



## Springtails (Hexapoda, Collembola) of Savadkuh (Mazandaran) with the description of a new species of *Isotomurus* Börner (Entomobryomorpha, Isotomidae)

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**ABSTRACT.** The present study was conducted to investigate springtail fauna of different ecosystems in Savadkuh County, southeast of Mazandaran province, during 2021–2022. Results of the current study led to the identification of 26 species, which were determined as new records for Savadkuh Collembola fauna. Additionally, a new species of *Isotomurus* Börner of the family Isotomidae is described from northern Iran. The new species, *Isotomurus matanicus* **sp. nov.** belongs to a species-group characterized by 3,3,1 trichobothria on Abd. II–IV, 3+3 laterodistal setae on ventral tube, and no seta on mucro. The main differences between *I. matanicus* **sp. nov.** and the other species determined in this study are summarized. The list of collected species with the description of the new species is given and illustrated.

**Key words:** Arthropoda, Fauna, Iran, Matankola forest, taxonomy

**Received:**

27 August, 2023

**Accepted:**

29 November 2023

**Published:**

01 January, 2024

**Subject Editor:**

Javier Arbea

**Citation:** Zamani Khormandichali, F., Shayanmehr, M., Yoosefi Lafooraki, E. & Mohamadi Sharif, M. (2024) Springtails (Hexapoda, Collembola) of Savadkuh (Mazandaran) with the description of a new species of *Isotomurus* Börner (Entomobryomorpha, Isotomidae). *Journal of Insect Biodiversity and Systematics*, 10 (1), 59–72.

## INTRODUCTION

The first attempt to present a checklist of Iranian Collembola was done by Daghighi et al. (2013), listing 84 species. Later, a concrete updated collection of all taxonomic information on the Collembola of Iran was undertaken by Shayanmehr et al. (2013), listing 112 species. This checklist was once more updated in 2020 with 232 Collembola species (Shayanmehr et al., 2020b). Subsequently, 35 new records and 24 new species of Collembola have been described from different regions of Iran (Vargovitsh & Kahrarian, 2020; Shayanmehr et al., 2020a, 2022, 2023; Mehrafrooz Mayvan et al., 2021, 2022; Smolis & Skarzyński, 2020; Yahyapour et al., 2020a, 2020b, 2021, 2022; Bakhshi et al., 2022; Vahedi Moghadam et al., 2022;

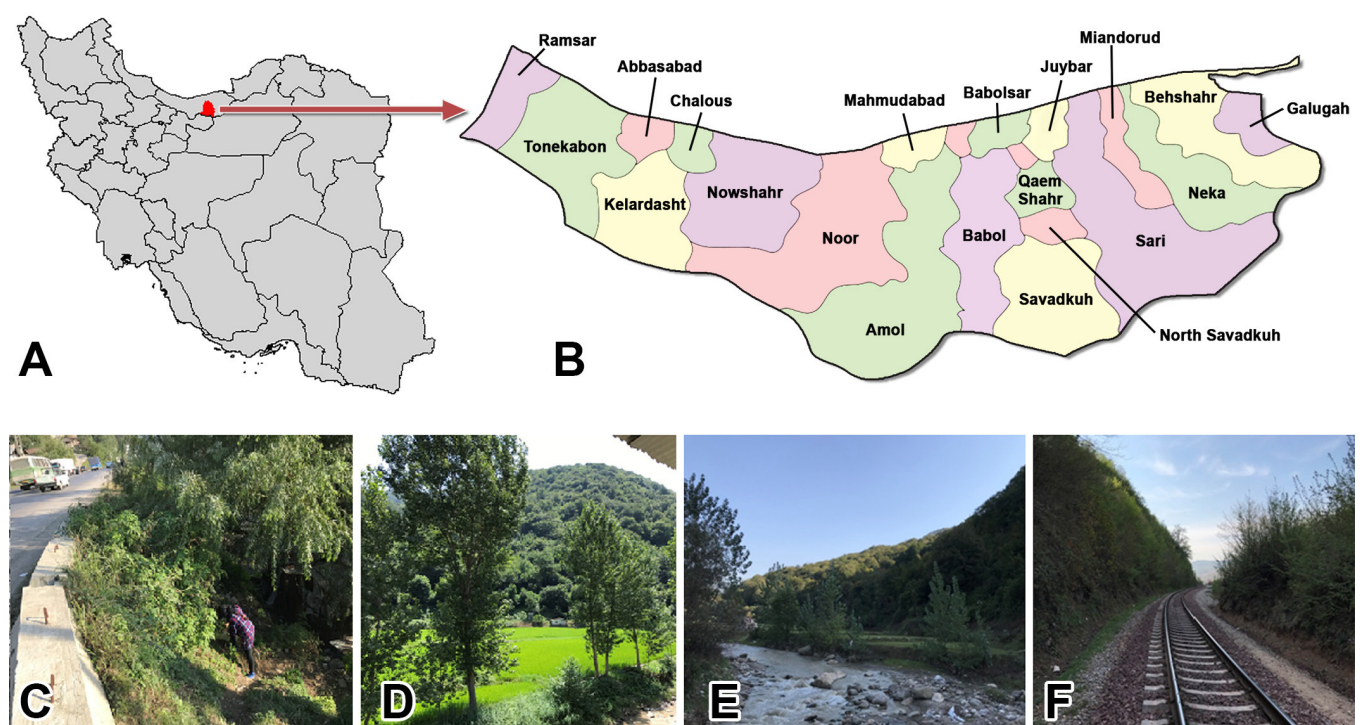
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Yoosefi Lafooraki et al., 2020a, 2020b, 2020c, 2023b; Ahmadi et al., 2023; Rabieh et al., 2023). Collembola species which are known as biological indicators play important roles in soil decomposition and nutrient circularity and are considered useful tools to determine soil fertility. Therefore, in this study, in continuation of increasing our information about these essential organisms in the soil system and knowledge of Iranian Collembola fauna, the Collembola of Savadkuh region is investigated. Savadkuh County is located in the Southeast of Mazandaran province, one of the northern provinces of Iran. The climate of the studied region is Mediterranean-type: temperate and semi-humid climate according to Köppen climate classification (Raziei, 2022). Considering all the biological importance of Collembola in the soil system and poor knowledge of Collembola fauna in the selected area for this study, the present investigation was conducted to direct such research towards the faunistic study of Collembola in different ecosystems of Iran.

