

New records of ants (Hymenoptera: Formicidae) from Iran

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ABSTRACT. The ant species list of Iran is far from complete. So far, only 110 species belonging to 26 genera have been recorded from Iran. For this study, we collected the majority of ant material in two periods of field work in spring and summer of 2007 and 2008. In total, we checked more than 35,000 specimens, and recorded 32 species and six genera new to Iran: *Dolichoderus*, *Myrmecina*, *Proformica*, *Pyramica*, *Stenamma* and *Strongylognathus*. Our new records from the Central Persian desert basins indicate that the ant fauna of this region probably has more species in common with that of the Central Asian deserts than with the hot subtropical deserts of the Middle East and Arabian Peninsula.

Keywords: ants, faunistic, *Dolichoderus*, *Myrmecina*, *Proformica*, *Pyramica*, *Stenamma*, *Strongylognathus*, Iran

INTRODUCTION

Iran is located in the mid-latitude band of arid and semi-arid regions of the Old World, in Southwest Asia. Western and especially southwestern Asia comprises vast arid and semi-arid areas and represents a number of distinctive ecoregions that support numerous endemic plants and animals (Zohary 1973; Olson *et al.* 2001). Biogeographically, this territory represents a transition zone between three regions: Palaearctic, Afrotropical and Oriental. Many of these unique ecoregions have not yet been studied intensively. Despite more than one hundred years of myrmecology and the publication of a considerable number of papers on the ant fauna of this region, comprehensive faunistic investigations on ants have not been provided. Additionally, many genera of this region, such as *Messor*, *Cataglyphis*, *Camponotus* and *Monomorium*, contain numerous taxa of ambiguous status and need modern revision.

The Iranian ant fauna has been poorly investigated. So far, 110 species belonging to 26 genera have been recorded from Iran (Paknia *et al.* 2008). In this paper, we introduce 28 species that are new for the Iranian fauna. This large number of new records, a short time after publishing a primary checklist for the country (Paknia *et al.* 2008) shows the incompleteness of our myrmecological knowledge of this region.

MATERIALS AND METHODS

The majority of ant samples were collected in two periods of extensive field work in spring and summer, of 2007 and 2008, respectively. The first field study was carried out along a transect from the north to the south of Iran through arid and semi-arid areas in four steppe and desert ecoregions. The second block of fieldwork was conducted inside the Central Persian desert basins in the centre of Iran and in the Caspian Hyrcanian mixed

forests in the north of Iran. Locations of the sample sites are indicated in Fig. 1. In the first year of sampling, we employed pitfall trapping and bait trapping for sampling ants, while in the second year, we used only pitfall trapping for the collection of ants in arid and semi-arid areas. Both methods are suitable for rapid survey of open habitats, and well represent epigeic ant species (Agosti & Alonso 2000). In forest areas, pitfall trapping and Winkler collectors were applied. Additionally, nest samples were collected during both years of sampling. Moreover, a small number of the samples were collected by hand during different expeditions and in a few cases by Iranian students of biology.

Samples were preserved in 96% alcohol, brought to the laboratory, and cleaned of debris and soil. In total, 35,450 specimens were checked and sorted to morphospecies. Most of the morphospecies were identified to species level, but some remained undetermined and were tentatively distinguished by species codes such as “sp. ir-abpari-01”.

Keys for adjacent regions and taxonomic revisions of different ant genera used in the present study were as follows: Arnoldi (1948, 1977b: Central Asia), Dlussky *et al.* (1990: Central Asia), Radchenko (1992a, 1992b, 1994a, 1994b, 1995a, 1997a, 1997b: Central Asia), Arakelyan (1994: Central Asia), Collingwood and Agosti (1996: Arabian Peninsula), and Bolton (2000: Dacetini ants). The following ant collections were also used: Museum and Institute of Zoology of Polish Academy of Sciences, Warsaw, Poland (MIZ); Zoological Museum of Moscow State University, Russia (ZMMU); Zoological Institute of Russian Academy of Sciences, St. Petersburg, Russia (ZISP); and Institute of Zoology of Ukrainian National Academy of Sciences, Kiev, Ukraine (IZK).

In this paper, we define the following ambiguous geographical terms as follows: Anatolia by its borders in Turkey, based on historical records from Asia Minor (all from within the Asian part of modern-day Turkey); the Arabian Peninsula as Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates and Yemen; the territory of

