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Diversity of the Holothuroid Fauna (Echinodermata) at La Réunion (Western Indian Ocean)

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Abstract—Echinoderms are conspicuous components of the tropical fauna and play important roles in the functioning of coral reefs. However, their diversity is not as well documented as that of other conspicuous reef organisms such as corals or fish. We review current knowledge of the diversity of the class Holothuroidea at La Réunion. Several recent initiatives that include MASMA (Conand & Muthiga 2007) and BIOTAS projects have considerably augmented the number of species recorded for the island. As a result of these surveys, the recorded holothuroid fauna has doubled. Thirty-seven species are presently recognized, 18 of which are new records for the island. The order Aspidochirotida, which includes the largest and most conspicuous holothuroids, is the most diverse, with 28 species. Seven species of Apodida and two species of Dendrochirotida constitute the balance of the fauna. These latter groups may prove more diverse with further investigation. The island's holothuroid fauna is compared with data available from other areas of the Western Indian Ocean and the Indo-west Pacific to evaluate their biogeographic relationships.

INTRODUCTION

The South-West Indian Ocean is recognized as one of the ten marine biodiversity hotspots in the world because of its high species richness and high level of endemism (Roberts *et al.,* 2002; Allen, 2008). While the fishes and the corals are well documented, other groups need further attention. We report here current knowledge on the diversity of the class Holothuroidea (Echinodermata) at La Réunion, a young and relatively large volcanic island in the Mascarene Archipelago (Faure, 1976). During the last decade, several studies have been conducted on the diversity, reproductive biology, ecology and genetics of several common holothurian species at the island (Conand, 1996; Conand & Mangion, 2002; Conand *et al.,* 2002; Uthicke *et al.,* 2001; Uthicke & Conand, 2005; Rowe & Massin 2006). More recently,

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a Western Indian Ocean Marine Science Association (WIOMSA) Marine Science for Management (MASMA) project (Conand *et al*., 2006; Conand & Muthiga, 2007; Conand & Frouin, 2007; Gaudron *et al.,* 2008; Kohler *et al.,* 2009) and the research programme "The Southwest Indian Ocean biodiversity hotspot: A biota-level study of diversification on land and sea" (BIOTAS) have increased the number of species recorded for La Réunion. Samyn (2003) has summarized the regional holothurian fauna of the Western Indian Ocean.

MATERIAL AND METHODS

Numerous sites were sampled, mostly on reefs (Figure 1). We used two complementary approaches to study the holothurians. Conand and collaborators studied holothurians in several projects between 1993-2008 at the Ecomar Laboratory (La Réunion University), including population and ecological studies on the more common species, opportunistic observations of holothuroids on various fringing reefs, and a compilation of observations and photographs. The BIOTAS project aims to assess patterns of diversification across islands in the South-West Indian Ocean by using morphology and genetic markers and contributes to documenting the marine fauna through intensive sampling at various locations (July-August 2007 for La Réunion).

RESULTS

Biodiversity

Thirty-seven species of holothuroids (Table 1) are now recorded for the island, one of which (*Actinopyga obesa*?) needs further evaluation as it has only been identified from a single specimen in the field. Eighteen (49%) of these represent new records since the most recent species list published for La Réunion (Conand & Frouin, 2007). The order Aspidochirotida, which includes the largest and most conspicuous holothuroids, is the most diverse with 28 species. Seven species of Apodida and two species of Dendrochirotida constitute the balance of the fauna.

Several well-known holothuroid species are turning out to be species complexes comprised of two or more similar but genetically (and usually also morphologically) distinct forms. In the fauna of La Réunion, these include the "species" *Holothuria impatiens* (represented in La Réunion by at least two species), *H. verrucosa*, and *H. fuscocinerea*. The taxonomy of the genus *Polyplectana* is somewhat confused in the literature, and most authors record only a single species, *P. kefersteini*, for most locations. Two species in this genus were encountered on La Réunion, both new records. Ongoing work will establish appropriate names for each form in these complexes. Two species (*Actinopyga mauritiana, Stichopus monotuberculatus*) recorded from across the Indo-West Pacific region in the literature represent Indian Ocean endemics based on genetic evidence; Pacific records of these are erroneous. Conversely, the Pacific endemic *Holothuria coluber* was incorrectly recorded at La Réunion in the past (Conand & Frouin, 2007).