## MATERIAL AND METHODS

To investigate the Collembola fauna of the Savadkuh region, southeast of Mazandaran province, several samples of the soil and leaf litter were collected from different ecosystems of this region during 2021–2022 (Fig. 1). Collembola specimens were extracted using light and heat in Berlese funnels and maintained in absolute ethanol. Then they were sorted, cleared in Nesbit's solution, and mounted on Hoyer's medium to make microscopic slides. Observations, identification, and images were obtained using a Nikon ECLIPSE E600 microscope with a Nikon camera. Illustrations were hand drawn under a camera lucida and then scanned, and traces were redrawn with Adobe Illustrator CS6 software (version 23.1.0). The genera and species were identified using valid identification keys presented by Karimi et al. (2021), Salimi et al. (2021), Yoosefi Lafooraki et al. (2023a, 2023b), and Bellinger et al. (1996–2023). The materials were stored in the laboratory of Sari Agricultural Sciences and Natural Resources University (SANRU), Mazandaran. *Abbreviations.* **Abd.**—abdominal segment; **Ant.**—antennal segment; **Mac.**—macrosetae; **Omma.**—ommatidium; **PAO**—postantennal organ; **Ret.**—retinaculum; **Trich.**—trichobotrium; **VT**—ventral tube (Potapov, 2001); **FZL**—Fatemeh Zamani Khormandichali.



**Figure 1.** The Sampling localities. **A.** Location in Iran; **B.** Map of Savadkuh in Mazandaran province. **C.** Roadside space; **D.** Rice farm; **E.** Riverside; **F.** Railroad tracks.

## RESULTS

The results of the study included 26 species belonging to six families from different regions in Savadkuh County, Mazandaran.

### *Taxonomic hierarchy*

**Phylum Arthropoda Latreille, 1829**

**Class Collembola Lubbock, 1871**

**Order Poduromorpha Börner, 1913**

**Family Hypogastruridae Börner, 1906**

**Genus *Ceratophysella* Börner, 1932**

***Ceratophysella stercoraria* Stach, 1963**

**Material examined.** 15 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, soil and leaf litter, 36°09'21.85" N, 53°00'01.51" E, 644 m a.s.l., rice field, soil, 36°09'45.25" N, 53°00'09.31" E, 464 m a.s.l., 13.IV.2022, leg. FZK.

**Distribution in Iran.** Golestan, Kermanshah, Kohgiluyeh and BoyerAhmad, Kerman, Lorestan, Mazandaran and Tehran (Shayanmehr et al., 2020b; Bakhshi et al., 2022).

**General distribution.** Palaearctic (Thibaud et al., 2004).

**Genus *Hypogastrura* Bourlet, 1839**

***Hypogastrura manubrialis* (Tullberg, 1869)**

**Material examined.** 55 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, rice, soil and leaf litter, 36°09'15.52" N, 52°58'59.23" E, 697 m a.s.l., 13.IV.2022; leg. FZK.

**Distribution in Iran.** Markazi, E. Azarbaijan, Golestan Guilan, Khuzestan, Kohgiluyeh and Boyer-Ahmad, Mazandaran, Tehran, W. Azarbaijan, and Zanjan (Shayanmehr et al., 2020b).

**General distribution.** Cosmopolitan (Bellinger et al., 1996–2023).

***Hypogastrura socialis* (Uzel, 1891)**

**Material examined.** 15 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: urban area, soil, 36°09'48.36" N, 53°00'10.43" E, 471 m a.s.l., 9.II.2022, leg. FZK.

**Distribution in Iran.** Markazi, Golestan, Guilan, E. Azarbaijan, Mazandaran, Kohgiluyeh and Boyer-Ahmad, Khuzestan, Tehran, W. Azarbaijan and Zanjan (Shayanmehr et al., 2020b).

**General distribution.** Cosmopolitan (Fjellberg, 1998).

**Genus *Schoettella* Schäffer, 1896**

***Schoettella ununguiculata* Tullberg 1869**

**Material examined.** 3 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, soil and leaf litter, 36°09'18.53" N, 53°00'00.56" E, 671 m a.s.l., 13.XII.2022, leg. FZK.

**Distribution in Iran.** Mazandaran (Shayanmehr et al., 2020b).

**General distribution.** Cosmopolitan (Bellinger et al., 1996–2023).

**Genus *Xenylla* Tullberg, 1869**

***Xenylla brevisimilis* Stach, 1949**

**Material examined.** 13 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, urban area, soil and leaf litter, 36°09'15.52" N, 52°58'59.23" E, 697 m a.s.l., 13.XII.2022, leg. FZK.

**Distribution in Iran.** Mazandaran (Shayanmehr et al., 2023).

**General distribution.** Palaearctic (Thibaud et al., 2004).

**Family Onychiuridae Lubbock, 1867****Genus *Protaphorura* Absolon, 1901*****Protaphorura sakatoi* (Yosii, 1966)**

**Material examined.** 12 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, soil and leaf litter, 36°09'21.85" N, 53°00'01.51" E, 644 m a.s.l., 9.II.2022, leg. FZK.

**Distribution in Iran.** Markazi, Mazandaran, Golestan, and Kermanshah (Shayanmehr et al., 2023).

**General distribution.** Palaearctic (Bellinger et al., 1996–2023).

**Order Entomobryomorpha Börner, 1913****Family Entomobryidae Schaffer, 1896****Genus *Entomobrya* Rondani, 1861*****Entomobrya nigrocincta* Denis, 1923 (Figs 2A–2B)**

**Material examined.** 40 specimens Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, rice, urban area, soil and leaf litter, 36°09'15.52" N, 52°58'59.23" E, 697 m a.s.l., 13.XII.2021; leg. FZK.