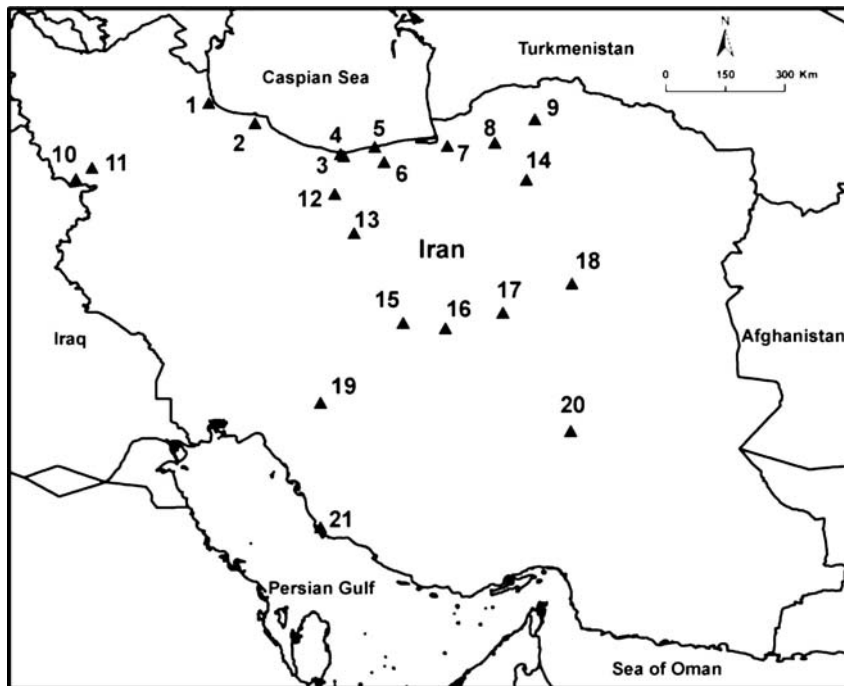


Fig. 1. Map of Iran. Triangles show sampling locations of newly recorded ants: 1- Talysh, 2- Astaneh, 3- Abpari, 4- Nur, 5- Babolsar, 6- Ghaemshahr, 7- Gorgan, 8- Khoshyelagh, 9- Golestan National Park, 10- Bane, 11- Saggez, 12- Khojir, 13- Kavir, 14- Turan, 15- Naeen, 16- Siahkooh, 17- Robat, 18- Tabas, 19- Dena, 20- Kerman and 21- Mond.

“Caucasus” as including Great Caucasus (i.e., Russian North Caucasian republics from the Black sea to Caspian sea) as well as Armenia, Azerbaijan and Georgia, while “Transcaucasus” covers only the territory of Armenia, Azerbaijan and Georgia; “Central Asia” as including Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan (i.e., excluding Kazakhstan); and the “Middle East” as consisting of Israel, Jordan, Lebanon, Palestine and Syria. The territory of Iraq is considered separately.

All determined and undetermined species were deposited in the Antbase.net Collection (ABNC) managed by M. Pfeiffer and in the private collection of O. Paknia.

RESULTS

Additional to the earlier published checklist (Paknia *et al.* 2008), we found 32 new ant species for Iran. Twenty-eight were identified to species level and the other four were identified to genus level and given species codes. Our collecting efforts also resulted in the addition of six ant genera new to Iran: *Dolichoderus*, *Myrmecina*, *Proformica*, *Pyramica*, *Stenamma*, and *Strongylognathus*. The new records are listed below.

Camponotus fallax (Nylander, 1856)

Material: 4 ♀, Caspian Hyrcanian mixed forest ecoregion, Gorgan, urban area (~36°50'23"N, 54°26'19"E), ~142 m asl, 1.IV.2006, leg. Omid Paknia.

Remarks: the species is distributed in Europe (northwards to southern Sweden), the Caucasus, Anatolia and northwestern Kazakhstan, and also reported from the southern part of western Siberia. Iran is at the southeasternmost edge of the known distribution of this species, that inhabits mainly light and dry deciduous and mixed forests, and often occurs in old parks and orchards. It nests in dead parts of living trees or in wooden constructions (Radchenko 1997c; Czechowski *et al.* 2002).

Camponotus interjectus Mayr, 1877

Material: 18 ♀, Alborz Range forest steppe, Golestan National Park (37°20'56"N, 56°14'46"E), 1256 m asl, 30.V.2007; 9 ♀, Alborz Range forest steppe,

Khoshyelagh Wildlife Refuge (36°47'41"N, 55°28'13"E), 1534 m asl, 3.VI.2007, leg. Omid Paknia.

Remarks: *C. interjectus* is distributed in Central Asia and Afghanistan (Dlussky *et al.* 1990; Radchenko 1997c) and recorded also from Iraq (Wheeler & Mann 1916) and Dagestan in Russia (Kuznetsov-Ugamsky 1929). It inhabits mainly mountain steppes; nests are built in soil, often under stones.

Camponotus kurdistanicus Emery, 1898

Material: 13 ♀, transitional region between Alborz Range forest steppe and Central Persian deserts, Khojir National Park (35°38'54"N, 51°43'44"E), 1485 m asl, 1.V.2008, leg. Omid Paknia; 2 ♀, Zagros Mountains forest steppe, Kurdistan, Bane (~35°59'N, 45°53'E), ~1557 m asl., summer 2004, leg. Shahin Mostafai.

Remarks: This species was known from Anatolia, Iraq and Azerbaijan (Emery 1898, 1925; Pisarski 1971; Radchenko 1997c).

Camponotus libanicus Andre, 1881

Material: 8 ♀, Alborz Range forest steppe, Khoshyelagh Wildlife Refuge (36°48'55"N, 55°31'54"E), 1701 m asl, 8.VI.2007, leg. Omid Paknia.

Remarks: *C. libanicus* is distributed in the Middle East countries and Anatolia (Radchenko 1997c). This species inhabits dry and semi-dry areas. Nests are built in soil.

Camponotus shaqualavensis Pisarski, 1971

Material: 4 ♀, Nubo Sindian deserts, Kerman, urban area (~30°16'N, 57°04'E), ~1760 m asl, 26.V.2004, leg. Shiva Sadeghirad.

Remarks: *C. shaqualavensis* was described from Iraq (Pisarski 1971) and additionally was recorded from Turkey (Aktaç 1977; see also Radchenko 1997b).

Camponotus staryi Pisarski, 1971

Material: 23 ♀, Zagros Mountains forest steppe, Dena Protected area (30°54'N, 51°25'E), 2683 m asl, 6.VII.2007, leg. Omid Paknia.

Remarks: *C. staryi* was described from Iraq (Pisarski 1971). This is the first record of this species outside its type locality.

