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Two new species and new data of Isotomidae Schaeffer, 1896
(Collembola: Entomobryomorpha) from Iran.Javier I. Arbea¹ & Morteza Kahrarian²¹ c/ Ría de Solía 3, ch. 39. E-39610 El Astillero (Cantabria, ESPAÑA). e-mail: jarbeapo@gmail.com² Department of Agronomy, Kermanshah Branch, Islamic Azad University, Kermanshah (IRAN). e-mail: mkahrarian@iauksh.ac.ir

Abstract: Sixteen species of the family Isotomidae (Collembola: Entomobryomorpha) are listed from Iran. Two new species are described: *Isotomodes korkorensis* sp. nov. can be easily recognized by the presence of a pair of dorsomedial macrochaetae on abdominal tergite V, 4+4 lateral chaetae on the ventral tube, and 2+2 retinacular teeth; *Isotoma iranica* sp. nov. is characterized by the manubrial thickening with two teeth in median part, body pigmentation and manubrial chaetotaxy. *Folsomia manolachei* Bagnall, 1939 is recorded for the first time in Iran. A key to the known Iranian genera and species of Isotomidae is provided.

Key words: Collembola, Isotomidae, Springtails, *Isotomodes korkorensis* sp. nov., *Isotoma iranica* sp. nov., systematics, taxonomy, biodiversity, identification key.

Resumen: Dos nuevas especies y nuevos datos de Isotomidae (Collembola: Entomobryomorpha) de Irán. Se citan dieciséis especies de la familia Isotomidae (Collembola: Entomobryomorpha) de Irán. Se describen dos nuevas especies: *Isotomodes korkorensis* sp. nov. puede reconocerse fácilmente por la presencia de un par de macrosedas dorsomediales en el terguito abdominal V, 4+4 sedas laterales en el tubo ventral y 2+2 dientes en el tenáculo; *Isotoma iranica* sp. nov. se caracteriza por tener dos dientes en el engrosamiento medio apical del manubrio, por la pigmentación del cuerpo y por la quetotaxia del manubrio. *Folsomia manolachei* Bagnall, 1939 se cita por primera vez en Irán. Se da una clave de identificación de los géneros y especies de Isotomidae de Irán.

Palabras clave: Collembola, Isotomidae, Saltarines, *Isotomodes korkorensis* sp. nov., *Isotoma iranica* sp. nov., sistemática, taxonomía, biodiversidad, clave de identificación.

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Introduction

The Iranian fauna of Collembola is poorly known. The first paper on Iranian Collembola (Cox 1982) lists 70 species, 17 of them belonging to the family Isotomidae. Since then two papers have been published on Iranian Isotomidae (Morawej *et al.* 2007 and Nematollahi *et al.* 2009). In recent years Falahati Hossein Abad (2012) from Gorgan region, Yahyapour (2012) and Yahyapour & Shayan Mehr (2014) from Sari region, Falahati Hossein Abad *et al.* (2013a) from the province of Golestan, Yoosefi-Lafooraki & Shayanmehr (2013) and Yahyapour & Shayan Mehr (2014) from the provinces of Mazandaran and Semnan, Daghighi *et al.* (2013a, b) from the province of Guilan, Qazi & Shayanmehr (2014) from the province of Tehran, Kahrarian & Arbea (2013) and Arbea & Kahrarian (2015) from the province of Kermanshah, Ahmadi Rad & Kahrarian (2015) from the province of Lorestan, reported some fauna of Isotomidae for the first time for Iran (Table 4).

In order to contribute to the knowledge of this family in Iran, a taxonomical study was made in the province of Kermanshah. In the present paper two new species are described, belonging to the genera *Isotomodes* Axelson, 1907 and *Isotoma* Bourlet, 1839.

Material and methods

This study was based on specimens collected in various localities from the province of Kermanshah, Western Iran (Table 1), which has a moderate and mountainous climate and elevation average about 1350 m above sea level. Winter is the most rainy season and is moderately warm in summer. The annual rainfall is 500 mm. The average temperature in the hottest months is above 22°C.

Samples were collected from the surface layer of soil and plant debris that exists under the trees. The species were extracted from soil samples using Berlese-Tullgren funnel and kept in 75% ethanol. Collembola specimens were sorted and mounted under slides in Hoyer's solution.

The determinations were based on Potapov (2001). The material was collected by the first author and is deposited in the insect collections of Kermanshah Branch, Islamic Azad University, Iran (IAUK), Museo Nacional de Ciencias Naturales, Madrid, Spain (MNCN) and J.I. Arbea's private collection (Spain).

Abbreviations used: The terminology of Gama (1963), Potapov (2001), Fjellberg (2003), and Arbea (2006) is used in the description of the species, with the following abbreviations: Abd—abdominal tergum, AIIIIO—antennal III sense organ, al/accp1-4—anterolateral/posterior sensilla, Ant—antennal segment, fa1-4/fp0-3—anterior/posterior foil chaetae, ms—microsensillum, PAO—postantennal organ, s—sensillum, Th—thoracic tergum, VT—Ventral tube.

Results

In the current paper sixteen springtail species belonging to eight genera within the family Isotomidae are reported from the province of Kermanshah, Western Iran. The species *Folsomia manolachei* Bagnall, 1939 is new record for the Collembola fauna of Iran and two species are described as new. Detailed information of these species are presented as below. Biology and distribution of the species according to Potapov (2001).

Annotated species list

Family ISOTOMIDAE Schaeffer, 1896

Subfamily PROISOTOMINAE Stach, 1947

Genus *Folsomia* Willem, 1902

Folsomia asiatica Martynova, 1971 (Figs. 1-6)

Material examined. Quri Qual'eh (loc. 6), 14.XII.2012, 2 males.

Biology. Gardens, grape plantations, irrigated arable soils. In Iran it was found in a walnut garden.

Distribution. Recorded in Middle Asia, from Tadjikistan and Azerbaijan. It is confirmed the presence of this species in Iran (as *F. cf. asiatica* in Ahmadi Rad & Kahrarian 2015).

Description of Iranian specimens.

Body size (without antennae and furca): 1.35-1.52 mm (2 males). Lacking pigment on body. Body as typical habitus for the genus (Fig. 1). Ocelli lacking.

PAO elliptical, slightly shorter than Ant I width, and much longer than inner unguis length (1.7-1.9) (Figs. 5, 6). Maxillary outer lobe with 4 sublobal hairs, maxillary palp bifurcate. Labral formula as 4/5,5,4, chaetae of apical and subapical row thick, chaetae of basal row thin. Labium as common for

the genus, with 3 proximal, 4 basomedial, and 5 basolateral chaetae. Ventral side of a head with 4+4 postlabial chaetae.

Ant I with 2 small basal ms (bms), dorsal and ventral, and 3-4 ventral s (Figs. 5, 6), Ant II with 3 bms and 1 latero-distal s, Ant III without bms, AIIIO with 6 sensilla, including 2 lateral ones (s and ms) and with 6-8 additional s (Fig. 5). Sensilla on Ant IV weakly differentiated, 2 dorsolateral s thicker.

Sensilla on body long and thin. Sensillar formula for Th II-Abd V: 4,3/2,2,2,3,5 s, 1,0/1,0,0 ms. On Th II-Abd III, medial s situated in posterior row of chaetae, corner s on Th II-III in posterior row of chaetae (Figs. 1, 2). On Abd IV three s, two long and one shorter; Abd V with 5 s arranged with 4 dorsal ones (al, accp1, accp2, accp3) somewhat longer than lateral s (accp4), all sensilla subequally thin (Figs. 1, 3). Macrochaetae smooth and long, 1,1/3,3,3,4 in number, medial ones on Abd V 2.2-2.5x shorter than dens and 3.8-4.0 times longer than mucro (Figs. 1, 3). Abd VI with a group of 15 foil chaetae arranged in two transversal rows as 4+4 anterior (fa1, fa2, fa3 and fa4) and 1+6 posterior (fp0, fp1, fp2 and fp3), respectively; foil-chaeta fp1 thicker and longer, 0.6x length of medial macrochaeta of Abd V (Fig. 3). Axial chaetotaxy as 10-11,6-8/4,4,4.

Unguis of normal shape, without lateral and inner teeth. Empodial appendage 0.50-0.55 as long as unguis. Tibiotarsal tenent chaetae pointed.

