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Inventory of the Carabid Beetle Fauna of the Gaoligong Mountains, Western Yunnan Province, China: Species of the Tribe Broscini (Coleoptera: Carabidae).

David H. Kavanaugh[1] and Hongbin Liang[2]

[1] *Department of Entomology, California Academy of Sciences, 55 Music Concourse Drive, Golden Gate Park, San Francisco, CA 94118, U.S.A.* [2] *Key Laboratory of Zoological Systematics, Institute of Zoology, Chinese Academy of Sciences, Beijing 100101, China*

Corresponding author: *David H. Kavanaugh* (dkavanaugh@calacademy.org)

Our study of 1,338 specimens of broscine carabid beetles collected during a ten-year biodiversity inventory project in the Gaoligong Shan region of western Yunnan Province, China, recognized fifteen different species representing four different genera. Eleven of the fifteen species are described as new: *Broscodera chukuai* sp. nov. (type locality: China, Yunnan, Gongshan County, Bingzhongluo Township, SW slope of Kawakarpu Shan, Chukuai Lake area); *B. gaoligongensis* sp. nov. (type locality: China, Yunnan, Lushui, Luzhang Township, Yaojiaping, 2500 m); *Broscosoma bicoloratum* sp. nov. (type locality: China, Yunnan, Gongshan County, Dulongjiang Township, NW slope of Heipu Yakou, 3350 m); *B. danzhuense* sp. nov. (type locality: China, Yunnan, Gongshan County, Cikai Township, Danzhu He drainage, 2720-2840 m); *B. furvum* sp. nov. (type locality: China, Yunnan, Fugong County, Lumadeng Township, second cirque S of Shibali Yakou at border post "31", 3710 m); *B. gongshanense* sp. nov. (type locality: China, Yunnan, Gongshan County, Cikai Township, Heipu Yakou area); *B. holomarginatum* sp. nov. (type locality: China, Yunnan, Gongshan County, Dulongjiang Township, Kongdang); *B. parvum* sp. nov. (type locality: China, Yunnan, Fugong County, Lumadeng Township, 8.5 km W of Shibali on Shibali road, North Fork of Yamu He, 3100 m); *B. purpureum* sp. nov. (type locality: China, Yunnan, Gongshan County, Dulongjiang Township, Kongdang area, 1500 m); *B. resbecqi* sp. nov. (type locality: China, Yunnan, Gongshan County, Dulongjiang Township, Siran Wang, 0.2. km above confluence with Dulong Jiang, 1720 m); and *B. viridicollare* sp. nov. (type locality: China, Yunnan, Fugong County, Lishadi Township, 9.5-10.0 km W of Shibali on Shibali Road, 3195-3200 m). New evidence suggests that *Broscosoma ribbei rougeriei* Deuve should be considered as a synonym of *B. ribbei* Putzeys. We present a key for identification of adults of all species in the study area as well as nomenclatural data, diagnoses, illustrations of dorsal habitus, male genitalia and other diagnostic features. We also provide information about geographical, altitudinal, and habitat distributions within the study area and overall geographical distribution for each species. Geographical and altitudinal distributions of the species within the study area are compared and broader geographical range patterns are characterized.

KEYWORDS: *Broscosoma*, *Broscodera*, *Broscus*, *Eobroscus*, China, Yunnan, Gaoligong Shan, new species, distribution, biodiversity hotspot

The Gaoligong Shan (Gaoligong Mountains) of extreme western Yunnan Province, China (Fig. 1) represents the southeasternmost extension of the Transhimalaya (Akciz et al. 2008). The range extends for more than 600 km north to south and, in the central part of the range, its crest forms the border between China and Myanmar. It also separates and forms parts of the watersheds of two of Southeast Asia's major rivers, the Irrawaddy and the Salween (known in China as the Nujiang). Elevations within the region range from a low of about 650 m in the south to more than 5000 m in the north. Chaplin (2006) reviewed the physical geography of the region. Because of its geographic isolation and rugged topography, much of this area has remained less disturbed than most other parts of China. Previous biological exploration of the area over the past 150 years has revealed exceptionally high species richness, based mainly on records for vertebrates (e.g., Stattersfield et al. 1998) and vascular plants (Li et al. 2000). Because of these traits, two large nature reserves have been established in the area, and the region has been included in the Three Parallel Rivers of Yunnan World Heritage Site (UNESCO 2003).

In late 1997, the California Academy of Sciences was invited to participate in a joint project with the Kunming Institutes of Botany and Zoology of the Chinese Academy of Sciences to conduct a biodiversity inventory of the Gaoligong Mountains. Scientists from several additional institutions, including the Institute of Zoology, Beijing, and Royal Botanical Garden (Edinburgh) joined in the collaboration. Principal target groups for the inventory included bryophytes and vascular plants, all vertebrate groups, arachnids, myriapods and insects, especially the Neuropteroidea, Mecoptera, and Coleoptera (the Carabidae in particular). Multidisciplinary and multi-institutional teams carried out biotic sampling through more than 25 separate expeditions during the period 1998 to 2007. Numerous reports on the project have been published to date, including partial results for bryophytes, higher plants, birds, amphibians, fishes, spiders, and carabid beetles (see Deuve et al. 2016 for pertinent references).

This report, on the tribe Broscini, represents the fourth of an intended series of treatments on the carabid beetle fauna of the Gaoligong Shan region, each dealing with one or more tribes or genera represented in the fauna. The first three reports have dealt with the Zabini (Kavanaugh et al. 2014), Trechini (Deuve et al. 2016), and Omophronini (Kavanaugh et al. 2021) of the region. Subsequent reports will appear as taxonomic work on each group can be completed and not in any particular taxonomic or phylogenetic order.

The tribe Broscini Hope, 1838 is a modestly diverse taxon (Häckel et al. 2010), currently including about 340 described species arrayed in five subtribes (Roig-Juñent, 2000) and 33 genera. Three of the subtribes (Barypina Jeannel, 1941, Creobiina Jeannel, 1941, and Nothobroscina Roig-Juñent, 2000), include 248 (73% of the) species and 22 (67% of the) genera and are restricted to the Southern Hemisphere. Subtribe Axonyina Roig-Juñent, 2000 currently includes only four species arrayed two genera. *Broscodes* Bolivar y Pieltain, 1914 includes three species (Wrase and Schmidt, 2017) and is distributed disjunctly along the southern edge of the Holarctic Region from eastern Turkey and Iran to Bhutan and Myanmar; and the monobasic genus, *Rawlinsius* Davidson and Ball (1998), is known only from the state of Guerrero in Mexico. Subtribe Broscina Hope is Holarctic in distribution, with one genus, *Zacotus* LeConte, 1869 restricted to western North America, six genera (*Broscosoma* Rosenhauer, 1846, *Broscus* Panzer, 1813, *Chaetobroscus* Semenov, 1900, *Craspedonotus* Schaum, 1863, *Eobroscus* Kryzhanovskij, 1951, and *Kashmirobroscus* Schmidt et al., 2013), restricted to Eurasia, and two genera (*Miscodera* Eschscholtz, 1830 and *Broscodera* Lindroth, 1961) with Holarctic distributions. *Miscodera* is represented by a single species with a subarctic circumpolar distribution. *Broscodera* currently includes four species arrayed in two subgenera: the nominate subgenus, represented by *B. insignis* (Mannerheim), 1852, endemic to northern North America, and subgenus *Sinobrosculus* Deuve, 1990, currently repre-

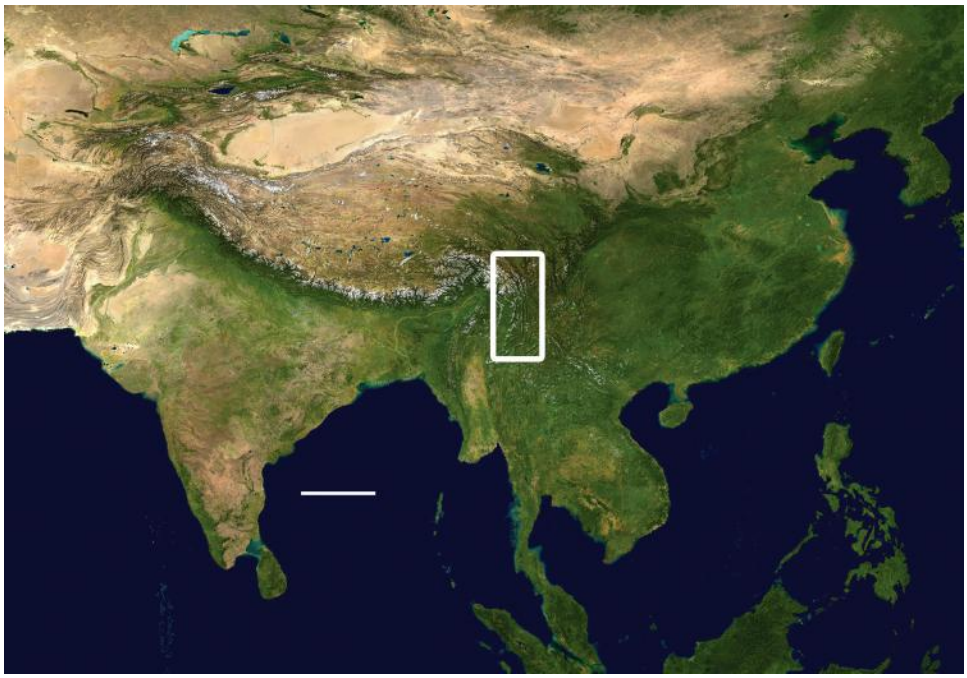


FIGURE 1. Map of Asia with study region outlined. Modified from Wikimedia Commons, World Atlas of the World, at URL: <*http://upload.wikimedia.org/wikipedia/commons/8/8f/Whole_world_-_land_and_oceans_12000.jpg*>. Scale line = 500 km.

sented by three species and two additional subspecies, each endemic to certain mountain ranges on the eastern margin of the Tibetan Plateau and the Greater Himalaya.

In the Palearctic Region, broscine taxa occupy a very broad range of habitats, including deserts, grasslands, coniferous forests, broadleaf evergreen and deciduous forests, montane riparian habitats, subalpine thickets, and subarctic steppe and treeline habitats (Häckel et al. 2010; Holdhaus 1954; Lindroth 1945; Schmidt and Arndt 2000). In the daytime, these beetles hide under stones, leaf litter or other debris on the soil surface or in mosses or in the soil itself. At night, they are active on the surface in wet, damp, or even dry areas, where they hunt for their small invertebrate prey.

As is the case with most other terrestrial arthropod groups, the broscine fauna of the study area has not been well documented previously. Only two species, *Broscosoma ribbei* Putzeys, 1877 (as subspecies *B. r. rougeriei* Deuve and Tian, 2002) (see also Jiang et al. 2021) and *Broscosoma gaoligongensis* Deuve and Wrase, 2015, have been recorded from the region. Based on our study of the material collected for the project and additional specimens from the region housed in other collections, we recognize a total of 15 broscine species, representing four genera, as occuring in the study area. We present here a key for identification of adults of these species, as well as nomenclatural data, diagnoses, illustrations of dorsal habitus, male genitalia, and other features, and information about geographical and habitat distributions within the study area and overall geographical distribution for each species. We also discuss geographical distributions of the species with respect to different parts of the study area (see below about "core areas") and to each other, as well as the broader geographical range patterns and the altitudinal ranges of the species. In order to reach our taxonomic conclusions about the identities of the Gaoligong Shan species, we reviewed material representing the known Eurasian genera and most of the species, including type material wherev-

er possible. Among the 15 species represented in the fauna, we recognize 11 of them as new to science, including two new species of *Broscodera*, subgenus *Sinobrosculus*, and nine new species of *Broscosoma*.

Materials and Methods

The natural physiographic limits of the study area for the project are as shown in Fig. 2 and include areas in eastern Myanmar and southern Xizang (Tibet); but we had permission to survey only those parts in Yunnan Province. Specialists for all taxonomic groups concentrated their efforts on seven core areas within the project region (Fig. 3), selected to facilitate comparisons of possible north to south and east to west spatial differences within the regional biota, as well as recognition of areas of local endemism. Other areas were sampled as time and opportunity permitted. The entomological team made a total of 13 expeditions to the Gaoligong region. Our sampling sites within the region are shown in Fig. 4. Habitats included in the study area range from subtropical lowland rainforest to the margin of glaciers and snowfields. In all, more than 35,000 carabid specimens were collected during the project by using a variety of collecting methods, including hand collecting both day and night, beating vegetation, sifting litter with subsequent extraction by hand or by mini-Winkler units, and Malaise flight traps and pitfall traps. All specimens were sorted to morphospecies (i.e., presumptive species units based on features of external structure and male and female genitalic traits) and detailed systematic studies of taxonomic groups are ongoing.

This study is based on the examination of 1,338 specimens of *broscine* species from the Gaoligong Shan region and hundreds of additional specimens from other regions, representing other broscine genera and species known to occur in Asia. Specimens acquired during our fieldwork have been divided among and are deposited in collections of our home institutions. Codens used throughout this report for collections in which specimens, including primary types, are deposited are as follows:

CAS California Academy of Sciences, San Francisco, U.S.A.
DWW David W. Wrase, Gusow-Platkow, Germany (working collection, part of Zoologische Staatssammlung München)
IOZ National Zoological Museum of China, Institute of Zoology, Beijing, China
MNHN Muséum National d'Histoire Naturelle, Paris, France
NHMB Naturhistorisches Museum, Basel, Switzerland
NSMT National Science Museum, Tokyo, Japan
OUMNH Oxford University Museum of Natural History, Oxford, United Kingdom
RBINS Royal Belgian Instutute of Natural Sciences, Brussels, Belgium
SCAU South China Agricultural University, Guangzhou, China

Measurements. The following measurements were recorded: body length (BL), measured longitudinally from the apex of the longer mandible to the apex of the longer elytron; pronotal length (PL), measured from anterior to posterior margin along midline; pronotal width (PW), measured transversely across the greatest pronotal width; elytral length (EL), measured along midline from the basal declivity to the apex of the longer elytron; elytral width (EW), measured transversely across the widest point of both elytra together; antennomere 3 length (A3); antennomere 5 length (A5); metepisternum length (ML), measured longitudinally along lateral margin; metepisternum width (MW), measured along the diagonal anterior margin. The following ratios were calculated using these measurements: A3/A5 (antennomere 3/ antennomere 5); EL/EW (elytral length/ elytral width); EL/PL (elytral length/ pronotal length); EW/PW (elytral width/ pronotal width); ML/MW (metasternum length/ metasternum width); and PL/PW (pronotal length/pronotal width). All measurements were taken with the aid of a calibrated ocular micrometer scale on a Wild M5 stereoscopic dissecting microscope.

