



Original article

Inventory of echinoderms in the Iles Eparses (Europa, Glorieuses, Juan de Nova), Mozambique Channel, France

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ABSTRACT

The multidisciplinary programme BioReCIE (Biodiversity, Resources and Conservation of coral reefs at Eparses Is.) inventoried multiple marine animal groups in order to provide information on the coral reef health of the Iles Eparses. All five classes of echinoderms were observed by visual census, photographed and later identified. About 100 species are reported, including a few unidentified ones which require further studies. The Holothuroidea and Ophiuroidea are the most diverse. One new species, the asterinid *Aquilonastra chantalae* O'Loughlin and McKenzie (2013), was discovered in addition to several new records of echinoderms. The illegal fishery targeting holothurians, which are presently highly valuable resources in this zone, is discussed.

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1. Introduction

The Iles Eparses (Scattered Islands) are isolated uninhabited French islands, in the South West Indian Ocean. These islands provide ideal conditions for evaluating marine biodiversity that has not been affected by anthropogenic influences. The multidisciplinary programme BioReCIE (Biodiversity, Resources and Conservation of coral reefs at Eparses Is.) undertook an inventory of several marine groups in order to provide information on the health of coral reefs on these islands (Chabanet et al., 2013, 2014a, 2014b, submitted for publication).

Few studies have been conducted on echinoderms from Iles Eparses (Vergonzannes, 1977; Quod et al., 2007; Mulochau and

Conand, 2008). The BioReCIE programme has recently provided data on Europa echinoderms (Conand et al., 2013) and on Glorieuses holothurians (Conand et al., 2014). Other studies on echinoderms have been conducted in several countries of the SW Indian Ocean region, on one class, or the whole phylum (Conand and Muthiga, 2007 and Muthiga and Conand, 2014); as for example on the holothurians of Kenya, Madagascar, Reunion, Seychelles and Tanzania; Conand, 2008; Conand et al., 2010; Eriksson et al., 2015; Samyn et al., 2006; Samyn and Tallon, 2005; FAO, 2013; Hoareau et al., 2013; O'Loughlin and McKenzie, 2013; Rowe and Richmond, 2011).

Although the Iles Eparses are generally described as pristine environments, some illegal fisheries for holothurians have developed in recent years (Conand et al., 2014). Illegal, Unreported and Unregulated Fishing (IUU) has recently caught international attention (FAO, 2001; Le Gallic, 2007). As the socioeconomic importance of holothurians has now been recognized (Purcell et al., 2013), threats to the resources will be discussed.

The objective of this paper is to report new data and synthesize our knowledge on the echinoderms in the Iles Eparses.

Abbreviations: ASFMA, Australian Fisheries Management Authority; IUU, illegal, unreported and unregulated fishing; MNHN, Muséum national d'Histoire naturelle, Paris; O, occurrence; rf, reef flat; rs, reef slope; sp., species; TAAF, Terres Australes et Antarctiques Françaises; WIO, Western Indian Ocean.

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2. Material and methods

The study areas of each archipelago and the general survey methods have already been presented in other contributions of this issue (Chabanet et al. 2014b submitted for publication; Poupin, in this issue) or in the other papers already published on echinoderms from the programme BioReCIE (Conand et al., 2013, 2014) and will not be detailed here. The list of the stations visited in Europa, Glorieuses and Juan de Nova is given in Appendix A (Tables A.1, A.2 and A.3), with the date, GPS position, depth and habitat, as presented by Poupin (in this issue) for the Crustacea of the programme.

Representatives of all five echinoderm classes were observed by visual census at low tide on reef flats or by SCUBA diving down to 20 m, on the reef slopes. Some individuals were sampled and photographed for identification. Several taxonomists have assisted with specimen identification (see Acknowledgements). The taxonomy follows the World Register of Marine Species (Boxshall et al., 2014).

Despite various geomorphologic descriptors used on the field (see Appendices), the habitats have been brought together as two main categories: reef flat (RF) and outer reef slope (OR) to allow a first general comparison in these islands. To show the relative presence of each echinoderm species at each island, its occurrence has been calculated, defined as the number of stations (n) where it was present in a specific habitat (RF or OR), divided by the total number of stations (N) studied for this habitat.

When available, the populations of some species have also been categorized from the field observations, as dense or sparse.

Information on illegal fisheries for sea cucumbers in the Iles Eparses have been obtained from TAAF and ASFMA (see Abbreviations).

3. Results

A synthetic view of the general diversity of echinoderms in the Iles Eparses is presented in Table 1.

