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First discoveries of colonies of the rare ant species *Camponotus tergestinus* Müller, 1921 (Hymenoptera: Formicidae) *in situ*

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Abstract. The rare ant species *Camponotus tergestinus* Müller, 1921 has so far been reported from few central and southern European localities, but none of its colonies have ever been recorded *in situ*. In 2016 and 2017, two colonies were found at Lipica (SW Slovenia), the first nesting on *Quercus pubescens* at the height of 3.2 m, the second on *Q. cerris* at the height of 2.2 m. Both nests had two entrances each. Numerous visits have been carried out at the site in order to observe both colonies. Based on available data, *Camponotus tergestinus* is an arboricolous species having a strong association with oaks. Its arboricolous and presumably nocturnal habits could be the main reasons for the paucity of available data. A list of all known localities, retrieved from both published and unpublished records, is also provided.

Key words: ants, *Camponotus tergestinus*, *Quercus*, nest, behaviour, distribution, Slovenia

Izvleček. Prva odkritja kolonij redke vrste mravlje *Camponotus tergestinus* Müller, 1921 (Hymenoptera: Formicidae) *in situ* – Redka vrsta mravlje *Camponotus tergestinus* Müller, 1921 je bila doslej najdena na maloštevilnih lokalitetah v srednji in južni Evropi, a doslej ni bila najdena še nobena kolonija *in situ*. V letih 2016 in 2017 smo našli dve koloniji v Lipici (JZ Slovenija). Prva je imela mravljišče na puhastem hrastu (*Quercus pubescens*) na višini 3,2 m, druga na ceru (*Q. cerris*) na višini 2,2 m. Obe mravljišči sta imeli po dva vhoda. Opravili smo več obiskov lokalitete z namenom opazovanja obeh kolonij. Na podlagi razpoložljivih podatkov lahko domnevamo, da je *Camponotus tergestinus* drevesna vrsta, ki je močno povezana s hrasti. Drevesni in domnevno nočni način življenja je verjetno glavni razlog za majhno število razpoložljivih podatkov. Pripravili smo tudi seznam vseh znanih lokalitet, pridobljen iz objavljenih in neobjavljenih podatkov.

Ključne besede: mravlje, *Camponotus tergestinus*, *Quercus*, mravljišče, vedenje, razširjenost, Slovenija

Introduction

Camponotus Mayr, 1861 is the second most speciose ant genus in Europe, containing 58 species (Czechowski et al. 2012). Most *Camponotus* species occurring in Central Europe have relatively well known biology and distribution (Seifert 2007, Markó et al. 2009, Czechowski et al. 2012, Wagner 2014). One exception is *Camponotus tergestinus* Müller, 1921, a rarely collected taxon, whose ecology and life-history are almost unknown. Müller (1921) described a worker from Coloncovez near Trieste (Italy) and a queen from nearby Lipica (Slovenia). Subsequently, the species was only sporadically reported from some central and southern European countries (Menozzi 1928, Agosti & Collingwood 1987, Ionescu-Hirsch et al. 2009, Ješovnik et al. 2011, Lapeva-Gjonova & Kiran 2012, Wiezik & Wieziková 2013). Usually, only single specimens were found at each locality or reported from collections. So far, only two colonies were discovered, but not *in situ*. Müller (1921) found a hibernating colony in oak wood brought as firewood to the Trieste Museum from Coloncovez. In the second case, *C. tergestinus* was found in the Port of Haifa (Israel) in a container with oak logs from Plopeni (Romania) (Ionescu-Hirsch et al. 2009). Consequently, it was presumed that this species is associated with oak forests and nests in wood in the tree canopies (Ionescu-Hirsch et al. 2009, Wiezik & Wieziková 2013), although no colonies were found in living trees.

Here we report on the first discovery of two arboricolous colonies of *C. tergestinus* from Lipica in southwestern Slovenia, as well as on our observations carried out during multiple visits to the site in 2016 and 2017. Also, we list all known localities of *C. tergestinus*, retrieved from both published and unpublished records.

Materials and methods

In 2016, we were performing a general inventory of the ant fauna in the area of Lipica (southwestern Submediterranean Slovenia). The area is covered by thermophilous meadows and pastures with scattered oaks, Submediterranean karst forest and scrub. After our finding of some *Camponotus tergestinus* workers on a tree, we repeatedly visited the site in 2016 and 2017. We discovered the *C. tergestinus* colonies by climbing the tree with a ladder and following any detectable worker. Later, we performed further observations of the colonies from a distance of at least two metres to prevent ants from seeing us. During our visits we also looked for other ant species living in the same tree.

