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Tardigrades from the Tsinling Mountains, central China with descriptions of two new species of Echiniscidae (Tardigrada)

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Tardigrades from the Tsinling Mountains, central China with descriptions of two new species of Echiniscidae (Tardigrada)

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Abstract

A checklist of 63 species of tardigrades from the Tsinling Mountains is given in this paper. Thirty-seven species of tardigrades that had never been found in the Tsinling Mountains were reported here. Twenty of them are new records for the mountains, 15 of them are new records for China, two of them are new to science. *Pseudechiniscus pilatoi* sp. n. is similar to *Pseudechiniscus quadrilobatus* Iharos, 1969. It differs from *P. quadrilobatus* in different cuticular sculpture, in the joints of paired-plates, near the dorsal median line, uplifting but not protruding backward, and in lacking notches on terminal plate. *Echiniscus marleyi* sp. n. differs from *E. canadensis* Murray in having filaments D; it differs from *E. mediantus* Marcus in lacking filaments C but in having filaments D; it differs from *E. spinulosus* (Doyère) in lacking teeth B, C, E, and in having filaments D instead of teeth D.

Keywords: China, *Echiniscus marleyi* sp. n., new record, new species, *Pseudechiniscus pilatoi* sp. n., Tardigrada, taxonomy, Tsinling Mountains

Introduction

The Tsinling Mountains, the highest mountains in central China, and also the watershed for the Yangtze River and Yellow River catchment areas, are located in the central part of Shaanxi Province (in previous papers the translation of the name of these mountains has been spelt phonetically as Qinling Mountains). The Tardigrada fauna of Tsinling Mountains has been studied since 2004. Tardigrades from over 10 sites, from varying locations on the mountains, have been reported (Li et al. 2004, 2005a, 2005b, 2007; Li and Liu 2005; Li and Wang 2005a, 2005b, 2006; Wang and Li 2005, 2006).

In autumn 2006, the author of this paper went to the mountains again, and collected more than 300 moss samples growing on the bark of trees or on rocks. This paper reports the many new species recorded as new to science, new to China, and new to the Tsinling Mountains. Unless otherwise stated, my specimens fit with the descriptions given by Ramazzotti and Maucci (1983). Taxonomic literature published since Ramazzotti and

Maucci wrote their monograph in 1983 is also considered. The new species are figured and described and a checklist of tardigrades from the Tsinling Mountains is also given.

Materials and methods

Mosses were collected mainly from two sites, Ningshan County and Mount Taibai, during the autumn field trip to the Tsinling Mountains. The two sampling sites may be representative of the habitats of tardigrades in the Tsinling Mountains. Mount Taibai, the highest peak of the Tsinling Mountains, has an elevation of 3767 m. Ningshan County, located in the hinterland of the Tsinling Mountains, 200 km away from Mount Taibai, has vegetation and elevation typical of most areas of the Tsinling Mountains. Over 1000 specimens were extracted individually using a pipette from moss samples and were mounted in Hoyer's medium. Observation and measurements were made using phase contrast microscopy (PCM; Leica DM LB2) and an eyepiece micrometer. Photomicrographs were made using PCM associated with a digital camera (Leica DFC Twain 6.1.1).

Taxonomic accounts

In this study 37 species were recorded and notes for these are presented here. A full checklist of all 63 species of tardigrades reported from the Tsinling Mountains is presented in Table I.

HETEROTARDIGRADA Marcus, 1927

ECHINISCOIDEA Marcus, 1927

ECHINISCIDAE Thulin, 1928

Cornechiniscus lobatus (Ramazzotti)

Material examined

Six specimens were collected from Ningshan County, two specimens from Mount Taibai.

Remarks

This species was reported as a new record for China from Guangdong Province (Bartoš 1963). It has never been reported from the Tsinling Mountains.

Echiniscus limai da Cunha and do Nascimento Ribeiro

Material examined

Three specimens were collected from Ningshan County, two specimens from Mount Taibai.

Remarks

This species was reported as a new record for China from Yunnan Province (Beasley and Cleveland 1996). It has never been reported from the Tsinling Mountains.

Table I. Checklist of Tardigrada from the Tsinling Mountains.

Heterotardigrada Marcus, 1927

Echiniscoidea Marcus, 1927

Echiniscidae Thulin, 1928

Cornechiniscus Maucci and Ramazzotti, 1981

Cornechiniscus lobatus (Ramazzotti)^a

Echiniscus Schultze, 1840

Echiniscus bisetosus Heinis

Echiniscus canadensis Murray

Echiniscus cheonyoungi Moon and Kim

Echiniscus japonicus Morikawa

Echiniscus limai da Cunha and do Nascimento Ribeiro^a

Echiniscus marleyi sp. n.

Echiniscus mediantus Marcus

Echiniscus melanophthalmus Bartoš

Echiniscus nelsonae Li, Wang, and Yu

Echiniscus nepalensis Dastyh

Echiniscus ramazzottii Binda and Pilato

Echiniscus reticulatus Murray^a

Echiniscus shaanxiensis Li, Wang, and Yu

Echiniscus taibaiensis Wang and Li

Echiniscus tardus Mihelčič

Echiniscus testudo (Doyère)^a

Echiniscus trisetosus Cuénot

Echiniscus wendti Richters^a

Pseudechiniscus Thulin, 1911

Pseudechiniscus asper Abe Utsugi and Takeda

Pseudechiniscus beasleyi Li, Wang, and Li

Pseudechiniscus facettalis Petersen^a

Pseudechiniscus papillosus Li, Wang, Liu, and Su

Pseudechiniscus pilatoi sp. n.

