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A contribution to the study of Collembola (Arthropoda; Hexapoda) of Khuzestan in south-western Iran

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ABSTRACT. During a faunistic study on the springtails (Collembola) of Khuzestan in south-western Iran, eight species including three Hypogastruridae, four Isotomidae and one Sminthuridae were collected and identified. *Acherontiella* and *Acherontiella bougisi* Cassagnau et Delamare Deboutteville, 1955 (Hypogastruridae), *Ballistura tuberculata* (Stach, 1947) (Isotomidae) and *Sminthurus wahlgreni* Stach, 1920 (Sminthuridae) are new for Iran while *Hypogastrura manubrialis* (Tullberg, 1869) (Hypogastruridae), *Isotomurus palustris* (Müller, 1776) and *Parisotoma notabilis* (Schäffer, 1896) (Isotomidae) are new for Khuzestan fauna.

Key words: Collembola, fauna, new records, Iran, Khuzestan

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Introduction

Sprigtails (Collembola) are minute wingless arthropods characterized by a ventral downward process of the first abdominal segment called ventral tube or colophore (Bellinger et al., 2019). Collembola are cosmopolitan hexapods found nearly in all niches with a few forms are neustons though most species are terrestrial which are most widespread in soils and leaf litter, but many species live in vegetation, littoral habitats, caves, and ice fields or glaciers (Hopkin, 1997). Most sprigtails feed on fungi, bacteria, and decaying vegetation, some are carnivores or herbivores, and a number are fluid-feeders (Hopkin, 1997). Ecologically, Collembola play an important role in the development and maintenance of healthy soils which is not generally appreciated (Bellinger et al., 2019). Overall, sprigtails are not injurious to human; parasitic forms and disease transmitters are not known yet however some species like Lucerne flea (*Sminthurus viridis* (Linnaeus, 1758)) are plant pest (Hopkin, 1997).

Contrary to the contributions published on the Collembola fauna of Iran which can be found partially in Shayanmehr et al. (2013), sprigtail biodiversity of Iran and especially some provinces including Khuzestan in the southwest has been not recognized broadly. To

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date from Khuzestan only [Gardenhire \(1959\)](#) and [Thibaud et al. \(2012\)](#) documented *Sminthurus viridis* (Sminthuridae) from wheat and alfalfa fields and *Ceratophysella gibbosa* (Bagnall, 1940) and *Xenylla humicola* (O. Fabricius, 1780) (Hypogastruridae) and *Desoria* cf. *olivacea* (Tullberg, 1871) and *Hemisotoma ponticus* (Stach, 1947) (Isotomidae) from date-palm orchards while [Ramezani & Mossadegh \(2017\)](#) conducted an ecological study on the Collembola of this province, since it is necessary to conduct investigation to identify the Collembola fauna of Khuzestan province and this note is a partial result of one research exploring the Collembola of Khuzestan.

Material and methods

Soil and leaf litter samples were collected during 2010-2011 from Ramin University campus in Mollasani in Bawi County and a garden and a field in Ramhormoz County, Khuzestan province. The Collembola specimens were extracted using Berlese funnel, then bleached by lactophenol and finally fixed on the microscopic slides utilizing Hoyer's medium. [Bretfeld \(1999\)](#), [Potapov \(2001\)](#) and [Thibaud et al. \(2004\)](#) were referred for the determination of species which was conducted by the second author. The material is deposited at the Insect Collection of Plant Protection Department, Agricultural Sciences and Natural Resources University of Khuzestan.

Results

Eight sprigtail species were collected and determined including three hypogastrurids (Hypogastruridae), four isotomids (Isotomidae) and one sminthurid (Sminthuridae). The taxa are listed alphabetically. For morphological terms, [Bretfeld \(1999\)](#), [Potapov \(2001\)](#) and [Thibaud et al. \(2004\)](#) are followed.

Family Hypogastruridae

Genus: *Acherontiella* Absolon, 1913

Diagnosis: species of this genus have fine and granulate integument and chewing mouthparts but lack ommatidium, postantennal organ (PAO), empodium, retinaculum, furca, anal papilla and anal spine; antennal organ IV contains 4 globular and proximal sensory vesicles (3 external, 1 dorsal), a cylindrical sensory vesicle and 4 distal sensory cones.

Distribution: cosmopolitan except Australia ([Thibaud et al., 2004](#)) and Iran from Khuzestan province (present study) thus *Acherontiella* is new for the Iranian fauna.

