



Three new records of Collembola (Hexapoda) from Birjand (South Khorasan, Iran)

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ABSTRACT. During samplings were performed during 2019 in Birjand area located in South Khorasan province, three species are identified from families Entomobryidae and Bourletiellidae. *Drepanura tuxeni* Nosek, 1964, *Drepanosira gisini* Nosek, 1964 and *Cassagnaudiella* c.f. *gamae* (Bretfeld, 1994) are newly reported for the Iranian fauna of Collembola. The material examined, brief description and some illustration were given. *Cassagnaudiella* c.f. *gamae* represents the second species record of the family Bourletiellidae from Iran.

Key words: Bourletiellidae, Entomobryidae, fauna, soil, springtails

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INTRODUCTION

The class Collembola includes small, wingless arthropods that resemble insects with a webbed body, three pairs of legs on the thorax, and a pair of antennae. Most of these animals live in moist environments, play an important role in their decomposition through crushing organic matter, and also affect soil microbial communities (Thimm et al., 1998; Kahrarian, 2019). They are also known as biological indicators and are used to assess the extent of disturbances caused by tillage, chemical pollution, fire, loss of plant life, etc. (Fiera, 2009; Winkler & Tóth, 2012). Hence, they are considered one of the most useful organisms for the environment. However, some of them are pests of agricultural products. These small arthropods have a wide global distribution and are found on all continents. Habitats with unfavorable climates, such as deserts and Polar Regions, have few species, but in places where there are many niches, their fauna is very diverse (Hopkin, 1997).

The first comprehensive study that was conducted in the field of fauna identification in Iran was related to Cox (1982) who collected 70 species from the northern and central provinces of the country.

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During the last ten years, many researchers investigated the fauna of these arthropods. So that in 2020, 232 species of them were reported from the country (Shayanmehr et al., 2020). Subsequently 12 new records and 20 new species of Collembola have been described from different regions of Iran (Mehrafrooz Mayvan et al., 2021, 2022; Shayanmehr et al., 2019, 2022; Smolis & Skarżyński, 2020; Yoosefi Lafooraki et al., 2020a, 2020b; Yahyapour et al., 2020, 2021, 2022). Collembola fauna is not known in eastern Iran. Most of the studies on the identification of these arthropods in Iran have focused on the northern and western regions of the country (Shayanmehr et al., 2020). In this study, Collembola of Birjand area is investigated. Birjand city is the capital of this area which is located in South Khorasan province, one of the eastern provinces of Iran. The climate of this city is desert and semi-desert with hot and dry summers and cold winters. Because of this, the amount of rainfall in this city is low. Mountainous areas are seen in the southern and western regions of this city. From the review of articles published in the past years (Shayanmehr et al., 2020; Mehrafrooz Mayvan et al., 2021, 2022), it is understood that the Collembola fauna of Iran is unique and the study of these arthropods still leads to the report of a significant number of new species that are native to the country. This issue proves the need to investigate the springtails fauna in other provinces of the country in order to obtain more accurate statistics of their species diversity in the country. Until now, there has been no report of Collembola from Birjand area. Considering the importance of these arthropods, the present study was conducted to identify some of Collembola species in this area.

MATERIAL AND METHODS

In order to investigate the Collembola fauna, soil and leaf litter samples were collected from different parts of Birjand area, South Khorasan province and transported to the laboratory (Table 1). Springtail samples were extracted using Berlese funnel and preserved in 75% ethanol alcohol. To prepare the microscopic slide, first the specimens were placed in 10% potassium solution for 3–5 minutes to make them clear. Then they were mounted on a slide using Hoyer's medium and placed in an oven at a temperature of 45°C for two weeks. Samples were identified using the identification keys of Bretfeld (1999), Fjellberg (2007), and Jordana (2012). All specimens are deposited at the Insect collection of the Laboratory of Entomology, Sari Agricultural sciences and Natural Resources University, Iran.

RESULTS

Taxonomic hierarchy

Phylum Arthropoda von Siebold, 1848

Class Collembola Lubbock, 1871

Order Entomobryomorpha Börner, 1913

Family Entomobryidae Schäffer, 1896

Subfamily Entomobryinae Schäffer, 1896

Tribe Entomobrini Börner, 1906

***Drepanura tuxeni* Nosek, 1964 (Figs 1A–1B)**

Material examined. South Khorasan province, Birjand, Band-darreh, 32°49.11'N, 59°13.00'E, Soil, 1682 m, 11.v.2019, n= 10, leg. M.M. Rabieh.

