Thalassaphorurini (Collembola: Onychiuridae) in Shandong Province, China, with Description of Two New Species

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Thalassaphorurini (Collembola: Onychiuridae) in Shandong Province, China, with description of two new species

Xin Sun1,2 and Yu Li1,*

Abstract

The 4 species Thalassaphorura encarpata (Denis, 1931), Thalassaphorura lifouensis (Thibaud & Weiner, 1997), Thalassaphorura biquaternata sp. nov., and Allonychiurus shandongensis sp. nov. were recorded from Shandong Province, China. Thalassaphorura biquaternata sp. nov. is peculiar in the genus by having more posterior pseudocelli on the head, fewer pseudocelli on the prothoracic tergum, papillae and guard chaetae on the antennal segment III sensory organ, guard chaetae on labial papilla E, and chaetae in the distal row of tibiotarsi, and by the absence of chaeta d0 dorsally on the head. Allonychiurus shandongensis sp. nov. belongs to the "volinensis-group" by having the small body size and smooth sensory clubs on the antennal segment III sensory organ, but with 5 papillae on the antennal segment III sensory organ. It is similar to the species A. songi Sun & Wu, 2012, and it can be recognized easily by the number of p-chaetae between 2 inner posterior pseudocelli on the head, the pseudocellus on abdominal segment IV sternum, and the number of papillae on the antennal segment III sensory organ.

Key Words: taxonomy; North China; Thalassaphorura; Allonychiurus

Resumen

Se registraron las 4 especies Thalassaphorura encarpata (Denis, 1931), Thalassaphorura lifouensis (Thibaud y Weiner, 1997), Thalassaphorura biquaternata sp. nov., y Allonychiurus shandongensis sp. nov., de la provincia de Shandong, China. Thalassaphorura biquaternata sp. nov., que es peculiar en el género por tener más pseudoceli en la parte posterior de la cabeza, menos pseudoceli en el tergo del protorax, papilas y setas de guardia en el órgano sensorial del segmento III de la antena, setas de guardia sobre papila E de labial y setas en una fila distal de tibiotarsi, y por la ausencia de seta d0 dorsalmente en la cabeza. Allonychiurus shandongensis sp. nov., pertenece al grupo "volinensis" por tener el tamaño de cuerpo pequeño y sensorias clavadas y lisas en el órgano sensorial del segmento III de antena, pero con 5 papilas en el órgano sensorial del segmento III de antena. Es similar a la especie A. songi Sun y Wu, 2012, y puede reconocerla fácilmente por el número de setas-p entre los dos pseudoceli interiores y posteriores en la cabeza, el pseudocelues en el esternón del segmento IV de abdomen, y el número de papilas en el órgano sensorial del segmento III de antena.

Palabras Clave: taxonomía; Norte de China; Thalassaphorura; Allonychiurus

Shandong Province is located on the eastern edge of the North China Plain and in the lower reaches of the Yellow River and extends out to sea as the Shandong Peninsula. It covers an area of 157,100 km², accounting for 1.64% of the nation's total area. The fauna of Onychiuridae in this large and distinct area has been scarcely studied. Until now, only 2 species in this family, i.e., Thalassaphorura breviseptosa Sun, Gao & Potapov, 2014 and Thalassaphorura duplopunctata (Strenzke, 1954) have been recorded from this province, and both are from beach areas (Sun et al. 2014). During our study of Onychiuridae in mushroom greenhouses, we found 4 species, all belonging to the tribe Thalassaphorurini. The detailed descriptions and illustrations of the 2 new species are given.

Materials and Methods

Specimens were collected by Berlese extraction, cleared in lactic acid, and mounted in Marc André II solution. They were studied using a Nikon Eclipse 80i microscope. The material was deposited in the Key Laboratory of Wetland Ecology and Environment, Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, Changchun 130102, China.

Abbreviations used in descriptions: Ant.—antennal segments, PAO—postantennal organ, Th.—thoracic segments, Abd.—abdominal segments, ms—microsensillum, pso—pseudocellus, psx—parapseudocellus, psp—pseudopore, "—unpaired pseudopore or parapseudocellus.

