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Addition to Iranian Springtails fauna and a checklist of the Collembola from Kurdistan province

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ABSTRACT. The study was conducted in oak forests and the conifer stands in Marivan county located in west of Kurdistan province. The leaf litter and soils samples from these forests were taken during 2016 to 2019 and specimens were extracted by the Berlese funnels. Results of the study led to identification of 39 species of 11 families. The three genera *Doutnacia* Rusek, 1974 (Tullbergiidae), *Heterosminthurus* Stach, 1955 (Bourletiellidae) and *Calx* Christiansen, 1958 (Entomobryidae) and eight species including *Willemia virae* Kapruś, 1997, *Xenylla tullbergi* Börner, 1903 (Hypogastruridae), *Axenyllodes caecus* (Gisin, 1952) (Odontellidae), *Thalassaphorura franzi* (Stach, 1946) (Onychiuridae), *Doutnacia xerophila* Rusek, 1974 (Tullbergiidae), *Calx kailashi* Mandal, 2018, *Seira dori* Gruia, Poliakov & Broza, 2000 (Entomobryidae) and *Heterosminthurus insignis* (Reuter, 1876) (Bourletiellidae) are new for Iranian fauna. All species from the present study are reported for the first time from Kurdistan province. Short explanation of each collected species including material examined, distribution and short description and illustration for the new records are given.

Key words: Springtails, northwestern Iran, distribution, new record, checklist

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INTRODUCTION

Collembola (springtails) are widespread and abundant soil living micro-arthropods, which are small (0.12–10 mm), entognathous (mouthparts located within a gnathal pouch), wingless hexapods with antennae always present (Hopkin, 1997). Most but not all Collembola may be recognised by a posterior

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ventral forked abdominal appendage, the furca. They are a very old taxon; indirect fossils date Collembola back to 412 million years suggesting that Collembola were an important component of the earliest terrestrial ecosystems (Hopkin, 1997; Chahartaghi et al., 2005). Collembola are frequently found in leaf litter and other decaying material, where they are primarily detritivores and microbivores (Ponge, 1991; Guzik et al., 2021). Most species are beneficial and only a few species are pests on crops (Hopkin, 1997; Chahartaghi et al., 2005). Collembola play an important role in decomposition processes, nutrient cycling, forming soil microstructures and modifying plant growth, and thus received considerable attention (Petersen, 2002; Filser et al., 2002). There are 9000 published species worldwide (Bellinger et al., 1996–2022) and Iran's share of this number is only 232 species (Shayanmehr et al., 2020). However, the Collembola fauna in many parts of Iran including the province of Kurdistan has not yet been investigated. From western Iran provinces, 88 species were published which were mainly from Kermanshah and Ilam provinces (Shayanmehr et al., 2020; Kahrarian et al., 2016; Kahrarian, 2019).

The province of Kurdistan is 28,817 km² in area. It is located in the west of Iran bound by Iraqi Kurdistan on the west, the provinces of West Azerbaijan to the north, Zajan to the northeast, Hamedan to the east and Kermanshah to the south (Jazirehi & Ebrahimi, 2003). The province contains different ecosystems which the most prominent of which is the oak forests of Zagros. The Zagros forests cover a vast area of the Zagros mountain ranges stretching from Piranshahr (Western Azerbaijan province) in the northwest of Iran to the vicinity of Firooz-Abad (Fars province), having an average length and width of 1300 km and 200 km, respectively (Sagheb-Talebi et al, 2004; Jazirehi & Ebrahimi, 2003). These forests cover approximately an area of 5 million ha, and because of dominancy of species of oak genus, these forests are called as western oak forests (Sagheb-Talebi et al, 2004). These forest probably harbored rich fauna of Collembola. In order to extend the work on Iranian Collembola fauna, several sampling were collected from the oak forests and the conifer stands of Marivan county as one of Major County in Kurdistan province (west of Iran).

MATERIAL AND METHODS

The sampling was conducted during 2016 and 2019 in oak forests and the conifer stands which is caused by change of the untouched oak forest of Marivan county in the west of Kurdistan province, Iran (Fig. 1). The mountainous forests, with an area of around 300000 ha account 21% of the Zagros forest in west of Iran (Haidari et al, 2012; Sagheb-Talebi et al, 2004). The oak forest has semi-humid climate by almost 800 mm (Sadeghi et al., 2017). Therefore, these forests are considered semi-arid and dry forests (Jazirehi & Ebrahimi, 2003; Sagheb-Talebi et al, 2004). The other main tree species in the mentioned forest include *Pistacia mutica* (wild pistachio), *Crataegus* spp. and *Pyrus* spp. (Jazirehi & Ebrahimi, 2003). The Herbaceous layer is richness and the main families include Apiaceae, Asteraceae, Boraginaceae, Brassicaceae, Caryophyllaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Poaceae, Orchidaceae, Rosaceae and Rubiaceae (Shakeri et al, 2021). Several samples were taken from soil and leaf litter in different habitats within two sampling sites of Marivan County. The specimens were excreted from the collected samples of soil and leaf litter using a Berlese funnel. Before sorting, the collected specimens were preserved in 85% alcohol. The specimens were cleared using potassium hydroxide (KOH) for 3–5 minutes and then they were mounted by use of the Hoyer medium. Finally, they were studied using Nikon Eclipse 100 microscope and Olympus BX-51 microscope. The determination of Collembola was carried out using modern identification keys and cite the electronic resource where they are given (Bellinger et al., 1996–2022). Photos of specimens and characters on the body were obtained by camera fixed on Nikon Eclipse 600 microscope by resolution of 10X to 40X. The material was measured using a micrometer eyepiece. Microscopic slides and specimens preserved in alcohol were maintained in the laboratory of Sari University of Agricultural Sciences and Natural Resources (SARU) and main portion of material of the studied species is housed in the State Natural History Museum, Ukrainian National Academy of Sciences in L'viv.