Diagnosis. Body colour pattern as Figure 1A. Diagnostic characters of the species according to Jordana (2012) is as below: "Body length up to 4 mm excluding antennae. Head: Antennal length approximately 1.96 mm, between 2 and 3 times the length of the head (2.45), Antennal segment IV without apical vesicle. Relative length of antennal segments I: II: III: IV = 2: 3.8: 3.6: 3.2. Eyes 8+8 (Fig. 1B), GH smaller than EF. Length ratio of Abdominal segments IV: III <4. Claw with 4 internal teeth: first pair at 64% distance from base of claw, and 2 unpaired teeth, first one at 77% distance from base and the most distal one minute.

Table 1. The sampling localities in Birjand area, South Khorasan province.

| Localities | Date | Coordinate data | Altitude (m a.s.l.) | Sample type |
|----------------|-----------|--------------------------|---------------------|-------------|
| Esfahrud | 26.v.2019 | 32°47.01' N, 59°17.59' E | 1888 | Leaf litter |
| Razag | 06.v.2019 | 32°47.42' N, 59°15.39' E | 1836 | Leaf litter |
| Band-darreh | 11.v.2019 | 32°49.11' N, 59°13.00' E | 1682 | Soil |
| Chahkand | 31.v.2019 | 32°49.55' N, 59°09.37' E | 1716 | Leaf litter |
| Kuhestan Hotel | 13.v.2019 | 32°49.40' N, 59°10.48' E | 79 | Leaf litter |
| Giuk waterfall | 17.v.2019 | 32°47.31' N, 59°07.33' E | 1961 | Soil |
| Chahardeh | 21.v.2019 | 32°48.52' N, 59°14.16' E | 1658 | Leaf litter |

Dorsal tooth absent. Empodium spike-like, with smooth external edge on leg III. Length of Man+dens = 1.8 mm. Mucro falcate, mucronal spine present. Abdomen: Abd I: II: III: IV: V: VI = 1.3: 1.5: 1.6: 5.8: 0.8: 0.4. Furca shorter than antenna. Manubrium: dens ratio = 38:45''.

Distribution. Palaearctic, Tajikistan. The species is reported for the first time from Iran.

Tribe Willowsini Yoshii & Suhardjono, 1989

Drepanosira gisini Nosek, 1964 (Figs 1C–1E)

Material examined. South Khorasan province, Birjand, Esfahrud, 32°47.01'N, 59°17.59'E, Leaf litter, 1888 m, 26.v.2019, n=11; Razag, 32°47.42'N, 59°15.39'E, Leaf litter, 1836 m, 06.v.2019, n=2; Band-darreh, 32°49.11'N, 59°13.00'E, Soil, 1682 m, 11.v.2019, n=1; Chahkand, 32°49.55'N, 59°09.37'E, Leaf litter, 1716 m, 31.v.2019, n=4; Kuhestan Hotel, 32°49.40'N, 59°10.48'E, Leaf litter, 79 m, 13.v.2019, n=2; Giuk waterfall, 32°47.31'N, 59°07.33'E, Soil, 1961 m, 17.v.2019, n=4; Chahardeh, 32°48.52'N, 59°14.16'E, Leaf litter, 1658 m, 21.v.2019, n= 2, leg. M.M. Rabieh.

Diagnosis. Body colour pattern as Figure 1C. Diagnostic characters of the species according to Nosek (1964) is as below: "Body length 2.6 mm excluding antenna and furca, main colour yellowish white. The dark, black-blue pigments cover the anterior and lateral margins of the head, lateral margins of thoracic segments II and III and form torn spots on thoracic segment II, abdominal segments II and III. On Abd IV the pigments form a torn, zigzag transverse band as in *Willowsia nigromaculata*. Antenna and dorsal side of the manubrium and ventral side of the abdomen are bluish. A black spot appears at the base of the legs and femur. The body has plenty of bristles and is covered with narrow, pointed, fine scales (Fig. 1D). Antenna: head diagonal= 69.5: 23. Relative length of antennal segments I: II: III: IV= 9.5: 19.5: 19.5: 21. The sensory organ of antennal segment III consists of two short sensory rods, each standing in a small depression and protected by an integumentary fold. Ant IV with dense but short bristles, with a lateral papilla at the apex. Eyes 8+8, GH significantly smaller than the others. Labrum near the anterior margin with a transverse row of four tiny papillae; each is armed with a fine, short brush. Th II: Th III = 17: 11. Claw narrow, armed with a small outer tooth, indistinct lateral teeth and 3 inner teeth. Empodial appendage narrow, lanceolate, $\frac{2}{3}$ as long as inner edge of claw. Tibiotarsal hair severely twisted. Length ratio of Abdominal segments I: II: III: IV: V: VI = 9: 11: 9: 32: 8: 3. Manubrium: dens ratio = 26: 34. Mucro falcate with a long basal spine (Fig. 1E), three times shorter than the inside of the claw. The unnotched terminal part of the dens is about 2 times longer than mucro''.

