Universidade de Aveiro Departamento de Biologia
Ano 2019

DAVID DA SILVA ALVES

CHARACTERIZATION OF POLLINATOR AND PLANT COMMUNITIES OF THE UNIVERSITY OF AVEIRO: FIRST STEP TOWARDS SUSTAINABLE MANAGEMENT

CARACTERIZAÇÃO DAS COMUNIDADES DE POLINIZADORES E PLANTAS DA UNIVERSIDADE DE AVEIRO: PRIMEIRO PASSO PARA UMA GESTÃO SUSTENTÁVEL

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Dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Ecologia Aplicada, realizada sob a orientação científica da Doutora Olga Maria Correia Chitas Ameixa, investigadora auxiliar do CESAM e do Departamento de Biologia da Universidade de Aveiro e da Doutora Paula Alexandra Aquino Maia, investigadora auxiliar do CESAM e do Departamento de Biologia da Universidade de Aveiro.

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agradecimentos

Agradeço a todos que colaboraram para a finalização deste trabalho.

À Doutora Olga Ameixa pelo seu apoio e ensinamentos ao longo destes dois anos, e por despertar em mim uma paixão pelos insetos.
À Doutora Paula Maia pelo seu apoio e ajuda na identificação de inúmeras espécies de plantas.
À equipa do Herbário de Aveiro (AVE), em especial à Dr.ª Rosa Pinho pela disponibilização do espaço de trabalho, ajuda na identificação e técnicas de herborização. Ainda, também, pelo contacto privilegiado com os Serviços Técnicos e Logísticos da Universidade de Aveiro, a quem também agradeço pelo envio de informação, mapas e interesse para a realização deste trabalho.
Ao Pedro Duarte, Bruno Pereira, Francisco Pereira e à Rita Sousa pela vossa disponibilidade e ajuda durante as saídas do campo.
A todos os investigadores que de uma forma ou outra, me ajudaram a identificar os insetos, em especial a Rui Andrade.

Especial queria agradecer à minha mãe, pelo seu apoio familiar e incentivo ao longo destes anos.

keywords Urban green spaces, insect, plants, pollinators, University of Aveiro *Campi*.

abstract

The creation of urban green spaces is one way to mitigate the impact of the human population and cities. Despite the benefits that urban green spaces have, these spaces are subject to constant disturbance, allowing only the survival of species that are adapted to such conditions. Proper management of these spaces is one of the ways to optimize and preserve their potential biodiversity and ecosystem services.

The University of Aveiro *Campi* has several habitats that are subject to these disturbances. Thus, arose the need to characterize each habitat, namely the relationships between plants and insect pollinators, in order to provide a baseline for the elaboration of appropriate management plans to improve these habitats and its biodiversity.

The main objective of this study was to characterize the plant and insect pollinator communities of three habitats of the University of Aveiro: the seminatural meadow of the *Campus* Universitário de Santiago, the salt pan of Santiago da Fonte and the artificial "pseudo-dune" formation of ECOMARE. As a secondary objective, this study aimed to analyse the threats of the three sampled habitats and provide possible management measures that could allow an improvement and a better conservation of these habitats and ecosystem services.

We sampled 156 plant species and 194 insect species, in which 92 (47.4%) were classified as pollinators. The semi-natural meadow presented a greater floristic richness, as well as of insect pollinators. In this habitat, it was observed that of the 170 insect species found here, 43 showed preference for a specific group of plant species.

The sampled habitats harbour distinct plant and insect pollinator communities, and several associations between insect and plant species, especially in the semi-natural meadow. As suggestions for sustainable management, we highlight the need to control invasive plants, as they pose a threat to local biodiversity, as well as to mow the vegetation in a heterogeneous manner, maintaining high vegetation mosaics with the permanence of flowering species, as well as places for egg deposition and shelter.

palavras-chave

Espaços verdes urbanos, insetos, plantas, polinizadores, *Campi* da Universidade de Aveiro.

resumo

A criação de espaços verdes urbanos é uma das formas de mitigar o impacto da população humana e das cidades. Apesar dos benefícios que os prados verdes urbanos possam trazer, estes locais estão sujeitos a constantes perturbações, que apenas permite a sobrevivência de espécies que estejam adaptadas a tais condições. Uma gestão correta destes espaços é uma das formas de otimizar e preservar a sua biodiversidade potencial e os serviços de ecossistema.

Os *Campi* da Universidade de Aveiro albergam diversos habitats que estão sujeitos essas perturbações. Assim, surgiu a necessidade de caracterizar cada habitat, nomeadamente as relações entre as plantas e os insetos polinizadores, de forma a providenciar uma base para a elaboração de planos de gestão adequados ao melhoramento destes habitats e da sua biodiversidade.

Este estudo teve como objectivo principal a caracterização do elenco florístico e da comunidade de insetos polinizadores de três habitats da Universidade de Aveiro: o prado seminatural do *Campus* Universitário de Santiago, as salinas Santiago da Fonte e a formação artificial “pseudo-dunar” do ECOMARE. Como objectivo secundário, este estudo pretendeu analisar as ameaças aos três habitats e fornecer possíveis medidas de gestão que permitiram um melhoramento e uma melhor conservação destes habitats e dos serviços de ecossistema.

Foram amostradas 156 espécies de plantas e 194 espécies de insetos, nos quais 92 (47.4%) foram classificadas como polinizadores. O prado seminatural apresentou uma maior riqueza florística, bem como de insetos polinizadores. Neste habitat, foi observado que das 170 espécies de insetos aqui encontrados, 43 demonstravam preferência por um grupo exclusivo de espécies de plantas.

Os habitats estudados albergam comunidades de plantas e de insetos polinizadores distintas entre si, sendo que, alguns insetos demonstraram uma preferência por algumas espécies de plantas, especialmente no prado seminatural. Como sugestões de gestão sustentável, são realçadas a necessidade de controlar as plantas invasoras, pela ameaça que estas colocam à biodiversidade local, bem como realizar o corte da vegetação de forma heterogénea, mantendo mosaicos de vegetação alta com permanência de espécies em floração, bem como locais de abrigo e postura.

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Abbreviations

SNM- Semi-Natural Meadow

SP- Salt Pan

APD- Artificial Pseudo-Dune

ESAN- Escola Superior de Aveiro Norte- Aveiro Norte High School

ESTGA- Escola Superior de Tecnologias e Gestão de Águeda- Águeda School of Technology and Management

1. Introduction

The development of cities has several negative impacts in the local biodiversity, especially when the few remaining natural and semi-natural areas are managed according with costs without considering sustainable techniques for the conservation of the native communities (Šumpich and Konvička 2012). The growth of cities around the world, which is expected to continue (Seto et al. 2011), amplify the expected impacts of cities on biodiversity and their ecosystem services. These impacts may come in the form of new exotic species introduction, increasing of the urban heat island effect (phenomenon in which cities have higher temperatures than the surrounding areas), habitat fragmentation, and air pollution. The latter, nowadays, originate mainly from road traffic, unlike in the past where the big polluters were the industry and the energy production (Manninen et al. 2010). The impacts of cities also affects its surrounding areas, in the form of pollution, changes in the surrounding habitats, hydrologic systems, and climate change (Grimm et al. 2008).

Despite the apparent paradox, some species are adapted to live in urban areas, differing from the species assemblage of the surrounding natural areas. These differences can occur in the type of organisms, such as changes in bird species from insectivorous to granivorous or in arthropods species changing from specialists to generalists (Grimm et al. 2008). Urban areas also present new conditions that can influence the survival rate, like the lack of natural predators or the presence of different predators, different parasites, and competition resulting from the introduction of exotic species. These different ecological dynamics create unique communities within each city (Grimm et al. 2008).

To mitigate the impact of cities, the construction of urban green spaces could be a solution. Similar to natural habitats, it has been shown that urban green spaces still provide several important ecosystem services, like the decrease of temperature, mitigating the urban heat island effect (Bolund and Hunhammar 1999, Grimm et al. 2008). Urban green spaces can also increase the wind flow, helping in the dispersion, absorption and deposition of PM_{10} (≤10 µm diameter particles), NO_x (nitrogen oxides) (Janhäll 2015), and metals in the soil (copper, potassium, calcium, magnesium and zinc) (Manninen et al. 2010), and help in the control and regulation of floods, soil erosion,

and geochemical cycles (water, phosphorous, nitrogen, carbon, etc) (Faucon et al. 2017). Urban green spaces also provide important shelter areas and precious resources for many animals, becoming “oasis” for many species (native and exotic), that otherwise would not be able to survive in a city environment. Furthermore, urban green spaces are also adaptable, potentially presenting many different types of habitats, such as forests and grasslands like large parks, semi-natural meadows, lakes and rivers, green roofs, small gardens and bioswales (vegetated channels designed to transport stormwater runoff) (Lepczyk et al. 2017), which enable the construction of one of those types of urban green spaces in most urban conditions.

While urban green spaces are reported to mitigate several unnatural conditions created by cities, they are usually aimed for recreation and leisure activities, which promote the human physical and psychological well-being (Lepczyk et al. 2017, Southon et al. 2018). Furthermore, its management is usually done with minimal possible costs, which can result in the use of management practices that can negatively influence biodiversity (Aronson et al. 2017). Having the potential to be biodiversity hotspots (Baldock et al. 2019), urban green spaces could be instead designed and managed to optimize its biodiversity and ecosystem services, complementarily with other intended uses.

A first step to determine the best management practices to optimize the biodiversity in urban green spaces is to characterize their species assemblages. This characterization can identify threats (like the presence of invasive species) or help to underpin areas were management should be prioritized (like the presence of protected or endangered species). Moreover, the management impacts on the communities can be evaluated, enabling to draw adequate management guidelines for each type of urban green spaces.

Many researchers, when studying the management of natural and urban grasslands, focus mainly on the response of only one taxonomic group to management practices, without considering other *taxa* (Bonari et al. 2017). When studying the impacts of management practices on grasslands, the most studied taxonomic group are plants (e.g. Wilcox et al. 2007, Manninen et al. 2010, Bretzel et al. 2016) and arthropods

(e.g. Morris and Lakhani 1979, Johst et al. 2006, Šumpich and Konvička 2012, Klink et al. 2013), with only a few studies focusing on both plants and arthropods (e.g. Venn 2013, Tälle et al. 2016, Bonari et al. 2017, Johansen et al. 2017).

Even though plants are one of the most important components of grasslands, providing an immense amount of ecosystem services such as food and shelter, water filtration, nitrogen and carbon fixation, regulation of soil erosion, and nutrient cycles (Faucon et al. 2017), insects and other arthropods are also extremely important. Insects offer several important ecosystem services, such as food, degradation of organic matter, soil aeration, pollination and biological control (Losey and Vaughan 2006, Ameixa et al. 2018, Noriega et al. 2018). These have been estimated in almost 60 billion dollar per year, in the United States alone (Losey and Vaughan 2006), giving insects and their ecosystem services great value to humans well-being.

Although all insect species have a role in the ecosystem, the pollination provided by insects (entomophily) is by far the most known ecosystem service (Morse and Calderone 2000). Not only insect pollinators and angiosperm plants co-evolved, meaning most species of insect pollinators survive exclusively by feeding on nectar and pollen of angiosperms (Cappellari et al. 2013), while some angiosperms can only produce fruit from outcrossing pollination provided by insects (Hmeljevski et al. 2017). This co-dependency relationship between angiosperm plants and insect pollinators can also be observed by the impact of management practices, which mainly affect plants and insect pollinators, while other non-pollinating insects such as ground beetles, grasshoppers and crickets are more influenced by changes in weather and habitat complexity (Bonari et al. 2017).

The city of Aveiro and the University of Aveiro *Campi* exhibit a unique case, where several different habitats coexist. In addition to the already spoken types of urban habitats, the University of Aveiro *Campi* also presents several unique habitats such as salt pans, saltmarshes and artificial “pseudo-dune” formations, that also have unique communities of plants and insects. The salt pans and saltmarshes are unique areas used by many migratory birds as feeding and nesting habitats. Furthermore, several salt pans are still in use, providing an economic resource. The artificial “pseudo-dune” formation

created around the new building of the University of Aveiro on the coast, presents a unique aesthetic, using natural components of the area such as native dune vegetation instead of the normal garden types vegetation. These different habitats in the University of Aveiro *Campi,* give the university different assemblances of fauna and flora, which, at the same time, also gives to the university, a great responsibility of proper management for the conservation of those habitats and its ecosystem services.

1.2 Objectives

The main objective of this work was to improve the baseline information about the communities of plants, insect pollinators and their relations, that occur in three habitats of the University of Aveiro *Campi*. In the near future, this information should be used to draw strategic management guidelines for the optimization and protection of the biodiversity and its ecosystem services. Specifically, the present work aims to:

- characterize the flora of the University of Aveiro *Campi*;
- characterize the insect pollinator community (with emphasis on Hymenoptera) in the University of Aveiro *Campi*, as well as their preferences and associations with plants;
- identify the main threats for the different green spaces of the University of Aveiro *Campi* and propose several management guidelines for their improvement and conservation.

2. Methods

2.1. Study area

This study was conducted in the University of Aveiro *Campi*, in the district of Aveiro, Portugal (Figure 1). The University of Aveiro *Campi* are spread across the district of Aveiro, comprising a series of different natural and semi-natural habitats. The main location, University *Campus* of Santiago (Figure 1D), is situated between the Aveiro costal lagoon (Figure 1C, inlet R) and the centre of Aveiro (40˚ 37' 53'' N; 8˚ 39' 27'' W). In terms of habitats it comprises saltmarsh areas (Figure 1D, inlet SM), several meadows ranging from small lawns to semi-natural meadows (Figure 1D, inlet SNM), and several artificial lagoons. Adjacent to the University *Campus* of Santiago is the salt pan Santiago da Fonte (40° 37' 44" N; 8° 39' 39" W) (Figure 1D, inlet SP), acquired in 1993 by the University of Aveiro.

The other three *Campi* of the University of Aveiro are dispersed throughout the district of Aveiro. The ECOMARE (laboratory for the innovation and sustainability of the marine biological resources) in Gafanha da Nazaré (40° 38´ 16" N; 8° 43´ 41" W) near the coast is surrounded by artificial pseudo-dunes formation (Figure 1E), ESTGA (Águeda School of Technology and Management) in Águeda (40° 34' 27" N; 8° 26' 38" W), and ESAN (Aveiro Norte High School) in Oliveira de Azeméis (40° 51' 42" N; 8° 28' 35" W).

For this work three semi-natural areas of the University of Aveiro *Campi* were chosen: the semi-natural meadows of the University *Campus* of Santiago (here after SNM), the salt pan Santiago da Fonte (here after SP), and the artificial sand formation of the ECOMARE, dominated by dune vegetation (here after APD, standing for artificial pseudo-dune).

The SNM (Figure 2), with an area of 5.60 ha, is dominated by ruderal plants like Fabaceae (e.g. *Trifolium repens* L., *Vicia sativa* L., *Medicago sativa* L.), Asteraceae (e.g. *Senecio vulgaris* L., *Sonchus oleraceus* L., *Cichorium intybus* L.) and Poaceae (e.g. *Avena barbata* Link, *Briza minor* L., *Dactylis glomerata* L.) and the margins of the lagoon (Figure 2, inlet 4) dominated by *Salix atrocinerea* Brot. and *Arundo donax* L. This habitat is managed several times a year, with motorized mowers. The management occurs

irrespectively of the phenological state of the plants, which has raised the concern about the impacts of the management operations, its timing and frequency.

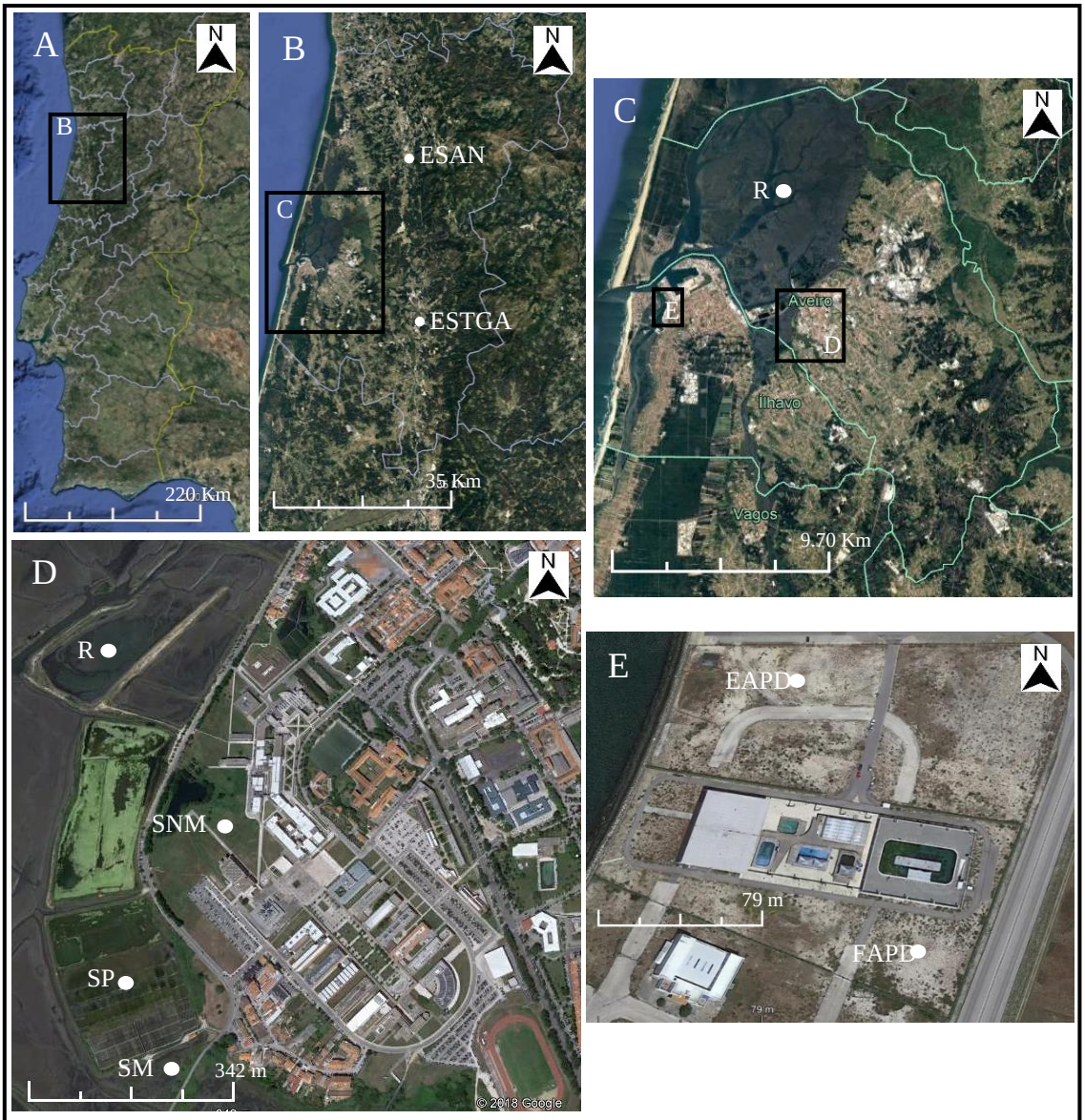


Figure 1. University of Aveiro *Campi*. (A) Location of Aveiro district, (B) Location of Aveiro county, (C) Location of University of Aveiro *Campi*, (D) University *Campus* of Santiago, (E) ECOMARE, (ESAN) location of ESAN, (ESTGA) Location of ESTGA, (FAPD) Fenced artificial pseudo-dune, (EAPD) Exterior artificial pseudo-dune, (R) Aveiro costal lagoon, (SM) Saltmarsh, (SNM) Semi-natural meadow, and (SP) Salt pan (*source: Google Earth, Out. of 2019*).

