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A survey on Entomobryomorpha (Collembola, Hexapoda) fauna in Northern Iran with an identification key

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Members of order Entomobryomorpha (Collembola) are known by their elongate body and small, setae-less prothorax. In the course of the study the Collembola fauna in Mazandaran province, several soil samples were collected from forests, agricultural fields and gardens in 2011-2013 and the animals were extracted by Berlese funnels. A total of 21 species and 18 genera of order Entomobryomorpha were collected and identified. The family Paronellidae, two genera *Cyphoderus* Nicolet, 1842 and *Sinella* Brook, 1882 and the three species, *C. albinus* Nicolet, 1842 (Paronellidae), *S. curviseta* Brook, 1882 and *Entomobrya lindbergi* Stach, 1960 (Entomobryidae), are reported for the first time from Mazandaran province. We also provided an identification key for the collected families and genera which have been reported until now from this province is presented.

Key words: Entomobryomorpha, Iran, identification key.

INTRODUCTION

The class Collembola is contained of four order Poduromorpha, Entomobryomorpha, Symphypleona and Neelipleona (Deharveng, 2004). The members of Entomobryomorpha are distinguished from the other groups by their body characters. They have elongate body and small prothorax without dorsal setae. Body is covered by scales or setae, with or without post antennal organ (PAO). The body color varies between dark to white; with 8+8 ocelli or fewer, some are blind. This order includes four superfamilies: Isotomoidea, Coenaletoidea, Tomoceroidea and Entomobryoidea (Soto-Adams et al., 2008). The superfamily Coenaletoidea has never been recorded from Iran; Tomoceroidea includes families Tomoceridae and Oncopoduridae which have been reported from Iran; from Isotomoidea, only Isotomidae was recorded from Iran; but two families Entomobryidae and Paronellidae belonging to Entomobryoidea have been recorded from Iran (Shayanmehr et al., 2013).

Until now, several studies have been done to achieve a better understanding of the Collembola fauna in Iran and several species of Entomobryomorpha have been reported (Shayanmehr et al., 2013). Cox (1982) recorded 30 species of the four families Entomobryidae, Isotomidae, Tomoceridae and Oncopoduridae from Mazandaran, Gilan, East and West Azerbaijan, Zanjan and Central (Tehran, Qom and Qazvin). Moravvej (2003) identified 10 species of the families Entomobryidae and Isotomidae from Tehran region. Nematollahi et al. (2009) recorded two species *Sinella tenebricosa* Folsom 1902 and *Proisotoma minuta* Reuter 1895 from Isfahan. Four species of Isotomidae were

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collected by Falahati (2012) from Gorgan region. Kahrarian et al. (2012) identified 5 Isotomidae and 2 Entomobryidae species from Kermanshah province. Yahyapour (2012) collected 6 species of Isotomidae from Sari region. Daghighi et al. (2013a) reported 18 species belonging to the families Isotomidae, Entomobryidae and Kattianidae from Rasht region which 11 species belonged to Entomobryidae and 6 species belonged to Isotomidae. Daghighi et al. (2013b) 11 species belonging to 8 genera of family Isotomidae collected from Rasht region in Gilan province. Ghahramaninezhad et al. (2013) recorded 3 species from Kermanshah region. Shayanmehr et al. (2013) prepared a checklist of Iranian Collembola which includes 56 species belonging to the families Paronellidae, Entomobryidae, Isotomidae, Tomoceridae and Oncopoduridae. Yahyapoor and Shayanmehr (2013) identified 5 species of Entomobryidae from Caspian regions in northern Iran which three of them were new records for Iran. Yoosefi Lafooraki and Shayanmehr (2013) reported 11 species of Collembola including five species of Entomobryomorpha from Mazandaran, Isfahan and Semnan. Kahrarian et al. (2014) collected 11 species of the family Entomobryidae from Kermanshah province. They reported five new species and one new genus for the fauna of Iran.

Collembola are abundant and widespread in soil ecosystems and are important members of the decomposer community (Hopkin, 1997). These arthropods have still remained unknown in Iran and their fauna is poorly recognized. In this study, the Entomobryomorpha fauna of Mazandaran province is investigated. Furthermore, an identification key is presented for all reported families and genera of this order which have been reported until now from Mazandaran province.

MATERIAL AND METHODS

This study was performed in several regions of Mazandaran province in 2011-2013 (Fig. 1). The soil, leaf litter and moss from forests and crop fields were carried to the laboratory and springtails were extracted by modified Berlese funnels. The specimens were preserved in 80% ethanol. The pigmented samples were cleared in KOH and their important taxonomic structures were made visible. After preparing microscopic slides by Hoyer's medium, the specimens were identified using available keys (Potapov, 2001; Fjellberg, 2007; Jordana, 2012), and the final identifications confirmed by Dr. Rafael Jordana from Spain and Dr. Ernest C. Bernard from the USA. In this paper, a complete list of families, genera and species of order Entomobryomorpha collected from Mazandaran province is provided. The descriptions, photos and identification key for members of family Isotomidae is available in Yoosefi Lafooraki and Shayanmehr (2014). Here, some information on sampling sites and their distribution is presented. For other families, genera and species, in addition to collecting data and distribution, some notes on their description and also photos and identification key for genera is provided. There are some microscopic slides and in alcohol preserved specimens of the materials in Entomology laboratory of Agricultural Sciences and Natural Resources university of Sari.

RESULTS

Totally, 21 species and 18 genera belonging to five families of the Entomobryomorpha were collected and identified from Mazandaran province in Northern Iran. These species list and their sampling information are given.

