Biodiversity Data Journal 10: e81410
doi: 10.3897/BDJ.10.e81410

Data Paper

SLAM Project - Long Term Ecological Study of the Impacts of Climate Change in the Natural Forest of Azores: II - A survey of exotic arthropods in disturbed forest habitats

Paulo A. V. Borges[‡,§,|], Lucas Lamelas-Lopez[‡], Peter E. Stüben[¶], Alejandra Ros-Prieto[‡], Rosalina Gabriel[‡,|,§], Mário Boieiro[‡,§,|], Noelline Tsafack[‡,#], Maria Teresa Ferreira[#]

‡ cE3c—Centre for Ecology, Evolution and Environmental Changes/Azorean Biodiversity Group, Faculty of Agriculture and Environment, Universidade dos Açores, 9700-042, Angra do Heroísmo, Azores, Portugal
§ IUCN SSC Mid-Atlantic Islands Invertebrates Specialist Group, Angra do Heroísmo, Azores, Portugal
| CHANGE – Global Change and Sustainability Institute, Angra do Heroísmo, Azores, Portugal
¶ CURCULIO Institute, Hauweg 62, D-41066, Mönchengladbach, Germany
# Regional Secretariat of Environment and Climate Change, Project LIFE BEETLES (LIFE 18 NAT/PT/000864), Rua do Galo n118, 9700-040, Angra do Heroísmo, Azores, Portugal

Corresponding author: Paulo A. V. Borges (paulo.av.borges@uac.pt)

Academic editor: Rui Elias

Received: 29 Jan 2022 | Accepted: 10 Mar 2022 | Published: 29 Mar 2022

Citation: Borges PAV, Lamelas-Lopez L, Stüben PE, Ros-Prieto A, Gabriel R, Boieiro M, Tsafack N, Ferreira MT (2022) SLAM Project - Long Term Ecological Study of the Impacts of Climate Change in the Natural Forest of Azores: II - A survey of exotic arthropods in disturbed forest habitats. Biodiversity Data Journal 10: e81410. https://doi.org/10.3897/BDJ.10.e81410

Abstract

Background

The data we present consist of an inventory of exotic arthropods, potentially invasive, collected in exotic and mixed forests and disturbed native forest patches of the Azores Archipelago. The study was carried out between 2019 and 2020 in four islands: Corvo, Flores, Terceira and Santa Maria, where a total of 45 passive flight interception SLAM traps were deployed, during three to six consecutive months. This manuscript is the second contribution of the “SLAM Project - Long Term Ecological Study of the Impacts of Climate Change in the Natural Forest of Azores”.

New information

We provide an inventory of terrestrial arthropods belonging to Arachnida, Diplopoda, Chilopoda and Insecta classes from four Azorean islands. We identified a total of 21,175 specimens, belonging to 20 orders, 93 families and 249 species of arthropods. A total of 125 species are considered introduced, 89 native non-endemic and 35 endemic. We registered 34 new records (nine for Corvo, three for Flores, six for Terceira and 16 for Santa Maria), of which five are new for Azores, being all exotic possibly recently introduced: *Dieckmanniellus nitidulus* (Gyllenhal, 1838), *Gronops fasciatus* Küster, 1851, *Hadroplontus trimaculatus* (Fabricius, 1775), *Hypurus bertrandi* (Perris, 1852) (all Coleoptera, Curculionidae) and *Cardiocondyla mauritanica* Forel, 1890 (Hymenoptera, Formicidae). This publication highlights the importance of planted forests and disturbed native forest patches as reservoirs of potentially invasive arthropods and refuges for some rare relict endemic arthropod species.

Keywords

Arthropoda, Azores, endemic species, exotic species, exotic forest, inventory, Macaronesia, long-term sampling, SLAM traps

Introduction

Arthropod communities, particularly insects, are being affected by unprecedented and rapid population declines (Hallmann et al. 2017, Sánchez-Bayo and Wyckhuys 2019, Cardoso et al. 2020, Harvey et al. 2020Cowie et al. 2022). The most important causes for this biodiversity loss are habitat loss, degradation and fragmentation, climate change and the introduction and spread of invasive species (Russell et al. 2017, Borges et al. 2019a). In this context, the biodiversity of oceanic islands has been especially and dramatically affected by these drivers as consequence of human colonisation, global trade and tourism (Triantis et al. 2010, Borges et al. 2019b, Cowie et al. 2022, Stüben 2022).

In the case of Azores islands, since Portuguese settlement in the 15th century, the original landscape was strongly altered by replacing pristine and native forest areas with exotic tree plantations, crops, pastures and urban areas (Triantis et al. 2010, Borges et al. 2019b, Norder et al. 2020). Currently, the remaining native forest covers only about 5% of the total surface of the Archipelago, being restricted to the higher elevation and inaccessible areas of the islands (Gaspar et al. 2008, Triantis et al. 2010, Stüben and Borges 2019, Norder et al. 2020).

Native forest destruction (Triantis et al. 2010) and the consequent lack of connectivity between forest patches (Aparício et al. 2018), climate change (Ferreira et al. 2016) and invasive species are the main factors that contribute to arthropod decline in Azores (Stüben 2003, Stüben 2004, Borges et al. 2019b). Previous studies demonstrated that endemic species of Azorean arthropods are restricted mainly to native vegetation dominated

habitats, while introduced species usually occupy human-altered habitats (Cardoso et al. 2009, Florencio et al. 2015, Florencio et al. 2016). Additionally, the proportion of introduced arthropod species in Azores is higher than native (around 60%) and, due to the higher adaptability to environmental conditions of many introduced species, they represent one of the main threats to indigenous biota in the native forest areas (Borges et al. 2019b). Moreover, Tsafack et al. (2021) showed the importance of isolated and small native forest patches, as well exotic and mixed forests close to native areas, which can function as refuges for native and rare endemic species, playing a relevant role for conservation of native biota outside Azorean protected areas.

This publication is the second data paper of the project “SLAM Project - Long Term Ecological Study of the Impacts of Climate Change in the Natural Forest of Azores” (see first in Costa and Borges 2021) that aims to monitor the distribution and abundance of arthropods in native forests from Azores using SLAM traps (Sea, Land and Air Malaise traps). Additional publications, using data coming from this project, tested specific ecological questions, namely patterns of seasonal variation on species abundance (Borges et al. 2017), patterns of temporal beta diversity in native and exotic species (Matthews et al. 2018), the potential decline of endemic insects (Borges et al. 2020), patterns of arthropod diversity in Azorean urban gardens (Arteaga et al. 2020), patterns of species richness and beta diversity in a small elevational gradient (de Vries et al. 2021) and the investigation of the role of small lowland patches of exotic forests as refuges for rare endemic Azorean arthropods (Tsafack et al. 2021).

In this second data paper, we aim to: i) survey arthropods in exotic and mixed forests and small disturbed remnants of native forests; ii) investigate the occurrence and current distribution of exotic (potentially invasive) arthropods in those habitats; and also iii) investigate the occurrence of rare endemic arthropods in those habitats.

General description

Purpose: This publication provides an inventory of arthropods present in exotic and mixed forests of four Azores Islands (Corvo, Flores, Terceira and Santa Maria), as well as from small remnants of disturbed native forests in three Islands (Flores, Terceira and Santa Maria).

Additional information: The data we present are part of the long-term project SLAM (Long Term Ecological Study of the Impacts of Climate Change in the Natural Forest of Azores) that started in 2012 aiming to understand the impact of biodiversity erosion drivers on Azorean native forests (Azores, Macaronesia, Portugal). Passive flight interception SLAM traps (Sea, Land and Air Malaise traps) are being used to sample native forest plots in several Azorean islands (Costa and Borges 2021).

Project description

Title: SLAM Project II - A survey of exotic and endemic arthropods in Azorean disturbed Azorean forest habitats

Personnel: The project was conceived and led by Paulo A.V. Borges.

Fieldwork: Corvo Island - Alejandra Ros-Prieto, Maria Teresa Ferreira, Mário Boieiro, Paulo A. V. Borges, Rosalina Gabriel; Flores Island - Alejandra Ros-Prieto, Maria Teresa Ferreira, Mário Boieiro, Paulo A. V. Borges, Rosalina Gabriel; Terceira Island - Alejandra Ros-Prieto, Paulo A. V. Borges, Rosalina Gabriel; Santa Maria Island - Alejandra Ros-Prieto, Nelson Moura, Paulo A. V. Borges, Rosalina Gabriel.

Parataxonomists: Alejandra Ros-Prieto, Jonne Bonnet and Sébastien Lhoumeau.

Taxonomists: Paulo A. V. Borges, Mário Boieiro and Peter E. Stüben.

Voucher specimen management was mainly undertaken by Alejandra Ros-Prieto and Paulo A. V. Borges.

Study area description: The study area comprises Corvo, Flores, Terceira and Santa Maria Islands, in the Azores Archipelago, located in the North Atlantic, roughly at 38°43'21"N 27°13'14"W and 38°27'30"N 28°19'22"W (Fig. 1). The climate is temperate oceanic, with regular and abundant rainfall, high levels of relative humidity and persistent winds, mainly during the winter and autumn seasons. The exotic forests are located at lower and mid-elevations and are dominated mainly by *Pittosporum undulatum* Vent., *Eucalyptus* spp., *Cryptomeria japonica* D.Don, *Acacia melanoxylon* R.Br. and *Pinus pinaster* Aiton. The studied native forests are located at several elevations and are mainly dominated by *Erica azorica* Hochst. ex Seub., *Laurus azorica* (Seub.) Franco, *Ilex azorica* Gand. and *Juniperus brevifolia* (Hochst. ex Seub.). Mixed forests included both exotic and native tree species.

Design description: Passive flight interception SLAM traps (Sea, Land and Air Malaise traps) (Fig. 2) were used to sample 45 sites in the four study Islands (Corvo (n = 1), Flores (n = 5), Santa Maria (n =16) and Terceira (n = 23)) with one trap being set up at each plot. Although this protocol was originally developed to sample flying arthropods, by working as an extension of the tree, non-flying species can also crawl into the trap (Borges et al. 2017), enhancing the range of groups that can be sampled by this technique. Recent studies have used this sampling technique to study diversity and abundance variations in the communities of arthropod on Azorean native areas (Borges et al. 2017, Matthews et al. 2018, Borges et al. 2020, de Vries et al. 2021, Tsafack et al. 2021). The samples were collected every three or six months depending on sites. The collected specimens were sorted to morphospecies and posteriorly identified at species level by an expert taxonomist in laboratory.

Funding: Portuguese National Funds, through FCT – Fundação para a Ciência e a Tecnologia, within the project UID/BIA/00329/2013-2023.

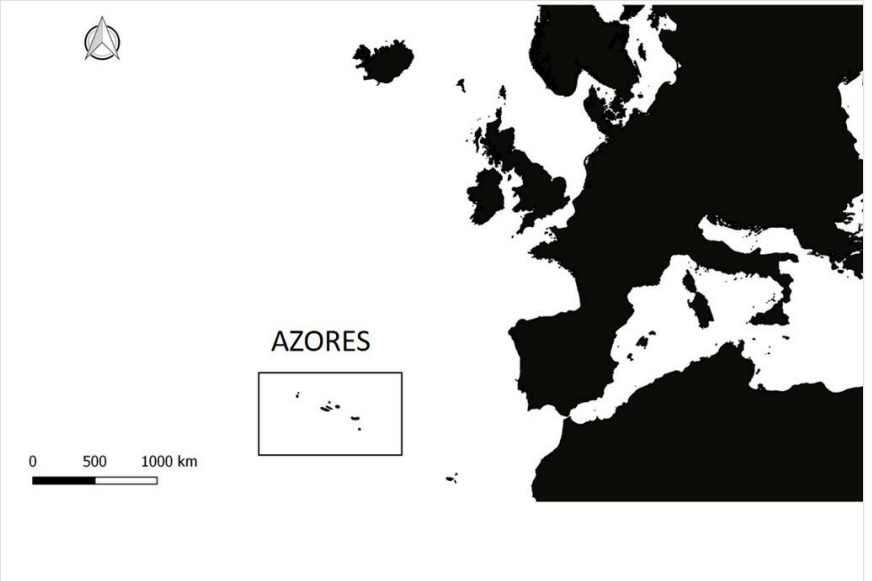

Figure 1. doi

The Azores Archipelago location (Credit: Enésima Pereira, Azorean Biodiversity Group).

Figure 2. doi

Passive flight interception SLAM trap (Sea, Land and Air Malaise traps) (Credit: Paulo A. V. Borges).

Direcção Regional do Ambiente - PRIBES (LIFE17 IPE/PT/000010) (2019-2020).

Direcção Regional do Ambiente – LIFE-BETTLES (LIFE18 NAT_PT_000864) (2020-2024).

AZORESBIOPORTAL –PORBIOTA (ACORES-01-0145-FEDER-000072) (2019-2022).

The database management and Open Access was funded by the project “MACRISK-Trait-based prediction of extinction risk and invasiveness for Northern Macaronesian arthropods” Fundação para a Ciência e Tecnologia FCT - PTDC/BIA-CBI/0625/2021 (2022-2024).

Sampling methods

Study extent: The study was conducted in four Islands of the Azores Archipelago, Corvo, Flores, Terceira and Santa Maria. The sampled habitats included exotic, mixed and disturbed native forest patches (Table 1).

Table 1.

List of the 45 sampled sites in the Corvo (n = 1), Flores (n = 5), Santa Maria (n =16) and Terceira (n = 23) Islands. Information about LocationID, Locality, decimal coordinates and elevation in metres are provided.

