Journal of Insect Biodiversity and Systematics 08 (2), 151–174 *https://jibs.modares.ac.ir*

OPEN ACCESS

Tarbiat Modares University Press **Research Article** https://doi.org/10.52547/jibs.8.2.151 **ISSN**: 2423-8112

Entomological Society of Iran *http://zoobank.org/urn:lsid:zoobank.org:DC4DD95B-9065-441A-9F97-80C1A0BCCFD8*

Contribution to the knowledge of Entomobryomorpha (Hexapoda: Collembola) from Northeastern Iran with new records and a key to the species

Mahmood Mehrafroz Mayvan
Department of Plant Protection, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, Razavi Khorasan, Iran.
✉ *mahmood_mehrafrooz@yahoo.com*; https://orcid.org/0000-0002-7494-0981

Hussein Sadeghi-Namaghi
Department of Plant Protection, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, Razavi Khorasan, Iran.
✉ *sadeghin@um.ac.ir*; https://orcid.org/0000-0002-8329-2699

Masoumeh Shayanmehr
Department of Plant Protection, Faculty of Crop Sciences, Sari University of Agricultural Sciences and Natural Resources, Sari, Iran.
✉ *m.shayanmehr@sanru.ac.ir*; https://orcid.org/0000-0002-5024-1182

Penelope Greenslade
Centre for Environmental Management, School of Science, Psychology and Sport, Federation University, Ballarat, Victoria 3353, Australia; Department of Biology, Australian National University, Australian Capital Territory.
✉ *p.greenslade@federation.edu.au*; https://orcid.org/0000-0002-2123-5306

ABSTRACT. Soil-dwelling Entomobryomorphan Collembola from the Northeast of Iran were sampled for the first time as part of a biodiversity surveying study with the aim of improving ecosystem conservation. Materials were obtained by sampling in three different ecosystems including forest, rangeland and agricultural fields between 2018 and 2019. The specimens were cleared using either Nesbitt's fluid or lactic acid and permanent microscopic slides were prepared using Hoyer's medium. As the result of this study, twenty-nine species belonging to twenty-two genera and five families of the order Entomobryomorpha were identified. Among them, two genera and eight species are recorded for the first time from Iran. The new records are *Desoria trispinata* (MacGillivray, 1896), *Drepanosira hussi* Neuherz, 1976, *Heteromurtrella* sp., *Orchesella flavescens* (Bourlet, 1839), *Willowsia bartkei* Stach, 1965, *Agrenia* sp., and *Isotomiella gracilimucronata* Rusek, 1981. Micrographs of their important features and a key to the species are also provided.

Key words: checklist, agricultural species, forest species, soil fauna, springtails

Received: 28 November, 2021

Accepted: 26 December, 2021

Published: 09 March, 2022

Subject Editor: Javier Arbea

Citation: Mehrafroz Mayvan, M., Sadeghi-Namaghi, H., Shayanmehr, M. & Greenslade, P. (2022) Contribution to the knowledge of Entomobryomorpha (Hexapoda: Collembola) from Northeastern Iran with new records and a key to the species. *Journal of Insect Biodiversity and Systematics*, 8 (2), 151–174.

INTRODUCTION

Collembola with approximately 9,000 published species worldwide are one of the most successful, abundant, and dominant micro-arthropods in most terrestrial ecosystems (Buda et al., 2020; Sharman et al., 2020; Kuyucu & Chown, 2021; Saifutdinov et al., 2021; Bellinger et al., 1996–2021). Order Entomobryomorpha with the largest species number are characterized by the reduction of first thoracic segment

Corresponding author: Sadeghi-Namaghi, H., E-mail: *sadeghin@um.ac.ir*

i.e. tergite of Th I is reduced and hidden under the tergite of Th II, well-developed furca, presence of sensilla on body and antennae, chaetae and sometimes scales covering the body segments (Jordana, 2012; Zhang et al., 2015, 2019). Based on Soto-Adames et al. (2008), the suprageneric classification of the order Entomobryomorpha includes four superfamilies: Tomoceroidea, Isotomoidea, Entomobryoidea, and Coenaletoidea. Furthermore, these superfamilies are further divided into eleven families: Oncopoduridae, Tomoceridae, Isotomidae, Actaletidae, Protentomobryidae, Orchesellidae, Paronellidae, Praentomobryidae, Entomobryidae, Oncobryidae, and Coenaletidae.

Iran with a surface area of 1648000 square kilometers has a variety of terrestrial ecosystems which have not yet been explored in terms of species diversity (Sadrizadeh, 2001). The most previous studies on Collembola have been done in the north and west of the country (e.g., Kahrarian et al., 2012; Daghighi et al., 2013a, 2013b; Shoeibi et al., 2013; Kahrarian, 2019; Yahyapour et al., 2019b; Shayanmehr et al., 2020a; Yoosefi Lafooraki et al., 2020a). Nevertheless, the fauna of Collemobla in Northern Khorasan province has never been studied. Literature review showed that the order of Entomobryomorpha consists of 105 species belonging to 34 genera of four families (Mehrafrooz Mayvan et al., 2015; Kahrarian, 2019; Shayanmehr & Yahyapour, 2019; Yahyapour et al., 2019a; Yoosefi Lafooraki et al., 2020b; Shayanmehr et al., 2020c). Therefore, the present study aims to a) collect, identify and add more data to the Collembola fauna of Iran, specifically focus on northeastern part of Iran and, b) to provide an identification key to the Collembola species reported from the north Khorasan province in Iran.

MATERIAL AND METHODS

Study area and sampling sites

The study area, North Khorasan province (Fig. 1) located in North-East, Iran and lies between 36°37' to 38°17' N latitude and 55°53' to 58°20' E longitude and has an area of about 28,400 km^2. The altitude is from 1,000 to 2,500 m above sea level (Meghdadi & Kamkar, 2011) and it has a common border in the north east with Turkmenistan. The province has a moderate climate, with an average annual rainfall about 250 mm (Moshaverinia et al., 2012). The minimum and maximum temperatures recorded in the North Khorasan province are -15 and +40 degrees, respectively.

Samples were taken from three different ecosystems including the forest of Darkesh-Jozak, the Golil-Sarany rangeland conservation area, and three alfalfa fields in the vicinity of Shirvan city (37°23′48″N latitude and 57°55′46″E longitude). The latter was a representative of an agricultural ecosystem. The Darkesh-Jozak forest is a part of Hyrcanian forests has an area of about 22,500 hectares with a climate of a cold-humid type according to Amberger coefficient (Mashayekhan et al., 2015a). Its elevation ranges from 1000 m to more than 2455 m above sea level (Mashayekhan et al., 2015b). The sampling site is located between 37°23′ to 37°26′ N latitude and 56°43′ to 56°58′ E longitude. The average annual rainfall in this region is 377 mm and the average annual temperature is 10.6 °C. The highest rainfall is in April (61.53 mm) and the lowest in September (7.12 mm). The minimum and maximum annual temperature is -10.69 °C in January and + 33.4°C in July (Karimi et al., 2016). The rangeland area under study is the Golil-Sarany protected rangeland. This protected area with 17800 hectares is located in north of Shirvan city located between 37°42′ to 37°54′ N latitude and 57°13′ to 57°52′ E longitude. The lowest altitude in this area is about 1422m and the highest one is about 2922m above sea level (Farkhani, 2016). The average annual rainfall in the region is 338 mm and the minimum and maximum annual temperature is -8.67° C in January and + 26° C in July (Esmaeelpoor, 2014). The third sampling site, as representatives of agricultural systems, were three alfalfa fields in the vicinity of Shirvan.

Collembola sampling

The soil samples were collected with a soil Corer of 5 in diameter and to a depth of 0–10 cm. Soil sampling commenced in June 2018 and continued monthly until June 2019. Sampling was carried out between the hours of 8.00 and 10.00 am on each date. Each sample was immediately placed individually

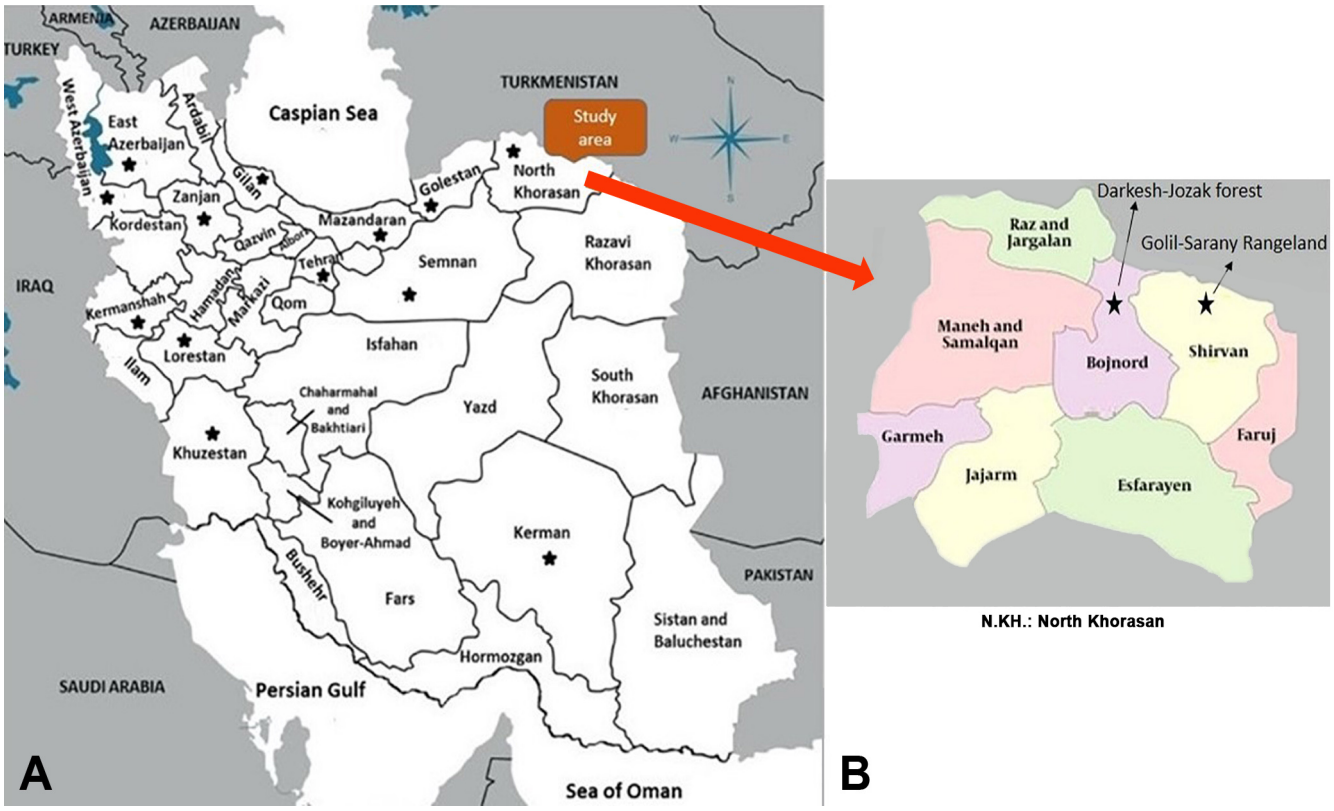

Figure 1. A. Map of Iranian provinces (* = Localities from which Entomobryomorpha have been reported); **B.** Study area indicated by arrow (North Khorasan province) (Adapted from Mahrafrooz Mayvan et al., 2021).

in a sealed plastic bag and transferred to the laboratory. Collembola were extracted from each soil sample by using a modified Berlese-Tullgren funnel and transferred into 75% ethanol. Extracted specimens were stored for later identification. The specimens were cleared using either Nesbitt's fluid or lactic acid and mounted on microscopic slides. Permanent microscopic slides were prepared using Hoyer's medium and examined at high magnification with help of a compound light microscope under phase contrast illumination. Specimens were identified using Potapov (2001), Fjellberg (2007), Jordana (2012) and other relevant literature. Voucher specimens are deposited at Systematic Entomology Laboratory, Ferdowsi University of Mashhad, Iran. For each species, their bibliographical data, habitat, ecology and distribution are provided here. New records are denoted by an asterisk (*).

The following abbreviations are used in the text: **Abd** = abdominal segment; **Ant** = antennal segment; **Man** = manubrium; **Mac** = macrochaetae; **PAO** = post antennal organ; **Th** = thoracic segment; **Tib** = tibiotarsi; **Tricho** = trichobothria.

