Zootaxa 4303 (3): 350–360
http://www.mapress.com/j/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.4303.3.2
http://zoobank.org/urn:lsid:zoobank.org:pub:260F1C3F-4FC8-4DA4-8AEE-0DD11A99185F

Revision of the genus *Sinobathyscia* Perreau (Coleoptera, Leiodidae, Cholevinae) from China, with description of a new species

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Abstract

Sinobathyscia tianma **sp. nov.** (Coleoptera: Leiodidae: Cholevinae: Leptodirini) is described from Shanghai, China. The genus *Sinobathyscia* is redescribed with respect to the discovery of the male. Relevant morphological characters of the species examined are illustrated with colour plates, and their known distributions are mapped.

Key words: Leiodidae, Cholevinae, Leptodirini, *Sinobathyscia*, taxonomy, new species, China

Introduction

Leptodirini is the most speciose tribe in Cholevinae (Leiodidae), or arguably, the most diverse radiation of subterranean animals, with ca. 230 genera and subgenera and ca. 950 species worldwide (Perreau 2000, 2015; Newton 2016).

The geographical distribution of Leptodirini is centred on the Mediterranean Basin, but with four notable exceptions: *Platycholeu*s Horn, 1880 from the United States, *Coreobathyscia* Szymczakowski, 1975 from South Korea, *Proleptodirina* Perkovsky, 1998 from the Russian Far East and *Sinobathyscia* Perreau, 1999 from China. After two other Far Eastern Asiatic genera were recently removed from Leptodirini: *Sciaphyes* Jeannel, 1910, transferred to a new tribe Sciaphyini (Perreau 2000) and *Fusi* Perkovsky, 1989, transferred to Cholevina (Cholevini), the relationships of the three remaining oriental genera to Leptodirini is under discussion (Fresneda *et al.* 2011). They are all monotypic and known based on the limited number of type specimens. However, the North American genus *Platycholeu*s has recently been confirmed as a member of Leptodirini, and probably as the sister group of all other genera of the tribe (Fresneda *et al.* 2011; Kilian & Newton 2017).

The genus *Sinobathyscia* Perreau, 1999 from China was established from four females collected by sifting litter in Hubei, China. In this paper, a new species from Shanghai, China is described and illustrated: *S. tianma* **sp. nov.** The genus characters, especially those of the male which were previously unknown, are redescribed, allowing a more accurate discussion of the phylogenetic relationships of *Sinobathyscia* within Leptodirini.

Material and methods

Specimens were relaxed and softened in a hot saturated solution of potassium hydroxide for 4 minutes (for dry mounted specimens) or 8 minutes (for alcohol-preserved specimens), and then transferred to distilled water to rinse the residual potassium hydroxide off and stop any further bleaching. The softened specimens were moved into glycerin and dissected there to observe morphological details. After examination, the body parts were mounted on a glass slip with Euparal Mounting Medium for future studies. Habitus photographs were taken using a Canon

 Accepted by J. Klimaszewski: 24 May 2017; published: 10 Aug. 2017

macro photo lens MP-E 65mm on a Canon 550D. Photographs of Figs. 3K–L were taken with a Keyence VHX5000 microscope with a VH-Z250T lens. Observations, photographs and measurements of morphological details were performed using an Olympus BX53 microscope with an Olympus DP73 camera. The final deep focus images were created with Zerene Stacker 1.04 stacking software. Adobe Photoshop CS6 was used for post processing. Exact label data are cited, while authors' remarks and addenda are placed in square brackets; separate label lines are indicated by a slash (/), and separate labels are indicated by a double slash (//).

The material examined for this study is deposited in the following collections and museums (with names of curators in parentheses):

BMNH—Natural History Museum (formerly British Museum), London, United Kingdom (M. Barclay)
CJRZ—Collection of Jan Růžička, Prague, Czech Republic
CMPR—Collection of Michel Perreau, Paris, France
MHNG—Muséum d'Histoire Naturelle, Genève, Switzerland (G. Cuccodoro)
SNUC—Insect Collection of Shanghai Normal University, Shanghai, China (L. Tang)

The following measurements in millimetres (mm) were made:

Antennal length: length between the antennal base and the apex.
Basitarsal width: maximum width of proximal protarsomere.
Extended body length: summation of lengths of head, pronotum, elytra and exposed scutellum, preventing the error introduced by exposed or retracted head.
Elytral length: length between the posterior end of scutellum and the elytral apex.
Elytral width: widest part of both elytra combined.
Head length: length between the anterior apex of clypeus and the posterior margin of occipital carina along the midline.
Head width: maximum width of head.
Pronotal length: length of the pronotum along the midline.
Pronotal width: maximum width of pronotum.
Tibial width: maximum width of protibia (excluding spines along outer margin etc.).

Taxonomy

Genus *Sinobathyscia* Perreau, 1999 (华冥小葬甲属)

Perreau, 1999: 404 (species included: *kurbatovi*); Perreau, 2000: 170 (world catalogue; 1 species); Perreau, 2015: 210 (Palaearctic catalogue; 1 species).
Type species: *Sinobathyscia kurbatovi* Perreau, 1999, fixed by original designation.

Redescription. Small size, less than 1.5 mm. Body (Figs. 1A–E) *Bathyscia*-like, oval and rather convex. Dorsum consistently clothed with homogeneous fine, prostrate pubescence.

Head wider than long; clypeofrontal suture (Fig. 2D) distinct. Anophthalmic, compound eyes (Fig. 2E) completely absent. Occipital carina vestigial. Labrum (Fig. 2H) transverse, rounded subrectangle; epipharyngeal area with torma. Left and right mandibles (Figs. 2F–G) asymmetrical, each with a tooth on inner margin of subapex; subapical orthogonal penicillus made up of slender, fine setae; mola well-developed. Maxillary palp (Figs. 2I–J) with penultimate palpomere slightly swollen, length/width = 1.7; ultimate palpomere quite slender, nearly as long as and about half as wide as penultimate palpomere. Labium as shown in Fig. 2K, premier labial palpomere only a little longer than ultimate palpomere, and ultimate palpomere nearly twice as long as penultimate palpomere. Antennae (Figs. 2A–C) with basal two antennomeres much strong and nearly as long as each other. Cervical sclerite (Fig. 2L) tooth-like, tapering posteriorly, apex subacute, length/width = 2.9.

