Marine algal flora of Graciosa Island, Azores

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Abstract

Background

The macroalgal flora of Graciosa (central group of Azores archipelago) is poorly known, with only 116 species recorded so far (authors personal data). The published information reflects occasional collections from sporadic field visits to the Island. To overcome this, a thorough investigation under the Expedition “GRACIOSA/2004”, the Campaigns “PADEL/2006”, “MACROBIOLOMOL/2014” and “PIMA-BALA/2017” involving sample collecting and presence data recording, was undertaken over an area of 19 km² encompassing littoral and sublittoral levels down to about 40 m around the Island. This paper lists the taxonomic records and provides information on species ecology and occurrence around the Island improving the knowledge of the Azorean macroalgal flora at both local and regional scales.
New information

A total of 1692 specimens belonging to 250 taxa of macroalgae (and including 55 taxa identified only at the genus level) are registered, comprising 166 Rhodophyta, 36 Chlorophyta and 48 Ochrophyta (Phaeophyceae). From these, 195 are identified to the species level (126 Rhodophyta, 31 Chlorophyta and 38 Ochrophyta) and comprise 156 native, 20 of uncertain origin and 14 introductions to the Island. *Predaea feldmannii* subsp. *azorica* Gabriel is an Azorean endemic, whereas *Codium elisabethiae* O.C. Schmidt, *Botryocladia macaronesica* Afonso-Carrillo, Sobrino, Tittley & Neto, *Phyllophora gelidioides* P.Crouan & H.Crouan ex Karsakoff and *Laurencia viridis* Gil-Rodríguez & Haroun represent Macaronesian endemics. Seventy-nine species are newly recorded to the algal flora of the Island.

Keywords

Macroalgae, Azores, Graciosa Island, new records, endemism, native, uncertain, introduced, occurrence data.

Introduction

Around 400 species of marine macroalgae have been recorded in the isolated mid-Atlantic Azores archipelago so far (Freitas et al. 2019). The Azorean algal flora is cosmopolitan with species shared with Macaronesia *sensu lacto*, North Africa, the Mediterranean Sea, Atlantic Europe and America. Overall, it shares more species with the east Atlantic flora than with the west (Tittley and Neto 2006, Wallenstein et al. 2009).

Based on extensive analysis encompassing widely-dispersing phyla (as coastal fishes, echinoderms and macroalgae) and less-dispersing phyla (as brachyurans, polychaetes and gastropods), Freitas et al. (2019) suggested that the Azores should be a biogeographical entity of its own and proposed a re-definition of the Lusitanian biogeographical province, in which they consider four ecoregions: the South European Atlantic Shelf, the Saharan Upwelling, the Azores ecoregion and a new ecoregion herein named Webbnesia, which comprises the archipelagos of Madeira, Selvagens and the Canary Islands. In their paper, when comparing the Azorean algal flora to that of the new Webbnesia region, they reported that the Canary Islands, with 689 species, are by far the most diverse archipelago, followed by the Azores (405), Madeira (396) and Cabo Verde (333). The Selvagens are the least diverse one (295 species). When compared to that of other remote oceanic Islands (e.g. the Shetlands and Faroes in the colder North Atlantic and Ascension and Tristan da Cunha in the Southern Atlantic), the algal flora of the Azores can also be considered relatively rich (Tittley 2003, Neto et al. 2005, Tittley and Neto 2005, Tittley and Neto 2006, Wallenstein et al. 2009).

From all Azorean Islands, São Miguel is by far the one with the largest amount of research dedicated to the study of the algal flora. The total number of algal species is at the moment
260, a number that is likely to increase due to ongoing research by authors of the present paper. Most of the remaining Islands have received less attention. To overcome this and to improve the understanding of the archipelago's macroalgal flora, research has been conducted over the past three decades in all the Islands. Data on the Islands of Pico and Terceira are already available on the recently-published papers by Neto et al. (2020a), Neto et al. (2020b). Table 1 summarises the available information at the moment.

| Phylum     | Santa Maria | São Miguel | Terceira | Graciosa | São Jorge | Pico | Faial | Flores | Corvo |
|------------|-------------|------------|----------|----------|-----------|------|-------|--------|-------|
| Rhodophyta | 68          | 168        | 73       | 79       | 35        | 142  | 59    | 59     | 13    |
| Chlorophyta| 20          | 39         | 24       | 21       | 17        | 41   | 16    | 16     | 2     |
| Ochrophyta | 28          | 53         | 16       | 16       | 10        | 42   | 8     | 16     | 4     |
| Total      | 116         | 260        | 113      | 116      | 62        | 225  | 83    | 91     | 19    |

The present paper presents both physical and occurrence data and information gathered from macroalgae surveys undertaken on Graciosa (central group of the archipelago) by the Island Aquatic Research Group of the Azorean Biodiversity Centre of the University of the Azores (Link: https://ce3c.ciencias.ulisboa.pt/sub-team/island-aquatic-ecology), the MARBE, Marine Biodiversity and Environment Research Group of CIBIO-Açores at the University of the Azores (Link: http://cibio.uac.pt/en/research-groups/marbe-marine-biodiversity-and-environment) and the OKEANOS Centre of the University of the Azores (Link: http://www.okeanos.uac.pt). In these surveys, particular attention was given to the small filamentous and thin sheet-like forms that are often short-lived and fast-growing species, very difficult to identify in the wild, requiring the aid of a microscope.

The paper aims to provide a practical resource for biological studies, such as systematics, diversity and conservation, biological monitoring, climate change and ecology and also for academics, students, government, private organisations and the general public.

**General description**

**Purpose:** In this contribution, we list taxonomic records for Graciosa and present general information for the occurrence of each taxon around the Island. By doing this, we are contributing to address several biodiversity shortfalls (see Cardoso et al. 2011, Hortal et al. 2015), namely, the need to catalogue the Azorean macroalgae (Linnean shortfall) and to improve the current information on their local and regional geographic distribution (Wallacean shortfall), as well as on species abundances and dynamics in space (Prestonian shortfall).
Project description

Title: Marine algal flora of Graciosa Island, Azores

Personnel: Collections were undertaken and occurrence data recorded during several years (2004-2017). The main collectors were Amine Sebti, Ana F. Ferreira, Ana I. Neto, André Amaral, Andrea Z. Botelho, Catarina Santos, Daniel Torrão, Daniela Gabriel, David Milla-Figueras, Edgar Rosas-Alquicira, Eunice Nogueira, Francisco Wallenstein, Gonçalo Graça, Inês Machado, João Brum, Jorge Fontes, José M. N. Azevedo, Ian Tittley, Karla Leon Cisneros, Manuela I. Parente, Marlene Terra, Nil Alvaréz-Segura, Nuno Álvaro, Pedro Monteiro, Pedro Raposeiro, Patricia Madeira, Raquel Torres, Ruben Couto, Rui Sousa, Sara Peres and Sandra Medeiros.

Preliminary in situ identifications were done by Ana I. Neto, Andrea Z. Botelho, Daniela Gabriel, David Milla-Figueras, Edgar Rosas-Alquicira, Francisco Wallenstein, Karla Leon Cisneros, Ian Tittley, Manuela I. Parente, Marlene Terra and Ruben Couto.

Ana I. Neto, Andrea Z. Botelho, David Milla-Figueras, Edgar Rosas-Alquicira, Karla Leon Cisneros, Ian Tittley and Manuela I. Parente were responsible for the final species identification.

Voucher specimen management was mainly done by Afonso Prestes, Ana I. Neto, Andrea Z. Botelho, David Milla-Figueras, Eunice Nogueira, Manuela I. Parente, Natália Cabral and Roberto Resendes.