**Distribution in Iran.** Golestan, Mazandaran and Kermanshah (Shayanmehr et al., 2020b).

**General distribution.** Sub-cosmopolitan (Bellinger et al., 1996–2023).

***Entomobrya obscurella* (Brown, 1925)**

**Material examined.** 7 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, urban area, soil and leaf litter, 36°09'31.84" N, 53°00'04.09" E, 565 m a.s.l., 18.VIII.2022; leg. FZK.

**Distribution in Iran.** Mazandaran (Shayanmehr et al., 2020b).

**General distribution.** Palaearctic (Bellinger et al., 1996–2023).

**Genus *Heteromurus* Wankel, 1860*****Heteromurus major* (Moniez, 1889)**

**Material examined.** 21 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, urban area, rice field, soil and leaf litter, 36°09'21.85" N, 53°00'01.51" E, 644 m a.s.l., soil, 36°09'45.25" N, 53°00'09.31" E, 464 m a.s.l., 18.VI.2022; leg. FZK.

**Distribution in Iran.** Markazi, E. Azarbaijan, Guilan, Mazandaran, Kermanshah, Lorestan and Tehran (Shayanmehr et al., 2020b; Bakhshi et al., 2022).

**General distribution.** Cosmopolitan (Fjellberg, 2007).

***Heteromurus nitidus* (Templeton, 1835) (Fig. 2C)**

**Material examined.** 5 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, rice field, soil and leaf litter, 36°09'25.18" N, 53°00'02.66" E, 619 m a.s.l., 13.XII.2021; leg. FZK.

**Distribution in Iran.** Golestan, Guilan and Mazandaran (Shayanmehr et al., 2020b; Bakhshi et al., 2022).

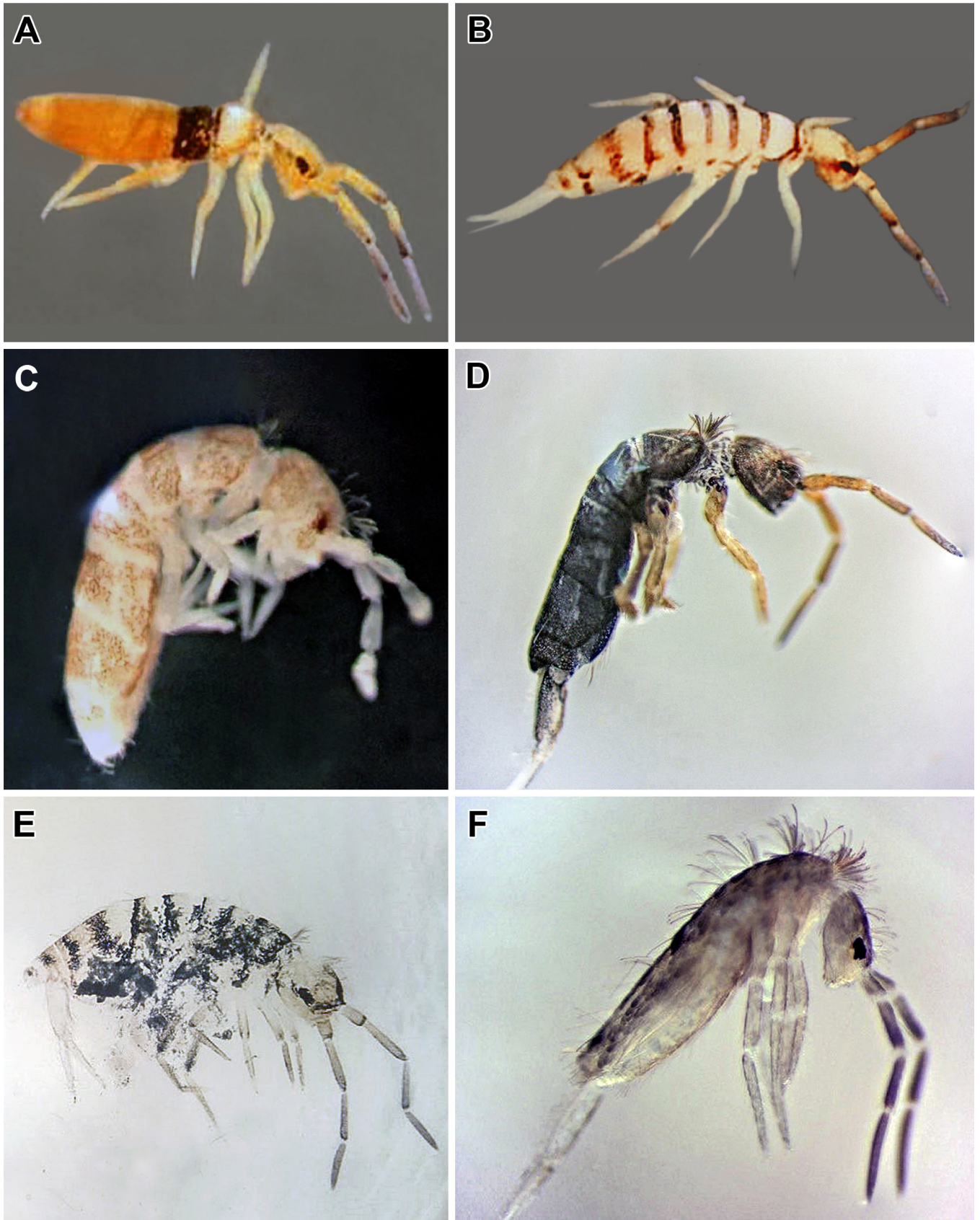
**General distribution.** Cosmopolitan (Fjellberg, 2007).

