



RESEARCH ARTICLE

***Eustra petrovi* sp. nov. - first record of a troglobitic Ozaenini from China (Coleoptera: Carabidae: Paussinae)**

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Abstract: *Eustra petrovi* sp. nov. from China, Yunnan Province (type locality: cave Xianren Dong near to village Datianba, Longling County, Baoshan City) is described and illustrated. The new species exhibits troglomorphic features (depigmentation of tegument, brachyptery, microphthalmia) and can be separated from other species of *Eustra* by presenting a particular combination of character states.

Key words: Coleoptera, Carabidae, *Eustra*, new species, China, Yunnan Province.

Introduction

To date, the genus *Eustra* Schmidt-Goebel, 1846 includes 24 species and 5 subspecies (Deuve 2001, 2002, 2005; Faille 2010). The representatives of this genus live in Thailand (five species), India (three species), Indonesia (three species), Japan (three species), Vietnam (three species), Burma (two species), Malaysia (two species), the Philippines (two species), Taiwan (two species), Brunei (one species), China (one species), Laos (one species), Nepal (one species), Singapore (one species), and Sri Lanka (one species). Eight taxa are hitherto considered troglobitic (Faille 2010), i.e., *E. lebretoni* Deuve, 1987, *E. trogliphila* Deuve, 1987, *E. leclerci* Deuve, 1986 and *E. deharvengi* Deuve, 1986 (the four from north Thailand), *E. honchongensis* Deuve, 1986 (southern Vietnam), *E. lao* Deuve, 2000 (north-western Laos), *E. pseudomatanga cavernicola* Deuve, 2001 and *E. saripaensis* Deuve, 2002 (both from Sulawesi Island, Indonesia). Recently, Moore *et al.* (2011) described the larval instars of *Eustra* and suggested that representatives of this genus may be facultative predators or facultative symbionts of ants. It is worth noting that a partial neoteny was described in all the

members of the genus *Eustra*, concerning the female genitalia (Deuve 2001), which is exceptional for all holometabolous insects. This is the most important morphological characteristic of this genus and it is an autapomorphy of it.

Up to now, only one species, *E. chinensis* Bänninger, 1949, was recorded from China. The species inhabits the surroundings of Shanghai City, as well as Taiwan and the Japanese islands of Ryu-Kyu and Ishigaki (Deuve 2001; Faille 2010; Terada *et al.* 2013).

In November 2013, a Bulgarian-Chinese speleological expedition visited several unexplored cave systems in Yunnan. Among the ground beetles collected by Boyan Petrov, a scientist from the National Museum of Natural History, Sofia (NMNHS) and a member of the Biospeleology Research Center at the Museum, I found a considerable series of a microphthalmic species of *Eustra*. The study revealed that the series belongs to a species new to the science, which description is presented here.

Material and methods

Specimens were observed using an Olympus SZX10 stereomicroscope and were measured with a stereomicroscope ocular micrometer. Drawings were made using a stereoscopic microscope Carl Zeiss Jena Technival 2. The photos of the habitus were taken by a Zeiss Stemi 2000 microscope equipped with an AxioCam ERc 5s camera and were stacked using CombineZM image stacking software.

The following abbreviations are used in the description: BL= total body length, measured from the apex of the longer mandible to the apex of the elytra; BW= maximum body width, measured across the widest place; HW= maximum head width, the linear distance across the head, including the eyes; PW= maximum pronotal width; PL= pronotal length, measured from the apical margin to the basal margin along the midline; PA= width of pronotal apex, measured between the tips of the fore angles; PB= width of pronotal base, measured between the tips of the hind angles; EW= maximum elytral width, EL= elytral length, measured from an imaginary line connecting the apices of the humeral angles to the apex of the longer elytron.

The examined material in this study is deposited in the following public and private collections:

BMNH British Museum of Natural History, London, United Kingdom
MNHN Muséum National d'Histoire Naturelle, Paris, France
NMNHS National Museum of Natural History, Sofia, Bulgaria
NSMT National Museum of Nature and Science, Tsukuba, Japan
SCAU South China Agricultural University, Guangzhou, China
cSM collection Seiji Morita, Tokyo, Japan
cWR collection David W. Wrase, Berlin, Germany

The nomenclature of the female genitalia follows the works of Liebherr & Will (1998) and Deuve (2001).

