



SHORT NOTE

Plesiobiotic Associations Between Ants: A Common Yet Underreported Phenomenon in the Mediterranean Region?

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Article History

Edited by

Evandro Nascimento Silva, UEFS, Brazil

Received 25 September 2022

Initial acceptance 02 November 2022


Final acceptance 08 January 2023

Publication date 10 February 2023

Keywords

Ant nests, ant-termite associations, cleptobiosis, Sicily.

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Abstract

Among ants, plesiobiotic associations are defined as occasional or regular nesting of heterospecific colonies nearby and without any biological interdependence. Habitats with a scarcity of available nesting microhabitats and ecological dissimilarity between the involved species are supposed to favor the frequency of plesiobiosis. In the last review published on this topic, the authors summarized all the plesiobiotic species pairs reported in the literature for the Holarctic region, listing 48 species pairs. Based on our field investigation in the Mediterranean island of Sicily (Italy), we report additional 81 plesiobiotic ant-ant species pairs, two associations of three ant species, and four ant-termite pair associations. We suggest plesiobiosis to be severely underreported rather than rare, at least in the Mediterranean region.

Introduction

Plesiobiosis is the most rudimentary form of heterospecific association among ants. It is probably the least studied, it consists of a minimum of two heterospecific colonies nesting separately but nearby (e.g., under the same rock, log, stump, etc.), without any biological interdependence; the two colonies do not mix their members, which may potentially be hostile if encounters take place (Kanizsai et al., 2013). Other forms of heterospecific association are based on colony mixing within a single nest (e.g., temporary social parasitism, inquilinism) or on separate nesting characterized by meaningful biological interactions favoring one (e.g., cleptobiosis, lestobiosis) or both colonies (parabiosis) (Wasmann, 1891; Wheeler, 1901; Hölldobler & Wilson, 1990; Buschinger, 2009). Note that the term parabiosis is sometimes used to describe only the trail-following behavior of certain ant species, which may create misunderstandings (Schifani et al., 2022).

The chances of plesiobiotic associations taking place are thought to be increased by the degree of dissimilarity between the ant species involved (decreasing the potential competition): plesiobiotic species usually belong to different genera. They have different diets and foraging strategies (Kanizsai et al., 2013). Moreover, ecological constraints that limit the number of suitable nesting sites may force species together and be key to the emergence of plesiobiosis (Czechowski, 2002; 2004; Kanizsai et al., 2013). Kanizsai et al. (2013) compiled a key review of plesiobiotic associations among ants of the Holarctic realm, where plesiobiosis was observed the most: they reported 48 plesiobiotic pairs, mostly dominated by *Formica fusca* Linnaeus, 1758 and *Lasius flavus* (Fabricius, 1782). Additional nine associations were recorded more recently (Gallé et al., 2014; Kvitte et al., 2017; Balzani et al., 2022).

During our myrmecological exploration of the Mediterranean island of Sicily (Italy) (see Schifani et al., 2021),



we detected several plesiobiotic associations between ants or ants and termites. These observations were overlooked, only part of them was annotated, and unfortunately, only a few details were reported. However, the number of annotated associations, which are reported for the first time, is still very significant to the overall understanding of plesiobiosis between ants.

Material and methods

Observations were conducted in eastern Sicily during 1991-1997 by A. Alicata and in western Sicily during 2016-2019 by E. Schifani. Ant and termite species were identified based on samples observed under a stereoscopic microscope thanks to the following taxonomic literature: Emery (1916), Sanetra et al. (1999), Boer (2013), Luchetti et al. (2013), Scicchitano et al. (2018), Alicata and Schifani (2019), Galkowski et al. (2019), Seifert (2019; 2020), Schifani et al. (2021).

Results

Results are presented in detail in the supplementary table. A total of 81 ant-ant plesiobiotic associations were discovered under stones, while in two cases, associations involved three ant species at once. Moreover, four ant-termite associations were discovered under stones or in deadwood. The involved ant species were 41, belonging to 17 genera, while two termite species from two genera were also found. In all cases, nests of the different species were not directly in contact when they were discovered.

Discussion

The species found in associations are about one-third of the total number of species currently known from Sicily and include most of the commonly encountered ones (Schifani et al., 2021; Schifani, 2022). The most frequently observed species in plesiobiotic associations was *Aphaenogaster semipolita* (Nylander, 1856), endemic to Sicily and a very small southern area of Calabria, which is particularly common and widespread on the island. Donisthorpe (1927) earlier recorded plesiobiotic associations between *A. semipolita* and *Camponotus micans* (Nylander, 1856) from Mondello (Palermo, Sicily), which was missed by Kaniszai et al. (2013). The high frequency of *A. semipolita* in such associations may be partly attributed to its natural abundance and other biological or ecological traits. Notably, no supercolonial species was ever involved, probably because their populous colonies would alone occupy all the available space under a rock.

The observed associations largely follow the rule that the species involved should not be particularly similar in their morphology, foraging strategies, and general lifestyle and generally belong to different genera (Kaniszai et al., 2013). In more than half of the cases, the associated species belong to different subfamilies, mostly Formicinae and Myrmicinae,

while Myrmicinae-Myrmicinae associations represented about one-third of the cases. The only associations of ants of the same genus involved two *Aphaenogaster* species, one which mainly forages aboveground and one which mainly forages underground (*A. pallida* (Nylander, 1849) and *A. semipolita*). There was no apparent scarcity of stones under which nests could be built in any of the investigated sites. However, targeted investigations would be needed to evaluate if a scarcity of favorable microhabitats had a role in favoring plesiobiosis. When stones under which multiple ant species nested were lifted, fragile boundaries between them would break. The ants of different colonies behaved unfriendly towards each other, either escaping contact or attacking. Fights were sometimes quite destructive (e.g. *Bothriomyrmex corsicus* Santschi, 1923 workers quickly eliminated all the visible workers of a neighboring *Solenopsis* cf. *latro* Forel, 1894 nest).

Some of the associations we reported may not be truly plesiobiotic. It is the case of those involving *Solenopsis* ants. While their taxonomy and phylogeny in the region are poorly resolved (Schifani et al. 2021), it is suggested that species such as *S. cf. latro* may be facultative cleptobiotics in the same way as *S. fugax* (Latreille, 1798) (Seifert 2018). Ant-termite associations may also involve predation (Tuma et al., 2020), yet no termite-specialist predatory ant is known in Europe (apart from a recent introduction by Menchetti et al., 2022). More in general, when considering if plesiobiosis may lead to parasitism, it is important to note that social parasitism among ants tends to follow, at least in its broader interpretation, Emery's rule (Degueldre et al., 2021), while plesiobiotic pairs usually consist in very different ants (Kaniszai et al., 2013). The number of plesiobiotic associations reported in this paper and observed in Sicily is larger than the number of associations hitherto reported for the whole Holarctic region, which leads us to think that this phenomenon is severely underreported rather than rare.

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