RESULTS

Among twenty-nine identified Collembola species from the North Khorasan province, two genera and eight species are recorded for the first time for fauna of Iran. These new records are as follows: *Desoria trispinata* (MacGillivray 1896), *Drepanosira hussi* Neuherz 197, *Heteromurtrella* sp., *Orchesella flavescens* (Bourlet 1839), *Willowsia bartkei* Stach 1965, *Agrenia* sp., and *Isotomiella gracilimucronata* Rusek 1981. Below, the taxonomic information of all identified species with some ecological information and micrographs of their important features are presented.

Taxonomy

Class Collembola Lubbock, 1871

Order Entomobryomorpha Börner, 1913

Superfamily Entomobryoidea Womersley, 1934

Family Entomobryidae Schäffer, 1896

Subfamily Entomobryinae Schäffer, 1896

Genus *Drepanura* Schött, 1891

Drepanura sp.

Material examined: 3 specimens, Darkesh-Jozak forest, 37°25′32″N, 56°45′25″E, 1284 m a.s.l, collected from soil under Oak trees (*Quercus castaneifolia*), July 2018; 2 specimens, Golil-Sarany rangeland, 37°48′12″N, 57°56′24″E, 1645 m a.s.l, collected from soil under Juniper trees (*Juniperus excelsa*), July 2018.

Habitat and distribution in Iran: We are unable to identify this taxon to species level. This species has already been collected from straw in Kermanshah (Qasr-e-shirin) by Kahrarian et al. (2014).

Genus *Entomobrya* Rondani, 1861

Entomobrya corticalis (Nicolet, 1841)

Material examined: 3 specimens, Darkesh-Jozak forest, 37°25′17″N, 56°40′29″E, 1255 m a.s.l, collected from soil under Oak trees (*Quercus castaneifolia*), April 2018; 3 specimens, Golil-Sarany rangeland, 37°49′11″N, 57°55′33″E, 1629 m a.s.l, collected from soil under Juniper trees (*Juniperus excelsa*), April 2018; 2 specimens, Zoeram village, 37°19′42″N, 57°44′31″E, 1258 m a.s.l, collected from soil in alfalfa fields, April 2018.

Habitat and distribution in Iran: This species has already been reported from soil and leaf litter in Golestan (Golestan National Park) by Cox (1982) and Khanahmadi (2018).

General distribution and ecology: This species has a Palaearctic distribution and it is common under bark on dead trees, both hardwood and conifers (Fjellberg, 2007).

Genus *Sinella* Brook, 1882

Sinella sp.

Material examined: 1 specimen, Darkesh-Jozak forest, 37°25′17″N, 56°40′29″E, 1255 m a.s.l, collected from soil under Oak trees (*Quercus castaneifolia*), July 2018; 1 specimen, Golil-Sarany rangeland, 37°49′11″N, 57°55′33″E, 1629 m a.s.l, collected from soil under Juniper trees (*Juniperus excelsa*), September 2018.

Subfamily Lepidocyrtinae Wahlgren, 1906

Genus *Lepidocyrtus* Bourlet, 1839

Lepidocyrtus lanuginosus (Linnaeus in Gmelin, 1790)

Material examined: 4 specimens, Darkesh-Jozak forest, 37°27′06″N, 56°49′27″E, 1593 m a.s.l, collected from soil under Oak trees (*Quercus castaneifolia*), November 2018; 3 specimens, Golil-Sarany rangeland, 37°49′50″N, 57°54′02″E, 1759 m a.s.l, collected from soil under yarrow plants (*Achillea pachycephala*), November 2018; 2 specimens, Mayvan village, 37°12′41″N, 58°02′14″E, 1357 m a.s.l, collected from soil of alfalfa field, Novermber 2018.

Habitat and distribution in Iran: This species was already reported from soil and leaf litter in Mazandaran, Guilan, East Azarbaijan and Golestan (Gorgan, Palangpa forest) by Cox (1982) and Hosseini et al. (2016).

General distribution and ecology: Holarctic (Babenko et al., 2019).

Genus *Pseudosinella* Schäffer, 1897

Pseudosinella octopunctata Börner, 1901

Material examined: 5 specimens, Darkesh-Jozak forest, 37°27′01″N, 56°48′46″E, 1573 m a.s.l, collected from soil under maple trees (*Acer monspessulanum* sub sp. *turcomanicum*), May 2019; 2 specimens, Golil-Sarany rangeland, 37°50′38″N, 57°51′51″E, 1972 m a.s.l, collected from soil under centaury plants (*Centaurea aucheri*), May 2019; 4 specimens, Oghaz village, 37°32′19″N, 58°10′43″E, 1604 m a.s.l, collected from soil of alfalfa field, May 2019.

Habitat and distribution in Iran: It has already been reported from soil, leaf litter, moss on rocks and in a rice field in Zanjan, Guilan, East Azarbaijan, West Azarbaijan, Mazandaran (Sari, Babolsar, Qaemshahr, Larijan, Babol), Tehran, Isfahan (Zarrinshahr), Golestan (Kordkuy, Imam Reza forest, Palangpa forest, Gorgan, Alangdarreh forest, Naharkhoran forest, Ziarat), Kermanshah (Sar-e-pol-e-Zahab, Patagh, Qareh Bolagh, Rijab, Habibvand, Sahneh, Sonqor, Guilan-e-Gharb, Qasr-e-shirin, Kangavar, Paveh, Harsin, Gahvareh, Eslamabad-e-gharb, Tazeh abad, Javanrud, Sonqor), Kerman (Shahdad, Sirch village) and Lorestan by Cox (1982), Yahyapour (2012), Yoosefi Lafooraki (2014), Yoosefi Lafooraki & Shayanmehr (2013, 2014), Qazi & Shayanmehr (2014), Kahrarian et al. (2014, 2015), Balvasi et al. (2015), Mehrafrooz Mayvan et al. (2015), Darvish-Motevalli (2016), Hosseini et al. (2016), Alijani-Ardeshir et al. (2017), Ghasemi Cherati (2017), Moradi et al. (2018) and Abdolalizadeh et al. (2019).

General distribution and ecology: Cosmopolitan. A characteristic species in dry, warm habitats with patchy vegetation such as scree and gravel/sand slopes (Fjellberg, 2007).

Subfamily Seirinae Yosii, 1961

Genus *Seira* Lubbock, 1869

Seira atlantica Negri, Pellechia & Fanciulli, 2005

Material examined: 7 specimens, Varaghi village, 37°22′16″N, 57°45′16″E, 1146 m a.s.l, collected from soil of alfalfa field, August 2018.

Habitat and distribution in Iran: This species already has been reported from soil and leaf litter under of alfalfa fields in Zanjan (Kheyrabad) by Shayanmehr et al. (2020b).

General distribution and ecology: Morocco (Negri et al., 2005) and Iran (Shayanmehr et al. 2020b).

Subfamily Willowsiinae Yoshii & Suhardjono, 1989

Genus *Drepanosira* Bonet, 1942

Drepanosira hussi Neuherz, 1976 *

Material examined: 5 specimens, Darkesh-Jozak forest, 37°25′32″N, 56°45′25″E, 1284 m a.s.l, collected from soil under Oak trees (*Quercus castaneifolia*), May 2019.

Habitat and distribution in Iran: This species is reported here for the first time (Fig. 2A–B).

General distribution and ecology: Paleotropical (Baquero et al., 2015).

Genus *Willowsia* Shoenbotham, 1917

Willowsia bartkei Stach, 1965 *

Material examined: 3 specimens, Darkesh-Jozak forest, 37°27′09″N, 56°49′49″E, 1543 m a.s.l, collected from soil under Oak trees (*Quercus castaneifolia*), October 2018.

Habitat and distribution in Iran: The occurrence of this species (Fig. 2C–E) is reported here for the first time in Iran.

General distribution and ecology: Vietnam and Iran (Zhang, 2015).

Family Orchesellidae Börner, 1906

Subfamily Heteromurinae Absolon & Kseneman, 1942

Genus *Heteromurtrella* Mari Mutt, 1979

***Heteromurtrella* sp. ***

Material examined: 3 specimens, Golil-Sarany rangeland, 37°50′38″N, 57°51′51″E, 1972 m a.s.l, colected from soil under Juniper trees (*Juniperus excelsa*), Janurey 2019.

Habitat and distribution in Iran: We were unable to identify this taxon to species level. The occurrence of this genus (Fig. 2F–G) in Iran is reported for the first time.

Genus *Heteromurus* Wankel, 1860

***Heteromurus nitidus* (Templeton, 1835)**

Material examined: 10 specimens, Darkesh-Jozak forest, 37°25′32″N, 56°45′25″E, 1284 m a.s.l, collected from soil under Oak trees (*Quercus castaneifolia*), July 2018; 3 specimens, Golil-Sarany rangeland, 37°48′12″N, 57°56′24″E, 1645 m a.s.l, collected from soil under Juniper trees (*Juniperus excelsa*), July 2018; 7 specimens, Mayvan village, 37°12′41″N, 58°02′14″E, 1357 m a.s.l, collected from soil of alfalfa field, July 2018.

Habitat and distribution in Iran: This species (Fig. 3) had already been reported from soil and leaf litter in Guilan, Mazandaran (Savadkooh, Sari, Babol, Qaemshahr), Kermanshah (Harsin) and Golestan (kordkouy, Palangpa forest) by Cox (1982), Yoosefi Lafooraki (2014), Yoosefi Lafooraki & Shayanmehr (2014), Kahrarian et al. (2014), Mehrafrooz Mayvan et al. (2015), Hosseini et al. (2016), Darvish-Motevalli (2016), Alijani-Ardeshir et al. (2017) and Ghasemi Cherati (2017).

General distribution and ecology: This species has a cosmopolitan distribution and it is common in deep forest soil, under the rocks and rotting timber. Less common in meadows (Fjellberg, 2007).

***Heteromurus variabilis* (Martynova, 1974)**

Material examined: 4 specimens, Darkesh-Jozak forest, 37°26′15″N, 56°47′51″E, 1284 m a.s.l, collected from soil under Boissier pear trees (*Pyrus boissieriana*), April 2019.

Habitat and distribution in Iran: This species has already been reported from soil and leaf litter in Mazandaran (Sari) by Ghasemi Cherati (2017).

General distribution and ecology: Palaearctic (Mari Mutt, 1980).

Subfamily Orchesellinae Börner, 1906

Genus *Orchesella* Templeton, 1835

***Orchesella cincta* (Linnaeus, 1758)**

Material examined: 10 specimens, Darkesh-Jozak forest, 37°25′14″N, 56°40′30″E, 1325 m a.s.l, collected from soil under maple trees (*Acer monspessulanum* sub sp. *turcomanicum*), June 2018; 5 specimens, Golil-Sarany rangeland, 37°48′17″N, 57°56′22″E, 1591 m a.s.l, collected from soil under barberry plants (*Berberis integerrima*), June 2018.

Habitat and distribution in Iran: This species has already been reported from leaf litter and moss on the rocks in Mazandaran (Babol, Neka, Savadkooh, Forest of Jawarom, Alasht, Serin village, Larijan) and Golestan (Kordkuy, Imam Reza forest, Palangpa forest) by Yoosefi Lafooraki (2014), Yoosefi Lafooraki & Shayanmehr (2013, 2014), Balvasi et al. (2015), Hosseini et al. (2016) and Yahyapour et al. (2019b).

General distribution and ecology: This species has a Holarctic distribution and usually found in litter around foot of trees, in moss on tree trunks and rocks, sometimes in meadows (Fjellberg, 2007).