Figure 1. The map of sampling area, oak forests and the conifer stands of Marivan County in west of Kurdistan province, Iran. The asterisk (*) indicate the sampling locations.

RESULTS

The results of identification of Collembola fauna in Marivan County in west of Kurdistan province leads to introducing 39 species belonging to 25 genera from 11 families. Three genera and eight species are new for Iranian fauna. All the species are new for Kurdistan province. The species list and their sampling information and for new Iranian records (*) also description and some illustrations are given.

Taxonomic hierarchy

Phylum Arthropoda von Siebold, 1848

Class Collembola Lubbock, 1871

Order Poduromorpha Börner, 1913

Family Hypogastruridae Börner, 1906

Genus *Hypogastrura* Bourlet, 1839

***Hypogastrura vernalis* (Carl, 1901)**

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47"N, 46°50'50"E, 1335 m, 5.VI., 27.VI., and 1.VIII.2016, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-

Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V., 5.VI., 27.VI., 1.VIII., 27.VIII., and 23.IX.2016, soil and leaf litter under oak and cypress trees, soil in outside the oak trees.

Distribution. Cosmopolitan (Bellinger et al., 1996–2022), Iran - Kohgiluyeh and Boyer Ahmad, Mazandaran, Tehran (Shayanmehr et al., 2020), and Kurdistan (new record) provinces.

Genus *Willemia* Börner, 1901

Willemia virae Kapruś, 1997*

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V.2016, soil and leaf litter under oak trees.

Distribution. Until now, this species was known only from caves in the Carpathians (Ukraine, Poland, and Slovak Republic) and from mixed forests in Crimean Mountains (Ukraine) (Skarżyński & Smolis, 2002; Kapruś, unpublished data), Iran (**New record**).

Genus *Xenylla* Tullberg, 1869

Xenylla tullbergi Börner, 1903*

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 15.V., and 15.VI.2019, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 15.V., and 15.VI.2019, soil and leaf litter under oak and cypress trees, soil in outside the oak trees.

Distribution. Biogeographic regions for this species: Europe, Mediterranean, Caribbean mainland (Bellinger et al., 1996–2022), Iran (**New record**).

Family Neanuridae Börner, 1901

Genus *Pseudachorutes* Tullberg, 1871

Pseudachorutes corticicolus (Schäffer, 1897)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 15.V.2019, soil and leaf litter under oak trees.

Distribution. Arctic & Sub-arctic, Europe, Himalayan, Mediterranean, American, Caribbean mainland (Bellinger et al., 1996–2022), Iran - Mazandaran (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Pseudachorutes kurdistanicus Kapruś, Shayanmehr & Ghobari, 2022

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 15.V.2019, soil and leaf litter under oak trees.

Distribution. Until now, the species was known only from locus typicus: Iran, Kurdistan province, Marivan-Pirsafa, oak forest (Shayanmehr et al., 2022).

Family Odontellidae Massoud, 1967

Genus *Axenyllodes* Stach, 1949

Axenyllodes caecus (Gisin, 1952)* (Fig. 2)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 5.VI., and 27.VI.2016, soil and leaf litter under oak trees.

Distribution. Europe (Bellinger et al., 1996–2022), Iran (**New record**).

