



Contribution to Collembola (Hexapoda: Entognatha) fauna from Golestan province, Iran

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ABSTRACT. Improved studies on Collembola fauna of Iran have been started only recently and springtails species from many regions of the country are still unknown. This study presents the results of a faunistic survey of springtails from Golestan province, Northern Iran. Samplings were done in different habitats of Gorgan and Kordkuy counties (Golestan province) including forests, agricultural fields and citrus orchards during 2014–2015. In total, 37 species from the families Entomobryidae, Paronellidae, Isotomidae, Tomoceridae, Onychiuridae and Tullbergiidae were identified. *Entomobrya numidica* Baquero, Hamra-Kroua & Jordana, 2009; *E. nivalis* Linnaeus, 1758; *E. nicoleti* Lubbock, 1868; *Cyphoderus agnotus* Börner, 1906; *Isotomurus* cf. *balteatus* Reuter, 1876; *Vertagopus* sp.; *Protaphorura* cf. *salsa* Kaprus, Pasnik et Weiner, 2014; *Mesaphorura yosii* Rusek, 1967; *Mesaphorura critica* Ellis, 1976 represent new records for Iranian fauna.

Key words: Arthropleona, Collembola, Golestan, Iran, new record.

Received:
10 August, 2016

Accepted:
27 September 2016

Published:
28 September 2016

Subject Editor:
Ehsan Rakhshani

Citation: Hosseini, F.S., Shayanmehr, M. and Amiri Besheli, B. 2016. Contribution to Collembola (Hexapoda: Entognatha) fauna from Golestan province, Iran. *Journal of Insect Biodiversity and Systematics*, 3 (3): 321–338.

Introduction

Collembola as a class of Hexapoda are small (1–5 mm), entognathous (mouthparts, such as mandibulae and maxillae, located within a gnathal pouch), wingless hexapods with antennae always present. Most, but not all Collembola may be recognized by furca (a posterior ventral forked appendage). Collembola distinguishes from the other entognathous Hexapoda including Protura and Diplura by antennae and absence of cerci (Bellinger *et al.* 2016). Nowadays, class of Collembola is divided into four orders

including Poduromorpha, Entomobryomorpha, Symphypleona and Neelipleona (Bellinger *et al.* 2014). Poduromorpha and Entomobryomorpha which already classified as Arthropleona have elongate body, while Symphypleona and Neelipleona (which has been separated from Symphypleona) have globular body shape (Fjellberg 2007). Order of Entomobryomorpha which recognized by elongate body, clearly separated thorax and abdomen and narrow first thorax segment without dorsal seta

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(Fjellberg 1998). In Poduromorpha legs and antennae are typically short and the first segment of thorax has dorsal setae (Fjellberg 1998, 2007).

The fauna of Collembola was investigated in many parts of the world, mainly in Europe and North America but still many parts of the world were not investigated especially in Asia. Iran is located in western Asia and it is the second-largest country in the Middle East (Encyclopedia Britannica, 2012). The old noteworthy study on Iranian Collembola fauna was performed by Cox (1982), who reported some species from Iran including those from Northern provinces. The next faunistic study on springtails was provided by Moravvej (2003). Shayanmehr *et al.* (2013) in a checklist of Iranian Collembola reported 112 species from Iran. Majority of species were reported from northern Iran especially Mazandaran province (Yahyapour and Shayanmehr 2011, 2013; Yoosefi Lafooraki and Shayanmehr 2013, 2014a, b, 2015; Alijani *et al.* 2015; Mehrafroz Mayvanet *al.* 2015a). The fauna of Collembola was poorly investigated in other parts of the country as well as many localities in northern Iran which include an extreme range of habitat diversity (Bazdid Vahdati *et al.* 2014).

Golestan Province is one of the 31 provinces of Iran, located in the north-east of the country south of the Caspian Sea. Its capital is Gorgan. It was split off from the province of Mazandaran in 1997.

In the faunistic study by Cox (1982), some species from Mazandaran and Guilan provinces were reported however it was not exactly defined those species from which localities in north of Iran were reported. Lately, Falahati (2012) reported some species (15 taxa) from Golestan province, but most specimens were identified at generic level. From

Entomobryomorpha, species including *Anurophorus coiffaiti* Cassagnau and Delamare, 1955, *Isotomurus punctiferus* Yossi, 1963, *I. maculatus* (Schaffer, 1869), *Folsomia penicula* (of Isotomidae), *Entomobrya* spp., *Lepidocyrtus* spp. and *Heteromurus* sp. were reported from Golestan province (Falahati Hossein Abad 2012).

From Poduromorpha, *Ceratophysella* sp., *Hypogastrura* sp. (Hypogastruridae) and *Protaphorura* sp. (Onychiuridae) were reported in Golstan. The only reported species from Symphypleona in Golestan was *Sminthurinus elegans* Fitch, 1863 (Falahati Hossein Abad 2012). Two new species including *Cryptonura persica* Smolis, 2012 and *Cryptonura maxima* Smolis, 2012 from Neanuridae were also introduced from Golestan province (Smolis *et al.* 2012).

Considering the poorly known diversity of Collembola in many habitats and many habitats of Golestan province the present study was conducted in this area.

Material and methods

In the present study specimens were collected from Golestan province, Iran, during 2014 and 2015. Golestan province is located at the Northeast region of the country, south to the Caspian Sea. In Golestan, there are various ecosystems including forests, agro-ecosystems and grasslands. Two sampling sites were chosen: Gorgan (36°50'N, 54°30'E), capital of Golestan province; and Kordkuy (36°48'N, 54°07'E) which are located at the west region of Golestan (Figure 1). The samplings were made from soil and leaf litter from forestry regions such as Alangdarreh Forest Park, Naharkhoran Forest, forest area of Ziarat village (Gorgan), Imam Reza forest park, Palangpa forest, and some agro-ecosystems such as citrus orchards and Rice, Wheat, Soybean fields (in Kordkuy).

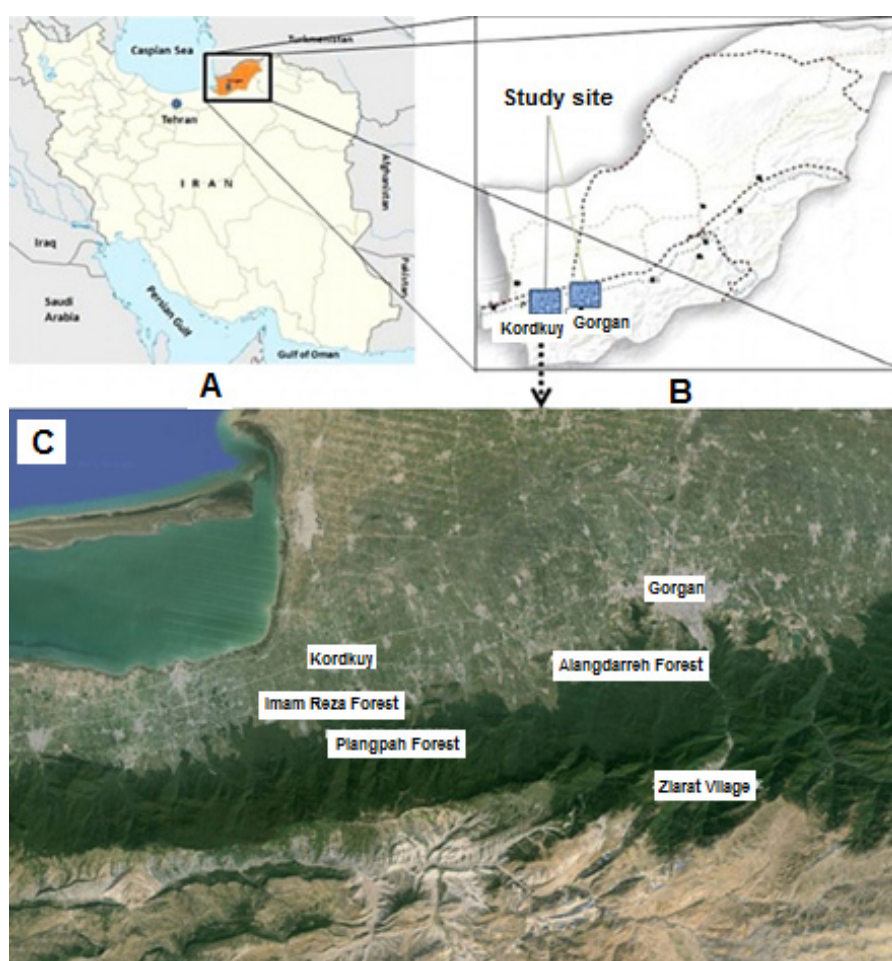


Figure 1. Sampling areas for Collembola in Golestan province, Iran: **A.** Iran map; **B.** Golestan province map; **C.** Gorgan and Kordkuy (study sites).