Pronotum (Figs. 3A–C) widest at base, punctate and microreticulate but not transversely striolated (Fig. 3K). Elytra not fused with each other, with fine transverse striolations (Fig. 3L). Sutural striae absent. Epipleura commonly narrow. Metathoracic wings absent.

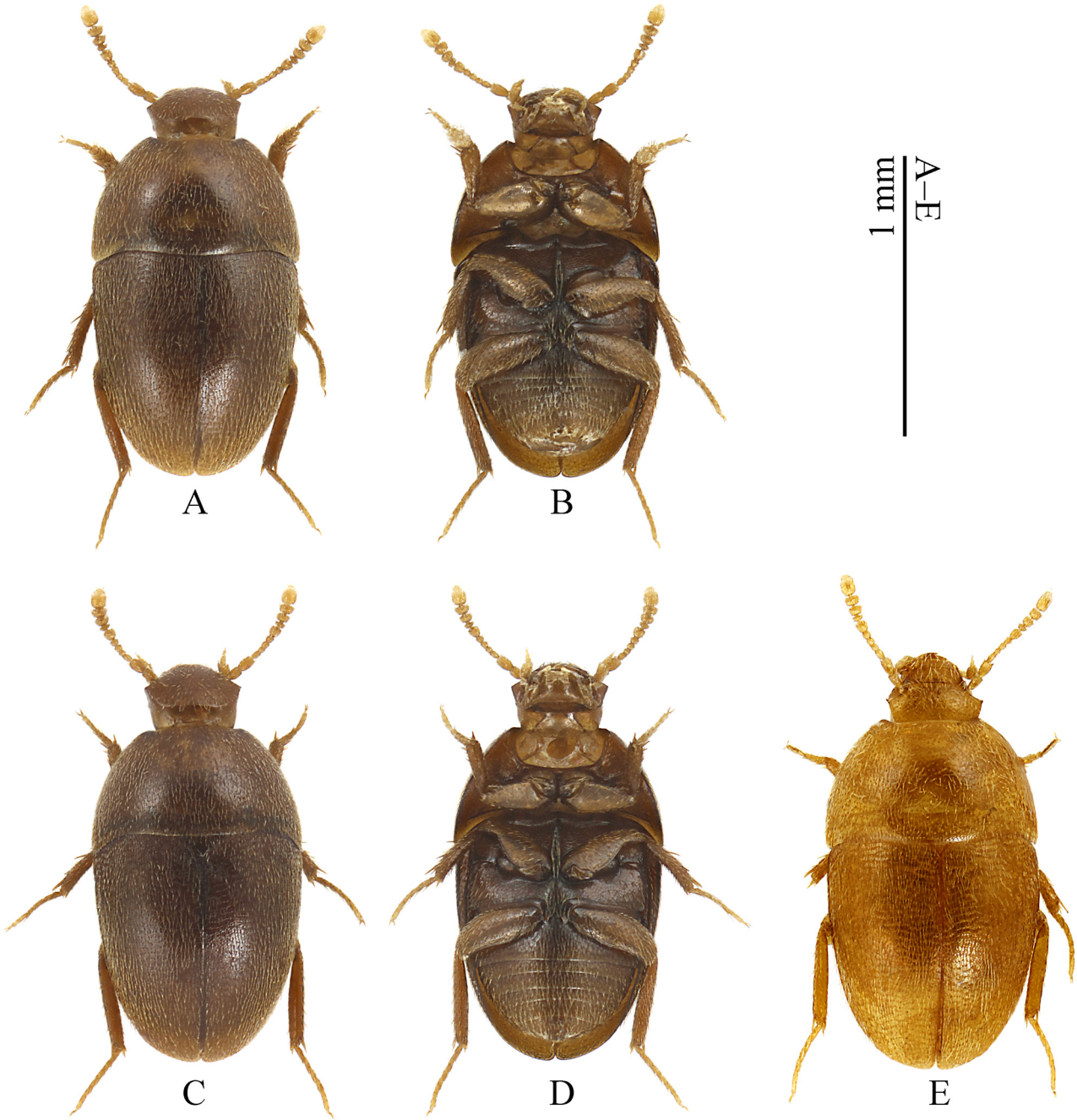

FIGURE 1. Habitus of *Sinobathyscia tianma* sp. nov.: **A–B**, holotype ♂; **C–D,** paratype ♀. **Habitus of *S. kurbatovi* Perreau, 1999**: **E**, holotype ♀. (**A, C, E,** dorsal view; **B, D,** ventral view).

Scutellum much wide, tightly integrated with metanotum. Metanotum (Fig. 3I) short but with moderately and narrowly elongated metatergal apophysis, reaching about the basal third of elytra. Metendosternite (Fig. 3J) with stalk short, (stalk length)/(furcal arm width) = 0.3.

Meso- and metaventrite as shown in Figs. 3D–E, and shapes of mesepisternum, mesepimeron, metaepisternum and metepimeron can be fully seen in Fig. 3E; mesepimera wider than long, outer margin longer than inner margin. Mesoventral carina (Fig. 3E) strongly developed, lamellate, high, somewhat thickened, and shortly extended under metaventrite. Metacoxal cavities distinctly separated.

Abdominal tergites (Fig. 4G) only the last two sclerotized, the others membranous.

Protarsi pentamerous and expanded in male (Fig. 4B), tetramerous and linear in female (Figs. 4D, F). Protibiae with several small outer spines but not forming into a row (Figs. 4A, C, E). Meso- and metatibiae without spine combs around apex. Outer spurs well-developed. Mesotarsi simply linear.

