Entomofauna

ZEITSCHRIFT FÜR ENTOMOLOGIE

Band 23, Heft 14: 157-172 ISSN 0250-4413 Ansfelden, 31. Juli 2002

Notes on the socially parasitic ants of Turkey and the synonymy of *Epimyrma*

(Hymenoptera, Formicidae)

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Abstract

New data on the distribution of socially parasitic ants of Turkey are presented. During recent field studies, *Myrmoxenus gordiagini* RUZSKY, 1902, *Myrmoxenus ravouxi* (ANDRÉ, 1896), *Myrmoxenus stumperi* (KUTTER, 1950), *Strongylognathus testaceus* (SCHENCK, 1852), *Strongylognathus silvestrii* MENOZZI, 1936, *Strongylognathus* cf. *alpinus* WHEELER, 1909, *Plagiolepis* sp., *Rossomyrmex minuchae* TINAUT, 1981 and *Polyergus rufescens* (LATREILLE, 1802) were found in Turkey for the first time. Furthermore, we rediscovered *Strongylognathus kervillei*, a species that has not been found again since its first description by SANTSCHI in 1921. New localities for two previously but rarely recorded species, *Chalepoxenus muellerianus* (FINZI, 1922) and *Anergates atratulus* (SCHENCK, 1852), are provided. The occurrence of the guest ant *Formicoxenus nitidulus* (SCHENCK, 1852) is also new for Turkey. Altogether, 15 species of permanent social parasites can presently be attributed to the Turkish ant fauna. Taxonomic, zoogeographical and ecological considerations are given in an annotated species list. Additionally, we establish the priority of *Myrmoxenus* RUZSKY, 1902 over the synonymous genus *Epimyrma* EMERY, 1915 **(syn. nov.)**.

Zusammenfassung

Neue Erkenntnisse über die sozialparasitischen Ameisen der Türkei werden dargelegt. Im Rahmen umfangreicher Neuaufsammlungen konnten *Myrmoxenus gordiagini* RUZSKY, 1902, *Myrmoxenus ravouxi* (ANDRÉ, 1896), *Myrmoxenus stumperi* (KUTTER, 1950), *Strongylognathus testaceus* (SCHENCK,1852), *Strongylognathus silvestrii* MENOZZI, 1936,

Strongylognathus cf. *alpinus* WHEELER, 1909, *Plagiolepis (Aporomyrmex)* sp., *Rossomyrmex minuchae* TINAUT, 1981 und *Polyergus rufescens* (LATREILLE, 1802) erstmals für die Türkei nachgewiesen werden. Weiterhin gelang der Wiederfund von *Strongylognathus kervillei*, einer Art die bislang nur von ihrer Erstbeschreibung durch SANTSCHI im Jahre 1921 bekannt war. Zusätzlich konnten die bereits aus der Türkei gemeldeten, aber sehr seltenen Arten, *Chalepoxenus muellerianus* (FINZI, 1922) und *Anergates atratulus* (SCHENCK, 1852), gefunden werden. Das Vorkommen der Gastameise *Formicoxenus nitidulus* (SCHENCK, 1852) in der Türkei ist ebenfalls neu. Insgesamt können damit 14 (15) permanent sozialparasitisch lebende Arten für das Land angegeben werden. In einer kommentierten Artenliste werden taxonomische, zoogeographische und ökologische Befunde zusammengefaßt. Wir zeigen auf, daß *Myrmoxenus* RUZSKY, 1902 gegenüber der synonymen Gattung *Epimyrma* EMERY, 1915 (**syn. nov.**) Priorität besitzt.

Introduction

The world ant fauna comprises more than 10,000 described species, of which about 250 live as social parasites (HÖLLDOBLER & WILSON 1990; BOLTON 1995). These social parasites are generally much rarer than independent ant species and often very limited in their geographic distribution (e.g. HÖLLDOBLER & WILSON 1990). In particular, the highly advanced relationships between socially parasitic ants and their hosts have attracted the attention of sociobiologists. Two main categories of ant parasitism can be distinguished. After mating, the queens of "temporary parasites" invade colonies of their host species where the host workers rear the parasite's brood. Host workers are later completely replaced by the parasites which then are able to maintain independent colonies. By contrast, "permanently parasitic" ants spend the entire life cycle in the nests of their host species. The "permanent parasites" can be subdivided into slave-makers and inquilines, either tolerant or intolerant of host queen. While inquilines usually are workerless species, active slave-makers produce a numerous workerforce specifically designed to raid other host colonies for worker supply. All parasitic species mentioned in this paper are permanent social parasites, including the guest ant *Formicoxenus nitidulus*, which has a different life style and host adaptation (see BUSCHINGER 1990).

Up to now the knowledge of the Turkish ant fauna still remains very poor. Only few papers have been published that deal with ant distribution or ecology in this geographic region, (e.g. FOREL 1906; EMERY 1921; SCHKAFF 1924; SANTSCHI 1926 & 1934; BARONI URBANI 1964; AKTAÇ 1976; AKTAÇ 1987; ARAS & AKTAÇ 1987; ÇAMLITEPE & AKTAÇ 1987; HEINZE 1987; HEINZE & KAUFFMANN 1993). Two more extensive studies by FOREL (1911) and SANTSCHI (1921) mainly treat species level taxonomy and the description of new varieties and forms. Some zoogeographical aspects of the ants of Turkey and the Near East have been outlined by BYTINSKI-SALZ (1953). While most permanent social parasites are known from the comparatively well studied faunas of North America, Europe and North Africa, only six species have so far been recorded from Turkey. The first record of a socially parasitic ant from Turkey, *Strongylognathus kervillei*, was provided by SANTSCHI (1921) from the environs of Ankara. ÇAMLITEPE & AKTAÇ (1987) reported *Anergates atratulus* (SCHENCK, 1852) from the Istranca Dağları (Prov. Trakya) and HEINZE (1987) found this peculiar species at Tavşanlı (Prov. Kütahya). Additionally, *Chalepoxenus muellerianus* (FINZI, 1922) from Kazkıran Geçidı (Prov. Sakarya) and *Myrmoxenus*

(=Epimyrma) kraussei (EMERY, 1915) from Termessos (Prov. Antalya) were recorded by the latter author. More recently, HEINZE & KAUFFMANN (1993) presented two species new to the ant fauna of Turkey, *Harpagoxenus sublaevis* from Ilgaz Dağı Geçidi (Prov. Çankırı) and *Plagiolepis* cf. *ampeloni* (FABER, 1969) from İlyasbey (Prov. Kastamonu), along with an annotated list of all known social parasites of Turkey. Since this publication no further records of social parasites have been added to the ant fauna of the country.

