

Additional records of parasitic *Camponotus* Mayr (Hymenoptera: Formicidae) species from Turkey with queen description of *Camponotus rusei* Karaman, 2012

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The genus *Camponotus* Mayr is the second speciose ant genus after *Pheidole* Westwood and includes two parasitic species, *Camponotus rusei* Karaman and *C. universitatis* Forel which are known only from Turkey to co-exist. We present new records with some biological notes of this parasitic species from Turkey and describe the hitherto unknown queen of *C. rusei*. Also, the parasitism status of *C. rusei* is discussed.

Keywords: *Camponotus universitatis*; social parasitism; Black Sea Region; Anatolia

Introduction

Ant nests are very complex microcosms and contain many different types of intra- and interactions, including relationships between individuals belonging to the same species, different species and non-ant organisms with ants (Hölldobler & Wilson, 1990). From these, the relationship where two different ant species live together in a mixed nest is defined as true social parasitism. Three different strategies are known for this phenomenon: temporary social parasites, dulotic social parasites, and inquiline social parasites.

After their nuptial flights, temporary social parasite queens get the opportunity to enter the nests of the host ant species, kill host queens, and lay their own brood which is raised by the host workers. Parasite workers are able to live independently and they replace host workers after their emergences. In contrast, dulotic and inquiline ant species live with their host species for all of their life stages. Dulotic species are slave-makers raiding on host nests to obtain and transport the larvae and pupae of the host species to their nests to be used as slaves. Inquilines are more specialised parasites which are generally workerless and always depend on their host species. They may either kill or tolerate the queen of their host species.

Formicidae is represented by approximately 14,000 species, and approximately 410 of these are defined as true social parasites (Bolton, 2021; Rabeling, 2020). These parasitic species belong to six of the 17 subfamilies of Formicidae. From these six subfamilies, Formicinae is the second speciose subfamily with 156 parasitic species placed in 10 genera. *Camponotus* is the largest genus of the subfamily with 1,052 species but the parasitism rate is the lowest compared to other genera of the subfamily. Only *C. universitatis* Forel and *C. rusei* Karaman are known to have as social parasites (Rabeling, 2020).

Workers of *C. universitatis* were described from France and queens and males by Tinaut et al., from Spain (Tinaut et al., 1992). It has a patchy distribution in southern Europe, covering France, Switzerland, Italy, Albania, Spain, Bulgaria, and Turkey

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(Karaman et al., 2015). Turkey deserves attention in terms of social parasitism in *Camponotus* because it is the only country which harbors a second parasitic species of the genus, *C. rusei*, in addition to *C. universitatis*. Workers and the male of *C. rusei* have been described as a putative parasitic species from Turkey in the nest of *C. oertzeni* Forel (Karaman, 2012) [the host was initially misidentified as *C. aethiops* (Latreille) and reidentified as *C. oertzeni* here according to Salata and Borowiec (2018)]. No further record of *C. rusei* was obtained since then and the queen of the species is still unknown. The parasitic situation of *C. rusei* is unclear. It might be a temporary parasite or an inquiline, although it shares some inquiline characters of *C. universitatis*.

Here, we report additional records of *C. universitatis* and *C. rusei* from Turkey and describe the queen of *C. rusei*, hitherto unknown, and discuss its status with regard to social parasitism.

Material and Methods

The specimens of *Camponotus universitatis* and *C. rusei* were collected in 68 days of field research carried out in 2017 and 2018 in the Middle Black Sea Region of Turkey. An aspirator was used for collecting the ants and an Olympus SZ51 stereomicroscope for taxonomic studies. Photographs were taken using a Nikon d800e SLR camera with 3.2 and 8× microscope objective and Helicon Focus software (Helicon Soft Ltd., Kharkiv Ukraine). Measurements were taken using an Olympus SZ51 stereomicroscope equipped with an Olympus U-OCMC 10/100XY stage micrometer. All measurement data are given as arithmetic means (in mm) [minimum, maximum].

