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Research Article

Notes on the ant fauna (Hymenoptera: Formicidae) of Iran (Part I)

Arsalan Khalili-Moghadam[1,2], Sebastian Salata[3] & Lech Borowiec[3]

1- Plant Protection Department, Agricultural College, Shahrekord University, Shahrekord, Iran
2- Institute of Biotechnology, Shahrekord University, Shahrekord, Iran
3- Myrmecological Laboratory, Department of Biodiversity and Evolutionary Taxonomy, University of Wrocław, Przybyszewskiego 65, 51–148 Wrocław, Poland

Abstract. Ants are integral components of terrestrial ecosystems, and their diversity is crucial for the functioning and maintenance of many ecosystems. The aim of this study was identifying specimens collected from different habitats and localities in Esfahan and Chaharmahal Va Bakhtiari Provinces. Direct sampling (hand collecting) was used for collecting materials, and all specimens were preserved in 75% ethanol. As a result, a list of 42 identified species belonging to 13 genera of three subfamilies, collected from 66 sampling sites in Chaharmahal Va Bakhtiari and Esfahan Provinces, is given. Two species are recorded for the first time from Iran, namely *Camponotus jaliensis* Dalla Torre, 1893 and *Tetramorium staerckei* Kratochvíl, 1944. Also, fifteen and six species are recorded for the first time from Esfahan and Chaharmahal Va Bakhtiari Provinces, respectively. Result showed that the Iranian ant fauna is rich and in need of more faunistic studies.

Keywords: Ants, Esfahan, Chaharmahal Va Bakhtiari, faunistic, new record

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Corresponding author:
Arsalan Khalili-Moghadam

E-mail: arsalan.khalili@gmail.com

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Introduction

Despite recent additions to the ant fauna of Iran, the knowledge on the Iranian myrmecofauna is still relatively poor. The very first comprehensive checklist was published by Paknia *et al.,* (2008) who reviewed the literature and added some new records. Since then, numerous faunistic and taxonomic studies have been carried out in various parts of Iran (e.g. Rafinejad *et al.,* 2009; Paknia *et al.,* 2010; Radchenko & Paknia, 2010; Firouzi *et al.,* 2011; Mohammadi *et al.,* 2012; Hossein Nezhad *et al.,* 2012; Shiran *et al.,* 2013; Hosseini *et al.,* 2015; Khandehroo *et al.,* 2015; Mirzamohamadi *et al.,* 2015; Moradloo *et al.,* 2015; Mortazavi *et al.,* 2015; Ghobadi *et al.,* 2016; Heidari *et al.,* 2017; Pashaei Rad *et al.*, 2018; Mohseni & Pashaei Rad, 2019; Samin *et al.,* 2020; Safariyan *et al.,* 2021; Khalili-Moghadam *et al.,* 2019, 2021, 2023a, b; Salata *et al.,* 2020, 2021; Farajollahzade *et al.,* 2022; Khalili-Moghadam & Oraie, 2023a, b; Mohseni & Mikheyev, 2023; Salata *et al.,* 2024). Currently, approximately 320 ant species and subspecies are known from Iran (Guénard *et al.,* 2017) but some of the literature records seem unreliable. Considering that many areas of Iran have not been studied, the number of ant species in this country's fauna is very likely much higher.

Approximately 28 and 40 ant species belonging to four subfamilies (Formicinae, Myrmicinae, Dolichoderinae and Ponerinae) were recorded from Esfahan and Chaharmahal Va Bakhtiari Provinces, respectively (Paknia *et al.,* 2010; Shiran *et al.,* 2013; Pashaei Rad *et al.,* 2018; Khalili-Moghadam *et al.,* 2109, 2021, 2023a, b; Khalili-Moghadam, 2021; Pashaei Rad and Iravani, 2022; Khalili-Moghadam & Saeidi, 2023; Salata *et al.,* 2020, 2024).

The presented study is focused on ant fauna in some regions of Chaharmahal Va Bakhtiari and Esfahan Provinces. Here, we present species of three subfamilies (Dolichoderinae, Formicinae, Myrmicinae) collected from Chaharmahal Va Bakhtiari and Esfahan Provinces together with 21 new provincial records and two country records. Morphological characters and related photos of ant workers were presented for new country records, as well as notes on distribution of all species.

Materials and methods

Study Area

Chaharmahal Va Bakhtiari Province lies in the southwestern part of Iran. Zagros Mountains cover about 76% of its surface, the majority of which is overgrown with oak forests (*Quercus* spp.), Milkvetch (*Astragalus* spp.), Kheshk (*Daphne mucronata*), and a lot of seasonal plants. The remaining part is dominated by plains. As shown in previous studies and our results, this situation and the existence of many springs and rivers is good habitat for colonization of ants. The specimens in this study were collected from the following counties: Lordegan, Saman, Ardal, Shahrekord, Farokhshahr, Koohrang, Naghan, Nafch, Hafshejan, Boroujen and Sooreshjan.

Esfahan Province lies in the central part of the country. About 33% of this province is covered by desert. However, some parts of the province are mountainous and have a moderate climate. The majority of desert is overgrown with *Artemisia* spp. and Milkvetch (*Astragalus* spp.). The material in this province was collected from the following counties: Mobarakeh, Varzaneh, Esfahan, Minadasht, Falavarjan, Golpayegan (Mouteh protected area) and Baghbahadoran counties.

The paper is based mainly on the new material collected by Arsalan Khalili-Moghadam from the mentioned provinces. The ants' nests were explored in various habitats and location, on the ground, in leaf litter, under stones, dead wood, tree trunks, and twigs, then the specimens were collected using hand collecting method. Nests were searched in rock cracks using a chisel. All specimens (at least 10 workers for each species) were preserved in 75% ethanol. The photographs were used from ant database (Antweb.org) and Salata *et al.,* (2023). The specimens were identified based on appropriate literature such as: Radchenko, (1998), Mohseni & Mikheyev, (2023), Khalili-Moghadam *et al.,* (2021, 2023b), Salata *et al.,* (2021), Sharaf *et al.* (2021), Borowiec & Salata, (2022), Salata *et al.* (2024) and etc. Distribution in Iran refers to Guénard *et al.* (2017). Geographical coordinates are given in a decimal system. Duplicates of materials for each species are deposited in the both following institutions: Museum of Natural History, University of Wroclaw, Poland (MNHW) and Entomological Laboratory, Plant Protection Department, Agriculture College, Shahrekord University, Iran (EPAS). The species are arranged according to their taxonomic groups, subfamilies, and different genera in alphabetical order.

