



A survey on Entomobryomorpha (Collembola) fauna in northern forests of Iran

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ABSTRACT. Present study was done in forests of northern Iran during 2016 to investigate Entomobryomorpha (Collembola) fauna. Seven genera and nine species belonging to families Tomoceridae and Entomobryidae were found. The genus *Pogonognathellus* Paclt, 1944 and species *P. flavescens* (Tullberg, 1871) belonging to Tomoceridae family are recorded for the first time from Iran, also three new records from Entomobryidae of genus *Entomobrya* Rondani, 1861 are reported for Mazandaran province fauna.

Key words: *Pogonognathellus*, Entomobryomorpha, Mazandaran

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Introduction

Hyrceanian forests are located in northern Iran and mostly are composed of deciduous trees. The climate of south Caspian region is humid with most precipitation occurring in autumn, winter and spring (Siadati et al., 2010). Soil and leaf litter in these forest occupied by different soil-dwelling animals especially Collembola.

The class of Collembola or springtails is the most abundant soil-living arthropods which found everywhere especially in forest soils (Petersen & Luxton, 1982). More than one fourth of collembolan species belong to superfamily Entomobryoidea

possessing a well-developed furcula (Zhang et al., 2015). Furca or furcula which comprised from three parts manubrium, dens and mucro, give them ability to jumping and it is perhaps the most characteristic feature of Collembola especially in Entomobryomorpha (Christian & Vollenkle, 1979). Characteristics of all three parts of furcula and distribution and morphology of body scales are also important diagnostic characters at generic and suprageneric levels in Entomobryoidea (Zhang et al., 2015). Different researchers classified Entomobryomorpha in different way for example Entomobryomorpha

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classified as four superfamilies including Tomoceroidea Szeptycki, 1979, Isotomoidea Szeptycki, 1979, Entomobryoidea Womersley, 1934 and Coenaletioidea Bellinger, 1985 and eight families (Soto-Adames et al., 2008). Entomobryoidea classified by Soto-Adames et al. (2008) as three families (Table 1).

Most Entomobryoidea species are belonging to Entomobryidae family, which is the most diverse family of Collembola sometimes called "slender springtails" (Bellinger et al., 1996–2018; Soto-Adames et al., 2008). The species of this family usually characterized by having an enlarged fourth abdominal segment, a well-developed appendages such as antennae, legs and furca, like other Entomobryomorpha (Bellinger et al., 1996–2018; Christiansen & Bellinger, 1998). Additionally, Entomobryidae distinguishes itself from other families by the presence of multiciliated setae on body, crenulate dens and a small mucro with one or two well-developed teeth (Zeppelini & Bellini, 2006; Soto-Adames et al., 2008). Some species in this family may be heavily scaled and can be very colorful. The scale-less Entomobryidae are commonly caught in pitfall traps around the plants, and also occur in canopy faunas high up in trees. There are more than 700 described species in Entomobryidae (Bellinger et al., 1996–2018). Tomoceridae with 201 described species formerly treated as part of Entomobryidae. The species in this family have elongate antennal segments as compared to Entomobryidae which are evenly sized (Bellinger et al., 1996–2018).

First report of Collembola in the Middle East is ascribed to Brown (1926) who reported 20 species from Mesopotamia region. Christiansen (1957) studied Cyphoderidae and Oncopoduridae families in Lebanon and Syria. Özata et al. (2017) studied Entomobryomorpha fauna in Ordu province, Turkey and identified 20 new

species. Study of Collembola fauna have been received more attention in recent decade in Iran. Several researchers worked on springtail fauna in different ecosystems as well as northern forests in Iran (Shayanmehr et al., 2013; Yahyapour & Shayanmehr, 2013; Qazi & Shayanmehr, 2014a, 2014b, 2016; Kahrarian & Arbea, 2013; Yoosefi-Lafooraki & Shayanmehr, 2014; Kahrarian et al., 2014, 2015; Ahmadi-Rad & Kahrarian, 2015; Amiri & Kahrarian, 2015; Arbea & Kahrarian, 2015a, 2015b; Balvasi et al., 2015; Mehrafrooz-Mayvan et al., 2015; Potapov et al., 2015; Hosseini et al., 2016; Shayanmehr & Zamani, 2016; Alijani-Ardeshir et al., 2017; Arbea & Kahrarian, 2017; Shayanmehr et al., 2017; Ramezani & Mossadegh, 2017). In Iran from Entomobryidae 42 species (Shayanmehr et al., 2018) and from Tomoceridae only two species were recorded until yet (Shayanmehr et al., 2013).