Acherontiella bougisi Cassagnau et Delamare Deboutteville, 1955

Material examined: Iran, Khuzestan province, Mollasani: a wheat field: 2 specimens, 30.XI.2010; 2 specimens, 14.XII.2010; 2 specimens, 7.X.2011; 1 specimen, 20.XII.2011. Khuzestan province, Ramhormoz: a rice field: 5 specimens, 4.XI.2010; 8 specimens, 30.XI.2010; 5 specimens, 19.XI.2011.

Diagnosis: Length: about 1 mm. Body colorless. Without eyes, PAO, empodium, retinaculum and furca. Antenna: segments I and II with 7 and 10-11 setae, respectively; antennal organ on segment III with two short, internal sensilla housed in an integumentary depression, framed by two protective longer sensilla; segment III also with a ventral microsensillum, 4 hidden sensory vesicles, in particular, in the cuticular folds at the apex of the fourth antennal segment, the apical bladder on fourth antennal segment is simple. Labrum with 3 rows of 4-5, 5 and 4 setae.

Tibiotarsi I-III with 17, 17 and 16 setae, respectively and with or without capitate tenant hairs. Claws without inner tooth. Two small anal spines present. Chaetotaxy: pronotum with 3 + 3, meso- and meta-notum each with 4 + 5 - 4 + 5 a (anterior), 4 + 4 m (median) and 6 + 6 p (posterior) setae, sensilla m_4 and p_4 ; abdominal terga I-III each with 4 + 4 a and 4 + 4 p; abdomen segment IV with 2 + 2 a, 2 + 2 m and 3 + 3 p.

Distribution: Mediterranean (Algeria, Azores Island, Canary Islands, Crete, France, Iberian Peninsula, Lebanon and Rhodes) (Thibaud et al., 2004) and Iran from Khuzestan province (present study) consequently *Acherontiella bougisi* is new for the fauna of Iran.

Ecology: a soil, manure or cave-dwelling species (Thibaud et al., 2004).

Genus: *Ceratophysella* Börner, 1932

***Ceratophysella gibbosa* (Bagnall, 1940)**

Material examined: Iran, Khuzestan province, Mollasani: - a date-palm orchard: 3 specimens, 2.IV.2010; 5 specimens, 4.XI.2010; 8 specimens, 11.XI.2011 -a wheat field: 1 specimen, 14.XI.2010; 3 specimens, 7.XI.2011. Khuzestan province, Ramhormoz: a date-palm orchard: 2 specimens, 4.XI.2010.

Distribution: Africa, Eurasia, North America (Thibaud et al., 2004) and Iran from Kermanshah (Kahrarian, 2019), Tehran (Moravvej, 2003; Qazi & Shayanmehr, 2016) and Khuzestan (Thibaud et al., 2012; present study) provinces.

Ecology: it has been collected from compost heaps, pastures, field crops, home gardens as well as litter in disturbed vegetation and also is commonly encountered in fungi in pine forests (Greenslade et al., 2014).

Genus: *Hypogastrura* Bourlet, 1839

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

Material examined: Iran, Khuzestan province, Mollasani: - a wheat field: 3 specimens, 7.XI.2010; 1 specimen, 19.XI.2010; 6 specimens, 11.XII.2010; 1 specimen, 24.I.2011; 7 specimens, 12.II.2011; 3 specimens, 1.III.2011 - a date-palm orchard: 2 specimens, 14.XI.2010; 2 specimens, 7.XI.2011. Khuzestan province, Ramhormoz: - a date-palm orchard: 5 specimens, 6.XI.2010; 1 specimen, 30.XI.2010 - a wheat field: 7 specimens, 10.XII.2010; 2 specimens, 11 Mar. 2011; 5 specimens, 19.XI.2011; 4 specimens, 4.II.2012.

Distribution: cosmopolitan (Greenslade et al., 2014) including Iran in East Azerbaijan, West Azerbaijan, Guilan, Kermanshah, Kohgiluyeh-va-Boyer-Ahmad, Mazandaran, Tehran, Zanjan (Shayanmehr et al., 2013; Kahrarian, 2017) and Khuzestan (present study) provinces.

Ecology: a hygrophilous species known as pest due to damaging mushroom cultures (Greenslade et al., 2014).

Family Isotomidae

Genus: *Ballistura* Börner, 1906

Comment: species of *Ballistura* have tibiotarsi with an unpaired mid-ventral seta and a thick and cylindrical dens but lack ventral manubrial setae. *Ballistura* has been previously recorded from Iran only from Guilan province by *Ballistura schoetti* (Dalla Torre, 1895) (Cox, 1982).