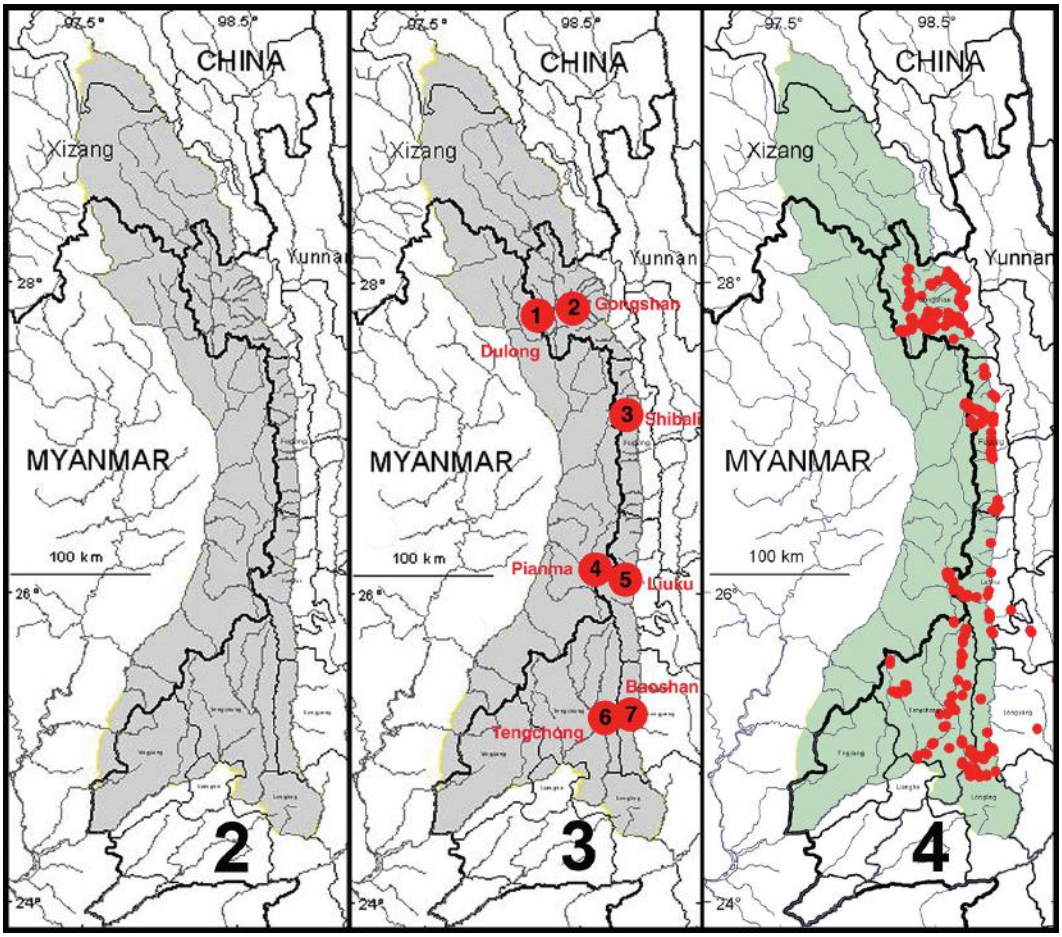


FIGURE 2–4. Fig. 2. Map showing natural extent of study area, colored in green (however, sampling was permitted only in those portions in Yunnan Province. Fig. 3. Map showing location of core sampling areas. Fig. 4. Map showing locations of all entomological sampling sites. Scale lines = 100 km.

Dissections of male genitalia were prepared from specimens relaxed in hot (near boiling) soapy water by severing the membranes between the genital capsule and tergite VII and sternite VII and extracting the capsule intact. The dissections were then cleared in warm 10% KOH and further dissected to separate the sclerotized parts enough to visualize structures to be compared. Following dissection, preparation and study, genitalia were placed in glycerine in microvials and pinned beneath the specimens from which they were extracted.

Illustrations. Digital images of whole specimens and particular structures were taken using a Leica imaging system including an M165C dissecting microscope, DFC550 video camera, and two KL1500 LCD light sources. Stacked images were captured and combined into single montage images using the Leica Application Suite V4.2.0. Plates of images were created using Adobe Photoshop CS5. Distribution maps for each species were generated from geographical coordinate data maintained in a Biota Version 3.0 database (Colwell 2012) using the ArcMap program in ArcGIS for Desktop Version 10.2 software from Esri.

Geographical Coordinate Data. All geographical coordinate data are presented in decimal degree format, with the first entry degrees North and the second degrees East, separated by "/". Exceptions to this format include verbatim label data only.

Treatments for new species. For all new species, label data for all specimens of the type series are quoted verbatim (between quotation marks), with data for multiple labels separated by "/" and any editorial additions included between brackets ("[-]").

Taxonomy

Adult specimens of broscine species represented in the Gaoligong Shan region can be distinguished using the following key. It is provided only for distinguishing members of taxa (different genera or species) represented in this region and may not be appropriate for more general use. In each couplet, features that are most diagnostic for identification are listed first, followed by supporting supplementary features that can help to confirm identifications.

Key for identification of adults of broscine species of the Gaoligong Shan Region

1 Size large, BL of male or female greater than 15.0 mm 2
1' Size moderate, BL of male or female less than 13.0 mm 3

2(1) Head (Fig. 5a) with very deep, sharply defined and impunctate cleft on vertex between tempora; male with protarsomeres 1 and 2 and mesotarsomeres 1 and 2 with ventral pads of adhesive setae … Genus *Eobroscus* Kryzhanovskij . . . . *Eobroscus bhutanensis* Morvan
2' Head (Fig. 5b) with shallower, broader, and distinctly punctate transverse sulcus between tempora; male protarsomeres 1 to 3 with ventral pads of adhesive setae, all male mesotarsomeres lacking ventral pads of adhesive setae … Genus *Broscus* Panzer . *Broscus punctatus* (Dejean)

3(1') Pronotum (Figs. 5c-d) with basolateral setae present; antennomere 3 with sparse pubescence in apical one-third to one half, antennomere 4 pubescent; male protarsomeres and mesotarsomeres 1 and 2 with small ventral pads of adhesive setae … Genus *Broscodera* Lindroth subgenus *Sinobrosculus* Deuve 4
3' Pronotum (Figs. 6, 7) with basolateral setae absent; antennomeres 3 and 4 glabrous except for apical whorl of setae; male protarsomeres 1 to 3 with larger ventral pads of adhesive setae, mesotarsomeres 1 and 2 with larger ventral pads … Genus *Broscosoma* Rosenhauer 5

4 (3) Size larger, BL = 10.0 mm or more; body color piceous or dark brown; head (Fig. 5d) with eyes more convex and slightly larger, their diameter equal to length of tempora, vertex with post-temporal transverse sulcus densely, coarsely and, more widely punctate; hindwings full-sized, functional for flight; hind trochanter asetose (Fig. 8a); male genitalia as in Fig. 14 . . . . ***Broscodera gaoligongensis* sp. nov.**
4' Size smaller, BL = 9.5 mm or less; body color reddish brown; head (Fig. 5c) with eyes flatter and smaller, their diameter less than length of tempora, vertex with post-temporal transverse sulcus narrowly punctate only along bottom of sulcus; hindwings slightly reduced, non-functional for flight; hind trochanter unisetose (Fig. 8b); male genitalia as in Fig. 12 . . . . ***Broscodera chukuai* sp. nov.**

5 Elytral silhouette subparallel to subovoid, with humeri (shoulders) more (Figs. 24a, 28a, 32a) or less (Figs. 17a, 26a, 30a) distinct 6
5' Elytral silhouette ovoid, with humeri indistinct (Figs. 15a, 18a, 20a, 22a, 34a) 11

6 (5') Pronotum with lateral margination (lateral bead) complete (Fig. 9a) between apical and basal margins; dorsal surface with distinct blue or blue-green luster, legs pale rufous; elytral microsculpture distinct, comprised of isodiametric to slightly longitudinally stretched sculpti-

cells, elytral striae distinctly punctate; male genitalia as in Fig. 25 . . . . . ***Broscosoma holomarginatum* sp. nov.**

6' Pronotum with lateral margination absent or incomplete (Figs. 9b-d) 7

7 (6') Pronotum with lateral margination complete anterior to midlateral seta, interrupted briefly in basal half (Fig. 9b); elytral humeri as in Fig. 30; dorsal surface of head and pronotum vivid metallic green, elytra darker blue-green, legs pale rufous; vertex with post-temporal transverse sulcus relatively shallow and broadly and densely punctate (Fig. 6d); elytral microsculpture effaced; metatrochanter asetose (Fig. 8c); male genitalia as in Fig. 29 . . . . . ***Broscosoma resbecqi* sp. nov.**

7' Pronotum with lateral margination absent, present only posterior to sub-basal constriction, or also present in area of midlateral seta (in a few specimens of *B. ribbei* extended almost to anterior margin (Fig. 9c), but these specimens have the metatrochanter unisetose) 8

8(7') Elytral microsculpture distinct, comprised of moderately impressed isodiametric sculpticells; metatrochanters unisetose (Fig. 9d) (except asetose unilaterally in some specimens); elytral silhouette as in Fig. 32a; size larger, BL = 8.9 mm or more; pronotum globose anterior to sub-basal constriction as in Fig. 6b, in most specimens with lateral margination present in region of midlateral seta (Fig. 9c) and also basal to sub-basal constriction and/or extended further anterior to midlateral seta in some specimens (absent entirely from a few specimens); vertex with post-temporal transverse sulcus relatively shallow and narrowly and sparsely punctate (Fig. 6b); entire dorsum of body bright metallic golden-green, green (Fig. 32a), or blue-green; male genitalia as in Fig. 33 . . . . . *Broscosoma ribbei* Putzeys

8' Elytral microsculpture faintly impressed or effaced; metatrochanters asetose (Fig. 8c) (although a few specimens of *B. purpureum* have one or both metatrochanters unisetose); size generally smaller, BL = 8.5 mm or less (except BL of *B. danzhuense* holotype = 9.3 mm); pronotum of different shape (Figs. 6c,e,f), with lateral margination absent or present only at or posterior to sub-basal constriction (Fig. 9d); dorsum of body bright metallic blue, blue-green, or darker and duller green 9

9 (8') Dorsum of body bright metallic blue or bluish-purple, head with greenish hue in some specimens, legs (including femora) pale rufous; elytral humeri distinct (Fig. 28a), angulate, elytral striae coarsely punctate, elytral microsculpture effaced; shape of pronotum as in Fig. 6c; male genitalia as in Fig. 29 . . . . . ***Broscosoma purpureum* sp. nov.**

9' Dorsum of body green or blue-green, legs with femora darker, reddish-brown to piceus; elytral humeri (Figs. 17a, 26a) less distinct, more rounded, elytral striae more finely punctate, elytral microsculpture faint but evident; shape of pronotum as in Figs. 6e,f 10

10 (9') Body larger, BL = 9.3 mm; elytral silhouette (Fig. 17a) with greatest width distinctly posterior to midlength; eyes (Fig. 6e) moderately convex; elytra with only stria 1 impressed, all other striae represented only be punctures diminishing in size and depth laterally and posteriorly, elytral intervals flat; entire dorsum of body dark green; male unknown . . . . . ***Broscosoma danzhuense* sp. nov.**

10' Body smaller, BL 8.5 mm or less; elytral silhouette (Fig. 26a) with greatest width at or near midlength; eyes (Fig. 6f) less convex, slightly flattened in some specimens; elytra with two or more striae impressed, all striae punctate with punctures diminishing in size and depth laterally and posteriorly, at least medial two or more elytral intervals very slightly to moderately convex; dorsum with head green, elytra blue-green and pronotum either green or blue-green; male genitalia as in Fig. 27 . . . . . ***Broscosoma parvum* sp. nov.**

11 (5') Metatrochanter unisetose (Fig. 8d) 12
11' Metatrochanter asetose (Fig. 8c) (except unilaterally unisetose in very few specimens of *B. bicoloratum*) 13

12 (11') Dorsum of body piceous, without any trace of metallic reflection (Fig. 18a); antennomeres 3 and 4 distinctly darker than antennomeres 1 and 2; pronotum anterior to sub-basal constriction (Fig. 7a) longitudinally slightly ovoid in dorsal view; genal ridge evident, extended from base of head to ventral margin of eye (Fig. 10a); male genitalia as in Fig. 19, with median lobe longer and more slender and with apical lamella distinctly expanded ventrally in lateral view . . . . ***Broscosoma furvum*** **sp. nov.**
12' Dorsum of head and pronotum black or dark piceous, elytra with bright metallic green or blue-green reflection (Fig. 20a); antennomeres 1 through 4 concolorous, pale rufous; pronotum anterior to sub-basal constriction (Fig. 7d) globose in dorsal view; genal ridge evident basal to post-temporal constriction but extended only to or slightly anterior to the constriction (Fig. 10b); male genitalia as in Fig. 21, with median lobe slightly shorter and thicker and apical lamella more symmetrically rounded in lateral view . . . *Broscosoma gaoligongense* Deuve and Wrase

13 (11') Head and pronotum black to piceous but with distinct metallic green band across anterior part of pronotum (Fig. 7b) anterior to anterior transverse impression; head with tempora slightly inflated, sharply convex or vaguely angulate; pronotum anterior to sub-basal constriction slightly to moderately longitudinally ovoid in dorsal view; elytral microsculpture distinct, comprised of moderately impressed isodiametric sculpticells; male genitalia as in Fig. 35, with median lobe slightly longer and apical lamella broader in lateral view . . . . ***Broscosoma viridicollare*** **sp. nov.**
13' Head and pronotum black to piceous, without metallic reflection (except a few specimens of *B. bicoloratum* have faint a metallic green band across anterior part of pronotum); head with tempora only slightly (Fig. 7e) or distinctly (Fig. 7c) convex; pronotum either globose or slightly longitudinally ovoid in dorsal view; elytral microsculpture indistinct, effaced or only extremely faintly evident in some areas 14