The following morphometric parameters were used: CL: Maximum head length, from anterior point of median lobe of clypeus to midpoint of occipital margin; CW: Maximum measurable head width, maximum width behind posterior margin of eyes; ED: Maximum diameter of eye; SL: Maximum straight line scape length, excluding basal condyle; ClyL: Maximum length of clypeus, including posterior lobes (if present); ClyW: Maximum width of clypeus between tentorial pits in dorsal view; HFL: Maximum length of hind femur; HFW: Maximum width of hind femur; HTL: Maximum length of hind tibiae; MH: Mesosoma height, from upper level of mesonotum to lower margin of mesopleura; ML: Mesosoma length, diagonal length of mesosoma laterally from anterior-dorsal margin of mesosoma to posterior margin of lobe of metapleura; SCL: Maximum length of scutum; SCW: Maximum width of scutum; Indices: CI (Cephalic index): $(CL/CW) \times 100$; SI1 (Scape index1): $(SL/CL) \times 100$; SI2 (Scape index2): $(SL/CW) \times 100$; ClyI (Clypeal index): $(ClyW/ClyL) \times 100$; MI (Mesosomal index): $(ML/MH) \times 100$; HFI (Hind femur index): $(HFW/HFL) \times 100$; HTI (Hind tibia index): $(HTL/HW) \times 100$; SCI (Scutum index): $(SCW/SCL) \times 100$.

Results

We sampled 7042 ant nests in the Middle Black Sea Region of Turkey, and 842 of the samples were of the genus *Camponotus* of which 290 belonged to *C. aethiops* and 48 belonged to *C. oertzeni*. From 338 samples of *C. aethiops* and *C. oertzeni*, we recorded only three mixed nests with parasitic ant species (two with *C. rusei* and one with *C. universitatis*).

Camponotus rusei Karaman, 2012

Material. TURKEY: 17♀, 2♂; Ordu province: Akkuş, Yolbaşı Vill.; 40°41.92'N, 37°00.17'E; 1123 m; 07.viii.2018, K. Kiran & C. Karaman leg.; EMTU 18/0965c; from nest of *C. oertzeni*, 100♂, 4♂ – 1♀; Amasya province: Taşova, Gürsu Vill.; 40°50.06'N, 36°17.90'E; 865 m; 12.viii.2018, K. Kiran & C. Karaman leg.; EMTU 18/1339b; from nest of *C. oertzeni* Forel, 50♂.



Figure 1. *Camponotus rusei* queen. A. Head (in frontal), B. Habitus in lateral view.

Description of the queen (Figure 1A-B): Morphometrics (n=17): CL: 1.53 (1.49–1.57), CW: 1.33 (1.24–1.39), ClyL: 0.44 (0.40–0.46), ClyW: 0.68 (0.61–0.73), EL: 0.49 (0.46–0.51), HFL: 1.79 (1.71–1.87), HFW: 0.37 (0.33–0.39), HTL: 1.87 (1.80–1.93), MH: 1.78 (1.59–1.89), ML: 2.61 (2.47–2.83), SCL: 1.42 (1.28–1.51), SCW: 1.44 (1.27–1.61), SL: 1.46 (1.41–1.49), CI: 114.94 (111.27–119.61), ClyI: 153.55 (131.92–161.11), HFI: 20.37 (18.48–22.22), HTI: 140.58 (135.21–147.06), MI: 146.98 (131.34–159.80), SCI: 101.91 (95.16–126.15), SI1: 95.68 (90.63–99.19), SI2: 109.97 (105.46–117.65).

