



An updated checklist to the biodiversity data of ladybeetles (Coleoptera: Coccinellidae) of the Azores Archipelago (Portugal)

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Abstract

Background

A recently-published review from 2021 presents a comprehensive checklist of ladybeetles of Portugal, including the Azores and Madeira Archipelagos. Until then, the available information was very scattered and based on a single revision dating back to 1986, a few international catalogues and databases, individual records and studies on communities of agroecosystems. However, no information was available on faunal composition across the Azorean islands and their habitats, using standardised inventories. Here, we present data about the biodiversity of ladybeetles and their distribution and abundance in five Islands of the Azores (Faial, Graciosa, Pico, São Jorge and São Miguel). Surveys included herbaceous and arboreal habitats from native to anthropogenic-managed habitats: ruderal road vegetation, vegetable garden, mixed forest of endemic and non-native host plants, coastal prairies, coastal mixed vegetation, cornfields and urban areas. We aimed to

contribute to the ongoing effort to document the terrestrial biodiversity of Portugal, including the Archipelago of the Azores, within the research project AZORESBIOPORTAL-PORBIOTA (ACORES-01-0145-FEDER-000072).

New information

In this study, a total of 1,487 specimens of Coccinellidae belonging to 19 species are reported for several habitats. The listed species are from one single sub-family (Coccinellinae) and six tribes; Chilocorini (one species), Coccidulini (three species), Coccinellini (six species), Noviini (one species), Scymnini (seven species), Stethorini (one species). The number of species collected per island differed; Faial (10 species), Graciosa (four species), Pico (seven species), São Jorge (seven species) and São Miguel (12 species). For six species, new island records are given. Currently, the number of species known to occur in the Azores are 32, including two doubtful records. The majority of species are Scymnini, being *Scymnus* (*Scymnus*) *interruptus* (Goeze, 1777) and *Scymnus* (*Scymnus*) *nubilus* Mulsant, 1850, the most abundant species (relative abundance 71.1%). This database will be the baseline of a long-term monitoring project allowing assessment of the impact of ongoing global changes in the distribution and abundance of ladybeetles.

Keywords

Arthropoda, Ladybeetles, Azores, Faial, Graciosa, Pico, São Jorge, São Miguel

Introduction

Insects, like other taxonomic groups, are at high risk of extinction (Harvey et al. 2020). Insects deliver fundamental services to agricultural and forest ecosystems, including pollination, decomposition and pest control, which, in turn, translates into relevant consequences for food production and security (e.g. Ameixa et al. 2018, IPBES 2019, Cardoso et al. 2020).

The family Coccinellidae contains between 6000 and 7000 described species (Seago et al. 2011). Currently the number of Coccinellidae known for Azores is 32, including two doubtful records (Soares et al. 2021b).

Despite being very diverse in terms of morphology, life history traits, habitat use and food relationships (see Hodek et al. 2012 for review), they are primarily top carnivorous predators and thus useful natural enemies of herbivorous arthropods, including aphids (Aphidoidea), scale insects (Coccoidea), whiteflies (Aleyrodoidea) or mites (Acari) (Hodek et al. 2012). Until very recently, this group was thought to exhibit only sexual reproduction. However, it was found that some populations of *Nephus* (*Nephus*) *voeltzkowi* Weise, 1910, including the Azorean populations, showed parthenogenetic reproduction, which constitutes the first case of parthenogenesis in ladybeetles (Magro et al. 2019).