List of sampling localities (Fig. 1)

Chaharmahal Va Bakhtiari Province**:**

1. Ardal, 1785-1887 m, 16.iix.2021, 31.97055-32.00777 N, 50.57194-50.66416 E, nest in the agricultural area;
2. Ardal (Behesht Abad), 1674 m, 16.iix.2021, 32.02944 N 50.62694 E, nest in the agricultural area;
3. Ardal (Karim Abad), 1883 m, 17.iix.2021, 32.08472 N 50.56611 E, nest in the agricultural area;
4. Ardal (Rostam Abad), 1892-2038 m, 17-18.iix.2021, 32.0011-32.13777 N 50.51611-50.55027 E, nest in the agricultural area;
5. Ardal (Eslam Abad), 1898 m, 17.iix.2021, 32.09777 N 50.54944 E, nest in the agricultural area;
6. Ardal (Holoosad), 1406-1470 m, 27.iix.2021 and 10-11.x.2021, 31.7233-31.72944 N 50.05666-50.57611 E, nest in the agricultural area;
7. Ardal (Deh Kohne), 1408 m, 27.iix.2021, 31.71138 M 50.59027 E, nest in the agricultural area;
8. Ardal (Gandomkar olia, sofla), 1887-1941 m, 09.x,2021, 31.80472 N 50.56416 E, nest in the agricultural area;
9. Ardal (Geleshoor), 1702 m, 09.x.2021, 31.73527 N 50.53972 E, nest in the agricultural area;
10. Ardal (Karoon 4), 1789 m, 09.x.2021, 31.72444 N 50.54527 E, nest in the agricultural area;
11. Ardal (Sarkhoon), 1500 m, 09.x.2021, 31.74861 N 50.54805 E, nest in the agricultural area;
12. Ardal (Lirabi), 1948 m, 14.ix.2021, 31.95666 N 50.48777 E, nest in the agricultural area;
13. Ardal (Ghale Rashid), 1948 m, 18.xii.2021, 32.11444 N 50.51944 E, nest in the agricultural area;
14. Ardal (Ghale Darvish), 1816 m, 18.xii.2021, 32.10805 N 50.51138 E, nest in the agricultural area;
15. Ardal (Zarmeytan), 1878 m, 18.xii.2021, 32.12222 N 50.50583 E, nest in the agricultural area;
16. Ardal (Davazdah Emam), 1877 m, 14.ix.2021, 31.99694 N 50.54472 E, nest in the agricultural area;
17. Ardal (Sarchah), 1833 m, 14.ix.2021, 31.99277 N 50.53027 E, nest in the agricultural area;
18. Ardal (Sarmoor), 1947 m, 14.ix.2021, 31.96166 N 50.52388 E, nest in the agricultural area;
19. Ardal (Najaf abad), 2038 m, 16.ix.2021, 32.02472 N 50.39472 E, nest in the agricultural area;
20. Ardal (Abas abad), 2128 m, 10.i.2021, 32.04888 N 50.43277 E, nest in the agricultural area;
21. Ardal (Ghorrab), 2061 m, 10.i.2021, 32.02777 N 50.39472 E, nest in the agricultural area;
22. Ardal (Dashtak), 1862-2014 m, 10.i.2021, 32.148333-32.16777 N 50.45083-50.45527 E, nest in the agricultural area;
23. Ardal (Alikooh), 1899-1978 m, 10.i.2021, 32.13055-32.13416 N 50.49888-50.51194 E, nest in the agricultural area;
24. Ardal (Dopolan), 1523 m, 26.iix.2021, 31.91472 N 50.60611 E, nest in the agricultural area;

25. Ardal (Rahim abad), 1701 m, 26.iix.2021, 31.90388 N 50.58166 E, nest in the agricultural area;
26. Ardal (Firooz abad), 2051 m, 26.iix.2021, 31.86861 N 50.58888 E, nest in the agricultural area;
27. Ardal (Bare morde), 2306 m, 26.iix.2021, 31.83333 N 50.56777 E, nest in the agricultural area;
28. Ben, 2190 m, 15.v.2019, 32.54027 N 50.73111 E, nest in the agricultural area;
29. Boroujen, 2223 m, 25.iv.2017, 31.97694 N 50.28527 E, nest in the agricultural area;
30. Farokhshahr, 2107 m, 04.vi.2014, 11.iv.2015, 25.v.2016, 09.iv.2018, 17.v.2019, 32.25055 N 50.96138 E, nest in the agricultural area;
31. Farokhshahr (Dahak farm), 2115 m, 07.iv.2021, 32.25166 N 50.97055 E, nest in Walnut orchard;
32. Farokhshahr (Sadr farm), 2169 m, 19.v., 14.vi., 24.iix.2021, 32.29666 N 50.02527 E, nest in Walnut, Almond and Willow orchard;
33. Hafshejan, 2048 m, 20.ii.2018, 32.21361 N 50.78277 E, nest in the agricultural area;
34. Koohrang (Dejdaran valley), 2268-2348 m, 22-23.iv.2021, 32.15916 N 50.25861 E, nest in grazing area;
35. Koohrang (Cheri), 1645-1783 m, 22.iv.2021, 32.15388 N 50.11833 E, nest in oak forest;
36. Koohrang (Mavarz), 1507 m, 22.iv.2021, 32.18083 N 50.06861 E, nest in oak forest near the river;
37. Koohrang (Faryak), 1554 m, 22.iv.2021, 32.21444 N 50.01805 E, nest near the river;
38. Koohrang (Chamangoli, Baghcendar), 1865-1914 m, 23.iv.2021, 32.27194 N 50.96055 E, nest in Oak forest;
39. Lordegan (Mashkdozan), 1381 m, 01.iv.2020, 31.55527 N 50.56972 E, nest in oak forest;
40. Naghan, 2136 m, 09.iv.2014, 31.94666 N 50.73444 E, nest in the agricultural area;
41. Nafch, 2163 m, 09.ix., 27.iii.2013, 32.40916 N 50.77833 E, nest in the agricultural area;
42. Saman, 1949 m, 19.iv.2017, 32.46416 N 50.906111 E, nest in the agricultural area;
43. Saman (Hoseinabad farm), 1938 m, 14.iv., 12.vi., 14.iix.2021, 32.47027 N 50.91027 E, nest in Walnut orchard (some on the trunk of Walnut tree);
44. Saman (Shoorab kabir farm), 2005 m, 21.iv. 2021, 32.50638 N 50.95888 E, nest in Almond orchard;
45. Shahrekord, 2100 m, 19.iv., 15.v., 06.vi, 08.x.2014, 04.v.2016, 05.v.2018, 05.v.2019, 32.36777 N 50.76194 E, nest in the agricultural area;
46. Shahrekord, 2103 m, 19.iv.2017, 32.35611 N 50.83055 E, nest in the agricultural area;
47. Shahrekord (Chaleshtor farm), 2125 m, 21.vi., 07.iix.2021, 32.39333 N 50.80111 E, nest in Walnut orchard;
48. Shahrekord (Urban Parks), 2130-2230 m, 29.iv.2021 and 26.iix.2021, 32.32583-32.33611 N 50.84222-50.88722 E, nest in Urban Parks (green space);
49. Shahrekord (Shahrekord University), 2106 m, 03.iix.2020, 32.35611 N 50.83055 E, nest in the agricultural area;