In the following we present a species list of parasitic ants of Turkey, which comprises many new findings and localities as well as information about taxonomy, distribution and ecology.

Annotated list of species

In the lists of the material examined for each species, records are arranged alphabetically by principal administrative regions where possible. As it is sometimes a problem that in different sources, like national and international maps or atlases, local names and geographical units are written differently we decided to copy the labels on the insect pins in the lists. The current records are shown in Figs. 1-2. If not stated otherwise the material is deposited in the collection of the first author.

The following abbreviations are used:
rkm = distance in road kilometers between named localities; a.s.l. = above sea-level;
BZLL = Biologie-Zentrum des Oberösterreichischen Landesmuseums, Linz, Austria.

***Formicoxenus nitidulus* (NYLANDER, 1846) - new to Turkey**

Prov. Bursa, Uludağ mountain, 10 km SE Bursa, 1000 m, 05.07.1993, leg. A. SCHULZ [40°08'N 29°09'E].

For this species we prefer to use the term guest ant (see BUSCHINGER 1990). It lives in the nests of different species of the *Formica rufa* group. Not surprisingly, the distribution area of *Formicoxenus* chiefly coincides with that of their host species group. In Turkey, *F. nitidulus* was found not far away from the street to Ilgaz Dağı near Bursa in a rather dense *Pinus sylvestris* forest which is a component of the central European floristic region (POLUNIN 1987). The host species was determined as *Formica rufa* LINNÉ, 1758. Records from adjacent regions concern northern Greece (BUSCHINGER & DOUWES 1993) and the Caucasian mountains (RADCHENKO pers. comm.). The occurrence of *F. nitidulus* in Turkey shows an interesting extension of the known range to more eastern regions.

***Myrmoxenus gordiagini* RUSZKY, 1902 - new to Turkey**

Prov. Konya, 17 km W Seydişehir, 35 km S Beyşehir, 1200 m, 24.05.1990, leg. A. SCHULZ [37°23'N 31°43'E]. Prov. İzmir, Boz Dağ mountains, 15 km NE Ödemiş, 70 km E İzmir, 1200-1600 m, 19.05.1993, leg. A. SCHULZ [38°20'N 28°05'E]. Prov. Neveşehir, 10 km SEE Ürgüp, 30 km E Neveşehir, 1300 m, 01.06.1993, leg. A. SCHULZ [38°36'N 35°01'E]. Prov. Konya, 15 km W Seydişehir, 40 km S Beyşehir, 1400 m, 05.06.1993, leg. A. SCHULZ [37°24'N 31°55']. Prov. Antalya, 1 rkm S Imrasan Geçidi, 10 km N Akseki, 1500 m, 03.05.1997, leg. M. SANETRA, A. SCHULZ, K. VOCK [37°09'N 31°48'].

Originally described from Kazakhstan, the presently known distribution of *M. gordiagini* stretches from the Dalmatian coast, Bulgaria, and Greece (BUSCHINGER & DOUWES 1993), eastwards to Kazakhstan (BUSCHINGER et al. 1983). The five new localities from Turkey contribute to a better understanding of the species' range by closing the large gap between the European and Asian records. In Turkey, colonies of *M. gordiagini* were dis-