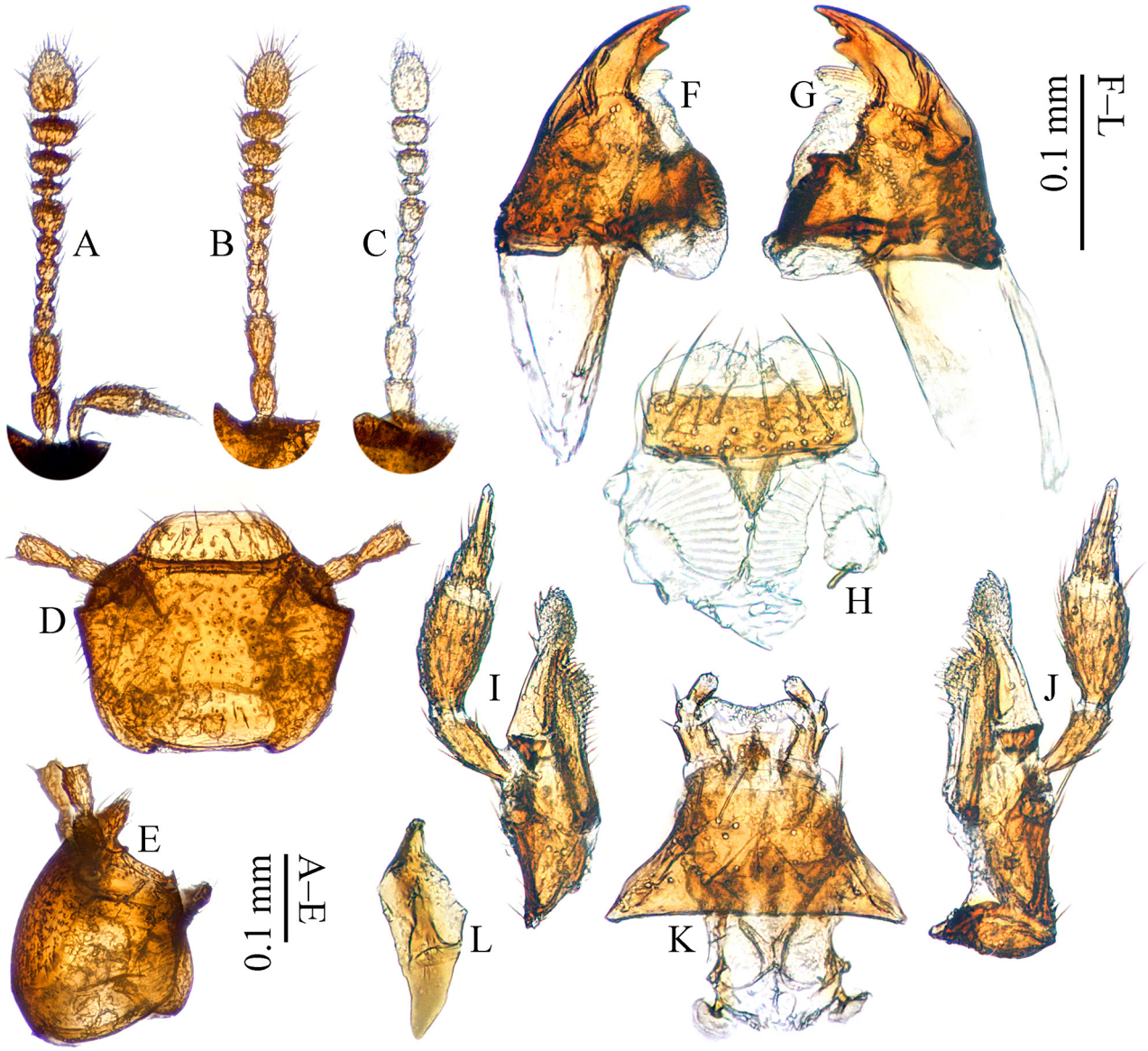

FIGURE 2. ***Sinobathyscia tianma*** **sp. nov.**: **A**, holotype, ♂; **B, D–L**, paratype, ♀. ***S. kurbatovi*** **Perreau, 1999**: **C**, paratype, ♀. **A–C**, antenna; **D–E**, head capsule; **F**, left mandible; **G**, right mandible; **H**, labrum and epipharynx; **I**, left maxilla; **J**, right maxilla; **K**, labium and mentum; **L**, cervical sclerite. (**A–D, F–J**, dorsal view; **E**, lateral view; **K**, ventral view; **L**, medial view).

Male genital segment (Fig. 4I) with spiculum gastrale poorly sclerotized, ill-defined. Aedeagus (Fig. 5A) slender; parameres thick, reaching the apex level of median lobe; basal lama short; endophallus with two obvious bands of phanerae.

Spermatheca (Figs. 6B, E) large, trilobed, the middle one the largest, and the two apical ones separated by a narrow unsclerotized region. Ovipositor with minute stylus.

Distribution. China (as in Fig. 8).

Diagnosis. *Sinobathyscia* well resembles *Coreobathyscia* from South Korea, but the latter is larger than 2.0 mm in body length, antennae with basal two antennomeres distinctly more slender, parameres much exceeding the apex level of median lobe, endophallus without sclerites.

Sinobathyscia tianma **sp. nov.** (天马华冥小葬甲)

(Figs. 1A–D; 2A–B, D–L; 3A–B, D–G, I–J; 4A–D, G–J, L; 5A–H; 6C–D, E; 7A–C)

Type material. Holotype: ♂, CHINA, Shanghai: / Songjiang District, / Tianmashan (天马山), / alt. 40 m, 31°04'35.95"N / 121°08'45.45"E, // sifted from rotten wood, / 19.XII.2016, / Xiao-Bin Song leg. (SNUC).

Paratypes: 1♂8♀♀, same data as holotype (1♂5♀♀ in SNUC, 1♀ in CJRZ, 1♀ in CMPR and 1♀ in BMNH).