The SP (Figure 3), with an area around 5.50ha, is dominated by halophyte vegetation (e.g. *Juncus maritimus* Lam., *Halimione portulacoides* (L.) Aellen, *Sarcocornia perennis* (Mill.) A.J.Scott) closer to the water. This area is managed by the "marnoto" (name given to the salt pan workers in Aveiro region). The upper more terrestrial area is dominated by ruderal plant, similar to the SNM, which are mowed 1 to 2 time a year.

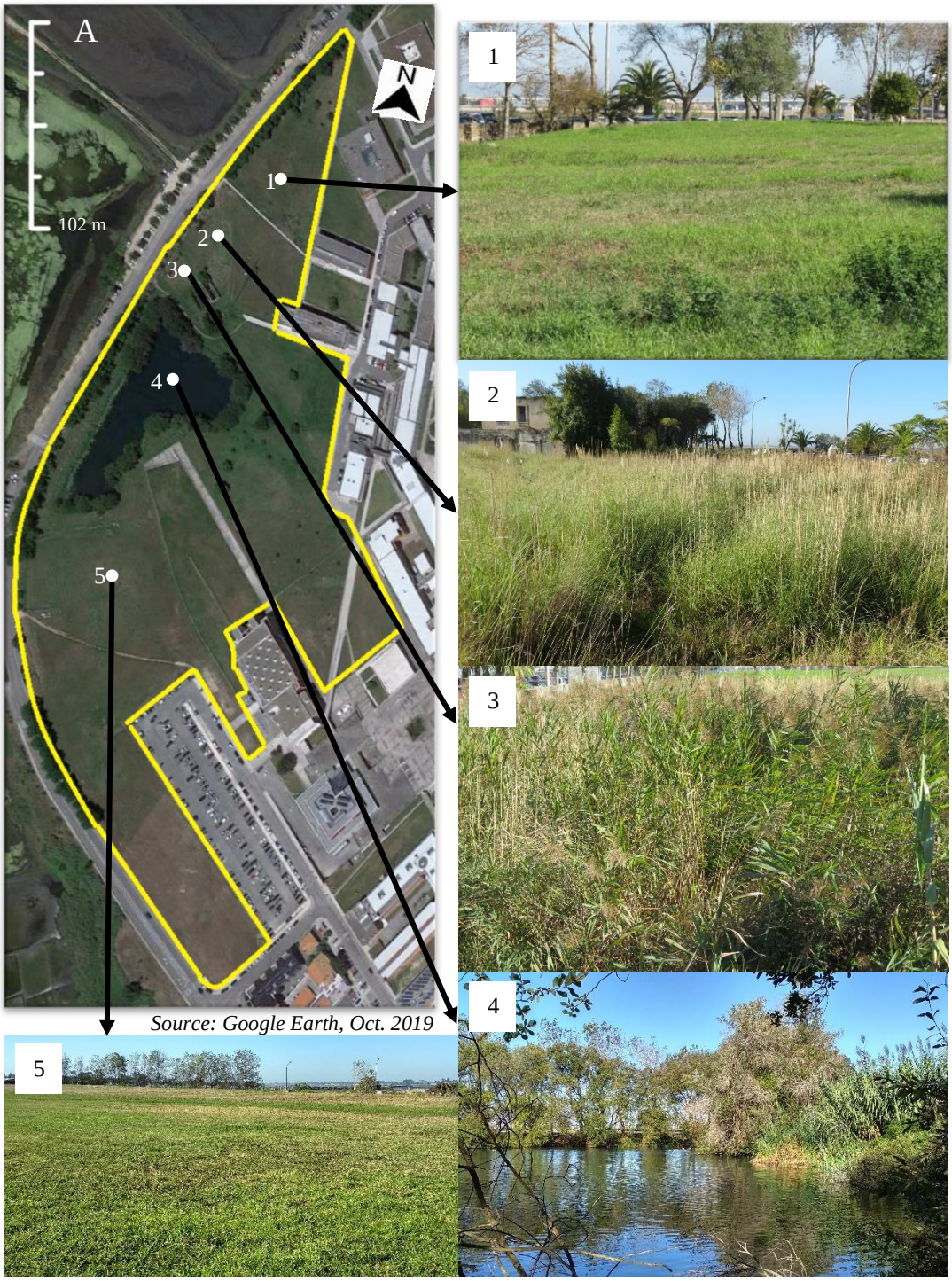
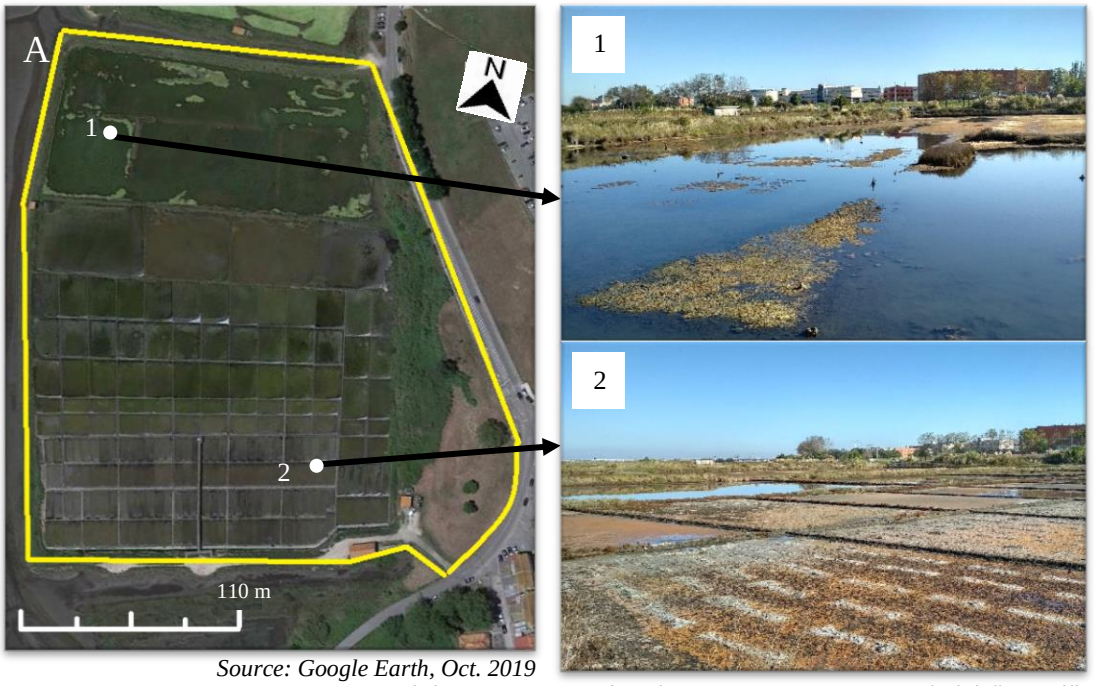


Figure 2. Semi-natural meadow. (A) Aerial image of the SNM (yellow line delimits area), (1) North area, (2) *Cortaderia selloana* (Schult. et Schult.f.) Asch. et Graebn. invaded area, (3) *Phragmites australis* (Cav.) Trin. ex Steud. area, (4) Lagoon, and (5) South area.

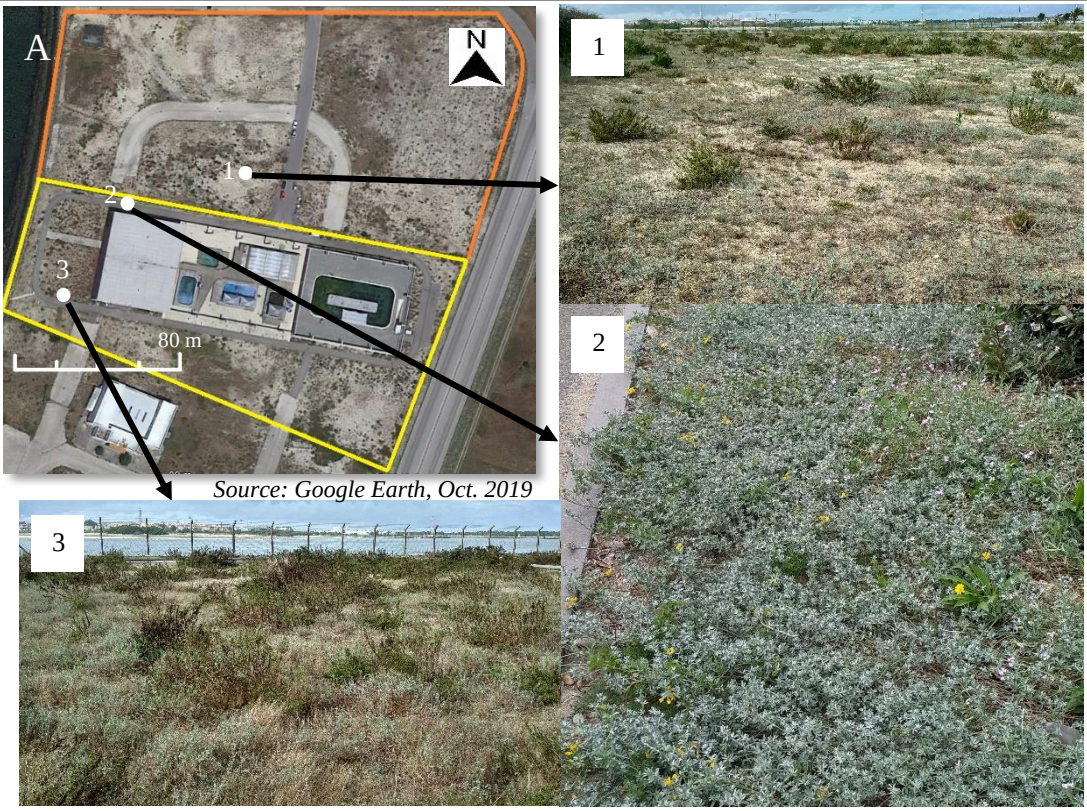
The ECOMARE (Figure 4) study site is an artificial sandy formation, constructed with beach sand, and therefore, dominated by dune vegetation. It comprises an area around 3.8 ha (fenced area of 1.3 ha and exterior area of 2.5 ha), dominated by

Malcolmia littorea (L.) R.Br., *Lotus creticus* L. and *Artemisia campestris* Arcang. subsp. *maritima*.



Source: Google Earth, Oct. 2019

Figure 3. Salt pan Santiago da Fonte. (A) Aerial image of SP (yellow line delimits area), (1) "Algibé", and (2) "Cabeceiras".



Source: Google Earth, Oct. 2019

Figure 4. ECOMARE artificial pseudo-dunes formation. (A) Aerial image of ECOMARE (yellow line delimits area of fenced APD, and orange line delimits area of exterior APD), (1) exterior APD, (2) Dune bed flowers near the fence, and (3) Fenced APD.

2.2. Field sampling

Plant and insect diversity were sampled on each site from 2017 to 2019, in late Winter, Spring and early Summer (Table 1). Plants were identified *in situ* and whenever the identification was not possible, they were collected for *ex situ* identification. After identification, several specimens of most species were collected, dried and prepared for insertion in the Herbarium of the University of Aveiro (AVE).

Table 1. General schedule of the sampling campaign.

Insect sampling days			**Plant sampling days**	
Habitat	**Date**	**Technique**	**Date**	**Location**
SNM	08/07/2016	Observed	23/04/2018	SNM
SNM	July/17	Target	27/06/2018	SNM
SNM	July/17	Non-Target	24/02/2019	SNM
SNM	May/18	Non-Target	27/02/2019	SNM
SNM	27/06/2018	Non-Target	19/03/2019	SNM
SNM	27/06/2018	Target	20/03/2019	SNM
SNM	July/18	Non-Target	15/04/2019	SNM
SNM	09/07/2018	Observed	02/05/2019	SNM
SNM	16/07/2018	Observed	24/02/2019	SP
SNM	22/02/2019	Target	15/04/2019	SP
SNM	22/02/2019	Observed	03/05/2018	APD
SNM	27/02/2019	Non-Target	22/02/2019	APD
SNM	March/19	Non-Target	24/05/2019	APD
SNM	19/03/2019	Non-Target		
SNM	20/03/2019	Non-Target		
SNM	05/05/2019	Target		
SNM	05/05/2019	Non-Target		
APD	22/02/2019	Target		
APD	22/02/2019	Observed		
APD	24/05/2019	Non-Target		
APD	24/05/2019	Target		
APD	June/2019	Observed		
SP	19/03/2019	Observed		
SP	19/03/2019	Non-Target		
SP	22/03/2019	Non-Target		

Insects were sampled only in the morning on sunny days by direct catch, directly with the sample jar or with an insect aspirator, and by sweep-netting the vegetation, collected to sample jars, and frozen. While some insects were collected directly from one flower or from a small area with high abundance of flowers of few plant species (target sampling), others were collected when observed or by sweep-netting the vegetation (non-target). Some insects were catch, identified *in situ* and released or just identified by observation (observed). Especially in ECOMARE, where insect collection (mostly Lepidoptera) was kept to a minimum, due to the low observed abundance in the area.

After a couple of weeks in the freezer, insects were mounted using entomology pins and identified. Insects were then air dried and placed in the insectarium of the University of Aveiro for future reference.

2.3. Species Identification

In the plant species identification was used “Flora iberica” (Castroviejo 2012) and the website “Flora-On” (Sociedade Portuguesa de Botânica 2014). The field guide for the flora of “Baixo Vouga Lagunar” area in Aveiro (Pinho et al. 2018), was also often used to confirm species identification.

Due to lack of bibliographic references with identification keys for Portuguese insects, the majority of identification keys and other tools for insect identification, were from British and other European bibliography. For general insect *in situ* identification was used the guidebook “Insects of Britain and Western Europe” (Chinery 2012). For the identification of butterflies the guidebook “the butterflies of Portugal” was used (Maravalhas et al. 2003). For Coleoptera identification was used the website “Mike's insect keys” (Mike 2019), a website with experimental dichotomous keys for most of the families of Coleoptera from Britain. For Hemiptera identification was used the website “British bugs: An online identification guide to UK Hemiptera” (Bantock and Botting 2018). For the identification of Hymenoptera specimens was used the book “Field guide

to Bee of the Great Britain and Ireland" (Falk 2015) for bee of Apoidea, the experimental draft key from "Identification key to the subfamilies of Ichneumonidae (Hymenoptera)" (Broad 2011) for parasitic Ichneumonidae, and the journal article "Key to the paper and social wasps of Central Europe (Hymenoptera: Vespidae)" (Dvoák and Roberts 2006) for Vespidae specimen.

For the identification of families of Diptera specimens the books "The European Families of the Diptera. Identification diagnosis, biology" (Oosterbroek 2006) and "Flies. The Natural History and Diversity of Diptera" (Marshall 2012) were consulted, and after reaching the family, the identification was done using other books, websites and articles. For Syrphidae specimens was used "Tvåvingar: Blomflugor. Diptera, Syrphidae, Syrphinae" (Bartsch et al. 2009a), "Tvåvingar: Blomflugor. Diptera, Syrphidae, Eristalinae & Microdontinae" (Bartsch et al. 2009b) and the website "BRITISH HOVERFLIES" (Webster 2019). For Calliphoridae and Rhinophoridae was used "British blowflies (Calliphoridae) and woodlouse flies (Rhinophoridae)" (Falk 2016) an experimental draft key for this families of Britain and "Two new species of European Stevenia Robineau-Desvoidy (Diptera: Rhinophoridae) and a key to the Palaearctic species" (Cerretti and Pape 2007). For Chironomidae and Tipulidae species was used the "Handbooks for the Identification of British Insects. Diptera: Nematocera: families Tipulidae to Chironomidae" (Coe et al. 1950). For portuguese Chloropidae species was used "The Chloropidae (Diptera, Brachycera) of mainland Portugal with description of a new species of *Lasiosina* Becker" (Ebejer and Andrade 2015).

All the other orders and families of insects not listed above were identified with the help of specialist and enthusiasts with several years of experience. The website "Naturdata" (Naturdata 2018), a website with most species of fauna and flora of Portugal, was also used for insect identification or to confirm the occurrence of the species in Portugal.

After insect species identification, the identification of pollinators was confirmed by the field guide "Guía de campo de los polinizadores de Espanã", where the most common families of insect pollinators from Spain are described (Martin et al. 2017). For Diptera was used "The European Families of the Diptera. Identification, diagnosis,

biology" (Oosterbroek 2006). For Chrysopidae specimens was used the chapter 10 from "Ecofriendly Pest Management for Food Security" book (Dhandapani et al. 2016). For Hymenoptera species was used "Trophic relations between vespid wasps (Hymenoptera, Vespidae) and flowering plants in the Crimea" (Fateryga 2010), "Monographic revision of the melittid bees (Hymenoptera, Apoidea, Melittidae sensu lato)" (Michez 2008), "Colletidae nesting biology (Hymenoptera: Apoidea)" (Almeida 2008), "Zur Verbreitung der Seidenbienenarten Colletes marginatus Smith, 1846 und Colletes chengtehensis Yasumatsu, 1935 in Österreich (Hymeno ptera: Apidae: Colletinae)" (Zettel et al. 2019), and "Pollinator diversity (Hymenoptera and Diptera) in semi-natural habitats in Serbia during Summer" (Mudri-Stojnić et al. 2012). For the confirmation of several Coleoptera species was used "The Family Malachiidae (Insecta: Coleoptera) in Collections of the Natural History Museum in Belgrade" (Mirutenko 2013), "Flower constancy in Heliotaurus ruficollis Fabricius, 1781 (Coleoptera: Alleculidae)" (De-Los-Mozos-Pascual and Domingo 1991) and "A la recherche de Tytthaspis sedecimpunctata (L.)" (Vincent 2011).

