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Two new species of the "ultimate" parasitic ant genus *Teleutomymex* KUTTER, 1950 (Hymenoptera: Formicidae) from the Western Palaearctic

Kadri KIRAN, Celal KARAMAN, Albena LAPEVA-GJONOVA & Volkan AKSOY



Abstract

Two new "ultimate" parasitic ant species, *Teleutomymex seiferti* KIRAN & KARAMAN sp.n. and *Teleutomymex buschingeri* LAPEVA-GJONOVA sp.n., are described from one site each in Turkey and Bulgaria. The hosts belong to *Tetramorium* cf. *cheffeti* FOREL, 1911. The findings increase the number of described *Teleutomymex* species to four.

Key words: Taxonomy, ants, Formicidae, *Teleutomymex*, social parasites, new species, Turkey, Bulgaria.

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Introduction

According to their life histories, ant species can be classified into two different categories, free living and socially parasitic species. The social parasites depend on other free living ant species during at least one period of their life and are mainly divided into temporary and permanent parasites with the latter being subdivided in dulotic and inquiline parasites (BUSCHINGER 2009). In extreme cases, inquilines have lost their worker caste secondarily. Queens of these workerless species invade nests of their hosts, generally closely related ant species, and rely on the worker force of the hosts to rear their own brood (HÖLDOBLER & WILSON 1990, BUSCHINGER 2009).

An important factor of the caste determination system in ants is the quantity of the food provided during the larval period. A main character of workerless inquilines is the small body size of females and males which implicates two advantages: Sexuials are produced with low energetic costs and the small-sized broods of the parasite cannot be distinguished from the worker brood of the hosts based on size characteristics. If sexual production of the host is not suppressed by the parasite, the parasite larvae develop into sexuials before the host produces its own sexuials (ARON & al. 2004). The average total body length of gynes of *Teleutomymex schneideri* KUTTER, 1950 is only 2.5 mm, and this species is presumably the parasitic species with the most extreme body-size difference between parasite and host (HÖLDOBLER & WILSON 1990). Because of their small body size, altered wing morphologies, and reduced flight and dispersal abilities, inquilines are among the rarest ants with very local occurrence, although their hosts can be common (TRONTTI & al. 2006). Due to their rarity and dependence on the host species, most of the inquiline

species are listed as potentially threatened in the IUCN red list of threatened animals (IUCN 2016).

Teleutomymex was first described by KUTTER (1950) from Switzerland, with the generic name meaning "final ant". Members of the genus are known as ectoparasites spending most of their time riding particularly on mesosoma or abdomen of their host queens. This uncommon habit of *Teleutomymex* queens in host nests led to the development of some special morphological characters – i.e., a strongly concave ventral surface of an extremely flattened gaster, very large tarsal claws, and huge arolia allowing tight adhesion on glabrous surfaces of the host queen.

Teleutomymex schneideri and *T. kutteri* TINAUT, 1990 are the two species of the genus *Teleutomymex* known so far. After the first record of *T. schneideri* from Switzerland (KUTTER 1950, STUMPER 1951), COLLINGWOOD (1956), BUSCHINGER (1985, 1987, 1999), ESPADALER & CUESTA (2006) and WEGNEZ & al. (2015) recorded this species from the Swiss Alps (Saas Fee, Simplon), the French Alps (Briançon, Vallée de la Maurienne) and the French Pyrenees (Vallée d'Ossau). The studies of KUTTER (1950), BRUN (1952), GÖSSWALD (1953), and CUESTA & al. (2009) provided additional data on biology and anatomy of the species. A *Teleutomymex* finding from Farap (previously: Farab) in Turkmenistan was attributed by DLUSSKY & al. (1990) to *T. schneideri*. Yet, considering the weak dispersal capacity of *Teleutomymex* in general and specifically the comparably cold thermal niche of *T. schneideri* with habitats in the upper montane and alpine zone of the Alps, it is difficult to believe that a finding in a hot Middle Asian lowland desert some 4500 km east of Switzerland should refer to the same species.

TINAUT (1990) described a second species, *Teleutomyrmex kutteri*, from the Sierra Nevada in Spain which differs mainly by hair length on propodeum and petiole, and genitals of males. *Teleutomyrmex kutteri* was recently recorded in Cazorla, La Empanada (Spain, Andalucía) (LÓPEZ & MARTINEZ 2011).

WARD & al. (2015) proposed to synonymize the ant genera *Teleutomyrmex* KUTTER, 1950, *Rhoptrymyrmex* MAYR, 1901, and *Anergates* FOREL, 1874 with *Tetramorium* MAYR, 1855 which, as a consequence, would become a mega-genus containing over 450 described species. This extreme decision would mean that both species of *Teleutomyrmex* would fall into secondary homonymy. *Teleutomyrmex schneideri* KUTTER, 1950 would become a junior secondary homonym of *Tetramorium schneideri* EMERY, 1898; accordingly, WARD & al. (2015) proposed to replace the name *Tetramorium schneideri* KUTTER with *Tetramorium inquilinum* WARD, BRADY, FISHER & SCHULTZ, 2015. Yet, they overlooked that *Tetramorium kutteri* TINAUT, 1990 would also become a junior secondary homonym of *Tetramorium semilaeve* var. *kutteri* SANTSCHI, 1927 if their concept would be accepted. We do not follow here the proposals of WARD & al. (2015). The mega-genus *Tetramorium* in the conception of WARD & al. (2015) refers to a big clade of myrmecine ants collecting at least eight subclades under a single name but each of these morphologically (and apparently also genetically – see WARD & al. 2015: fig. 1) well-defined subclades deserves to have a genus name on its own. Combining well-differentiated clades with most different life histories under a single name would make communication between recent and future myrmecologists extremely cumbersome and confusing. SEIFERT & al. (2016) presented three lines of argumentation under which conditions paraphyletic clades deserve a genus name. The most important of their arguments was perhaps saving the functionality of scientific language. Yet, the expectable subdivision of the mega-genus *Tetramorium* sensu WARD & al. (2015) into at least eight monophyletic subclades with each potentially deserving a genus rank makes a paraphyly discussion not necessary in this case.

