Sociobiology 64(1): 119-121 (March, 2017) DOI: 10.13102/sociobiology.v64i1.1199

Sociobiology
An international journal on social insects

SHORT NOTE

Kick Out The Ants: A Novel and Striking Behavior in Ant-Wasp Interactions

LS Ricioli, G Mendes, R Guillermo-Ferreira

Department of Hydrobiology, Federal University of São Carlos, São Paulo, Brazil

Article History

Edited by
Jean Santos, UFU, Brazil
Received 28 September 2016
Initial acceptance 07 December 2016
Final acceptance 27 January 2017
Publication date 29 May 2017

Keywords
Kleptoparasitism, mutualism, foraging, competition, savannah, Brazil.

Corresponding author
Rhainer Guillermo-Ferreira.
Universidade Federal de São Carlos
Departamento de Hidrobiologia
Rodovia Washington Luis, Km 235
CEP 13565-905, São Carlos-SP, Brasil
E-Mail: rhainerguillermo@gmail.com

Abstract
Trophobiosis between ants and Hemiptera is widely known. Nevertheless, this interaction can also happen between hemipterans and other animals in a non-mutualistic way. For instance, here we observed the wasp *Pseudopolybia vespiceps* (Hymenoptera: Vespidae) collecting honeydew flickered by *Aethalion reticulatum* (Hemiptera: Cicadomorpha) as an alternative food resource. Field work was conducted during three consecutive days, when we made *ad libitum* behavioral observations using video footage. We noted the behavior of *P. vespiceps* when collecting honeydew from *A. reticulatum*. Strikingly, our observations resulted in the description of novel wasp behavior. The wasps compete with ants for access to hemipterans, first by hovering above the ants, and kicking them out of the plant, until all the ants were removed, and start antennating the aethalionids to obtain honeydew. Studies like this contribute to the understanding of trophic networks that depend on hemipteran honeydew.

Mutualism is an interaction where two organisms obtain higher reproductive success when together than would if they lived without such relationship. Mutualism is clearly profitable for both parts and it is known as an important interaction for survival (Stefani et al., 2015; Del-Claro et al., 2016). There are many forms of mutualism in nature, for instance, the widely known case of the trophobiosis observed between ants and hemipterans (Del-Claro & Oliveira, 1999; Styrsky& Eubanks., 2007). This relationship is based on the hymenopteran use of honeydew, a sweet flavored, carbohydrate rich substance that is excreted by sap sucking insects. The honeydew is exploited as a food resource by ants, which establish a mutualistic relationship with the hemipterans by offering protection in exchange (Del-Claro & Oliveira, 2000).

Wasps can also use honeydew as a food resource (Letourneau & Choe, 1987). Therefore, competition between ants and wasps for access to hemipterans may occur. Wasps establish a foraging territory and exclude ants that attempt to disrupt this exploitative interaction (Dejean & Turillazzi, 1992). In this case, wasps are benefited with the resource exploration while there is no mutualistic relationship with the hemipterans. The opportunistic foraging, also known as kleptobiosis (or kleptoparasitism), is a behavior observed in social wasps, which steal the resource during foraging (Grangier & Lester, 2011; Breed et al., 2012).

In this study, we observed the interaction between *Camponotus crassus* (Hymenoptera: Formicidae) and *Aethalion reticulatum* (Linnaeus, 1767) (Hemiptera: Cicadomorpha) on *Crecopiapa chystachya* Trécul (Urticaceae), where ants collected the honeydew from the hemipterans in exchange for protection (Oliveira & Del-Claro, 1999). More surprisingly, we observed the exploitation of this interaction by the wasp *Pseudopolybia vespiceps* (de Saussure, 1854) (Hymenoptera: Vespidae, Polistinae), which, besides collecting the honeydew and not protecting the hemipteran, kick the ants out of the plant using their forelegs while hovering.

Field work was conducted in the Federal University of São Carlos Campus in São Carlos, São Paulo, Brazil, during

three consecutive days in March 2016. We made *ad libitum* behavioral observations using video footage (Fuji Finepix HS10). We noted the behavior of *P. vespiceps* when collecting honeydew from *A. reticulatum* and excluding ant competitors. The observations were carried out between 10:00AM and 02:00PM.

While the ants were attending the hemipterans (Fig 1a), *P. vespiceps* wasps hovered in circles around the ants and stroke them with the forelegs (supplementary video 1) and landed on the hemipterans (Fig 1b). This behavior started when the wasps flew up, stretched the forelegs and flew down towards the ants, which fell from the plant (Fig. 1c, N =12). Moreover, the hemipterans did not remain inert. The hemipterans attempted to use their hind legs to hit and avoid the wasp, without success. When the wasps had removed most of the ants, the wasps landed on the hemipterans and started to antennate their abdomen (supplementary video 2). Ants and wasps exhibit this tactile stimulus that leads the hemipterans to flick a droplet of honeydew (Styrsky & Eubanks, 2007), however, the wasp did not appear to focus on a specific area, antennating all along the hemipteran body. The wasp spent around 30 seconds hovering in circles and kicking the ants off the plant, and 26.5 seconds (N=2) antennating the hemipterans. The interactions occurred in the lower surface of the leaf, close to the petiole.