An identification key for the families and genera of order Entomobryomorpha is also presented. This key includes all the genera which have reported from Mazandaran province in previous studies as well as this study.

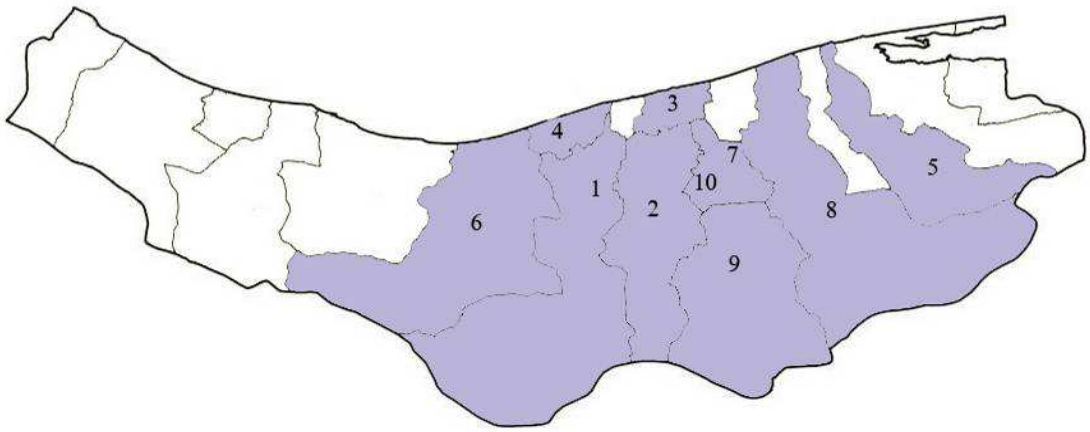

FIGURE 1. The map of Mazandaran province in Northern Iran, sampling sites are indicated by numbers: 1-Amol, 2- Babol, 3- Babolsar, 4- Mahmood-abad, 5- Neka, 6- Noor, 7- Qaemshahr, 8- Sari, 9- Savadkooh, 10- Simorq.

Family Entomobryidae Shäffer, 1896

***Entomobrya lindbergi* Stach, 1960**

Material examined: Sari, Forest of Zare wildlife refuge, Leaf litter, N 36°33´ E 53°08´, 95 m, 20 Apr. 2012; Sari, Soil and leaf litter under walnut trees, N 36°35´, E 53°03´, 19 m; 18 Dec. 2012.

Distribution: Afghanistan, Egypt, Yemen, United Arab Emirate (Jordana, 2012), Iran: Tehran (Moravvej, 2003), Gilan/Rasht (Daghighi et al., 2013b), Kermanshah (Kahrarian et al., 2014). It is recorded for the first time from Mazandaran Province.

Diagnosis: With 8 ommatidia. Body color pattern is as long strip in lateral side (Fif. 2). Labral papillae wrinkled or with some projections. Antennal length 1039 μm, 2-3 times the length of the head, fourth antennal segment with bilobed apical vesicle. Claw with 4 teeth on internal edge: first pair at 50% distance from base of claw, and 2 unpaired teeth, first one at 75% distance from base and the most distal one minute. Dorsal tooth basal. Empodium spike-like, with smooth external edge on leg III. Mucro with 2 teeth, antero-apical tooth bigger than the apical one. Mucronal spine present (Jordana, 2012).

***Heteromurus major* (Moniz, 1889)**

Material examined: Savadkooh, Lafoor, Leaf litter, N 36°13´ E 52°48´, 384 m, 18 Oct. 2012; Noor, Katel-shani, Leaf litter under Persian ironwoods, N 36°20´ E 51°53´, 1237 m, 1 Mar. 2013; Sari, Agricultural College, Leaf litter under *Acacia* sp., N 36°39´ E 53°04´, -10 m, 25 Aug. 2012; Sari, Soil and leaf litter under walnut, N 36°35´ E 53°03´, 19 m, 18 Dec. 2012; Qaemshahr, Citrus garden, N 36°28´ E 52°52´, 42 m, 18 Feb. 2012; Noor, Forest of Sisangan wildlife refuge, Leaf litter, N 36°28´ E 51°49´, 830 m; 28 Sep. 2012.

Distribution: Australia, Chile, France, Germany, Greece, Czechoslovakia, Hungary, Italy, Mexico, Palestine, Portugal, Romany, Spain, Switzerland, Republic of Azerbaijan, Yugoslavia (Mari Mutt, 1980), Iran: Central, East Azerbaijan, Mazandaran, Gilan (Cox, 1982), Gilan/Rasht (Daghighi et al., 2013b), Mazandaran/Sari (Yahyapoor and Shayanmehr, 2013), Kermanshah (Kahrarian et al., 2014).

Diagnosis: Coloration variable. Composed of pigment distributed throughout the antenna (Fig. 3). Eyes 8+8 on dark patches. Tibiotarsi without smooth setae. Unguis quadridentate (Fig. 4), seldom tridentate. Unguiculus with small outer tooth. Tenent hair apically clavate. Furcula without smooth setae. Mucro with basal spine (Fig. 5) (Mari Mitt, 1980).

FIGURE 2. Body color pattern in *E. lindbergi* (scale: 1000 μm).

FIGURE 3. *H. major* with pigmented antenna (scale: 1000 μm).

