



***Myrmica karavajevi* (Arn.) (Hymenoptera, Formicidae) in Poland: a species not as rare as it is thought to be?**

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Abstract: The ant *Myrmica karavajevi* is an extremely rarely found and poorly known workerless social parasite of ants of the *Myrmica scabrinodis* species group. Hereafter detailed information of its previously published findings from four geographical regions in Poland (Bieszczady Mts, Pieniny Mts, Pomeranian Lakeland and Mazovian Lowland) as well as data on three new records from the Rostocze Upland, Lubelska Upland and Krakowsko-Częstochowska Upland is given. The latter suggests higher than hitherto suspected degree of host species infestation by *M. karavajevi*. Use of *M. rugulosa* as a host by *M. karavajevi* is also discussed.

Key words: ants, fauna of Poland, inquilines, *Myrmica rugulosa*, *Myrmica scabrinodis*, new localities, social parasitism

INTRODUCTION

Myrmica karavajevi (Arnoldi, 1930) is a European obligate socially parasitic workerless inquiline of other *Myrmica* Latr. species. The parasite queen coexists with the host queen (or queens), and broods of both species are produced in a mixed colony. *Myrmica scabrinodis* Nyl., *M. sabuleti* Mein., *M. lonae* Finzi, *M. rugulosa* Nyl. and *M. gallienii* Bondr., all members of the *scabrinodis* species group, are named as the host species of *M. karavajevi* (Radchenko & Elmes 2010). The species is known from Spain, England, France, Belgium, Norway, Sweden, Switzerland, Germany, northern Italy, Austria, the Czech Republic, Poland, Finland, Estonia, Belarus, the European part of Russia, Ukraine, Moldova (Radchenko & Elmes 2010) and Hungary (Csőszt et al. 2011). Usually various host species are reported from different countries (Radchenko & Elmes 2003, 2010).

A taxonomic position of *M. karavajevi* (and relative workerless parasites) within ant system has been disputable for a long time. Originally, it was described under the name *Symbiomyrma karavajevi* – Arnoldi (1930) created for it a new genus *Symbiomyrma* [later synonymized with *Sifolinia* Em. by Samšiňák (1964), and revived from synonymy by Seifert (1994)]. Then, in the course of several dozen years' taxonomic history of the species, *M. karavajevi* was either transferred to the genus *Myrmica* (Bolton 1988, Radchenko & Elmes 2003) or excluded of it (Seifert 1994); for details see Radchenko & Elmes (2003, 2010). Currently, a moot point is a location of *M. karavajevi* within the very system of *Myrmica*. Radchenko & Elmes (2003) considered *M. karavajevi* and its relatives as a new distinct species group within the genus *Myrmica*, whereas Seifert (2007) put them in a specially distinguished subgenus *Symbiomyrma* within this genus. In turn, results of the recent molecular phylogenetic study by Jansen et al. (2010) suggested that *M. karavajevi* may be classified within the *scabrinodis* group, i.e. together with its host species, as supposed to have a common ancestor with the latter, however it is quite distantly related to modern species of the group (for further discussion see Jansen et al. 2010). Basing on this significant evolutionary distance between *M. karavajevi* (and relative

species) and its (their) hosts, Radchenko & Elmes (2010) sustained their earlier (2003) decision and maintained validity of the *M. karavajevi* group as a distinct species group (sensu Radchenko 1994) within the genus *Myrmica*.

More than 80 years after the species description, *M. karavajevi* is an extremely rarely found and poorly known ant species. It is reported from less than 30 localities scattered throughout nearly 20 European countries (see Map 49 in Czechowski et al. 2012). As Radchenko and Elmes (2010) wrote in their monograph on the *Myrmica* ants of the Old World, *usually myrmecologists can find one or two infested colonies [that is to say, when searching plenty of possible host nests on a given area] and no more, despite repeated searching*. It results from both natural rarity of inquiline ant species and their cryptic mode of life; in appearance, infested colonies usually do not differ from normal colonies of host species.

MYRMICA KARAVAJEVI IN POLAND (Fig. 1)

Old data. So far in Poland *M. karavajevi* was reported from a few localities in four zoogeographical regions (in chronological order): the Bieszczady Mts, the Pieniny Mts, the Pomeranian Lakeland and the Mazovian Lowland (Czechowski et al. 2012).

