



Biota from the coastal wetlands of Praia da Vitória (Terceira, Azores, Portugal): Part 4 - Vascular plants

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Abstract

Background

The data presented here come from field observations, carried out between 2014 and 2017, as part of a LIFE research project aiming to preserve and restore three coastal wetlands of Praia da Vitória (Terceira Island, Azores, Portugal) (LIFE-CWR). A total of 23 vascular plant species surveys were carried out in three sites: one for each semester in Paul da Praia da Vitória (PPV) and Paul da Pedreira do Cabo da Praia (PPCP); one for each semester (except in 2014) in Paul do Belo Jardim (PBJ). The main objectives were to determine the plant richness of the three sites and to monitor yearly variation on species composition.

New information

A total of 107 taxa, belonging to 50 families, were observed, many of which are new records for the area, especially in PBJ and PPCP, where 78 and 92% of species records were new. A few very rare species in the Azores were recorded in these coastal wetlands, namely *Lotus creticus*, *Bolboschoenus maritimus*, *Juncus maritimus* and *Polygonum maritimum*.

Keywords

Azores, Magnoliophyta, Magnoliopsida, Liliopsida, Terceira, Plantae, Pteridophyta, wetlands

Introduction

Before human settlement in the 15th century, Azorean natural vegetation was most probably dominated by forests (Elias et al. 2016). Those forest habitats were gradually replaced (except for a few mountainous areas of some islands) by agriculture fields, urban areas, pastures, production forests and exotic forests (Martins 1993). In coastal areas, natural vegetation (where it still remains) consists essentially of supratidal communities (with the endemics *Azorina vidalii*, *Euphorbia azorica* and *Spergularia azorica*), coastal grasslands (mainly of *Festuca petraea*) and coastal scrublands, usually dominated by *Erica azorica* and *Morella faya*. Given that rocky cliffs dominate the Azorean coastline and human-induced habitat changes were higher on low elevation areas, dune communities and coastal wetlands are extremely rare. Coastal wetlands usually have shallow lagoons, separated from the sea by natural barriers. Typically, lagoons are fringed by mangroves in the tropics and marsh plants, like *Juncus*, in the temperate zones (Morton 2014).

In the Azores, only six sites can be properly called coastal wetlands: Lajes do Pico (Pico Island), Fajã do Santo Cristo and Fajã dos Cubres (in São Jorge Island) and the three sites of the coastal wetland complex of Praia da Vitória (Terceira Island). These habitats are home to rare species (in the Azores), like the aquatic plants *Ruppia maritima* and *R. spiralis* (Morton 2019). The coastal wetland complex of Praia da Vitória (Terceira Island, Azores, Portugal) is composed by Paul da Praia da Vitória (PPV), Paul do Belo Jardim (PBJ) and Paul da Pedreira do Cabo da Praia (PPCP). Since the earlier works by Dias et al. (1991), Morton et al. (1997) and Morton et al. (1998), the first comprehensive study of Praia da Vitória wetlands was done by the LIFE-CWR coastal wetlands restoration project, under the responsibility of Praia da Vitória Municipality. The present data paper is the fourth of a series dealing with the biota from these coastal wetlands (see Borges et al. 2018, Gabriel et al. 2019, Goulart et al. 2019).

General description

Purpose: This work is part of a comprehensive study regarding the biodiversity of the coastal wetlands of Praia da Vitória (Terceira, Azores) under the scope of the LIFE-CWR coastal wetlands restoration project. The aim of this work was to inventory the vascular plants present in the three coastal areas of Praia da Vitória (PPV, PBJ and PPCP), in order to determine the plant richness of the three sites and the yearly variation in species composition.

Project description

Title: Inventory of vascular plant species of three coastal wetlands of Terceira Island (Azores)

Personnel: The inventory was conducted during four years between April 2014 and September 2017 by Mariana R. Brito, with the collaboration of César Pimentel, under the responsibility of Elisabete C. Nogueira and advice of Rui B. Elias. Species identification was performed by Mariana R. Brito and Rui B. Elias. Paulo A. V. Borges coordinated the publication of the series of data papers regarding the biodiversity of Terceira island coastal wetlands (arthropods, bryophytes, vascular plants and birds).