Over the past 30 years, rapid declines of formerly common native ladybird species - including in North America (Harmon et al. 2006), Europe (Roy et al. 2012, Honěk et al. 2016) and others (reviewed in Roy et al. 2016) - have been occurring. Most declines are associated with climate change, agricultural intensification and urbanisation and invasions of alien species (Honěk et al. 2017), especially with an increasing density, spread and dominance of the invasive *Harmonia axyridis* Pallas. Despite its high invasive capacity resulting in its rapid spread and fast establishment under distinct climatic conditions, *H. axyridis* did not establish in the Azores where it was intentionally and repeatedly released (Soares et al. 2008, Soares et al. 2018), for the same reasons as in other regions, for agricultural pest control purposes. This apparent failure is an interesting case study for invasion biology. Several hypotheses were tested to explain the inability of this species to become invasive (Soares et al. 2017, Alaniz et al. 2020). The lack of high density of their preferred aphid preys may be a key factor hampering its establishment. Indeed, the composition of Coccinellidae fauna seems to be dominated by small species [like *Scymnus* spp., which require low aphid density (Soares et al. 2017)]. Apparently, the climatic conditions of the Azores do not seem likely to hinder the invasion of *H. axyridis*, as areas with similar climates have experienced extensive invasion. Indeed, climatic models have predicted the spread of *H. axyridis* to regions with subtropical conditions (Poutsma et al. 2008, Bidinger et al. 2010). However, for the Azores and contrary to that prediction, the absence of suitable temperature to overwinter will force adults to become active during the winter season and females will not find enough suitable food (in quantity and quality) to reproduce and this will hinder the build-up of the first generation (Alaniz et al. 2020).

General description

Purpose: We aimed to contribute to characterise the richness and abundance of ladybeetles in several herbaceous and arboreal habitats, from native to anthropogenic-managed habitats. We also aimed to contribute to address two key shortfalls: i) the need for improving current information on the local and regional distribution of Azorean arthropods (the Wallacean shortfall); and ii) the need for collecting abundance data for future monitoring purposes (the Prestonian shortfall) (see Cardoso et al. 2011).

In addition, we provide an updated checklist of Azorean ladybeetles with their known distribution in the nine Azorean islands.

Project description

Title: AZORESBIOPORTAL–PORBIOTA: inventory of ladybeetles of the Azores (Portugal)

Personnel: António O. Soares, Isabel Borges and Hugo R. Calado collected the samples and managed the database. Paulo A.V. Borges assisted us in managing the database to GBIF.

Study area description: We focused the inventory on five islands of the Azores (Table 1), these being five of the nine islands from the Azores Archipelago. The climate in the Azores is temperate oceanic, with regular and abundant rainfall, high levels of relative humidity and persistent winds, mainly during winter and autumn seasons. The landscape of the islands is composed by a mosaic of habitats, ranging from herbaceous to arboreal habitats and from native to anthropogenic-managed habitats. The surveys were done on ruderal road vegetation, vegetable garden, mixed forest of endemic and non-native host plants, coastal prairies, coastal mixed vegetation, cornfields and urban areas.

Table 1.

List of studied islands, habitats and localities with indication of elevation and geographical coordinates (datum WGS84).

Island	Habitat	Locality	Elevation (m)	Latitude	Longitude
Faial	Citrus orchard	Castelo Branco	57	38.5231	-28.68917
	Corn field	Cedros	166	38.62475	-28.68011
	Coastal mixed vegetation	Norte Pequeno	12	38.59263	-28.82711
	Coastal prairies	Pasteleiro	67	38.53005	-28.647701
	Coastal prairies	Praia do Almojarife	5	38.5541	-28.61053
	Coastal prairies	Varadouro	8	38.56639	-28.77042
	Mixed forest of endemic and non-native host plants	Varadouro	175	38.57394	-28.77713
	Mixed forest of endemic and non-native host plants	Norte Pequeno	128	38.59433	-28.81541
	Ruderal road vegetation	Pasteleiro	93	38.53605	-28.64981
	Ruderal road vegetation	Varadouro	198	38.57952	-28.78283
Graciosa	Urban poplar grove	Angústias	39	38.52806	-28.6367
	Vegetable garden	Feteira	37	38.52494	-28.68179
	Abandoned vineyards	Beira Mar	10	39.02123	-28.00697
	Coastal prairies	Beira Mar	7	39.021	-28.00711
	Coastal prairies	Beira Mar	21	39.02373	-28.00686
	Coastal prairies	Sta. Cruz da Graciosa	25	39.09572	-28.03441
	Coastal Prairies, dominated by <i>Canica</i> sp.	Carapacho	17	39.01185	-27.97651
Pasture: <i>Medicago sativa</i> L.	Jorge Gomes	58	39.0607	-28.06173	