The first finding was that by Pisarski (1962) at Ustrzyki Górne [UTM FV24] in the Bieszczady Mts. On 23rd August 1961, he found there 13 dealate females and one male of *M. karavajevi* (reported under a synonymic name *Sifolinia pechi* Samš.) in a nest of *M. rugulosa*. All the *M. karavajevi* individuals were in one peripheral nest chamber, whereas *M. rugulosa* occupied the rest of the nest. Over *M. rugulosa* as a host species the controversy aroused. Radchenko & Elmes (2003, 2010) questioned correctness of B. Pisarski's species identification, and recognized it as *M. gallienii*. They wrote: *in Poland the host species was M. gallienii (Pisarski 1962 noted as host species M. rugulosa, misidentification, material examined)*. That, however, was hardly acceptable in the light of the local habitat conditions: *Cette fourmière se trouvait sur la pente sud, couverte d'herbe, sur une vieille route non pratiquée. L'endroit était empierré d'une végétation éparse, surtout de Hieracium piloselle L., Potentilla erecta (L.), Hampe et Euphrasia sp., poussant dans un sol argileux, sec et exposé à l'action solaire (Pisarski 1962)*. And in a next paper (translated from Polish): *The nest was situated on a south slope [...]. The slope [was] stony, with very poor vegetation, overgrown with tufts of grass, thyme and lichen [Cladonia sp.] (Parapura & Pisarski 1971)*. Such a habitat, dry and hot, is typical for *M. rugulosa*, but it seems to be extremely unfavorable for *M. gallienii*. Thus we searched the proof specimens out in the collection and checked them once more. B. Pisarski was right: it was, with no doubts, *M. rugulosa*. (So far, *M. gallienii* is not reported neither from the Bieszczady Mts, nor from any other mountains in Poland; Czechowski et al. 2012).

The next published report originates from the Pieniny Mts, where one alate queen of *M. karavajevi* was found in a nest of *M. rugulosa* on a dry pasture at the foot of the Three Crowns Massive [UTM DV57] in 1973 (Czechowska 1976). Then Woyciechowski (1985) quoted earlier unpublished J. Pełal's finding: an individual of *M. karavajevi* found in 1970 in the Small Pieniny Mts (eastern part of the Pieniny Mts) at Jaworki [UTM DV67] on a dry pasture. No more details are given but it is known that, alike in Central Pieniny (Czechowska 1976), the most abundant ant species on dry pastures in Small Pieniny was *M. rugulosa*, however other possible hosts of *M. karavajevi*, *M. scabrinodis* and *M. sabuleti*, occurred there as well, although much scarcely (Pełal 1974, Woyciechowski 1985). In the recent monograph of the Polish ants (Czechowski et al. 2012) a passus can be seen: *among the findings [of M. karavajevi in Poland], two nests (with M. rugulosa as a host species) were in the Bieszczady Mts and two (with M. scabrinodis) in the Pieniny Mts*. It requires two corrections: (1) in

Bieszczady, there was only one finding (that by Pisarski 1962); the second, seemingly original information (Parapura and Pisarski 1971) is in fact a secondary report on the former; (2) in Pieniny, the host species was also *M. rugulosa* (and not *M. scabrinodis*) – in one case certainly (Czechowska 1976), in the second most probably (Woyciechowski 1985, see above).

Szujecki et al. (1978) informed about five individuals of *M. karavajevi* among ca. 23 thousand other ants caught in pitfall traps in pine forests in “north-west Poland” in the years 1973–1975. No details are given, however it is known that the study was carried out in the Tucholskie Forest on the Pomeranian Lakeland, most probably within the forest district Niedźwiady [UTM XV46]. A few years later, in 1976 or 1977, one more individual was found (also in pitfall trap material) in a pine plantation in the same region (Mazur 1983). Three possible *M. karavajevi* host species occurred on the same site: *M. rugulosa* (most abundantly), *M. scabrinodis* and *M. sabuleti*.

