

A new species with 2+2 ommatidia in the genus *Sinella* (Collembola: Entomobryidae) from Dongbai Mountain in Zhejiang Province

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Abstract: In this paper, an eyed new species of genus *Sinella* is described. It is identified by 2+2 ommatidia transverse arranged, dorsal body (except Abd. V–VI) scattered with brown spots, mac a2 present on Abd. II, 3 mac on central and 5 on lateral of Abd. IV. Illustrations and detailed differences between 2+2 ommatidia transverse arranged species are provided.

Key words: *Sinella transoculata*; cheatotaxy; taxonomy; China

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浙江东白山裸长角蛸属—2+2 单眼新种（弹尾纲：长角蛸科）

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摘要: 记述裸长角蛸属 1 有眼新种: 横眼裸长角蛸 *Sinella transoculata* sp. nov.。该新种的鉴定特征有 2+2 横向排列单眼, 身体背部 (除腹部第 V–VI 节) 散布有棕色斑点, 腹部第 II 节具 a2 大刚毛, 腹部第 IV 节后侧中间具 3 根大刚毛及侧面具 5 根大刚毛。文中给出了该新种的特征图及该属 2+2 单眼横向排列物种之间的特征差异。

关键词: 横眼裸长角蛸; 毛序; 分类; 中国

Introduction

The genus *Sinella* is an abundant group of springtails in China. There is an especially high species diversity in southeast China. So far, 64 species have been reported worldwide (Bellinger *et al.* 1996–2013). Among them, 28 species are from China (17 eyed and 11 ommatidia-absent species) (Yuan & Pan 2013). Ten species (1 described by Feng ZHANG unpublished) with 2+2 ommatidia are from all over the world. Four of them (1 unpublished)

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with 2+2 ommatidia longitudinally arranged (*Sinella curviseta* Brook 1882; *Sinella plebeia* Chen & Christiansen 1993; *Sinella browni* Chen & Christiansen 1993) are recorded from China. Two species with 2+2 ommatidia transverse arranged (*Sinella subquadrioculata* Yosii 1956; *Sinella quadrioculata* Mill 1935) have been reported abroad. This is the first time the 2+2 transverse arranged species is reported from China. Two taxonomists, Prof. Jianxiu CHEN (Nanjing University) and Dr. Feng ZHANG (Nanjing Agricultural University) from China have made contributions to the taxonomy of this genus (Chen & Christiansen 1993; Zhang & Deharveng 2009; Zhang *et al.* 2010; Zhang & Deharveng 2011).

Sinella is characterized by a reduced ommatidia number (0–6 on each side), 4-segmented antennae and Ant. IV without apical bulb, body without scales and scattered with brown spots or without pigment, and denes without spines. They are usually found in shaded and wet habitats, such as under stones, in rotted wood and under thick leaf litter.

Dongbai Mountain, located in Zhuji County, Shaoxin City, Zhejiang Province, belongs to subtropical climate, with the peak altitude rising up to 1194 m. Two species from the family Entomobryidae have been described from this mountain (*Homidia jordanai* Pan *et al.* 2011; *Acrocyrthus zhujiansis* Xu *et al.* 2013) by our team previously. Here, a 2+2 ommatidia transverse arranged new species is described and illustrations and detailed differences between 2+2 ommatidia transverse arranged species in this genus are provided.

Material and methods

Specimens were deposited in alcohol and under -20 Celsius degree conditions, cleared in lactic acid, mounted under a coverslip in Marc André II solution, and checked using Nikon 80i microscope with phase contrast. Photographs were taken under a Nikon SMZ1000 stereomicroscope mounted with a Nikon DS-Fi1 camera. Illustrations were based on photographs using Photoshop CS2 (Adobe Inc.). All length data were measured employing NIS-Elements Documentation 3.1 software (Nikon). Cephalic dorsal chaetotaxy is designated following Chen & Christiansen's system (1993), with labial palp chaetae after Fjellberg (1998), labial chaetae after Gisin (1964), and dorsal chaetotaxy of terga after Szeptycki (1979).