14 (13') Pronotum globose anterior to sub-basal constriction as in Fig. 7c; head with tempora distinctly convex behind eyes; male genitalia as in Fig. 16 . . . ***Broscosoma bicoloratum*** **sp. nov.**
14' Pronotum anterior to sub-basal constriction slightly longitudinally ovoid in dorsal view (Fig. 7e); head with tempora straight or only slightly convex behind eyes; male genitalia as in Fig. 23 . . . . ***Broscosoma gongshanense*** **sp. nov.**

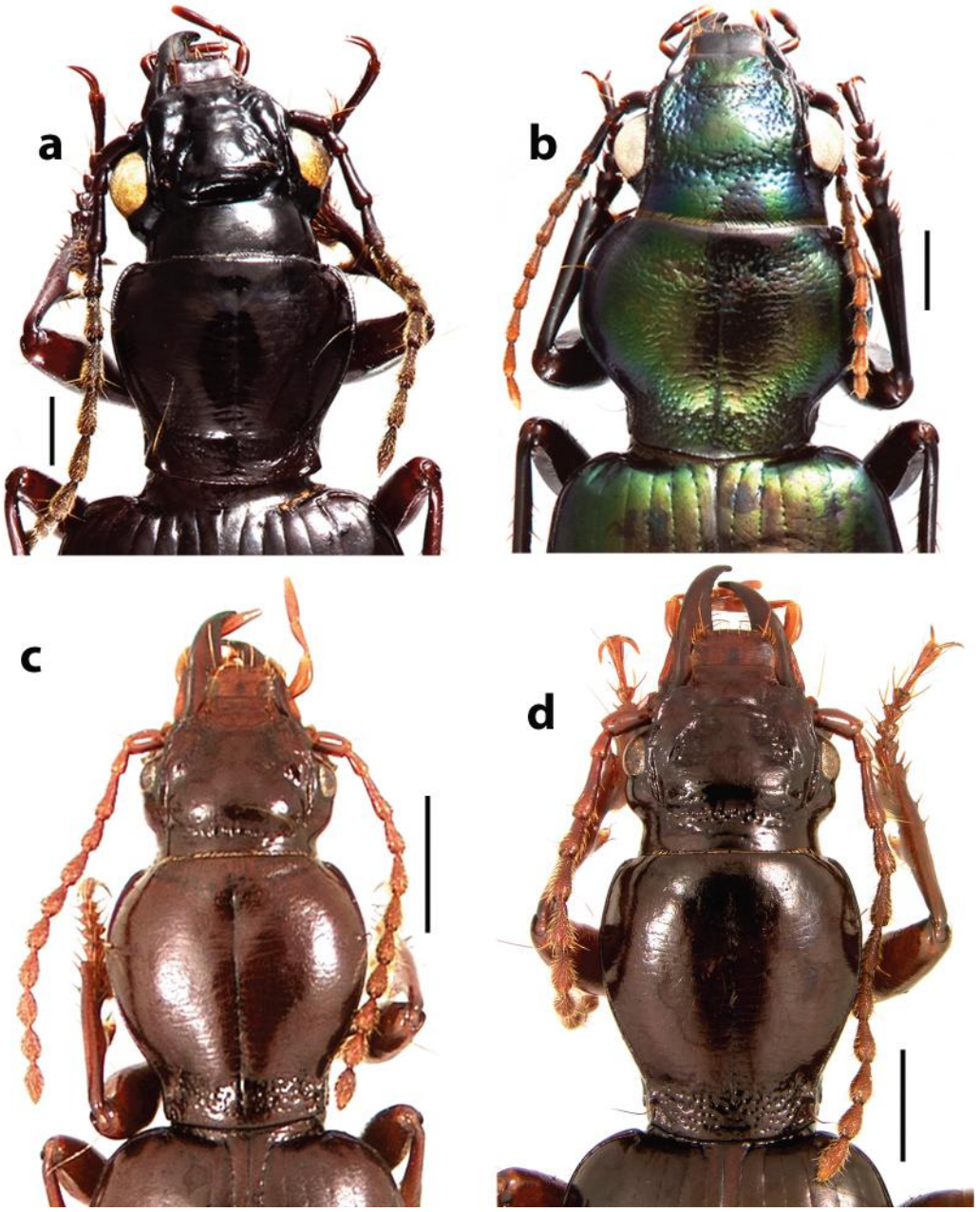


FIGURE 5. Forebody of broscine carabids, dorsal aspect. a. *Eoboscus bhutanensis* Morvan (CASENT1019340; Lishadi Township, Fugong County, Yunnan, China); b. *Broscus punctatus* (Dejean) (CASENT1011066; Heiwadi, Cikai Township, Gongshan County, Yunnan, China); c. *Broscodera chukuai* sp. nov. (CASENT1026168; NNE of Chukuai Lake, Bingzhongluo Township, Gongshan County, Yunnan, China); d. *Broscodera gaoligongensis* sp. nov. (CASENT1020104; South Fork of Yamu He, Lumadeng Township, Fugong County, Yunnan, China).

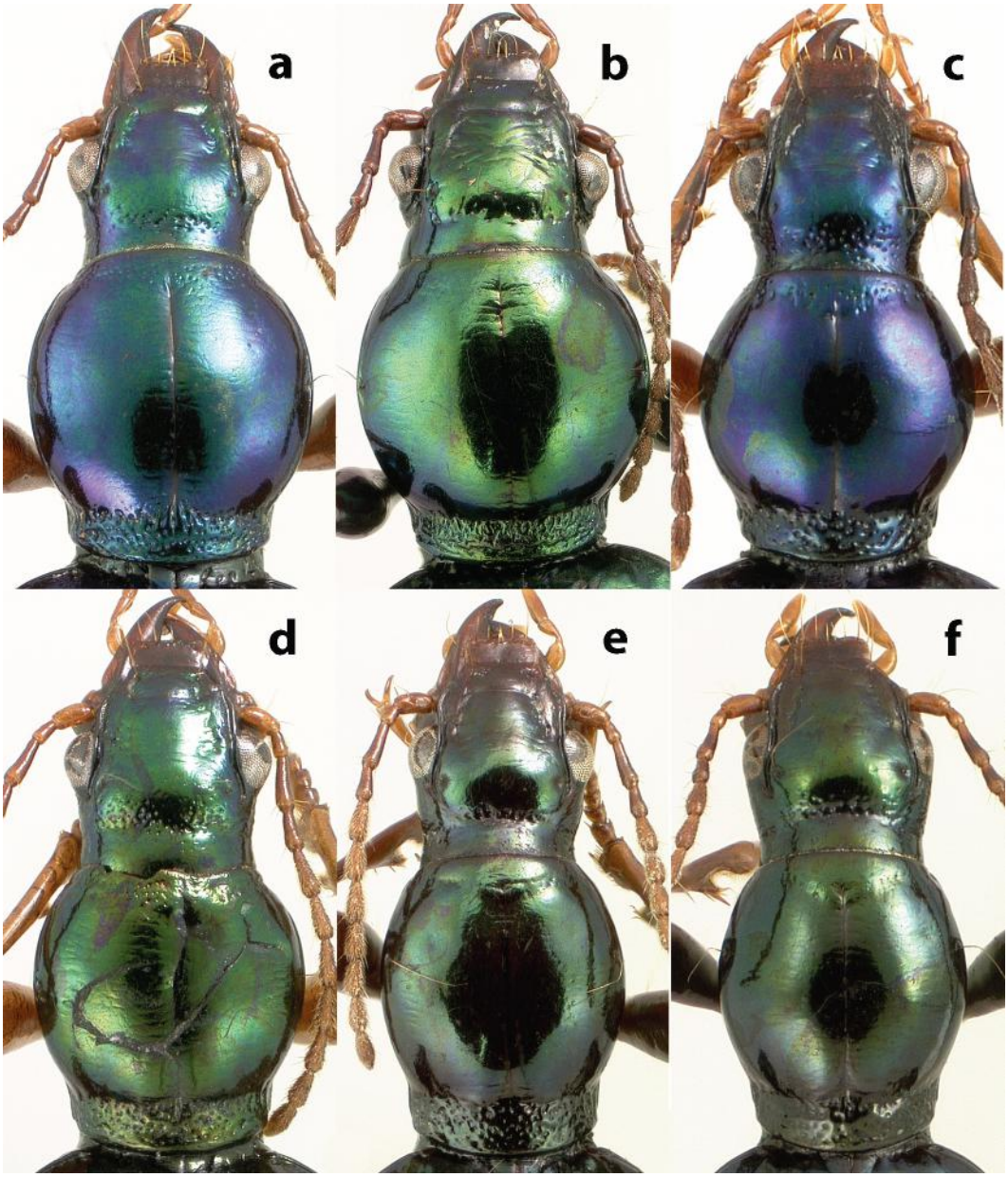


FIGURE 6. Forebody, *Broscosoma* species, dorsal aspect. a. *B. holomarginatum* sp. nov. (CASENT1015162; 0.5 km N of Kongdang, Dulongjiang Township, Gongshan County, Yunnan, China); b. *B. ribbei* Putzeys (CASENT1025337; 0.5 km WSW of Maku village, Dulongjiang Township, Gongshan County, Yunnan, China); c. *B. purpureum* sp. nov. (CASENT1015338; 0.5 km N of Kongdang, Dulongjiang Township, Gongshan County, Yunnan, China); d. *B. resbecqi* sp. nov. (Holotype; Siran Wang, Dulongjiang Township, Gongshan County, Yunnan, China); e. *B. danzhuense* sp. nov. (Holotype; Danzhum He drainage, Cikai Township, Gongshan County, Yunnan, China); f. *B. parvum* sp. nov. (CASENT1023565; 11.5 km above Shibali, Lishadi Township, Fugong County, Yunnan, China).

FIGURE 7. Forebody, *Broscosoma* species, dorsal aspect. a. *B. furvum* sp. nov. (CASENT1020001; first cirque S of Shibali Yakou, Fugong County, Yunnan, China); b. *B. viridicollare* sp. nov. (CASENT1022787; 8.5 km above Shibali, Lishadi Twonship, Fugong County, Yunnan, China); c. *B. bicoloratum* sp. nov. (CASENT1026704; slope NW of Heipu Yakou, Dulongjiang Townhip, Gongshan County, Yunnan, China); d. *B. gaoligongense* Deuve and Wrase (CASENT1027285; just W of Fenxue Yakou, Pianma Township, County, Yunnan, China); e. *B. gongshanense* sp. nov. (CASENT1008139; Dongshaofang area, Gongshan County, Yunnan, China).

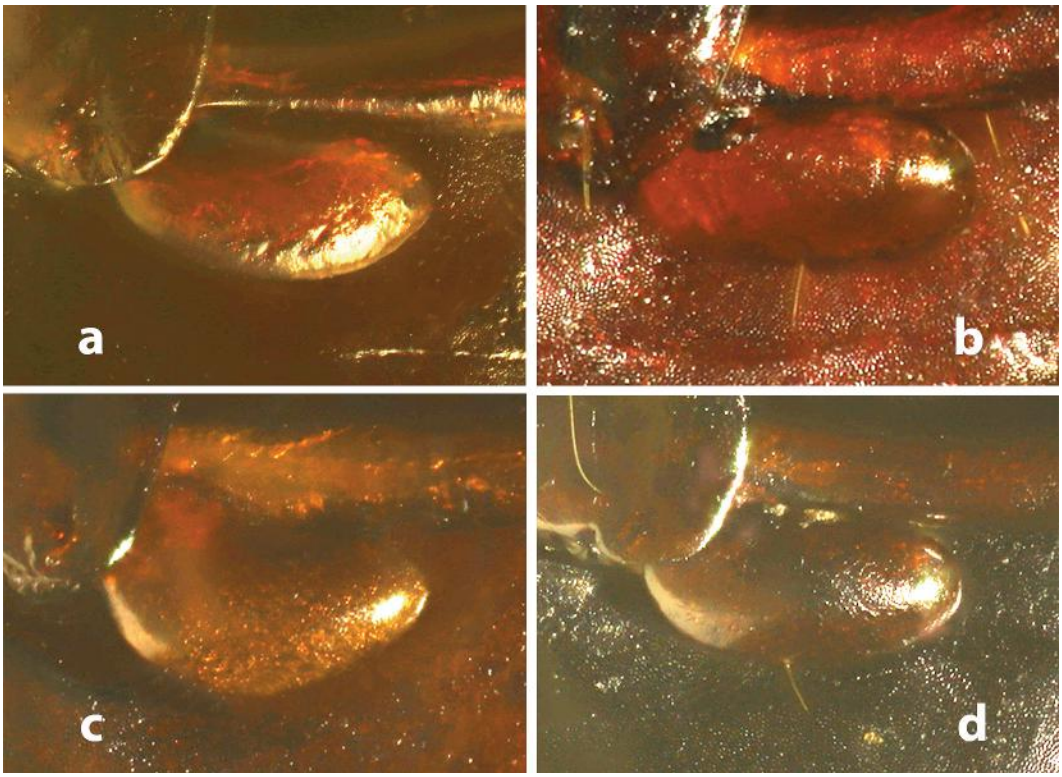


FIGURE 8. Left metatrochanter, broscine species, ventral aspect. a. *Broscodera gaoligongensis* sp. nov. (Yaojiaping, Lushui County, Yunnan, China); b. *Broscodera chukuai* sp. nov. (CASENT1026771; Chukuai Lake, Bingzhongluo, Gongshan County, Yunnan, China); c. *B. bicoloratum* sp. nov. (CASENT1034187; Qiqi-Dulong Yakou, Cikai Township, Gongshan County, Yunnan, China); d. *B. ribbei* Putzeys (CASENT1000578; Nankang Yakou, Longyang County, Yunnan, China).