Island	Habitat	Locality	Elevation (m)	Latitude	Longitude
	Nerium oleander L. and Hibiscus rosa-sinensis L.	Alto do Sul	29	39.01192	-27.97911
	Ruderal road vegetation: herbaceous vegetation	Bom Jesus	9	39.08346	-28.05213
	Ruderal road vegetation: herbaceous vegetation	Bom Jesus	13	39.08189	-28.0542
	Ruderal road vegetation: herbaceous vegetation	Bom Jesus	19	39.08094	-28.05473
	Ruderal road vegetation: herbaceous vegetation	Jorge Gomes	69	39.06235	-28.06227
	Trees of Tamarix sp.	Bom Jesus	8	39.08376	-28.0524
	Vegetable garden	Porto da Barra	8	39.08469	-27.99925
Pico	Citrus orchard	Sete Cidades	119	38.52796	-28.50286
	Citrus orchard	Terra do Pão	55	38.42747	-28.40318
	Corn field	Monte	69	38.49832	-28.52976
	Corn field	São Vicente	113	38.54541	-28.36608
	Corn field	Sete Cidades	116	38.5286	-28.50279
	Coastal prairies	Madalena	3	38.52013	-28.53784
	Coastal prairies	Madalena	8	38.53957	-28.52029
	Evergreen forest	Toledos	15	38.54746	-28.50961
	Evergreen of endemic and exotic forest	Campo Raso	36	38.44743	-28.49908
	Pine trees	Sete Cidades	29	38.53353	-28.52339
	Pine trees	Sete Cidades	884	38.4976	-28.41566
	Ruderal road vegetation	Farrobo	114	38.54266	-28.42825
	Ruderal road vegetation: Arundo donax L.	Silveira	90	38.41783	-28.29147
	Ruderal road vegetation: Evergreen of endemic and exotic Forest	Cachorro	26	38.55574	-28.44033
	Ruderal road vegetation: Herbaceous plants	Cachorro	26	38.55574	-28.44033
	Ruderal road vegetation: Tamarix sp.	Madalena	3	38.52013	-28.53784
	Vegetable garden: cabbage	São Mateus	48	38.43294	-28.45794
	Vegetable garden: cabbage	São Vicente	113	38.54541	-28.36608

Island	Habitat	Locality	Elevation (m)	Latitude	Longitude
São Jorge	Citrus orchard	Fajã de S. Amaro	60	38.66226	-28.17184
	Citrus orchard	Fajã de S. Amaro	78	38.66261	-28.17155
	Coastal herbaceous plants: Erica and Myrica	Portinho da Queimada	18	38.66651	-28.18714
	Coastal prairies	Queimada	14	38.67241	-28.19456
	Coastal prairies	Velas	27	38.6889	-28.2188
	Coastal prairies: Tamarix sp.	Velas	34	38.68693	-28.21873
	Vegetable garden: cabbage, bean and cucumber	Urzelina	60	38.64404	-28.1194
	Vegetable garden: cabbage, bean and cucumber	Velas	40	38.68181	-28.20469
	Wood: Acacia trees	Urzelina	59	38.64813	-28.12971
	Wood: Pinus trees	Urzelina	58	38.64383	-28.11937
São Miguel	Ruderal road vegetation: Arundo donax L.	Arrifres	130	37.75388	-25.70472
	Ruderal road vegetation: Arundo donax L.	Calhetas	18	37.82279	-25.61368
	Ruderal road vegetation: Arundo donax L.	São Roque	13	37.75152	-25.61896
	Ruderal road vegetation: Arundo donax L.	São Roque	13	37.75205	-25.62264
	Ruderal road vegetation: Arundo donax L.	São Roque	14	37.75205	-25.62264
	Coastal prairies	Fenais da Luz	30	37.83083	-25.635
	Coastal prairies	Pópulo	30	37.75023	-25.62106
	Coastal prairies	Rabo de Peixe	18	37.81583	-25.56694
	Coastal prairies	Rabo de Peixe	35	37.81378	-25.56706
	Coastal prairies	Relva	30	37.73737	-25.69819
	Coastal prairies	Relva	30	37.74711	-25.71359
	Coastal prairies	Santa Clara	30	37.7333	-25.686
	Coastal prairies	Santa Clara	30	37.73495	-25.69359
	Coastal prairies	São Roque	13	37.75152	-25.61896
	Corn field	Fenais da Luz	18	37.82666	-25.63194
	Corn field	Ribeira Seca	18	37.81659	-25.53795
Corn field	São Sebastião	87	37.75424	-25.67236	