2.4. Data Analysis

To analyse the differences among communities of insects and plants in the different habitats, a Whittaker β-diversity (βw) was used, followed by a Kruskal-Wallis test and Mann-Whitney pairwise post hoc test, using the program PAST (Hammer et al. 2001). The Whittaker β-diversity is able to analyse the β-diversity from presence/absence data matrix (Whittaker 1960), by comparing the community composition of the different sampled habitats. In this way, to compare de composition of two or more different communities in different location, Whittaker β-diversity compares the numbers of species found in both locations with the number of species unique to each location (Koleff et al. 2003):

$$\frac{a+b+c}{(2a+b+c)/2} \text{ or } \frac{a+b+c}{(2a+b+c)/2} - 1$$

where *a* is the total number of species that occur in both locations, *b* is the total number of unique species that occur in the first location, and *c* is the total number of unique species that occur in the second location.

To analyse if there were significant differences (α=0.05) between the number of insect species between habitats, the non-parametric Kruskal-Wallis test was used, followed by a Mann-Whitney pairwise post-hoc test, to see differences between each habitat.

Using the same procedure, it was also analysed the differences between communities of insect pollinators and plants in the three studied habitats, and the individual association between plants and insects in SNM habitat.

In the procedure to analyse the association between plants and insects in the SNM habitat, instead of a β-diversity test, a paired group similarity test was performed, with a Sørensen–Dice coefficient, which enables to analyse the similarity of insect species between different plants from absence/presence data matrix. Sørensen–Dice coefficient follows the equation (Albuquerque et al. 2016):

$$S_{Sor} = \frac{2|A \bigcap B|}{|A| + |B|} = \frac{2P(A \bigcap B)}{P(A) + P(B)} = \frac{2p_1p_2}{p_1 + p_2} = \frac{2a}{2a + b + c}$$

where for this analyse, *a* is the number of insect species common to plant *A* and *B*, *b* is the number of insect species present only in *A*, and *c* is the number of insect species present only in *B*.

The data used in this test was collected from the SNM in on morning (5th of May of 2019), where several small areas with different plants were sampled. Two of the selected areas were dominated by only one plant, a *Melilotus officinalis* (L.) Pall. dominated area and an *Oenanthe crocata* L. dominated area, while the three other areas were dominated by more than two plants, a *Trifolium pratense* L. subsp. *pratense* and *Poa sp.* dominated area, a *Vicia sativa*, *Lathyrus hirsutus* L. and *Lathyrus aphaca* L.

dominated area, and a *Vicia sativa*, *Lathyrus annuus* L. and *Rubus ulmifolius* Schott var. *ulmifolius* dominated area.

2.4.1. SWOT Analysis

After the characterization of the insect pollinator and plant assemblages of the different habitats of the University of Aveiro *Campi*, as well as the identification of the threats and management impacts in these habitats, a preliminary SWOT analysis was used to analyse the University of Aveiro *Campi*, in order to formulate new management guidelines for their conservation and improvement.

A SWOT analysis is a common economic analysis that evaluates management strategies according with the internal factors (strengths and weaknesses) and external factors (opportunities and threats) of an enterprise (Chang and Huang 2006). In recently years, SWOT analysis is being used and adapted to formulate management strategies for ecosystems, in which, the internal factors are the strengths and weaknesses of the ecosystem, while the external factors are the opportunities and threats that could affect the ecosystem (Falcone et al. n.d., Scolozzi et al. 2014, Comino and Ferretti 2016).

As a simple way to analyse the conditions of the habitats and propose the right strategies to achieve a sustainable management, in Figure 5 follows the strengths, weakness, opportunities and threats considered in this SWOT analysis of the University of Aveiro *Campi*:

Strengths	Opportunities
• University of Aveiro *Campi* with its semi-natural areas (meadows, salt pans, dune areas, etc) generate identity and character, representing a major landscape resource for Aveiro city • These habitats create conditions for different animals, including endemic, terrestrial and aquatic species to thrive here • A road (Rua da Pêga) that divides the semi-natural meadows from the salt pans, and its used by local population for walking, running, dog walking trails, bird watching areas or even, touristic guided tours	• To use these areas as a conservation urban habitat, *in situ* laboratory, and as permaculture garden • University of Aveiro is currently part of the national network of Sustainable Campus • Current works to improve Rua da Pêga already removed exotic species such as C. selloana contributing to decrease the colonizations of the campus habitats. These will also improve this area for walker and other users.
Weaknesses	**Threats**
• Current management practices • Existence of exotic species • Underrated value given to these semi-natural spaces	• Presence of invasive species in the surrounding areas which facilitates the colonization of the habitats by these species. • The quality and quantity of management interventions which can lead to local extinctions

Figure 5. SWOT analysis of the University Aveiro *Campi*. (adapted from Lillebø et al. 2015)

3. Results

3.1. Insects

A total of 194 species of insects were identified in all the studied habitats (Annex 1). These species belonged to 85 Families in 12 insect Orders (Figure 6). From these 194 species, 92 were classified as pollinators (where some are acknowleged pollinators, and others are known to feed on pollen and nectar, indicative of their potential role as pollinators).

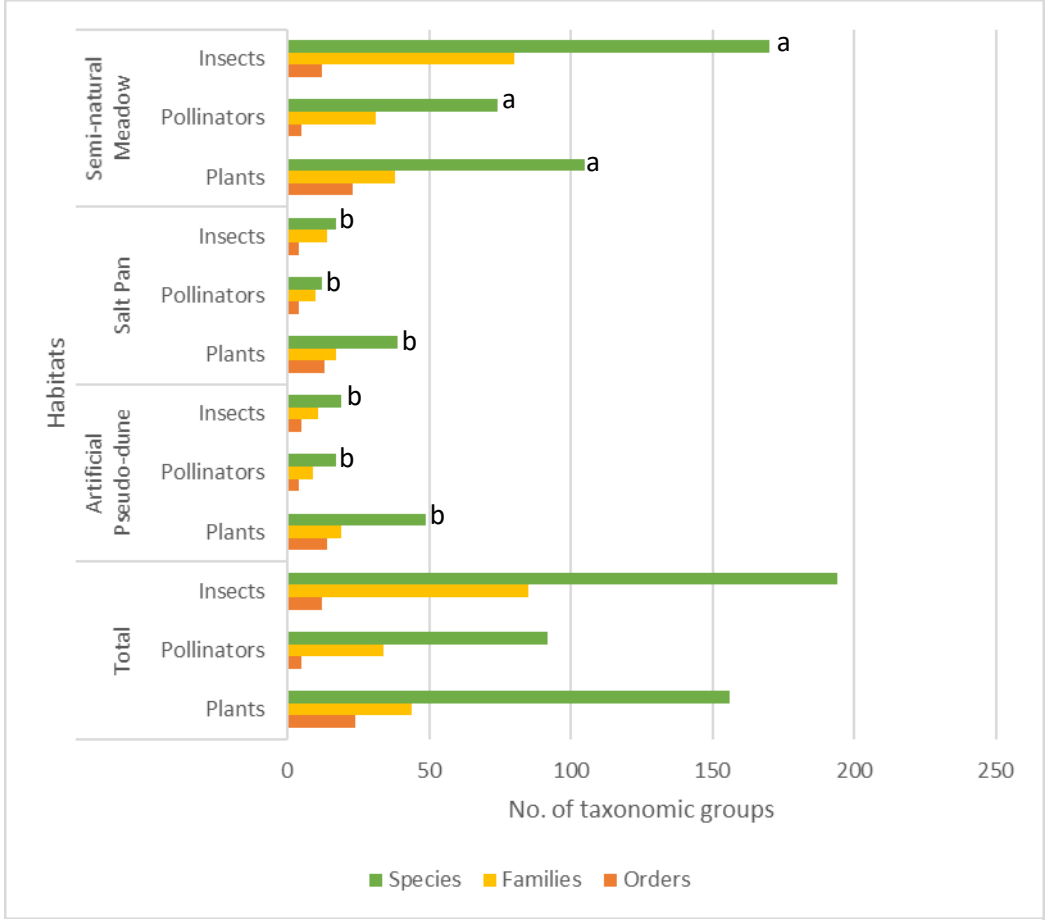


Figure 6. Taxonomic richness in the University of Aveiro *Campi*. Different letters denote significant differences in specific richness between habitats.

Whitaker β-diversity showed high values, close to 1, demonstrating the differences in different insect communities between the sampled habitats (βw= 0.95 between SMN - SP, βw= 0.93 between SMN - APD, and βw= 0.83 between SP - APD). Species richness of insect was significantly different amongst the three sampled habitats (H=237.8; p<0.001). The number of species in the SNM was significantly higher (170

species) than in the SP (17 species) (p<0.001), and significantly higher than in the APD (19 species) (p<0.001).

Diptera and Hymenoptera were the most species rich Orders (69 and 41 species, respectively) and the most species rich in terms of the pollinators functional group (44 and 26 species, respectively) (Figure 7).

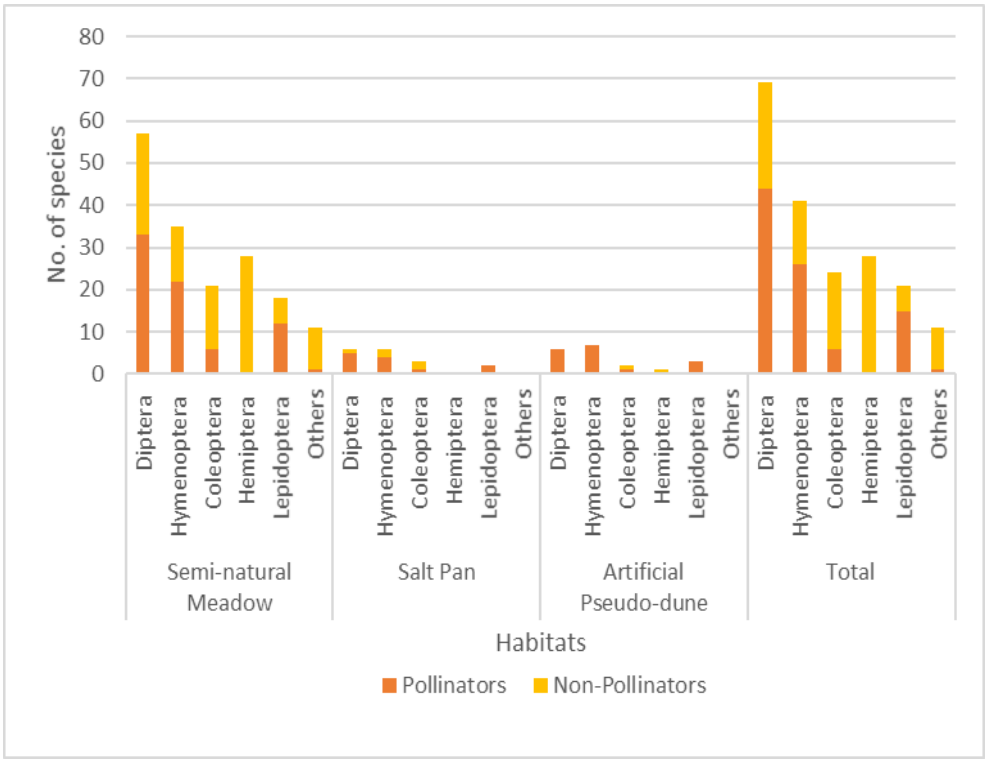


Figure 7. Number of pollinating and non-pollinating insect species per Order in the University of Aveiro *Campi*.

Regarding the insect pollinators, the Whitaker β-diversity also demonstrated different insect pollinator species assemblages between the three sampled habitats (βw= 0.88 between SNM - SP, βw= 0.87 between SNM - APD, and βw= 0.79 between SP - APD). Insect pollinator species richness was also significantly different amongst the three sampled habitats (H=77.09, p<0.001). The number of insect pollinator species in the SNM was significantly higher (74 species) than in the SP (12 species) (p<0.001), and also significantly higher than in the APD (17 species) (p<0.001).

A full list of all insects classified as pollinators is presented in Annex 2.

3.2. Plants

In total, 156 plant species belonging to 44 Families of 24 Orders were identified in the sampled habitats (Figure 6). The most abundant plant Families were Asteraceae, Fabaceae and Poaceae, representing almost half of the overall plant species (Figure 8).

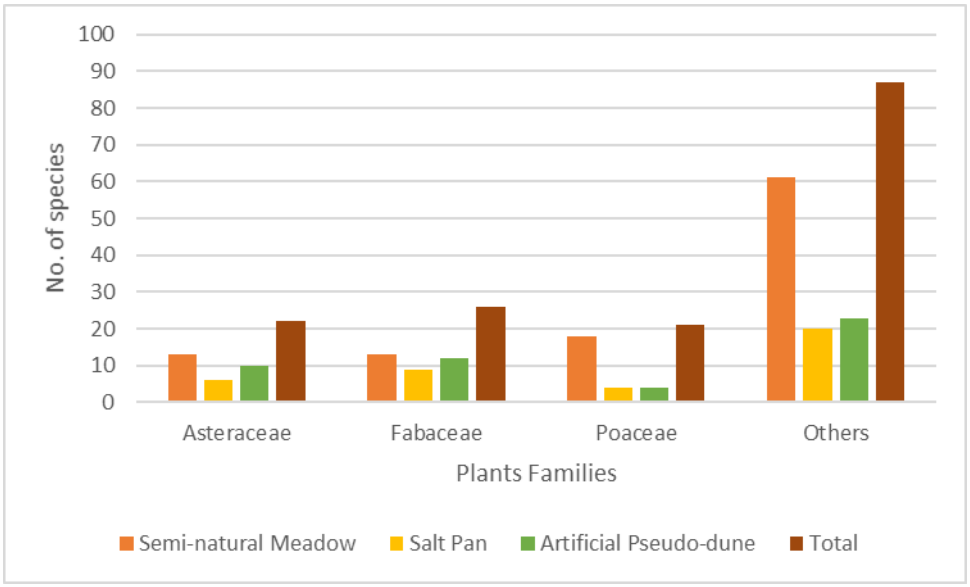


Figure 8. Species richness of plants families sampled in the University of Aveiro *Campi*.

Regarding the plants, the Whitaker β-diversity also demonstrated different plant species assemblages between the three sampled habitats (βw= 0.69 between SNM - SP, βw= 0.82 between SNM - APD, and βw= 0.75 between SP - APD). Moreover, species richness was significantly different amongst the three sampled habitats (H= 48.56; p<0.001). The number of plant species in the SNM was significantly higher (105 species) than in the SP (39 species) (p<0.001), and also significantly higher than in the APD (49 species) (p<0.001).

The list of all identified plants is presented in Annex 3.

3.3. Plant-insect association

A total of 58 insect species belonging to 38 Families of 6 insect Orders were collected by sweep-netting on 5 small areas with different assemblages of plants in the SNM (Annex 4). While several insect species were collected in more than one area, others were only present in a single area. This trend was observed for all insect species, as well as for insect pollinator species (Table 2).

Table 2. Number of insect species collected in the semi-natural meadow during 5th of May of 2019. Exclusive species refers to the number of insect species that were only sampled in one specific area. Full list in Annex 4.

	Total		Pollinators	
Sampled areas	No. of species	No. of exclusive species (%)	No. of species	No. of exclusive species (%)
Melilotus officinalis dominated area	6	50 %	4	50 %
Oenanthe crocata dominated area	10	40 %	9	33.33 %
Trifolium pratense subsp. *pratense* and *Poa sp.* dominated area	12	41.67 %	7	42.86 %
Vicia sativa, Lathyrus hirsutus and *Lathyrus aphaca* dominated area	31	61. 29 %	12	58.33 %
Vicia sativa, Lathyrus annuus and *Rubus ulmifolius* var. *ulmifolius* dominated area	19	63.16 %	8	62.50 %

The similarity Sørensen–Dice test showed low overall similarity between the insect species assemblage sampled in the different areas (Figure 9). Insect species richness was significantly different amongst 5 sampled small areas (H= 19.86; p<0.001). The values of insect species richness of the area dominated by *V. sativa, L. hirsutus* and *L. aphaca* showed significantly higher insect species richness than the *M. officinalis* dominated area (p<0.001), *O. crocata* dominated area (p<0.01), *T. pratense* and *Poa sp.* dominated area (p<0.001)., and *V. sativa, L. annuus* and *R. ulmifolius* dominated area

(p<0.05). The area dominated by *V. sativa, L. annuus* and *R. ulmifolius* also showed significantly higher insect species richness than the *M. officinalis* dominated area (p<0.01).