Description. *Male holotype*. Extended body length: 1.4 mm. Length (mm) of different body parts: head (0.2): antenna (0.5) : pronotum (0.4) : elytra (0.7); width (mm): head (0.3) : pronotum (0.7) : elytra (0.7). Proportion of antennomeres from base to tip in μm (length × width): 49 × 32, 58 × 34, 28 × 24, 20 × 22, 22 × 24, 22 × 27, 33 × 38, 15 × 35, 26 × 47, 30 × 54, 71 × 54.

Habitus (Figs. 1A–D) oval, much convex and sublustrous. Moderately pigmented: mostly brown; mouthparts, antennae and tarsi somewhat paler. Dorsum continuously clothed with fine, prostrate, yellowish pubescence. Insertions of pubescence on dorsal surfaces of elytra and femora aligned along superficial transverse striolations; interspace between two striolations microreticulate. Dorsal surfaces of head and pronotum finely and sparsely punctate, not transversely striolated; interspace microreticulate.

Head retractile, width/length = 1.4. Clypeus subtrapezoidal, front margin straight. Antennae (Fig. 2A) slender and incompact, AL/HW = 1.4; antennomere I and II wide, about 1.4 times wider than antennomere III; antennomere VIII transverse, wider than twice of its length; antennomere IX and X nearly twice as wide as long; antennomere XI pear-like, length/width = 1.30.

Pronotum (Fig. 3A) transverse, widest at base, width/length = 1.7. Sides gently arched, gradually narrowing from posterior to anterior; hind angles projected backwards and bluntly rounded. Posterior margin emarginate near hind angles.

Elytra oval, tightly combined with each other but can be separated using some force, as wide as long and widest at base. Sides evenly arched, gradually narrowing from bases to apices; apices (Fig. 3F) almost obliquely truncated.

Abdominal ventrite VIII (Fig. 4H) transverse, almost not emarginate on posterior margin, and a subrounded median patch strongly sclerotized posteriorly. Genital segment (Fig. 4I) longer than wide, with spiculum gastrale poorly sclerotized, ill-defined; genital plate quite narrow; tergite IX rounded ventro-apically.

Prolegs (Fig. 4A) short but strong, with protarsi pentamerous, basal three protarsomeres (Fig. 4B) strongly expanded: (tibial width)/(basitarsal width) = 1.1. Protibiae strongly expanded towards apex. Profemora broad. Mesotibiae with inner side inconspicuously bisinuate, outer side with several big spines erecting from pubescence. Metatibiae straight, outer side with several small spines hidden in pubescence.

Aedeagus (Fig. 5A) with median lobe slender, gradually narrowing apically and terminated to a lanceolate apex (Fig. 5C) in dorsal view; parameres thick, gently convergent inwards, slightly expanded before apex and narrowly subrounded at apex, reaching the apex level of median lobe; two strong apical setae inserted on inner side, the posterior one distinctly longer and stronger than the anterior one, their arrangements as shown in Figs. 5E–H; basal lamella short. In lateral view (Fig. 5B), median lobe regularly bent ventrad and acuminate at apex (Fig. 5D); parameres with a rounded knob at apex (Fig. 5H). Endophallus with two obvious bands of phanerae, a pair of small sclerites in the middle region and a U-shaped complex in the basal region.

Female. Similar to male in general appearance (Figs. 1C–D), including elytral apices (Fig. 3G), but distinct in the following characters: pronotum (Fig. 3B) with hind angles narrower; protarsi (Fig. 4D) tetramerous and simply linear; protibiae (Fig. 4C) considerably narrower; ventrite VIII (Figs. 4J, L) generally rounded at posterior edge, only slightly protruded in the median, spiculum ventrale quite narrow, nearly parallel-sided; tergite IX (Fig. 6C) widely rounded at posterior edge, with four minute setae posteriorly; valvifer with one lateral seta; coxite (Figs. 6C–D) with two subapical and two lateral setae; stylus minute (Figs. 6C–D), cylindrical, with one long seta; spermatheca (Fig. 6E) large, trilobed, and the middle one the largest.

Field observations. Specimens were found in an abandoned termite nest in rotten wood (Fig. 7A–C), located near a regular latrine site of *Meles meles* (Linnaeus, 1758) (Mustelidae) or *Nyctereutes procyonoides* Gray, 1834 (Canidae).

Distribution. China (Shanghai) (Fig. 8).

Etymology. The specific epithet is from the Chinese name (Pinyin) of the type locality "Tianmashan", which means "flying horse".

Diagnosis. This new species is similar to *Sinobathyscia kurbatovi* from Wuhan, Hubei, but with stable differences on the spiculum ventrale of female ventrite VIII, the most important character for identifying females of Cholevinae: in *S. tianma* **sp. nov.**, the spiculum ventrale is narrow (Figs. 4J, L); while in *S. kurbatovi*, the spiculum ventrale is much wider, about 1.4 times as wide as in the new species (Figs. 4K, M).

