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First observation of an ant colony of *Formica fuscocinerea* Forel, 1874 invaded by the social parasite *F. truncorum* Fabricius, 1804 (Hymenoptera, Formicidae)

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Abstract

In the northern Alps of Switzerland we observed a mixed ant colony of *Formica truncorum* Fabricius, 1804 and *F. fuscocinerea* Forel, 1874 at the foot of a schoolhouse wall in the built-up centre of the small town of Näfels (canton of Glarus). Based on the fact that the habitat is favorable only for *F. fuscocinerea* and that *F. truncorum* is a notorious temporary social parasite, we conclude that in this case a colony of *F. fuscocinerea* must have been usurped by *F. truncorum*. This is remarkable, as it is the first reported case where a colony of *F. fuscocinerea* has been taken over by a social parasite. We consider the observed unusually small workers of *F. truncorum* to be a starvation form. This is probably due to the suboptimal urban nest site, as this species typically occurs along the edge of forests or in clearings.

Key Words

Central Europe, northern Alps, social insects, temporary social parasitism, urban ecology

Introduction

Parasitism is an extremely common life history strategy. Adopting a broad definition – obligate feeding on a living organism without (at least immediately) causing the death of the host – about half of all animal species can be considered parasites (Poulin and Morand 2000, 2004). In social insects (namely some ants, bees and wasps), however, there is a very particular mode of life called interspecific temporary social parasitism, in which a parasite species depends on a host species during its colony-founding phase (Forel 1898; Wilson 1971; Hölldobler and Wilson 1990). The host queen is replaced by an invading, freshly mated parasite female, which will then start to lay her own eggs and thus become the queen herself. The host workers will nurse the parasite queen's brood until they gradually die off. With the death of the last host worker, the founding phase of the parasite colony ends. By this time, there is a large population of the parasite's own offspring available to run the nest (Kutter 1968; Buschinger 1986, 2009).

There are 24 ant species of the genus *Formica* Linnaeus, 1758 recorded from Switzerland (Neumeyer and Seifert 2005). These species are classified in four subgenera, two of which (*Formica* subgenus *Formica* and *Formica* subgenus *Serviformica* Forel, 1913) are of interest here. While in *Serviformica* the inseminated females of all ten species occurring in Switzerland (Neumeyer and Seifert 2005) can establish a colony independently, those of the other species of the genus *Formica* occurring in Switzerland are incapable of doing so (Kutter 1968, 1977; Seifert 2018). For colony establishment the females of *Formica* subgenus *Formica* either need existing colonies of the same species or those of a species of *Formica* subgenus *Serviformica*. Only females of *Formica truncorum* Fabricius, 1804 may

occasionally also parasitize colonies of *Formica polyctena* Förster, 1850 (Kutter 1968), which belongs to the subgenus *Formica*. But otherwise also females of *F. truncorum* invade colonies of the subgenus *Serviformica*, such as *Formica fusca* Linnaeus, 1758 (Seifert 2018) and probably also *Formica lemani* Bondroit, 1917 (Kutter 1956).

Most species of the subgenus *Serviformica* are predominantly monodomous, that is the population of the whole colony is united in a single nest. These species are generally prone to social parasites (Kutter 1968; Seifert 2018). Only the three representatives (*Formica cinerea* Mayr, 1853; *F. fuscocinerea* Forel, 1874; *F. selysi* Bondroit, 1918) of the *Formica cinerea* group (Seifert 2002) are known for their tendency to form polydomous supercolonies with the population inhabiting several spatially distributed nests (Kutter 1968; Seifert 2018). These species are hardly ever invaded by social parasites. While the widespread species *Formica cinerea* has been reported to serve as a host of socially parasitic ants (Czechowski 2001; Zacharov 2015; Seifert 2018), we are not aware of any case of previously reported social parasitism in *F. selysi* or *F. fuscocinerea*.

Materials and methods

In the course of inventorying the ants of selected reserves in the canton of Glarus located in the northern Alps of Switzerland, we also tried to locate some of the hitherto missing species from the *Formica cinerea* group in built-up areas not existing in the reserves. We collected the ants by hand or using a small insect aspirator (pooter). The ants were killed and preserved in ethanol (80%). They were examined with the help of a stereo microscope (Olympus SZH10) with ring illumination using magnifications between 10× and 70×. The specimens were identified by Rainer Neumeyer following the key in Seifert (2018). The identification was later confirmed by Bernhard Seifert (Görlitz). Voucher specimens are deposited in the entomological collection of the Senckenberg Museum in Görlitz, Germany. The collection locality of the specimens reported in this article is in the center of the small town of Näfels (population 4000) in the canton of Glarus in Switzerland. The street address is *Im Dorf 14b*, the elevation is 440 meters above sea level and the coordinates are 47.09944°N and 9.06223°E. The colony was found at the cobbled foot of the south-facing wall of the school building, erected in 1877 (Fig. 1). Its neighborhood is largely urban, although the outer boundary of the built-up area is only about 200 meters away in north-western direction. In addition, about 400 meters to the west there is a steep forest with interspersed rock faces (https://s.geo.admin.ch/8dd530cefe).