Results

Overview of all *Camponotus tergestinus* records

So far, *C. tergestinus* is known from 13 localities (Tab. 1, Fig. 1). The records from Lipica include a queen (Müller 1921) and the two colonies mentioned in the present paper.

Table 1. All known records of *Camponotus tergestinus*.
Tabela 1. Vsi znani podatki za vrsto *Camponotus tergestinus*.

Site	Country	Reference
Coloncovez near Trieste	Italy	Müller 1921
Lipica	Slovenia	Müller 1921 new records
Bologna	Italy	Menozzi 1928
Turkish Thrace	Turkey	Agosti & Collingwood 1987
Fóti Somlyó Mt.	Hungary	Ionescu-Hirsch et al. 2009
Plopeni (Prahova County)	Romania	Ionescu-Hirsch et al. 2009
Cetăţuia (Tulcea County)	Romania	Ionescu-Hirsch et al. 2009
Nera Valley near Damian (Caraş-Severin County)	Romania	Ionescu-Hirsch et al. 2009
Paklenica National Park	Croatia	Ješovnik et al. 2011
Sinemorets (Tsarevo district)	Bulgaria	Lapeva-Gjonova & Kiran 2012
Štiavnické vrchy Mts.	Slovakia	Wiezik & Wieziková 2013
Camigliatello Silano (Calabria)	Italy	unpublished record, F. Rigato, pers. comm. 2017
Antalya	Turkey	unpublished record from ant collection of Cedric Collingwood, stored in National Museums Liverpool

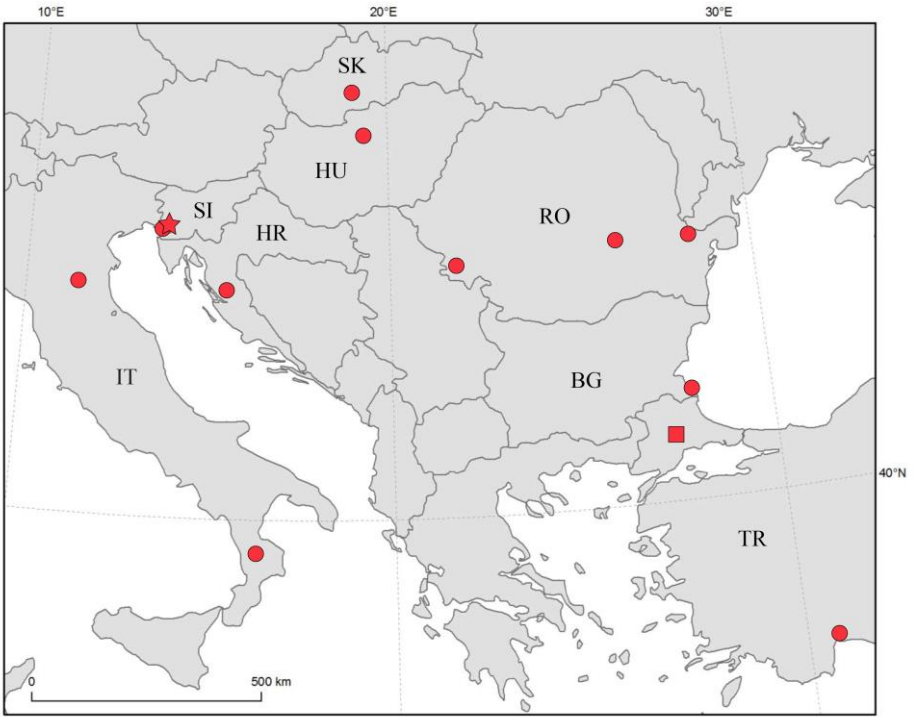

Figure 1. Known records of *Camponotus tergestinus* (Lipica is marked with a star, an unspecified locality from Turkish Thrace with a rectangle).
Slika 1. Znani podatki o vrsti *Camponotus tergestinus* (Lipica je označena z zvezdo, nespecificirana lokaliteta iz Turške Trakije pa s kvadratom).

Description of *C. tergestinus* nest sites from Lipica

On 21. 5. 2016 we discovered some *C. tergestinus* workers walking on the branch of a pubescent oak (*Quercus pubescens*). The oak was approximately 12 m high, standing isolated in a karst meadow near the entrance to the Lipica Stud Farm estate, 45°39.62'N, 13°53.46'E, 410 m a.s.l. Since we could not find any *C. tergestinus* nest, we revisited the site on 18. 7. 2016 and discovered a colony (colony A) in a burl on one of oak's four main branches at the height of 3.2 m (Fig. 2A). The nest had two entrances 15 cm apart and with diameter of approximately 5 mm each (Fig. 3A).