Pseudechiniscus suillus (Ehrenberg)^a

Eutardigrada Richters, 1926

Apochela Schuster, Nelson, Grigarick, and Christenberry, 1980

Milnesiidae Ramazzotti, 1962

Milnesium Doyère, 1840

Milnesium tardigradum Doyère^a

Parachela Schuster, Nelson, Grigarick, and Christenberry, 1980

Macrobotidae Thulin, 1928

Richtersius Pilato and Binda, 1989

Richtersius coronifer (Richters)

Macrobotus Schultze, 1834

Macrobotus areolatus Murray^b

Macrobotus cf. furciger Murray^b

Macrobotus harmsworthi Murray^a

Macrobotus hufelandi Schultze^a

Macrobotus montanus Murray^b

Macrobotus occidentalis Murray^a

Macrobotus ragonesei Binda, Pilato, Moncada, and Napolitano^b

Macrobotus cf. richtersi Murray^a

Minibiotus Schuster, 1980

Minibiotus intermedius (Plate)^a

Hypsibiidae Pilato, 1969

Doryphoribius Pilato, 1969

Doryphoribius flavus (Iharos)^a

Doryphoribius gibber Beasley and Pilato^b

Table I. Continued.

Doryphoribius qinlingense Li, Su, and Yu
Doryphoribius zyxiglobius (Horning, Schuster, and Grigarick)^b
Hypsibius Ehrenberg, 1848
Hypsibius cf. *convergens* (Urbanowicz)^b
Hypsibius cf. *dujardini* (Doyère)^a
Hypsibius hypostomus Bartoš^b
Hypsibius stiliferus Abe^b
Isohypsibius Thulin, 1928
Isohypsibius borkni Tumanov
Isohypsibius liae Li and Wang
Isohypsibius lumulatus (Iharos)^b
Isohypsibius cf. *prosostomus* Thulin^b
Isohypsibius qinlingensis Li, Wang, and Yu
Isohypsibius rahmi Li and Wang
Isohypsibius cf. *sattleri* (Richters)^a
Isohypsibius taibaiensis Li and Wang
Diphascon (*Diphascon*) Plate, 1889
Diphascon (*Diphascon*) *patanei* Binda and Pilato^b
Diphascon (*Diphascon*) cf. *pingue* Marcus^a
Diphascon (*Adropion*) Pilato, 1987
Diphascon (*Adropion*) *carolae* Binda and Pilato^b
Diphascon (*Adropion*) *modestum* Binda, Pilato, and Dastych^b
Diphascon (*Adropion*) *rivularis* (Mihelčič)
Diphascon (*Adropion*) *scoticum* Murray
Platicrista Pilato, 1987
Platicrista angustata (Murray)^a
Ramazottius Binda and Pilato, 1986
Ramazottius cf. *oberhaeuseri* (Doyère)^a
Astatumen Pilato, 1997
Astatumen trinacriae (Arcidiacono)^a
Itaquascon De Barros, 1939
Itaquascon placophorum Maucci^b

^aNew record for Tsinling Mountains; ^bnew record for China.

***Echiniscus marleyi* sp. n.**
(Figures 1, 2; Table II)

Material examined

Holotype (adult female; slide no. MT0610009), seven paratypes (six adult females and one adult male; slide nos MT0610001–MT0610006, MT0610008) were collected from Mount Taibai (33°5'22.01"N, 107°45'44.30"E) at 3700 m above sea level. The specimens are deposited at the College of Life Sciences, Shaanxi Normal University, P. R. China.

Description of the holotype

Measurements are provided in Table II. Colour red. Eyed. Cuticular sculpture composed of many small round or polygonal projections (see Figure 1a). The biggest granule with a diameter of 1.8 μm. Ventral side smooth except the area beside the gonopore with many small pores. Cephalic appendages include internal buccal cirrus, cephalic papilla, external buccal cirrus, cirrus A, and clava; lateral and dorsal appendages consist of filaments D, C^d and spine D^d. Armour consists of single cephalic plate, scapular plate, first single median