Distribution. Palaearctic. The species is reported for the first time from Iran.

Order Symphypleona Börner, 1901

Family Bourletiellidae Börner, 1913

Cassagnaudiella cf. gamae (Bretfeld, 1994) (Figs 1F–1I)

Material examined. South Khorasan province, Birjand, Razag, 32° 47.42' N, 59° 15.39' E, Leaf litter, 1836 m, 06.v.2019, n=2; Chahkand, 32°49.55'N, 59°09.37'E, Leaf litter, 1716 m, 31.v.2019, n=3; Kuhestan Hotel, 32°49.40'N, 59°10.48'E, Leaf litter, 79 m, 13.v.2019, n=2; Giuk waterfall, 32°47.31'N, 59°07.33'E, Soil, 1961 m, 17.v.2019, n= 2, leg. M.M. Rabieh.

Diagnosis. Main colour of Iranian specimens brownish yellow with pale parts; head dorsally with small pale region, large abdomen with pale area on middle of dorsal side, laterally with pale spots (Figs 1F-1G). Diagnostic characters of the species according to Bretfeld (1999) is as below: "Total length 1 mm. Ventral head-back with 2+2 oval organs. Ant IV with about 10 subsegments (Fig. 1H). Tibiotarsus II row p:5 setae, length of longest setae of Tibiotarsus III>3x diameter of Tibiotarsus. Mucro with narrow anterior furrow (Fig. 1I). Secondary sexual characteristics of male: Abdominal segment VI dorsally with median crest, setae m1+2 as long, abruptly curved spines, DL1+2 as slender spines of equal form, other neighboring setae forming a basket around tip, all setae curved posteriorly, large abdomen posterodorsally with slightly swollen setae".

Distribution. Portugal. The species is reported for the first time from Iran.