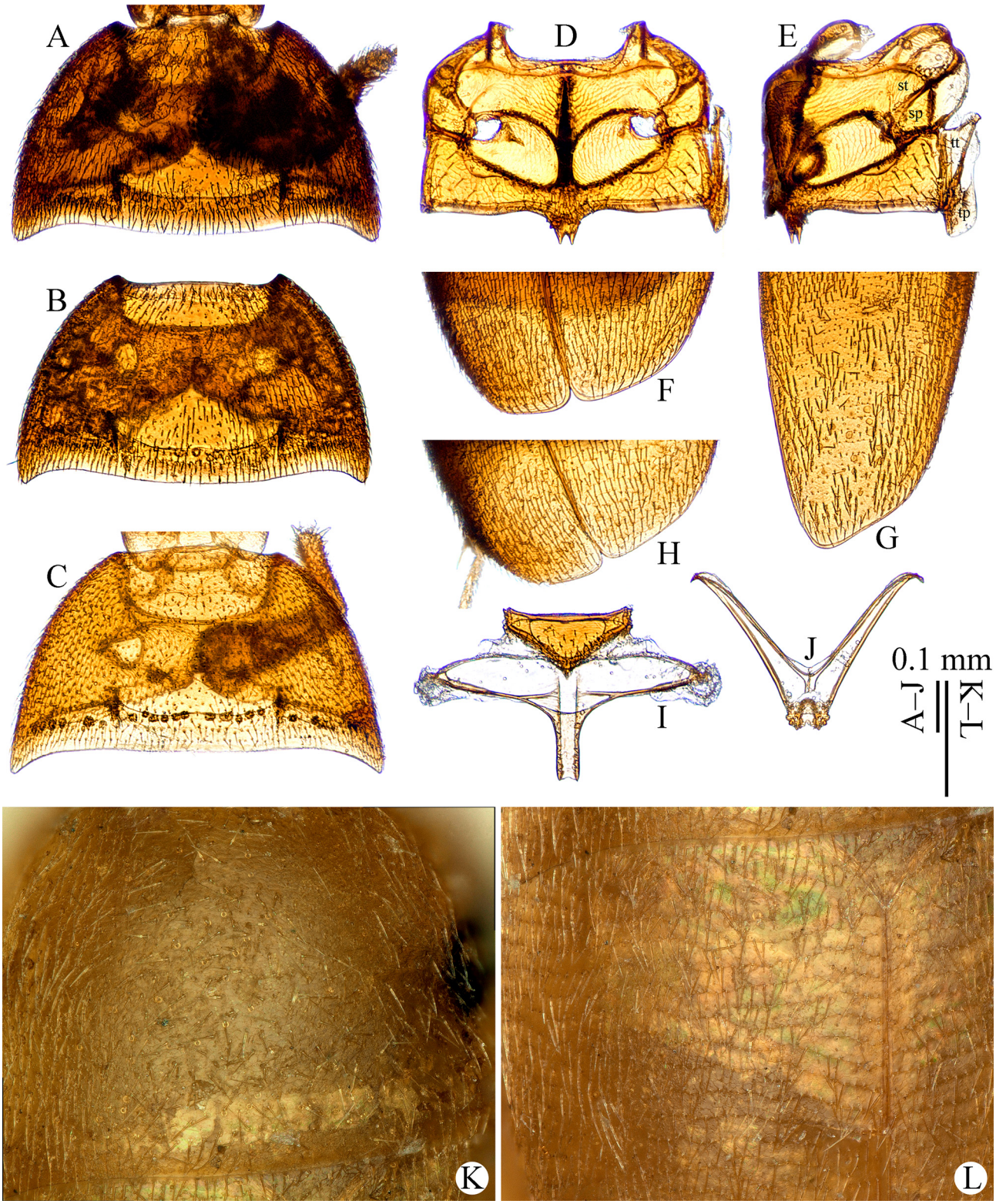

FIGURE 3. ***Sinobathyscia tianma*** **sp. nov.**: **A**, holotype, ♂; **B, D–G, I–J**, paratype, ♀. ***S. kurbatovi*** **Perreau, 1999**: **C, H, K–L**: paratypes, ♀. **A–C**, pronota; **D–E**, meso- and metasterna (**st**, mesepisternum; **sp**, mesepimeron; **tt**, metaepisternum; **tp**, metepimeron); **F–H**, elytral apices; **I**, scutellum and metanotum; **J**, metendosternite; **K**, microsculpture on pronotum; **L**, microsculpture on elytra. (**A–C, I–L**, dorsal view; **D**, ventral view; **E**, lateroventral view; **F–H**, dorsoapical view).