Here we describe two new "ultimate" parasitic ant species, *Teleutomyrmex seiferti* KIRAN & KARAMAN sp.n. and *Teleutomyrmex buschingeri* LAPEVA-GJONOVA sp.n. from Turkey and Bulgaria found in nests of *Tetramorium* cf. *chefketi* FOREL, 1911.

Materials and methods

The studied specimens were collected from the north-eastern part of the Black Sea region of Turkey and the Eastern Rhodopes Mountain of Bulgaria using an aspirator in the field. The habitats are illustrated in Figures 1 and 2. Collection details are given in the results section.

The photographs of the specimens were taken using a Nikon d70s SLR camera with 3.2 and 8× microscope objective and Combine ZP free software. The photographs of male genitalia were taken using an Olympus BH-2 microscope with a ProgRes C12 Plus camera and ProgRes Capture Pro 2.6 software. Measurements were taken using an Olympus SZ51 stereomicroscope with 110AL2X objective at a magnification of 80× equipped with an Olympus U-OCMC 10 / 100XY stage micrometer. All measurement data were given as arithmetic mean ± standard deviation [minimum, maximum].

The exploratory data analysis principal component analysis, Ward hierarchical clustering and K-Means clustering as well as the ANOVA testing were performed with the software package SPSS 15.0. The long-term mean of seasonal standard air temperature TAS, referring to the period 1 May - 31 August and measured two meters above ground was calculated following SEIFERT & PANNIER (2007). TAS is basically calculated by interpolating distance-weighted data of the three next meteorological stations under site-specific correction for a temperature decrease of 0.661 °C per 100 m increase of elevation. The long-term mean refers to the years 1961 to 1990 and reference data were provided by Klimaabteilung der Zentralanstalt für Meteorologie und Geodynamik Vienna / Austria (1996). TAS data provide a rough estimate of the thermal niche of a species.

Loans of comparison material were from the British Museum Natural History London (BMNH), Zoologische Staatssammlung München (ZSM) and Senckenberg Museum für Naturkunde Görlitz (SMN).

All labels previously written by the original researchers are given in their original spelling; separate labels are indicated by "-".

Material examined for comparison

***Teleutomyrmex schneideri* KUTTER, 1950:** One syntype gyne with six labels from BMNH labelled "Switzerland, Saas-Fee, 25 July 1949 – *Teleutomyrmex schneideri* det. B. Bolton, 1974 – BMNH(E) 1014424 – ANTWEB CAS-ENT 0901024 – SYNTYPE – COTYPE".

Three gynes with two labels on one pin from ZSM labelled "*Teleutomyrmex schneideri* A. Schulz det. – FRANKREICH, Dep. Dautes-Alpes, Col de Granon, NW. Briancon, 2000 - 2100 mH, 26.07.1994, Leg. M. Sanetra. 397".

***Teleutomyrmex kutteri* TINAUT, 1990:** Four paratype gynes from SMN Görlitz labelled "SPA 37.110° N, 3.390° E, Sierra Nevada, 2250 m, Prados de Otero, Juniperus-Genista brushwood. Tinaut 1982.07.26".

Morphometrics

AOL	maximum length of anterior ocellus
AOW	anterior ocellus width; maximum width of anterior ocellus in frontal view
CL	maximum cephalic length in median line
ClyW	clypeal width; maximum width of clypeus
CS	cephalic size, $CS = (CL + CW) / 2$
CW	maximum cephalic width including eyes
DLO	maximum distance between the inner margin of the posterior ocelli
DFC	distance between frontal carinae at the level of hind margin of scape joint capsule
ECW	distance between the outer margins of the dorsal propodeal carinae at the point where the carinae begin to curve down along the caudal propodeal slope (this is the point where spines would be situated if there were any)
EL	maximum diameter of the eye over all structurally visible ommatidia
HFL	with the large diameter of hind femur in visual plane, maximum length of hind femur along its central axis
HTL	with the large diameter of hind tibia in visual plane, maximum length of hind tibia along its central axis



Figs. 1 - 2: General view of the habitats of (1) *Teleutomymex seiferti* sp.n. and (2) *T. buschingeri* sp.n.

MNW maximum mesonotal width before tegulae
 PNW pronotal width; maximum pronotum width in dorsal view
 PPW maximum width of postpetiole

PW maximum width of petiole
 SL scape length; maximum scape length excluding articular condyle



Fig. 3: Heads of gynes in frontal view. (a) *Teleutomymex seiferti* sp.n., (b) *T. buschingeri* sp.n., (c) *T. schneideri* (syn-type), (d) *T. schneideri* (non-type specimen), (e) *T. kutteri* (paratype).

Results

Teleutomymex seiferti KIRAN & KARAMAN sp.n. (Figs. 3 - 7, Tab. 1)

Etymology: The species is dedicated to Dr. Bernhard Seifert for his great contributions to this study.

Type material: Holotype (gyne) from Turkey, Artvin, Yusufeli, 3 km NW of Kinalıçam Village, N 40° 45' 36", E 41° 34' 46", 1801 m above sea level (a.s.l.), 25.VI.2013, 13 / 1592c, leg. K. Kiran, C. Karaman & V. Aksoy (in Collection of Biological Department, Trakya University, Edirne, Turkey). Paratypes: 16 gynes, 7 males from same nest as the holotype (14 gynes, 5 males in Collection of Biological Department, Trakya University, Edirne; 1 gyne, 1 male in Sofia University, Bulgaria; 1 gyne, 1 male in Senckenberg Museum of Natural History Görlitz, Germany).

Material of host examined: 3 ♀♀ (alate), 75 ♂♂ of *Tetramorium* cf. *chefketi*, in the same nest.

Diagnosis: Gynes differ from *Teleutomymex schneideri* by larger CS, HTL / CS, PPW / CS, and DLO / CS (Tab. 1). They differ from *T. kutteri* by larger CS and DLO / CS, and by much longer and more erect pilosity on ap-

pendages and whole body. They differ from *Teleutomymex buschingeri* sp.n. by smaller CW / CL, larger DLO / CS, by the dorsolateral margins of the propodeum forming distinct carinae, and by much less developed microsculpture on lateral mesosomal sclerites and petiole (Fig. 3a, Tab. 1).