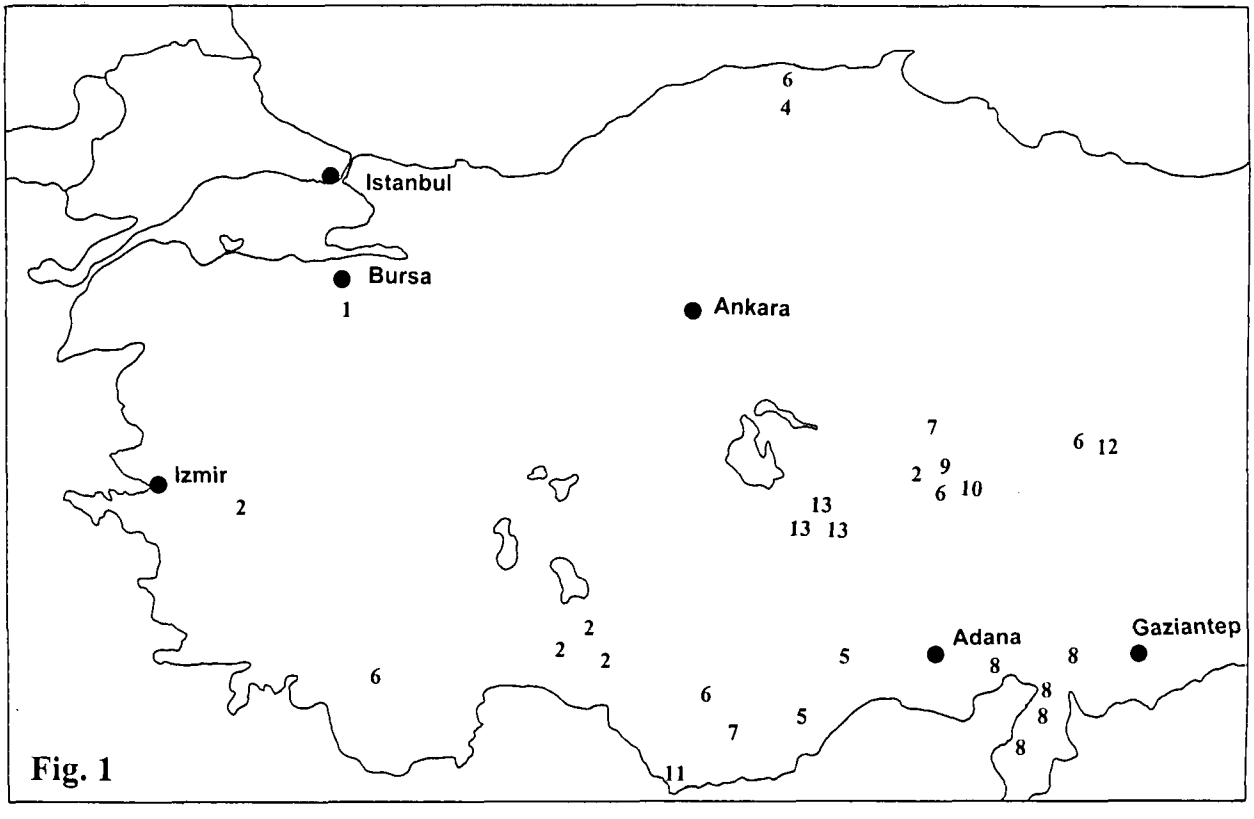

Fig. 1

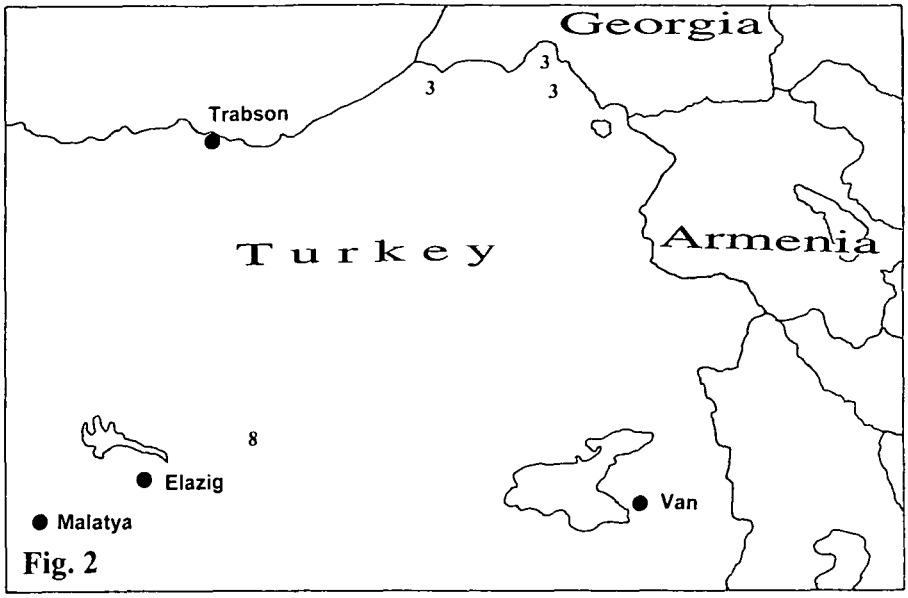

Fig. 1 (left): Map of socially parasitic ants of western Turkey; 1. *Formicoxenus nitidulus* (NYLANDER, 1846), 2. *Myrmoxenus gordiagini* RUSZKY, 1902, 4. *Myrmoxenus stumperi* (KUTTER, 1950), 5. *Chalepoxenus muellerianus* (FINZI, 1922), 6. *Strongylognathus testaceus* (SCHENCK, 1852), 7. *Strongylognathus silvestrii* MENOZZI, 1936, 8. *Strongylognathus kervillei* SANTSCHI, 1921, 9. *Strongylognathus* cf. *alpinus* WHEELER, 1909, 10. *Anergates atratulus* (SCHENCK, 1852), 11. *Plagiolepis* spec., 12. *Rossomyrmex minuchae* TINAUT, 1981, 13. *Polyergus rufescens* (LATREILLE, 1802)
Fig. 2 (wright): Map of socially parasitic ants of eastern Turkey; 3. *Myrmoxenus ravouxi* (ANDRÉ, 1896), 8. *Strongylognathus kervillei* SANTSCHI, 1921

covered in quite different types of habitat from the montane to the subalpine zone. The new sites include the mountainous regions of western Turkey (Boz Dağ) predominantly covered with deciduous forests (*Fagus* sp.), the mountain ridge of the Taurus (S Beyşehir and Imrasan Geçidi) showing belts of coniferous forests formed by *Abies, Pinus* and *Cedrus* and strongly cultivated places with popllar trees in the central Anatolian steppe (near Ürgüp). Nest sites of *M. gordiagini* were found beneath flat stones, in detritus of roots and in one instance in a small piece of rotten timber lying on the ground. The most frequently observed host species of *M. gordiagini* in Turkey was *Leptothorax korbi* EMERY, 1922, a close relative of *L. parvulus* (SCHENCK, 1851). However, at one locality (10 km SEE Ürgüp) *L. bulgaricus* Forel, 1892 served as host species. *L. korbi* has not been found on the northern Balkan where the main host of *M. gordiagini* is *L. lichtensteini* BONDROIT, 1918 (BUSCHINGER 1989).

***Myrmoxenus ravouxi* (ANDRÉ, 1896) - new to Turkey**

Prov. Kars, near Posof, 1700 m, 25.06.1993, leg. A. SCHULZ [41°31N 42°43'E]. Prov. Kars, Ilgardağı Geçıdı, 10 km S Posof, 2500 m, 25.06.1993, leg. A. SCHULZ [41°25'N 42°46'E]. Prov. Artvin, 20 km NW Sarıgöl, 60 km SW Artvin, 1600-1900 m, 28.06.1993, leg. A. SCHULZ [40°58'N 41°20']. Prov. Artvin, near Civan, 3 km S Borçka, 50 m, 29.06. 1993, leg. A. SCHULZ [41°20'N 41°41'E].