***Ballistura tuberculata* (Stach, 1947)**

Material examined: Iran, Khuzestan province, Mollasani: - a wheat field: 2 specimens, 11.XI.2010; 1 specimen, 4.XII.2010; 7 specimens, 28.III.2011; 4 specimens, 12.II.2012 - a date-palm orchard: 1 specimen, 7.XII.2010; 3 specimens, 7.XI.2011.

Diagnosis: Body: up to 0.9 mm, pale bluish grey. Eyes with 8 + 8 pigmented ommatidia. PAO broadly oval, not constricted, 1.5 time as long as ommatidium. Claws without teeth. Empodium sharply acuminate. 1, 2, 2 blunt or slightly clavate tenent hairs on tibiotarsi I-III. Ventral tube with 4-5 + 4-5 laterodistal and a pair of posterior setae. Retinaculum with 3 + 3 teeth and 1 seta. Manubrium: without anterior seta, posterior side with about 20 setae. Dens: on anterior side with 5 setae in distal part, posterior side with six broad notches and 10 setae. Mucro: massive, bidentate, with subapical tooth more broad than apical, wide lamella of proximal part hardly separated from posterior side of dens, its length about half as long as mucro. Mucro : dens = 1:2.7. Chaetotaxy: setae short, macrosetae hardly differentiated, only lightly longer than common setae.

Distribution: Europe (Austria, Belarus, Poland, Russia and Ukraine), North America (Potapov, 2001) and Iran from Khuzestan province (present study).

Ecology: one of the abundant species in successions of decaying manure in soil and decaying hay in agricultural fields; also known from flower pots (Potapov, 2001).

Genus: *Hemisotoma* Bagnall, 1949***Hemisotoma ponticus* (Stach, 1947)**

Material examined: Iran, Khuzestan province, Mollasani: - a wheat field: 1 specimen, 1.II.2011 - a date-palm orchard: 2 specimens, 17.XI.2011; 4 specimens, 7.II.2012.

Distribution: Africa (Morocco), Asia (Afghanistan, Lebanon, Kyrgyzstan, Republic of Georgia), Europe (Austria, Crete, Croatia, France, Germany, Hungary, Italy, Portugal, Slovakia, Spain, Switzerland), Azores Island, Rhodes (Potapov, 2001) and Iran from East Azerbaijan, West Azerbaijan, Guilan, Kermanshah, Markazi, Mazandaran, Tehran (Shayanmehr et al., 2013) and Khuzestan (Thibaud et al., 2012; present study) provinces.

Ecology: a xerothermic and ruderal species (Potapov, 2001).

Genus: *Isotomurus* Börner, 1903***Isotomurus palustris* (Müller, 1776)**

Material examined: Iran, Khuzestan province, Mollasani: - a wheat field: 4 specimens, 7.XI.2010; 5 specimens, 6.XII.2010; 6 specimens, 12.II.2011 - a date-palm orchard: 2 specimens, 7.XI.2010; 5 specimens, 6.XII.2011. Khuzestan province, Ramhormoz: - a date-palm orchard: 5 specimens, 6.XI.2010; 3 specimens, 21.XI.2011; 2 specimens, 30.XII.2012 - a wheat field: 1 specimen, 10.XII.2010; 2 specimens, 5.III.2011.

Distribution: Holarctic (Potapov, 2001) including Iran from Guilan, Markazi, Mazandaran (Cox, 1982), Golestan (Hosseini et al., 2016) and Khuzestan (present study) provinces.

Ecology: a hydrophilous species; common and numerous in humid locations (Potapov, 2001).

Genus: *Parisotoma* Bagnall, 1940***Parisotoma notabilis* (Schäffer, 1896)**

Material examined: Iran, Khuzestan province, Mollasani: - a date-palm orchard: 1 specimen, 19.XI.2010 - a wheat field: 1 specimen, 12.II.2011. Khuzestan province, Ramhormoz: 2 specimens, 21.XI.2010.

Distribution: Cosmopolitan (Potapov, 2001) including Iran from East Azerbaijan, West Azerbaijan, Golestan, Guilan, Kerman, Kermanshah, Kohgiluyeh-va-Boyer-Ahmad, Lorestan, Markazi, Mazandaran, Tehran, Zanjan (Shayanmehr et al., 2013; Ahmadi Rad & Kahrarian, 2015; Hosseini et al., 2016; Abdolalizadeh et al., 2019) and Khuzestan (present study) provinces.

Ecology: a eurytopic and mesophilic litter-dwelling species with high abundances (Potapov, 2001).