Gynes: Head in full face view not much wider than long (CL / CW 0.951 - 1.000), lateral sides convex and rounding to slightly concave posterior margin, anterior part of head narrower than posterior one. Eyes protruding and small (EL / CS 0.224 - 0.250), occupying less than one quarter of lateral head side, ocelli relatively well developed, distance of posterior ocelli rather large (DLO / CS 0.244 - 0.275), anterior clypeal margin deeply concave, posterior margin broadly convex, mandibles atrophied, largely triangular, and with pointed apex. Antennal scape as long as head length (SL / CL 0.974 - 1.000), slightly surpassing posterior margin of head, funiculus 10-segmented, 3rd funicular segment slightly longer than 4th one and almost twice as long as 2nd; three apical segments forming a small club.

Pronotum narrower than head (PNW / CS 0.732 - 0.835), anterolaterally with small angles, in lateral view

Tab. 1: Measurements of gynes and males of the genus *Teleutomyrmex*. Data written in italics could be recorded in three specimens only. For numeric analysis of gynes, we used CS as an indicator of absolute body size plus the twelve shape variables SL / CS, ClyW / CS, PNW / CS, MNW / CS, DLO / CS, AOL / CS, AOW / CS, DFC / CS, PPW / CS, HFL / CS, HTL / CS, and EL / CS. PW / CS and ECW were excluded because data were missing here in some specimens. All three exploratory data analyses – (1) principal component analysis, (2) K-Means clustering, and (3) Ward hierarchical clustering – showed most similar results. Three well separated clusters are confirmed: *Teleutomyrmex seiferti* sp.n. and *T. buschingeri* sp.n. forming a common cluster, *T. schneideri*, and *T. kutteri*. Figure 9 presents the plotting of the principal component analysis of the gynes.

	<i>T. seiferti</i> males (n = 6)	<i>T. seiferti</i> gynes (n = 10)	<i>T. buschingeri</i> gynes (n = 2)	<i>T. schneideri</i> gynes (n = 4)	<i>T. kutteri</i> gynes (n = 4)
CS [mm]	0.469 ± 0.006 [0.463, 0.476]	0.491 ± 0.005 [0.482, 0.500]	0.474 ± 0.001 [0.474, 0.476]	0.469 ± 0.005 [0.463, 0.473]	0.445 ± 0.009 [0.438, 0.457]
CL / CW	0.924 ± 0.009 [0.910, 0.935]	0.971 ± 0.015 [0.951, 1.000]	0.904 ± 0.035 [0.880, 0.929]	0.965 ± 0.016 [0.949, 0.987]	1.010 ± 0.020 [0.989, 1.028]
SL / CS	0.886 ± 0.016 [0.871, 0.907]	0.971 ± 0.009 [0.956, 0.988]	0.986 ± 0.017 [0.974, 0.998]	0.956 ± 0.020 [0.929, 0.974]	1.041 ± 0.020 [1.013, 1.062]
ClyW / CS	0.670 ± 0.015 [0.658, 0.693]	0.685 ± 0.016 [0.659, 0.708]	0.675 ± 0.012 [0.667, 0.684]	0.683 ± 0.011 [0.671, 0.697]	0.734 ± 0.027 [0.708, 0.770]
PNW / CS	0.780 ± 0.017 [0.762, 0.805]	0.770 ± 0.032 [0.732, 0.835]	0.747 ± 0.013 [0.738, 0.756]	0.742 ± 0.011 [0.736, 0.758]	0.778 ± 0.035 [0.733, 0.808]
MNW / CS	0.566 ± 0.012 [0.558, 0.591]	0.656 ± 0.026 [0.634, 0.709]	0.632 ± 0.023 [0.615, 0.648]	0.664 ± 0.029 [0.645, 0.706]	0.656 ± 0.029 [0.613, 0.677]
DLO / CS	0.257 ± 0.013 [0.247, 0.282]	0.257 ± 0.011 [0.244, 0.275]	0.220 ± 0.002 [0.218, 0.222]	0.202 ± 0.012 [0.184, 0.209]	0.232 ± 0.010 [0.219, 0.241]
AOL / CS	0.115 ± 0.011 [0.095, 0.123]	0.105 ± 0.010 [0.086, 0.122]	0.090 ± 0.001 [0.090, 0.091]	0.081 ± 0.006 [0.077, 0.090]	0.094 ± 0.011 [0.082, 0.107]
AOW / CS	0.092 ± 0.010 [0.081, 0.107]	0.075 ± 0.007 [0.061, 0.088]	0.075 ± 0.002 [0.074, 0.077]	0.075 ± 0.006 [0.066, 0.078]	0.069 ± 0.011 [0.057, 0.083]
DFC / CS	0.329 ± 0.008 [0.320, 0.343]	0.348 ± 0.014 [0.325, 0.373]	0.377 ± 0.011 [0.369, 0.385]	0.361 ± 0.009 [0.348, 0.368]	0.396 ± 0.008 [0.384, 0.402]
PW / CS	0.676 ± 0.019 [0.658, 0.698]	0.369 ± 0.018 [0.325, 0.390]	0.386 ± 0.003 [0.385, 0.388]	<i>0.380 ± 0.039</i> [0.353, 0.408]	0.340 ± 0.009 [0.329, 0.347]
PPW / CS	1.103 ± 0.041 [1.047, 1.154]	0.705 ± 0.015 [0.683, 0.734]	0.710 ± 0.011 [0.702, 0.718]	0.663 ± 0.006 [0.658, 0.671]	0.694 ± 0.013 [0.684, 0.712]
HFL / CS	1.136 ± 0.031 [1.096, 1.170]	1.178 ± 0.013 [1.163, 1.200]	1.169 ± 0.021 [1.154, 1.184]	1.125 ± 0.018 [1.098, 1.135]	1.176 ± 0.020 [1.147, 1.193]
HTL / CS	0.997 ± 0.014 [0.980, 1.014]	0.974 ± 0.023 [0.938, 1.000]	0.994 ± 0.045 [0.962, 1.026]	0.923 ± 0.007 [0.915, 0.929]	0.931 ± 0.019 [0.906, 0.952]
EL / CS	0.255 ± 0.015 [0.233, 0.272]	0.237 ± 0.009 [0.224, 0.250]	0.228 ± 0.004 [0.226, 0.231]	0.260 ± 0.003 [0.258, 0.263]	0.230 ± 0.003 [0.227, 0.233]
ECW / CS	0.417 ± 0.020 [0.403, 0.456]	0.301 ± 0.004 [0.294, 0.309]		0.335 ± 0.006 [0.327, 0.342]	<i>0.281 ± 0.014</i> [0.267, 0.294]