Specimens were extracted from leaf litter and soil samples by Berlese-Tullgren funnels and preserved in 75% ethanol. Photographs were taken under a Canon camera attached to a Nikon SMZ-U stereomicroscope. Obtained specimens were cleared with potassium hydroxide and mounted on slides in Hoyer's medium. The slide-mounted specimens were examined using a Nikon Eclips microscope E200, then photographed. Identifications were done on the basis of reliable keys (Fjellberg 1980, 1998, 2007; Jordana 2008; Potapov 2001; Bellinger *et al.* 2014), then confirmed by Dr. Igor Kaprus (Ukraine), Dr. Ernest C. Bernard (USA) and Dr. Bruno Bellini (Brazil). The voucher materials

which comprise slide mounted specimens are deposited in the Department of Plant Protection, Faculty of Crop Sciences, Sari University of Agricultural Sciences and Natural Resources (SANRU), Mazandaran province, Iran.

Results

In the present study 37 species belonging to six families (Entomobryidae, Paronellidae, Isotomidae, Tomoceridae, Onychiuridae, Tullbergidae) are recognized. The eight species including *Entomobrya nivalis* Linnaeus, 1758; *E. numidica* Baquero, Hamra-Kroua & Jordana, 2009; *E. nicoleti* Lubbock, 1868; *Cyphoderus agnotus* Börner, 1906; *Mesaphorura yosii* Rusek, 1967;

Mesaphorura critica Ellis, 1967; *Protaphorura* cf. *salsa* Kaprus, Pasnik, and Weiner, 2014 and *Vertagopus* sp. are reported for the first time for Iranian fauna. All identified species and 16 genera (*Seira* Lubbock, 1870; *Mesentotoma* Salmon, 1942; *Lepidocyrtus* Bourlet, 1839; *Pseudosinella* Schaefer, 1897; *Orchesella* Lubbock, 1873; *Cyphoderus* Nicolet, 1842; *Tomocerus* Nicolet, 1842; *Folsomides* Stach, 1922; *Isotomiella* Bagnall, 1939; *Vertagopus* Bagnall, 1939; *Proisotoma* Börner, 1901; *Parisotoma* Bagnall, 1940; *Heteraphorura* Bagnall, 1948; *Allonychiurus* Yosii 1995; *Thalassaphorura* Bagnall, 1949 and *Mesaphorura* Börner, 1901) are reported for the first time for Golestan province. A brief taxonomic note including distribution with some illustrations for the newly reported species are given.

Family Entomobryidae

Genus *Seira* Lubbock, 1870

Seira domestica Nicolet, 1842

(Figure 2A–B)

Material examined: Golestan province, Kordkuy, Crop field, 15 specimens, soil, 19.IV.2015; Kordkuy, Palangpa forest, soil and leaf litter under Ironwood, 1.IX.2014, 6.XI.2014 and 11.XI.2014; Kordkuy, Citrus garden, soil, 19.IV.2015; Gorgan, Alangdarreh forest, leaf litter 23.X.2014, Gorgan, Naharkhoran forest, on the trunk of the tree 30.VI.2015.

Distribution: Australia, Austria, France, Germany, Italy, Malta, Moldova, Portugal, UK, Argentina, Chile, Costa Rica (Mari-Mutt 1990) and Brazil (Abrantes *et al.* 2010, 2012).

Distribution in Iran: Mazandaran-Sari (Yahyapour 2012), Kermanshah-Harsin (Kahrarian *et al.* 2011), Guilan-Rasht (Daghighi 2012; Daghighi *et al.* 2013b).

Remarks. This genus is recorded for the first time from the Golestan province.

Genus *Heteromurus* Wankel, 1860

Heteromurus nitidus Templeton, 1835

(Figure 2C)

Material examined: Golestan province, Kordkuy, Crop field, 6 specimens, Soil, 19.IV.2015; Kordkuy, Palangpa forest, Soil, 21.IV.2014.

Distribution: Holarctic, Also present in Nearctic Region (Christiansen & Bellinger 1980), Argentina, Chile, New Zealand (Mari Mutt 1980).

Distribution in Iran: Mazandaran, Guilan (Cox 1982), Kermanshah (Kahrarian *et al.* 2014); Mazandaran (Yoosefi Lafooraki and Shayanmehr 2013).

Heteromurus major Moniez, 1889

(Figure 2D)

Material examined: Golestan province, Gorgan, Alangdarreh forest, more than 20 specimens, Soil under Horn beam, 23.X.2014; Kordkuy, Imam Reza forest, Soil, 7.XII.2014; Gorgan, Alangdarreh forest, Soil, 11.VII.2015.

Distribution: Australia, Chile, France, Germany, Greece, former Czechoslovakia, Hungary, Italy, Mexico, Palestine, Portugal, Romania, Spain, Switzerland, Republic of Azerbaijan, former Yugoslavia (Mari Mutt 1980),

Distribution in Iran: Central, East Azerbaijan, Mazandaran, Guilan (Cox 1982), Rasht (Daghighi *et al.* 2013b), Mazandaran-Sari (Yoosefi Lafooraki and Shayanmehr 2013), Kermanshah (Kahrarian *et al.* 2014)

Genus *Mesentotoma* Salmon, 1942

Mesentotoma subdolfusi Jacquemart, 1974

Material examined: Golestan province, Gorgan, Ziarat, 4 specimens, Soil and leaf litter, 11.XI.2014; Kordkuy, Palangpa forest, Soil under Horn beam and Ironwood, 25.IV.2015.

Distribution: England (Hopkin 1997), Tunisia (Jacquemart 1974).

