Cave-dwelling *Coecobrya* from southern China with a survey of clypeal chaetae in Entomobryoidea (Collembola)

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**Abstract.** Four new species of the genus *Coecobrya*, *C. gejianbangi* sp. nov., *C. annulata* sp. nov., *C. ciliata* sp. nov., and *C. oculata* sp. nov., are described from Guangxi caves as the representative of the genus in China. *Coecobrya oculata* sp. nov. of the *boneti*-group has 1+1 eyes and a serrate outer edge of the unguiculus. The other three species, devoid of eyes and with a tiny outer tooth on the unguiculus, are assigned here to the *tenebricosa*-group, assuming that the large tooth on the unguiculus is transformed into a tiny one in cave-obligate species. Clypeal chaetae in Entomobryoidea are systematically surveyed for the first time, and are found to be well diversified at species level. They have a potential taxonomical value in discriminating taxa of morphologically conserved groups.

**Keywords.** Entomobryidae, taxonomy, new species, Guangxi, clypeal chaetotaxy.


**Introduction**

The taxonomical history and diagnosis of the genus *Coecobrya* Yosii, 1956 have been recently reviewed by Zhang et al. (2009). All species of the genus have polymacrochaetotic chaetotaxy, no labral papillae, inverted intrusion on labral margin U-shaped, chaetae mel of labium always smooth, reduced eye number (0 to 3 on each side), pigment reduced or absent, antennal apical bulb absent, falcate mucro with a basal spine, and scales and dental spines absent. Later, Zhang et al. (2011a) divided the genus into *tenebricosa*- and *boneti*-groups, blind and with a large outer tooth on unguiculus in the former and eyed and with the outer edge of unguiculus smooth or serrate in the latter.
So far, 45 species of the genus have been reported in the world (Bellinger et al. 1996–2016). More than \( \frac{1}{3} \) of them were recorded from cave or both cave and non-cave habitat, with Coecobrya draconis Zhang & Dong, 2014 among species described from a Chinese cave. During biospeological expeditions to Guangxi Province, South China, conducted during the last decade, many springtails, mainly Entomobryidae, were discovered in caves (Deharveng et al. 2008). Among them were four Coecobrya species new to science, which are described here in detail. The group assignation of these new species is discussed. The taxonomical value of clypeal chaetae in Entomobryoidea is systematically presented for the first time.

**Material and methods**

Specimens 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 enhanced with Photoshop CS2/PC (Adobe Inc.). The dorsal and ventral chaetotaxy of head and the Ant. III organ are described after Chen & Christiansen (1993). Dorsal body chaetae are designated following Szeptycki (1979), Zhang et al. (2011b) and Zhang & Deharveng (2015). The number of macrochaetae is given by half-tergite in the descriptions. Material is deposited in the collections of the Department of Entomology, Nanjing Agricultural University (NJAU), P.R. China and Museum national d’Histoire naturelle (MNHN), Paris, France.

**Abbreviations**

Ant. I–IV = antennal segment I–IV  
Th. I–III = thoracic segment I–III  
Abd. I–VI = abdominal segment I–VI  
mac = macrochaeta, -ae  
mic = microchaeta, -ae  
ms = S-microchaeta, -ae (microsensillum, -a)  
sens = ordinary S-chaeta, -ae on terga group  
Gr. = group

**Results**

The following characters are shared by the four species included in this paper and are not repeated in the descriptions: smooth spine-like mic at base of antennae (3 dorsal, 3 (2 in C. oculata) ventral on Ant. I, 1 internal, 1 external and 1 ventral on Ant. II); Ant. IV apical bulb absent; labral papillae absent, inverted intrusion on labral margin U-shaped; prelabral and labral chaetae 4/5, 5, 4, all smooth; five chaetae of the first row of labrum subequal (Fig. 8A); subapical chaeta of maxillary outer lobe slightly larger than the apical one; 3 smooth sublobal hairs on maxillary outer lobe; tip of lateral process of labial palp reaching beyond apex of labial papilla; labial chaetae mel, l always smooth; inner outstanding tibiotarsal mac 1–2, located at about 0.33 distance from base, ciliate and tapered; all tenent hairs pointed, subequal to unguiculus in length; tenaculum with 4 + 4 teeth and one large striate chaeta; manubrium without smooth or modified chaetae; mucro falcate with long basal spine, nearly reaching the tip of the apical tooth.
**Class** Collembola Lubbock, 1873  
**Order** Entomobryomorpha Börner, 1913  
**Family** Entomobryidae Tömösvary, 1882  
**Genus** Coecobrya Yosii, 1956