Study area description: The Azores archipelago, located in the North Atlantic, roughly at 38°43′49″N 27°19′10″W (Fig. 1) comprises nine Islands and several Islets spread over 500 km in a WNW direction. The climate is temperate oceanic, with persistent winds, regular and abundant rainfall and high levels of relative humidity mainly during winter and autumn (Morton et al. 1998). The Islands have a restricted coastal extension due to the lack of a continental shelf and deep waters occur within a few kilometres offshore. The tidal range is small (< 2 m, see Hidrográfico 1981) and coasts are subjected to swell and surge most of the year. Shore geomorphology alternates between high cliffs and rocky cobble/boulder beaches (Borges 2004).

Graciosa (in black in Fig. 1) is the second smallest Island of the Azores archipelago. Located in the central group, roughly at 39°0′38″N, 27°59′1″W, about 37 km north of São Jorge and 58 km north-west of Terceira, it has an area of about 62 km² and a maximum altitude of 402 m at the summit of the Caldeira, located at the south-western tip of the Island (Neto et al. 2009).

With the exception of Serra Branca, bordered by cliffs higher than 200 m and the area between Lagoa and Barra, where the coastline consists of steep cliffs, the remaining coastline of the Island is low (below 50 m), with long stretches of cobble beaches interspaced with lava flows (forming irregular extensions of bedrock), boulder areas and the single sandy beach near the small village of Praia. Between Ponta Branca and Carapacho, there are several bays, of which the bay of Filipe is the largest in size and
easily accessible by land. Rock pools are common on the bedrock shores around the Island, creating a shallow subtidal habitat with a rich diversity of marine life (Neto et al. 2009).

As on the remaining Azores Islands, the intertidal and shallow subtidal rocky-shore communities of Graciosa are dominated by macroalgae (Neto et al. 2005). The high intertidal level communities are characterised by a patchy mosaic of algae (principally \textit{Fucus spiralis} Linnaeus, \textit{Gelidium microdon} Kützing and \textit{Gymnogongrus} spp.) and a few animals (mainly chthamalid barnacles) (Fig. 2). Lower, the shore is covered by algal turfs (growth forms of either diminutive algae or diminutive forms of larger species that create a dense, compact mat 20-30 mm thick), either monospecific or composed of several species, for example, calcareous algae (e.g. \textit{Ellisolandia} and \textit{Jania}) or by soft algae (e.g. \textit{Centroceras clavulatum} (C.Agardh) Montagne, \textit{Chondracanthus} and \textit{Laurencia}) (Fig. 3). At this level, a few limpets may be seen. The erect, corticated macrophytes \textit{Ellisolandia elongata} (J.Ellis & Solander) K.R.Hind & G.W.Saunders, \textit{Pterocladiella capillacea} (S.G.Gmelin) Santelices & Hommersand (Fig. 4) and \textit{Treptacantha abies-marina} (S.G.Gmelin) Kützing are common in the transition zone to the subtidal, which is usually dominated by large foliose species (Neto et al. 2009). Subtidally, algal communities are characterised by associations of two or three frondose macrophytes (Fig. 5), predominantly the brown seaweeds, for example, \textit{Dictyota} spp., \textit{Halopteris} spp. and \textit{Zonaria tournefortii} (J.V.Lamouroux) Montagne (Neto et al. 2009).
Figure 2. The red macrophyte *Gelidium microdon*, a characteristic species of the Azorean high intertidal level (by the Island Aquatic Ecology Subgroup of cE3c-ABG).

Figure 3. Algal turf at mid-shore intertidal level (by the Island Aquatic Ecology Subgroup of cE3c-ABG).
Figure 4. Red macrophytes *Asparagopsis armata* and *Ellisolandia elongata* at lower intertidal level (by the Island Aquatic Ecology Subgroup of cE3c-ABG).

Figure 5. Frondose brown macrophytes (*Zonaria tournefortii* and *Dictyota* spp.) together with *Asparagopsis armata* at subtidal level (by the Island Aquatic Ecology Subgroup of cE3c-ABG).
**Design description:** The algae, referred to in this paper, were collected during field studies at littoral and sublittoral levels down to approximately 40 m on the Island of Graciosa. Each sampling location was visited several times. On each occasion, a careful and extensive survey was undertaken to provide good coverage of the area. Both presence recording and physical collections were made by walking over the shores or by scuba diving. The specimens collected were taken to the laboratory for identification and preservation and the resulting vouchers were deposited at the AZB Herbarium Ruy Telles Palhinha and the Molecular Systematics Laboratory at the Faculty of Sciences and Technology of the University of the Azores.

**Funding:** This study was mainly financed by the following projects/scientific expeditions:

- Expedition GRACIOSA/2004, Departamento de Biologia da Universidade dos Açores Ilha do Pico, Açores, June 2004;
- Campaign PADEL/2006, under the project “PADEL: Património natural e desenvolvimento sustentável do litoral dos Açores: a Ilha Graciosa como caso de estudo”. 2006 - 2007. The Azores Regional Government;
- Campaign MACROBIOMOL/2014, under the project “MACROBIOMOL, Macroalgal biodiversity under molecular lens - towards a better understanding of North Atlantic biogeography” (PTDC/MAR/114 613/2009). 2011 - 2015. Operational Programme COMPETE (ERDF funds), FCT (UID/BIA/50027/2013) and POCI-01-0145-FEDER-006821;
- Campaign PIMA-BALA/2017, under the projects “PIMA (3/DRAM/2015), Elaboração do programa de implementação da Diretiva-Quadro Estratégia Marinha - Programa invasoras marinhas nos Açores” and “BALA (2/DRAM/2015), Elaboração do programa de implementação da diretiva-quadro estratégia marinha - biodiversidade dos ambientes litorais dos Açores”. ERDF funds, and the Azores Regional Government;
- Project “ACORES-01-0145-FEDER-000072 - AZORES BIOPORTAL – PORBIOTA. Operational Programme Azores 2020 (85% ERDF and 15% regional funds);
- Portuguese National Funds, through FCT – Fundação para a Ciência e a Tecnologia, within the projects UID/BIA/00329/2013, 2015- 2019, UID/BIA/00329/2020-2023 and UID/BIA/50027/2019 and POCI-01-0145-FEDER-006821;
- Portuguese Regional Funds, through DRCT – Direção Regional da Ciência e Tecnologia, within several projects, 2019 and 2020;
- CIRN/DB/UAc (Research Centre for Natural Resources, Universidade dos Açores, Departamento de Biologia);
- CIIMAR (Interdisciplinary Centre of Marine and Environmental Research, Porto, Portugal).

**Sampling methods**

**Study extent:** This study covers a relatively-large area, approximately 19 km², encompassing littoral and sublittoral levels down to approximately 40 m around the Island of Graciosa (Table 2, Fig. 6).
Table 2.
Location of the sampling sites on Graciosa Island.

