First Record of the Inquiline Ant *Leptothorax kutteri* Buschinger, 1965 from Turkey

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**Abstract**

We report on the occurrence of the ant *Leptothorax kutteri* Buschinger, 1965 in two sites in Northern and Eastern Turkey. *Leptothorax kutteri* is a workerless inquiline living in the colonies of *L. acervorum* (Fabricius, 1793) so far known from various parts of Northern and Central Europe. Our findings greatly increase the range of this small and rare ant.

**Introduction**

Ant societies typically are protected against intruders or parasites through a highly efficient system of nestmate recognition. Nevertheless, numerous species of arthropods and other animals have evolved mechanisms of invading the nests of ants by masking themselves with or mimicking the recognition cues of their hosts. In addition to myrmecophile beetles, crickets, flies, etc. (Kronauer & Pierce, 2011) this includes the socially parasitic ants, i.e., ants that rather than establishing their own colonies temporarily or permanently rely on the support of workers from other ant species (Buschinger, 2009).

Inquiline ants have the most derived life history of social parasites, as they have completely lost or greatly reduced the worker caste (Buschinger, 2009). Queens of many inquiline ants live alongside the host queen and host workers and produce only sexual offspring, while host workers take over all daily duties, such as brood care, foraging, and nest defense. Because of their strict dependence on host ants, inquilines typically can be found only in dense host populations, and spotting the few inquiline queens among the host ants is often difficult. Our knowledge about the occurrence and distribution of inquilines is therefore incomplete and novel findings are worth of being mentioned.

We here report on the occurrence of *Leptothorax kutteri* Buschinger, 1965 (previously also referred to as *Doronomyrmex kutteri*) from two sites in Northern and Eastern Turkey. *Leptothorax kutteri* is a workerless social parasite of the Holarctic myrmicine *Leptothorax acervorum* (Fabricius, 1793). Originally described from a dry pinewood close to Nuremberg, Germany, it has thence been recorded from the Massif Central in France (Blatrix et al., 2013), the Alps (Winter, 1972; Buschinger, 1992, 1999), various sites in Scandinavia and Finland (Douwes & Buschinger, 1983; Saaristo, 1995; Ødegard et al., 2015), Estonia (Maavara, 1981), in Northern Russia in Karelia (V.E. Kipyatkov, pers. comm.) and the Nenets Autonomous Okrug (Paukkunen & Kozlov, 2020) and Poland (Radchenko & Czechowski, 1997; Borowiec, 2006) (see also Seifert, 2018). The finding in Turkey greatly increases the known range of this rare ant.
Materials and Methods

During the survey of the ant fauna of Turkey we found two colonies of *L. acervorum* containing very small queens, female sexuals, and pupae. One nest (12/3071b), with one dealate queen and three winged female sexuals, was found on 12.08.2012 in a very old *Pinus sylvestris* L. and *Picea orientalis* (L.) forest under a stone at Şavşat, Arsiyan Plateau (Artvin prov., N 41°24' 26", E 42°28' 09") at 2214 m (Fig 1). The other colony (13/3684c), with one winged female sexual, was found in a very old *P. sylvestris* and *Abies nordmanniana* (Steven) Spach forest in a rotten pine tree trunk on 24.08.2013, Mesudiye, Arıkmusa Village (Ordu prov., N 40°24' 37", E 37°55' 24") at 1914 m (Fig 2), 385 km WSW of the first site. Colony 13/3684b contained also a morphologically aberrant male. Table 1 lists other ant species found in these two sites.
Mounted specimens were measured using a Keyence VHX-500FD digital microscope at 200x magnification following the definitions of various measures given by Seifert (2018). The collected material is deposited in the Entomological Museum of Trakya University (EMTU), Turkey.

Results and Discussion

The small queens and female sexuals found in colonies of *L. acervorum* in Turkey closely match the original description of *L. kutteri* by Buschinger (1965), photos of this species (Batrix et al., 2013; Borowiec, 2006; Seifert, 2018) and also mounted queens and female sexuals of *L. kutteri* collected near the type locality in 1994 (collection J. Heinze) in their small size and the presence of a pronounced ventral, postpetiolar tooth (Fig 3). The measures of most traits of Turkish specimens (Table 2) are in the range given by Seifert (2018) for *L. kutteri* from Europe, and disagreements, e.g., in head shape and mesosoma width, might be due to different instruments and slightly different methodology. The propodeal spines of the Turkish samples (propodeal spine index appr. 1.6) are similar in length to those in specimens from the type locality and Switzerland (propodeal spine index 1.4-1.6, Kutter, 1967), but shorter than those in *L. kutteri* from Massif Central (propodeal spine index 1.94, Batrix et al., 2013).