***Cataglyphis bergianus* Arnoldi, 1964**

Material: 5 ♀, Central Persian deserts, Tabas (33°36'53"N, 57°05'36"E), 1083 m asl, 16.V.2008, leg. Omid Paknia.

Remarks: *C. bergianus* was known from Central Asia, southern Kazakhstan and Afghanistan (Pisarski 1967, 1970; Radchenko 1997a).

***Cataglyphis cinnamomeus* (Karavaiev, 1910)**

Material: 3 ♀, Central Persian deserts, Siahkooch National Park (32°35'57"N, 54°13'56"E), 995 m asl, 25.V.2008, leg. Omid Paknia; 4 ♀, Central Persian deserts, Turan National Park (35°58'N, 56°04'E), 1191 m asl, 16.VI.2007, leg. Omid Paknia; 6 ♀, Central Persian deserts, South of Naeen (32°43'11"N, 53°16'42"E), 1372 m asl, 27.V.2008, leg. Omid Paknia.

Remarks: Outside of Iran, *C. cinnamomeus* was recorded from Central Asia, southern Kazakhstan (Karavaiev 1910) and Afghanistan (Pisarski 1967; Radchenko 1997a). This species is the most thermophilous among Central Asian *Cataglyphis*, inhabiting mainly stony and clayey deserts. In mountain areas, it lives in dry parts of river valleys.

***Cataglyphis cugiai* Menozzi, 1939**

Material: 18 ♀, Alborz Range forest steppe, Golestan National Park (37°20'57"N, 56°14'44"E), 1258 m asl, 30.V.2007, leg. Omid Paknia.

Remarks: This species was known only from the northwest of India, Karakorum region (Menozzi 1939; Radchenko 1997a).

***Cataglyphis kurdistanicus* Pisarski, 1965**

Material: 54 ♀, Zagros Mountains forest steppe, Dena Protected Area (30°54'45"N, 51°24'39"E), 2695 m asl, 7.VII.2007, leg. Omid Paknia; 4 ♀, Zagros Mountains forest steppe, Kurdistan, Bane (~35°59'N, 45°53'E), ~1557 m asl, summer 2004, leg. Shahin Mostafai.

Remarks: *C. kurdistanicus* was described from Iraq (Pisarski 1965) and recorded additionally from Anatolia (Aktaç 1977; Radchenko 1997a).

***Dolichoderus quadripunctatus* (Linnaeus, 1771)**

Material: 1 ♀, Caspian Hyrcanian mixed forests, Talysh (37°42'19"N, 48°53'14"E), 66 m asl, 6.VII.2008, leg. Omid Paknia.

Remarks: The genus *Dolichoderus* Lund comprises more than 130 species, distributed in all zoogeographic realms except Africa and Madagascar. Only one species, *D. quadripunctatus*, is known from the western Palaearctic. Its range covers central and southern Europe, central and southern parts of eastern Europe, the Caucasus, Anatolia, southwest Siberia, and the Tien-Shan range in Central Asia and China. This genus is new to Iran.

***Messor* sp. (cf. *M. oertzeni* Forel, 1910)**

Material: 3 ♀, Zagros Mountains forest steppe, Kurdistan, Saggez (~36°14'N, 46°15'E), ~1481 m asl, 2004, leg. Shahin Mostafai; 4 ♀, Tehran, urban area (~35°41'N, 51°25'E), ~1162 m asl, 16.VII.2005, leg. Nasim Vakhideh; 5 ♀, Mashad, urban area (~36°17'N, 59°35'E), ~985 m asl, leg. Nayereh Ghafarian.

Remarks: *M. oertzeni* is known from the Balkans and Anatolia (Agosti & Collingwood 1987; Atanassov & Dlussky 2002). It belongs to the *structor* species-group, but reliable determination of many species from this group is impossible before a taxonomic revision is provided.

***Messor excursionis* Ruzsky, 1905**

Material: 21 ♀, Central Persian deserts, Kavir National Park (34°45'14"N, 52°10'07"E), 1092 m asl, 7.VI.2008, leg. Omid Paknia.

Remarks: *M. excursionis* was recorded from Central Asia, Afghanistan and Mongolia (Karavaiev 1910; Stärcke 1935; Pisarski 1967; Arnoldi 1970, 1977a; Dlussky *et al.* 1990; Pfeiffer *et al.* 2006).

***Messor perantennatus* Arnoldi, 1970**

Material: 9 ♀, Alborz Range forest steppe, Khoshyelagh Wildlife Refuge (36°47'43"N, 55°28'12"E), 1536 m asl, 4.VI.2007, leg. Omid Paknia.

Remarks: This species was known only from Turkmenistan (Arnoldi 1970; Dlussky *et al.* 1990).

***Messor subgracilinodis* Arnoldi, 1970**

Material: 8 ♀, Central Persian deserts, Turan National Park (35°57'48"N, 56°05'35"E), 1131 m asl, 12.VI.2007, leg. Omid Paknia; 7 ♀, Central Persian deserts, Tabas (33°36'44"N, 57°05'45"E), 1083 m asl, 16.V.2008, leg. Omid Paknia; 3 ♀, Central Persian deserts, Siahkoo National Park (32°35'55"N, 54°13'59"E), 996 m asl, 25.V.2008, leg. Omid Paknia; 5 ♀, Central Persian deserts, Robat Posht Badam (32°57'26"N, 55°32'08"E) 1401 m asl, 20.V.2008, leg. Omid Paknia.

Remarks: *M. subgracilinodis* was recorded from Turkmenistan (Arnoldi 1970, 1977b; Dlussky *et al.* 1990).