Study area description: The Azores belong to the Holarctic Biogeographical Kingdom and Eurosiberian Region (Rivas-Martinez et al. 2002). Terceira Island is the third largest island of the archipelago and has the fourth longest shoreline (Forjaz et al. 2004) (Fig. 1). Like other Azorean islands (with the exception of Santa Maria and Graciosa), the prevalent type of climate in Terceira is temperate with no dry season and with a mild summer (Köppen Climate Classification - Cfb). However, in Praia da Vitória (a lowland area in the east of the island), the climate is temperate with hot and dry summers (Csa) (Atlas 2012). For more details on the description of the study area see Borges et al. (2018). During the study period, conservation measures were implemented, namely the creation/enlargement of water bodies in PBJ and PPV and the improvement of bird watching regulation and control of *Arundo donax* in PPCP and PPV.

Design description: A total of 23 surveys were carried out in three sites (PPV, PBJ and PPCP). Surveys took place in each semester (except for PBJ in 2014) during 2-3 days (depending on the dimension of the study areas), for a total of 51 days of direct observation. Study areas were delimited using GPS and included the margins of water bodies and the surrounding terrestrial areas.

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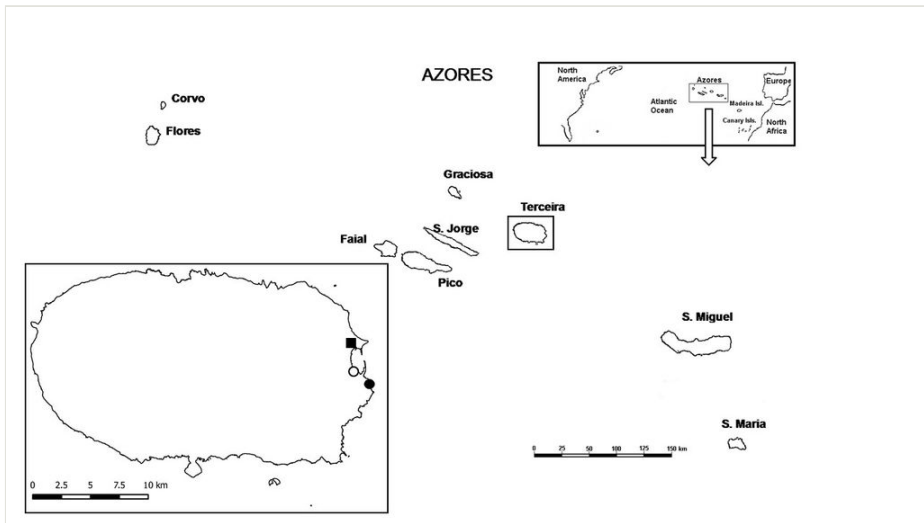


Figure 1. [doi](#)

Location of the study areas in Terceira island: ■ Paul da Praia da Vitória (PPV); ○ Paul do Belo Jardim (PBJ); ● Paul da Pedreira do Cabo da Praia (PPCP). The geographical setting of the Azores islands and the location of the archipelago in the North Atlantic Ocean are also shown.

Sampling methods

Study extent: This study covers a small coastal area with 3.58 km extension between PPV and PPCP.

Study dates: April 2014 – September 2017

Sampling description: In each survey, the presence of vascular plant taxa was recorded. For the most common taxa, plant samples were collected, dried and stored in the Environment Division of Praia da Vitória Municipality. Most taxa were identified in the field. Whenever this was not possible, a plant sample was collected and the identification confirmed later. A photo archive of the recorded taxa was also done. Information and taxonomical keys from Franco and Afonso (1994), Franco and Afonso (1998), Franco and Afonso (2003) and Schäfer (2005) were used for taxon identification. Nomenclature follows Silva et al. (2010).

Geographic coverage

Description: Terceira Island (Azores), Macaronesia, Portugal

Coordinates: 38°42'09"N and 38°42'47.95"N Latitude; 27°02'39" and 27°03'46" Longitude.