In this project, we present new information on the occurrence of some collembolan species of Entomobryomorpha group in Mazandaran province. However, many more species presumably exist in Iran yet to be discovered. The objective of this study as a part of our ongoing research on the Collembola fauna of Iran is to improve our knowledge of Entomobryomorpha group.

Table 1. Classification of Entomobryomorpha group according Soto-Adames et al. (2008).

Superfamilies	Families
Coenaletioidea	Coenaletidae
Entomobryoidea	Microfalculidae
	Entomobryidae
Isotomoidea	Paronellidae
	Isotomidae
Tomoceroidea	Actaletidae
	Oncopoduridae
	Tomoceridae

Material and methods

The materials of present study were collected during 2016 in forests of Mazandaran province. The specimens were collected from pitfall traps or soil and leaf litter sampling method. Geographical data of sampling sites was fixed using GPS receiver. Soil and leaf litter samples were transferred to the laboratory of Sari University of Agricultural Sciences and Natural Resources, Mazandaran. Where Collembola specimens were extracted by Tullgren funnels and Entomobryomorpha specimens were isolated for more study. Some specimens were cleared in Nesbit's solution, then were mounted on Hoyer's medium to make microscopic slides. Then they were identified to genera and species levels using valid keys including: [Fjellberg \(2007\)](#) and [Jordana \(2012\)](#). Microscopic slides and in alcohol preserved specimens are maintained in laboratory of the university.

Results

Totally, seven genera and nine species were found of these *Pogonognathellus flavescens* (Tullberg, 1871) together with genus, *Pogonognathellus* Paclt, 1944, are recorded for the first time from Iran. Besides that three species of *Entomobrya* are recorded for the first time from Mazandaran province. Below are some considerations about each of the collected specie.

Family: Entomobryidae

Subfamily: Entomobryinae

Entomobrya schoetti Stach, 1922

Materials examined: Two specimens, Neka, Hezar jrib forest, leaf litter, 12-viii-2016, 36°37'12" N, 53°21'31" E, 198 m a.s.l., leg.: E. Yahyapour.

Distribution in Iran: Kermanshah ([Kahrarian et al., 2014](#)) and it is recorded for the first time from Mazandaran province.

Distribution in the world: Europe, Mediterranean, West Asia ([Bellinger et al., 1996–2018](#)).

Entomobrya corticalis (Nicolet, 1842)

Materials examined: Three specimens, Sari, Shahid Zare forest, leaf litter, 30-vi-2016, 36°32'44" N, 53°07'53" E, 113 m a.s.l., leg.: E. Yahyapour.

Distribution in Iran: Guilan ([Cox, 1982](#)) and it is recorded for the first time from Mazandaran province.

Distribution in the world: North Eurasia, West and central Asia, Europe ([Bellinger et al., 1996–2018](#)).

Entomobrya nigrocincta Denis, 1923

(Figs 1–2)

Materials examined: Six specimens, Sari, Chahardangeh, Langar village, soil and leaf litter, 29-iv-2016, 36°14'20" N, 53°39'10" E, 1800 m a.s.l.; two specimens, Sari, Dasht-e-Naz, soil and leaf litter, 24-v-2016, 36°71'10" N, 53°09'11" E, -11 m a.s.l.; Three specimens, Sari, Salar Darreh forest, leaf litter, 28-iv-2016, 36°27'10" N, 53°07'11" E, 178 m a.s.l., leg.: E. Yahyapour.



Figure 1. Habitus of *Entomobrya nigrocincta* (male) (original 10x).

Distribution in Iran: Kermanshah (Kahrarian et al., 2014) and it is recorded for the first time from Mazandaran province.

Distribution in the world: Europe, Mediterranean, West Asia (Bellinger et al., 1996–2018).



Figure 2. Habitus of *Entomobrya nigrocincta* (female) (Original, 10x).

Family: Tomoceridae

Pogonognathellus flavescens (Tullberg, 1871) (Figs 3–4)

Materials examined: Two specimens, Babol, Filband, soil and leaf litter, 25-viii-2016, 52°30'45" N, 36°22'12" E, 1950 m a.s.l., leg.: E. Yahyapour.

Distribution in Iran: The genus and species are recorded for the first time from Iran.

Distribution in the world: Arctic and sub-arctic, Europe, North Eurasia, Mediterranean (Bellinger et al., 1996–2018).



Figure 3. Habitus of *Pogonognathellus flavescens* (Original, 10x).