***H. nitidus* (Templeton, 1835)**

Material examined: Savadkooh, Forest of Jawarom wildlife refuge, Leaf litter, N 36°13´ E 52°53´, 770 m, 3 Jun 2012; Sari, Agricultural College, Leaf litter under *Acacia* sp., N 36°39´ E 53°04´, -10 m, 25 Aug. 2012.

Distribution: Holarctic, Argentina, Chile, New Zealand (Mari Mitt, 1980), Iran: Mazandaran, Gilan (Cox, 1982), Kermanshah (Kahrarian et al., 2014).

Diagnosis: White or with diffuse reddish pigment on body and under the 1+1 ocelli (Fig. 6). Head and body with blunt finely striate scales which are also present on antennae (Fig. 7), legs and furca. Manubrium with about 10+10 smooth dorsal setae, dens with one dorsal smooth seta near base. Tibiotarsi with a double row of smooth setae on the inner side. Apical tenent hair short, pointed. Claws with a pair of small subequal inner teeth set in the middle of unguis ventral edge, sometimes with a weak distal tooth in distal 1/3. Lateral teeth small, set near base. Unguiculus with a ventral tooth (Fjellberg, 2007).

FIGURE 4. Quadridentate claws in *H. major* (scale: 25 μm).

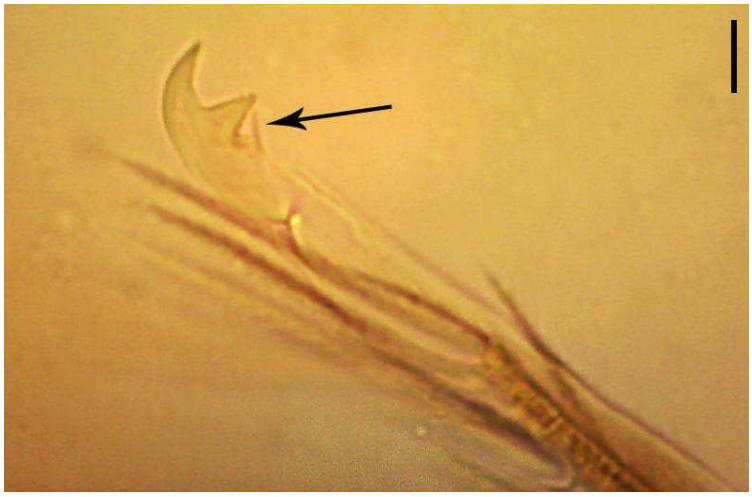

FIGURE 5. Mucro with basal spine in *H. major* (scale: 25 μm).

***Lepidocyrtus* sp.**

Material examined: Sari, Forest of Zare wildlife refuge, Leaf litter, N 36°33´ E 53°08´, 95 m, 20 Apr. 2012; Mahmood-abad, Soil and leaf litter under poplar, N 36°37´ E 52°15´, -24 m, 12 Nov. 2012.

Distribution: Cosmopolitan. Iran: Central, Mazandaran. Gilan, Zanjan, East Azerbaijan (Cox, 1982), Mazandaran/Sari (Yahyapoor and Shayanmehr, 2013).

Diagnosis: 8+8 ocelli. Silvery or metallic blue color due to the cover of scales on the body. Some species with scales on legs and antenna (Fjellberg, 2007).

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

Material examined: Savadkooh, Forest of Jawarom wildlife refuge, Leaf litter, N 36°13´ E 52°53´, 770 m, 3 Jun 2012; Savadkooh, Alasht, Serin village, Moss on the rock, N 36°03´ E 52°53´, 1940 m, 15 Sep. 2012.

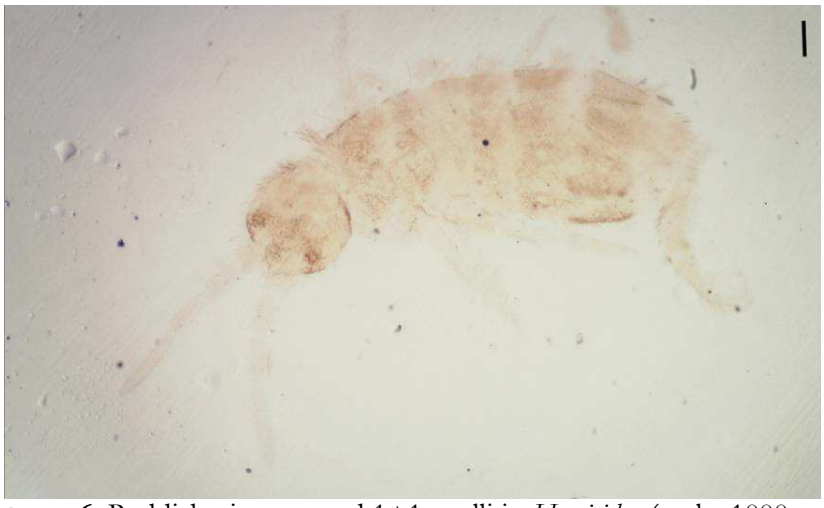

FIGURE 6. Reddish pigment and 1+1 ocelli in *H. nitidus* (scale: 1000 µm).