scutum raised over pronotum, dorsal surface of scutum and prescutum straight, scutellum higher than scutum, metanotum very small, like a tooth. Dorsolateral margins of propodeum developed as distinct carinae, the longer dorsal and the shorter declivitous profile of carinae forming an obtuse angle with a blunt tooth at the position where spines normally are based; distance of propodeal spiracle from posterior margin of propodeum twice as long as the distance from anterior margin to spiracle. Petiolar scale in profile triangular, with a nearly linear frontal and broadly convex caudal profile. Dorsal outline of postpetiole convex in lateral view. Gaster typically dorso-ventrally flattened in virgin females.

Head smooth and shiny, only genae between antennal sockets and compound eyes microreticulate. Mesosoma and petiole microalveolate. In dorsal view, postpetiole superficially microreticulate and gaster glabrous.

Head and hind tibiae with long erect hairs, scape and hind femur with dense semi-erect hairs. Dorsum of mesosoma, petiole and postpetiole with brush-like hairs, anepisternum and gaster almost bare, katepisternum with long decumbent hairs.

Clypeus, mandibles, antennae, and legs yellow. Rest of head, mesosoma, and petiole brown; postpetiole brownish yellow; gaster brownish yellow except yellow lateral sides and articulations.

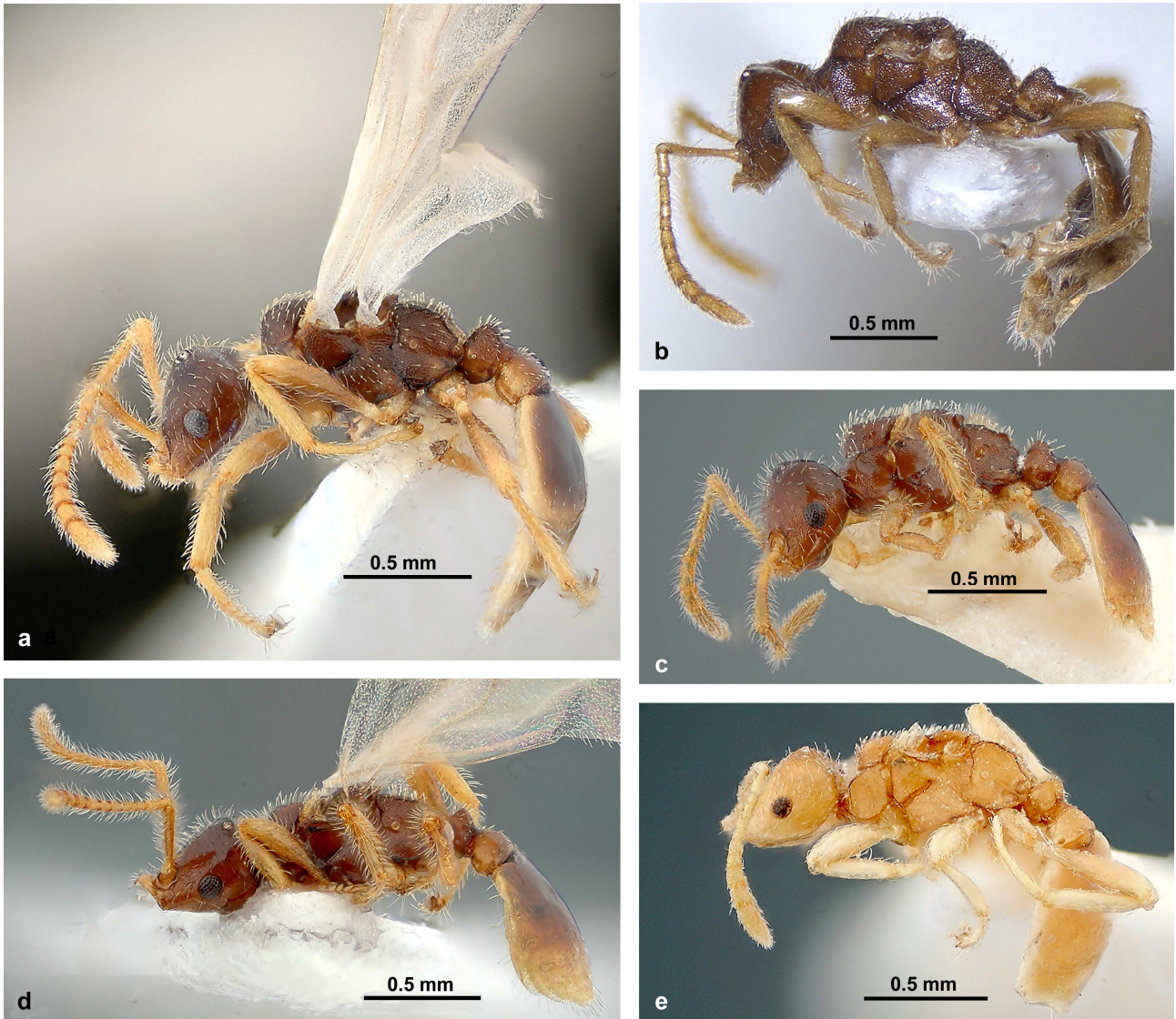


Fig. 4: Gynes, lateral view. (a) *Teleutomymex seiferti* sp.n., (b) *T. buschingeri* sp.n., (c) *T. schneideri* (syntype), (d) *T. schneideri* (non-type specimen), (e) *T. kutteri* (paratype).