***Messor turcmenochoassanicus* Arnoldi, 1977**

Material: 65 ♀, Zagros Mountains forest steppe, Dena Protected Area (30°54'45"N, 51°24'39"E), 2627 m asl, 6.VII.2007, leg. Omid Paknia; 7 ♀, Caspian Hyrcanian mixed forests Nur, urban area (~36°33'N, 51°52'E), ~3 m asl, 17.III.2005, leg. Masud Tavakoli.

Remarks: *Messor turcmenochoassanicus* was recorded only from the Kopetdag Mountains in Turkmenistan (Arnoldi 1977b; Dlussky *et al.* 1990).

***Messor variabilis* Kuznetsov-Ugamsky, 1927**

Material: 4 ♀, Alborz Range forest steppe, Golestan National Park (37°20'57"N, 56°14'44"E), 1254 m asl, 28.V.2007, leg. Omid Paknia; 6 ♀, Central Persian deserts, Kavir National Park (34°45'47"N, 52°10'24"E), 1051 m asl, 23.VI.2007, leg. Omid Paknia.

Remarks: *M. variabilis* is distributed in plains and foothills of Central Asia, where it inhabits different kinds of deserts (Arnoldi 1970, 1977b; Dlussky *et al.* 1990).

***Monomorium barbatulum* Mayr, 1877**

Material: 3 ♀, Central Persian deserts, Robat Posht Badam (32°57'22"N, 55°32'09"E), 1406 m asl, 17.V.2008, leg. Omid Paknia; 6 ♀, Central Persian deserts, Tabas (33°36'57"N, 57°05'35"E), 1074 m asl, 15.V.2008, leg. Omid Paknia.

Remarks: *M. barbatulum* has a wide distribution from the southeast of Europe (Astrakhan Province of Russia) to Central Asia and Afghanistan (Pisarski 1967; Tarbinsky 1976; Dlussky *et al.* 1990) and the Arabian Peninsula (Collingwood & Agosti 1996).

***Monomorium dentigerum* (Roger, 1862)**

Material: 13 ♀, Nobu Sindian deserts, Mond Protected Area (28°07'08"N, 51°23'50"E), 9 m asl, 14.VII.2007, leg. Omid Paknia.

Remarks: *M. dentigerum* can be found all over the Middle East (Radchenko 1997d) and the Arabian Peninsula including Yemen (Collingwood & Agosti 1996).

***Monomorium perplexum* Radchenko, 1997**

Material: 24 ♀, transitional region of Alborz Range forest steppe and Central Persian deserts, Khojir National Park (35°39'11"N, 51°43'37"E), 1462 m asl, 1.V.2008, leg. Omid Paknia.

Remarks: Outside of Iran, the species is distributed in the Transcaucasus, Anatolia, the Aegean Islands and Greece (Radchenko 1997d).

***Monomorium ruzskyi* Dlussky *et* Zabelin, 1985**

Material: 3 ♀, transitional region of Alborz Range forest steppe and Central Persian deserts, Khojir National Park (35°38'56"N, 51°43'45"E), 1466 m asl, 3.V.2008, leg. Omid Paknia.

Remarks: *M. ruzskyi* was recorded from the Transcaucasus, Turkmenistan and Uzbekistan (Dlussky & Zabelin 1985; Arakelyan 1994).

***Myrmecina* sp. ir-abpari-01 and ir-ghaemshahr-01**

Material: 8 ♀, Caspian Hyrcanian mixed forests, Ghaemshahr (36°22'16"N, 52°50'53"E), 155 m asl, 4.VI.2008, leg. Omid Paknia; 4 ♀, Caspian Hyrcanian mixed forests, Abpari (36°30'05"N, 51°55'58"E), 308 m asl, 22.VI.2008, leg. Omid Paknia.

Remarks: The genus *Myrmecina* Curtis consists of about 40 described species distributed in the Holarctic, South and Southeast Asia, Australia and South America. It is absent in the Afrotropical and Malagasy Regions. The highest speciosity occurs in the Oriental Region. In the western Palaearctic, there are four known species distributed from the Iberian Peninsula and Algeria to the Transcaucasus and the Middle East. This genus is new to Iran.

***Myrmica specioides* Bondroit, 1918**

Material: 8 ♀, Caspian Hyrcanian mixed forests, Babolsar, in urban area (36°42'30"N, 52°38'04"E), 10 m asl, 18.IX.2002, leg. Omid Paknia.

Remarks: This species has a very wide distribution that includes Europe (northwards to the south of England and Denmark), the Caucasus, Anatolia, Turkmenistan, southwest Siberia and northern Kazakhstan, eastwards to the Altai Mountains (Radchenko & Elmes 2004; Radchenko 1994b); it was introduced to North America (Jansen & Radchenko 2009).

***Proformica epinotalis* Kusnetsov-Ugamsky, 1927**

Material: 19 ♀, Alborz Range forest steppe, Golestan National Park (37°20'54"N, 56°14'42"E), 1261 m asl, 29.V.2007, leg. Omid Paknia; 11 ♀, Alborz Range forest steppe, Khoshyelagh Wildlife Refuge (36°46'24"N, 55°22'42"E), 1707 m asl, 6.VI.2007, leg. Omid Paknia.

Remarks: This species is distributed from Romania in the west through southeast Europe, southwest

Siberia and Kazakhstan to Tuva in Siberia (Dlussky 1969), the Central Asian Mountains (Dlussky *et al.* 1990). This genus is new to Iran.