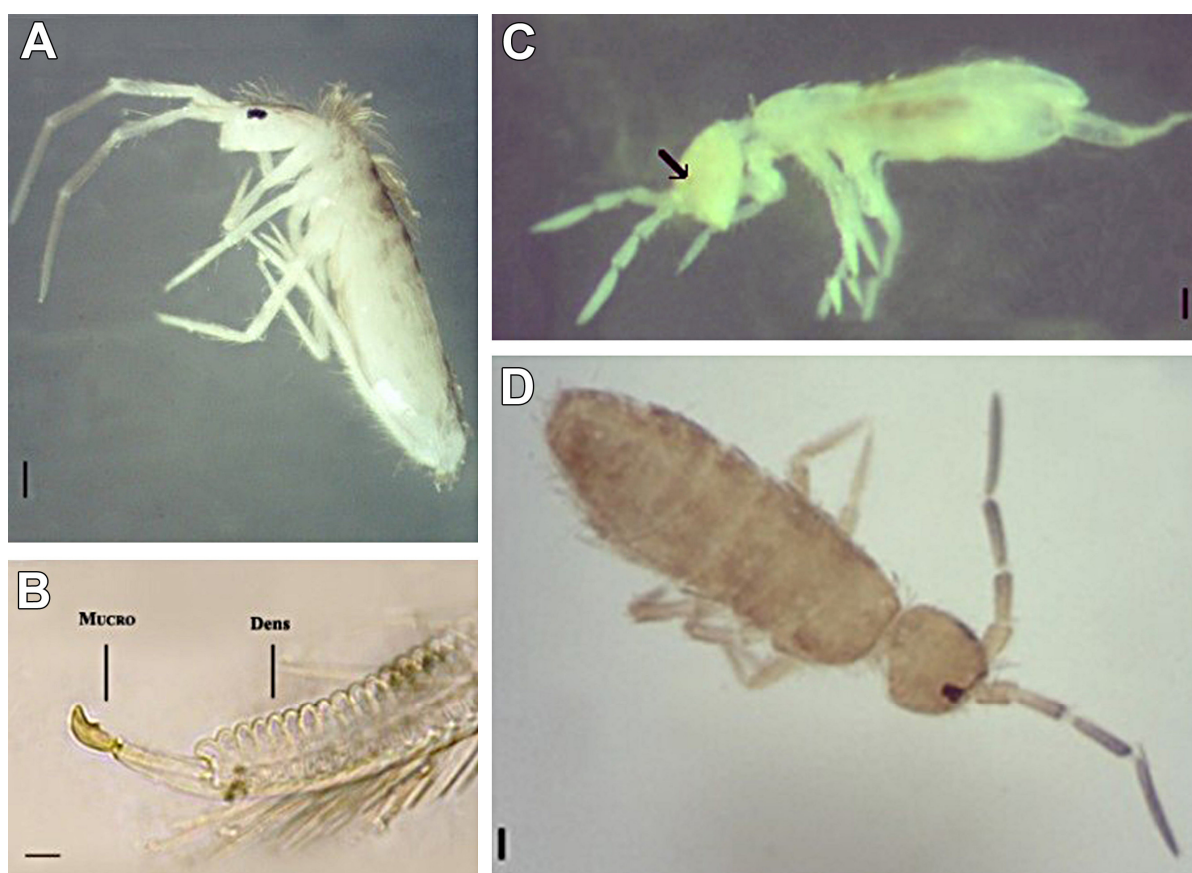


Figure 2. *Seira domestica* (A,B): **A.** Habitus, Scale bar = 100 μ m; **B.** Strongly crenulated dens and a highly distinctive mucro with a single tooth, Scale bar = 10 μ m; **C.** *Heteromorbus nitidus*: White body and 1+1 ocelli, Scale bar = 200 μ m; **D.** *Heteromorbus major*: Habitus presenting, pigment distributed throughout the antennae, Scale bar = 200 μ m.

Distribution in Iran: Guilan-Rasht (Daghighi 2012; Daghighi *et al.* 2013b).

Remarks. This genus is recorded for the first time from the Golestan province.

Genus *Entomobrya* Rondani, 1861

Entomobrya numidica Baquero, Hamra-Kroua and Jordana, 2009 (Figure 3A)

Material examined: Golestan province, Gorgan, Naharkhoran forest, 5 specimens, Soil and leaf litter, 21.IV.2014.

Distribution: Algeria (Jordana 2012).

Remarks. This species is recorded for the first time from Iran.

Entomobrya multifasciata Tullberg, 1871 (Figure 3B)

Material examined: Golestan province, Gorgan, Naharkhoran forest, 3 specimens, soil and leaf litter, 11.XI.2014; Kordkuy, Imam Reza forest, soil and leaf litter, 10.IV.2015 and 13.VI.2015.

Distribution: Nearctic Region (Christiansen and Bellinger 1980), Argentina, Juan Fernandez Islands, Eastern Island (a Chilean island in the southeastern Pacific Ocean) and Peru (Mari Mutt 1990), Sweden, France, Switzerland, Norway, Spain, Russia (Jordana 2012).

Distribution in Iran: Mazandaran, Sari (Yahyapour 2012; Yahyapour *et al.* 2011).

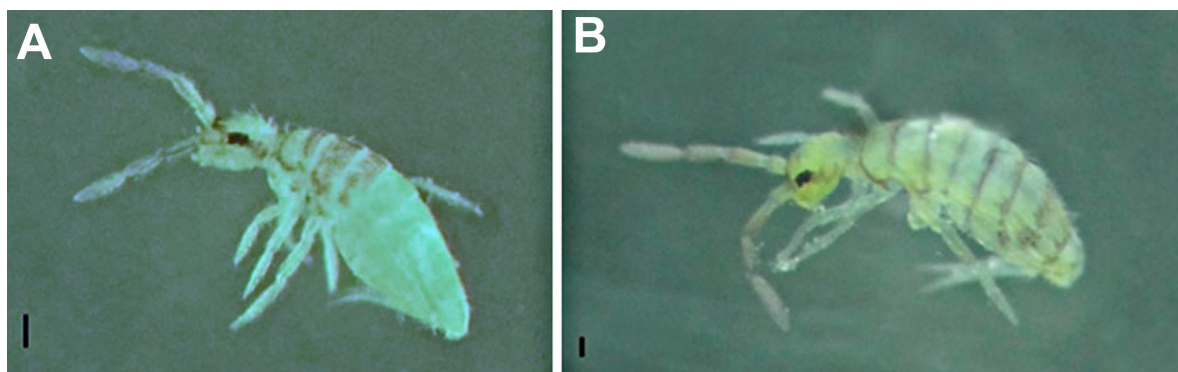


Figure 3. A. *Entomobrya numidica*: Habitus showing stripes on thorax, Scale bar = 200 μm ; B. *Entomobrya multifasciata* habitus, Scale bar = 100 μm .

***Entomobrya nivalis* Linnaeus, 1758**

Material examined: Golestan province, Gorgan, Naharkhoran forest, 3 specimens, soil and leaf litter near Iron wood, 11.XI.2014; Kordkuy, Rice field, soil from wheat field, 10.IV.2015 and 13.VI.2015.

Distribution: Cosmopolitan (Jordana 2012).

Remarks. This species is recorded for the first time from Iran.

***Entomobrya atrocincta* Schott, 1896**

Material examined: Golestan province, Gorgan, Naharkhoran forest, 8 specimens, soil and leaf litter, 07.V.2014.

Distribution: Argentina, Colombia, Costa Rica, Guatemala, Mexico, Peru and Venezuela (Mari Mutt 1990), North America (Jordana 2012).

Distribution in Iran: Mazandaran-Sari (Yahyapour 2012; Yahyapour *et al.* 2011); Kermanshah-Harsin (Kahrarian *et al.* 2012).

Remarks. This species is recorded for the first time from Golestan.

***Entomobrya nicoleti* Lubbock, 1868**
(Figure 4A–B)

Material examined: Golestan province, Gorgan, Naharkhoran forest, 8 specimens, Soil and leaf litter, 11.XI.2014; Kordkuy, Imam Reza forest, Soil and leaf litter, 10.IV.2015 and 13.VI.2015.

Distribution: Spain, Switzerland, Paris, Egypt, Russia, England, Germany (Jordana 2012).

Remarks. This species is recorded for the first time from Iran.

Genus *Lepidocyrtus* Bourlet, 1839

***Lepidocyrtus cyaneus* Tullberg, 1871**

(Figure 4C)

Material examined: Golestan province, Gorgan, Alangdarreh forest, 13 specimens, soil and leaf litter under Iron wood. 1. XII.2014; Kordkuy, Imam Reza forest, 6.XI.2014; Kordkuy, Palangpa forest, soil near Oak trees. 24.V.2014.

Distribution: Holarctic (Fjellberg, 2007).

Distribution in Iran: Mazandaran, Guilan, East Azarbaijan, Zanzan (Cox 1982).

***Lepidocyrtus lanuginosus* Gmelin, 1788.**

Material examined: Golestan province, Gorgan, Palangpa forest, 3 specimens, soil and leaf litter. 23. X.2014.

Distribution: Widely distributed (Fjellberg, 2007; Bellinger *et al.* 2016).

Distribution in Iran: Central, Mazandaran, Guilan, East Azarbaijan (Cox 1982).