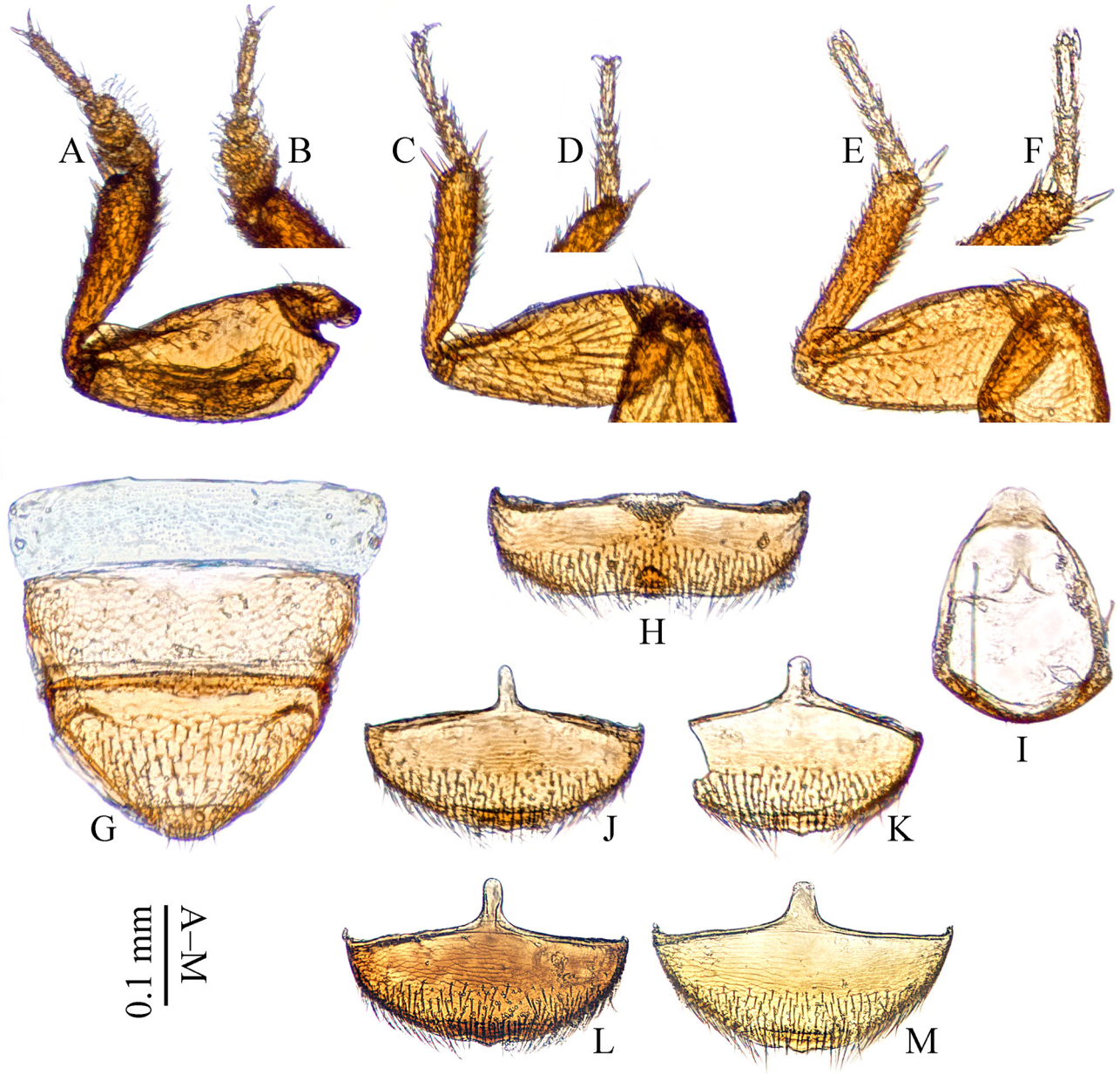

FIGURE 4. ***Sinobathyscia tianma*** **sp. nov.**: **A–B, H–I**, holotype, ♂; **C–D, G, J, L**, paratypes, ♀. ***S. kurbatovi*** **Perreau, 1999**: **E–F, M**, paratype, ♀; **K**, holotype, ♀. **A, C, E**, protibiae & profemora; **B, D, F**, protarsi; **G**, tergites VI–VIII; **H**, ventrite VIII; **I**, genital segment; **J–M,** ventrites VIII. (**A, C–G**, dorsal view; **B, H–M**, ventral view).

Sinobathyscia kurbatovi **Perreau, 1999 (库夫华冥小葬甲)**
(Figs. 1E; 2C; 3C, H, K–L; 4E–F, K, M; 6A–B)

Perreau, 1999: 404 (*Sinobathyscia*; type locality: China, Hubei, Wuhan, 200 m; MHNG); Perreau, 2015: 210 (*Sinobathyscia*; in Palaearctic catalogue).

Material examined. Type material. Holotype: ♀, China, Hubei / Wuhan, litter / in the park / 200 m 28.V.1995 / leg. S. Kurbatov // HOLOTYPE / Sinobathyscia / kurbatovi n. gen. / n. sp. / M. Perreau det. 1999 (MHNG). **Paratypes:** 3♀♀, same data as holotype except: PARATYPE (2♀♀ in MHNG and 1♀ CMPR).

Distribution. China (Hubei) (Fig. 8).

Diagnosis. See under *Sinobathyscia tianma* **sp. n.** above.

Remarks. Only when a male topotype of this species is found, can its most crucial diagnostic characters be finally defined. Finding a male is thus one of the important targets of our future field work.