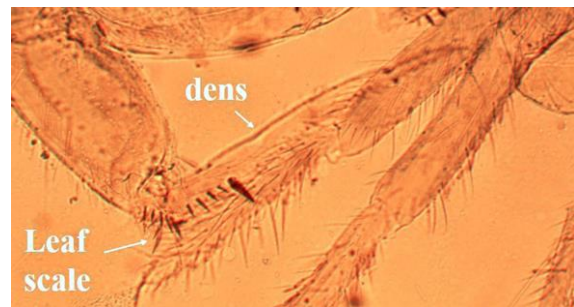


Figure 4. The spines on the inner side of the dens *Pogonognathellus flavescens* and large leaf-shaped scale next to manubrium. (Original, 40x).

Family: Entomobryidae

Subfamily: Seirinae

Seira domestica (Nicolet, 1842) (Fig. 5)

Materials examined: One specimens, Neka, Hezar Jrib forest, leaf litter, 12-viii-2016, 36°37'12" N, 53°21'31" E, 198 m a.s.l.; Two specimens, Babol, Filband, soil and leaf litter, 25-viii-2016, 52°30'45" N, 36°22'12" E, 1950 m a.s.l.; Three specimens, Sari, Salar Darreh forest, leaf litter, 28-iv-2016, 36°27'10" N, 53°07'11" E, 178 m a.s.l.; Two specimens, Qaemshahr, Jadeh-Nezami, leaf litter, 12-vi-2016, 36°27'17" N, 52°49'16" E, 188 m a.s.l., leg.: E. Yahyapour.

Distribution in Iran: Mazandaran (Yahyapour & Shayanmehr, 2013), Kermanshah (Kahrarian et al., 2012), Guilan (Daghighi et al., 2013), Golestan (Hosseini et al., 2016).

Distribution in the world: Australia, Eurasia, Mediterranean, Pacific North America, Macaronesian (Bellinger et al., 1996–2018).



Figure 5. Habitus of *Seira domestica* (Original, 10x).

Family: Entomobryidae**Subfamily: Heteromurinae*****Heteromurus major* (Moniez, 1889)** (Fig. 6)

Materials examined: 10 specimens, Neka, Hezar Jrib forest, leaf litter, 12-viii-2016, 36°37'12" N, 53°21'31" E, 198 m a.s.l.; 15 specimens, Babol, Filband, soil and leaf litter, 25-viii-2016, 52°30'45" N, 36°22'12" E, 1950 m a.s.l.; Eight specimens, Sari, Salar Darreh forest, leaf litter, 28-iv-2016, 36°27'10" N, 53°07'11" E, 178 m a.s.l.; Nine specimens, Qaemshahr, Jadeh-Nezami, leaf litter, 12-vi-2016, 36°27'17" N, 52°49'16" E, 188 m a.s.l.; Four specimens, Sari, Dasht-e-Naz, soil and leaf litter, 24-v-2016, 36°71'10" N, 53°09'11" E, -11 m a.s.l.; 20 specimens, Sari, Shahid Zare forest, leaf litter, 30-iv-2016, 36°32'44" N, 53°07'53" E, 113 m a.s.l., leg.: E. Yahyapour.

Distribution in Iran: Central, Mazandaran, Guilan, E. Azarbaijan (Cox, 1982; Yahyapour & Shayanmehr, 2013; Yoosefi-Lafooraki & Shayanmehr, 2014; Balvasi et al., 2015; Mehrafrooz-Mayvan et al., 2015; Daghighi et al., 2013), Tehran (Qazi & Shayanmehr, 2014a), Golestan (Hosseini et al., 2016), Kermanshah (Kahrarian et al., 2014, 2016).

Distribution in the world: Europe, West and central Asia, Mediterranean, Macaronesian, Pacific North America, Andean, Australia (Bellinger et al., 1996–2018).



Figure 6. Habitus of *Heteromurus major* (Original, 10x).

Family: Entomobryidae**Subfamily: Lepidocyrtinae*****Lepidocyrtus* sp.** (Fig. 7)

Materials examined: Two specimens, Sari, Chahardangeh, Langar village, soil and leaf litter, 29-iv-2016, 36°14'20" N, 53°39'10" E, 1800 m a.s.l., leg.: E. Yahyapour.

Distribution in Iran: Central, Mazandaran, Guilan, E. Azarbaijan, Zanjan (Cox, 1982), Golestan (Hosseini et al., 2016).

Distribution in the world: The genus has worldwide distribution (Fjellberg, 2007) but the species is unknown.



Figure 7. Habitus of *Lepidocyrtus* sp. (Original 10x).

***Pseudosinella* sp.**

Materials examined: Two specimens, Neka, Hezar jrib forest, leaf litter, 12-viii-2016, 36°37'12" N, 53°21'31" E, 198 m a.s.l., leg.: E. Yahyapour.