On 17. 5. 2017, while inspecting several other oaks in the area, we found another colony of *C. tergestinus* (colony B) nesting on a Turkey oak (*Quercus cerris*) inside the Lipica Stud Farm estate, 45°39.69'N, 13°53.44'E, 410 m a.s.l., 150 m from colony A. The tree was approximately 15 m high, standing in the meadow/pasture with other scattered oaks. The nest

was located in a tree knot on the trunk at the height of 2.2 m (Fig. 2B). As in the case of colony A, the nest had two entrances 3 cm apart and with diameters of 6 mm and 3 mm, respectively (Fig. 3B).

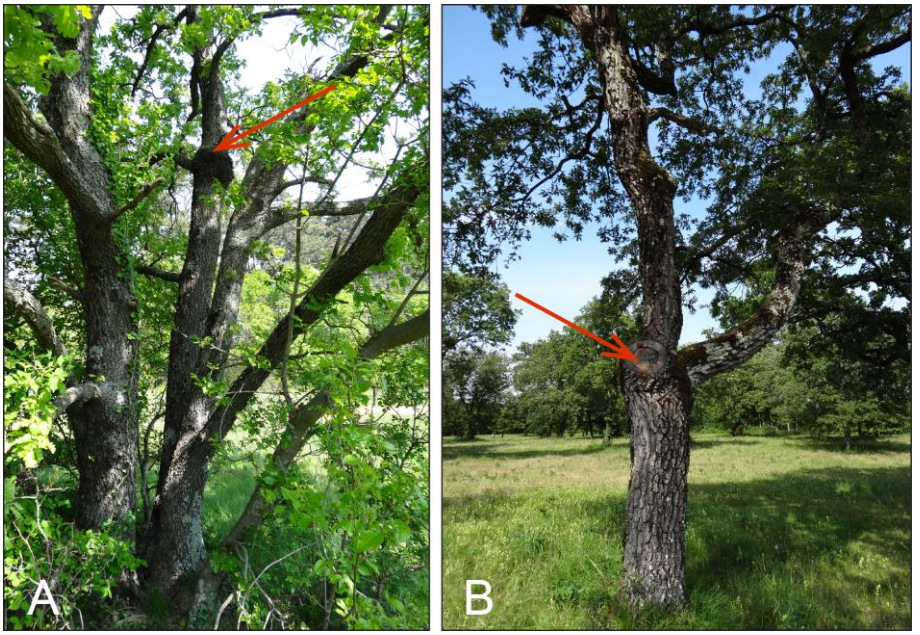

Figure 2. Position of the nests of *Camponotus tergestinus* colonies from Lipica (pointed by an arrow): A – colony A nest on *Quercus pubescens*, B – colony B nest on *Quercus cerris*.
Slika 2. Položaj mravljišč kolonij *Camponotus tergestinus* iz Lipice (označen s puščico): A – mravljišče kolonije A na *Quercus pubescens*, B – mravljišče kolonije B na *Quercus cerris*.

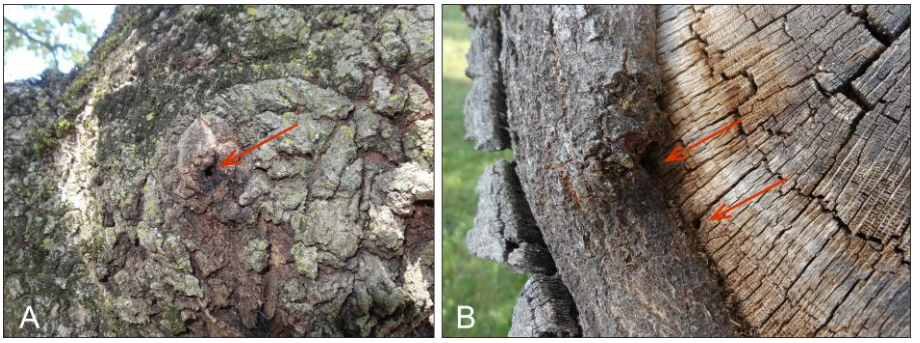

Figure 3. Nest entrances of *Camponotus tergestinus* colonies from Lipica (pointed by arrows): A – one of the two nest entrances of colony A, B – the two nest entrances of colony B.
Slika 3. Vhodi mravljišč kolonij *Camponotus tergestinus* iz Lipice (označeni s puščicami): A – eden od dveh vhodov mravljišča kolonije A, B – vhoda mravljišča kolonije B.

Observations of *C. tergestinus* colonies

We visited and observed both colonies several times (Tab. 2).