**Table 1.** List of ant species collected in the two sites in Turkey.

| Arsiyan Plateau                                      | Arkmusa Village                  |
|------------------------------------------------------|----------------------------------|
| *Camponotus ligniperda* (Latreille, 1802)            | *Aphaenogaster* sp. (*A. subterranea* species group) |
| *Formica cunicularia* Latreille, 1798                | *Camponotus oertzeni* Forel, 1889 |
| *Formica fusca* Linnaeus, 1758                       | *Camponotus piceus* (Leach, 1825) |
| *Formica rufibarbis* Fabricius, 1793                 | *Formica cunicularia* Latreille, 1798 |
| *Formica sanguinea* Latreille, 1798                  | *Formica fusca* Linnaeus, 1758    |
| *Lasius flavus* (Fabricius, 1782)                    | *Formica rufa* Linnaeus, 1761    |
| *Leptothorax acervorum* (Fabricius, 1793)            | *Lasius alienus* (Foerster, 1850) |
| *Leptothorax muscorum* (Nylander, 1846)              | *Lasius flavus* (Fabricius, 1782) |
| *Manica rubida* (Latreille, 1802)                    | *Leptothorax acervorum* (Fabricius, 1793) |
| *Myrmica anatolica* Elmes, Radchenko, Aktaç, 2002    | *Leptothorax muscorum* (Nylander, 1846) |
| *Myrmica hellenica* Finzi, 1926                      | *Leptothorax scanni* Ruzsky, 1905 |
| *Myrmica ruginodis* Nylander, 1846                   | *Messor* cf. *structor*           |
| *Temnothorax tuberum* (Fabricius, 1775)              | *Myrmica caucasicola* Arnol’di, 1934 |
| *Tetramorium* cf. *caespitum*                        | *Myrmica lonae* Finzi, 1926       |
|                                                      | *Myrmica ruginodis* Nylander, 1846 |
|                                                      | *Tapinoma erraticum* (Latreille, 1798) |
|                                                      | *Temnothorax unifasciatus* (Latreille, 1798) |
|                                                      | *Tetramorium* cf. *caespitum*     |

In contrast to the type material, the discoidal cell in the forewing of female sexuals is closed by a well-developed transverse medio-cubital vein in three individuals from both collecting sites. Furthermore, the frontal area between clypeus and median ocellus is more heavily sculptured (Fig 4) than reported for the type and specimens from Sweden (e.g., see https://www.antweb.org/bigPicture.do?name=antweb1041362&shot=h&number=1).

**Fig 3.** Female sexual of the inquiline ant *Leptothorax kutteri* from Arkmusa Village, Turkey.

**Fig 4.** Head of a female sexual of the inquiline ant *Leptothorax kutteri* from Arsiyan Plateau in frontal view, Turkey.
Like *L. kutteri* from Europe, the specimens from Turkey differ from the other two recognized palearctic inquilines of *L. acervorum*, *L. goesswaldi* Kutter, 1967 and *L. pacis* (Kutter, 1945) in their shorter and less dense hairs and a less concave clypeus with a straight anterior margin.

The male found in the colony from Mesudiye Arıkmusa Village was strikingly different from previously reported males of *L. acervorum*, *L. kutteri*, and other inquiline species (Fig 5). Its petiole and postpetiole had a very peculiar, inflated shape, which resembled those found in teratological phenotypes of *L. acervorum* (Fig 36 in Buschinger & Stoewesesda, 1971; Dekoninck et al. 2012).

As sequencing of the mitochondrial genes CO I/CO II failed due to the presence of nuclear copies (unpublished results), it cannot be excluded that a closer morphological and genetic examination might reveal the Turkish material to form a phylogenetic lineage distinct from other populations of *L. kutteri*. Inquilines have been suggested to evolve sympatrically within the populations of their hosts via intraspecific parasitism and queen size polymorphism (Buschinger, 1990; Bourke & Franks, 1991; Savolainen & Vepsäläinen, 2003). *Leptothorax acervorum* is one of the two ant species with the widest native geographical distribution (e.g., Heinze & Hölldobler, 1994; Schär et al. 2018) and it is therefore not surprising that inquilinism has evolved repeatedly. This is evidenced by the occurrence of the two other inquilines of *L. acervorum* but also by a striking polymorphism of chromosome numbers between *L. kutteri* populations from the type locality, Sweden, and the Alps (Buschinger & Fischer, 1991) and considerable morphological variation in different populations in Finland (Saaristo, 1995). In case additional collection revealed the “morphologically aberrant” males to be the regular males of the inquiline, the hypothesis that the Turkish specimens belong to a novel species would clearly have to be reassessed. At present we consider the single male to be a deformed

