



**FIRST RECORD OF A SLAVE-MAKING ANT *MYRMOXENUS GORDIAGINI* RUZSKY, 1902 (HYMENOPTERA: FORMICIDAE) IN SLOVENIA**

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**Abstract** - An active slave-making ant *Myrmoxenus gordiagini* Ruzsky, 1902 is recorded for the first time for Slovenia. The species was found on the Tinjan hill near Koper in two *Temnothorax* host colonies, most probably identical to *T. lichtensteini* sp. 2, in the years 2007 and 2009. This is the northernmost record of *M. gordiagini* in its southeast European part of the range.

**KEY WORDS:** *Myrmoxenus gordiagini*, Formicidae, Slovenia, social parasitism

**Izvleček** - PRVA NAJDBA ZASUŽNJEVALSKE MRAVLJE *MYRMOXENUS GORDIAGINI* RUZSKY, 1902 (HYMENOPTERA: FORMICIDAE) V SLOVENIJI

Aktivno zaslužnjevalska mravlja vrste *Myrmoxenus gordiagini* Ruzsky, 1902 je bila prvič zabeležena v Sloveniji. Vrsta je bila najdena na Tinjanu pri Kopru v dveh gostiteljskih kolonijah rodu *Temnothorax*, verjetno identičnih *T. lichtensteini* sp. 2, v letih 2007 in 2009. To je najsevernejša najdba vrste *M. gordiagini* v njenem jugovzhodno evropskem delu areala.

**KLJUČNE BESEDE:** *Myrmoxenus gordiagini*, Formicidae, Slovenija, socialni parazitizem

### Introduction

Social parasitism is a relatively common phenomenon among ants and can be expressed in many forms. The socially parasitic ant genus *Myrmoxenus* Ruzsky, 1902 exhibits an evolutionary transition from active slave-making, like in *M. ravouxi* (André, 1896) or *M. stumperi* (Kutter, 1950), through degenerate slave-maker *M.*

*kraussei* (Emery, 1915), where only a few workers are present and normally do not conduct slave-raids, to a completely workerless parasitic condition, like in *M. adlerzi* (Douwes, Jessen & Buschinger, 1988) or *M. corsicus* (Emery, 1895) (Buschinger 1989). Furthermore, the species differ in mating behaviour, with a transition from nuptial flights to intranidal mating and continuous inbreeding. About 12 species of the genus *Myrmoxenus* are known and they all parasitize ants of the genus *Temnothorax* Mayr, 1861 (Buschinger 2009). The genus *Myrmoxenus* is distributed mostly in areas around the Mediterranean sea. Some species have larger ranges, like *M. ravouxi* which is distributed in southern and central Europe and also eastern Turkey and the Caucasus (Buschinger 1997, Schulz & Sanetra 2002). Some are known only from single localities, like *M. bernardi* (Espadaler, 1982) which was recorded only from the Sierra de Gredos in Spain (Tinaut et al. 2005), or *M. birgatae* (Schulz, 1994) known from Tenerife only (Schulz 1994).

The species we report on in this contribution is *M. gordiagini* Ruzsky, 1902. It was described from Kokshetau in Akmola Province, northern Kazakhstan (Ruzsky 1902). It was found also in Astrakhan Province in southwestern Russia (Radchenko pers. comm.), while all other records derive from southeastern Europe and Turkey. The species was reported from several localities along the eastern Adriatic coast of Croatia and Montenegro, that is from Momjan in Istria (Finzi 1924), near Dvigrad (= Dva grada) in Istria, NW of Baška (Krk Island), S of Suha Punta (Rab Island) (Buschinger et al. 1983), Murvica near Zadar, Golubić near Knin (Buschinger & Douwes 1993), near Kozica on NE slope of Biokovo Mountain (unpublished record, leg. S. Vít), and from Savina near Herceg Novi in Montenegro (Soudek 1925). It is known also from the vicinity of Cherven Bryag in Bulgaria, Perachora near Korinthos in Greece (Buschinger & Douwes 1993) and from few localities in western and central Turkey, i.e. W of Seydişehir (Konya Province), NE of Ödemiş (İzmir Province), SE of Ürgüp (Neveşehir Province) and N of Akseki (Antalya Province) (Schulz & Sanetra 2002). The recent records from Turkey and southwestern Russia are of high importance as they fill in the geographical gap that existed previously between the distribution records in southeastern Europe and the Kazakhstan.