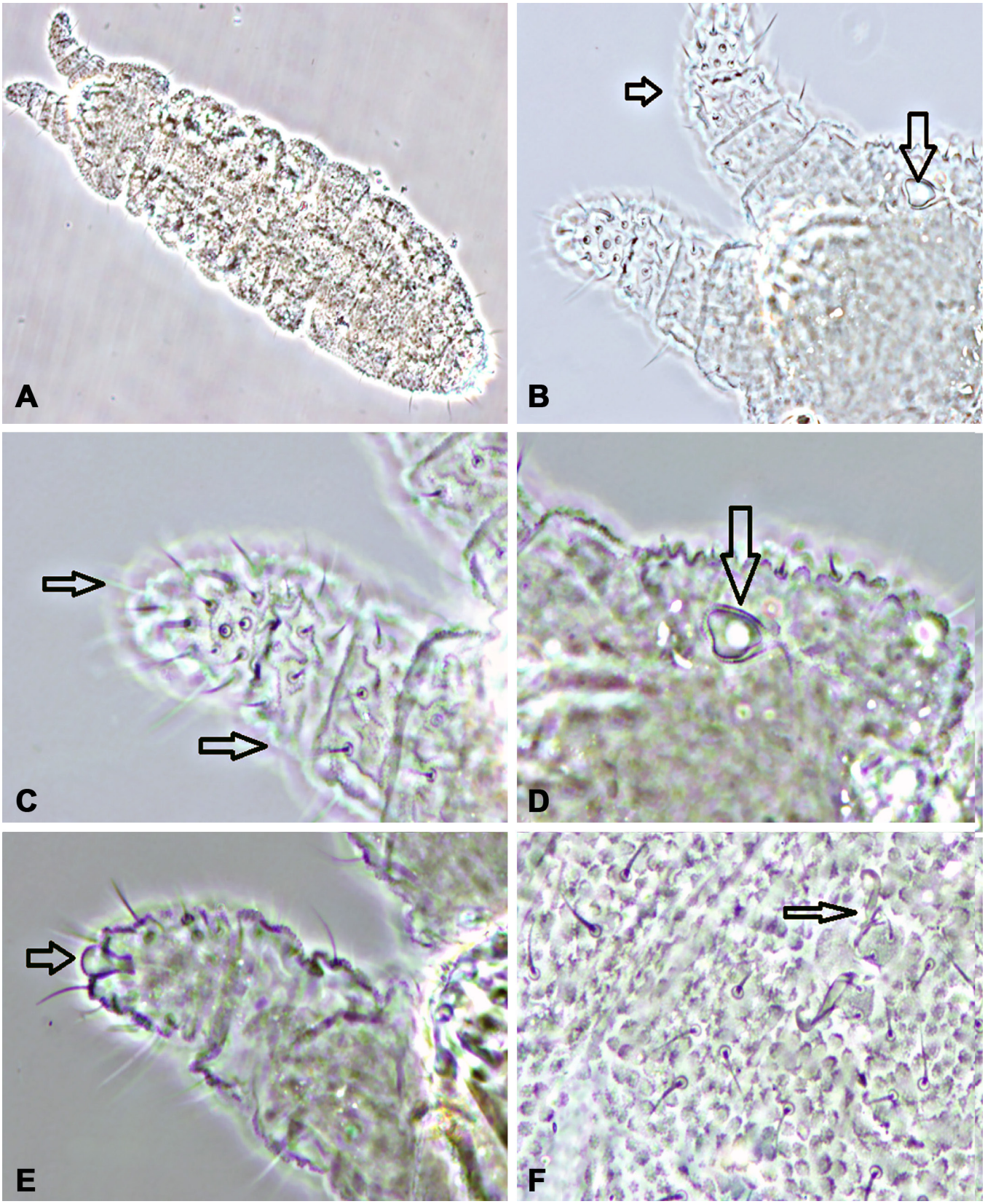

Figure 2. *Axenyllodes caecus* (Gisin, 1952). **A.** Shape of the body or general view (40x); **B.** Head with PAO and AIIIO (100x); **C.** Dorsal side of antennal segments with sensory organ of antennal segment III and sensilla of antennal segment IV (100x); **D.** Post antennal organ (PAO) (100x); **E.** Apical vesicle of antennal segment IV (100x); **F.** Chaetotaxy of central part of abdominal sternum IV with furca (100x).

Family Onychiuridae Lubbock, 1871

Genus *Protaphorura* Absolon, 1901

Protaphorura levantina (Christiansen, 1956)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V., 5.VI., 27.VI.2016 and 15.V.2019, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V., and 1.VIII.2016, soil and leaf litter under oak and cypress trees, soil in outside the oak trees and farmland.

Distribution. West and Central Asia, Mediterranean (Bellinger et al., 1996–2022), Iran – Golestan, Kermanshah (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Genus *Thalassaphorura* Bagnall, 1949

Thalassaphorura franzi (Stach, 1946)* (Fig. 3)

Material examined. Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V., 5.VI.2016 and 15.V.2019, soil and leaf litter under oak and cypress trees, soil in outside the oak trees and farmland.

Distribution. Until now, the species was known only from mountaneous regions of Austria, Italy and Turkey (Kapruś & Weiner, 1994), Iran (**New record**).

Thalassaphorura zschokkei (Handschin, 1919) sensu Pomorski, 1998

Material examined. Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V., 5.VI., 1.VIII.2016 and 15.VI.2019, soil and leaf litter under oak and cypress trees.