Thorax without ventral chaetae. VT with 4-7+4-7 laterodistal and 2-3+2-3 posterior chaetae, anteriorly without chaetae. Retinaculum with 4+4 teeth and 1 chaeta on corpus. Anterior furcal subcoxae with 12-15, posterior one with 6-9 chaetae. Anterior side of manubrium with (3)4+(3)4 chaetae arranged in two irregular longitudinal lines (Fig. 4). Posterior side of manubrium with 4+4 laterobasal, 1+1 apical chaetae, 3+3 chaetae in distal transversal row, two pairs of lateral chaetae, and 6-7+6-7 in central part (Fig. 4). Dens with 16-24 anterior chaetae; posterior side of dens crenulated and with 5 chaetae (3 basal and 2 medial) (Fig. 4). Mucro bidentate. Ratio manubrium:dens:mucro = 6.5-7.0:8.8-10.0:1.

***Folsomia similis* Bagnall, 1939 (Figs. 7-16)**

Material examined. Kermanshah (4 females as *Folsomia* n. sp. in Kahrarian & Arbea, 2013). Shabankareh village (loc. 7), 6-II-2013, 1 juvenile.

Biology. *F. similis* is primarily a nitrophilous species of greenhouses, gardens, flower pots, etc. (its type locality, for example). It is an introduced species probably from warmer areas. In Europe, it has mostly been found in protected soils, gardens, caves and compost.

Distribution. Probably a widely distributed species in the Holarctic, and an artificially introduced species.

Description of Iranian specimens.

Body size (without antennae and furca): 1.13-1.23 mm (3 females). With black pigment granules scattered on body. Body as typical habitus for the genus (Fig. 7).

With 1+1 pigmented ocelli. PAO elliptical, slightly longer than Ant I width, and much longer than inner unguis length (1.9-2.0) (Fig. 16). Maxillary outer lobe with 4 sublobal hairs, maxillary palp bifurcate. Labral formula as 4/5,5,4, chaetae of apical and subapical row thick, chaetae of basal row thin. Labium as common for the genus, with 3 proximal, 4 basomedial, and 5 basolateral chaetae. Ventral side of the head with 4+4 postlabial chaetae.

Ant I with 3 small bms, 2 dorsal and 1 ventral, and 3 ventral s (Fig. 13), Ant II with 3 bms and 1 latero-distal s, Ant III without bms, AIIIO with 5 sensilla (including 1 lateral ms) and without additional s (Fig. 13). Sensilla on Ant IV weakly differentiated, with 3-4 dorsolateral s thicker.

Sensilla on body relatively long and thin (Fig. 8). Sensillar formula for Th II-Abd V: 4,3/2,2,2,3,5 s, 1,0/1,0,0 ms (Figs. 7-9). On Th II-Abd III, medial s situated in front of posterior row of chaetae, corner s on Th II-III in posterior row of chaetae (Fig. 7, 8). On Abd IV three s, two

long and one shorter; Abd V with 5 s arranged with 4 dorsal ones (al, accp1, accp2, accp3) somewhat longer than lateral s (accp4), all sensilla subequally thin (Fig 7, 8). Macrochaetae smooth and short, longer on lateral region, 1,1/1,2,2,4 in number (Fig. 7), medial ones on Abd V 3.0-3.9x shorter than dens and 1.4-1.8x longer than mucro (Fig. 9). Axial chaetotaxy as 12-14,9-10/5-6,6,6-7.

Unguis normal shaped, without lateral and inner teeth. Empodial appendage 0.55-0.60 as long as unguis (Fig. 14). Tibiotarsal tenent chaetae pointed.

Thorax without ventral chaetae. VT with 4+4 laterodistal and 2+2 posterior chaetae, anteriorly without chaetae (Fig. 15). Retinaculum with 4+4 teeth and 1 chaeta on corpus. Anterior furcal subcoxae with 7-9, posterior one with 4 chaetae. Anterior side of manubrium with (3)5+(3)5 chaetae arranged in two irregular longitudinal lines (Figs. 10, 12, 13); posterior side of manubrium with 4+4 laterobasal, 1+1 apical chaetae, 2+2 chaetae in distal transversal row, one pair of lateral chaetae, and 6+6 in central part (Fig. 11). Dens with 14-15 anterior chaetae (Figs. 10, 12). Posterior side of dens crenulated and with 6 chaetae (3 basal, 2 medial and 1 apical microchaeta) (Fig. 11). Mucro bidentate. Ratio manubrium:dens:mucro = 4.8-5.0:5.4-5.7:1.

***Folsomia manolachei* Bagnall, 1939**

Material examined. Bilevar city (loc. 3), V-2013, 3 ex.; Shahu city (loc. 8), 14-XII-2013, 1 ex.

Biology. Eurytopic species.

Distribution. Probably all over the Palaearctic. It is the first record of this species in Iran.

***Folsomia quadrioculata* (Tullberg, 1871)**

Material examined. Char zabar (loc. 4), 15-II-2013, 10 ex.; 5-IV-2013, 10 ex.; Shikh salaeh village (loc. 15) and Ghap Gholi village (loc. 13), 20-XII-2012, 2 ex.; Sia Khor village (loc. 1), 5-IV-2013, 2 ex.

Biology. Eurytopic litter-dwelling species with a moderate preference to damp and cold sites; one of the most generalistic species in the Palaearctic.

Distribution. Widely distributed Holarctic species.

***Folsomia penicula* Bagnall, 1939**

Material examined. Shikh salaeh village (loc. 15) and Ghap Gholi village (loc. 13), 20-XII-2012, 2 ex.

Biology. Mesophilic and mostly forest species, eurytopic species.

Distribution. In the Palaearctic, it is a widely distributed European species (Central and South Europe). It is known from N America.

Genus *Folsomides* Stach, 1922

***Folsomides marchicus* (Frenzel, 1941)**

Material examined. Patagh area (loc. 11), 10-II-2013, oak jungle, 1 ex.; 10-II-2013, grassland, 2 ex. Shia Khor village (loc. 1), 5-IV-2013, 3 ex.

Biology. In Europe it was found in saxicolous and dry calciphilous communities.

Distribution. Europe (Potapov 2001) and Iran (Kahrarian *et al.* 2012, Kahrarian & Arbea 2013).

***Folsomides parvulus* Stach, 1922**

Material examined. Bilevar city (loc. 3), V-2013, 14 ex.; Shia Khor village (loc. 1), 5-IV-2013, 8 ex.

Biology. Xerophilous and psammophilous species of soils of open biotopes. Southern areas with a dry climate.

Distribution. Cosmopolitan species.

***Folsomides subvinosus* Arbea & Kahrarian, 2015**

Material examined. Shabankareh village (loc. 7), 6-II-2013, 3 ex.; 10-V-2013, 1 ex.; Patagh area (loc. 11), 14-V-2013, oak jungle, 16 ex.; Char zabar (loc. 4), 15-II-2013, 19 ex.; Hassan Abad village (loc. 2), 14-XII-2012, 2 ex.; Sia Khor village (loc. 1), 5-IV-2013, 8 ex.

Biology. Found in grassland soil and in forest soil and leaf litter at 1404-1632 m altitude; only females known.

Distribution. Only known from Kermanshah, W Iran.

***Folsomides halshinicus* Arbea & Kahrarian, 2015**

Material examined. Char zabar (loc. 4), 15-II-2013, 1 ex.; Shabankareh village (loc. 7), 6-II-2013, 10 ex.; Patagh area (loc. 11), 10-II-2013, oak jungle, 2 ex.; Hassan Abad village (loc. 2), 14-XII-2012, 9 ex.; Sia Khor village (loc. 1), 14-V-2013, 2 ex.

Biology. This species is most abundant in forest soil and leaf litter at 1404-1663 m altitude; also in grassland soil at 1442 m altitude; only females known.

Distribution. Only known from Kermanshah, W Iran.

Subfamily ANUROPHORINAE Börner, 1901

Genus *Hemisotoma* Bagnall, 1949

***Hemisotoma orientalis* (Stach, 1947)**

Material examined. Patagh area (loc. 11), 10-II-2013, oak jungle, 1 ex.; Habibvand village (loc. 10), 10-II-2013, 10 ex.

Biology. Xerothermic species.

Distribution. Several records from Ukraine, Kazakhstan, S Siberia (Khakassia), SE France.

***Hemisotoma thermophila* (Axelson, 1900)**

Material examined. Derkah village (loc. 9), Rijab city (loc. 12) and Shikh salaeh village (loc. 14), XII-2012, 4 ex.

Biology. Thermophilous and nitrophilous species.

Distribution. Cosmopolitan species.

Genus *Isotomodes* Axelson, 1907

***Isotomodes korkorensis* sp. nov. (Figs. 17-22)**

Type locality. Western Iran: Char zabar (Kor Kor Mountain), Kermanshah County, Kermanshah Province, 34°13' N, 46°40' E, 1592 m a.s.l.

Type material. Holotype female and juvenile paratype, Iran, Kermanshah Province, Char zabar (loc. 4), oak jungle soil and leaf litter, 15-II-2013, Morteza Kahrarian leg. Holotype and paratype deposited in IAUK.

Description.