In frontal view, head slightly elongate, longer than wide, slightly diverging posteriorly, posterior margin almost convex, sides straight and subparallel. Eyes large (EL/CS=0.333) and protruding; first ocellus situated at the line connecting posterior margin of the eyes. Posterior margin of clypeus straight, clypeal carina prominent; mandible triangular, masticatory margin armed with 5 teeth. Antennal scape almost as long as CS, surpassing the posterior cephalic border by almost half of scape length. Pronotum prominent, anterior surface convex, scutum 1.25 times wider than long, dorsal surface of scutum straight, prescutum shallower than scutum, scutellum higher than scutum. Propodeum rather convex, declivity surface concave, dorsal and declivity surface almost same length. Hind femur and tibia almost same length. Petiolar node thin, tapering to the apex seen in profile, anterior surface slightly convex, posterior face straight, dorsal margin “^” shaped in frontal view. – Head with imbricate sculpture; mesosoma, petiole and gaster finely imbricate and shiny. Gena with 1 or 4–5 long erect setae, posterolateral corners and posterior margin with dense erect setae. Clypeus, frons and vertex with dense, long, erect setae; clypeus with long, appressed pubescence; mandible with dense, short, erect setae; ventral surface of head with dense, long, semi-erect and erect setae; pronotum with few erect setae; anteromedian part of scutum with almost ten pairs of short, erect setae, rest of scutum and scutellum with few long, erect setae; antero-ventral parts of katepisternum with dense, erect setae, rest of mesopleuron bare; dorsal surface and declivitous surface of propodeum bare, the joining line of the two surfaces with a row of dense, long, erect setae, transversal latero-dorsal surface of propodeum with eight long, erect setae, rest of lateral sides bare; anterior surface of petiole with thick, dense, decumbent pubescence, dorsal surface of petiole dense, thick, long erect setae, gastric tergites with short, sparse pubescence, basal half of first gastric tergite with dense, long, erect setae, rest with sparse, long, erect setae; tibiae with dense, long, decumbent pubescence, inner surface of tibiae without a row of spiny bristles; femora with short, dense, decumbent pubescence and with dense, scattered, erect setae. – Head,



Figure 2. Mixed nest of *Camponotus oertzeni* and *C. universitatis* from Akkuş-Yolbaşı Village, Ordu province (Turkey).

mesosoma except brown pronotum and petiole black, mandibles yellowish red, basal half of scape reddish rest of it brown; first five funicular segments brown, rest of it reddish brown; gaster reddish brown to brown, coxae brown; trochanters and 2/3 basal part of femora reddish brown, rest of it yellowish red. Wings yellow, veins and pterostigma brown.

Remarks: Akkuş-Yolbaşı Village locality (Ordu prov.) is characterised with an old *Pinus brutia* Tenore forest. The ground of the forest was shaded and planted with dense *Festuca* sp., and small *Quercus* sp. bushes and the ground was covered with pine needles. The nest was found in the soil close to a pine root that was sticking out (Figure 2). The nest was crowded with lots of *C. oertzeni* workers and the queens tried to escape from the nest upon digging. Seventeen small-sized *C. rusei* queens were determined in the nest. Four male individuals of the host species were also found in the nest. The males of *C. oertzeni* can be differentiated from males of *C. rusei* by dense, long, erect hairs on gena, posterolateral corners and posterior margin of head, scutum and gaster (Figure 3A-B), robust body, longer dorsal surface of propodeum, thick petiole, and more matt body (Figure 3C-D). *Formica fusca* L., *Lasius alienus* (Foerster), *L. myops* Forel, *Lasius* sp., *Myrmica lonae* Finzi, *M. schencki* Viereck, *Plagiolepis perperamus* Salata et al., *Ponera testacea* Emery, *Solenopsis fugax/lusitanica*, *Tapinoma erraticum* (Latreille), *T. simrothi* Krausse and *Temnothorax unifasciatus* (Latreille) were also recorded from this locality.