| Location No | Location ID      | Municipality | Locality              | Latitude / Longitude | geodeticDatum | Littoral zone |
|-------------|------------------|--------------|-----------------------|----------------------|---------------|---------------|
| 1           | GRA_SC_BPL       | Santa Cruz   | Baixa do Pesqueiro    | 39.123197, -28.045288 | WGS84         | Intertidal    |
| 2           | GRA_SC_BV        | Santa Cruz   | Barro Vermelho        | 39.095344, -28.026032 | WGS84         | Intertidal    |
| 3           | GRA_SC_Cb1       | Santa Cruz   | Carapacho|Baía 1    | 39.011211, -27.960628 | WGS84         | Subtidal      |
| 4           | GRA_SC_Cem       | Santa Cruz   | Carapacho|Entre-marés| 39.010819, -27.961696 | WGS84         | Intertidal    |
| 5           | GRA_SC_Cib       | Santa Cruz   | Carapacho|Ilhéu de Baixo| 39.009987, -27.942812 | WGS84         | Subtidal      |
| 6           | GRA_SC_Fop       | Santa Cruz   | Folga|porto     | 39.017394, -27.999973 | WGS84         | Intertidal    |
| 7           | GRA_SC_PAp       | Santa Cruz   | Porto Afonso|porto| 39.065946, -28.06759 | WGS84         | Intertidal    |
| 8           | GRA_SC_Pi        | Santa Cruz   | Praia|Ilhéu     | 39.058972, -27.954659 | WGS84         | Intertidal    |
| 9           | GRA_SC_Psm       | Santa Cruz   | Praia|São Mateus| 39.049412, -27.969379 | WGS84         | Intertidal    |
| 10          | GRA_SC_SCbf      | Santa Cruz   | Santa Cruz|Baixa do Ferreiro| 39.092344, -27.988639 | WGS84         | Subtidal      |
| 11          | GRA_SC_SCp       | Santa Cruz   | Santa Cruz|porto    | 39.088680, -28.008354 | WGS84         | Intertidal    |
| 12          | GRA_SC_SCpf      | Santa Cruz   | Santa Cruz|Ponta do Ferreiro| 39.088263, -27.996325 | WGS84         | Intertidal    |
| 13          | GRA_SC_SCpp      | Santa Cruz   | Santa Cruz|Ponta da Pesqueira| 39.086693, -27.994449 | WGS84         | Intertidal    |
| 14          | GRA_SC_BF        | Santa Cruz   | Baía do Filipe       | 39.022164, -28.012561 | WGS84         | Subtidal      |
| 15          | GRA_SC_Cb1       | Santa Cruz   | Carapacho|Baía 1    | 39.011211, -27.960628 | WGS84         | Subtidal      |
| 16          | GRA_SC_Cb2       | Santa Cruz   | Carapacho|Baía 2    | 39.012446, -27.958205 | WGS84         | Subtidal      |
| Location N0 | Location ID | Municipality | Locality | Latitude / Longitude | geodeticDatum | Littoral zone |
|------------|-------------|--------------|----------|----------------------|---------------|---------------|
| 17 | GRA_SC_Cem | Santa Cruz | Carapacho|Entre-marés | 39.010819, -27.961696 | WGS84 | Intertidal |
| 18 | GRA_SC_Cib | Santa Cruz | Carapacho|Ilhéu de Baixo | 39.009987, -27.942812 | WGS84 | Subtidal |
| 19 | GRA_SC_Ct | Santa Cruz | Carapacho|Termas | 39.01245, -27.959901 | WGS84 | Intertidal |
| 20 | GRA_SC_F | Santa Cruz | Fenais | 39.044619, -27.963737 | WGS84 | Intertidal |
| 21 | GRA_SC_Fob | Santa Cruz | Folga|Baía | 39.016995, -28.000629 | WGS84 | Subtidal |
| 22 | GRA_SC_PAbc | Santa Cruz | Porto Afonso|Baía das Caldeirinhas | 39.065128, -28.067997 | WGS84 | Subtidal |
| 23 | GRA_SC_PAp | Santa Cruz | Porto Afonso|porto | 39.065946, -28.06759 | WGS84 | Intertidal |
| 24 | GRA_SC_PB | Santa Cruz | Ponta Branca | 39.020325, -28.031507 | WGS84 | Subtidal |
| 25 | GRA_SC_Pbl | Santa Cruz | Praia|Baía da Lagoa | 39.059392, -27.975943 | WGS84 | Intertidal |
| 26 | GRA_SC_Pp | Santa Cruz | Praia|porto | 39.052321, -27.966435 | WGS84 | Subtidal |
| 27 | GRA_SC_SCb | Santa Cruz | Santa Cruz|Barra | 39.088431, -28.005052 | WGS84 | Subtidal |
| 28 | GRA_SC_SCba | Santa Cruz | Santa Cruz|Barra-Anel | 39.088456, -28.001856 | WGS84 | Intertidal |
| 29 | GRA_SC_SCba | Santa Cruz | Santa Cruz|Barra-Anel | 39.088694, -28.001464 | WGS84 | Subtidal |
| 30 | GRA_SC_SCbf | Santa Cruz | Santa Cruz|Baía da Fonte | 39.080207, -27.98857 | WGS84 | Subtidal |
| 31 | GRA_SC_SCbsc | Santa Cruz | Santa Cruz|Baía de Santa Catarina | 39.087896, -27.998773 | WGS84 | Intertidal |
| 32 | GRA_SC_SCbsv | Santa Cruz | Santa Cruz|Baía Senhora da Vitória | 39.071636, -28.067268 | WGS84 | Intertidal |
| 33 | GRA_SC_SCpb | Santa Cruz | Santa Cruz|Ponta da Barca | 39.089915, -27.995677 | WGS84 | Subtidal |
| Location N0 | Location ID | Municipality | Locality                        | Latitude / Longitude | geodeticDatum | Littoral zone |
|------------|-------------|--------------|---------------------------------|----------------------|---------------|---------------|
| 34         | GRA_SC_SCt  | Santa Cruz   | Santa Cruz|Terreiros                        | 39.092024, -28.013401 | WGS84         | Intertidal    |
| 35         | GRA_SC_SCpb | Santa Cruz   | Santa Cruz|Ponta da Barca                   | 39.089915, -27.995677 | WGS84         | Intertidal    |
| 36         | GRA_SC_BV   | Santa Cruz   | Barro Vermelho                   | 39.095344, -28.026032 | WGS84         | Intertidal    |
| 37         | GRA_SC_Cp   | Santa Cruz   | Carapacho|Ponta                           | 39.011703, -27.955194 | WGS84         | Intertidal    |
| 38         | GRA_SC_PAp  | Santa Cruz   | Porto Afonso|porto                        | 39.065946, -28.06759  | WGS84         | Intertidal    |
| 39         | GRA_SC_SCap | Santa Cruz   | Santa Cruz|Atrás do porto                   | 39.09, -28.01         | WGS84         | Intertidal    |
| 40         | GRA_SC_BB   | Santa Cruz   | Baixa do Badejo                  | 39.021049, -27.94005  | WGS84         | Subtidal      |
| 41         | GRA_SC_BPLpf| Santa Cruz   | Baixa do Pesqueiro|Longo|Picos de Fora              | 39.02105, -28.047544 | WGS84         | Subtidal      |
| 42         | GRA_SC_BV   | Santa Cruz   | Barro Vermelho                   | 39.02105, -28.0285    | WGS84         | Subtidal      |
| 43         | GRA_SC_BVbpcn| Santa Cruz   | Barro Vermelho|Baixa do Pintado|Costa Norte         | 39.02105, -28.03465 | WGS84         | Subtidal      |
| 44         | GRA_SC_Cib  | Santa Cruz   | Carapacho|Ilhéu de Baixo                  | 39.009987, -27.942812 | WGS84         | Subtidal      |
| 45         | GRA_SC_Cpr  | Santa Cruz   | Carapacho|Ponta da Restinga               | 39.017723, -27.946526 | WGS84         | Subtidal      |
| 46         | GRA_SC_IB   | Santa Cruz   | Ilhéu da Baleia                  | 39.095601, -28.046544 | WGS84         | Subtidal      |
| 47         | GRA_SC_IP   | Santa Cruz   | Ilhéu da Praia                   | 39.055066, -27.957481 | WGS84         | Subtidal      |
| 48         | GRA_SC_PB   | Santa Cruz   | Ponta Branca                     | 39.020325, -28.031507 | WGS84         | Subtidal      |
| 49         | GRA_SC_SCbf | Santa Cruz   | Santa Cruz|Baixa do Ferreiro                | 39.092344, -27.988639 | WGS84         | Subtidal      |
| 50         | GRA_SC_SCpb | Santa Cruz   | Santa Cruz|Ponta da Barca                   | 39.089915, -27.995677 | WGS84         | Subtidal      |
Figure 6. 
Sampling locations around Graciosa Island (by Nuno V. Álvaro).