***Heteromurus variabilis* (Martynova, 1974) (Fig. 2D)**

**Material examined.** 9 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, soil and leaf litter, 36°09'18.53" N, 53°00'00.56" E, 671 m a.s.l., 14.X.2021; leg. FZK.

**Distribution in Iran.** Mazandaran (Ghasemi charati et al., 2022).

**General distribution.** Cosmopolitan (Fjellberg, 2007).



**Figure 2.** Entomobryomorpha order, Entomobryidae family from Savadkuh (Mazandaran). Habitus of: **A–B.** *Entomobrya nigrocincta* Denis, 1923, male and female; **C.** *Heteromurus nitidus* (Templeton, 1835); **D.** *Heteromurus variabilis* (Martynova, 1974); **E.** *Mesentotoma subdollfusi* Jacquemart, 1974; **F.** *Seira domestica* (Nicolet, 1842).

**Genus *Mesentotoma* Salmon, 1942*****Mesentotoma subdollfusi* Jacquemart, 1974 (Fig. 2E)**

**Material examined.** 4 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, soil and leaf litter, 36°09'15.52" N, 52°58'59.23" E, 697 m a.s.l., 13.XII.2021; leg. FZK.

**Distribution in Iran.** Golestan, Guilan and Mazandaran (Shayanmehr et al., 2020b).

**General distribution.** Palaearctic (Bellinger et al., 1996–2023).

**Genus *Pseudosinella* Schäffer, 1897*****Pseudosinella octopunctata* Börner, 1901**

**Material examined.** 26 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, soil and leaf litter, 36°09'38.58" N, 53°00'07.31" E, 487 m a.s.l., 13.XII.2021, leg. FZK.

**Distribution in Iran.** Markazi, E. Azarbaijan, Golestan, Guilan, Mazandaran, Kerman, Kermanshah, Lorestan, Isfahan, W. Azarbaijan, Tehran and Zanjan (Shayanmehr et al., 2020b).

**General distribution.** Cosmopolitan (Fjellberg, 2007).

**Genus *Seira* Lubbock, 1869*****Seira domestica* (Nicolet, 1842) (Fig. 2F)**

**Material examined.** 36 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, urban area, soil and leaf litter, 36°09'28.54" N, 53°00'03.81" E, 597 m a.s.l., soil, 18.VII.2022, leg. FZK.

**Distribution in Iran.** Golestan, Guilan, Kermanshah, and Mazandaran (Shayanmehr et al., 2020b).

**General distribution.** Sub-cosmopolitan (Bellinger et al., 1996–2023).

**Family Isotomidae Schäffer, 1896****Genus *Desoria* Agassiz & Nicolet, 1841*****Desoria neglecta* Schäffer, 1900 (Fig. 3A)**

**Material examined.** 3 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: urban area, forest, soil and leaf litter, 36°09'45.25" N, 53°00'09.31" E, 464 m a.s.l., 13.XII.2022, leg. FZK.

**Distribution in Iran.** Lorestan (Shayanmehr et al., 2020b).

**General distribution.** Sub-cosmopolitan (Bellinger et al., 1996–2023).

**Genus *Folsomia* Willem, 1902*****Folsomia penicula* Bagnall, 1939 (Fig. 3B)**

**Material examined.** 20 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, urban area, soil and leaf litter, 36°09'18.53" N, 53°00'00.56" E, 671 m a.s.l., 8.VIII.2022, leg. FZK.

**Distribution in Iran.** Markazi, Mazandaran, E. Azarbaijan, Golestan, Guilan, Tehran, and Kermanshah (Shayanmehr et al., 2020b).

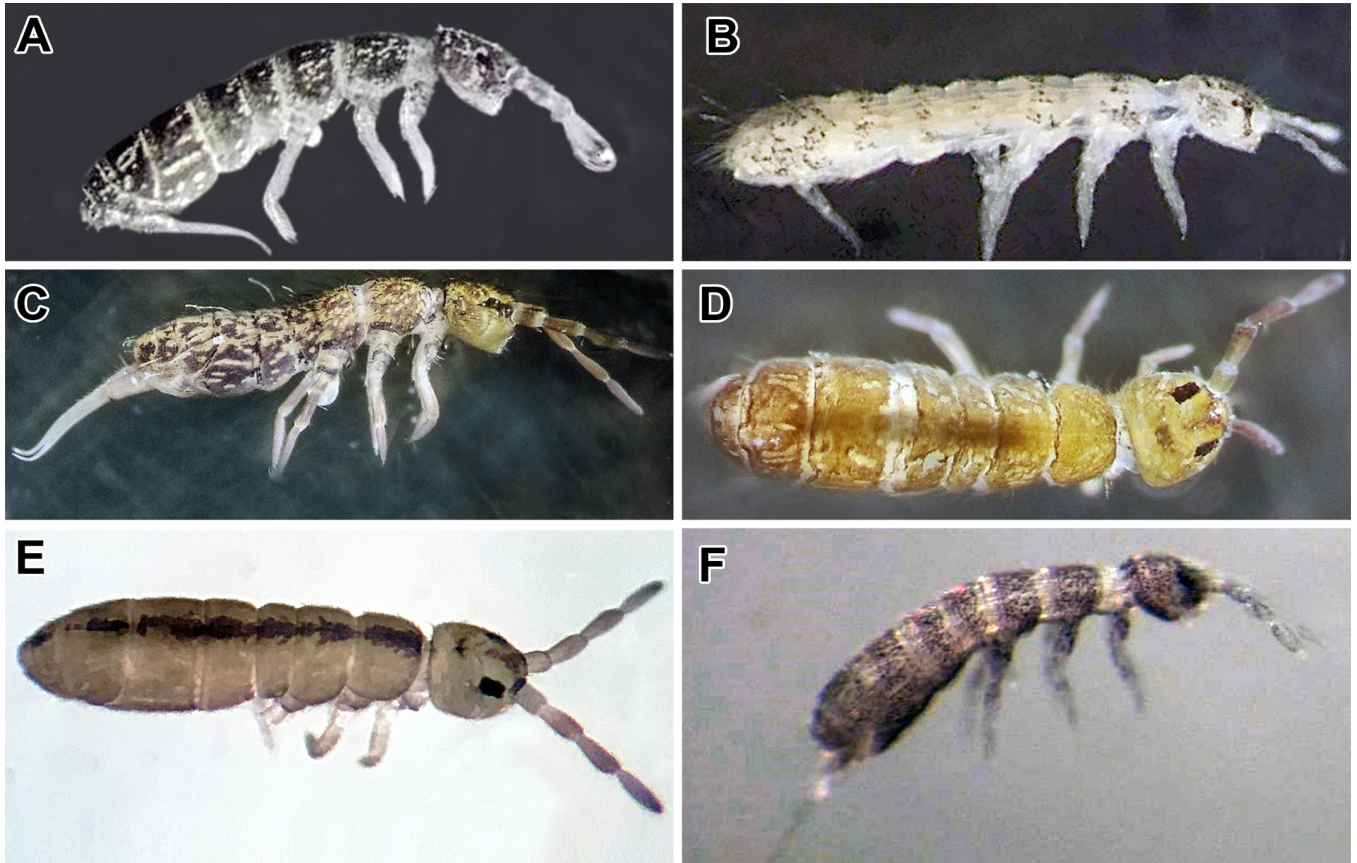
**General distribution.** Sub-cosmopolitan (Bellinger et al., 1996–2023).