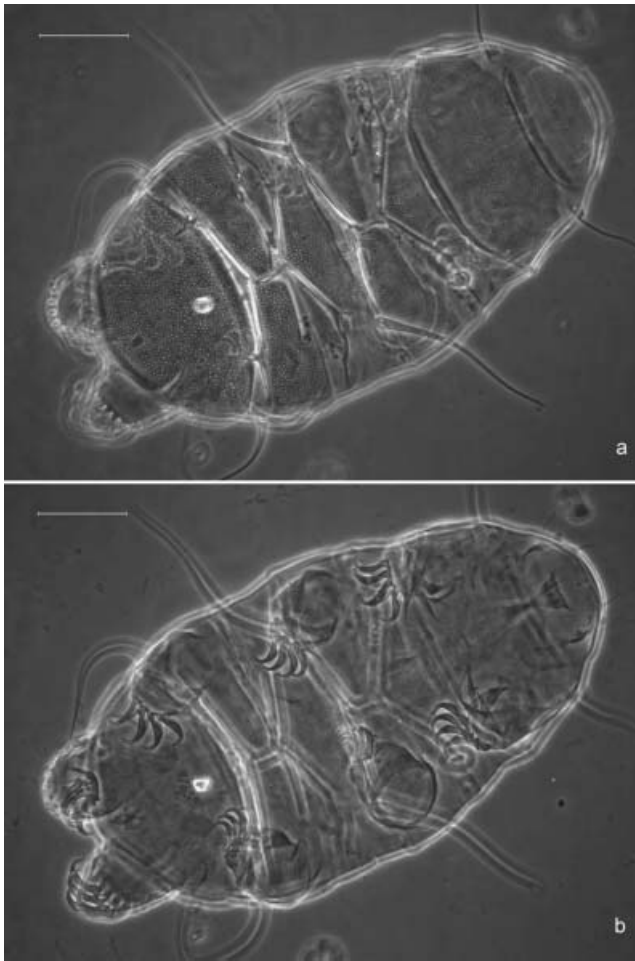


Figure 1. *Echiniscus marleyi* sp. n. (a) Habitus in dorsal view (holotype) focused to show the sculpture and plates; (b) habitus (holotype) focused to show claws. Scale bars: 50 μ m.

plate, first paired-plates, second median plate, second paired-plates, and terminal plate; third median plate absent, terminal plate with normal notches; two paired-plates with smooth bands. The fourth pair of legs with dentate collar containing six or seven teeth. Papilla-like projection present on the lateral surface of the fourth pair of legs, teeth present on the first pair of legs. Lateral side of each leg with many small granules (see Figures 1a, b, 2a). Spurs that pointed towards the base of the claw present on the internal two claws on all legs; three short teeth present on the external claws near the base on hind legs, a small tooth also present on the external claws near the base on third pair of legs (see Figure 2b, c).

Eggs smooth, 98.9 μ m long, 83.2 μ m wide. Laid in exuviae.

Etymology

This species is dedicated to Mr Nigel Marley, School of Biological Sciences, University of Plymouth, UK.

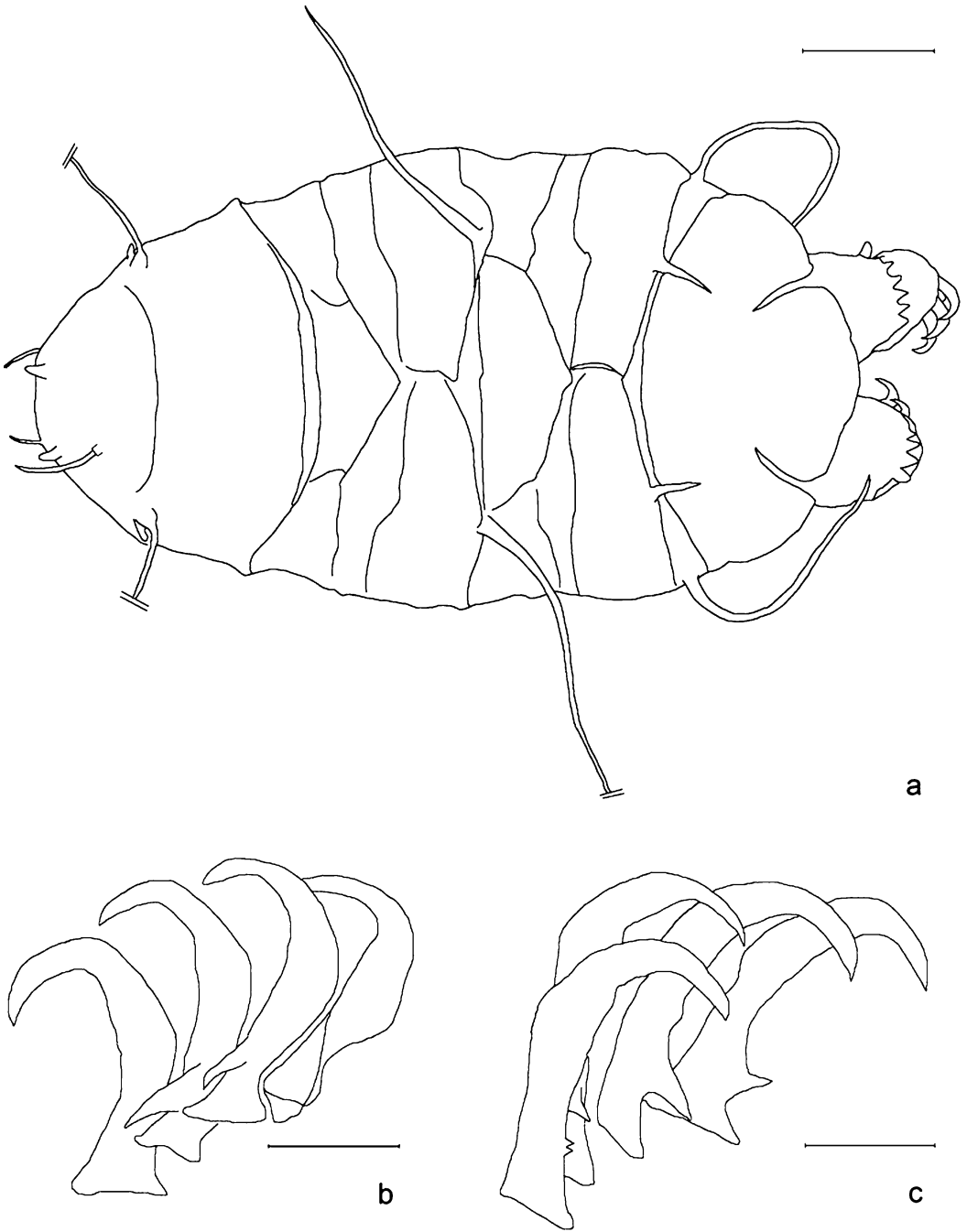


Figure 2. *Echiniscus marleyi* sp. n. (a) Habitus (holotype); (b) claws on first pair of legs; (c) claws on fourth pair of legs. Scale bars: 50 μ m (a); 10 μ m (b, c).