Abbreviations. Ant. — antennal segment; Th. — thoracic segment; Abd. — abdominal segment; ms — specialized microchaeta(e); s — specialized ordinary chaeta(e); mac — macrochaeta(e); mic — microchaeta(e); Gr. — group.

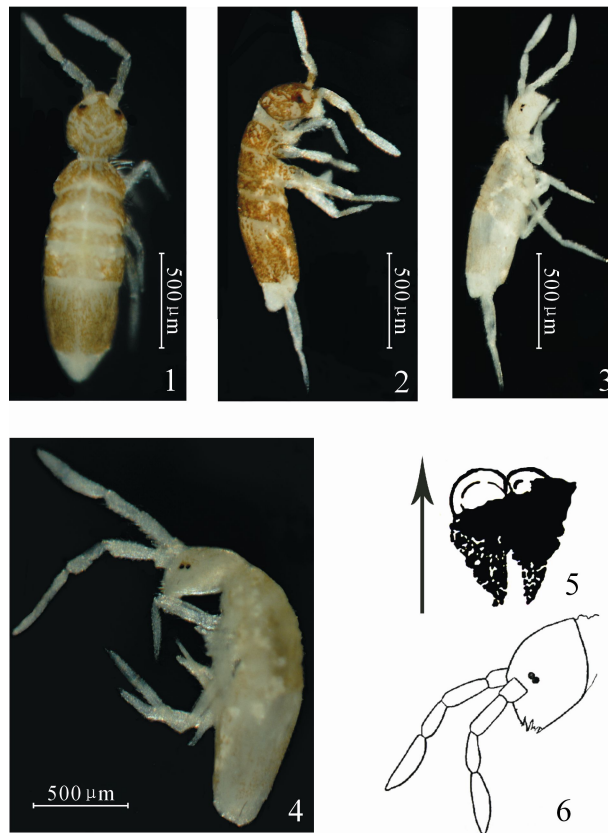
Description

Sinella transoculata sp. nov. (Figs. 1–26)

Body length up to 1.16 mm. Dorsal body from head to Abd. IV, coxa and trochanter of leg scattered with brown spots; ommatidia patches dark blue; antennae with brown pigment and gradually lighter from Ant. I to Ant. III; Ant. IV, Abd. V–VI, edge of segments, furcula and tibiotarsus of legs are pale white (Figs. 1, 2).

Head. Antennae 1.10–2.13 times as long as cephalic diagonal. Antennal segment ratio as I : II : III : IV = 1 : 1.32–2.09 : 1.45–2.10 : 2.58–4.06. Smooth spiny mic at base of antennae as 3 dorsal, 3 ventral on Ant. I (Fig. 8) and 3 on Ant. II (Fig. 9). Ant. III organ with 5 S-chaetae, 2