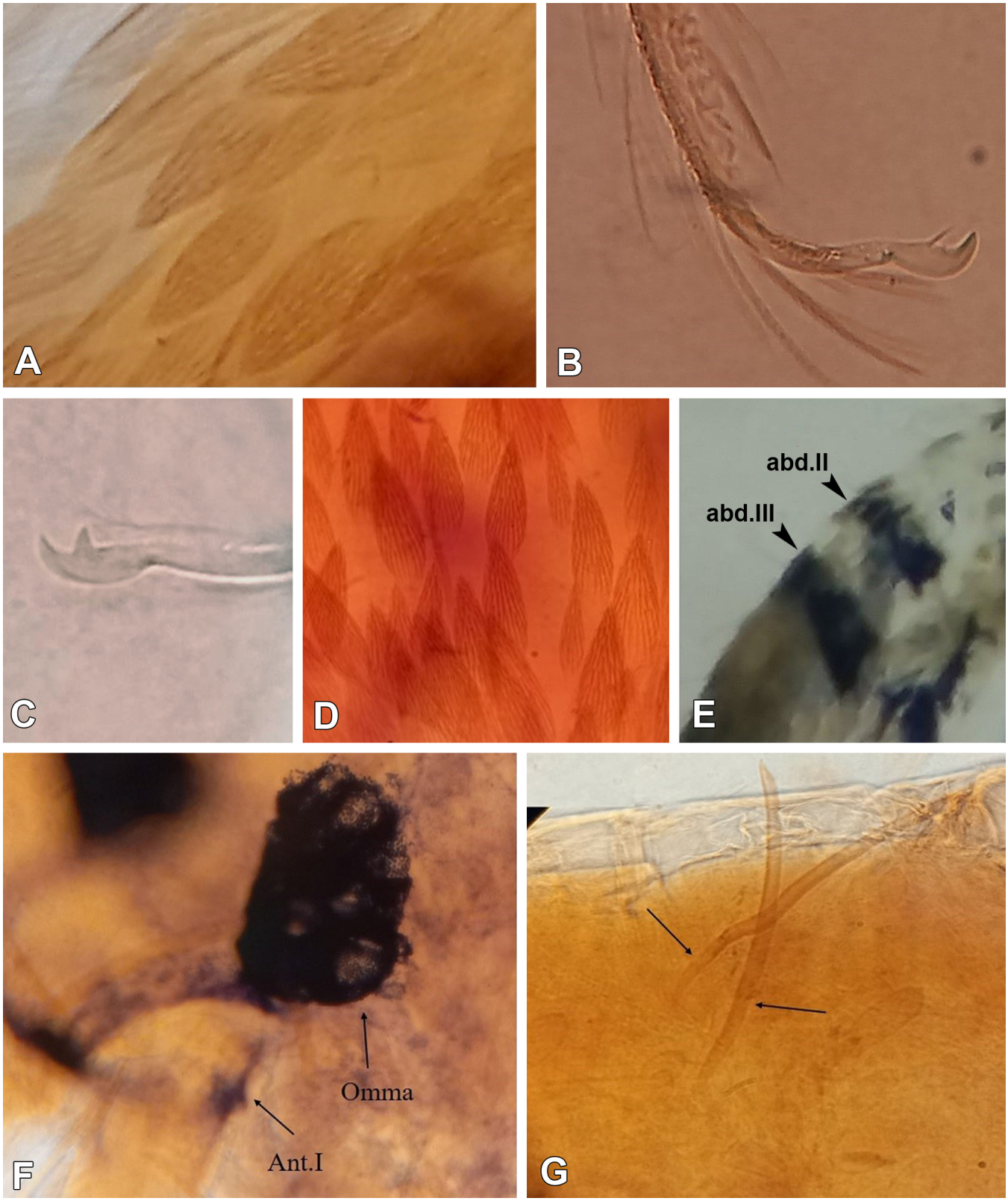

Figure 2. *Drepanosira hussi* Neuherz, 1976: **A.** Body scales (40X); **B.** Mucro falcate with basal spine (40X); *Willowsia bartkei* Stach, 1965: **C.** Mucro (40X); **D.** Body scales (40X); **E.** Dark blue pigment on Abd II & III.; *Heteromurtrella* sp.: **F.** Omma without PAO (40X), **G.** 1+1 central mac. on Abd II (40X).

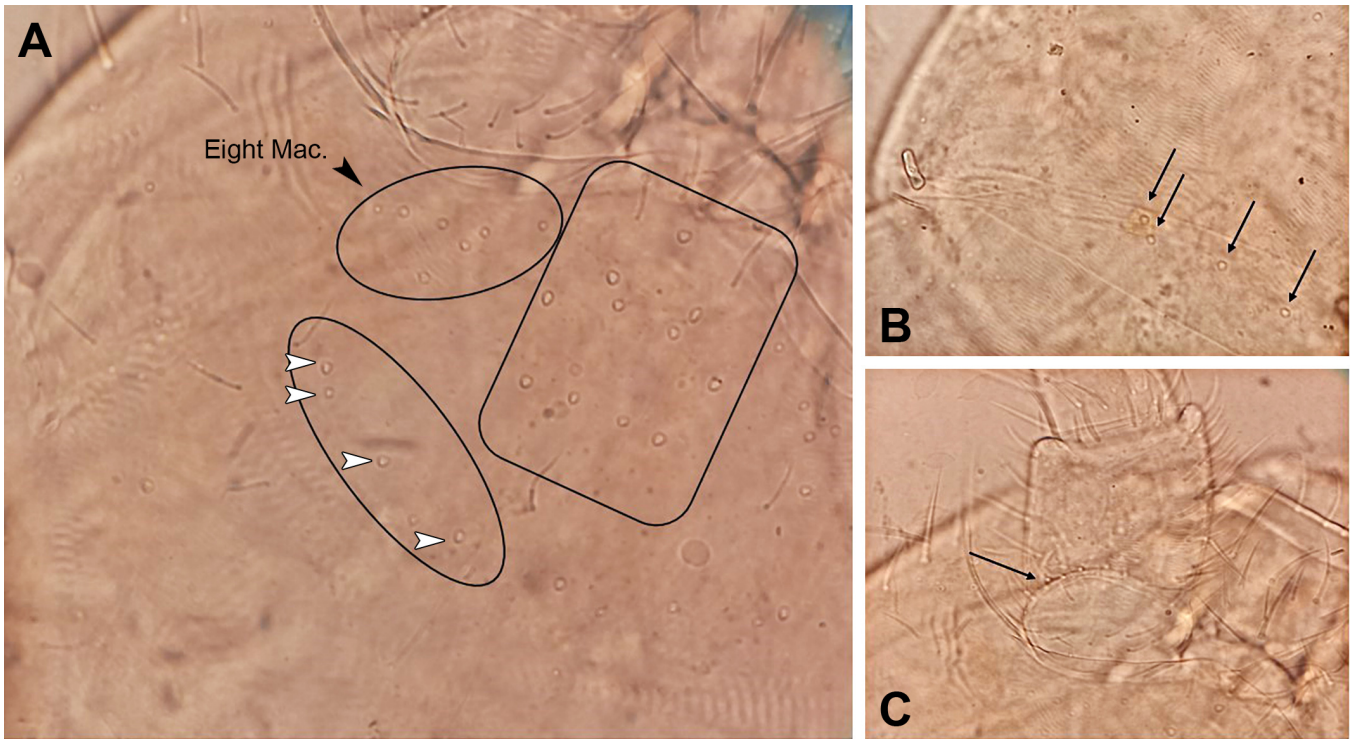

Figure 3. *Heteromurus nitidus* (Templeton, 1835): **A–B.** Macrochaetotaxy in head (A) and in Th II (B) (40X); **C.** Subsegmentation (arrow) of Ant I (40X).

***Orchesella flavescens* (Bourlet, 1839) ***

Material examined: 8 specimens, Golil-Sarany rangeland, 37°52′34″N, 57°53′15″E, 1952 m a.s.l, collected from soil under *Alyssum inflatum*, December 2018.

Habitat and distribution in Iran: This species (Fig. 4A) is reported here for the first time in Iran.

General distribution and ecology: This species has a Holarctic distribution and often found in moss and litter in damp habitats (Fjellberg, 2007).

Superfamily Isotomoidea Schäffer, 1896

Family Isotomidae Börner, 1913

Subfamily Anurophorinae Börner, 1901

Genus *Hemisotoma* Bagnall, 1949

***Hemisotoma pontica* (Stach, 1947)**

Material examined: 3 specimens, Darkesh-Jozak forest, 37°27′01″N, 56°48′46″E, 1573 a.s.l, collected from soil under maple trees (*Acer monspessulanum* sub sp. *turcomanicum*), March 2019.

Habitat and distribution in Iran: This species has already been reported from soil in Lorestan, Kermanshah and Tehran by Moravvej (2003), Kahrarian & Arbea (2013) and Moradi et al. (2018).

General distribution and ecology: Palaearctic (Potapov, 2001; Kahrarian & Arbea, 2013).

Genus *Isotomiella* Bagnall, 1939

Isotomiella gracilimucronata* Rusek, 1981

Material examined: 4 specimens, Golil-Sarany rangeland, 37°49′50″N, 57°54′02″E, 1759 m a.s.l, collected from soil under yarrow plants (*Achillea pachycephala*), November 2018.

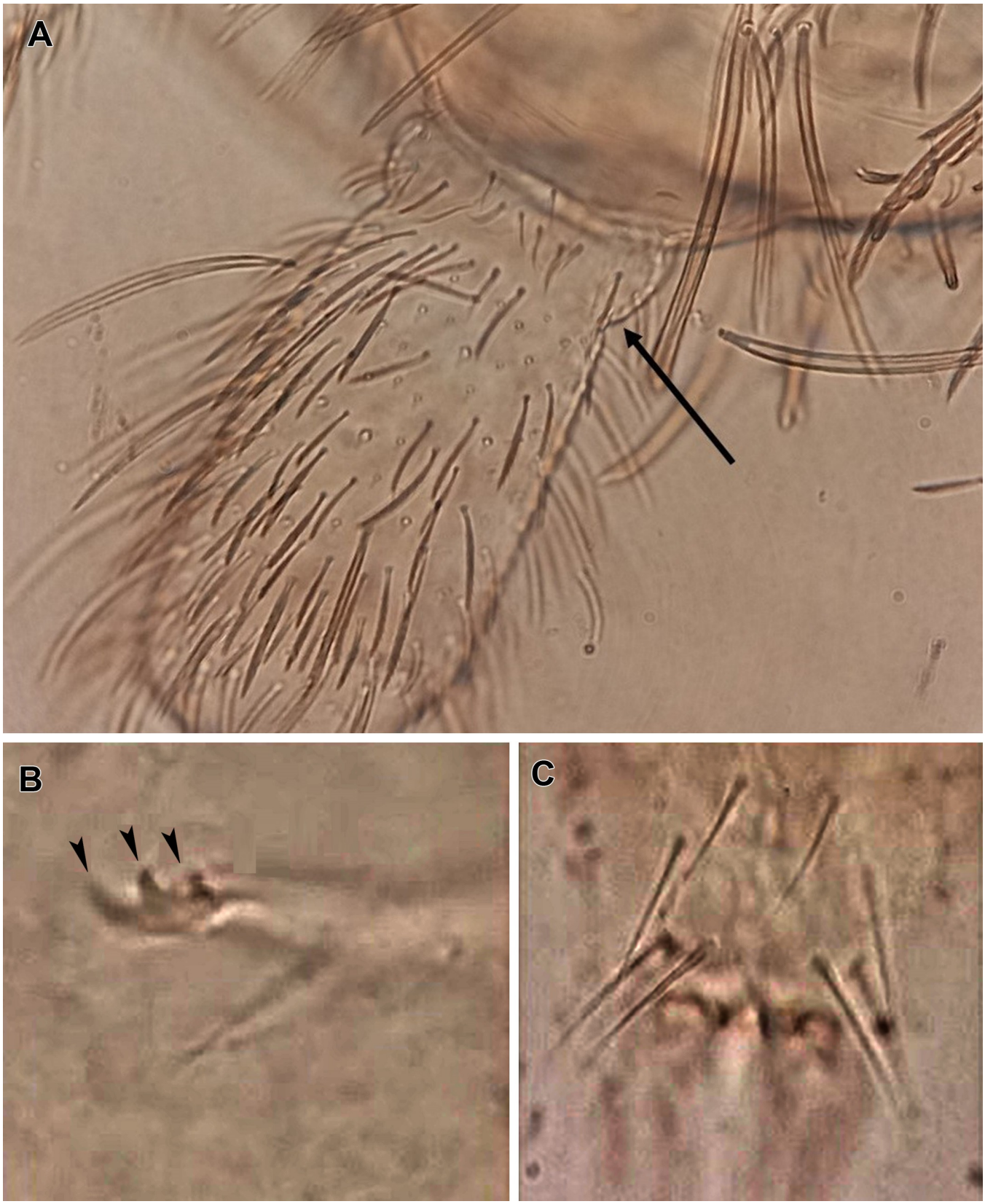

Figure 4. *Orchesella flavescens* (Bourlet, 1839): **A.** Ant I subdivided in short basal (indicated by arrow) and long apical part (40X); *Isotomiella gracilimucronata* Rusek, 1981: **B.** Mucro with three toothed indicated by arrow (100X); **C.** Manubrium with 4+4 anterior chaetae (2+2, 1+1, 1+1) (100X).

Habotat and distribution in Iran: The occurrence of this species (Fig. 4B–C) in Iran is reported here for the first time.

General distribution and ecology: Iran and Iraq (Potapov, 2001).

Isotomiella minor (Schäffer, 1896)

Material examined: 5 specimens, Darkesh-Jozak forest, 37°26′43″N, 56°47′21″E, 1540 m a.s.l, collected from soil under Oak trees (*Quercus castaneifolia*), Februrey 2019; 6 specimens, Golil-Sarany rangeland, 37°50′38″N, 57°51′51″E, 1972 m a.s.l, collected from soil under Juniper trees (*Juniperus excelsa*), Februery 2019.