Results

Searching our study area for colonies of *Formica fuscocinerea* we discovered one small colony in sandy soil between cobble stones along the building wall. At the nest entrance we not only found workers of *Formica fuscocinerea* (Fig. 2), but also somewhat more numerous ants of the parasitic species *Formica truncorum* Fabricius, 1804 (Fig. 3) on 25th May 2020 at 6:30 p.m. After a preliminary identification of some specimens, we returned to the site four days later, on 29th May 2020 at 1 p.m. for taking pictures and recording video footage (https://youtu.be/nSY1wzVkigs). We collected two voucher specimens of each species emerging from the nest entrance.

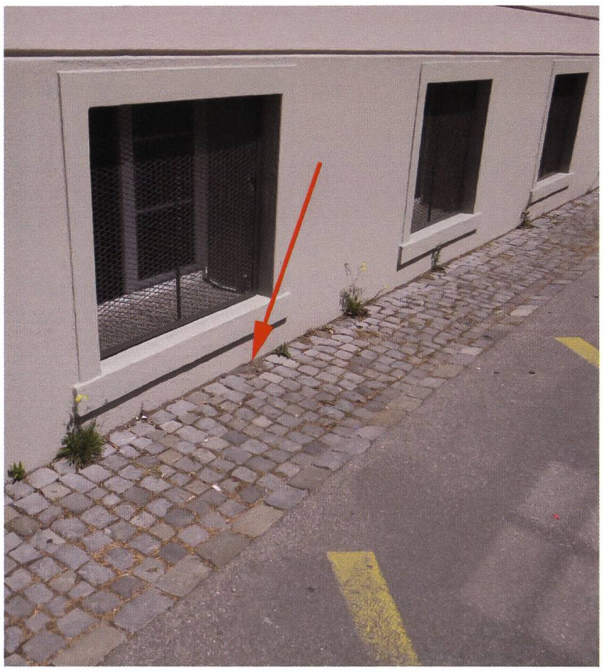

Figure 1. Location of the only active nest entrance of the examined small colony along the south-facing wall of the school building. Photo: Rainer Neumeyer.

The workers of *Formica truncorum* were all below average in size – hardly larger than the workers of the host species *F. fuscocinerea* – and at first sight they resembled small workers of *Formica rufa* Linnaeus, 1761 in terms of their dark pigmentation, especially on the head (Fig. 3). In contrast, in medium and large workers of *F. truncorum*, the whole head is uniformly light reddish brown in the vast majority of cases (Seifert 2018: 134–135).

We observed the nest entrance for 15 minutes in sunny and windless conditions at 21 °C, counting a total of five workers (one *Formica fuscocinerea* and four *F. truncorum*) returning to the colony and eleven (four *Formica fuscocinerea* and seven *F. truncorum*) emerging from the colony. Along the south- and west-facing wall of the school building we found three additional ant species, namely *Lasius emarginatus* Olivier, 1792, *Myrmica sabuleti* Meinert, 1861 and *Tetramorium impurum* (Förster, 1850). When we returned to the site on 17th September 2020, the nest entrance had apparently shifted almost a meter to the west in the meantime. However, this does not necessarily mean that the colony had also moved its underground nest chambers.

Figure 2. Close-up of a worker of the host species *Formica fuscocinerea*. Photo: Jürg Sommerhalder.

Figure 3. Close-up of a worker of the socially parasitic species *Formica truncorum*. Its dark head marking is typical for nanitic workers of this species, but not for normal sized ones. Photo: Jürg Sommerhalder.

Discussion

All species of *Formica* subgenus *Formica* occurring in Switzerland – including *Formica truncorum* – can establish their colonies as interspecific temporary social parasites of colonies of certain species of *Formica* subgenus *Serviformica* (Kutter 1968). Another potential explanation for our observation would be if *Formica truncorum* was behaving in a dulotic manner, that is hunting slaves from *F. fuscocinerea* to be brought to an already existing *F. truncorum* colony. However, within the genus *Formica,* in Europe so far only *Formica* (*Raptiformica*) *sanguinea* Latreille, 1798 is known to behave in this way (Kutter 1968; Buschinger 2009). Thus, we rather assume that at the schoolhouse of Näfels a female of *Formica truncorum* usurped a nest of *F. fuscocinerea* after her nuptial flight. This assumption seems justified given that the built-up habitat is typical only for *F. fuscocinerea* (Kutter 1977; Seifert 2018), a species originally inhabiting alluvial sand and gravel banks, nowadays also anthropogenic habitats such as gravel pits, industrial wastelands and the interior of settlements. *F. truncorum,* on the other hand, is a species typically occurring in habitats such as at the edge of forests or in clearings, moreover, also in bogs developing to heathland and bushy xerothermic grassland (Seifert 2018). Therefore, in this case we exclude the possibility of a daughter colony formation of *F. truncorum* with subsequent dulosis.