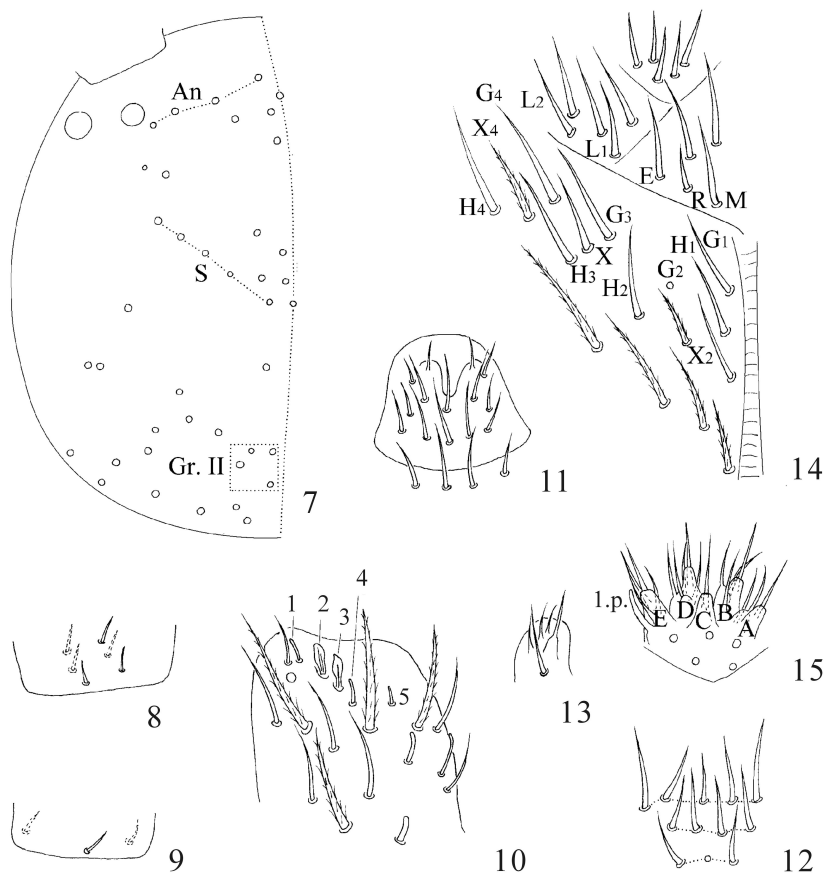
of them flame-like (Fig. 10). Ommatidia 2+2, separated and transverse arranged. Dorsal cephalic chaetotaxy with 4 antennal (An), 5 sutural (S) and 4 mac in Gr. II (Fig. 7). Labral papillae absent; prelabral and labral chaetae as 4/5, 5, 4, all smooth; labial intrusion U-shaped (Fig. 11). Clypeus with 12 chaetae arranged in 3 rows (5/4/3 chaetae respectively) (Fig. 12). Subapical chaeta of maxillary outer lobe subequal to apical one; 3 smooth sublobal hairs on maxillary outer lobe (Fig. 13). Labial setae as MREL₁L₂, all smooth; chaeta R about half of M in length; chaetae X₂ and X₄ ciliate, X smooth, all as long as chaetae in G and H series; X₃ absent; 3 anterior smooth and 3 posterior ciliate (only 1 ciliate shown in Fig. 14) chaetae along ventral cephalic groove (Fig. 14). Five papillae A–E on labial palp with 0, 5, 0, 4, 3 guard chaetae, respectively. Lateral process (l.p.) of labial palp thicker than normal chaetae, with tip beyond apex of labial papilla E (Fig. 15). Mandible with 4/5 (left/right side) teeth.



Figures 1–6. Habitus of 2+2 ommatidia species. 1, 2. *Sinella transoculata* sp. nov.: 1. Dorsal view; 2. Lateral view; 3. *S. curviseta* (author's specimen); 4. *S. plebeia* (author's specimen); 5. *S. subquadrioculata* (after Mill 1935); 6. *S. quadrioculata* (after Yosii 1956).

Thorax. Complete body s as 22/122 (9–10) 3; ms as 10/10100. Th. II with 3 (m₁, m₂ and m_{2i}) medio-medial, 3 medio-lateral (m₄, m_{4i}, m_{4p}), 18–22 posterior mac and 3 S-chaetae (msantero-internal or internal to s); p₄ and p₅ as mac, p₆ as mic, p_{1i2} absent. Th. III with 23–25 mac and 2 lateral S-chaetae; p₄, p₅, p₆, a_{5e} and m_{5p} as mic (Fig. 16). Coxal

macrochaetal formula as 3 (2 p)/4+1, 3 (2 p)/4+2 (pseudopore unclear) (Fig. 17). Trochanteral organ with 8–10 smooth spiny chaetae; 6–8 in arms and 2–3 between them (Fig. 18). Inner tibiotarsus without “smooth” chaetae. Tenent hair all acuminate and shorter than inner edge of unguis. Unguis with 3 inner, 2 lateral and 1 outer teeth, basal paired inner teeth unequal, outer one larger. Unguiculus acuminate with outer edge slightly serrated (Fig. 19).



Figures 7–15. *S. transoculata* sp. nov. 7. Dorsal chaetotaxy of head; 8. Basal Ant. I; 9. Basal Ant. II; 10. Distal Ant. III; 11. Labral and prelabral chaetae; 12. Clypeal chaetae; 13. Maxillary outer lobe; 14. Labial base; 15. Labial palp.