Habitat and distribution in Iran: This species has already been reported from soil (*Quercus* sp., *Prunus* sp., *Pinus* sp.), and leaf litter in Mazandaran (Sari, Nowshahr; Noor, Forest of Sisangan), Guilan (Rasht), East Azarbaijan, Tehran, Kermanshah (Shabankareh village, Patagh), Golestan (Kordkuy, Palangpa forest), Kerman (Koohpayeh village) and Lorestan by Cox (1982), Moravvej et al. (2007), Yahyapour (2012), Daghighi (2012), Ghahramaninezhad et al. (2013), Daghighi et al. (2013a, 2013b), Yoosefi Lafooraki (2014), Yoosefi Lafooraki & Shayanmehr (2014), Amiri & Kahrarian (2015), Arbea & Kahrarian (2015), Mehrafrooz Mayvan et al. (2015), Hosseini et al. (2016), Ghasemi Cherati (2017), Abdolalizadeh et al. (2019), Moradi et al. (2018) and Kahrarian (2019).

General distribution and ecology: Holarctic. Common species in different habitat, apparently with a preference for humid forest soils rather than high mountains (Fjellberg, 2007).

Genus *Folsomia* Willem, 1902

Folsomia penicula Bagnall, 1939

Material examined: 5 specimens, Darkesh-Jozak forest, 37°25′17″N, 56°40′29″E, 1255 m a.s.l, collected from soil under Oak trees (*Quercus castaneifolia*), September 2018.

Habitat and distribution in Iran: This species has already been reported from soil and leaf litter under oak trees (*Quercus* sp.) in East Azarbaijan, Golestan (Gorgan), Guilan (Rasht), Mazandaran (Nowshahr, Kojur, Lashkenar, Bahnamir), Kermanshah (Shikh salaeh village, Ghap Gholi village) and Tehran by Cox (1982), Falahati et al. (2011), Daghighi (2012), Daghighi et al. (2013a, 2013b), Qazi & Shayanmehr (2014), Yoosefi Lafooraki (2014), Yoosefi Lafooraki & Shayanmehr (2014), Arbea & Kahrarian (2015), Ghasemi Cherati (2017) and Mehrafrooz Mayvan et al. (2015).

General distribution and ecology: This species has a Palaearctic distribution and it is abundant in composted leaf litter (Fjellberg, 2007).

Folsomia quadrioculata (Tullberg, 1871)

Material examined: 5 specimens, Darkesh-Jozak forest, 37°26′43″N, 56°47′21″E, 1540 m a.s.l, collected from soil under maple trees (*Acer monspessulanum* sub sp. *turcomanicum*), Aguust 2018; 6 specimens, Golil-Sarany rangeland, 37°50′38″N, 57°51′51″E, 1972 m a.s.l, collected from soil under centaury plants (*Centaurea aucheri*), August 2019.

Habitat and distribution in Iran: This species has already been reported from soil and leaf litter in Mazandaran, Guilan, East Azarbaijan, West Azarbaijan, Kermanshah (Char zabar, Shikh salaeh village, Ghap Gholi village, Sia Khor village) and Lorestan by Cox (1982), Amiri & Kahrarian (2015), Arbea & Kahrarian (2015), and Moradi et al. (2018).

General distribution and ecology: Holarctic. This species has no any clear habitat preferences and occurs in a variety of habitats (Fjellberg, 2007).

Subfamily Isotominae Schäffer, 1896

Genus *Agrenia* Börner, 1906

Agrenia **sp.***

Material examined: 4 specimens, Zoeram village, 37°19′11″N, 57°44′16″E, 1283 m a.s.l, collected from soil under alfalfa fields, October 2018.

Habitat and distribution in Iran: We were unable to identify this taxon to species level. The occurrence of the genus in the study are is reported here for the first time in Iran.

Genus *Desoria* Nicolet in Desor, 1841

Desoria trispinata **(MacGillivray, 1896)***

Material examined: 8 specimens, Darkesh-Jozak forest, 37°25′32″N, 56°45′25″E, 1284 m a.s.l, collected from soil under Oak trees (*Quercus castaneifolia*), May 2019.

Habitat and distribution in Iran: The occurrence of this species (Fig. 5A–C) is reported for the first time in Iran.

General distribution and ecology: Cosmopolitan. This species can be found in compost and other organic debris (Fjellberg, 2007; Babenko et al., 2019).

Genus *Isotoma* Bourlet, 1839

Isotoma viridis **Bourlet, 1839**

Material examined: 8 specimens, Darkesh-Jozak forest, 37°27′01″N, 56°48′46″E, 1573 m a.s.l, collected from soil under Oak trees (*Quercus castaneifolia*), Janury 2019.

Habitat and distribution in Iran: This species has already been reported from soil and leaf litter in East Azarbaijan, West Azarbaijan, Mazandaran (Sari, Babol), Kermanshah (Shabankareh, Paveh) and Golestan (Golestan National Park) by Cox (1982), Yahyapour (2012), Amiri & Kahrarian (2015), Alijani-Ardeshir et al. (2017), Khanahmadi (2018) and Kahrarian (2019).

General distribution and ecology: Holarctic. Common and widely distributed in a variety of habitats, both in forest, meadows, seashores and alpine tundra. It is possibly this species tolerates some drier conditions (Fjellberg, 2007).

Genus *Isotomurus* Börner, 1903

Isotomurus graminis **Fjellbeg, 2007**

Material examined: 8 specimens, Golil-Sarany rangeland, 37°52′34″N, 57°53′15″E, 1952 m a.s.l, collected from soil under *Alyssum inflatum*, December 2018.

Habitat and distribution in Iran: This species has already been reported from soil in alfalfa fields in North khorasan by Mehrafrooz Mayvan & Greenslade (2020).

General distribution and ecology: Palaearctic. Usually individuals are found in large numbers in humid disturbed open grasslands, rarer in forests or besides standing ponds and lakes or streams (Fjellberg, 2007).

Genus *Parisotoma* Bagnall, 1940

Parisotoma notabilis **(Schäffer, 1896)**

Material examined: 10 specimens, Darkesh-Jozak forest, 37°25′14″N, 56°40′30″E, 1325 m a.s.l, collected from soil under maple trees (*Acer monspessulanum* sub sp. *turcomanicum*), June 2018; 5 specimens, Golil-Sarany rangeland, 37°48′17″N, 57°56′22″E, 1591 m a.s.l, collected from soil under barberry plants (*Berberis integerrima*), June 2018; 9 specimens, Gelyan village, 37°18′07″N, 57°55′33″E, 1188 m a.s.l, collected from soil of alfalfa field, June 2018.

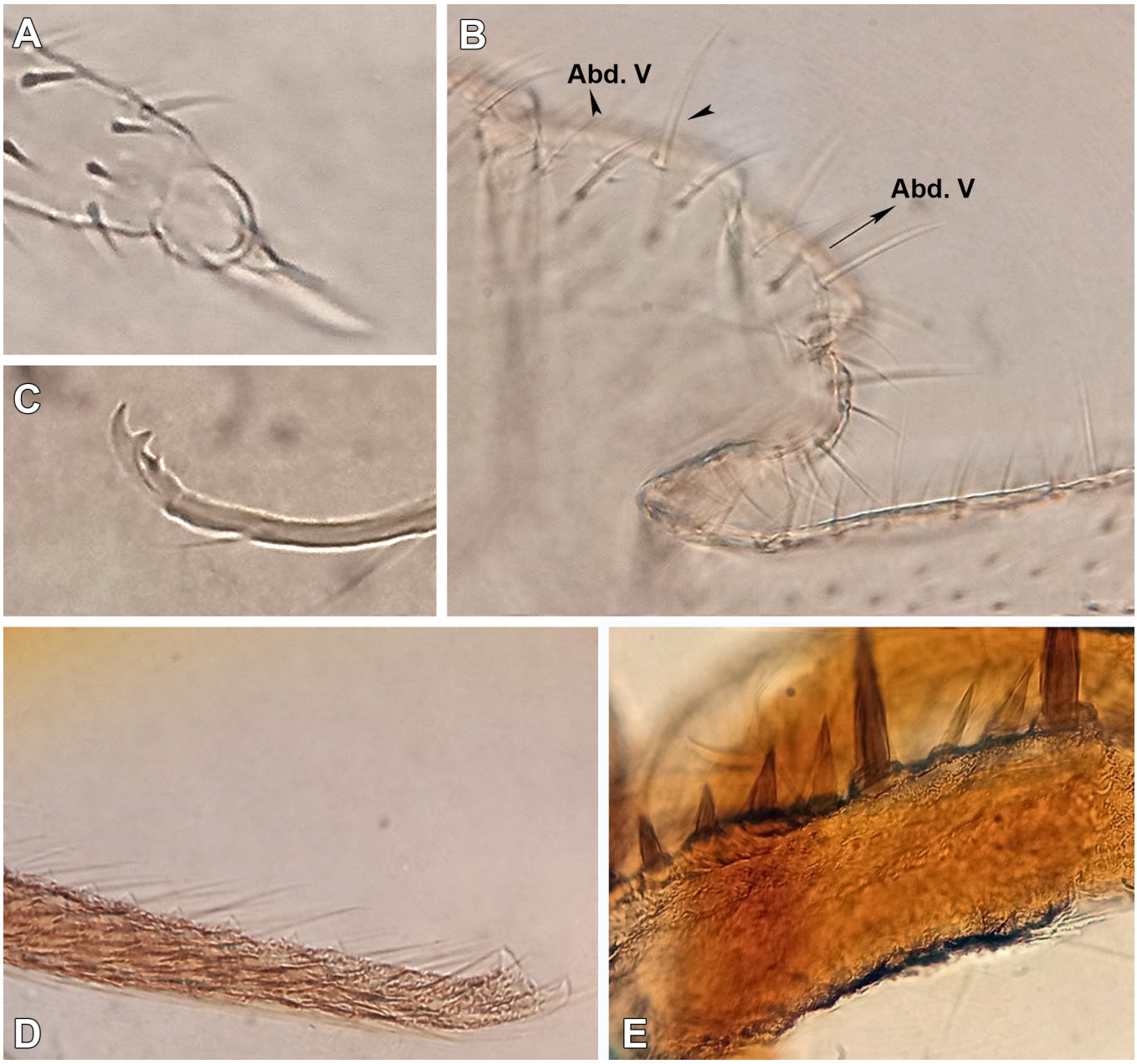

Figure 5. *Desoria trispinata* (MacGillivray, 1896): **A.** Apical ring of Tib III (40X); **B.** Macrochaetae on Abd V smooth (40X); **C.** Mucro; *Tomocerus vulgaris* (Tullberg, 1871): **D.** Mucro (40X); **E.** Dorsal spines on dens simple (40X).

Habitat and distribution in Iran: This species has already been reported from soil and leaf litter in different habitats in East Azarbaijan, West Azarbaijan, Zanjan, Tehran, Guilan (Rasht), Mazandaran (Noor, Royan, Kodirsar), Kermanshah (Shabankareh village, Patagh), Golestan (Kordkuy, Palangpa forest, Golestan National Park), Khuzestan, Kerman (Shahdad, Sirch village, Mahan, Sekonj village, Koohpayeh village) and Lorestan by Cox (1982), Moravvej et al. (2007), Kahrarian et al. (2012), Daghighi (2012),Daghighi et al. (2013a, 2013b), Yoosefi Lafooraki & Shayanmehr (2014), Amiri & Kahrarian (2015), Arbea & Kahrarian (2015), Hosseini et al. (2016), Ramezani & Mossadegh (2017), Khanahmadi (2018), Moradi et al. (2018), Abdolalizadeh et al. (2019) and Kahrarian (2019).

General distribution and ecology: Cosmopolitan. This species is a common and widely distributed species (Fjellberg, 2007; Babenko et al., 2019).

Subfamily Proisotominae Stach, 1947

Genus *Folsomides* Stach, 1922

Folsomides parvulus Stach, 1922

Material examined: 2 specimens, Golil-Sarany rangeland, 37°50′38″N, 57°51′51″E, 1972 m a.s.l, collected from soil under centaury plants (*Centaurea aucheri*), March 2019.

Habitat and distribution in Iran: It has already been reported from soil under *Morus* sp. trees, leaf litter and soil of a black cherry garden in East Azarbaijan, West Azarbaijan, Kermanshah (Harsin, Chahar Zebar-e-Oliya), Guilan (Rasht), Tehran, Semnan (Mahdishahr), Mazandaran (Savadkooh, Forest of Jawarom, Alasht, Serin village, Babolsar, Qaemshahr, Babol, Sari), Golestan (Kordkuy, Palangpa forest), Kerman (Mahan, Sekonj village) and Lorestan by Cox (1982), Yahyapour (2012), Kahrarian et al. (2012), Daghighi (2012), Daghighi et al. (2013a, 2013b), Qazi & Shayanmehr (2014), Yoosefi Lafooraki & Shayanmehr (2013, 2014), Amiri & Kahrarian (2015), Hosseini et al. (2016), Alijani-Ardeshir et al. (2017), Moradi et al. (2018) and Abdolalizadeh et al. (2019).