The pseudocelli, parapseudocelli, and pseudopores formulae are the number of pseudocelli, parapseudocelli, or pseudopores by half-cellus.
tergum (dorsally) or half-sternum (ventrally) as follows: head anterior, head posterior/Th. I–III/Abd. I–V (for instance: 33/033/33343).

Results

**Thalassaphorura encarpata** (Denis, 1931)

**MATERIAL EXAMINED**


**Thalassaphorura lifouensis** (Thibaud & Weiner, 1997)

**MATERIAL EXAMINED**

Four females and 1 male on slides, CHINA, Shandong Province, Laiwu City, Fangxia Town, Wulongkou Village (36.2154°N, 117.4886°E), 1 Apr 2014, soil of the greenhouse planting with *P. ostreatus*, Xin Sun coll. (SDLW-140401).

**Thalassaphorura biquaternata sp. nov.** (Figs. 1–12)

**MATERIAL EXAMINED**


**DESCRIPTION**

Body white in alcohol. Length of body 1.50–1.80 mm in females; holotype 1.75 mm. Shape of body cylindrical with anal spines on papillae. Anal spines 0.8 times as long as inner edge of hind unguis (Fig. 1).

Pso formula 33/033/333(4)43 dorsally and pso absent ventrally (Figs. 1, 2, 6). Subcoxae 1 of legs I–III without pso. Pxs formula 01/000/110101 ventrally and pso absent dorsally (Figs. 1, 2, 6). Subcoxae 1 of legs I–III with 1 pxs each. Psp formula 00/011/111100 dorsally and 00/111/001100 ventrally (Figs. 1, 2, 6).

Head. Antennae as long as head. Length ratio of Ant. I: II: III: IV about 1: 1.8: 1.8: 2.0. Subapical organite on Ant. IV with globular apex; basolateral ms above the 2nd proximal row of chaetae (Fig. 7). Ant. III sensory organ consists of 4 papillae, 4 guard chaetae, 2 small rods, and 2 granulated sensory clubs; lateral ms just behind sensory organ (Fig. 5). Ant. II with 14–15 chaetae. Ant. I with 9 chaetae. Antenna base well marked. PAO with 24–26 simple vesicles arranged in 2 rows along axis of organ (Fig. 4). Dorsal cephalic chaeta d0 absent. Head with 4+4+4 chaetae along axial line (Fig. 1). Abd. III–IV terga with unpaired chaeta m0 each, Abd. V tergum with chaeta a0, Abd. VI tergum with chaeta m0 (Fig. 10). Th. I, II, and III sterna with 0+0, 1+1, and 1+1 chaetae, respectively.

Appendages. Subcoxae 1 of legs I, II, and III with 5, 5, and 5 chaetae, subcoxae 2 with 1, 5, and 5 chaetae, respectively. Coxae of legs I, II, and III with 3, 9, and 12 chaetae, respectively, trochanters with 9 chaetae each, and femora with 15 chaetae each. Tibiotarsi of legs I, II, and III with 16 (1, 8, 7) chaetae each (Figs. 8, 9). Unguis without teeth. Unguicularus as long as inner edge of unguis, without inner basal lamella (Figs. 8, 9). Ventral tube with 5–6–5–6 distal chaetae and 2+2(1) basal chaetae, without anterior chaetae. Furca reduced to finely granulated area, with 4 small dental chaetae arranged in 2 rows posteriorly and 1 manubrial row of chaetae (Figs. 6, 11).

Female genital plate with 15–20 chaetae. Anal valves with numerous acuminate chaetae; each lateral valve with chaetae a0, 2a1, and 2a2; upper valve with chaetae a0, 2b1, 2b2, c0, 2c1, and 2c2 (Fig. 12).

**DERIVATIO NOMINIS**

The species name refers to both the sets of 4 papillae and 4 guard chaetae on Ant. III sensory organ.