Taxonomic coverage

Description: Plantae - Spermatophyta

Temporal coverage

Notes: April 2014 – September 2017

Usage rights

Use license: Open Data Commons Attribution License

Data resources

Data package title: LIFE_CWR_TER_Plants

Resource link: http://ipt.gbif.pt/ipt/resource?r=azorean_vascularplants

Alternative identifiers: <http://islandlab.uac.pt/software/ver.php?id=33>

Number of data sets: 1

Data set name: Vascular Plants from Praia da Vitória

Download URL: http://ipt.gbif.pt/ipt/resource?r=azorean_vascularplants

Data format: Darwin Core Archive

Data format version: version 1

Description: In this data table, we include all the records for which a taxonomic identification of the species was possible. The dataset submitted to GBIF (Global Biodiversity Information Facility) 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 23 records. One extension data table also exists. An extension record supplies extra information about a core record. The number of records in each extension data table is illustrated in the IPT (Integrated Publishing Toolkit) 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. The versions table lists other versions of the resource that have been made publicly available and allows tracking changes made to the resource over time.

| Column label | Column description |
|--------------------------|--|
| Table Events | The sub-table with events |
| country | Country of the sampling site |
| countryCode | ISO code of the country of the sampling site |
| stateProvince | Name of the region of the sampling site |
| islandGroup | Name of archipelago |
| Island | Name of the island |
| municipality | Name of the municipality |
| locationRemarks | Details on the locality site |
| eventID | Identifier of the events, unique for the dataset |
| fieldNumber | Number given to each sample |
| verbatimCoordinates | Original coordinates recorded |
| decimalLatitude | Approximate centre point decimal latitude of the field site in GPS coordinates |
| decimalLongitude | Approximate centre point decimal longitude of the field site in GPS coordinates |
| coordinatePrecision | Precision of the coordinates |
| geodeticDatum | The reference point for the various coordinate systems used in mapping the earth |
| georeferenceSources | Method used to obtain coordinates |
| minimumElevationInMetres | Minimum elevation in metres |
| maximumElevationInMetres | Maximum elevation in metres |
| eventDate | Date or date range the sampling |
| startDayOfYear | Day of the year the sampling started |
| endDayOfYear | Day of the year the sampling ended |
| samplingProtocol | The sampling protocol used to capture the species |
| samplingEffort | The amount of time of each sampling |
| sampleSizeValue | The numeric amount of time spent in each sampling |
| sampleSizeUnit | The unit of the sample size value |
| taxonRank | Taxonomic rank to which the specimens were identified |
| Table Occurrences | The sub-table with occurrence data |
| Type | Type of the record, as defined by the Public Core standard |
| occurrenceID | Identifier of the record, coded as a global unique identifier |
| licence | Reference to the licence under which the record is published |

| | |
|--------------------------|--|
| InstitutionCode | The code of the institution publishing the data |
| InstitutionID | The identity of the institution publishing the data |
| datasetName | Name of the dataset |
| basisOfRecord | The nature of the data record |
| recordedBy | Name of the person who performed the sampling of the specimens |
| eventID | Identifier of the events, unique for the dataset |
| recordedBy | Name of the person who performed the sampling of the specimens |
| kingdom | Kingdom name |
| phylum | Phylum name |
| class | Class name |
| order | Order name |
| family | Family name |
| genus | Genus name |
| specificEpithet | Specific epithet |
| infraspecificEpithet | Infraspecific epithet, when available |
| scientificNameAuthorship | Name of the author of the lowest taxon rank included in the record |
| scientificName | Complete scientific name including author and year |
| taxonRank | Lowest taxonomic rank of the record |
| establishmentMeans | The process of establishment of the species in the location, using a controlled vocabulary: 'native non-endemic', 'introduced', 'endemic'. |
| identifiedBy | Name of the person who made the identification |
| dateIdentified | Date on which the record was identified |

Additional information

During the four-year observation period (2014-2017), a total of 107 taxa, belonging to 50 families, were observed (Table 1). Almost all were flowering plants (only three fern species were recorded), mostly Magnoliopsida (75%). Regarding the colonisation status, 83% were introduced species and only 17% were native non-endemic or endemic. The number of species in the three sites ranged from 74, in PPCP, to 79, in PPV. In this contribution, we add 23 records for PPV, 61 records for PBJ and 68 records for PPCP.

