REVISTA DE FOTOGRAFIA CIENTÍFICA AMBIENTAL

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

Ana Carolina Grillo

Centro de Pesquisa e Conservação da Biodiversidade Marinha do Nordeste, Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) Rua Samuel Hardman, 55578000, Tamandaré, Pernambuco, Brasil
Correspondencia: a.grillomonteiro@gmail.com

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 turnplants 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 preys. 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-e-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-visiting 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 leucanthemum* Linnaeus, 1753, as well as their feeding behavior, using photographic methods.

MATERIALS AND METHODS

This study was conducted in the Private Reserve of Natural Heritage Grand Araucaria Forest, located in the municipality of Bom Retiro, in the state of Santa Catarina, Brazil, in November of 2015. The ecosystem is characterized as a mixed ombrophilous forest, or coniferous forest, with the dominance of araucaria pines and a temperate humid climate, with high annual precipitations.

A single flower clump of *C. leucanthemum* was present in the open and sunny study area, surrounded by pastureland. Observations of the flower clump were carried out from three to four times a day, for four consecutive days, during the hottest hours (between 9 am and 3 pm) to assess the composition of the flower-visiting arthropods.

Arthropods were recorded using a digital SLR camera Canon EOS 550 D, EF-S 18-55mm lens *f*/3.5–5.6, and identified to the level of order.

RESULTS

Twenty-one arthropods were registered visiting the flower clump of *C. leucanthemum* (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 1. Arthropods recorded visiting a single flower clump of *Chrysanthemum leucanthemum*. A-H: Araneae (arrows indicating spider web). I-M: Coleoptera. N-Q: Diptera. R,S: Hymenoptera. T, U: Hemiptera. Source: The author.

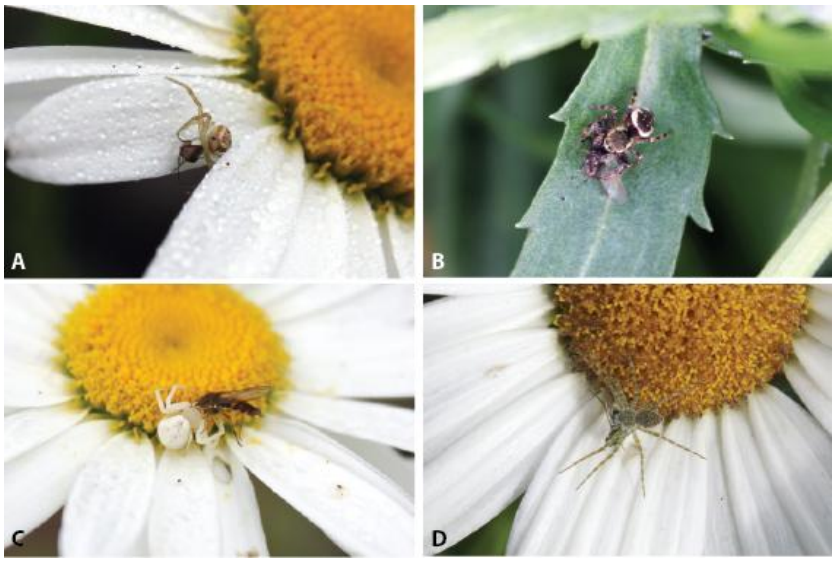

Figure 2. Spiders preying on flower-visiting insects over the flowers (A, C, D) and leaves (B) of *Chrysanthemum leucanthemum*. Source: The author.

DISCUSION

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. leucanthemum* 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.

ACKNOWLEDGMENTS

Special thanks to Felipe Colvara Teixeira for helping with image editing and processing, and to Felipe Miranda Ramos for the help provided in the identification of arthropods.

REFERENCES

Araújo VA, Antonini Y, Araújo APA. 2006. Diversity of bees and their floral resources at altitudinal areas in the Southern Espinhaço Range, Minas Gerais, Brazil.Neotropical Entomology 35(1): 30–40. doi:10.1590/s1519-566x2006000100005

Aued AW, Smith, F Quimbayo JP, Cândido DV, Longo GO, Ferreira CEL, Witman JD, Floeter SR, Segal B. 2018. Large-scale patterns of benthic marine communities in the Brazilian Province.PloS one 13(6), e0198452.doi:10.1371/journal.pone.0198452

Ferrari R, Marzinelli EM, Ayroza CR, Jordan A, Figueira WF, Byrne M, Malcolm HA, Williams SB, Steinberg PD. 2018. Large-scale assessment of benthic communities across multiple marine protected areas using an autonomous underwater vehicle. PloS one13(3), e0193711.doi: 10.1371/journal.pone.0193711

Gallai N, Salles JM, Settele J, Vaissière BE. 2009. Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. Ecological Economics 68(3): 810-821. doi:10.1016/j.ecolecon.2008.06.014

Glen AS, Cockburn S, Nichols M, Ekanayake J, Warburton B. (2013).Optimising camera traps for monitoring small mammals. PloS one8(6), e67940.doi: 10.1371/journal.pone.0067940

Graham RT, Roberts CM. 2007. Assessing the size, growth rate and structure of a seasonal population of whale sharks (*Rhincodontypus* Smith 1828) using conventional tagging and photo identification. Fisheries Research 84(1): 71-80. doi: 10.1016/j.fishres.2006.11.026

Grillo AC, Bonaldo RM, Segal B. 2018. Physical contact interactions with scleractinian corals in hard substrate communities.Marine Ecology 39(1), e12482. doi: 10.1111/maec.12482

Heiling AM, Chittka L, Cheng K, Herberstein ME. 2005. Colouration in crab spiders: substrate choice and prey attraction. Journal of Experimental Biology208(10): 1785-1792. doi: 10.1242/jeb.01585

Lee MT, Yong DL, Ong TP. 2009. A photographic record of Silvery Pigeon *Columba argentina* from the Mentawai Islands, Indonesia, with notes on identification, distribution and conservation. Bulletin of the British Ornithologists' Club 129(3): 122-128.doi: boc1293-090804-cut:BOCBulletin

Ollerton J, Winfree R, Tarrant S. 2011. How many flowering plants are pollinated by animals? Oikos120(3): 321-326. doi: 10.1111/j.1600-0706.2010.18644.x

Salisbury A, Armitage J, Bostock H, Perry J, Tatchell M, Thompson K. 2015. Enhancing gardens as habitats for flower-visiting aerial insects (pollinators): should we plant native or exotic species? Journal of Applied Ecology 52(5):1156-1164. doi: 10.1111/1365-2664.12499

The Plant List. 2013. Versão 1.1. *Royal Botanic Gardens Kew and Missouri Botanic Garden.*Disponível em: http://www.theplantlist.org/1.1/browse/A/Compositae/. Acesso em: 7 de agosto de 2018.

Torres C, Galetto L. 2002. Are nectar sugar composition and corolla tube length related to the diversity of insects that visit Asteraceae flowers? Plant Biology4(3): 360-366. doi: 10.1055/s-2002-32326

Wardhaugh CW. 2015. How many species of arthropods visit flowers? Arthropod-Plant Interactions 9(6): 547-565.doi: 10.1007/s11829-015-9398-4