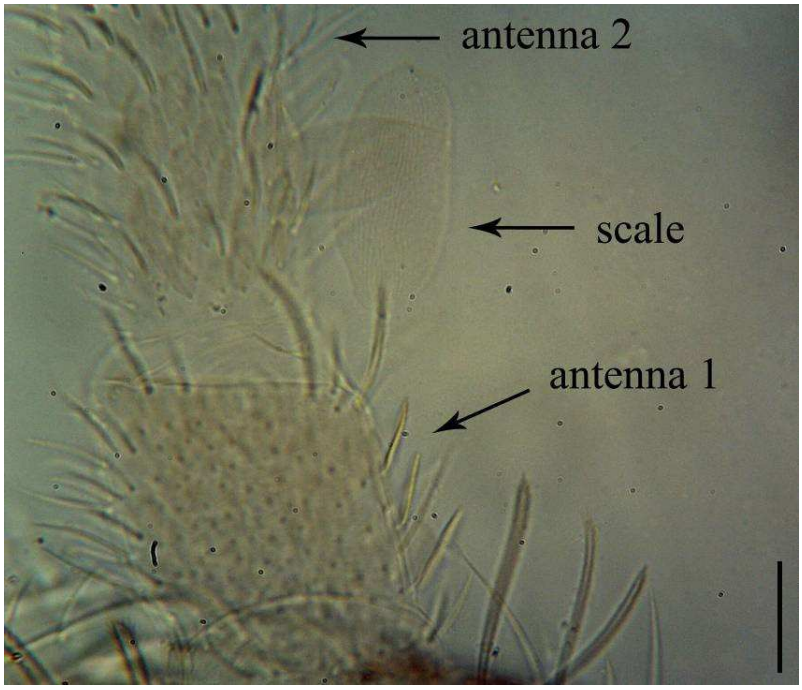

FIGURE 7. Scales on antenna in *H. nitidus* (scale: 25 µm).

Distribution: Holarctic, Iran: Mazandaran, Savadkooh, Alasht, Serin (Yoosefi Lafooraki and Shayanmehr, 2013).

Diagnosis: The dark dorsal disk of third abdominal segment and the contrasting white part of second abdomen is Characteristic (Fig. 8). It is almost black, just antenna 3-4, distal part of antenna 1, distal parts of legs and furca and posterior part of abdomen 2 are unpigmented. The dark pattern in younger specimens is less developed. Ventroapical manubrial thickening with 3-4 large teeth (Fjellberg, 2007).

***Pseudosinella octopunctata* Börner, 1901**

Material examined: Sari, Agricultural College, Leaf litter under *Acacia* sp., N 36°39´ E 53°04´, -10 m, 25 Aug. 2012; Babolsar, Leaf litter in citrus garden, N 36°41´ E 52°39´, -22 m, 15 May 2012; Qaemshahr, Leaf litter of Japanese medlar, N 36°27´ E 52°50´, 60 m, 26 Nov. 2011.

FIGURE 8. Dark disk on third abdominal segment in *O. cincta* (scale: 1000 µm).

FIGURE 9. Body shape of *P. octopunctata* (scale: 1000 µm).

Distribution: Cosmopolite, Iran: Gilan, Zanjan, East and West Azerbaijan, Central, Mazandaran (Cox, 1982), Mazandaran (Yahyapoor and Shayanmehr, 2013), Isfahan/Zarrinshahr (Yoosefi Lafooraki and Shayanmehr, 2013), Kermanshah (Kahrarian et al., 2014).
Diagnosis: White, with diffuse bluish grey pigment on antenna and dorsal and ventral side of head (Fig. 9), body with scattered brownish red pigment. With 4+4 ommatidia. Maxillary outer lobe with 3 sublobal hairs and a small spine. Claws narrow, with small paired inner teeth, posterior slightly larger and more distal than anterior. Lateral teeth small, set beyond middle of unguis. Fourth segment of abdomen with 3+3 macrochaetae in the median field (Fjellberg, 2007).

***Sinella curviseta* Brook, 1882**
Material examined: Savadkooh, Forest of Jawarom wildlife refuge, Leaf litter, N 36°13´ E 52°53´, 770 m, 3 Jun 2012; Babol, Leaf litter under poplar, N 36°31´ E 52°43´, 12 Nov. 2012.
Distribution: China, Japan, USA, Europe (Jordana, 2012), Iran: Tehran (Moravvej, 2003).
Diagnosis: white with diffuse brownish red pigmentation, ocelli 2+2 on individual eye-spots (Fig. 10). Mucro with two teeth and a spine. Claws slender, ununguiculus without ventral tooth (Fjellberg, 2007).

FIGURE 10. *S. curviseta* with two ocelli (scale: 1000 µm).

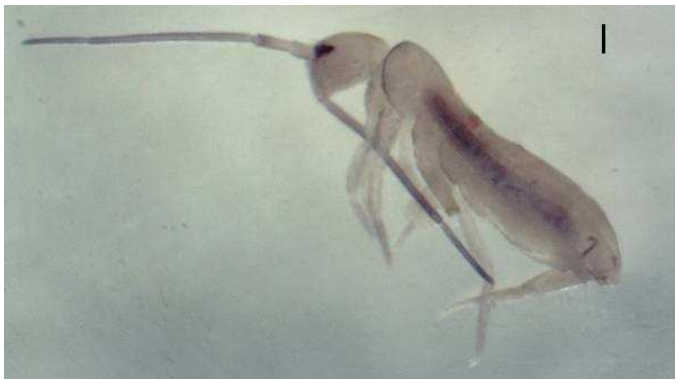

FIGURE 11. *T. vulgaris* with ling antenna (scale: 1000 µm).