Distribution in Iran: Central, Mazandaran, Guilan, E. Azarbaijan, W. Azarbaijan, Zanjan (Cox, 1982; Yahyapour & Shayanmehr, 2013; Daghighi et al., 2013; Yoosefi-Lafooraki & Shayanmehr, 2013, 2014; Balvasi et al., 2015; Mehrafrooz-Mayvan et al., 2015; Alijani-Ardeshir et al.,

2017), Tehran (Qazi & Shayanmehr, 2014a, 2014b), Isfahan (Yoosefi-Lafooraki & Shayanmehr, 2013), Kermanshah (Ghahramaninezhad et al., 2012; Kahrarian, 2015; Kahrarian et al., 2014, 2015), Golestan (Hosseini et al., 2016), Khorasan-e-Shomali (Shayanmehr & Zamani, 2016).

Distribution in the world: The genus has worldwide distribution (Fjellberg, 2007) but the species is unknown.

Family: Entomobryidae

Subfamily: Orcheseliinae

Orchesella cincta (Linnaeus, 1758)

Materials examined: Two specimens, Neka, Hezar jrib forest, leaf litter, 12-viii-2016, 36°37'12" N, 53°21'31" E, 198 m a.s.l.; one specimens, Babol, Filband, soil and leaf litter, 25-viii-2016, 52°30'45" N, 36°22'12" E, 1950 m a.s.l., leg.: E. Yahyapour.

Distribution in Iran: Mazandaran (Yoosefi-Lafooraki & Shayanmehr, 2013, 2014; Balvasi et al., 2015), Golestan (Hosseini et al., 2016).

Distribution in the world: Arctic and sub-arctic, Europe, Mediterranean, North America, West Asia, Ascension and St. Helena (Bellinger et al., 1996-2018).

Discussion

The specie, *Pogonognathellus flavescens*, is distributed in the Holarctic region and recently it was recorded by Özata et al. (2017) from Turkey, wherein it was found in the debris of *Pinus* at Ordu province. This specie belongs to Tomoceridae a family of Entomobryoidea that are recorded for the first time from Iran as well as the genus *Pogonognathellus* and *P. flavescens*. This record increases the number of Entomobryomorpha's genera and species recorded in Iran to 33 and 99, respectively. Three species of *Entomobrya* are recorded for the first time from Mazandaran province, *E. cf. schoetti*, *E. corticalis* and *E. nigrocincta*. So, number of

Entomobryomorpha species in Mazandaran increases to 56 species.

Conclusion

The attention paid to the identification of Iran's Collembola fauna has been increasing for several years, but particular attention to the specific fauna of the northern forests of Iran, one of the most important forests of the world in respects to age and genetic treasures is limited. In one of researches was done by Mehrafrooz-Mayvan et al. (2015), in sum 20 species were identified from Semeskandeh forest (northern Iran). This is despite the fact that the number of forest species in Iran should be much higher, which many species may still not be collected and identified. In this study, faun of Collembola were investigated more relatively precise in different northern forests. The part of results of the study indicated identification of seven genera and nine species belonging to families Tomoceridae and Entomobryidae were found. Entomobryidae usually has more rich species than Tomoceridae. From Tomoceridae only two species were recorded until yet and with new reports of this study, the genus *Pogonognathellus* and species *P. flavescens* the number of genera and species of family reaches two and three, respectively. Also, from Entomobryidae family, up to now, 11 genera and 42 species were recorded. With new record of this study, species number of family reaches to 43. Three species from genus *Entomobrya* are also reported for the first time of Mazandaran province. But still impplementary researchs need to describe species were remained as unknown species.

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Conflict of Interests

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

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بررسی فون انتموبریومورفا (پادمان) در جنگل‌های شمال ایران

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چکیده: مطالعه حاضر به منظور بررسی فون پادمان گروه انتموبریومورفا (پادمان) در سال ۱۳۹۵ در جنگل‌های شمال ایران انجام گرفت. هفت جنس و نه گونه از خانواده‌های Entomobryidae و Tomoceridae جمع‌آوری و شناسایی شد. جنس *Pogonognathellus* Paclt, 1944 و گونه *P. flavescens* (Tullberg, 1871) از خانواده Tomoceridae برای اولین بار از ایران گزارش می‌شود. همچنین سه گونه از خانواده Entomobryidae از جنس *Entomobrya* Rondani, 1861 برای فون مازندران گزارش جدید هستند.

واژگان کلیدی: *Pogonognathellus*, Entomobryomorpha, مازندران