Table II. Dimensions (in μm) of *Echiniscus marleyi* sp. n.

Structure	Holo.	Par. 1	Par. 2	Par. 3	Par. 4	Par. 5	Par. 6	Par. 7
Body length	310.0	330	340.0	350.0	380.0	330.0	340.0	370.0
Internal buccal cirrus	10.4	10.4	10.4	10.4	10.4	10.4	10.4	13.0
External buccal cirrus	23.4	13.0	15.6	13.0	15.6	18.2	15.6	26.0
Cephalic papilla	9.1	10.4	10.4	10.4	10.4	10.4	10.4	10.4
Cirrus A	59.8	46.8	49.4	52.0	52.0	52.0	49.4	72.8
Clava	7.8	10.4	7.8	7.8	10.4	7.8	10.4	10.4
C ^d	122.2	117	130.0	88.4	130	111.8	98.8	143.0
D ^d	20.8	13.0	18.2	15.6	18.2	15.6	18.2	18.2
Cirrus D	130.0	49.4	91	91.0	96.2	85.8	91.0	91.0
Claws on the 1st pair of legs	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8
Claws on the 2nd pair of legs	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8
Claws on the 3rd pair of legs	22.1	22.1	23.4	23.4	23.4	20.8	22.1	23.4
Claws on the 4th pair of legs	23.4	26.0	24.7	24.7	26.0	23.4	24.7	26.0

Par., paratype; Holo., holotype.

Remarks

This new species differs from *E. canadensis* Murray in having filaments D; it differs from *E. mediantus* Marcus in lacking filaments C but in having filaments D; it differs from *E. spinulosus* (Doyère) in lacking teeth B, C, E, and in having filaments D instead of teeth D.

Echiniscus reticulatus Murray

Material examined

Two specimens were collected from Ningshan County, four specimens from Mount Taibai.

Remarks

This species was reported as a new record for China from the Sechuan Province (Beasley et al. 2006). My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastych 1988). It has never been reported from the Tsinling Mountains.

Echiniscus testudo (Doyère)

Material examined

Fifteen specimens were collected from Mount Taibai.

Remarks

This species was reported as a new record for China from Hebei Province and Guangdong Province (Pilato 1974). It was subsequently reported from Sechuan Province (Beasley et al. 2006). My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastych 1988). It has never been reported from the Tsinling Mountains.

Echiniscus wendti Richters*Material examined*

Twenty-one specimens were collected from Ningshan County, 26 specimens from Mount Taibai.

Remarks

This species was reported as a new record for China from Inner Mongolia (Rahm 1936–1937b). My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastych 1988). It has never been reported from the Tsinling Mountains.

Pseudechiniscus pilatoi sp. n.

(Figures 3, 4; Table III)

Material examined

Holotype (adult; slide no. XYB0608087), two paratypes (adult; slide nos XYB0608086, XYB0608088) were collected from Ningshan County, Tsinling Mountains, Shaanxi Province, China (33°32'34.08"N, 108°32'15.11"E) at 1500 m above sea level. The specimens are deposited at the College of Life Sciences, Shaanxi Normal University, P. R. China.

Diagnosis

Small in size. Colour red. Eyespots not detected. Head with normal appendages except clava rather long. Dorsal plates and areas between dorsal plates covered with sculpture composed of densely distributed granules, connected by lines so as to form a reticular design. Cephalic plate faceted; armour consists of single cephalic plate, scapular plate, first single median plate crescent-shaped, first paired-plates, second single median plate, second paired-plates, third single median plate, pseudosegmental plate subdivided along the mid-sagittal plane of the body and with a single lobe on the posterior edge along the dorsal median line; this lobe triangle-shaped, uplifted and protruded backward; terminal plate without notches. All median plates undivided and somewhat poorly developed. The joints of paired-plates, near the dorsal median line, uplifted but not protruded backward. A papilla present on the external side of the fourth pair of legs near their bases, spurs absent on all claws.

Description

Small in size (see Table III). Colour red. Eyespots not detected. Cephalic appendages include internal buccal cirrus, cephalic papilla short and wide, external buccal cirrus, cirrus A, and clava rather long. No other appendages present. Dorsal plates and areas between dorsal plates covered with sculpture very similar to *Echiniscus elegans* Richters (Ramazzotti and Maucci 1983), that is, the sculpture composed of densely distributed granules, connected by lines so as to form a reticular design with the granule located at the crossing of lines (see Figure 3b). Cephalic plate faceted; armour consists of single cephalic plate, scapular plate, first single median plate crescent-shaped, first paired-plates, second single median plate, second paired-plates, third single median plate, pseudosegmental plate