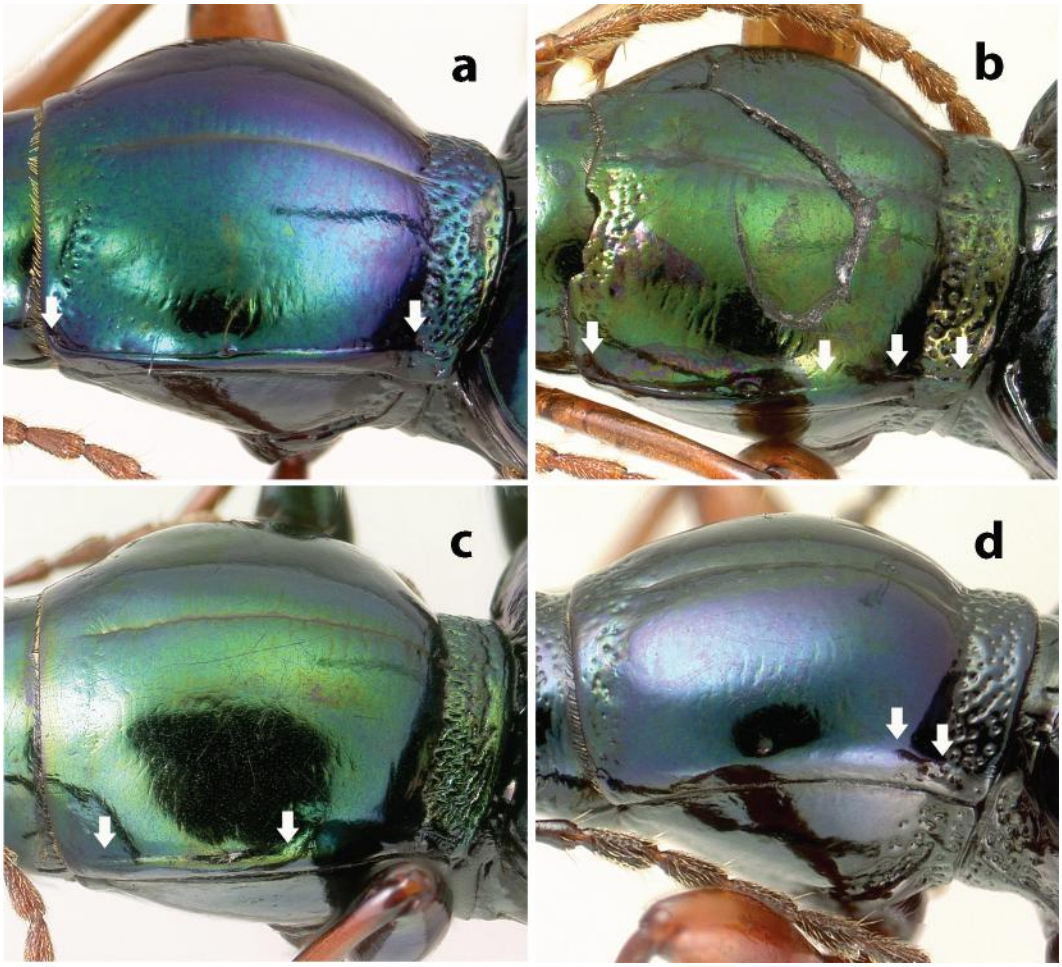


FIGURE 9. Prothorax, *Broscosoma* species, oblique left lateral aspect. a. a. *B. holomarginatum* sp. nov. (CASENT1016746; 0.5 km N of Kongdang, Dulongjiang Township, Gongshan County, Yunnan, China); b. *B. resbecqi* sp. nov. (Holotype; Siran Wang, Dulongjiang Township, Gongshan County, Yunnan, China); c. *B. ribbei* Putzeys (CASENT1025337; 0.5 km WSW of Maku village, Dulongjiang Township, Gongshan County, Yunnan, China); d. *B. purpureum* sp. nov. (CASENT1015871; Moqie Wang, Dulongjiang Township, Gongshan Yunnan, China). White arrows denote end points of lateral margination.

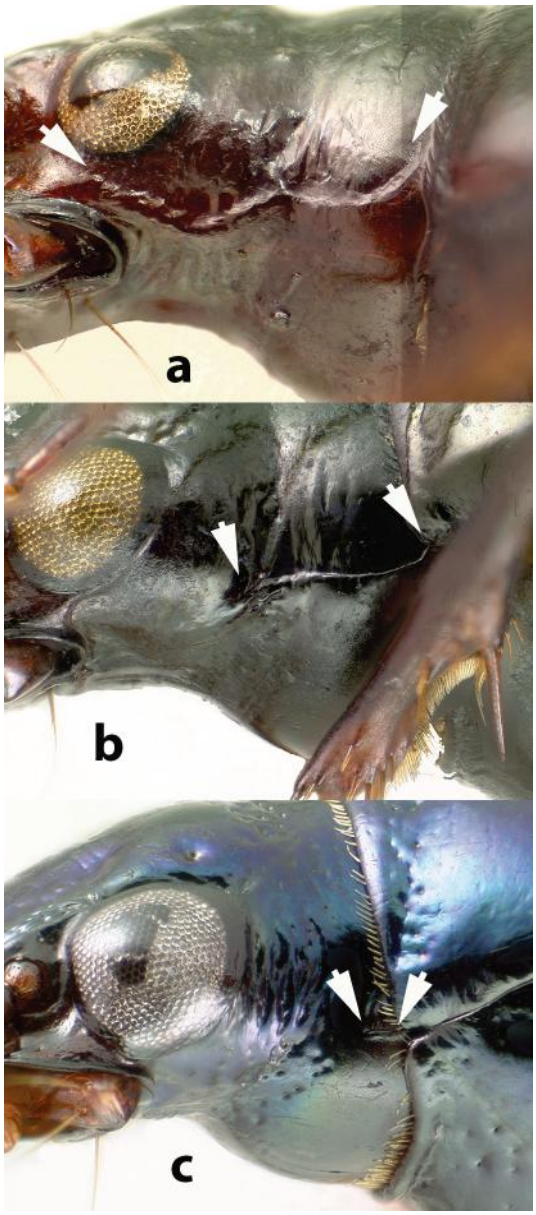


FIGURE 10. Head, *Broscosoma* species, lateral aspect. a. *B. furvum* sp. nov. (CASENT1020001; first cirque S of Shibali Yakou, Fugong County, Yunnan, China); b. *B. gaoligongense* Deuve and Wrase (CASENT1027285; just W of Fenxue Yakou, Pianma Township, County, Yunnan, China); c. *B. purpureum* sp. nov. (CASENT1015871; Moqie Wang, Dulongjiang Township, Gongshan Yunnan, China). White arrows denote endpoints of genal ridge.

Genus *Broscodera* Lindroth, 1961

Broscodera Lindroth, 1961:150. Type species: *Miscodera insignis* Mannerheim, 1852:296.
Sinobrosculus Deuve, 1990:186. Type species: *Sinobrosculus dreuxi* Deuve, 1990:187.

Diagnosis. Members of this genus can be distinguished from those of other broscine genera in the region by the following combination of character states: body small to moderate in size (BL<13.0 mm); body surface without metallic reflection; head with post-temporal transverse sulcus moderately deep and broadly or narrowly punctate; genal ridge present, extended from posterior region of head to ventral margin of eye; maxillae with three setae on eustipes, stipes with dorsobasal setae distinctly less than half as long as ventrobasal setae; mentum with one or two pairs of setae present, paramedial region deeply foveate; submentum with three or four pairs of setae; antennae with antennomere 3 with sparse pubescence in apical one-third to one half, antennomere 4 pubescent; pronotum with lateral margination (lateral bead) present and complete from apical margin to pronotal base, one pair of basolateral setae present; elytra with parascutellar seta absent, discal setae absent, umbilicate setal series comprised of one post-humeral and three preapical setae; male pro- and mesotarsi each with small pads of adhesive setae on tarsomeres 1 and 2 only.

Taxonomic notes. Members of the nominate subgenus (*Broscodera insignis*) have only one pair of setae on the mentum, those of subgenus *Sinobrosculus*, including those of both species described below, have two pairs of setae (Deuve 1990; Roig-Juñent 2000).

Diversity and geographical distribution. At present, this genus includes only four described species and two additional subspecies arrayed in two subgenera. *Broscodera* s. str. includes a single western North American species, and subgenus *Sinobrosculus* includes three described species and two additional subspecies. These previously described species of *Sinobrosculus* are recorded from Gansu and Sichuan Provinces, China and Nepal. The two new species described here represent the first species recorded from Yunnan Province.

1. *Broscodera* (*Sinobrosculus*) *chukuai* Kavanaugh and Liang, sp. nov.

Figures 5c, 8b, 11, 12, 40, 48-50

Type material. Holotype, a male, in IOZ, labeled: " CASENT 1026170"/ "CHINA, Yunnan, Gongshan County, Bingzhongluo Township, SW slope of Kawakarpu Shan, 0.3 km NNE of Chukuai Lake, N27.98393°/E098.47491°"/ "3745 m, 19 August 2006, Stop #DHK-2006-081 D.H. Kavanaugh, J.A. Miller & D.Z. Dong collectors"/ "HOLOTYPE *Broscodera* (*Sinobrosculus*) *chukuai* Kavanaugh & Liang sp. nov. designated 2021" [red label]. Paratypes (a total of 31): three males and ten females (CAS, IOZ) labeled: same as holotype except first label: "CASENT 1026167" to "CASENT 1026169" and "CASENT 1026171" to "CASENT 1026180", respectively; three males and four females (CAS, IOZ) labeled: "CASENT 1026771" to "CASENT 1026773" and "CASENT 1026774" to "CASENT 1026777", respectively/ "CHINA, Yunnan, Gongshan County, Bingzhongluo Township, SW slope of Kawakarpu Shan at Chukuai Lake, 3720 m,"/ " N27.98121°/E098.47580°, 18 August 2006, Stop #DHK-2006-079 D.H. Kavanaugh, J.A. Miller, D.Z. Dong & Y. Liu collectors"; two males (CAS, IOZ) labeled: "CASENT 1024860" and "CASENT 1024861", respectively/ "CHINA, Yunnan, Gongshan County, Bingzhongluo Township, SW slope of Kawakarpu Shan, on slope NE of Chukuai Lake, 3950 m,"/ " N27.98206°/E098.48027°, 20 August 2006, Stop #DHK-2006-086 Y. Liu, P. Hu, D.Z. Dong & J. Wang collectors"; one male and two females (CAS, IOZ) labeled: "CASENT 1024904" and "CASENT 1024905" to "CASENT 1024906", respectively/ "CHINA, Yunnan, Gongshan County, Bingzhongluo Township, SW slope of Kawakarpu Shan, 0.8 km N of Chukuai Lake, N27.98785°/E098.47322°"/ "3920 m, 20 August 2006, Stop #DHK-2006-088 D.H. Kavanaugh,

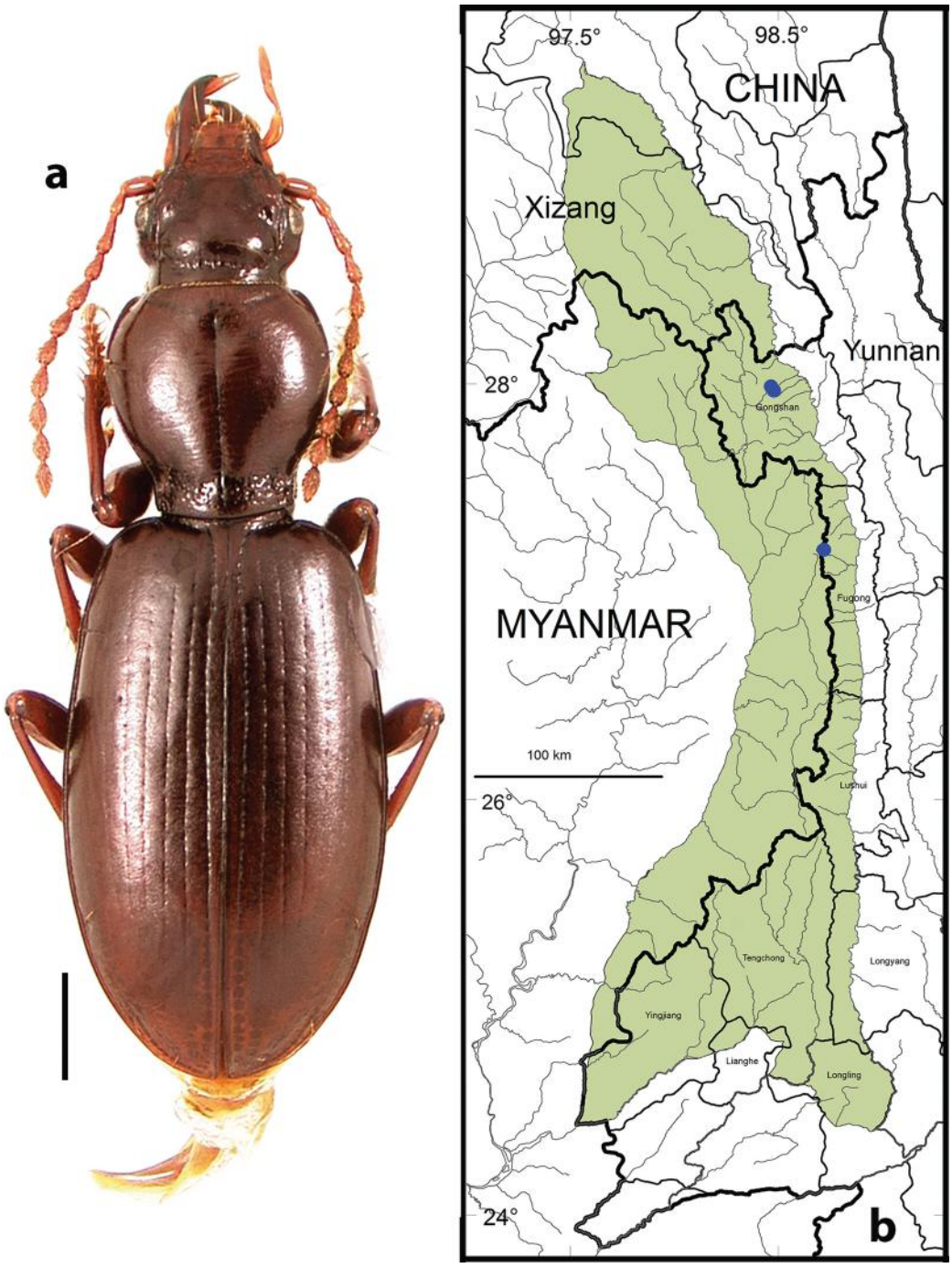


Figure 11. *Broscodera chukuai* sp. nov. a. Habitus (CASENT1026168; NNE of Chukuai Lake, Bingzhongluo, Gongshan County, Yunnan, China), dorsal aspect, scale line = 1.0 mm; b. Map showing locality records (blue circles) for this species in the Gaoligong Shan region, scale line = 100 km.