**Coecobrya gejianbangi** sp. nov.  
urn:lsid:zoobank.org:act:FB0EB4BF-5950-4CFF-BC3A-A01347DB95C3  
Figs 1A, 2, 3, 9B; Table 1

**Diagnosis**  
Size large; Ant. IV annulated; 11 ciliate clypeal chaetae; labial chaetae X₁ and M₁ present; unguis elongate and devoid of unpaired tooth; unguiculus truncate with a tiny tooth on outer edge; 9+9 mac on Abd. I with a1 as mac; Abd. II with 4+4 central mac; Abd. IV with 4+4 central and 9+9 lateral mac.

**Etymology**  
Named after Mr. Jianbang Ge, who provided help for our trip in the Mulun Natural Reserve.

**Material examined**  
**Holotype**  
CHINA: ♀ on slide, Guangxi, Huanjiang, Mulun Natural Reserve, Dong Qiao Dong, 25.181667° N, 108.008611° E, altitude 440 m, 5 Nov. 2009, Tian MY leg. (# CHIgx09-077). Deposited in NJAU.

**Paratypes**  
CHINA: 2 ♀♀ on slides and 5 ♀♀ in alcohol, same data as holotype. One paratype deposited in NJAU and others in MNHN.

**Description**  
Body length up to 4.2 mm. Body colour white (Fig. 1A).

Antenna 2.5–2.7 times as long as cephalic diagonal. Antennal segments ratio as I : II : III : IV = 1 : 1.4–1.9 : 1.1–1.9 : 3.6–4.3. Long smooth straight chaetae absent on antennae. Ant. II distally with 3 dorsal rod-like S-chaetae. Two internal S-chaetae of Ant. III organ slightly expanded (Fig. 2A). Ant. IV distinctly annulated under light microscope but annulations not easily seen under stereoscope.

Eyes absent. Clypeal chaetae 11, all ciliate (Fig. 9B). Dorsal cephalic chaetotaxy with 5 sutural (S) and 4 mac in Gr. II (Fig. 2B). Lateral process of labial palp as thick as normal chaetae (Fig. 2C). Labial chaetae as m₁,m₁₁,m₁i₁; r and X₁ as spiny mic; chaetae X₂, X₃ and X₄ as ciliate mic; chaeta X₅ absent (Fig. 2D). Cephalic groove with 8 chaetae, anterior five smooth and others ciliate.

Trochanteral organ with 17–20 smooth spine-like chaetae; 8–9 in arms and 8–12 between them (Fig. 2E). Partial inner differentiated tibiotarsal chaetae ciliate with ciliations not closely appressed to axis. Unguis narrow with 2 subequal tiny inner teeth near base; unpaired tooth absent. Unguiculus truncate with a tiny tooth on outer edge (Fig. 2F–G). Abd. IV 4.0–5.0 times as long as Abd. III along dorsal midline. Ventral tube anteriorly with about 7 ciliate chaetae on each side (Fig. 2H); posteriorly with 16–18 chaetae, three of them smooth (Fig. 2I); each lateral flap with 7–8 smooth chaetae (Fig. 2J). Manubrial plaque with 2 pseudopores and 4 ciliate chaetae (Fig. 2K). Distal smooth part of dens 0.7–0.8 times as long as mucro.

Th. II with 3 medio-medial (m₁, m₂, m₂i), 3(2) medio-lateral (m₄, m₄i, m₄p) and 25–26 posterior mac; p₄–5 and p₄i as mac; mac m₄i rarely absent. Th. III with about 35 mac; mac m₅i and a₆i present; p₃p rarely present (Fig. 3A). Abd. I with 9 (a₁–3, m₂–4, m₂i, m₄i, m₄p) mac. Abd. II with 4 (a₂, a₃,
Fig. 1. Habitus. A. Coecobrya gejianbangi sp. nov. B. Coecobrya annulata sp. nov. C. Coecobrya ciliata sp. nov. D. Coecobrya oculata sp. nov. Scale bars: 500 μm.