Figure 7. 
Collecting macroalgae at the rocky intertidal (by the Island Aquatic Ecology Subgroup of cE3c-ABG).
**Sampling description:** Intertidal collections were made during low tide by walking over the shores. Subtidal collections were made by scuba diving around the area. Sampling involved specimen collecting and species-presence recording. For the former, at each location, samples were obtained by scraping (Fig. 7) one or two specimens of all different species found into labelled bags. Species-recording data were gathered by registering all species present in the sampled locations visited (Fig. 8). Complementary data, for example, shore level (high, mid, low), orientation and type of substrate (bedrock, boulders, cobbles, mixed), habitat (tide pool, open rock, gully, crevice, cave) were also recorded.

**Quality control:** Each sampled taxon was identified by trained taxonomists and involved morphological and anatomical observations of whole specimens by eye or of slide preparations under the microscope for the diagnostic features described in literature.

**Step description:** Specimens were brought back to the laboratory, sorted and studied following standard procedures used in macroalgae identification.

Species identification was based on morphological and anatomical characters and reproductive structures. For small and simple thalli, this required the observation of the entire thallus with the naked eye and/or using dissecting and compound microscopes. For larger and more complex algae, investigation of the thallus anatomy required histological preparations (longitudinal and transverse sections) for the observation of cells, reproductive structures and other diagnostic characters.
As the Azorean algal flora has representatives from several geographical regions, often causing difficulty in identification, floras and keys for the North Atlantic, Tropical Atlantic and Western Mediterranean were used (e.g. Schmidt 1931, Taylor 1967, Taylor 1978, Levring 1974, Dixon and Irvine 1977, Lawson and John 1982, Irvine 1983, Gayral and Cosson 1986, Fletcher 1987, Afonso-Carrillo and Sansón 1989, Burrows 1991, Boudouresque et al. 1992, Cabioc’h et al. 1992, Maggs and Hommersand 1993, Irvine and Chamberlain 1994, Brodie et al. 2007, Lloréns et al. 2012 and Rodríguez-Prieto et al. 2013).

For more critical and taxonomically-difficult taxa, specimens were taken to the Natural History Museum (London) for comparison with collections there.

A reference collection was made for all collected specimens by assigning them a herbarium code number and depositing them at the AZB Herbarium Ruy Telles Palhinha and the Molecular Systematics Laboratory, University of Azores. Depending on the species and on planned further research, different types of collections were made, namely (i) liquid collections using 5% buffered formaldehyde seawater and then replacing it by the fixing agent Kew (Bridsen and Forman 1999); (ii) dried collections, either by pressing the algae (most species) as described by Gayral and Cosson (1986) or by letting them air-dry (calcareous species); and (iii) silica gel collections for molecular study.

Nomenclatural and taxonomic status used here follow Algaebase (Guiry and Guiry 2020). The database was organised on FileMaker Pro.

**Geographic coverage**

**Description:** Graciosa Island, Azores, Macaronesia, Portugal (approximately 39°0'38"N, 27°59'1"W).

**Coordinates:** 39.002 and 39.104 Latitude; -28.076 and -27.927 Longitude.

**Taxonomic coverage**

**Description:** All macroalgae were identified to genus or species level. In total, 250 taxa were identified belonging to 31 orders and 66 families, distributed by the phyla Rhodophyta (17 orders and 41 families), Chlorophyta (4 orders and 9 families) and Ochrophyta (10 orders and 16 families).

**Taxa included:**

| Rank     | Scientific Name | Common Name   |
|----------|-----------------|---------------|
| phylum   | Rhodophyta      | Red algae     |
| phylum   | Chlorophyta     | Green algae   |
| phylum   | Ochrophyta      | Brown algae   |
Temporal coverage

Living time period: 2004 - 2017.

Notes: The sampling was performed on several occasions in the period between 2004 and 2017.

Collection data

Collection name: AZB | Marine macroalgae collection of Graciosa Island (Azores) – Expedition GRACIOSA/2004; AZB | Marine macroalgae collection of Graciosa Island (Azores) – Project PADEL; AZB | Marine macroalgae collection of Graciosa Island (Azores) – Occasional sampling; Marine macroalgae collection of Graciosa Island (Azores)-Project MACROBIOMOL; Marine macroalgae collection of Graciosa Island (Azores)-Campaign PIMA/BALA; Marine macroalgae occurrence in Graciosa Island (Azores) – Project PADEL

Collection identifier: 5ee0202d-c659-436f-9b78-664df8e2791d; 915baa3f-e5b0-4673-ba80-00c05420e1ef; c1904e12-0389-4e52-b78d-8cd18942fd3d; dc0e952e-51be-4677-8789-a02e57869e7a; fc35e5ae-2143-4b62-87af-ede8db82fc2c; e29a0327-dcd3-4626-831a-4606c7862220

Parent collection identifier: AZB Herbarium Ruy Telles Palhinha, Faculty of Sciences and Technology of the University of the Azores; AZB Herbarium Ruy Telles Palhinha, Faculty of Sciences and Technology of the University of the Azores; AZB Herbarium Ruy Telles Palhinha, Faculty of Sciences and Technology of the University of the Azores; MACROBIOMOL Macroalgae collection, Faculty of Sciences and Technology of the University of the Azores; PIMA/BALA Macroalgae collection, Faculty of Sciences and Technology of the University of the Azores; AZB Herbarium Ruy Telles Palhinha, Faculty of Sciences and Technology of the University of the Azores.

Specimen preservation method: Air-dry, Dried and pressed; Liquid (Formalin; fixing agent Kew), Silica.

Curatorial unit: AZB Herbarium Ruy Telles Palhinha, Faculty of Sciences and Technology of the University of the Azores.

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Data resources

Data package title: Marine algal (seaweed) flora of Graciosa Island, Azores

Resource link: http://ipt.gbif.pt/ipt/resource?r=graciosa_seaweed_flora&v=1.9
Alternative identifiers: http://ipt.gbif.pt/ipt/resource?r=graciosa_seaweed_flora; https://doi.org/10.15468/uxjpmx

Number of data sets: 1

Data set name: Marine algal (seaweed) flora of Graciosa Island, Azores

Download URL: http://ipt.gbif.pt/ipt/resource?r=graciosa_seaweed_flora&v=1.9

Data format: Darwin Core Archive

Data format version: 1.6

Description: This data paper presents both physical and occurrence data from macroalgal surveys undertaken on Graciosa Island between 2004 and 2017 (Neto et al. 2020c. The dataset submitted to GBIF is structured as a sample event dataset, with two tables: event (as core) and occurrences. The data in this sampling event resource have been published as a Darwin Core Archive (DwCA), which is a standardised format for sharing biodiversity data as a set of one or more data tables. The core data table contains 50 records (eventID). The extension data table has 1692 occurrences. An extension record supplies extra information about a core record. The number of records in each extension data table is illustrated in the IPT link. This IPT archives the data and thus serves as the data repository. The data and resource metadata are available for downloading in the downloads section.

| Column label                  | Column description                                                                 |
|-------------------------------|-----------------------------------------------------------------------------------|
| Table of Sampling Events      | Table with sampling events data (beginning of table)                              |
| eventID                       | Identifier of the event, unique for the dataset                                   |
| country                       | Country of the sampling site                                                      |
| countryCode                  | Code of the country where the event occurred                                      |
| stateProvince                 | Name of the region                                                                |
| island                        | Name of the island                                                                |
| municipality                  | Name of the municipality                                                          |
| locality                      | Name of the locality                                                              |
| locationID                    | Identifier of the location                                                        |
| decimalLatitude               | The geographic latitude of the sampling site                                       |
| decimalLongitude              | The geographic longitude of the sampling site                                      |
| geodeticDatum                 | The spatial reference system upon which the geographic coordinates are based      |
| coordinateUncertaintyInMetres | The horizontal distance (in metres) from the given decimalLatitude and decimalLongitude describing the smallest circle containing the whole of the Location |
| Event Date | Time interval when the event occurred |
|------------|--------------------------------------|
| Year       | The year of the event                |
| Sampling Protocol | Sampling method used during an event |
| Location Remarks | Zonation level                     |
| Minimum Depth In Metres | The minimum depth in metres where the specimen was found |
| Maximum Depth In Metres | The maximum depth in metres where the specimen was found |
| Event Remarks | Notes about the event                |