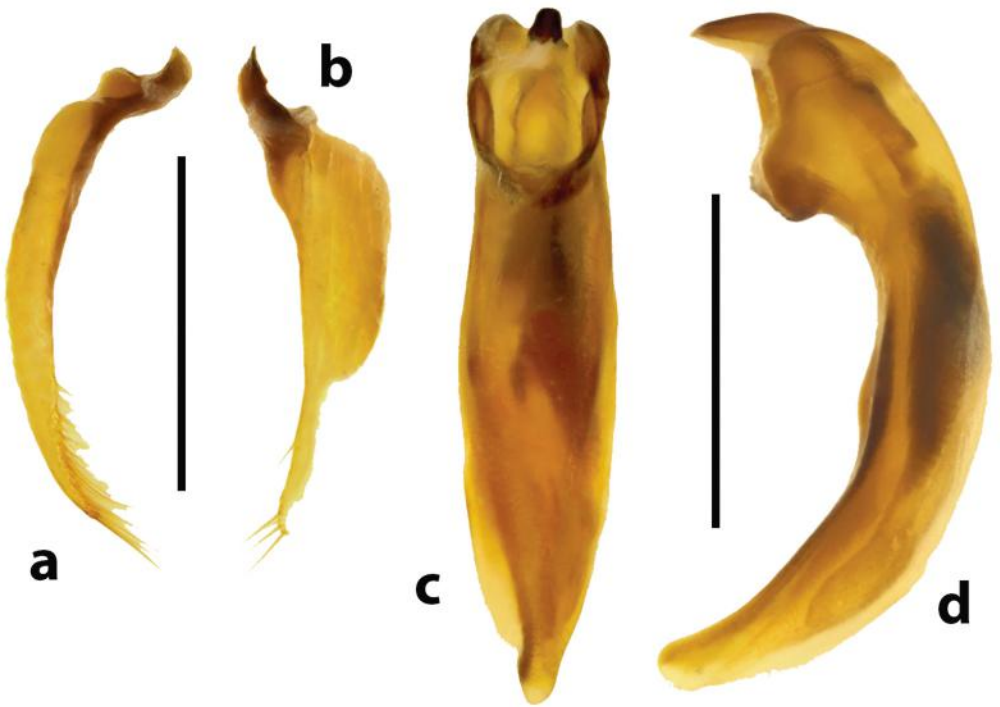


FIGURE 12. Male genitalia, *Broscodera chukuai* sp. nov. (CASENT1026169; NNE of Chukuai Lake, Bingzhongluo, Gongshan County, Yunnan, China). a. Right paramere, lateral aspect; b. Left paramere, lateral aspect; c. Median lobe, left lateral aspect; d. Median lobe, ventral aspect; scale line = 1.0 mm.

J.A. Miller, J. Xiong, &C.H. Li collectors"; one male (CAS) labeled: "CASENT 1025034"/ "CHINA, Yunnan, Gongshan County, Bingzhongluo Township, SW slope of Kawakarpu Shan, 0.9 km N of Chukuai Lake,"/ "27.99005°/E098.47518°,4035 m, 21 August 2006 Stop #DHK-2006-090 D.H. Kavanaugh collector"; one male and one female (CAS, IOZ) labeled: "CASENT 1025823" and "CASENT 1025824", respectively/ "CHINA, Yunnan, Gongshan County, Bingzhongluo Township, SW slope of Kawakarpu Shan, 0.3 km SW of Chukuai Lake at campsite, N27.97686°/E098.47799°"/ "3750 m, 19 August 2006, Stop #DHK-2006-082 Y. Liu collector; two females (CAS, IOZ) labeled: "CASENT 1017826" and "CASENT 1017827", respectively/ "CHINA, Yunnan, Fugong County, Lumadeng Township, second cirque S of Shibali Yakou at border post "31", N27.20333°/E098.69303°"/ "3710 m, 17 August 2005, Stop #DHK-2005-095, H.B. Liang, D.Z. Dong, & J.F.Zhang collectors"; one female (IOZ) labeled: "CASENT 1018367"/ "CHINA, Yunnan, Fugong County, Lishadi Township, headwaters of North Fork Yamu He just E of Shibali Yakou, 3450 m,"/ "N27.21034°/E098.70141°, 7 August 2005, Stop# LHB-05-52, H.B. Liang & J.F.Zhang collectors. All paratypes also bear the following label: "PARATYPE *Broscodera* (*Sinobrosculus*) *chukuai* Kavanaugh & Liang, sp. nov. designated 2021" [yellow label].

Type locality. China, Yunnan, Gongshan County, Bingzhongluo Township, SW slope of Kawakarpu Shan, Chukuai Lake area.

Derivation of species name. The species epithet, *chukuai*, is a noun in apposition and derived from the name of a lake on the southwestern slope of Kawakarpu Shan, in the vicinity of which most of the specimens of the type series were found.

Diagnosis. Adults of this species (Fig. 11a) can be distinguished from those of other species in the region by the following combination of character states: size small, BL male = 8.0–8.8 mm, female = 7.8–9.5 mm; body color reddish-brown; head (Fig. 5c) with eyes small, only slightly convex, their diameter slightly less than length of tempora; frontal furrows deeply impressed, smooth and impunctate; vertex with post-temporal transverse sulcus deep, sharply impressed and only narrowly punctate along bottom of sulcus; gula smooth, without transverse grooves; antennomere 3 with pubescence on apical half; pronotum with posterior transverse impression shallow and vaguely delineated; elytra with lateral margins slightly arcuate, microsculpture comprised of distinct and deeply impressed isodiametric meshes; hindwings slightly reduced; prosternum, proepisternum, metasternum, and metepisternum smooth or faintly punctulate; hind trochanter unisetose; abdominal sternite VI of female with two pairs of apicoparamedial setae. Male genitalia as in Fig. 12; median lobe with ventral surface moderately concave with ventrolateral edges elevated and distinctly flanged near mid-length, especially on right edge; apex of apical lamella evenly rounded in lateral view.

Description. Fig. 11a. Size small, BL male = 8.0–8.8 mm, female = 7.8–9.5 mm, ratio EL/PL = 2.2-2.4. Body color reddish brown, all appendages reddish brown.

Head. Fig. 5c. Eyes small, only slightly convex, their diameter slightly less than length of tempora. Frontal furrows deeply impressed, narrow, smooth, impunctate. Vertex with post-temporal transverse sulcus deep, sharply impressed and only narrowly punctate along bottom of sulcus. Tempora roundly subangulate. Gula without transverse grooves.

Pronotum. Markedly cordate, moderately convex, narrowed posteriorly, widest distinctly anterior to middle of discal region; apical margination absent; lateral margination present, narrow, distinctly delineated throughout pronotal length; basal margination absent; anterior transverse impression absent or shallow and indistinct; median longitudinal impression moderately impressed; posterior transverse impression shallow and vaguely delineated; anterior region smooth, or faintly and sparsely rugulose; pronotal base coarsely punctate and rugulose; one pair of midlateral pronotal setae present at anterior one-third to one-fourth, one pair of basolateral pronotal setae present slightly anterior to basal angles.

Elytra. Elytral silhouette symmetrically subovoid, widest at or just behind middle, ratio EL/EW = 1.5–1.7, greatest elevation above lateral margin (in lateral view) posterior to middle; humeri distinctly present, roundly obtuse; lateral margins slightly arcuate; parascutellar striole present, short, distally merged in a distinct jog with free base of stria 1. Nine striae present; stria 1 moderately deeply and sharply impressed; striae 2 to 3, 4, or 5 moderately impressed in basal two-thirds and successively more shallowly impressed in apical third, striae 3 to 8 successively more shallowly impressed laterally and apically; stria 9 divergent medially from lateral groove in apical half; stria 1 moderately or finely punctate at least in basal half; striae 2 to 8 shallowly and sparsely punctate in basal two-thirds and successively more shallowly and sparsely punctate in apical third. Parascutellar setiferous pore absent, discal setae absent, umbilicate series comprised of one subhumeral and three subapical setae. Elytral microsculpture comprised of distinct and deeply impressed isodiametric sculpticells.

Hindwings. Slightly reduced, incapable of supporting flight.

Thoracic venter. Prosternum and proepisternum smooth or faintly punctulate, mesosternum and mesepisternum coarsely but sparsely punctate, metasternum and metepisternum smooth or faintly punctulate. Metepisternum ratio ML/MW = 2.0–2.1.

Legs. Hind trochanter unisetose. Tarsomeres with sparse long setae dorsally; tarsomere 5 with a single subapical pair of setae ventrally; male pro- and mesotarsi each with small pads of adhesive setae on tarsomeres 1 and 2.

Abdomen. Sternite VI of male with one pair of apicoparamedial setae, female with two pairs. Male genitalia. As in Fig. 12.

Comments. Members of this species can be distinguished from those of *B. gaoligongensis* by the features listed above in the key and diagnosis. They differ from members of all three subspecies of *B. dreuxi* from Sichuan Province, China in having a lighter body color (reddish-brown rather than dark brown to piceous), head with impunctate (rather than punctate) frontal furrows and the post-temporal transverse sulcus only narrowly (rather than more broadly) punctate, the elytral striae only finely (rather than more coarsely) punctate, and the median lobe of the male genitalia shorter, thicker, and slightly more arcuate in lateral view compared with the illustration provided by Deuve (1998:228). They differ from members of *Broscodera morvani* Deuve, 2004 from Gansu Province, China in having the eyes smaller, their diameter less than the length of the tempora (rather than greater than the temporal length), the antennae with antennomere 2 (the pedicel) longer, antennomere 3 with pubescence in its apical half (rather than without pubescence in addition to the apical setal whorl), the pronotum relatively longer and with a single midlateral seta on each side (rather with than two or three such setae), the elytral silhouette elongate-subovid with the lateral margins less rounded (rather than shorter, more ovoid, and with more markedly rounded lateral margins), and the median lobe of the male genitalia shorter, thicker, and more arcuate in lateral view (compared with the illustration provided for *B. morvani* (Deuve 2004, Fig. 3). Members of *B. chukuai* differ from those of *Broscodera holzschuhi* Wrase, 1995 from Nepal in having smaller eyes, their diameter less than the length of the tempora (rather than greater than the temporal length), the pronotum relatively shorter and broader and widest distinctly anterior to mid-length (rather than closer to mid-length), and the elytral silhouette relatively shorter, broader, laterally more evenly curved throughout, and widest at or closer to midlength (rather than laterally nearly straight in basal half and more curved posteriorly and widest near two-thirds elytral length). We have not examined a male of *B. holzschuhi* for comparison of the genitalia.

Habitat distribution. Members of this species have been found under stones on open slopes above treeline, under deeply embedded stones on organic substrate in alpine tundra areas and near snow patches (Fig. 40a), and under stones on the upper banks of meltwater streams and on adjacent tundra flats. Specimens collected in Fugong County near Shibali Yakou were found under stones on organic soil along a small stream and in bamboo thickets (Fig. 40b). Within the Gaoligong Shan region, this species occurs at relatively high elevations, with our records documenting its occurrence in the 3450 to 4035 m range (Fig. 49).

Geographical distribution within the Gaoligong Shan. Fig. 11b. We examined a total of 32 specimens (12 males and 20 females) from the northern to the northcentral part of the Gaoligong Shan in Fugong and Gongshan Counties. Our records from Gongshan and Fugong Counties are on the eastern side of the range (in Core Areas 2 and 3, respectively (Fig. 48) (see Type material above for exact collection data).

Overall geographical distribution. This species currently is known only from the northern to northcentral part of the Gaoligong Shan, in western Yunnan Province, China.

Geographical relationships with other *Broscodera* species. As noted below for *B. gaoligongensis*, the known geographical range of that species partially overlaps with that of *B. chukuai*, but they have not been found together (Fig. 50) and appear to occupy non-overlapping altitudinal ranges. No other described species of *Broscodera* has been recorded from Yunnan Province.

2. *Broscodera (Sinobrosculus) gaoligongensis* Kavanaugh and Liang, sp. nov.
Figures 5d, 8a, 13, 14, 41, 48-50

Type material. Holotype, a male, in IOZ, labeled [in Chinese]: Yunnan, Lushui, Yaojiaping, 2500 m, Chinese Academy of Sciences"/ "1981.VI.1, Liao Subai coll."/ "HOLOTYPE *Broscodera* (*Sinobrosculus*) *gaoligongensis* Kavanaugh & Liang sp. nov. designated 2021" [red label]. Paratypes (a total of 16): four females (IOZ) labeled [in Chinese]: same as holotype; two females (IOZ) labeled [in Chinese]: same first label same as holotype, second label "1981.VI.2, Wang Shuyong coll."; one male (IOZ) labeled [in Chinese]: same first label as holotype, second label "1981.VI.4, Wang Shuyong coll."; one male and three females (CAS, IOZ) labeled [in Chinese]: same first label as holotype, second label "1981.VI.6, Liao Subai coll."; two females (IOZ) labeled [in Chinese]: same first label as holotype, second label "1981.VI.6, Zhao Jianming coll."; one female (IOZ) labeled: "Yunnan, Lushui, Pianma, 2300 m, Chinese Academy of Sciences"/ "1981.V.29, Wang Shuyong coll."; one male (CAS) labeled: "CASENT 1020104"/ "CHINA, Yunnan, Fugong County, Lumadeng Township, South Fork Yamu He, 1.3 km E of Lao Shibali, 2250 m, N27.08180°/E98.78670°,"/ "15 August 2005, Stop# DHK-2005-087, D.H. Kavanaugh, H.B. Liang, & J.F. Zhang collectors; one female (CAS) labeled: "CASENT 1001456"/ "CHINA, Yunnan Province, Gaoligong Shan, Nujiang Prefecture, Gongshan County, Danzhu He drainage, 13.5-15.7 airkm SSW of Gongshan [Cikai], 2700-3100 m,"/ "N27.63063°/E98.62074° to N27.62705°/E98.59204°, 30 June – 5 July 2000, Stop#00-17A, D.H. Kavanaugh, C.E. Groswold [sic], Liang H.-B., D. Ubick, & Dong D.-Z. collectors". All paratypes also bear the following label: "PARATYPE *Broscodera* (*Sinobrosculus*) *gaoligongensis* Kavanaugh & Liang, sp. nov. designated 2021" [yellow label].