Remarks. This genus is recorded for the first time from the Golestan province.

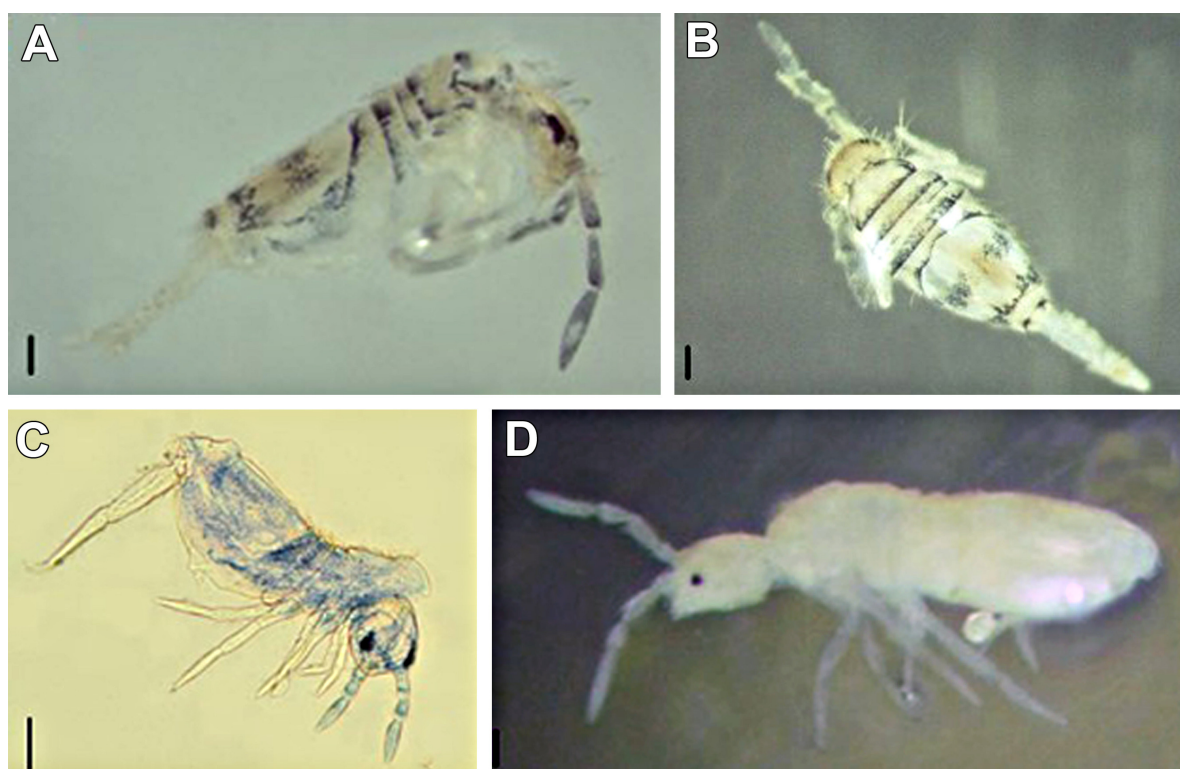


Figure 4. *Entomobrya nicoleti* (A, B): A. Lateral habitus; B. Dorsal habitus, Scale bars = 300 μ m; C. *Lepidocyrtus cyaneus* habitus, Scale bar=300 μ m; D. *Pseudosinella octopunctata* habitus: White, with diffuse bluish grey pigment eyepatches, Scale bar = 200 μ m.

Genus *Pseudosinella* Schaefer, 1897

Pseudosinella octopunctata Böner, 1901
(Figure 4D)

Material examined: Golestan province, Kordkuy, Imam Reza forest, on the rock that overgrown with moss, 25 specimens, 7.XII.2014 and 19.VII.2015; Kordkuy, Palangpa forest, 21.IV.2014; Kordkuy, Crop field, 25.IV.2015; Gorgan, Alangdarreh forest, 11.VII.2015; Gorgan, Naharkhoran forest, 18.VII.2015; Gorgan, Ziarat, soil and leaf litter, 18.VII.2015.

Distribution: Cosmopolitan (Fjellberg 2007).

Distribution in Iran: Guilan, Zanzan, East and West Azarbaijan, Central, Mazandaran (Cox 1982), Mazandaran (Yahyapoor and Shayanmehr 2013), Isfahan, Zarrinshahr (Yoosefi Lafooraki and Shayanmehr 2013), Kermanshah (Kahrarian *et al.* 2014).

Remarks. This genus is recorded for the first time from the Golestan province.

Genus *Orchesella* Lubbok, 1873

Orchesella cincta Linnaeus, 1758
(Figure 5A)

Material examined: Golestan province, Kordkuy, Imam Reza forest, 5 specimens, leaf litter, 07.XII.2014 and Kordkuy, Palangpa forest, leaf litter and soil near Alder trees, 19.VI.2015.

Distribution: Holarctic (Fjellberg 2007).

Distribution in Iran: Mazandaran, Savadkooch, Alasht, Serin (Yoosefi Lafooraki and Shayanmehr 2013).

Remarks. This genus is recorded for the first time from the Golestan province.

Family Paronellidae

Genus *Cyphoderus* Nicolet, 1842
Cyphoderus agnotus Börner, 1906
(Figure 5B).

Material examined: Golestan province, Gorgan, Naharkhoran forest, 5 specimens, soil under stone, 30.I.2015; Kordkuy, Imam Reza forest, soil 19. IV. 2015.

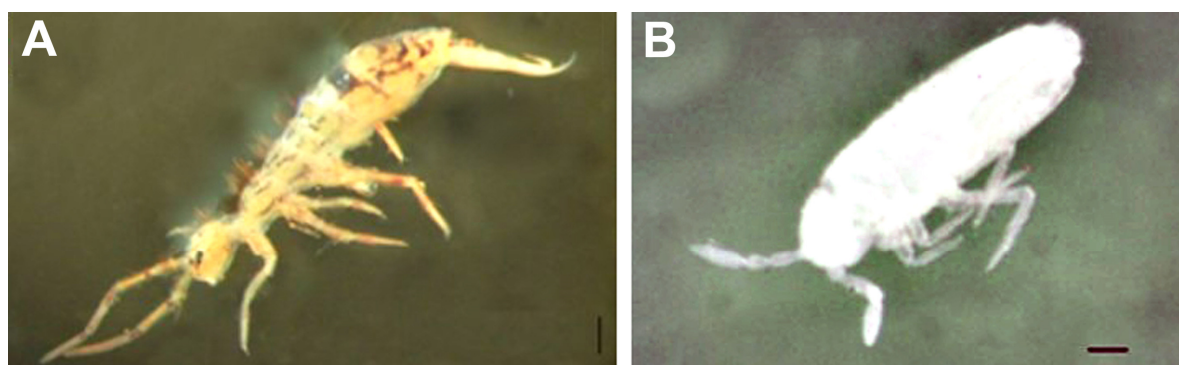


Figure 5. A. *Orchesella cincta* habitus: dark disc of pigment on third abdominal segment, Scale bar = 300 μ m; B. *Cyphoderus agnotus* habitus: Eyes absent, Scale bar = 200 μ m.

Distribution: South America (Bellinger *et al.* 2016).

Remarks. This genus is recorded for the first time from the Golestan and *C. agnotus* represents a new record for Iran fauna.

Family Isotomidae

Genus *Anurophorus* Nicolet, 1842

Anurophorus sp. (Figure 6A–B)

Material examined: Golestan province, Kordkuy, Palangpa forest, 15 specimens, soil near Ironwood and a river, 06.VI.2015.

Distribution: Holarctic (Potapov 2001).

Remarks. The species *A. coiffaiti* Cassagnau and Delmare, 1955 already reported from Golestan province was collected by Falahati (2012), but the specimens from the present study were different from *A. coiffaiti*.