Males: In full face view head wider than long (CL / CW 0.910 - 0.935), lateral sides convex, rounding to straight posterior margin, anterior part of head slightly narrower than posterior one, eyes relatively big (EL / CS 0.233 - 0.272), located in the middle of head sides, ocelli well developed, distance of posterior ocelli rather large (DLO / CS 0.247 - 0.282), anterior margin of clypeus slightly notched medially, posterior margin broadly convex, mandibles atrophied and very small. Antennal scape short (SL / CS 0.871 - 0.907), scape hardly reaching posterior margin of head, funiculus 10-segmented, last three articles form a club.

Pronotum short and distinctly narrower than head (PNW / CS 0.762 - 0.805). With mesosoma in lateral view, mesonotum not raised as in female, its dorsum almost straight; scutellum strongly raised, metanotum lower than scutellum; dorsal surface of propodeum sloping posteriorly, slightly longer than declivitous surface and joining by an obtuse angle, and forming here a small tooth. Propodeal spiracle located close to anterior propodeal border. Dor-

sal part of petiole in profile almost rectangular, petiole distinctly wider than the distance between propodeal teeth, postpetiole very wide and short in dorsal view. Gaster dorsoventrally flattened.

Posterior margin of subgenital plate convex. Shape of sagitta and subgenital plate more similar to *Teleutomymex kutteri* on the contrary volsella completely different from *T. kutteri* and *T. schneideri* (Fig. 8).

Head densely microreticulate and matt, mesosoma and petiole densely microalveolate. Postpetiole, first and second abdominal tergites with very dilute microreticulum and rest of gaster glabrous.

Long hairs absent or very rare. Short, erect and suberect hairs present on head, scape, mesosoma, petiole, and postpetiole. Gaster bare.

Lower parts of head, antennae, and legs yellow; rest of head, mesosoma, petiole, and postpetiole yellowish brown. Gaster brownish yellow.

Ecology: The type series was collected from a *Tetramorium* cf. *chefketi* nest located under a stone in a *Pinus*



Fig. 5: Close views of heads of gynes, lateral view. (a) *Teleutomymex seiferti* sp.n., (b) *T. buschingeri* sp.n., (c) *T. schneideri* (syntype), (d) *T. schneideri* (non-type specimen), (e) *T. kutteri* (paratype).

sylvestris L. forest older than 100 years. There are many trees about to die because of their old age, and therefore there are very large sun exposed areas on the forest ground. The ground is not inclined near the nest because the nest site is placed on the top of the hill (Fig. 1).

The habitat is similar to that reported by TINAUT (1990) for the type locality of *Teleutomymex kutteri*. Herb layer plants of the forest ground consist mainly of *Astragalus* sp., *Hieracium* sp., *Thymus* sp., *Pilosella* sp., *Ajuga* sp., *Centaurea* sp., *Juniperus communis* L., and *Stipa* sp. The following 14 ant species were recorded from the type locality: *Camponotus aethiops* (LATREILLE, 1798), *C. piceus* (LEACH, 1825), *Cataglyphis aenescens* (NYLANDER, 1849), *Crematogaster schmidti* (MAYR, 1853), *Formica clara* FOREL, 1886, *F. cunicularia* LATREILLE, 1798, *Lasius alienus* (FOERSTER, 1850), *Messor structor* (LATREILLE, 1798), *Proformica striaticeps* (FOREL, 1911), *Tapinoma* cf. *simrothi* KRAUSSE-HELDRUNGEN, 1911, *Temnothorax interruptus* (SCHENCK, 1852), *Tetramorium* cf. *caespitum* (LINDAEUS, 1758), *T. ferox* RUZSKY, 1903, *T. moravicum* KRATOCHVIL, 1941. The long-term average of mean air temperature in 2 m height from 1 May to 31 August TAS is 11.3 °C.

***Teleutomymex buschingeri* LAPEVA-GJONOVA sp.n.**
(Figs. 3 - 7, Tab. 1)

Etymology: The species is dedicated to Prof. Alfred Buschinger who has made great contributions to the study of socially parasitic ants.

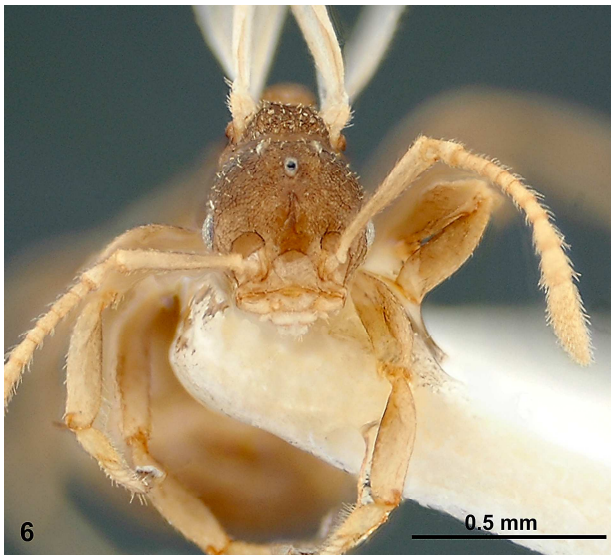
Type material: Holotype (dealated gyne) from Bulgaria, Eastern Rhodopes Mt., Chernichino Village, N 41° 35' 29.71", E 25° 50' 55.03", 640 m a.s.l., 25.IV.2012,

leg. A. Lapeva-Gjonova; deposited in the museum collection of Sofia University, Bulgaria (BFUS). Paratypes (1 dealated gyne) from the same nest as the holotype, deposited in the National Museum of Natural History in Sofia (NMNHS), Bulgaria.