***Pyramica* sp. ir-golestan-01 and ir-ghaemshahr-01 (*argiola*-group)**

Material: 1 ♀, Caspian Hyrcanian mixed forests, Ghaemshahr (36°22'16"N, 52°50'53"E), 155 m asl., 4.VI.2008, leg. Omid Paknia. ; 1 ♀, Caspian Hyrcanian mixed forests, Golestan National Park (37°24'04"N, 55°48'04"E), 520 m asl, 11.VI.2008, leg. Omid Paknia.

Remarks: In the last ten years, the systematics of the tribe Dacetini, to which *Pyramica* Roger belongs, was cardinaly changed. First of all, Bolton (1999) revived the name *Pyramica* from synonymy and proposed to consider it as a senior synonym of more than 20 generic names. A year later, he published a huge taxonomic revision of this tribe, describing several hundred new species (Bolton 2000). As a result, *Pyramica* is now one of the world's biggest ant genera that includes more than 300 species; its range encompasses the whole world, with the overwhelming majority of species distributed in the tropics. This genus is new to Iran.

Several *Pyramica* species were recorded from the Mediterranean region of Europe and Africa, the Middle East, Anatolia and the Transcaucasus, while it is not yet known from Central Asia (e.g., Arakelyan & Dlussky 1991; Arakelyan 1994; Bolton *et al.* 2006; Radchenko 2007).

It is necessary to note that in the latest revision of the tribe Dacetini (Baroni Urbani & De Andrade 2007), the name *Pyramica* is considered a junior synonym of *Strumigenys*, but in this paper, we retain *Pyramica* until there is a definitive opinion on this question.

***Stenammas* sp. ir-talysh-01**

Material: 1 ♀, Caspian Hyrcanian mixed forests, Talysh (37°40'44"N, 48°48'27"E), 869 m asl, 7.VII.2008, leg. Omid Paknia.

Remarks: *Stenammas* is a small genus, comprising about 50 species distributed mainly in the Holarctic Region, but some of which penetrated

into Central America, India and Pakistan (Himalayan region), and Southeast Asia. The highest species richness of this genus occurs in the rather warm and humid deciduous Holarctic forests, many of which can be considered relict habitats. *Stenammina* is also quite speciose in Caucasian and Anatolia forests (Arnoldi 1975; DuBois 1998). This genus is new to Iran.

***Strongylognathus* sp. ir-astaneh-01**

Material: 3 ♀, Caspian Hyrcanian mixed forests, Astaneh, rural area (~37°15'N, 49°56'E), ~0 m asl, summer 2004, leg. Faeze Mohammaddoost.

Remarks: The genus *Strongylognathus* is new to Iran. It is one of few genera endemic to the Palaearctic Region. It comprises about 25 species, centred in the western Palaearctic (the range being Europe, northwest Africa, Anatolia, the Middle East, Kazakhstan, Central Asia and southwest Siberia), and only three species are known from the eastern Palaearctic (China, Korea and Japan) (e.g., Radchenko 1985, 1991; Radchenko 1995b; Wei *et al.* 2001; Japanese Ant Database Group 2003; Radchenko 2005). All *Strongylognathus* species are permanent social parasites in nests of the *Tetramorium* Mayr species.

***Temnothorax anodonta* (Arnoldi, 1977)**

Material: 5 ♀, Caspian Hyrcanian mixed forests, Golestan National Park (37°23'53"N, 55°48'01"E), 500 m asl, 11.VI.2008, leg. Omid Paknia.

Remarks: Outside Iran, *T. anodonta* was recorded from Armenia (Arnoldi 1977a; Arakelyan 1994; Radchenko 1995a).

***Temnothorax nadigi* (Kutter, 1925)**

Material: 3 ♀, Caspian Hyrcanian mixed forests, Abpari (36°30'07"N, 51°55'58"E), 315 m asl, 28.VI.2008, leg. Omid Paknia.

Remarks: Known from southern Europe, Anatolia, the Transcaucasus and Turkmenistan (including its junior synonyms *Leptothorax caucasicus* Arnoldi and *L. hasardaghi* Dlussky (Radchenko 1995a; Czechowski *et al.* 2002).

***Tetramorium armatum* Santschi, 1927**

Material: 14 ♀, Alborz Range forest steppe, Golestan National Park (37°20'36"N, 56°14'57"E), 1226 m asl, 28.V.2007, leg. Omid Paknia; 7 ♀, Central Persian deserts, Kavir National Park (34°45'47"N, 52°10'24"E), 1045 m asl, 21.VI.2007, leg. Omid Paknia; 6 ♀, Central Persian deserts, Turan National Park (35°58'22"N, 56°04'43"E), 1174 m asl, 15.VI.2007, leg. Omid Paknia.

Remarks: *T. armatum* is morphologically close to *T. inerme* Mayr, but in contrast to the latter, which lives in the Central Asian plains, it has been found predominantly in mountains, of Central Asia, the Transcaucasus, Afghanistan and Mongolia (Dlussky *et al.* 1990; Radchenko 1992b).

***Tetramorium schneideri* Emery, 1898**

Material: 21 ♀, Alborz Range forest steppe, Golestan National Park (37°20'36"N, 56°14'57"E), 1226 m asl, 28.V.2007, leg. Omid Paknia.

Remarks: *T. schneideri* was recorded in the plains and foothills of Central Asia and Afghanistan (Dlussky *et al.* 1990; Radchenko 1992b).