Table 1.

List of vascular plants observed in the three coastal wetlands of Praia da Vitória (Terceira Island, Azores, Portugal) - *Paul da Praia da Vitória* (PPV), *Paul do Belo Jardim* (PBJ) and *Paul da Pedreira do Cabo da Praia* (PPCP). For each taxon, Phylum, Class, Order and Family are indicated. Colonisation status follows Silva et al. (2010): Introduced (INT), Native (NAT) or Endemic (END).

| Phylum | Class | Order | Family | Taxon | Colonization | PPV | PBJ | PPCP |
|---------------|----------------|--------------|------------------|---|--------------|-----|-----|------|
| Pteridophyta | Polypodiopsida | Polypodiales | Dryopteridaceae | <i>Cyrtomium falcatum</i> (L.fil.) C. Presl | INT | | | x |
| Pteridophyta | Polypodiopsida | Polypodiales | Polypodiaceae | <i>Polypodium azoricum</i> (Vasc) R. Fern. | END | | | x |
| Pteridophyta | Polypodiopsida | Polypodiales | Dennstaedtiaceae | <i>Pteridium aquilinum</i> (L.) Kuhn | NAT | x | x | x |
| Magnoliophyta | Magnoliopsida | Lurales | Lauraceae | <i>Laurus azorica</i> (Seub.) Franco | END | x | | x |
| Magnoliophyta | Magnoliopsida | Ranunculales | Papaveraceae | <i>Fumaria muralis</i> Sonder ex Koch subsp. <i>muralis</i> | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Ranunculales | Papaveraceae | <i>Papaver dubium</i> L. | INT | x | | |
| Magnoliophyta | Magnoliopsida | Ranunculales | Papaveraceae | <i>Papaver rhoeas</i> L. | INT | | x | x |
| Magnoliophyta | Magnoliopsida | Ranunculales | Ranunculaceae | <i>Ranunculus repens</i> L. | INT | x | x | |
| Magnoliophyta | Magnoliopsida | Proteales | Proteaceae | <i>Banksia integrifolia</i> L. | INT | x | | |
| Magnoliophyta | Magnoliopsida | Fagales | Myricaceae | <i>Morella faya</i> (Aiton) Wilbur | NAT | x | | x |
| Magnoliophyta | Magnoliopsida | Rosales | Rosaceae | <i>Rubus ulmifolius</i> Schott | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Rosales | Urticaceae | <i>Urtica membranacea</i> Poir. | INT | | x | x |
| Magnoliophyta | Magnoliopsida | Fabales | Fabaceae | <i>Lotus creticus</i> L. | NAT | x | x | x |
| Magnoliophyta | Magnoliopsida | Fabales | Fabaceae | <i>Lotus parviflorus</i> Desf. | INT | x | | x |
| Magnoliophyta | Magnoliopsida | Fabales | Fabaceae | <i>Medicago lupulina</i> L. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Fabales | Fabaceae | <i>Melilotus indicus</i> (L.) All. | INT | x | x | |
| Magnoliophyta | Magnoliopsida | Fabales | Fabaceae | <i>Trifolium fragiferum</i> L. | INT | x | | |
| Magnoliophyta | Magnoliopsida | Fabales | Fabaceae | <i>Trifolium pratense</i> L. | INT | x | x | |