Distribution and abundance

The five most common species are *Holothuria atra*, *H. leucospilota*, *Stichopus chloronotus*, *Actinopyga echinites* and *Synapta maculata*. They are conspicuous and live exposed during the day on most back reefs and reef flats at La Réunion. For these reasons, they have been the focus of several studies that investigated various aspects of their biology (Conand, 1996, 2004; Conand & Mangion, 2002; Conand *et al.,* 2002; Flammang & Conand, 2004; Jaquemet *et al.,* 1999; Mangion *et al.,* 2004; Uthicke & Conand, 2005; Uthicke *et al.,* 2001). Other conspicuous species are frequently observed but are found in lower densities or are restricted in distribution. *Actinopyga mauritiana* is a good example of this; it is locally common, but almost entirely restricted to a narrow band on the outer reef flat and reef front. Other large species, including *Actinopyga capillata, Opheodesoma grisea* and *Euapta godeffroyi*, are active and visible only at night. Most of the fauna, however, is comprised of relatively

Figure 1: Map of sampling localities (•) at La Réunion.

small species that shelter under rocks or are buried in sediment during the day, though many emerge at night. They may be locally abundant when conditions are favourable (e.g., *H. difficilis*, *H. hilla*, *Polyplectana* spp.). Some of the uncommon holothurians are depicted in Figure 2.

DISCUSSION

The diversity of shallow-water holothurian recorded at La Réunion is higher than at Rodrigues (30 species; Rowe & Richmond, 2004) but lower than in the Comoros (48 species; Samyn *et al.,* 2006) and Madagascar (122 species; Cherbonnier, 1988). These differences are partly the result of different intensities in sampling, as well as the size, location, and diversity of habitats on these islands.

Most of the holothurian fauna at La Reunion are widespread Indo-West Pacific species (e.g., *Holothuria atra*, *Stichopus chloronotus*) and Indian Ocean endemics (*Bohadschia subrubra*, *H. nobilis*, *S. monotuberculatus*). As is typical of oceanic islands, the dendrochirotid fauna of La Réunion is poor, represented only by *Afrocucumis africana* and *Ohshimella ehrenbergi*, both new records. The rarity of dendrochirotids contributes to most of the difference in species richness between Madagascar and La Réunion, as 42 species of dendrochirotids are found at the former (Cherbonnier, 1988).

The dominance of the tropical holothurian fauna in the western Indian Ocean by the aspidochirotids has previously been noted by Samyn & Tallon (2005) who attributed this to the limited dispersal abilities of dendrochirotids.

The recent increase in the number of species recorded at La Réunion has resulted from intensive sampling efforts which increased the probability of finding less common and cryptic species. Exploration of the outer reef slope and night diving have

Table 1. List of holothuroid species recorded from La Réunion. Species marked * need confirmation. I: new record for the island (cf Conand and Frouin, 2007). Voucher numbers are for the Florida Museum of Natural History, University of Florida (UF, unnumbered), Muséum National d'Histoire Naturelle, Paris (MNHN) and Royal Belgian Institute of Natural Sciences, Brussels (IRSNB). Photo vouchers are available from the authors or their institutions. Several species currently recognized in the literature are species complexes based on ongoing genetic analyses (FM, GP, unpublished); these are so marked