Island	Habitat	Location ID	Locality	Latitude	Longitude	Elevation
Corvo	Mixed Forest - *Picconia*, *Pittosporum*	COR-CORO-Z-16	Coroa do Pico	39.68854	-31.09191	248
Flores	*Exotic* Forest - *Cryptomeria*	FLO-LAFLOR-T29	Lajes- Estação Florestal	39.39416	-31.20682	315
Flores	*Exotic* Forest - *Cryptomeria*	FLO-MAPS-TT25	Criptomérias ao lado do T16	39.48697	-31.18462	607
Flores	Native Forest	FLO-NFFR-T-07	Encosta Caldeira Funda	39.40324	-31.2175	381
Flores	Native Forest	FLO-NFMA-T-08	Morro Alto Este	39.46003	-31.20941	769
Flores	Mixed Forest	FLO-PDEL-Z-11	Ponta Delgada Km18_Mata das Acácias	39.50744	-31.2017	106
Santa Maria	Native Forest - *Erica*, *Picconia*	SMR_PRIBS_T01	Ponta do Pinheiro	37.00336	-25.12854	192
Santa Maria	Mixed Forest - *Erica*, *Picconia*, *Hedychium*	SMR_PRIBS_T02	Miradouro Pedra Rija	36.97597	-25.07578	355
Santa Maria	Mixed Forest - *Picconia*, *Pittosporum*, *Pinus*	SMR_PRIBS_T03	Piedade	36.93424	-25.0668	184
Santa Maria	Mixed Forest - *Laurus*, *Pittosporum*, *Picconia*, *Ilex*	SMR_PRIBS_T04	Setada	36.95356	-25.07398	374

Island	Habitat	Location ID	Locality	Latitude	Longitude	Elevation
Santa Maria	Native Forest - *Laurus*, *Erica*, *Ilex*	SMR_PRIBS_T05	Casas Velhas	36.95375	-25.07494	377
Santa Maria	Mixed Forest - *Picconia*, *Pittosporum*, *Erica*, *Hedychium*, *Vaccinium*	SMR_PRIBS_T06	Fontinhas Florestal	36.96325	-25.07505	406
Santa Maria	Mixed Forest - *Picconia*, *Pittosporum*	SMR_PRIBS_T07	Miradouro Espigão	36.98215	-25.0488	191
Santa Maria	Mixed Forest - *Erica*, *Picconia*, *Pittosporum*	SMR_PRIBS_T08	Estação Loran	37.00931	-25.05792	164
Santa Maria	Mixed Forest - *Erica*, *Cryptomeria*, *Hedychium*	SMR_PRIBS_T10	Piquinhos	36.97206	-25.08278	420
Santa Maria	Mixed Forest - *Picconia*, *Pittosporum*	SMR_PRIBS_T11	Lapa	36.94849	-25.02598	221
Santa Maria	Mixed Forest - *Acacia*, *Picconia*	SMR_PRIBS_T12	Monteiro	36.97013	-25.10942	191
Santa Maria	*Exotic* Forest - *Acacia*	SMR_PRIBS_T13	Aeroporto	36.97048	-25.1549	112
Santa Maria	*Exotic* Forest - *Pittosporum*	SMR_PRIBS_T14	Figueiral	36.94919	-25.12562	142
Santa Maria	Mixed Forest	SMR_PRIBS_T15	Ribeira dos Lemos	37.00141	-25.14769	61
Santa Maria	Native Forest - *Erica*, *Picconia*	SMR_PRIBS_T16	Caldeira	36.99592	-25.09864	304
Santa Maria	Mixed Forest - *Picconia*, *Erica*, *Laurus*, *Vaccinium*, *Hedychium*, *Myrcide*	SMR-NFPA-T-01 (SMR_PRIBS_T09)	Pico Alto T01	36.97804	-25.08756	460
Terceira	*Exotic* Forest - *Pittosporum*	TER_PRIBS_T02	Universidade	38.65868	-27.23262	43
Terceira	*Exotic* Forest - *Pittosporum*	TER_PRIBS_T04	Mata Estado Veredas	38.69814	-27.2421	450
Terceira	*Exotic* Forest - *Pittosporum*	TER_PRIBS_T07	*Pittosporum* Carpintaria dos Biscoitos	38.79017	-27.24136	93
Terceira	*Exotic* Forest - *Pittosporum*	TER_PRIBS_T08	Caldeira Lajes	38.77705	-27.11853	18
Terceira	Native Forest - *Juniperus*	TER_PRIBS_T11	Juniperal Trilho das Bestas	38.7087	-27.19133	521
Terceira	Native Forest - *Erica*	TER_PRIBS_T12	Erical Trilho das Bestas	38.70957	-27.18324	462

Island	Habitat	Location ID	Locality	Latitude	Longitude	Elevation
Terceira	Native Forest - *Juniperus*	TER_PRIBS_T13	Terra-Brava Rocha Cedrorum	38.74598	-27.19762	652
Terceira	*Exotic* Forest - *Cryptomeria*, *Calluna*	TER_PRIBS_T14	Pico Alto Cryptomeria_Calluna	38.75212	-27.20132	584
Terceira	*Exotic* Forest - *Pittosporum*, *Eucalyptus*	TER_PRIBS_T15	Eucaliptal Agualva	38.77109	-27.1934	344
Terceira	*Exotic* Forest - *Pittosporum*	TER_PRIBS_T17	Pittosporum_Eucalito Pizza-UT	38.75087	-27.07099	87
Terceira	*Exotic* Forest - *Pittosporum*	TER_PRIBS_T19	*Pittosporum* Maria Vieira	38.65377	-27.08076	102
Terceira	*Exotic* Forest - *Eucalyptus*	TER_PRIBS_T20	Ermida Penha França	38.66603	-27.23969	118
Terceira	*Exotic* Forest - *Eucalyptus*, *Acacia*	TER_PRIBS_T22	Eucalipto_Acacia_Canada Entre Picos	38.6615	-27.26605	78
Terceira	*Exotic* Forest - *Eucalyptus*, *Hedychium*	TER_PRIBS_T23	Eucalipto_Echinodium Escampador	38.70309	-27.27717	340
Terceira	*Exotic* Forest - *Pittosporum*, *Betula*	TER_PRIBS_T24	Betulas_Lagoa das Patas	38.71833	-27.28923	524
Terceira	*Exotic* Forest - *Eucalyptus*	TER_PRIBS_T27	Eucaliptal_Gruta Chocolate	38.77696	-27.25107	298
Terceira	*Exotic* Forest - *Pittosporum*, *Eucalyptus*	TER_PRIBS_T28	Eucaliptal_Pico Rachado_Altares	38.76211	-27.30704	522
Terceira	Mixed Forest - *Eucalyptus*, *Erica*	TER-ACAR-T-25 (TER_PRIBS_T10)	Eucaliptal Algar do Carvão	38.72638	-27.22258	530
Terceira	*Exotic* Forest - *Pittosporum*	TER-CABI-T166 (TER_PRIBS_T06)	Caparica - Biscoitos	38.77094	-27.26185	331
Terceira	*Exotic* Forest - *Acacia*	TER-FTER-T-36 (TER_PRIBS_T09)	Fontinhas 1	38.73765	-27.13681	245
Terceira	Native Forest - *Laurus*, *Erica*	TER-MATE-T-13 (TER_PRIBS_T01)	Matela 1	38.70063	-27.26074	392
Terceira	*Exotic* Forest - *Cryptomeria*	TER-MNEG-T-62 (TER_PRIBS_T05)	Lagoa do Negro	38.73977	-27.26341	571
Terceira	*Exotic* Forest - *Pittosporum*	TER-POSA-T172 (TER_PRIBS_T03)	Posto Santo	38.68365	-27.24457	246

Sampling description: A total of 45 passive flight interception SLAM traps (Sea, Land and Air Malaise traps) were used to sample the plots in the four study Islands, with one trap being set up at each plot. Trap size is of approximately 110 x 110 x 110 cm. The trap functions on the basis of intercepting arthropods that crawl up the mesh and then fall inside

the sampling recipient, which is filled with propylene glycol (pure 1,2-propanodiol) (Borges et al. 2017). A total of 19 SLAM traps were deployed in exotic forest areas, eight on native forest patches and 18 on mixed forests. The trap samples were collected every three months in Flores and Corvo and six months in Terceira and Santa Maria. In Corvo Island, one trap was available in a mixed forest (Fig. 3; Table 1). In Flores Island, five traps were available in both exotic forests and native forests (Fig. 4; Table 1). In Santa Maria Island, a total of 16 traps were available with only three located in disturbed native forest patches (Fig. 5; Table 1). Finally, in Terceira Island, 23 traps were available with only four in disturbed native forest patches (Fig. 6; Table 1).

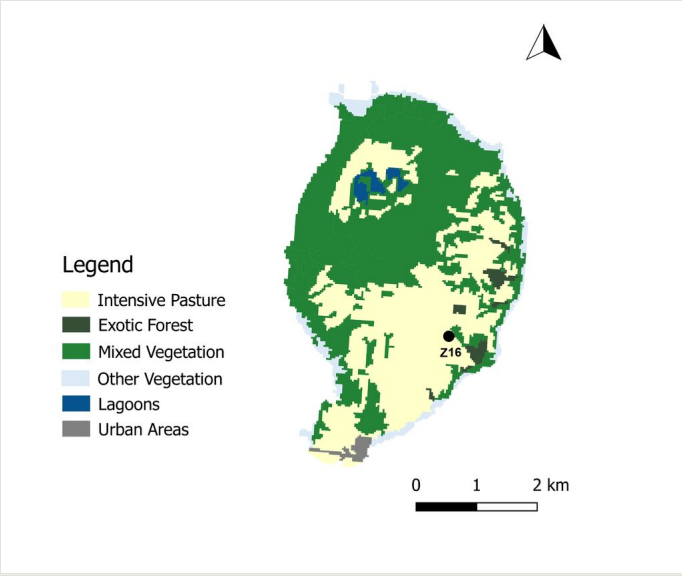

Figure 3. doi

Map with the location of the sampling sites in Corvo Island, Azores. Codes of sites as in Table 1 (Land-use data extracted from Cruz et al. 2007) (Credit: Enésima Pereira, Azorean Biodiversity Group).

Quality control: All sampled individuals were first sorted by trained paratoxonomists (see list above). All specimens were allocated to a taxonomic species by Paulo A. V. Borges. Despite the uncertainty of juvenile identification, juveniles are also included in the data presented in this paper, since the low diversity allowed a relatively precise identification of this life-stage in Azores.

Step description: At the laboratory, specimen sorting and arthropod identification followed standard procedures during the last 20 years or arthropod surveys in Azores. First, a combination of morphological and anatomical characters and reproductive structures was used for morphospecies creation. After, morphospecies were sent to experts for proper identification. With this procedure, a reference collection was made for all collected specimens by assigning them a morphospecies code number and respective taxonomic name and depositing them at the Dalberto Teixeira Pombo Insect Collection, University of

Azores. Colonisation status of the species was obtained from the last updated checklist of Azorean arthropods (Borges et al. 2010).

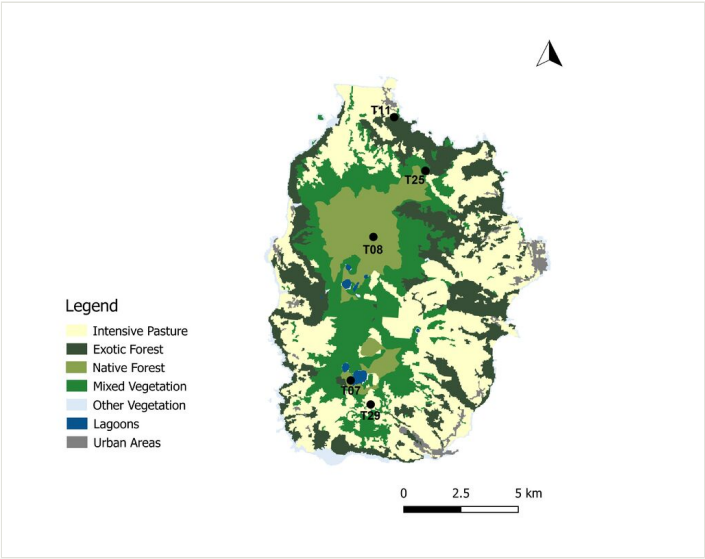

Figure 4. doi

Map with the location of the sampling sites in Flores Island, Azores. Codes of sites as in Table 1 (Land-use data extracted from Cruz et al. 2007) (Credit: Enésima Pereira, Azorean Biodiversity Group).

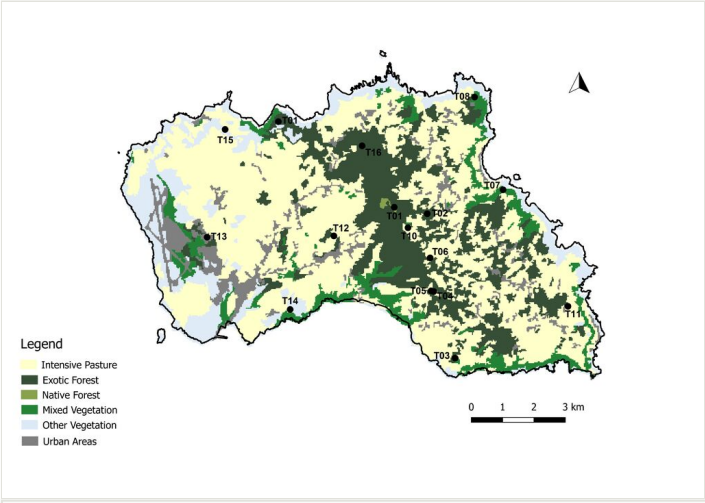

Figure 5. doi

Map with the location of the sampling sites in Santa Maria Island, Azores. Codes of sites as in Table 1 (Land-use data extracted from Cruz et al. 2007) (Credit: Enésima Pereira, Azorean Biodiversity Group).