Family Tomoceridae Schäffer, 1896

***Tomocerus vulgaris* (Tullberg, 1871)**
Material examined: Savadkooh, Forest of Jawarom wildlife refuge, Leaf litter, N 36°13´ E 52°53´, 770 m, 3 Jun. 2012.
Distribution: Cosmopolitan, Iran: Central, Mazandaran, Gilan, East and West Azerbaijan (Cox, 1982).
Diagnosis: Antenna long (Fig. 11). 6+6 ocelli. Body with striped scales in various sizes and shapes. Scales present on dorsal and ventral surface and absent on last antennal segment and dorsal surface of dens. Retinaculum with 4+4 teeth. Tibiotarsi with a long clavate tenant hair. Unguis with strong lateral teeth on claw base. Unguiculus with a dorsal tooth. Dorsal spines on dens simple. Mucro with more than 10 small teeth on mid-section (Fjellberg, 2007).

Family Paronellidae Börner, 1913

***Cyphoderus albinus* Nicolet, 1842**
Material examined: Babolsar, Leaf litter in citrus garden, N 36°41´ E 52°39´, -22 m, 15 May 2012.
Distribution: Palearctic, Iran: Gilan/Rasht (Daghighi, 2012), Isfahan/Zarrinshahr (Yoosefi Lafooraki and Shayanmehr, 2013). The genus and species are recorded for the first time from Mazandaran province.

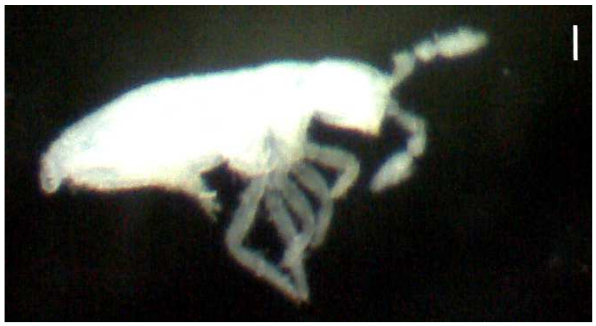

Figure 12. Body shape of *C. albinus* (scale: 1000 µm).

FIGURE 13. *C. albinus* without eye (scale: 100 µm).

Diagnosis: White (Fig. 12), eyes absent (Fig. 13). Body shaped flattened, broad. Sides of thorax 2-3 roof like flattened, hiding bases of legs. Thin transparent scales are present on dorsal side of head and body, including legs, two basal segments of antennae and ventral side of dens. Thorax and abdomen with macrochaetae and ciliated setae only along sides, not on dorsal disc. Ventral tube with 2+2 long anterior setae, 2+2 short distal and 6-7 posterior setae of which three are longer than others. Retinaculum with 4+4 teeth and one setae. Claws slender, apically expended, unguis with a long needle-like basal tooth on the back side, inner edge with a small subapical tooth. Unguiculus with a strong, wing-like ventral tooth. Manubrium with a differentiated cover of dorsal ciliate setae, in particular the 3+3 lateral macrochaetae in distal half are distinct. Dens dorsally with double rows in a single row of 4 ciliate macrochaetae. Proximal part with 3 setae, of which one is smooth. Ventral side of dens with many hyaline scales. Mucro elongate, almost half as long as dens, with two apical teeth (Fig. 14) (Fjellberg, 2007).

Family Oncopoduridae Carl and Lebedinsky, 1905

***Oncopodura* sp.**
Material examined: Noor, Royan, Forest, Leaf litter, N 36°20´ E 51°53´, 1237 m, 1 Mar. 2013.
Distribution: Palearctic, Iran: Mazandaran, Gilan (Cox, 1982), Gilan/Rasht (Daghighi, 2012).
Diagnosis: White, without eye and pigment. PAO star-shaped. Mucro with more than two teeth. Dorsal setae of dens not blade-like (Fjellberg, 2007).

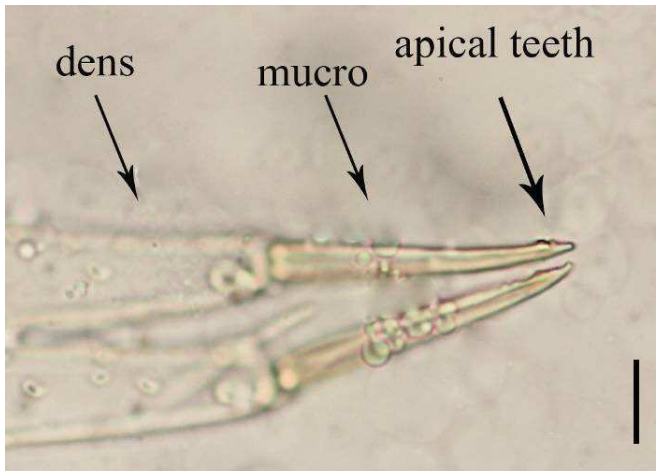

FIGURE 14. Mucro with two apical teeth in *C. albinus* (scale: 100 µm).

FIGURE 15. Head of *Isotomiella* without eye and PAO (scale: 100 µm).

Family Isotomidae Schäffer, 1896

***Anurophorus* sp.**
Material examined: Savadkooh, Alasht, Serin village, Moss on the trees, N 36°03´ E 52°53´, 1940 m, 15 Sep. 2012.
Distribution: Holarctic, Iran: Gilan/Rasht (Daghighi, 2013a), Golestan/Gorgan (Falahati, 2013).

***Hemisotoma thermophila* (Axelson, 1900)**
Material examined: Mahmood-abad, Soil and leaf litter under poplar, N 36°37´ E 52°15´, -24 m, 12 Nov. 2012; Noor, Royan, Kodirsar, Leaf litter under oak, N 36°26´ E 51°49´, 1700 m, 9 Jan. 2013.
Distribution: Palearctic, Europe, Russia, China, Japan, Iran: Central, Mazandaran, Gilan, East and West Azerbaijan (Cox, 1982), Gilan/Rasht (Daghighi et al., 2013a).

