Flower-visiting arthropods: *Chrysanthemum leucanthemum* Linnaeus, 1753 (Asteraceae) as an attractor for photographic record

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Abstract
Arthropod-plant interactions are one of the most studied relations in nature. More than 80% of angiosperms rely on animals, especially insects, for their pollination, and in turn plants provide nectar and pollen as alimentary resources for their visitors. Non-pollinating invertebrates, like spiders, can also benefit from flowers by preying on other organisms that visit the plant. Flower-visiting arthropods can be easily captured in photographs, which can help register their occurrence and behavior. Thus, this study aimed to record and identify arthropods visiting *Chrysanthemum leucanthemum* using photographic methods. A single clump of daisy flowers was constantly observed to assess the composition of its visiting arthropods, which were recorded using a digital SLR camera Canon EOS 550 D. Twenty-one arthropods were registered visiting the flower clump, including eight spiders and 13 insects of the orders Coleoptera, Diptera, Hymenoptera and Hemiptera. At least three insects were registered feeding on the nectar and other three transporting pollen. Five spiders were registered hiding between or under the petals of the flowers, one among the leaves, and two were registered with their webs, illustrating their sit-and-wait behavior. Moreover, four spiders were also recorded in the moment they attacked their insect prey. These photographic records exemplify the variety of interactions among arthropods and plants, as well as the central role of an Asteraceae flower clump in the richness of arthropods and as an attractor for registering the feeding behavior of insects and spiders in this microenvironment.

Keywords: Ecological interactions, insects, photography, pollination, predation, spiders.

Resumo
Interações entre artrópodes e plantas são uma das relações mais estudadas na natureza. Mais de 80% das angiospermas dependem de animais, principalmente insetos, para sua polinização, e em troca as plantas fornecem néctar e pólen como recursos alimentares para seus visitantes.
Invertebrados não polinizadores, como aranhas, também podem se beneficiar das flores ao predarem outros organismos que visitam a planta. Artrópodes visitantes de plantas podem ser facilmente capturados em fotografias, o que pode ajudar a registrar suas ocorrências e comportamentos. Assim, este estudo objetivou registrar e identificar artrópodes visitantes de *Chrysanthemum leucanthemum* utilizando métodos fotográficos. Uma touceira de flores de margaridas foi constantemente observada para obter a composição de seus artrópodes visitantes, os quais foram registrados utilizando uma câmera digital SLR Canon EOS 550 D. Vinte e um artrópodes foram registrados visitando a touceira de flores, incluindo oito aranhas e 13 insetos das ordens Coleoptera, Diptera, Hymenoptera e Hemiptera. Pelo menos três insetos foram registrados alimentando-se do néctar e outros três transportando pólen. Cinco aranhas foram registradas escondendo-se entre ou abaixo das pétalas das flores, uma entre as folhas, e duas foram registradas com suas teias, ilustrando seu comportamento de senta-espera. Ainda, quatro aranhas foram também registradas no momento em que atacavam suas presas. Estes registros fotográficos exemplificam a variedade de interações entre artrópodes e plantas, assim como o papel central de uma touceira de flores de asterácea na riqueza de artrópodes e como um atrator para o registro do comportamento alimentar de insetos e aranhas neste microambiente.

**Palavras-chave:** aranhas, fotografia, insetos, interações ecológicas, polinização, predação.

**INTRODUCTION**

Interactions between flowering plants and arthropods are essential for their survival. In pollination, insects help plants to reproduce while they obtain their main alimentary resources. Humans also rely on this mutualistic interaction for the world crop production, and the total economic value of pollination has been estimated in € 153 billion annually (Gallai et al. 2009). Furthermore, arthropods also benefit from angiosperms to prey on other flower-visitor invertebrates or to mate (Wardhaugh 2015). Consequently, the number of arthropods that use flower resources, directly or indirectly, is extremely high, emphasizing the role of flowers in the richness and diversity of arthropods (Wardhaugh 2015).