| Phylum | Class | Order | Family | Taxon | Colonization | PPV | PBJ | PPCP |
|---------------|---------------|----------------|-----------------|--|--------------|-----|-----|------|
| Magnoliophyta | Magnoliopsida | Fabales | Fabaceae | <i>Trifolium repens</i> L. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Fabales | Fabaceae | <i>Vicia sativa</i> L. subsp. <i>sativa</i> | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Oxalidales | Oxalidaceae | <i>Oxalis pes-caprae</i> L. | INT | x | x | |
| Magnoliophyta | Magnoliopsida | Malpighiales | Euphorbiaceae | <i>Ricinus communis</i> L. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Malvales | Malvaceae | <i>Malva pseudolavatera</i> Webb & Berthel. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Malvales | Malvaceae | <i>Sida rhombifolia</i> L. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Brassicales | Brassicaceae | <i>Lobularia maritima</i> (L.) Desv. | INT | | x | x |
| Magnoliophyta | Magnoliopsida | Brassicales | Brassicaceae | <i>Raphanus raphanistrum</i> L. subsp. <i>raphanistrum</i> | INT | | x | |
| Magnoliophyta | Magnoliopsida | Brassicales | Brassicaceae | <i>Rapistrum rugosum</i> (L.) All. subsp. <i>rugosum</i> | INT | | | x |
| Magnoliophyta | Magnoliopsida | Brassicales | Resedaceae | <i>Reseda luteola</i> L. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Brassicales | Tropaeolaceae | <i>Tropaeolum majus</i> L. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Myrtales | Onagraceae | <i>Oenothera rosea</i> L'Hér. ex Aiton | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Geraniales | Geraniaceae | <i>Geranium dissectum</i> L. | INT | | x | |
| Magnoliophyta | Magnoliopsida | Geraniales | Geraniaceae | <i>Geranium molle</i> L. | INT | | x | |
| Magnoliophyta | Magnoliopsida | Geraniales | Geraniaceae | <i>Geranium purpureum</i> Vill. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Saxifragales | Crassulaceae | <i>Umbilicus rupestris</i> (Salisb.) Dandy | INT | | | x |
| Magnoliophyta | Magnoliopsida | Caryophyllales | Aizoaceae | <i>Tetragonia tetragonoides</i> (Pall.) O. Kuntze | INT | | x | x |
| Magnoliophyta | Magnoliopsida | Caryophyllales | Amaranthaceae | <i>Atriplex prostrata</i> Boucher ex DC. | NAT | x | x | x |
| Magnoliophyta | Magnoliopsida | Caryophyllales | Amaranthaceae | <i>Salsola kali</i> L. subsp. <i>tragus</i> (L.) Nyman | INT | | x | |
| Magnoliophyta | Magnoliopsida | Caryophyllales | Caryophyllaceae | <i>Silene gallica</i> L. | INT | x | | x |

| Phylum | Class | Order | Family | Taxon | Colonization | PPV | PBJ | PPCP |
|---------------|---------------|----------------|------------------|--|--------------|-----|-----|------|
| Magnoliophyta | Magnoliopsida | Caryophyllales | Caryophyllaceae | <i>Spergularia marina</i> (L.) Griseb | INT | | | x |
| Magnoliophyta | Magnoliopsida | Caryophyllales | Phytolaccaceae | <i>Phytolacca americana</i> L. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Caryophyllales | Polygonaceae | <i>Persicaria capitata</i> (Buch. Ham. ex D. Don) H. Gross | INT | | | x |
| Magnoliophyta | Magnoliopsida | Caryophyllales | Polygonaceae | <i>Polygonum maritimum</i> L. | NAT | | x | |
| Magnoliophyta | Magnoliopsida | Caryophyllales | Portulacaceae | <i>Portulaca oleracea</i> L. subsp. <i>oleraceae</i> | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Caryophyllales | Tamaricaceae | <i>Tamarix africana</i> Poir. | INT | x | x | |
| Magnoliophyta | Magnoliopsida | Ericales | Primulaceae | <i>Anagallis arvensis</i> L. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Gentianales | Gentianaceae | <i>Centaureum scilloides</i> (L. Fil.) Samp. | NAT | | x | |
| Magnoliophyta | Magnoliopsida | Gentianales | Rubiaceae | <i>Galium aparine</i> L. | INT | x | x | |
| Magnoliophyta | Magnoliopsida | Gentianales | Rubiaceae | <i>Sherardia arvensis</i> L. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Lamiales | Lamiaceae | <i>Clinopodium ascendens</i> (Jord.) Samp. | NAT | | x | x |
| Magnoliophyta | Magnoliopsida | Lamiales | Lamiaceae | <i>Mentha pulegium</i> L. | NAT | | x | |
| Magnoliophyta | Magnoliopsida | Lamiales | Lamiaceae | <i>Mentha suaveolens</i> Ehrh. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Lamiales | Orobanchaceae | <i>Orobanche minor</i> Sm. | INT | x | | |
| Magnoliophyta | Magnoliopsida | Lamiales | Orobanchaceae | <i>Parentucellia viscosa</i> (L.) Caruel | INT | | x | x |
| Magnoliophyta | Magnoliopsida | Lamiales | Plantaginaceae | <i>Plantago coronopus</i> L. | NAT | x | x | x |
| Magnoliophyta | Magnoliopsida | Lamiales | Plantaginaceae | <i>Plantago lanceolata</i> L. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Lamiales | Plantaginaceae | <i>Plantago major</i> L. | INT | x | | x |
| Magnoliophyta | Magnoliopsida | Lamiales | Scrophulariaceae | <i>Veronica persica</i> Poir. | INT | x | | |
| Magnoliophyta | Magnoliopsida | Lamiales | Verbenaceae | <i>Lantana camara</i> L. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Lamiales | Verbenaceae | <i>Verbena bonariensis</i> L. | INT | x | x | |
| Magnoliophyta | Magnoliopsida | Lamiales | Verbenaceae | <i>Verbena officinalis</i> L. | INT | x | x | x |