Genus *Folsomides* Stach, 1922

Folsomides parvulus Fjellberg, 1993 (Figure 6C)

Material examined: Golestan province, Kordkuy, Palangpa forest, 30 specimens, soil, 11.XI.2014.

Distribution: Cosmopolitan (Potapov 2001).

Distribution in Iran: Central, Mazandaran, Guilan, E, W. Azarbaijan (Cox 1982); Guilan, Rasht (Daghighi 2012); Kermanshah, Harsin (Kahrarian *et al.* 2012); Mazandaran, Sari (Yahyapour 2012) and (Yoosefi Lafooraki 2014); Tehran (Ghazi 2015).

Remarks. This genus is recorded for the first time from the Golestan province.

Genus *Isotomiella* Bagnall, 1939

Isotomiella minor Schaffer, 1896 (Figure 6D)

Material examined: Golestan province, Kordkuy, Palangpa forest, 15 specimens, soil and straw, 06.VI.2015 and 01.III.2015.

Distribution: Mexico, Iran, North of Africa, North America, Eurasia (Fjellberg 2007).

Distribution in Iran: Mazandaran, Guilan, E. Azarbayjan, Tehran (Cox 1982); Tehran (Moravvej 2003); Guilan, Rasht (Daghighi 2012); Mazandaran, Sari (Yahyapour 2012); Kermanshah (Ghahramaninezhad *et al.* 2014); Mazandaran, Noshahr (Yoosefi Lafooraki 2014); Tehran (Ghazi 2015).

Remarks. This genus is recorded for the first time from the Golestan province.

Genus *Isotomurus* Börner, 1903

Isotomurus cf. *palustris* Muller, 1776 (Figure 7A–B)

Material examined: Golestan province, Kordkuy, Palangpa forest, 10 specimens, 24.V.2014, 31.XII.2014, 11.XI.2014, 1.VI.2014; Kordkuy, Imam Reza forest, soil near Hornbeam and Ironwood trees, 15.V.2015.

Distribution: Holarctic (Potapov 2001).

Distribution in Iran: Central, Mazandaran, Guilan (Cox 1982).

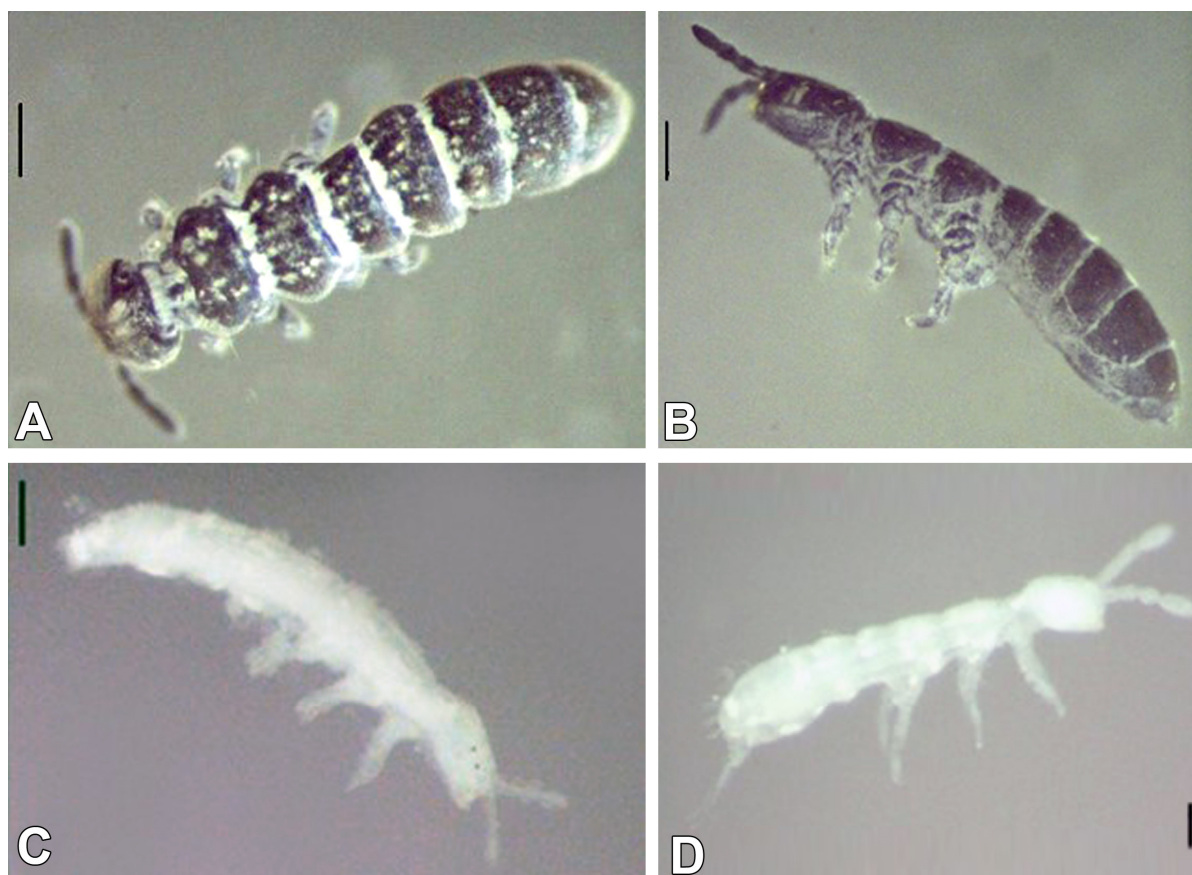


Figure 6. *Anorophorous* sp. habitus. Body dark and furca absent (A,B): **A.** Lateral habitus; **B.** Dorsal habitus, Scale bar = 200 μ m; **C.** *Folsomides parvulus* habitus, Body shape tube-like, Omma 2+2; posterior one far apart from the anterior, Scale bar = 100 μ m; **D.** *Isotomiella minor* habitus: white color, without Omma, Scale bar = 300 μ m.

***Isotomurus* sp.1** (Figure 7C)

Material examined: Golestan province, Kordkuy, Palangpa forest, 12 specimens, soil and leaf litter, 21.XI.2014 and 25.IV.2015, Kordkuy, Imam Reza forest, soil, 05.V.2015, Kordkuy, Rice field, soil, 19.IV.2015.

Remarks. Resembles *Isotomurus cf. palustris* but stripe thinner, more uniform; body with splotches and spots of purple.

***Isotomurus* sp. 2** (Figure 7D)

Material examined: Golestan province, Kordkuy, Palangpa forest, 10 specimens, soil, 21.XI.2014, Kordkuy, Imam Reza forest, soil, 05.V.2015.

Remarks. Uniform brownish-purplish color, no stripes or bands.

***Isotomurus cf. balteatus* Reuter, 1876**

(Figure 7E)

Material examined: Golestan province, Kordkuy, Imam Reza forest, 9 specimens, leaf litter, 19.IV.2015.

Distribution: Latvia, Korea, India, Australia (Potapov 2001).

Remarks. This species is recorded for the first time from Iran.

Genus *Isotoma* Bourlet, 1839

***Isotoma* sp.** (Figure 8 A–B)

Material examined: Golestan province, Kordkuy, Palangpa forest, 8 specimens, soil near Hornbeam 01.XII.2014 and 25.IV.2015.

