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Original article

Marine flora of the Iles Eparses (Scattered Islands): A longitudinal transect through the Mozambique Channel

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ABSTRACT

The diversity of marine macrophytes of small islands in the South Western Indian Ocean region has been poorly documented and little or no information is available for the Iles Eparses (or Scattered Islands) in the Mozambique Channel. We present the first species checklist for the three largest islands of the Iles Eparses: Europa, Juan de Nova and Glorioso. Overall, with a total of 321 marine macrophyte species recorded (incl. 56% Rhodophyta, 27% Chlorophyta, 15% Phaeophyceae and 2% Magnoliophyta; Europa: 134 spp., Juan de Nova: 157 spp. and Glorioso: 170 spp.) these islands harbour 23.5% of the total species recorded for the Mozambique Channel region. We report 36 new records for the Mozambique Channel including 29 undescribed new and cryptic species. Our results highlight a decrease in species richness southward in the Channel. Because of their longitudinal arrangement between the northern and the southern ends of the Channel and their central position, Europa, Juan de Nova and Glorioso Islands represent data points of particular biogeographical interest and could be critical 'stepping stones' for connectivity in the highly dynamic Mozambique Channel region.

1. Introduction

The diversity of marine macrophytes in the South Western Indian Ocean (SWIO) is mainly known from scattered checklists and regional taxonomic publications for Madagascar, Mauritius, Mozambique, Réunion, and the Seychelles (e.g. Børgesen, 1940–1957; Bornet, 1885; Carvalho and Bandeira, 2003; Coppejans et al., 2004; Critchley et al., 1997; De Clerck et al., 2004; Hariot, 1902; Massingue and Bandeira, 2007; Mshigeni, 1985; Payri, 1985; Rabesandratana, 1988; Wynne, 1995) while four illustrated books focus on sections of the African East coast in Kenya, Tanzania and South Africa (Jaasund, 1976; De Clerck et al., 2005; Moorjani and Simpson, 1988; Oliveira et al., 2005). All literature records prior to 1996 have been comprehensively listed by Silva et al. (1996), but further unpublished data are available for the region (e.g. Madagascar: Douternlungne, 2003; Farghaly, 1980). Most of these texts deal exclusively with marine macroalgae (seaweeds), with some including macroscopic cyanobacteria and/or marine angiosperms (seagrasses). The marine floras of the islands in the Mozambique Channel remain poorly understood; for example, Algaebase (Guiry and Guiry, 2015) records only 59 spp. for the Comoros (incl. Mayotte) and no published species lists are available for the Iles Eparses (Scattered Islands).

The Iles Eparses are a group of five uninhabited islands and reefs administered by France, on behalf the French Southern and Antarctic Lands (TAFF: Terres Australes et Antartiques françaises), which despite the visits of several botanists from the middle of the 19th century (http://ileseparses.cbnm.org/index.php/histoire-de-la-botanique, accessed 20/01/2015), seem to have been avoided by phycologists, although a few scattered collections appear in local reports.

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The three largest islands of the Iles Eparses: Europa, Juan de Nova and Glorioso, are spread across 10° of latitude between the southern and the northern ends of the Mozambique Channel (Fig. 1). The other two are Bassas da India, a reef emersed only at low tide just north of Europa, and Tromelin, a tiny island (less than 1 km^2, (Andréfouët et al., 2008) with very limited terrestrial vegetation, north-east of Madagascar.

The Mozambique Channel is of particular interest from a biogeographical perspective as it is affected by a combination of complex currents and mesoscale eddies (Quartly and Srokosz, 2004; Halo et al., 2014; Hancke et al., 2014), which have been put forward as vectors of unique patterns of distribution and connectivity (Gopal et al., 2006; Marsac et al., 2014; Obura, 2012; Reddy et al., 2014; Tew Kai and Marsac, 2010). A study on reef-building corals (Obura, 2012) shows evidence for a high diversity region in the northern section of the Mozambique Channel, decreasing southward with increasing eddy–shelf interactions and upwelling from the South Madagascar Plateau, resulting in a transition to colder/higher nutrient fauna and habitats. Obura (2012) suggested that patterns observed for corals may be similar for other shallow marine taxa. Due to the longitudinal arrangement of the Iles Eparses in the Mozambique Channel, the shallow marine biodiversity of Europa, Juan de Nova and Glorioso may be expected to follow the same trend.

Due to their isolation, the Iles Eparses are subject to very limited human disturbance. Nevertheless, Juan de Nova and Glorioso are situated in the 'Western Madagascar marine ecoregion' (considered vulnerable) and one of 22 global 'Tropical coral' ecoregions considered most critical for global conservation (Olson and Dinerstein, 2002). The fauna and flora of the archipelago are protected by the TAAF and enforcement is maintained by a permanent military detachment on each of the three main islands. Although the anthropogenic influence is strictly controlled, there are anecdotal reports of illegal visits by foreign fishermen. There are also invasive populations of cats and goats and relics of attempted colonisation on some islands. With the aim of providing baseline studies for registering these islands as Marine Protected Areas (MPAs), the BIORECIE program (Biodiversité, Ressources et Conservation des Récifs Coralliens des Iles Eparses), led by the French Institut de Recherche pour le Développement (IRD) was funded for a period of three years (2011–2013). As part of this program, during three intensive SCUBA diving and snorkelling-based field expeditions the first significant marine macrophyte reference collections were made for the Iles Eparses.