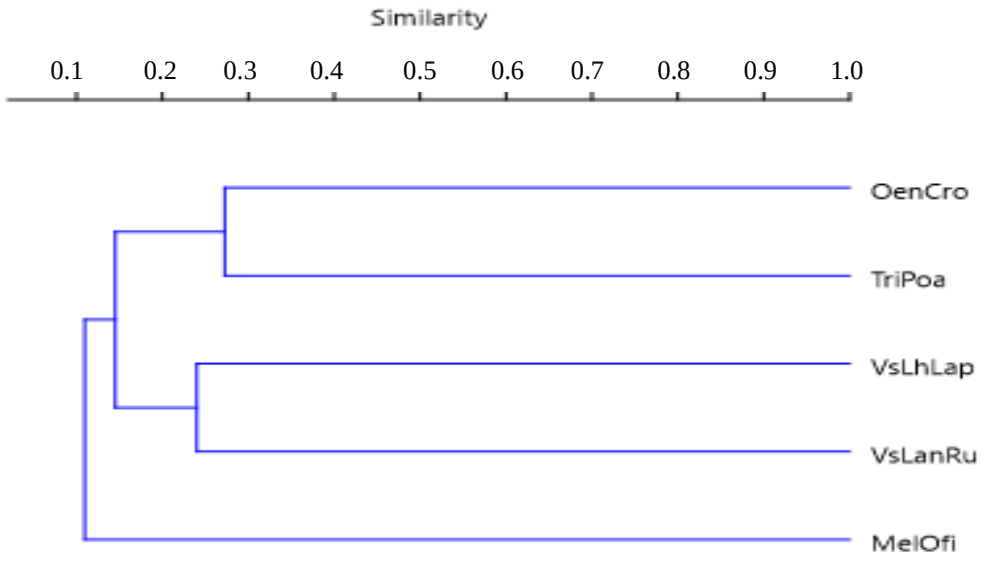


Figure 9. Sørensen–Dice similarity dendrogram of insect species associated with different small areas dominated by different plant species in the semi-natural meadow of the University of Aveiro. (OenCro) *Oenanthe crocata* L. dominated area, (TriPoa) *Trifolium pratense* L. subsp. *pratense* and *Poa sp.* dominated area, (VsLhLap) *Vicia sativa* L., *Lathyrus hirsutus* L. and *Lathyrus aphaca* L. dominated area, (VsLanRu) *Vicia sativa* L., *Lathyrus annuus* L. and *Rubus ulmifolius* Schott var. *ulmifolius* dominated area, and (MelOfi) *Melilotus officinalis* (L.) Pall. dominated area

4. Discussion

4.1. Plant and insect communities of the University of Aveiro *Campi*

The characterization of plant and insect pollinator communities from the different habitats of the University of Aveiro *Campi* showed a total of 156 plant species and 194 insect species, with 47,4% considered as pollinators. For instance, in the small area within the SNM, a total of 74 species of insect pollinators and 105 species of plants were collected, in which 66 species of insect pollinators and 78 species of plants were exclusive to this particular habitat. Despite the higher number of species in the SNM, the other two habitats also showed exclusive species composition demonstrated by the values of the β-diversity, with the APD presenting 11 and 33 exclusive species of insect pollinators and plants, respectively, and the SP presenting 7 and 15 exclusive species of insect pollinators and plants, respectively. Although APD and SP were less sampled than the SNM, those areas were visited regularly, but the insect pollinators observed were similar, and thus, it was not needed a new sampling for the characterization of the insect pollinator community. Furthermore, those sampled habitats were highly exposed to marine wind dynamics (Jarmalavičius et al. 2012) and were considered as habitats with low insect and insect pollinator diversity (Weiss and West 1924, Han 2010, Fantinato et al. 2018, Fantinato 2019), which can explain the low species richness in these habitats. The ECOMARE is also a recent construction (inaugurated in 2017), and thus, may present a characteristic dune community which may be not fully stabilized.

The SNM presented a dominance of ruderal plants, such as herbs and grasses, and several areas dominated by invasive species such as *A. donax*, *Cortaderia selloana* (Schult. & Schult.f.) Asch. & Graebn., *Ageratina adenophora* (Spreng.) R.M.King & H.Rob., *Oenothera rosea* L'Hér. ex Aiton. Other exotic species were also present in the SNM like *Salpichroa origanifolia* (Lam.) Baill., *Zantedeschia aethiopica* (L.) Spreng., *Paspalum sp.*, *Oxalis pes-caprae* L., *Modiola caroliniana* (L.) G.Don, *Erigeron bonariensis* L., and *Cyperus eragrostis* Lam.

The SP presented a dominance of ruderal glycophyte plants like the SNM in the upper more terrestrial areas, which can be explained by the close distance. Even though most of the ruderal plants were also present in the SNM, the SP also had eight exclusive

ruderal plants, such as *Carduus tenuiflorus* Curtis, *Conium maculatum* L., *Diplotaxis virgata* (Cav.) DC. subsp. *virgata*, *Melilotus albus* Medik., *Spergularia sp.*, *Trifolium arvense* L., and *Trifolium resupinatum* L. and a *Geranium sp.* different from the other geraniums found in SNM. Closer to the water, the vegetation was dominated by halophyte plants, exclusive to this habitat and the surrounding saltmarshes, like *Aster tripolium* subsp. *pannonicus* (Jacq.) Soó, *H. portulacoides*, *Salicornia ramosissima* J.Woods, *S. perennis* and *Triglochin maritimum* L. The SP also presented several exotic and invasive species, such as *C. selloana* and *O. pes-caprae* in the upper more terrestrial areas, and *Spartina versicolor* Fabre and *Cotula coronopifolia* L. closer to the salt water.

The APD of ECOMARE demonstrated a dominance of characteristic dune plants, but also several ruderal plants common to the other sampled habitats. The APD presented the only representatives of endemic flora, such as *Antirrhinum cirrhigerum* (Welw. ex Ficalho) Rothm. and *Linaria polygalifolia* Hoffmanns. & Link subsp. *polygalifolia*, endemic species of the Iberian Peninsula, and *Diplotaxis siifolia* subsp. *vicentina* (Welw. ex Samp.) Mart.-Laborde, endemic species of continental Portugal, with a conservation status of vulnerable, being listed in Annex IV of the Habitats Directive and Annex II of the Habitats Directive. Furthermore, the APD also presented several exotic and invasive species such as *Acacia longifolia* (Andrews) Willd., *Arctotheca calendula* (L.) Levyns, *Carpobrotus edulis* (L.) N.E.Br., *C. selloana,* and *Oenothera sp.*, mostly in the exterior APD.

Not only each sampled habitat presented a different community of insects and plants, several species of insects also presented different preferences and associations with different plants and vice-versa (Table 2). The choice to sample several plant species together was due to the difficulty to separate these species *in situ*, in which, the different plants formed dense and complex areas, and thus the sampling of insects from a single plant species was impossible. Nevertheless, high abundance of insect pollinators like bees were seen in those areas moving from one plant species to another.

Additionally, several wildflower species were observed to attract many insects, especially in areas with high number of Fabaceae species such as areas with several *Lathyrus* (*L. annuus*, *L. aphaca*, and *L. hirsutus*), *Vicia* (*V. sativa* and *Vicia disperma* DC.)

and Trifolium (*Trifolium campestre* Schreb., *T. pratense*, *T. repens* , *T. resupinatum* , and *Trifolium squamosum* L.). In plants of *Leontodon taraxacoides* (Vill.) Mérat was very common to observe many flowers with *Halictus tumurolum* L. and *Psilothrix sp.* Kuster feeding on their pollen, and Syrphidae species such *Sphaerophoria scripta* L. and *Melanostoma mellinum* L. were very common in flowers of *Convolvulus arvensis* L., as well as *Tytthaspis sedecimpunctata* L. Other insects were also collected directly from plants. In the SNM, specimens such as *Hylaeus pictus* Smith, *Pollenia rudis* Fabricius, *Longitarsus lycopi* Foudras, *Eysarcoris ventralis* Westwood, *Meromyza femorata* Macquart, *Prokelisia marginata* Van Duzee, *Carpocoris fuscispinus* Boheman, *Chyromya flava* L., *Colletes marginatus* Smith and *Alydus calcaratus* L. were only collected from *Mentha suaveolens* Ehrh. In the APD, *Brachypterolus pulicarius* L. and *Meliscaeva auricollis* Meigen were collected in *Lobularia maritima* (L.) Desv. subsp. *maritima*, *Lasioglossum* sp. Curtis in *L. criticus* and *Episyrphus balteatus* De Geer from *M. littorea*.

In the book “Guía de campo de los polinizadores de Espanã” (Martin et al. 2017), several plants are mentioned for the amazing rewards that they provide, several of which were identified in this study. While plants like *C. arvensis*, *Raphanus raphanistrum* L. subsp. *raphanistrum*, *M. officinalis*, *T. repens*, *V. sativa*, *Linum bienne* Mill., and *Verbena officinalis* L. reward insect pollinators with high quantities of nectar and *Bellis perennis* L. and *S. atrocinerea* with high quantities of pollen, plants such as *Lonicera etrusca* Santi, *Lamium purpureum* L., and *T. pratense* provide high quantities of both nectar and pollen (Martin et al. 2017), making these plants important for the insect pollinator assemblages.

The association between plants and insects showed that several insect species showed preferences for a specific plant, and thus, this association between plants and specific insect species substantiates the need for an adequate management of these areas. Furthermore, the *M. officinalis* dominated area and the *T. pratense* and *Poa sp.* dominated area presented two completely different insect assemblages. The other areas also presented several exclusive species that were only collected in those areas, but they also presented several species that were common. In this case, an incorrect management can drive several plant species to a local extinction (Beltman et al. 2003),

which could cascade to their associated entomofauna, leading these to flee to other areas or to try to adapt to other plants, which might not reward in the same way, both in quality and quantity. In the case of species with low dispersion abilities, this can lead to local extinctions as well (Moir et al. 2014).

4.2. Threats and management proposals for conservation

The biggest threats observed in the sampled habitats of the University of Aveiro *Campi* were the presence of exotic plant species, and the homogeneous mowing of the vegetation (undifferentiated mown of the whole area in a small amount of time).

The presence of exotic species in the sampled habitats can have several negative consequences for the local biodiversity. Not only the exotic plant species increase the competition for resources, space and pollinators (Totland et al. 2006), exotic species with an invasive character can also have a larger persistent seed banks and are able to disrupt soil surface, which can create new conditions for their growth and facilitate the colonization by other invasive species (D'Antonio and Meyerson 2002). Furthermore, several invasive species dominate several areas, especially in SNM, where a couple of areas near water are dominated by only one species. As seen in Figure 2, the area around inlet 2 and 3 is dominated mostly by the invasive *C. selloana* and the native *Phragmites australis* (Cav.) Trin ex.Steud. Being an area of difficult access, full of stones and with a depression that remains flooded most of the year, it is normally left unmanaged, leaving the *C. selloana* uncontrolled while the rest of the SNM is totally mown (Figure 10A). In the SP, a similar situation was observed, where only the half of the plant that was on the path was mown (Figure 10B).

The other major threat, the homogeneous mowing of vegetation, is the most frequently used management practice in the SNM and in the exterior area of APD. This type of practice is considered by several authors as an incorrect management practice, placing an excessive disturbance in the habitats (e.g. Morris 1969, Cremene et al. 2005, Johst et al. 2006, Šumpich and Konvička 2012, Valkó et al. 2012, Bonari et al. 2017).

Nevertheless, mowing is necessary, especially in grassland habitats, where it is an important tool for the preservation of biodiversity. Mowing has been shown to increase and/or maintain the species richness by reducing the abundance of the dominant species and the vegetation biomass, and by increasing seedling recruitment (Lepš 2014, Bretzel et al. 2016).

Figure 10. *Cortaderia selloana* (Schult. et Schult. f.) Asch. et Graebn. (A) Semi-natural meadow unmanaged invaded area, and (B) Unmanaged individuals in the salt pan habitat.

Furthermore, the homogeneous mowing carried out in the SNM was considered as excessive, being executed more than 2 times a year. Many authors agree that grasslands should be mown at most once per year (Šumpich and Konvička 2012, Valkó

et al. 2012, Lepš 2014, Tälle et al. 2016, Unterweger et al. 2018) to maintain the right level of disturbance and conditions where species richness is higher.

Although there can be several management practices, no approach can totally preserve all species of flora and fauna simultaneously (Morris 1969), so, this should be carefully thought in order to preserve the maximum number of species.

4.2.1. SWOT analysis of the current management

Since the University of Aveiro *Campi* presents several types of habitat with different assemblages of flora and associated entomofauna, the management practices of each habitat should be personalised. These practices should prioritize endemic species such as *A. cirrhigerum*, *D. siifolia* subsp. *vicentina* and *L. polygalifolia* subsp. *polygalifolia* which occurs in the APD. This management should also prioritize the control and eradication of invasive species (Wilcox et al. 2007), while being minimal as possible to the characteristic flora of each habitat.

In the case of the sampled habitats of University of Aveiro *Campi*, to mitigate the weaknesses and threats, and strengthen the strengths and opportunities analysed in the SWOT analysis, is suggested two major strategies that could improve the management and the conservation of those habitats:

1. Implementation of sustainable practices
2. Monitorization of the surrounding areas

The implementation of sustainable practices could preserve and improve the number of native species while controlling the invasive. This strategy could in theory enhance the strengths and mitigate the weaknesses, while exploring its opportunities. The sustainable practices suggested are the heterogenous mowing, low annual frequency of timed mowing, prioritized control of invasive species, creation of solitary bee nesting areas (known as bee hotels), and creation of paths.

The heterogenous mowing, where small areas as mown in different periods, is suggested as the most adequate management practice, creating a heterogenous habitat with mown and unmown areas (Figure 11), accomplishing the objective of the management while maintaining several sites where animals can still find refuge, food and nesting areas (Šumpich and Konvička 2012, Valkó et al. 2012, Bonari et al. 2017), and where plants can complete their life cycles. Even in the same taxonomic group, different species may prefer different habitat vegetation. In the work of Šumpich and Konvička (2012), the authors studied the response of moths to grassland management and conclude that microlepidoptera were more associated with mown areas (regular mown) while macrolepidoptera preferred unmown areas (temporary abandonment), proving the importance of heterogeneous mowing for maintaining species richness (Šumpich and Konvička 2012)

Figure 11. Semi-natural meadow experimental heterogenous mown. (Photo by Olga Ameixa).

The time and frequency of mowing should be carefully thought, without intercepting the critical stages of plants and their associated entomofauna. Several studies suggested that the best time to mown should be after the flowering and frutification period of most plants (Johst et al. 2006, Manninen et al. 2010, Venn 2013), to ensure the production of seed, while providing a bigger feeding season for insects that feed on pollen and nectar.

The specified control of invasive species could remove their impact on the habitat, while native plants would be undistributed. The creation of bee hotels would increase the nesting areas of solitary bees, and other invertebrates. This bee hotels can be created with simple materials, like parts from reeds of *A. donax*, commonly found in the SNM. The creation of paths could mitigate the stepping of the vegetation (Venn 2013, Fantinato 2019), which is commonly observed in the SNM, were several dirt paths were created by students and teachers moving from the parking lots to the university.

The monitorization of the surrounding areas works as an assurance. The presence of several invasive species in the surrounding areas could potentiate the invasion by these species in the University of Aveiro *Campi*. Both the SNM and SP are surrounded by a *C. selloana* invaded area, meaning that, when controlling this species in the University of Aveiro *Campi*, these surrounding areas should also be managed and monitored to prevent new invasion.

For the SNM the heterogeneous mown is suggested as the best possible management. Not only each area should be mown once a year in different intervals (several weeks to a month period) but also performed only after flowering and fructification phases of most plant species, which occurs between July and August (Figure 12), in order to allow seed formation in late flowering plants (Venn 2013).

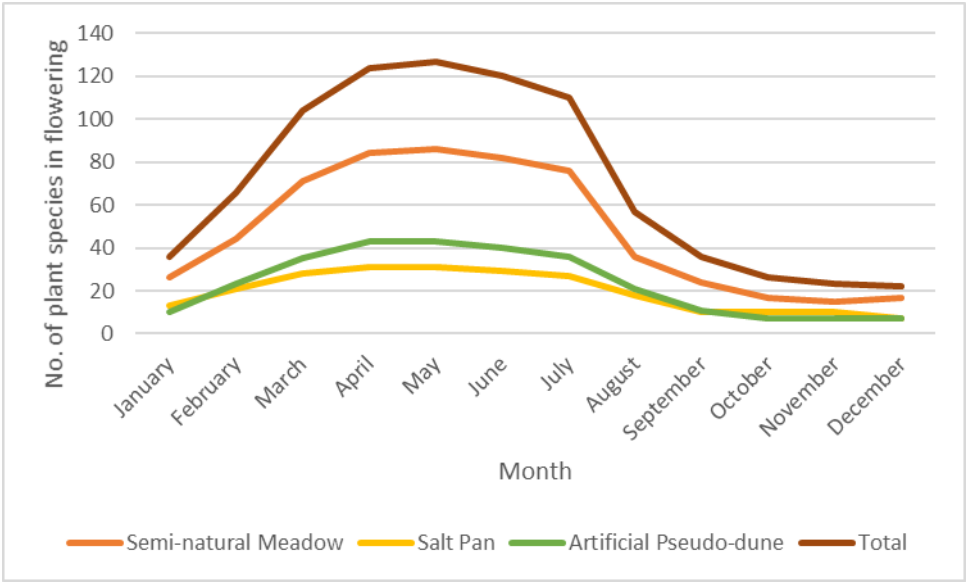


Figure 12. Flowering period of the plant species of University of Aveiro *Campi*. Species flowering period obtained from Flora-On (Sociedade Portuguesa de Botânica 2014)

Also, the removal of this vegetation will allow the growth of Summer plant species, such as *C. intybus*, *M. sativa* and *C. arvensis*, which are important species for insect pollinators in middle Summer and need mown areas to grow (personal observation). In the SNM is also necessary to control the growth and proliferation of the invasive plants *C. selloana*, *A. donax*, and *A. adenophora*. This control can be achieved by doing the opposite as with the native plants, namely, mowing before flowering or fructification.

At SP, closer to the water, it should be prioritised the growth of native halophyte plants, important as nesting areas of several bird species like *Himantopus himantopus* L., *Sternula albifrons* Pallas and *Charadrius alexandrinus* L. (Rodrigues et al. 2011), and the control of *S. versicolor*, which is replacing the native vegetation such as *J. maritimus* and *H. portulacoides* (personal observation). On the upper more terrestrial areas surrounding the salt pan the management should be minimal, focusing in the control of invasive species like *C. selloana* and *A. donax*, and the growth of vegetation on the pathway, which is often use by birdwatchers and others for recreational activities.

At the APD, although the formation was unintentional, this does not mean that it should not be well managed. Presenting a different aesthetic comparing to the main *campus*, this dune like vegetation is also more adapted to the coastal area, requiring less management. At the fenced APD, its current management is already good, focusing on the removal of invasive species by hand. On the exterior APD, the efforts are also concentrated in the control and eradication of several invasive species such as, *A. longifolia*, *A. calendula* and *C. edulis*. The control done with heavy machinery once a year has reduced significantly the occurrence of these invasive species, at the cost of also disturbing the native dune vegetation. At this point, the current management may be exchanged to less excessive interventions, such as removing by hand the few remaining individuals of invasive species without destroying all the dune like vegetation. Being a new habitat and artificially constructed in a pre-existing habitat, there are several ruderal plants such as, *T. repens*, *Plantago lanceolata* L., *Plantago coronopus* L. and *Bromus diandrus* Roth, which can increase the competition with the dune like vegetation

and thus, should also be considered to be controlled, choosing to preserve a more pure characteristic dune like vegetation.

6. Conclusions and Future perspectives

In conclusion, the characterization of insect pollinator and plant communities in the University of Aveiro *Campi* revealed how much it is important the conservation of those urban green spaces. The presence of 194 insect and 156 plant species in three habitats, in which three endemic and several invasive plant species were present, demands a correct and sustainable management of the University of Aveiro green spaces. Instead of an annual management schedule, management practices should be decided after an observation of the phenological state of the habitat vegetation. A management with a heterogeneous mown and a target control of invasive and other exotic species is suggested as the best management practice, which could promote the best conditions for most species, and even attract new native species from natural surrounding areas.