**Table of Species Occurrence**

- Occurrence ID | Identifier of the record, coded as a global unique identifier
- Institution ID | The identifier for the institution having custody of the object or information referred to in the record
- Institution Code | The acronym of the institution having custody of the object or information referred to in the record
- Collection ID | An identifier of the collection to which the record belongs
- Collection Code | The name of the collection from which the record was derived
- Dataset Name | The name identifying the dataset from which the record was derived
- Event ID | Identifier of the event, unique for the dataset
- Kingdom | Kingdom name
- Phylum | Phylum name
- Class | Class name
- Order | Order name
- Family | Family name
- Genus | Genus name
- Specific Epithet | The name of the first or species epithet of the scientificName
- Infraspecific Epithet | The name of the lowest or terminal infraspecific epithet of the scientificName, excluding any rank designation
- Accepted Name Usage | The specimen accepted name, with authorship
- Previous Identifications | Previous name of the specimen, with authorship
- Scientific Name | The name without authorship applied on the first identification of the specimen
- Basis of Record | The specific nature of the data record
- Habitat | Description of the habitat where the specimen was found
- Recorded By | Person(s) responsible for sampling
This paper accommodates the 1692 specimens of macroalgae recorded from Graciosa Island in 250 taxa with 195 confirmed species and 55 taxa identified only to genus level. The confirmed species (Tables 3, 4) comprise 126 Rhodophyta, 31 Chlorophyta and 38 Ochrophyta (Phaeophyceae). Of these, 79 species are newly recorded to the algal flora of the Island (47 Rhodophyta, 10 Chlorophyta and 22 Ochrophyta). Most species are native, including the Azorean endemic *Predaea feldmannii* subsp. *azorica* Gabriel and the Macaronesian endemics *Botryocladia macaronesica* Afonso-Carrillo, Sobrino, Tittley & Neto, *Phyllophora gelidioides* P.Crouan & H.Crouan ex Karsakoff, *Laurencia viridis* Gil-Rodríguez & Haroun and *Codium elisabethiae* O.C. Schmidt. Fourteen species are introductions to the algal flora and 20 have an uncertain status.