***Tetramorium striativentre* Mayr, 1877**

Material: 16 ♀, Central Persian deserts, Daranjir Protected Area (32°26'18"N, 55°01'21"E), 1227 m asl, 19.V.2008, leg. Omid Paknia; 2 ♀, Central Persian deserts, Siahkooch National Park (32°35'55"N, 54°13'59"E), 998 m asl, 25.V.2008, leg. Omid Paknia; 26 ♀, Central Persian deserts (32°57'23"N, 55°32'08"E), 1392 m asl, 17.V.2008, leg. Omid Paknia; 4 ♀, Central Persian deserts, Tabas (33°36'44"N, 57°05'46"E), 1083 m asl, 14.V.2008, leg. Omid Paknia; 22 ♀, Central Persian deserts, South of Naeen (32°43'11"N, 53°16'39"E), 1372 m, asl, 26.V.2008, leg. Omid Paknia; 23 ♀, transitional region of Alborz Range forest steppe and Central Persian deserts, Khojir National Park (35°38'56"N, 51°43'45"E), 1466 m asl, 29.IV.2008, leg. Omid Paknia; 32 ♀, Central Persian deserts, Kavir National Park (34°45'40"N, 52°10'19"E), 1057 m asl, 7.V.2008, leg. Omid Paknia; 39 ♀, Central Persian deserts, Turan National Park (35°58'22"N, 56°04'43"E), 1176 m asl, 17.VI.2007, leg. Omid Paknia.

Remarks: Inhabits mainly mountains of Central Asia and Afghanistan, whereas the morphologically similar *T. schneideri* lives in plains (Dlussky *et al.* 1990; Radchenko 1992b).

DISCUSSION

Iran's ant species list is far from complete. Iran is a vast country with a total area of 1.6 million square kilometres. Although arid and semi-arid areas cover nearly half of the country, Iran also includes high mountains with alpine areas (Noroozi *et al.* 2008), broadleaf forest in the southern coastal plains of the Caspian forests, and steppe forests in the north and west (Zohary 1973). Thus, the 138 recorded species for the ant fauna of Iran is still far from the true number. Additionally, our sampling sites were limited to the north and the centre of Iran and no samples were collected from the east, the southeast or the southwest of the country (Fig. 1). As a result, it is not yet possible to draw complete and correct biogeographic conclusions about the overall ant fauna of Iran. Nevertheless, the recorded species give clues about how the ant fauna is biogeographically structured in the areas we have substantially sampled, like the north and centre of Iran.

Many species on this list were recorded from the north and centre of the Central Persian desert basins (Fig. 1), where the highest sampling effort was applied. The deserts and semi-deserts of Iran represent a transitional zone between the hot and cold deserts of Asia (Breckle 2002). The Central Persian desert basins, except in the southeast of the region, are characterised by cold winters and an annual average occurrence of 60 frost days, and thus can be likened to the belt of Central Asian deserts. Our new records from the Central Persian desert basins indicate that the ant fauna of this region has more species in common with that of the Central Asian deserts (e.g., *C. bergianus*, *M. subgracilinodis*, *M. variabilis* and *M. ruzskyi*) than with those of the hot subtropical deserts of the Middle East and Arabian Peninsula.

The Caspian Hyrcanian mixed forests are geologically old and preserve the last remnants of primary temperate deciduous broadleaved forests worldwide, existing there since the late Tertiary period (Zohary 1973; Ramezani *et al.* 2008).

Apart from *Proformica*, all the newly recorded genera (*Dolichoderus*, *Myrmecina*, *Pyramica*, *Stenammina* and *Strongylognathus*) were collected from this region. As the natural history (fauna and flora) of the Caspian Hyrcanian mixed forests is close to those of the Caucasian and Anatolian regions, the ant fauna of the region is most likely related to them. Interestingly, specimens of three ant genera, *Dolichoderus*, *Myrmecina* and *Pyramica* were extracted by Winkler collector from the leaf litter of Caspian Hyrcanian mixed forests. This finding requires us to make further efforts to explore the litter layer in such forest ecosystems. Future intensive studies in the Caspian Hyrcanian area, and in the east, southeast and southwest of the country, are most likely to reveal new records or even new species for science.

In closing, we emphasise the need for fundamental studies in this part of Asia and invite all myrmecologists, especially those from Asia, to take part in this job.

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REFERENCES

- Agosti D and Alonso L, 2000. The ALL protocol: a standard protocol for the collection of ground-dwelling ants. In: Agosti D, Majer J, Alonso L, and Schultz T (eds), *Ants: Standard Methods for Measuring and Monitoring Biodiversity*, 204–6. Washington, D.C: Smithsonian Institution Press.
- Agosti D and Collingwood CA, 1987. A provisional list of the Balkan ants (Hym. Formicidae) and a key to the worker caste. I. Synonymic list. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft or Bulletin de la Societe Entomologique Suisse*. 60:51–62.