Island	Habitat	Locality	Elevation (m)	Latitude	Longitude
	Pine trees	São Sebastião	76	37.75036	-25.67572
	Pine trees	São Sebastião	76	37.75036	-25.67572

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Sampling methods

Study extent: Five Islands of the Azores (Portugal): São Miguel, Graciosa, Faial, Pico and So Jorge.

Sampling description: The sampling programme in Faial, Graciosa, Pico and São Jorge consisted of travelling through each Island by car, for 3 to 4 days depending on the size of the Island. For São Miguel, we also included results taken in 2012 (Borges et al. 2011) in which fieldwork included a similar sampling effort. The samplings took place in representative habitats of the vegetation cover of the Islands that are visited by ladybeetles. The methods used to collect the samples were sweeping, beating and direct observations. Sampling from the herbaceous plants and canopy up to a height of ca. 3 m was standardised by using a standard sweep net (35-cm diameter, 140-cm handle) operated by António O. Soares, Isabel Borges and Hugo R. Calado. Independently of the method, the sampling effort was standardised in terms of the number of persons per unit of time (e.g. 1 person per 2 hours, 1 person per 30', 1 person per 15'). Fieldwork occurred between 09:00 h and 16 :00 h on sunny and calm days. Ladybeetle adults were identified immediately and were released at the site and *Scymnus* spp were brought back to laboratory to identification.

Geographic coverage

Description: Azores Islands (Portugal): Faial, Graciosa, Pico, São Jorge and São Miguel

Coordinates: 36.906 and 39.589 Latitude; -24.961 and -31.311 Longitude.

Taxonomic coverage

Description: The sampling programme targeted ladybeetles (Coleoptera: Coccinellidae)

Taxa included:

Rank	Scientific Name	Common Name
family	Coccinellidae	Ladybeetles/ ladybirds/ ladybird beetles/ ladybugs

Traits coverage

There are no trait data associated.

Temporal coverage

Notes: 20 April 2012 to 6 July 2020

Collection data

Collection name: Ladybeetles of the Azores

Collection identifier: ladybeetles

Specimen preservation method: Ethanol 96%

Curatorial unit: University of the Azores, Faculty of Sciences and Technology

Usage licence

Usage licence: Creative Commons Public Domain Waiver (CC-Zero)

Data resources

Data package title: Biodiversity data of ladybeetles (Coleoptera: Coccinellidae) of the Azores Archipelago (Portugal)

Resource link: <https://www.gbif.org/dataset/2292e622-129e-4c66-9ad6-fccaa377ff58>

Alternative identifiers: http://ipt.gbif.pt/ipt/resource?r=coccinellidae_azores&v=1.5

Number of data sets: 2

Data set name: Table of Sampling Events

Download URL: http://ipt.gbif.pt/ipt/resource?r=coccinellidae_azores&v=1.5

Data format: Darwin Core Archive**Data format version:** version 1.5

Description: The following data table includes 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: in the current event table, 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 file contains 98 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 from Soares et al. (2021a).

Column label	Column description
id	Unique identification code for species abundance data. Equivalent here to eventID.
eventID	Identifier of the events, unique for the dataset.
samplingProtocol	The sampling protocol used to capture the species.
samplingEffort	The numeric amount of time spent in each sampling.
eventDate	Date or date range the record was collected.
year	Year of the event.
month	Month of the event.
day	Day of the event.
habitat	The habitat of the sample.
fieldNumber	An identifier given to the event in the field. Serves here as a link between field notes and the Event.
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.
verbatimLocality	The original textual description of the place.
maximumElevationInMetres	The upper limit of the range of elevation (altitude, usually above sea level), in metres.

locationRemarks	Details on the locality site.
verbatimCoordinates	The verbatim original spatial coordinates of the Location.
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.
coordinatePrecision	Precision of the coordinates.
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: Table of Species Occurrence

Download URL: http://ipt.gbif.pt/ipt/resource?r=coccinellidae_azores&v=1.5

Data format: Darwin Core

Data format version: version1.5

Description: The following data table includes 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: in the current occurrences table, 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 file contains 218 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 from Soares et al. (2021a).