Table 2. Observations of *C. tergestinus* colonies from Lipica.
Tabela 2. Opazovanja kolonij *C. tergestinus* iz Lipice.

Date	Time period	Weather conditions	Colony	Notes
21.5.2016	afternoon	sunny, T 23°C–24°C	A	few individual workers were spotted in the tree
18.7.2016	morning	sunny, T 27°C–29°C	A	nest discovered
1.10.2016	12h–13h	changeable cloudy, T around 20°C	A	one worker outside the nest
1.5.2017	11h–12h	sunny, T 18°C	A	no workers in the tree; later, some came out lured with a blade of straw (Fig. 4)
17.5.2017	16h–17h	changeable cloudy and windy, T 22°C	A	4 workers leaving/entering the nest to/from the upper parts of the tree
17.5.2017	afternoon	mostly sunny and windy, T 21°C	B	nest discovered
30.5.2017	8.45h–9.45h	sunny, T 24°C–25°C	A	16 workers leaving/entering the nest, all but one to/from the upper parts of the tree
30.5.2017	10.15h–11.15h	sunny, T 25°C–26°C	B	4 workers leaving/entering the nest to/from the upper parts of the tree
30.5.2017	15h–16h	sunny, T 26°C–27°C	A	6 workers leaving/entering the nest to/from the upper parts of the tree
30.5.2017	16.30h–17.30h	sunny, T 27°C	B	one worker entering the nest from upper parts of the tree
27.7.2017	14h–15h	sunny, T around 28°C	A	one worker entering the nest from upper parts of the tree
23.9.2017	11h–12h	changeable cloudy, T around 19°C	A	no workers in the tree
4.10.2017	16.30h–17.30h	mostly sunny, 18°C–19°C	A	one worker leaving the nest to the upper parts of the tree
4.10.2017	20h–21h (night observation)	14°C–15°C	A	some 30 workers outside the nest, most of them descending to the height of about half a metre; then going to the contiguous main branch where they were directed to the upper parts of the tree; five workers were carrying nestmates (adult transport)

Figure 4. *Camponotus tergestinus* workers of colony A after being lured out from the nest with a blade of straw (on the left a *Crematogaster schmidti* worker is also visible).
Slika 4. Delavke *Camponotus tergestinus* iz kolonije A, potem ko smo jih izvabili iz mravljišča s slamico (na levi je vidna tudi delavka *Crematogaster schmidti*).

The following ant species were found in oaks with *C. tergestinus* colonies: *Camponotus aethiops* (Latreille, 1798), *C. fallax* (Nylander, 1856), *C. piceus* (Leach, 1825), *Colobopsis truncata* (Spinola, 1808), *Crematogaster schmidti* (Mayr, 1853), *Dolichoderus quadripunctatus* (Linnaeus, 1771), *Formica gagates* Latreille, 1798, *Lasius paralienus* Seifert, 1992, *Temnothorax affinis* (Mayr, 1855), *T. crassispinus* (Karavaiev, 1926), *T. italicus* (Consani & Zangheri, 1952) and *T. jailensis* (Arnoldi, 1977) in the oak with colony A, and *Camponotus ligniperda* (Latreille, 1802), *Crematogaster schmidti*, *Formica cunicularia* Latreille, 1798, *F. fusca* Linnaeus, 1758, *Temnothorax affinis*, *T. jailensis* and *T. tergestinus* (Finzi, 1928) in the oak with colony B. *C. schmidti* was the commonest species in both trees with some separate trails leading along the branches. One trail was just few cm from one of the entrances of *C. tergestinus* colony A.

Discussion

The rediscovery of the rare ant species *C. tergestinus* at Lipica is important because it has allowed the first observations of its colonies in nature (*in situ*). *C. tergestinus* is an arboricolous species, nesting in trunk cavities or large branches in the tree canopy, as already indicated by other authors (Wiezik & Wieziková 2013). As it nests and forages in trees, it can be defined as a true arboricolous species (Seifert 2008). Moreover, we assume that *C. tergestinus* is associated with oaks. Oaks are constantly reported in relation to previous records of *C. tergestinus* (Müller 1921, Ionescu-Hirsch et al. 2009, Lapeva-Gjonova & Kiran 2012, Wiezik & Wieziková 2013). One exception is the record of a single specimen from Paklenica NP (Croatia), where a beech forest is mentioned as habitat (Ješovnik et al. 2011). It is quite possible, however, that this specimen of *C. tergestinus* was accidentally collected in a lower section of the Park, where oaks are more common (A. Ješovnik & M. Zec, pers. comm. 2017). In general, different *Quercus* species, especially old trees with rough bark and cavities, are preferentially inhabited by several other arboricolous ant species, e.g. *Camponotus fallax*, *Colobopsis truncata*, *Dolichoderus quadripunctatus*, *Temnothorax affinis*, *T. corticalis* (Schenck, 1852) (Buschinger 1993, Seifert 2007, 2008). Based on the present and previous findings, *C. tergestinus* can be considered a thermophilous species, preferring warm habitats where oaks are present.