At first it is necessary to correct a nomenclatural error regarding the priority of the generic names *Myrmoxenus* and *Epimyrma*. BOLTON (1994 & 1995) considered these two genera as synonymous because of the morphological similarities between *Myrmoxenus gordiagini* and the species of the genus *Epimyrma*. Probably by mistake, he gave priority to *Epimyrma* EMERY, 1915 and put *Myrmoxenus* RUZSKY, 1902 into synonymy. It is clear, however, that *Epimyrma* **syn. nov.** is a junior synonym of *Myrmoxenus* which is established here.

Morphological investigations showed that eastern Turkish *M. ravouxi* are nearly indistinguishable from European specimens. This finding suggests a possible synonymy with *M. tamarae*, described by ARNOL'DI (1968) from the Caucasus (Georgia, Borschomi). ARNOL'DI (1968) stated only subtle differences between *M. tamarae* and *M. ravouxi* based on morphometric measurements, which obviously did not include large enough sample sizes. Direct comparisons of east Turkish and European material of *M. ravouxi* with the types of *M. tamarae* may bring more clarity about the taxonomic status of these populations. Additionally, in 1995 one species of *Myrmoxenus*, which was determined as *M. ravouxi* (BUSCHINGER & RADCHENKO pers. comm.), was found on the Crimea peninsula (Ukraine).

M. ravouxi is distributed throughout most parts of Europe excluding the North including several records from the Balkan. BUSCHINGER & DOUWES (1993) reported the species from northwestern Greece which is geographically closest to the Turkish localities. If the records of *M. tamarae* were added, the current distribution of *M. ravouxi* would extend farther to Crimea and the Caucasian mountains. It appears that in eastern Turkey a wide variety of different altitudes can be inhabited by *M. ravouxi*. At one occasion we even found a nest at an elevation of 2500 m a.s.l. on a seasonally wet, alpine meadow near a brook. European *M. ravouxi* usually occur in the lowlands, or sometimes in mountain habitats (e.g. Switzerland, Alps, Wallis, vic. Vercorin, 1500m pers. comm. A. BUSCHINGER) but previous findings of this species from high alpine regions did not exist. The host species was *Leptothorax unifasciatus* in all collected nests.

***Myrmoxenus stumperi* (KUTTER, 1950) - new to Turkey**

Prov. Kastamonu, near Seydiler, 40 km N Kastamonu, 1200 m, 08.07.1989 & 22.05. 1990, leg. A. SCHULZ [41°39'N 33°43'E].

From a zoogeographical viewpoint, the hitherto unknown and probably isolated population of *M. stumperi* in Turkey is quite remarkable since no published records are available from the Balkan states (BUSCHINGER & DOUWES 1993) and the Russian states (RADCHENKO, pers. comm.). In Europe, *M. stumperi* appears confined to southern areas in the Swiss and French Alps (BUSCHINGER 1985) and from an unpublished record from southern Peloponnissos (BUSCHINGER pers. comm.). The presumably patchy occurrence in Turkey thus fits best into the picture that the distribution pattern of *M. stumperi* is the result of postglacial disjunctions. However, the Turkish population occurs in strikingly

different environments compared to those typical for the alpine populations of central Europe. The new site lies near the Black Sea at moderate elevation of 1200 m a.s.l. above sealevel on a strongly rugged landscape with limestone rocks, covered with a low degraded oak wood (*Quercus* spp.). Surface shading reached up to 50 %. The first author found a total of seven *Myrmoxenus* colonies at this locality in two different years and the proportion of parasitized colonies was estimated to be about 1 %. In all recorded colonies host workers belonged to *Leptothorax unifasciatus* (LATREILLE, 1798), the nests of which were usually detected in small cavities of the limestone cliffs. In the Alps, the known host of *M. stumperi* are the often polygynous *L. tuberum* (FABRICIUS, 1775) in one case (Switzerland, Simplon, 1500m; pers. comm. A. BUSCHINGER) and the monogynous *L. unifasciatus* that serves as host species in Turkey.

***Chalepoxenus muellerianus* (FINZI, 1922)**

Prov. Mersin, 8 rkm S Kırobası, 900m, 07.05.1997, leg. M. SANETRA, A. SCHULZ, K. VOCK [36°40'N 33°55'E]. Prov. Mersin, 30 km N Mersin (label): ASIA MINOR Namrun, 1815, 1964, Leg. Fr. RESSL [37°10'N 34°37'] [BZLL].

In the Middle East, *C. muellerianus* has so far been known from Kazkıran Geçıdı (Prov.: Sakarya) in Turkey (HEINZE 1987) and from the neighboring island of Cyprus (BUSCHINGER 1997). The overall distribution further encompasses Spain, southern France, southern Switzerland, Italy, the Balkan and Crimea (BUSCHINGER et al. 1988, BUSCHINGER pers. comm.). Further species of *Chalepoxenus* have been described from the Mediterranean region and from Russia, but their taxonomic value appears rather doubtful. From the Balkan states, Turkey and the Near East, only *C. muellerinus* has been recorded. The colony of *C. muellerianus* at Kırobası was detected in a small crevice of a rock, situated in an open *Juniperus-Quercus* wood. The surrounding area was composed of treeless fields under extensive agriculture. As host species, *Leptothorax* cf. *bulgaricus* could be identified. From the second record, located farther east in the same province, only the information from the printed label is available (see collection data).

***Strongylognathus testaceus* (SCHENCK, 1852) - new to Turkey**

Prov. Kastamonu, 10 km S Küre, 30 km S İnebolu, 1000 m, 10.07.1989, leg.A.SCHULZ [41°46'N 33°43'E]. Prov. Muğla, Dirimii Geçıdı, 30 km SSE Golhisar, 1600 m, 22.05. 1993, leg. A. SCHULZ [36°57'N 29°38'E]. Prov. Konya, 5 km S Yellibeli Geçıdı 27 km N Ermenek, 1800 m, 05.05.1997, leg. M. SANETRA, A. SCHULZ, K. VOCK [36°50'N 32° 58'E]. Prov. Kayseri, Ziyarettepesi Geçıdı, (ca. 130 km E. Kayseri), 1900 m, 09.05. 1997, leg. M. SANETRA, A. SCHULZ, K. VOCK [39°50'N 36° 54'E]. Prov. Kayseri, 12 rkm W Develi, 1000 m, 10.05.1997, leg. M. SANETRA, A. SCHULZ, K. VOCK [38°24'N 35°23'E].