This study was performed in three different habitats of the University of Aveiro *Campi*, but other types of habitats exist in the main campus, such as several small gardens, a saltmarsh and an invaded riparian habitat. These areas should also be characterized, and their threats identified. Furthermore, a quantitative analysis of the real value of impacts of management should be performed for all the University of Aveiro green spaces to better quantify which management practices is the best for the conservation of the University of Aveiro green spaces.

In ECOMARE, the impacts of the foreseen construction of the new greenhouses may cause severe changes in the APD dynamics, and thus, a follow-up assessment would be useful to quantify how these changes will affect this APD community.

Being an important first step for the characterization of insect pollinator and plants communities, as well as the threats of the various habitats of the University of Aveiro *Campi*, this study should serve as a guideline to create new management protocols, following sustainable practices that should be oriented to the conservation and optimization of the *Campi* biodiversity. Furthermore, being a study where many species of insects and plants were identified, this study may contribute to enhance their knowledge.

7. Bibliographic references

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Annex

Annex 1

Annex 1. List of insect species sampled in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*. Insects were observed (some were caught, identified and released), target search (insect pollinators were actively searched in flowers and flowering areas) and non-target search (insects were caught using sweep-nets).

Habitat	Date	Species Name	Technique	Collector
SNM	08/07/2016	*Amphorophora rubi* Kaltenbach	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Anacridium aegyptium* L.	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Andricus quercustozae* Bosc	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Apis mellifera* L.	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Autographa gamma* L.	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Blatta orientalis* L.	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Coccinella septempunctata* L.	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Colias croceus* Fourcroy	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Hister quadrimaculatus* L.	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Lasiocampa trifolii* Denis & Schiffermüller	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Mythimna vitellina* Hübner	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Ocypus olens* O. Muller	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Oedionychus cinctus* Fabricius	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Pararge aegeria* L.	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Propylea quatuordecimpunctata* L.	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Propylea quatuordecimpunctata* L.	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Rhagonycha iberica* Dahlgren	Observed	Ameixa, O.; Bioblitz
SNM	08/07/2016	*Tytthaspis sedecimpunctata* L.	Observed	Ameixa, O.; Bioblitz
SNM	July/17	*Stenodema laevigata* L.	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Syritta pipiens* L.	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Alydus calcaratus L.*	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Nysius senecionis* Schilling	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Chyromya flava* L.	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Meromyza femorata* Macquart	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Hylaeus pictus* Smith ♂	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Halictus confusus* Smith ♀	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Scirtothrips dorsalis* Hood	Target	Ameixa, O. & Maia, P.

Annex 1 (cont.). List of insect species sampled in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*. Insects were observed (some were caught, identified and released), target search (insect pollinators were actively searched in flowers and flowering areas) and non-target search (insects were caught using sweep-nets).

Habitat	Date	Species Name	Technique	Collector
SNM	July/17	*Hylaeus pictus* Smith ♂	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Colletes marginatus* Smith ♂	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Colletes marginatus* Smith ♂	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Anoecia corni* Fabricius	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Halictus scabiosae* Rossi ♀	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Halictus eurygnathus* Bluethgen ♂	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	*Sphaerophoria scripta* L. ♀	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	*Pollenia rudis* Fabricius ♀	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Carpocoris fuscispinus* Boheman	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Prokelisia marginata* Van Duzee	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Eysarcoris ventralis* Westwood	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Longitarsus lycopi* Foudras	Target	Ameixa, O. & Maia, P.
SNM	July/17	*Monomorium carbonarium* F. Smith	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	*Hylaeus brevicornis* Nylander ♂	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	*Trichogramma sp.* Westwood	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	*Longitarsus lycopi* Foudras	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	*Orthops kalmii* L.	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	ninfa de Hemiptera sp. 1	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	*Chironomidae sp.* 1	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	*Chironomidae sp.* 1	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	*Chironomidae sp*. 2	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	*Chironomidae sp*. 2	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	*Tanytarsus sp.* van der Wulp	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	*Ceratopogonidae sp*. 1	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	*Dasyhelea sp.* Kieffer	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	*Dasyhelea sp.* Kieffer	Non-Target	Ameixa, O. & Maia, P.
SNM	July/17	*Xysticus audax* Schrank	Non-Target	Ameixa, O. & Maia, P.

Annex 1 (cont.). List of insect species sampled in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*. Insects were observed (some were caught, identified and released), target search (insect pollinators were actively searched in flowers and flowering areas) and non-target search (insects were caught using sweep-nets).

Habitat	Date	Species Name	Technique	Collector
SNM	May/18	*Dichagyris nigrescens* Höfner	Non-Target	Alves, D.
SNM	May/18	*Tipula paludosa* Meigen	Non-Target	Alves, D.
SNM	May/18	*Melanostoma mellinum* L. ♀	Non-Target	Alves, D.
SNM	May/18	*Chloromyia formosa* Scopoli ♂	Non-Target	Alves, D.
SNM	May/18	*Stevenia deceptoria* Loew	Non-Target	Alves, D.
SNM	May/18	*Pherbellia cinerella* Fallen	Non-Target	Alves, D.
SNM	May/18	*Chironomidae sp*. 2	Non-Target	Alves, D.
SNM	May/18	*Chironomus sp*. Meigen	Non-Target	Alves, D.
SNM	May/18	*Rhynchophorus ferrugineus* Olivier	Non-Target	Alves, D.
SNM	May/18	*Geomyza tripunctata* Fallen	Non-Target	Alves, D.
SNM	May/18	*Scaptomyza sp*. Hardy	Non-Target	Alves, D.
SNM	May/18	*Dicraeus sp*. Loew	Non-Target	Alves, D.
SNM	May/18	*Piezodorus lituratus* Fabricius	Non-Target	Alves, D.
SNM	May/18	*Trichogramma sp.* Westwood	Non-Target	Alves, D.
SNM	May/18	*Eucera sp.* Scopoli ♀	Non-Target	Alves, D.
SNM	May/18	*Hoplia philanthus* Fuesslin ♂	Non-Target	Alves, D.
SNM	May/18	*Smaragdina affinis* Illiger	Non-Target	Alves, D.
SNM	27/06/2018	*Vanessa cardui* L. ♂	Non-Target	Alves, D.
SNM	27/06/2018	*Eupelix cuspidata* Fabricius	Non-Target	Alves, D.
SNM	27/06/2018	*Plagiodera sp.* Chevrolat	Non-Target	Alves, D.
SNM	27/06/2018	*Chironomidae sp*. 3	Non-Target	Alves, D.
SNM	27/06/2018	*Agromyza sp.* Fallén	Non-Target	Alves, D.
SNM	27/06/2018	*Bombus terrestris* L. ♀ (worker)	Non-Target	Alves, D.
SNM	27/06/2018	*Aiolopus sp.* Fieber ♀	Non-Target	Alves, D.
SNM	27/06/2018	*Chironomidae sp*. 2	Non-Target	Alves, D.
SNM	27/06/2018	*Chironomidae sp*. 2	Non-Target	Alves, D.
SNM	27/06/2018	*Chironomidae sp*. 2	Non-Target	Alves, D.
SNM	27/06/2018	*Psilopa nitidula* Fallen	Non-Target	Alves, D.

Annex 1 (cont.). List of insect species sampled in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*. Insects were observed (some were caught, identified and released), target search (insect pollinators were actively searched in flowers and flowering areas) and non-target search (insects were caught using sweep-nets).

Habitat	Date	Species Name	Technique	Collector
SNM	27/06/2018	*Psilopa nitidula* Fallen	Non-Target	Alves, D.
SNM	27/06/2018	*Psilopa nitidula* Fallen	Non-Target	Alves, D.
SNM	27/06/2018	*Leptogaster sp.* Meigen	Non-Target	Alves, D.
SNM	27/06/2018	*Leptogaster sp.* Meigen	Non-Target	Alves, D.
SNM	27/06/2018	*Dicaelotus sp.* Wesmael	Non-Target	Alves, D.
SNM	27/06/2018	*Mesopsocus sp.* Kolbe	Non-Target	Alves, D.
SNM	27/06/2018	*Parochthiphila coronata* Loew	Non-Target	Alves, D.
SNM	27/06/2018	*Ensina sonchi* L. ♀	Non-Target	Alves, D.
SNM	27/06/2018	*Eupelix cuspidata* Fabricius	Non-Target	Alves, D.
SNM	27/06/2018	*Hydrobaenus sp.* Fries	Non-Target	Alves, D.
SNM	27/06/2018	*Cerodontha sp.* Rondani	Non-Target	Alves, D.
SNM	27/06/2018	*Ceratopogonidae sp*. 2	Non-Target	Alves, D.
SNM	27/06/2018	*Plagiodera sp.* Chevrolat	Non-Target	Alves, D.
SNM	27/06/2018	*Ensina sonchi* L. ♂	Non-Target	Alves, D.
SNM	27/06/2018	*Chloropidae sp*. 1	Non-Target	Alves, D.
SNM	27/06/2018	*Liriomyza sp.* Mik	Non-Target	Alves, D.
SNM	27/06/2018	*Chirothrips sp.* ♀ Haliday	Non-Target	Alves, D.
SNM	27/06/2018	tribo *Deltocephalini sp. 1*	Non-Target	Alves, D.
SNM	27/06/2018	tribo *Deltocephalini sp.* 2	Non-Target	Alves, D.
SNM	27/06/2018	ninfa de Miridae sp. 1	Non-Target	Alves, D.
SNM	27/06/2018	*Laodelphax striatellus* Fallen	Non-Target	Alves, D.
SNM	27/06/2018	ninfa de *Trigonotylus caelestialium* Kirkaldy	Non-Target	Alves, D.
SNM	27/06/2018	*Tytthaspis sedecimpunctata* L.	Non-Target	Alves, D.
SNM	27/06/2018	*Bruchidius sp.* Schilsky	Non-Target	Alves, D.
SNM	27/06/2018	*Bruchidius sp.* Schilsky	Non-Target	Alves, D.
SNM	27/06/2018	*Bruchidius sp.* Schilsky	Non-Target	Alves, D.
SNM	27/06/2018	*Bruchidius sp.* Schilsky	Non-Target	Alves, D.
SNM	27/06/2018	*Chrysoperla sp.* Steinmann	Non-Target	Alves, D.

Annex 1 (cont.). List of insect species sampled in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*. Insects were observed (some were caught, identified and released), target search (insect pollinators were actively searched in flowers and flowering areas) and non-target search (insects were caught using sweep-nets).

Habitat	Date	Species Name	Technique	Collector
SNM	27/06/2018	*Rhagonycha fulva* Scopoli	Non-Target	Alves, D.
SNM	27/06/2018	*Rhagonycha fulva* Scopoli	Non-Target	Alves, D.
SNM	27/06/2018	*Rhagonycha fulva* Scopoli	Non-Target	Alves, D.
SNM	27/06/2018	*Rhagonycha fulva* Scopoli	Non-Target	Alves, D.
SNM	27/06/2018	*Sphaerophoria scripta* L. ♀	Non-Target	Alves, D.
SNM	27/06/2018	*Sphaerophoria scripta* L. ♀	Non-Target	Alves, D.
SNM	27/06/2018	*Pollenia leclercqiana* Lehrer ♀	Non-Target	Alves, D.
SNM	27/06/2018	*Minettia subvittata* Loew ♀	Non-Target	Alves, D.
SNM	27/06/2018	*Minettia subvittata* Loew ♂	Non-Target	Alves, D.
SNM	27/06/2018	*Minettia subvittata* Loew ♀	Non-Target	Alves, D.
SNM	27/06/2018	*Minettia subvittata* Loew ♀	Non-Target	Alves, D.
SNM	27/06/2018	*Chrysoperla sp.* Steinmann	Target	Alves, D.
SNM	27/06/2018	*Chrysoperla sp.* Steinmann	Target	Alves, D.
SNM	27/06/2018	*Melanostoma mellinum* L. ♀	Target	Alves, D.
SNM	27/06/2018	*Melanostoma mellinum* L. ♀	Target	Alves, D.
SNM	27/06/2018	*Melanostoma mellinum* L. ♀	Target	Alves, D.
SNM	27/06/2018	*Melanostoma mellinum* L. ♂	Target	Alves, D.
SNM	27/06/2018	*Melanostoma mellinum* L. ♀	Target	Alves, D.
SNM	27/06/2018	*Melanostoma mellinum* L. ♀	Target	Alves, D.
SNM	27/06/2018	*Sphaerophoria scripta* L. ♀	Target	Alves, D.
SNM	27/06/2018	*Sphaerophoria scripta* L. ♀	Target	Alves, D.
SNM	27/06/2018	*Sphaerophoria scripta* L. ♂	Target	Alves, D.
SNM	27/06/2018	*Sphaerophoria scripta* L. ♀	Target	Alves, D.
SNM	27/06/2018	*Sphaerophoria scripta* L. ♀	Target	Alves, D.
SNM	27/06/2018	*Minettia subvittata* Loew ♀	Target	Alves, D.
SNM	27/06/2018	*Campiglossa sp.* Rondani ♀	Target	Alves, D.
SNM	27/06/2018	*Chironomidae sp*. 2	Target	Alves, D.
SNM	27/06/2018	*Ceratopogonidae sp*. 3	Target	Alves, D.

Annex 1 (cont.). List of insect species sampled in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*. Insects were observed (some were caught, identified and released), target search (insect pollinators were actively searched in flowers and flowering areas) and non-target search (insects were caught using sweep-nets).

Habitat	Date	Species Name	Technique	Collector
SNM	27/06/2018	*Psilopa nitidula* Fallen	Target	Alves, D.
SNM	27/06/2018	*Asteia algeriensis* Sabrosky	Target	Alves, D.
SNM	27/06/2018	*Scaptomyza sp*. Hardy	Target	Alves, D.
SNM	27/06/2018	*Aphaniosoma sp.* Becker	Target	Alves, D.
SNM	27/06/2018	*Forcipomyia bipunctata* L. ♂	Target	Alves, D.
SNM	27/06/2018	*Pyralidae sp*. 1	Target	Alves, D.
SNM	27/06/2018	*Nabis pseudoferus* Remane	Target	Alves, D.
SNM	27/06/2018	tribo *Deltocephalini sp.* 2	Target	Alves, D.
SNM	27/06/2018	tribo *Deltocephalini sp.* 2	Target	Alves, D.
SNM	27/06/2018	*Javesella sp.* Fennah	Target	Alves, D.
SNM	27/06/2018	*Empoasca pteridis* Dahlbom ♀	Target	Alves, D.
SNM	27/06/2018	*Empoasca pteridis* Dahlbom ♀	Target	Alves, D.
SNM	27/06/2018	*Empoasca pteridis* Dahlbom ♂	Target	Alves, D.
SNM	27/06/2018	*Melitta tricincta* Kirby ♀	Target	Alves, D.
SNM	27/06/2018	*Melitta tricincta* Kirby ♂	Target	Alves, D.
SNM	27/06/2018	*Halictus tumulorum* L. ♀	Target	Alves, D.
SNM	27/06/2018	*Cremastinae sp.*	Target	Alves, D.
SNM	27/06/2018	*Rhagonycha fulva* Scopoli	Non-Target	Alves, D.
SNM	27/06/2018	*Rhagonycha fulva* Scopoli	Non-Target	Alves, D.
SNM	27/06/2018	*Nabis pseudoferus* Remane	Non-Target	Alves, D.
SNM	27/06/2018	*Minettia subvittata* Loew ♂	Non-Target	Alves, D.
SNM	27/06/2018	*Melanostoma mellinum* L. ♂	Non-Target	Alves, D.
SNM	27/06/2018	*Melanostoma mellinum* L. ♀	Non-Target	Alves, D.
SNM	27/06/2018	*Melanostoma mellinum* L. ♂	Non-Target	Alves, D.
SNM	27/06/2018	*Nemotelus sp.* Geoffroy ♂	Non-Target	Alves, D.
SNM	27/06/2018	*Nemotelus sp.* Geoffroy ♀	Non-Target	Alves, D.
SNM	27/06/2018	*Nemotelus sp.* Geoffroy ♂	Non-Target	Alves, D.
SNM	27/06/2018	*Nemotelus sp.* Geoffroy ♂	Non-Target	Alves, D.

Annex 1 (cont.). List of insect species sampled in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*. Insects were observed (some were caught, identified and released), target search (insect pollinators were actively searched in flowers and flowering areas) and non-target search (insects were caught using sweep-nets).

Habitat	Date	Species Name	Technique	Collector
SNM	27/06/2018	*Chironomidae sp.* 1	Non-Target	Alves, D.
SNM	27/06/2018	*Chironomidae sp*. 2	Non-Target	Alves, D.
SNM	27/06/2018	*Chironomidae sp.* 1	Non-Target	Alves, D.
SNM	27/06/2018	tribo *Deltocephalini sp.* 2	Non-Target	Alves, D.
SNM	27/06/2018	tribo *Deltocephalini sp.* 1	Non-Target	Alves, D.
SNM	27/06/2018	*Psilopa nitidula* Fallen	Non-Target	Alves, D.
SNM	27/06/2018	*Aphididae sp.* 1	Non-Target	Alves, D.
SNM	27/06/2018	*Melanostoma mellinum* L. ♀	Non-Target	Alves, D.
SNM	27/06/2018	*Melanostoma mellinum* L. ♂	Non-Target	Alves, D.
SNM	27/06/2018	*Sphaerophoria scripta* L. ♀	Non-Target	Alves, D.
SNM	27/06/2018	*Rhagonycha fulva* Scopoli	Non-Target	Alves, D.
SNM	27/06/2018	*Tytthaspis sedecimpunctata* L.	Non-Target	Alves, D.
SNM	27/06/2018	*Idaea ochrata* Scopoli	Non-Target	Alves, D.
SNM	27/06/2018	*Plagiodera sp.* Chevrolat	Non-Target	Alves, D.
SNM	27/06/2018	Larva de Coleoptera sp. 1	Non-Target	Alves, D.
SNM	27/06/2018	*Tebenna micalis* Mann	Non-Target	Alves, D.
SNM	27/06/2018	*Melitta tricincta* Kirby ♀	Non-Target	Alves, D.
SNM	27/06/2018	*Panurgus calcaratus* Scopoli ♂	Non-Target	Alves, D.
SNM	27/06/2018	*Tessellana tessellata* Charpentier	Non-Target	Alves, D.
SNM	July/18	Lagarta de Lepidoptera sp. 1	Non-Target	Alves, D.
SNM	July/18	*Euthycera sp*. Latreille	Non-Target	Alves, D.
SNM	July/18	*Aphidius avenae* Haliday	Non-Target	Alves, D.
SNM	July/18	*Sphaerophoria scripta* L. ♀	Non-Target	Alves, D.
SNM	July/18	*Stangeia siceliota* Zeller	Non-Target	Alves, D.
SNM	July/18	*Achyra nudalis* Hübner	Non-Target	Alves, D.
SNM	July/18	*Idaea ochrata* Scopoli	Non-Target	Alves, D.
SNM	July/18	*Alydus calcaratus L.*	Non-Target	Alves, D.
SNM	July/18	*Andrena thoracica* Fabricius ♀	Non-Target	Alves, D.