***H. pontica* Stach, 1947**
Material examined: Simorq, Soil under common reed, N 36°36´ E 52°48´, -9 m, 12 Nov. 2012; Mahmood-abad, Soil and leaf litter under poplar, N 36°37´ E 52°15´, -24 m, 12 Nov. 2012;

FIGURE 16. 2+2 ocelli in *Folsomides* (scale: 500 µm).

FIGURE 17. 1+1 ventral setae on manubrium (scale: 10 µm).

Bahnamir, Soil, N 36°39´ E 52°45´, -16 m, 12 Nov. 2012; Babolsar, Soil, rice field, N 36°41´ E 52°43´, -23 m, 12 Nov. 2012.
Distribution: Portugal, Spain, France, Australia, Germany, Italy, Hungary, Lebanon, Afghanistan, Iran: Central, Mazandaran, Gilan, East and West Azerbaijan (Cox, 1982), Tehran (Moravvej et al., 2007), Kermanshah (Kahrarian et al., 2012), Mazandaran/Sari (Yahyapour, 2012).

***Folsomia penicula* Bagnall, 1939**
Material examined: Nowshahr, Kojur, Lashkenar, Leaf litter under oak, N 36°28´ E 52°28´, 2202 m, 23 Oct. 2012; Bahnamir, Soil, Grass, N 36°39´ E 52°45´, -16 m, 12 Nov. 2012.
Distribution: Europe, Caucasus, North America, Iran: Central, Mazandaran, East Azerbaijan (Cox, 1982), Gilan/Rasht (Daghighi et al., 2013a), Golestan/Gorgan (Falahati, 2013).

***F. ksenemani* Stach, 1947**
Material examined: Noor, Royan, Kodirsar, Leaf litter under oak, N 36°26´ E 51°49´, 1700 m, 9 Jan. 2013; Savadkooh, Alasht, Serin village, Leaf litter under plum, N 36°03´ E 52°53´, 1940 m, 13 Dec. 2012; Savadkooh, Forest of Jawarom wildlife refuge, Leaf litter, N 36°13´ E 52°53´, 770 m, 3 Jun. 2012.
Distribution: Europe.

FIGURE 18. Abdomen 5 and 6 fused in *Hemisotoma* (scale: 500 µm).

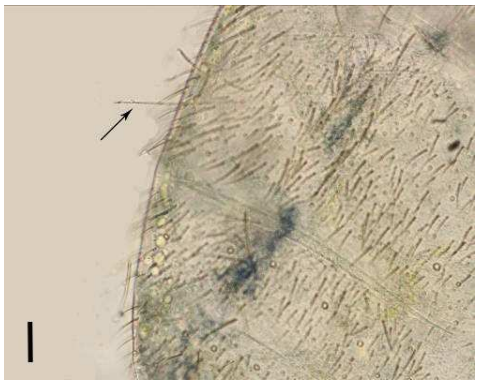

FIGURE 19. Trichobothria on abdomen 5 of *Isotomurus* (scale: 25 µm).

***Folsomides parvulus* Stach, 1922**

Material examined: Savadkooh, Forest of Jawarom wildlife refuge, Leaf litter, N 36°13´ E 52°53´, 770 m, 3 Jun. 2012; Savadkooh, Alasht, Serin village, Leaf litter under *Pyrus* sp., N 36°03´ E 52°53´, 1940 m, 14 Sep. 2012; Babolsar, Leaf litter in citrus garden, N 36°41´ E 52°39´, -22 ,; 15 May 2012; Qaemshahr, Leaf litter of Japanese medlar, N 36°27´ E 52°50´, 60 m, 26 Nov. 2011; Babol, Leaf litter under poplar, N 36°31´ E 52°43´, 3 m, 12 Nov. 2012; Sari, Agricultural college, leaf litter under *Acacia* sp., N 36°39´ E 53°04´, -10 m, 26 Aug. 2013.

Distribution: Cosmopolitan. Iran: Central, East and West Azerbaijan, Mazandaran, Gilan (Cox, 1982), Gilan/Rasht (Daghighi et al., 2013a,b), Kermanshah/Kermanshah, Sahneh, Harsin (Kahrarian et al., 2012), Mazandaran/Sari (Yahyapour, 2012).

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

Material examined: Nowshahr, Leaf litter under oak, N 36°38´ E 51°29´, -5 m, 4 Jan. 2013; Noor, Forest of Sisangan wildlife refuge, Leaf litter, N 36°28´ E 51°49´, 830 m, 28 Sep. 2012.

Distribution: Cosmopolitan, Iran: Mazandaran, Gilan, East Azerbaijan, Central (Cox, 1982), Tehran (Moravvej, 2003), Gilan/Rasht (Daghighi et al., 2013a,b), Mazandaran/Sari (Yahyapour, 2012), Kermanshah (Ghahramaninezhad et al., 2013).