Results

Eustra petrovi sp. nov. (Figs. 1–2; 5–9)

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Type locality: China, Yunnan Province, Baoshan City, Longling County, east of village Datianba, cave Xianren Dong, N24.35809 E99.03793, altitude 692 m.

Type material: Holotype ♂, “CHINA, Yunnan, Longling County, cave Xian Ren Dong at village Datianba, 692 m, N24.35809 E99.03793, 6-7.11.2013, B. Petrov leg.” [printed, white label] / “Holotype *Eustra petrovi* sp. nov. B. Guéorguiev des. 2014” [printed, red label]. Paratypes 1♂, 16♀♀ (one of them teneral), with the same data as the holotype. Type series depositories: holotype and 10♀♀ paratypes in NMNHS; 2 paratypes (1♂, 1♀) in MNHN; 1♀ paratype in BMNH; 1♀ paratype in NSMT; 1♀ paratype in SCAU; 1♀ paratype in cSM; 1♀ paratype in cDW.

Diagnosis: The new species is distinct from the other species of the genus by the following combination of characters: 1– tegument of body depigmented; 2– eyes fairly reduced, each one with the diameter equal to or slightly larger than the diameter of the base of scapus; 3– genae fairly convex; 4– antennomeres 6-9 globular, each of them slightly longer than wide; 5– pronotum cordate, wider than long, with apical margin one quarter to one third wider than basal margin, anterior angles acutely porrect and basal angles pointed at tip; 6– shoulders of elytra protruding forward, shortly rounded at tip; 7– basal margin of elytra concave next to shoulder; 8– hind wings reduced; 9– median lobe of aedeagus narrow and elongate, with apex wide and curved; 10– right paramere boatlike, widened and setose at apical part; 11– gonocoxa fusiform, moderately elongate, with a minute, hardly noticeable gonostylus; 12– spermatheca back inverted, without visible folds, C-curved distally.

Description

Habitus. Relatively short and wide, moderately convex species, with tegument wholly and evenly pubescent, though not too densely (Fig. 1).

Size. BL: 3.10-3.65 mm (mean 3.42 mm); BW: 1.20-1.50 mm (mean 1.4 mm).

Color. Body yellowish, slightly shiny, head, antennomeres 3-11, and sometimes pronotum slightly darker, yellow-brownish.

Microsculpture. Obliterate on head and pronotum, perceptible but rather reduced on elytra.

Head. Elongate with fine frontal furrows; disc smooth. Eyes fairly reduced, depigmented, each eye elliptic (maximum width transversely situated), with vestigial ommatidia, as long as one third of genae, with diameter equal to or slightly larger than diameter of base of scapus (Fig. 2). Genae fairly tumid. Labrum conical, nearly as long as wide, anterior margin undulating, with eight setiferous punctures. Clypeus subtrapezoid, wider than long, anterior margin emarginate, with four long setae somewhat removed back from margin; suture between clypeus and frons distinct. Mandibles moderately long, scrobe with 2-4 setae. Mentum with two laterobasal setae out of common hairs and a medial tooth slightly protruded forward. Antennae entirely pubescent, segments 6-9 globular, each of them slightly longer than wide, terminal segment 2.6 times longer than segment 10, three times longer than each of segments 6-9, almost completely exceeding basal margin of pronotum.

Pronotum. Clearly cordiform, wider than long, widest at apical third; PW/HW 1.03-1.17 (mean 1.12); PW/PL 1.43-1.59 (mean 1.54); disc moderately vaulted medially; midline distinct, not reaching both anterior and posterior borders; basal impressions indistinct. Apex wider than base and widely emarginated, PA/PB 1.24-1.38 (mean 1.31), with anterior angles very acute porrect. Lateral sides slightly narrowed anteriorly, a bit concave before the angles, PW/PA 1.06-1.16 (mean 1.10); sides significantly contracted behind, clearly concave before posterior angles, PW/PB 1.38-1.52 (mean 1.44); lateral margins more or less explanate and reflexed throughout. Posterior margin straight medially, slightly oblique onward laterally; posterior angles pointed at tips and protruding outwards.