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m3, m3e) central and 1 (m5) lateral mac. Abd. III with 1 (m3) central and 4 (a7, am6, pm6, p6) lateral mac; ms absent (Fig. 3B). Abd. IV with 4 central (I, M, B5, A6), 9 lateral mac (F1–3, F3a, E2–4, E2p, D3) and several additional large mesochaetae or small mac laterally (Fig. 3C). Abd. V with 3 sens (Fig. 3D). S-chaetae formula: 2+ms, 2/1+ms, 2, 2+ms, 2, 3. Uncertain number of longer S-like chaetae on Abd. IV.

Ecology
Cave-restricted species.

Fig. 3. Coecobrya gejianbangi sp. nov. A. Thoracic chaetotaxy. B–D. Abdominal chaetotaxy. B. Abd. I–III. C. Abd. IV. D. Abd. V. Scale bars: 200 μm.
Remarks

_Coecobrya gejianbangi_ sp. nov. is characterized by a very large size, distinctly annulated Ant. IV, elongate unguis devoid of unpaired tooth, 11 ciliate clypeal chaetae, labial chaetae X₁ and M₁ present, mac a₁ on Abd. I, mac a₂ and a₃ on Abd. II, mac a₇ on lateral Abd. III, and 9+9 lateral mac on Abd. IV. It is closest to another cave species, _C. ciliata_ sp. nov., but differs from it in labial chaetae, and abdominal chaetotaxy (Table 1).
Coecobrya annulata sp. nov.
urn:lsid:zoobank.org:act:D7CC34A6-E891-46AA-8FBD-570CAB9C9449
Figs 1B, 4, 5, 9C; Table 1

Diagnosis
Ant. IV weakly annulated; 9 smooth clypeal chaetae; tiny mic r, X, X₁ and X₄ on the ventral side of head; partial inner differentiated tibiotarsal chaetae “smooth”; unguiculus lanceolate with a tiny tooth on outer edge; 9+9 mac on Abd. III with 2+2 lateral mac; Abd. IV with 6+6 central and 8+8 lateral mac.

Etymology
Named after the weakly annulated Ant. IV (Latin word “annulata”).

Material examined

Holotype
CHINA: ♀ on slide, Guangxi, Longzhou, Dong Liang Dong, 14 Apr. 2010, Louis Deharveng and Anne Bedos leg. (# CHIgx10-03). Deposited in NJAU.

Paratypes
CHINA: 2 ♀♀ on slides and 4 ♀♀ in alcohol, same data as holotype. One paratype deposited in NJAU and others in MNHN.

Description
Body length up to 3.0 mm. Body colour white or with weak orange pigments (Fig. 1B).

Antenna 2.1–2.8 times as long as cephalic diagonal. Antennal segments ratio as I : II : III : IV = 1 : 1.8–2.1 : 2.1–2.4 : 2.7–3.4. Long smooth straight chaetae absent on antennae. Two internal S-chaetae of Ant. III organ paddle-like (Fig. 4A). Ant. IV weakly annulated in large specimens.

Eyes absent. Clypeal chaetae 9, all smooth (Fig. 9C). Dorsal cephalic chaetotaxy with 5 sutural (S) and 4(5) mac in Gr. II (Fig. 4B). Papilla E with 4 guard chaetae; lateral process of labial palp as thick as normal chaetae. Labial chaetae as mrel1l2; chaetae r, X, X₁ and X₄ as smooth tiny mic; chaeta X₃ absent (Fig. 4C). Cephalic groove with 8 chaetae, anterior three and the fifth smooth and others ciliate.

Trochanteral organ with 15–23 smooth spine-like chaetae; 8–11 in arms and 7–12 between them (Fig. 4D).