**Genus *Folsomides* Stach, 1922*****Folsomides parvulus* Stach, 1922**

**Material examined.** 27 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, urban area, soil and leaf litter, 36°09'15.52" N, 52°58'59.23" E, 697 m a.s.l., soil, 18.VII.2022; leg. FZK.

**Distribution in Iran.** Markazi, E. Azarbaijan, Golestan, Guilan, Kerman, Kermanshah, Mazandaran, Semnan, Tehran, and W. Azarbaijan (Shayanmehr et al., 2020b)

**General distribution.** Cosmopolitan (Bellinger et al., 1996–2023).



**Figure 3.** Entomobryomorpha order, Isotomidae family from Savadkuh (Mazandaran). Habitus of: **A.** *Desoria neglecta* Schäffer, 1900; **B.** *Folsomia penicula* Bagnall, 1939; **C.** *Isotoma iranica* Arbea & Kahrarian, 2015; **D.** *Isotomurus katule* Yoosefi Lafooraki & Shayanmehr, 2023; **E.** *Isotomurus matanicus* sp. nov.; **F.** *Parisotoma notabilis* (Schäffer, 1896).

### Genus *Isotoma* Bourlet, 1839

#### *Isotoma iranica* Arbea & Kahrarian, 2015 (Fig. 3C)

**Material examined.** 2 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, soil and leaf litter, 36°09'21.85" N, 53°00'01.51" E, 644 m a.s.l., 9.II.2022, leg. FZK.

**Distribution in Iran.** Kermanshah and Mazandaran (Yoosefi Lafooraki et al., 2020b).

**General distribution.** Endemic (Yoosefi Lafooraki et al., 2020b).

### Genus *Isotomiella* Bagnall, 1939

#### *Isotomiella minor* (Schäffer, 1896)

**Material examined.** 24 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, rice field, soil and leaf litter, 36°09'21.85" N, 53°00'01.51" E, 644 m a.s.l., soil, 14.X.2021, leg. FZK.

**Distribution in Iran.** E. Azarbaijan, Golestan, Guilan, Kerman, Kermanshah, Mazandaran, and Tehran (Shayanmehr et al., 2020b). **General distribution.** Cosmopolitan (Bellinger et al., 1996–2023).

### Genus *Isotomurus* Börner, 1903

#### *Isotomurus hyrcanicus* Yoosefi Lafooraki & Shayanmehr, 2023

**Material examined.** 13 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, soil and leaf litter, 36°09'21.85" N, 53°00'01.51" E, 644 m a.s.l., 13.XII.2021, leg. FZK.

**Distribution in Iran.** Mazandaran and Golestan (Yoosefi Lafooraki et al., 2023b).

**General distribution.** Endemic (Yoosefi Lafooraki et al., 2023b).

***Isotomurus katule* Yoosefi Lafooraki & Shayanmehr, 2023 (Fig. 3D)**

**Material examined.** 3 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, soil and leaf litter, 36°09'21.85" N, 53°00'01.51" E, 644 m a.s.l., 13.IV.2022, leg. FZK.

**Distribution in Iran.** Golestan (Yoosefi Lafooraki et al., 2023b).

**General distribution.** Endemic (Yoosefi Lafooraki et al., 2023b).

***Isotomurus matanicus* Shayanmehr, Yoosefi & Zamani sp. nov. (Figs 3E, 4A–4E)**

<https://zoobank.org/urn:lsid:zoobank.org:act:6134EBFD-44A3-4232-B28F-9DBE82BE42A5>

**Type material. Holotype:** Iran, Mazandaran province, Savadkuh region, Zirab, Matankola, forest, soil and leaf litter, 36°09'28.54" N, 53°00'03.81" E, 597 m a.s.l., 13.IV.2022, leg. FZK; **Paratypes:** Mazandaran province, Savadkuh region, Zirab, Matankola, forest, soil and leaf litter, 36°09'21.85" N, 53°00'01.51" E, 644 m a.s.l., 13.IV.2022, 3 specimens, leg. FZK.