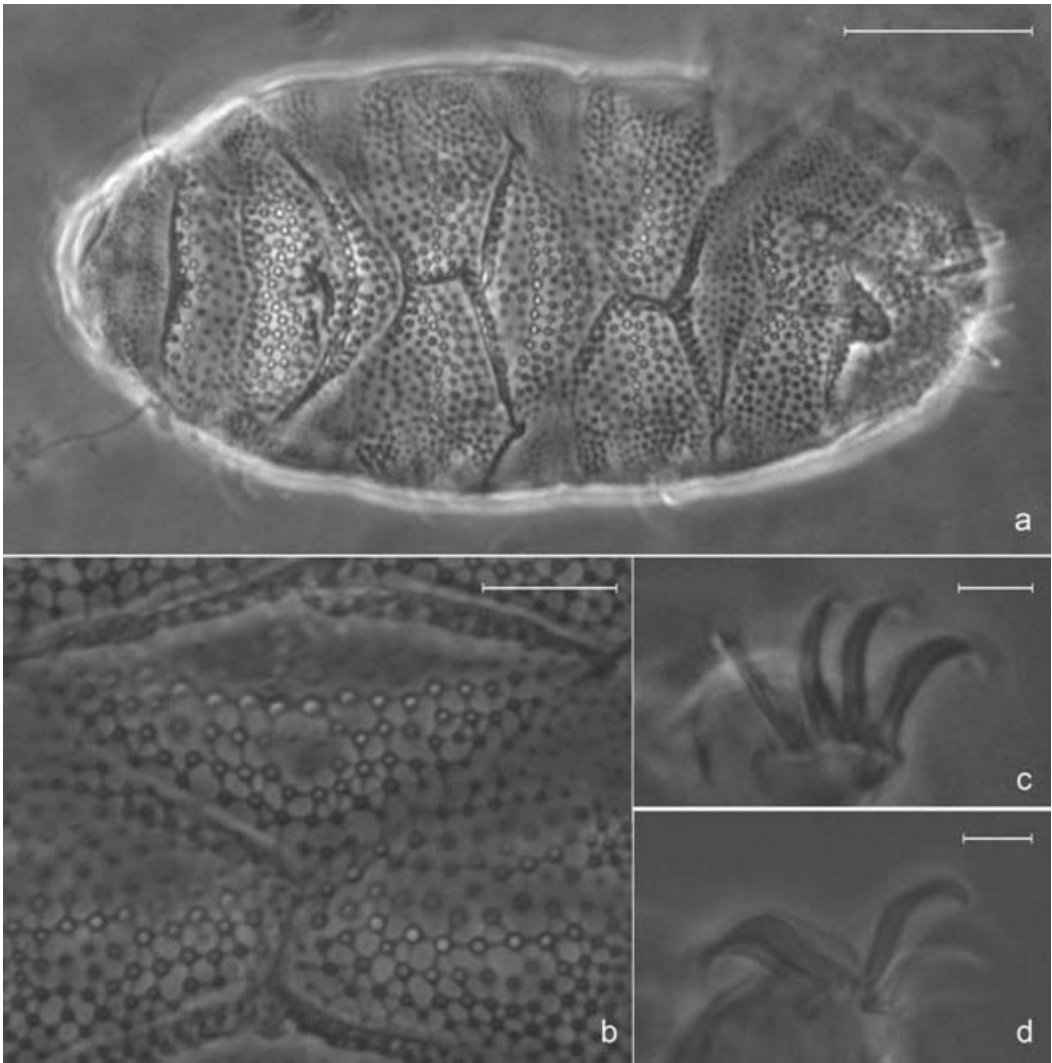


Figure 3. *Pseudechiniscus pilatoï* sp. n. (a) Habitus in dorsal view (holotype, slightly damaged on the right side); (b) cuticular sculpture on dorsal plates (holotype); (c) claws on third pair of legs (paratype, slide no. XYB0608088); (d) claws on fourth pair of legs (paratype, slide no. XYB0608088). Scale bars: 30 μm (a); 10 μm (b); 5 μm (c, d).

subdivided along the mid-sagittal plane of the body, the pseudosegmental plate with a single lobe on the posterior edge along the dorsal median line, the lobe triangle-shaped, uplifted (very remarkable when observed in profile) and protruded backward, the point that directed backward round; terminal plate without notches; scapular plate transversely divided into an anterior part and posterior part. All median plates undivided and somewhat poorly developed. The joints of paired-plates, near the dorsal median line, uplifted but not protruded backward (see Figures 3a, 4a).

Legs normal length (see Table III); a papilla present on the external side of the fourth pair of legs near their bases; dentate collar absent; claws normally curved distally, without spurs near the bases on each leg (see Figures 3c, d, 4b, c).

Eggs unknown.

