Two syntopic and remarkably similar new species of *Sinella* and *Coecobrya* from South China (Collembola, Entomobryidae)

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ABSTRACT

*Sinella colorata* n. sp. and *Coecobrya mulun* n. sp., both pigmented and 3+3-eyed, are described from Guangxi Province in southern China. *Coecobrya mulun* n. sp., is the first 3+3-eyed species in the large genus *Coecobrya* Yosii, 1956. The two species live in syntopy and are similar in many respects, but easily separated by their mucro, bidentate in *Sinella* Brook, 1882 and falcate in *Coecobrya*, the ratio between the length of the non-annulated distal part of the dens and the mucro (3 vs 1.5), and the position of the tooth on inner side of the claw (at 45 vs 65% from base).

RÉSUMÉ

Deux nouvelles espèces syntopiques et remarquablement similaires des genres *Sinella* et *Coecobrya* du sud de la Chine (Collembola, Entomobryidae). *Sinella colorata* n. sp. et *Coecobrya mulun* n. sp., deux espèces d’Entomobryidae pigmentées et pourvues de 3+3 yeux, sont décrites de la province du Guangxi dans le sud de la Chine. *Coecobrya mulun* n. sp., est la première espèce à 3+3 yeux au sein du grand genre *Coecobrya* Yosii, 1956. Les deux espèces vivent en syntopie et sont similaires par de nombreux traits, mais peuvent être aisément séparées par la forme du mucron, bidenté chez *Sinella* Brook, 1882 et falciforme chez *Coecobrya*, le rapport entre la longueur de la partie distale non annelée de la dens et le mucron (3 versus 1.5) et par la position de la dent interne de la griffe (45 versus 65 % depuis la base).
INTRODUCTION

The genera Coecobrya Yosii, 1956 (see Zhang et al. 2009 for a justification of its taxonomic level as genus rather than subgenus of Sinella) and Sinella Brook, 1882 belong to the subfamily Entomobryinae Schäffer, 1896 characterized by the absence of body scales, a reduced eye number (0-6 on each side), antennal segments not subdivided and not annulated, and the presence of trochanteral organ on leg III. The two genera share several morphological features, though all of them are also found in various other genera of the subfamily: four smooth prelabral chaetae, absence of labral papillae, median U-shaped intrusion of labral margin, polymacrochaetotactic chaetotaxy, thoracic chaetotaxy of the multiplet type, and absence of dental spines. The assignation of specimens to either genus only relies on mucronal structure, bidentate in Sinella and falcate in Coecobrya. The s-chaetotaxy and macrochaetotaxy of tergites were studied in detail in the two genera (Zhang & Deharveng 2009; Zhang et al. 2009), but they did not result in additional generic characters.

In the course of work in the Guangxi Nature Reserves organized by the Guangxi Forestry Bureau and implemented by the World Bank for the Global Environment Facility, a rich material of various taxa, including several new Collembola, was collected, mainly in Mulun and Yachang nature reserves. The Entomobryidae genera Coecobrya and Sinella were particularly diverse in caves as well as in forest soils. We describe here two species of remarkably similar habitus (3+3 eyes and pigmented body), one in each genus, which occur in syntopy in this latter habitat of the Mulun Nature Reserve.

MATERIAL AND METHODS

Specimens, including both adult and young individuals, were mounted after clearing in lactic acid under a coverslip in Marc André II solution, and were studied using a Leica DMLB microscope. Photographs were taken with a Leica DMLB microscope using a mounted ProgRes microscope camera, and were enhanced with Photoshop CS2 (Adobe Inc.). The chaetae on both sides of head are described after Chen & Christiansen (1993), and dorsal body chaetotaxy are designated using Szeptycki’s system (1979).

SYSTEMATICS

Family Entomobryidae Schäffer, 1896

Genus Sinella Brook, 1882

Sinella colorata n. sp. (Figs 1A, B; 2; 3)

Type material. — China. Guangxi, Huanjiang, Mulun National Reserve, Min Li forest, litter, Berlese extraction, sample no. CHIgx05-102, 14.III.2005, Deharveng L. & Bedos A. leg., holotype on slide (NJU). — Paratypes: same data as holotype, 1 ♀, 1 specimen with sex not visible (probably ♂) on slide (NJU); 1 ♂, 1 juvenile, 1 specimen with sex not visible (probably ♂) on slide (MNHN).