Diagnosis: Gynes differ from the other three species by the absence of any carinae or teeth on dorsal surface of propodeum, by a very short dorsal profile of propodeum, by a much stronger developed reticulate or alveolate microsculpture covering the whole surface of lateral mesosoma and petiole and by smaller CL / CW. Furthermore, they differ from *Teleutomymex seiferti* sp.n. by a much smaller DLO / DFC (0.567 - 0.600 vs. 0.667 - 0.786). Additional differences to *T. schneideri* are a larger HTL / CS and a smaller EL / CS, and to *T. kutteri* a much smaller CL / CW, larger PW / CS and HTL / CS, and smaller ClyW / CS (Tab. 1).

Gynes: Head in full face view wider than long (CL / CW 0.904), its lateral sides distinctly convex, anterior part of head narrower than posterior one, eyes small (EL / CS 0.228), lateral ocelli well developed, lateral ocelli less distant from each other than in *Teleutomymex seiferti* sp.n. (DLO / CS 0.219). Anterior clypeal margin deeply concave and posterior margin rather convex. Mandibles reduced and triangular, with a pointed apex. Antennal scape distinctly longer than head length, exceeding the dorsal margin of head. Funiculus 10-segmented, 2nd segment 0.043 mm, 3rd segment 0.067 mm, 4th segment 0.055 mm long, the three apical segments form a small club.

Pronotum narrower than head (PNW / CS 0.747), anterolaterally with small angles. Mesonotum raised over pronotum, its dorsum straight, scutellum higher than meso-



Figs. 6 - 7: Male of *Teleutomymex seiferti* sp.n., frontal (6) and lateral view (7).

notum. Dorsal surface of propodeum much shorter than declivitous surface, both surfaces form a convex outline without any traces of propodeal teeth. Propodeal spiracle located near to anterior border of propodeum. Petiolar scale in profile triangular with straight frontal and convex posterior surface. Dorsal outline of postpetiole convex in lateral view. Gaster in virgin gynes typically dorso-ventrally flattened. Hind tibiae very long (HTL / CS 0.994) distinctly longer than in *Teleutomymex kutteri* and *T. schneideri*.

Clypeus and frons up to the level of anterior ocellus smooth and shiny, between compound eye and antennal socket densely microreticulate. Mesosoma and petiole densely microalveolate and matt, postpetiole slightly microreticulate and more shiny. Gaster glabrous.

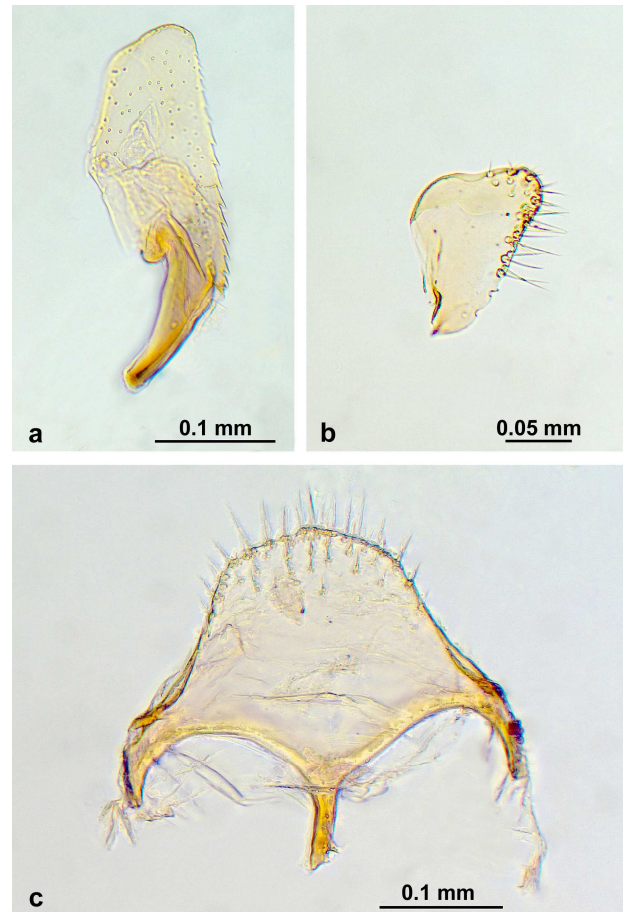


Fig. 8: Male genitalia of *Teleutomymex seiferti* sp.n. (a) Sagitta; (b) volsella; (c) subgenital plate.

Head with moderately long erect hairs. Scape with semi-erect hairs. Mesosoma and petiole with brush like hairs. Postpetiole with very short brush like hairs. Gaster bare. Hind femora with long subdecumbent hairs. Tibiae with very long, erect hairs. Katepisternum and lateral portion of propodeum with very few and short decumbent hairs.

Clypeus, mandibles, antennae, and legs yellow. Head, mesosoma and petiole dark brown. Postpetiole yellowish brown, first gaster segment brown, the rest brownish yellow.

Males: Unknown.

Host: The two dealated queens were found on the back of a dealated queen of *Tetramorium* cf. *chefketi* together with few host workers in the nest. The host ant species belongs to the *T. chefketi* species complex in contrast to the hosts from the *T. caespitum* / *impurum* complex reported for *Teleutomymex schneideri* and *T. kutteri* in Europe.

Ecology: The nest of *Tetramorium* cf. *chefketi* with *Teleutomymex buschingeri* sp.n. was found under a stone on a southern slope of a dry grassland situated in an oak forest (Fig. 2). The habitat type is quite different from the known habitats of related species. The altitude of 640 m, where the species was sampled, is notably less than the altitudes of the localities of the other ultimate ant parasites (1600 - 2300 m) (excluding the one in Turkmenistan, see discussion in the section below).