We completely assign the Turkish material to *S. testaceus* because the validity of *S. karawajewi* PISARSKI, 1966 described from Crimea peninsula must be considered as doubtful. Although many specimens from Turkey show a much more reduced sculpture on the head and mesosoma than usual *testaceus* from central Europe (see RADCHENKO 1991), the value of this feature for species distinction appears rather low. Intermediate forms frequently occur within samples from Turkey and Crimea, suggesting the synonymy of *S. karawajewi* with *S. testaceus*. We have examined specimens from mainland Greece also exhibiting shiny, nearly unsculptured heads. Further investigations, however, are necessary to show whether more reliable differences will be found that allow the recognition

of two different species of the *S. testaceus* group in western Asia. According to the present knowledge, we assume that the Turkish populations belong to *S. testaceus*.

S. testaceus inhabits almost all parts of Europe from Britain to the southern Mediterranean region. RADCHENKO (1991) mentioned the species from Ukraine, Caucasus, SW Siberia and N Kazakhstan. It is therefore not surprising that *S. testaceus* is also well represented in Turkey. We detected the few and often inconspicuous workers in *Tetramorium* nests which were built under stones on montane or alpine meadows. The host species in these typical habitats is close to *Tetramorium caespitum* or *T. impurum*. Exceptionally, one nest of *S. testaceus* was discovered in the semi-arid environments of the central Anatolian salt-steppe (W Develi). *T.* cf. *goniommoides* POLDI, 1979 was tentatively recorded as host species. The new information about *S. testaceus* from Turkey concurs with previous findings from the Mediterranean region according to which elevations between 1000 m a.s.l. and 2000 m a.s.l. are usually inhabited by this species (SANETRA et al. 1999).

***Strongylognathus silvestrii* Menozzi, 1936 - new to Turkey**

Prov. Mersin, 14 rkm E Suçatı, 27 rkm W Mut, 600 m, 06.05.1997, leg. M. SANETRA, A.SCHULZ, K.VOCK [36°34'N 33°08'E]. Prov.Kayseri, 2 rkm NE İnçesu, 30 km SW Kayseri, 1100 m, 10.05.1997, leg. M. SANETRA, A. SCHULZ, K. VOCK [38°39'N 35°13'E].

Species level taxonomy of the *Strongylognathus huberi* group in the eastern Mediterranean region has yet to be resolved. Available literature records suggest the occurrence of three *Strongylognathus* species on the southern Aegean islands, leading to a zoogeographically dubious pattern. The species involved are *S. silvestrii* described from Rhodes (MENOZZI 1936), *S. dalmaticus* BARONI URBANI, 1969 reported from Karpathos by COLLINGWOOD (1993) and *S.* cf. *insularis* BARONI URBANI, 1968 reported from Crete by BUSCHINGER & DOUWES (1993). Recently the type material of *S. silvestrii* (Syntypes: one worker, one queen from Rhodes, Mte. Attaviros and one worker from Rhodes, Cattavia) was examined and compared with the *Strongylognathus* populations of Crete. Little doubt remains that both populations are conspecific (R. GÜSTEN pers. comm.). Moreover, we know of two populations from mainland Greece and Peloponnissos that are morphologically very similar to the Cretan *Strongylognathus* and so are the Turkish specimens (SCHULZ unpubl.). After observation of the type material of *S. silvestrii* we postulate that only one taxonomically valid species of the *huberi* group exists on the southern Balkans and the Aegean islands. This species, however, displays large intraspecific variability both within and among populations, sometimes even at colony level. After all, the synonymy of *S. dalamaticus* described from the Dalmatian coast with *S. silvestrii* seems very likely, whereas *S. insularis* from Malta is closer to *S. destefanii* (see also SANETRA et al. 1999). The host species recorded by us belong to *Tetramorium semilaeve* ANDRÉ, 1883 or a very similar species.

***Strongylognathus kervillei* SANTSCHI, 1921**

Prov. Elaziğ, near Başyurt, 40 km W Bingöl, 1400 m, 28.06.1989, leg. A. SCHULZ [38° 55'N 40°04'E]. Prov. Gaziantep, 7 rkm N Islâhiye, (ca. 70 km W Gaziantep), 500 m, 11.05.1997, leg. M. SANETRA, A. SCHULZ, K. VOCK [37°05'N 36°40'E]. Prov. Antakya, Nur Dağları, 14 rkm W Hassa, 1600 m, 11.05.1997, leg. M. SANETRA, A. SCHULZ, K. VOCK [36°50'N 36°23'E]. Prov. Antakya, Nur Dağları, 7-10 rkm W Hassa, 1000-1200 m,

12.05.1997, leg. M. SANETRA, A. SCHULZ, K. VOCK [36°48'N 36°27'E]. Prov. Adana, Nur Dağları Geçidi, 20 rkm NW Islâhiye, ca. 1200 m., 12.05.1997, leg. M. SANETRA, A. SCHULZ, K. VOCK [36°56'N 36°25'E]. Prov. Adana, Ceyhan, 04.1966., leg. K. BILEK [37°03'N 35°50'E] [BZLL].

Since the first description by SANTSCHI (1921) no further records of *S. kervillei* have been published and the queen caste has been previously unknown. The information given by HEINZE & KAUFFMANN (1993) that the type specimen were 'a queen sexual captured in flight' is erroneous. SANTSCHI (1921) described only the workers of *S. kervillei* which is concordant with our inspection of his collection at Basle where no queen could be found. By comparison with the types, our samples are clearly assignable to that species because even the workers are relatively conspicuous in appearance. Their heads are bulky and the pronotum angles are exceptionally prominent. The latter feature is also markedly developed in the two queens which we obtained from different nests. A sample of four workers from Ceyhan (K. BILEK leg.) located in the BZLL also belongs to *S. kervillei*.