Body size (without antennae): Holotype female 0.74 mm, paratype juvenile 0.50 mm. Without pigment and eyes. Integument minutely granulate. Body as typical habitus for the genus (Figs. 17, 18).

Antennae as long as the head. Ant I with 12 chaetae and 2 sensilla; Ant II and III with 25-26 chaetae each. AIIIO with two globular sensilla in separate pits, two subcylindrical guard sensilla and one ventrolateral accessory sensillum. Ant IV with about 20 subcylindrical dorsal sensilla. Dorsoexternal subapical sensory organ present, consisting of one globular cup microsensillum and one subcylindrical sensillum.

Labium typical for the genus (after Fjellberg 1999 and Potapov 2001), with two guard chaetae on papillae E. Labrum with 4/4,5,4 chaetae. PAO broadly elliptical, almost as long as the width of Ant I, with six posterior chaetae (Fig. 19).

Tibiotarsi I,II,III with 21,21,22 acuminate chaetae respectively. Unguis without teeth. Unguiculus lanceolate, half as long as the claw (Fig. 20).

Abdominal ventral chaetotaxy represented in Fig. 18. Thoracic sternites with 2,3,4 chaetae. Subcoxa I with two macrochaetae. VT with 5+5 distal and 2+2 proximal chaetae in posterior margin.

Furcula present; manubrium longer than dens, with 12+12 posterior chaetae. Dens with two posterior and one anterior chaetae. Mucro bidentate, separated from dens (Fig. 21). Furcal subcoxa with three chaetae on the anterior half and four chaetae on the posterior half. Retinaculum with 3+3 teeth and one chaeta.

Dorsal chaetotaxy as in Fig. 17. Head with three dorsomedial chaetae (seta *a0* present). Dorsomedial chaetotaxy on thorax and abdomen: 7,6/4,4,5. Macrochaetotaxy: 1,1/3,3,3,2+2. Sensillar chaetotaxy: 1,1/2,1,2,2 posterior sensilla (*accp*) and 3,2/0,1,0,0 lateral sensilla (*al*); Abd V+VI with a pair of lateroventral sensilla situated just below *P5* and *P6* macrochaetae. Abd IV with the dorsomedial chaeta *dm2* present. 11-13 chaetae present between the macrochaetae *S1*. Two chaetae present between the macrochaetae *S3*. Three microchaetae *m* present. Among the posterior *Pp*-series chaetae of Abd IV there are 25 chaetae between the sensilla *p13*: 17 thin chaetae (*p0* + 2 *p2*, *p4*, *p5*, *p7*, *p8*, *p9*, *p11*, *p12*) and 8 thicker chaetae (2 *P1*, *P3*, *P6*, *P10*). Abd V with a pair of strong dorsal macrochaetae, 4+4 dorsal microchaetae and 1+1 dorsolateral sensilla which are thinner and shorter than the microchaetae. Abd VI with *P0*, *P1*, *P3* spiniform chaetae, macrochaeta *P4* non-spiniform, long (Fig. 22).

Discussion. According to the dorsal chaetotaxy of Abd V this species is related to the group formed by 22 species with a pair of dorsomedial macrochaetae on Abd V. Main differences between *I. korkorensis* sp. nov. and these species are summarized in Table 2. The new species is similar to *I. denisi* from Hawaii, which shares the same chaetotaxy of Abd VI and the same dental chaetotaxy. It differs from these species by the number of lateral chaetae on ventral tube and the number of retinacular teeth (see Table 2).

Etymology. The species has been named after the type locality (Kor Kor Mountain).

Subfamily ISOTOMINAE Schaeffer, 1896

Genus *Desoria* Agassiz & Nicolet in Desor, 1841

Desoria tigrina Nicolet, 1842

Material examined. Derkah village (loc. 9), Rijab city (loc. 12) and Shikh salaeh village (loc. 14), XII-2012, 10 ex.; Sarfirooz Abdb (loc. 5), 3-XII-2012, 2 ex.; Shabankareh village (loc. 7), 6-II-2013, 1 ex.; Patagh area (loc. 11), 1 ex.

Biology. Nitrophilous and anthropophilous species. Under unfavorable conditions, young specimens develop a transverse row of spines on Abd V (ecomorphosis).

Distribution. Probably cosmopolitan species.

Genus *Isotoma* Bourlet, 1839

***Isotoma iranica* sp. nov. (Figs. 23-34)**

Type locality. Western Iran, Kermanshah Province, Paveh, Shahu city, 34°56' N, 46°27' E, 1663 m a.s.l.

Type material. Holotype male and three paratypes (2 females, 1 male), Iran, Kermanshah Province, Paveh, Shahu city (loc. 8), walnut garden, 14-XII-2012, Morteza Kahrarian leg. Holotype and one paratype female deposited in IAUK; two paratypes (male and female) in MNCN.

Description.

Body size (without antennae and furca): 3.1-4.3 mm. The spotted pattern is characteristic, with narrow middorsal longitudinal band on body, interrupted on Abd III-IV, and variable dorsolateral patches on thorax and abdomen; darker pigmentation on antennae and coxae bluish (Fig. 23). Legs and furca paler. Integument smooth, without visible granulation. The cover of body with simple and serrated chaetae, with varying lengths and thickness. Serrated macrochaetae number 22/33334 on Tor II-Abd V. Abd VI with 6 pairs of macrochaetae in addition to a central unpaired one (Fig. 23). Median macrochaetae on Abd V about twice as long as tergite.

Antenna far longer than diagonal head (1.9:1); ratio of Ant I:II:III:IV as about 10:15:16:19. AIIIO with 2 typical curved sensilla; about 17 dorsolateral thin microsensilla on Ant III (Fig. 26). Ant IV with bifurcate subapical pin chaeta and short rod-shaped subapical organite in a pit (Fig. 27).

Each side of head with 8 large ocelli. PAO roundish, smaller than nearest ocellus (4/9) (Fig. 24). Labrum with 4/554 slender chaetae. Labral papilla variable, laterals often only slightly larger than medians (Fig. 25). Maxillary outer lobe with bifurcate palp and 4 sublobal chaetae. Labial palp with apical papillae A-E present, 4 proximal chaetae. Basal fields of labium with 4 median and 5 lateral chaetae. Head with 4+4 postlabial chaetae along ventral line. Mandibles normal, with moderately strong teeth. Maxillae with short lamellae which have no long marginal cilia.

VT with numerous chaetae. Retinaculum with 4+4 teeth and many chaetae on corpus (more than 50). Manubrium with 4+4 or 5+5 strong, spine-like, smooth chaetae in antero-apical field (Fig. 34). Antero-apical manubrial thickening with two median teeth on each side (Figs. 33-34). The posterior inner proximal macrochaetae on manubrium (A) is shorter than the outer (B) (Fig. 30). Dens with three macrochaetae in postero-basal part (Fig. 30). Mucro with 3 subequal teeth, a minute fourth tooth often present on the ventral edge (Fig. 31). One specimen with four teeth on mucro, in addition to the minute ventral tooth, asymmetrically (Fig. 32).

Unguis with two minute inner teeth and a pair of distinct lateral teeth. Unguiculus slightly longer than 1/2 internal margin of unguis, with a distinct tooth at internal lamella. Tibiotarsi with 11 apical chaetae; tenent hair pointed (Figs. 28-29).

Discussion. According to the manubrial ventroapical teeth this species is related to the group formed by seven palaeartic species with bispinose manubrial thickening. Main differences between *I. iranica* sp. nov. and these species are summarized in Table 3. The new species is characterized by the coloration pattern and the dorsal chaetotaxy of manubrium and dens.

Etymology. The name of the new species refers to Iran, the country of the type locality.

Genus *Isotomiella* Bagnall, 1939

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

Material examined. Shabankareh village (loc. 7), 6-II-2013, 5 ex. ; Patagh area (loc. 11), 10-II-2013,

oak jungle, 1 ex. ; Ghap Gholi village (loc. 13) and Shikh salaeh village (loc. 15), 20-XII-2012, 1 ex.; Quri Qal'eh (loc. 6), 14-XII-2012, 2 ex.

Biology. Eurytopic litter-dwelling species with high abundance and a moderate preference for wet and forest sites.

Distribution: It is a cosmopolitan springtail, which is abundant in the Holarctic region.

Genus *Parisotoma* Bagnall, 1940

***Parisotoma notabilis* (Schäffer, 1896)**

Material examined. Shabankareh village (loc. 7), 6-2-2013, 3 ex.; 10-V-2013, 6 ex.; Patagh area (loc. 11), 10-II-2013, oak jungle, 2 ex.; Char zabar (loc. 4), 5-IV-2013, 2 ex.

Biology. Eurytopic and mesophilic litter-dwelling species with high abundance.