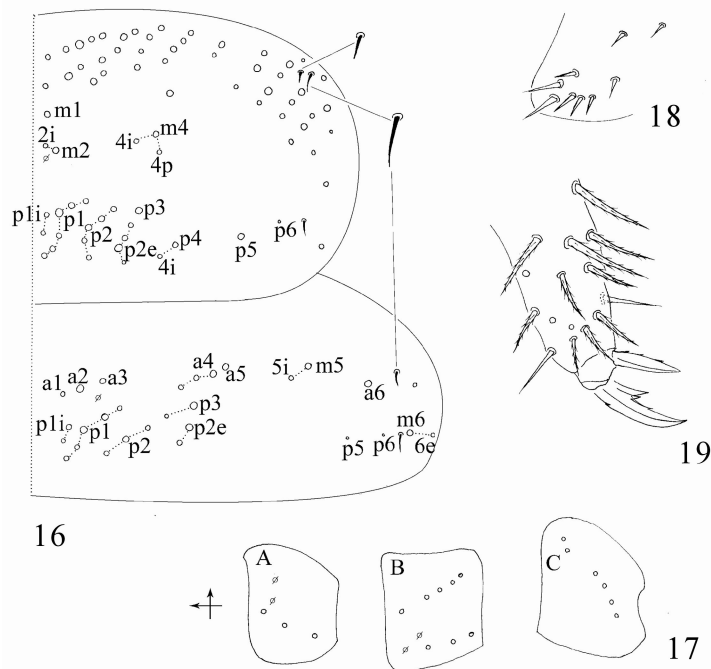
Abdomen. Abd. IV 2.65–3.91 times Abd. III in dorsal axial length. Abd. I with 6 (a3, m2–4, m2i, m4p) mac and 2 S-chaetae (ms antero-external to s). Abd. II with 3 (a2, m3 and m3e) central, 1 (m5) lateral mac and 2 S-chaetae. Abd. III with 1 (m3) central, 3 (am6, pm6, p6) lateral mac and 3 S-chaetae (Fig. 20). Abd. IV with 3 central (A6, B4 and anterior one homologous uncleared mac), 5 lateral mac (F1, E2–4 and E4p), 7–8 elongate and 2 normal S-chaetae (Fig. 21). Abd. V with 3 obvious mac (m2, m3 and m5) and 3 S-chaetae (Fig. 22). Anterior face of ventral tube with 5 ciliate chaetae on each side (1 of them larger); posterior with 2+2 basal smooth and 2+2 subapical smooth chaetae; lateral flap with 4 (5) smooth setae (Fig. 23). Manubrium without smooth chaetae. Manubrial plaque with 2 pseudopores and 2–3 ciliate chaetae on each side (Fig. 24). Distal smooth part of dens 2.05–2.61 times mucro in

length. Mucro bidentate with basal spine reaching subapical tooth (Fig. 25). Tenaculum with 4+4 teeth and one large basal chaeta (Fig. 26).

Ecology. Found under leaf litter of bamboo beside stream, alt. 280 m.

Holotype. ♀ on slide, **China:** Zhejiang Province, Shaoxin City, Zhuji County, Dongbai Mountain, 29°30'53"N, 120°26'29"E. Sample number S4349, collected by Zhixiang PAN & Chenchong SI, 19-VII-2012. **Paratypes.** 4♀1♂ on slide and 4 in alcohol, same data as holotype, all types deposited in the School of Life Sciences, Taizhou University.

Etymology. Named using the Latin word “trans+oculata” (transversely arranged ommatidia).