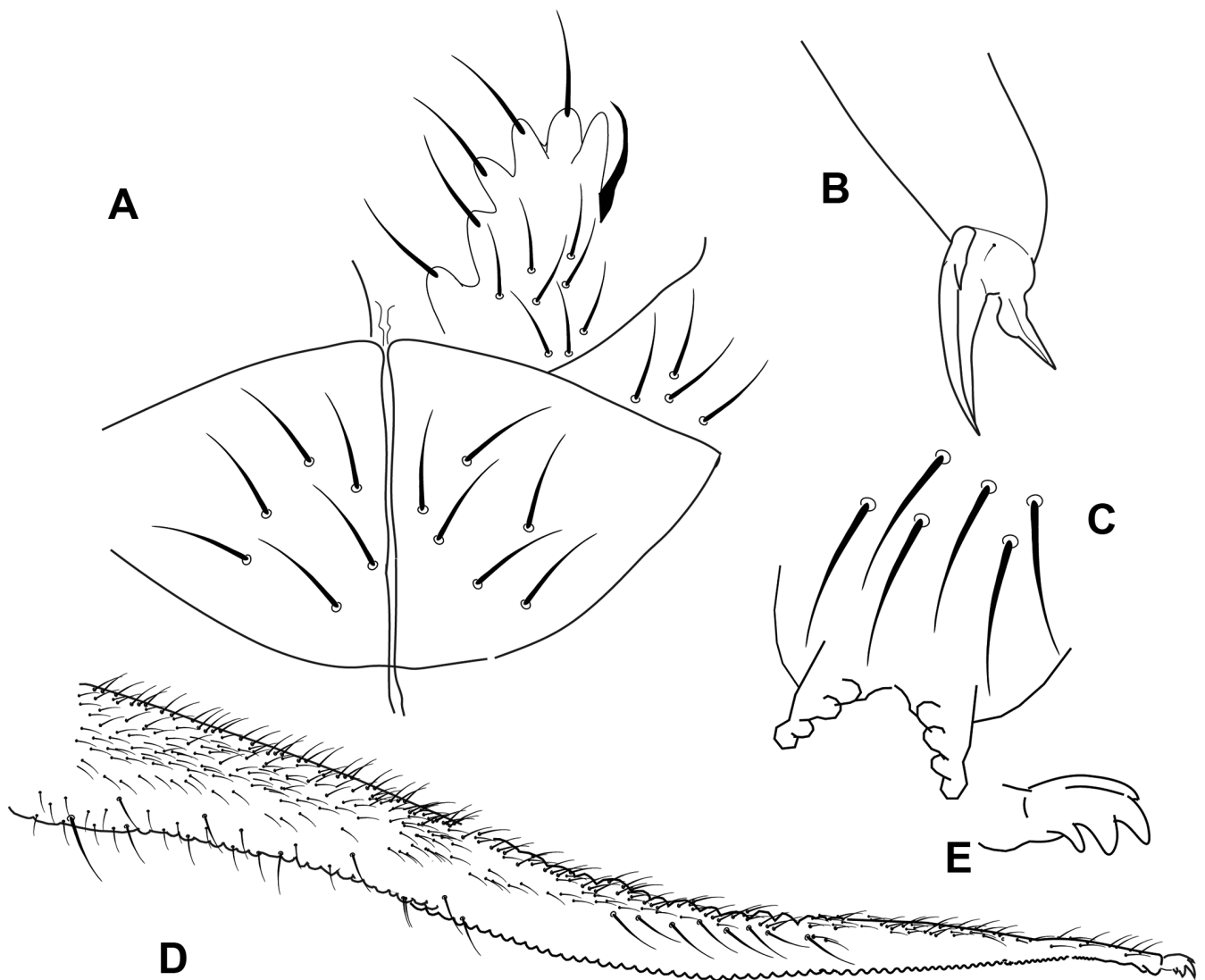
**Description.** — Body shape as it is for the genus; Background colour light brown. Body with a dark brown dorsomedial band on Th. II–Abd. V, without lateral bands or patches. Dorsomedial band rather wide and interrupted on Abd. IV. Posterior part of head with large black medial spot. Central part of head and bases of antennae pigmented (Fig. 3E). Antennae and legs dark, furca paler (Fig. 3E). 8+8 Omma. PAO elliptical, 0.76 times as long as the nearest Omma. Maxillary outer lobe with 4 sublobal hairs and bifurcate palp. Labrum with 4 pre-labral setae, labral edge as common for the genus, with four sharp ridges and ventro-apical ciliation. Labium with 6 basomedian, ~ 8 proximal, 4 basolateral setae (Fig. 4A). Antennae about 1.88 as long as head diagonal. With rather few s-setae on three first antennal segments. Ant. IV with a subapical pin seta and some short blunt lateral sensilla. Body covered with smooth setae of unequal length, 3,3,1 Trich. on Abd. II, III, and IV, and Mac. with multilateral ciliation. Legs with normal claws. Claw Without inner tooth, with lateral and outer teeth (Fig. 4B). Empodial appendage without inner tooth. Ret. with 4+4 teeth and 6–7 setae (Fig. 4C). VT with 3+3 laterodistal and many anterior and posterior setae. Manubrium densely covered by mesosetae. Manubrial thickening is simple, without teeth in the medial part. Dens are rather slender, continuously narrowed, with a sparse cover of dorsal setae, in basal 1/3 only. One of posterior setae in basal part slightly longer than others. Posterior side of dens crenulated, wrinkles regular in distal half and more disordered in basal half (Fig. 4D). Mucro with four teeth and without setae, apical tooth small (Fig. 4E). Ratio manubrium: dens: mucro as 20: 44.4: 1. Ratio of mucro to outer edge of claw III as 0.34. Modified male setae on Abd. III and IV absent.