Both, workers and queens are similar to *S. destefanii* and *S. silvestrii*, but at least the queen caste differs clearly from the other species. These morphological observations let us believe that *S. kervillei* represents a well definable species, though differences with other taxa of the *huberi* group in the Middle East, like *S. palaestinensis* MENOZZI, 1933 and *S. minutus* RADCHENKO, 1991, remain largely unclear. The newly discovered sites are located in Elaziğ province about 600 km east of the type locality near Ankara and in the southernmost provinces of Adana and Antakya (Nur Dağları) showing that the distribution of *S. kervillei* ranges throughout central Anatolia to the Levant. Hence, the occurrence of this species in Syria, Lebanon and Palestine along the Orontes-Jordan rift valley may be expected.

***Strongylognathus* cf. *alpinus* WHEELER, 1909 - new to Turkey**

Prov. Kayseri, Erciyes Dağı, 2200 m, 01.V.1964, leg. H. HAMANN [38°32'N 35°31'E] [BZLL]. Prov. Kayseri, Erciyes Dağı, 20 km N Develi, 2500 m, 01.06.1993, leg. A. SCHULZ [38°32'N 35°31'E]. Prov. Kayseri, Erciyes Dağı, 20 km S Kayseri, 2300-2500 m, 08.05.1997, leg. M. SANETRA, A. SCHULZ, K. VOCK [38°32'N 35°31'E].

On the upper heights of the isolated volcano Ercyes Dağı in the central Anatolian plateau we discovered a *Strongylognathus* population that closely resembles *S. alpinus*. This well-known species has long been considered endemic to the southernmost valleys of the Swiss and French Alps, but recent records from southern Italy suggest a much wider distribution (SANETRA et al. 1999). We succeeded to collect a single queen on Ercyes Dağı mainly differing from typical *alpinus* from Switzerland by its smaller size and less developed sculpture. Workers of these two populations as well show insignificant differences only. In other parts of Turkey and on the southern Balkans the occurrence of *S. alpinus*-like forms is not known. However, workers of *S. alboini* FINZI, 1924 from Slovenia, the queen caste of which is still unknown, are morphologically similar.

The distribution of *S. alpinus* in Europe and Turkey shows the typical pattern of a post-glacial relict, now being confined to higher altitudes. Preferred types of habitat are subalpine or alpine meadows with a high density of *Tetramorium* nests. On Ercyes Dağı, vegetation in the alpine zone mainly comprises treeless grassland with *Artemisia* and *Astragalus* where mixed colonies of *S.* cf. *alpinus-Tetramorium* could be detected in the humus-rich soil under suitable stones. The host species has provisionally been attributed

to *Tetramorium caespitum* or *T. impurum*. Of approx. 100 host nests examined, during the 1993 excursion a number of 8-10 were found infested by this parasite. Four years later, such high population densities could not be rediscovered.

***Anergates atratulus* (SCHENCK, 1852)**

Prov. Kayseri, Erciyes Dağı, 20 km S Kayseri, 2300-2500 m, 08.05.1997, leg. M. SANETRA, A. SCHULZ, K. VOCK [38°32'N 35°31'E].

A. atratulus is a workerless obligate parasite which has been quoted from most European countries and as far east as central Siberia (BARONI URBANI 1971). We found a nest of *Anergates* in the same biotope as *Strongylognathus* cf. *alpinus* by recognizing the conspicuous yellowish larvae. Rearing the brood in the laboratory indeed confirmed this sample to belong to this peculiar parasite species. In the Alps, *A. atratulus* also co-occurs with *S. alpinus* (e.g. Swiss Valley, Lötschen valley) and can be quite common at higher elevations (BUSCHINGER 1971). A form similar to *Tetramorium caespitum* serves as host in the population of the Ercyes Dağı, whereas *Tetramorium chefketi* FOREL, 1911 was determined by A.S. in the sample reported by HEINZE (1987) from Tavsanli (Prov.: Kütahya). These observations support the growing evidence that *Anergates* is particularly capable of using a broad range of host species.

***Plagiolepis* sp.**

Prov. Mersin, near Anıtlı, 35 km W Anamur, 50 m, 14.05.1988, leg. A. SCHULZ [36°06'N 32°35'E].

There has been some debate about the taxonomic validity of the genus name "*Aporomyrmex*" (HEINZE & KAUFFMANN 1993, BOLTON 1994, 1995). We prefer to use the name *Plagiolepis* as an inclusive genus for both hosts and parasites (BOLTON 1995). Obviously, most of the social parasites in *Plagiolepis* are local endemics, and very little is known on the Turkish members of this group. Our new finding of *Plagiolepis* represents an as yet undescribed species, which is distinguishable from other parasitic members of the genus by the morphologically well defined male genitals (BUSCHINGER pers. comm.).

The recorded colony was located in a stone slit on the ground of a bright *Pinus halepensis* wood in the Mediterranean coastal area. It contained fully matured specimens of both sexes, which were observed swarming out of the nest through the entrance hole. The host species was an unidentified *Plagiolepis* species.

***Rossomyrmex minuchae* TINAUT, 1981 - new to Turkey**

Prov. Kayseri, Ziyarettepesi Geçıdı, 1900 m, 09.05.1997, leg. M. SANETRA, A. SCHULZ, K. VOCK [39°50'N 36° 54'E].