The last published information is that by Czechowski (1990), who vaguely mentioned *M. karavajevi* among ant species present in Warsaw parks (i.e. on the Mazovian Lowland). More specifically, one female fell into a pitfall trap in the Łazienki Królewskie park. Extensive studies in urban areas in Warsaw were carried out in the years 1974–1978; analyzed ant material consisted of ca. 200 thousand individuals (see Ślipiński et al. 2012) with only this one *M. karavajevi* specimen among them. Both in this park and the whole Warsaw two possible host species occurred: *M. rugulosa* (abundantly) and *M. scabrinodis* (sporadically) (Ślipiński et al. 2012, W. Czechowski, unpubl.).

New data. In July 2004, a dealate queen of *M. karavajevi* was found near Szczepczyszyn [UTM FB31] on the Roztocze Upland in a nest of *M. rugulosa* in dry grassland.

Next finding of *M. karavajevi* is coming from the Krakowsko-Częstochowska Upland, a place located 4 km from the centre of Kraków [UTM DA14]. The study was conducted on the wet meadow complex, where dominant plants were *Molinia caerulea* and *Sanguisorba officinalis*, in the latter half of June 2013. This site was inhabited by *Myrmica* ants and their non-ant social parasites: butterflies of the genus *Maculinea* van Eecke and the hoverfly *Microdon myrmicae* Schönrogge et al. The main aim of the study was to detect the influence of these social parasites on fitness of *M. scabrinodis* colonies. From three closely located (0.8–5 km) patches within the meadow complex 45 *M. scabrinodis* nests were excavated and the number of workers, queens and brood was calculated in the laboratory. Despite of *M. scabrinodis* also other *Myrmica* species were present in the studied area: *M. ruginodis*, *M. rubra* and *M. rugulosa*. *Myrmica karavajevi* individuals were found in three *M. scabrinodis* nests coming only from one of the three patches, from where totally 11 nests were taken to laboratory. Inside the first nest were found, among others, three dealate queens and seven queen pupae of *M. scabrinodis*, as well as three alate queens and three queen pupae of *M. karavajevi*. The second nest contained two dealate queens and 18 queen pupae and 12 male pupae of *M. scabrinodis* and two alate queens of *M. karavajevi*. Inside the third nest five dealate queens and no sexual brood of *M. scabrinodis*, as well as 10 alate queens and one dealate queen of *M. karavajevi* were found.

The most recent finding is coming from Kosyń [UTM FB79] on the Lubelska Upland where the study was conducted at the turn of August and September 2013 and the main aim was to detect the infestation rate of *M. scabrinodis* nests by *Maculinea teleius* and *Microdon myrmicae* larvae. The study site was a wet meadow dominated by *Molinia caerulea*. Altogether, 30 *M. scabrinodis* nests were dug up and in one of them a dealate *M. karavajevi* queen was found. Our previous study (Witek et al. 2013) indicated that *M. scabrinodis* was the most abundant *Myrmica* species but also other species such as *M. rubra* and *M. gallienii* were present there.