Partial inner differentiated tibiotarsal chaetae “smooth” with ciliations closely or moderately appressed to axis. Unguis with 3 inner teeth; 2 paired teeth unequal, outer one large. Ungoicus lanceolate with a tiny tooth, sometimes inconspicuous, on its outer edge (Fig. 4E). Abd. IV 4.6–6.2 times as long as Abd. III along dorsal midline. Ventral tube anteriorly with 7 ciliate chaetae on each side (Fig. 4F); posteriorly with 11–14 smooth chaetae (Fig. 4G); each lateral flap with 8–11 smooth. Manubrial plaque with 2(1) pseudopores and 4(5) ciliate chaetae. Distal smooth part of dens subequal to mucro in length (Fig. 4H).

Th. II with 3 medio-medial (m1, m2, m2i), 3 medio-lateral (m4, m4i, m4p) and 24–25 posterior mac; p5 as mac (Fig. 5A). Th. III with 27–28 mac; p5, m5i and a6i as mac (Fig. 5B). Abd. I with 6 (m2–4, m2i, a3, m4p) mac. Abd. II with 3 (a2, m3, m3e) central and 1 (m5) lateral mac. Abd. III with 1 (m3) central and 2 (pm6, p6) lateral mac (Fig. 5C). Abd. IV with 6 central (I, M, B4–5, A5–6), 8 lateral mac (F1–3, E2–4, E2p, D3) (Fig. 5D). Abd. V with 4 mac (m2, m3, m5, a5i) (Fig. 5E). S-chaetae formula: 2+ms, 2/1+ms, 2, 2+ms, 2, 3. Uncertain number of longer S-like chaetae on Abd. IV.

Ecology
Cave-restricted species with troglomorphic characters (long antennae, slightly modified claw, large size).
Fig. 4. *Coecobrya annulata* sp. nov. A. Ant. III organ. B. Dorsal cephalic chaetotaxy. C. Chaetae on the ventral side of head. D. Trochanteral organ, ventral view. E. Hind claw. F. Anterior face and lateral flap of ventral tube. G. Posterior face of ventral tube. H. Mucro. Scale bars: A, C–E, H = 50 μm; B, F–G = 100 μm.
Remarks

*Coecobrya annulata* sp. nov. is characterized by annulated Ant. IV, two paddle-like internal S-chaetae of Ant. III organ, tiny mic r, X, X₁, and X₄ on the ventral side of head, 9 smooth clypeal chaetae, an outer tiny tooth on unguiculus (sometimes inconspicuous), 2+2 lateral mac on Abd. III, 6+6 central and 8+8 lateral mac on Abd. IV. It is also the only species having ms on Abd. III among Chinese cave *Coecobrya* species. It is closest to *C. oculata* sp. nov. from which it differs in anophthalmy, smooth clypeal chaetae, chaetae on the ventral side of head, “smooth” inner differentiated tibiotarsal chaetae, ventral tube and dorsal chaetotaxy (Table 1).

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**Fig. 5.** *Coecobrya annulata* sp. nov. A. Chaetotaxy of Th. II. B. Chaetotaxy of Th. III. C–E. Abdominal chaetotaxy. C. Abd. I–III. D. Abd. IV. E. Abd. V. Scale bars: 200 μm.
**Coecobrya ciliata** sp. nov.

Figs 1C, 6, 7, 9D; Table 1

**Diagnosis**
Small size; long smooth straight chaetae present on antennae; 15 ciliate clypeal chaetae; labial chaeta R ciliate; postlabial chaetae H_{1-4} ciliate; unguis elongate; unguiculus truncate or swollen with a tiny tooth on outer edge; Abd. IV with 3+3 central and 5+5 lateral mac.

**Etymology**
Named after the ciliate chaetae H_{1-4} on the ventral side of head.

**Material examined**

**Holotype**
CHINA: ♀ on slide, Guangxi, Huanjiang, Mulun, Mashan Dong, 19 May 2007, Louis Deharveng, Anne Bedos and Youbang Li leg. (# CHIgx07-19-01). Deposited in NJAU.

**Paratype**
CHINA: ♀ on slide and same data as holotype. Deposited in MNHN.

**Additional material**

**Description**
Body length up to 1.35 mm. Ground colour pale yellow in alcohol (Fig. 1C).

Antenna 1.4–1.8 times as long as cephalic diagonal. Antennal segments ratio as I : II : III : IV = 1 : 1.5–2.2 : 1.1–1.9 : 2.5–3.0. Ant. I ventrally with long smooth straight chaetae. Two internal S-chaetae of Ant. III organ slightly expanded (Fig. 6A). Ant. IV not annulated.