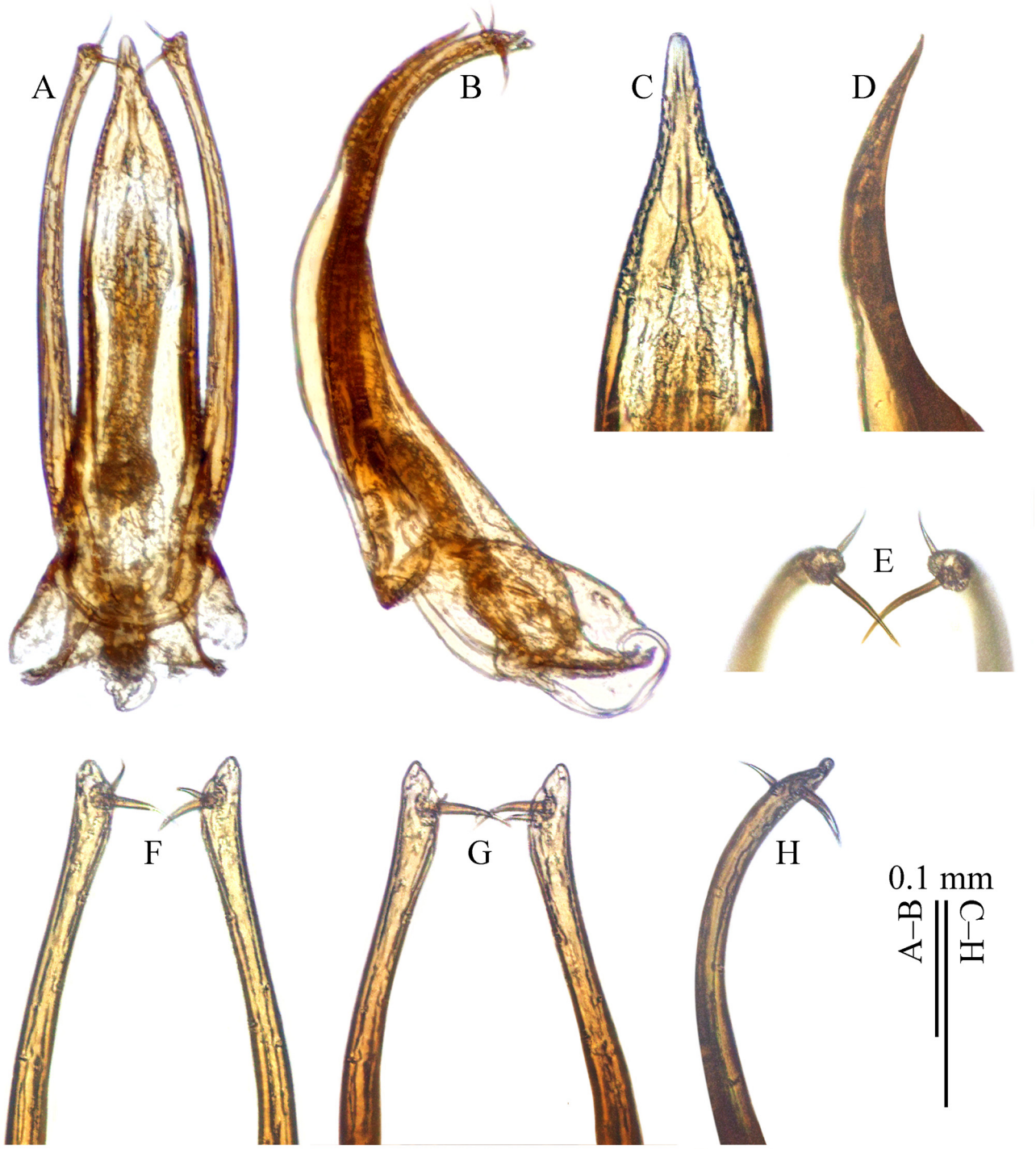

FIGURE 5. ***Sinobathyscia tianma*** **sp. nov.**: holotype, ♂. **A–B**, aedeagus; **C–D**, apex of median lobe; **E–H**, parameres. (**A, C, F**, dorsal view; **B, D, H**, lateral view; **E**, top view; **G**, ventral view).

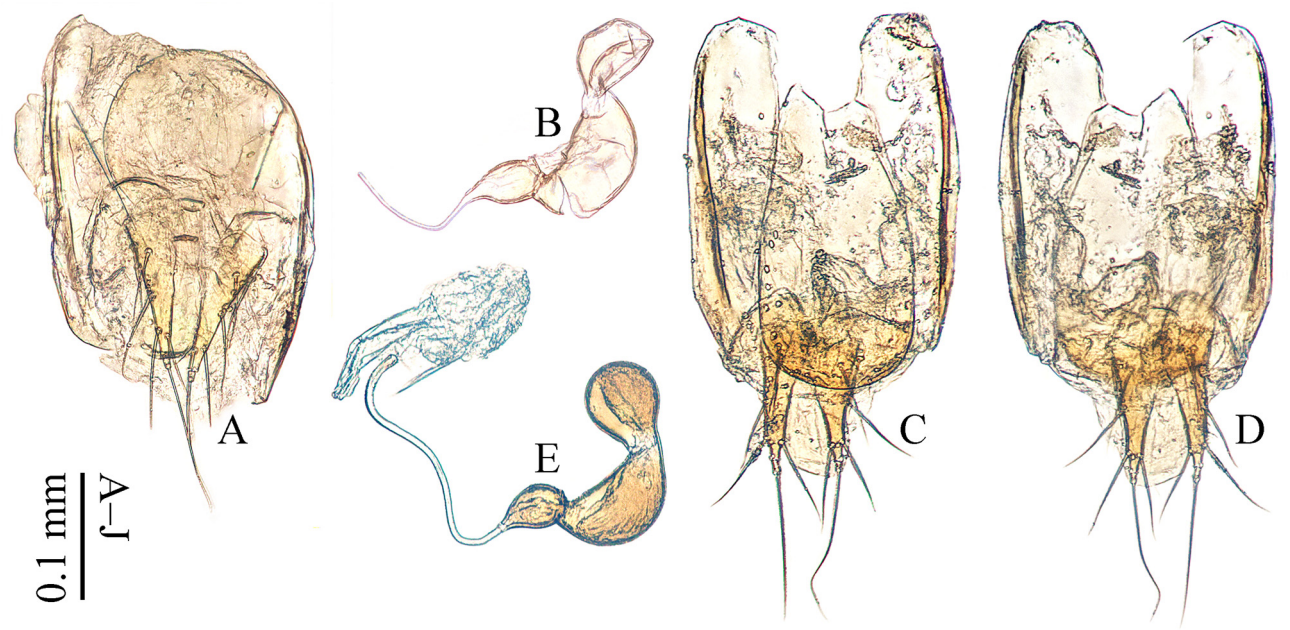

FIGURE 6. ***Sinobathyscia tianma*** **sp. nov.**: **C–D, E**, paratype, ♀. ***S. kurbatovi*** **Perreau, 1999**: **A–B,** holotype, ♀. (**A, C**, dorsal view; **D**, ventral view).

FIGURE 7. Field observations (Shanghai: Tianmashan) of ***Sinobathyscia tianma*** **sp. nov. (Photographed by Xiao-Bin Song).** (**A**, dorsal view; **B**, lateral view; **C**, oblique anterodorsal view).

Discussion

The combination of the four following characters: metacoxae clearly separated (Figs. 1B, D), male genital segment reduced to a ring (Fig. 4I), female protarsi tetramerous (Figs. 4C–F) and spermatheca (Figs. 6B, E) divided in (at least) two sclerotised lobes separated by an unsclerotised peduncle (sometimes with an additional basal third lobe as present in *Sinobathyscia*) suggests the tribal assignation of this genus to Leptodirini according to the present morphological definition of this tribe (Perreau 2000).

However, the tentative placement in the subtribe Bathysciina initially proposed in the original description of the first species, in the absence of male specimens (Perreau 1999) is refuted, since male protarsi of *Sinobathyscia* are pentamerous and are not tetramerous (Figs. 4A–B). The combination of the pentamerous male protarsi and of the lack of a lateral row of spines on protibia or an apical comb of spines on mesotibia and metatiba suggests placement in Pholeuina, together with *Coreobathyscia* and *Proleptodirina*. According to the original description, females of *Proleptodirina* have tetramerous protarsi strongly supporting a generic placement in Leptodirini, however females of *Coreobathyscia* are unknown, leaving uncertainty as to its tribal placement.