Distribution. Until now, the species was known only from South Europe, Israel and Iran (Kapruś & Paśnik, 2017), Iran – Kermanshah, Lorestan (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Family Tullbergiidae Bagnall, 1935

Genus *Doutnacia* Rusek, 1974*

Doutnacia xerophila Rusek, 1974* (Fig. 4)

Material examined. Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V.2016, soil and leaf litter under oak trees.

Distribution. Europe, Mediterranean, Antillean & S. Florida (Bellinger et al., 1996–2022), Iran (**New record**).

Genus *Mesaphorura* Börner, 1901

Mesaphorura yosii (Rusek, 1967)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V.2016 and 15.V.2019, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V.2016, soil and leaf litter under oak trees.

Distribution. Cosmopolitan (Bellinger et al., 1996–2022), Iran - Golestan (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Mesaphorura italica (Rusek, 1971)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 5.VI.2016, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V.2016, soil and leaf litter under oak trees and farmland soil.

Distribution. Holarctic (Bellinger et al., 1996–2022), Iran - Kermanshah (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

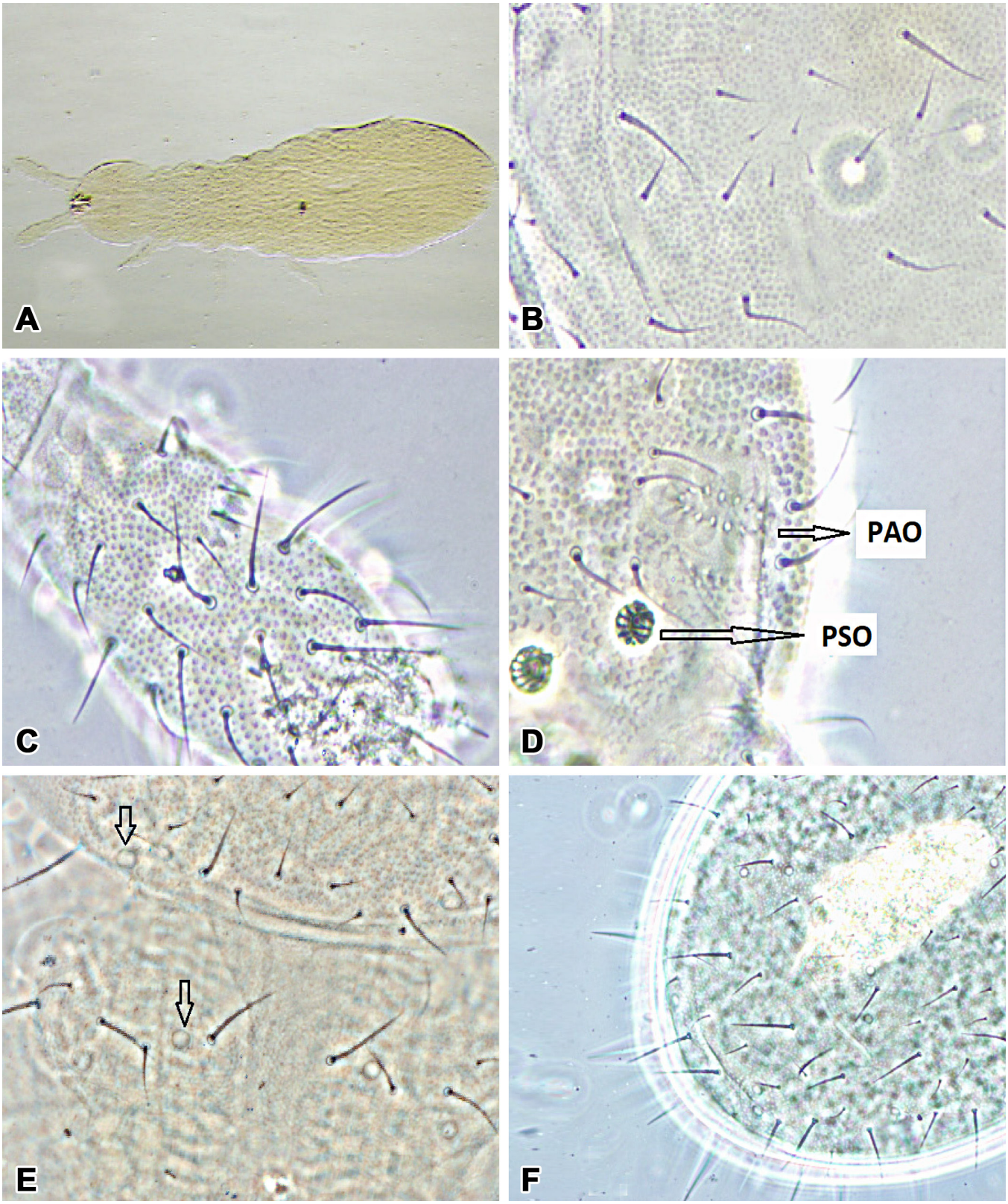

Figure 3. *Thalassaphorura franzi* (Stach, 1946). **A.** Shape of the body or general view (40x); **B.** Central part of abdominal sternum IV with chaetotaxy of manubrial field (100x); **C.** Dorsal side of antennal segments III and IV with sensory organ of antennal segment III (AIIIO) (100x); **D.** Postantennal organ (PAO) and anterior cephalic pseudocelli (a pso) (100); **E.** Posterior cephalic pseudocelli (p pso) and thoracic tergum I (Th I) (100x); **F.** Chaetotaxy of abdominal terga III-VI (100x).