General distribution and ecology: Cosmopolitan. Usually found on warm sunny slopes with sand/gravel and thermophilic vegetation (Fjellberg, 2007).

Family Paronellidae Börner, 1906

Subfamily Cyphoderinae Börner, 1906

Genus *Cyphoderus* Nicolet, 1842

Cyphoderus albinus Nicolet, 1842

Material examined: 2 specimens, Darkesh-Jozak forest, 37°25′32″N, 56°45′25″E, 1284 m a.s.l, collected from soil under Oak trees (*Quercus castaneifolia*), July 2018.

Habitat and distribution in Iran: This species has already been reported from soil under plane trees (*Platanus* sp.), leaf litter in citrus garden and rice field in Guilan (Rasht), Tehran, Isfahan (Zarrinshahr), Mazandaran (Babolsar, Qaemshahr) and Kermanshah (Qasr-e-shirin, Parviz Khan and Kerman and Shahdad) by Daghighi (2012), Qazi & Shayanmehr (2014), Yoosefi Lafooraki (2014), Yoosefi Lafooraki & Shayanmehr (2014), Darvish-Motevalli (2016), Abdolalizadeh (2018) and Kahrarian (2019).

General distribution and ecology: Palaearctic. Probably widespread with ants (Fjellberg, 2007).

Superfamily Tomoceroidea

Family Tomoceridae Schäffer, 1896

Genus *Tomocerus* Nicolet, 1842

Tomocerus vulgaris (Tullberg, 1871)

Material examined: 5 specimens, Darkesh-Jozak forest, 37°26′43″N, 56°47′21″E, 1540 m a.s.l, collected from soil under Oak trees (*Quercus castaneifolia*), February 2019.

Habitat and distribution in Iran: This species (Fig. 5D–E) already has been reported from soil in Mazandaran, Guilan, East Azarbaijan, Zanjan, Kermanshah and Golestan by Cox (1982), Shayanmehr et al. (2013), Yoosefi Lafooraki (2014), Yoosefi Lafooraki and Shayanmehr (2014), Balvasi et al. (2015), Mehrafrooz Mayvan et al. (2015), Kahrarian et al. (2014, 2015), Hosseini et al. (2016), Alijani-Ardeshir et al. (2017), Ghasemi Cherati (2017) and Khanahmadi (2018).

General distribution and ecology: Cosmopolitan. Common and widely distributed in forest litter, often in damp habitats (Fjellberg, 2007).

Key to the Entomobryomorpha species in Northeast of Iran

(Adapted from Potapov, 2001; Fjellberg, 2007; Soto-Adames et al., 2008; Jordana, 2012).

1. Body without scale or with a cover of sparse ciliated Mac (absent in two species), Abd IV–VI distinct, but if fused then shorter than length of Th II to Abd III (Isotomidae). **4**
— Body with scale or with a cover of dense ciliated Mac (Fig. 6B–F), PAO absent. If present (one species), then strongly lobed. **2**

2. Mucro short, hook-like (Entomobryidae). **14**
— Mucro long, elongate. **3**

3. Large species (up to 4–5 mm) with pigment and dark eye-spots. Ant strongly prolonged. Mucro with chaetae (Tomoceridae), Tib with several differentiated Mac on inner surface, Mid-section of mucro with more than 3 teeth, Dorsal spines of dens simple. ..... ***Tomocerus vulgaris*** (Tullberg, 1871)
— Small (<1.5 mm) white species without eyes. Ant normal. PAO absent. Mucro only with apical and subapical teeth. Dens dorsally with flattened, blade-like chaetae. ..... ***Cyphoderus*** Nicolet

4. PAO absent. Only white species without eyes, Mucro 3 toothed (*Isotomiella* Bagnall). **5**
— PAO present. Pigmented and some white species, Mucro 2 or 3 toothed. **6**

5. Man with 4+4 anterior chaetae (2+2, 1+1, 1+1), and 2+2 lateral chaetae. ..... ***I. gracilimucronata*** Rusek, 1981
— Man with 5(6) + 5(6) anterior chaetae (2+2, 2+2 – 3+3, 1+1), and 3+3 lateral chaetae. ***I. minor*** (Schäffer, 1896)

6. All segments of Abd IV–VI fused (*Folsomia* Willem). **7**
— Abd IV demarcated from Abd V. **8**

7. Man with 1+1 ventroapical chaetae, Ocelli 2+2, Th 2 with hind corner sensillum set within the p-row..... ..... ***F. quadrioculata*** (Tullberg, 1871)
— Man with more than 1+1 ventroapical chaetae, Ocelli 2+2, microsens on Th III and Abd III present. .... ***F. penicula*** Bagnall, 1939

8. Man with six or fewer mid-ventral anterior chaetae. **9**
— Man with at least eight chaetae in the mid-ventral anterior group. **10**

9. Man with two or more anterior chaetae, Abd V–VI fused, 5+5 ocelli..... ***Hemisotoma pontica*** (Stach 1947)
— Man without anterior chaetae, Abd V–VI clearly demarcated, 2+2 ocelli..... ***Folsomides parvulus*** Stach, 1922

10. Tricho present on Abd IV, usually also on Abd II–III. Ventral tube with 3+3 laterodistal chaetae (rarely with more). ..... ***Isotomurus graminis*** Fjellbeg, 2007
— Tricho absent. If ventral tube has 3+3 lateral chaetae, then labial palp with 3 or 4 proximal chaetae. 11

11. Subapical chaetae of dens long which extends beyond tip of mucro. Maxillary outer lobe without sublobal hairs. ..... ***Agrenia*** Börner, 1906
— Apical chaetae of dens shorter, not extending beyond tip of mucro. Maxillary outer lobe with 4 sublobal hairs. **12**

12. Ocelli at most 4–5 on each side. Eye-spots small, square or punctual with 3–4 ocelli on each side, Mucro with 3 teeth. ..... ***Parisotoma notabilis*** (Schäffer, 1896)
— Ocelli 5–8 on each side. Eye-spot large, elongate, Mucro with 3 or 4 teeth. **13**

13. Tib mostly with 11 apical chaetae. Man with normal, slender ventroapical chaetae, Mucro with 3 teeth, Maxillary palp trifurcate. Abd V macrochaetae smooth, shorter than tergite. Ventral tube with 3+3 lateroapical chaetae. ..... ***Desoria trispinata*** (MacGillivray, 1896)
— Tib with 8 apical chaetae. Man ventroapical chaetae spine-like, Ventroapical manubrial teeth simple, Mucro usually with a minute fourth tooth on the ventral edge, Abd V macrochaetae more than twice as long as tergite, Body uniformly coloured, without 3 longitudinal lines..... ***Isotoma viridis*** Bourlet, 1839

14. Abd IV in dorsal midline about 1.5 as long as Abd III (Fig. 6A). Ant I with a basal short subsegment (Orchesellidae). **15**
— Abd IV in dorsal midline more than twice as long as Abd III (Fig. 6B). Ant I not subdivided (Entomobryidae). **19**

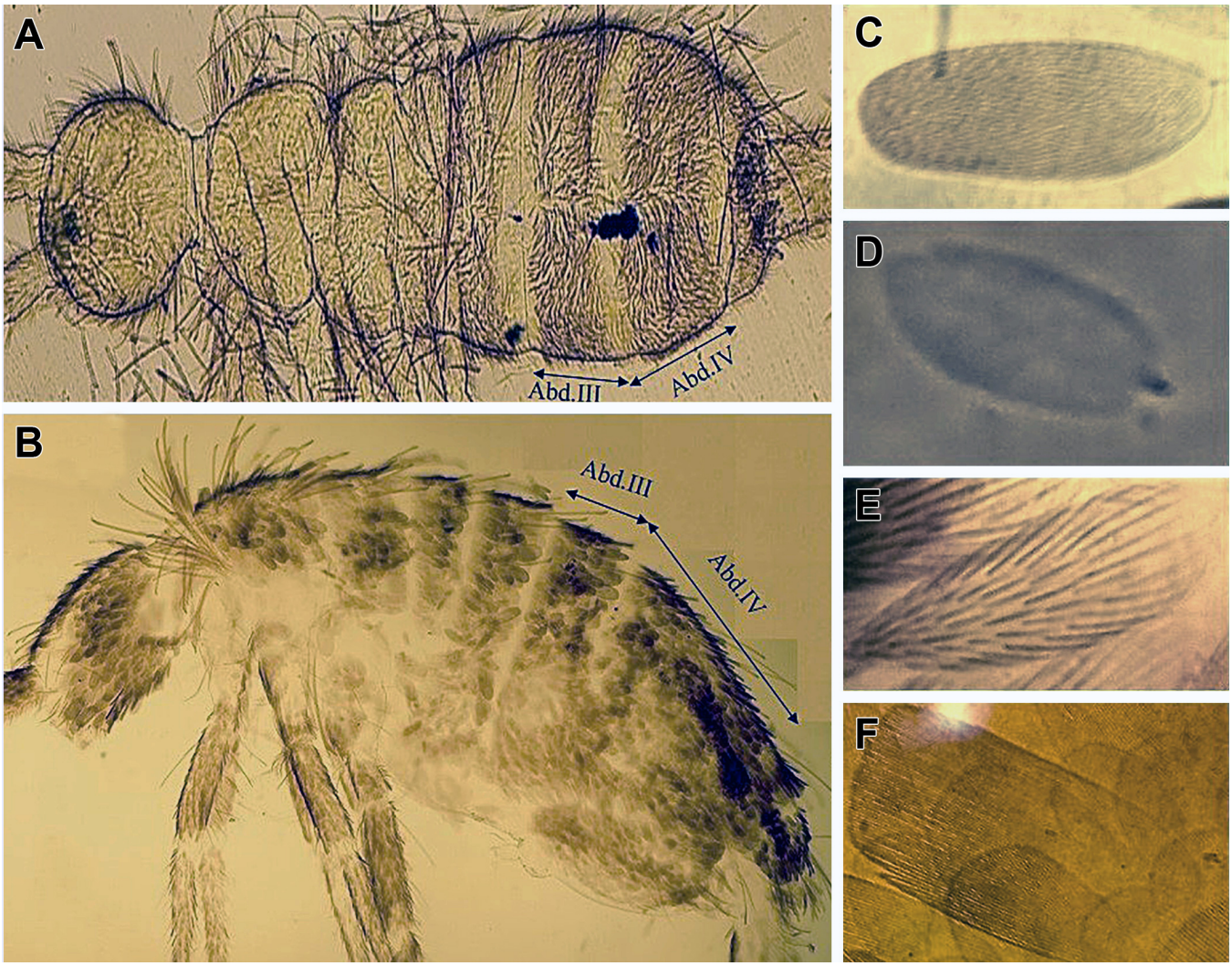

Figure 6. Morphological structures of Entomobryidae. **A–B.** different proportions of Abd III–IV in *Orchesella* (A) and *Seira* (B); **C–F.** scales from dorsal side of abdomen in *Seira* (C), *Heteromurus* (D), *Willowsia* (E) and *Tomocerus* (F).