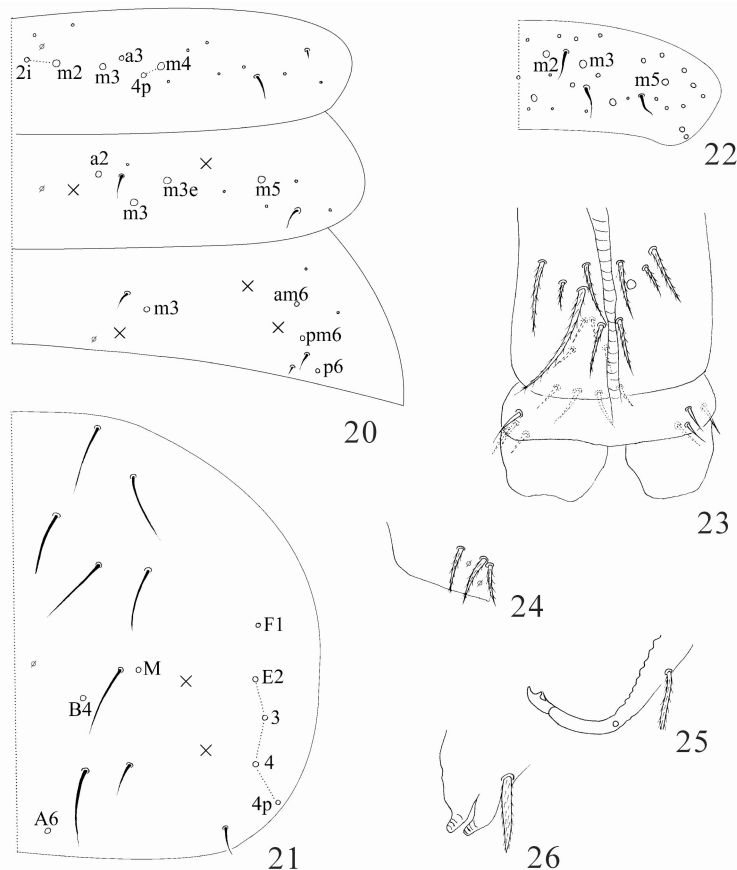


Figures 16–19. *S. transoculata* sp. nov. 16. Dorsal chaetotaxy of Th. II–III; 17. Coxal mac formula (A. Fore leg; B. Mid leg; C. Hind leg); 18. Trochanteral organ; 19. Apical tibiotarsus and claw of hind leg.

Remarks. The new species is characterized by 2+2 ommatidia transverse arranged, dorsal body scattered with brown spots (except Abd. V–VI), 12 clypeal chaetae arranged in 3 rows, labial chaetae MREL₁L₂ all smooth, labial basal chaetae X₂ and X₄ ciliate, X smooth and X₃ absent, mac a2 present on Abd. II, 3 mac on posterior central and 5 on lateral of Abd. IV.

This new species is most similar to *S. subquadrioculata* in 2+2 ommatidia transverse arranged, inner tibiotarsus without “smooth” chaetae, 3 inner unguis teeth, serrated unguiculus outer edge and acuminate tenent hair. However, it can be discriminated from the latter by two separated ommatidia (close together in the latter) (Fig. 5), brown spots scattered on dorsal body (white in the latter). Also, it is similar to *S. quadrioculata* in 2+2 ommatidia transverse arranged. However, it can be easily differentiated from the latter by two separated ommatidia (close together in the latter) (Fig. 6), colour pattern, tenent hair and ratio of smooth denes/mucro. Detailed differences between the three 2+2 ommatidia transverse arranged

species are listed in Table 1. The new species can also be easily distinguished from other 2+2 ommatidia species from China in this genus by the transverse arrangement of the ommatidia (others are longitudinally arranged) (Figs. 3, 4).



Figures 20–26. *S. transoculata* sp. nov. 20–22. Dorsal chaetotaxy: 20. Abd. I–III; 21. Abd. IV; 22. Abd. V; 23. Ventral tube; 24. Manubrial plaque; 25. Apical dens and mucro; 26. Tenaculum.

Table 1. Differences between the new species and 2+2 ommatidia transverse arranged species of genus *Sinella*

Characters	<i>S. transoculata</i>	<i>S. subquadrioculata</i>	<i>S. quadrioculata</i>
Ommatidia arranged pattern	TS	TT	TT
Brown spots scattered on body	With	Without	Without
Body length	Up to 1.16	Up to 1.7	Up to 1.7
Maximum ratio of Abd. IV/III	3.91	4.5	3
Maximum ratio of smooth dens/mucro	2.61	?	7
“Smooth” on inner tibiotarsus	Without	Without	With
Tenent hair	Acuminate	Acuminate	Clavate
Distribution	China	Japan	America

Notes. TS: ommatidia transverse separated; TT: ommatidia transverse close together; ?: character unclear.

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