**Etymology.** The name reflects the type locality (Matankola forest).

**Ecology.** It is usually found in broad-leaf forests in leaf litter and soil.

**Diagnosis.** *Isotomurus matanicus* sp. nov. belongs to the group of species without a seta on mucro, with 3,3,1 Trich. on Abd. II, III, and IV, and with 3+3 laterodistal setae on VT. The main differences between *I. matanicus* sp. nov. and these species are summarized in Table 1. The new species resembles *I. afghanicus* Yosii, 1963 by having a dorsomedial band and not having lateral spots and bands. The differences between them are in dorsomedial band (on Th. II–Abd. IV in *I. afghanicus* and on Th. II–Abd. V in *I. matanicus* sp. nov.), the number of setae on Ret. (10 setae in *I. afghanicus* and 6 in *I. matanicus* sp. nov.) and manubrial thickening (multidentate in *I. afghanicus* and simple in *I. matanicus* sp. nov.). The new species is closely related to *I. pseudopalustris* Carapelli, Frati, Fanciulli & Dallai 2001 which can be separated by the number of setae on Ret. (10–18 in *I. pseudopalustris* against 6–7 in *I. matanicus* sp. nov.). The new species is close to *I. unifasciatus* (Börner, 1901) which has modified male setae on Abd. III and IV (absent in *I. matanicus* sp. nov.). Also, they can be separated by the number of setae on Ret. (10–25 in *I. unifasciatus* against 6–7 in *I. matanicus* sp. nov.). *I. matanicus* sp. nov. is close to *I. potapovi* Yoosefi Lafooraki & Shayanmehr, 2023 which can be distinguished by dorsomedial band (indistinct in *I. potapovi* and dark and rather wide in *I. matanicus* sp. nov.).





**Figure 4.** *Isotomurus matanicus* sp. nov. **A.** Basomedian, proximal, and basolateral setae of labium; **B.** Claw and empodium; **C.** retinaculum; **D.** Dens lateral view; **E.** Mucro.

***Isotomurus potapovi* Yoosefi Lafooraki & Shayanmehr, 2023**

**Material examined.** 4 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: urban area, soil, 36°09'45.25" N, 53°00'09.31" E, 464 m a.s.l., 13.XII.2021, leg. FZK.

**Distribution in Iran.** Golestan, Guilan, and Mazandaran (Yoosefi Lafooraki et al., 2023b).

**General distribution.** Endemic (Yoosefi Lafooraki et al., 2023b).

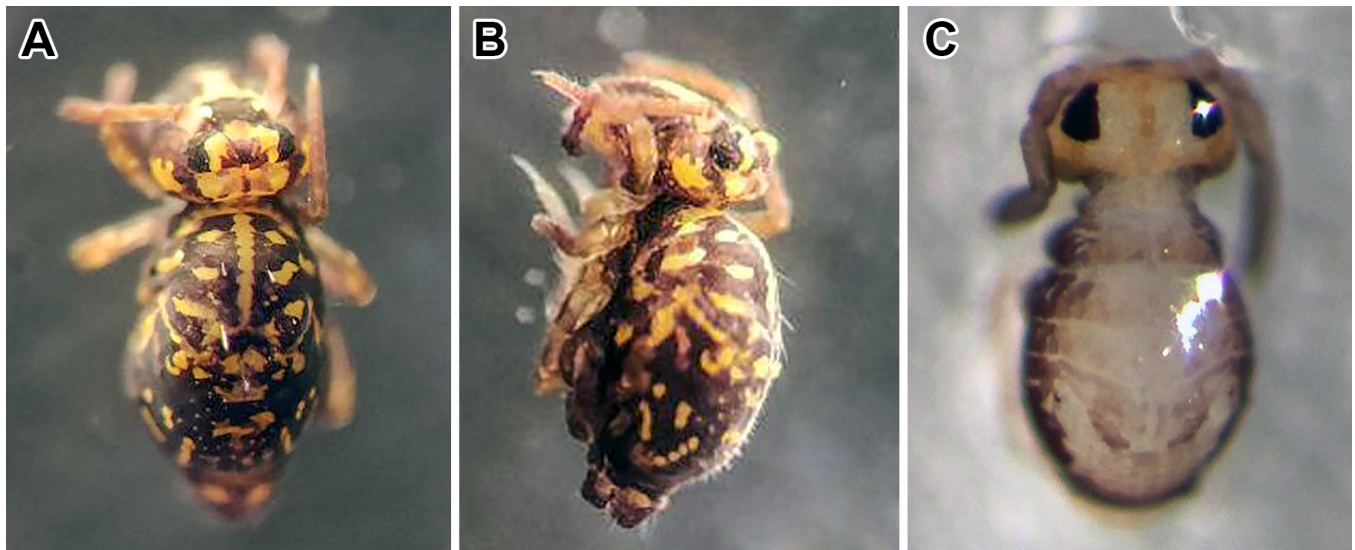
**Genus *Parisotoma* Bagnall, 1940**

***Parisotoma notabilis* (Schäffer, 1896) (Fig. 3F)**

**Material examined.** 21 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, urban area, soil and leaf litter, 36°09'38.58" N, 53°00'07.31" E, 487 m a.s.l., 14.X.2021, leg. FZK.

**Distribution in Iran.** Markazi, E. Azarbaijan, Golestan, Guilan, Kerman, Kermanshah, Khuzestan, Mazandaran, Tehran, W. Azarbaijan, and Zanjan (Shayanmehr et al., 2020b).

**General distribution.** Cosmopolitan (Bellinger et al., 1996–2023).



**Figure 5.** Symphypleona order from Savadkuh (Mazandaran). Habitus of: **A–B.** *Dicyrtoma ghilarovi* Bretfeld 1996 (Dicyrtomidae), dorsal and lateral view; **C.** *Sminthurinus elegans* Fitch, 1863 (Katiannidae).

### Order Symphypleona Börner, 1901

#### Family Katiannidae Börner, 1913

#### Genus *Sminthurinus* Börner, 1901

#### *Sminthurinus elegans* Fitch, 1863 (Fig. 5C)

**Material examined.** 3 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, soil and leaf litter, 36°09'21.85" N, 53°00'01.51" E, 644 m a.s.l., 13.XII.2021, leg. FZK.

**Distribution in Iran.** Markazi, Mazandaran, Golestan, and Kermanshah (Shayanmehr et al., 2023).

**General distribution.** Sub-cosmopolitan (Bellinger et al., 1996–2023).

#### Family Dicyrtomidae Lubbock, 1862

#### Genus *Dicyrtoma* Bourlet, 1841

#### *Dicyrtoma ghilarovi* Bretfeld 1996 (Figs 5A–5B)

**Material examined.** 2 specimens, Iran, Mazandaran province, Savadkuh region, Zirab, Matankola: forest, soil and leaf litter, 36°09'18.53" N, 53°00'00.56" E, 671 m a.s.l., 13.XII.2021, leg. FZK.