Taşova-Gürsu Village locality (Amasya prov.) is characterised by a *Quercus* sp. forest with some *Juniperus communis* L. bushes. The forest was not dense with some glades. The nest was under a stone. *Aphaenogaster holtzi* (Emery), *A. subterranea* (Latreille), *Camponotus aethiops*, *C. lateralis* (Olivier), *C. piceus* (Leach), *Crematogaster schmidtii* (Mayr), *Cr. sordidula* ssp. *aeolia* Forel, *Formica cunicularia* Latreille,

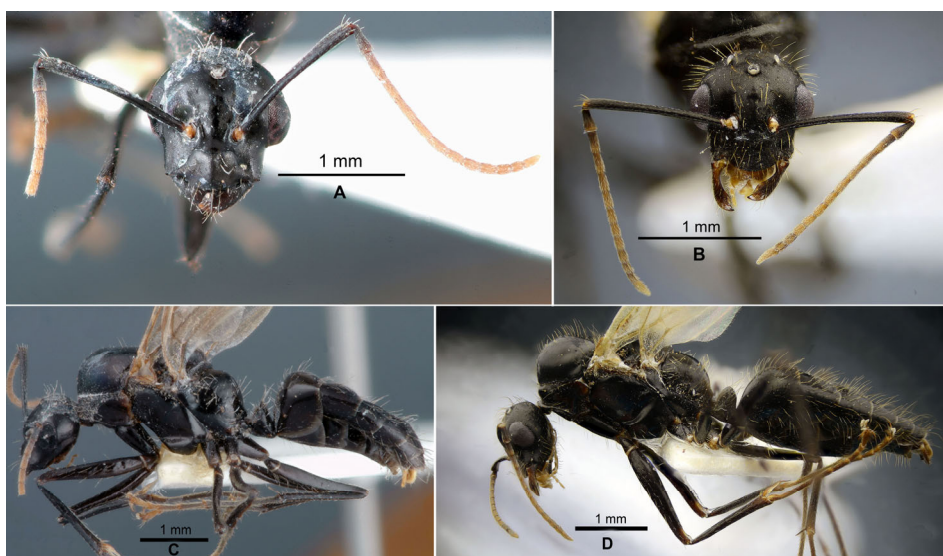


Figure 3. Male of *Camponotus ruseni* (A, C) and *C. oertzeni* (B, D).