Other material examined. — Same data as holotype, except Berlese extraction following sieving (CHIgx05-109), 1 ♀, 4 specimens with sex not visible on slide (NJU); 1 ♀, 4 specimens with sex not visible on slide (MNHN).

Type locality. — China, Guangxi, Huanjiang, Mulun National Reserve, Min Li forest.

Etymology. — Named after its well-pigmented body.

Ecology. — In leaf litter of broadleaf forest.

Description

Body length up to 1.25 mm.

Body colour stable, pale beige-violet to pale orange, antennae pale violet-bluish (Fig. 1A, B). Eyes black, subdivided into a large anterior patch (2 eyes) and a small posterior patch (1 eye).

Head: antenna about 2 times as long as cephalic diagonal. Ratio of antennal segment I : II : III : IV as 1 : 1.8-2.0 : 1.5-1.6 : 3.1-3.2. Ant. III organ with 2 slightly expanded rods. Ant. IV without apical bulb.
Eyes 3+3. Labral papillae absent. Prelabral and labral chaetae 4/5, 5, 4, all smooth. Lateral process of labial palp as thick as normal chaetae, with tip just reaching apex of labial papilla (Fig. 2A). Subapical chaeta of maxillary outer lobe large, slightly larger than apical one; 4 smooth sublobal hairs on maxillary outer lobe (Fig. 2B). Basal chaetae on labium as MREL1L2, all smooth; chaeta R 0.5 length of chaeta M. Ventral chaeta X behind labium smooth, X4 ciliate, X2 and X3 absent (Fig. 2C). Dorsal cephalic chaetotaxy with 5 sutural macrochaetae (S) and 3 macrochaetae in Gr. II (Fig. 2D).

Thorax: dorsal macrochaetae shown in Figure 2E. Th. II with 3 (m1, m2, m2i) medio-medial, 3 (m4, m4p, m4i) medio-lateral, 14-16 posterior macrochaetae (with p4 and p5 as macrochaetae, p4i often absent) and 3 lateral s-chaetae (the internal one smaller). Th. III with 20-22 macrochaetae and 2 s-chaetae; p5, m6p and a7 as microchaetae. Trochanteral organ with 8-13 smooth spiny chaetae, 6-10 in arms and 2 or 3 between them (Fig. 2F). Inner differentiated tibiotarsal chaetae ciliate with ciliations not closely appressed to axis; inner outstanding macrochaeta ciliate and tapered at tip, located at about 0.33 distance from base. Unpaired tooth of claw at 45% from inner edge base. Ungual inner basal paired teeth unequal, outer one much larger. A pair of small outer basal teeth. Unguiculus lanceolate with outer edge smooth. Tenent hairs of all tibiotarsi thin and acuminata (Fig. 2G).

Abdomen: Abd. IV 2.8-3.8 times as long as Abd. III along dorsal midline. Abd. I with 5 (m2i, m2-4, m4p) central macrochaetae and 2 s-chaetae. Abd. II with 3 (a2, m3, m3e) central, 1 (m5) lateral macrochaetae and 2 s-chaetae. Abd. III with 1 (m3) central, 2 (pm6, p6) lateral macrochaetae and 3 s-chaetae; am6 as microchaeta (Fig. 2H). Abd. IV with 3 (A6, B4-5) central, 6 (F1, E2-4, E2p, D3) lateral macrochaetae and about 13 s-chaetae (Fig. 2I). Abd. V with about 30 chaetae and 3 s-chaetae; m2, m3 and m5 always much larger than others (Fig. 3A). Tenaculum with 4+4 teeth and one large, distally bent, apparently weakly striate chaeta. Ventral tube anteriorly with 4 ciliate chaetae on each side (Fig. 3B); posteriorly with 6-10 smooth chaetae, always 4 in distal row (Fig. 3C); each lateral flap with 5 smooth chaetae in adults (Fig. 3B) and often 4 in subadults. Manubrium without smooth chaetae. Manubrial plaque with 2+2 pseudopores and 2+2 ciliate chaetae. Distal smooth part of dens 3 times the length of mucro. Mucro bidentate and basal spine short with tip reaching apex of subapical tooth (Fig. 3D).