Type locality. China, Yunnan, Lushui, Luzhang Township, Yaojiaping, 2500 m.

Derivation of species name. The species epithet, *gaoligongensis*, is derived from the name of the mountain range, the Gaoligonmg Shan, in which all specimens of the type series were collected, and the Latin suffix, *-ensis*, denoting place.

Diagnosis. Adults of this species (Fig. 13a) can be distinguished from those of other species in the region by the following combination of character states: size medium, BL male = 10.0–11.2 mm, female 10.2–11.2 mm; body color dark brown to piceous; head (Fig. 5d) with eyes small but moderately convex, their diameter about equal to length of tempora; frontal furrows moderately impressed, shallowly punctate; vertex with post-temporal transverse sulcus deep, sharply but slightly more broadly impressed, more densely, coarsely, and widely punctate; gula with shallow, vaguely defined transverse grooves; antennomere 3 with sparse pubescence mainly in apical one-third; pronotum with posterior transverse impression moderately deep, but vaguely delineated; elytra with lateral margins moderately arcuate, microsculpture comprised of distinctly but shallowly impressed isodiameteric meshes; hindwings full-sized; prosternum, proepisternum, metasternum, and metepisternum coarsely but sparsely punctate; hind trochanter asetose; abdominal sternite VI of female with one pair of apicoparamedial setae. Male genitalia as in Fig. 14; median lobe with ventral surface faintly concave and with ventrolateral edges only faintly elevated and without distinct flange near mid-length; apex of apical lamella slightly asymmetrical and slightly pointed in lateral view.

Description. Fig. 13a. Size medium, BL male = 10.0–11.2 mm, female 10.2–11.2 mm, ratio EL/PL = 2.4–2.5. Body color piceous, or dark brown, all appendages reddish brown.

Head. Fig. 5d. Eyes small, moderately convex, their diameter about equal to length as tempora. Frontal furrows moderately impressed, narrow, distinctly divergent posteriorly, shallowly punctate. Vertex with post-temporal transverse sulcus deep, sharply impressed and densely and coarse-

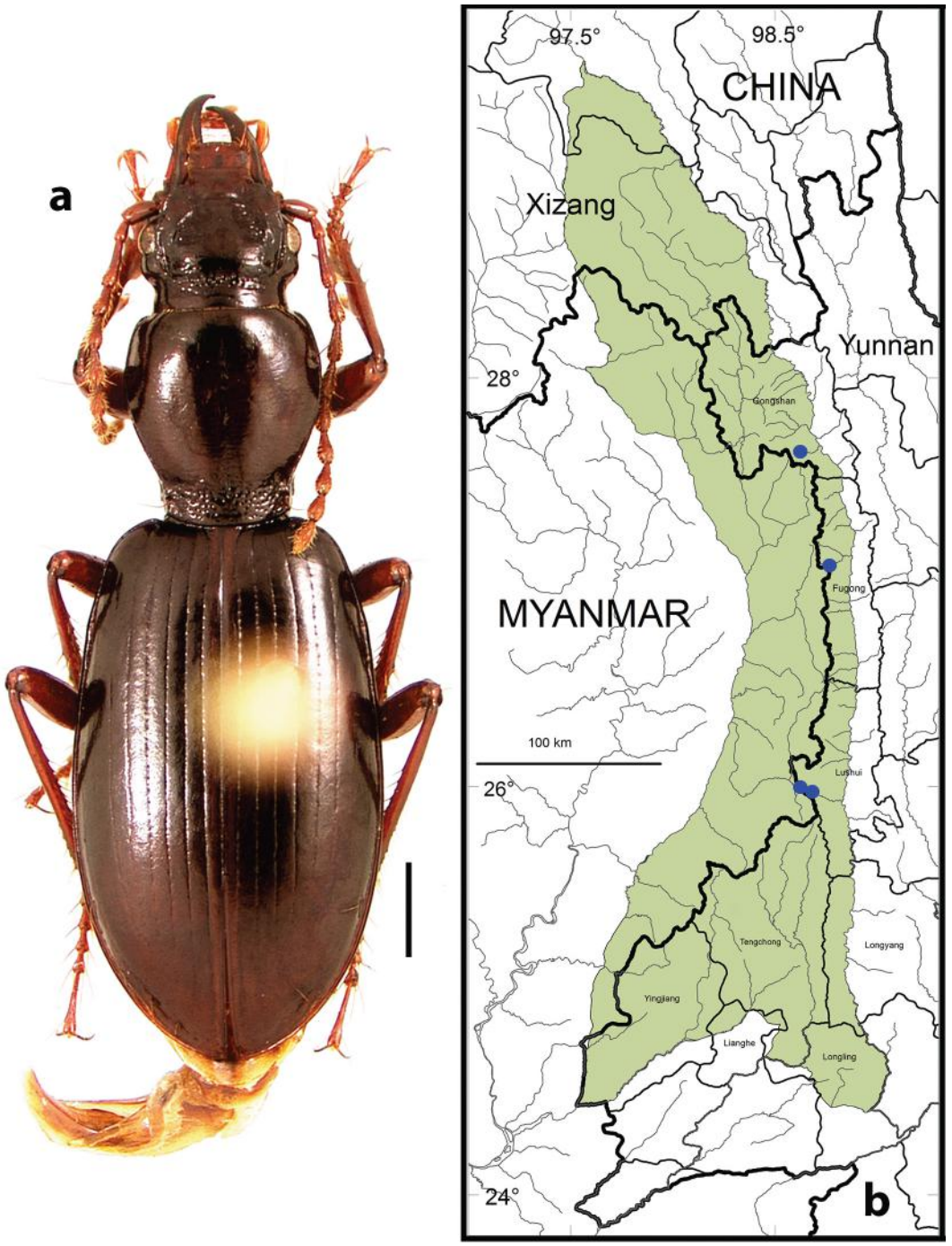


FIGURE 13. *Broscodera gaoligongensis* sp. nov. a. Habitus (CASENT1020104; South Fork of Yamu He, Lumadeng Township, Fugong County, Yunnan, China), dorsal aspect, scale line = 1.0 mm; b. Map showing locality records (blue circles) for this species in the Gaoligong Shan region, scale line = 100 km.

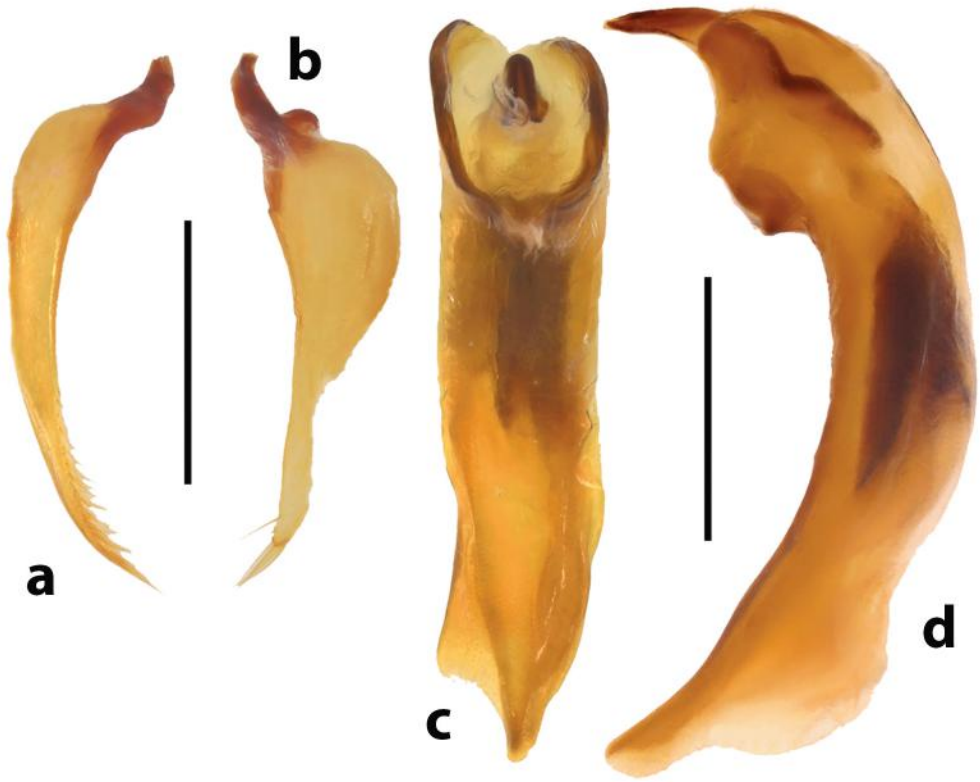


FIGURE 14. Male genitalia, *Broscodera gaoligongensis* sp. nov. (Yaojiaping, Lushui County, Yunnan, China). a. Right paramere, lateral aspect; b. Left paramere, lateral aspect; c. Median lobe, left lateral aspect; d. Median lobe, ventral aspect; scale line = 1.0 mm.

ly punctate. Tempora slightly swollen, roundly subangulate. Gula with shallow, vaguely defined transverse grooves.

Pronotum. Markedly cordate, moderately convex, narrowed posteriorly, widest distinctly anterior to middle of discal region; apical margination absent; lateral margination present, narrow, distinctly delineated throughout pronotal length; basal margination absent; anterior transverse impression absent or shallow and indistinct; median longitudinal impression moderately impressed; posterior transverse impression moderately deep, but vaguely delineated; anterior region of disk smooth; pronotal base coarsely punctate and rugulose; one pair of midlateral setae present at anterior one-third to one-fourth of discal region; one pair of basolateral setae present slightly anterior to basal angles.

Elytra. Elytral silhouette symmetrically subovoid, ratio EL/EW = 1.7, widest at or just behind middle, greatest elevation above lateral margin (in latateral view) posterior to middle; humeri distinctly present, roundly obtuse; lateral margins moderately arcuate; parascutellar striole present, short, distally merged in a distinct jog with free base of stria 1. Nine striae present; stria 1 moderately deeply and sharply impressed (more shallowly impressed in some specimens), striae 2 to 3, 4, or 5 sharply and deeply impressed in basal two-thirds and successively more shallowly impressed in apical third, striae 3 to 8 successively more shallowly impressed laterally and apically, stria 9 divergent medially from lateral groove in apical half; stria 1 moderately punctate at least

in basal half, striae 2 to 8 successively more shallowly and sparsely punctate both laterally and apically. Parascutellar setiferous pore absent, discal setae absent, umbilicate series comprised of one subhumeral and three subapical setae. Elytral microsculpture comprised of distinctly but shallowly impressed isodiametric meshes.

Hindwings. Full-sized, functional.

Thoracic venter. Prosternum, proepisternum, mesosternum and mesepisternum, metasternum, and metepisternum coarsely but sparsely punctate. Metepisternum ratio ML/MW = 2.1–2.2.

Legs. Hind trochanters asetose (one seta found unilaterally in one specimen). Tarsomeres with sparse long setae dorsally; tarsomere 5 with a single subapical pair of setae ventrally. Male pro- and mesotarsi each with small pads of adhesive setae on tarsomeres 1 and 2.

Abdomen. Sternite I coarsely and sparsely punctate. Sternite VI of both males and females with one pair of apicoparamedial setae.

Male genitalia. As in Fig. 14.

Comments. Members of this species can be distinguished from those of *B. chukuai* by the features listed above in the key and diagnosis. They differ from members of all three subspecies of *B. dreuxi* in having the eyes more convex and the tempora more swollen and roundly angulate (rather than more smoothly rounded), the elytral striae only finely (rather than more coarsely) punctate, and the median lobe of the male genitalia shorter, thicker, and slightly more arcuate in lateral view compared with the illustration provided by Deuve (1998:228). They differ from members of *B. morvani* in having the eyes smaller, their diameter about equal to the length of the tempora (rather than greater than the temporal length), the antennae with antennomere 2 (the pedicel) longer, antennomere 3 with pubescence in at least its apical one-third (rather than without pubescence in addition to the apical setal whorl), the pronotum relatively longer and with a single mid-lateral seta on each side (rather with than two or three such setae), the elytral silhouette elongate-subovid with the lateral margins less rounded (rather than shorter, more ovoid, and with more markedly rounded lateral margins), and the median lobe of the male genitalia shorter, thicker, and more arcuate in lateral view (compared with the illustration provided for *B. morvani* (Deuve 2004, Fig. 3). They differ from members of *B. holzschuhi* in having smaller eyes, their diameter about equal to the length of the tempora (rather than greater than the temporal length), the tempora more swollen and roundly angulate (rather than more smoothly rounded), the pronotum relatively shorter and broader and widest distinctly anterior to mid-length (rather than closer to mid-length), and the elytral silhouette relatively shorter, broader, laterally more evenly curved throughout, and widest at or closer to midlength (rather than laterally nearly straight in basal half and more curved posteriorly and widest near two-thirds elytral length). Again, we have not examined a male of *B. holzschuhi* for comparison of the genitalia.

Habitat distribution. Members of this species have been found under large stones along road-cuts at the base of cutbanks (Fig. 41b) and on the rocky banks of small to moderate-sized streams (Fig. FX41a). Within the Gaoligong Shan region, this species occurs at moderate elevations, with our records documenting its occurrence in the 2300 to 3100 m range (Fig. 41b).

Geographical distribution within the Gaoligong Shan. Fig. 13b. We examined a total of 17 specimens (six males and 11 females) from the northern to the southcentral part of the Gaoligong Shan in Fugong, Gongshan and Lushui Counties. Our records from Gongshan and Fugong Counties are on the eastern side of the range (in Core Areas 2 and 3, respectively) but those from Lushui County are from both western and eastern slopes (Core Areas 4 and 5, respectively) (Fig. 48) (see Type material above for exact collection data).

Overall geographical distribution. This species currently is known only from the northern to southcentral part of the Gaoligong Shan, in western Yunnan Province, China.

Geographical relationships with other *Broscodera* species. The northern and northcentral part of the geographical range of this species overlaps with that of *Broscodera chukuai*. However, we have not found the two species together (syntopic) (Fig. 50) and our records suggest that they occupy non-overlapping altitudinal ranges and therefore are unlikely to co-occur. *Broscodera gaoligongensis* appears to be restricted to elevations below 3100 m and mainly well below that level, whereas *B. chukuai* has been found only at elevations above 3400 m (Fig. 49). The ranges of the other described species do not include Yunnan Province.