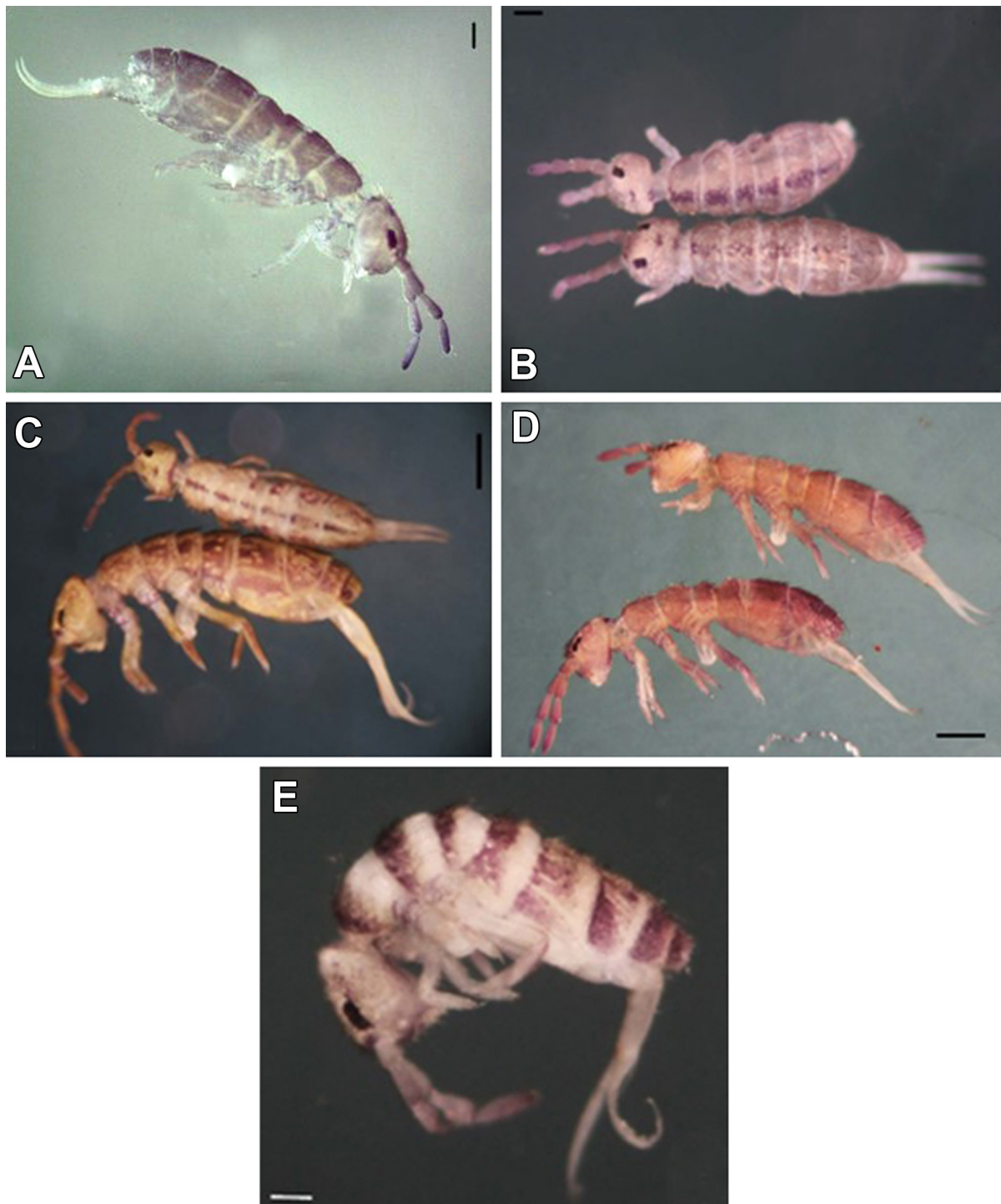


Figure 7. *Isotomurus* cf. *palustris* habitus (A,B); **A.** Lateral part of tergites with some lateral spots and indistinct thin bands; **B.** with the dark dorsomedian band frequently interrupted, Scale bar = 200 μ m; **C.** *Isotomurus* sp.1 habitus, Dorsal and lateral view, Body stripe thin, more uniform, body with splotches and spots of purple, Scale bar = 300 μ m; **D.** *Isotomurus* sp.2 habitus, Lateral view, Uniform brownish-purplish color, no stripes or bands, Scale bar = 300 μ m; **E.** *Isotomurus* sp. habitus, Transverse stripes on body segments, Scale bar = 200 μ m.

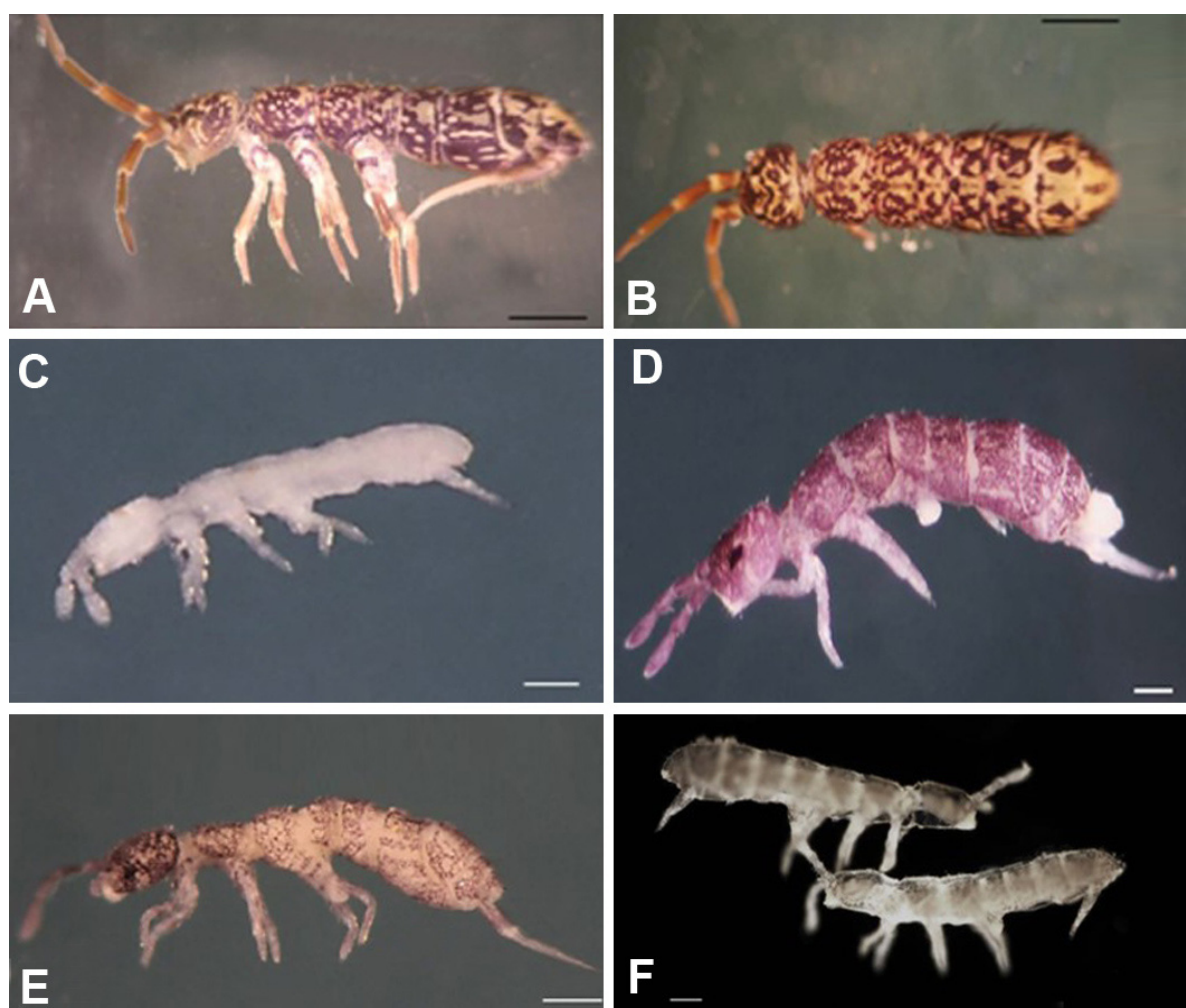


Figure 8. *Isotoma* sp. habitus (A, B): strong mottled patterns: **A.** Lateral; **B.** Dorsal, Scale bar = 1000 μ m; **C.** *Folsomia* sp habitus, Body rather straight and cylindrical, Posterior end without prominent curved setae. The three last abdominal segments fused, Scale bar = 200 μ m; **D.** *Vertagopus* sp. with spine or chitinised corona-like wart on abdomen, Scale bar = 100 μ m; **E.** *Parisotoma notabilis* habitus: from pale to diffusely grey or rarely blackish, Small eyespots, Scale bar = 100 μ m; **F.** *Proisotoma minuta* habitus above, *Proisotoma* sp. habitus below, Scale bar = 200 μ m.