- Aktaş N, 1977. Studies on the myrmecofauna of Turkey I. Ants of Siirt, Bodrum and Trabzon. *Istanbul Üniversitesi Fen Fakültesi Mecmuası. Seri B* 41:115–35.
- Arakelyan GR, 1994. *Fauna of the Republic of Armenia. Hymenopterous Insects. Ants (Formicidae)*. [in Russian]. Gitutium, Erevan, p. 153.
- Arakelyan GR and Dlussky GM, 1991. Dacetine ants (Hymenoptera: Formicidae) of the USSR. [in Russian]. *Zoologicheskii Zhurnal* 70:149–52.
- Arnoldi KV, 1948. Ants of Talysh and the Diabar depression. Their importance for the characterization of communities of terrestrial invertebrates and for historical analysis of the fauna. [in Russian]. *Trudy Zoologicheskogo Instituta Akademii Nauk SSSR* 7(2):206–62.
- Arnoldi KV, 1970. New species and races of the ant genus *Messor* (Hymenoptera: Formicidae). [in Russian]. *Zoologicheskii Zhurnal* 49:72–88.
- Arnoldi KV, 1975. A review of the species of the genus *Stenammina* (Hymenoptera: Formicidae) of the USSR and description of new species. [in Russian]. *Zoologicheskii Zhurnal* 54:1819–829.
- Arnoldi KV, 1977a. New and little known ant species of the genus *Leptothorax* Mayr (Hymenoptera: Formicidae) in the European USSR and the Caucasus. [in Russian]. *Entomologicheskoye Obozreniye* 56:198–204.
- Arnoldi KV, 1977b. Review of the harvester ants of the genus *Messor* (Hymenoptera: Formicidae) in the fauna of the USSR. [in Russian]. *Zoologicheskii Zhurnal* 56:1637–48.
- Atanassov N and Dlussky GM, 2002. *Fauna Bulgaria 22. Hymenoptera, Formicidae* [in Bulgarian]. Bulgarian Academy of Sciences, Sofia, p. 310.
- Baroni Urbani C and De Andrade ML, 2007. The ant tribe Dacetini: limits and constituent genera, with descriptions of new species (Hymenoptera: Formicidae). *Annali del Museo Civico di Storia Naturale Giacomo Doria* 99:1–191.
- Bolton B, 1999. Ant genera of the tribe Dacetonini (Hymenoptera: Formicidae). *Journal of Natural History* 33:1639–89.
- Bolton B, 2000. The ant tribe Dacetini. *Memoirs of the American Entomological Institute* 65:1–1028.
- Bolton B, Alpert G, Ward PS and Naskrecki P, 2006. *Bolton's Catalogue of Ants of the World: 1758–2005*, CD-ROM. Cambridge, MA: Harvard University Press.
- Breckle SW, 2002. Salt deserts in Iran and Afghanistan. In: Barth HJ and Boer B (eds), *Sabkha Ecosystems*. Dordrecht, Kluwer Academic Publishers, p368.
- Collingwood CA and Agosti D, 1996. Formicidae (Insecta: Hymenoptera) of Saudi Arabia (Part 2). *Fauna Saudi Arabia* 15:300–85.
- Czechowski W, Radchenko A and Czechowska W, 2002. *The Ants (Hymenoptera: Formicidae) of Poland*. Museum and Institute of Zoology PAS, Warsaw, p200.
- Dlussky GM, 1969. Ants of the genus *Proformica* Ruzs. of the USSR and contiguous countries (Hymenoptera: Formicidae). [in Russian]. *Zoologicheskii Zhurnal* 48:218–232.
- Dlussky GM, Soyunov OS and Zabelin SI, 1990. *Ants of Turkmenistan*. Ashkhabad: Ylym Press, p273.
- Dlussky GM and Zabelin SI, 1985. Ant fauna (Hymenoptera: Formicidae) of the River Sumbar Basin (south-west Kopetdag). [In Russian]. In: Nechaevaya NT (ed), *The Vegetation and Animal World of Western Kopetdag*. [In Russian] Ylym, Ashkhabad. 208–46.
- DuBois MB, 1998. A revision of the ant genus *Stenammina* in the Palaearctic and Oriental regions (Hymenoptera: Formicidae: Myrmicinae). *Sociobiology* 32:193–403.
- Emery C, 1898. Beiträge zur Kenntniss der palaearktischen Ameisen. *Öfversigt af Finska Vetenskaps-Societetens Förhandlingar* 20:124–51.
- Emery C, 1925. I *Camponotus* (*Myrmentoma*) palearctici del gruppo lateralis. *Rendiconti delle Sessioni della Reale Accademia delle Scienze dell'Istituto di Bologna Classe di Scienze Fisiche* 29:62–72.
- Jansen G and Radchenko A, 2009. *Myrmica specioides* Bondroit—a new invasive ant species in the USA? *Biological Invasions* 11:253–56.
- Japanese Ant Database Group, 2003. *Ant Image Database 2003*. Japanese Ant Database Group, Sendai.
- Karavaiev V, 1910. Nachtrag zu meinen “Ameisen aus Transcaspien und Turkestan”. *Russkoye Entomologicheskoye Obozreniye* 9:268–72.
- Kuznetsov-Ugamsky NN, 1929. Die Ameisenfauna Daghestans. *Zoologischer Anzeiger* 83:34–45.
- Menozi C, 1939. Formiche dell'Himalaya e del Karakorum raccolte dalla Spedizione italiana comandata da S. A. R. il Duca di Spoleto (1929). *Atti della Società Italiana di Scienze Naturali e del Museo Civile di Storia Naturale, Milano* 78:285–345.
- Noroozi J, Akhiani H and Breckle SW, 2008. Biodiversity and phytogeography of the alpine flora of Iran. *Biodiversity and Conservation* 17:493–521.