**Distribution in Iran.** Mazandaran and Lorestan (Mehrafrooz Mayvan et al., 2021).

**General distribution.** Palearctic (Bellinger et al., 1996–2023).

## DISCUSSION

In the present study, 26 species of springtails are reported for the first time in Savadkuh County among which a new species of *Isotomurus* is described. It appears that most species of the present study are cosmopolitan. Cosmopolitan species usually extend across most of the world, in suitable habitats and are known to be highly adaptable to a range of climatic and environmental conditions. Collembola species are major components of terrestrial ecosystems which prefer moist surroundings. These ubiquitous organisms are significant members of the soil communities. Savadkuh County, North of Iran, with its temperate and semi-humid climate, contains a variety of cosmopolitan Collembola species. Among collembolan species collected from this county, 10 species are thought to be cosmopolitan: *Hypogastrura manubrialis*, *H. socialis*, *Schoettella ununguiculata*, *Heteromurus major*, *H. nitidus*, *H. variabilis*, *Pseudosinella octopunctata*, *Folsomides parvulus*, *Isotomiella minor*, and *Parisotoma notabilis*. Five species *Entomobrya nigrocincta*, *Seira domestica*, *Desoria neglecta*, *Folsomia penicula*, and

*Sminthurinus elegans* found in present work are known as sub-cosmopolitan species. *E. nigrocincta* occurs in the Palaearctic and Australia; *S. domestica* is found in the Palaearctic, Australia, and North America; *D. neglecta* and *F. penicula* are found only in the Northern Hemisphere; and *S. elegans* has a sub-cosmopolitan distribution, in much of the Northern Hemisphere and south in Australia and Antarctic. Six species have been collected in our study that are considered to be the elements of the Palaearctic region including *Ceratophysella stercoraria*, *Xenylla brevisimilis*, *Protaphorura sakatoi*, *Entomobrya obscurella*, *Mesentotoma subdollfusi*, and *Dicyrtoma ghilarovi*. Five species *Isotoma iranica*, *Isotomurus hyrcanicus*, *I. katule*, *I. potapovi*, and *I. matanicus* **sp. nov.** are thought to be endemic to Iran. *Isotoma iranica* was previously reported from Kermanshah, Lorestan, and Mazandaran provinces (Arbea & Kahrarian, 2015; Moradi et al., 2018; Yoosefi Lafooraki et al., 2020b). *Isotomurus hyrcanicus*, *I. katule*, and *I. potapovi* were found and described from Mazandaran, Golestan, and Guilan provinces (Yoosefi Lafooraki et al., 2023b). The fifth endemic species of the present study is the new *Isotomurus* species, *I. matanicus* **sp. nov.**, which is characterized by 3,3,1 trichobothria on Abd. II–IV, 3+3 laterodistal setae on the ventral tube, no seta on mucro, and a rather wide dark dorsomedial band that is interrupted on Abd. IV. To date, 15 species of *Isotomurus* have been reported or described from Iran (Yoosefi Lafooraki et al., 2023b).

#### AUTHOR'S CONTRIBUTION

The authors confirm their contribution in the paper as follows: F.Z.Kh.: Performed the project as a thesis for Master of Science; M.Sh.: Supervised the project for Conceptualization, methodology, Funding acquisition and original drafting; F.ZK.: Sampling and field works, software and programming; M.M.S: Review & editing; E.Y.L.: Methodology, drawing and Photography. All authors approved the final version of the manuscript.

#### FUNDING

This research received no specific grant from any funding agencies.

#### AVAILABILITY OF DATA AND MATERIAL

The specimens listed in this study are deposited in the laboratory of Sari Agricultural Sciences and Natural Resources University (SANRU), Mazandaran and are available from the curator, upon request.

#### 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 first author is most grateful to Sari Agricultural Sciences and Natural Resources University (SANRU) for financial support during her master's science dissertation.

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## پادمان (Hexapoda, Collembola) سوادکوه مازندران با توصیف یک گونه جدید از جنس *Isotomurus* Börner (Entomobryomorpha, Isotomidae)

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ا تاریخ دریافت: ۰۵ شهریور ۱۴۰۲ | تاریخ پذیرش: ۰۸ آذر ۱۴۰۲ | تاریخ انتشار: ۱۱ دی ۱۴۰۲

**چکیده:** مطالعه حاضر طی سال‌های ۱۴۰۱-۱۴۰۰ به منظور بررسی فون پادمان در اکوسیستم‌های مختلف شهرستان سوادکوه واقع در جنوب شرق استان مازندران انجام شد. نتایج حاصل از این پژوهش عبارت از شناسایی ۲۶ گونه از پادمان می‌باشد که برای نخستین بار از شهرستان سوادکوه گزارش شدند. علاوه بر این یک گونه جدید از جنس *Isotomurus* Börner از خانواده Isotomidae در این مطالعه توصیف شد. گونه جدید *Isotomurus matanicus* sp. nov. متعلق به گروهی از گونه‌هاست که دارای ۳، ۳ و ۱ تریکوبوتری روی بندهای دوم تا چهارم شکم، دارای ۳+۳ موی جلویی-جانبی روی لوله شکمی و فاقد مو روی موکرو هستند. به علاوه تفاوت‌های اصلی گونه *I. matanicus* sp. nov. و برخی از گونه‌های جنس فوق، به شکل خلاصه در این مطالعه اشاره شد. همچنین فهرست گونه‌های جمع‌آوری شده و توصیف گونه جدید به همراه ترسیم و عکس گونه‌ها آورده شد.

**واژگان کلیدی:** بندپایان، اکوسیستم، فون، ایران، جنگل متانکلا، تاکسونومی