15. Body with scales (Fig. 6D). Body pigment absent or pale (Heteromurinae). **16**
– Body with normal chaetae only, no scales. Body with characteristic colour patterns (*Orchesella* Templeton). **18**

16. Abd II with 1+1 central mac, dental spines usually absent. ..... ***Heteromurtrella*** Mari Mutt
– Abd II with 2+2 central mac, Mucro with basal spine (*Heteromurus* Wankel, 1860)..... **17**

17. 1+1 ocelli, Man with about 10+10 smooth dorsal chaetae, scales present on Ant III and legs. .... ***H. nitidus*** (Templeton, 1835)
– 8+8 ocelli, Man without smooth dorsal chaetae, second row of base of labium without smooth chaetae. ....***H. variabilis*** (Martynova, 1974)

18. Dorsal disc of Abd III entirely dark, only Abd III dark pigmented, Abd II pale. ....***O. cincta*** (Linnaeus, 1758)
– Abd III at most with dorsolateral dark spots as part of longitudinal bands of the body or dark pattern broken into spots, Body with dorsolateral continuous longitudinal bands running from Th II to Abd II or further. Abd II never with a dark transverse band. Ant dark from base to tip of Ant II. ....***O. flavescens*** (Bourlet, 1839)

19. Tricho 2, 3, 3 on Abd II–IV; tergal sens formula as 11|022–3; mucro falcate without basal spine or lamella; scales present (Seirinae), Th III with 15 central Mac. ..... ***Seira atlantica*** Negri, Pellecchia & Fanciulli, 2005
— Tricho 2, 3, 2 on Abd II–IV; tergal sens formula not 11|022–3; mucro falcate or bidentate; scales present or absent. **20**

20. Body with normal chaetae only, no scales. **21**
— Body with chaetae and transparent scales (which easily fall off). **23**

21. Ocelli absent or 2+2, body without distinct colour patterns. Dens abruptly constricted just before tip. .... ***Sinella*** Brook
— Ocelli 8+8, most species with distinct colour patterns. Dens more gradually tapering towards tip. **22**

22. Mucro with two teeth, Chaetae on body not flattened, Abd III either completely dark..... ..... ***Entomobrya corticalis*** (Nicolet, 1841)
— Mucro falcate, large Mac present on anterior margin of Th II, Mucro with basal spine. .. ***Drepanura*** Schott

23. Body scales pointed (Fig. 6E), with sharp striae, absent ventrally on dens (Willowsiinae). **24**
— Body scales rounded, without sharp striae, also present ventrally on dens. **25**

24. Mucro falcate, Mucronal basal spine present. ..... ***Drepanosira*** Bonet
— Mucro bidentate, Mucronal basal spine absent, Scales absent on Man, Abd II–III with dark blue pigment, at least partly..... ***Willowsia bartkei*** Stach, 1965

25. Ocelli 8+8, on large ocellar spots, (*Lepidocyrtus* Bourlet); Head with Mac S and T present between the eyes. ..... ***L. lanuginosus*** (Gmelin, 1788)
— Ocelli 0–4 on each side, ocellar spots small or absent (*Pseudosinella* Schäffer); Ocelli 4+4, Th 2 with one posterior Mac. ..... ***P. octopunctata*** (Böner, 1901)

DISCUSSION

During this study, belonging to twenty-two genera and five families of order Entomobryomorpha were identified, which are listed in Table 1. In the studies of Iranian Collembola fauna conducted from 2013 to 2021, most reported collembolan species were collected only from Guilan, Golestan, Kermanshah, and Mazandaran provinces (Shayanmehr et al., 2020a). However, because of the vast area and great variations in terms of climate and other environmental conditions, the springtail fauna of many parts of the country has not been yet explored. Previously 105 species belonging to six families and 34 genera of order Entomobryomorpha had been reported from Iran (Shayanmehr at al., 2020c). Of the total species of order Entomobryomorpha in Iran, the family Isotomidae with 21 genera and 56 species contains 52%, followed by family Entomobryidae with 10 genera and 34 species (31%), family Orchesellidae with 3 genera and 9 species (8%), family Tomoceridae with three genera and four species (4%), family Paronellidae with one genus and 3 species (3%) and Oncopoduridae with 1 genus and 2 species (2%) (Fig. 7).

Iran mainly belongs to the Palaearctic biogeographic realm, but southern part of the country is affected by the Afrotropical realm. *Folsomia penicula*, *H. pontica*, *I. graminis*, *E. corticalis*, *H. variabilis* and *D. hussi* that are among the identified species are distributed in the Palaearctic realm. *Folsomia quadrioculata*, *I. minor*, *I. viridis*, *L. lanuginosus*, *O. cicncta* and *O. flavescens* (Bourlet, 1839) are among those considered as holaratic species. Also, the species including *D. trispinata*, *P. notabilis*, *F. parvulus*, *H. nitidus*, *P. octopunctata* and *T. vulgaris* are distributed in the cosmopolitan realm. Except for *P. octopunctata* and *O. cincta* that collected from mosses on the rock, most of the species reported from Iran have been collected from the soil and leaf litter of trees such as *Quercus* sp. and *Morus* sp., *Prunus* sp., *Pinus* sp., *Platanus* sp., *Ulmus* sp., *Cupressus* sp., *Alnus* sp., *Parrotia persica* (CA Meyer) and alfalfa fields. Unlike *S. atlantica*, which is herbivorous species and has the potential to become a pest in alfalfa fields and cause damage to crops, all species found in this study feed on organic matter, bacteria, fungal hyphae and spores in the litters.

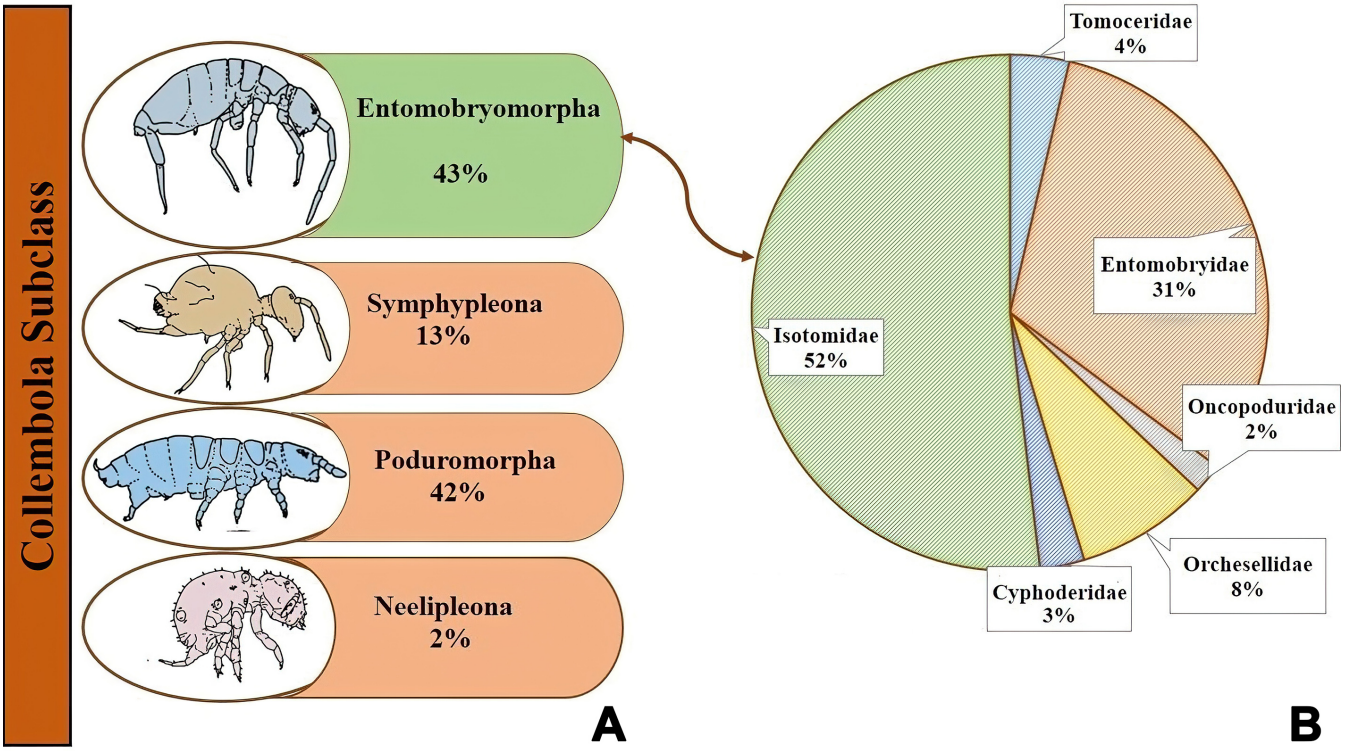

Figure 7. A. percentage of Collembola subclass recorded until March 2021 in Iran; **B.** Pie diagram shows the percentage of families of Entomobryomorpha springtails recorded until March 2021 in Iran.

Some species were found in only one ecosystem, and some lived in a variety of ecosystems. For example, *H. variabilis*, *D. hussi*, *W. bartkei*, *F. penicula*, *Heteromurtrella* sp., *D. trispinata*, *T. vulgaris*, *Cyphoderus* sp. and *H. pontica* were collected only from the forest ecosystem. Several species i.e. *O. flavescens*, *I. viridis*, *I. graminis*, *F. parvulus* and *I. gracilimucronata* were found from the rangelands and *S. atlantica* and *Agrenia* sp. were found from the agricultural ecosystem. Also, the species *E. corticalis*, *Sinella* sp., *Parisotoma* sp., *H. nitidus*, *P. octopunctata* and *L. lanuginosus* studied here can be found in all three ecosystems.

Very few studies have been conducted on springtails fauna in the neighboring countries of Iran e. g., Pakistan, Armenia, and Iraq (Yosii & Ashraf, 1964; Yosii, 1966; Ashraf, 1970; Rusek, 1981). In recent years publications by Jordana et al. (2011) in Armenia (two species), Sevgili & Özata (2014) and Özata et al. (2017) in Turkey (29 species), and Abdul-Rassoul (2021) in Iraq (33 species) have added to much more data to springtails fauna of Iran's neighboring countries. Common species reported so far from Iran's neighboring countries are as follows: *F. parvulus*, *F. penicula*, *I. gracilimucronata*, *I. minor*, *I. viridis*, *P. notabilis* from Isotomidae family, *H. nitidus*, *L. lanuginosus* and *P. octopunctata* from family Entomobryidae. *I. gracilimucronata* has previously been reported only from Iraq, while this species is reported for the first time from Iran. *S. atlantica* Negri *et al.* 2005 was also collected for the first time in Morocco and is now identified in Iran (Shayanmehr et al., 2020a). Because of the different climatic regions and various ecosystems in Iran and the fact that many parts of the country is still unexplored in terms of soil faunistic studies, it would be expected that a large number of springtails be discovered after some further studies in the future.

Table 1. Family, Subfamily, species, habitat and distribution of Entomobryomorpha order species recorded in the North Khorasan province, Iran.

Family Subfamily	Collembola Species		Habitat	Presence or absence in the ecosystem			Sampling area (Province)
				Forest	Pastureland	Agriculture	
Entomobryidae Entomobryinae	1	*Drepanura* sp.	soil and leaf litter	+	+	-	North Khorasan
Entomobryidae Entomobryinae	2	*Entomobrya corticalis* (Nicolet, 1841)	soil and leaf litter	+	+	+	Golestan, Guilan, North Khorasan
Entomobryidae Entomobryinae	3	*Sinella* sp.	soil of alfalfa field	+	+	+	North Khorasan
Entomobryidae Entomobryinae	12	*Drepanosira hussi* Neuherz, 1976*	soil and leaf litter	+	-	-	North Khorasan
Entomobryidae Entomobryinae	13	*Willowsia bartkei* Stach 1965*	soil and leaf litter	+	-	-	North Khorasan
Entomobryidae Lepidocyrtinae	7	*Lepidocyrtus lanuginosus* (Gmelin, 1788)	soil and leaf litter	+	+	+	East Azarbaijan, Golestan, Guilan, Mazandaran, North Khorasan
Entomobryidae Lepidocyrtinae	8	*Pseudosinella octopunctata* Böner, 1901	soil, leaf litter, moss on the rocks	+	+	+	East Azarbaijan, Golestan, Guilan, Isfahan, Kerman, Kermanshah, Lorestan, North Khorasan, West Azarbaijan, Tehran, Zanjan
Entomobryidae Seirinae	11	*Seira atlantica* Negri et al. 2005	soil of alfalfa field	-	-	+	North Khorasan, Zanjan,
Orchesellidae Heteromurinae	4	*Heteromurtrella* sp.*	soil and leaf litter	+	-	-	North Khorasan
Orchesellidae Heteromurinae	5	*Heteromurus nitidus* (Templeton, 1835)	soil and leaf litter	+	+	+	Golestan, Guilan, Kermanshah, Mazandaran, North Khorasan
Orchesellidae Heteromurinae	6	*Heteromurus variabilis* (Martynova, 1974)	soil and leaf litter	+	-	-	Mazandaran North Khorasan
Orchesellidae Orchesellinae	9	*Orchesella cincta* (Linnaeus, 1758)	leaf litter and moss on the rock	+	+	-	Golestan, Mazandaran, North Khorasan
Orchesellidae Orchesellinae	10	*Orchesella flavescens* (Bourlet, 1839)*	soil and leaf litter	-	+	-	North Khorasan
Isotomidae Anurophorinae	14	*Folsomia penicula* Bagnall, 1939	soil (*Quercus* sp.) and leaf litter under oak trees	+	-	-	East Azarbaijan, Golestan Guilan, Kermanshah, Mazandaran, Tehran
Isotomidae Anurophorinae	15	*Folsomia quadrioculata* (Tullberg, 1871)	soil and leaf litter	+	+	-	East Azarbaijan, Guilan, Kermanshah, Lorestan, North Khorasan, West Azarbaijan
Isotomidae Anurophorinae	16	*Hemisotoma pontica* (Stach, 1947)	soil	+	-	-	Kermanshah, North Khorasan, Tehran
Isotomidae Anurophorinae	17	*Isotomiella gracilimucronata* Rusek, 1981*	soil	-	+	-	North Khorasan
Isotomidae Anurophorinae	18	*Isotomiella minor* (Schäffer, 1896)	soil and leaf litter (*Quercus* sp., *Prunus* sp., *Pinus* sp.)	+	+	-	East Azarbaijan, Golestan Guilan, Kerman, Kermanshah, Lorestan, Mazandaran, North Khorasan, Tehran
Isotomidae Isotominae	19	*Agrenia* sp.*	soil of alfalfa field	-	-	+	North Khorasan
Isotomidae Isotominae	20	*Desoria trispinata* (MacGillivray, 1896)*	soil and leaf litter	+	-	-	North Khorasan
Isotomidae Isotominae	21	*Isotoma viridis* Bourlet, 1839	soil and leaf litter	-	+	-	East Azarbaijan, Golestan Kermanshah, Mazandaran, North Khorasan, West Azarbaijan
Isotomidae Isotominae	22	*Isotoma* sp.	soil of alfalfa field	-	-	+	North Khorasan
Isotomidae Isotominae	23	*Isotomurus graminis* Fjellbeg, 2007	soil	-	+	-	North Khorasan

Table 1. Countinued.