Genus *Broscosoma* Rosenhauer, 1846

Broscosoma Rosenhauer, 1846:1. Type species: *Broscosoma baldense* Rosenhauer, 1846:4.

Diagnosis. Members of this genus can be distinguished from those of other broscine genera in the region by the following combination of character states: body small to moderate in size (BL >13.0 mm); body surface with or without metallic reflection; head with post-temporal transverse sulcus moderately deep and broadly or narrowly punctate; genal ridge present, but varied in extent; maxillae with two setae on eustipes, stipes with dorsobasal setae at least half as long as ventrobasal setae; mentum with one pair of setae present, paramedial region moderately to deeply foveate; submentum with one to three pairs of setae; antennae with antennomeres 3 and 4 glabrous except for apical whorl of fixed setae; pronotum with basolateral setae absent; elytra with parascutellar seta present, umbilicate setal series comprised of one post-humeral and two preapical setae; male protarsi with pads on adhesive setae ventrally on tarsomeres 1 to 3, and mesotarsi with pads of adhesive setae on tarsomeres 1 and 2.

Taxonomic notes. The generic diagnosis presented above properly applies only among those species occurring in the study area. Members of some species of the genus occurring elsewhere present exceptions to several of the character states listed. Even the features most widely applied as characteristic of the genus are subject to exceptions, including among species of the study area. Roig-Juñent (2000) distinguished *Broscosoma* species from *Miscodera arctica* (Paykull), 1798 principally on differences in the lateral margination of the pronotum (present in *Miscodera* and absent from *Broscosoma*) and paramedial foveae on the mentum (present in *Miscodera* and absent from *Broscosoma*). However, we have found lateral margination of the pronotum present in at least some form (Figs. 9a-d) in several of the species occurring in the study area and fully present in members of one species. Similarly, we have found that members of most *Broscodera* species in the study area have at least shallow paramedial foveae on the mentum, and one species has foveae comparably deep to those of *M. arctica* members. Other features listed by Roig-Juñent in his description of the genus are also subject to greater variation among *Broscosoma* species in the study area than was represented in his sample of only three species. Among these are development of the genal (or "temporal") ridge (Figs. 10a-d), number of pairs of setae on the submentum, and pubescence on antennomere 4.

Since Sciaky and Facchini (2005) presented their excellent key to the *Broscosoma* species of China, the number of species known from that country has more than tripled, from eight to 26, not including any of the species newly described herein. Clearly, a new key to Chinese species is needed; but new species continue to be discovered (see Jiang et al. 2020 and Jiang et al. 2021 for the most recent additions) at such a rate as to make creating such a key a rapidly 'moving target', which we plan to attempt, nonetheless, in the near future.

Diversity and geographical distribution. To date, 43 species and an additional five subspecies of *Broscosoma* have been described. The genus is strictly Palearctic in distribution, with a range extended from the Alps of northern Italy eastward to Japan and Taiwan, but with wide dis-

junctions apparent. The main distributional gaps occur between (1) northern Italy and the Caucasus Mountains, (2) the Caucasus and the Himalaya in central Nepal, and (3) Chongqing and Shaanxi Provinces and Fujian Province, Taiwan, and Japan.

3. *Broscosoma bicoloratum* Kavanaugh and Liang, sp. nov.
Figures 7c, 8c, 15, 16, 42, 48-50

Type material. Holotype, a male, in IOZ, labeled: "CASENT 10265704"/ "CHINA, Yunnan, Gongshan County, Dulongjiang Township, NW slope of Heipu Yakou, 3350m" N27.77437º/E098.44793º"/ "13 August 2006, Stop # DHK-2006-075, D.H. Kavanaugh & J.A. Miller collectors"/ "HOLOTYPE *Broscosoma bicoloratum* Kavanaugh & Liang, CH-04 Kavanaugh & Liang sp. nov. designated 2021" [red label]. Paratypes (a total of 29): two males and one female (CAS, IOZ) labeled: same as holotype except first label: "CASENT 10265703" and "CASENT 10265705" and "CASENT 10265706", respectively; three males and five females (CAS, IOZ) labeled: "CASENT 1006243", "CASENT 1006245", "CASENT 1008140" and "CASENT 1008141" to "CASENT 1008145", respectively/ "CHINA, Yunnan Province, Gaoligong Shan, Nujiang Prefecture, Nujiang State Nature Reserve, Dulong/Gongshan Yakou area, 21 airkm W of Gongshan"/ "3300-3680m, 16-17 July 2000, Stop #00-24C, D.H. Kavanaugh, C.E. Griswold, H.-B. Liang, D. Ubick & D.-Z. Dong collectors"; one female (IOZ) labeled: "CASENT 1025606"/ "CHINA, Yunnan, Gongshan County, Cikai Township, southeastern slope of Heipu Yakou, 3365m" /N27.77032º/E098.44674º",/ "11 August 2006, Stop # DHK-2006-069B, D.H. Kavanaugh, D.Z. Miller, D.-Z. Dong & Y. Liu collectors"; one male and two females (CAS, IOZ) labeled: "CASENT 1025709"to "CASENT 1025710" to "CASENT 1025711", respectively/ "CHINA, Yunnan, Gongshan County, Cikai Township, southeastern slope of Heipu Yakou, 3365m"/ "N27.77032º/E098.44674º "11 August 2006, Stop # DHK-2006-072, Y. Liu collectors"; two males and three females (CAS, IOZ) labeled:, "CASENT 1026544" to "CASENT 1026545" and "CASENT 1026546" and "CASENT 10265548", respectively/ "CHINA, Yunnan, Gongshan County, Cikai Township, southeastern slope of Heipu Yakou, 3365m" /N27.77032º/E098.44674º"/ "13 August 2006, Stop # DHK-2006-074, D.-Z. Dong & Y. Liu collectors"; one male and one female (CAS, IOZ) labeled: "CASENT 1033874" and "CASENT 1033875", respectively/ "CHINA, Yunnan, Gongshan County, Cikai Township, headwaters South Fork Qiqi He on SE slope below Qiqi-Dulong Yakou, 3570 m,"/ "N27.69490°/E098.45646°, 27 September 2007, Stop# 2007-053, D.H. Kavanaugh, H.B. Liang, & H.L. Shi collectors"; one male (IOZ) labeled: "CASENT 1033984"/ "CHINA, Yunnan, Gongshan County, Cikai Township, Qiqi Trail SE of Qiqi-Dulong Yakou, 3525 m, N27.69367°/E098.46004°,"/ "29 September 2007, Stop# 2007-057, D.H. Kavanaugh & H.B. Liang collectors"; three males and one female (CAS, IOZ) labeled: "CASENT 1034174"to "CASENT 1034176" and "CASENT 1034177", respectively/ "CHINA, Yunnan, Gongshan County, Cikai Township, Qiqi-Dulong Yakou, 3675 m, N27.69659°/E098.45398°,"/ "27 September 2007, Stop# HBL-2007-05A, H.B. Liang, H.L. Shi, & X.J. Feng collectors"; one male (IOZ) labeled: "CASENT 1033899"/ "CHINA, Yunnan, Gongshan County, Cikai Township, Qiqi-Dulong Yakou, 3675 m, N27. 69653°/E098.45393°, 27-29 September 2007,"/ Stop# 2007-054, D.H. Kavanaugh, H.B. Liang, & H.L. Shi collectors, in pitfall trap"; one male (IOZ) labeled: "CASENT 1034187"/ "CHINA, Yunnan, Gongshan County, Cikai Township, Qiqi-Dulong Yakou, 3675 m, N27.70401°/E098.45398°, 27-29 September 2007,"/ Stop# HBL-2007-05B, H.B. Liang, H.L. Shi, & X.J. Feng collectors, in pitfall traps". All paratypes also bear the following label: "PARATYPE *Broscosoma bicoloratum* Kavanaugh & Liang, sp. nov. designated 2021" [yellow label].

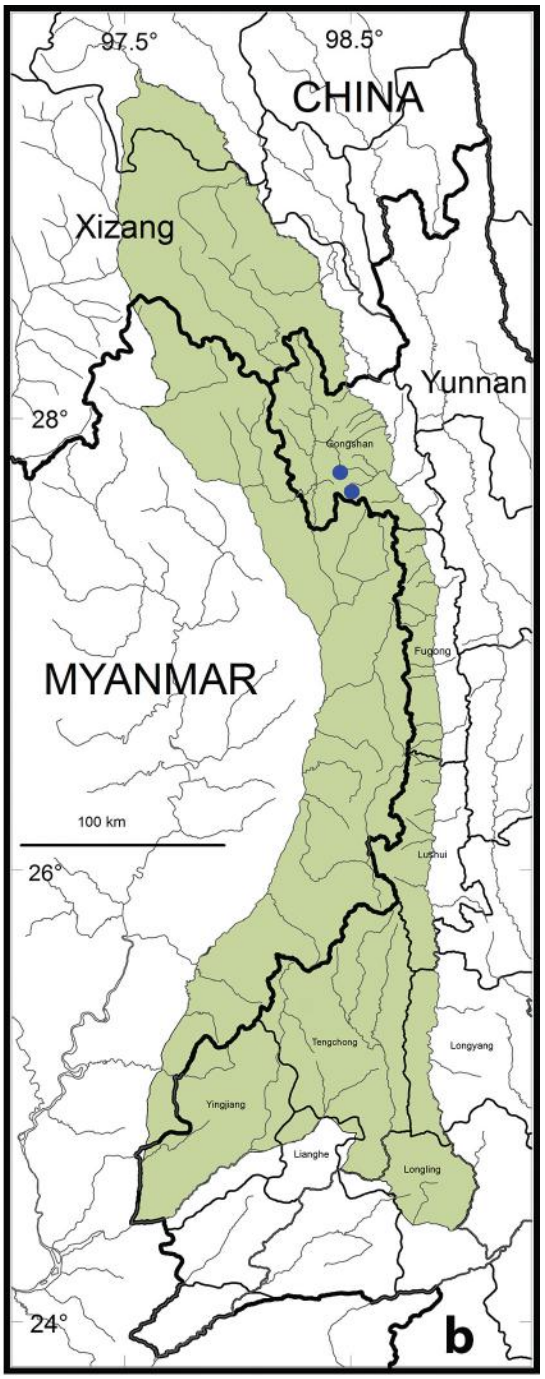


FIGURE 15. *Broscosoma bicoloratum* sp. nov. a. Habitus (CASENT1026704; slope NW of Heipu Yakou, Dulongjiang Townhip, Gongshan County, Yunnan, China), dorsal aspect, scale line = 1.0 mm; b. Map showing locality records (blue circles) for this species in the Gaoligong Shan region, scale line = 100 km.

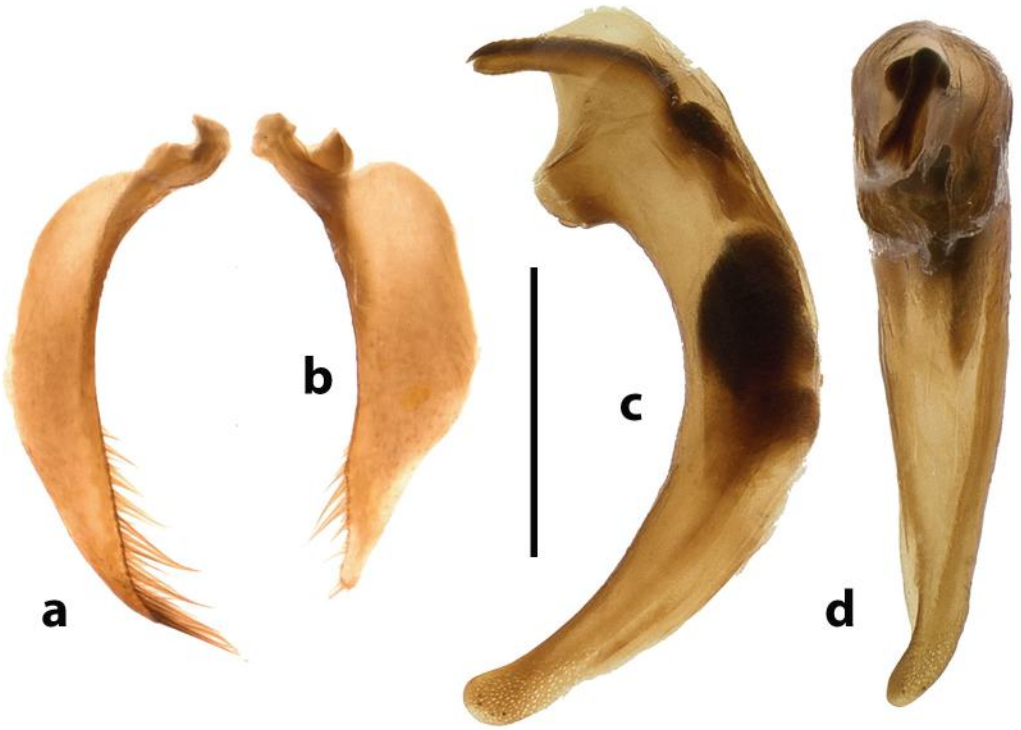


FIGURE 16. Male genitalia, *Broscosoma bicoloratum* sp. nov. (CASENT1025709; southeast slope of Heipu Yakou, Cikai Township, Gongshan County, Yunnan, China). a. Right paramere, lateral aspect; b. Left paramere, lateral aspect; c. Median lobe, left lateral aspect; d. Median lobe, ventral aspect; scale line = 1.0 mm.

Type locality. CHINA, Yunnan, Gongshan County, Dulongjiang Township, NW slope of Heipu Yakou, 3350 m.

Derivation of species name. The species epithet, *bicoloratum*, is an adjective derived from the Latin words, *bis*, meaning two, and *coloratus*, meaning colored. The name refers to the distinct color difference in dorsal view between the forebody (black) and the elytra (metallic green or bluish-green) in members of this species.

Diagnosis. Adults of this species (Fig. 15a) can be distinguished from those of other species in the region by the following combination of character states: size moderate, BL = 9.6 to 10.8 mm; head and pronotum black to piceous, without metallic reflection (except a few specimens with a faint metallic green band across anterior part of pronotum anterior to the anterior transverse impression); head with tempora distinctly convex behind eyes (Fig. 7c); genal ridge varied, extended from base of head to just anterior to temporal constriction or to below ventral margin of eye; antennomeres 3 and 4 glabrous except for apical whorl of setae; pronotum globose anterior to subbasal constriction (Fig. 7c), lateral margination absent, basolateral setae absent; elytral silhouette ovoid, with humeri indistinct, elytral microsculpture effaced or extremely faintly impressed; metatrochanters asetose (except unisetose unilaterally in very few specimens); male protarsi with tarsomeres 1 to 3 with ventral pads of adhesive setae; male genitalia as in Fig. 16.