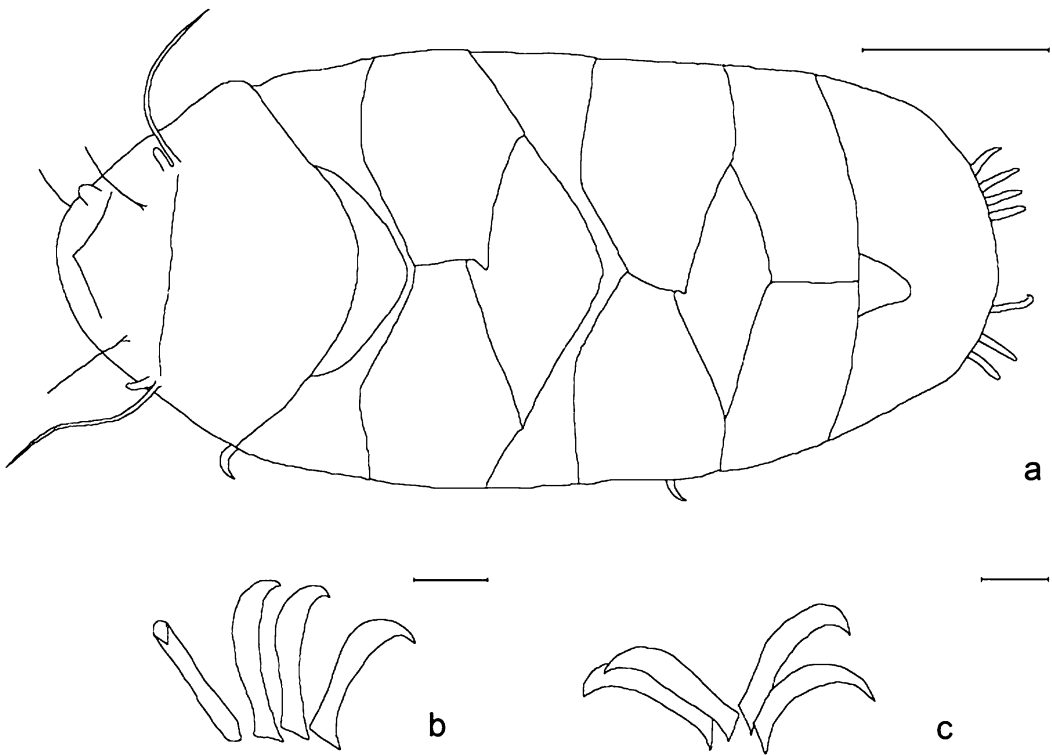


Figure 4. *Pseudechiniscus pilatoi* sp. n. (a) Habitus in dorsal view (holotype); (b) claws on third pair of legs (paratype, slide no. XYB0608088); (c) claws on fourth pair of legs (paratype, slide no. XYB0608088). Scale bars: 30 μm (a); 5 μm (b, c).

Etymology

This species is dedicated to Dr Giovanni Pilato, professor at Dipartimento di Biologia Animale “Marcello La Greca” dell’Università, Catania, Italy.

Table III. Dimensions (in μm) of *Pseudechiniscus pilatoi* sp. n.

Character	Holotype (male)	Paratype 1 (male)	Paratype 2 (female)
Body length	150.8	143.0	163.8
Internal buccal cirrus	7.8	9.6	7.8
External buccal cirrus	13.0	13.0	15.6
Cephalic papilla	2.6	2.6	2.6
Cirrus A	26.0	25.5	28.6
Clava	5.2	5.2	5.2
Claws on the 1st pair of legs	10.4	9.4	10.4
Claws on the 2nd pair of legs	10.4	9.4	10.4
Claws on the 3rd pair of legs	10.4	9.4	10.4
Claws on the 4th pair of legs	10.4	9.6	10.4

Remarks

This new species is similar to *Pseudechiniscus quadrilobatus* Iharos, 1969. It differs from *P. quadrilobatus* in a different cuticular sculpture on dorsal plates, in the joints of paired-plates, near the dorsal median line, uplifting but not protruding backward, and in lacking notches on terminal plate.

Pseudechiniscus facettalis Petersen*Material examined*

Seventeen specimens were collected from Ningshan County, 12 specimens from Mount Taibai.

Remarks

This species was reported as a new record for China from Yunnan Province (Yang 2002). It has never been reported from the Tsinling Mountains.

Pseudechiniscus suillus (Ehrenberg)*Material examined*

Seven specimens were collected from Ningshan County, five specimens from Mount Taibai.

Remarks

This species was reported as a new record for China from Beijing Municipality, Hebei Province and Guangdong Province (Rahm 1936–1937a, 1936–1937b, 1937). My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastych 1988). It has never been reported from the Tsinling Mountains.

EUTARDIGRADA Richters, 1926**PARACHELA** Schuster, Nelson, Grigarick, and Christenberry, 1980**MACROBIOTIDAE** Thulin, 1928***Macrobotus areolatus*** Murray*Material examined*

Three specimens were collected from Ningshan County, five specimens from Mount Taibai.

Remarks

My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastych 1988). Eyes present. Colourless. Cuticle smooth. The buccal tube wide. Pharynx with apophyses and three macroplocoids of rod shape, microplocoid absent, when present extremely small. Claws of *hufelandi* type, with lunule. This species is a new record for China.

***Macrobotus cf. furciger* Murray**

Material examined

Eleven specimens were collected from Mount Taibai.

Remarks

My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastyh 1988; McInnes 1995). Cuticle smooth. Colourless. Eyes present. Buccal tube rather wide. Pharynx with three macroplacoids of about equal length and a large microplacoid. Double claws of *hufelandi* type. This species is a new record for China. Its type locality is in Southern Orkney, UK.

***Macrobotus harmsworthi* Murray**

Material examined

Thirty-three specimens were collected from Ningshan County, over 1000 specimens from Mount Taibai.

Remarks

This species was reported as a new record for China from Beijing Municipality and Guangdong Province (Rahm 1936–1937a, 1936–1937b). It was subsequently collected from Shanxi Province (Bartoš 1963), from Yunnan Province (Beasley and Cleveland 1996), from Sechuan Province (Yang 2003). My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastyh 1988). It has never been reported from the Tsinling Mountains.

***Macrobotus hufelandi* Schultze**

Material examined

Twenty-four specimens were collected from Ningshan County, over 300 specimens from Mount Taibai.

Remarks

My specimens fit the redescription of this species (Bertolani and Rebecchi 1993). This species was reported as a new record for China from Beijing Municipality and Hebei Province (Rahm 1936–1937a). It was subsequently collected from Guangdong Province (Mathews 1937) and from Inner Mongolia and Hong Kong (Pilato 1974). It has never been reported from the Tsinling Mountains.

***Macrobotus montanus* Murray**

Material examined

Three specimens were collected from Mount Taibai.