| Phylum | Class | Order | Family | Taxon | Colonization | PPV | PBJ | PPCP |
|---------------|---------------|-------------|----------------|--|--------------|-----|-----|------|
| Magnoliophyta | Magnoliopsida | Lamiales | Verbenaceae | <i>Verbena rigida</i> Spreng. | INT | x | | |
| Magnoliophyta | Magnoliopsida | Solanales | Convolvulaceae | <i>Convolvulus arvensis</i> L. subsp. <i>arvensis</i> | INT | | x | x |
| Magnoliophyta | Magnoliopsida | Solanales | Convolvulaceae | <i>Ipomoea indica</i> (Burm.fil.) Merr. | INT | x | | |
| Magnoliophyta | Magnoliopsida | Solanales | Solanaceae | <i>Datura stramonium</i> L. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Solanales | Solanaceae | <i>Physalis peruviana</i> L. | INT | x | | x |
| Magnoliophyta | Magnoliopsida | Solanales | Solanaceae | <i>Salpichroa origanifolia</i> (Lam.) Baill. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Solanales | Solanaceae | <i>Solanum nigrum</i> L. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Boraginales | Boraginaceae | <i>Echium plantagineum</i> L. | INT | | x | x |
| Magnoliophyta | Magnoliopsida | Asterales | Asteraceae | <i>Ageratina adenophora</i> (Spreng.) R. M. King & H. Rob. | INT | x | | x |
| Magnoliophyta | Magnoliopsida | Asterales | Asteraceae | <i>Conyza bonariensis</i> (L.) Cronquist | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Asterales | Asteraceae | <i>Cichorium intybus</i> L. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Asterales | Asteraceae | <i>Dittrichia viscosa</i> (L.) Greuter | INT | | | x |
| Magnoliophyta | Magnoliopsida | Asterales | Asteraceae | <i>Erigeron karvinskianus</i> DC. | INT | x | | x |
| Magnoliophyta | Magnoliopsida | Asterales | Asteraceae | <i>Galactites tomentosa</i> Moench | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Asterales | Asteraceae | <i>Helminthotheca</i> <i>echioides</i> (L.) Holub | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Asterales | Asteraceae | <i>Hypochaeris radicata</i> L. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Asterales | Asteraceae | <i>Leontodon saxatilis</i> Lam. susp. <i>longirostris</i> (Finch & P. D. Sell) P. Silva | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Asterales | Asteraceae | <i>Pseudognaphalium</i> <i>luteoalbum</i> (L.) Hilliard & B. L. Burt | NAT | x | x | x |