Eyes absent. Clypeal chaetae 15, all ciliate (Fig. 9D). Dorsal cephalic chaetotaxy with 5 sutural mac and 4 mac in Gr. II (Fig. 6B). Lateral process of labial palp thicker than normal chaetae (Fig. 6C). Labial base as mRel_{1/2}, all smooth except R; R/m = 0.5; chaetae H_{1-4}, X and X_{2-4} ciliate (Fig. 6D). Cephalic groove with 7 chaetae, the anterior one (G1) smooth and others ciliate.

Trochanteral organ with 9–16 smooth spine-like chaetae; 7–8 in arms and 3–6 between them (Fig. 6E). Inner differentiated tibiotarsal chaetae ciliate with ciliations not closely appressed to axis, most distal one smooth on hind claw. Ungual basal paired teeth unequal with outer one larger, 20% distance from the base; distal unpaired tooth tiny, 25% distance from the base. Unguiculus truncate or swollen with a tiny tooth, sometimes inconspicuous, on outer edge (Fig. 6F). Abd. IV 3.1–3.5 times as long as Abd. III along dorsal midline. Ventral tube anteriorly with 5–6 ciliate chaetae on each side, one of them much larger than others (Fig. 6G); posteriorly with 2 apical smooth and 7–8 ciliate chaetae (Fig. 6H); lateral flap with 5 smooth and 1–2 ciliate chaetae. Manubrial plaque with 2 pseudopores and 4–5 ciliate chaetae. Distal smooth part of dens 0.7 times as long as mucro (Fig. 6I).

Th. II with 3(4) (m1, m2, m2i) medio-median, 3 (m4, m4p, m4i) medio-lateral and about 20 posterior mac; p4, p4i and p5 as mac; mac m1i and p4i rarely present. Th. III with about 31 mac; m5i, a6i and p5 as mac (Fig. 6J). Abd. I with 6 (m2i, m2, m3, a3, m4 and m4p) mac. Abd. II with 3 (a2, m3, m3e) central and 1 (m5) lateral mac. Abd. III with 1 (m3) central and 3 (am6, pm6, p6) lateral mac (Fig. 7A). Abd.
IV with 3 (A6, M, B5) central, 5 (F1, E2–4, E2p) lateral mac (Fig. 7B). Abd. V with 3 sens (Fig. 7C). S-chaetae formula: 2+ms, 2/1+ms, 2, 2+ms, 2, 3. Uncertain number of longer S-like chaetae on Abd. IV.

Ecology
Cave-restricted species, moderately troglomorphic (slightly modified claw).

Remarks
Ciliate chaetae H1–4 on the ventral side of head in C. ciliata sp. nov. are observed in Coecobrya for the second time since C. draconis. Small size, 15 ciliate clypeal chaetae, long smooth straight chaetae on antennae, elongate unguis, truncate or swollen unguiculus, tiny outer tooth on unguiculus (sometimes inconspicuous), and 5+5 lateral mac on Abd. IV are also characteristic. It is closest to C. draconis but differs from it in long smooth straight chaetae on antennae and chaetotaxy of Abd. IV (Table 1).

**Fig. 7.** Abdominal chaetotaxy of Coecobrya ciliata sp. nov. A. Abd. I–III. B. Abd. IV. C. Abd. V. Scale bars: 50 μm.
**Coecobrya oculata** sp. nov.

urn:lsid:zoobank.org:act:ABEEC710-582D-4381-9D81-83C2D5948912

Figs 1D, 8; Table 1

**Diagnosis**

Small size; eyes 1+1; clypeal chaetae ciliate; chaeta R, H₁, H₂, X, X₂ and X₄ ciliate on the ventral side of head; unguiculus lanceolate with outer edge serrate; Abd. IV with 4+4 central and 8+8 lateral mac.

**Etymology**

Named after the presence of eyes.

**Material examined**

**Holotype**


**Paratypes**

CHINA: ♀ on slide and 5 in alcohol, same data as holotype; 3 ♀♀ on slides and 4 in alcohol, Guangxi, Shanglin, Longshan, Ganlin Dong, 23.45932° N, 108.73436° E, 18 Mar. 2005, Louis Deharveng and Anne Bedos leg. (# CHIgx05-136). Deposited in MNHN.