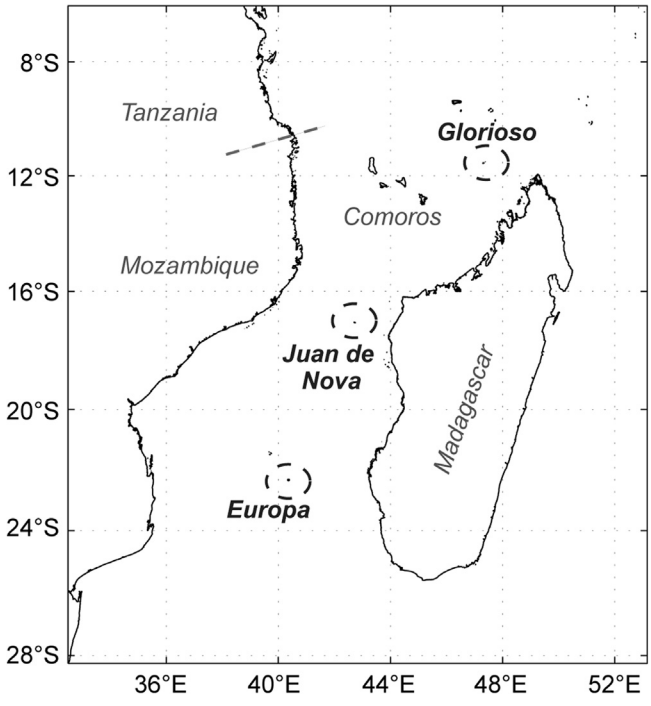

Fig. 1. Geographical position of Europa, Juan de Nova and Glorioso Islands in the Mozambique Channel.

The present study aims to fill a gap in our knowledge of the marine flora (including macroalgae and seagrasses) of the Iles Eparses, to provide a baseline species checklist for future biogeographical studies and management purposes, and to conduct a preliminary investigation of diversity patterns between the three largest islands: Europa, Juan de Nova and Glorioso.

2. Material & methods

2.1. Sites and sample collection

Europa is the southernmost island in the Mozambique Channel, located 550 km east of southern Mozambique and 300 km west of southern Madagascar (22°21′59″S, 40°22′06″E, Fig. 1). It is the largest island (31.63 km^2 land surface area) of the Iles Eparses with a roughly circular shape of 6–7 km diameter. It is surrounded by sand dunes and fringing reefs, with a maximum elevation of 7 m. The shallow lagoon is almost empty at low tide and half of its surface is occupied by mangroves. Reefs and lagoon area account for a total of 17.5 km^2.

The Island of Juan de Nova is situated about 400 km north of Europa, about 100 km west of Madagascar and 200 km east of Mozambique (17°03′19″S, 42°43′24″E, Fig. 1). It is a small island (5.48 km^2 land surface area), measuring 6 km at its longest end and 1.6 km at its narrowest end. Sand dunes reach up to 12 m high. The island is surrounded by a large lagoon and fringing reefs which together cover 206.69 km^2.

The Glorioso archipelago represents the northernmost islands of the Mozambique Channel. It is located about 140 km north-west of the northern tip of Madagascar and about 170 and 500 km north east of Mayotte (Comoros) and Juan de Nova respectively, and 460 km east of the northern tip of Mozambique (11°34′44″S, 47°17′28″E, Fig. 1). The archipelago is composed of two main islands: Grande Glorieuse, the largest, which is 2.3 km at its widest section, and Ile du Lys, which is only 600 m long. The two islands are separated by 10 km of shallow reefs and are surrounded by a lagoon and reefs (196.56 km^2 total area) (surface areas are from Andréfouët et al., 2008); for more information on the Scattered Islands see also http://ileseparses.cbnm.org/ and http://www.taaf.fr/-District-des-iles-Eparses).

Samples were collected from a total of 17 sites at Europa (December 2011), 26 sites at Glorioso (December 2012) and 27 sites at Juan de Nova (December 2013). All collections were thus made in the Austral summer. Sites were chosen based primarily on satellite images in order to represent as many of the different habitats found around those islands (see Andréfouët et al., 2015 in this issue) from the intertidal down to about 20 m deep, and taking into account logistic difficulties. At each site, sampling effort was 60 min and all different species encountered were collected. Samples were sorted, photographed, given preliminary identifications and pressed the same day. At least two specimens of each species found at each island were processed to form a principal and a duplicate voucher collection. The principal voucher collection of Europa was deposited in the Herbarium of the Muséum National d'Histoire Naturelle (PC) in Paris, France with duplicates in the Herbarium of the Université de la Réunion (REU), France. Voucher collections for Juan de Nova and Glorioso Islands will also be deposited in these Herbaria.