| Phylum | Class | Order | Family | Taxon | Colonization | PPV | PBJ | PPCP |
|---------------|---------------|-------------|----------------|---|--------------|-----|-----|------|
| Magnoliophyta | Magnoliopsida | Asterales | Asteraceae | <i>Solidago gigantea</i> Aiton subsp. <i>serotina</i> McNeill | NAT | x | | |
| Magnoliophyta | Magnoliopsida | Asterales | Asteraceae | <i>Sonchus asper</i> (L.) Hill subsp. <i>asper</i> | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Apiales | Apiaceae | <i>Daucus carota</i> L. subsp. <i>azoricus</i> Franco | END | x | x | x |
| Magnoliophyta | Magnoliopsida | Apiales | Apiaceae | <i>Foeniculum vulgare</i> Mill. | INT | x | x | x |
| Magnoliophyta | Magnoliopsida | Apiales | Araliaceae | <i>Tetrapanax papyriferus</i> (Hook.) K. Koch | INT | x | | |
| Magnoliophyta | Magnoliopsida | Apiales | Pittosporaceae | <i>Pittosporum undulatum</i> Vent. | INT | x | x | x |
| Magnoliophyta | Liliopsida | Alismatales | Araceae | <i>Zantedeschia</i> <i>aethiopica</i> (L.) Spreng. | INT | | x | |
| Magnoliophyta | Liliopsida | Asparagales | Amaryllidaceae | <i>Brunsvigia rosea</i> (Lam.) L. S. Hannibal | INT | x | | |
| Magnoliophyta | Liliopsida | Asparagales | Asparagaceae | <i>Agave americana</i> L. | INT | | x | |
| Magnoliophyta | Liliopsida | Poales | Cyperaceae | <i>Bolboschoenus</i> <i>maritimus</i> (L.) Palla | NAT | x | | |
| Magnoliophyta | Liliopsida | Poales | Cyperaceae | <i>Cyperus eragrostis</i> Lam. | INT | x | x | x |
| Magnoliophyta | Liliopsida | Poales | Cyperaceae | <i>Cyperus esculentus</i> L. | INT | x | x | x |
| Magnoliophyta | Liliopsida | Poales | Cyperaceae | <i>Cyperus longus</i> L. | NAT | x | x | x |
| Magnoliophyta | Liliopsida | Poales | Juncaceae | <i>Juncus acutus</i> L. | NAT | x | x | x |
| Magnoliophyta | Liliopsida | Poales | Juncaceae | <i>Juncus maritimus</i> Lam. | NAT | | x | |
| Magnoliophyta | Liliopsida | Poales | Poaceae | <i>Arundo donax</i> L. | INT | x | x | x |
| Magnoliophyta | Liliopsida | Poales | Poaceae | <i>Briza maxima</i> L. | INT | | x | x |
| Magnoliophyta | Liliopsida | Poales | Poaceae | <i>Bromus catharticus</i> Vahl | INT | x | x | |
| Magnoliophyta | Liliopsida | Poales | Poaceae | <i>Cortaderia selloana</i> (Schult. & Schult. fil.) Asch. & Graebn. | INT | x | | |
| Magnoliophyta | Liliopsida | Poales | Poaceae | <i>Cynodon dactylon</i> (L.) Pers. | INT | x | x | x |

| Phylum | Class | Order | Family | Taxon | Colonization | PPV | PBJ | PPCP |
|---------------|------------|--------------|---------------|--|--------------|-----|-----|------|
| Magnoliophyta | Liliopsida | Poales | Poaceae | <i>Dactylis glomerata</i> L. | INT | | | x |
| Magnoliophyta | Liliopsida | Poales | Poaceae | <i>Holcus lanatus</i> L. | INT | x | x | x |
| Magnoliophyta | Liliopsida | Poales | Poaceae | <i>Hordeum murinum</i> L. subsp. <i>leporinum</i> (Link) Asch. & Graebn. | INT | x | x | x |
| Magnoliophyta | Liliopsida | Poales | Poaceae | <i>Lagurus ovatus</i> L. | INT | x | x | x |
| Magnoliophyta | Liliopsida | Poales | Poaceae | <i>Paspalum dilatatum</i> Poir. | INT | x | x | x |
| Magnoliophyta | Liliopsida | Poales | Poaceae | <i>Spartina versicolor</i> Fabre | INT | x | x | |
| Magnoliophyta | Liliopsida | Poales | Poaceae | <i>Sporobolus africanus</i> (Poir.) Robyns & Tournay | INT | x | x | x |
| Magnoliophyta | Liliopsida | Zingiberales | Cannaceae | <i>Canna indica</i> L. | INT | x | | |
| Magnoliophyta | Liliopsida | Commelinales | Commelinaceae | <i>Tradescantia</i> <i>fluminensis</i> Vell. | INT | | x | |

