

Abstract*

The specialization in groups of ants tending aphid colonies (Hymenoptera: Formicidae; Homoptera: Aphididae)

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Data are reported on a comparative analysis of the behaviour and work organization of different ant species tending aphids in multi-species communities. The "teams" of ants tending separate aphid colonies (milkers) are shown to include both "passive" and "active" foragers. The functions of the former are usually restricted to collecting and transporting honeydew. Active foragers are multifunctional. They can guard trophobionts, search for new aphid colonies and even coordinate the group activity to some extent in addition to the common functions (collecting and transporting honeydew). The comparative analysis of the schemes of interaction of different ant species with aphids has revealed that the depth of functional differentiation in working groups of milkers is caused by the requirements of an ant colony for carbohydrate food. One of the main factors causing "deep specialization" in the groups appears to be the ant colony numbers. Different species of ants have been found to use definite schemes of interaction with aphids; ranging from the individual foraging of unspecialized milkers to "professional specialization" in working groups. The most complicated interaction was observed for ants with numerous colonies (*Formica* s. str.) dominating in multi-species communities (REZNIKOVA & NOVGORODOVA 1998, NOVGORODOVA 2004). It is characterized by the clear division of two main functions (protection of the aphid colony and honeydew collecting) in constant "teams" of ants tending separate aphid colonies. The largest number of professional groups ("shepherds", "guards", "scouts" and "transporters") was noted only for red wood ants (*Formica rufa* LINNAEUS, 1761 group), whereas merely two groups ("shepherds" and multifunctional "guards") were discerned in the "teams" of *Formica pratensis* RETZIUS, 1783 ants living in smaller colonies (NOVGORODOVA 2005). Other members of multi-species ant communities demonstrate simpler schemes based on a partial division of labour (*Camponotus saxatilis* RUZSKY, 1895) or individual foraging by unspecialized milkers (*Formica fusca* LINNAEUS, 1758, *F. cunicularia* LATREILLE, 1798 and *Lasius niger* (LINNAEUS, 1758)). Another factor regulating the depth of professional specialization appears to be the available resources (the num-

ber and productivity of the trophobionts). On the one hand, insufficient carbohydrate food resources were found to lead to reorganization of the milkers' work and the appearance of constant protection of the aphid colonies by *F. fusca*, *F. cunicularia*, and *L. niger*. This was observed in nature and was demonstrated in experiments involving a decrease in the available aphid colonies from 10 to 1. The number of ants (*F. cf. cunicularia*) attending the last remaining aphid colony increased as did their aggressiveness. The ants started to protect the aphids to some extent. On the other hand, decrease in the aphids' productivity, on the underground parts of the plants in autumn in particular, proved to lead to a simplification of the organization of *Formica* s. str. milkers' work. The number of ants collecting honeydew in the separate aphid colonies decreased. Only non-aggressive "shepherds" (with / without "transporters") still took care of the aphids. There were no "guards", so the effectiveness of protection was lower. On the whole, the specialization in the working groups seems to be facultative. A tendency for the functional differentiation in the ant "teams" to deepen is observed as the ant colony numbers increase and also as a consequence of insufficient food resource at both intra- and interspecies levels.

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