Distribution: Cosmopolitan species which is abundant in the Holarctic.

Key to genera and species

Only 36 Isotomidae species are recorded so far in Iran (Table 4), because of the paucity of works on the Collembolan fauna in this country. More species undoubtedly occur in this country (probably many more). Therefore, this study should be considered just as a preliminary paper. To help in further study of this fauna, a key to genera and species of the known Iranian Isotomidae is presented here.

Key to genera and species of Iranian Isotomidae		
1.	With spines arranged on dorsal surface of Abd V.....	ecomorphic <i>Desoria tigrina</i> Nicolet, 1842
-	Without spines on Abd.....	2
2.	Furca absent.....	<i>Anurophorus coiffaiti</i> (Cassagnau & Delamare, 1955)
-	Furca present.....	3
3.	Abd IV-VI dorsally fused.....	<i>Folsomia</i> Willem, 1902.....4
-	Abd IV and V distinctly separate.....	12
4.	1+1 anterior chaetae on manubrium. 2+2 ocelli.....	5
-	3+3 or more anterior chaetae on manubrium.....	6
5.	Corner sens on Th II in front of p-row.....	<i>F. quadrioculata</i> (Tullberg, 1871)
-	Corner sens on Th II inside p-row.....	<i>F. manolachei</i> Bagnall, 1939
6.	No ocelli.....	7
-	Ocelli present.....	9
7.	With ventral chaetae on Th III.....	<i>F. candida</i> (Willem, 1902)
-	No ventral chaetae on Th III.....	8
8.	Manubrium with 4+4 anterior chaetae arranged as 3+3, 1+1.....	<i>F. fimetaria</i> (Linnaeus, 1758)
-	Manubrium with (3)5+(3)5 chaetae arranged in two irregular longitudinal lines.....	<i>F. asiatica</i> Martynova, 1971
9.	Manubrium with more than 10 anterior chaetae, arranged as 3+3, 1-2+1-2 or 2+2, 1+1 and several in axial part. Microsens on Th III and Abd III present.....	10
-	Manubrium with at most 10 anterior chaetae; if more, with only 1+1 or 2+2 in an apical transverse row. Microsens on Th III and Abd III absent.....	11

10.	2+2 ocelli.....	<i>F. penicula</i> Bagnall, 1939
-	1+1 ocelli.....	<i>F. ksenemani</i> Stach, 1947
11.	14 or more anterior chaetae on dens. Abd II-III with medial sensillum between Mac2 and Mac3 macrochaetae.....	<i>F. similis</i> (Bagnall, 1939)
-	At most 11 anterior chaetae on dens. Abd II-III with medial sensillum between Mac1 and Mac2 macrochaetae.....	<i>F. binoculata</i> (Wahlgren, 1899)
12.	PAO absent and ocelli absent. Ant IV with thicker sensilla.....	<i>Isotomiella minor</i> (Schäffer, 1896)
-	PAO and/or ocelli present. Ant IV with slender sensilla.....	13
13.	Abd V and VI strikingly different from Abd IV in chaetotaxy, both or sometimes only Abd VI has strong straight macrochaetae and a few normal chaetae.....	<i>Isotomodes korkorensis</i> sp. nov.
-	Chaetotaxy of Abd V and VI not strikingly different, if macrochaetae present there are numerous small chaetae.....	14
14.	Manubrium with 10 -usually 6- or fewer anterior chaetae.....	15
-	Manubrium with 11 -usually 14- or more anterior chaetae.....	27
15.	Manubrium with 2 or more anterior chaetae.....	16
-	Manubrium without anterior chaetae.....	22
16.	Abd V and VI separated.....	<i>Proisotoma</i> Börner, 1901.....17
-	Abd V and VI fused.....	<i>Hemisotoma</i> Bagnall, 1949.....20
17.	Mucro bidentate.....	<i>P. tenella</i> Reuter, 1895
-	Mucro tridentate.....	18
18.	5+5 ocelli.....	<i>P. minima</i> Absolon, 1901
-	7+7 ocelli or more.....	19
19.	7+7 ocelli. No ventromedial chaetae on Th III.....	<i>P. subminuta</i> Denis, 1931
-	8+8 ocelli. 1-2+1-2 ventromedial chaetae on Th III.....	<i>P. minuta</i> (Tullberg, 1871)
20.	5+5 ocelli.....	<i>H. pontica</i> (Stach, 1947)
-	6+6 ocelli or more.....	21
21.	6+6 ocelli.....	<i>H. orientalis</i> (Stach, 1947)
-	8+8 ocelli.....	<i>H. thermophila</i> (Axelson, 1900)
22.	Dens with more than 1+1 anterior chaetae.....	<i>Ballistura schoetti</i> (Dalla Torre, 1895)
-	Dens with no more than 1+1 anterior and with 1-5 posterior chaetae.....	<i>Folsomides</i> Stach, 1922 ... 23
23.	2+2 ocelli. Medial sensillum on Abd IV just behind subaxial macrochaeta (SA). PAO very narrow.....	<i>F. parvulus</i> (Stach, 1947)
-	5+5 ocelli. Medial sensillum on Abd IV between subaxial (SA) and medial (M) macrochaetae. PAO more roundish.....	24
24.	Retinaculum with 4+4 teeth. Dens with 1 anterior and 3 posterior chaetae.....	<i>F. angularis</i> Axelson, 1905
-	Retinaculum with 3+3 teeth.....	25
25.	Dens with 1 anterior and 3 posterior chaetae.....	<i>F. subvinosus</i> Arbea & Kahrarian, 2015
-	No anterior chaeta on dens.....	26
26.	Dens with 3 posterior chaetae.....	<i>F. marchicus</i> (Frenzel, 1941)
-	Dens with 2 posterior chaetae.....	<i>F. halshinicus</i> Arbea & Kahrarian, 2015
27.	Abd II-IV with bothriotracha.....	<i>Isotomurus</i> Börner, 1903.....28
-	Abd II-IV without bothriotracha.....	33
28.	Uniform body colour without bands.....	29
-	Pigmentation in bands or spots.....	30
29.	Abd with very long ciliate macrochaetae.....	<i>I. fucicolus</i> Schött, 1893
-	Abd with macrochaetae shorter, completely smooth.....	<i>I. italicus</i> Carapelli, Fanciulli, Frati & Dallai, 1995

30.	Body with dorsolateral patches on the tergites.....	31
-	Body without dorsolateral patches, or only small spots on Abd II-IV.....	32
31.	With almost continuous median longitudinal band and variable dorsolateral patches.....	<i>I. palustris</i> (Müller, 1776)
-	Body with characteristic spotted pattern, leaving an unpigmented median field in anterior parts on Abd.....	<i>I. maculatus</i> (Schäffer, 1869)
32.	Whitish, Abd II, III, IV with 3+3, 3+3, 1+1 small dark spots marking the bothriotracha bases. More than 9+9 laterodistal chaetae on VT.....	<i>I. punctiferus</i> Yossi, 1963
-	Background colour whitish, body with dark dorsomedian band on Th II-Abd IV continuously disappearing towards the posterior. At most 6+6 laterodistal chaetae on VT.....	<i>I. afghanicus</i> Yosii, 1963
33.	Tibiotarsus with clavate chaetae.....	<i>Pseudisotoma sensibilis</i> (Tullberg, 1876)
-	Tibiotarsus without clavate chaetae.....	34
34.	Anteromedial group of manubrial chaetae spine-like.....	<i>Isotoma</i> Bourlet, 1839.....35
-	Anteromedial group of manubrial chaetae not spine-like.....	36
35.	Body uniformly coloured, not with sharp longitudinal lines. Manubrial thickening simple.....	<i>I. viridis</i> Bourlet, 1839
-	Body with sharp middorsal line and patchy lateral bands. Manubrial thickening bispinose.....	<i>I. iranica</i> sp. nov.
36.	0+0-5+5 ocelli, if present in a squarish eye spot.....	<i>Parisotoma notabilis</i> (Schäffer, 1896)
-	6+6-8+8 ocelli in long eye spot.....	<i>Desoria tigrina</i> Nicolet, 1842

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Table 1. - List of sampling localities in the province of Kermanshah, Western Iran.