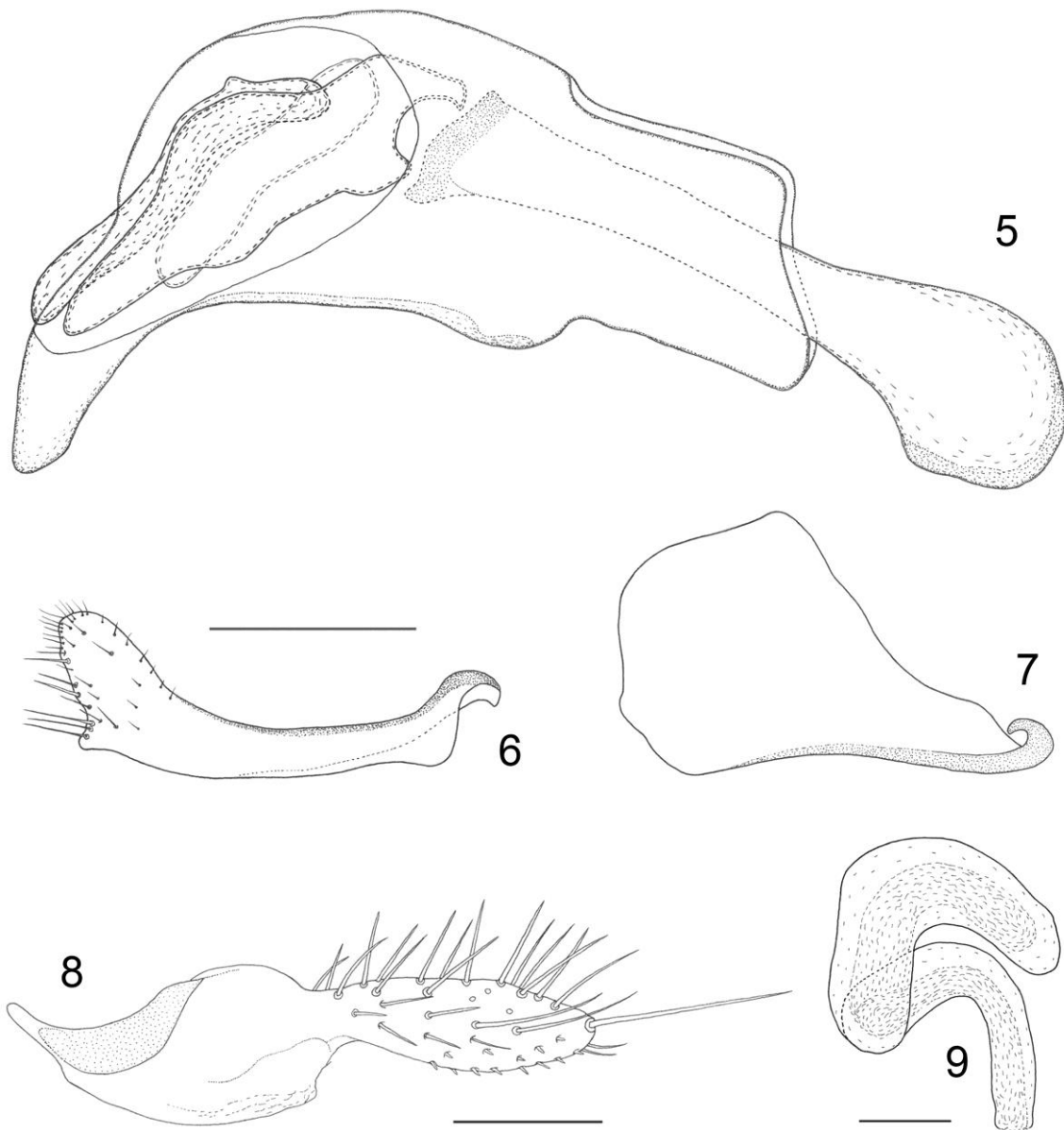
Figures 1–4. (Figs. 1–2) *Eustra petrovi* sp. nov. and (Figs. 3–4) *Eustra caeca* Uéno, 1981, holotype. **1**, habitus, male paratype; **2**, head, right lateral view, female paratype; **3**, habitus; **4**, head with pronotum and type labels. Scale bars = 0.2 mm (Fig. 2); 0.5 mm (Fig. 4).