Remarks

Eye spots present. Buccal tube wide. Pharynx with apophyses and three macroplacoids of granule shape and of about equal size. Double claws of *hufelandi* type. This species is a new record for China.

***Macrobotus occidentalis* Murray**

Material examined

Eight specimens were collected from Ningshan County, five specimens from Mount Taibai.

Remarks

This species was reported as a new record for China from Beijing Municipality and Hebei Province (Rahm 1936–1937b, 1937). It was subsequently collected from Yunnan Province (Beasley and Cleveland 1996). My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastych 1988). It has never been reported from the Tsinling Mountains.

***Macrobotus ragonesei* Binda, Pilato, Moncada, and Napolitano**

Material examined

Four specimens were collected from Mount Taibai.

Remarks

My specimens fit the description of this species (Binda et al. 2001). Colourless. Eyes present. Cuticle smooth with pearls. Pharynx with apophyses and two rod-shaped macroplacoids and microplacoid. First macroplacoid with a central constriction, longer than the second macroplacoid. Claws of *hufelandi* type. Lunules and cuticular bar present. Eggs with conical processes covered by a reticular sculpture. This species is a new record for China. Its type locality is in Mohanga, Democratic Republic of Congo.

***Macrobotus cf. richtersi* Murray**

Material examined

Fifteen specimens were collected from Ningshan County, over 500 specimens from Mount Taibai.

Remarks

This species was reported as a new record for China from Yunnan Province (Beasley and Cleveland 1996). It was subsequently reported from Hubei Province (Yang 2007). My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastych 1988). It has never been reported from the Tsinling Mountains.

Minibiotus intermedius (Plate)

Material examined

Twenty specimens were collected from Ningshan County, 18 specimens from Mount Taibai.

Remarks

This species was reported as a new record for China from Hainan Island and Hebei Province (Rahm 1936–1937b, 1937). It was subsequently reported from Sechuan Province and Yunnan Province (Beasley et al. 2006). My specimens fit the description of Claxton's monograph (Claxton 1998). It has never been reported from the Tsinling Mountains.

HYPHIBIIDAE Pilato, 1969

Doryphoribius flavus (Iharos)

Material examined

Three specimens were collected from Mount Taibai.

Remarks

This species was reported as a new record for China from Guangdong Province (Pilato 1974). It was subsequently reported from Yunnan Province (Beasley et al. 2006). It has never been reported from Tsinling Mountains.

Doryphoribius gibber Beasley and Pilato

Material examined

Nine specimens were collected from Ningshan County.

Remarks

The cuticular sculpture, the number and arrangement of the gibbosities in our specimens fit the description of this species (Beasley and Pilato 1987). This species is a new record for China. Its type locality is in North America.

Doryphoribius zyxiglobius (Horning, Schuster, and Grigarick)

Material examined

Six specimens were collected from Ningshan County, 10 specimens from Mount Taibai.

Remarks

The cuticular sculpture, two macroplacoids, and the number and arrangement of the gibbosities in my specimens fit the description of this species (Horning et al. 1978;

Ramazzotti and Maucci 1983). This species is a new record for China. Its type locality is in New Zealand.

Hypsibius cf. convergens (Urbanowicz)

Material examined

Nine specimens were collected from Ningshan County, 13 specimens from Mount Taibai.

Remarks

My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastych 1988; Kathman 1990). Eyes present. Buccal tube rather narrow. Pharynx contains apophyses and two macroplacoids, the first macroplacoid longer than the second one, microplacoid absent or present; when present, it is very small. Double claws of *Hypsibius* type. Smooth egg deposited in the exuvium. This species is a new record for China. Its type locality is in Poland.

Hypsibius cf. dujardini (Doyère)

Material examined

Over 50 specimens were collected from Ningshan County, 21 specimens from Mount Taibai.

Remarks

This species was reported as a new record for China from Hebei Province (Mathews 1937). My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastych 1988; McInnes 1995). It has never been reported from Tsinling Mountains.

Hypsibius hypostomus Bartoš

Material examined

Eight specimens were collected from Ningshan County, 10 specimens from Mount Taibai.

Remarks

Eye spots present. Cuticle smooth. Buccal aperture narrow and turned ventrally narrow. Pharynx with robust apophyses and two granule-shaped macroplacoids, of which the first a little larger than the second; microplacoid absent. Double claws of *Hypsibius* type. This species is a new record for China.

Hypsibius stiliferus Abe

Material examined

Eleven specimens were collected from Mount Taibai.

Remarks

My specimens fit the description of this species (Abe 2004). Dorsum covered with irregularly shaped sculpture. Buccal tube narrow. Pharynx with two granule-shaped macroplacoids, microplacoid absent. Cuticular bar present between the anterior claw and the posterior claw on hind legs. This species is a new record for China. Its type locality is in Sakhalin Island, Far East Russia.

***Isohypsibius lunulatus* (Iharos)**

Material examined

Ten specimens were collected from Ningshan County, 14 specimens from Mount Taibai.

Remarks

My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastych 1988; Kathman 1990). Colourless. Eye spots present. Cuticular sculpture consists of many granules, 10 transverse rows of large gibbosities present with the following configuration: three gibbosities in row 1, two in row 2, three in row 3, four in row 4, three in row 5, four in row 6, three in row 7, four in row 8, two in row 9, three in row 10. Pharynx with two rod-shaped macroplacoids. Claws of *Hypsibius* type. This species is a new record for China. Its type locality is in Hungary.