**Remarks**

*Sinella colorata* n. sp. is characterized by the presence of 4 smooth sublobal hairs on maxillary outer lobe, 3+3 eyes, ciliate chaeta X4 behind labium, macrochaetae p4 and p5 on Th. II, macrochaeta m5i on Th. III, microchaeta am6 on Abd. III, and long distal smooth part of dens. The 4 sublobal hairs on maxillary outer lobe are observed in *Sinella* for the first time, though the character is unknown in many species. Among *Sinella* with 3+3 eyes, *S. colorata* n. sp. is closest to the Vietnamese species *S. pseudostraminea* Stach, 1965 in number of eyes, absence of external tooth on unguiculus, and 1+1 central macrochaetae on Abd. III; it differs from the latter in shorter mucronal basal spine, presence of a2 and absence of m3ep on Abd. II, and fewer macrochaetae on Abd. IV (Table 1). The 3+3 eyed species of the genus *Sinella* may be separated by the following key.
Fig. 2. — *Sinella colorata* n. sp.: A, lateral process of labial palp; B, maxillary outer lobe; C, chaetae on labium and ventral side of the head; D, dorsal cephalic chaetotaxy (eyes are represented by their pigment trace, which has migrated anteriorly during the clearing process); E, thoracic chaetotaxy; F, trochanteral organ; G, hind claw in lateral view, with detail of basal teeth in dorsal view; H, I, abdominal chaetotaxy; H, Abd. I-III; I, Abd. IV; D, E, H, I, macrochaetae and large ordinary chaetae represented by their sockets; s-chaetae represented in full. Scale bars: A, B, 10 μm; C, D, F, G, 25 μm; E, H, I, 50 μm.
KEY TO THE 3+3-EYED SPECIES OF *SINELLA* BROOK, 1882

1. Unguiculus with a clear tooth on outer edge .................................................. 2
   — Unguiculus smooth or serrate or with a tiny tooth on outer edge .................. 4

2. Mucronal basal spine long reaching at least half way from tip of subapical tooth to tip of apical tooth; Abd. III with 2+2 central macrochaetae; eyes equally distant ....................... 
   — Mucronal basal spine short, at most slightly exceeding tip of subapical tooth; eyes in two groups (2 anterior and 1 posterior) ................................................................. 3

3. Abd. III with 1+1 central macrochaetae ......................................................... 5
   — Abd. III with 2+2 central macrochaetae ....................................................... S. triocula, China

4. Dental smooth part more than 5 times mucro in length .................................. 6
   — Dental smooth part less than 4 times mucro in length .................................. 7

5. Inner basal paired teeth of unguis at 50% from inner edge base .... S. hexophthalma, Chile
   — Inner basal paired teeth of unguis at 65% from inner edge base ........... S. recens, USA

6. Abd. III with 3+3 central macrochaetae ....................................................... S. sexoculata, USA
   — Abd. III with 1+1 central macrochaetae ..................................................... 7

7. Abd. IV with 3+3 central macrochaetae ........................................ S. colorata n. sp., South China
   — Abd. IV with 7+7 central macrochaetae ........................................ S. pseudostraminea, Vietnam

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**FIG. 3.** — *Sinella colorata* n. sp.: **A**, chaetotaxy of Abd. V; **B**, anterior face and lateral flap of ventral tube; **C**, posterior face of ventral tube; **D**, distal part of dens and mucro; **A**, macrochaetae and large ordinary chaetae represented by their sockets; *s*-chaetae represented in full. Scale bars: A, D, 25 μm; B, C, 10 μm.
Genus *Coecobrya* Yosii, 1956

**TYPE SPECIES.** — *Sinella (Coecobrya) akiyoshiana* Yosii, 1956.

*Coecobrya mulun* n. sp. 
(Figs 1C, D; 4)

**TYPE MATERIAL.** — **China.** Guangxi, Huanjiang, Mulun National Reserve, Min Li Forest, sample no. CHIgx05-102, 14.III.2005, Deharveng L. & Bedos A. leg., ♀ holotype on slide. — Paratypes: same data as holotype, 1 ♀ on slide (NJU); 1 ♀ on slide (MNHN).

**OTHER MATERIAL EXAMINED.** — Same data as holotype, except Berlese extraction following sieving (CHIgx05-109), 1 ♀ (MNHN); 1 specimen with sex not visible on slide (NJU).