Elytra. Relatively wide, narrower basally, gradually widened apically as widest at posterior third. Disc fairly vaulted, pubescence arranged in longitudinal rows. Shoulders distinct, prominent forward, shortly rounded at tip. Basal margins concave next to shoulders. Lateral sides slightly explanate. Striae superficial and irregular throughout.

Hind wings. Reduced, approximately as long as two fifths to half of elytron length, much narrower than elytron width, obviously functionless.

Ventral surface. Body underneath more or less pubescent, more densely on abdomen medially; metepisterna about twice longer than wide; abdominal sternites II and III partially fused, suture between them more strongly reduced internally, less externally. Legs pubescent, relatively long and slender, first segment of hind tarsi as long as following three segments combined.

Male genitalia. Median lobe of aedeagus moderately sclerotized, fairly narrow and elongate, in lateral view, with right-handed apical orifice and long, wide and curved apex, which ends in a blunt tip (Fig. 5); ventral side twice concave, once distally and secondly proximally; basal part bilobed, widely opened dorsally and proximally at large basal orifice; dorsal margin rather convex; median lobe almost straight in dorsal view, only blade scarcely bent to left. Inner sac armed with very large, articulated copulatory piece; basal piece largest and longest, with the basal portion protruding out of basal orifice; apical pieces hardly discernible, at least consisting of two more chitinized fore pieces, one spine-like at medial position (seen dorsally), another plate-like, right-sided (seen dorsally), and a medial, less chitinized plate, left-sided (seen dorsally). Right paramere arcuate, boatlike, with widened and setose apical part, rounded at tip and basal part hooked at extremity (Fig. 6). Left paramere large, conchoids and hyaline, glabrous, hooked basally at internal face (Fig. 7).



Figures 5–9. *Eustra petrovi* sp. nov., holotype (Figs. 5–7) and female paratype (Figs. 8–9). **5**, median lobe of aedeagus, right lateral view; **6**, right paramere, internal face; **7**, left paramere, internal face; **8**, left stylomere, ventral view; **9**, spermatheca, ventral view. Scale bars = 0.2 mm (Figs. 5–7); 0.1 mm (Figs. 8–9).

Female genitalia. Gonocoxa (“gonopode IX”, according to Deuve 2001) of ovipositor fusiform, moderately elongate, with a tiny gonostylus bearing long apical, trichoid seta, at ventral surface with approximately 24-26 longer setae situated mostly medially and externally and 10-12 shorter spikes situated mostly apically and internally (Fig. 8). Spermatheca tubular, membranous, back inverted, without visible folds, with more compact internal frame and terminal half extended, C-curved (Fig. 9).

Detailed data about variations of some measurements and ratios are given in Table 1.