*M. gordiagini* can be distinguished from all other species of the genus by having antennae with 12 segments (females) compared to the 11-segmented antennae in the rest. These were for many years classified in the separate genus *Epimyрма* Emery, 1915, which was eventually synonymized with *Myrmoxenus* (Schulz & Sanetra 2002). The biology of *M. gordiagini* was studied by Buschinger et al. (1983). The species is an active slave-maker. Young inseminated queen enters a host *Temnothorax* colony and kills its queen by throttling her. *M. gordiagini* workers conduct slave raids against neighbouring *Temnothorax* colonies with group recruitment and sting fighting, rob the brood and enslave the emerged *Temnothorax* workers. Colonies of *M. gordiagini* are monogynous and nuptial flights are present (Buschinger 1989). So far it was reported to parasitize five *Temnothorax* species. *T. lichtensteini* (Bondroit, 1918) was the host of *M. gordiagini* in Croatia, Montenegro and Bulgaria (Buschinger et al. 1983, Buschinger & Douwes 1993), *T. graecus*

(Forel, 1911) in Greece (Buschinger & Douwes 1993), *T. korbi* (Emery, 1924) and *T. bulgaricus* (Forel, 1892) were both reported as the hosts in Turkey (Schulz & Sanetra 2002), and *T. servicus* (Ruzsky, 1902) in Kazakhstan (Ruzsky 1902).

In Slovenia, two *Myrmoxenus* species have been recorded so far (Bračko 2007). *M. ravouxi* (= *Epimyrma goesswaldi*) was found near Škocjan (Buschinger et al. 1981) and *M. krausse* near Pivka (Collingwood pers. comm.). Here we give first report on occurrence of *M. gordiagini*, the third species of the genus found in Slovenia.

### *Myrmoxenus gordiagini* in Slovenia

Within the past few years, the Tinjan hill, 8 km east of Koper, was visited on several occasions as part of the studies of the ant fauna of Submediterranean Slovenia. On 28th June 2007, a *Temnothorax* colony was also sampled. When checking the samples later in the laboratory, we discovered that besides *Temnothorax* workers also one dealate queen of *M. gordiagini* was present in the sampled colony. The host *Temnothorax* was identified to belong to the »*T. lichtensteini*/parvulus group« using the taxonomic key in Seifert (2007). The colony was found under a stone in thermophilous deciduous forest with *Quercus pubescens* and *Fraxinus ornus*. The site is located on the southwestern slope of the Tinjan hill at 325 m a.s.l., 45° 33' 35'' N, 13° 49' 54'' E. Exactly after two years, on 28th June 2009, the same site was revisited and a colony of *T. lichtensteini*/parvulus with 1 dealate *M. gordiagini* queen and 9 *Myrmoxenus* workers was found again in a crevice of a stone. Colony was situated just few meters away from the place where *M. gordiagini* was collected two years before. The area of about 100 m<sup>2</sup> around these sites was investigated systematically for potential host colonies, mostly under stones and in the stone crevices. Twenty colonies of the *T. lichtensteini*/parvulus group, identified as *T. lichtensteini* sp. 2, were found but none contained *M. gordiagini*.

### Discussion

The new record of *M. gordiagini* on the Tinjan hill in southwestern Submediterranean Slovenia represents the northernmost known locality of the species in southeast European part of its distribution (Fig. 1). The occurrence of *M. gordiagini* on Tinjan hill is not surprising, as it is only 15 km northeast of Momjan in Croatian part of Istria, where the species was reported from by Finzi (1924). Both localities are situated at about the same altitude on flysch bedrock. It seems that the Tinjan hill slope that is exposed southwest offers suitable living conditions for *M. gordiagini* and its host species. The two colonies we have found in deciduous forest under a stone and in a stone crevice were found in similar habitat and nest sites as the records from Croatia reported by Buschinger et al. (1983). These Croatian colonies were situated in shady places in deciduous forest or in the underbrush, underneath small, flat stones or in crevices between such stones. Similar habitat was also mentioned by Soudek (1925) for the record from Montenegro. An important charac-

teristic of the investigated forest of the Tinjan hill is its ground with many flat, stratified stones, having many crevices representing potential nest sites for *M. gordiagini* and its hosts. So even though only one *M. gordiagini* colony was found during the inspection in 2009, it can be assumed that the local habitat is favourable for this species and that more colonies could be present there. Generally, nests of parasitic species rarely occur in isolation, so if one has been detected then more colonies could be expected in the vicinity (Buschinger 1997). *M. gordiagini* is probably present in similar habitats in the nearby areas, including the neighbouring Italy (Trieste region), where it has not been registered yet (Rigato pers. comm.).

The record from Slovenia can be treated as a part of the southeastern European part of the distribution area of *M. gordiagini*, which extends from Istria towards the southern Balkans (Greece and Bulgaria). Along the eastern coast of the Adriatic, this species is expected to be more common than could be concluded from known localities. In this kind of parasitic species, it is usual that they are found in more or less isolated patches within the range of their hosts and these patches are often characterized by particularly high densities of the host species (Buschinger 2009).