Column label	Column description
id	Unique identification code for species abundance data. Equivalent here to eventID.
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.
collectionID	The identity of the collection publishing the data.
institutionCode	The code of the institution publishing the data.
collectionCode	The code of the collection where the specimens are conserved.
datasetName	Name of the dataset.

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.
individualCount	A number or enumeration value for the quantity of organisms.
organismQuantityType	The type of quantification system used for the quantity of organisms.
lifeStage	The life stage of the organisms captured.
establishmentMeans	The process of establishment of the species in the location, using a controlled vocabulary: 'native', 'introduced', 'endemic', "uncertain".
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	Comments or notes about the Identification.
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.
taxonRank	Lowest taxonomic rank of the record.
scientificNameAuthorship	Name of the author of the lowest taxon rank included in the record.

Additional information

A total of of 1,487 specimens of Coccinellidae belonging to 19 species were sampled (see Table 2). The listed species are from one single sub-familiy (Coccinellinae) and four tribes; Chillocorini (one species), Coccidulini (11 species), Coccinellini (six species) and Noviini (one species). The number of species collected from each island differed; São Miguel (12 species), Graciosa (four species), Faial (four species), Pico (seven species) and São Jorge (seven species).

Table 2.

List of species with indication of number of individuals collected from each island. FAI - Faial; GRA - Graciosa; PIC - Pico; SJG - São Jorge; SMG - São Miguel. * refers to new species records for the island.

Species	Tribe	FAI	GRA	PIC	SJG	SMG	Total
<i>Adalia bipunctata</i> (Linnaeus, 1758)	Coccinellini	2	0	0	0	0	2
<i>Adalia decempunctata</i> (Linnaeus, 1758)	Coccinellini	0	0	0	0	4	4
<i>Chilocorus bipustulatus</i> (Linnaeus, 1758)	Chilocorini	0	0	0	0	25	25
<i>Clitostethus arcuatus</i> (Rossi, 1794)	Scymnini	0	0	32	1	0	33
<i>Coccinella undecimpunctata</i> Linnaeus, 1758	Coccinellini	0	0	0	0	7	7
<i>Myrrha octodecimguttata</i> (Linnaeus, 1758)	Coccinellini	0	0	3	0	0	3
<i>Nephus (Geminosipho) reunioni</i> (Fürsch 1974)	Scymnini	0	0	0	0	1	1
<i>Nephus (Nephus) voeltzkowi</i> Weise, 1910	Scymnini	8	2	0	1	147	158
<i>Novius cardinalis</i> (Mulsant, 1850)	Noviini	5	0	29	6	0	40
* <i>Oenopia doublieri</i> (Mulsant, 1846)	Coccinellini	6*	0	0	0	0	6
* <i>Propylea quatuordecimpunctata</i> (Linnaeus, 1758)	Coccinellini	1*	0	0	0	0	1
<i>Rhyzobius chrysomeloides</i> (Herbst, 1792)	Coccidulini	0	0	0	0	25	25
<i>Rhyzobius litura</i> (Fabricius, 1787)	Coccidulini	1	0	0	0	63	64
* <i>Rhyzobius lophanthae</i> (Blaisdell, 1892)	Coccidulini	0	0	3*	3	0	6
<i>Scymnus (Pullus) subvillosus</i> (Goeze, 1777)	Scymnini	1	0	0	0	4	5
* <i>Scymnus (Pullus) suturalis</i> Thunberg 1795	Scymnini	0	0	0	0	6*	6
<i>Scymnus (Scymnus) interruptus</i> (Goeze, 1777)	Scymnini	20	21	22	25	322	410
<i>Scymnus (Scymnus) nubilus</i> Mulsant, 1850	Scymnini	66	149	218	35	180	648
* <i>Stethorus pusillus</i> (Herbst, 1797)	Stethorini	5	2*	26	6	4	43