Table 1. Data on variation in values among <i>Eustra petrovi</i> sp. nov. (ten - teneral).										
Specimen	Sex	BL/mm	BW/mm	PW/HW	PW/PL	PW/PA	PW/PB	PA/PB	EW/PW	EL/EW
HT	♂	3.45	1.4	1.13	1.48	1.10	1.42	1.29	1.68	1.33
PT 1	♂	3.3	1.35	1.10	1.57	1.10	1.50	1.36	1.64	1.37
PT 2 (ten)	♀	3.4	1.4	1.03	1.43	1.10	1.43	1.30	1.70	1.38
PT 3	♀	3.35	1.35	1.10	1.43	1.10	1.43	1.30	1.64	1.44
PT 4	♀	3.3	1.4	1.10	1.57	1.10	1.38	1.25	1.58	1.44
PT 5	♀	3.6	1.5	1.16	1.57	1.09	1.44	1.32	1.64	1.39
PT 6	♀	3.4	1.35	1.10	1.52	1.07	1.39	1.30	1.69	1.33
PT 7	♀	3.5	1.45	1.16	1.57	1.09	1.44	1.32	1.53	1.47
PT 8	♀	3.1	1.2	1.11	1.55	1.07	1.48	1.38	1.52	1.47
PT 9	♀	3.35	1.45	1.13	1.59	1.13	1.52	1.35	1.57	1.42
PT 10	♀	3.45	1.4	1.17	1.59	1.09	1.40	1.28	1.57	1.40
PT 11	♀	3.45	1.4	1.14	1.57	1.10	1.50	1.36	1.67	1.40
PT 12	♀	3.3	1.3	1.10	1.57	1.10	1.38	1.25	1.61	1.40
PT 13	♀	3.5	1.4	1.13	1.52	1.13	1.46	1.29	1.60	1.39
PT 14	♀	3.4	1.35	1.10	1.57	1.06	1.43	1.35	1.64	1.39
PT 15	♀	3.4	1.45	1.10	1.54	1.06	1.42	1.33	1.68	1.32
PT 16	♀	3.55	1.45	1.13	1.57	1.16	1.44	1.24	1.53	1.45
PT 17	♀	3.65	1.5	1.12	1.54	1.09	1.42	1.31	1.62	1.35
PT 18	♀	3.55	1.5	1.13	1.52	1.09	1.46	1.33	1.60	1.43
range	-	3.1-3.65	1.2-1.5	1.03-1.17	1.43-1.59	1.06-1.16	1.38-1.52	1.24-1.38	1.52-1.70	1.32-1.47
mean	-	3.42	1.4	1.12	1.54	1.10	1.44	1.31	1.62	1.40

Etymology: A noun in the genitive case. Honours Boyan Petrov, a proficient Bulgarian biospeleologist, who collected the type series.

Similarities: *Eustra petrovi* sp. nov. is treated morphologically most similar to *E. caeca* Uéno, 1981 (Figs. 3-4), with which it agrees in the most key characters given by Deuve (2001: 563-565), excluding only the ratio PA/PB. The similarity between these species may be consequence of a convergence following their adaptation to identical habitats.

Actually, the new species differs readily from its closer congener (in brackets) in the following respects: 1– genae more convex (vs. genae less convex); 2– ratio PA/PB: 1.24-1.38 (vs. PA/PB: 1.59); 3– ratio PW/PB: 1.38-1.52 (vs. PW/PB: 1.71); 4– shoulder of elytron

protruding forward, shortly rounded at tip, so that basal margin concave next to shoulder (vs. shoulder of elytron not prominent forward, widely rounded, basal margin gently concave). I give here only external character states, as *E. caeca* has been described by single teneral male specimen and its genitalia remain unknown.

Additionally, the new taxon can be identified by modifying couplets 21-23 of the key to *Eustra* (Deuve 2001):

- 21 Basal angles of pronotum obtuse. 22
 – Basal angles of pronotum acute, right or nearly right, distinctly pointed 23
 22 Eyes reduced, with diameter equal to base of scapus. Anterior angles of pronotum acute. Smaller species (2.8-3.0 mm). *E. honchongensis* Deuve, 1986
 – Eyes more reduced, with diameter smaller than base of scapus. Anterior angles of pronotum blunt. Larger species (4.5 mm) *E. lao* Deuve, 2000
 23 Middle antennomeres short, globular, not or scarcely longer than wide. Pronotum 1.4 to 1.6 times larger than long. Length of body 3.0-3.7 mm. 24
 – Middle antennomeres prolonged, around twice longer than wide. Pronotum cordate, 1.3 times larger than long. Length of body 3.8 mm. *E. deharvengi* Deuve, 1986
 24 Shoulder of elytron prominent forward, shortly rounded at tip; basal margin concave next to shoulder (Fig. 1). Pronotum with sides less constricted from widest point to base and apical margin less wide than basal margin. Genae fairly convex. BL: 3.10-3.65 mm. *E. petrovi* sp. nov.
 – Shoulder of elytron not prominent forward, widely rounded; basal margin convex next to shoulder (Fig. 3). Pronotum with sides more constricted from widest point to base and apical margin much wider than basal margin (Fig. 4). Genae gently convex. BL: 3.17 mm. *E. caeca* Uéno, 1981