The percentage of native species ranged between 15% in PPV and 18% in PBJ. These coastal habitats are surrounded by urban areas and pastures and the high percentage of exotic species is the natural consequence of the degree of disturbance that these wetlands have experienced in the past and the human pressure that they still endure.

Overall, only 18 native (endemic and non-endemic) taxa were present in these wetlands. *Polypodium azoricum* (Fig. 2), *Laurus azorica* and *Daucus carota* subsp. *azoricus* (Fig. 3) were the only endemic taxa recorded. The latter is typical of coastal areas, but the others (especially *L. azorica*) are not commonly found at such low altitudes. Amongst native non-endemic species, *Juncus acutus* (Fig. 4) and *Morella faya* (Fig. 5) are diagnostic species of Azorean natural supratidal communities and coastal scrublands, respectively.

A few rare species, in the Azores, were also found, namely *Lotus creticus*, *Bolboschoenus maritimus*, *Juncus maritimus* and *Polygonum maritimum*. *Lotus creticus* (Fig. 6) and *Bolboschoenus maritimus* (Fig. 7) occur only in Terceira. *Juncus maritimus* (Fig. 8) occurs in a few coastal areas of the islands of Pico, São Jorge and Terceira. *Polygonum maritimum*, is an equally rare species that can be found only in São Miguel, Terceira, Faial and Pico (Silva et al. 2010). All these species are threatened because of the low number of surviving populations (and individuals), habitat change and human pressure.



Figure 2. [doi](#)

Polypodium azoricum (Photo by Rui Elias).



Figure 3. [doi](#)

Daucus carota subsp. *azoricus* (Photo by Rui Elias).



Figure 4. [doi](#)
Juncus acutus (Photo by Rui Elias).



Figure 5. [doi](#)
Morella faya (Photo by Rui Elias).



Figure 6. [doi](#)
Lotus creticus (Photo by LIFE-CWR).



Figure 7. [doi](#)
Bolboschoenus maritimus (Photo by LIFE-CWR).



Figure 8. [doi](#)

Juncus maritimus (Photo by Rui Elias).

Variation in species composition was higher in PPV and PPCP but only significant in the latter (Qui-square 43.6; $p < 0.05$). In PPCP, 39 taxa were recorded in 2014, 59 in 2015 and 2016 and 69 in 2017. These differences may be, at least in part, attributed to the conservation measures applied in this wetland, namely the increased regulation of bird-watching activities and control of the invasive species *Arundo donax*.

Concluding remarks

This is the fourth contribution, based on a comprehensive project that aimed to inventory the biota of a rare habitat in the Azores (coastal wetland). In previous contributions, arthropods (Borges et al. 2018), bryophytes (Gabriel et al. 2019) and birds (Goulart et al. 2019) were listed with taxonomical and ecological remarks. Amongst those records, 11 were new for the Azores and 19 were new for Terceira. Overall, during this project, 489 taxa were recorded: 58 bryophytes, 107 vascular plants, 216 arthropods and 108 birds. As expected, because these wetlands were subjected to severe anthropogenic disturbances, for arthropods and vascular plants, most taxa are exotic. Nevertheless, for both groups, a few rare species were found. This series of papers has demonstrated the importance of the coastal wetlands of Praia da Vitória in the Azorean context. Active conservation and ecological restoration must continue to be a priority for the stakeholders.

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Author contributions

MRB and ECN conceived the project. RBE and PAVB conceived and drafted the manuscript. MRB, CMMP and RBE collected the data. RBE and MRB identified the species and organised the final database. All authors revised and contributed to the final text.

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