**TYPE LOCALITY.** — China, Guangxi, Huanjiang, Mulun National Reserve, Min Li Forest.

**ETYMOLOGY.** — Named after the type locality.

**ECOLOGY.** — In leaf litter of broadleaf forest.

**DESCRIPTION**  
Body length up to 1.40 mm.  

Body pale violet-bluish; antennae violet-bluish (Fig. 1C, D). Eyes black, subdivided into a large anterior patch (2 eyes) and a small posterior patch (1 eye).

Head: antenna 1.6-1.9 times as long as cephalic diagonal. Ratio of antennal segments I : II : III : IV as 1 : 1.5-1.8 : 1.3-1.5 : 2.3-2.5. Ant. III organ not clearly seen. Ant. IV without apical bulb. Eyes 3+3. Labral papillae absent. Prelabral and labral chaetae 4/5, 5, 4, all smooth. Lateral process of labial palp slightly thicker than normal chaetae, with tip reaching beyond apex of labial papilla (Fig. 4A). Subapical chaeta of maxillary outer lobe large, subequal to apical one; 3 smooth sublobal hairs on maxillary outer lobe (Fig. 4B). Basal chaetae on labium as MREL1L2, all smooth; R 0.4 length of chaeta M; ventral chaeta X behind labium smooth and 0.5 length of chaeta M; chaetae X2 and X4 ciliate; chaeta X3 absent (Fig. 4C). Cephalic dorsal chaetotaxy with 5 sutural macrochaetae (S) and 4 macrochaetae in Gr. II (Fig. 4D).

Thorax: dorsal macrochaetae shown in Figure 4E. Th. II with 3 (m1, m2, m2i) medio-medial, 3 (m4, m4i, m4p) medio-lateral, 17-20 posterior macrochaetae (with p4, p5 and p4i as macrochaetae) and 3 lateral s-chaetae (the internal one smaller). Th. III with 23 macrochaetae and 2 s-chaetae; p5 as microchaeta and m5i as macrochaeta. Trochanteral organ with 10 or 11 smooth spiny chaetae, 7 or 8 in arms and 2-4 between them (Fig. 4F). Inner differentiated ti-biotsarsal chaetae ciliate with ciliations not closely appressed to axis; inner outstanding macrochaeta ciliate and tapered, located at about 0.33 distance from base. Unpaired tooth of claw at 65% from inner edge base. Ungual inner basal paired teeth unequal, outer one larger. A pair of small outer basal teeth. Unguiculus with outer edge smooth. Tenent hair on hind leg clavate and others thin and acuminate, subequal to unguiculus in length in the only specimen (holotype) where tenent hairs have been preserved (Fig. 4G).

Abdomen: Abd. IV 3-3.6 times as long as Abd. III along dorsal midline. Abd. I with 5 (m2-4, a3, m4p) central macrochaetae and 2 s-chaetae. Abd. II with 3 (a2, m3, m3e) central, 1 (m5) lateral macrochaetae and 2 s-chaetae. Abd. III with 1 (m3) central, 3 (am6, pm6, p6) lateral macrochaetae and 3 s-chaetae (Fig. 4H). Abd. IV with 3 (A6, B4-5) central, 6 (D3, F1, E2-4, E2p) lateral macrochaetae and about 13 s-chaetae (Fig. 4I). Abd. V with 3 s-chaetae (Fig. 4J). Tenaculum with 4+4 teeth and one large, distally bent, apparently weakly striate chaeta. Ventral tube anteriorly with 5 ciliate chaetae on each side (Fig. 4K); posteriorly with 8 smooth chaetae (Fig. 4L); each lateral flap with 7 smooth chaetae. Manubrium without smooth chaetae. Manubrium plaque with 2+2 pseudopores and 3+3 ciliate chaetae. Distal smooth part of dens 1.5 times length of micro. Mucro falcate and basal spine long with tip reaching apex of apical tooth (Fig. 4M).