Arthropods that visit flowers can be easily captured in photographs. In science, photographic tools present a great number of applications. This technology has been used to record the occurrence (Lee et al. 2009) and diversity of species (Aued et al. 2018), size of populations (Graham and Roberts 2007), interactions between organisms (Grillo et al. 2018) and to remotely monitor terrestrial and marine...
biodiversity (Glen et al. 2013, Ferrari et al. 2018), among others. Thus, photographs can help to register the occurrence of arthropods involved in the interactions with plants. The aim of this study, therefore, was to record and identify arthropods visiting an exotic flower clump of *Chrysanthemum leucanthenum* Linnaeus, 1753, as well as their feeding behavior, using photographic methods.

**RESULTS**

Twenty-one arthropods were registered visiting the flower clump of *C. leucanthenum* (Figure 1). Of these, eight are spiders (Figure 1 A-H) and 13 are insects, belonging to the orders Coleoptera, Diptera, Hymenoptera and Hemiptera (Figure 1 I-U). At least three insects were registered feeding on the nectar (Figure 1 N, O, R) and other three transporting pollen (Figure 1 J, L, R), two spiders were registered with their webs (Figure 1 C, G) and four spiders were recorded preying on insects that were visiting the flower clump (Figure 2).

Figure 2. Spiders preying on flower-visiting insects over the flowers (A, C, D) and leaves (B) of *Chrysanthemum leucanthemum*. Source: The author.
DISCUSSION

The high richness of arthropods, registered in less than a week, visiting a single flower clump demonstrates the importance of flowers for these invertebrates. It is known that more than 85% of all flowering plants are pollinated by animals (Ollerton et al. 2011), most of them being insects, and that in turn they provide nectar and pollen to the pollinators. The majority of arthropods registered in this study are insects, and several were recorded feeding on the nectar (Figure 1 N, O, R) and transporting pollen (Figure 1 J, L, R). Although Hemipterans are well known to feed on sap from plants by piercing and sucking them, they also represent common flower-visiting insects (Wardhaugh 2015), and two species were recorded over the flower and the leaves (Figure 1 T, U). Consequently, the presence of a flower clump plays a central role in the richness of insects and in sustaining biological interactions among species in this microenvironment.

Apart from the alimentary resources that flowers themselves provide to arthropods, they can also offer an opportunity for predators to find a potential prey. In this case, predators benefit from the high number of other organisms that visit the flower to take a prey, mostly presenting a sit-and-wait behavior (Wardhaugh 2015). As examples, five spiders were registered hiding between or under the petals of C. leucanthemum (Figure 1 A, B, D, E, H), including one belonging to the family Thomisidae, which presents a cryptic coloration matching the flower (Heiling et al. 2005) (Figure 1 A); one spider was found among the leaves of the flower clump (Figure 1 F); one building its web over the petals (Figure 1 C) and another among the leaves (Figure 1 G). Four spiders were also registered in the moment they were attacking their insect preys (Figure 2). These records exemplify the variety of feeding behaviors of predators that benefit from visiting flowers.

The Asteraceae family presents one of the highest richness of species within angiosperms, with more than 30,000 accepted species (The Plant List 2013), and they are visited by a great number of
insects (Torres and Galetto 2002, Araújo et al. 2006), which indicates a generalist pollination system (Torres and Galetto 2002). In this study, the fact of C. leucantheum being an exotic plant seemed to pose no limitation to the high range of visiting arthropods. Additionally, it has been reported that exotic species do provide valuable resources for invertebrates, supporting biodiversity (Salisbury et al. 2015). Therefore, apart from its biological and ecological importance, Asteraceae plants can also act as a natural attractor for photographic registration of visiting insects and other arthropods, as well as an environment to easily assess their feeding behavior and interactions, as revealed in this study.

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REFERENCES


SHORT COMMUNICATION: Flower-visiting arthropods: *Chrysanthemum leucanthemum* Linn. 1753 (Asteraceae) as an attractor for photographic record