The following 21 ant species were recorded in the same area: *Bothriomyrmex corsicus* SANTSCHI, 1923, *Campo-*

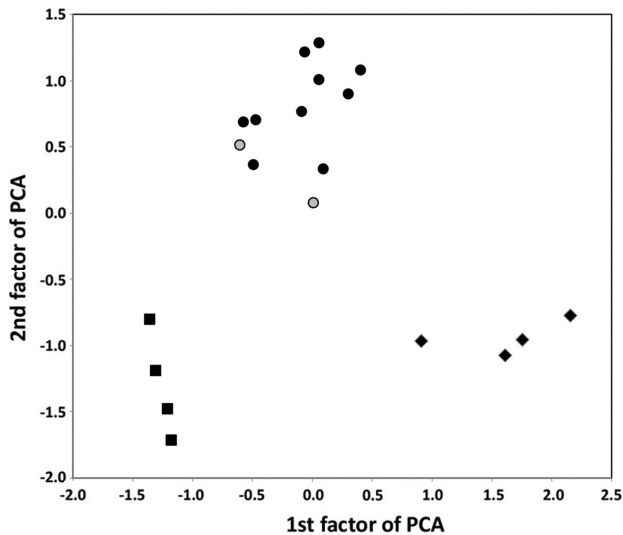


Fig. 9: Principal component analysis of gynes of *Teleutomyrmex seiferti* sp.n. (black dots), *T. buschingeri* sp.n. (grey dots), *T. schneideri* (rhombs) and *T. kutteri* (squares) based on evaluation of absolute cephalic size and twelve shape variables.

notus aethiops, *C. piceus*, *C. samius* FOREL, 1889, *Cataglyphis nodus* (BRULLÉ, 1883), *Formica cunicularia*, *F. gagates* LATREILLE, 1798, *Lasius* cf. *distinguendus* (EMERY, 1916), *L. psammophilus* SEIFERT, 1992, *Messor structor*, *Myrmica specioides* BONDROIT, 1918, *Pheidole* cf. *pallidula* (NYLANDER, 1849), *Plagiolepis pygmaea* (LATREILLE, 1798), *Ponera testacea* EMERY, 1895, *Solenopsis fugax* (LATREILLE, 1798), *Tapinoma erraticum* (LATREILLE, 1798), *Temnothorax parvulus* (SCHENCK, 1852), *T. semiruber* (ANDRÉ, 1881), *Tetramorium hungaricum* RÖSZLER, 1935, *T. indocile* SANTCHI, 1927, and *T. moravicum*. The ant community is mainly composed by xerothermophilous species preferring warm and sunny areas. The Eastern Rhodopes have low and hilly landscape with an average altitude of 320 m and the highest point is 1483 m. Continental-Mediterranean climate determines the relatively high average annual temperature of 12 °C and the mean long-term air temperature in 2 m height from 1 May to 31 August TAS is 18.0 °C.

Key for identification of *Teleutomyrmex* species

(Males of *T. buschingeri* sp.n. unknown.)

- 1 Gynes. 2
- Males. 5
- 2 Carinae or teeth on dorsal surface of propodeum absent, dorsal profile of propodeum much shorter than the declivitous one. All lateral surfaces of mesosoma and petiole covered by a well-developed reticulate or alveolate microsculpture. Head length index $CL / CW < 0.945$. Southern Balkans. ***T. buschingeri* sp.n.**
- Carinae or teeth on dorsal surface of propodeum present, dorsal profile of propodeum not much shorter than the declivitous one. Surfaces of lateral mesosoma and petiole only in patches

covered by a reticulate or alveolate microsculpture or completely smooth. Head length index $CL / CW > 0.945$ 3

- 3 Scape long, $SL / CS > 1.00$. Distance of frontal carinae clearly larger than petiolar width, $DFC / PW > 1.096$. Size small, $CW < 464 \mu\text{m}$. Scapes and tibiae with weaker, largely decumbent pilosity. Southern Iberia. ***T. kutteri***
- Scape shorter, $SL / CS < 1.00$. Distance of frontal carinae not much larger than petiolar width, $DFC / PW < 1.096$. Size larger, $CW > 464 \mu\text{m}$. Scapes and tibiae with profuse erect or suberect pilosity. 4
- 4 Ratio of distance between lateral ocelli and large diameter of complex eye larger: $DLO / EL 0.93 - 1.11$. Katepisternum with many long decumbent hairs, posterior corners of head posterior of the eyes smooth, absolute scape length larger: $SL > 457 \mu\text{m}$. Anatolia. ***T. seiferti* sp.n.**
- Ratio of distance between lateral ocelli and large diameter of complex eye smaller: $DLO / EL 0.70 - 0.80$. Katepisternum without or only with a few decumbent hairs, posterior corners of head posterior of the eyes densely microreticulate, absolute scape length smaller: $SL < 457 \mu\text{m}$. Alps and Pyrenees. ***T. schneideri***
- 5 Anterior clypeal margin straight. 6
- Anterior clypeal margin concave medially. ***T. seiferti* sp.n.**
- 6 Subgenital plate broadly convex, sagitta with sinusoidal shape. ***T. kutteri***
- Subgenital plate slightly concave, sagitta broadly convex. ***T. schneideri***

Discussion

The extreme rarity, small absolute sample size, and very few sampling localities from which *Teleutomyrmex* material is available makes relational assessment of within- and between-species variability problematic and mathematic arguments to rest on rather shaky foundations. Yet, the whole body of information allows the formation of reasonable species hypotheses. Our recognition of four different species is based on the following lines of argumentation. Firstly, the exploratory data analyses PCA, K-Means and Ward clustering, using linear morphometric characters, coincide in demonstrating three clearly separate clusters: *Teleutomyrmex kutteri*, *Teleutomyrmex schneideri* and the cluster formed by *Teleutomyrmex seiferti* sp.n. plus *Teleutomyrmex buschingeri* sp.n. Secondly, this morphometric separation in three clusters (about separating the fourth cluster see below) is supported by additional structural characters which are mentioned in the differential diagnoses, the key and in the following text. Thirdly, these three clusters show a wide zoogeographic separation, which is noteworthy because *Teleutomyrmex* gynes most probably have a weak long-range dispersal capacity, concluded from their mesosomal and wing morphology. Obviously, we can speak here of three populations with very strong postglacial isolation (and certainly much inbreeding), which are embedded in three different

faunal contexts. Fourthly, there seem to exist differences in host species selection. Whereas *Teleutomyrmex kutteri* and *Teleutomyrmex schneideri* use species of the *Tetramorium caespitum* complex, *Teleutomyrmex seiferti* sp.n. and *Teleutomyrmex buschingeri* sp.n. selected species of the *Tetramorium chefketi* species complex – despite the presence of species of the *Tetramorium caespitum* complex at both the Bulgarian and Anatolian type locality of the new species. In order to strengthen our four-species hypothesis, we perform in the following a pairwise comparison of only the geographically closest neighbours, travelling from Iberia over the Alps and the Balkans to Anatolia.