Species	New record	Voucher
Apodida: Synaptidae		
Euapta godeffroyi (Semper, 1898)	I	6322, 6355, 6432
*Leptosynapt*a sp.	I	6372
Opheodesoma grisea (Semper, 1867)	I	2632, 6562, 6563, 6564, 6569
Polyplectana sp. 1	I	6327, 6340, 6501, 6594
Polyplectana sp. 2	I	6530, 6542, 6543, 6580, 6589
Synapta maculata (Chamisso & Eysenhardt, 1821)		2068, 6339, 6368
Apodida: Chiridotidae		
Chiridota sp.	I	Photo voucher
Aspidochirotida: Holothuriidae		
Actinopyga echinites (Jaeger, 1833)		6316, 6317, 6318, 6319, 6337, 6399
Actinopyga mauritiana (Quoy & Gaimard, 1834)		2066, 2069, 6332, 6333, 6365, 6558, 6922, 6985
Actinopyga capillata Rowe & Massin 2006		MNHN EcHh 8078 (holotype)
*Actinopyga obesa?** (Selenka, 1867) complex	I	No voucher (observation by Chantal Conand l'Hermitage, October 7th 2007)
Bohadschia subrubra (Quoy & Gaimard, 1834)	I	6330
Bohadschia vitiensis (Semper, 1868)		6454, 6561
Holothuria atra Jaeger, 1833		6430, 6457, 6510, 6511, 6565, 6566, 6567, 6645
Holothuria cinerascens (Brandt, 1835)		6630
Holothuria arenicola Semper, 1868	I	6374
Holothuria difficilis Semper, 1868		6402, 6492, 6551, 6622, 6644, 7415
Holothuria flavomaculata Semper, 1868	I	6331
Holothuria fuscocinerea Jaeger, 1833 complex	I	6560, 7416
Holothuria hilla Lesson, 1830		6488, 6528
*Holothuria impatien*s (Forsskål, 1775) complex sp. 1	I	6485, 6487, 6588, 6663
Holothuria impatiens (Forsskål, 1775) complex sp. 2	I	6371
Holothuria leucospilota (Brandt, 1835)		6356, 6422, 6486
Holothuria lineata Ludwig, 1875	I	6369, 6375, 6435
Holothuria nobilis (Selenka, 1867)		7414
Holothuria pardalis Selenka, 1867		IRSNB 661048-HOL.1154
Holothuria pervicax Selenka, 1867		2079, 6321, 6336, 6398, 6456, 6559, 6619, 7413
Holothuria verrucosa Selenka, 1867 complex	I	6338, 6568
Holothuria aff. inhabilis (Selenka, 1867)	I	IRSNB 641841-HOL.991
Labidodemas pertinax (Ludwig, 1875)		6349
Pearsonothuria graeffei (Semper, 1868)		6593
Aspidochirotida: Stichopodidae		
Stichopus chloronotus Brandt, 1835		2089, 6315, 6367, 6396, 6397, 6552
Stichopus herrmanni Semper, 1868		6572
Stichopus monotuberculatus (Quoy & Gaimard, 1834)		6329, 6370, 6570, 6571
Thelenota ananas (Jaeger, 1833)		Photo voucher
Dendrochirotida: Sclerodactylidae		
Afrocucumis africana (Semper, 1867)	I	IRSNB 641171-HOL.944
*Ohshimella ehrenbergi*i (Selenka, 1868)	I	6423

contributed most to the new records. Genetic studies are also leading to the recognition of numerous cryptic species and are clarifying species limits in several common species.

Despite its young age, La Réunion offers a wide variety of habitats and supports a relatively diverse holothurian fauna. However, suitable habitats are geographically restricted on the island and the abundance of many species is low. Additional investigation of cryptic (e.g. reef matrix, sediment) and microhabitats, deeper waters, and many areas on the island not yet surveyed (Figure 1), will probably further increase the documented species richness of the holothurian fauna. Moreover, molecular data may reveal additional species and further augment the fauna of La Réunion.

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Figure 2. Some uncommon holothurians from La Réunion. Left column, top to bottom: *Holothuria lineata* **(UF 6375, total length 5 cm),** *Polyplectana* **sp. (UF 6594, total length 15 cm),** *Bohadschia subrubra* **(UF 6330, total length 25 cm),** *Holothuria arenicola* **(UF 6374, total length 12 cm). Right column, top to bottom:** *Pearsonothuria graeffei* **(juvenile, UF 6593, total length 4 cm),** *Labidodemas pertinax* **(UF 6349, total length 30 cm),** *Stichopus monotuberculatus* **(UF 6329, total length 25 cm),** *Ohshimella ehrenbergi* **(UF 6423, total length 3 cm).**

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