**Table 3.**
Macroalgae species from Graciosa Island, with information on their relative abundance, origin and status.

| Phylum           | Species (Accepted Name)                                      | Number of records | Establishment Means | Occurrence Remarks |
|------------------|-------------------------------------------------------------|-------------------|---------------------|--------------------|
| Chlorophyta      | *Anadyomene saldanhae* A.B.Joly & E.C.Oliveira             | 1                 | Native              | New record         |
| Chlorophyta      | *Bryopsis cupressina* J.V.Lamouroux                         | 2                 | Native              |                    |
| Chlorophyta      | *Bryopsis hypnoides* J.V.Lamouroux                          | 9                 | Native              |                    |
| Chlorophyta      | *Chaetomorpha linum* (O.F.Müller) Kützing                  | 1                 | Native              |                    |
| Chlorophyta      | *Chaetomorpha mediterranea* (Kützing) Kützing              | 1                 | Native              | New record         |
| Chlorophyta      | *Chaetomorpha pachynema* (Montagne) Kützing                | 27                | Native              |                    |
| Chlorophyta      | *Cladophora albida* (Nees) Kutzling                        | 5                 | Native              |                    |
| Chlorophyta      | *Cladophora coelothrix* Kützing                            | 1                 | Native              |                    |
| Phylum      | Species (Accepted Name)                              | Number of records | Establishment Means | Occurrence Remarks |
|-------------|-----------------------------------------------------|-------------------|---------------------|-------------------|
| Chlorophyta | Cladophora conferta P.Crouan & H.Crouan            | 4                 | Native              |                   |
| Chlorophyta | Cladophora laetevirens (Dillwyn) Kützing            | 1                 | Uncertain           |                   |
| Chlorophyta | Cladophora liebetruthii Grunow                     | 8                 | Native              |                   |
| Chlorophyta | Cladophora prolifera (Roth) Kützing                 | 15                | Native              |                   |
| Chlorophyta | Codium adhaerens C. Agradh                         | 24                | Native              |                   |
| Chlorophyta | Codium decorticatum (Woodward) M.Howe              | 1                 | Native              | New record        |
| Chlorophyta | Codium elisabethiae O.C.Schmidt                    | 2                 | Macaronesian endemism | New record    |
| Chlorophyta | Codium fragile subsp. fragile (Suringar) Hariot     | 1                 | Introduced          | New record        |
| Chlorophyta | Codium taylorii P.C. Silva                          | 1                 | Native              | New record        |
| Chlorophyta | Codium vermilara (Olivi) Delle Chiaje               | 11                | Native              | New record        |
| Chlorophyta | Derbesia tenuissima (Moris & De Notaris) P.Crouan & H.Crouan | 5 | Uncertain | |
| Chlorophyta | Lychaete pellucida (Hudson) M.J.Wynne              | 5                 | Native              |                   |
| Chlorophyta | Microdictyon umbilicatum (Velley) Zanardini        | 11                | Native              | New record        |
| Chlorophyta | Phyllodictyon anastomosans (Harvey) Kraft & M.J.Wynne | 5 | Native              | New record        |
| Chlorophyta | Ulva clathrata (Roth) C.Agardh                     | 10                | Native              |                   |
| Chlorophyta | Ulva compressa Linnaeus                             | 19                | Native              |                   |
| Chlorophyta | Ulva intestinalis Linnaeus                          | 4                 | Native              |                   |
| Chlorophyta | Ulva linza Linnaeus                                 | 1                 | Native              | New record        |
| Chlorophyta | Ulva prolifera O.F.Müller                           | 1                 | Native              |                   |
| Chlorophyta | Ulva rigida C.Agardh                                | 37                | Native              |                   |
| Chlorophyta | Valonia macrophysa Kützing                          | 3                 | Native              |                   |
| Chlorophyta | Valonia utricularis (Roth) C.Agardh                 | 2                 | Native              |                   |
| Ochrophyta  | Ascophyllum nodosum (Linnaeus) Le Jolis             | 2                 | Native              |                   |
| Ochrophyta  | Bachelotia antillarum (Grunow) Gerloff             | 5                 | Native              |                   |
| Ochrophyta  | Carpomitra costata (Stackhouse) Batters             | 6                 | Native              | New record        |
| Ochrophyta  | Cladostephus spongiosum (Hudson) C.Agardh          | 15                | Native              | New record        |
| Ochrophyta  | Colpomenia sinuosa (Mertens ex Roth) Derbès & Solier | 39 | Native              | New record        |
| Ochrophyta  | Cutleria multifida (Turner) Greville               | 1                 | Uncertain           |                   |
| Ochrophyta  | Cystoseira compressa (Esper) Gerloff & Nizamuddin  | 12                | Native              | New record        |
| Phylum     | Species (Accepted Name)                                                                 | Number of records | Establishment Means | Occurrence | Remarks  |
|------------|----------------------------------------------------------------------------------------|-------------------|---------------------|------------|----------|
| Ochrophyta | *Cystoseira humilis* Schousboe ex Kützing                                               | 8                 | Native              | New record |          |
| Ochrophyta | *Dictyopteris polypodioides* (A.P.de Candolle) J.V.Lamouroux                           | 10                | Native              | New record |          |
| Ochrophyta | *Dictyota bartayresiana* J.V.Lamouroux                                                 | 1                 | Native              | New record |          |
| Ochrophyta | *Dictyota dichotoma* (Hudson) J.V.Lamouroux                                            | 11                | Native              |            |          |
| Ochrophyta | *Dictyota dichotoma var. intricata* (C.Agardh) Greville                                | 1                 | Native              | New record |          |
| Ochrophyta | *Dictyota fasciola* (Roth) J.V.Lamouroux                                                | 2                 | Native              | New record |          |
| Ochrophyta | *Ectocarpus siliculosus* (Dillwyn) Lyngbye                                              | 1                 | Uncertain           | New record |          |
| Ochrophyta | *Feldmannia irregularis* (Kützing) Hamel                                                | 4                 | Native              | New record |          |
| Ochrophyta | *Feldmannia paradoxa* (Montagne) Hamel                                                  | 4                 | Native              | New record |          |
| Ochrophyta | *Fucus spiralis* Linnaeus                                                                | 15                | Uncertain           |            |          |
| Ochrophyta | *Halopteris filicina* (Grateloup) Kützing                                               | 15                | Native              |            |          |
| Ochrophyta | *Halopteris scoparia* (Linnaeus) Sauvageau                                              | 24                | Native              |            |          |
| Ochrophyta | *Hydroclathrus clathratus* (C.Agardh) M.Howe in N.L.Britton & C.F.Millspaugh            | 2                 | Native              | New record |          |
| Ochrophyta | *Hydroclathrus tilesii* (Endlicher) Santiañez & Wynne                                  | 9                 | Introduced          | New record |          |
| Ochrophyta | *Laminaria ochroleuca* Bachelot de la Pylaie                                            | 9                 | Native              | New record |          |
| Ochrophyta | *Leathesia marina* (Lyngbye) Decaisne                                                   | 4                 | Uncertain           |            |          |
| Ochrophyta | *Lobophora variegata* (J.V.Lamouroux) Womersley ex E.C.Oliveira                         | 3                 | Native              | New record |          |
| Ochrophyta | *Myrionema strangulans* Greville                                                       | 3                 | Native              | New record |          |
| Ochrophyta | *Nemoderma tingitanum* Schousboe ex Bornet                                              | 4                 | Native              |            |          |
| Ochrophyta | *Padina pavonica* (Linnaeus) Thivy                                                     | 14                | Native              |            |          |
| Ochrophyta | *Papenfusiella kuromo* (Yendo) Inagaki                                                  | 16                | Introduced          |            |          |
| Ochrophyta | *Petalonia binghamiae* (J.Agardh) K.L.Vinogradova                                       | 14                | Introduced          |            |          |
| Ochrophyta | *Ralfsia verrucosa* (Areschoug) Areschoug                                              | 1                 | Native              | New record |          |
| Ochrophyta | *Sargassum cymosum* C.Agardh                                                            | 5                 | Native              |            |          |
| Ochrophyta | *Sargassum desfontainesii* (Turner) C.Agardh                                             | 1                 | Native              | New record |          |
| Ochrophyta | *Sargassum furcatum* Kützing                                                            | 10                | Native              | New record |          |
| Ochrophyta | *Sphacelaria cirrosa* (Roth) C.Agardh                                                   | 5                 | Native              |            |          |
| Ochrophyta | *Sphaerotrichia divaricata* (C.Agardh) Kylin                                             | 3                 | Uncertain           | New record |          |
| Ochrophyta | *Taonia atomaria* (Woodward) J.Agardh                                                   | 4                 | Native              | New record |          |
| Phylum        | Species (Accepted Name)                                                                 | Number of records | Establishment Means | Occurrence Remarks |
|--------------|----------------------------------------------------------------------------------------|-------------------|---------------------|--------------------|
| Ochrophyta   | Treptacantha abies-marina (S.G.Gmelin) Kützing                                         | 25                | Native              |                    |
| Ochrophyta   | Zonaria tournefortii (J.V.Lamouroux) Montagne                                           | 27                | Native              |                    |
| Rhodophyta   | Acrosorium ciliolatum (Harvey) Kylin                                                    | 11                | Native              |                    |
| Rhodophyta   | Aglaothamnion bipinnatum (P.Crouan & H.Crouan) Feldmann & G.Feldmann                   | 3                 | Native              | New record         |
| Rhodophyta   | Aglaothamnion cordatum (Børgesen) Feldmann-Mazoyer                                      | 5                 | Introduced          |                    |
| Rhodophyta   | Aglaothamnion tenuissimum (Bonnemaison) Feldmann-Mazoyer                                | 5                 | Uncertain           |                    |
| Rhodophyta   | Ahnfeltiopsis devoniensis (Greville) P.C.Silva & DeCew                                  | 6                 | Native              |                    |
| Rhodophyta   | Amphiroa beauvoisii J.V.Lamouroux                                                       | 1                 | Native              |                    |
| Rhodophyta   | Amphiroa cryptarthrodia Zanardini                                                       | 2                 | Native              |                    |
| Rhodophyta   | Amphiroa fragilissima (Linnaeus) J.V.Lamouroux                                          | 2                 | Native              | New record         |
| Rhodophyta   | Amphiroa rigida J.V.Lamouroux                                                           | 3                 | Native              | New record         |
| Rhodophyta   | Anotrichium furcellatum (J.Agardh) Baldock                                              | 1                 | Uncertain           |                    |
| Rhodophyta   | Antithamnion diminatum Wollaston                                                       | 7                 | Introduced          |                    |
| Rhodophyta   | Antithamnionella spirographidis (Schiffler) E.M.Wollaston                              | 1                 | Introduced          |                    |
| Rhodophyta   | Asparagopsis armata Harvey                                                             | 14                | Introduced          |                    |
| Rhodophyta   | Asparagopsis armata Harvey, phase                                                       | 2                 | Introduced          |                    |
| Rhodophyta   | Asparagopsis taxiformis (Dellile) Trevisan                                              | 6                 | Native              |                    |
| Rhodophyta   | Asteromenia peltata (W.R.Taylor) Huisman & A.J.K.Millar                                  | 5                 | Native              | New record         |
| Rhodophyta   | Bornetia secundiflora (J.Agardh) Thuret                                                | 1                 | Native              |                    |
| Rhodophyta   | Botryocladia macaronesica Afonso-Carrillo, Sobrino, Tittley & Neto                      | 1                 | Macaronesian endemism | New record         |
| Rhodophyta   | Callithamnion corymbosum (Smith) Lyngbye                                               | 13                | Native              |                    |
| Rhodophyta   | Callithamnion granulatum (Ducluzeau) C.Agardh                                           | 1                 | Native              | New record         |
| Rhodophyta   | Callithamnion tetragonum (Withering) S.F.Gray                                        | 4                 | Native              | New record         |
| Rhodophyta   | Callithamnion tetricum (Dillwyn) S.F.Gray                                              | 2                 | Native              | New record         |
| Rhodophyta   | Carradoriella denudata (Dillwyn) A.M.Savoie & G.W.Saunders                              | 8                 | Uncertain           |                    |
| Phylum     | Species (Accepted Name)                                                                 | Number of records | Establishment Means | Occurrence Remarks | Remarks  |
|------------|----------------------------------------------------------------------------------------|-------------------|---------------------|--------------------|----------|
| Rhodophyta | *Carradoriella elongata* (Hudson) A.M.Savoie & G.W.Saunders                            | 17                | Native              |                    |          |
| Rhodophyta | *Catenella caespitosa* (Withering) L.M.Irvine                                          | 1                 | Native              |                    |          |
| Rhodophyta | *Caulacanthus ustulatus* (Mertens ex Turner) Kützing                                   | 7                 | Uncertain           |                    |          |
| Rhodophyta | *Centroceras clavulatum* (C.Agardh) Montagne                                           | 16                | Native              |                    |          |
| Rhodophyta | *Ceramium botryocarpum* A.W.Griffiths ex Harvey                                        | 1                 | Native              | New record         |          |
| Rhodophyta | *Ceramium ciliatum* (J.Ellis) Ducluzeau                                                | 10                | Native              |                    |          |
| Rhodophyta | *Ceramium codii* (H.Richards) Mazoyer                                                   | 3                 | Native              | New record         |          |
| Rhodophyta | *Ceramium diaphanum* (Lightfoot) Roth                                                  | 12                | Native              |                    |          |
| Rhodophyta | *Ceramium virgatum* Roth                                                                | 31                | Native              |                    |          |
| Rhodophyta | *Champia parvula* (C.Agardh) Harvey                                                    | 2                 | Native              | New record         |          |
