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Nest relocation in the ant *Myrmecina graminicola* (Hymenoptera: Formicidae)

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Abstract

Nest relocation behaviour of *Myrmecina graminicola* (LATREILLE, 1802) is described for the first time. In laboratory conditions, the colonies were prompted to move from one nest site to another at a distance of about 20 cm. Obstacles in the arena forced the emigration to proceed via an indirect route. After removal of the obstacles during the relocation the ants continued to proceed along the pre-formed path for 10 minutes, evidently guided by a pheromone trail. No nest scouting, invitation, worker carrying, tandem running or other recruitment behaviour was observed. With the exception of brood all colony members walked to the new nest, including alate sexuals and the queen.

Key words: *Myrmecina graminicola*, nest relocation, trail pheromone.

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Introduction

Recruitment behaviour in ants is usually employed in the context of foraging for food, and in nest relocation. A variety of techniques such as social carrying, tandem running and trail laying have been described (HÖLLDOBLER & WILSON 1990). However, recruitment during relocation has been studied in only a small number of species. The first observations of nest relocation in *Myrmecina graminicola* (LATREILLE, 1802) are reported here.

This species has small colonies and nests in the ground or under large rocks. It is a secretive but common ant throughout large parts of Europe. Due to its secluded nesting and foraging habits in the soil and in leaf litter, very little is known of its life history. Ordinary dealate queens (gynomorphs) live in monogynous colonies, whereas colonies with intermorphic (more or less workerlike) queens may be polygynous (BUSCHINGER & SCHREIBER 2002, BUSCHINGER 2005, STEINER & al. 2006). Mated intermorphs apparently return to the mother colonies.

Nest relocation in this species was observed in the laboratory as well as in the field. First, in laboratory culture the colonies were sometimes forced to move from one chamber to another within their three-chambered formicaries when the site of the first nest had to be cleaned. Often the ants formed a noticeably Z-shaped column through the middle chamber, in transit from the old nest chamber to the new nest in the third chamber. Secondly, putative colony fissions were observed in situ on two occasions, when collecting colonies located beneath rocks in the field. The colonies were polygynous with several intermorphic queens each, and the larger colony was linked to a second "nest" by a small column of workers going back and forth and carrying larvae towards the presumed new nest. These observations lead the author to study nest relocation behaviour in more detail, i.e., search for conditions in which the formation of emigration columns became recognizable.

Materials and methods

Colonies of *Myrmecina graminicola* were collected in appropriate habitats in southern Hesse and northern Bavaria, Germany (BUSCHINGER & SCHREIBER 2002). They were kept in artificial annual daylength and temperature cycles of 9 - 10 months for up to five years. The colonies were housed in 3-chambered plastic formicaries of 10 cm × 10 cm × 3 cm (l × w × h) with a 3 mm bottom of plaster (BUSCHINGER 1974). The three chambers were connected by two holes in the separating walls.

The "nest" itself consisted of a plastic frame (3 mm thick), covered by a microscopic slide (76 × 26 mm) and a cover of clear, red plastic for dimming the light (Fig. 1). In contrast to BUSCHINGER (1974) the "nests" had no bottom so that the ants were sitting on the plaster floor of the formicary.

The plaster bottom was kept humid in the nest chamber, dry in the central chamber where food (diluted honey and insect pieces) was provided, and humid in the third chamber with a small dish containing drinking water. Formicaries with colonies were placed in arenas of 30 cm × 20 cm size, with an additional empty formicary each in opposite corners. Holes in the walls of the nest chambers provided access to the arena (Fig 1). The experiments were run with two colonies and were repeated three and four times, respectively.

The arena contained two obstacles (glass blocks of 4 cm × 4 cm × 1 cm) that did not permit the formation of a straight trail between the two entrance holes. The walls of the glass blocks and of the arena were coated with a thin layer of liquid paraffin that prevented the ants from climbing the walls.

Colonies were prompted to move from the original formicary by removing the covering "nest" (i.e., the frame and lid and red foil) and exposing the ants to light. They soon found the exit to the arena, and then after a while,

the new nest in the second formicary. Two to three days after they had moved to the new nest they had settled there, such that another nest relocation could be elicited, usually back into the original formicary. The arenas were washed out after each experiment and the position of the two formicaries and the obstacles was altered so that any former pheromone trails deposited by ants were destroyed.