Esfahan Province:

50. Baghbahadoran, 1778 m, 09.iii.2017 and 19.iv.2019 32.36805 N 51.18805 E, nest in the agricultural area;
51. Boin Miandasht, 2449 m, 05.vii.2018, 33.08527 N 50.15277 E, nest in the agricultural area;
52. Esfahan (Zeynabiyeh), 1556 m, 27,iv.2020 and 23.iix.2021, 32.73694 N 51.72472 E, nest in the agricultural area (Vegetable and Corn farms; Rose flower and Mulberry orchards);
53. Esfahan (Alavegeh), 1852 m, 21-27.iv.2020, 32.04777 N 51.08777 E, nest in Mulberry orchards;
54. Esfahan (Zeyar), 1529 m, 28.v.2020, 32.51694 N 51.94083 E, nest in the fruit orchards;
55. Esfahan (Nazhvan), 1578 m, 29.x.2020 and 12.xi.2021, 32.63666 N 51.62083 E, nest under trees or on trunks of Willow, Poplar, Elm, Plane, Walnut, Pomegranate and Mulberry;
56. Esfahan (Abshar forest Park), 1568 m, 05.vii.2021, 32.63694 N 51.69611 E, nest under or on trunks of Willow;
57. Esfahan (Zayanderood Park), 1584 m, 05.vi., 8.iiv.2021, 32.63638 N 51.70194 E, nest under or on trunks of Acacia, Mulberry, Pine, Piracanta;
58. Esfahan (Isargaran forest Park), 1567 m, 05-17.vii.2021, 32.63777 N 51.69184 E, nest under trees or on trunks of Pine, Willow and Elm;
59. Esfahan (Minadasht), 1643 m, 17.vii.2021, 32.48888 N 51.43583 E, nest under Willow;
60. Esfahan, 1579 m, 25.iv., 06 and 12.v., 06.iix., 12.x.2017, 32.63583 N 51.62388 E, nest in the agricultural area;
61. Falavarjan, 1607 m, 01.vi.2021 and 16.iix.2021, 32.55944 N 51.51361 E, nest under trees or on trunks of Poplar, Plane, Peach, Walnut and Mulberry;
62. Mobarakeh, 1680 m, 12.vi.2018, 32.33472 N 51.49861 E, nest in the agricultural area;

63. Shahinshahr Va Meymeh (Mouteh Refuge (protected area)) 1847-1950 m, 05.v.2021, 33.61305-33.68777 N 50.66361-50.92694 E, nest in protected area covered by *Artemisia* sp.;
64. Tiran, 1827 m, 19.iv.2019 32.68777 N 51.14194 E, nest in the agricultural area;
65. Varzaneh, 1475 m, 25.v.2017, 13.x.2020 and 26.iix.2021, 32.39694 N 52.64916 E, nest in the agricultural area (Wheat, Alfalfa, Cotton farms; Pistachio, Pomegranate orchards; Elm, Tamarisk, saxaul trees and near the greenhouse).

Results

We identified 42 species, members of three subfamilies Dolichoderinae, Formicinae and Myrmicinae, collected from Chaharmahal Va Bakhtiari and Esfahan Provinces. Two species are reported for the first time from Iran, namely *Camponotus jaliensis* Dalla Torre, 1893 and *Tetramorium staerckei* Kratochvíl, 1944. Six and fifteen species are also new records for the Chaharmahal Va Bakhtiari and Esfahan Provinces, respectively.

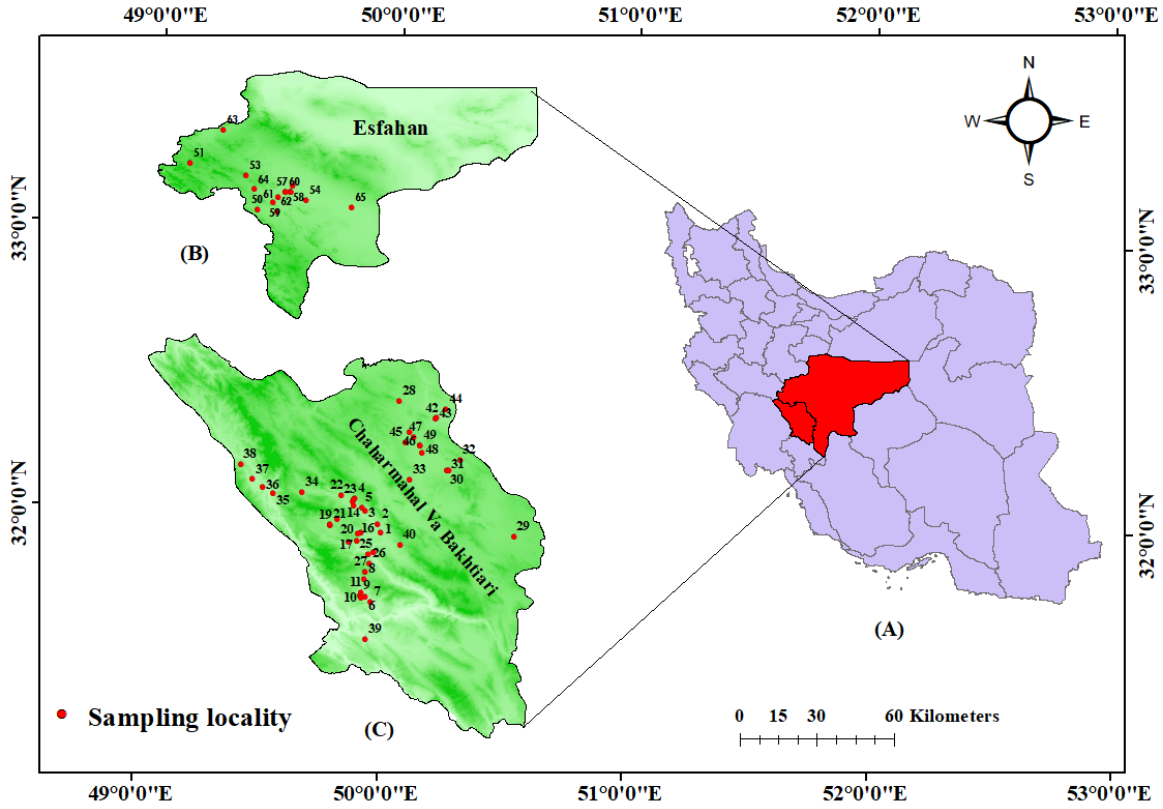

Fig. 1. Sampling localities of ants in two Iranian provinces, according to the numbering given in the material and methods (source map © 2023 Copyright: Newebcreations).

List of species

Subfamily Dolichoderinae Forel, 1878

Tapinoma karavaievi Emery, 1925

Localities: 1, 31, 32, 33, 38, 43, 44, 45, 47, 48, 52, 53, 55, 65.