Annex 1 (cont.). List of insect species sampled in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*. Insects were observed (some were caught, identified and released), target search (insect pollinators were actively searched in flowers and flowering areas) and non-target search (insects were caught using sweep-nets).

Habitat	Date	Species Name	Technique	Collector
SNM	July/18	*Halictus scabiosae* Rossi ♀	Non-Target	Alves, D.
SNM	July/18	*Halictus scabiosae* Rossi ♀	Non-Target	Alves, D.
SNM	09/07/2018	*Adalia bipunctata* L.	Observed	Olga, A. e Alves, D.
SNM	09/07/2018	*Autographa gamma* L.	Observed	Olga, A. e Alves, D.
SNM	09/07/2018	*Bombus muscorum* L.	Observed	Olga, A. e Alves, D.
SNM	09/07/2018	*Bombus terrestris* L.	Observed	Olga, A. e Alves, D.
SNM	09/07/2018	*Chrysoperla sp.* Steinmann	Observed	Olga, A. e Alves, D.
SNM	09/07/2018	*Colias croceus* Fourcroy ♂	Observed	Olga, A. e Alves, D.
SNM	09/07/2018	*Eucera sp.* Scopoli ♀	Observed	Olga, A. e Alves, D.
SNM	09/07/2018	*Heliotaurus ruficollis* Fabricius	Observed	Olga, A. e Alves, D.
SNM	09/07/2018	*Ischnura graellsii* Rambur	Observed	Olga, A. e Alves, D.
SNM	09/07/2018	*Pieris brassicae* L. ♂	Observed	Olga, A. e Alves, D.
SNM	09/07/2018	*Pieris rapae* Boisduval	Observed	Olga, A. e Alves, D.
SNM	09/07/2018	*Polistes gallicus* L. ♀	Observed	Olga, A. e Alves, D.
SNM	09/07/2018	*Rhagonycha fulva* Scopoli	Observed	Olga, A. e Alves, D.
SNM	09/07/2018	*Xylocopa* sp. Latreille	Observed	Olga, A. e Alves, D.
SNM	16/07/2018	*Apis mellifera* L.	Observed	Olga, A. e Alves, D.
SNM	16/07/2018	*Autographa gamma* L.	Observed	Olga, A. e Alves, D.
SNM	16/07/2018	*Chrysoperla sp.* Steinmann	Observed	Olga, A. e Alves, D.
SNM	16/07/2018	*Colias croceus* Fourcroy ♂	Observed	Olga, A. e Alves, D.
SNM	16/07/2018	*Colletes marginatus* Smith ♂	Observed	Olga, A. e Alves, D.
SNM	16/07/2018	*Heliotaurus ruficollis* Fabricius	Observed	Olga, A. e Alves, D.
SNM	16/07/2018	*Ischnura graellsii* Rambur	Observed	Olga, A. e Alves, D.
SNM	16/07/2018	*Pieris rapae* Boisduval	Observed	Olga, A. e Alves, D.
SNM	16/07/2018	*Xylocopa* sp. Latreille	Observed	Olga, A. e Alves, D.
SNM	22/02/2019	*Scathophaga stercoria* L.	Target	Ameixa, O.
SNM	22/02/2019	*Lasiomma sp.* Stein	Target	Ameixa, O.
SNM	22/02/2019	*Sitona sp.* Germar	Target	Ameixa, O.

Annex 1 (cont.). List of insect species sampled in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*. Insects were observed (some were caught, identified and released), target search (insect pollinators were actively searched in flowers and flowering areas) and non-target search (insects were caught using sweep-nets).

Habitat	Date	Species Name	Technique	Collector
SNM	22/02/2019	*Coccinella septempunctata* L.	Observed	Alves, D.
SNM	27/02/2019	*Phragmatobia fuliginosa* L. ♀	Non-Target	Alves, D.
SNM	March/19	*Pararge aegeria* L. ♀	Non-Target	Maia, P.
SNM	19/03/2019	*Halictus eurygnathus* Bluethgen ♂	Non-Target	Alves, D.
SNM	19/03/2019	*Bombus terrestris* L. ♂	Non-Target	Alves, D.
SNM	19/03/2019	*Halictus subauratus* Rossi ♀	Non-Target	Alves, D.
SNM	20/03/2019	Lagarta de Lepidoptera sp. 1	Non-Target	Alves, D.
SNM	20/03/2019	*Oenopia doublieri* Mulsant	Non-Target	Alves, D.
SNM	05/05/2019	*Halictus tumulorum* L. ♀	Target	Alves, D.
SNM	05/05/2019	*Halictus tumulorum* L. ♀	Target	Alves, D.
SNM	05/05/2019	*Psilothrix sp.* Kuster	Target	Alves, D.
SNM	05/05/2019	*Sphaerophoria scripta* L. ♂	Non-Target	Alves, D.
SNM	05/05/2019	*Camptopus lateralis* Germar	Non-Target	Alves, D.
SNM	05/05/2019	*Chloromyia formosa* Scopoli ♂	Non-Target	Alves, D.
SNM	05/05/2019	*Camptopus lateralis* Germar	Non-Target	Alves, D.
SNM	05/05/2019	*Pherbina sp.* Robineau-Desvoidy	Non-Target	Alves, D.
SNM	05/05/2019	*Coenosia tigrina* Fabricius	Non-Target	Alves, D.
SNM	05/05/2019	*Rhagio sp*. Fabricius ♀	Non-Target	Alves, D.
SNM	05/05/2019	ninfa de *Tettigonia sp.* L.	Non-Target	Alves, D.
SNM	05/05/2019	*Polistes gallicus* L. ♀	Target	Alves, D.
SNM	05/05/2019	*Sarcophaga sp.* Meigen	Target	Alves, D.
SNM	05/05/2019	*Coccinella septempunctata* L.	Target	Alves, D.
SNM	05/05/2019	*Suillia variegata* Loew	Target	Alves, D.
SNM	05/05/2019	*Stevenia deceptoria* Loew	Target	Alves, D.
SNM	05/05/2019	*Dioctria sp.* Meigen	Target	Alves, D.
SNM	05/05/2019	*Machaerium maritimae* Haliday	Target	Alves, D.
SNM	05/05/2019	*Tachinidae sp*. 1	Target	Alves, D.
SNM	05/05/2019	*Tryphoninae sp.*	Target	Alves, D.

Annex 1 (cont.). List of insect species sampled in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*. Insects were observed (some were caught, identified and released), target search (insect pollinators were actively searched in flowers and flowering areas) and non-target search (insects were caught using sweep-nets).

Habitat	Date	Species Name	Technique	Collector
SNM	05/05/2019	*Chironomidae sp*. 2	Target	Alves, D.
SNM	05/05/2019	*Chironomidae sp*. 2	Target	Alves, D.
SNM	05/05/2019	*Chironomidae sp*. 2	Target	Alves, D.
SNM	05/05/2019	*Tryphoninae sp.*	Target	Alves, D.
SNM	05/05/2019	*Ceratopogonidae sp*. 5	Target	Alves, D.
SNM	05/05/2019	*Geomyza tripunctata* Fallen	Target	Alves, D.
SNM	05/05/2019	*Camilla atrimana* Strobl	Target	Alves, D.
SNM	05/05/2019	*Camilla atrimana* Strobl	Target	Alves, D.
SNM	05/05/2019	*Chloropidae sp*. 2	Target	Alves, D.
SNM	05/05/2019	*Ceratopogonidae sp*. 3	Target	Alves, D.
SNM	05/05/2019	*Sepsis sp.* Fallen	Target	Alves, D.
SNM	05/05/2019	*Coscinia striata* L.	Non-Target	Alves, D.
SNM	05/05/2019	*Bruchidius sp.* Schilsky	Target	Alves, D.
SNM	05/05/2019	*Smaragdina affinis* Illiger	Target	Alves, D.
SNM	05/05/2019	*Clonopsis gallica* Charpentier	Target	Alves, D.
SNM	05/05/2019	*Autographa gamma* L.	Non-Target	Alves, D.
SNM	05/05/2019	*Eucera sp.* Scopoli ♂	Non-Target	Alves, D.
SNM	05/05/2019	*Sphaerophoria scripta* L.	Non-Target	Alves, D.
SNM	05/05/2019	*Stevenia deceptoria* Loew	Non-Target	Alves, D.
SNM	05/05/2019	*Apis mellifera* L. ♀ (obreira)	Target	Alves, D.
SNM	05/05/2019	*Chironomidae sp*. 2	Target	Alves, D.
SNM	05/05/2019	*Halictus quadricinctus* Fabricius ♂	Target	Alves, D.
SNM	05/05/2019	*Stevenia deceptoria* Loew	Target	Alves, D.
SNM	05/05/2019	*Sceliphron caementarium* Drury	Target	Alves, D.
SNM	05/05/2019	*Bombus terrestris* L. ♀ (worker)	Target	Alves, D.
SNM	05/05/2019	*Bombus lucorum* L. ♀ (queen)	Non-Target	Alves, D.
SNM	05/05/2019	*Eucera sp.* Scopoli ♂	Non-Target	Alves, D.
SNM	05/05/2019	*Megachile willughbiella* Kirby	Non-Target	Alves, D.

Annex 1 (cont.). List of insect species sampled in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*. Insects were observed (some were caught, identified and released), target search (insect pollinators were actively searched in flowers and flowering areas) and non-target search (insects were caught using sweep-nets).

Habitat	Date	Species Name	Technique	Collector
SNM	05/05/2019	*Eucera sp.* Scopoli ♀	Non-Target	Alves, D.
SNM	05/05/2019	*Melitta tricincta* Kirby ♀	Non-Target	Alves, D.
SNM	05/05/2019	*Pararge aegeria* L. ♂	Non-Target	Alves, D.
SNM	05/05/2019	*Pararge aegeria* L. ♂	Non-Target	Alves, D.
SNM	05/05/2019	*Stevenia deceptoria* Loew	Target	Alves, D.
SNM	05/05/2019	*Chloromyia formosa* Scopoli ♀	Target	Alves, D.
SNM	05/05/2019	*Chloromyia formosa* Scopoli ♂	Target	Alves, D.
SNM	05/05/2019	*Sphaerophoria scripta* L. ♀	Target	Alves, D.
SNM	05/05/2019	*Melinda sp*. Robineau-Desvoidy	Target	Alves, D.
SNM	05/05/2019	*Delia platura* Meigen	Target	Alves, D.
SNM	05/05/2019	*Halictus scabiosae* Rossi ♀	Target	Alves, D.
SNM	05/05/2019	*Bombus muscorum* L. ♀ (queen)	Target	Alves, D.
SNM	05/05/2019	*Bombus hortorum* L. ♀ (worker)	Target	Alves, D.
SNM	05/05/2019	*Chloromyia formosa* Scopoli ♂	Target	Alves, D.
SNM	05/05/2019	*Chloromyia formosa* Scopoli ♂	Target	Alves, D.
SNM	05/05/2019	*Chloromyia formosa* Scopoli ♀	Target	Alves, D.
SNM	05/05/2019	*Chloromyia formosa* Scopoli ♂	Target	Alves, D.
SNM	05/05/2019	larva de *Coccinella septempunctata* L.	Target	Alves, D.
SNM	05/05/2019	*Aphis sp.* L.	Target	Alves, D.
SNM	05/05/2019	*Stevenia deceptoria* Loew	Target	Alves, D.
SNM	05/05/2019	*Stevenia deceptoria* Loew	Target	Alves, D.
SNM	05/05/2019	*Stevenia deceptoria* Loew	Target	Alves, D.
SNM	05/05/2019	*Coenosia tigrina* Fabricius	Target	Alves, D.
SNM	05/05/2019	*Pherbina sp.* Robineau-Desvoidy	Target	Alves, D.
SNM	05/05/2019	*Pherbina sp.* Robineau-Desvoidy	Target	Alves, D.
SNM	05/05/2019	*Coccinella septempunctata* L.	Target	Alves, D.
SNM	05/05/2019	*Coccinella septempunctata* L.	Target	Alves, D.

Annex 1 (cont.). List of insect species sampled in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*. Insects were observed (some were caught, identified and released), target search (insect pollinators were actively searched in flowers and flowering areas) and non-target search (insects were caught using sweep-nets).

Habitat	Date	Species Name	Technique	Collector
SNM	05/05/2019	*Ceraleptus gracilicornis* Herrich-Schäffer	Target	Alves, D.
SNM	05/05/2019	*Sitona sp.* Germar	Target	Alves, D.
SNM	05/05/2019	*Sitona sp.* Germar	Target	Alves, D.
SNM	05/05/2019	*Sitona sp.* Germar	Target	Alves, D.
SNM	05/05/2019	*Sitona griseus* Fabricius	Target	Alves, D.
SNM	05/05/2019	*Bruchidius sp.* Schilsky	Target	Alves, D.
SNM	05/05/2019	*Bruchidius sp.* Schilsky	Target	Alves, D.
SNM	05/05/2019	*Bruchidius sp.* Schilsky	Target	Alves, D.
SNM	05/05/2019	*Bruchidius sp.* Schilsky	Target	Alves, D.
SNM	05/05/2019	*Bruchidius sp*. Schilsky	Target	Alves, D.
SNM	05/05/2019	*Bruchidius sp.* Schilsky	Target	Alves, D.
SNM	05/05/2019	*Stictopleurus sp*. Stål	Target	Alves, D.
SNM	05/05/2019	*Meteorus sp.* Haliday	Target	Alves, D.
SNM	05/05/2019	Cryptinae sp.	Target	Alves, D.
SNM	05/05/2019	*Ichneumonidae sp*. 1	Target	Alves, D.
SNM	05/05/2019	*Ichneumonidae sp*. 1	Target	Alves, D.
SNM	05/05/2019	*Braconidae sp.*	Target	Alves, D.
SNM	05/05/2019	*Ichneumonidae sp*. 2	Target	Alves, D.
SNM	05/05/2019	*Empoasca pteridis* Dahlbom	Target	Alves, D.
SNM	05/05/2019	*Chironomidae sp.* 1	Target	Alves, D.
SNM	05/05/2019	*Chironomidae sp.* 1	Target	Alves, D.
SNM	05/05/2019	*Chironomidae sp.* 1	Target	Alves, D.
SNM	05/05/2019	*Chironomidae sp.* 1	Target	Alves, D.
SNM	05/05/2019	*Chironomidae sp.* 1	Target	Alves, D.
SNM	05/05/2019	*Machaerium maritimae* Haliday	Target	Alves, D.
SNM	05/05/2019	*Agromyzidae sp. 1*	Target	Alves, D.
SNM	05/05/2019	*Eutropha albipilosa* Becker	Target	Alves, D.
SNM	05/05/2019	*Camilla atrimana* Strobl	Target	Alves, D.

Annex 1 (cont.). List of insect species sampled in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*. Insects were observed (some were caught, identified and released), target search (insect pollinators were actively searched in flowers and flowering areas) and non-target search (insects were caught using sweep-nets).

Habitat	Date	Species Name	Technique	Collector
SNM	05/05/2019	*Sepsis sp.* Fallen	Target	Alves, D.
SNM	05/05/2019	*Sepsis sp.* Fallen	Target	Alves, D.
SNM	05/05/2019	microLepidoptera sp. 1	Target	Alves, D.
SNM	05/05/2019	*Bombus terrestris* L. ♀ (worker)	Target	Alves, D.
SNM	05/05/2019	*Chloromyia formosa* Scopoli ♂	Target	Alves, D.
SNM	05/05/2019	*Chloromyia formosa* Scopoli ♂	Target	Alves, D.
SNM	05/05/2019	*Chloromyia formosa* Scopoli ♂	Target	Alves, D.
SNM	05/05/2019	*Chloromyia formosa* Scopoli ♂	Target	Alves, D.
SNM	05/05/2019	*Aphis sp.* L.	Target	Alves, D.
SNM	05/05/2019	*Chironomidae sp*. 2	Target	Alves, D.
SNM	05/05/2019	*Chironomidae sp*. 2	Target	Alves, D.
SNM	05/05/2019	*Chironomidae sp*. 2	Target	Alves, D.
SNM	05/05/2019	*Chironomidae sp*. 2	Target	Alves, D.
SNM	05/05/2019	*Chironomidae sp*. 2	Target	Alves, D.
SNM	05/05/2019	*Chironomidae sp.* 1	Target	Alves, D.
SNM	05/05/2019	*Tanytarsus sp.* van der Wulp	Target	Alves, D.
SNM	05/05/2019	tribo *Deltocephalini sp*. 3	Target	Alves, D.
SNM	05/05/2019	tribo *Deltocephalini sp*. 4	Target	Alves, D.
SNM	05/05/2019	*Ceraleptus gracilicornis* Herrich-Schäffer	Target	Alves, D.
SNM	05/05/2019	*Stictopleurus sp*. Stål	Target	Alves, D.
SNM	05/05/2019	*Malachius lusitanicus* Erichson	Target	Alves, D.
SNM	05/05/2019	*Tytthaspis sedecimpunctata* L.	Target	Alves, D.
SNM	05/05/2019	*Tytthaspis sedecimpunctata* L.	Target	Alves, D.
SNM	05/05/2019	*Tytthaspis sedecimpunctata* L.	Target	Alves, D.
SNM	05/05/2019	*Tytthaspis sedecimpunctata* L.	Target	Alves, D.
SNM	05/05/2019	*Apis mellifera* L. ♀ (obreira)	Target	Alves, D.
SNM	05/05/2019	*Apis mellifera* L. ♀ (obreira)	Target	Alves, D.
SNM	05/05/2019	*Apis mellifera* L. ♀ (obreira)	Target	Alves, D.

Annex 1 (cont.). List of insect species sampled in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*. Insects were observed (some were caught, identified and released), target search (insect pollinators were actively searched in flowers and flowering areas) and non-target search (insects were caught using sweep-nets).