This wasp-hemipteran interaction is usually considered non-mutualistic, but a parasitism. Differently from the ant-hemipteran interaction, the wasps provide no protection to the hemipterans. Thus, the wasps only parasitize the ant-hemipteran interaction and exploit the resource without further costs.

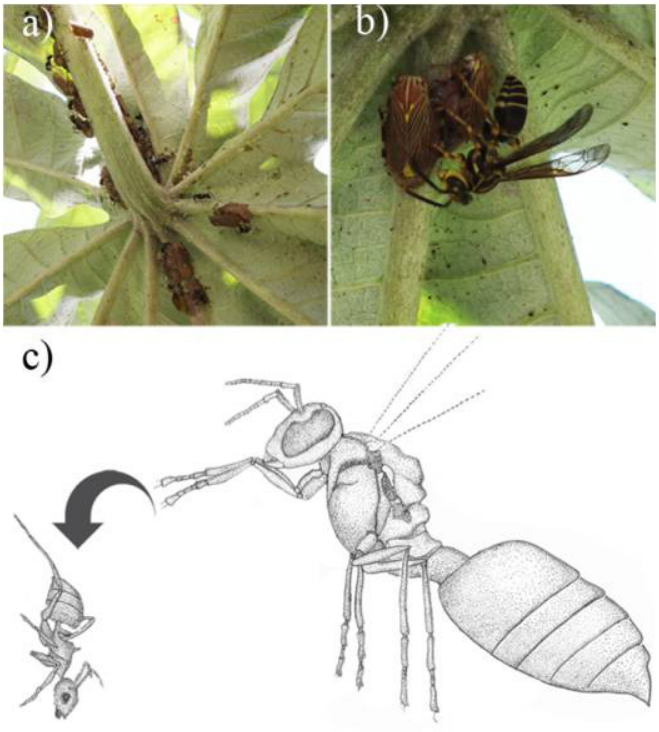

Fig 1. (a) *Camponotus crassus* ants, and (b) *Pseudopolybia vespiceps* wasps collecting honeydew from *Aethalion reticulatum,* and (c) kicking ants out of the plant.

Furthermore, the wasps may imply costs to hemipterans because the interaction with ants is interrupted by force and because the honeydew is lost in a non-profitable interaction. However, although this interaction apparently only benefits wasp, another study suggests that wasps may defend a territory around hemipterans (Dejean & Turillazzi, 1992). In this case, although wasp protection may not be as effective as it would be with ants, wasps may ultimately provide an indirect benefit to hemipterans.

The ant-hemipteran interaction is no novelty. The same mutualism is very usual in nature between ants and aphids (Stadler & Dixon, 2005) and lepidopteran larvae (Kaminski et al., 2013). Wasp-hemipteran interactions can also be commonly found (Letorneau & Choe, 1987; MacCarroll & Reeves, 2004), however, the interference behavior adopted by wasps is rarely reported (Dejean & Turillazzi, 1992). As a rare case, *Vespula vulgaris* wasps pick ant workers with their mandibles, fly backwards and drop them far from the food resource (Grangier & Lester, 2011). The interaction between *C. crassus* and *P. vespiceps* can be considered an exploitative interaction, where wasps exclude ant competitors and exploit a coevolutionary trait of ant-hemipteran interactions.

Several insect species have been reported to collect honeydew from *A. reticulatum*, such as the stingless bees *Trigona branneri* (Barônio et al., 2012), *T. spinipes* (Vieira et al., 2007), *T. hyalinata* (Oda et al., 2009), *Oxytrigona tataira* (Hymenoptera: Apidae, Meliponini) (Oda et al., 2014), and *Camponotus crassus* ants (Brown, 1975). Here we show the case of *P. vespiceps*, which is a species considered an indicator of high conservation status of riparian forests (de Souza et al., 2010). Therefore, we suggest that Hemiptera-hymenopteran interactions in the Brazilian Cerrado may be an important factor for insect conservation and maintenance of ecological processes (Styrsky & Eubanks, 2007).

Acknowledgments

We thank Ana Paula Guaratini, Aline Mandelli, Diogo Silva Vilela and Gustavo Rincon Mazão for valuable comments in the initial version of the manuscript. We thank Fernando Barbosa Noll for wasp RGF thanks CNPq and FAPESP for constant financial support.

Suppplementary material

Video 1
http://dx.doi.org/10.13.102/sociobiology.v64i1.1199.s1374
http://periodicos.uefs.br/index.php/sociobiology/rt/suppFileMetadata/1199/0/1374

Vídeo 2
http://dx.doi.org/10.13.102/sociobiology.v64i1.1199.s1375
http://periodicos.uefs.br/index.php/sociobiology/rt/suppFileMetadata/1199/0/1375

References

Barônio, G., Pires, A. C. V. & Aoki, C. (2014). *Trigona branneri* (Hymenoptera: Apidae) as a collector of honeydew from *Aethalion reticulatum* (Hemiptera: Aethalionidae) on *Bauhinia forficata* (Fabaceae: Caesalpinoideae) in a Brazilian savanna. Sociobiology, 59: 407-414.