Note: This species is known from Tehran, Chaharmahal Va Bakhtiari, Golestan, Fars, Markazi, Kurdistan, Kermanshah, and Mazandaran Provinces in Iran (Paknia *et al.,* 2008**;** Shiran *et al.,* 2013; Ghahari *et al.,* 2009; Ghahari & Collingwood, 2013; Pashaei Rad *et al.*, 2018; Khalili-Moghadam *et al.*, 2019)**.** Our record is first from Esfahan Provinces.

Subfamily Formicinae Latreille, 1802

Camponotus jaliensis Dalla Torre, 1893

Locality: 38.

Note: First record for Iranian ant fauna. *Camponotus jaliensis* is a rare and thermophilous species that is known from the eastern part of the Mediterranean Basin: Greece (southern mainland, Aegean Islands, Crete, Dodecanese

and Ionian Islands), Turkey, Cyprus, and Israel (Guénard *et al.,* 2017). In Iran, it was observed under a fallen oak trunk in current study.

Morphological characters

(worker)**.** The species is moderately large, polymorphic (Fig. 2A, B), belonging to the subgenus *Tanaemyrmex*, recognizable by the erect setae on the genae (Fig. 2 B); dorsal surface of antennal scape and hind tibia with completely appressed pubescence (hind tibiae lacking row of spines or thorns); body color variable, mostly whole body brown to dark brown; head approximately as long as wide, widest in basal ¼ length, sides softly rounded and converging anterad, posterior margin concave; in full-face view anterior margin of clypeus distinctly crenulate, central plate of clypeus with more numerous erected setae, anterior margin in the middle with 6 very long setae, gular area with more than 15 short to long erected setae; scape proportionally shorter than width of head; funicular segments elongate and thin, first and third segments distinctly longer than second, the rest of funicular segments very elongate (Fig. 2B); mesosoma in profile forming more convex arch, propodeum with almost straight posterior angle, dorsally and laterally distinctly sculptured tending to form longitudinal, transverse and oblique microstriatrion, surface strongly shiny; setation of all mesosomal parts more numerous, pronotum with 7-12 setae, mesonotum and propodeum with 3-9 setae (Fig. 2B); gaster tergites with fine transverse microstriation, interspaces without additional microsculpture thus surface of gaster appears strongly shiny, covered with short and scarce appressed hairs (Fig. 2B).

In Iran, this species is similar to *Camponotus oertzeni* Forel, 1889 and *Camponotus aethiops* (Latreille, 1798) but, *C. jaliensis* differs from these species in inner margin of hind tibiae lacking row of spines while *C. aethiops* and *C. oertzeni* have at least 2-3 spines in apical part of inner margin of tibia. Also, *C. jaliensis* is a diverse species in terms of body coloration and its specimens can be completely yellow to almost completely dark (Fig. 2A, B), while in *C. aethiops* and *C. oertzeni* brown specimens predominate.

Camponotus oasium Forel, 1890

Localities: 36, 40.

Note: This species has previously been recorded from the Fars, Mazandaran, and Khuzestan Provinces (Paknia *et al.,* 2008; Ghahari *et al.,* 2009; Shiran *et al.,* 2013; Pashaei Rad *et al.,* 2018). This is the first record from Chaharmahal Va Bakhtiari Province.

Camponotus sanctus Forel, 1904

Locality: 39.

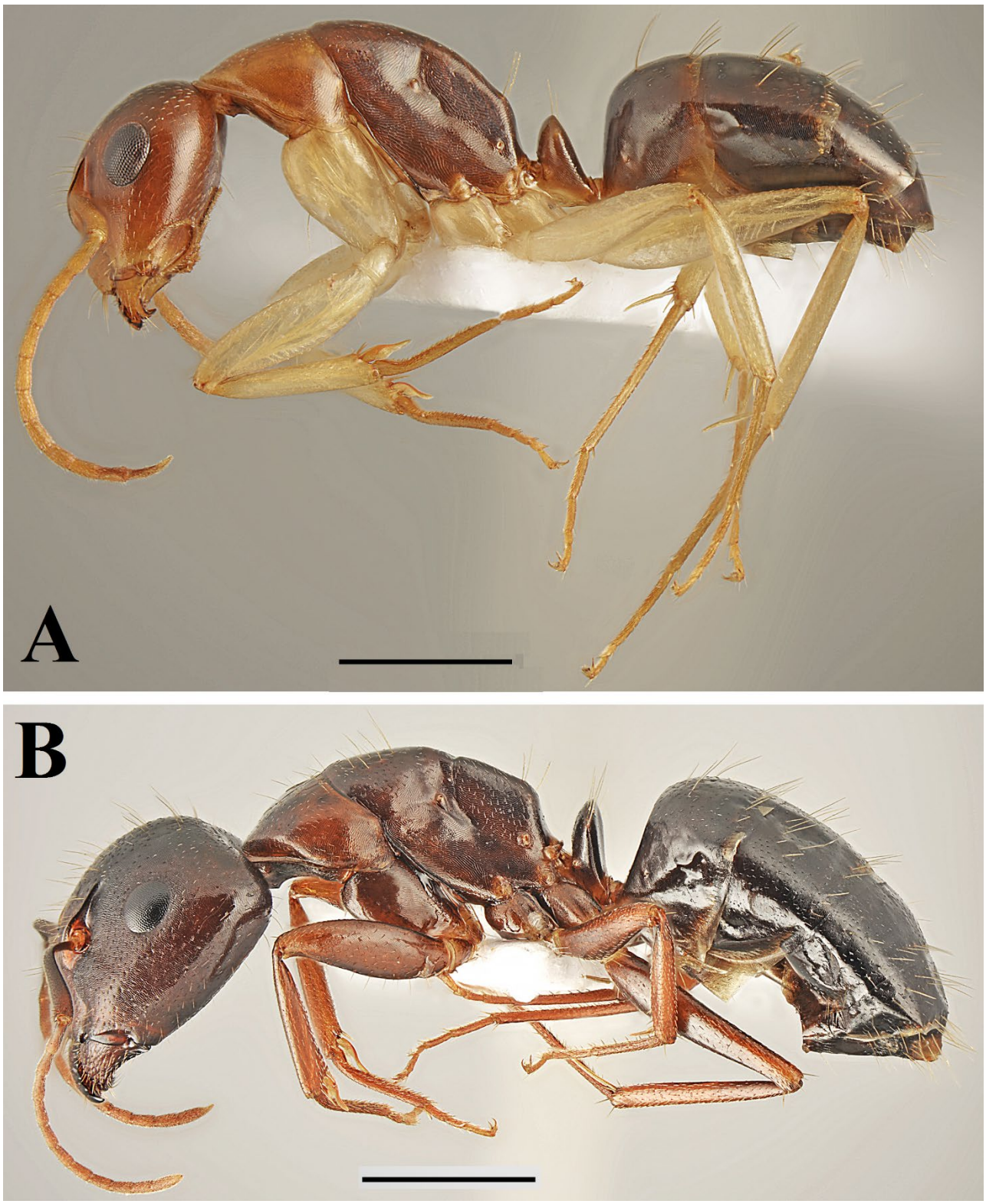

Fig. 2. *Camponotus jaliensis* Dalla Torre, 1893: A. minor worker, lateral view of the body; B. major worker, lateral view of the body (scale bar = 2 mm).