Propylea quatuordecimpunctata (Linnaeus, 1758), despite being previously listed to the Azores, but without island details by Soares et al. (2021b), is now recorded for the first time to Faial island. *Oenopia doublieri* (Mulsant, 1846) was recently recorded as new for the Azores by Borges et al. (2018) (Terceira Island in Paúl da Praia da Vitória) and now is recorded to an additional island (Faial). Three additional species, *Rhyzobius lophanthae* (Blaisdell, 1892), *Scymnus (Pullus) suturalis* Thunberg 1795 and *Stethorus pusillus* (Herbst, 1797), are new records to Pico, S. Miguel and Graciosa Islands, respectively.

Currently, the number of known species of ladybeetles in the Azores is 32 species (Soares et al. 2021b). The current list includes 30 confirmed species and two doubtful records (Table 3) and most of them considered exotic introduced species (n = 24) and only eight

Scientific name	Col.	AZ	COR	FLO	FAI	PIC	GRA	SJG	TER	SMG	SMR
<i>Rhyzobius forestieri</i> (Mulsant, 1853)	INTR									SMG	
<i>Rhyzobius lophanthae</i> (Blaisdell, 1892)	INTR			FLO		PIC	GRA	SJG	TER	SMG	SMR
<i>Rhyzobius litura</i> (Fabricius, 1787)	NAT				FAI		GRA		TER	SMG	SMR
<i>Scymniscus helgae</i> (Fürsch, 1965)	INTR			FLO					TER		SMR
<i>Scymnus (Neopullus) haemorrhoidalis</i> Herbst, 1797	INTR										SMR
<i>Scymnus (Pullus) subvillosus</i> (Goeze, 1777)	NAT				FAI			SJG	TER	SMG	SMR
<i>Scymnus (Pullus) suturalis</i> Thunberg, 1795	INTR				FAI				TER	SMG	SMR
<i>Scymnus (Scymnus) interruptus</i> (Goeze, 1777)	NAT		COR	FLO	FAI	PIC	GRA	SJG	TER	SMG	SMR
<i>Scymnus (Scymnus) nubilus</i> Mulsant, 1850	NAT		COR	FLO	FAI	PIC	GRA	SJG	TER	SMG	SMR
<i>Scymnus (Scymnus) rubromaculatus</i> (Goeze, 1777)	NAT	AZ									
<i>Scymnus (Scymnus) schmidti</i> Fürsch, 1958	INTR	AZ									
<i>Stethorus pusillus</i> (Herbst, 1797)	NAT			FLO	FAI	PIC	GRA	SJG	TER	SMG	SMR

Doubtful records include *Eriopsis connexa* (Germar, 1824) and *Coccinella septempunctata* Linnaeus, 1758. We never collected these species in our extensive sampling programmes. With regard to *E. connexa*, it could result from misidentification given that this Neotropical species was never recorded outside its native region. In the case of *C. septempunctata*, although its previous presence in the Azores is well documented, its extinction may have occurred after the end of the cultural cycle of cereals, these being preferential habitats of the species (Soares et al. 2018).

The three Islands with highest economic activity are the ones with more species recorded (S. Miguel -22; Terceira - 16 and Faial - 13). The exception is Santa Maria that also has many species recorded (17), that can be explained by the proximity to S. Miguel and commercial exchanges between both Islands.

Interestingly, the same Islands are also the most diverse in the native fauna: S. Miguel - 7; Terceira - 6; Faial - 5; Santa Maria - 5. Only S. Jorge Island also has similar native species richness (five species) (Table 3).

Five alien species to the Palearctic Region were introduced in this region, as biological control agents of crop pests: *Delphastus catalinae* (Horn, 1895), *Nephus (Geminosipho) reunioni* (Fürsch, 1974), *Novius cardinalis* (Mulsant, 1850), *Rhyzobius forestieri* (Mulsant, 1853) and *Rhyzobius lophanthae* (Blaisdell, 1892) (Soares et al. 2021b).

The majority of the specimens was collected on herbaceous plants, including coastal prairies and ruderal road vegetation.

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