reefs (Fig. 3). Habitats

are grouped as follows (Nicet et al. 2009): outer reef slope, which covers a large part of the park (A); reef flats and lagoon (B); pass (C); bay (D). The species richness was found to be high for scleractinarian corals, fish and molluscs during the survey.

Holothurian diversity is presented by habitat in Table 1. Only 10 species were recorded, mostly on the reef slopes and reef flat habitats. *Theleota ananas* was recorded on the slope of the pass. Most of the species are relatively common in the west Indian Ocean region.

**Table 1.** Holothurians found in Blue Bay and Balaclava marine parks, by habitat.

Family	Genus	Species	Blue Bay Marine Park <sup>1</sup>						Balaclava Marine Park <sup>2</sup>			
			A	B	C	D	E	F	A	B	C	D
Holothuriidae	<i>Actinopyga</i>	<i>echinites</i>					x		x	x		
	<i>Actinopyga</i>	<i>capillata</i>										
	<i>Actinopyga</i>	<i>mauritiana</i>										
	<i>Bohadschia</i>	<i>atra</i>										
	<i>Bohadschia</i>	<i>marmorata</i>		x			x					
	<i>Bohadschia</i>	<i>subrubra</i>		x			x					x
	<i>Bohadschia</i>	<i>vitiensis</i>		x		x						x
	<i>Holothuria</i>	<i>arenicola</i>										
	<i>Holothuria</i>	<i>atra</i>		x		x		x		x		
	<i>Holothuria</i>	<i>cinarescens</i>										
	<i>Holothuria</i>	<i>flavomaculata</i>	x									
	<i>Holothuria</i>	<i>fuscocinerea</i>										
	<i>Holothuria</i>	<i>impatiens</i>					x					
	<i>Holothuria</i>	<i>hilla</i>					x			x		
	<i>Holothuria</i>	<i>leucospilota</i>		x								
	<i>Holothuria</i>	<i>nobilis</i>					x					
	<i>Holothuria</i>	<i>notabilis</i>					x					
	<i>Holothuria</i>	<i>pervicax</i>				x	x		x		x	
	<i>Holothuria</i>	<i>scabra</i>										
	<i>Pearsonothuria</i>	<i>graeffei</i>		x								
Stichopodidae	<i>Stichopus</i>	<i>chloronotus</i>		x		x		x	x	x	x	
	<i>Stichopus</i>	<i>hermanni</i>		x				x				
	<i>Stichopus</i>	<i>monotuberculatus</i>				x						
	<i>Theleota</i>	<i>ananas</i>									x	
Synaptidae	<i>Synapta</i>	<i>maculata</i>		x						x	x	

<sup>1</sup> A = outer slopes (fringing and barrier reefs); B = lagoon (shallow and deep terraces); C = pass; D = bay; E = barrier reef flat; and F = fringing reef flat.

<sup>2</sup> A = outer reef slope (which covers a large part of the park); B = reef flats and lagoon; C = pass; D = bay.

## Discussion

The present inventories are mostly based on field observations and photographs taken during surveys of the marine parks in the north and south of the main island of Mauritius. No specimens were collected for ossicle examination or genetics, which are needed for precise identification (Purcell et al. 2012). Therefore no reference collection exists for verification.

The high diversity of habitats in Blue Bay Marine Park, despite the relatively small size, explains the diversity of holothurians. A few commercial species are found (*H. nobilis*, *T. ananas*, *Actinopyga* spp., *Bohadschia* spp.), which deserve protection since illegal captures are common in most of the world's protected areas (Conand et al. 2015).

In the Balaclava Marine Park survey and report, echinoderms have not been studied in detail. This could have introduced a bias in the results and explain why echinoderm diversity was found to be low.

Table 2 synthesises the distribution of holothurians on the main island of Mauritius, based on the current two surveys and Lampe-Ramdoo et al. (2014). The most extensive study was that by Lampe-Ramdoo et al. (2014), with 20 identified species. It is noteworthy that the present study, based on relatively short surveys in limited areas, has helped to increase the holothurian inventory for Mauritius, which now has a total of 25 species. This remains low compared with Réunion, a younger and less diversified island, where 37 species have been inventoried (Conand et al. 2010).

**Table 2.** Synthesis of holothurian species present on the main island of Mauritius.

			Blue Bay Marine Park	Balaclava Marine Park	Study by Lampe- Ramdoo et al. (2014)
			17 sp.	10 sp.	20 sp.
Family	Genus	Species			
Holothuriidae	<i>Actinopyga</i>	<i>echinites</i>	x	x	x
	<i>Actinopyga</i>	<i>capillata</i>			x
	<i>Actinopyga</i>	<i>mauritiana</i>			x
	<i>Bohadschia</i>	<i>atra</i>			x
	<i>Bohadschia</i>	<i>marmorata</i>	x		x
	<i>Bohadschia</i>	<i>subrubra</i>	x	x	x
	<i>Bohadschia</i>	<i>vitiensis</i>	x	x	x
	<i>Holothuria</i>	<i>arenicola</i>			x
	<i>Holothuria</i>	<i>atra</i>	x	x	x
	<i>Holothuria</i>	<i>cinarescens</i>			x
	<i>Holothuria</i>	<i>flavomaculata</i>	x		
	<i>Holothuria</i>	<i>fuscocinerea</i>			x
	<i>Holothuria</i>	<i>impatiens</i>	x		
	<i>Holothuria</i>	<i>hilla</i>	x	x	x
	<i>Holothuria</i>	<i>leucospilota</i>	x		x
	<i>Holothuria</i>	<i>nobilis</i>	x		x
	<i>Holothuria</i>	<i>notabilis</i>	x		
	<i>Holothuria</i>	<i>pervicax</i>	x	x	x
	<i>Holothuria</i>	<i>scabra</i>			x
	<i>Pearsonothuria</i>	<i>graeffei</i>	x		
Stichopodidae	<i>Stichopus</i>	<i>chloronotus</i>	x	x	x
	<i>Stichopus</i>	<i>herrmanni</i>	x	x	x
	<i>Stichopus</i>	<i>monotuberculatus</i>	x		x
	<i>Thelenota</i>	<i>ananas</i>		x	
Synaptidae	<i>Synapta</i>	<i>maculata</i>	x	x	x

In Mauritius some species of holothurians were observed long ago, such as *A. mauritiana* described by Quoy and Gaimard in 1833. Lampe-Ramdoe et al. (2014) noted the first occurrence of the following species: *H. arenicola*, *A. capillata*, *H. scabra* and *H. fuscocinerea*. In this paper, we present the first occurrence in Mauritius of the following four species: *H. flavomaculata*, *H. impatiens*, *H. notabilis* and, surprisingly, *Thelenota ananas*, a species commonly found in the Mascareignes and the tropical Indo-Pacific (Purcell et al. 2012).

Further studies are necessary to complete the inventory. A reference collection is also important, to confirm the evolution of this group, which includes commercially important species.

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