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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 ants 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.

Fig 1. Collecting site of Arsiyan Plateau, Turkey, where the inquiline ant *Leptothorax kutteri* was found in a nest of *Leptothorax acervorum*.

Fig 2. Collecting site of Arıkmusa Village, Turkey, where the inquiline ant *Leptothorax kutteri* was found in a nest of *Leptothorax acervorum*.

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 (Blatrix 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, Blatrix et al., 2013).

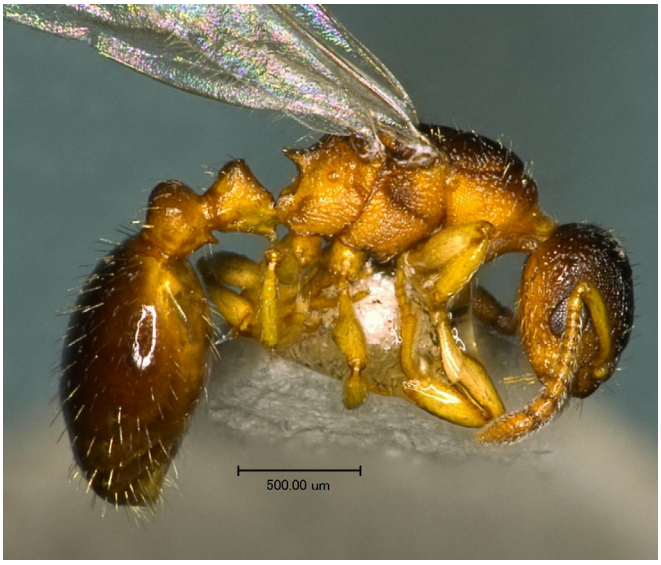

Fig 3. Female sexual of the inquiline ant *Leptothorax kutteri* from Arıkmusa Village, Turkey.

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).

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

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

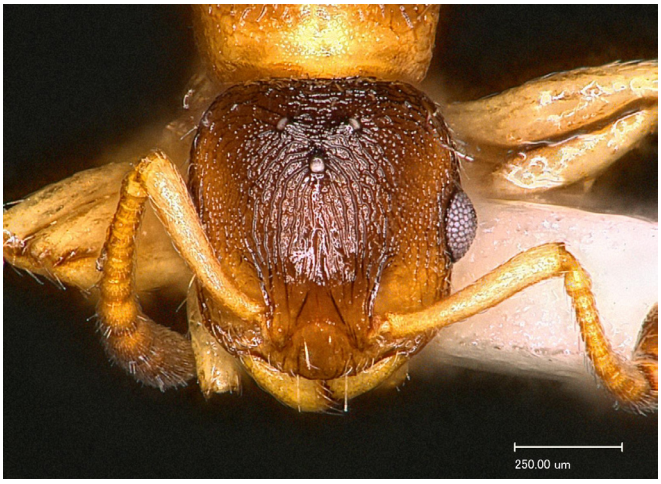

Fig 4. Head of a female sexual of the inquiline ant *Leptothorax kutteri* from Arsiyan Plateau in frontal view, Turkey.

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 & Stoewesand, 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

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			
	1	2	3	4		Min.	Max.	Mean
Max. head length, CL	668	707	699	677	667	667	707	683.6
Max. head widht, 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.

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

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 Crematogastrini, 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 & Kauffmann, 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 (Heinze & Kauffmann, 1993; 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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