Note: This species was recorded from Iran without locality information (Paknia *et al.,* 2008), and detailed data come from Esfahan and Alborz Provinces (Pashaei Rad *et al.,* 2018). Our record is the first for Chaharmahal Va Bakhtiari Province (nest in oak forest).

Camponotus xerxes Forel, 1904

Localities: 30, 44, 45, 47, 48.

Note: This is a common species in Iran, and it is recorded in most provinces (Paknia *et al.,* 2008; Hosseini *et al.,* 2015; Ghahari *et al.,* 2009, 2015; Moradloo *et al.,* 2015; Pashaei Rad *et al.,* 2018; Khalili-Moghadam *et al.,* 2019).

Cardiocondyla persiana Seifert, 2003

Locality: 55.

Note: In Iran, this species was recorded only from Fars Province (Seifert, 2003; Pashaei Rad *et al.,* 2018) and is now reported for the first time from Esfahan Province. Outside Iran, it is known only from Georgia, Bahrain and Israel (Seifert, 2023), (nest under a willow tree in a green area).

Cataglyphis bazoftensis Khalili-Moghadam, Salata & Borowiec, 2021

Localities: 10, 35, 37, 38.

Note**:** This is a recently described species (Khalili-Moghadam *et al.,* 2021). Its workers were collected under stones inside a deciduous oak forest surrounded by a grazing area (Bazoft) and in the agricultural area: Ardal (Karoon 4) as a new record locality. It is probably a species endemic to Iran.

Cataglyphis bellicosa (Karavaiev, 1924)

Localities: 10, 35, 45, 55, 61, 63, 65.

Note: This is a rare species known only from Iran and Azerbaijan (Guénard *et al.,* 2017)**.** In Iran, it was reported from Tehran, Kurdistan, Lorestan, Qom, Alborz, Razavi Khorasan**,** Chaharmahal Va Bakhtiari provinces and central regions of Iran without locality information **(**Paknia *et al.,* 2008; Moradloo *et al.,* 2015; Pashaei Rad *et al.*, 2018; Mohseni & Pashaei Rad, 2019, 2021; Khalili-Moghadam *et al.,* 2019**).**

Cataglyphis dejdaranensis Khalili-Moghadam, Salata & Borowiec, 2021

Locality: 39.

Note**:** This is a recently described species (Khalili-Moghadam *et al.,* 2021). Nests were found on mountain pastures with scant vegetation. Its workers were collected under large stones. Collecting site was located on high altitude: 2348 m. It is probably a species endemic to Iran.

Cataglyphis fritillariae Khalili-Moghadam, Salata & Borowiec, 2021

Localities: 27, 34.

Note: This is a recently described species (Khalili-Moghadam *et al.,* 2021). Nests were found on mountain pastures with scant vegetation (Koohrang, Dejdaran valley) and in the agricultural area: Ardal (Bare morde). Its workers were collected under large stones. The collecting site was placed at a high altitude: 2306-2348 m. It is probably a species endemic to Iran.

Cataglyphis lirabiensis Khalili-Moghadam, Salata & Borowiec, 2023

Locality: 12.

Note: It is a recently described species (Khalili-Moghadam *et al.,* 2023b). Nests were found in the agricultural area. The collecting site was placed at a high altitude: 1948 m. It is probably endemic to Iran.

Cataglyphis livida (André, 1881)

Localities: 45, 63, 65.

Note: This is a common species in Iran, recorded from Tehran, Alborz, Fars, Mazandaran, Sistan & Baluchestan, Khuzestan, Kurdistan, Kermanshah, Ardabil, Qom, Esfahan and Zanjan Provinces **(**Paknia *et al.,* 2008; Ghahari *et al.,* 2009; Ghahari & Collingwood, 2011; Shiran *et al.,* 2013; Moradloo *et al.,* 2015; Pashaei Rad *et al.*, 2018; Mohseni & Pashaei Rad, 2019, 2021**).** Our record is first for Chaharmahal Va Bakhtiari Province.

Cataglyphis lutea Pisarski, 1967

Locality**: 6.**

Note: This is a rare species, known only from Iran, Iraq and Afghanistan (Guénard *et al.,* 2017). It was reported from Iran by Paknia *et al*. (2008) without locality information. Our report from Chaharmahal Va Bakhtiari Province is the first precisely located record (nest in the agricultural area).

Cataglyphis nigra (André, 1881)

Localities: 51, 59, 63.

Note: It is a common species in the Middle East (Guénard *et al.,* 2017). In Iran, it has been recorded from Tehran, Alborz, Fars, Khuzestan, Ardabil, Qom, Esfahan, and Hormozgan (Qeshm Island) Provinces (Paknia *et al.,* 2008; Rafinejad *et al.,* 2009; Ghahari & Collingwood, 2011; Pashaei Rad *et al.*, 2018; Mohseni & Pashaei Rad, 2019, 2021**).** This species is reported for the first time from Chaharmahal Va Bakhtiari Province.

Cataglyphis nodus (Brullé, 1833)

Localities: 1, 2, 3, 6, 11, 14, 18, 30, 33, 32, 39, 41, 43, 44, 47, 48, 54, 60, 65**.**

Note: It is a common species in the Middle East and Europe (Guénard *et al.,* 2017)**.** In Iran, it was reported from several parts **(**Paknia *et al.,* 2008; Shiran *et al.,* 2013; Mortazavi *et al.,* 2015; Pashaei Rad *et al.*, 2018; Khalili-Moghadam *et al.,* 2019).

Cataglyphis setipes (Forel, 1894)

Localities: 12, 36, 39.

Note: It is a common species in Iran, recorded from Tehran, Khuzestan, Razavi Khorasan, Ardabil, Chaharmahal Va Bakhtiari**,** Qom, and Lorestan Provinces **(**Paknia *et al.,* 2008; Ghahari & Collingwood, 2011; Ghahari *et al.,* 2015; Moradloo *et al.,* 2015; Pashaei Rad *et al.*, 2018; Khalili-Moghadam *et al.,* 2019; Mohseni & Pashaei Rad, 2019, 2021).

Cataglyphis shahrekordensis Khalili-Moghadam, Salata & Borowiec, 2023

Localities: 1, 5, 8, 12, 21, 26**,** 28, 41, 45, 48.

Note: This is a recently described species. Firstly, noted by Khalili-Moghadam et al., (2019) **from** Chaharmahal Va Bakhtiari Provinces under the name *Cataglyphis kurdistanica***.** But in a subsequent paper, Khalili-Moghadam *et al.* (2023) described it as a new species for science. Previous records of *Cataglyphis kurdistanica* from Ardabil**,** Esfahan, Lorestan, Zanjan, Kurdistan and Kohgiluyeh & Boyer-Ahmad Provinces (Paknia *et al.,* 2010; Moradloo *et al.,* 2015; Pashaei Rad *et al.*, 2018) should be verified because they may partly concern *Cataglyphis shahrekordensis.*

Formica clara Forel, 1886

Localities: 45, 48, 50, 55, 57.