Family Sminthuridae

Genus: *Sminthurus* Latreille, 1802

Sminthurus wahlgreni Stach, 1920

Material examined: Iran, Khuzestan province, Mollasani: - a wheat field: 3 specimens, 7.XI.2010; 6 specimens, 6.XII.2010; 3 specimens, 12.II.2011 - a date-palm orchard: 4 specimens, 7.XI.2010; 3 specimens, 6.XII.2011. Khuzestan province, Ramhormoz: - a date-palm orchard: 2 specimens, 6.XI.2010; 4 specimens, 21.XI.2011; 1 specimen, 30.XII.2012 - a wheat field: 6 specimen, 10.XII.2010; 3 specimens, 5.III.2011.

Diagnosis: Eye-spots dark, with 8 + 8 ocelli. Antennae elbowed between segments 3 and 4; antennal segment IV with 21 subsegments; males' antennae simple, without clasping organ; females' ones with a pair of modified subanal setae. Trochanter with normal seta on the back side. Tibiotarsi with pointed apical setae which are not adressed to the claws. Pretarsus with two setae (anterior/posterior). Abdomen globular, segment 5 with one pair of trichobothria. Dens with at least 9 ventral setae. Mucro with both posterior edges smooth, without mucronal seta.

Distribution: eastern and central Europe (Bretfeld, 1999) and Iran from Khuzestan province (present study).

Ecology: a litter-dwelling species (Bretfeld, 1999).

Table 1. Updated list of Collembola known from Khuzestan province of Iran.

Family	Species	Reference
Hypogastruridae	<i>Acherontiella bougisi</i> Cassagnau et Delamare	present study
	Deboutteville, 1955	
	<i>Ceratophysella falcifer</i> (Cassagnau, 1959)	Thibaud et al. (2012)
	<i>Ceratophysella gibbosa</i> (Bagnall, 1940)	Thibaud et al. (2012); present study
	<i>Hypogastrura manubrialis</i> (Tullberg, 1869)	present study
Isotomidae	<i>Xenylla humicola</i> (O. Fabricius, 1780)	Thibaud et al. (2012)
	<i>Ballistura tuberculata</i> (Stach 1947)	present study
	<i>Desoria</i> cf. <i>olivacea</i> (Tullberg, 1871)	Thibaud et al. (2012)
	<i>Hemisotoma ponticus</i> (Stach, 1947)	Thibaud et al. (2012); present study
	<i>Isotomurus palustris</i> (Müller, 1776)	present study
Sminthuridae	<i>Parisotoma notabilis</i> (Schäffer, 1896)	present study
	<i>Sminthurus viridis</i> (Linnaeus, 1758)	Gardenhire (1959)
	<i>Sminthurus wahlgreni</i> Stach 1920	present study

Discussion

By this study, one genus, viz. *Acherontiella* Absolon, 1913 (Hypogastruridae) and three species, namely *Acherontiella bougisi* (Hypogastruridae), *Ballistura tuberculata* (Isotomidae) and *Sminthurus wahlgreni* (Sminthuridae) are recorded as new for the Iranian fauna. Except for *Ceratophysella gibbosa* and *Hemisotoma ponticus*, the genera *Hypogastrura* Bourlet, 1839 (Hypogastruridae), *Ballistura* Börner, 1906, *Isotomurus* Börner, 1903 and *Parisotoma* Bagnall, 1940 (Isotomidae) and the other species are herein documented for the first time for Khuzestan province. Along with two previous reports, totally twelve Collembola species are known from Khuzestan as listed in Table 1, which indicates unexplored fauna of southwestern Iran, thus investigations are required to determine province's springtail biodiversity.

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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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مطالعه‌ای بر پادمان (Arthropoda; Hexapoda) در استان خوزستان، جنوب غرب ایران

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چکیده: طی مطالعه پادمان (Collembola) استان خوزستان در جنوب غرب ایران، هشت گونه شامل سه گونه از خانواده Hypogastruridae، چهار گونه از خانواده Isotomidae و یک گونه از خانواده Sminthuridae جمع‌آوری و شناسایی شد. جنس *Acherontiella* و گونه‌های *Acherontiella bougisi* (Hypogastruridae) Cassagnau et Delamare Deboutteville, 1955 و *Sminthurus* (Isotomidae) *Ballistura tuberculata* (Stach 1947) و *Sminthurus wahlgreni* Stach, 1920 (Sminthuridae) برای ایران و گونه‌های *Hypogastrura manubrialis* (Tullberg, 1869) (Hypogastruridae)، *Parisotoma notabilis* (Schäffer, 1896) و *Isotomurus palustris* (Müller, 1776) (Isotomidae) برای خوزستان گزارش جدید هستند.

واژگان کلیدی: پادمان، فون، گزارش‌های جدید، ایران، خوزستان