Results

When a nest (frame and lid) was removed, most of the ants remained in place with the brood, often for several hours. A fraction of the workers swarmed out, walking erratically through the formicary, or through the arena. *Myrmecina graminicola* is a slowly moving species, but any kind of trail laying or recruitment could never be observed. Often after ½ or 1 hour, a few ants had arrived independently at the new nest, as if by chance. Carrying of brood began slowly, and increasingly more ants joined the first ones, eventually forming a column of ants walking in both directions (Fig. 2). Since the ants were not individually marked it was not possible to say whether the first ants that returned from the new nest initiated brood transportation. Once brood transport began, the relocation normally was completed about 20 - 30 minutes later.

During the relocations, neither an invitation behaviour of a "scout" to follow the trail, nor a tandem running was observed, and no social carrying behaviour occurred. Only the brood instars were carried to the new nest. Young female sexuals and even the queen had to walk by themselves. In one instance, the colony queen needed 55 minutes between the old and the new nest.

Only 3-5 males were present in the two colonies. Apparently they were unable to join the column or to follow the trail. They stumbled around and, eventually, somehow arrived at the entrance of the new nest.

In experimental arenas with obstacles an emigration trail was formed along the edges of the formicaries and the glass blocks. When the obstacles were removed, the ants followed the same indirect route for several minutes, as if the obstacles had remained in the arena.

Figure 2 depicts the situation just prior to removal of the glass blocks; Fig. 3 shows the column five minutes later. At least for up to 10 minutes, most ants stuck to the trail while a few ones tried separate paths individually. A straight, direct connection between the two formicary entrances never formed after removal of the obstacles.

Discussion

Nest relocation in small ant colonies such as those of *M. graminicola* has been studied in a few species only. In *Leptothorax* (MÖGLICH & al. 1974, MÖGLICH & HÖLLDOBLER 1974) and in *Temnothorax* (LANE 1977; *Leptothorax unifasciatus* (LATREILLE, 1798) is now in the genus *Temnothorax*), nest relocation is initiated by scouts who lead nest mates singly by tandem running to a new nest site. Then brood and additional nest mates are carried to the target. The leading or carrying ants are assumed to orient themselves visually.

WILSON & HÖLLDOBLER (1986) reported on the emigration behaviour of a neotropical species with similarly small colonies, *Basiceros manni* BROWN & KEMPF, 1960. Like *M. graminicola*, they are slow-moving and "freeze" (feign death) when disturbed. For emigration, however, workers that have detected a new suitable nest site stimulate their nest mates tactically to search for it on their own.

Fig. 1: Overview of the experimental setup. Left: the nest in the left chamber of the formicary is covered with a piece of red foil. Top right: a second formicary. After the colony had moved into this formicary a few days earlier, the nest and red film were removed. The ants clustered outside of the entrance and began to form a column towards the old formicary. Two glass obstacles prevented the formation of a straight trail between the two formicary entrances.

Fig. 2: A well-defined column has formed.

Fig. 3: The two obstacles were removed at 12:04. The ants continued using the trail at 12:09.

In *M. graminicola* no obvious recruitment behaviour for nest relocation could be detected. This corresponds to the fact that food recruitment apparently also is lacking: During years of rearing numerous colonies nothing like recruitment to the food dishes had ever been seen.

The observations in *M. graminicola* are somewhat preliminary and should be repeated under varying conditions.

At first glance the ants seemed to orient thigmotactically along the walls. However, removing the obstacles revealed that a pheromone trail must exist.

In the field, such nest relocations may be comparatively frequent given (I) the very probable foundation of new colonies by fission of polygynous colonies (with intermorphic queens), and (II) the destruction of nests by rooting wild boars. Also burying moles and voles may come close to the nests making them uninhabitable. This has been observed in the areas where the author had collected the experimental colonies. Nest relocations most probably take place beneath the surface.

The experimental design may be helpful for studying nest relocation also in other small and subterranean ant species.

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Zusammenfassung

Das Verhalten beim Nestumzug von *Myrmecina graminicola* (LATREILLE, 1802) wird erstmals beschrieben. Die Kolonien wurden unter Laborbedingungen zum Umzug von einer Nistgelegenheit zu einer anderen in 20 cm Entfernung gezwungen. Sie mussten aufgrund von Hindernissen in der Arena einen gewundenen Weg ablaufen. Wurden während des Umzugs die Hindernisse entfernt, folgten die Ameisen dem gewundenen Kurs weiterhin für bis zu 10 Minuten, wobei sie offenbar durch eine Pheromonspur geleitet wurden. Scouting, ein Einladungsverhalten, soziales Tragen, Tandemlauf oder eine andere Art von Rekrutierungsverhalten wurden nicht beobachtet. Abgesehen von der Brut mussten alle Koloniemitglieder einschließlich geflügelter Geschlechtstiere und der Königin selbständig laufen.

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