Habitat	Date	Species Name	Technique	Collector
SNM	05/05/2019	*Apis mellifera* L. ♀ (obreira)	Target	Alves, D.
SNM	05/05/2019	*Apis mellifera* L. ♀ (obreira)	Target	Alves, D.
SNM	05/05/2019	*Apis mellifera* L. ♀ (obreira)	Target	Alves, D.
SNM	05/05/2019	*Andrena nitidiuscula* Schenck ♂	Target	Alves, D.
SNM	05/05/2019	*Sphaerophoria scripta* L. ♀	Target	Alves, D.
SNM	05/05/2019	*Halictus confusus* Smith ♀	Target	Alves, D.
SNM	05/05/2019	*Minettia subvittata* Loew	Target	Alves, D.
SNM	05/05/2019	*Minettia subvittata* Loew	Target	Alves, D.
SNM	05/05/2019	*Minettia subvittata* Loew	Target	Alves, D.
SNM	05/05/2019	*Machaerium maritimae* Haliday	Target	Alves, D.
APD	22/02/2019	*Meliscaeva auricollis* Meigen ♂	Target	Alves, D.
APD	22/02/2019	*Episyrphus balteatus* De Geer ♂	Target	Alves, D.
APD	22/02/2019	*Nysius senecionis* Schilling	Target	Alves, D.
APD	22/02/2019	*Lasioglossum sp.* Curtis ♀	Target	Alves, D.
APD	22/02/2019	*Lasioglossum sp.* Curtis ♀	Target	Alves, D.
APD	22/02/2019	*Brachypterolus pulicarius* L.	Target	Alves, D.
APD	22/02/2019	*Bombus terrestris* L.	Observed	Alves, D.
APD	22/02/2019	*Colias croceus* Fourcroy ♂	Observed	Alves, D.
APD	22/02/2019	*Polyommatus bellargus* Rottemburg ♀	Observed	Alves, D.
APD	22/02/2019	*Polyommatus icarus* Rottemburg ♂	Observed	Alves, D.
APD	24/05/2019	*Villa sp.* Lioy	Non-Target	Alves, D.
APD	24/05/2019	*Eristalis tenax* ♂	Non-Target	Alves, D.
APD	24/05/2019	*Calliphora vicina* Robineau-Desvoidy ♀	Non-Target	Alves, D.
APD	24/05/2019	*Bombus muscorum* L. ♀ (worker)	Non-Target	Alves, D.
APD	24/05/2019	*Halictus eurygnathus* Bluethgen ♀	Non-Target	Alves, D.
APD	24/05/2019	*Nomioides sp*. Schenck	Non-Target	Alves, D.

Annex 1 (cont.). List of insect species sampled in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*. Insects were observed (some were caught, identified and released), target search (insect pollinators were actively searched in flowers and flowering areas) and non-target search (insects were caught using sweep-nets).

Habitat	Date	Species Name	Technique	Collector
APD	24/05/2019	*Nomioides sp*. Schenck	Non-Target	Alves, D.
APD	24/05/2019	*Psilothrix sp.* Kuster	Non-Target	Alves, D.
APD	24/05/2019	*Psilothrix sp.* Kuster	Non-Target	Alves, D.
APD	24/05/2019	*Apis mellifera* L. ♀ (obreira)	Target	Alves, D.
APD	June/19	*Osmia sp.* Panzer	Observed	Alves, D.
APD	June/19	*Lucilia sericata* Meigen	Observed	Alves, D.
SP	19/03/2019	*Tytthaspis sedecimpunctata* L.	Observed	Alves, D.
SP	19/03/2019	*Celastrina argiolus* L. ♀	Non-Target	Alves, D.
SP	19/03/2019	*Bombus terrestris* L. ♀ (queen)	Non-Target	Alves, D.
SP	19/03/2019	*Bombus muscorum* L. ♀ (queen)	Non-Target	Alves, D.
SP	19/03/2019	*Apis mellifera* L. ♀ (obreira)	Non-Target	Alves, D.
SP	19/03/2019	*Apis mellifera* L. ♀ (obreira)	Non-Target	Alves, D.
SP	19/03/2019	*Eristalinus sepulchralis* L. ♀	Non-Target	Alves, D.
SP	19/03/2019	*Cassida vittata* Villers	Non-Target	Alves, D.
SP	19/03/2019	*Chrysolina bankii* Fabricius	Non-Target	Alves, D.
SP	22/03/2019	*Pieris brassicae* L. ♂	Non-Target	Alves, D.
SP	22/03/2019	*Gravenhorstia picta* Boie	Non-Target	Alves, D.
SP	22/03/2019	*Ancistrocerus sp.* Wesmael	Non-Target	Alves, D.
SP	22/03/2019	*Scathophaga litorea* Fallen	Non-Target	Alves, D.
SP	22/03/2019	*Miscogaster sp.* Walker	Non-Target	Alves, D.
SP	22/03/2019	*Ceratopogonidae sp*. 4	Non-Target	Alves, D.
SP	22/03/2019	*Ceratopogonidae sp*. 4	Non-Target	Alves, D.
SP	22/03/2019	*Oscinella sp*. Becker	Non-Target	Alves, D.
SP	22/03/2019	*Asteia amoena* Meigen	Non-Target	Alves, D.
SP	22/03/2019	*Cricotopus sp.* van der Wulp ♂	Non-Target	Alves, D.

Annex 2

Annex 2. Sampled insect species considered as pollinators in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*.

Order	Family	Species Name	SNM	SP	APD	Source
Coleoptera	Cantharidae	*Rhagonycha fulva* Scopoli	1	0	0	(Martin et al. 2017)
Coleoptera	Cantharidae	*Rhagonycha iberica* Dahlgren	1	0	0	(Martin et al. 2017)
Coleoptera	Coccinelidae	*Tytthaspis sedecimpunctata* L.	1	1	0	(Vincent 2011)
Coleoptera	Dasytidae	*Psilothrix sp.* Kuster	1	0	1	(Martin et al. 2017)
Coleoptera	Malachiidae	*Malachius lusitanicus* Erichson	1	0	0	(Mirutenko 2013)
Coleoptera	Tenebrionidae	*Heliotaurus ruficollis* Fabricius	1	0	0	(De-Los-Mozos-Pascual and Domingo 1991)
Diptera	Asteiidae	*Asteia algeriensis* Sabrosky	1	0	0	(Oosterbroek 2006)
Diptera	Asteiidae	*Asteia amoena* Meigen	0	1	0	(Oosterbroek 2006)
Diptera	Bombyliidae	*Villa sp.* Lioy	0	0	1	(Oosterbroek 2006)
Diptera	Calliphoridae	*Calliphora vicina* Robineau-Desvoidy ♀	0	0	1	(Oosterbroek 2006)
Diptera	Calliphoridae	*Lucilia sericata* Meigen	0	0	1	(Oosterbroek 2006)
Diptera	Calliphoridae	*Melinda sp*. Robineau-Desvoidy	1	0	0	(Oosterbroek 2006)
Diptera	Calliphoridae	*Pollenia leclercqiana* Lehrer ♀	1	0	0	(Oosterbroek 2006)
Diptera	Calliphoridae	*Pollenia rudis* Fabricius ♀	1	0	0	(Oosterbroek 2006)
Diptera	Camillidae	*Camilla atrimana* Strobl	1	0	0	(Oosterbroek 2006)
Diptera	Ceratopogonidae	*Ceratopogonidae sp*. 1	1	0	0	(Oosterbroek 2006)
Diptera	Ceratopogonidae	*Ceratopogonidae sp*. 2	1	0	0	(Oosterbroek 2006)
Diptera	Ceratopogonidae	*Ceratopogonidae sp*. 3	1	0	0	(Oosterbroek 2006)
Diptera	Ceratopogonidae	*Ceratopogonidae sp*. 4	0	1	0	(Oosterbroek 2006)
Diptera	Ceratopogonidae	*Ceratopogonidae sp*. 5	1	0	0	(Oosterbroek 2006)
Diptera	Ceratopogonidae	*Dasyhelea sp.* Kieffer	1	0	0	(Oosterbroek 2006)
Diptera	Chironomidae	*Chironomidae sp.* 1	1	0	0	(Oosterbroek 2006)
Diptera	Chironomidae	*Chironomidae sp*. 2	1	0	0	(Oosterbroek 2006)
Diptera	Chironomidae	*Chironomidae sp*. 3	1	0	0	(Oosterbroek 2006)
Diptera	Chironomidae	*Chironomus sp.* Meigen	1	0	0	(Oosterbroek 2006)
Diptera	Chironomidae	*Cricotopus sp.* van der Wulp ♂	0	1	0	(Oosterbroek 2006)
Diptera	Chironomidae	*Hydrobaenus sp.* Fries	1	0	0	(Oosterbroek 2006)
Diptera	Chironomidae	*Tanytarsus sp.* van der Wulp	1	0	0	(Oosterbroek 2006)
Diptera	Chloropidae	*Chloropidae sp*. 1	1	0	0	(Oosterbroek 2006)
Diptera	Chloropidae	*Chloropidae sp*. 2	1	0	0	(Oosterbroek 2006)
Diptera	Chloropidae	*Dicraeus sp*. Loew	1	0	0	(Oosterbroek 2006)
Diptera	Chloropidae	*Eutropha albipilosa* Becker	1	0	0	(Oosterbroek 2006)

Annex 2 (cont.). Sampled insect species considered as pollinators in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*.

Order	Family	Species Name	SNM	SP	APD	Source
Diptera	Chloropidae	*Meromyza femorata* Macquart	1	0	0	(Oosterbroek 2006)
Diptera	Chloropidae	*Oscinella sp*. Becker	0	1	0	(Oosterbroek 2006)
Diptera	Chyromyidae	*Aphaniosoma sp.* Becker	1	0	0	(Oosterbroek 2006)
Diptera	Chyromyidae	*Chyromya flava* L.	1	0	0	(Oosterbroek 2006)
Diptera	Rhagionidae	*Rhagio sp*. Fabricius ♀	1	0	0	(Oosterbroek 2006)
Diptera	Rhinophoridae	*Stevenia deceptoria* Loew	1	0	0	(Oosterbroek 2006)
Diptera	Sarcophagidae	*Sarcophaga sp.* Meigen	1	0	0	(Oosterbroek 2006)
Diptera	Stratiomyidae	*Chloromyia formosa* Scopoli ♀	1	0	0	(Oosterbroek 2006)
Diptera	Stratiomyidae	*Nemotelus sp.* Geoffroy ♀	1	0	0	(Oosterbroek 2006)
Diptera	Syrphidae	*Episyrphus balteatus* De Geer ♂	0	0	1	(Oosterbroek 2006)
Diptera	Syrphidae	*Eristalinus sepulchralis* L. ♀	0	1	0	(Oosterbroek 2006)
Diptera	Syrphidae	*Eristalis tenax* ♂	0	0	1	(Oosterbroek 2006)
Diptera	Syrphidae	*Melanostoma mellinum* L. ♂	1	0	0	(Oosterbroek 2006)
Diptera	Syrphidae	*Meliscaeva auricollis* Meigen ♂	0	0	1	(Oosterbroek 2006)
Diptera	Syrphidae	*Sphaerophoria scripta* L.	1	0	0	(Oosterbroek 2006)
Diptera	Syrphidae	*Syritta pipiens* L.	1	0	0	(Oosterbroek 2006)
Diptera	Tephritidae	*Campiglossa sp.* Rondani ♀	1	0	0	(Oosterbroek 2006)
Diptera	Tephritidae	*Ensina sonchi* L. ♀	1	0	0	(Oosterbroek 2006)
Hymenoptera	Andrenidae	*Andrena nitidiuscula* Schenck ♂	1	0	0	(Mudri-Stojnić et al. 2012)
Hymenoptera	Andrenidae	*Panurgus calcaratus* Scopoli ♂	1	0	0	(Mudri-Stojnić et al. 2012)
Hymenoptera	Apidae	*Andrena thoracica* Fabricius ♀	1	0	0	(Mudri-Stojnić et al. 2012)
Hymenoptera	Apidae	*Apis mellifera* L.	1	1	1	(Mudri-Stojnić et al. 2012)
Hymenoptera	Apidae	*Bombus hortorum* L. ♀ (worker)	1	0	0	(Mudri-Stojnić et al. 2012)
Hymenoptera	Apidae	*Bombus lucorum* L. ♀ (queen)	1	0	0	(Mudri-Stojnić et al. 2012)
Hymenoptera	Apidae	*Bombus muscorum* L.	1	1	1	(Mudri-Stojnić et al. 2012)
Hymenoptera	Apidae	*Bombus terrestris* L.	1	1	1	(Mudri-Stojnić et al. 2012)
Hymenoptera	Apidae	*Eucera sp.* Scopoli ♀	1	0	0	(Mudri-Stojnić et al. 2012)
Hymenoptera	Apidae	*Megachile willughbiella* Kirby	1	0	0	(Mudri-Stojnić et al. 2012)
Hymenoptera	Apidae	*Xylocopa* sp. Latreille	1	0	0	(Mudri-Stojnić et al. 2012)

Annex 2 (cont.). Sampled insect species considered as pollinators in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*.

Order	Family	Species Name	SNM	SP	APD	Source
Hymenoptera	Colletidae	*Colletes marginatus* Smith ♂	1	0	0	(Zettel et al. 2019)
Hymenoptera	Colletidae	*Hylaeus brevicornis* Nylander ♂	1	0	0	(Almeida 2008)
Hymenoptera	Colletidae	*Hylaeus pictus* Smith ♂	1	0	0	(Almeida 2008)
Hymenoptera	Halictidae	*Halictus confusus* Smith ♀	1	0	0	(Mudri-Stojnić et al. 2012)
Hymenoptera	Halictidae	*Halictus eurygnathus* Bluethgen ♀	1	0	1	(Mudri-Stojnić et al. 2012)
Hymenoptera	Halictidae	*Halictus quadricinctus* Fabricius ♂	1	0	0	(Mudri-Stojnić et al. 2012)
Hymenoptera	Halictidae	*Halictus scabiosae* Rossi ♀	1	0	0	(Mudri-Stojnić et al. 2012)
Hymenoptera	Halictidae	*Halictus subauratus* Rossi ♀	1	0	0	(Mudri-Stojnić et al. 2012)
Hymenoptera	Halictidae	*Halictus tumulorum* L. ♀	1	0	0	(Mudri-Stojnić et al. 2012)
Hymenoptera	Halictidae	*Lasioglossum sp.* Curtis ♀	0	0	1	(Mudri-Stojnić et al. 2012)
Hymenoptera	Halictidae	*Nomioides sp*. Schenck	0	0	1	(Mudri-Stojnić et al. 2012)
Hymenoptera	Megachilidae	*Osmia sp*. Panzer	0	0	1	(Mudri-Stojnić et al. 2012)
Hymenoptera	Melittidae	*Melitta tricincta* Kirby ♀	1	0	0	(Michez 2008)
Hymenoptera	Vespidae	*Ancistrocerus sp.* Wesmael	0	1	0	(Fateryga 2010)
Hymenoptera	Vespidae	*Polistes gallicus* L. ♀	1	0	0	(Fateryga 2010)
Lepidoptera	Crambidae	*Achyra nudalis* Hübner	1	0	0	(Macgregor et al. 2014)
Lepidoptera	Erebidae	*Coscinia striata* L.	1	0	0	(Macgregor et al. 2014)
Lepidoptera	Erebidae	*Phragmatobia fuliginosa* L. ♀	1	0	0	(Macgregor et al. 2014)
Lepidoptera	Geometridae	*Idaea ochrata* Scopoli	1	0	0	(Macgregor et al. 2014)
Lepidoptera	Lycaenidae	*Celastrina argiolus* L. ♀	0	1	0	(Martin et al. 2017)
Lepidoptera	Lycaenidae	*Polyommatus bellargus* Rottemburg ♀	0	0	1	(Martin et al. 2017)
Lepidoptera	Lycaenidae	*Polyommatus icarus* Rottemburg ♂	0	0	1	(Martin et al. 2017)
Lepidoptera	Noctuidae	*Autographa gamma* L.	1	0	0	(Macgregor et al. 2014)
Lepidoptera	Noctuidae	*Dichagyris nigrescens* Höfner	1	0	0	(Macgregor et al. 2014)
Lepidoptera	Noctuidae	*Mythimna vitellina* Hübner	1	0	0	(Macgregor et al. 2014)
Lepidoptera	Nymphalidae	*Pararge aegeria* L.	1	0	0	(Martin et al. 2017)
Lepidoptera	Nymphalidae	*Vanessa cardui* L. ♂	1	0	0	(Martin et al. 2017)
Lepidoptera	Pieridae	*Colias croceus* Fourcroy	1	0	1	(Martin et al. 2017)

Annex 2 (cont.). Sampled insect species considered as pollinators in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*.

Order	**Family**	**Species Name**	**SNM**	**SP**	**APD**	**Source**
Lepidoptera	Pieridae	*Pieris brassicae* L. ♂	1	1	0	(Martin et al. 2017)
Lepidoptera	Pieridae	*Pieris rapae* Boisduval	1	0	0	(Martin et al. 2017)
Neuroptera	Chrysopidae	*Chrysoperla sp.* Steinmann	1	0	0	(Dhandapani et al. 2016)

Annex 3

Annex 3. Taxonomic list of plants identified and/or collected during plant sampling in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*.