Remarks. This species is not *I. iranica* Arbea and Kahrarian (2015), pattern not quite right and has single manubrial teeth, rather than bifurcate. This species is recorded for the first time from Iran.

Genus *Folsomia* Willem, 1902

Folsomia sp. (Figure 8C)

Material examined: Golestan province, Kordkuy, Palangpa forest, 6 specimens, soil, 11.XI.2014.

Genus *Vertagopus* Bagnall, 1939

Vertagopus sp.

(Figure 8D)

Material examined: Golestan province, Kordkuy, Palangpa forest, 5 specimens, soil under stone, 21.XI.2014.

Remarks. This genus is recorded for the first time from Iran.

Genus *Parisotoma* Bagnall, 1940

***Parisotoma notabilis* Schaffer, 1896**
(Figure 8E)

Material examined: Golestan province, Kordkuy, Palangpa forest, 14 specimens, soil under stone, 21.XI.2014.

Distribution: Cosmopolitan (Bei-Bienko 1967; Fjellberg 2007; Hopkin 1997).

Distribution in Iran: Mazandaran, Markazi, Guilan, Zanjan, E,W. Azarbaijan (Cox 1982); Tehran (Moravvej 2002); Guilan, Rasht (Daghighi 2014); Kermanshah (Kahrarian *et al.* 2012); Mazandaran, Noor (Yoosefi Lafooraki 2014).

Remarks. This genus is recorded for the first time from the Golestan province.

Genus *Proisotoma* Börner, 1901

***Proisotoma minuta* Tullberg, 1871**
(Figure 8F)

Material examined: Golestan province, Kordkuy, Palangpa forest, 10 specimens, soil near a river, 30.VI. 2015.

Distribution: Cosmopolitan (Potapov 2001).

Distribution in Iran: Markazi, Mazandaran, Guilan, Zanjan, East and West Azarbayian (Cox 1982); Tehran (Moravvej 2002); Guilan, Rasht (Daghighi 2014); Kermanshah (Kahrarian *et al.* 2012); Mazandaran, Mahmoud Abad (Yoosefi Lafooraki and Shayanmehr 2014).

Remarks. This genus is recorded for the first time from the Golestan province.

***Proisotoma* sp.** (Figure 8F)

Material examined: Golestan province, Kordkuy, Palangpa forest, 4 specimens, soil near a river, 30.VI.2015.

Remarks. Very similar to *P. minuta* but without ventral setae on Thorax III. This genus is recorded for the first time from the Golestan province.

Family Tomoceridae**Genus *Tomocerus* Nicolet, 1842**

***Tomocerus vulgaris* Tullberg, 1871**
(Figure 9 A-C)

Material examined: Golestan province, Gorgan, Ziarat village, 10 specimens, Leaf litter, 11. XI.2014; Kordkuy, Palangpa forest, on the Alder tree, 25.IV.2015.

Distribution: Cosmopolitan (Fjellberg 2007).

Distribution in Iran: Guilan, Zanjan, East Azerbaijan, Central, Mazandaran (Cox 1982); Mazandaran, Sari (Yoosefi Lafooraki 2014).

***Tomocerus minor* Lubbock, 1862**

(Figure 9D)

Material examined: Golestan province, Gorgan, Ziarat, 6 specimens, leaf litter, 11.XI. 2014; Kordkuy, Palangpa forest, 25.IV.2015.

Distribution: Holarctic (Fjellberg 2007).

Remarks. This genus is recorded for the first time from the Golestan province and species *T. minor* is new for Iran fauna.

Family Onychiuridae**Genus *Allonychiurus* Yosii 1995**

***Allonychiurus* sp.**

Material examined: Golestan province, Gorgan, Alangdarreh forest, 15 specimens, Soil under Horn beam, 23.X.2014; Kordkuy, Imam Reza forest, Soil, 7.XII. 2014; Gorgan, Alangdarreh forest, Soil, 11.VII.2015.

Distribution: Palaearctic (Bellinger *et al.* 2016).

Distribution in Iran: This genus was reported by Qazi and Shayanmehr (2014) from Tehran province, but the species remained understudied. The specimens from present study and specimens of *Allonychiurus* sp. collected by Ghazi and Shayanmehr (2015) are the same and it seems to be new for science and the description will be done in the future.

Remarks. This genus is recorded for the first time from the Golestan province.

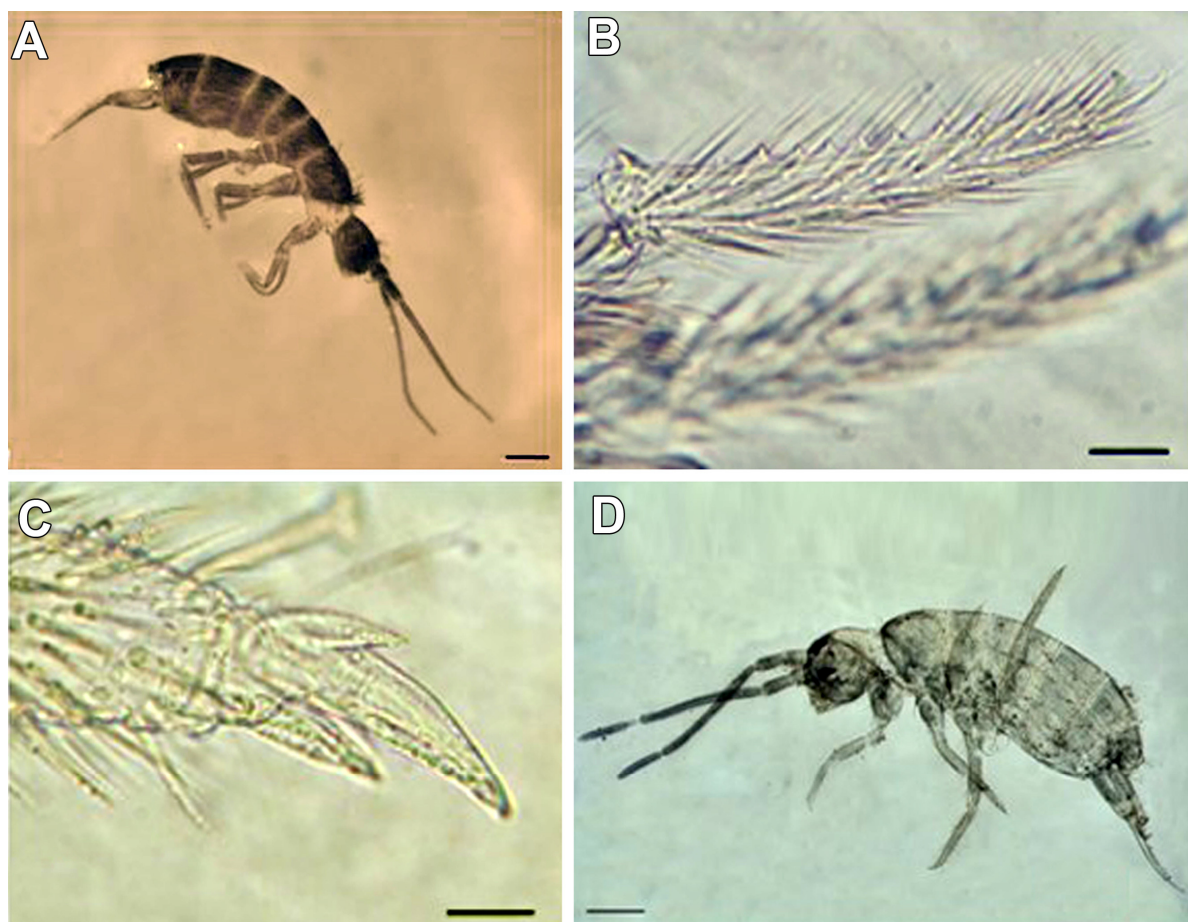


Figure 9. *Tomocerus vulgaris* (A-C): **A.** Habitus, antennae about 5 times as long as head, Scale bar = 300 µm; **B.** smaller median teeth in the midsection of mucro; **C.** Strong lateral teeth at the base of the claws, Scale bars = 10 µm; **D.** *Tomocerus minor* habitus, Scale bar = 200 µm.