This rare species, hitherto known only from the Spanish Sierra Nevada near El Dornajo at an elevation of 1900 m a.s.l. (TINAUT 1981; TINAUT et al. 1995), has been discovered for the first time apart from its type locality. Our new record in Turkey originated from the southern central Anatolian plateau on the Ziarettpesi Geçıdı about 130 km east of Kayseri. Due to the great similarity between *R. minuchae* and its *Proformica* hosts, the former was not detected in the field. Thus, only a single specimen could be gained from a host colony. At 1900 m a.s.l. near the base of a limestone cliff, nests of the still unidentified *Proformica* host species were found beneath flattened, thermally favourable stones. Vegetation consisted of alpine meadows and grassland being heavily grazed by sheep. Most

strikingly, we could find no evidence for some geographic variation between the Spanish and Turkish population notwithstanding the large distance in between. As far as yet known, *R. minuchae* lives in subalpine and alpine areas with a cold winter climate and hot dry summers. By contrast, another species of the genus, *R. proformicarium*, appears confined to lowland steppes or semi-deserts in Turkmenistan and Kazakhstan (ARNOL'DI 1928, MARIKOVSKI 1974). *Rossomyrmex quandratinodum* has been reported from steppe-like environments in the mountains of China (XIA & ZHENG 1995).

***Polyergus rufescens* (LATREILLE, 1802) - new to Turkey**

Prov. Aksaray, Aksaray town, 1000 m, 02.05.1988, leg. A. SCHULZ [38°23'N 34°02'E]. Prov. Aksaray, near Kizikadağ, 1300-1400 m 21.05.1993, leg. A. SCHULZ [38°11'N 33°52'E]. Prov. Aksaray, 10 km S Aksaray, 1000 m, 02.06.1993, leg. A. SCHULZ [38°19'N 34°00'E].

P. rufescens is a widespread species occurring all over Europe being now confirmed for Turkey. Its range probably extends further to western Asia and the Caucasus mountains (ZHIZHILASHVILI 1967; ARAKELJAN 1994). Surprisingly, *P. rufescens* was observed in Turkey exclusively in agricultural land or environments strongly influenced by human agency. One colony nested close to an irrigation channel flowing through cultivated fields, while another one was found in the urban areas of Aksaray. Species of *Polyergus* depend on hosts of the subgenus *Serviformica*. In the Taurus mountains only uninfested nests of *Formica* could be recorded, but this observation might be due to insufficient sample size.

Discussion

The ant fauna of Turkey shows at least as great a species diversity and complexity as in most southern European countries. This is also reflected by the frequent occurrence of social parasites. In the present study we recorded 12 species of socially parasitic ants, of which 9 have previously been unknown from Turkey. Including our findings and all available literature records we get a total of 15 permanent social parasites plus one guest ant. For comparison, the much better investigated and also very diverse Greek ant fauna presently comprises 11 permanent social parasites (BUSCHINGER & DOUWES 1993); only one species of the *Strongylognathus huberi* group is considered here (for details see the section on *S. silvestrii*). Between Greece and Turkey 8 of these species are shared, while *Symbiomyrma karavajevi*, *Myrmoxenus adlerzi* and *Plagiolepis xene* are not known to occur in Turkey. In all Balkan states and Greece combined, 14 permanently parasitic species have been recorded (AGOSTI & COLLINGWOOD 1987; BUSCHINGER & DOUWES 1993), but only one additional species, *Harpagoxenus sublaevis*, is shared with Turkey. Furthermore, a larger number of temporary social parasites have been discovered in Turkey, most of them occur in the genera *Bothriomyrmex*, *Lasius* and *Formica* which are well represented on the Balkans, in Greece and Turkey.

Species richness of the Turkish ant fauna is apparently due to the existence of manifold types of landscapes and climatic regions. Large species numbers have also been reported in other groups of insects (e.g. Lepidoptera: HESSELBARTH et al. 1995). One of the most important factors contributing to this present-day diversity is the geological history of the area, which led to the formation of several mountain ranges and isolated volcanoes (Erol 1983). Barrier-like, the Pontic mountains in the north and the Taurus mountain ridge in

the south encircle the strongly uplifted Anatolian plain. Four main climatic regions are discernible in Turkey: the warm and humid conditions along the Black Sea coast, the continental climate of the central Anatolian mountains and plateau, the southern coast at the Mediterranean Sea with winter rainfall and the higher eastern Anatolian plateau. The main vegetation types Mediterranean, Pontic and Anatolian steppe almost coincide with the climatic regions.

As far as yet known, the level of endemism among social parasites of Turkey is rather low. Only two species, *S. kervillei* and *Plagiolepis* sp., have not been found outside the borders of this country. *M. gordiagini* and *S. silvestrii*, both being known from adjacent Greece, appear confined to the Pontomediterranean region. On the other hand, most of the remaining species, such as *M. ravouxi*, *C. muellerianus*, *S. testaceus*, *A. atratulus* and *P. rufescens*, have a large distribution range throughout the Mediterranean basin to central Europe. Since Turkey is a transitional zone where plant and animal communities of three zoogeographical regions intermingle with each other, the existence of yet undiscovered endemic forms could be expected.

The considerable diversity of social parasites in the tribes Formicoxenini and Tetramoriini deserves special attention. The occurrence of four species of the genus *Myrmoxenus* and another four of the genus *Strongylognathus* in Turkey is quite remarkable. Among the species of *Myrmoxenus M. ravouxi* shows a striking tendency to colonize high altitude sites, and *M. stumperi* has adapted to mountainous regions, while *M. gordiagini* uses a wide variety of different habitats but apparently prefers mediterran climata. Species of *Strongylognathus* display more specific preferences to certain large-scale climatic and ecological conditions. *S. silvestrii* occurs in the Mediterranean part of Turkey from the coast up to about 1000 m a.s.l., whereas the cold-adapted species *S.* cf. *alpinus* has only been found above 2000m on alpine meadows. Recorded from 500-1000 m a.s.l., *S. kervillei* might be a characteristic inhabitant of more steppe-like environments. However, the ranges of *S. silvestrii* and *S. kervillei* may partially overlap in central Anatolia. Such overlaps are particularly interesting, since they show the existence of several biologically distinct species in the *S. huberi* group in which many of the described taxa cannot continue to be recognized. Further, observed differences in niche preference agree with previous findings that the syntopic occurrence of two *Strongylognathus* species of the *huberi* group is a notable exception (see SANETRA et al. 1999 for southern Italy). The inquilinous *S. testaceus* inhabits a large range of elevations from see level to 2000 m a.s.l. but does obviously not penetrate into the warmer Mediterranean lowlands.