Breed, M.D., Cook, C. & Krasnec, M.O. (2012). Cleptobiosis in Social Insects. Psyche, 484765. doi:10.1155/2012/484765

de Souza, M. M., Louzada, J., Eduardo Serráo, J. & Cola Zanuncio, J. (2010). Social wasps (Hymenoptera: Vespidae) as indicators of conservation degree of riparian forests in Southeast Brazil. Sociobiology, 56: 387-396.

Dejean, A. & Turillazzi, S. (1992). Territoriality during trophobiosis between wasps and homopterans. Tropical Zoology, 5: 237-247. doi: 10.1080/03946975.1992.10539196

Del-Claro, K. & Oliveira, P. S. (1999). Ant-homoptera interactions in a neotropical savanna: the honeydew-producing treehopper, *Guaya quilaxiphias* (Membracidae), and its associated ant fauna on *Didymopanax vinosum* (Araliaceae). Biotropica, 31: 135-144. doi: 10.2307/2663967

Del-Claro, K. & Oliveira, P.S. (2000). Conditional outcomes in a neotropical treehopper-ant association: temporal and species-specific variation in ant protection and homopteran fecundity. Oecologia, 124:156-165. doi: 10.1007/s004420050002

Del-Claro, K., Rico-Gray, V., Torezan-Silingardi, H. M., Alves-Silva, E., Fagundes, R., Lange, D., & Rodriguez-Morales, D. (2016). Loss and gains in ant–plant interactions mediated by extrafloral nectar: fidelity, cheats, and lies. Insectes Sociaux, 63: 207-221. doi:10.1007/s00040-016-0466-2

Grangier, J. & Lester, P.J. (2011). A novel interference behaviour: invasive wasps remove ants from resources and drop them from a height. Biology Letters,rsbl20110165.doi: 10.1098/rsbl.2011.0165

Kaminski, L. A., Mota, L. L., Freitas, A. V. & Moreira, G. R. (2013). Two ways to be a myrmecophilous butterfly: natural history and comparative immature-stage morphology of two species of *Theope* (Lepidoptera: Riodinidae). Biological Journal of the Linnean Society, 108: 844-870. doi: 10.1111/bij.12014

Letourneau, D. K. & Choe, J. C. (1987). Homopteran attendance by wasps and ants: the stochastic nature of interactions. Psyche, 94: 81-91.

MacCarroll, M. A. & Reeves, W. K. (2004). Attendance of *Aetalion reticulatum* (Hemiptera: Aetalionidae) by *Polistes erythrocephalus* (Hymenoptera: Vespidae) in Peru. Entomological news, 115: 52-53.

Oda, F. H., Aoki, C., Oda, T. M., da Silva, R. A. & Felismino, M. F. (2009). Interação entre abelha *Trigona hyalinata* (Lepeletier, 1836) (Hymenoptera: Apidae) e *Aethalion reticulatum* Linnaeus, 1767 (Hemiptera: Aethalionidae) em *Clitoria fairchildiana* Howard (Papilionoideae). Entomobrasilis, 2: 58-60.

Oda, F. H., de Oliveira, A. F. & Aoki, C. (2014). *Oxytrigona tataira* (Smith) (Hymenoptera: Apidae: Meliponini) as a collector of honey dew from *Erechtia carinata* (Funkhouser) (Hemiptera: Membracidae) on *Caryocar brasiliense* Cambessèdes (Malpighiales: Caryocaraceae) in the Brazilian Savanna. Sociobiology, 61: 566-569.

Stadler, B. & Dixon, A. F. (2005). Ecology and evolution of aphid-ant interactions. Annual review of Ecology, Evolution, and Systematics, 36: 345-372. doi: 10.1146/annurev.ecolsys.36.091704.175531

Stefani, V., Pires, T. L., Torezan-Silingardi, H. M. & Del-Claro, K. (2015). Beneficial effects of ants and spiders on the reproductive value of *Eriotheca gracilipes* (Malvaceae) in a tropical savanna. Plos One, 10: e0131843. doi: 10.1371/journal.pone.0131843

Styrsky, J. D. & Eubanks, M. D. (2007). Ecological consequences of interactions between ants and honeydew-producing insects. Proceedings of the Royal Society of London B: Biological Sciences, 274: 151-164. doi: 10.1098/rspb.2006.3701

Vieira, C. U., Rodovalho, C. D. M., Almeida, L. O., Siqueroli, A. C. S. & Bonetti, A. M. (2007). Interação entre *Trigona spinipes* Fabricius, 1793 (Hymenoptera: Apidae) e *Aethalion reticulatum* Linnaeus, 1767 (Hemiptera: Aethalionidae) em *Mangifera indica* (Anacardiaceae). Bioscience Journal, 23: 10-13.