**REMARKS**

*Thalassaphorura biquaternata* sp. nov. is peculiar in the genus *Thalassaphorura* as having the following combined characters: posterior pso on head as 3+3, pso on Th. I tergum absent; 4 papillae and 4 guard chaetae on Ant. III sensory organ; chaeta d0 on head absent; maxillary pap with sublobal hair; 1 guard chaeta on labial papilla E, chaetae in distal row of tibiotarsi as 7. The new species shares the character “4 papillae on Ant. III sensory organ” with 4 known species: *T. butrosi* (Christiansen, 1956), *T. franzi* (Stach, 1946), *T. cryptopyga* (Denis, 1931), and *T. tovtrensis* (Kaprus’ & Weiner, 1995). These species can be distinguished easily by the dorsal pso formulae (33/033/33343 in the new species, 32/122/22332 in *T. butrosi*, 32/133/33333 in *T. franzi*, and 32/233/33343 in *T. cryptopyga* and *T. tovtrensis*). The new species is similar to the Chinese species *T. problematica* Sun, Deharveng & Wu, 2013 as having reduced number of chaetae in row A of the tibiotarsi (6 or 7) and none in row T, chaeta d0 on head absent, and 5 proximal chaetae in labial area. These 2 species can be distinguished by the pso formulae (33/033/33343 dorsally and absent ventrally in the new species, 32/133/33343 dorsally and 11/000/00010 ventrally in *T. problematica*), the ventral pso formulae (01/000/110101 in the new species, 1120011 in *T. problematica*), the number of papillae and guard chaetae on Ant. III sensory organ (4 and 4, respectively, in the new species, 5 and 5, respectively, in *T. problematica*), the labial type (A in the new species, A8 in *T. problematica*), and the axial chaetae on Abd. IV–VI (m0, a0, and m0 in the new species, p0, p0, a0, and p0 in *T. problematica*). The new species also shares the peculiar character “chaeta d0 on head absent” with the Indonesian species *T. jailolonis* (Yoshii & Suhardjono, 1992), but it can be recognized easily by the pso formulae (32/133/33334 dorsally and 1/000/01120 ventrally in *T. jailolonis*) and the absence of pso on subcoxae 1 of legs I–III (1,1,1 in *T. jailolonis*).

**Allonychiurus shandongensis** sp. nov. (Figs. 13–25)

**MATERIAL EXAMINED**

HOLOTYPE male, CHINA, Shandong Province, Laiwu City, Fangxia Town, Wulongkou Village (36.2154°N, 117.4886°E), 1 Apr 2014, soil of the greenhouse planting with *P. ostreatus*, Xin Sun coll. (SDLW-140401). PARATYPES 7 females and 1 male, same data as holotype.
Figs. 1–6. *Thalassaphorura biquaternata* sp. nov. 1. Dorsal chaetotaxy of body; 2. Ventral chaetotaxy of head; 3. Labium; 4. PAO; 5. Papillae, sensory rods, and sensory clubs of Ant. III sensory organ; 6. Chaetotaxy of Abd. II–VI sterna. Scale bars: 0.1 mm (Figs. 1, 2, 6), 0.01 mm (Figs. 3–5).
Fig. 7–12. Thalassaphorura biquaternata *sp. nov.* 7. Antenna; 8. Distal part of leg I; 9. Distal part of leg II; 10. Chaetotaxy of Abd. III–VI terga; 11. Chaetotaxy of Abd. IV–VI sterna; 12. Anal valves. Scale bars: 0.1 mm (Figs. 7, 10–11), 0.01 mm (Figs. 8–9, 12).
Figs. 13–18. *Allonychiurus shandongensis* sp. nov. 13. Dorsal chaetotaxy of body; 14. PAO; 15. Labium; 16. Papillae, sensory rods, and sensory clubs of Ant. III sensory organ; 17. Antenna; 18. Chaetotaxy of Abd. I–VI sterna. Scale bars: 0.1 mm (Figs. 13, 17–18), 0.01 mm (Figs. 14–16).
DESCRIPTION

Body white in alcohol. Length of body 0.75–0.98 mm in females, 0.75–0.78 mm in males; holotype 0.75 mm. Shape of body cylindrical with anal spines on papillae. Anal spines 0.8 times as long as inner edge of hind unguis.

Pso formula 33/233/33343 dorsally and 11/000/01110 ventrally (Figs. 13, 18). Subcoxae 1 of legs I–III with 2 pso each. Psp formula 00/000/100000 ventrally and psp absent dorsally (Figs. 13, 18). Subcoxae 1 of legs I–III without psp. Psp formula 00/011/111100 dorsally and 00/111/000100 ventrally (Figs. 13, 18).