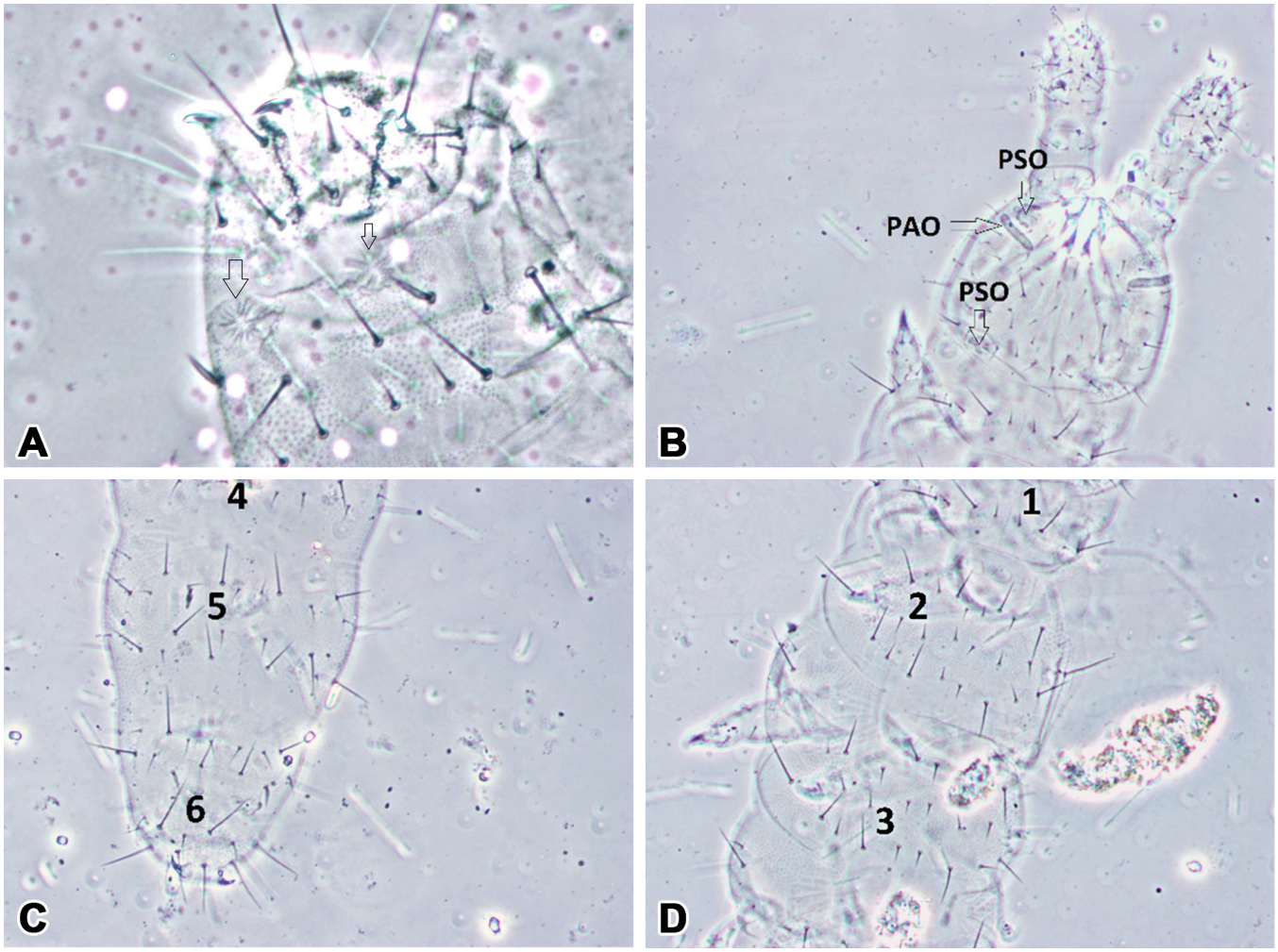

Figure 4. *Doutnacia xerophila* Rusek, 1974. **A.** Abdominal terga V-VI with pso, sensilla and claws (100x); **B.** Head and thoracic terga I with AIIIO, PAO and posterior cephalic pseudocelli (100x); **C.** Chaetotaxy of abdominal terga IV-VI (100x); **D.** Chaetotaxy of thoracic terga I-III (100x).

Genus *Metaphorura* Stach, 1954

Metaphorura riozoi Castaño-Meneses, Palacios-Vargas & Traser, 2000

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V., and 5.VI.2016, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V., 5.VI., and 1.VIII.2016, soil and leaf litter under oak and cypress trees and soil in farmland.