Loc.	County	City/Town/District	Coordinates	Elevation	Habitat
1	EslamAbad-e-Gharb	Sia Khor village	34°07'N, 46°36'E	1442 m	Grassland
2	Kangavar	Hassan Abad village	34°31'N, 47°55'E	1480 m	Forest plane (Buttonwood)
3	Kermanshah	Bilevar city	34°20'N, 47°00'E	1600 m	Cave
4	Kermanshah	Char zabar (Kor Kor Mount.)	34°13'N, 46°40'E	1592 m	Oak jungle, soil and leaf litter
5	Kermanshah	Sarfirooz Abdb (Halshi)	34°02'N, 47°10'E	1624 m	Oak jungle, soil and leaf litter
6	Paveh	Quri Qal'eh	34°53'N, 46°30'E	1624 m	Walnut garden
7	Paveh	Shabankareh village	34°52'N, 46°30'E	1632 m	Oak jungle, soil and leaf litter
8	Paveh	Shahu city	34°56'N, 46°27'E	1663 m	Walnut garden
9	Sahneh	Derkah village	34°28'N, 45°58'E	2041 m	Plum
10	Sar-e-pol-e-Zahab	Habibvaud village	34°25'N, 45°56'E	1454 m	Wheat farm
11	Sar-e-pol-e-Zahab	Patagh area	34°25'N, 46°01'E	1034 m 1404 m	Grassland Oak jungle, soil and leaf litter
12	Sar-e-pol-e-Zahab	Rijab city	34°14'N, 46°41'E	2602 m	Oak jungle, soil and leaf litter
13	Tazeh Aba	Ghap Gholi village	34°44'N, 46°15'E	1295 m	Forest plane (Buttonwood)
14	Tazeh Aba	Shikh salaeh village	34°12'N, 46°29'E	2248 m	Walnut garden
15	Tazeh Aba	Shikh salaeh village	34°58'N, 45°54'E	1287 m	Walnut garden

Table 2. - Basic morphological characters of *Isotomodes korkorensis* sp. nov. and the species of *Isotomodes* with a pair of dorsomedial macrochaetae on Abd V.

1—number of macrochaetae on subcoxa I; 2—number of lateral chaetae on ventral tube; 3—number of retinacular teeth; 4—number of *m* microchaetae on Abd IV; 5—chaeta *p*₁₂ on Abd IV; 6—number of anterior chaetae on dens; 7, 8, 9, 10—shape of *P*₀, *P*₁, *P*₃ and *P*₄ chaetae on Abd VI, respectively (OC: ordinary acuminate chaeta, SC: spine-like or blunt chaeta). Similarities in red.

Species	1	2	3	4	5	6	7	8	9	10	Distribution
<i>korkorensis</i> sp. nov.	1	4+4	2+2	3	+	1	SC	SC	SC	OC	Iran
<i>alavensis</i> Simón et al., 1994	2	4+4	3+3	4-6	-	4	SC	SC	SC	OC	Spain
<i>alexius</i> Palacios-Vargas & Kovac, 1995	1	4+4	4+4	6	-	6	SC	SC	SC	OC	Mexico
<i>armatus</i> Naglitsch, 1962	1	3+3	2+2	3	-	2	OC	SC	SC	OC	Germany, Portugal
<i>buchardi</i> Thibaud, 2008	?	4+4	3+3	0	-	2	SC	SC	SC	OC	Madagascar
<i>carioca</i> Thibaud & Palacios-Vargas, 1999	?	4+4	4+4	6	-	6	OC	OC	OC	OC	Brazil
<i>cassagnai</i> Izarra, 1969	?	3+3	3+3	2	-	6	OC	SC	SC	OC	Argentina
<i>cuzcoensis</i> Winter 1963	?	3+3	3+3	7	-	2	OC	OC	OC	OC	Peru
<i>dagamae</i> Prabhoo, 1971	?	4+4	4+4	3	-	6	OC	OC	OC	OC	India, Hawaii
<i>denisi</i> Folsom, 1932	?	3+3	3+3	?	?	1	SC	SC	SC	OC	Hawaii
<i>falsus</i> Christiansen & Bellinger, 1980	?	4+4	3+3	6	+	2	SC	SC	SC	OC	N America, Japan, S France
<i>fiscus</i> Christiansen & Bellinger, 1980	?	4+4	3+3	?	-	2(3)	OC	OC	OC	OC	N America, Hawaii
<i>gamae</i> Izarra, 1969	?	3+3	4+4	3	+	5	OC	SC	SC	OC	Tierra del Fuego
<i>martae</i> Simón et al., 1994	2	4+4	3+3	5-7	-	3	OC	SC	SC	OC	Spain
<i>productus</i> (Axelson, 1906)	2	5+5	3+3	6	+	1	OC	OC	OC	OC	Cosmopolitan
<i>pseudoproductus</i> Stach, 1965	?	4+4	4+4	6	+	6	OC	OC	OC	OC	N Vietnam
<i>rafaeli</i> Arbea, 2006	2	5+5	3+3	6	+	5	OC	OC	SC	OC	Spain
<i>sotoensis</i> Simón et al., 1994	2	5+5	3+3	5-6	-	5	OC	SC	SC	OC	Spain
<i>subarmatus</i> Jordana & Arbea, 1990	2	4+4	3+3	3	-	2	OC	SC	SC	OC	Spain
<i>trisetosus</i> (Denis, 1923)	2	5+5	3+3	6	+	6	OC	OC	OC	OC	Europe, Morocco, Madeira, Azores
<i>venezuelensis</i> Rapoport & Maño, 1969	?	3+3	4+4	3	-	6	OC	OC	OC	OC	Venezuela, Cuba
<i>xishaensis</i> Chen, 1986	?	3+3	4+4	6	+	6	OC	OC	OC	OC	China

Table 3. - Basic morphological characters of *Isotoma iranica* sp. nov. and the species of Palaearctic *Isotoma* with manubrial thickening bispinose in median part.

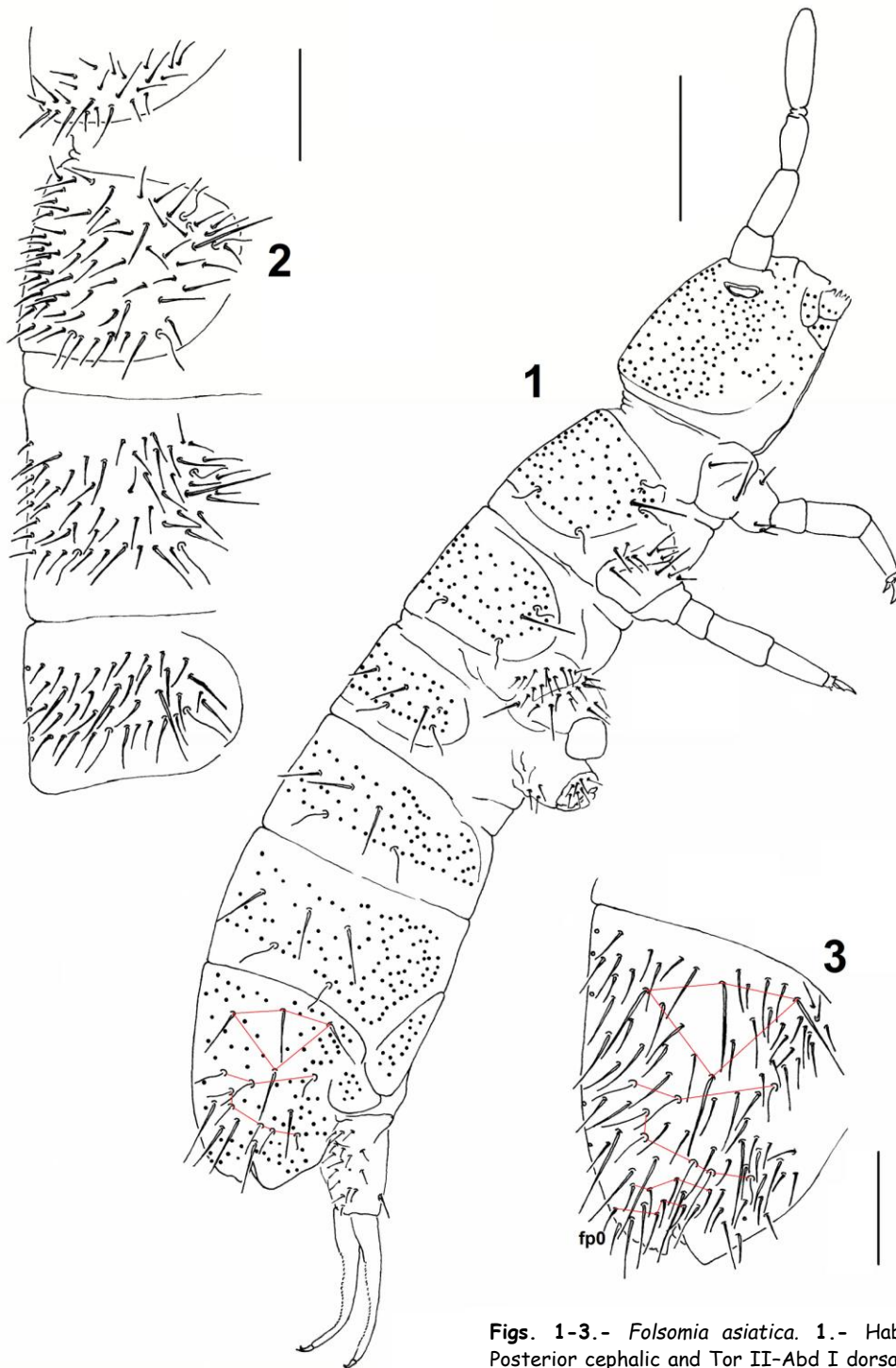
1—Manubrial dorsal macrochaetae (A: A macrochaeta longer than B, and A is moved forward in relation to B; B: A macrochaetae shorter than B); 2—number of dental dorsobasal macrochaetae; 3—Ratio PAO/nearest ocellus; 4—number of manubrial ventroapical spine-like chaetae; 5—number of chaetae on retinaculum. Similarities in red. Morphodiagnostic characters after Fjellberg (2003) and Potapov (2001).