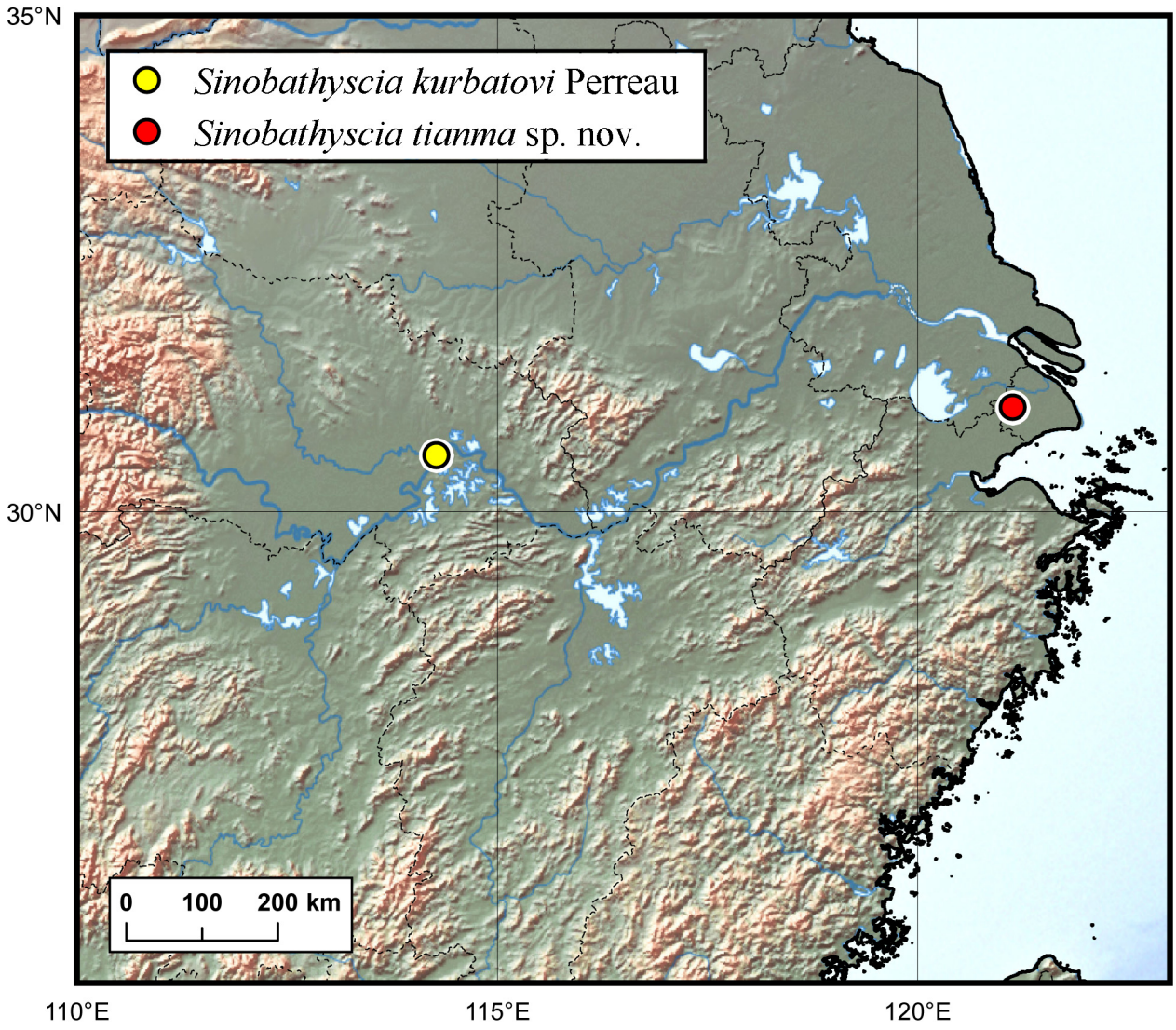

FIGURE 8. Distribution of *Sinobathyscia*.

At present, the other genera of Pholeuina (also of all Leptodirini) with the most easterly distributions: *Capraiola* Zoia & Rampini, 1994, *Iranobathyscia* Zoia & Rampini, 1994, *Sbordoniola* Zoia & Rampini, 1994, *Sengletiola* Zoia & Rampini, 1994 do not extend east of Iran (Zoia & Rampini 1994; Perreau *et al.* 2017). A wide gap in the distribution of Leptodirini occurs in Asia, and this has been used as an argument to question the placement of *Coreobathyscia*, *Proleptodirina* and *Sinobathyscia* in Leptodirini (Fresneda *et al.* 2011). There is no reliable phylogenetic organisation of global Leptodirini, and the monophyly of the major subtribes, including Pholeuina, is doubtful.

We provide here an identification key to these three most easterly Palaearctic genera, pending further investigations of their phylogenetic relationships, especially molecular comparisons with Mediterranean and Balkan fauna of Leptodirini. Except for *Sinobathyscia*, this identification table is based on original descriptions:

1. Eyes present and pigmented . . . . . *Proleptodirina* Perkovsky
- Anophthalmous 2
2. Antennae slender: antennomeres I and II as wide as the III, IV, V, antennomeres IX and X less than 1.2 times as wide as long. Male protarsi moderately expanded, significantly narrower than the apex of protibiae. Parameres much longer than the median lobe and with five apical or subapical setae . . . . . *Coreobathyscia* Szymczakowski
- Antennae more compact: antennomeres I and II much wider than the III, IV, V, antennomeres IX and X more than 1.5 times as wide as long. Male protarsi widely expanded, approximately as wide as the apex of protibiae. Parameres with two apical setae, and of the same length as the median lobe . . . . . *Sinobathyscia* Perreau

Acknowledgements

We would like to express our sincere thanks to Maxwell V. L. Barclay (BMNH, London, United Kingdom), Yasuhiko Hayashi (Kawanishi, Japan), Hideto Hoshina (Fukui University, Fukui, Japan), Alfred F. Newton (Field Museum of Natural History, Chicago, USA), Stewart B. Peck (Carleton University, Ottawa, Canada), Vadim Zinchenko (Russian Academy of Sciences, Siberian Branch, Novosibirsk, Russia) and Hong-Zhang Zhou (Institute of Zoology, Chinese Academy of Sciences, Beijing, China) for their considerable help in our study. We are obliged to Pavel Jakubec (Czech University of Life Sciences, Prague, Czech Republic) for helping with habitus photographs and with the camera system. We thank Maxwell V. L. Barclay for linguistic revision of the text. We are grateful to an anonymous reviewer who provided constructive comments on previous version of the manuscript.

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