Distribution. Palaearctic (Bellinger et al., 1996–2022), Iran - Ilam (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Order Entomobryomorpha Börner, 1913

Family Isotomidae Schäffer, 1896

Genus *Folsomides* Stach, 1922

Folsomides angularis (Axelson, 1905)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V.2016, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak

forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V., and 5.VI.2016, soil and leaf litter under oak and cypress trees, soil in outside the oak tress and farmland.

Distribution. Holarctic, widely distributed species (Potapov, 2001; Bellinger et al., 1996–2022), Iran – Kermanshah, Guilan (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Folsomides halshinicus Arbea & Kahrarian, 2015

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V.2016, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V., and 5.VI.2016, soil and leaf litter under cypress trees and soil in outside the oak trees.

Distribution. Until now, this species was known only from locus typicus: Western Iran - Kermanshah province (Arbea & Kahrarian, 2015), and Kurdistan (New record) provinces.

Folsomides parvulus Stach, 1922

Material examined. Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V.2016, soil and leaf litter under cypress trees.

Distribution. Cosmopolitan, very common in tropics (Potapov, 2001; Bellinger et al., 1996–2022), Iran - Mazandaran, East Azarbaijan, Golestan, Guilan, Kermanshah, Lorestan, Tehran, West Azarbaijan (Shayanmehr et al., 2020), and Kurdistan (New record), provinces.

Folsomides marchicus (Frenzel, 1941)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V.2016, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75”N, 46°18'2.69"E, 1335 m, 5.VI.2016, soil and leaf litter under cypress trees.

Distribution. Europe, West & Central Asia, Mediterranean, North America, Caribbean mainland (Bellinger et al., 1996–2022), Iran - Kermanshah and Lorestan provinces (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Genus *Folsomia* Willem, 1902

Folsomia quadrioculata (Tullberg, 1871)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V.2016, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V.2016, soil and leaf litter under cypress trees.

Distribution. Widely distributed Holarctic species (Potapov, 2001; Bellinger et al., 1996–2022), Iran - East Azarbaijan, Guilan, Kermanshah, Lorestan, Markazi, Mazandaran, West Azarbaijan, Tehran (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Folsomia candida Willem, 1902

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 15.V.2019, soil and leaf litter under oak trees.

Distribution. Cosmopolitan (Potapov, 2001; Bellinger et al., 1996–2022), Iran - East Azarbaijan, Guilan, Markazi, Mazandaran, Tehran (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Folsomia manolachei Bagnall, 1939

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 15.V.2019, soil and leaf litter under oak trees.

Distribution. Probably Palaearctic species (Potapov, 2001; Bellinger et al., 1996–2022), Iran - Kermanshah (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Folsomia penicula Bagnall, 1939

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 15.V.2019, soil and leaf litter under oak trees.

Distribution. Palearctic and Northern Holarctic species (Potapov, 2001; Bellinger et al., 1996–2022), Iran - East Azerbaijan, Golestan, Guilan, Kermanshah, Markazi, Mazandaran, Tehran (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Genus *Desoria* Nicolet 1841

Desoria neglecta (Schäffer 1900)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 15.V.2019, soil and leaf litter under oak trees.

Distribution. Widely distributed in northern areas of the Holarctic, Arctic and Subarctic, Europe (Bellinger et al., 1996–2022), Iran - Lorestan (Shayanmehr et al., 2020) and Kurdistan (New record) provinces.

Genus *Hemisotoma* Bagnall, 1949

Hemisotoma pontica (Stach, 1947)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V.2016, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75”N, 46°18'2.69"E, 1335 m, 13.V., and 5.VI.2016, soil and leaf litter under oak and cypress trees and soil in outside the oak trees.

Distribution. Europe, West & Central Asia, Mediterranean (Bellinger et al., 1996–2022), Iran – Kermanshah, Mazandaran (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Hemisotoma quadrioculata (Martynova, 1967)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 15.V.2019, soil and leaf litter under oak trees.

Distribution. Until now this species is known only from type locality in Tajikistan and Iran (Ilam - (Bellinger et al., 1996–2022; Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Genus *Isotoma* Bourlet, 1839

Isotoma viridis Bourlet, 1839

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V.2016, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75”N, 46°18'2.69"E, 1335 m, 13.V.2016, soil and leaf litter under cypress trees.

Distribution. Holarctic (Bellinger et al., 1996–2022; Potapov, 2001), Iran - Central, East Azerbaijan, Golestan, Kermanshah, Mazandaran, West Azerbaijan (Shayanmehr et al., 2020) and Kurdistan (New record) provinces.

Genus *Isotomiella* Bagnall, 1939

Isotomiella minor (Schäffer, 1896)

Material examined. Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V.2016, soil and leaf litter under cypress trees.