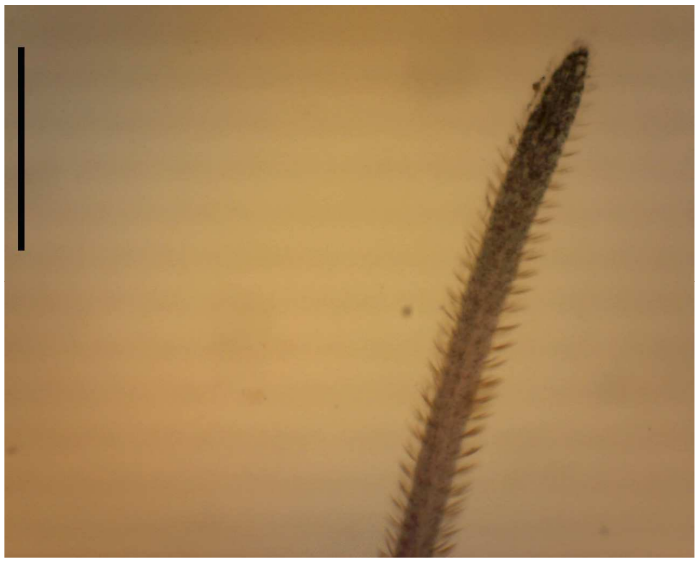

FIGURE 20. Rings of setae on antenna 4 in *Heteromurus* (scale: 25 µm).

***Isotomurus afghanicus* Yosii, 1963**
Material examined: Mahmood-abad, Soil, rice field, N 36°37´ E 52°15´, -24 m, 12 Nov. 2012; Sari, Miandorud, Soil, citrus garden, N 36°26´ E 52°53´, 56 m, 2 Mar. 2013; Noor, Forest of Sisangan wildlife refuge, Leaf litter, N 36°28´ E 51°49´, 830 m, 28 Sep. 2012; Amol, Soil, barley field, N 36°28´ E 52°26´, 48 m, 12 Nov. 2012; Neka, Hezarjerib forest, Leaf litter under ironwoods, N 36°37´ E 53°21´, 217 m, 28 Mar. 2013.
Distribution: Afghanistan.

***I. fucicolus* (Schött, 1893)**
Material examined: Qaemshahr, Soil, rice field, N 36°26´ E 52°50´, 80 m, 7 Sep. 2012.
Distribution: Spain, Portugal, France, Finland, Denmark, Russia, Germany, Norway, Iceland.

***Parisotoma notabilis* (Schäffer, 1896)**
Material examined: Noor, Royan, Kodirsar, Leaf litter under oak, N 36°26´ E 51°49´, 1700 m, 8 Jan. 2013.
Distribution: Cosmopolitan, Iran: Mazandaran, Central, Gilan, Zenjan, East and West Azerbaijan (Cox, 1982), Tehran (Moravvej et al., 2007), Gilan/Rasht (Daghighi et al., 2013a,b), Kermanshah (Kahrarian et al., 2012).

***Proisotoma minima* (Absolon, 1903)**
Material examined: Qaemshahr, Leaf litter of Japanese medlar, N 36°27´ E 52°50´, 60 m, 26 Nov. 2011.
Distribution: Holarctic, Europe, Palearctic, North of Africa, Caucasus, Siberia, Japan. Iran: Mazandaran/Sari (Yahyapour, 2012), for detailed characters see Yoosefi Lafooraki and Shayanmehr (2014).

***P. minuta* (Tullberg, 1871)**
Material examined: Mahmood-abad, Soil, rice field, N 36°37´ E 52°15´, -24 m, 12 Nov. 2012.
Distribution: Cosmopolitan, Iran: Mazandaran, Central, Gilan, Zenjan, East and West Azerbaijan (Cox, 1982), Tehran (Moravvej, 2003), Kermanshah (Kahrarian et al., 2012).

***P. subminuta* Denis, 1931**
Material examined: Amol, Soil, barley field, N 36°28´,E 52°26´, 48 m, 12 Nov. 2012.
Distribution: Palearctic, Iran: Tehran (Moravvej et al., 2007), Gilan/Rasht (Daghighi et al., 2013a,b).

***Pseudisotoma sensibilis* (Tullberg, 1876)**
Material examined: Noor, Royan, Dead wood, N 36°20´ E 51°53´, 1237 m, 1 Mar. 2013.
Distribution: Palearctic.

Identification key for Entomobryomorpha families and species in Mazandaran province (Northern Iran):

1- Body without scale or with a cover of sparse ciliated macrochaetae (Isotomidae) …… 2
- Body with scale or with a cover of dense ciliated macrochaetae …….. 11
2- PAO absent, white species, without eye (Fig. 15) …… *Isotomiella*
- PAO present ……..……...… 3
3- Abdomen 4-6 fused ……...…… *Folsomia*
- Abdomen 4 and 5 separated …… 4
4- Furca and retinaculum absent …….. *Anurophorus*
- Furca and retinaculum present ……..……...…….. 5
5- Manubrium with at least 5 mid-ventral setae …… 6
- Manubrium with at most 8 mid-ventral setae ……... 8
6- Manubrium without ventral setae, ocelli 2+2 (Fig. 16) …… *Folsomides*
- Manubrium with 1+1 (Fig. 17) or more ventral setae ……..……. 7
7- Abdomen 5 and 6 separated ……..……..…….. *Proisotoma*
- Abdomen 5 and 6 fused (Fig. 18) …….. *Hemisotoma*
8- Trichobothria present on abdomen 4 (Fig. 19) ……..…. *Isotomurus*
- Trichobothria absent ……..……... 9
9- Tibiotarsi with apical clavate setae ……..……..…. *Pseudisotoma*
- Tibiotarsi with apical pointed setae ……..……..……...…….. 10
10- Eye patches large and elongate ……...……..…… *Isotoma*
- Eye patches square and punctual ……..…... *Parisotoma*
11- Mucro short and hook-like (Entomobryidae) …….. 12
- Mucro long and elongate (Fig. 14) …..……...…… 19
12- Abdomen 3 in midline more than twice as long as abdomen 4 (Entomobryinae) 13
- Abdomen 3 in midline less than 1.7 as long as abdomen 4 (Orchesellinae)…...……... 18
13- Body and ventral side of dens with scale ……...……. 14
- Body without scale, sometimes with scale-like setae but very narrower ……..…… 15
14- Scales with rude grooves, sometimes with picked tip (Seirini), mucro crescent, ocelli 8+8 ……..……..…… *Seira*
- Scales without groove, with fine teeth and round tip (Lepidocyrtini) ……..….....…… 17
15- Ocelli 8+8, mucro with two teeth ...……...……..…….. *Entomobrya*
- Ocelli 2+2 ..……...……...…… *Sinella*
16- Ocelli 8+8 on large eye patches ……..……..……...…. *Lepidocyrtus*
- Ocelli 3+3 or 4+4, eye patches small or absent ……..…...……...…… *Pseudosinella*
17- Body with scale, rings of setae on antenna 4 (Heteromurini) (Fig. 20) ……. *Heteromurus*
- Body without scale, distinct color pattern and dense cover of ciliated setae and long macrochaetae (Orchesellini) ……..……...…. *Orchesella*