The hitherto known ranges of *Myrmoxenus stumperi*, *Strongylognathus* cf. *alpinus* and *Rossomyrmex minuchae* show the main characteristics of postglacial disjunction. After warming up at the end of the last glaciation, these cold-adapted species have apparently become restricted to the now isolated high mountain areas. This is particularly obvious in *R. minuchae* being recorded only from as distant locations as the Spanish Sierra Nevada and central Anatolia. It seems likely that *R. minuchae* as well as the different host species of *Proformica* once occurred in a broad range around the glaciated parts of north and central Europe. Climatic conditions similar to those presently occurring on the high mountains did probably prevail in southern areas during the pleistocene glaciations. For instance, 17,000-22,000 years ago the southern European lowland and most parts of western Anatolia were too cold and dry for the growth of forests and, as revealed by

pollen analyses, steppe formations (mainly composed of *Artemisia* and Chenopodiaceae) were the predominant type of vegetation (e.g. VAN ZEIST & BOTTEMA 1991). In contrast, the Mediterranean species *Myrmoxenus gordiagini*, *Myrmoxenus kraussei*, *Chalepoxenus muellerianus* probably extended their ranges postglacially from proximate refuge areas. The status of *Anergates atratulus* and *Strongylognathus testaceus* can hardly be assessed, but these species may have spread throughout the western Palaearctic region during the glacial-interglacial oscillations in a stepwise manner.

From the present data the picture emerges that some geographic regions harbour particularly interesting ant communities. In central and southern Turkey as much as 10 species of social parasites have so far been recorded. Hence, this part of the country is a valuable research area for studying social parasites. For a more detailed survey of different elevation ranges with respect to socially parasitic ants the isolated volcano of Ercyes Dağı and its surroundings seems very promising. Regional species richness is high and at least four species of *Tetramorium* parasites, *Strongylognathus testaceus*, *S.* cf. *alpinus*, *S. silvestrii* and *A. atratulus*, occur in this rather limited area. While the lowland salt-steppes and lava fields have diverse ant faunas mainly comprising steppic elements with scattered Mediterranean species, the fauna of the high altitudes is strongly impoverished. Above 2300 m a.s.l. a single species each of *Leptothorax*, *Tetramorium*, *Tapinoma*, *Proformica* and *Lasius* can be found. In addition, two social parasites of *Tetramorium*, *S.* cf. *alpinus* and *A. atratulus*, inhabit the alpine zone. Though we did not find the very rare and localized parasite *Teleutomyrmex schneideri* Kutter 1950, its occurrence on the Ercyes Dağı is nonetheless probable.

In the Pontic mountains, the species composition of the ant fauna is very similar to that of central Europe. Most striking is the shared abundance of the genus *Myrmica* as well as the occurrence of three species of the *Leptothorax* (s. stricto) group. Given the presence of these central European ant communities, the social parasites of the genera *Symbiomyrma*, *Myrmica* and *Leptothorax* (=*Doronomyrmex*) can be predicted to occur in this area, too. The boreo-alpine slave-maker *Harpagoxenus sublaevis* has already been found in the Pontic mountains (Heinze & Kauffmann 1993). *Symbiomyrma karavajevi* has been reported from adjacent Greece and *Leptothorax pacis* from the Balkans (BUSCHINGER & DOUWES 1993). However, there certainly are further social parasite species that still await their discovery. For instance, *S. rehbinderi* FOREL, 1904 known from the eastern shores of the Black Sea and Transcaucasia is much likely to penetrate into the northeastern part of Turkey. In any case, more field work in this zoogeographically important transition zone will bring about further interesting or new records of socially parasitic ants.

The long term influence of man in changing the natural plant cover created many new habitats in Turkey. *Polyergus rufescens* appears to be a recent colonizer of cultivated areas in the central Anatolian steppe where it frequently occurs on irrigated fields. However, it is rather the exception than the rule that socially parasitic ants are able to survive in agricultural land. Most of the species are ecologically very specialized and therefore bound to certain often only locally distributed types of habitat (see also BUSCHINGER & DOUWES 1993). But nowadays many of the unique landforms have already been destroyed through the intensive agriculture and large irrigation projects (e.g. south of Sanli Urfa), the construction of large dams and the particularly severe deforestation (EROL 1983, MAYER & AKSOY 1986). As a consequence, it is much likely that the remarkable diversity

of socially parasitic ants in Turkey is threatened by at least some of these processes.

Acknowledgements

We sincerely thank the following persons who enabled us to see relevant material from different museums and which were all very helpful: Fritz Gusenleitner (Biologie-Zentrum des Oberösterreichischen Landesmuseums, Linz, Austria), Michel Brancucci (Naturhistorisches Museum, Basel, Switzerland), Piero Baronio (Istituto di Entomologia "G. Grandi", Universita di Bologna, Italy), We are grateful to Manfred Verhaagh (Staatliches Museum für Naturkunde, Karlsruhe, Germany) for his comments on an earlier draft of this paper and to Philip Ward (University of California, Davis, USA) who most kindly improved the English. The Deutsche Forschungsgemeinschaft has supported field research by a grant to A. Buschinger (Bu 310/26-1).

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Druck, Eigentümer, Herausgeber, Verleger und für den Inhalt verantwortlich:
Maximilian SCHWARZ, Konsulent für Wissenschaft der O.Ö. Landesregierung,
Eibenweg 6, A-4052 Ansfelden
Redaktion: Erich DILLER (ZSM), Münchhausenstrasse 21, D-81247 München, Tel.(089)8107-159
Fritz GUSENLEITNER, Lungitzerstrasse 51, A-4222 St. Georgen / Gusen
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