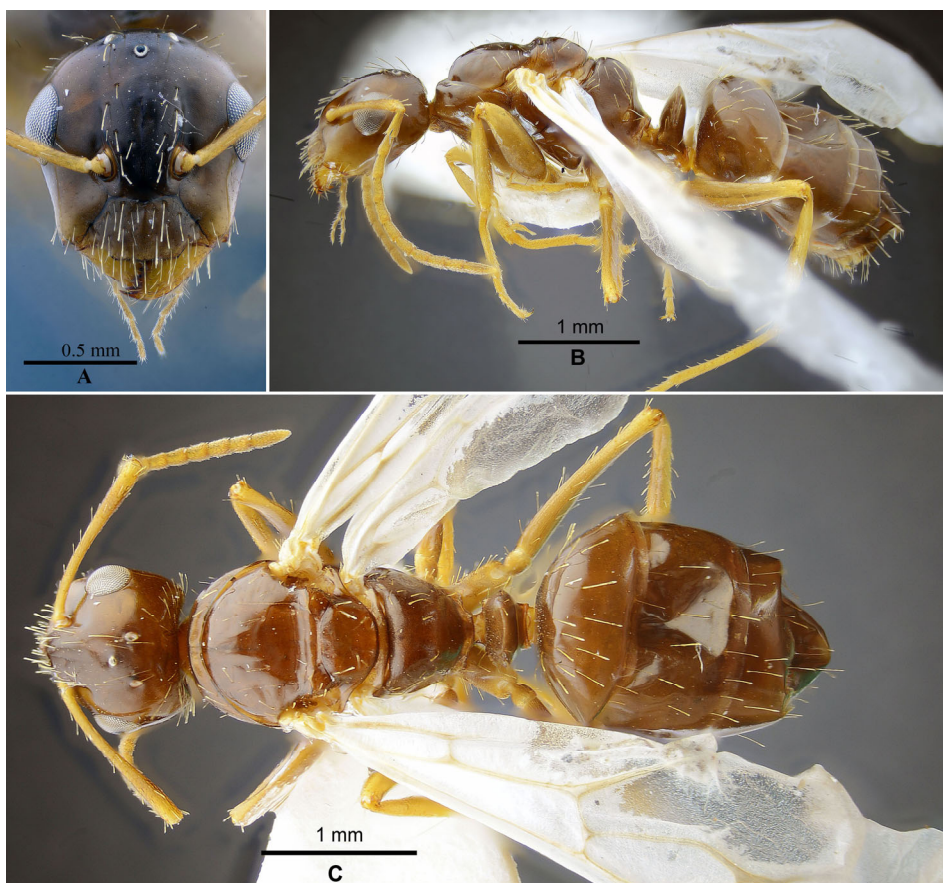


Figure 4. *Camponotus universitatis*: A. Head (in frontal), B. Habitus in lateral view, C. Habitus in dorsal view.



Figure 5. Distribution map of parasitic *Camponotus* species in Turkey. □: *Camponotus ruseni*, Δ: *Camponotus universitatis* (red color: old records, blue color: new locality records) (remodelled from Google Earth).

Lasius brunneus (Latreille), *Messor structor* (Latreille), *Pheidole* cf. *pallidula*, *Plagiolepis pygmaea* (Latreille), *Solenopsis fugax/lusitanica*, *Tapinoma simrothi*, *Temnothorax affinis* (Mayr), *T. semiruber* (André), *Tetramorium chefketi* Forel and *T. flavidulum* Santschi were also recorded from the same locality.

Camponotus universitatis Forel, 1890 (Figure 4A–C)

Material. TURKEY: 1♀; Çorum province, Çağsak Village; 40°21.53'N, 34°31.71'E; 1221 m; 02.vii.2017; K. Kiran & C. Karaman leg. (EMTU 17/0763b), from nest of *C. aethiops*, 6♂.

Morphometrics of the queen. CL: 1.34, CW: 1.12, ClyW: 0.63, ClyL: 0.34, EL: 0.44, HFL: 1.49, HFW: 0.31, HTL: 1.61, MH: 1.29, ML: 2.10, SCL: 0.88, SCW: 1.17, SL: 1.29, CI: 119.57, CLI: 185.71, HFI: 20.49, HTI: 143.48, MI: 162.26, SCI: 133.33, SI1: 96.36, SI2: 115.22.

Tinaut et al. (1992) described the queen and male of *C. universitatis* and gave some morphometrics of the queen (CL: 1.5, CW: 1.15, MH: 1.12-1.20, ML: 2.5-2.6, SL: 1.65).

Remarks. Our measurements are quite different from these measurements. A revision study is needed to determine the reasons for this difference.

Çağsak Village locality (Çorum prov.) is characterised by an old *Pinus nigra* Arnold forest, there was a small creek, forest floor slope was changing from 10 to 45° and dominated by *Festuca* sp. The nest was under moss on a rock. *Bothriomyrmex communista* Santschi, *Camponotus aethiops*, *Cataglyphis aenescens* (Nylander), *Formica anatolica* Seifert & Schultz, *F. cunicularia*, *F. fusca*, *F. rufa* L., *Lasius balcanicus/distinguendus*, *L. bombycina* Seifert & Galkowski, *L. flavus* (Fabricius), *L. turcicus* Santschi, *Lasius*



Figure 6. Worker of *Camponotus ruseni*: A. Head (in frontal), B. Habitus in lateral view, C. Whole body (in dorsal).

sp., *Myrmica hellenica* Finzi, *M. sabuleti* Meinert, *Plagiolepis pygmae* (Latreille), *Polyergus rufescens* (Latreille), *Solenopsis fugax/lusitanica*, *Tapinoma simrothi*, *Temnothorax crasecundus* Seifert & Csösz, *T. helenae* Csösz et al., *T. parvulus* (Schenck), *Temnothorax* sp., *Tetramorium flavidulum*, *T. moravicum* Novák & Sadil and *Tetramorium* sp. were also recorded from the same locality.