Notes on the type locality and habitat: Xianren Dong represents a two-storied cave, with an underground river, a lot of stones, clay, and guano inside. The cave is developed in Cretaceous limestone at the base of the Hengshan Mountain. The total length is 1863 meters and the depth is -51 meters. The cave's entrance is at 692 meters above sea level, close to the village Datianba, Longling County (Fig. 10). The terrain above the cave is covered with sparse bushy vegetation and agricultural plots. The entrance lies within the yard of a functioning small factory and the initial 200 meters are partially developed for tourist visits. The average air temperature measured during the collecting visit was 21.8°C. Specimens of the new species have been found at three spots, exclusively in the non-developed sections of the cave (Fig. 11). The individuals mostly crept on clay between stones. They rarely stand under larger rocks.

Additionally examined material

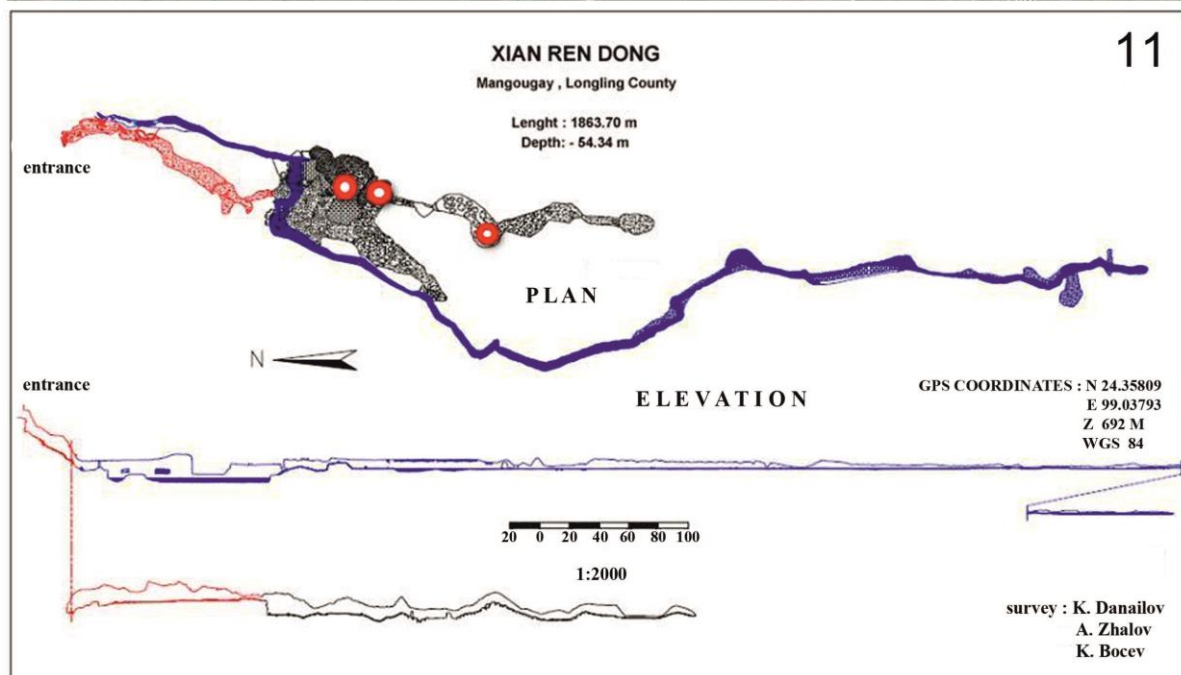
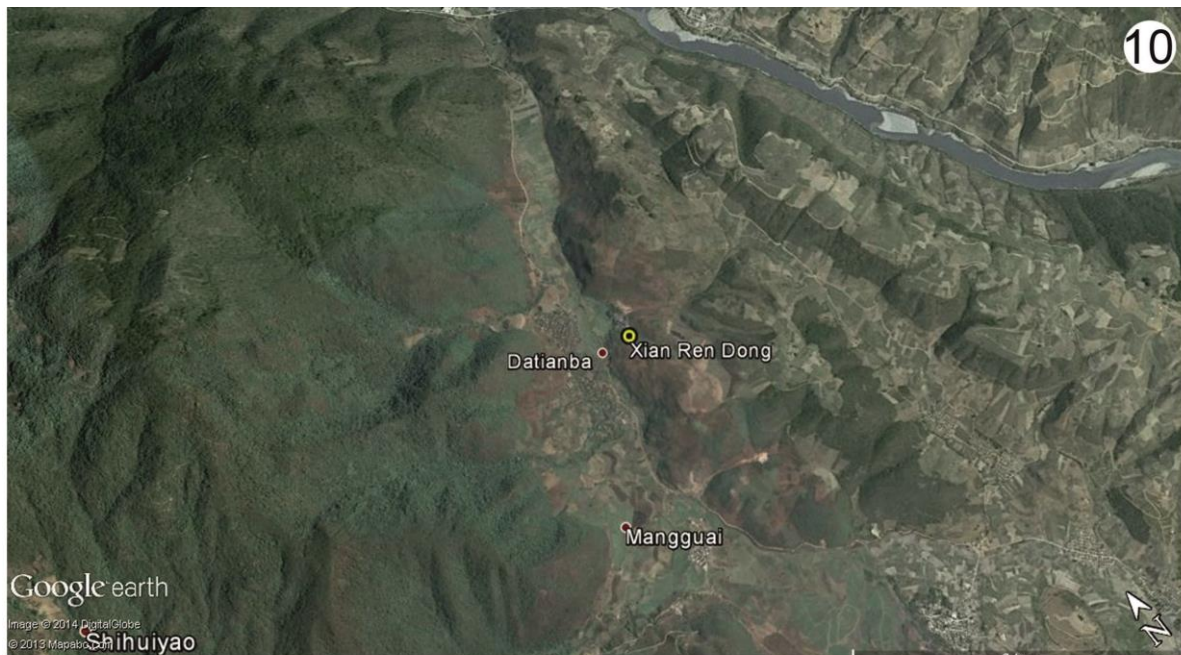
Eustra caeca Uéno, 1981 (Figs. 3–4)

Eustra caeca Uéno, 1981: 621 (type locality: “Mt. Doi Suthep, ca 1,300 m alt., in Changwat Chiang Mai of northern Thailand”)

Type material. Holotype ♂, teneral specimen, “Mt. Doi Suthep ca. 1,300m alt. Changwat Chiang Mai” [printed, white label], “N Thailand 8-IX-1967 S. Uéno leg.” [printed,

white label], “HOLOTYPE” [printed, red label], “*Eustra caeca* S. Uéno, **sp. nov.** det. S. Uéno, 1981” [handwritten, white label], “Uéno” [handwritten, white label] (NSMT).

Remarks: Uéno (1981: 621) records that the length of the holotype is 2.85 mm. He took this dimension from the anterior margin of clypeus to the apex of elytra. Deuve (2001: 565) gives for the same specimen, first 3.4 mm in the key of the species, and secondly 3.2 mm in the text (Deuve *ibid.*: 569). A repeated measurement of the holotype performed as BL (see “Material and methods”) by Mr. Kamezawa and me ascertained that the specimen length is 3.17 mm.



Figures 10–11. Maps on type locality and habitat. **10**, Map of the surroundings of cave Xianren Dong; **11**, Scheme of the cave Xianren Dong, with red dots indicating the spots of collecting *Eustra petrovi* **sp. nov.**

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