On the basis of known records, *C. tergestinus* has a relatively large distribution, from Central Europe (Slovakia and Hungary) to southern Italy (Calabria) and southeastern Balkan Peninsula (Turkish Thrace), and even further to Anatolia (Antalya). It looks quite strange that despite its large distribution so few records of this species are known. *C. tergestinus* is certainly not as common as some other arboricolous species occurring in the same regions (e.g. *Camponotus fallax*, *Colobopsis truncata*, *Temnothorax affinis*). The reasons could be low competitiveness in comparison to similar species and a narrower ecological niche. Nevertheless, one of the main reasons for the paucity of records is probably its arboricolous lifestyle. Arboricolous species are often underrated in faunistic surveys due to their difficult detectability and lack of target sampling methods (Wagner et al. 2011). Being a true arboricolous species, *C. tergestinus* activity is restricted to trees, and normally it avoids foraging near the ground, as could have been concluded from our observation on 30. 5. 2017; consequently, it can hardly be seen by any researcher. In addition, our observations showed that in the daytime *C. tergestinus* is quite inconspicuous, with individually foraging workers that mostly leave nest in low numbers. On few occasions actually no ants were seen outside the nest, although workers of other species (e.g. *Crematogaster schmidti*, *Camponotus fallax*, *Colobopsis truncata*, *Dolichoderus quadripunctatus*, *Formica gagates*) were active. According to the number of workers detected outside the nest, the situation was very different in the nocturnal observation of 4. 10. 2017, when colony A was more active than during all our previous visits. Although only a single nocturnal observation was carried out, this one could indicate *C. tergestinus* having its peak of activity by night. That could be a further reason for the paucity of records.

The rediscovery of *C. tergestinus* at Lipica, after almost a century (Müller 1921), indicates that species might not be rare in this region. The discovery of further colonies could reveal new details about the biology of this enigmatic species.

Povzetek

Med mravljami iz rodu *Camponotus*, ki so razširjene tudi v srednji Evropi, je vrsta *C. tergestinus* ena najmanj poznanih. O njej imamo podatke z maloštevilnih lokalitet, pri čemer tu prvič navajamo dve še neobjavljeni lokaliteti (J Italija in Antalija). Doslej so bile v večini primerov najdene le posamezne delavke, kolonije pa le v dveh primerih, a ne *in situ*. Potem ko je Müller (1921) opisal matico *C. tergestinus* iz Lipice, smo tu vrsto leta 2016 in 2017 ponovno odkrili. Našli smo dve koloniji, ena je imela mravljišče na eni od glavnih vej puhastega hrasta (*Quercus pubescens*) na višini 3,2 m, druga pa na deblu cera (*Q. cerris*) na višini 2,2 m, obe mravljišči pa sta imeli po dva vhoda. Gre za prvo dokumentirano najdbo kolonij te vrste *in situ*. V omenjenih dveh letih smo koloniji večkrat opazovali. Dostikrat smo opazili le malo ali nobene delavke obravnavane vrste, čeprav so bile takrat na istem drevesu mravlje drugih vrst aktivne (npr. *Crematogaster schmidti*, *Camponotus fallax*, *Colobopsis truncata*, *Dolichoderus quadripunctatus*, *Formica gagates*). Kadar so bile delavke *C. tergestinus* zunaj mravljišča, so v večini primerov prihajale oziroma so odhajale navzgor proti višjim delom drevesa. Opravili smo tudi eno nočno opazovanje in takrat je bilo število delavk zunaj mravljišča najvišje izmed vseh opazovanj. *C. tergestinus* je po vsej verjetnosti prava drevesna vrsta, ki poseljuje termofilne habitate s hrastom, na katere je, kot kaže, močno vezana. Eden izmed glavnih razlogov, da je kljub relativno velikemu območju razširjenosti, ki sega od srednje Evrope do južne Italije in Balkana ter celo v Anatolijo, o tej vrsti tako malo podatkov, je njen drevesni način življenja. Delavke se večinoma zadržujejo v višjih predelih dreves in so tako težje dostopne pri vzorčenjih. Dodatni razlog je, da so, kot kaže, bolj aktivne v nočnem času. Predvidevamo, da *C. tergestinus* na obravnavanem območju ni redka.

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