Species	Colour	Size (mm)	1	2	3	4	5	Distribution
<i>iranica</i> sp. nov.	Characteristic spotted pattern, with narrow middorsal longitudinal band and variable dorsolateral patches.	3.1-4.3	B	3	4/9	4-5+4-5	>50	Iran
<i>anglicana</i> Lubbock, 1873	Uniformly blue-violet.	3.4	A	3	2/3	4+4	>40	Palaearctic
<i>caerulea</i> Bourlet, 1839	Uniformly paler green-blue.	2-4	B	2	1/2 ?	4-6+4-6 ?	>40 ?	Holarctic
<i>decorata</i> Brown, 1925	Dark stripes and spots forming a characteristic V-pattern on tergites.	4-6	?	2	1/2	4-6+4-6	?	W Asia
<i>gorodkovi</i> Martynova, 1970	Yellowish or pale greenish to greyish brown.	3	?	2	1/2	4+4	30-32	N Asia
<i>jayasrae</i> Bhattacharjee, 1984	Black or blue-black.	3.8	?	2	2/3	rather thin	35	NE India
<i>nepalica</i> (Yosii, 1966)	Totally violetish black.	1.5	?	?	1/1	3+3	9-10	Nepal
<i>nishihirai</i> Yosii, 1965	Brownish white with broad transverse band on anterior half of Th III-Abd V.	2.5	?	?	1/1	rather thin	20	Japan

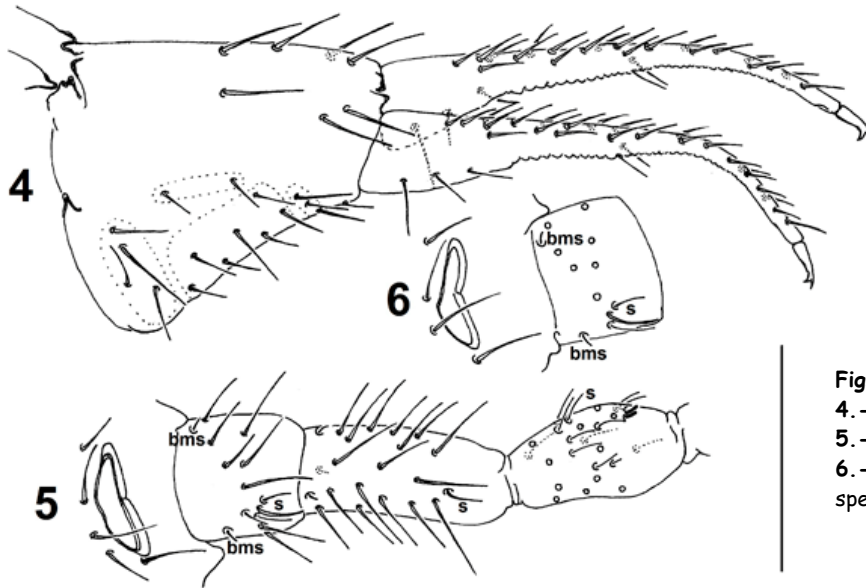
Table 4. - Isotomidae species from Iran. References: (1) Cox 1982; (2) Falahati Hossein Abad 2012; (3) Moravvej et al. 2007; (4) Nematollahi et al. 2009; (5) Yahyapour 2012; (6) Falahati Hossein Abad et al. 2013a; (7) Falahati Hossein Abad et al. 2013b; (8) Kahrarian et al. 2012; (9) Kahrarian & Arbea 2013; (10) Arbea & Kahrarian 2015; (11) Shayanmehr et al. 2013; (12) Yahyapour & Shayan Mehr 2014; (13) Yoosefi-Lafooraki & Shayanmehr 2013; (14) Yahyapour & Shayan Mehr 2014; (15) Daghighi et al. 2013a & 2013b; (16) Ahmadi Rad & Kahrarian 2015; (17) Qazi & Shayanmehr 2014; (*) present paper.

Species	Distribution	References
<i>Anurophorus coiffaiti</i> (Cassagnau & Delamare, 1955)	Eurasian	2, 6, 7, 11, 15
<i>Ballistura schoetti</i> (Dalla Torre, 1895)	Cosmopolitan	1, 7, 11
<i>Desoria tigrina</i> Nicolet, 1842	Cosmopolitan	1, 7, 8, 9, 11, 16, *
<i>Folsomia asiatica</i> Martynova, 1971	Middle Asia	16, *
<i>F. binoculata</i> (Wahlgren, 1899)	Circumpolar	11
<i>F. candida</i> (Willem, 1902)	Cosmopolitan	1, 5, 7, 11, 12
<i>F. fimetaria</i> (Linnaeus, 1758)	Holarctic	1, 7, 11
<i>F. ksenemani</i> Stach, 1947	European	14
<i>F. manolachei</i> Bagnall, 1939	Palaearctic	*
<i>F. penicula</i> Bagnall, 1939	Holarctic	1, 2, 6, 7, 11, 14, 15, 17, *
<i>F. quadrioculata</i> (Tullberg, 1871)	Holarctic	1, 7, 11, 16, *
<i>F. similis</i> (Bagnall, 1939)	Holarctic	2, 7, 11, 15, 16, *
<i>Folsomides angularis</i> Axelson, 1905	Holarctic	11, 15
<i>F. halshinicus</i> Arbea & Kahrarian, 2015	Iran	10, *
<i>F. marchicus</i> (Frenzel, 1941)	European	8, 9, 11, 16, *
<i>F. parvulus</i> (Stach, 1947)	Cosmopolitan	1, 5, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, *
<i>F. subvinosus</i> Arbea & Kahrarian, 2015	Iran	10, *
<i>Hemisotoma orientalis</i> (Stach, 1947)	Palaearctic	1, 7, 11, *
<i>H. pontica</i> (Stach, 1947)	Palaearctic	1, 3, 5, 7, 8, 9, 11, 12, 14
<i>H. thermophila</i> (Axelson, 1900)	Cosmopolitan	1, 7, 11, 14, 15, *
<i>Isotoma iranica</i> sp. nov.	Iran	*
<i>I. viridis</i> Bourlet, 1839	Holarctic	1, 5, 7, 11, 12
<i>Isotomiella minor</i> (Schäffer, 1896)	Palaearctic	1, 3, 5, 7, 11, 12, 14, 15, 16, *
<i>Isotomodes korkorensis</i> sp. nov.	Iran	*
<i>Isotomurus afghanicus</i> Yosii, 1963	Middle Asia	14
<i>I. fucicolus</i> Schött, 1893	European	13, 14
<i>I. maculatus</i> (Schäffer, 1869)	European	2, 6, 7, 11