- Olson DM, Dinerstein E, Wikramanayake ED *et al.*, 2001. Terrestrial ecoregions of the world: a new map of life on earth. *Bioscience* 51(11):933–38.
- Paknia O, Radchenko A, Alipanah H and Pfeiffer M, 2008. A preliminary checklist of the ants (Hymenoptera: Formicidae) of Iran. *Myrmecological News* 11:151–59.
- Pfeiffer M, Schultz R, Radchenko A, *et al.*, 2006. A critical checklist of the ants of Mongolia (Hymenoptera: Formicidae). *Bonner Zoologische Beitrage* 55(1):1–8.
- Pisarski B, 1965. Les fourmis du genre *Cataglyphis* Foerst. en Irak (Hymenoptera: Formicidae). *Bulletin de L'Academie Polonaise des Sciences Série des Sciences Biologiques* 13:417–22.
- Pisarski B, 1967. Fourmis (Hymenoptera: Formicidae) d'Afghanistan récoltées par M. Dr. K. Lindberg. *Annales Zoologici* 24:375–425.
- Pisarski B, 1970. Beiträge zur Kenntnis der Fauna Afghanistans. Formicidae, Hymenoptera. *Casopis Moravského Musea Brne* 54 (Suppl.): 305–26.
- Pisarski B, 1971. Les fourmis du genre *Camponotus* Mayr (Hymenoptera: Formicidae) d'Iraq. *Bulletin de L'Academie Polonaise des Sciences Série des Sciences Biologiques* 19:727–31.
- Radchenko A, 1985. Ants of the genus *Strongylognathus* (Hymenoptera: Formicidae) in the European part of the USSR. [In Russian]. *Zoologicheskii Zhurnal* 64:1514–23.
- Radchenko A, 1991. Ants of the genus *Strongylognathus* (Hymenoptera: Formicidae) of the USSR fauna. [In Russian]. *Zoologicheskii Zhurnal* 70:84–90.
- Radchenko A, 2005. Monographic revision of the ants (Hymenoptera: Formicidae) of North Korea. *Annales Zoologici* 55(2):127–221.
- Radchenko A, 2007. Fauna Europea: Formicidae. In: Noyes J (Ed.): *Fauna Europea: Hymenoptera: Apocrita*. Fauna Europea version 1.3, <http://www.faunaeur.org>, accessed on 15 May 2007.
- Radchenko AG, 1992a. Ants of the genus *Tetramorium* (Hymenoptera: Formicidae) of the USSR fauna. Report 1. [In Russian]. *Zoologicheskii Zhurnal* 71:39–49.
- Radchenko AG, 1992b. Ants of the genus *Tetramorium* (Hymenoptera: Formicidae) of the USSR fauna. Report 2. [In Russian]. *Zoologicheskii Zhurnal* 71:50–58.
- Radchenko AG, 1994a. A key to species of the *Leptothorax* (Hymenoptera: Formicidae) from central and eastern Palearctic. [in Russian]. *Zoologicheskii Zhurnal* 73:146–158.
- Radchenko AG, 1994b. A key to the ants of the genus *Myrmica* (Hymenoptera, Formicidae) of the Central and Eastern Palaearctic. [In Russian with English summary]. *Zoologicheskii Zhurnal* 73:130–45.
- Radchenko AG, 1995a. A review of the ant genus *Leptothorax* (Hymenoptera: Formicidae) of the central and eastern Palearctic. Communication 3. Groups *nylanderi*, *korbi*, *nassonovi*, and *susamyri*. [In Russian]. *Vestnik Zoologii* 1995(4):3–11.
- Radchenko AG, 1995b. *Strongylognathus potanini* sp. n. - a new ant species from China. [In Russian]. *Zhurnal Ukrains'kogo Entomolohichnogo Tovaristva* 1(3-4):57–58.
- Radchenko AG, 1997a. Review of ants of the genus *Cataglyphis* Foerster (Hymenoptera: Formicidae) of Asia. [In Russian]. *Entomologicheskoye Obozrenie* 76:424–42.
- Radchenko AG, 1997b. Review of ants of the subgenera *Tanaemyrmex*, *Colobopsis*, *Myrmamblis*, *Myrmosericus*, *Orthonotomyrmex* and *Paramyrmamblis* of the genus *Camponotus* (Hymenoptera: Formicidae) in the Asian Palearctic. [In Russian.]. *Zoologicheskyy Zhurnal* 76:806–15.
- Radchenko AG, 1997c. Review of ants of the subgenus *Myrmentoma* genus *Camponotus* (Hymenoptera: Formicidae) of the Asian Palearctic. [In Russian.]. *Zoologicheskii Zhurnal* 76:703–11.
- Radchenko AG, 1997d. Review of the ants of scabriceps group of the genus *Monomorium* Mayr (Hymenoptera: Formicidae). *Annales Zoologici* 46:211–24.
- Radchenko AG and Elmes GW, 2004. Taxonomic notes on the scabrinodis-group of *Myrmica* species (Hymenoptera: Formicidae) living in Eastern Europe and western Asia, with a description of a new species from Tien Shan. *Proceedings of the Russian Entomological Society* 75(1):222–33.
- Ramezani E, *et al.*, 2008. The late-Holocene vegetation history of the Central Caspian (Hyrceanian) forests of northern Iran. *Holocene* 18(2):307–21.
- Stärke A, 1935. Zoologie. Formicidae. *Wissenschaftliche Ergebnisse der Niederländischen Expedition in den Karakorum* 1:260–9.
- Tarbinsky YS, 1976. *The ants of Kirghizia*. [in Russian]. Ilim, Frunze, p217.
- Wei C, Xu ZH and He H, 2001. A new species of the ant genus *Strongylognathus* Mayr (Hymenoptera: Formicidae) from Shaanxi, China. *Entomotaxonomia* 23:68–70.
- Wheeler WM and Mann WM, 1916. The ants of the Phillips Expedition to Palestine during 1914. *Bulletin of the Museum of Comparative Zoology at Harvard University* 60:167–74.
- Zohary M, 1973. *Geobotanical foundations of the Middle East*. Gustav Fischer Verlag, Stuttgart, p738.