Discussion

Camponotus is a speciose ant genus in Turkey and many new species have been described from the country in the last decade (e.g., Karaman & Aktaş, 2013; Salata et al., 2019). Turkey also harbors many parasitic ant species (Degueldre et al., 2021; Karaman et al., 2015; Kiran et al., 2021; Wagner et al., 2018). Based on our present knowledge, Turkey may serve as the speciation center for the parasitic species group of the genus *Camponotus*, given the presence of two parasitic *Camponotus* species in the country.

Camponotus ruseni workers and males were recorded from Western Anatolia in 2008 (Karaman, 2012). Almost 10 years later we have recorded workers and females of the species from two different localities in the Middle Black Sea Region of Turkey. These records suggest that the species might have a more widespread distribution than

actually known and might be expected to also occur in the Western Black Sea Region (Figure 5). The species was first recorded from a *Pinus nigra* forest at 1462 m elevation. The records of the species presented in the present study come from a *P. brutia* forest from Ordu at 1123 m and a *Quercus* sp. forest from Amasya at 865m indicating that the species can be found in different habitats and elevations.

We recorded two workers and 17 queens of *C. rusei* in the nest of *C. oertzeni* from Ordu, but these workers were not dimorphic as was recorded in the nest discovered in 2008 (Karaman, 2012) (Figure 6A–C). While we were digging the nest, the workers were trying to escape deeper into the nest and so we probably did not have the opportunity to collect both worker castes. In Amasya, we could not realize the presence of *C. rusei* in the nest of *C. oertzeni* in the field but noticed the parasitic worker in the laboratory.

Karaman (2012) compared the properties of the parasitic status of *C. rusei* and *C. universitatis*. *Camponotus rusei* did not possess all of the inquiline-like characters mentioned in Hölldobler and Wilson (1990) and Buschinger (2009) such as presence of intercastes or ergatogynes, pupoid males, reduced funicular segments and wing venation in males, and/or absence of worker caste. *Camponotus rusei* shows a parallelism with inquilism with small body sizes of individuals. Although Karaman (2012) and Rabeling (2020) catalogued *C. rusei* as inquiline (putative), the two mixed nest records of *C. rusei* prove that *C. rusei* is a really parasitic ant species using *C. oertzeni* as the host species.

Karaman (2012) recorded 7 males on 14 July and we recorded 17 queens (1 dealate and 16 alate) on 7 August. These records indicate that the nuptial flight (if present) or dispersal of the newly mated queens is in the second half of August. If the newly mated queen invades the host colony later, than the parasitic queen should overwinter in the host colony (hibernation period) or outside the colony alone. The accuracy of this phenomenon should be tested in the field and also in laboratory.

Workers of queenless ant colonies gain ability of lay haploid eggs, which develop into males. We also recorded males of the host species, *C. oertzeni* but we did not record any host queen. We recorded queens of *C. oertzeni* from six different localities between 12.08-10.09.2018 in the Middle Black Sea Region of Turkey where the parasitic *Camponotus* material was collected. This indicates that, the reproducing queen of *C. oertzeni* is generally present in the nest later than early August. Hence we expect that our mixed nest also contained a reproducing queen indicating that *C. rusei* is not killing its host queen. In other words, this might give evidence for the inquiline parasitic syndrome within *C. rusei*. Moreover, Tinaut et al. (1992) identified a case where the host queen was also present in a nest parasitized by *C. universitatis* from the Serranía de Cuenca, Spain suggesting evidence of inquilinism in *C. universitatis*. However, the host queen had the funiculus without the ultimate and the last two funicle segments. A similar situation was described by Buschinger and Klump (1988) in *Leptothorax goesswaldi* (Kutter, 1967), which cuts the funicle segments of the queens of the host species *Leptothorax acervorum* (Fabricius, 1793) and these mutilated queens soon die due to their inability to establish normal social relationships with their workers (Tinaut et al., 1992).

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Disclosure Statement

No potential conflict of interest was reported by the authors.

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