**Description**

Body length up to 1.38 mm. Body colour white (Fig. 1D).

Antenna 1.6–1.7 times as long as cephalic diagonal. Antennal segments ratio as I : II : III : IV = 1: 1.5–1.8: 1.2–1.6: 2.6–2.7. Long, smooth straight chaetae absent on antennae. Ant. II distally with 1 small rod-like S-chaeta. Ant. III organ with 2 rods. Ant. IV not annulated.

Eyes 1+1. Clypeal chaetae ciliate but their arrangement not clearly seen. Dorsal cephalic chaetotaxy with 4 sutural chaetae and 5(4) mac in Gr. II (Fig. 8B). Lateral process of labial palp straight, thicker than normal chaetae (Fig. 8C). Labial base as mRel1l2, chaeta R ciliate and 0.45–0.60 length of M; chaetae H₁, H₂, X, X₂ and X₄ ciliate; chaeta X₃ absent (Fig. 8D). Cephalic groove with 6 chaetae, the first and the third smooth and others ciliate.

Trochanteral organ with 9–13 smooth spine-like chaetae; 7–9 in arms and 2–4 between them (Fig. 8E). Inner differentiated tibiotarsal chaetae ciliate with ciliations not closely appressed to axis. Ungual basal paired teeth unequal, outer one large. Unguiculus lanceolate with outer edge serrate (Fig. 8F). Abd. IV 3.0–4.4 times as long as Abd. III along dorsal midline. Ventral tube anteriorly with 4 ciliate chaetae on each side and two of them much larger (Fig. 8G); posteriorly with 6 smooth chaetae (Fig. 8H); each lateral flap with 5 smooth chaetae and 1 additional ciliate chaeta rarely present. Manubrial plaque with 2 pseudopores and 3(2) ciliate chaetae. Distal smooth part of dens slightly longer than mucro (Fig. 8I).

Th. II with 4 (m₁, m₁, m₂, m₂) medio-median, 3 (m₄, m₄, m₄p) medio-lateral and 21–23 posterior mac. Th. III with about 29 mac; m₅i, a₆i, p₅, m₆e, m₆i as mac; a₄i₂ and a₆i sometimes absent in young specimens (Fig. 8J). Abd. I with 6 (m₂–₄, m₂i, a₃, m₄p) mac. Abd. II with 3 (a₂, m₃, m₃e) central and 1 (m₅) lateral mac. Abd. III with 1 (m₃) central and 3 (am₆, pm₆, p₆) lateral mac (Fig. 8K). Abd. IV with 4 central (A₆, B₄–₅, M), 8 lateral mac; F₂ and F₃ as mac (Fig. 8L). Abd. V with 3 sens (Fig. 8M).

S-chaetae formula: 2+ms, 2/1+ms, 2, 2+ms, 2, 3. About 6 long S-like chaetae on Abd. IV.
Ecology
Cave-restricted species, non-troglomorphic.

Remarks
*Coecobrya oculata* sp. nov. is characterized by small size, 1+1 eyes, ciliate chaetae R, H₁, H₂, X, X₂, and X₄ on the ventral side of head, serrate outer edge of unguiculus, absence of ms on Abd. III and 4+4 central mac on Abd. IV. See Table 1 for comparison with other Chinese cave species.

![Fig. 9. Clypeal chaetae. A. Diagram. B. Coecobrya gejianbangi sp. nov. C. Coecobrya annulata sp. nov. D. Coecobrya ciliata sp. nov. E. Coecobrya brevis. F. Coecobrya pani. Figures of the latter two species after Xu et al. (2012). Scale bars: 40 μm.](image-url)
Discussion

Modification of the unguiculus in cave species and redefinition of the tenebricosa-group