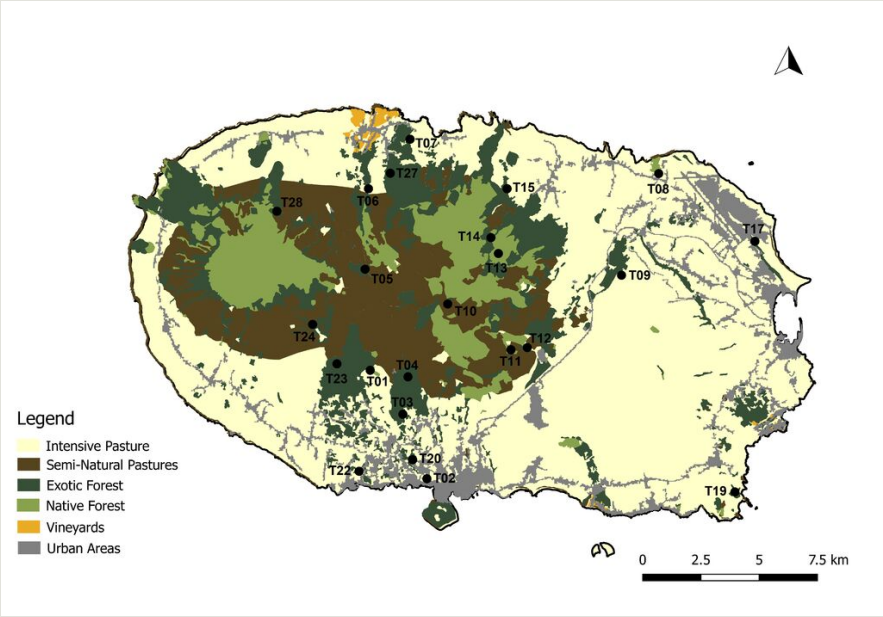

Figure 6. doi

Map with the location of the sampling sites in Terceira Island, Azores. Codes of sites as in Table 1 (Land-use data extracted from Cruz et al. 2007) (Credit: Enésima Pereira, Azorean Biodiversity Group).

Geographic coverage

Description: Corvo, Flores, Terceira and Santa Maria Islands, in the Azores Archipelago (Portugal).

Coordinates: 36.90597988519294 and 39.740986355883564 Latitude; -31.2945556640625 and -24.949951171875 Longitude.

Taxonomic coverage

Description: The following Classes and Orders are covered:

Arachnida: Araneae; Opiliones; Pseudoscorpiones

Chilopoda: Geophilomorpha; Lithobiomorpha; Scolopendromorpha; Scutigeromorpha

Diplopoda: Julida; Polydesmida

Insecta: Archaeognatha; Blattodea; Coleoptera; Dermaptera; Hemiptera; Hymenoptera; Isoptera; Neuroptera; Orthoptera; Phasmatodea; Psocoptera; Thysanoptera; Trichoptera.

Taxa included:

Rank	Scientific Name	Common Name
order	Araneae	Spiders
order	Opiliones	Harvestmen
order	Pseudoscorpiones	Pseudoscorpions
class	Chilopoda	Centipedes
class	Diplopoda	Millipedes
order	Archaeognatha	Bristletails
order	Blattodea	Cockroaches
order	Coleoptera	Beetles
order	Dermaptera	Earwig
order	Hemiptera	Bugs
order	Hymenoptera	Ants
order	Isoptera	Termites
order	Neuroptera	Lacewings
order	Orthoptera	Grasshoppers, crickets
order	Phasmatodea	Stick insects
order	Psocodea	Booklice
order	Thysanoptera	Thrips
order	Trichoptera	Caddisflies

Collection data

Collection name: Entomoteca Dalberto Teixeira Pombo (DTP); University of Azores

Collection identifier: DTP

Specimen preservation method: All specimens were preserved in 96% ethanol.

Curatorial unit: Curator: Paulo A. V. Borges

Usage licence

Data resources

Data package title: A survey of exotic arthropods in disturbed Azorean forest habitats using SLAM traps.

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

Alternative identifiers: https://www.gbif.org/dataset/020231d8-39b6-478f-ac24-715bf97c8ef4

Number of data sets: 2

Data set name: Event Table

Character set: UTF-8

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

Data format: Darwin Core Archive format

Data format version: version 1.5

Description: The dataset was published in Global Biodiversity Information Facility platform, GBIF (Borges et al. 2022). The following data table includes all the records for which a taxonomic identification of the species was possible. The dataset submitted to GBIF is structured as a sample event dataset that has 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 file contains 45 records (eventID). This IPT (Integrated Publishing Toolkit) archives the data and thus serves as the data repository. The data and resource metadata are available for download in the Portuguese GBIF Portal IPT (Borges et al. 2022).

Column label	Column description
id	Unique identification code for sampling event data.
eventID	Identifier of the events, unique for the dataset.
samplingProtocol	The sampling protocol used to capture the species.
sampleSizeValue	The numeric amount of time spent in each sampling.
sampleSizeUnit	The unit of the sample size value.
eventDate	Date or date range the record was collected.
year	Year of the event.
minimumElevationInMetres	The lower limit of the range of elevation (altitude, usually above sea level), in metres.
verbatimEventDate	The verbatim original representation of the date and time information for an Event. In this case, we use the season and year.

habitat	The habitat of the sample.
locationID	Identifier of the location.
islandGroup	Name of archipelago.
island	Name of the island.
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.
municipality	Municipality of the sampling site.
locality	Name of the locality.
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.
geodeticDatum	The ellipsoid, geodetic datum or spatial reference system (SRS) upon which the geographic coordinates given in decimalLatitude and decimalLongitude are based.
coordinateUncertaintyInMetres	Uncertainty of the coordinates of the centre of the sampling plot in metres.
coordinatePrecision	A decimal representation of the precision of the coordinates given in the decimalLatitude and decimalLongitude.
georeferenceSources	A list (concatenated and separated) of maps, gazetteers or other resources used to georeference the Location, described specifically enough to allow anyone in the future to use the same resources.

Data set name: Occurrence Table

Character set: UTF-8

Download URL: https://www.gbif.org/dataset/020231d8-39b6-478f-ac24-715bf97c8ef4

Data format: Darwin Core Archive format

Data format version: version 1.5

Description: The dataset was published in Global Biodiversity Information Facility platform, GBIF (Borges et al. 2022). The following data table includes all the records for which a taxonomic identification of the species was possible. The dataset submitted to GBIF is structured as an occurrence table that has 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 file contains 2095 records (occurrenceID). This IPT (Integrated Publishing Toolkit) archives the data and thus serves as the data repository. The data and resource metadata are available for download in the Portuguese GBIF Portal IPT (Borges et al. 2022).

Column label	Column description
id	Unique identification code for sampling event data.
type	Type of the record, as defined by the Public Core standard.
licence	Reference to the licence under which the record is published.
institutionID	The identity of the institution publishing the data.
institutionCode	The code of the institution publishing the data.
collectionID	The identity of the collection publishing the data.
collectionCode	The code of the collection where the specimens are conserved.
basisOfRecord	The nature of the data record.
occurrenceID	Identifier of the record, coded as a global unique identifier.
recordedBy	A list (concatenated and separated) of names of people, groups or organisations who performed the sampling in the field.
organismQuantity	A number or enumeration value for the quantity of organisms.
organismQuantityType	The type of quantification system used for the quantity of organisms.
sex	The sex and quantity of the individuals captured.
lifeStage	The life stage of the organisms captured.
establishmentMeans	The process of establishment of the species in the location, using a controlled vocabulary: in the GBIF database, we used the Borges et al. (2010) original data: 'native', 'introduced', 'endemic'.
eventID	Identifier of the events, unique for the dataset.
identifiedBy	A list (concatenated and separated) of names of people, groups or organisations who assigned the Taxon to the subject.
dateIdentified	The date on which the subject was determined as representing the Taxon.
identificationRemarks	Information about morphospecies identification (code in Dalberto Teixeira Pombo Collection).
scientificName	Complete scientific name including author and year.
kingdom	Kingdom name.
phylum	Phylum name.
class	Class name.
order	Order name.
family	Family name.
genus	Genus name.
specificEpithet	Specific epithet.

infraspecificEpithet	Infrapecific epithet.
taxonRank	Lowest taxonomic rank of the record.
scientificNameAuthorship	Name of the author of the lowest taxon rank included in the record.

Additional information

We collected a total of 27,958 specimens (Suppl. material 1; Borges et al. 2022) from which it was possible to identify to species level 76% of the specimens (21,175) (Table 2). These identified specimens belong to 20 orders, 93 families and 249 species of arthropods. A total of 125 species are considered introduced, 89 native non-endemic and 35 endemic (Table 2). Additionally, a total of 147 taxa were recorded at genus, family or order level (Suppl. material 1).

Table 2.

List of arthropod species collected in four islands of Azores, between 2019 and 2020 using SLAM traps. The list includes individuals identified at species-level. Scientific name, colonization status (CS: intr – introduced; nat - native non-endemic; end - endemic) and abundance per island (COR - Corvo; FLO - Flores; TER - Terceira; SMR - Santa Maria). Bold scientific names constitute new records for the Azores and bold numbers new records for a given island.

Class	Order	Family	Scientific Name	CS	COR	FLO	TER	SMR
Arachnida	Araneae	Agelenidae	*Tegenaria pagana* C.L. Koch, 1840	intr			118	1
Arachnida	Araneae	Agelenidae	*Textrix caudata* L. Koch, 1872	intr			3	
Arachnida	Araneae	Araneidae	*Agalenatea redii* (Scopoli, 1763)	intr		1		
Arachnida	Araneae	Araneidae	*Araneus angulatus* Clerck, 1757	intr			1	
Arachnida	Araneae	Araneidae	*Gibbaranea occidentalis* Wunderlich, 1989	end		5	85	3
Arachnida	Araneae	Araneidae	*Mangora acalypha* (Walckenaer, 1802)	intr			1	
Arachnida	Araneae	Araneidae	*Zygiella x-notata* (Clerck, 1757)	intr			4	
Arachnida	Araneae	Cheiracanthiidae	*Cheiracanthium erraticum* (Walckenaer, 1802)	intr			2	2
Arachnida	Araneae	Cheiracanthiidae	*Cheiracanthium floresense* Wunderlich, 2008	end		5		

Class	Order	Family	Scientific Name	CS	COR	FLO	TER	SMR
Arachnida	Araneae	Cheiracanthiidae	*Cheiracanthium mildei* L. Koch, 1864	intr			**28**	39
Arachnida	Araneae	Clubionidae	*Clubiona terrestris* Westring, 1851	intr			6	1
Arachnida	Araneae	Clubionidae	*Porrhoclubiona decora* (Blackwall, 1859)	nat			158	43
Arachnida	Araneae	Clubionidae	*Porrhoclubiona genevensis* (L. Koch, 1866)	intr	**15**	19	41	47
Arachnida	Araneae	Dictynidae	*Emblyna acoreensis* Wunderlich, 1992	end			3	
Arachnida	Araneae	Dictynidae	*Lathys dentichelis* (Simon, 1883)	nat		2	16	7
Arachnida	Araneae	Dictynidae	*Nigma puella* (Simon, 1870)	intr			6	1
Arachnida	Araneae	Dysderidae	*Dysdera crocata* C.L. Koch, 1838	intr		5	70	49
Arachnida	Araneae	Gnaphosidae	*Marinarozelotes lyonneti* (Audouin, 1826)	intr			1	
Arachnida	Araneae	Linyphiidae	*Acorigone acoreensis* (Wunderlich, 1992)	end		1	35	1
Arachnida	Araneae	Linyphiidae	*Agyneta fuscipalpa* (C. L. Koch, 1836)	intr			11	
Arachnida	Araneae	Linyphiidae	*Canariphantes acoreensis* (Wunderlich, 1992)	end			1	
Arachnida	Araneae	Linyphiidae	*Canariphantes relictus* Crespo & Bosmans, 2014	end				2
Arachnida	Araneae	Linyphiidae	*Erigone autumnalis* Emerton, 1882	intr			12	3
Arachnida	Araneae	Linyphiidae	*Erigone dentipalpis* (Wider, 1834)	intr			2	1
Arachnida	Araneae	Linyphiidae	*Lessertia dentichelis* (Simon, 1884)	intr				**3**
Arachnida	Araneae	Linyphiidae	*Microlinyphia johnsoni* (Blackwall, 1859)	nat			348	
Arachnida	Araneae	Linyphiidae	*Minicia floresensis* Wunderlich, 1992	end			2	