Func. Group	Family	Species Name	SNM	SP	APD
Tree	Lauraceae	*Laurus nobilis* L.	1	0	0
Tree	Lauraceae	*Laurus nobilis* L.	1	0	0
Tree	Malvaceae	*Tilia tomentosa* Moench	1	0	0
Tree	Salicaceae	*Salix atrocinerea* Brot.	1	0	0
Tree	Tamaricaceae	*Tamarix africana* Poir.	1	1	0
Shrub/Tree	Caprifoliaceae	*Lonicera etrusca* Santi	1	0	0
Shrub/Tree	Fabaceae	*Acacia longifolia* (Andrews) Willd.	0	0	1
Shrub	Amaranthaceae	*Sarcocornia perennis* (Mill.) A.J.Scott	0	1	0
Shrub	Asteraceae	*Helichrysum italicum* subsp. *picardi* (Boiss. & Reut.) Franco	0	0	1
Grass/herb	Aizoaceae	*Carpobrotus edulis* (L.) N.E.Br.	0	0	1
Grass/herb	Amaranthaceae	*Halimione portulacoides* (L.) Aellen	0	1	0
Grass/herb	Amaranthaceae	*Salicornia ramosissima* J.Woods	0	1	0
Grass/herb	Apiaceae	*Angelica sylvestris* L.	1	0	0
Grass/herb	Apiaceae	*Conium maculatum* L.	0	1	0
Grass/herb	Apiaceae	*Oenanthe crocata* L.	1	0	0
Grass/herb	Apiaceae	*Seseli tortuosum* L.	0	0	1
Grass/herb	Apocynaceae	*Vinca difformis* subsp. *difformis* Pourr.	1	0	0
Grass/herb	Araceae	*Arum italicum* Mill. subsp. *italicum*	1	0	0
Grass/herb	Araceae	*Zantedeschia aethiopica* (L.) Spreng.	1	0	0
Grass/herb	Asteraceae	*Ageratina adenophora* (Spreng.) R.M.King & H.Rob.	1	0	0
Grass/herb	Asteraceae	*Anacyclus radiatus* Loisel.	0	1	1
Grass/herb	Asteraceae	*Andryala integrifolia* L.	1	0	1
Grass/herb	Asteraceae	*Arctotheca calendula* (L.) Levyns	0	0	1
Grass/herb	Asteraceae	*Artemisia campestris* subsp. m*aritima* Arcang.	0	0	1
Grass/herb	Asteraceae	*Aster tripolium* subsp. *pannonicus* (Jacq.) Soó	0	1	0
Grass/herb	Asteraceae	*Bellis perennis* L.	1	0	0
Grass/herb	Asteraceae	*Carduus tenuiflorus* Curtis	0	1	0
Grass/herb	Asteraceae	*Chamaemelum fuscatum* (Brot.) Vasc.	1	1	1
Grass/herb	Asteraceae	*Cichorium intybus* L.	1	0	0
Grass/herb	Asteraceae	*Cotula coronopifolia* L.	0	1	0
Grass/herb	Asteraceae	*Crepis capillaris* (L.) Wallr.	1	0	1
Grass/herb	Asteraceae	*Crepis* sp.	0	0	1
Grass/herb	Asteraceae	*Erigeron bonariensis* L.	1	0	0
Grass/herb	Asteraceae	*Helminthotheca echioides* (L.) Holub	1	0	0
Grass/herb	Asteraceae	*Hypochaeris radicata* L.	1	0	0
Grass/herb	Asteraceae	*Leontodon taraxacoides* (Vill.) Mérat	1	0	0
Grass/herb	Asteraceae	*Pseudognaphalium luteo-album* (L.) Hilliard & B.L.Burtt	1	0	1

Annex 3 (cont.). Taxonomic list of plants identified and/or collected during plant sampling in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) habitats of the University of Aveiro *Campi*.

Func. group	Family	Species Name	SNM	SP	APD
Grass/herb	Asteraceae	*Senecio vulgaris* L.	1	0	0
Grass/herb	Asteraceae	*Reichardia gaditana* (Willk.) Cout.	0	0	1
Grass/herb	Asteraceae	*Sonchus oleraceus* L.	1	1	0
Grass/herb	Boraginaceae	*Myosotis discolor* Pers.	1	0	0
Grass/herb	Brassicaceae	*Diplotaxis siifolia* subsp. *vicentina* (Welw. ex Samp.) Mart.-Laborde	0	0	1
Grass/herb	Brassicaceae	*Diplotaxis virgata* (Cav.) DC. subsp. *virgata*	0	1	0
Grass/herb	Brassicaceae	*Lobularia maritima* subsp. *maritima* (L.) Desv.	0	0	1
Grass/herb	Brassicaceae	*Malcolmia littorea* (L.) R.Br.	0	0	1
Grass/herb	Brassicaceae	*Raphanus raphanistrum* L. subsp. *raphanistrum*	1	0	0
Grass/herb	Caryophyllaceae	*Cerastium glomeratum* Thuill.	1	0	0
Grass/herb	Caryophyllaceae	*Herniaria ciliolata* subsp. *robusta* Chaudhri	0	0	1
Grass/herb	Caryophyllaceae	*Silene scabriflora* Brot.	0	0	1
Grass/herb	Caryophyllaceae	*Spergularia sp.*	0	1	0
Grass/herb	Caryophyllaceae	*Stellaria media* (L.) Vill.	1	0	0
Grass/herb	Convolvulaceae	*Convolvulus arvensis* L.	1	0	0
Grass/herb	Crassulaceae	*Sedum acre* L.	0	0	1
Grass/herb	Crassulaceae	*Sedum sediforme* (Jacq.) Pau	0	0	1
Grass/herb	Cucurbitaceae	*Bryonia dioica* Jacq.	1	0	0
Grass/herb	Cyperaceae	*Carex cuprina* (I.Sándor ex Heuff.) Nendtv. ex A.Kern.	1	0	0
Grass/herb	Cyperaceae	*Carex divulsa* Stokes	1	0	0
Grass/herb	Cyperaceae	*Cyperus capitatus* Vand.	0	0	1
Grass/herb	Cyperaceae	*Cyperus eragrostis* Lam.	1	0	0
Grass/herb	Cyperaceae	*Cyperus longus* L.	1	0	0
Grass/herb	Euphorbiaceae	*Euphorbia helioscopia* L. subsp. *helioscopia*	1	0	0
Grass/herb	Fabaceae	*Lathyrus annuus* L.	1	0	0
Grass/herb	Fabaceae	*Lathyrus aphaca* L.	1	0	0
Grass/herb	Fabaceae	*Lathyrus hirsutus* L.	1	0	0
Grass/herb	Fabaceae	*Lotus creticus* L.	0	0	1
Grass/herb	Fabaceae	*Lupinus luteus* L.	0	0	1
Grass/herb	Fabaceae	*Medicago littoralis* Rohde ex Loisel.	0	0	1
Grass/herb	Fabaceae	*Medicago marina* L.	0	0	1
Grass/herb	Fabaceae	*Medicago polymorpha* L.	1	1	0
Grass/herb	Fabaceae	*Medicago sativa* L.	1	0	0
Grass/herb	Fabaceae	*Melilotus albus* Medik.	0	1	0
Grass/herb	Fabaceae	*Melilotus indicus* (L.) All.	0	0	1
Grass/herb	Fabaceae	*Melilotus officinalis* (L.) Pall.	0	1	0

Annex 3 (cont.). Taxonomic list of plants identified and/or collected during plant sampling in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) of the University of Aveiro *Campi*.

Func. Group	Family	Species Name	SNM	SP	APD
Grass/herb	Fabaceae	*Ornithopus pinnatus* (Mill.) Druce	0	0	1
Grass/herb	Fabaceae	*Ornithopus sativus* Brot.	0	0	1
Grass/herb	Fabaceae	*Scorpiurus sulcatus* L.	0	0	1
Grass/herb	Fabaceae	*Trifolium angustifolium* L.	0	1	1
Grass/herb	Fabaceae	*Trifolium arvense* L.	0	1	0
Grass/herb	Fabaceae	*Trifolium campestre* Schreb.	1	1	1
Grass/herb	Fabaceae	*Trifolium pratense* L. subsp. *pratense*	1	0	0
Grass/herb	Fabaceae	*Trifolium repens* L.	1	1	1
Grass/herb	Fabaceae	*Trifolium resupinatum* L.	0	1	0
Grass/herb	Fabaceae	*Trifolium squamosum* L.	1	0	0
Grass/herb	Fabaceae	*Vicia disperma* DC.	1	0	0
Grass/herb	Fabaceae	*Vicia parviflora* Cav.	1	0	0
Grass/herb	Fabaceae	*Vicia sativa* L.	1	1	0
Grass/herb	Gentianaceae	*Blackstonia perfoliata* (L.) Huds.	0	0	1
Grass/herb	Geraniaceae	*Erodium aethiopicum* (Lam.) Brumh. & Thell	0	0	1
Grass/herb	Geraniaceae	*Erodium moschatum* (L.) L'Hér.	1	0	0
Grass/herb	Geraniaceae	*Geranium dissectum* L.	1	0	0
Grass/herb	Geraniaceae	*Geranium purpureum* Vill.	1	0	0
Grass/herb	Geraniaceae	*Geranium pusillum* L.	1	0	0
Grass/herb	Geraniaceae	*Geranium sp.*1	1	0	0
Grass/herb	Geraniaceae	*Geranium sp.*2	0	1	0
Grass/herb	Juncaceae	*Juncus maritimus* Lam.	1	1	0
Grass/herb	Juncaginaceae	*Triglochin maritimum* L.	0	1	0
Grass/herb	Lamiaceae	*Lamium purpureum* L.	1	1	0
Grass/herb	Lamiaceae	*Mentha suaveolens* Ehrh.	1	0	0
Grass/herb	Lamiaceae	*Prunella vulgaris* L.	1	0	0
Grass/herb	Lamiaceae	*Stachys arvensis* (L.) L.	1	1	0
Grass/herb	Linaceae	*Linum bienne* Mill.	1	1	1
Grass/herb	Malvaceae	*Lavatera cretica* L.	1	1	1
Grass/herb	Malvaceae	*Modiola caroliniana* (L.) G.Don	1	0	0
Grass/herb	Oleaceae	*Olea europaea* L. var. *europaea*	1	0	0
Grass/herb	Onagraceae	*Oenothera rosea* L'H	1	0	0
Grass/herb	Onagraceae	*Oenothera sp.*	0	0	1
Grass/herb	Orchidaceae	*Ophrys apifera* Huds.	1	0	0
Grass/herb	Orchidaceae	*Serapias parviflora* Parl.	1	0	0
Grass/herb	Orobanchaceae	*Bartsia trixago* L.	0	0	1
Grass/herb	Orobanchaceae	*Parentucellia viscosa* (L.) Caruel	1	0	0
Grass/herb	Oxalidaceae	*Oxalis corniculata* L.	1	0	0
Grass/herb	Oxalidaceae	*Oxalis pes-caprae* L.	1	1	0

Annex 3 (cont.). Taxonomic list of plants identified and/or collected during plant sampling in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) of the University of Aveiro *Campi*.

Func. Group	Family	Species Name	SNM	SP	APD
Grass/herb	Papaveraceae	*Fumaria capreolata* L.	1	1	0
Grass/herb	Papaveraceae	*Fumaria muralis* Sond. ex Koch	1	1	0
Grass/herb	Plantaginaceae	*Antirrhinum cirrhigerum* (Welw. ex Ficalho) Rothm.	0	0	1
Grass/herb	Plantaginaceae	*Cymbalaria muralis* subsp. *muralis* G. Gaertn.	1	0	0
Grass/herb	Plantaginaceae	*Linaria polygalifolia* subsp. *polygalifolia* Hoffmanns. & Link	0	0	1
Grass/herb	Plantaginaceae	*Plantago coronopus* L.	1	1	1
Grass/herb	Plantaginaceae	*Plantago lanceolata* L.	1	1	1
Grass/herb	Plantaginaceae	*Plantago major* subsp. *intermedia* (DC.) Arcang.	1	0	0
Grass/herb	Plantaginaceae	*Veronica arvensis* L.	1	1	0
Grass/herb	Poaceae	*Agrostis curtisii* Kerguélen	1	0	0
Grass/herb	Poaceae	*Arundo donax* L.	1	0	0
Grass/herb	Poaceae	*Avena barbata* Link	1	0	0
Grass/herb	Poaceae	*Briza maxima* L.	1	0	0
Grass/herb	Poaceae	*Briza minor* L.	1	0	0
Grass/herb	Poaceae	*Bromus diandrus* Roth	1	0	1
Grass/herb	Poaceae	*Bromus hordeaceus* L.	1	0	0
Grass/herb	Poaceae	*Bromus rubens* L.	0	0	1
Grass/herb	Poaceae	*Cortaderia selloana* (Schult. & Schult.f.) Asch. & Graebn.	1	1	1
Grass/herb	Poaceae	*Dactylis glomerata* L.	1	1	1
Grass/herb	Poaceae	*Deschampsia flexuosa* (L.) Trin.	1	0	0
Grass/herb	Poaceae	*Elymus athericus* (Link) Kerguélen	1	0	0
Grass/herb	Poaceae	*Holcus lanatus* L.	1	0	0
Grass/herb	Poaceae	*Hordeum murinum* L.	1	0	0
Grass/herb	Poaceae	*Lagurus ovatus* L.	0	0	1
Grass/herb	Poaceae	*Lolium multiflorum* Lam.	1	0	0
Grass/herb	Poaceae	*Phragmites australis* (Cav.) Trin ex.Steud.	1	1	0
Grass/herb	Poaceae	*Paspalum* sp.	1	0	0
Grass/herb	Poaceae	*Poa trivialis* L.	1	0	0
Grass/herb	Poaceae	*Polypogon monspeliensis* (L.) Desf.	1	0	0
Grass/herb	Poaceae	*Spartina versicolor* Fabre	0	1	0
Grass/herb	Polygonaceae	*Rumex bucephalophorus* L.	0	0	1
Grass/herb	Polygonaceae	*Rumex crispus* L.	1	0	0
Grass/herb	Primulaceae	*Anagallis arvensis* L.	1	0	0
Grass/herb	Ranunculaceae	*Ranunculus parviflorus* L.	1	0	0
Grass/herb	Ranunculaceae	*Ranunculus repens* L.	1	0	0
Grass/herb	Ranunculaceae	*Ranunculus trilobus* Desf.	1	0	0

Annex 3 (cont.). Taxonomic list of plants identified and/or collected during plant sampling in the semi-natural meadow (SNM), salt pan (SP) and dune (APD) of the University of Aveiro *Campi*.

Func. Group	Family	Species Name	SNM	SP	APD
Grass/herb	Rubiaceae	*Galium aparine* L.	1	0	0
Grass/herb	Rubiaceae	*Sherardia arvensis* L.	1	0	0
Grass/herb	Scrophularia	*Scrophularia frutescens* L.	0	0	1
Grass/herb	Solanaceae	*Salpichroa origanifolia* (Lam.) Baill.	1	0	0
Grass/herb	Urticaceae	*Parietaria judaica* L.	1	0	0
Grass/herb	Valerianaceae	*Centranthus calcitrapae*(L.) Dufr.	1	0	1
Grass/herb	Verbenaceae	*Verbena officinalis* L.	1	0	0

Annex 4

Annex 4. Insect species collected in the semi-natural meadow of the University of Aveiro on 5th of May of 2019, by sweep-netting on a (MeOf) *Melilotus officinalis* (L.) Pall. dominated area, (OeCr*) Oenanthe crocata* L. dominated area, (TrPo) *Trifolium pratense* L. subsp. *pratense* and *Poa sp*. dominated area, (VsLnLap) *Vicia sativa* L., *Lathyrus hirsutus* L. and *Lathyrus aphaca* L. dominated area, and (VsLanRu) *Vicia sativa* L., *Lathyrus annuus* L. and *Rubus ulmifolius* Schott var. *ulmifolius* dominated area.

Insects / **Plants**	**MeOf**	**OeCr**	**TrPo**	**VsLhLap**	**VsLanRu**
Agromyzidae sp. 1	0	0	0	1	0
Andrena nitidiuscula Schenck ♂	1	0	0	0	0
Aphis sp. L.	0	0	1	1	0
Apis mellifera L. ♀	6	1	0	0	0
Autographa gamma L.	0	0	0	1	0
Bombus lucorum L. ♀	0	0	0	1	0
Bombus terrestris L. ♀	0	1	1	0	0
Braconidae sp.	0	0	0	1	0
Bruchidius sp. Schilsky	0	0	0	6	1
Camilla atrimana Strobl	0	0	0	1	2
Ceraleptus gracilicornis Herrich-Schäffer	0	0	1	1	0
Ceratopogonidae sp. 3	0	0	0	0	1
Ceratopogonidae sp. 5	0	0	0	0	1
Chironomidae sp. 1	0	0	1	5	0
Chironomidae sp. 2	0	1	5	0	3
Chloromyia formosa Scopoli ♀	0	2	4	4	0
Chloropidae sp. 2	0	0	0	0	1
Clonopsis gallica Charpentier	0	0	0	0	1
Coccinella septempunctata L.	0	0	0	3	1
Coenosia tigrina Fabricius	0	0	0	1	0
Cryptinae sp.	0	0	0	1	0
Delia platura Meigen	0	1	0	0	0
Dioctria sp. Meigen	0	0	0	0	1
Empoasca pteridis Dahlbom	0	0	0	1	0
Eucera sp. Scopoli ♀	0	0	0	3	0
Eutropha albipilosa Becker	0	0	0	1	0
Geomyza tripunctata Fallen	0	0	0	0	1
Halictus confusus Smith ♀	1	0	0	0	0
Halictus quadricinctus Fabricius ♂	0	1	0	0	0
Halictus scabiosae Rossi ♀	0	1	0	0	0
Ichneumonidae sp. 1	0	0	0	2	0
Ichneumonidae sp. 2	0	0	0	1	0
Machaerium maritimae Haliday	1	0	0	1	1
Malachius lusitanicus Erichson	0	0	1	0	0
Megachile willughbiella Kirby	0	0	0	1	0
Melinda sp. Robineau-Desvoidy	0	1	0	0	0
Melitta tricincta Kirby ♀	0	0	0	1	0

Annex 4 (cont.). Insect species collected in the semi-natural meadow of the University of Aveiro on 5th of May of 2019, by sweep-netting on a (MeOf) *Melilotus officinalis* (L.) Pall. dominated area, (OeCr*) Oenanthe crocata* L. dominated area, (TrPo) *Trifolium pratense* L. subsp. *pratense* and *Poa sp*. dominated area, (VsLnLap) *Vicia sativa* L., *Lathyrus hirsutus* L. and *Lathyrus aphaca* L. dominated area, and (VsLanRu) *Vicia sativa* L., *Lathyrus annuus* L. and *Rubus ulmifolius* Schott var. *ulmifolius* dominated area.

Insects / **Plants**	**MeOf**	**OeCr**	**TrPo**	**VsLhLap**	**VsLanRu**
Meteorus sp. Haliday	0	0	0	1	0
microLepidoptera sp. 1	0	0	0	1	0
Minettia subvittata Loew	3	0	0	0	0
Pararge aegeria L. ♂	0	0	0	2	0
Pherbina sp. Robineau-Desvoidy	0	0	0	2	0
Polistes gallicus L. ♀	0	0	0	0	1
Sarcophaga sp. Meigen	0	0	0	0	1
Sepsis sp. Fallen	0	0	0	2	1
Sitona griseus Fabricius	0	0	0	1	0
Sitona sp. Germar	0	0	0	3	0
Smaragdina affinis Illiger	0	0	0	0	1
Sphaerophoria scripta L.	1	1	0	1	0
Stevenia deceptoria Loew	0	2	0	4	1
Stictopleurus sp. Stål	0	0	1	1	0
Suillia variegata Loew	0	0	0	0	1
Tachinidae sp. 1	0	0	0	0	1
Tanytarsus sp. van der Wulp	0	0	1	0	0
tribo *Deltocephalini sp*. 3	0	0	1	0	0
tribo *Deltocephalini sp*. 4	0	0	1	0	0
Tryphoninae sp.	0	0	0	0	2
Tytthaspis sedecimpunctata L.	0	0	4	0	0