Distribution. Cosmopolitan (Bellinger et al., 1996–2022; Potapov, 2001), Iran - East Azerbaijan, Golestan, Guilan, Kermanshah, Lorestan, Mazandaran, Tehran (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Genus *Parisotoma* Bagnall, 1940

Parisotoma notabilis (Schäffer, 1896)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V.2016 and 15.V.2019, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75”N, 46°18'2.69"E, 1335 m, 13.V., 05.VI.2016 and 15.VI.2019 , soil and leaf litter under oak and cypress trees.

Distribution. Cosmopolitan (Bellinger et al., 1996–2022; Potapov, 2001), Iran - East Azarbaijan, Golestan, Guilan, Kerman, Kermanshah, Khuzestan, Markazi, Mazandaran, Tehran, West Azarbaijan, Zanjan (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Family Paronellidae Börner, 1906

Genus *Cyphoderus* Nicolet, 1842

Cyphoderus albinus Nicolet, 1842

Material examined. Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V.2016, soil in outside the oak trees.

Distribution. Europe, North Eurasia, West & Central Asia, Mediterranean, Macaronesian, Indian (Bellinger et al., 1996–2022), Iran - Guilan, Isfahan, Kermanshah, Mazandaran, Tehran (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Family Entomobryidae Schäffer, 1896

Genus *Calx* Christiansen, 1958*

Calx kailashi Mandal, 2018 (Fig. 5)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 5.VI.2016, soil and leaf litter under oak trees.

Distribution. Indian (Bellinger et al., 1996–2022), Iran (**new record**).

Genus *Entomobrya* Rondani, 1861

Entomobrya multifasciata (Tullberg, 1871)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V., 5.VI., 27.VIII.2016 and 15.V.2019, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V., 5.VI., 27.VI., 1.VIII. and 27.VIII.2016, soil and leaf litter under oak trees, soil in outside the oak trees and farmland.

Distribution. Holarctic (Jordana, 2012; Bellinger et al., 1996–2022), Iran – Mazandaran, Golestan (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Entomobrya handschini Stach, 1922

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V.2016, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75”N, 46°18'2.69"E, 1335 m, 13.V., and 5.VI.2016, soil in outside the oak trees.

Distribution. Europe, North Eurasia, Sino-Japanese, West and Central Asia, Mediterranean (Bellinger et al., 1996–2022), Iran – Kermanshah, Tehran (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Genus *Pseudosinella* Schäffer, 1897

Pseudosinella alba (Packard, 1873)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64”N, 46°5'50.50"E, 1335 m, 15.V.2019, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 15.V., and 15.VI.2019, soil and leaf litter under cypress trees.

Distribution. Cosmopolitan (Bellinger et al., 1996–2022), Iran - Guilan (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Pseudosinella octopunctata Börner, 1901

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64”N, 46°5'50.50"E, 1335 m, 13.V., 5.VI., 27.VI.2016 and 15.V.2019, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V., 5.VI., 27.VI.2016, 15.V., and 15.VI.2019, soil and leaf litter under oak and cypress trees, soil in outside the oak trees and farmland.

Distribution. Cosmopolitan (Bellinger et al., 1996–2022), Iran – East Azarbaijan, Golestan, Guilan, Isfahan, Kermanshah, Markazi, Mazandaran, Tehran, West Azerbaijan, Zanjan (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Pseudosinella sexoculata (Schött, 1902)

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V.2016, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V.2016, soil and leaf litter under oak trees and soil in outside the oak trees.

Distribution. Cosmopolitan (Bellinger et al., 1996–2022), Iran - Kermanshah (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Genus *Seira* Lubbock, 1870

Seira dori Gruia, Poliakov & Broza, 2000*

Material examined. Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 27.VI.2016, soil and leaf litter under cypress trees, soil in outside the oak trees and farmland.

Distribution. Until now this species was known only from Mediterranean region (Bellinger et al., 1996–2022), Iran (**new record**).

Figure 5. *Calx kailashi* Mandal, 2018, general habitus.

Family Orchesellidae Börner 1906

Genus *Heteromurus* Wankel, 1860

***Heteromurus gigans* Mari Mutt & Stomp, 1980**

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 15.V.2019, soil and leaf litter under oak trees.

Distribution. Untill now this species is known only from Mediterranean region (Bellinger et al., 1996–2022), Iran - Mazandaran (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

***Heteromurus major* (Moniez, 1889)**

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V., and 5.VI.2016, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V., 5.VI., 27.VI., and 1.VIII.2016, soil and leaf litter under oak and cypress trees, soil in outside the oak trees and farmland.

Distribution. Cosmopolitan (Bellinger et al., 1996–2022), Iran - East Azarbaijan, Golestan, Guilan, Kermanshah, Markazi, Mazandaran, Tehran (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

Order Symphypleona Börner, 1901

Family Bourletiellidae Börner, 1913

Genus *Heterosminthurus* Stach, 1955*

Heterosminthurus insignis* (Reuter, 1876)

Material examined. Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 15.V.2019, soil and leaf litter under oak trees.