As we have seen, common nests of *F. truncorum* and *F. fuscocinerea* are likely to remain the exception, if only because the two species generally colonize different habitats and accordingly encounter each other at most in transitional areas. In addition, *Formica fuscocinerea* is known to form vigorous supercolonies (Seifert 2018), which can be expected to be difficult to approach for any socially parasitic female. However, as Seifert (2018: 312–313) reported, it appears that *Formica fuscocinerea* retained the potential for single-queen colony foundation at least in certain regions. Accordingly, we conclude that the observed nest entrance belonged to a small monogynous (single-queen) or even queenless colony of *Formica fuscocinerea*, when it was taken over by the social parasitic *F. truncorum* female. In fact, we were not able to locate another colony of *Formica fuscocinerea* in the immediate area surrounding the schoolhouse. Given the relatively few host workers left, the colony was most likely taken over already in 2019, if not 2018.

Nanitic workers are somewhat smaller than usual ones. They are rather characteristic of the initial phase of a colony founded claustrally, i.e. by independent colony foundation in a closed cavity (founding chamber) by a single, recently mated female (Hölldobler and Wilson 1990; Seifert 2018). These smaller workers are expected to occur only when food is scarce and needs to be saved (Peeters and Ito 2015). They are therefore perhaps best understood as starvation forms (Dejean and Dejean 1998). Consequently, nanitic workers are less likely to occur after a social parasitic colony takeover, where food-supplying workers of the host species are available from the beginning. Hence, the fact that we nevertheless observed exclusively dwarf workers of *Formica truncorum* suggests that the present colony is starving, probably because the colony is located in an urban setting, an environment that is certainly not ideal for this particular species (Seifert 2018). As suggested by Bernhard Seifert (pers. comm.), it can be expected that the colony will need to relocate to a more favorable habitat to avoid perishing. However, the nearest suitable habitats are at least 400 meters further west in the forest and scree of the steep mountain slopes rising to an elevation of more than 1000 meters above sea level within a distance of about 1200 meters. Several hundred meters is likely to be an insurmountable distance for a relocating colony. At best, it could be covered in a stepwise fashion over the course of several years. Indeed, observations on such a migrating *F. truncorum* population in Finland suggest relocation distances of 95 meters at most per year (Elias et al. 2005). For such a stepwise migration the colony would have to rely on suitable stepping stone habitats such as gardens and meadows with trees.

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References

Buschinger A (1986) Evolution of social parasitism in ants. Trends in Ecology and Evolution 1(6): 155–160. https://doi.org/10.1016/0169-5347(86)90044-3

Buschinger A (2009) Social parasitism among ants: a review. Myrmecological News 12: 219–235.

Czechowski W (2001) Mixed colony of *Formica pratensis* Retz. + *Formica cinerea* Mayr + *Formica sanguinea* Latr. and its presumed origin. Annales Zoologici (Warszawa) 51(2): 205–209.

Dejean A, Dejean A (1998) How a ponerine ant acquired the most evolved mode of colony foundation. Insectes Sociaux 45: 343–346. https://doi.org/10.1007/s000400050093

Elias M, Rosengren R, Sundström L (2005) Seasonal polydomy and unicoloniality in a polygynous population of the red wood ant *Formica truncorum*. Behavioral Ecology and Sociobiology 57: 339–349. https://doi.org/10.1007/s00265-004-0864-8

Forel A (1898) La parabiose chez les fourmis. Bulletin de la Société Vaudoise des Sciences Naturelles 34(130): 380–384.

Hölldobler B, Wilson EO (1990) The Ants. Springer, Berlin, 732 pp. https://doi.org/10.1007/978-3-662-10306-7

Kutter H (1956) Beiträge zur Biologie palaearktischer *Coptoformica*. Mitteilungen der Schweizerischen Entomologischen Gesellschaft 29: 1–18.

Kutter H (1968) Die sozialparasitischen Ameisen der Schweiz. Neujahrsblatt auf das Jahr 1969 der Naturforschenden Gesellschaft in Zürich 171: 1–62.

Kutter H (1977) Hymenoptera: Formicidae. Insecta Helvetica, Fauna 6: 1– 298.

Neumeyer R, Seifert B (2005) Kommentierte Liste der frei lebenden Ameisen in der Schweiz. Mitteilungen der Schweizerischen Entomologischen Gesellschaft 78: 1–17.

Peeters C, Ito F (2015) Wingless and dwarf workers underlie the ecological success of ants. Myrmecological News 21: 117–130.

Poulin R, Morand S (2000) The diversity of parasites. The Quarterly Review of Biology 75(3): 277–293. https://doi.org/10.1086/393500

Poulin R, Morand S (2004) Parasite Biodiversity. Smithsonian Books, Washington, 215 pp.

Seifert B (2002) A taxonomic revision of the *Formica cinerea* group. Abhandlungen und Berichte des Naturkundemuseums Görlitz 74(2): 245–272.

Seifert B (2018) The Ants of Central and North Europe. Lutra, Tauer, 407 pp.

Wilson EO (1971) The Insect Societies. Belknap Press of Harvard University Press, Cambridge, 548 pp.

Zacharov AA (2015) Ants of Forest Communities, their Life and Role in the Forest [in Russian]. KMK Scientific Press, Moscow, 404 pp.