Note: It is a common species in Europe and Asia **(**Guénard *et al.,* 2017), and it is known in Iran from Mazandaran, Guilan, Tehran, Razavi Khorasan, Chaharmahal Va Bakhtiari, and Esfahan Provinces (Paknia *et al.*, 2008**;** Moradloo *et al.*, 2015**;** Pashaei Rad *et al.*, 2018**;** Khalili-Moghadam *et al.*, 2019).

Lasius neglectus Van Loon, Boomsma & Andrasfalvy, 1990

Localities: 22, 29, 32, 43, 45, 48, 64.

Note: It is a common species. In Iran, it is known from Golestan, Mazandaran, Guilan and Chaharmahal Va Bakhtiari Provinces **(**Paknia & Kami, 2007; Ghahari *et al.*, 2009; Pashaei Rad *et al.*, 2018; Khalili-Moghadam *et al.*, 2019**).** This species is reported for the first time from Esfahan Province (nest in the agricultural area).

Lepisiota semenovi (Ruzsky, 1905)

Localities: 13, 22, 43, 45, 55, 57, 60, 63, 65.

Note: It is a widely distributed species but, with great probability, represents a complex of cryptic species. In Iran, it is known from Fars, Qom, Razavi Khorasan, Lorestan, Tehran, Hormozgan, and Chaharmahal Va Bakhtiari Provinces. This species is reported for the first time from Esfahan Province (Paknia *et al.*, 2008**;** Ghahari & Collingwood, 2013; Moradloo *et al.*, 2015; Pashaei Rad *et al.*, 2018; Khalili-Moghadam *et al.,* 2019).

Plagiolepis pallescens Forel, 1889

Localities: 1, 55.

Note: This species is known in Iran from Fars, Tehran, Alborz, Chaharmahal Va Bakhtiari, Ardabil, Esfahan, Khuzestan, Razavi Khorasan, Mazandaran, and East Azerbaijan Provinces (Paknia *et al.,* 2008**;** Shiran *et al.,* 2013; Mortazavi *et al.,* 2015; Pashaei Rad *et al.*, 2018; Khalili-Moghadam *et al.*, 2019)**.**

Plagiolepis perperamus Salata, Borowiec & Radchenko, 2018

Localities: 55, 57.

Note: This species is known only from Chaharmahal Va Bakhtiari and Khuzestan Provinces in Iran (Shiran *et al.,* 2013; Khalili-Moghadam *et al.,* 2019). It is reported for the first time from Esfahan Province.

Subfamily Myrmicinae Forel, 1878

Crematogaster sorokini Ruzsky, 1905

Locality: 63.

Note: It is a rare species, known only from Iran, Iraq, Kazakhstan, and Turkmenistan (Guénard *et al.,* 2017). In Iran, it was reported from Chaharmahal Va Bakhtiari, Kurdistan and Fars Provinces (Paknia *et al.*, 2008; Pashaei Rad *et al.*, 2018; Khalili-Moghadam *et al.*, 2019). This species is reported for the first time from Esfahan Province.

Crematogaster subdentata Mayr, 1877

Localities: 1, 22, 23, 30, 32, 43, 44, 45, 47, 55, 56, 60, 61, 62, 65.

Note: It is a common species in Iran, recorded from Alborz, Kerman, West Azerbaijan, Mazandaran, Fars, Tehran, Razavi Khorasan, Chaharmahal Va Bakhtiari and Lorestan, Esfahan Provinces (Paknia *et al.*, 2008; Ghahari *et al.*, 2009**;** 2011**,** 2015**;** Moradloo *et al.*, 2015; Mortazavi *et al.*, 2015; Pashaei Rad *et al.*, 2018; Khalili-Moghadam *et al.*, 2019**;** Farajollahzade *et al.*, 2022).

Messor caducus (Victor, 1839)

Localities: 1, 4, 5, 7, 11, 24, 25, 35, 36, 37, 45, 49.

Note: It was recorded from Fars, Tehran, Mazandaran, and Chaharmahal Va Bakhtiari Provinces (Paknia *et al.*, 2008; Ghahari *et al.,* 2009; Khalili-Moghadam *et al.,* 2019).

Messor incorruptus Kuznetsov-Ugamsky, 1929

Localities: 15.

Note: In Iran, it is known from the western part of the country without locality information and in detail from Chaharmahal Va Bakhtiari Provinces (Pashaei Rad *et al.*, 2018; Khalili-Moghadam *et al.,* 2019**).**

Messor intermedius Santschi, 1927

Localities: 63.

Note: In Iran, it was recorded from Chaharmahal Va Bakhtiari and Bushehr Provinces (Paknia *et al.*, 2008; Khalili-Moghadam *et al.,* 2019). This species is reported for the first time from Esfahan Province.

Messor mediosanguineus Donisthorpe, 1946

Localities: 16, 17.

Note: In Iran, it was reported only from Chaharmahal Va Bakhtiari Province (Khalili-Moghadam *et al.,* 2019).

Messor muticus (Nylander, 1849)

Localities: 32, 47, 55.

Note: This species was reported from the USSR and Europe (Guénard *et al.,* 2017). Alipanah *et al.* (1995) reported this species as a new record from Iran and later was reported again by Ghasemi *et al.* (2000). However, Paknia *et al.* (2008) excluded it from Iranian ant fauna based on rechecked materials and confirmed misidentification in previous studies. After that, Khalili-Moghadam & Saeidi (2023) recorded the species for the first time from Iran. This species is reported for the first time from Esfahan Province (nest in urban parks).

Messor platyceras Crawley, 1920

Localities: 4, 19, 30, 32, 38, 41, 45, 47, 48.

Note: This species was described from the Northwest of Iran, without locality information, and our data from Chaharmahal Va Bakhtiari Province are the first precisely located record (Crawley, 1920; Khalili-Moghadam *et al.,* 2019).

Messor subgracilinodis Arnoldi, 1970

Locality: 63.

Note: It is recorded only from three countries except Iran (China, Uzbekistan, and Turkmenistan) (Guénard *et al.,* 2017). In Iran, it was reported from Semnan, Yazd, and South Khorasan Provinces (Paknia *et al.*, 2010). This species is reported for the first time from Esfahan Province (nest in the protected area covered by *Artemisia* sp.), and is the second report from Iran.

Messor syriacus Tohmé 1969

Localities: 30, 31, 32, 42, 43, 45, 46, 47, 52, 53, 55, 59, 61, 65.