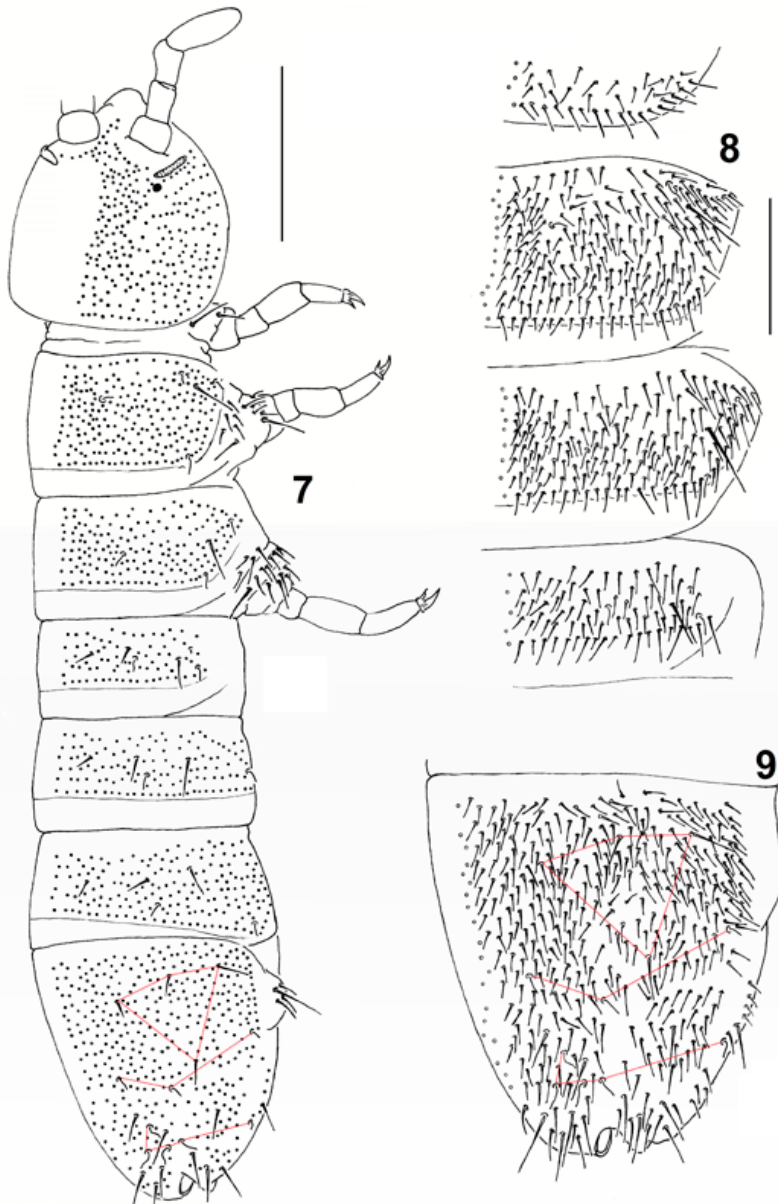
Species	Distribution	References
<i>I. sp. aff. italicus</i>	European	12
<i>I. palustris</i> (Müller, 1776)	Holarctic	1, 7, 11, 12
<i>I. punctiferus</i> Yossi, 1963	S Palaearctic	2, 6, 7, 11, 15
<i>Parisotoma notabilis</i> (Schäffer, 1896)	Cosmopolitan	1, 3, 7, 8, 9, 11, 14, 15, 16, *
<i>Proisotoma minima</i> Absolon, 1901	Holarctic	11, 12, 14
<i>P. minuta</i> (Tullberg, 1871)	Cosmopolitan	1, 4, 5, 7, 11, 14
<i>P. subminuta</i> Denis, 1931	Holarctic	1, 7, 11, 14, 15
<i>P. tenella</i> Reuter, 1895	Holarctic	11, 15
<i>Pseudisotoma sensibilis</i> (Tullberg, 1876)	Palaearctic	14



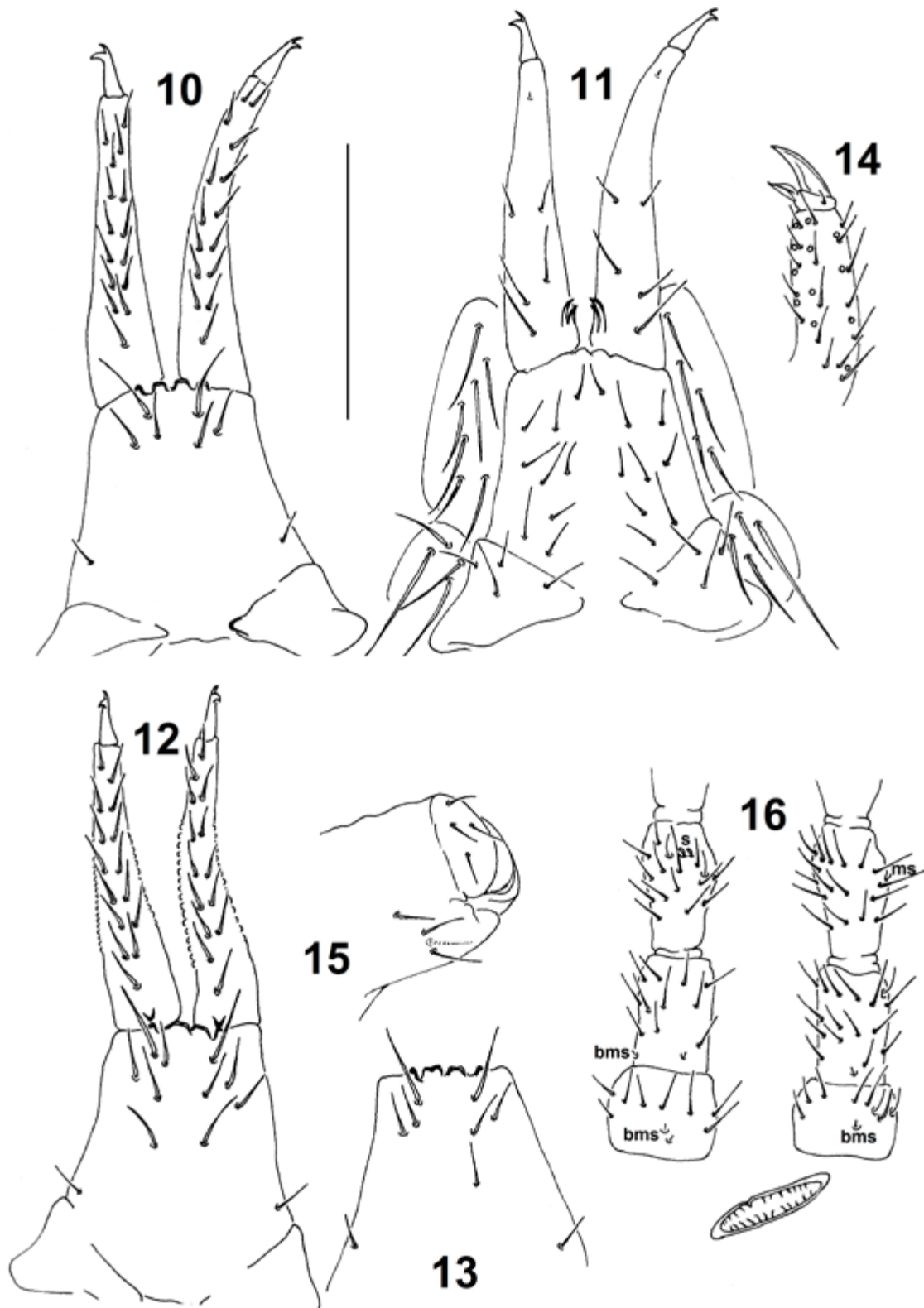
Figs. 1-3.- *Folsomia asiatica*. 1.- Habitus and chaetotaxy. 2.- Posterior cephalic and Tor II-Abd I dorsal chaetotaxy. 3.- Abd IV-VI dorsal chaetotaxy.



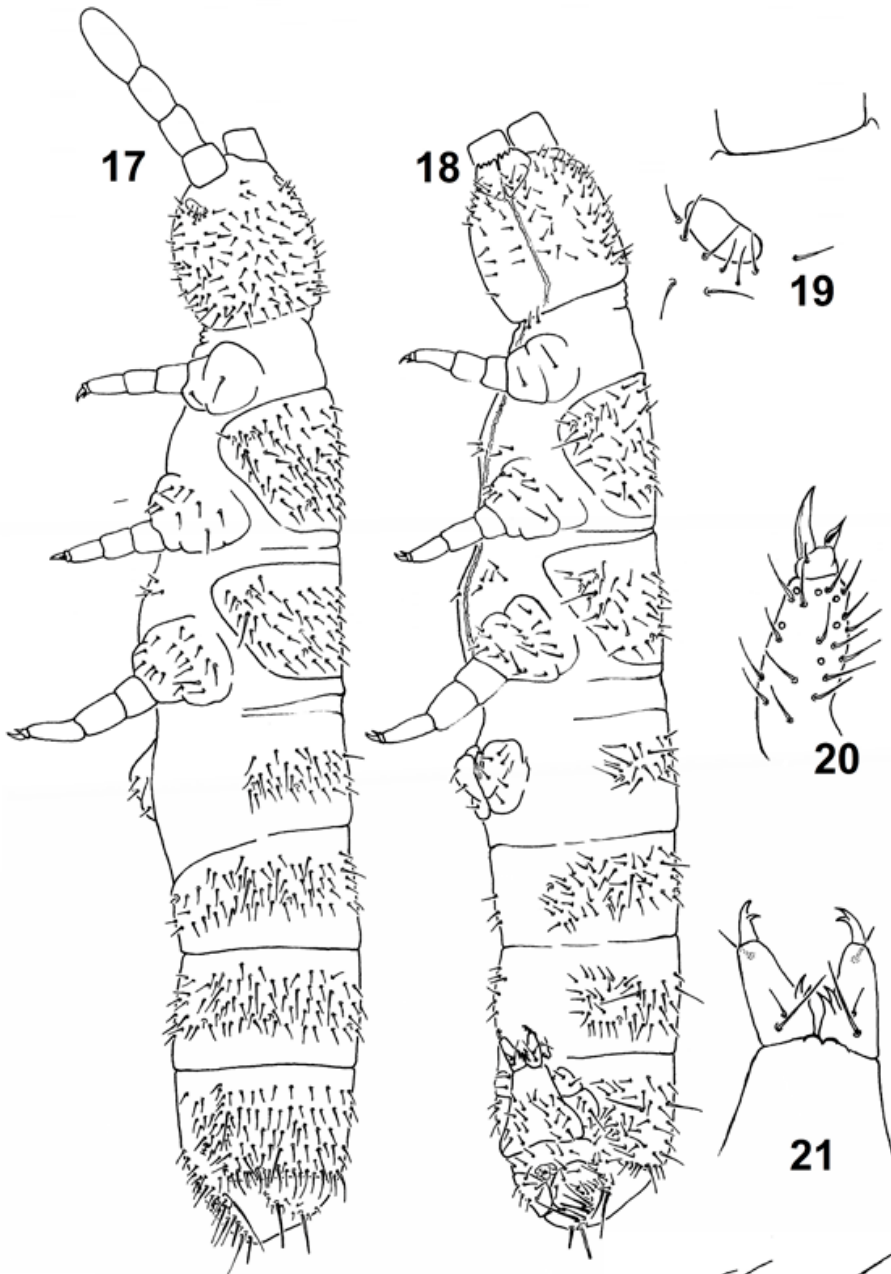
Figs. 4-6.- *Folsomia asiatica*.
 4.- Furca.
 5.- Ant I-III and PAO.
 6.- Ant I and PAO, another specimen.