The shortest known distance between the allopatric populations of *Teleutomyrmex kutteri* (Andalucia) and *T. schneideri* (Pyrenees) is 600 km. The two species are morphologically well differentiated. TINAUT (1990) already reported that *T. kutteri* from the Sierra Nevada differs from *T. schneideri* by a smaller average petiolar hair length which 18.9 μm in the former and 33.3 μm in the latter – a finding that was confirmed by LÓPEZ & MARTINEZ (2011) in material from near Cazorla / Andalusia. The following non-overlapping shape variables in our data sets show, when tested in an ANOVA, significant differences of the highest level: SL / CS ($F_{1,6} = 35.74$, $p < 0.001$), DFC / CS ($F_{1,6} = 32.44$, $p < 0.001$) and EL / CS ($F_{1,6} = 252.92$, $p \ll 0.001$). Significant differences with $p < 0.05$ are found in 56% of the 16 morphometric characters shown in Table 1.

The smallest known distance between the allopatric populations of *Teleutomyrmex schneideri* sp.n. and *T. buschingeri* sp.n. is 1300 km. The striking differences in microsculpture and propodeal shape were mentioned in the diagnosis and the key and the following non-overlapping shape variables show the most significant differences when tested in an ANOVA: EL / CS ($F_{1,4} = 161.89$, $p \ll 0.001$), PPW / CS ($F_{1,4} = 47.48$, $p < 0.002$) and HTL / CS ($F_{1,4} = 12.20$, $p < 0.025$). Significant differences with $p < 0.05$ are found in five of the 16 morphometric characters shown in Table 1. The species are also embedded in most different climatic contexts. *Teleutomyrmex schneideri* is a species of the highly montane to alpine zone: Six sites in the Pyrenees and Alps have a mean seasonal temperature TAS of 8.9 ± 1.9 [6.4, 11.3] °C whereas the type locality of *T. buschingeri* sp.n. in the colline zone of south Bulgaria has a TAS of 18.0 °C. A further argument for heterospecificity is that the host species belong to different species complexes.

Allocation to the same cluster by three different methods of exploratory data analyses (for PCA see Fig. 9), selection of host species of the same species complex and a relative zoogeographic proximity suggest that *Teleutomyrmex buschingeri* sp.n. and *T. seiferti* sp.n. are more closely related to each other than to *T. schneideri* or *T. kutteri*. The type localities of *T. buschingeri* sp.n. and *T. seiferti* sp.n. are separated by 1300 km. The TAS of the *T. seiferti* sp.n. site is 11.3 °C which is 6.7 °C less than in the *T. buschingeri* sp.n. site and the phytoassociations of both sites differ considerably. Yet, this is, if at all, only a moderate support of heterospecificity as we have a good number of examples in which such climatic and habitat differences occur intraspecifically (SEIFERT 2017) – this includes the genus *Tetramorium* (STEINER & al. 2010). The strongest argument for heterospecificity of *T. buschingeri* sp.n.

and *T. seiferti* sp.n. are the morphological differences. Very strong are the differences in propodeal shape. The rounded surface of the propodeum in *T. buschingeri* sp.n. is reminiscent to shapes seen in workers of some *Lasius* species, contrasting the bicarinate, angular situation in *T. seiferti* sp.n. This degree of a difference has a low probability to represent an intraspecific polymorphism. The same applies to the differences in microsculpture of mesosoma and head. These indications are supported by linear morphometrics with the following shape variables showing the highest differences when tested in an ANOVA: CL / CW ($F_{1,10} = 22.54$, $p < 0.001$), DLO / CS ($F_{1,10} = 22.69$, $p < 0.001$), and DFC / CS ($F_{1,10} = 7.24$, $p < 0.023$). The strongest morphometric difference seems to occur in the ratio of the distance of posterior ocelli against the distance of frontal carinae DLO / DFC ($F_{1,10} = 22.87$, $p < 0.001$).

The data presented above justify the separation of four *Teleutomyrmex* species – this is a surprising species richness for such an extremely evolved ant genus. Even more, this story is most certainly incomplete: The existence of a fifth, undescribed species from Middle Asia is most probable. A finding at the locality Farab (the former Farap, 39.15° N, 63.61° E, 190 m a.s.l.) in Turkmenistan made in 1988, is most unlikely to belong to *T. schneideri* under which name it has been published by DLUSSKY & al. (1990). Farab is 4500 km distant from the next site of *T. schneideri* in Switzerland and the climatic and faunistic context of this site situated in a river plane at the margin of the Kara-Kum desert is dramatically different: TAS in Farab is 35.0 °C and the *Tetramorium* species occurring there (DLUSSKY 1981) are different from the known host species of the described *Teleutomyrmex* species.

The age estimates of WARD & al. (2015) suppose a splitting of the genera *Anergates* and *Teleutomyrmex* in the Pliocene and it is likely that species divergence in *Teleutomyrmex* began in late Pliocene and was most intensive during Pleistocene. As three of the probably five known species are rather cold-tolerant, it seems likely that speciation in these species took place in interglacial periods when formerly connected and widely distributed populations became isolated in mountain areas – for Anatolia and adjacent areas this change between fusion and disruption of populations was considered by BILGIN (2011).

We expect that further intensive studies in high mountain areas of any region between Switzerland and Turkmenistan will provide new records of the genus *Teleutomyrmex* and will help us to better understand the distributional pattern and evolution of these species. However, a rapid improvement of knowledge is not expected in *Teleutomyrmex* as members of the genus are really rare: We found only a single sample of *Teleutomyrmex* within a total of 885 *Tetramorium* nest samples collected from the Eastern Black Sea Region of Turkey. Furthermore, repeated visits of the type locality of *T. buschingeri* sp.n. after its first collecting in 2012 did not result in finding further specimens.

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