18- Large species, with pigmentation and dark eye patches, antenna long, mucro with setae (Tomoceridae), inner side of dens without broad scale, mid-section of mucro with more than 3 teeth ……. *Tomocerus*
- Small species, white and without eye, antenna normal, mucro without setae ……..……. 20
19- PAO absent, mucro only with one apical and one subapical tooth, dens with flat and peculiar setae on dorsal side (Paronellidae), dens with fringed scale, furca with setae between large scales on dorsum of dens ……..…..……. *Cyphoderus*
- PAO star-shape, mucro with more than two teeth (Oncopoduridae) ...……...…… *Oncopodura*

DISCUSSION

In the present study, a total of 21 species and 18 genera belonging to five families were collected and identified. Two genera *Sinella* Brook, 1882 and *Cyphoderus* Nicolet, 1842 and three species *Sinella curviseta*, *Entomobrya lindbergi* (Entomobryidae) and *Cyphoderus albinus* (Paronellidae) are new for Mazandaran province. Family Paronellidae is also recorded for the first time from Mazandaran. Although Cox (1982) reported the *Cyphoderus ambigua* (Cox, 1982) belonging to this family from Mazandaran; but later, the generic name of this species was changed to *Oncopodura ambigua* (Christiansen, 1957); so the species identified in this study is the first record of the family Paronellidae from Mazandaran province.

Until now 5 families of order Entomobryomorpha have been reported from Iran. In this paper family Paronellidae and genus *Cyphoderus* is reported for the first time from Mazandaran province. The species *C. albinus* is the only species of this family in Iran that was reported by Daghighi (2012) from Gilan. Two species of genus *Oncopodura* belonging to family Oncopoduridae were reported from Iran. *O. ambigua* was reported from Mazandaran and Gilan (Cox, 1982) and was reported from Gilan (Daghighi, 2012). Some samples of this genus were found in current research, but the species has not been identified. The only reports of family Tomoceridae in Iran were done by Cox (1982) including *T. vulgaris* and *T. minor* (Lubbock, 1862). They were found in Central, Mazandaran, Gilan, East Azerbaijan and Zanjan provinces. Here, we just identified the species *T. vulgaris* among the samples collected from Mazandaran province.

Up to now 9 genera and 28 species from family Entomobryidae have been reported from Iran and 5 genera and 13 species have been reported from Mazandaran province (Cox, 1982; Daghighi, 2012; Ghahramaninezhad et al., 2012; Kahrarian et al., 2012; Moravvej, 2003; Nematollahi et al., 2009; Yahyapoor and Shayanmehr, 2013; Kahrarian et al., 2014). The Species *S. curviseta* was reported by Moravvej (2003) from Tehran province. In this study, the genus and species are reported for the first time from Mazandaran province. Four species of genus *Entomobrya* were reported from Mazandaran (Cox, 1982; Yahyapoor and Shayanmehr, 2013). *E. lindbergi* is reported for the first time from Mazandaran province. It was reported by Moravvej (2003) from Tehran and by Daghighi (2012) from Gilan. Three species belonging to genus *Heteromurus* were reported from Iran. Cox (1982) reported *H. major*, *H. nitidus* and *H. sexoculatus* Brown, 1926 from Mazandaran. Yahyapoor and Shayanmehr (2013) reported *H. major* form Sari region in this province. We reported this species form several other regions of province and also we found *H. nitidus*. The species *P. octopunctata* and *P. imparipunctata* Gisin, 1953 were reported from Mazandaran by Cox (1982). Yahyapoor and Shayanmehr (2013) reported the first species from Sari. In this study, some samples of this species were collected from different regions of province. With new reports of this paper, the number of genera and species of family Entomobryidae in province is increased to 7 genera and 15 species. A total of 26 genera and 65 species belonging to 5 families of Entomobryomorpha have been reported from Iran and 37 species and 18 genera belonging to 4 families have been reported from Mazandaran province (Shayanmehr et al., 2013; Yoosefi Lafooraki and Shayanmehr, 2013; Kahrarian et al., 2014; Yoosefi Lafooraki and Shayanmehr, 2014). The number of genera and species

Entomobryomorpha in Mazandaran province is increased to 20 genera, 39 species and 5 families with new finding of this paper.

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