| Rhodophyta | *Chondracanthus acicularis* (Roth) Fredericq                                           | 17                | Native              |                    |          |
| Rhodophyta | *Chondracanthus teedei* (Mertens ex Roth) Kützing                                      | 10                | Native              | New record         |          |
| Rhodophyta | *Chondria coerulescens* (J.Agardh) Sauvageau                                           | 4                 | Uncertain           |                    |          |
| Rhodophyta | *Chondria dasyphylla* (Woodward) C.Agardh                                              | 41                | Uncertain           |                    |          |
| Rhodophyta | *Corallina ferreyrae* E.Y.Dawson, Acleto & Foldvik                                     | 6                 | Native              | New record         |          |
| Rhodophyta | *Cryptonemia palmetta* (S.G.Gmelin) Woelkering, G.Furnari, Cormaci & J.McNeill         | 2                 | Native              | New record         |          |
| Rhodophyta | *Cryptopleura ramosa* (Hudson) L.Newton                                                | 11                | Native              |                    |          |
| Rhodophyta | *Dasya caraibica* Børjesen                                                             | 2                 | Native              |                    |          |
| Rhodophyta | *Dasya corymbifera* J.Agardh                                                           | 4                 | Native              |                    |          |
| Rhodophyta | *Dasya hutchinsiae* Harvey                                                             | 4                 | Native              |                    |          |
| Rhodophyta | *Dermocorynus dichotomus* (J.Agardh) Gargiulo, M.Morabito & Manghisi                   | 21                | Native              |                    |          |
| Rhodophyta | *Ellisolandia elongata* (J.Ellis & Solander) K.R.Hind & G.W.Saunders                   | 23                | Native              |                    |          |
| Rhodophyta | *Erythrocystis montagnei* (Derbès & Solier) P.C.Silva                                  | 7                 | Native              |                    |          |
| Rhodophyta | *Gaillona hookeri* (Dillwyn) Athanasiadis                                              | 3                 | Native              | New record         |          |
| Rhodophyta | *Gastroclonium reflexum* (Chauvin) Kützing                                             | 1                 | Native              |                    |          |
| Rhodophyta | *Gelidium arbuscula* Bory ex Børjesen                                                 | 4                 | Native              | New record         |          |
| Rhodophyta | *Gelidium corneum* (Hudson) J.V.Lamouroux                                              | 3                 | Native              | New record         |          |
| Phylum     | Species (Accepted Name)                                                                 | Number of records | Establishment Means | Occurrence Remarks |
|------------|----------------------------------------------------------------------------------------|-------------------|---------------------|--------------------|
| Rhodophyta | Gelidium microdon Kützing                                                                 | 17                | Native              |                    |
| Rhodophyta | Gelidium pusillum (Stackhouse) Le Jolis                                                 | 12                | Native              |                    |
| Rhodophyta | Gelidium spinosum (S.G.Gmelin) P.C.Silva                                               | 12                | Native              |                    |
| Rhodophyta | Gigartina pistillata (S.G.Gmelin) Stackhouse                                            | 3                 | Native              |                    |
| Rhodophyta | Grateloupia filicina (J.V.Lamouroux) C.Agardh                                           | 10                | Native              |                    |
| Rhodophyta | Griffithsia phyllamphora J.Agardh                                                      | 7                 | Native              | New record         |
| Rhodophyta | Gymnogongrus crenulatus (Turner) J.Agardh                                               | 8                 | Native              |                    |
| Rhodophyta | Gymnogongrus griffithsiae (Turner) C.Martius                                            | 19                | Native              |                    |
| Rhodophyta | Gymnothamnion elegans (Schousboe ex C.Agardh) J.Agardh                                 | 1                 | Native              |                    |
| Rhodophyta | Halarachnion ligulatum (Woodward) Kützing                                               | 1                 | Native              | New record         |
| Rhodophyta | Halurus equisetifolius (Lightfoot) Kützing                                               | 3                 | Native              | New record         |
| Rhodophyta | Halurus flosculosus (J.Ellis) Maggs & Hommersand                                        | 7                 | Native              |                    |
| Rhodophyta | Herposiphonia secunda (C.Agardh) Ambronn                                               | 7                 | Native              |                    |
| Rhodophyta | Heterosiphonia crispeola (C.Agardh) M.J.Wynne                                          | 10                | Native              |                    |
| Rhodophyta | Hildenbrandia crouaniorum J.Agardh                                                      | 3                 | Native              | New record         |
| Rhodophyta | Hypnea arbuscula P.J.L.Dangeard                                                        | 2                 | Native              |                    |
| Rhodophyta | Hypnea musciformis (Wulfen) J.V.Lamouroux                                              | 25                | Uncertain           |                    |
| Rhodophyta | Hypnea spinella (C.Agardh) Kützing                                                      | 10                | Native              | New record         |
| Rhodophyta | Hypoglossum heterocystideum (J.Agardh) J.Agardh                                       | 4                 | Introduced          | New record         |
| Rhodophyta | Jania capillacea Harvey                                                               | 2                 | Native              |                    |
| Rhodophyta | Jania longifurca Zanardini                                                         | 11                | Uncertain           |                    |
| Rhodophyta | Jania pedunculata var. adhaerens (J.V.Lamouroux) A.S.Harvey, Woelkerling & Reviers | 2                 | Native              | New record         |
| Rhodophyta | Jania pumila J.V.Lamouroux                                                          | 2                 | Native              |                    |
| Rhodophyta | Jania rubens (Linnaeus) J.V.Lamouroux                                                  | 5                 | Native              |                    |
| Rhodophyta | Jania virgata (Zanardini) Montagne                                                    | 4                 | Uncertain           |                    |
| Rhodophyta | Kallymenia reniformis (Turner) J.Agardh                                                | 2                 | Native              | New record         |
| Rhodophyta | Laurencia dendroides J.Agardh                                                          | 4                 | Introduced          |                    |
| Rhodophyta | Laurencia minuta Vandermeulen, Garbary & Guiry                                         | 1                 | Introduced          |                    |
| Phylum          | Species (Accepted Name)                                      | Number of records | Establishment Means | Occurrence Remarks | Remarks |
|-----------------|-------------------------------------------------------------|-------------------|---------------------|--------------------|---------|
| Rhodophyta      | Laurencia obtusa (Hudson) J.V.Lamouroux                      | 1                 | Native              |                    |         |
| Rhodophyta      | Laurencia pyramidalis Bory ex Kützing                       | 12                | Native              | New record         |         |
| Rhodophyta      | Laurencia tenera C.K.Tseng                                  | 1                 | Native              |                    |         |
| Rhodophyta      | Laurencia viridis Gil-Rodríguez & Haroun                   | 4                 | Macaronesian endemism |                |         |
| Rhodophyta      | Leptosiphonia brodiei (Dillwyn) A.M.Savoie & G.W.Saunders   | 1                 | Uncertain           |                    |         |
| Rhodophyta      | Liagora distenta (Mertens ex Roth) J.V.Lamouroux            | 7                 | Native              | New record         |         |
| Rhodophyta      | Liagora viscida (Forsskál) C.Agardh                         | 3                 | Native              | New record         |         |
| Rhodophyta      | Lithophyllum incrustans Philippi                            | 1                 | Native              | New record         |         |
| Rhodophyta      | Lomentaria articulata (Hudson) Lyngbye                      | 22                | Native              |                    |         |
| Rhodophyta      | Melanothamnus harveyi (Bailey) Díaz-Tapia & Maggs          | 4                 | Introduced          |                    |         |
| Rhodophyta      | Meredithia microphylla (J.Agardh) J.Agardh                  | 8                 | Native              | New record         |         |
| Rhodophyta      | Mesophyllum expansum (Philippi) Cabioch & M.L.Mendoza       | 1                 | Native              |                    |         |
| Rhodophyta      | Mesophyllum lichenoides (J.Ellis) Me.Lemoine                | 3                 | Native              | New record         |         |
| Rhodophyta      | Nemalion elminthoides (Velley) Batters                      | 19                | Native              | New record         |         |
| Rhodophyta      | Nitophyllum punctatum (Stackhouse) Greville                | 1                 | Native              | New record         |         |
| Rhodophyta      | Osmundea hybrida (A.P.de Candolle) K.W.Nam                  | 1                 | Native              |                    |         |
| Rhodophyta      | Osmundea oederi (Gunnerus) G.Furnari                       | 5                 | Native              | New record         |         |
| Rhodophyta      | Osmundea pinnatifida (Hudson) Stackhouse                    | 10                | Native              |                    |         |
| Rhodophyta      | Osmundea truncata (Kützing) K.W.Nam & Maggs                | 23                | Native              |                    |         |
| Rhodophyta      | Palisada patentiramea (Montagne) Cassano, Senties, Gil-Rodríguez & M.T.Fujii | 2 | Native | New record |         |
| Rhodophyta      | Peyssonnelia squamaria (S.G.Gmelin) Decaisne ex J.Agardh    | 4                 | Native              |                    |         |
| Rhodophyta      | Phyllophora crispa (Hudson) P.S.Dixon                      | 5                 | Native              | New record         |         |
| Rhodophyta      | Phyllophora gelidioides P.Crouan & H.Crouan ex Karsakoff    | 1                 | Macaronesian endemism |                |         |
| Rhodophyta      | Phymatolithon lenormandii (Areschoug) Adey                  | 1                 | Native              | New record         |         |
| Rhodophyta      | Platoma cyclocolpum (Montagne) F.Schmitz                    | 13                | Native              | New record         |         |
| Rhodophyta      | Pleonosporium borleri (Smith) Nägeli                       | 15                | Native              |                    |         |
| Phylum   | Species (Accepted Name)                                                                 | Number of records | Establishment Means | Occurrence | Remarks          |
|----------|----------------------------------------------------------------------------------------|-------------------|---------------------|------------|------------------|
| Rhodophyta | Plocamium cartilagineum (Linnaeus) P.S.Dixon                                            | 13                | Native              |            |                  |
| Rhodophyta | Polysiphonia ceramiiformis P.Crouan & H.Crouan                                         | 1                 | Native              | New record |                  |
| Rhodophyta | Polysiphonia stricta (Mertens ex Dillwyn) Greville                                    | 1                 | Native              |            |                  |
| Rhodophyta | Predaea feldmannii subsp. azorica Gabriel                                               | 7                 | Azorean endemism    |            |                  |
| Rhodophyta | Pterocladiella capillacea (S.G.Gmelin) Santelices & Hommersand                         | 44                | Native              |            |                  |
| Rhodophyta | Pterothamnion crispum (Ducluzeau) Nägeli                                               | 1                 | Native              |            |                  |
| Rhodophyta | Ptilothamnion pluma (Dillwyn) Thuret                                                   | 2                 | Uncertain           |            |                  |
| Rhodophyta | Rhodophyllis divaricata (Stackhouse) Papenfuss                                         | 1                 | Native              | New record |                  |
| Rhodophyta | Rhodymenia holmesii Ardissone                                                          | 7                 | Native              |            |                  |
| Rhodophyta | Rhodymenia pseudopalmata (J.V.Lamouroux) P.C.Silva                                    | 12                | Native              | New record |                  |
| Rhodophyta | Schizymenia apoda (J.Agardh) J.Agardh                                                   | 3                 | Native              |            |                  |
| Rhodophyta | Scinaia interrupta (A.P.de Candolle) M.J.Wynne                                         | 30                | Native              |            |                  |
| Rhodophyta | Sphaerococcus coronopifolius Stackhouse                                                 | 7                 | Native              | New record |                  |
| Rhodophyta | Spyridia filamentosa (Wulffen) Harvey                                                  | 3                 | Native              | New record |                  |
| Rhodophyta | Stypopodium zonale (J.V.Lamouroux) Papenfuss                                          | 2                 | Native              | New record |                  |
| Rhodophyta | Sympyocladia marchantioides (Harvey) Falkenberg                                       | 5                 | Introduced          |            |                  |
| Rhodophyta | Vertebrata fruticulosa (Wulffen) Kuntze                                                | 12                | Native              |            |                  |
| Rhodophyta | Vertebrata hypnoides (Welwitsch) Kuntze                                                | 4                 | Uncertain           |            |                  |
| Rhodophyta | Vertebrata reptabunda (Suhr) Diaz-Tapia & Maggs                                        | 5                 | Uncertain           |            |                  |
| Rhodophyta | Vertebrata tripinnata (Harvey) Kuntze                                                  | 2                 | Native              |            |                  |
| Rhodophyta | Xiphosiphonia pennata (C.Agardh) Savoie & G.W.Saunders                                 | 1                 | Native              |            |                  |
| Rhodophyta | Xiphosiphonia pinnulata (Kützing) Savoie & G.W.Saunders                                | 2                 | Introduced          |            |                  |
| Rhodophyta | Yuzuru poiteau (J.V.Lamouroux) Martin-Lescanne                                        | 5                 | Native              | New record |                  |
Many species were only sporadically recorded around the Island, but 12 were commonly found, namely: the Rhodophyta *Ceramium virgatum* Roth, *Chondria dasypylla* (Woodward) C. Agardh, *Hypnea musciformis* (Wulffen) J. V. Lamouroux, *Pterocladiella capillacea* (S. G. Gmelin) Santelices & Hommersand and *Scinaia interrupta* (A. P. de Candolle) M. J. Wynne; the Chlorophyta *Chaetomorpha pachynema* (Montagne) Kützing, *Codium adhaerens* C. Agradh and *Ulva rigida* C. Agardh; and the Ochrophyta *Colpomenia sinuosa* (Mertens ex Roth) Derbès & Solier in Castagne, *Halopteris scoparia* (Linnaeus) Sauvageau, *Treptacantha abies-marina* (S. G. Gmelin) Kützing and *Zonaria tournefortii* (J. V. Lamouroux) Montagne.