Class	Order	Family	Scientific Name	CS	COR	FLO	TER	SMR
Arachnida	Araneae	Linyphiidae	*Neriene clathrata* (Sundevall, 1830)	intr	**2**		1	
Arachnida	Araneae	Linyphiidae	*Oedothorax fuscus* (Blackwall, 1834)	intr			8	
Arachnida	Araneae	Linyphiidae	*Palliduphantes schmitzi* (Kulczynski, 1899)	nat			2	
Arachnida	Araneae	Linyphiidae	*Pelecopsis parallela* (Wider, 1834)	intr			2	
Arachnida	Araneae	Linyphiidae	*Prinerigone vagans* (Audouin, 1826)	intr			1	
Arachnida	Araneae	Linyphiidae	*Savigniorrhipis acoreensis* Wunderlich, 1992	end		30	197	7
Arachnida	Araneae	Linyphiidae	*Tenuiphantes miguelensis* (Wunderlich, 1992)	nat		3	16	
Arachnida	Araneae	Linyphiidae	*Tenuiphantes tenuis* (Blackwall, 1852)	intr	6	17	346	21
Arachnida	Araneae	Mimetidae	*Ero furcata* (Villers, 1789)	intr			10	
Arachnida	Araneae	Oecobiidae	*Oecobius navus* Blackwall, 1859	intr			13	
Arachnida	Araneae	Pisauridae	*Pisaura acoreensis* Wunderlich, 1992	end			57	
Arachnida	Araneae	Salticidae	*Macaroeris cata* (Blackwall, 1867)	nat			56	
Arachnida	Araneae	Salticidae	*Macaroeris diligens* (Blackwall, 1867)	nat		6	17	3
Arachnida	Araneae	Salticidae	*Neon acoreensis* Wunderlich, 2008	end				1
Arachnida	Araneae	Salticidae	*Phidippus audax* (Hentz, 1845)	intr				3
Arachnida	Araneae	Salticidae	*Pseudeuophrys vafra* (Blackwall, 1867)	intr				1
Arachnida	Araneae	Salticidae	*Salticus mutabilis* Lucas, 1846	intr			3	
Arachnida	Araneae	Segestriidae	*Segestria florentina* (Rossi, 1790)	intr			10	1

Class	Order	Family	Scientific Name	CS	COR	FLO	TER	SMR
Arachnida	Araneae	Tetragnathidae	*Metellina merianae* (Scopoli, 1763)	intr			12	
Arachnida	Araneae	Tetragnathidae	*Sancus acoreensis* (Wunderlich, 1992)	end		1	10	
Arachnida	Araneae	Theridiidae	*Cryptachaea blattea* (Urquhart, 1886)	intr			31	
Arachnida	Araneae	Theridiidae	*Lasaeola oceanica* Simon, 1883	end			2	1
Arachnida	Araneae	Theridiidae	*Rugathodes acoreensis* Wunderlich, 1992	end		7	81	7
Arachnida	Araneae	Theridiidae	*Steatoda grossa* (C. L. Koch, 1838)	intr			1	1
Arachnida	Araneae	Theridiidae	*Steatoda nobilis* (Thorell, 1875)	intr			10	10
Arachnida	Araneae	Theridiidae	*Theridion musivivum* Schmidt, 1956	nat			9	3
Arachnida	Araneae	Thomisidae	*Xysticus cor* Canestrini, 1873	nat			1	
Arachnida	Opiliones	Leiobunidae	*Leiobunum blackwalli* Meade, 1861	nat		13	857	**3**
Arachnida	Opiliones	Sclerosomatidae	*Homalenotus coriaceus* (Simon, 1879)	nat		1	24	
Arachnida	Pseudoscorpiones	Chthoniidae	*Chthonius ischnocheles* (Hermann, 1804)	intr			7	
Arachnida	Pseudoscorpiones	Chthoniidae	*Ephippiochthonius tetrachelatus* (Preyssler, 1790)	intr	11		37	29
Arachnida	Pseudoscorpiones	Neobisiidae	*Neobisium maroccanum* Beier, 1930	intr		1	13	
Chilopoda	Geophilomorpha	Linotaeniidae	*Strigamia crassipe*s (C.L. Koch, 1835)	nat			3	
Chilopoda	Lithobiomorpha	Lithobiidae	*Lithobius pilicornis pilicornis* Newport, 1844	nat		1	37	
Chilopoda	Scolopendromorpha	Cryptopidae	*Cryptops hortensis* (Donovan, 1810)	nat			1	

Class	Order	Family	Scientific Name	CS	COR	FLO	TER	SMR
Chilopoda	Scutigeromorpha	Scutigeridae	*Scutigera coleoptrata* (Linnaeus, 1758)	intr	**1**	**4**	27	148
Diplopoda	Julida	Blaniulidae	*Blaniulus guttulatus* (Fabricius, 1798)	intr			1	
Diplopoda	Julida	Blaniulidae	*Nopoiulus kochii* (Gervais, 1847)	intr			4	
Diplopoda	Julida	Julidae	*Ommatoiulus moreleti* (Lucas, 1860)	intr		38	166	23
Diplopoda	Polydesmida	Paradoxosomatidae	*Oxidus gracilis* (C.L. Koch, 1847)	intr		1	1	1
Diplopoda	Polydesmida	Polydesmidae	*Polydesmus coriaceus* Porat, 1870	intr			5	1
Insecta	Archaeognatha	Machilidae	*Dilta saxicola* (Womersley, 1930)	nat		8	582	16
Insecta	Archaeognatha	Machilidae	*Trigoniophthalmus borgesi* Mendes, Gaju, Bach & Molero, 2000	end			15	
Insecta	Blattodea	Blattellidae	*Loboptera decipiens* (Germar, 1817)	nat				1
Insecta	Blattodea	Corydiidae	*Zetha simonyi* (Krauss, 1892)	nat		8	127	79
Insecta	Coleoptera	Anthicidae	*Hirticollis quadriguttatus* (Rossi, 1792)	nat			18	
Insecta	Coleoptera	Apionidae	*Aspidapion radiolus* (Marsham, 1802)	nat			6	25
Insecta	Coleoptera	Apionidae	*Kalcapion semivittatum semivittatum* (Gyllenhal, 1833)	nat			27	1
Insecta	Coleoptera	Brentidae	***Dieckmanniellus nitidulus* (Gyllenhal, 1838)**	intr				**5**
Insecta	Coleoptera	Carabidae	*Anisodactylus binotatus* (Fabricius, 1787)	intr			1	
Insecta	Coleoptera	Carabidae	*Dromius meridionalis* Dejean, 1825	intr			11	2
Insecta	Coleoptera	Carabidae	*Notiophilus quadripunctatus* Dejean, 1826	nat				1

Class	Order	Family	Scientific Name	CS	COR	FLO	TER	SMR
Insecta	Coleoptera	Carabidae	*Olisthopus inclavatus* Israelson, 1983	end				1
Insecta	Coleoptera	Carabidae	*Stenolophus teutonus* (Schrank, 1781)	nat			2	
Insecta	Coleoptera	Cerambycidae	*Monochamus galloprovincialis* (Olivier, 1795)	intr				**1**
Insecta	Coleoptera	Chrysomelidae	*Chaetocnema hortensis* (Fourcroy, 1785)	intr			4	1
Insecta	Coleoptera	Chrysomelidae	*Chrysolina bankii* (Fabricius, 1775)	nat				1
Insecta	Coleoptera	Chrysomelidae	*Epitrix cucumeris* (Harris, 1851)	intr			7	1
Insecta	Coleoptera	Chrysomelidae	*Epitrix hirtipennis* (Melsheimer, 1847)	intr		**1**	4	1
Insecta	Coleoptera	Chrysomelidae	*Longitarsus kutscherae* (Rye, 1872)	intr		1	1	38
Insecta	Coleoptera	Chrysomelidae	*Psylliodes chrysocephalus* (Linnaeus, 1758)	intr		1		8
Insecta	Coleoptera	Chrysomelidae	*Psylliodes marcida* (Illiger, 1807)	nat	**1**		3	40
Insecta	Coleoptera	Coccinellidae	*Clitostethus arcuatus* (Rossi, 1794)	intr			1	
Insecta	Coleoptera	Coccinellidae	*Novius cardinalis* (Mulsant, 1850)	intr		9	3	2
Insecta	Coleoptera	Coccinellidae	*Rhyzobius litura* (Fabricius, 1787)	nat			1	
Insecta	Coleoptera	Coccinellidae	*Rhyzobius lophanthae* (Blaisdell, 1892)	intr			1	1
Insecta	Coleoptera	Coccinellidae	*Scymnus interruptus* (Goeze, 1777)	nat			5	2
Insecta	Coleoptera	Coccinellidae	*Stethorus pusillus* (Herbst, 1797)	nat			12	
Insecta	Coleoptera	Corylophidae	*Sericoderus lateralis* (Gyllenhal, 1827)	intr			89	172

Class	Order	Family	Scientific Name	CS	COR	FLO	TER	SMR
Insecta	Coleoptera	Cryptophagidae	*Cryptophagus cellaris* (Scopoli, 1763)	intr			1	3
Insecta	Coleoptera	Curculionidae	*Brachypera multifida* (Israelson, 1984)	end				7
Insecta	Coleoptera	Curculionidae	*Brachytemnus porcatus* (Germar, 1823)	intr			2	
Insecta	Coleoptera	Curculionidae	*Calacalles subcarinatus* (Israelson, 1984)	end		19	86	19
Insecta	Coleoptera	Curculionidae	*Cathormiocerus curvipes* (Wollaston, 1854)	nat				4
Insecta	Coleoptera	Curculionidae	*Charagmus gressorius* (Fabricius, 1792)	intr			1	7
Insecta	Coleoptera	Curculionidae	*Coccotrypes carpophagus* (Hornung, 1842)	intr			7	
Insecta	Coleoptera	Curculionidae	*Dichromacalles dromedarius* (Boheman, 1844)	intr				1
Insecta	Coleoptera	Curculionidae	*Gonipterus platensis* (Marelli, 1926)	intr			47	
Insecta	Coleoptera	Curculionidae	***Gronops fasciatus* Küster, 1851**	intr				**4**
Insecta	Coleoptera	Curculionidae	***Hadroplontus trimaculatus* (Fabricius, 1775)**	intr				**1**
Insecta	Coleoptera	Curculionidae	***Hypurus bertrandi* (Perris, 1852)**	intr			**1**	
Insecta	Coleoptera	Curculionidae	*Mecinus pascuorum* (Gyllenhal, 1813)	intr			17	4
Insecta	Coleoptera	Curculionidae	*Mogulones geographicus* (Goeze, 1777)	intr				2
Insecta	Coleoptera	Curculionidae	*Naupactus cervinus* (Boheman, 1840)	intr			49	23
Insecta	Coleoptera	Curculionidae	*Otiorhynchus cribricollis* Gyllenhal, 1834	intr			19	4
Insecta	Coleoptera	Curculionidae	*Otiorhynchus rugosostriatus* (Goeze, 1777)	intr			1	

Class	Order	Family	Scientific Name	CS	COR	FLO	TER	SMR
Insecta	Coleoptera	Curculionidae	*Pseudophloeophagus tenax borgesi* Stüben, 2022	nat	1	4	260	12
Insecta	Coleoptera	Curculionidae	*Rhopalomesites tardyi* (Curtis, 1825)	nat		2	4	
Insecta	Coleoptera	Curculionidae	*Sitona discoideus* Gyllenhal, 1834	intr			9	
Insecta	Coleoptera	Curculionidae	*Sitona lineatus* (Linnaeus, 1758)	intr			1	
Insecta	Coleoptera	Curculionidae	*Xyleborinus alni* Nijima, 1909	intr			2	
Insecta	Coleoptera	Dryopidae	*Dryops algiricus* (Lucas, 1846)	nat			2	1
Insecta	Coleoptera	Dryopidae	*Dryops luridus* (Erichson, 1847)	nat			18	
Insecta	Coleoptera	Elateridae	*Aeolus melliculus moreleti* Tarnier, 1860	intr				1
Insecta	Coleoptera	Elateridae	*Athous azoricus* Platia & Gudenzi, 2002	end			21	
Insecta	Coleoptera	Elateridae	*Heteroderes azoricus* (Tarnier, 1860)	end		11	30	47
Insecta	Coleoptera	Elateridae	*Heteroderes vagus* Candèze, 1893	intr			2	
Insecta	Coleoptera	Elateridae	*Melanotus dichrous* (Erichson, 1841)	intr		1		
Insecta	Coleoptera	Histeridae	*Carcinops pumilio* (Erichson, 1834)	intr			1	
Insecta	Coleoptera	Hydrophilidae	*Cercyon haemorrhoidalis* (Fabricius, 1775)	intr			5	
Insecta	Coleoptera	Latridiidae	*Cartodere bifasciata* (Reitter, 1877)	intr			21	1
Insecta	Coleoptera	Latridiidae	*Cartodere nodifer* (Westwood, 1839)	intr			16	1
Insecta	Coleoptera	Latridiidae	*Metophthalmus occidentalis* Israelson, 1984	end			15	
Insecta	Coleoptera	Leiodidae	*Catops coracinus* Kellner, 1846	nat			80	33