Family Subfamily	Collembola Species		Habitat	Presence or absence in the ecosystem			Sampling area (Province)
				Forest	Pastureland	Agriculture	
Isotomidae Isotominae	24	*Isotomurus* sp.	soil of alfalfa field	-	-	+	North Khorasan
Isotomidae Isotominae	25	*Parisotoma notabilis* (Schäffer, 1896)	soil and leaf litter	+	+	+	Golestan, Guilan, Kerman, Kermanshah, Khuzestan, Lorestan, Mazandaran, North Khorasan, Tehran, West Azarbaijan, Zanjan
Isotomidae Isotominae	26	*Parisotoma* sp.	soil and leaf litter	+	+	+	North Khorasan
Isotomidae Proisotominae	27	*Folsomides parvulus* Stach, 1922	soil and leaf litter	-	+	-	East Azarbaijan, Golestan Guilan, Kerman, Kermanshah, Lorestan, Mazandaran, North Khorasan, Semnan, Tehran, West Azarbaijan
Cyphoderidae Cyphoderinae	28	*Cyphoderus* sp.	soil and leaf litter	+	-	-	North Khorasan
Tomoceridae Tomoceridae	29	*Tomocerus vulgaris* (Tullberg, 1871)	soil and leaf litter	+	-	-	East Azarbaijan, Golestan, Guilan, Kermanshah, Mazandaran, North Khorasan, Zanjan

AUTHOR'S CONTRIBUTION

The authors confirm contribution in the paper as follows: M. Mehrafrooz Mayvan peformed the experiments and analyzed the results and wrote the manuscript; H. Sadeghi-Namaghi designed and supervised the study; M Shayanmehr and P. Greenslade participated in species identification and manuscript editing. All authurs approved the final version of the manuscript.

FUNDING

This research received no specific grant from any funding agency in the public.

AVAILABILITY OF DATA AND MATERIAL

Not applicable.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTERESTS

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

ACKNOWLEDGMENTS

The authors would like to express their thanks to the authorities of Ferdowsi University of Mashhad, Mashhad, Iran and of Federation University of Ballarat, Australia for their support during conducting this study. The present results are part of the PhD thesis of the first author.

REFERENCES

Abdolalizadeh, F., Khayrandish Kashkooei, M., Shayanmehr, M. & Bernard, E.C. (2019) Introduction of springtails (Collembola) from Kerman city and its suburbs with some new records for Iran fauna. *Applied Entomology and Phytopathology*, 87, 63–75 (In Persian with English summary). https://doi.org/10.22092/JAEP.2019.123392.1247

Abdul-Rassoul, M.S. (2021) Checklist of springtails (Class, Collembola) from Iraq. *Bulletin of the Iraq Natural History Museum*, 39, 1–23. https://doi.org/10.26842/inhmp.7.2021.1.39.0023

Alijani-Ardeshir, M., Shayanmehr, M. & Amiri-Besheli, B. (2017) Faunistic survey of Collembola in Babol regions, Mazandaran province: Introduction new species for Iranian fauna. *Plant Protection (Scientific Journal of Agriculture)*, 40, 45–61 (In Persian with English summary). https://doi.org/10.22055/PPR.2017.12835

Amiri, H. & Kahrarian, M. (2015) The new record of Isotomidae (Collembola: Apterygota) for Iranian Fauna: an update to the species List in Kermanshah province (Western Iran). *Journal of Biodiversity and Environmental Sciences*, 7, 195–200.

Arbea, J.I. & Kahrarian, M. (2015) Two new species and new data of Isotomidae Schaeffer, 1896 (Collembola: Entomobryomorpha) from Iran. *Arquivos Entomolóxicos*, 14, 71–88.

Ashraf, M. (1970) Studies on the population of Collembola in West Pakistan. *Revue d'écologie et de Biologie du sol*, 7, 54–231.

Babenko, A., Stebaeva, S. & Turnbull, M.S. (2019) An updated checklist of Canadian and Alaskan Collembola. *Zootaxa*, 4592, 001–125. https://doi.org/10.11646/zootaxa.4592.1.1

Balvasi, A., Chelav, H.S., Khashaveh, A. & Shayanmehr, M. (2015) New report of Collembola (Hexapoda: Enthognatha) from North of Iran (Larijan Region). *International Journal of Agriculture and Biosciences*, 5, 24–28.

Baquero, E., Mandak, G. & Jordana, R. (2015) Entomobryoidea (Collembola) from Himachal Pradesh (India) in the Himalayas. *Zootaxa*, 4027, 001–041. https://doi.org/10.11646/zootaxa.4027.1.1

Bellinger, P.F., Christiansen, K.A. & Janssens, F. (1996–2021) Checklist of the Collembola of the World. Available at: http://www.collembola.org [Accessed at 1 January 2021]

Buda, J., Azzoni, R.S., Ambrosini, R., Franzetti, A. & Zawierucha, K. (2020) Effects of locality and stone surface structure on the distribution of Collembola inhabiting a novel habitat – the stone-ice border on an alpine glacier. *Acta Oecologica*, 108, 103629. https://doi.org/10.1016/j.actao.2020.103629

Cox, P. (1982) The Collembola fauna of north and north western Iran. *Entomologist's Monthly Magazine*, 118, 39–43.

Daghighi, E. (2012) *Fauna of Collembola (Insecta: Apterygota) from Rasht and its regions* (Unpublished Master's Dissertation), Faculty of Agricultural Sciences, University of Guilan, Iran (in Persian with English abstract).

Daghighi, E., Hajizadeh, J., Hosseini, R. & Moravvej, A. (2013a) A checklist of Iranian Collembola with six new records from family Isotomidae (Collembola: Isotomidae). *Entomofauna*, 11, 149–156.

Daghighi, E., Hajizadeh, J., Hosseini, R. & Moravvej, A. (2013b) Introduction of eighteen species of springtails (Arthropoda: Collembola) from Guilan province with three new records for Iran. *Entomofauna*, 13, 177–184.

Darvish-Motevalli, M. (2016) *Faunistic survey and succession of insects in a rice field from planting to harvesting time* (Unpublished Master's Dissertation), Sari Agricaltural Science and Natural Resources University, Iran (in Persian with English abstract).

Esmaeelpoor, S. (2014) *Investigation and comparison of plant biodiversity in Goloul and Sarani protected area in North Khorasan province* (Unpublished master's dissertation), Department of Biology, Ferdowsi University of Mashhad (in Persian with English abstract).

Falahati Hossein Abad, A., Sarailoo, M.H., Shayanmehr, M. & Yazdanian, M. (2011) New reports of three species of Springtails (Collembola) from Iran. *Second Iranian Pest Management Conference (Iran), 2011, 14 September. Kerman, Iran*, Bahonar University, pp. 71–71.

Farkhani, H.G. (2016) *Land cover change detection in golul-sarani Protected Area using satellite data* (Unpublished Master's Dissertation), Hakim Sabzevari University, Iran (in Persian with English abstract).

Fjellberg, A. (2007) *The Collembola of Fennoscandia and Denmark. Part II: Entomobryamorpha and Symphypleona*. Vol. 35. Brill, Leiden, 264 pp. https://doi.org/10.1163/ej.9789004157705.i-265

Ghahramaninezhad, S., Shayanmehr, M. & Yoosefi Lafooraki, E. (2013) Report of new Collembola (Arthropoda: Hexapoda) species from Kermanshah. *Journal of Plant Protection*, 27, 136–138.

Ghasemi Cherati, M. (2017) *The comparison fauna, diversity and density of Collembola in an agricultural ecosystem versus a forest ecosystem* (Unpublished Master's Dissertation), Faculty of Agricultural Sciences, Sari Agricaltural Science and Natural Resources University (in Persian with English abstract).

Hosseini, F.S., Shayanmehr, M. & Amiri-Besheli, B. (2016) Contribution to Collembola (Hexapoda: Entognatha) fauna from Golestan province, Iran. *Journal of Insect Biodiversity and Systematics*, 2, 321–338.

Jordana, R. (2012) Synopses of Palaearctic Collembola: Capbryinae & Entomobryini. *Soil Organisms*, 84 (1), 1–390.

Jordana, R., Potapov, M. & Baquero, E. (2011) New species of Entomobryini from Russia and Armenia (Collembola, Entomobryomorpha). *Soil Organisms*, 83, 221–248.

Kahrarian, M. & Arbea, J. (2013) Preliminary Isotomidae fauna (Collembola: Entomobryomorpha) in Kermanshah areas, Western Iran. *Journal of the Entomological Research Society*, 37, 91–94.

Kahrarian, M. (2019) The checklist of Collembola (Hexapoda, Arthropoda) from west of Iran. *Journal of Insect Biodiversity and Systematics*, 5, 33–46.

Kahrarian, M., Nikpay, A. & Mohammadi-Noor, L. (2012) Preliminary checklist of the collembolan fauna in Kermanshah, Sahneh and Harsin counties (Kermanshah: Iran) with three new records from Iranian fauna. *Pakistan Entomologist*, 34, 27–30.

Kahrarian, M., Vafaei-Shoushtari, R., Soleyman-Nejadian, E., Shayanmehr, M. & Shams Esfandabad, B. (2015) New records of Isotomidae and Paronellidae for the Iranian fauna with an update Checklist of Entomobryomorpha fauna (Collembola) in Kermanshah province. *Journal of Entomological Research*, 7, 55–68.

Kahrarian, M., Vafaei-Shoushtari, R., Soleymannezhadyan, E., Shayanmehr, M. & Shams, B. (2014) A faunistic study on Entomobyridae (Collembola) in Kermanshah (Iran). *Natura Somogyiensis*, 24, 17–24.

Karimi, L., Marvie Mohadjer, M.R., Sagheb-Talebi, K.H. & Namiranian, M. (2016) Flora, life form and chorological studies of Darkesh forest region in North Khorasan province. *Forest Research and Development*, 2, 131–143 (In Persian with English abstract).

Khanahmadi, S. (2018) *Comparison fauna, diversity and density of Collembola associated with three different climate (cold-arid, semi-arid-temperate and sub humid temperate) in national park of Golestan* (Unpublished Master's Dissertation), Faculty of Agricultural Sciences, Sari Agricaltural Science and Natural Resources University (in Persian with English abstract).

Kuyucu, A.C. & Chown, S.L. (2021) Time course of acclimation of critical thermal limits in two springtail species (Collembola). *Journal of Insect Physiology*, 130, 104209. https://doi.org/10.1016/j.jinsphys.2021.104209

Mari Mutt, J.A. (1980) A revision of *Heteromurus* s. str. (Insecta: Colembola: Entomobryidae). *Transactions of the Illinois State Academy of Science*, 72, 29–50.

Mashayekhan, A., Pourmajidian, M.R., Jalilvand, H., Gholami, M.R. & Teimouri, M.S. (2015a) Ethno botanical urvey of herbal remedies rraditionally used in North Khorasan province of Iran. *Medicinal & Aromatic Plants*, 4, 1–5. https://doi.org/10.4172/2167-0412.1000192

Mashayekhan, A., Jalilvand, H., Pourmajidian, M.R., Gholami, M.R. & Teimouri, M.S. (2015b) Sustainable forest management through floristic study (Case study: Darkesh forest, Northern Khorasan province, Iran). *Journal of the Faculty of Forestry Istanbul University*, 65, 80–87. https://doi.org/10.17099/jffiu.29227

Meghdadi, N. & Kamkar, B. (2011) Land suitability analysis for Cumin in North Khorasan province (Iran) using geographical information systems. *International journal of Agriculture and crop science*, 3, 105–110. (In Persian; abstract in English).