Note: It has been recorded from Syria, Turkey, Saudi Arabia, Iran, Iraq, Palestine, and Libya (Guénard *et al.,* 2017)**.** In Iran, it is known from Fars, Tehran, Kurdistan, and Chaharmahal Va Bakhtiari Provinces (Pashaei Rad *et al.*, 2018; Khalili-Moghadam *et al.*, 2019**).** This species is reported for the first time from Esfahan Province.

Messor variabilis Kuznetsov-Ugamsky, 1927

Locality: 20.

Note: It is a rare species, recorded from Iran, Kazakhstan, Uzbekistan, Afghanistan and Turkmenistan (Guénard *et al.,* 2017). In Iran, it is known from Golestan, Semnan and Chaharmahal Va Bakhtiari Provinces **(**Paknia *et al.,* 2010; Khalili-Moghadam *et al.*, 2019)**.**

Monomorium abeillei Andre, 1881

Localities: 23, 31, 32.

Note: In Iran, it was recorded from Fars, Hormozgan, Khuzestan, and Chaharmahal Va Bakhtiari Provinces (Paknia *et al.,* 2008; Ghahari & Collingwood, 2011; Khalili-Moghadam *et al.,* 2019**;** Farajollahzade *et al.*, 2022).

Monomorium bicolor Emery, 1877

Localities: 55, 65.

Note: In Iran, this species was recorded only from Bushehr Province (Ghahari & Collingwood, 2011)**.** This species is reported for the first time from Esfahan Province.

Monomorium pharaonis (Linnaeus, 1758)

Locality: 57.

Note: This is a cosmopolitan species (Guénard *et al.,* 2017). In Iran, it was recorded from Qom, Ilam, Kermanshah, Lorestan, West Azerbaijan, Mazandaran and Bushehr Provinces (Paknia *et al.,* 2008; Ghahari *et al.,* 2009; Ghahari & Collingwood**,** 2013**;** Mohseni & Pashaei Rad, 2019, 2021). This species is reported for the first time from Esfahan Province.

Pheidole indica Mayr, 1879

Localities: 52, 56, 58.

Note: In Iran, this subcosmopolitian species was recorded from Khuzestan, Esfahan, Fars, Tehran, Alborz and Qom Provinces under the name *Pheidole teneriffana* Forel, 1893 (Paknia *et al.,* 2008; Ghahari & Collingwood, 2011**;** Shiran *et al.,* 2013; Mohseni & Pashaei Rad, 2019, 2021).

Pheidole koshewnikovi Ruzsky, 1905

Localities: 23, 31, 34, 38, 43, 45, 47, 65.

Note: This species is known only from Chaharmahal Va Bakhtiari and Fars Provinces in Iran (Pashaei Rad *et al.*, 2018; Khalili-Moghadam *et al.*, 2019). It is reported for the first time from Esfahan Province.

Tetramorium immigrans Santschi, 1927

Localities: 45, 55, 58.

Note: In Iran, this subcosmopolitan species is known only from West Azerbaijan Province (Samin *et al.,* 2020**)**. Our records are first for Esfahan and Chaharmahal Va Bakhtiari Provinces.

Tetramorium indocile Santschi, 1927

Localities: 43, 55.

Note: This species is known from Esfahan, Fars and Chaharmahal Va Bakhtiari Provinces in Iran (Pashaei Rad *et al.,* 2018; Farajollahzade *et al.,* 2022; Khalili-Moghadam & Saeidi, 2023), but is probably widespread and not distinguished from other species of the *T. caespitum* (Linnaeus, 1758) complex in previous studies.

Tetramorium schneideri Emery, 1898

Locality: 63.

Note: This species is known only from Golestan Province, in Iran (Paknia *et al.,* 2010). Our record is the first report from Esfahan Province.

Tetramorium staerckei Kratochvíl, 1944

Locality: 64.

Note: This species was recorded from Kyrgyzstan, Russia, Turkey, Romania, Bulgaria, Serbia, Macedonia, Hungary, Slovakia, Austria and Czech Republic (Guénard *et al.,* 2017). It is reported for the first time from Iran. The nest was observed in the agricultural area.

Morphological characters (worker): This species is rather larger than other members of *Tetramorium caespitum* complex. Body color dark brown to blackish, general surface appearance on average dull compared with other species; head, mesosoma, petiole, and postpetiole surface coarsely sculptured (Fig. 3); head dorsum and occiput with longitudinal costae and costulae. Postoculo-temporal area of head with many costae and costulae (Fig. 3). Dorsum of mesosoma longitudinally rugulose, lateral side of propodeum with strongest sculpture of complex. Dorsum of petiolar with sculpture or smooth; Connected stickman-like or reticulate microsculpture: moderate-sized units scattered over 1st gastral tergite; Some workers with long c-shaped, crinkly, or sinuous hairs on ventral head posterior to buccal cavity; Promesonotal dorsum convex, metanotal groove shallow (Wagner *et al*., 2017) (Fig. 3).

In Iran, this species is similar to *T. indocile* and *T. immigrans* but differs from the second species based on some characters: 1) *T. staerckei* is smaller than *T. immigrans,* 2) reticulate microsculpture on first gastral tergite is moderate in *T. staerckei* but pronounced in *T. immigrans*, 3) distance between antennal fossae in *T. staerckei* is larger than *T. immigrans*, 4) in *T. staerckei* mesosoma is longer than *T. immigrans*. Also *T. indocile* is separated from *T. staerckei* based on smaller size [vs. larger in *T. staerckei*], general appearance smooth and shiny [vs. dull in *T. staerckei*], small reticulate microsculpture on first gastral tergite [vs. moderate in *T. staerckei*], postoculo-temporal area of head with rather few longitudinal costae and costulae [vs. with many longitudinal costae and costulae in *T. staerckei*].

Fig. 3. *Tetramorium staerckei* Kratochvíl, 1944 (worker) lateral view of the body (scale bar = 0.5 mm).

Discussion

Based on the first comprehensive checklist of the Iranian ant fauna provided by Paknia *et al.,* (2008), 110 species belonging to 26 genera and six subfamilies have been recorded from different regions of Iran and this number undoubtedly stimulated further faunistic research. Currently, approximately 320 ant species and subspecies are

known from the country (Guénard *et al.,* 2017), but some of the literature records seem unreliable. For example, Alipanah *et al.* (1995) and Ghasemi *et al.,* (2000) reported *Messor muticus* as a new record from Iran, whereas Paknia *et al.* (2008) excluded it from the Iranian ant fauna based on rechecked materials and confirmed misidentification in previous studies. Afterwards, Khalili-Moghadam & Saeidi (2023) recorded this species for the first time from Iran. Studies on the biodiversity of Iranian ants are mainly hampered by the lack of modern keys for the identification of ants from the Middle East and the taxonomic challenges associated with many ant genera. For example, some species that, in the light of recent discoveries, certainly do not occur in this country are listed in some faunistic inventories of Iranian ants. Many of the foregoing come from habitats entirely different from those found in Iran or from geographical locations far distant from Iran. For example, *Linepithema humile* Meyr, 1868 which was reported from Mazandaran (Ghahari *et al.*, 2009) is native to South America (Guénard et al., 2017) and could be an erroneous record. On the other hand, recent taxonomic studies revealed hidden and undescribed biodiversity of such genera as *Cataglyphis*, *Camponotus*, *Tetramorium* and *Emeryopone* confirming the high biodiversity of Iranian ants (Radchenko & Paknia, 2010; Khalili-Moghadam *et al.,* 2021, 2023a, b; Salata *et al.,* 2020, 2021, 2024).