**REMARKS**  
All *Coecobrya* known so far had 0+0 or 1+1 eyes, except *C. tetrophthalmal* (Denis, 1948)
FIG. 4. — Coecobrya mulun n. sp.: A, lateral process of labial palp; B, maxillary outer lobe; C, chaetae on labium and ventral side of the head; D, dorsal cephalic chaetotaxy; E, thoracic chaetotaxy; F, trochanteral organ; G, hind claw; H-J, abdominal chaetotaxy; H, Abd. I-III; I, Abd. IV; J, Abd. V; K, anterior face and lateral flap of ventral tube; L, posterior face of ventral tube; M, distal part of dens and mucro; D, E, H-J, macrochaetae and large ordinary chaetae represented by their sockets; s-chaetae represented in full. Scale bars: A-C, 10 μm; D, F, G, J-M, 25 μm; E, H, I, 50 μm.
TABLE 1. — Differences between *Sinella colorata* n. sp., *Coecobrya mulun* n. sp. and their closest relatives, *S. pseudostraminea* Stach, 1965 (original description) and *C. tetrophthalma* (Denis, 1948) (from specimens of Dalat, Vietnam). —, information not available.

<table>
<thead>
<tr>
<th>Character</th>
<th><em>S. colorata</em> n. sp.</th>
<th><em>S. pseudostraminea</em></th>
<th><em>C. mulun</em> n. sp.</th>
<th><em>C. tetrophthalma</em></th>
</tr>
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<td>Distribution</td>
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<td>Vietnam</td>
<td>South China</td>
<td>Vietnam</td>
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<td>Pigment on body</td>
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<tr>
<td>Eyes</td>
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<td>3+3</td>
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<td>–</td>
<td>3</td>
<td>3</td>
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<td>Chaetae X₂ on ventral side of head</td>
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<td>–</td>
<td>ciliate</td>
<td>smooth</td>
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<td>–</td>
<td>5</td>
<td>3</td>
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<tr>
<td>Gr. II</td>
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<td>–</td>
<td>4</td>
<td>4</td>
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<td>–</td>
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<td>falcate</td>
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<tr>
<td>Ratio of smooth part of dens to mucro</td>
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<td>Ciliate chaetae on manubrial plaque</td>
<td>2</td>
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from Vietnam with 2+2 eyes. With 3+3 eyes, *C. mulun* n. sp. has the highest number of eyes recorded in *Coecobrya*. Many morphological and chaetotaxic features are shared by *C. mulun* n. sp. and *C. tetrophthalma*, but all are also found in various other species of the genus: 3 sublobal hairs on the maxillary outer lobe, 4 dorsal cephalic macrochaetae in Gr. II, similar claw structure (but see below), chaetotaxy of Abd. II, 1+1 central macrochaetae on Abd. III, and 3+3 central macrochaetae on Abd. IV. The two species differ by the number of eyes, pigmented versus unpigmented body, 5 versus 3 sutural chaetae on head and several chaetotaxic characters summarized in Table 1.

DISCUSSION

*Coecobrya mulun* n. sp. and *Sinella colorata* n. sp. belong to closely related, but well-defined genera. They have pigmented body and 3+3 eyes, a feature not rare in *Sinella*, but recorded for the first time in the genus *Coecobrya*. Their habitus extremely similar and their occurrence in the same litter samples of the Mulun forests raise problems at first sight regarding the status of the genera to which they belong. Aside habitus (the two species are hardly distinguishable in alcohol under low magnification, see Figure 1), they share several morphological features, such as ocular pattern, antenna length, absence of external tooth on unguiculus, labial and tergite chaetotaxy
(particularly on Th. II-III., Abd. II and IV, and s-chaetotaxy). However, these characters are also found in many other species of both genera, where eye number is different and pigment sometimes absent. Beside the obvious difference in mucronal morphology that separates the genera *Coecobrya* and *Sinella*, *C. mulun* n. sp. and *S. colorata* n. sp. also differ in important characters, such as the number of sublobal hairs (3 vs 4), the ratio of smooth part of dens to mucro, the position of the unpaired tooth on inner side of unguis (65 vs 45% from inner edge base), and several chaetotaxic details. The similarity in habitus, eyes and coloration between the two species might simply reflect the close relationships between *Coecobrya* and *Sinella*, combined to a plesiomorphic state of eye (in *Coecobrya*) and of pigment development. This similarity is not stronger than observed between blind species of both genera. The validity of the two genera *Coecobrya* and *Sinella* is therefore not questioned by our finding, as far as the character states used to discriminate them (falcate versus bidentate mucro) are unambiguous in all species known so far.

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