***Isohypsibius cf. prosostomus* Thulin**

Material examined

Eleven specimens were collected from Ningshan County, 21 specimens from Mount Taibai.

Remarks

My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastych 1988). Colourless. Eyes present. Cuticle smooth. Buccal tube wide. Pharynx with apophyses and three macroplacoids. The first two placoids almost contact each other. Claws of *Hypsibius* type. This species is a new record for China. Its type locality is in Sweden.

***Isohypsibius cf. sattleri* (Richters)**

Material examined

Nine specimens were collected from Mount Taibai.

Remarks

This species was reported as a new record for China from Sechuan Province and Yunnan Province (Beasley et al. 2006). The reticular sculpture, number and configuration of

gibbositities in my specimens fit the description of this species (Dastych 1990). It has never been reported from the Tsinling Mountains.

Diphascon (Diphascon) patanei Binda and Pilato

Material examined

Fifteen specimens were collected from Mount Taibai.

Remarks

Eyes present. Cuticle sculptured with eight transverse rows of hemispherical gibbositities (two per row); cuticle with characteristic polygonal sculpture. The gibbositities are dorsal in the first seven rows, dorsolateral in the last. The drop-like structure present between the buccal tube pharyngeal tube. Pharynx contains apophyses, two macroplacoids, and septula, without microplacoid. Double claws of *Hypsibius* type. This species is a new record for China. Its type locality is in Sicily, Italy.

Diphascon (Diphascon) cf. pingue Marcus

Material examined

Twenty-one specimens were collected from Mount Taibai.

Remarks

This species was reported as a new record for China from Sechuan Province and Yunnan Province (Beasley et al. 2006). My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastych 1988; McInnes 1995; Pilato and Binda 1997/98). It has never been reported from the Tsinling Mountains.

Diphascon (Adropion) carolae Binda and Pilato

Material examined

Only one specimen was collected from Mount Taibai.

Remarks

Eyes absent. Cuticle smooth. “Drop” formation on the buccal tube absent. Pharynx with very small apophyses and three macroplacoids of rod shape, the first two of almost equal length; microplacoid and septula absent. Double claws of *Hypsibius* type. This species is a new record for China. Its type locality is in Sicily, Italy.

Diphascon (Adropion) modestum Binda, Pilato, and Dastych

Material examined

Seven specimens were collected from Mount Taibai.

Remarks

My specimens fit the description of this species (Binda et al. 1984; Kathman 1990). Cuticle smooth. “Drop” formation on the buccopharyngeal tube absent. Pharynx with three rod-shaped macropilacoids, of which the first two are of about equal length. Micropilacoid absent. Claws of *Hypsibius* type. This species is a new record for China. Its type locality is in Poland.

Platicrista angustata (Murray)

Material examined

Two specimens were collected from Ningshan County, 14 specimens from Mount Taibai.

Remarks

This species was reported as a new record for China from Yunnan Province (Beasley et al. 2006). My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastych 1988). It has never been reported from the Tsinling Mountains.

Ramazzottius cf. oberhaeuseri (Doyère)

Material examined

Sixty-six specimens were collected from Mount Taibai.

Remarks

This species was reported as a new record for China from Fujian Province (Rahm 1936–1937a, 1936–1937b). My specimens fit the description of this species (Ramazzotti and Maucci 1983; Binda and Pilato 1986; Dastych 1988; Biserov 1997/1998). It has never been reported from the Tsinling Mountains.

Astatumen trinacriae (Arcidiacono)

Material examined

Two specimens were collected from Ningshan County.

Remarks

This species was reported as a new record for China from Yunnan Province (Beasley and Cleveland 1996). My specimens fit the description of this species (Ramazzotti and Maucci 1983; Dastych 1988; Pilato 1997). It has never been reported from the Tsinling Mountains.

Itaquascon placophorum Maucci

Material examined

Six specimens were collected from Ningshan County, 16 specimens from Mount Taibai.

Remarks

Cuticle smooth. Buccal tube divided into anterior rigid portion and posterior flexible portion with annulation. Pharynx without macroplacoids, microplacoid, or septulum. Claws of *Hypsibius* type. Cuticular bars present on the first three pairs of legs. This species is a new record for China.

APOCHELA Schuster, Nelson, Grigarick, and Christenberry, 1980
MILNESIIDAE Ramazzotti, 1962
Milnesium tardigradum Doyère

Material examined

Twenty-eight specimens were collected from Ningshan County, 167 specimens from Mount Taibai.

Remarks

This species was reported as a new record for China from Beijing Municipality, Shanghai Municipality, Tianjin Municipality, Hebei Province, and Shanxi Province (Rahm 1936–1937a, 1936–1937b, 1937). It was subsequently reported from Sechuan Province and Yunnan Province (Beasley and Cleveland 1996), and from Sechuan Province again (Beasley et al. 2006). My specimens fit the description of this species (Ramazzotti and Maucci 1983; Tumanov 2006). It has never been reported from the Tsinling Mountains.

Compared with the Tardigrada faunae of other parts of China, the Tardigrada fauna of the Tsinling Mountains is characterized by much higher species diversity and by some native species. Over 100 species have previously been reported from China (Li et al. 2007). The additional species listed here brings this total to nearly 120 species. Of these, 63 species have been found in the Tsinling Mountains. A total of 20 new records for China and 12 species new to science have been reported from the Tsinling Mountains (Li et al. 2004, 2005a, 2005b, 2007; Li and Liu 2005; Li and Wang 2005a, 2005b, 2006; Wang and Li 2005, 2006).

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