Although Esfahan is a large province (106786 km²) with different climate and plant cover, 33% of which is desert and some parts are mountainous, the ant fauna in the province isn't well known. Only 28 ant species belonging to 11 genera and three subfamilies (Formicinae, Myrmicinae and Dolichoderinae) were reported from this province. Considering that, these reports has been obtained from sparse studies (Paknia *et al.,* 2010; Shiran *et al.,* 2013; Pashaei Rad *et al.,* 2018; Pashaei Rad & Iravani, 2022; Salata *et al.,* 2024). Furthermore, the result of the current study, which reports fifteen species as new for Esfahan ant fauna, is another prove that this province is poorly explored. Most probably, the exact number of ants occurring in Esfahan Province is still unknown and expected to increase with future faunistic surveys and taxonomic revisions.

Although Chaharmahal Va Bakhtiari Province is much smaller (16421 km²) than Esfahan Province, in comparison, the ant fauna of this province has been better studied. Another reason of its high species richness could be the existence of some biosphere reserves, such as Tang-e Sayyad and Sabz Kouh in Chaharmahal Va Bakhtiari Province, which is a biodiversity hotspot known for its rich fauna and flora. Moreover, describing seven new species for science (five species of *Cataglyphis* and one species of *Camponotus* and *Tetramorium*) from this province in recent years (Khalili-Moghadam *et al.,* 2021, 2023a; Salata *et al.,* 2020, 2024), most likely, implies that the number of recorded ants occurring in this province will increase. Surprisingly, till 2019, no species of ants (at level of species) were reported from Chaharmahal Va Bakhtiari province. However, few ants were collected without precise species identification (Babaeian *et al.,* 2014). After that, 40 ant species belonging to 14 genera and four subfamilies (Formicinae, Myrmicinae, Dolichoderinae and Ponerinae) were reported from different parts of this province (Khalili-Moghadam *et al.,* 2109, 2021, 2023a, b; Khalili-Moghadam, 2021; Khalili-Moghadam & Saeidi, 2023; Salata *et al.,* 2020, 2024). According to result of the current study, six new provincial records, the number of recorded ants in Chaharmahal Va Bakhtiari Province up to 46 species till now.

Overall, Iran with 11 climate types is very diverse in climate, ranging from arid and semi-arid to subtropical along the Caspian coast and the northern forests (Hedayatnia & Van Den Bossche, 2020). Although there are forest steppe and woodlands in some parts of the country, especially in the West and North, overall, most part of Iran is arid (Heshmati, 2007). The arid and semi-arid ecosystems are the optimum habitat for desert ants (*Cataglyphis*) which are the most conspicuous and characteristic ants of arid and semiarid zones of the Palearctic (Amor & Ortega, 2014). So far, there are as many as 38 species of this genus recorded from Iran (as a hot spot of this genus), and the number constitutes 35% of all known *Cataglyphis* species (Khalili-Moghadam *et al.,* 2021, 2023). That was confirmed in this study (with 11 species). Thus, the exact number of ant taxa occurring in Iran is still unknown and is expected to increase with upcoming faunistic surveys and taxonomic revisions.

Author's Contributions

Arsalan Khalili-Moghadam: methodology, formal analysis, investigation, draft preparation, final review and edit, visualization, supervision, project administration and funding acquisition. **Lech Borowiec** & **Sebastian Salata**: confirmed identification, references data, draft additions and corrections, photos preparation.)

Author's Information

Arsalan Khalili-Moghadam	✉ arsalan.khalili@gmail.com	https://orcid.org/0000-0002-5806-1207
Sebastian Salata	✉ sebastian.salata@uwr.edu.pl	https://orcid.org/0000-0003-0811-2309
Lech Borowiec	✉ lech.borowiec@uwr.edu.pl	https://orcid.org/0000-0001-5668-6855

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Data Availability Statement

The specimens examined in this study are deposited in the following institutions: Museum of Natural History, University of Wroclaw, Poland (MNHW) and Entomological Laboratory, Plant Protection Department, Agriculture College, Shahrekord University, Iran (EPAS), and are available by the curator upon request.

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Ethics Approval

Insects were used in this study. All applicable international, national, and institutional guide lines for the care and use of animals were followed. This article does not contain any studies with human participants performed by any of the authors.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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یادداشت هایی درباره فون مورچه های (Hymenoptera: Formicidae) ایران (قسمت اول)

ارسلان خلیلی‌مقدم [۱،۲] ، سباستین سالاتا [۳] و لخ برووِیچ [۳]

۱- گروه گیاهپزشکی، دانشکده کشاورزی، دانشگاه شهرکرد، شهرکرد، ایران

۲- پژوهشکده زیست فناوری، دانشگاه شهرکرد، شهرکرد، ایران

۳- گروه، تنوع زیستی دانشگاه ورسلاو، ورسلاو، لهستان

چکیده: مورچه ها اجزای جدایی ناپذیر اکوسیستم‌های زمینی هستند و تنوع آنها برای عملکرد و نگهداری بسیاری از اکوسیستم‌ها حیاتی است. هدف این تحقیق شناسایی نمونه‌های جمع‌آوری شده از زیستگاه‌ها و مکان‌های مختلف در استان‌های اصفهان و چهارمحال و بختیاری بود. برای جمع‌آوری از روش نمونه‌برداری مستقیم (جمع‌آوری دستی) استفاده شد. تمام نمونه‌ها در اتانول ۷۵ درصد نگهداری شدند. در نتیجه فهرستی از ۴۲ گونه مورچه متعلق به ۱۳ جنس از سه زیرخانواده که از ۶۶ محل نمونه‌برداری در استان های چهارمحال و بختیاری و اصفهان جمع آوری شده ارائه می‌شود. دو گونه *Camponotus jaliensis* Dalla Torre, 1893 و *Tetramorium staerckei* Kratochvíl, 1944 برای اولین بار از ایران گزارش شده است. همچنین به ترتیب پانزده و شش گونه برای نخستین بار از استان‌های اصفهان و چهارمحال و بختیاری گزارش شده است. نتایج نشانگر آن است که فون مورچه‌های ایران غنی است و نیازمند مطالعات فونستیک بیشتر است.

کلمات کلیدی: مورچه‌ها، اصفهان، چهارمحال و بختیاری، فونستیک، رکورد جدید

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نویسنده مسئول: ارسلان خلیلی مقدم

ایمیل: arsalan.khalili@gmail.com

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