Most blind Coecobrya species have a large outer tooth on unguiculus and can be assigned to the tenebricosa-group (Zhang et al. 2011a). Among the five cave species from China, C. oculata sp. nov. lacks troglobromorphic features and is similar to non-cave members of the boneti-group. The four other species exhibit more or less marked troglobromorphic traits, e.g., elongated unguis with reduction of inner ungual teeth which is displaced towards unguis base when present in C. gejianbangi sp. nov., C. ciliata sp. nov. and C. draconis, or two paddle-like internal S-chaetae on Ant. III organ in C. annulata sp. nov. Among these four blind species, the outer tooth on unguiculus is extremely tiny or absent (Figs 2F, 4E, 6F) instead of being large in typical species of the tenebricosa-group. A tiny outer tooth of unguiculus is not exceptional in Entomobryidae, and often present in cave Pseudosinella Schäffer, 1897 species (Christiansen 1961). The link between cave life and reduction of unguiculus outer tooth in species of remotely related genera suggest evolutionary convergence of the character under similar selective pressure, though the functional basis of this evolution is obscure. Smooth outer edge in C. draconis might be a further reduction from a tiny tooth. Under the assumption of tiny tooth modified from large one, we place the five blind cave Coecobrya species in the tenebricosa-group, that is re-defined for those species devoid of eyes. Size and number of outer teeth on unguiculus are not the key character separating the two groups.

Clypeal chaetae in Entomobryoidea


To easily study clypeal chaetae, we divide this area into prefrontal and facial part (after Yoshii & Suhardjono 1992, modified), with a few lateral chaetae (Fig. 9A; Table 2). Lateral chaetae (L₁ and L₂), ciliate or smooth and usually larger than clypeal chaetae, are external to prelabral and clypeal chaetae. Prefrontal chaetae are 3 arranged in a row, usually all smooth or ciliate; middle chaeta is designated as pf₀, lateral ones as pf₁. Chaeta pf₀ is sometimes different from pf₁ in morphology, e.g., in Alloscopus tetracanthus (Börner, 1906) and in Coecobrya edenticulata (Handschin, 1926) (both after Yoshii & Suhardjono 1989).

Facial chaetotaxy is highly diversified in the number and arrangement of its chaetae, even in several groups morphologically conserved. Three families have a basic pattern of two chaetae arranged in a row. In lepidocyrtids where tergal chaetotaxy and many characters are quite conserved, number of facial chaetae varies from 2 to 13 in the recorded species. For the species with the same number of facial chaetae, they often have different arrangement and size. For example, both Coecobrya pani Xu, Yu & Zhang, 2012 and Coecobrya gejianbangi sp. nov. have 8 facial chaetae, the former with 2, 2, 2, 2 smooth chaetae arranged in four rows and two chaetae of the third row tiny (Fig. 9F), the latter with 1, 3, 2, 2 ciliate chaetae and two median ones of them much smaller than others (Fig. 9B).

Clypeal chaetae in Entomobryoidea don’t exhibit obvious differentiation at the familial level, but are diversified at the species level. It could be a powerful tool to help to discriminate species particularly in morphologically conserved groups, e.g., lepidocyrtids. To easily observe this character in a specimen on slide, it is suggested adjusting the specimen to the proper pose during slide preparation.
Table 2 (continued on next page). Clypeal chaetae in Entomobryoidea (sm = smooth; c = ciliate; * = original observations, different from the literature).

<table>
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<th>Source of clypeal information</th>
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Acknowledgments

We thank the staff of the natural reserves of Guangxi for having organized the field trips. Tian Mingyi and Li Youbang provided specimens as well as invaluable help in the field. The “Guangxi Integrated Forestry Development and Biodiversity Conservation Project”, a GEF-World Bank project, funded biological cave surveys in the province. Liu Jin (World Bank) and Tony Whitten (FFI) greatly facilitated our work all through the duration of the project. The Muséum national d’Histoire naturelle, Paris (France) provided a grant to the first author for working at the MNHN.

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Zhang F. 2013. Five new eyed species of *Sinella* (Collembola: Entomobryidae) from China, with a key to the eyed species of the genus. *Zootaxa* 3736: 549–568. [http://dx.doi.org/10.11646/zootaxa.3736.5.7](http://dx.doi.org/10.11646/zootaxa.3736.5.7)


*Manuscript received: 22 January 2016*
*Manuscript accepted: 5 April 2016*
*Published on: 1 September 2016*
*Topic editor: Gavin Broad*
*Desk editor: Kristiaan Hoedemakers*

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