Head. Antennae as long as head. Length ratio of Ant. I: II: III: IV about 1: 2: 2: 2.5. On Ant. IV subapical organite with globular apex, 2 S-chaetae differentiated, basolateral ms above the 2nd proximal row of chaetae (Fig. 17). Ant. III sensory organ consists of 5 papillae, 5 guard chaetae, 2 small rods, and 2 smooth sensory clubs; lateral ms just behind sensory organ (Fig. 16). Ant. II with 13–14 chaetae. Ant. I with 9 chaetae. Antennal base well marked. PAO with 10–11 compound vesicles arranged in 2 rows along axis of organ (Fig. 14). Dorsally on head 4+4 p-chaetae present between 2 posterior pso, p1 anterior to others (Fig. 19). Mandible with strong molar plate and 4 apical teeth. Maxilla bearing 3 teeth and 6 lamellae. Maxillary palp simple with 1 basal chaeta and 2 sublobal hairs. Labral chaeta 4/142. Labium with 3 palp formula 00 ventrally (Figs. 13, 18).

Body chaetotaxy. S-chaeta slightly distinguishable from ordinary chaetae. 5 chaetae on foreleg, 4 on middle leg, 3 on hind leg, and 2 sublobal hairs. Labral chaeta 4/142. Labium with 3 palp formula 00 ventrally (Figs. 13, 18).

Antennal base well marked. PAO with 10–11 compound vesicles arranged in 2 rows along axis of organ (Fig. 14). Dorsally on head 4+4 p-chaetae present between 2 posterior pso, p1 anterior to others (Fig. 19). Mandible with strong molar plate and 4 apical teeth. Maxilla bearing 3 teeth and 6 lamellae. Maxillary palp simple with 1 basal chaeta and 2 sublobal hairs. Labral chaeta 4/142. Labium with 3 palp formula 00 ventrally (Figs. 13, 18).

Body chaetotaxy. S-chaeta slightly distinguishable from ordinary chaetae, as having 5 papillae on Ant. III sensory organ consists of 5 papillae, 5 guard chaetae, 2 small rods, and 2 smooth sensory clubs; lateral ms just behind sensory organ (Fig. 16). Ant. II with 13–14 chaetae. Ant. I with 9 chaetae. Antennal base well marked. PAO with 10–11 compound vesicles arranged in 2 rows along axis of organ (Fig. 14). Dorsally on head 4+4 p-chaetae present between 2 posterior pso, p1 anterior to others (Fig. 19). Mandible with strong molar plate and 4 apical teeth. Maxilla bearing 3 teeth and 6 lamellae. Maxillary palp simple with 1 basal chaeta and 2 sublobal hairs. Labral chaeta 4/142. Labium with 3 palp formula 00 ventrally (Figs. 13, 18).

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Appendages. Subcoxae 1 of legs I, II, and III with 4, 4, and 4 chaetae, subcoxae 2 with 1, 4, and 4 chaetae, respectively. Coxae of legs I, II, and III with 3, 11, and 12 chaetae, respectively, trochanter 9 chaetae each, and femora with 14, 16, and 14 chaetae, respectively. Tibiotarsi of legs I, II, and III with 18 (1, 8, 9) each. Unguis without teeth. Unguiculus as long as inner edge of unguis, without inner basolamella (Figs. 21, 22). Ventral tube with 6+6 distal chaetae and 2+2 basal chaetae, without anterior chaetae. Furca reduced to finely granulated area, with 4 small dental chaetae in 2 rows posteriorly and 1 manubrial row of chaetae (Fig. 23).

Female genital plate with 10–13 chaetae and male with 22–26 (Figs. 18, 25). Male organ present, 2+2 thickened chaetae on distal ventral tube and 3+3 thickened chaetae on the genital plate. Anal valves with numerous acuminate chaetae; each lateral valve with chaetae a0 and 2a1; upper valve with chaetae a0, 2b1, 2b2, c0, 2c1, and 2c2 (Fig. 24).

DERIVATIO NOMINIS

The species name is derived from the name of the province (Shan- dong Province) where the species was found.