Class	Order	Family	Scientific Name	CS	COR	FLO	TER	SMR
Insecta	Coleoptera	Malachiidae	*Attalus lusitanicus lusitanicus* Erichson, 1840	nat			4	
Insecta	Coleoptera	Mycetophagidae	*Litargus balteatus* Le Conte, 1856	intr			3	
Insecta	Coleoptera	Mycetophagidae	*Typhaea stercorea* (Linnaeus, 1758)	intr			3	1
Insecta	Coleoptera	Nitidulidae	*Brassicogethes aeneus* (Fabricius, 1775)	intr			6	
Insecta	Coleoptera	Nitidulidae	*Carpophilus fumatus* Boheman, 1851	intr			1	
Insecta	Coleoptera	Nitidulidae	*Epuraea biguttata* (Thunberg, 1784)	intr		1		3
Insecta	Coleoptera	Nitidulidae	*Phenolia limbata tibialis* (Boheman, 1851)	intr			2	
Insecta	Coleoptera	Nitidulidae	*Stelidota geminata* (Say, 1825)	intr			19	106
Insecta	Coleoptera	Phalacridae	*Stilbus testaceus* (Panzer, 1797)	nat			16	25
Insecta	Coleoptera	Ptiliidae	*Ptenidium pusillum* (Gyllenhal, 1808)	intr			3	47
Insecta	Coleoptera	Ptinidae	*Anobium punctatum* (De Geer, 1774)	intr	2		69	
Insecta	Coleoptera	Ptinidae	*Calymmaderus solidus* (Kiesenwetter, 1877)	intr			1	
Insecta	Coleoptera	Rutelidae	*Popillia japonica* Newman, 1838	intr		**1**	6	
Insecta	Coleoptera	Scraptiidae	*Anaspis proteus* Wollaston, 1854	nat	1	24	290	1
Insecta	Coleoptera	Silvanidae	*Cryptamorpha desjardinsii* (Guérin-Méneville, 1844)	intr				1
Insecta	Coleoptera	Staphylinidae	*Aleochara bipustulata* (Linnaeus, 1760)	intr			19	12
Insecta	Coleoptera	Staphylinidae	*Aloconota sulcifrons* (Stephens, 1832)	nat			38	1
Insecta	Coleoptera	Staphylinidae	*Amischa analis* (Gravenhorst, 1802)	intr			1	

Class	Order	Family	Scientific Name	CS	COR	FLO	TER	SMR
Insecta	Coleoptera	Staphylinidae	*Astenus lyonessius* (Joy, 1908)	nat			2	3
Insecta	Coleoptera	Staphylinidae	*Atheta aeneicollis* (Sharp, 1869)	intr			17	9
Insecta	Coleoptera	Staphylinidae	*Atheta fungi* (Gravenhorst, 1806)	intr	**5**	1	358	282
Insecta	Coleoptera	Staphylinidae	*Carpelimus corticinus* (Gravenhorst, 1806)	nat			2	2
Insecta	Coleoptera	Staphylinidae	*Coproporus pulchellus* (Erichson, 1839)	intr			5	
Insecta	Coleoptera	Staphylinidae	*Cordalia obscura* (Gravenhorst, 1802)	intr			2	
Insecta	Coleoptera	Staphylinidae	*Euconnus azoricus* Franz, 1969	end			1	**2**
Insecta	Coleoptera	Staphylinidae	*Gyrohypnus fracticornis* (Müller, 1776)	intr			2	
Insecta	Coleoptera	Staphylinidae	*Hypomedon debilicornis* (Wollaston, 1857)	nat				1
Insecta	Coleoptera	Staphylinidae	*Nototheca dryochares* (Israelson, 1985)	end			1	
Insecta	Coleoptera	Staphylinidae	*Ocypus aethiops* (Waltl, 1835)	nat			1	
Insecta	Coleoptera	Staphylinidae	*Oligota pumilio* Kiesenwetter, 1858	nat			5	4
Insecta	Coleoptera	Staphylinidae	*Phloeonomus punctipennis* Thomson, 1867	nat			1	
Insecta	Coleoptera	Staphylinidae	*Proteinus atomarius* Erichson, 1840	nat			4	2
Insecta	Coleoptera	Staphylinidae	*Rugilus orbiculatus* (Paykull, 1789)	nat			2	1
Insecta	Coleoptera	Staphylinidae	*Sepedophilus lusitanicus* Hammond, 1973	nat			1	
Insecta	Coleoptera	Staphylinidae	*Stenomastax madeirae* Assing, 2003	nat				**4**
Insecta	Coleoptera	Staphylinidae	*Tachyporus chrysomelinus* (Linnaeus, 1758)	intr		1	22	14

Class	Order	Family	Scientific Name	CS	COR	FLO	TER	SMR
Insecta	Coleoptera	Staphylinidae	*Tachyporus nitidulus* (Fabricius, 1781)	intr			64	42
Insecta	Coleoptera	Staphylinidae	*Trichiusa immigrata* Lohse, 1984	intr			1	
Insecta	Coleoptera	Staphylinidae	*Trichophya pilicornis* (Gyllenhal, 1810)	nat				**1**
Insecta	Coleoptera	Staphylinidae	*Xantholinus longiventris* Heer, 1839	intr			1	
Insecta	Coleoptera	Tenebrionidae	*Lagria hirta* (Linnaeus, 1758)	intr				**382**
Insecta	Coleoptera	Teredidae	*Anommatus duodecimstriatus* (Müller, 1821)	intr				2
Insecta	Coleoptera	Zopheridae	*Tarphius rufonodulosus* Israelson, 1984	end				6
Insecta	Dermaptera	Anisolabididae	*Euborellia annulipes* (Lucas, 1847)	intr				7
Insecta	Dermaptera	Forficulidae	*Forficula auricularia* Linnaeus, 1758	intr			58	17
Insecta	Hemiptera	Anthocoridae	*Anthocoris nemoralis* (Fabricius, 1794)	nat			1	**3**
Insecta	Hemiptera	Anthocoridae	*Brachysteles parvicornis* (A. Costa, 1847)	nat			2	
Insecta	Hemiptera	Anthocoridae	*Buchananiella continua* (White, 1880)	intr			2	
Insecta	Hemiptera	Anthocoridae	*Orius laevigatus laevigatus* (Fieber, 1860)	nat		2	4	15
Insecta	Hemiptera	Aphididae	*Cinara juniperi* (De Geer, 1773)	nat	4	24	252	
Insecta	Hemiptera	Cicadellidae	*Aphrodes hamiltoni* Quartau & Borges, 2003	end			4	1
Insecta	Hemiptera	Cicadellidae	*Eupteryx azorica* Ribaut, 1941	end	14	64	107	23
Insecta	Hemiptera	Cicadellidae	*Eupteryx filicum* (Newman, 1853)	nat			39	43

Class	Order	Family	Scientific Name	CS	COR	FLO	TER	SMR
Insecta	Hemiptera	Cicadellidae	*Euscelidius variegatus* (Kirschbaum, 1858)	nat			2	3
Insecta	Hemiptera	Cicadellidae	*Sophonia orientalis* (Matsumura, 1912)	intr			4	
Insecta	Hemiptera	Cixiidae	*Cixius azofloresi* Remane & Asche, 1979	end		45		
Insecta	Hemiptera	Cixiidae	*Cixius azomariae* Remane & Asche, 1979	end				278
Insecta	Hemiptera	Cixiidae	*Cixius azoterceirae* Remane & Asche, 1979	end			968	
Insecta	Hemiptera	Delphacidae	*Kelisia ribauti* Wagner, 1938	nat			21	8
Insecta	Hemiptera	Flatidae	*Cyphopterum adcendens* (Herrich-Schäffer, 1835)	nat	1	44	1613	49
Insecta	Hemiptera	Flatidae	*Siphanta acuta* (Walker, 1851)	intr			136	**260**
Insecta	Hemiptera	Liviidae	*Strophingia harteni* Hodkinson, 1981	end			340	192
Insecta	Hemiptera	Lygaeidae	*Kleidocerys ericae* (Horváth, 1908)	nat			138	11
Insecta	Hemiptera	Lygaeidae	*Nysius atlantidum* Horváth, 1890	end		1	2	
Insecta	Hemiptera	Microphysidae	*Loricula elegantula* (Bärensprung, 1858)	nat		2	77	76
Insecta	Hemiptera	Miridae	*Campyloneura virgul*a (Herrich-Schaeffer, 1835)	nat		1	128	
Insecta	Hemiptera	Miridae	*Heterotoma planicornis* (Pallas, 1772)	nat			1	
Insecta	Hemiptera	Miridae	*Monalocoris filicis* (Linnaeus, 1758)	nat		8	100	5
Insecta	Hemiptera	Miridae	*Pilophorus confusus* (Kirschbaum, 1856)	nat			13	3
Insecta	Hemiptera	Miridae	*Pilophorus perplexus* Douglas & Scott, 1875	nat			1	
Insecta	Hemiptera	Miridae	*Pinalitus oromii* J. Ribes, 1992	end		1	18	35

Class	Order	Family	Scientific Name	CS	COR	FLO	TER	SMR
Insecta	Hemiptera	Miridae	*Taylorilygus apicalis* (Fieber, 1861)	intr			1	
Insecta	Hemiptera	Nabidae	*Nabis pseudoferus ibericus* Remane, 1962	nat			11	7
Insecta	Hemiptera	Pentatomidae	*Piezodorus lituratus* (Fabricius, 1794)	nat			1	
Insecta	Hemiptera	Psyllidae	*Acizzia uncatoides* (Ferris & Klyver, 1932)	intr			288	**23**
Insecta	Hemiptera	Reduviidae	*Empicoris rubromaculatus* (Blackburn, 1889)	intr			2	3
Insecta	Hemiptera	Rhyparochromidae	*Aphanus rolandri* (Linnaeus, 1758)	nat			1	
Insecta	Hemiptera	Rhyparochromidae	*Beosus maritimus* (Scopoli, 1763)	nat				2
Insecta	Hemiptera	Rhyparochromidae	*Emblethis denticollis* Horváth, 1878	nat			1	
Insecta	Hemiptera	Rhyparochromidae	*Eremocoris maderensis* (Wollaston, 1858)	nat			**1**	13
Insecta	Hemiptera	Rhyparochromidae	*Plinthisus brevipennis* (Latreille, 1807)	nat				2
Insecta	Hemiptera	Rhyparochromidae	*Plinthisus minutissimus* Fieber, 1864	nat			1	
Insecta	Hemiptera	Rhyparochromidae	*Scolopostethus decoratus* (Hahn, 1833)	nat		2	3	71
Insecta	Hemiptera	Saldidae	*Saldula palustris* (Douglas, 1874)	nat			2	
Insecta	Hemiptera	Tingidae	*Tingis auriculata* (A. Costa, 1847)	intr				1
Insecta	Hemiptera	Triozidae	*Trioza laurisilvae* Hodkinson, 1990	nat			56	59
Insecta	Hymenoptera	Apidae	*Bombus ruderatus* (Fabricius, 1775)	intr			6	
Insecta	Hymenoptera	Apidae	*Bombus terrestris* (Linnaeus, 1758)	intr		1	61	2
Insecta	Hymenoptera	Formicidae	***Cardiocondyla mauritanica* Forel, 1890**	intr			**1**	**4**

Class	Order	Family	Scientific Name	CS	COR	FLO	TER	SMR
Insecta	Hymenoptera	Formicidae	*Hypoponera eduardi* (Forel, 1894)	nat	**1**	1	23	173
Insecta	Hymenoptera	Formicidae	*Hypoponera punctatissima* (Roger, 1859)	intr				2
Insecta	Hymenoptera	Formicidae	*Lasius grandis* Forel, 1909	nat	31	38	856	348
Insecta	Hymenoptera	Formicidae	*Linepithema humile* (Mayr, 1868)	intr			55	199
Insecta	Hymenoptera	Formicidae	*Monomorium carbonarium* (F. Smith, 1858)	nat			786	310
Insecta	Hymenoptera	Formicidae	*Plagiolepis schmitzii* Forel, 1895	nat			**18**	343
Insecta	Hymenoptera	Formicidae	*Temnothorax unifasciatus* (Latreille, 1798)	nat			**18**	
Insecta	Hymenoptera	Formicidae	*Tetramorium bicarinatum* (Nylander, 1846)	intr				**230**
Insecta	Hymenoptera	Formicidae	*Tetramorium caespitum* (Linnaeus, 1758)	nat			52	4
Insecta	Hymenoptera	Formicidae	*Tetramorium caldarium* (Roger, 1857)	intr			121	**2**
Insecta	Isoptera	Kalotermitidae	*Kalotermes flavicollis* (Fabricius, 1793)	intr			10	
Insecta	Neuroptera	Hemerobiidae	*Hemerobius azoricus* Tjeder, 1948	end		2	31	15
Insecta	Orthoptera	Gryllidae	*Eumodicogryllus bordigalensis* (Latreille, 1804)	intr				1
Insecta	Orthoptera	Tettigoniidae	*Phaneroptera nana* Fieber, 1853	nat			1	
Insecta	Phasmatodea	Phasmatidae	*Carausius morosus* (Sinéty, 1901)	intr			1	3
Insecta	Psocodea	Caeciliusidae	*Valenzuela burmeisteri* (Brauer, 1876)	nat			136	35
Insecta	Psocodea	Caeciliusidae	*Valenzuela flavidus* (Stephens, 1836)	nat	5	14	713	74
Insecta	Psocodea	Ectopsocidae	*Ectopsocus briggsi* McLachlan, 1899	intr	1	23	298	15

Class	Order	Family	Scientific Name	CS	COR	FLO	TER	SMR
Insecta	Psocodea	Ectopsocidae	*Ectopsocus strauchi* Enderlein, 1906	nat		9	23	25
Insecta	Psocodea	Elipsocidae	*Elipsocus azoricus* Meinander, 1975	end		5	523	107
Insecta	Psocodea	Elipsocidae	*Elipsocus brincki* Badonnel, 1963	end		12	627	1
Insecta	Psocodea	Epipsocidae	*Bertkauia lucifuga* (Rambur, 1842)	nat			23	9
Insecta	Psocodea	Psocidae	*Atlantopsocus adustus* (Hagen, 1865)	nat		3	74	51
Insecta	Psocodea	Trichopsocidae	*Trichopsocus clarus* (Banks, 1908)	nat	8	56	618	143
Insecta	Thysanoptera	Aeolothripidae	*Aeolothrips gloriosus* Bagnall, 1914	nat	**1**			
Insecta	Thysanoptera	Phlaeothripidae	*Hoplothrips corticis* (De Geer, 1773)	nat	**3**	12		
Insecta	Thysanoptera	Thripidae	*Heliothrips haemorrhoidalis* (Bouché, 1833)	intr	**8**	4		
Insecta	Thysanoptera	Thripidae	*Hercinothrips bicinctus* (Bagnall, 1919)	intr		2		
Insecta	Trichoptera	Limnephilidae	*Limnephilus atlanticus* Nybom, 1948	end		3	1	

Just considering the 249 arthropod species identified at archipelago level, the five most abundant species were the native bug *Cyphopterum adcendens* (Herrich-Schäffer, 1835) (n = 1707), the ants *Lasius grandis* Forel, 1909 (n = 1273) and *Monomorium carbonarium* (F. Smith, 1858) (n = 1096), the endemic cixiid *Cixius azoterceirae* Remane & Asche, 1979 (n = 968) and the native harvestmen *Leiobunum blackwalli* Meade, 1861 (n = 873) (Table 2).