Figs. 7-9.- *Folsomia similis*.
 7.- Habitus and dorsal chaetotaxy.
 8.- Posterior cephalic and Tor II-Abd I dorsal chaetotaxy.
 9.- Abd IV-VI dorsal chaetotaxy.



Figs. 10-16.- *Folsomia similis*. 10.- Furca, anterior. 11.- Furca, posterior. 12.- Furca, anterior, another specimen. 13.- Manubrium, anterior, another specimen. 14.- Tibiotarsus and claw III. 15.- Ventral tube. 16.- PAO and Ant I-III, dorsal and ventral.



Figs. 17-21.- *Isotomodes korkorensis* sp. nov.
 17.- Dorsal chaetotaxy. 18.- Ventral chaetotaxy.
 19.- PAO. 20.- Tibiotarsus and claw III. 21.-
 Furca.

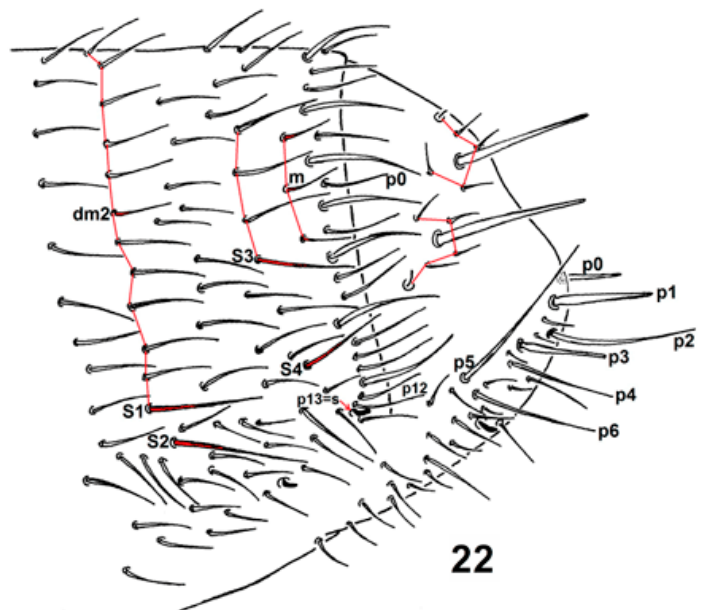
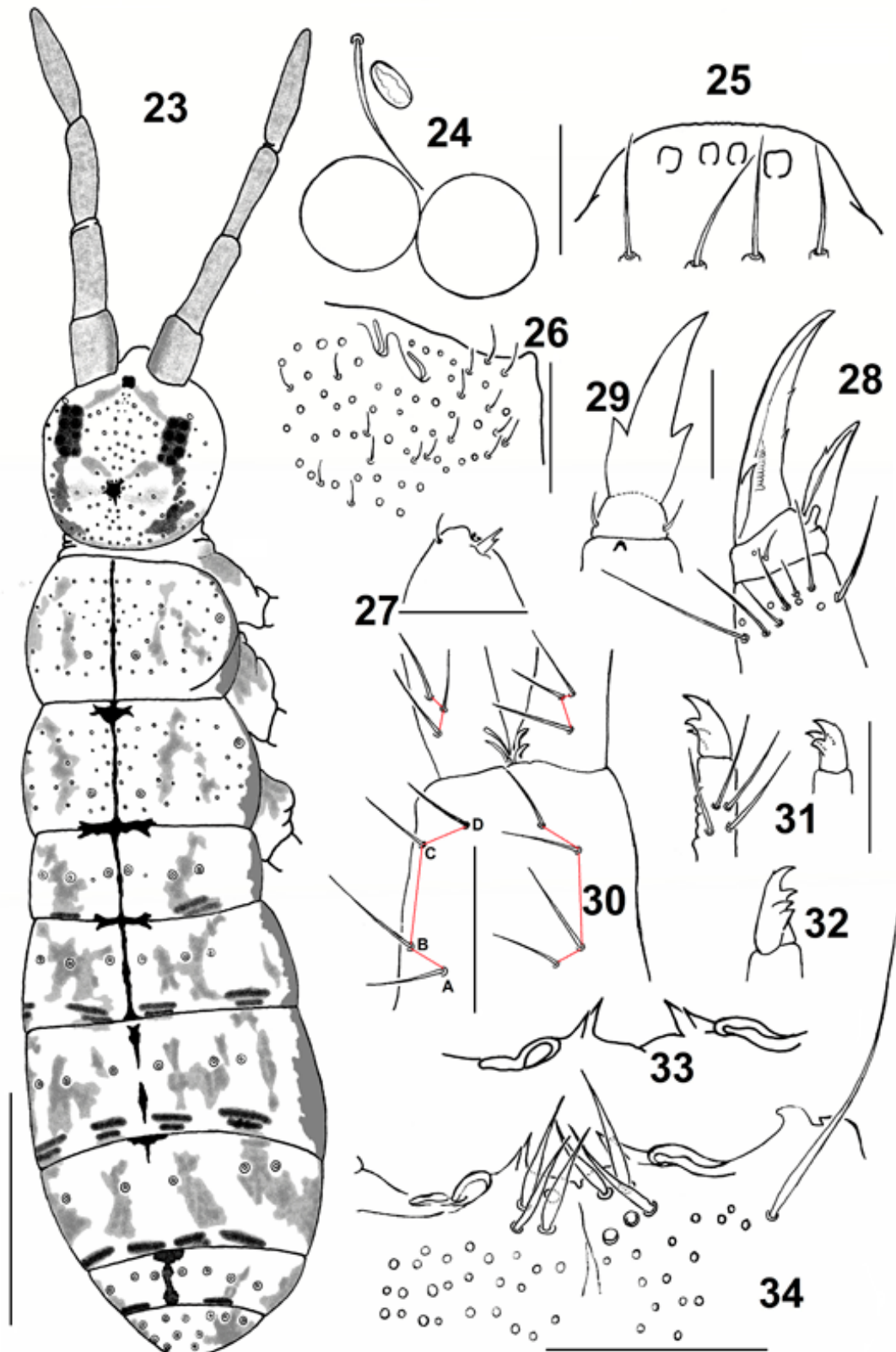


Fig. 22.- *Isotomodes korkorensis* sp. nov.
 Chaetotaxy of Abd IV-VI.



Figs. 23-34.- *Isotoma iranica* sp. nov. 23.- Habitus and macrochaetotaxy. 24.- PAO and nearest ocelli. 25.- Apical edge of labrum. 26.- AIIIIO and microsensilla of Ant III. 27.- Antennal tip. 28.- Claw, lateral view. 29.- Claw, outer view. 30.- Primary macrochaetae (A-D) on dorsal side of manubrium, dorsobasal macrochaetae on dens. 31.- Mucro, typical specimen. 32.- Mucro, atypical specimen. 33.- Manubrial thickening. 34.- Apical part of anterior side of manubrium.