Distribution. This species was known only from Mediterranean region (Bellinger et al., 1996–2022), Iran (**new record**).

Family Katiannidae Börner, 1913

Genus *Sminthurinus* Börner, 1901

***Sminthurinus aureus* (Lubbock, 1862)**

Material examined. Iran, Kurdistan province, Marivan-Pirsafa, oak forest, 35°33'47.64"N, 46°5'50.50"E, 1335 m, 13.V.2016, soil and leaf litter under oak trees; Iran, Kurdistan province, Marivan-Garan, oak forest, 35°31'59.75"N, 46°18'2.69"E, 1335 m, 13.V.2016, soil and leaf litter under oak and cypress trees and soil in outside the oak trees.

Distribution. Holarctic (Bellinger et al., 1996–2022), Iran – Guilan, Mazandaran (Shayanmehr et al., 2020), and Kurdistan (New record) provinces.

DISCUSSION

There are 232 published species in Iran and Kurdistan province's share of this number is nothing (Shayanmehr et al., 2020). In this research, for the first time, the Springtail fauna was investigated in Kurdistan province, and although only Marivan city was investigated, but a considerable number of species (39 species) were collected and identified. The three of four orders of the class Collembola were collected that more species were belong to Entomobryomorpha order. From order Entomobryomorpha, four families, 12 genera and 24 species were collected. Of the order Poduromorpha, five families, 10 genera and 13 species were collected. While from order of Symphypleona, only two families, two

genera and two species were collected. The habitat of *Pseudachorutes kurdistanicus* Kapruś, Shayanmehr & Ghobari, 2022 from the family Neanuridae was restricted to oak forest in west of Iran. However, the major part of the reported species are common elsewhere. All species are new for Kurdistan province. The three genera *Doutnacia* Rusek, 1974 (Tullbergiidae), *Heterosminthurus* Stach, 1955 (Bourletiellidae) and *Calx* Christiansen, 1958 (Entomobryidae) and eight species including *Willemia virae* Kapruś, 1997, *Xenylla tullbergi* Börner, 1903 (Hypogastruridae), *Axenyllodes caecus* Gisin, 1952 (Odontellidae), *Thalassaphorura franzi* (Stach, 1946) (Onychiuridae), *Doutnacia xerophila* Rusek, 1974 (Tullbergiidae), *Calx kailashi* Mandal, 2018, *Seira dori* Gruia, Poliakov & Broza, 2000 (Entomobryidae) and *Heterosminthurus insignis* (Reuter, 1876) (Bourletiellidae) are new for Iranian fauna.

AUTHOR'S CONTRIBUTION

The authors confirm their contribution in the paper as follows: S. Ahmadi: Performed the project as her MSc thesis; H. Ghobari: Supervised the project; M. Shayanmehr: Supervised the project and did the final identification of the specimens; K. Mohammadi-Samani and I. Kapruś advised the project and took the lead in writing the manuscript and I.K. confirmed the identifications and findings of this work. All authors approved the final version of the manuscript.

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

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یافته‌های جدید از فون دم‌فنری‌های ایران و چک لیست پادمان استان کردستان

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چکیده: این مطالعه در جنگل‌های بلوط و سوزنی‌برگ شهرستان مریوان در غرب استان کردستان انجام شد. نمونه‌های خاک و خاک‌برگ طی سال‌های ۲۰۱۶ تا ۲۰۱۹ جمع‌آوری و نمونه‌ها توسط قیف برلیز استخراج شد. نتایج مطالعه منجر به شناسایی ۳۹ گونه از پادمان متعلق به ۱۱ خانواده شد. سه جنس *Doutnacia* Rusek, 1974، (Tullbergiidae)، *Heterosminthurus* Stach, 1955، (Bourletiellidae) و *Calx* Christiansen, 1958، (Entomobryidae) و هشت گونه شامل جمله *Willemia virae* Kapruś, 1997 و *Xenylla tullbergi* Borner, 1903 از خانواده Hypogastruridae، *Axenyllodes caecus* (Gisin, 1952) (خانواده Odontellidae)، *Thalassaphorura franzi* (Stach, 1946) (خانواده Onychiuridae)، *Doutnacia xerophila* Rusek, 1974 (خانواده Tullbergiidae)، *Calx kailashi* Mandal, 2018، *Seira dori* Gruia, Poliakov & Broza, 2000 (خانواده Entomobryidae) و *Heterosminthurus insignis* (Reuter, 1876) (خانواده Bourletiellidae) برای فون پادمان ایران جدید هستند. تمامی گونه‌های مطالعه حاضر برای اولین بار از استان کردستان گزارش شدند. توضیح مختصر از هر گونه شامل مواد مورد بررسی، توزیع و تصویر برای گزارشات جدید ارایه شد.

واژگان کلیدی: دم‌فنری‌ها، شمال غرب ایران، پراکنش، گزارش جدید، چک لیست