Genus *Heteraphorura* Bagnall 1984

Heteraphorura cf. japonica Yosii 1967

Material examined: Golestan province, Gorgan, Alangdarreh forest, 26 specimens, Soil under Horn beam, 23.X.2014; Kordkuy, Imam Reza forest, Soil, 7.XII. 2014; Gorgan, Alangdarreh forest, Soil, 11.VII. 2015.

Distribution: Russia (Bellinger *et al.* 2016)

Distribution in Iran: Mazandaran (Yoosefi Lafooraki 2014) and Tehran (Qazi and Shayanmehr 2014).

Remarks. This genus is recorded for the first time from the Golestan province.

Genus *Protaphorura* Absolon, 1901

Protaphorura cf. salsa Kaprus, Pashnik, & Weiner, 2014

Material examined: Golestan province, Gorgan, Alangdarreh forest, 10 specimens, Soil, 23.X.2014. Kordkuy, Imam Reza forest, Soil, 07.XII.2014; Gorgan, Naharkhoran forest, Soil, 11.VII.2015.

Remarks. This species is recorded for the first time from Iran.

Protaphorura levantina (Christiansen, 1957)

Material examined: Golestan province, Gorgan, Alangdarreh forest, 25 specimens, Soil, 23.X.2014; Kordkuy, mam Reza forest,

Soil, 7. XII.2014; Gorgan, Naharkhoran forest, Soil, 11.VII.2015.

Distribution: Lebanon and Syria (Christiansen 1957).

Distribution in Iran: Kermanshah (Kahrarian *et al.* 2015); Ilam (Shayanmehr *et al.* 2015).

Remarks. This species is recorded for the first time from Golestan province.

Protophorura sakatoi Yosii, 1966

Material examined: Golestan province, Gorgan, Alangdarreh forest, 16 specimens, Soil, 23.X.2014; Kordkuy, Imam Reza forest, Soil under Oak trees, 7.XII.2014; Gorgan, Naharkhoran forest, Soil, 11.VII.2015.

Distribution: Palearctic (Bellinger *et al.* 1996-2016).

Distribution in Iran: Mazandaran (Yoosefi Lafooraki, 2014). Ilam (Shayanmehr *et al.* 2015).

Remarks. This genus is recorded for the first time from the Golestan province.

Genus *Thalassaphorura* Bagnall 1949

Thalassaphorura encarpata Denis, 1931

Material examined: Golestan province, Gorgan, Alangdarreh forest, 22 specimens, Soil, 23.X.2014; Kordkuy, Imam Reza forest, Soil under Oak trees, 7.XII.2014; Gorgan, Naharkhoran forest, Soil, 11.VII.2015.

Distribution: Cosmopolitan (Bellinger *et al.* 1996-2016).

Distribution in Iran: Mazandaran (Yoosefi lafooraki 2014); Tehran (Ghazi 2015).

Remarks. This genus is recorded for the first time from province.

Family Tulbergiidae

Genus *Mesaphorura* Börner, 1901

Mesaphorura yosii Rusek, 1967

Material examined: Golestan province, Gorgan, Alangdarreh forest, 14 specimens,

soil, 23.X.2014; Kordkuy, Palangpa forest, soil, 21.XI.2014 and, Kordkuy, Imam Reza forest, soil, 25.IV.2015.

Distribution: Holarctic, probably cosmopolitan (Dunger and Schlitt 2011).

Remarks. This species is recorded for the first time from Iran.

Mesaphorura critica Ellis, 1976

Material examined: Golestan province, Gorgan, Alangdarreh forest, 10 specimens, soil, 23.X.2014; Kordkuy, Palangpa forest, soil, 21.XI.2014 and, Kordkuy, Imam Reza forest, soil, 25.IV.2015

Distribution: Palearctic (Dunger and Schlitt 2011).

Remarks. This species is recorded for the first time from Iran.

Discussion

In the present study in sum, 37 species from Collembola were reported from Golestan province. All species were collected from soil and leaf litter. Some species from this study are common and widespread Collembola such as *H. major* which is the abundant species in hyrcanian forest, Semeskandeh (Sari, Mazandaran) (Mehrafroz Mayvan *et al.* 2015b). Species including *Entomobrya numidica*, *E. nivalis*, *E. nicoleti*, *Cyphoderus agnotus*, *Isotomurus* cf. *balteatus*, *Vertagopus* sp., *Protaphorura* cf. *salsa*, *Mesaphorura yosii*, *Mesaphorura critica* were recorded newly for Iranian fauna.

The species belong to Hypogastruridae and Neanuridae (Poduromorpha) and Symphypleona also collected which they were not identified yet. Unfortunately, no keys are published for the Asian countries. Therefore, the key for European countries such as Fjeellberg (1998, 2007) which are easy to handle and also are for Palearctic regions were used frequently. Also, the faun of Collembola in neighbor countries also not investigated comprehensively.

Only in Turkey, a checklist comprised 73 species have been recorded from only a few provinces (Sevgili and Özata 2014). In Iran still, many provinces were not examined yet. Therefore, the list of species from Iran will increase in future.

Acknowledgments

We thank Dr. Bruno Bellini for identifying the specimens of Entomobryidae. We wish to express our gratitude to Dr. Ernest Bernard for his useful comments and images and identifying the specimens of Isotomidae. We thank Dr. Igor Kaprus for identifying Onychiuridae. We also thank the Sari University of Crop Sciences and Natural Resources (SANRU), to provide the facilities for the study.

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تاریخ دریافت: ۷ شهریور ۱۳۹۵، تاریخ پذیرش: ۶ مهر ۱۳۹۵، تاریخ انتشار: ۷ مهر ۱۳۹۵

چکیده: مطالعات بیشتر بر روی فون پادمان ایران در چند سال اخیر شروع شده است، اما گونه‌های پادمان در بسیاری از نقاط ایران، بدون شناسایی باقی مانده‌اند. این تحقیق نتایج بخشی از بررسی فون پادمان استان گلستان (از استان‌های شمال ایران) را ارائه می‌دهد. نمونه‌برداری‌ها از زیستگاه‌های مختلف شامل جنگل‌ها، مزارع کشاورزی و باغ‌های مرکبات در بخش‌های گرگان و کردکوی (استان گلستان)، طی سال‌های ۱۳۹۴-۱۳۹۵ انجام گرفت. در مجموع ۳۷ گونه از خانواده‌های Entomobryidae، Paronellidae، Isotomidae، Tomoceridae، Onychiuridae و Tullbergiidae شناسایی شد. گونه‌های *Entomobrya nivalis*، *numidica* Baquero, Hamra-Kroua and Jordana, 2009، *Cyphoderus agnotus* Börner، *E. nicoleti* Lubbock, 1868، Linnaeus, 1758، *Protaphorura*، *Vertagopus* sp.، *Isotomurus* cf. *balteatus* Reuter, 1876، 1906، *Mesaphorura yosii* Rusek, 1967، cf. *salsa* Kaprus, Pasnik et Weiner, 2014 و *Mesaphorura critica* Ellis, 1976 برای اولین بار از ایران گزارش می‌شوند.

واژگان کلیدی: آرتروپلونا، پادمان، گلستان، ایران، گزارش جدید.