### Table 2. Morphometry of female sexuals of the inquiline ant *Leptothorax kutteri* collected in two sites in Turkey. Measures are as defined by Seifert (2018).

|                | Arsiyan Plateau | Arıkmusa |
|----------------|----------------|----------|
| Max. head length, CL | 668 707 699 677 | 667 667 | 707 683.6 |
| Max. head width, CW | 620 620 604 623 | 603 603 623 614 |
| CL/CW            | 1.077 1.140 1.157 1.087 | 1.106 1.077 1.157 1.114 |
| CS = (CL+CW)/2   | 644 664 652 650 | 635 635 664 649 |
| Distance of frontal carinae, FRS/CS | 0.377 0.387 0.422 0.392 | 0.375 0.375 0.422 0.391 |
| Max. scape length, SL/CS | 0.682 0.713 0.655 0.671 | 0.712 0.655 0.713 0.687 |
| Mesosoma width, MW/CS | 0.891 0.907 0.861 0.849 | 0.885 0.849 0.907 0.879 |
| Mesosoma height, MH/CS | 0.876 0.833 0.826 0.851 | 0.962 0.826 0.962 0.870 |
| Mesosoma length, ML/CS | 1.593 1.546 1.587 1.592 | 1.631 1.546 1.631 1.590 |
| Distance of propodeal spines at base, SPBA/CS | 0.323 0.323 0.367 0.352 | 0.391 0.323 0.391 0.351 |
| Distance of propodeal spines at tip, SPTI/CS | 0.384 0.405 0.419 0.395 | 0.433 0.384 0.433 0.407 |
| Length of propodeal spines, SP/CS | 0.219 0.197 0.178 0.212 | 0.219 0.178 0.219 0.205 |
| Distance between propodeal stigma and tip of propodeal spine, SPST/CS | 0.374 0.330 0.365 0.352 | 0.323 0.323 0.374 0.349 |
| Petiole width, PeW/CS | 0.314 0.271 0.313 0.311 | 0.324 0.271 0.324 0.307 |
| Petiole height, PeH/CS | 0.424 0.428 0.497 0.468 | 0.463 0.424 0.497 0.456 |
| Postpetiole height, PpW/CS | 0.480 0.458 0.503 0.478 | 0.469 0.458 0.503 0.478 |
| Length of longest seta on posterior margin of head, OccHL/CS | - 0.112 0.098 0.106 | 0.137 0.098 0.137 0.113 |

Fig 5. Teratological male found together with a female sexual of the inquiline ant *Leptothorax kutteri* in Arıkmusa Village, Turkey.
phenotype and conclude that the Turkish specimens are *L. kutteri*. This greatly increases the range of this species, with the geographically closest population in Southeastern Poland (Radchenko & Czechowski 1991) more than 1600 km to the Northwest of the sites in Turkey. Other inquilines found in the nests of *Leptothorax* also appear to have a surprisingly wide range: *L. goesswaldi*, originally known from the French and Swiss Alps and Scandinavia, has been documented in East Kazakhstan (Schultz & Buschinger, 2006), and *L. wilsoni* Heinze, 1989, first described from New Hampshire, New Brunswick, and Québec, has also been found on the other side of the continent, in Montana, Alberta, and Alaska (Buschinger & Schumann, 1994; www.antweb.org).

The finding of *L. kutteri* adds to the list of socially parasitic species reported from Turkey. Within the myrmicine tribe of Crematogastriini, to which *Leptothorax* belongs, it so far included several slavemaking ants (e.g., *Harpagoxenus sublaevis* (Nylander, 1849) and several species of *Temnothorax*, formerly referred to as *Chalepoxenus* and *Myrmoxenus*, Heinze & Kauffman, 1993; Kiran & Karaman, 2020), but no inquilines. Apart from this tribe, a number of workerless parasites have previously been reported from Turkey, including one new species of the “ultimate social parasite,” *Teleutomyrmex seiferti* Kiran & Karaman, 2017 (now synonymized as *Tetramorium seiferti*) (Kiran et al., 2017), *Tetramorium atratulum* (Schenck, 1852) (formerly *Anergates atratulus*), *Plagiolepis ampeloni* (Faber, 1969) and *Plagiolepis xene* Stärcke, 1936 (Kiran & Karaman, 2020). It is likely that further research will reveal additional populations of rare inquilines in this extraordinarily biodiverse country.

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Authors’ Contributions

KK: conceptualization, methodology, investigation, resources, writing – review & editing, project administration, funding acquisition.
CK: conceptualization, methodology, investigation, resources, writing – review & editing, project administration, funding acquisition.
JH: conceptualization, methodology, investigation, resources, writing – original draft, visualization,

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