At island scale, the native ant *Lasius grandis* was also one of the most abundant arthropods in Corvo (n = 31) and Santa Maria (n = 348). Curiously, in both Islands, one of the two most abundant species represent a new island record, being the exotic spider *Porrhoclubiona genevensis* (L. Koch, 1866) (n = 15), new for Corvo and the exotic (possibly invasive) beetle *Lagria hirta* (Linnaeus, 1758) (n =382), new for Santa Maria.

In Flores, the native *Trichopsocus clarus* (Banks, 1908) (n = 143) and the endemic *Eupteryx azorica* Ribaut, 1941 (n = 23) were the most abundant arthropod species. Finally, in Terceira, the native and endemic Hemiptera, respectively *Cyphopterum adcendens* (n = 1613) and *Cixius azoterceirae* (n = 968), were the most abundant species (Table 2).

New Azores species records

In this study, we registered a total of 34 new records for one or more islands of Azores (nine for Corvo, three for Flores, six for Terceira and 16 for Santa Maria), of which the curculionids *Dieckmanniellus nitidulus* (Gyllenhal, 1838), *Gronops fasciatus* Küster, 1851, *Hadroplontus trimaculatus* (Fabricius, 1775) and *Hypurus bertrandi* (Perris, 1852) are new records for Azores. In addition, the ant *Cardiocondyla mauritanica* Forel, 1890 (Hymenoptera, Formicidae) is also a new record for Azores. All these species are exotics, possibly recently introduced.

Dieckmanniellus nitidulus (Gyllenhal, 1838)

Dieckmanniellus nitidulus (Brentidae: Nanophyinae) is mainly widespread in the Mediterranean Region and lives monophagously on various Lythraceae (e.g. *Lythrum salicaria* L.). The record on Santa Maria (Azores) probably refers to *Lythrum borysthenicum* (Schrank) Litv. or *Lythrum junceum* Banks & Solander. The species was also introduced on five of the seven Canary Islands, where it lives on *Lythrum hyssopifolia* L., on which one of us (PS) was able to reliably detect it on La Gomera. Characteristic features: Head, funicle and club of antennae mainly black; elytra in front of the white, V-shaped transverse mark with a dark spot on the front third of the sutural strip (see Fig. 7); 1.4 – 2.1 mm (Stüben 2022).

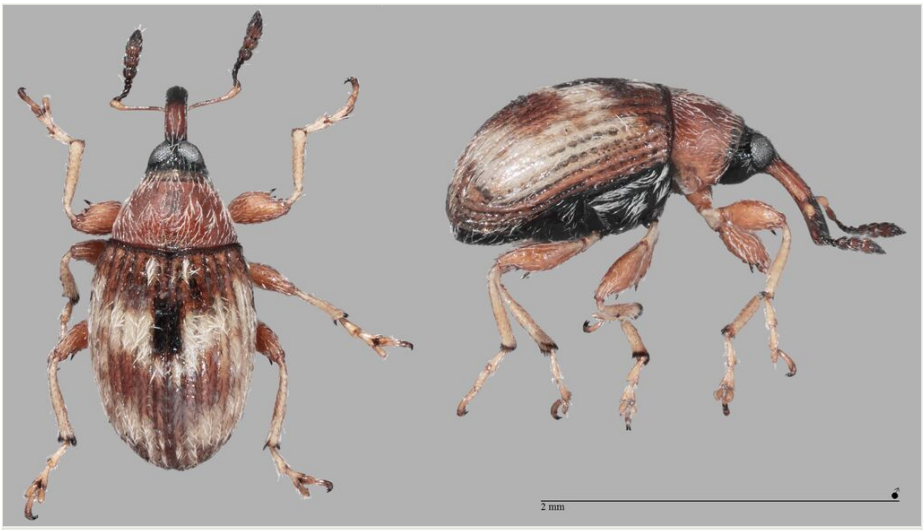

Figure 7. doi

Dieckmanniellus nitidulus (Brentidae: Nanophyinae) (Credit: Peter E. Stüben).

Gronops cf. *fasciatus* Küster, 1851

The genus *Gronops* (Curculionidae: Cyclominae: Rhytirrhinini) includes about 20 Palaearctic species, mainly from the arid regions of North Africa and is only represented with certainty on the Canary Islands by the species *Gronops fasciatus*. The determination

of the specimen of *Gronops cf. fasciatus*, a male, recorded at the airfield of Santa Maria (Azores) in December 2019, must be checked again by a specialist of this group. The biology of these terricolous, flightless species is largely unknown, although they are often found near Caryophyllaceae and Amaranthaceae. Carry-over with soil is conceivable. Characteristic features of *G. fasciatus* compared to *G. lunatus* (Fabricius, 1775): elytra shorter, hardly narrowing towards the apex (subparallel); pronotum wider, strongly widened in the front third (see Fig. 8); length: 2.2–3.2 mm (Stüben 2022).

Figure 8. doi

Gronops cf. *fasciatus* Küster, 1851 (Curculionidae: Cyclominae: Rhytirrhinini) (Credit: Peter E. Stüben).

Figure 9. doi

Hadroplontus trimaculatus (Fabricius, 1775) (Curculionidae: Ceutorhynchinae) (Credit: Peter E. Stüben).

Hadroplontus trimaculatus (Fabricius, 1775)

Both European species, *Hadroplontus litura* and *H. trimaculatus* (Curculionidae: Ceutorhynchinae) live on thistles. The latter lives on plants of the genus *Carduus*, mainly *C. nutans* and *C. acanthoides*. The single specimen (see Fig. 9) was sampled at Piquinhos, mixed forest with the presence of *Carduus tenuiflorus* W.M.Curtis. *H. trimaculatus* differs from the very similar species *H. litura* by the beige to greyish-brown (not completely white) suture interval of the cruciform elytral spot (Stüben et al. 2014, Stüben 2022).

Hypurus bertrandi (Perris, 1852)

Hypurus bertrandi (Perris, 1852) (Curculionidae: Ceutorhynchinae) (see Fig. 10), originally a Mediterranean, now nearly cosmopolitan species, which lives monophagously on *Portulaca oleracea* L. The species was first reported from the Macaronesian Islands by García et al. (2016), collected in the Escuela de Capacitación Agraria near Tacoronte on Tenerife in 2015. The species also occurs in Cape Verde (São Tiago: S. Jorge; Colonnelli 1990) and on the Azores (Terceira: Caldeira Lajes). A characteristic feature is the strongly thickened hind femora (see Fig. 10; Stüben et al. 2012, Stüben 2022).

Figure 10. doi

Hypurus bertrandi (Perris, 1852) (Curculionidae: Ceutorhynchinae) (Credit: Peter E. Stüben). The scale refers to the insect. The photo of the plants refers to *Portulaca oleracea* L., in which the species lives as monophagous.

Cardiocondyla mauritanica Forel, 1890

This ant species is native to northern Africa, Middle East, Afghanistan and Pakistan, but has been introduced in many other regions, including the United States of America, Mexico, Zimbabwe, several European countries and many islands worldwide (Wetterer

2012, Janicki et al. 2016, Seifert et al. 2017). In Macaronesia, *C. mauritanica* was perviously known to occur in Madeira and the Canary Islands (Espadaler 2008, Báez and Oromí 2010). These ants are small, inconspicuous and can be separated from other *Cardiocondyla* species using a combination of morphometric characters (Seifert 2003, Seifert et al. 2017) (see Fig. 11). They form polygynous colonies and mating occurs inside the nests (Seifert et al. 2017). These characteristics and their ability to co-exist with other aggressive invasive ant species, like the Argentine ant *Linepithema humile*, are important to explain their ecological success and ongoing spread (Wetterer 2012). However, contrary to other exotic ant species, *C. mauritanica* does not seem to have significant ecological impacts on native biodiversity (Wetterer 2012).

Figure 11. doi

Cardiocondyla mauritanica (Forel, 1890) (Formicidae). Specimen CASENT0746634 from AntWeb.org (Credit: Zach Lieberman).

Conservation remarks

This publication highlights the importance of exotic and mixed forest areas, as well as small native disturbed forest patches as potential reservoirs of both exotic potentially invasive species, as well as rare endemic species (see also Tsafack et al. 2021).

The high abundance of several native non-endemic (e.g. *Cyphopterum adcendens*; *Lasius grandis*, *Monomorium carbonarium*, *Leiobunum blackwalli*, *Trichopsocus clarus*) and endemic species (e.g. *Cixius azoterceirae*, *Elipsocus brincki*, *Elipsocus azoricus*, *Strophingia harteni*) (Table 2) in these habitats is noteworthy.

Within endemics, we wish to comment on the recently-described subspecies *Pseudophloeophagus tenax borgesi* Stüben, 2022 (Curculionidae: Cossoninae) (Fig. 12).

This subspecies, common in many islands of the Azores, was described only in 2022 (Stüben 2022). The nominotypic taxon occurs on Madeira. Accordingly, material of *P. tenax* from trap findings and in collections from the Azores must be assigned to this new subspecies. Type locality of *P. tenax borgesi* is on São Jorge (Vigia da Baleia), but perhaps the subspecies occurs on all islands of the Azores. Apart from clear molecular differences in the mitochondrial COI gene (Stüben et al. 2012), this subspecies of the Azores differs from the nominotypic taxon on Madeira in the following characteristics: elytral striae more strongly and deeply punctured and the interstriae much narrower than in the sister taxon from Madeira; aedeagus narrower (see Fig. 12, Stüben and Borges 2019, Stüben 2022).

Figure 12. doi

Pseudophloeophagus tenax borgesi Stüben, 2022 (Curculionidae: Cossoninae) (Credit: Peter E. Stüben).

Several other rare endemic species were found in this study (see list below), which highlights the importance of expanding surveys in Azores to small isolated forest patches in order to find relict populations of rare endemic species:

- *Canariphantes acoreensis* (Wunderlich, 1992) (Araneae, Linyphiidae). This rare spider is usually found in pristine native forests and is considered Vulnerable (VU) by IUCN (Borges and Cardoso 2021b). In the current study, we sampled a single specimen in a disturbed mixed forest of *Eucalyptus* spp. and *Pittospsorum undulatum* at Terceira Island located near a native forest at Pico Rachado.

- *Canariphantes relictus* Crespo & Bosmans, 2014 (Araneae, Linyphiidae). Another very rare species, classified as Critically Endangered (CR) (Borges and Cardoso 2021a). The species was found originally in high elevation at Santa Maria Island (Crespo et al. 2014), but in our study, two females were found at Piedade (PRIBS_T03_12_2019) at low elevation in a mixed forest of *Picconia azorica*, *Pittosporum undulatum* and *Pinus* sp. The species possibly has a larger distribution than originally recorded.

-*Olisthopus inclavatus* Israelson, 1983 (Coleoptera, Carabidae). This is a very rare ground-beetle classified as Critically Endangered (CR) by IUCN (Borges 2018) and currently occurring only in exotic forests (dominated by *Cryptomeria japonica*, *Acacia* spp.). In this study, the unique specimen was sampled in Monteiro (SMR_PRIBS_T12).

- *Athous azoricus* Platia & Gudenzi, 2002 (Coleoptera, Elateridae) (Fig. 13). This is a relatively rare species known from Flores, Graciosa, Terceira and S. Miguel Islands. Considered Endangered by the IUCN (Borges and Lamelas-López 2017a), this species tends to occur at low elevations in disturbed exotic forests. In the current study, we found the species in three places all at mid-elevations (300-500 m) and in three types of forest, one plantation of *Cryptomeria japonica* (Mistérios Negros; TER-MNEG-T-62 corresponding also to code TER_PRIBS_T05), a mixed forest dominated by *Eucalyptus* spp. (Escampadouro; TER_PRIBS_T23) and a mixed forest dominated by *Pittosporum undulatum* (Mata do Estado; TER_PRIBS_T04). At least in Terceira Island, the species seems to be more widespread than previously assumed.

Figure 13. doi

Athous azoricus Platia & Gudenzi, 2002 (Coleoptera, Elateridae) (Credit: Enésima Pereira, Azorean Biodiversity Group).

- *Brachypera multifida* (Israelson, 1984) (= *Donus multifudus* (Israelson, 1984)) (Coleoptera, Curculionidae) (Fig. 14). This is a particularly rare curculionid beetle classified as Critically Endangered (CR) (Borges and Lamelas-López 2017b). Previously, it was sampled at high elevation at Pico Alto in Santa Maria Island. In the current survey, we sampled this species in three sites, Estação Loran (SMR_PRIBS_T08), Piquinhos (SMR_PRIBS_T10) and Figueiral (SMR_PRIBS_T14) expanding the range of the species to lower elevations and to different types of forest.

Figure 14. doi

Brachypera multifida (Israelson, 1984) (= *Donus multifudus* (Israelson, 1984)) (Coleoptera, Curculionidae) (Credit: Peter E. Stüben).