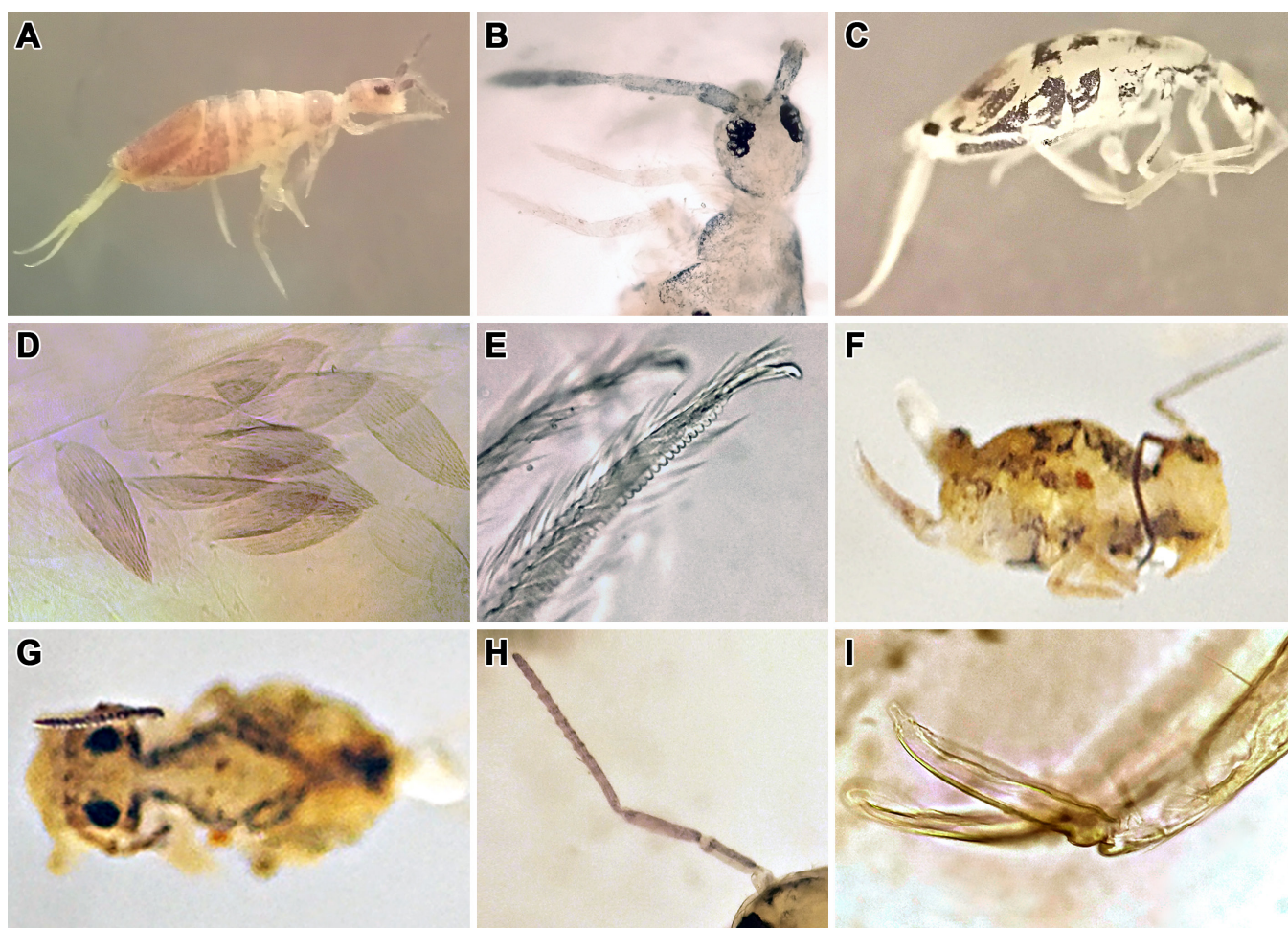


Figure 1. Collembola from Birjand (South Khorasan). **A.** Habitus of *Drepanura tuxeni* Nosek, 1964; **B.** Eye patches of *D. tuxeni*; **C.** *Drepanosira gisini* Nosek, 1964; **D.** Scales in *D. gisini*; **E.** Mucro of *D. gisini*; **F.** & **G.** *Cassagnaudiella* cf. *gamae* (Bretfeld, 1994), dorsal and lateral view of general habitus; **H.** Fourth antennal segment in *C. cf. gamae*; **I.** Mucro in *C. cf. gamae*.

DISCUSSION

Up to date, 13 genera and 45 species of family Entomobryidae were reported from Iran (Shayanmehr et al., 2020; Mehrafrooz Mayvan et al., 2022). With new records of this study, number of Entomobryidae species rises to 47 species. Here, we report the second species of *Drepanura*. The first record of the genus, *D. kirgisica* Martynova, 1971, was reported by Abdolalizadeh et al. (2018) from Kerman province. This species differs from *D. tuxeni* in body colour pattern. There are antero-lateral bands or lateral bands on mesothorax of *D. kirgisica*, while mesothorax of *D. tuxeni* is entirely coloured (Jordana, 2012). *Drepanosira gisini* which is reported in this article is the second report of the genus. *D. hussi* Neuherz, 1976 was reported from North Khorasan by Mehrafrooz Mayvan et al. (2022). These species are distinguished by their colour pattern.

The only report of family Bourletiellidae in Iran was done by Mehrafrooz Mayvan et al. (2021) from North Khorasan. They collected specimens of *Bourletiella* sp. which differs from *Cassagnaudiella gamae* in having clavate tenent hairs on Tibiotarsi. Up to now, 24 species of Symphypleona have been reported from Iran (Shayanmehr et al., 2019, 2020). With new report of this study this number raise to 25 species. Symphypleona is poorly known in Iran. It is expected that more investigations will distinguish more species of these globular Collembola in the country.

AUTHOR'S CONTRIBUTION

The authors confirm their contribution in the paper as follows: M.M. Rabieh & J. Noei: Collecting the specimens; M. Shayanmehr: Identification; E. Yoosefi Lafooraki: Writting the manuscript and taking the photographs. The authors read and approved the final version of the manuscript.

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AVAILABILITY OF DATA AND MATERIAL

The specimens listed in this study are deposited in the Insect collection of the Laboratory of Entomology, Sari Agricultural sciences and Natural Resources University, Iran 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.

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چکیده: طی نمونه‌برداری در سال ۱۳۹۸ در منطقه بیرجند (استان خراسان جنوبی)، سه گونه از خانواده‌های Entomobryidae و Bourletiellidae شناسایی شدند. این گونه‌ها شامل *Drepanura tuxeni* Nosek, 1964، *Drepanosira gisini* Nosek, 1964 و *Cassagnaudiella c.f. gamae* (Bretfeld, 1994) بوده و به تازگی برای فون پادمان ایران گزارش شدند. فهرست نمونه‌های بررسی شده و توصیف مختصر آنها به همراه تصاویر منتخب از گونه‌ها ارائه شد. لازم به ذکر است که گونه *Cassagnaudiella c.f. gamae* دومین رکورد گونه از خانواده Bourletiellidae از ایران محسوب می‌شود.

واژگان کلیدی: فون، خاک، دم‌فتری‌ها، Bourletiellidae، Entomobryidae