The host of *M. gordiagini* colonies in Croatia, Montenegro and Bulgaria, as reported by Buschinger et al. (1983) and Buschinger & Douwes (1993), was *T. lichtensteini*. In the laboratory experiments it was shown that *M. gordiagini* queens were all killed when they were placed together with the colonies of *T. parvulus* (Schenck, 1852) (Buschinger et al. 1983). However, the real identity of these two mentioned *Temnothorax* species can be put into question after taxonomic changes introduced by Seifert (2007). In his taxonomic key, other characters than in older literature are used to distinguish between three very similar species, i.e. *T. parvulus*, *T. lichtensteini* and still undescribed *T. lichtensteini* sp. 2, which are indicated here as the »*T. lichtensteini/parvulus* group«. It is relatively difficult to distinguish between these three species if only workers are available, but more clear separation is apparent in queens. Since in both parasitized colonies from Tinjan *Temnothorax* queens were not present (they were eliminated by *Myrmoxenus* queen), clear identification of the host colonies was not possible, although workers showed to be closer to *T. lichtensteini* or *T. lichtensteini* sp. 2. Nevertheless, in our case it can be assumed that *T. lichtensteini* sp. 2 is the host species of *M. gordiagini*. Of the two species, *T. lichtensteini* and *T. lichtensteini* sp. 2, to which our two host colonies are more alike, the first one can most likely be excluded. According to Seifert (2007) this species is distributed in southwestern Europe, while *T. lichtensteini* sp. 2 is distributed in southeastern Europe up to southern Austria. Moreover, the other colonies of the *T. lichtensteini/parvulus* group that were found on the Tinjan hill in 2009 could be identified as *T. lichtensteini* sp. 2, since in these colonies also the queens were available for identification. If *T. lichtensteini* sp. 2 is accepted as valid species, then it should be treated as the host species for all previously reported *M. gordiagini* records from southeastern Europe with *T. lichtensteini* listed as the host.

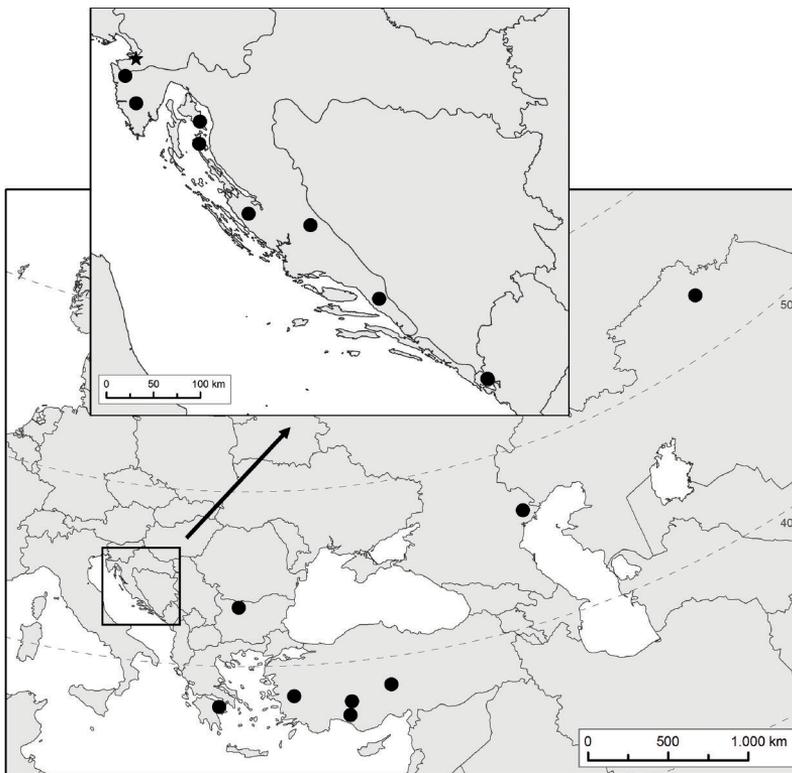
The composition of the *M. gordiagini* colony collected in the end of June 2009 (1 dealate queen and 9 workers) indicates the colony was probably founded in previous year. As observed by Buschinger et al. (1983), *M. gordiagini* queen enters a host spe-

cies colony in late summer. In those *Myrmoxenus* species that make nuptial flights, colony foundation occurs in summer or fall and only a few workers are produced in the first year after colony foundation (Buschinger 1989). The number of *M. gordiagini* workers in mature colonies can be up to 40 (Buschinger et al. 1983), therefore the colony we found in 2009 was still in its early stage. The same may be concluded also for the colony from the end of June 2007. The reason for the lack of *M. gordiagini* workers in 2007 could be that they were missed during collecting.

In future studies it would be useful to study more in detail the composition and life history of the local population of *M. gordiagini* on the Tinjan hill. We should carefully investigate also nearby areas, where additional records of this interesting species could be expected.

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**Fig. 1:** Known distribution of *Myrmoxenus gordiagini*. The new locality in Slovenia is marked with a star.

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