- *Tarphius rufonodulosus* Israelson, 1984 (Coleoptera, Zopheridae) (Fig. 15). This is a rare ironclade beetle also Critically Endangered (CR) (Borges and Lamelas-López 2018) that is associated with the canopies of native trees (e.g. *Picconia azorica*) and under-bark of dead trees, both in native and exotic forests (dominated by *Acacia* sp. and *Cryptomeria japonica*). In the current study, one specimen was collected in mixed forests of *Erica azorica*, *Cryptomeria japonica* and *Pittosporum undulatum* at three locations at high elevation (Piquinhos and Fontinhas forest areas).

Figure 15. doi

Tarphius rufonodulosus Israelson, 1984 (Coleoptera, Zopheridae) (Credit: Erno-Endre Gergely; Azorean Biodiverity Group).

Patterns of invasion

The main aim of this study was to investigate the importance of disturbed native forest patches and exotic vegetation areas as potential reservoirs of exotic potentially invasive arthropods. As expected, we found a large number of exotic species, some of them new for Azores, as listed above. In addition to the 125 species identified as introduced (Table 2), many more are waiting a proper identification (Suppl. material 1). In previous studies, we identified thirteen widespread exotic arthropods as new records for Azores (Borges et al. 2013) and some previously unknown exotic species in Azorean urban gardens (Arteaga et al. 2020). This clearly indicates that there is an ongoing continuous flux of new introductions in Azores.

Some of the introduced species found in the current study are a matter of concern for nature conservation in the Azores Archipelago and their populations should be monitored. For instance, *Lagria hirta* (Linnaeus, 1758) (Coleoptera, Tenebrionidae) that was recently recorded as new for Azores and found originally at Terceira Island (Borges et al. 2021), is expanding dramatically in Santa Maria. In Santa Maria, we found it everywhere at all elevations and habitats. This seems to be a recent introduction in Azores and the impact of this species is still unknown. The Australian exotic planthopper *Siphanta acuta* (Walker, 1851) (Hemiptera, Flatidae) was recorded originally for Azores in 2013 (Borges et al. 2013) and is expanding rapidly in several Azorean islands with potential impacts on agriculture. In our study, we found it quite abundant in many sites at Terceira and Santa Maria Islands. The expansion of the *Eucalyptus* snout beetle *Gonipterus platensis* (Marelli, 1926) (Coleoptera, Curculionidae) that was found in several sites at Terceira Island is also of concern. This species was originally recorded for Azores by Borges et al. (2013) and is currently known also from São Miguel Island.

In potential expansion in Terceira (and also known from Pico) is the two-spotted leafhopper *Sophonia orientalis* (Matsumura, 1912) (Hemiptera; Cicadellidae) (Tarantino et al. 2022). This species is native to south-east Asia and is a highly polyphagous pest, considered an invasive species that affects crops as well as endemic plants (Tarantino et al. 2022).

Several exotic ant species have been recorded in the Azores (Espadaler 2010) and, here, we report new findings at both island and archipelago levels that highlight their rapid spread. Jointly with the first record of *Cardiocondyla mauritanica* for Azores, we found that two exotic *Tetramorium* species (*T. bicarinatum* and *T. caldarium*) are now present in Santa Maria. Both *C. mauritanica* and *T. caldarium* do not seem to have significant impacts on native biodiversity (Wetterer 2012, Wetterer and Hita Garcia 2015), but *T. bicarinatum* and, particularly, the Argentine ant *L. humile*, are serious threats to island native invertebrates and natural ecological processes and have also been reported as agricultural pests (Wetterer 2009, Wetterer et al. 2009). The severe consequences of Argentine ant invasion on local biodiversity have been reported from many areas around the world, including oceanic islands, but their effects remain poorly understood in Macaronesian archipelagos (Holway et al. 2002, Wetterer and Espadaler 2010, Boieiro et al. 2018a, Boieiro et al. 2018b).

Finally, it is important to highlight that, amongst the most abundant introduced species in our study, several are listed in the TOP100 worst invasive species of Azores and Macaronesia (Silva et al. 2008), namely the woodlouse spider *Dysdera crocata* C.L. Koch, 1838, the Argentine ant *Linepithema humile* (Mayr, 1868) and the millipede *Ommatoiulus moreleti* (Lucas, 1860).

Our study stresses the need for arthropod biodiversity monitoring in different habitats of oceanic islands as an important strategy for early detection of invasive species that may have severe impacts on the environment, economy and human well-being (see also Borges et al. 2018). It also allows us to assess changes on species abundance and distribution, thus providing valuable information to support decision-making by conservation managers.

Acknowledgements

Many thanks to Enésima Pereira (Azorean Biodiversity Group, cE3c) for producing the maps. Trap acquisition and fieldwork were funded by the projects: Portuguese National Funds, through FCT – Fundação para a Ciência e a Tecnologia, within the project UID/BIA/00329/2013-2023; Direcção Regional do Ambiente - PRIBES (LIFE17 IPE/PT/000010) (2019-2020); Direcção Regional do Ambiente – LIFE-BETTLES (LIFE18 NAT_PT_000864) (2020-2024); AZORESBIOPORTAL – PORBIOTA (ACORES-01-0145-FEDER-000072) (2019-2022).

The database management and Open Access was funded by the project “MACRISK-Trait-based prediction of extinction risk and invasiveness for Northern Macaronesian arthropods” Fundação para a Ciência e a Tecnologia (FCT) - PTDC/BIA-CBI/0625/2021 (2022-2024).

MB was supported by FCT - DL57/2016/CP1375/CT0001. NT and MTF were supported by the project LIFE-BETTLES (LIFE18 NAT_PT_000864).

Author contributions

PAVB and RG contributed to study conceptualisation. PAVB, ARP, RG, MB and MTF performed the fieldwork. PAVB, MB, PES and ARP performed the species sorting and identification. PAVB, ARP and LLL contributed to dataset preparation and data analysis. All authors contributed to manuscript writing.

References

- Aparício BA, Cascalho J, Cruz M, Borges PAV, Azevedo EB, Elias RB, Ascensão F (2018) Assessing the landscape functional connectivity using movement maps: a case study with endemic Azorean insects. Journal of Insect Conservation 22 (2): 257-265. https://doi.org/10.1007/s10841-018-0059-7

- Arteaga A, Malumbres-Olarte J, Gabriel R, Ros-Prieto A, Casimiro P, Sanchez A, Albergaria I, Borges PAV (2020) Arthropod diversity in two Historic Gardens in the Azores, Portugal. Biodiversity Data Journal 8 (e54749): 1-27. https://doi.org/10.3897/BDJ.8.e54749
- Báez M, Oromí P (2010) Hymenoptera. In: Arechavaleta M, Rodríguez S, Zurita N, García A (Eds) Lista de especies silvestres de Canarias. Hongos, plantas y animales terrestres. 1st. Gobierno de Canarias, La Laguna, 356-357 pp.
- Boieiro M, Fagundes AI, Gouveia C, Ramos JA, Menezes D (2018a) Small but fierce: invasive ants kill Barolo Shearwater (*Puffinus lherminieri baroli*) nestling in Cima islet (Porto Santo, Madeira Archipelago). Airo 25: 44-50.
- Boieiro M, Catry P, Jardim CS, Menezes D, Silva I, Coelho N, Oliveira P, Gatt MC, Pedro P, Granadeiro JP (2018b) Invasive Argentine ants prey on Bulwer's petrels nestlings on the Desertas Islands (Madeira) but do not depress seabird breeding success. Journal for Nature Conservation 43: 35-38. https://doi.org/10.1016/j.jnc.2018.02.013
- Borges PAV, Vieira V, Amorim IR, Bicudo N, et al. (2010) List of arthropods (Arthropoda). In: Borges PAV, Costa A, Cunha R, Gabriel R, et al. (Eds) A list of the terrestrial and marine biota from the Azores. 1st. Princípia, Cascais, 179-246 pp. URL: http://hdl.handle.net/10400.3/1959 [ISBN 978-989-8131-75-1].
- Borges PAV, Reut M, Ponte NB, Quartau JA, Fletcher M, Sousa AB, Pollet M, Soares AO, Marcelino J, Rego C, Cardoso P (2013) New records of exotic spiders and insects to the Azores, and new data on recently introduced species. Arquipelago Life and Marine Sciences 30: 57-70. URL: http://hdl.handle.net/10400.3/2079
- Borges PAV, Lamelas-López L (2017a) *Athous azoricus*. The IUCN Red List of Threatened Species https://doi.org/10.1119/1.4979653.2
- Borges PAV, Lamelas-López L (2017b) *Donus multifidus*. The IUCN Red List of Threatened Species https://doi.org/10.1119/1.4979653.2
- Borges PAV, Pimentel R, Carvalho R, Nunes R, Wallon S, Ros Prieto A (2017) Seasonal dynamics of arthropods in the humid native forests of Terceira Island (Azores). Arquipelago Life and Marine Sciences 34: 105-122. URL: http://hdl.handle.net/10400.3/4470
- Borges PAV (2018) *Olisthopus inclavatus*. IUCN Red List of Threatened Species https://doi.org/10.2305/iucn.uk.2018-1.rlts.t97114574a99166549.en
- Borges PAV, Lamelas-López L (2018) *Tarphius rufonodulosus*. IUCN Red List of Threatened Species https://doi.org/10.2305/iucn.uk.2018-1.rlts.t112215339a112215436.en
- Borges PAV, Cardoso P, Kreft H, Whittaker RJ, Fattorini S, Emerson BC, Gil A, Gillespie RG, Matthews TJ, Santos AMC, Steinbauer MJ, Thébaud C, Ah-Peng C, Amorim IR, Aranda SC, Arroz AM, Azevedo JMN, Boieiro M, Borda-de-Água L, Carvalho JC, Elias RB, Fernández-Palacios JM, Florencio M, González-Mancebo JM, Heaney LR, Hortal J, Kueffer C, Lequette B, Martín-Esquivel JL, López H, Lamelas-López L, Marcelino J, Nunes R, Oromí P, Patiño J, Pérez AJ, Rego C, Ribeiro SP, Rigal F, Rodrigues P, Rominger AJ, Santos-Reis M, Schaefer H, Sérgio C, Serrano ARM, Sim-Sim M, Stephenson PJ, Soares AO, Strasberg D, Vanderporten A, Vieira V, Gabriel R (2018) Global Island Monitoring Scheme (GIMS): a proposal for the long-term coordinated survey and monitoring of native island forest biota. Biodiversity and Conservation 27 (10): 2567-2586. https://doi.org/10.1007/s10531-018-1553-7

- Borges PAV, Gabriel R, Fattorini S (2019a) Biodiversity erosion: causes and consequences. In: Leal Filho W, Azul A, Brandli L, Özuyar P, Wall T (Eds) Life on Land. Encyclopedia of the UN Sustainable Development Goals. The Springer Nature, Switzerland, 1-10 pp. https://doi.org/10.1007/978-3-319-71065-5_78-1
- Borges PAV, Santos AMC, Elias RB, Gabriel R (2019b) The Azores archipelago: biodiversity erosion and conservation biogeography. In: Anonymous (Ed.) Encyclopedia of the world's biomes -Earth systems and environmental sciences. Elsevier, Amsterdam, 1-18 pp. https://doi.org/10.1016/B978-0-12-409548-9.11949-9
- Borges PAV, Rigal F, Ros-Prieto A, Cardoso P (2020) Increase of insular exotic arthropod diversity is a fundamental dimension of the current biodiversity crisis. Insect Conservation and Diversity 13 (5): 508-518. https://doi.org/10.1111/icad.12431
- Borges PAV, Cardoso P (2021a) *Canariphantes relictus*. IUCN Red List of Threatened Species https://doi.org/10.2305/iucn.uk.2021-1.rlts.t58063699a58063710.en
- Borges PAV, Cardoso P (2021b) *Canariphantes acoreensis*. IUCN Red List of Threatened Species https://doi.org/10.2305/iucn.uk.2021-1.rlts.t58020645a58060882.en
- Borges PAV, Nunes R, Lamelas-López L, Pereira E, Costa R, Monjardino P, Lopes DH, Soares AO, Gil A, Rigal F, Ferrante M, Lövei G (2021) Monitoring arthropods in Azorean agroecosystems: the project AGRO-ECOSERVICES. Biodiversity Data Journal 9 (e77548). https://doi.org/10.3897/bdj.9.e77548
- Borges PAV, Lamelas-López L, Ros-Prieto A (2022) A survey of exotic arthropods in disturbed Azorean forest habitats using SLAM traps. v.1.5. Universidade dos Açores. Dataset/Samplingevent. GBIF. https://doi.org/10.15468/ucfehv
- Cardoso P, Aranda SC, Lobo JM, Dinis F, Gaspar C, Borges PAV (2009) A spatial scale assessment of habitat effects on arthropod communities of an oceanic island. Acta Oecologica 35 (5): 590-597. https://doi.org/10.1016/j.actao.2009.05.005
- Cardoso P, Barton P, Birkhofer K, Chichorro F, Deacon C, Fartmann T, Fukushima CS, Gaigher R, Habel JC, Hallmann CA, Hill MJ, Hochkirch A, Kwak ML, Mammola S, Ari Noriega J, Orfinger AB, Pedraza F, Pryke JS, Roque F, Settele J, Simaika JP, Stork NE, Suhling F, Vorster C, Samways MJ (2020) Scientists' warning to humanity on insect extinctions. Biological Conservation 242: 108426. https://doi.org/10.1016/j.biocon.2020.108426
- Colonnelli E (1990) Curculionidae Ceutorrhynchinae from the Canaries and Macaronesia (Coleoptera). Vieraea 18: 317-337. URL: http://www.macaronesian.org/assets/files/file-9ea2a75b6ef51e.pdf
- Costa R, Borges PAV (2021) SLAM Project - Long Term Ecological Study of the Impacts of Climate Change in the Natural Forest of Azores: I - the spiders from native forests of Terceira and Pico Islands (2012-2019). Biodiversity Data Journal 9 https://doi.org/10.3897/bdj.9.e69924
- Cowie R, Bouchet P, Fontaine B (2022) The Sixth Mass Extinction: fact, fiction or speculation? Biological Reviews https://doi.org/10.1111/brv.12816
- Crespo LC, Bosmans R, Cardoso P, Borges PAV (2014) On three endemic species of the linyphiid spider genus *Canariphantes* Wunderlich, 1992 (Araneae, Linyphiidae) from the Azores archipelago. Zootaxa 3841 (3): 403-417. https://doi.org/10.11646/zootaxa.3841.3.5
- Cruz JV, Pereira R, Moreira A (2007) Carta de ocupação do solo da região Autónoma dos Açores—projecto SUEMAC. Secretaria Regional do Ambiente. Direcção Regional

do Ordenamento do território e dos Recursos Hídricos., Horta, 56 pp. URL: https://www.azores.gov.pt/Gra/srrn-drotrh/conteudos/publicacoes/Carta+de+Ocupa%C3%A7%C3%A3o+do+Solo.htm?lang=pt&area=ct