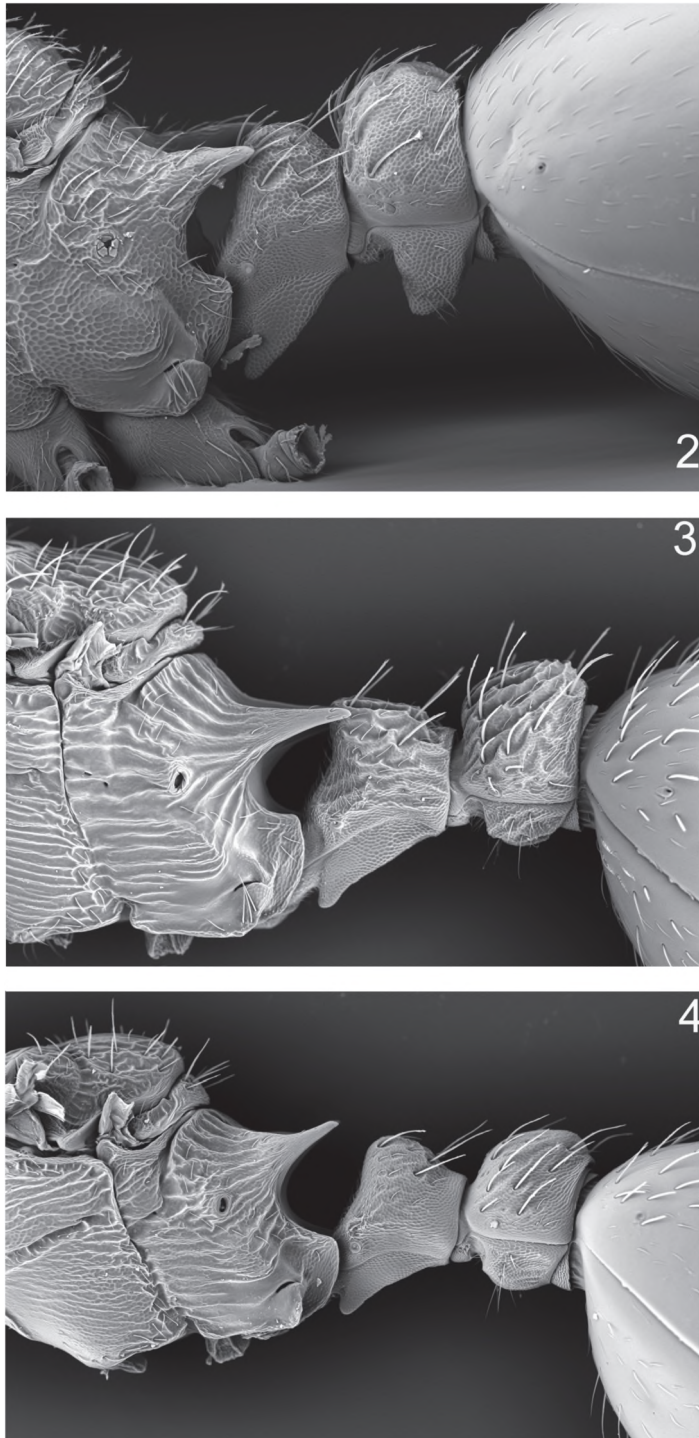


Fig. 1. Localities of *Myrmica karavajevi* in Poland.

ADDENDUM: HOW TO RECOGNIZE *M. KARAVAJEVI*?

All specialized workerless ant social parasites show some combination of morphological (and bionomical) features called by Wilson (1971) the inquiline syndrome, which distinguish inquilines from related free-living species. Such the syndrome is observed also within the genus *Myrmica* (Radchenko & Elmes 2003, 2010). In Poland, besides *M. karavajevi*, the only inquiline *Myrmica* is *M. hirsuta* Elmes (with the vestigial worker caste), a social parasite of *M. sabuleti* and *M. lonae*. It is, however, morphologically not to confuse with *M. karavajevi* (see Czechowski et al. 2012).

In this situation it is enough to point a single spectacular morphological feature, which allow to explicitly distinguish *M. karavajevi* from any other Polish (and in general Central European) *Myrmica* species. In females, such feature is the shape of the waist seen in profile: in *M. karavajevi* both petiole and postpetiole are ventrally with wide lamella (Fig. 2), whereas in queens and workers of other *Myrmica* postpetiole has no lamella, and petiole is only with small rounded tooth (Figs 3 and 4). Males differ in antennae: they are 12-segmented in *M. karavajevi* and 13-segmented in other species (for a full key see Czechowski et al. 2012).



Figs 2–4. Petiole and postpetiole in queens of *Myrmica karavajevi* (2) compared with those in queens of non-socially parasitic *Myrmica* species, *M. karavajevi*'s hosts as examples: *M. scabrinodis* (3) and *M. rugulosa* (4)

DISCUSSION

Circumstances of hitherto findings of *M. karavajevi* in Poland show that *M. rugulosa* and *M. scabrinodis* are its two equally used host species. It is even conceivable that *M. rugulosa* is more frequent host than *M. scabrinodis*. Outside Poland, *M. rugulosa* as *M. karavajevi*'s host was reported only from Sweden (see Radchenko & Elmes 2010), which, however, may result from general scarcity of data. Anyway, one cannot agree with Radchenko's and Elmes' (2010) statement: *one common feature is that all its [M. karavajevi's] hosts live in warm but relatively wet places in marshes, meadows and forest glades*. *Myrmica rugulosa*, as a quite thermophilic and xerophilic species, is hardly possible to be found in the mentioned habitats. The latter suit other possible *M. karavajevi*'s hosts: *M. scabrinodis*, *M. sabuleti*, *M. lonae* and, the most hygrophilic of them, *M. gallienii*. Therefore, *M. karavajevi* seems to be not only the most geographically widespread, and the most catholic in its choice of host species amongst the inquiline *Myrmica* social parasites (Radchenko & Elmes 2010), but also one of the widest ecological amplitude – unless different unrecognized cryptic forms go under its name.