Mehrafrooz Mayvan, M. & Greenslade, P. (2020) *Isotomurus graminis* Fjellberg (Collembola: Isotomidae) new for Iran, key to Iranian species in genus with comment on the validity of photographic records. *Zootaxa*, 4838, 445–450. https://doi.org/10.11646/zootaxa.4838.3.10

Mehrafrooz Mayvan, Sadeghi-Namaghi, H., Shayanmehr, M. & Greenslade, P. (2021) An annotated catalog of Iranian Symphypleona and Neelipleona (Hexapoda: Collembola): new records and key to species. *Journal of Asia-Pacific Biodiversity*, 14, 501–513. https://doi.org/10.1016/j.japb.2021.07.006

Mehrafrooz Mayvan, M., Shayanmehr, M. & Scheu, S. (2015) Depth distribution and inter-annual fluctuations in density and diversity of Collembola in an Iranian Hyrcanian forest. *Soil Organisms*, 87, 239–247.

Moradi, T. Vafaei-Shoushtari, R., Kahrarian, M. & Mohseni-Amin, A. (2018) The study on Springtails in west part of Iran with new records for Iranian fauna. *Journal of Entomological Research*, 10, 43–53.

Moravvej, S.A. (2003) *Biodiversity of Collembola of Tehran Region and Preliminary Observation on Several Species* (Unpublished Master's Dissertation), Tarbiat Modarres University, Iran (in Persian with English abstract).

Moravvej, S.A. Potapov, M. Kamali, K. & Hodjat, S.H. (2007) Isotomidae (Collembola of the Tehran region, Iran). *Zoology in the Middle East*, 41, 117–118. https://doi.org/10.1080/09397140.2007.10638238

Moshaverinia, A., Abedi, V. & safaei, H. (2012) A survey of *Nosema apis* infection in apiaries of North Khorasan province. Iran. *Iranian Journal of Veterinary Science and Technology*, 4 (2), 25–30. https://doi.org/10.22067/veterinary.v4i2.17418

Negri, I., Pellecchia M. & Fanciulli, P.P. (2005) Two new species within the genus Seira Lubbock, 1869 from Morocco (Collembola, Entomobryidae). *Zootaxa*, 840, 1–12. https://doi.org/10.11646/zootaxa.840.1.1

Potapov, M.B. (2001) *Synopses on Palaearctic Collembola*, *Volume 3: Isotomidae.* Senckenberg Museum of Natural History Görlitz, Görlitz, 603 pp.

Özata, M.A., Sevgili, H. & Kaprus, I. (2017) Contribution to the Collembola (Hexapoda) fauna of Turkey from Ordu and Rize provinces. *Biharean Biologist*, 11, 117–120.

Qazi, F. & Shayanmehr, M. (2014) Additional records for Iranian Collembola (Hexapoda: Entognatha) fauna from Tehran province. *Natura Somogyiensis*, 25, 27–34.

Ramezani, L. & Mossadegh, M.S. (2017) The effect of cropping on diversity and density of springtails (Hexapoda: Collembola) in Khuzestan province, Southwest of Iran. *Journal of Entomological Research*, 8, 51–57.

Rusek, J. (1981) Some Collembola from Iraq. *Vestnik Ceskoslovenske Spolecnosti Zoologicke*, 45, 63–80.

Sadrizadeh, B. (2001) Health Situation and Trend in the Islamic Republic of Iran. *Iranian Journal of Public Health*, 30, 1–8.

Saifutdinov, R.A., Sabirov, R.M. & Zaitsev, A.S. (2020) Springtail (Hexapoda: Collembola) functional group composition varies between different biotopes in Russian rice growing systems. *European Journal of Soil Biology*, 99, 103208. https://doi.org/10.1016/j.ejsobi.2020.103208

Sevgili, H. & Özata, M.A. (2014) Checklist of the springtails (Hexapoda: Collembola) of Turkey. *Zoology in the Middle East*, 60, 162–168. https://doi.org/10.1080/09397140.2014.914730

Sharma, P.K., Joshi, P.C. & Singh, D.K. (2020) First reports of Collembola (Spring Tails) (Insecta: Apterygota) from Delhi (India). *Journal of Environment and Bio-sciences*, 34, 45–48.

Shayanmehr, M., Mirab-balou, M., Yoosefi Lafooraki, E. & Kaprus, I. (2020a) Introduction to Springtails (Arthropoda: Hexapoda) fauna from Ilam province (western Iran) with a new record from Sminthuridae. *Journal of insect biodiversity and systematics*, 5, 399–410.

Shayanmehr, M., Marouf, A., Yoosefi Lafooraki, Y. & Cipola, N.G. (2020b) *Seira atlantica* Negri, Pellecchia & Fanciulli, 2005: New record of Collembola (Entomobryidae: Seirinae) from alfalfa field in Iran. *Journal of Insect Biodiversity*, 15, 001–005. https://doi.org/10.12976/jib/2020.15.1.1

Shayanmehr, M., Yoosefi Lafooraki, E. & Kahrarian, M. (2020c) A new updated checklist of Iranian Collembola (Arthropoda: Hexapoda). *Journal of Entomological Society of Iran*, 39 (4), 403–445. https://doi.org/10.22117/jesi.2019.124366.1285

Shayanmehr, M. & Yahyapour, E. (2019) The Collembola of north forests of Iran, list of genera and species. *Journal of Environmental Science and Engineering*, 8, 139–146. https://doi.org/10.17265/2162-5263/2019.04.003

Shayanmehr, M., Yahyapour, E., Kahrarian, M. & Yoosefi Lafooraki, E. (2013) An introduction to Iranian Collembola (Hexapoda): an update to the species list. *Zookeys*, 335, 69–83. https://doi.org/10.3897/zookeys.335.5491

Shoeibi, M., Shayanmehr, M., Yoosefi Lafooraki, E. & Mehrafrooz Mayvan, M. (2013) Faunistic survey of Entomobryidae family (Collembola: Hexapoda) in Iran. *Sociatatea Lepidopterologica Romana Buletin de Informare*, 23, 38–42.

Soto-Adames, F.N., Barra, J.A., Christiansen K.A. & Jordana, R. (2008) Suprageneric classification of Collembola Entomobryomorpha. *Annals of the Entomological Society of America*, 101, 501–513. https://doi.org/10.1603/0013-8746(2008)101[501:SCOCE]2.0.CO;2

Yahyapour, E. (2012) *Faunistic Study on Collembola (Insecta: Apterygota) in Sari Regions* (Unpublished Master's Dissertation), Sari Agricaltural Science and Natural Resources University, Iran (in Persian with English abstract).

Yahyapour, E., Vafaei-Shoushtari, R. & Shayanmehr, M. (2019a) Study on the Collembola fauna of Mazandaran (Iran) and new records from the forests of this province. *Journal of Entomological Research*, 10, 103–113.

Yahyapour, E., Vafaei-Shoushtari, R., Shayanmehr, M. & Arbea, J. (2019b) A survey on Entomobryomorpha (Collembola) fauna in northern forests of Iran. *Journal of Insect Biodiversity and Systematics*, 4, 307–316.

Yoosefi Lafooraki, E. & Shayanmehr, M. (2013) New records of Collembola (Hexapoda: Entognatha) for Iranian fauna from Mazandaran, Semnan and Isfahan provinces. *Natura Somogyiensis*, 23, 135–142.

Yoosefi Lafooraki, E. & Shayanmehr, M. (2014) A survey on Entomobryomorpha (Collembola, Hexapoda) fauna in Northern Iran with an identification key. *Iranian Journal of Animal Biosystematics*, 10, 101–117.

Yoosefi Lafooraki, E. (2014) *Morphological and Biological identification of Collembola (Hexapoda) in Mazandaran province* (Unpublished Master's Dissertation), Sari Agricaltural Science and Natural Resources University, Iran (in Persian with English abstract).

Yoosefi Lafooraki, E., Hajizadeh, J., Shayanmehr, M. & Hosseini, R. (2020a) Isotomidae (Collembola) from northern Iran with description of a new species of *Isotomodes* Linnaniemi. *Journal of Asia-Pacific Biodiversity*, 13, 545–553. https://doi.org/10.1016/j.japb.2020.08.012

Yoosefi Lafooraki, E., Hajizadeh, J., Antipova, M., Kremenitsa, A., Shayanmehr, M., Potapov, M. & Hosseini, R. (2020b) *Vertagopus* (Collembola, Isotomidae) of Iran and Caucasus. *Zootaxa*, 4786, 574–58. https://doi.org/10.11646/zootaxa.4786.4.9

Yosii, R. & Ashraf, M. (1964) On some Collembola from West Pakistan–III. *Pakistan Journal of Scientific Research*, 16, 52–58.

Yosii, R. (1966) On some Collembola of Afghanistan, India and Ceylon, collected by the Kuphe–Expedition, 1960. *Results of the Kyoto University Scientific Expedition to the Karakorama and Hindukush*, 8, 333–405.

Zhang, F. (2015) Some Willowsia from Nepal and Vietnam (Collembola: Entomobryidae) and description of one new species. *Zootaxa*, 3905 (4), 489–499. http://dx.doi.org/10.11646/zootaxa.3905.4.3

Zhang, F., Sun, D.D., Yu, D.Y. & Wang, B.X. (2015) Molecular phylogeny supports S-chaetae as a key character better than jumping organs and body scales in classification of Entomobryoidea (Collembola). *Scientific Reports*, 5, 12471. https://doi.org/10.1038/srep12471

Zhang, F., Bellini, B.C. & Soto-Adames, F.N. (2019) New insights into the systematics of Entomobryoidea (Collembola: Entomobryomorpha): first instar chaetotaxy, homology and classification. *Zoological Systematics*, 44, 249–278. http://dx.doi.org/10.5281/zenodo.4421087

گزارش‌های جدید از پادمان راسته‌ی Entomobryomorpha (Hexapoda: Collembola) از شمال شرق ایران به همراه کلید شناسایی گونه‌ها

محمود مهرافروز مایوان[۱]، حسین صادقی نامقی[۱*]، معصومه شایان‌مهر[۲] و پنه‌لوپه گرینزلید[۳]

۱ گروه گیـاهپزشکی، دانشکده کشـاورزی، دانشگاه فردوسی مشهد، خراسان رضوی، ایـران.
۲ گروه گیـاه‌پزشکی، دانشکده علوم زراعی، دانشگاه علوم کشـاورزی و منابع طبیعی ساری، سـاری، ایـران.
۳ مرکز مدیریت محیط، دانشکده علوم، روانشناسی و ورزش، دانشگاه فدریشن، بالارات، ویکتوریا ۳۳۵۳، استرالیا.
۴ گروه زیست شناسی، دانشگاه ملی استرالیا، قلمرو پایتخت استرالیا.
* پست الکترونیکی نویسنده مسئول مکـاتبه: *sadeghin@um.ac.ir*

| **تاریخ دریـافت:** ۰۷ آذر ۱۴۰۰ | **تاریخ پذیرش:** ۰۵ دی ۱۴۰۰ | **تاریخ انتشار:** ۱۸ اسفند ۱۴۰۰ |

چکیـده: پادمان خاک‌زی راسته‌ی Entomobryomorpha برای اولین بار در شمال شرق ایران به عنوان بخشی از یک مطالعه تنوع زیستی با هدف بهبود حفاظت از زیست‌بوم بررسی شدند. پادمان این راسته با نمونه‌برداری از سه زیست‌بوم مختلف شامل جنگل، مرتع و مزارع کشاورزی بین سال‌های ۱۳۹۷ تا ۱۳۹۸ به‌دست آمد. نمونه‌ها با استفاده از مایع نسبیت یا اسید لاکتیک بی‌رنگ شدند و اسلایدهای میکروسکوپی دایمی با استفاده از محیط هویر تهیه شد. در نتیجه‌ی این مطالعه، ۲۹ گونه متعلق به ۲۲ جنس و ۵ خانواده از راسته‌ی Entomobryomorpha شناسایی شد. از این میان ۲ جنس و ۸ گونه برای اولین بار از ایران ثبت شد. گزارش‌های جدید شامل *Desoria trispinata* (MacGillivray, 1896)، *Drepanosira hussi* Neuherz, 1976، *Heteromurtrella* sp.، *Orchesella flavescens* (Bourlet, 1839)، *Willowsia bartkei* Stach, 1965، *Agrenia* sp. و *Isotomiella gracilimucronata* Rusek, 1981 بودند. ویژگی‌های مهم افتراقی و کلید شناسایی گونه‌ها نیز ارایه شد.

واژگـان کلیدی: فهرست پادمان، کشاورزی، جنگل، جمعیت پادمان