- de Vries JPR, van Loon E, Borges PAV (2021) A small-scale snalysis of elevational species richness and beta diversity patterns of arthropods on an oceanic island (Terceira, Azores). Insects 12 (10). https://doi.org/10.3390/insects12100936
- Espadaler X (2008) Formicidae. In: Borges PAV, et al. (Ed.) A list of the terrestrial fungi, flora and fauna of Madeira and Selvagens archipelagos. 1st. Direcção Regional do Ambiente da Madeira and Universidade dos Açores, Funchal and Angra do Heroísmo, 352 pp.
- Espadaler X (2010) Formicidae. In: Borges PA, Costa A, Cunha R, Gabriel R, Gonçalves V, Martins AF, Melo I, Parente M, Raposeiro P, Rodrigues P, Santos R, Silva L, Vieira P, Vieira V (Eds) A list of the terrestrial and marine biota from the Azores. pp 245. Princípia, Cascais, 432 pp.
- Ferreira MT, Cardoso P, Borges PAV, Gabriel R, de Azevedo EB, Reis F, Araújo MB, Elias RB (2016) Effects of climate change on the distribution of indigenous species in oceanic islands (Azores). Climatic Change 138: 603-615. https://doi.org/10.1007/s10584-016-1754-6
- Florencio M, Lobo JM, Cardoso P, Almeida-Neto M, Borges PAV (2015) The colonisation of exotic species does not have to trigger faunal homogenisation: lessons from the assembly patterns of arthropods on oceanic islands. PLOS One 10 (5). https://doi.org/10.1371/journal.pone.0128276
- Florencio M, Rigal F, Borges PAV, Cardoso P, Santos AMC, Lobo JM (2016) The role of plant fidelity and land-use changes on island exotic and indigenous canopy spiders at local and regional scales. Biological Invasions 18 (8): 2309-2324. https://doi.org/10.1007/s10530-016-1162-x
- García R, García J, Sicilia P (2016) Nuevas aportaciones al elenco de coleópteros (Insecta: Coleoptera) de Canarias. Revista de la Academia Canaria de Ciencias 28: 79-88. URL: https://www.researchgate.net/publication/329542028_Nuevas_aportaciones_al_elenco_de_coleopteros_Insecta_Coleoptera_de_Canarias
- Gaspar C, Borges PAV, Gaston KJ (2008) Diversity and distribution of arthropods in native forests of the Azores archipelago. Arquipélago Life and Marine Sciences 25: 1-30. URL: https://repositorio.uac.pt/bitstream/10400.3/249/1/pp_1_30_Gaspar_etal_25.pdf
- Hallmann CA, Sorg M, Jongejans E, Siepel H, Hofland N, Schwan H, Stenmans W, Müller A, Sumser H, Hörren T, Goulson D, de Kroon H (2017) More than 75 percent decline over 27 years in total flying insect biomass in protected areas. PLOS One 12 (10). https://doi.org/10.1371/journal.pone.0185809
- Harvey JA, Heinen R, Armbrecht I, Basset Y, Baxter-Gilbert JH, Bezemer TM, Böhm M, Bommarco R, Borges PAV, Cardoso P, Clausnitzer V, Cornelisse T, Crone EE, Dicke M, Dijkstra K, Dyer L, Ellers J, Fartmann T, Forister ML, Furlong MJ, Garcia-Aguayo A, Gerlach J, Gols R, Goulson D, Habel J, Haddad NM, Hallmann CA, Henriques S, Herberstein ME, Hochkirch A, Hughes AC, Jepsen S, Jones TH, Kaydan BM, Kleijn D, Klein A, Latty T, Leather SR, Lewis SM, Lister BC, Losey JE, Lowe E, Macadam CR, Montoya-Lerma J, Nagano CD, Ogan S, Orr MC, Painting CJ, Pham T, Potts SG, Rauf A, Roslin TL, Samways MJ, Sanchez-Bayo F, Sar SA, Schultz CB, Soares AO, Thancharoen A, Tscharntke T, Tylianakis JM, Umbers KDL, Vet LEM, Visser M, Vujic A,

Wagner DL, WallisDeVries MF, Westphal C, White TE, Wilkins V, Williams PH, Wyckhuys KAG, Zhu Z, de Kroon H (2020) International scientists formulate a roadmap for insect conservation and recovery. Nature Ecology & Evolution 4 (2): 174-176. https://doi.org/10.1038/s41559-019-1079-8

- Holway DA, Lach L, Suarez AV, Tsutsui ND, Case TJ (2002) The causes and consequences of ant invasions. Annual Review of Ecology, Evolution, and Systematics 33: 181-233. https://doi.org/10.1146/annurev.ecolsys.33.010802.150444
- Janicki J, Narula N, Ziegler M, Guénard B, Economo EP (2016) Visualizing and interacting with large-volume biodiversity data using client–server web-mapping applications: The design and implementation of antmaps.org. Ecological Informatics 32: 185-193. https://doi.org/10.1016/j.ecoinf.2016.02.006
- Matthews TJ, Sadler J, Carvalho R, Nunes R, Borges PAV (2018) Differential temporal beta-diversity patterns of native and non-native arthropod species in a fragmented native forest landscape. Ecography 42 (1): 45-54. https://doi.org/10.1111/ecog.03812
- Norder SJ, de Lima RF, de Nascimento L, Lim JY, Fernández-Palacios JM, Romeiras MM, Elias RB, Cabezas FJ, Catarino L, Ceríaco LMP, Castilla-Beltrán A, Gabriel R, de Sequeira MM, Rijsdijk KF, Nogué S, Kissling WD, van Loon EE, Hall M, Matos M, Borges PAV (2020) Global change in microcosms: Environmental and societal predictors of land cover change on the Atlantic Ocean Islands. Anthropocene 30 (100242): 1-9. https://doi.org/10.1016/j.ancene.2020.100242
- Russell JC, Meyer JY, Holmes ND, Pagad S (2017) Invasive alien species on islands: impacts, distribution, interactions and management. Environmental Conservation 44 (4): 359-370. https://doi.org/10.1017/s0376892917000297
- Sánchez-Bayo F, Wyckhuys KAG (2019) Worldwide decline of the entomofauna: A review of its drivers. Biological Conservation 232: 8-27. https://doi.org/10.1016/j.biocon.2019.01.020
- Seifert B (2003) The ant genus *Cardiocondyla* (Insecta: Hymenoptera: Formicidae) - a taxonomic revision of the *C. elegans*, *C. bulgarica*, *C. batesii*, *C. nuda*, *C. shuckardi*, *C. stambuloffii*, *C. wroughtonii*, *C. emeryi* and *C. minutior* species groups. Annals of the Natural History Museum Wien 104: 203-338. URL: https://www.zobodat.at/pdf/ANNA_104B_0203-0338.pdf
- Seifert B, Okita I, Heinze J (2017) A taxonomic revision of the Cardiocondyla nuda group (Hymenoptera: Formicidae). Zootaxa 4290 (2). https://doi.org/10.11646/zootaxa.4290.2.4
- Silva L, Ojeda Land E, Rodriguez Luengo JL, Borges PAV, Oliveira P, Jardim R (2008) Invasive alien species in Macaronesia. In: Silva L, Ojeda Land E, Rodriguez Luengo JL (Eds) Invasive Terrestrial Flora & Fauna of Macaronesia. TOP 100 in Azores, Madeira and Canaries. ARENA, Ponta Delgada, 159-165 pp. URL: http://hdl.handle.net/10400.3/1978
- Stüben PE (2003) The Rediscovery of *Acalles droueti* Crotch 1867 and Curculionoidea collected on an excursion on the Azores: A Report. (Coleoptera: Curculionidae: Cryptorhynchinae). Weevil News 16: 1-10.
- Stüben PE (2004) Die Cryptorhynchinae der Azoren (Coleoptera: Curculionidae). SNUDEBILLER, Studies on taxonomy, biology and ecology of Curculionoidea 5 (53): 34-59.
- Stüben PE, Sprick P, Müller G, Bayer C, Behne L, Krátký J (2012) Digital-Weevil-Determination for Curculionoidea of West Palaearctic: Transalpina: Ceutorhynchinae (1.

Part). (Mononychini, Phytobiini, Hypurini, Cnemogonini, Scleropterini & Amalini). SNUDEBILLER: Studies on taxonomy, biology and ecology of Curculionoidea 13 (192): 18-33.

- Stüben PE, Müller G, Müller U, Krátký J, Bayer C, Sprick P, Behne L (2014) Digital-Weevil-Determination for Curculionoidea of the West Palearctic: Transalpina: Ceutorhynchinae (3 part). (Ceutorhynchini: *Datonychus*, *Ethelcus*, *Glocianus*, *Hadroplontus*, *Microplontus*, *Mogulones*, *Mogulonoides*, *Neoglocianus*, *Oprohinus*, *Parethelcus*, *Prisistus*, *Ranunculiphilus*). SNUDEBILLER: Studies on taxonomy, biology and ecology of Curculionoidea 15 (222): 1-25.
- Stüben PE, Borges PAV (2019) Die Curculionoidea (Coleoptera) von den Inseln der Azoren. SNUDEBILLER: Studies on taxonomy, biology and ecology of Curculionoidea 20 (279): 1-59. URL: https://www.researchgate.net/publication/340600093_Die_Curculionoidea_Coleoptera_von_den_Inseln_der_Azoren
- Stüben PE (2022) Weevils of Macaronesia – Canary Islands, Madeira, Azores (Coleoptera: Curculionoidea). 1st. CURCULIO-Institute, Mönchengladbach, 784 pp.
- Tarantino E, Ros-Prieto A, Lopes DJH, Borges PAV (2022) First finding of *Sophonia orientalis* (Matsumura) in the Azores. EPPO Bulletin https://doi.org/10.1111/epp.12812
- Triantis KA, Borges PAV, Ladle RJ, Hortal J, Cardoso P, Gaspar C, Dinis F, Mendonça E, Silveira LMA, Gabriel R, Melo C, Santos AMC, Amorim IR, Ribeiro SP, Serrano ARM, Quartau JA, Whittaker RJ (2010) Extinction debt on oceanic islands. Ecography 33: 285-294. https://doi.org/10.1111/j.1600-0587.2010.06203.x
- Tsafack N, Fattorini S, Boieiro M, Rigal F, Ros-Prieto A, Ferreira MT, Borges PAV (2021) The role of small lowland patches of exotic forests as refuges of rare endemic Azorean arthropods. Diversity 13 (9): 1-1. https://doi.org/10.3390/d13090443
- Wetterer JK (2009) Worldwide spread of the Penny ant, *Tetramorium bicarinatum* (Hymenoptera: Formicidae). Sociobiology 54: 811-830.
- Wetterer JK, Wild AL, Suarez AV, Roura-Pascual N, Espadaler X (2009) Worldwide spread of the Argentine ant, *Linepithema humile* (Hymenoptera: Formicidae). Myrmecol News 12: 187-194.
- Wetterer JK, Espadaler X (2010) Invasive ants of Macaronesia. In: Serrano AR, Borges PA, Boieiro M, Oromí P (Eds) Terrestrial arthropods of Macaronesia. Biodiversity, Ecology and Evolution. pp 133-143. Sociedade Portuguesa de Entomologia, Portugal.
- Wetterer JK (2012) Worldwide spread of the Moorish sneaking ant, *Cardiocondyla mauritanica* (Hymenoptera: Formicidae). Sociobiology 59: 985-997. https://doi.org/10.13102/sociobiology.v59i3.561
- Wetterer JK, Hita Garcia F (2015) Worldwide spread of *Tetramorium caldarium* (Hymenoptera: Formicidae). Myrmecological News 21: 93-99.

Supplementary material

Suppl. material 1: Complete list of species and morphospecies. doi

Authors: Borges, P.A.V.
Data type: Excel
Brief description: Complete list of arthropod species collected in four islands of Azores, between 2019 and 2020 using SLAM traps. The list includes individuals identified at species-level and also Morphospecies. Abundance per island (COR - Corvo; FLO - Flores; TER - Terceira; SMR - Santa Maria) is provided.
Download file (30.81 kb)