Conditions of infestation of host colonies by socially parasitic queens remain unknown. Undoubtedly this moment is the bottle neck in their life history. The case described by Pisarski (1962), who found several (young, as one can guess) *M. karavajevi* queens gathered in one chamber on the outskirts of the *M. rugulosa* nest, might be characteristic in the context under discussion. An association arises with unpublished results of the experiment made by G. W. Elmes. He tried to introduce parasitic queens freshly mated in the laboratory and the old queens from the mother nest into experimental cultures of *M. scabrinodis* (queenright or queenless groups of 50–60 workers from several different host colonies). In every case the introduction failed, either the foreign queen was killed or at best ignored and kept to the periphery of the nest where it eventually died (G. W. Elmes, personal communication). Therefore, the situation noticed by Pisarski (1962) might convey an introductory phase of (group) infestation (or an attempt of infestation) of a host colony by inquiline queens. It should be mentioned that both ant hosts *M. scabrinodis* and *M. rugulosa* have often polydomous and polygynous population structure (Czechowski et al. 2012), which can predispose them for being infested by socially parasitic ants (Hölldobler and Wilson 1990).

Myrmica karavajevi, like other ant species with cryptic mode of life, is definitely underrecorded both in Poland and in other parts of Europe. Basing on the distribution of its hitherto known localities in Poland (Fig. 1), one may predict that the species occurs all over the country – of course, nowhere abundantly, as befits an inquiline social parasite. On the other hand, results of the recent study in the Kraków region revealed that degree of an infestation of the *M. scabrinodis* population may be, at least locally, quite considerable. Among 11 *M. scabrinodis* nests, found at one of three patches studied, three of them contained individuals of *M. karavajevi*, which means that about 27% of nests were infested. In fact, the revealed degree of parasitism of *M. karavajevi* on the *M. scabrinodis* population might be even underestimated, since attention were paid only on presence/absence of alate *M. karavajevi* sexuals in the host colonies. If also queens (dealate females) were looked for, the actual degree of infestation might appear to be even higher. Also at Kosyń, where only one *M. scabrinodis* nest with one dealate *M. karavajevi* queen was found, the infestation rate can be underestimated. The nuptial flights of *M. karavajevi* occur in July and August (Czechowski et al. 2012), whereas our data were collected at the turn of August and September. Therefore, there was no chance to find *M. karavajevi* young sexuals inside host nests, which in turn are much easier to distinguish from host individuals with comparison to dealate queens. The latter have size similar to *M. scabrinodis* workers thus could be easily omitted during worker calculation.

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STRESZCZENIE

[*Myrmica karavajevi* (Arn.) (Hymenoptera: Formicidae) w Polsce – gatunek nie aż tak rzadki, za jaki uchodzi?]

Mrówki *Myrmica karavajevi* są niezwykle rzadko stwierdzanym i słabo poznanym pasożytem społecznym blisko z nimi spokrewnionych gatunków z grupy *Myrmica scabrinodis*. W pracy zostały podsumowane szczegółowe informacje na temat wcześniej opublikowanych znalezisk tego gatunku w Polsce (z Bieszczadów, Pienin, Pojezierza Pomorskiego i Niziny Mazowieckiej), a także przedstawione dane o nowych znaleziskach z Roztocza, Wyżyny Lubelskiej i Wyżyny Krakowsko-Częstochowskiej. Te sugerują możliwość powszechniejszego, niż dotychczas zakładano, występowania *M. karavajevi*, zarówno w skali kraju, jak i lokalnie. Dodatkowo przedyskutowano kwestię wykorzystywania kolonii *M. rugulosa* jako gospodarza *M. karavajevi*.

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