The taxonomic diversity differs between classes. Based on our sampling programme, the Holothuroidea and Ophiuroidea were the most diverse, with 31 species each (including 4 and 6 unidentified species respectively). The Crinoidea were the least diverse, with only 9 species (including 3 species not identified). The Asteroidea with 11 species (1 not identified) and the Echinoidea with 16 species (2 not identified) showed an intermediate diversity, from the results of this programme. In total, about 100 species were found (including 12 unidentified species, whose specimens were often juveniles). One new species, the asteroid *Aquilonastra chantalae* O'Loughlin and McKenzie (2013), has been discovered (O'Loughlin and McKenzie, 2013) and has been deposited and registered as MNHN IE–2013–617 at the Muséum national d'Histoire naturelle, Paris (MNHN).

All echinoderms from Europa collected during the BioReCIE

expedition will be catalogued and housed at the Muséum national d'Histoire naturelle, Paris; most of the brittle stars collected from Glorieuses and Juan are housed at the Swedish Museum of Natural History, Stockholm.

The echinoderm species are presented by class and by family, in the Tables 2–6 (including new records), with the occurrence of each species calculated for the main habitats (RF and OR) for each island, and then in total for the results from this programme, allowing comparisons with other sites in the WIO.

The **Holothuroidea** sampled were represented by five families (Table 2). The family Holothuriidae was the most diverse with 19 species identified +3 unidentified including 1 juvenile *Holothuria*. The diversity on the reef flats, with 17 species, is nearly twice as high as on the slopes, with 9 species. The species with total occurrence over, or near 0.20 will be presented here. Ranked by decreasing occurrences, *Bohadschia atra* shows the highest value (0.38), followed by *Holothuria nobilis* (0.25), *Holothuria atra* (0.23) and *Bohadschia subrubra* (0.21).

Four species belong to the family Stichopodidae. *Stichopus chloronotus*, with dense populations on reef flats, had an occurrence of 0.23 and *Thelenota ananas*, mostly found on slopes, has 0.180.

The other families have a low diversity, with 1 Sclerodactylidae *Afrocumia africana*, 2 Synaptidae +1 *Patinapta* sp. and 1 Chiridotidae.

Fourteen species are considered as new records, from the results of BioReCIE (including the species presented in Conand et al., 2013 for Europa and Conand et al., 2014 for Glorieuses); several species had been reported in Cherbonnier's study of Madagascar (1988); 11 species are from the family Holothuriidae.

The **Ophiuroidea** were represented by 8 families, all from the order Ophiurida (Table 3). As the systematics of this class is rapidly changing (O'Hara et al., 2014), the families are presented in the following order. The Ophiuridae was represented by 1 species, *Ophiura kinbergi*, found at 2 sites. The Ophiodermatidae were represented by 2 species, *Ophiarachnella gorgonia* and *Ophiopeza fallax*. The Ophiocomidae was the most diverse family and was represented by 13 species, including *Ophiocoma erinaceus* which showed the highest occurrence (0.24), followed by *Ophiocoma (Breviturma) brevipes* and *Ophiocoma cynthiae* (0.23). The Ophiotrichidae were represented by 4 identified species and 1 *Ophiothela* sp. The species in the other families had a low diversity and occurrence: the Ophiolepididae with 1 species and 1 juvenile of the same genus *Ophiolepis*, the Ophiactidae with 2 species of *Ophiactis*, with *Ophiactis savignyi* at Europa and Juan de Nova and 1 unidentified of the same genus, the Ophionereididae with 3 species of the genus *Ophionereis* only found at Juan, and finally the Amphiuroidae, with the only species *Amphipholis squamata* found at Europa. A cryptic black species, common in coral patches, was not collected (Conand et al., 2013).

Assessing the number of new records of ophiuroids is difficult, since several of the morphologically identified species have been found to comprise several genetic lineages that may have to be treated as separate species (Hoareau et al., 2013), which may revert to currently synonymized names. Since the morphological differences of these genetic lineages have not been worked out, we treat the species found by this study as operational units under the currently valid species names, bearing in mind that some may actually be species complexes. This allows comparison with previous studies. Twelve species are regarded as new for the Eparses Islands (including those reported by Conand et al., 2013 for Europa), but most of them have previously been recorded from the Mozambique Channel at Inhaca (Clark, 1980) and/or at Madagascar (Cherbonnier and Guille, 1978). *Ophiocoma doederleini* appears to be a new record for the area, possibly also *Ophiocoma dentata* if its identity is confirmed (although it may previously have been

Table 1
Diversity in number of species of Echinoderms, by class and total, in the Eparses Islands (Europa, Juan de Nova and Glorieuses), from the BioReCIE programme.

Classes	Europa	Juan de Nova	Glorieuses	Total
Asteroidea	5	7	8	13
Ophiuroidea	13	16	17	31
Echinoidea	8	10	11	16
Holothuroidea	8	21	20	31
Crinoidea	4	6	3	9
Total	38	60	59	100

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