A mismatch regarding the GBIF backbone taxonomy of some of the macroalgae species names was identified as detailed in Suppl. material 1.

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**Author contributions**

- AIN: Conceptualisation; Methodology; Investigation (field and laboratory work); Resources; Data Curation; Formal analysis and interpretation; Paper writing
- MIP: Investigation (field and laboratory work); Data Curation; Formal analysis and interpretation; Paper writing
- AZB: Investigation (field and laboratory work); Data Curation
- ACLP: Investigation (laboratory work); Resources; Paper writing
- RR: Resources; Data Curation
- PA: Resources
- NVA: Investigation (field and laboratory work); Maps elaboration; Paper writing
- DM-F: Investigation (field and laboratory work); Data Curation
- RMAN: Data Curation; Formal analysis and interpretation; Paper writing
- IT: Methodology; Investigation (field work and laboratory work); Data Curation; Paper writing
- IM: Data Curation; Formal analysis and interpretation; Paper writing

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Supplementary material

Suppl. material 1: DP-GRA-id_14140_normalized.csv

**Authors:** Ana I Neto

**Data type:** Macroalgae taxonomic mismatching

**Brief description:** GBIF does not have the more actualised nomenclature for some of the macroalgae species names. Therefore, the matching tools of its platform were applied to the species list, as required by Pensoft's data auditor, to identify the problematic taxonomic situations. The resulting file (DP-GRA-id_14140_normalized.csv) is included here, since the names will not be immediately updated in the GBIF Taxonomic Backbone. A request was already sent to GBIF helpdesk to solve this situation.

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