Description. Fig. 15a. Size medium, BL male = 10.3–10.8 mm, female = 9.6–10.8 mm, ratio EL/PL of male and female = 2.1–2.2. Body color black or dark piceous, last visible abdominal sternite dark brown or rufous brown, antennae with all antennomeres rufous brown, femora black, dark

piceous, or reddish brown, tibiae and tarsi reddish brown. Head and pronotum without metallic reflection (except a few speciemens with a faint metallic green band across anterior part of pronotum anterior to the anterior transverse impression), elytra with distinct green or greenish-blue metallic reflection, venter without metallic reflection.

Head. Fig. 7c. Eyes medium-sized, their diameter equal to or slightly greater than length of tempora. Frontal furrows deeply impressed, narrow to broad, arcuate, slightly convergent anteriorly and posteriorly, long, extended posteriorly beyond middle of eyes, rugulose, impunctate. Vertex with post-temporal sulcus deep, sharply defined, very sparsely and finely punctate to moderately punctate. Tempora obliquely convex. Genal ridges present, extended from base of head anteriorly to slightly beyond the post-temporal constriction or to the ventral margins of the eyes. Clypeus with one pair of setae. Supraorbital setae present, one pair. Eustipes of maxilla with two setae, the dorsobasal seta distinctly more than half as long as ventrobasal seta. Mentum with tooth present, simple, paramedial region shallowly foveate, one pair of mental setae present. Glosal sclerite (ligula) with one pair of setae. Submentum with one or two pairs of setae. Gula without transverse grooves. Antennomeres 3 and 4 without pubescence, ratio A3/A5 = 1.1–1.2.

Pronotum. Fig. 7c. Globose anterior to sub-basal constriction with base distinctly pedunculate, widest at middle of discal region, ratio PL/PW = 1.1–1.2, disk markedly convex; apical, lateral, and basal margination absent; anterior transverse impression shallow, broad and vaguely delineated, coarsely punctate both at bottom and on slopes of depression; median longitudinal impression moderately impressed; posterior transverse impression deep, sharply delineated; anterior region sparsely to densely punctate and rugulose; pronotal base coarsely punctate and rugulose; one pair of midlateral pronotal setae present at mid-length of discal region; basolateral pronotal setae absent.

Elytra. Elytral silhouette ovoid, short, widest at middle, ratio EL/EW male = 1.5–1.6, female = 1.5, greatest elevation above lateral margin (in lateral view) posterior to middle; humeri narrow, sloped, indistinct; lateral margins markedly arcuate, or markedly arcuate and faintly angulate subbasally; parascutellar striole present, short, distally merged in a distinct jog with free base of stria 1. Eight elytral striae present; stria 1 moderately deeply and sharply impressed, striae 2 to 3, 4, or 5 moderately or shallowly impressed in basal two-thirds of striae and successively more shallowly impressed in apical third and laterally, lateral striae indistinct in some specimens, striae 8 merged with lateral groove throughout its length or nearly so; stria 1 moderately punctate at least in basal half, striae 2 to 8 moderately to coarsely punctate in basal half and successively more finely and sparsely punctate in apical half and laterally. Elytral microsculpture effaced or only very faintly impressed. Parascutellar seta present at base of stria 2 in most specimens, on base of interval 3 or near base of stria 3 in a few specimens, discal setae absent, umbilicate series of elytral setae comprised of one post-humeral and two preapical setae.

Hindwings. Vestigial, incapable of supporting flight.

Thoracic venter. Metepisternum ratio ML/MW = 1.5–1.7.

Legs. Hind trochanter asetose. Tarsomeres without dorsal pubescence; tarsomere 5 with two or more pairs of setae ventrally; male protarsi with pads of adhesive setae on tarsomeres 1 to 3 ventrally, male mesotarsi with pads of adhesive setae on tarsomeres 1 and 2 ventrally.

Abdomen. Sternite VI of male with one to three pairs of apicoparamedial setae, of female with one pair of setae.

Male genitalia: As in Fig. 16.

Comments. This is one of four species in the study area members of which have the elytra with distinct metallic reflection but the forebody (head and pronotum) without metallic reflection or with that reflection confined to the pronotal area anterior to the anterior transverse impression.

Most members of *B. bicoloratum* have the pronotum without a trace of metallic reflection, but a few specimens have that anterior area with a faint metallic green band. That green band is found elsewhere only in all members of *B. viridicollare*, which are generally larger, have the elytral microscupture moderately distinctly impressed (effaced or nearly so in *B. bicoloratum*), and median lobe of the male genitalia longer, slightly less arcuate, and with the apical lamella slightly broader (Fig. 35c). *Broscosoma gaoligongense* members also have the forebody without metallic reflection, but they have the parascutellar setiferous pore inserted near the base of stria 3 (near base of stria 2 in most *B. bicoloratum* specimens), have the metatrochanter unisetose (asetose in most specimens of *B. bicoloratum*, but with a seta present unilaterally in a few specimens) and the eyes (Fig. 7d) slightly less convex (more convex in *B. bicoloratum*). Members of the fourth species, *Broscosoma gongshanense*, have the eyes less convex (Fig. 7e), the tempora shorter and nearly straight (tempora longer and distinctly more convex in *B. bicoloratum*), and the discal portion of the pronotum very slightly more elongate. The male genitalia of these two species are quite similar but differ in the shapes of the sclerites of the internal sac of the median lobe.

Among *Broscosoma* species known from outside the study area, members of only one species, *Broscosoma monticola* Habu, 1973, from Nepal, have the forebody without metallic reflection and markedly contrasting with the very distinct metallic reflection seen on the elytra in most specimens. However, *B. monticola* members have the genal ridge confined to the region from the post-temporal groove to the base of the head (extended anteriorly to ventral margin of eye in most *B. bicoloratum* specimens) and the median lobe of the male genitalia with a large protuberance on the ventral margin (see Habu 1973, fig. 6), which is absent from the median lobe of *B. bicoloratum* males.

Habitat distribution. In daytime, members of this species have been found under stones in moist alpine meadow areas (Fig. 42a) and along roadcuts and trails through bamboo and *Rhododendron* thickets (Fig. 42b). The beetles are active on the surface at night in the same areas, particularly in areas with a cover layer of mosses. Our records document occurrence of this species at moderately high elevations in the 3300 to 3675 m range (Fig. 49).

Geographical distribution within the Gaoligong Shan. Fig. 15b. We examined a total of 30 specimens (16 males and 14 females) from the northern part of the Gaoligong Shan in Gongshan County. Our records are all from the crest of the range and adjacent western and eastern slopes (in Core Areas 1 and 2, respectively (Fig. 48) (see Type material above for exact collection data).

Overall geographical distribution. This species has been recorded only from the crest of the Gaoligong Shan in Gongshan County in western Yunnan Province China.

Geographical relationships with other *Broscosoma* species. Members of this species have been found together only with those of *Broscosoma gongshanense* (described below) at one or more sites (Fig. 50). *Broscosoma ribbei* occurs in the same general area but mainly at lower elevations.

4. *Broscosoma danzhuense* Kavanaugh and Liang, sp. nov.

Figures 6e, 17, 43, 48-50

Type material. Holotype, a female, in IOZ, labeled: " CASENT 1004637"/ "CHINA, Yunnan Province, Gaoligong Shan, Nujiang Prefecture, Gongshan County, Danzhu He drainage, 13.5-13.8 airkm SSW of Gongshan [Cikai], 2720-2840 m,"/ "N27.63267°/E98.60861° to"/ "N27.63331°/E98.60356°, 30 June – 5 July 2000, Stop#00-17E, D.H. Kavanaugh, C.E. Groswold [sic], Liang H.-B., D. Ubick, & Dong D.-Z. Collectors"./ "HOLOTYPE *Broscosoma danzhuense* Kavanaugh & Liang sp. nov. designated 2021" [red label].

Type locality. China, Yunnan, Gongshan County, Cikai Township, Danzhu He drainage 2720-2840 m.

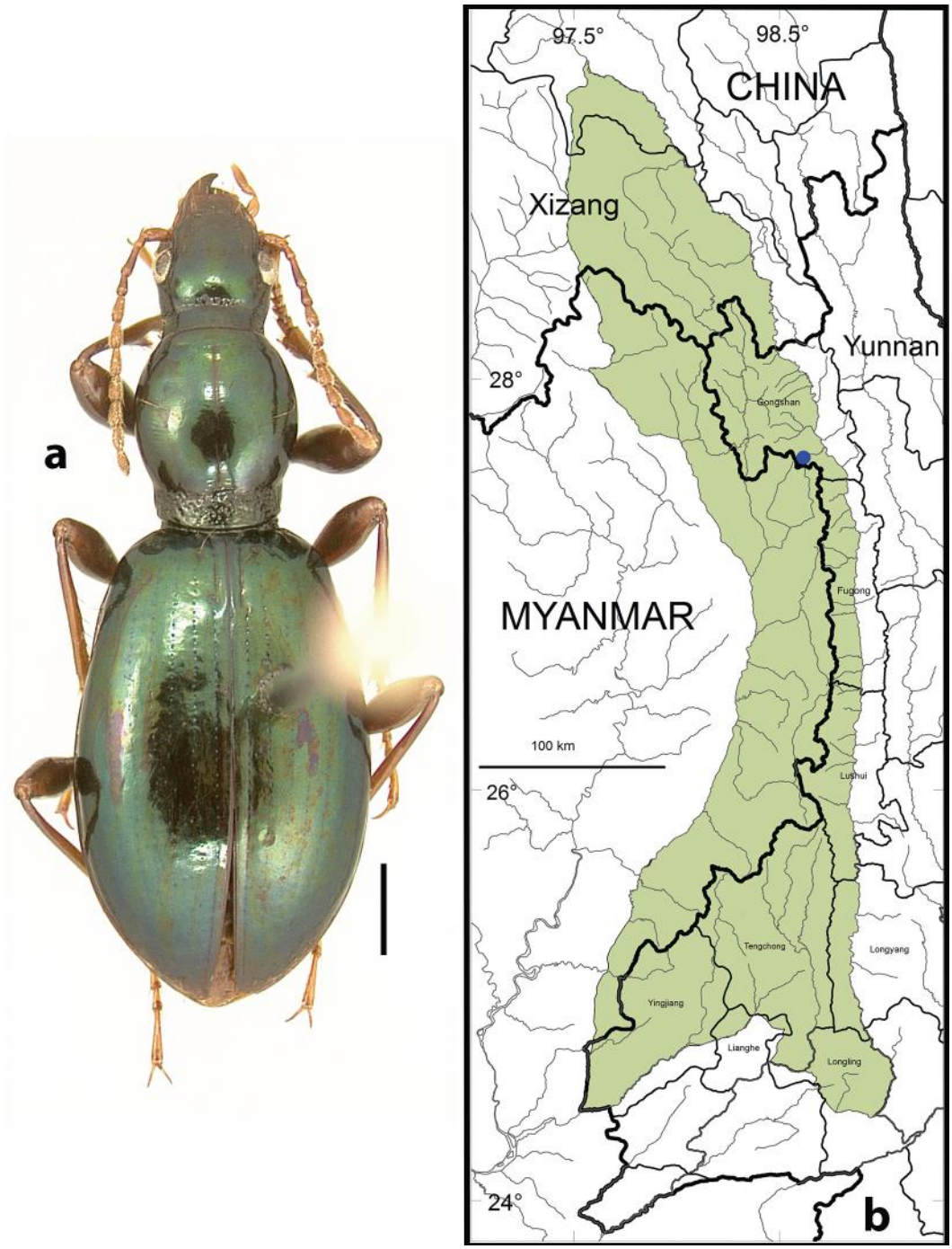


FIGURE 17. *Broscosoma danzhuense* sp. nov. a. Habitus (Holotype; Danzhum He drainage, Cikai Township, Gongshan County, Yunnan, China), dorsal aspect, scale line = 1.0 mm; b. Map showing locality records (blue circles) for this species in the Gaoligong Shan region, scale line = 100 km.

Derivation of species name. The species epithet, *danzhuense*, is derived from the name of the river valley in which the type specimen was collected, and the Latin suffix, *-ensis*, denoting place.

Diagnosis. Adults of this species (Fig. 17a) can be distinguished from those of other species in the region by the following combination of character states: size moderate, BL female = 9.3 mm; entire dorsum of body dark green, legs with femora darker (brown to piceous) than tibiae (reddish-brown); antennomeres 3 and 4 glabrous except for apical whorl of setae; eyes (Fig. 6e) moderately convex; pronotum with lateral margination absent, basolateral setae absent; elytral silhouette subovoid, greatest width distinctly posterior to midlength, with humeri rounded yet slightly evident, elytral microsculpture faintly impressed but evident, only striae 1 impressed, all other elytral striae represented only be punctures diminishing in size and depth laterally and posteriorly, elytral intervals flat; metatrochanters asetose.

Description. Fig. 17a. Size medium, BL female = 9.3 mm, ratio EL/PL = 2.3. Body color piceous. Last visible abdominal sternite dark or rufous brown, antennae with all antennomeres rufous brown, femora brown or piceous, tibiae and tarsi reddish brown. Head, Pronotum, elytra with distinct green metallic reflection, venter without metallic reflection.

Head. Fig. 6e. Eyes small, their diameter slightly less than length of tempora. Frontal furrows deeply impressed, narrow, arcuate, slightly convergent anteriorly and posteriorly, long, extended posteriorly beyond middle of eyes, faintly rugulose, impunctate. Vertex with post-temporal transverse sulcus deep, sharply and narrowly defined, narrowly punctulate only along bottom of sulcus. Tempora nearly straight, subparallel. Genal ridges present, restricted to head region distinctly behind post-temporal constriction. Clypeus with one pair of setae. Supraorbital setae present, one pair. Eustipes of maxilla with two setae, the dorsobasal seta distinctly more than half as long as ventrobasal seta. Mentum with tooth present, simple, paramedial region shallowly foveate, one pair of mental setae present. Glosal sclerite (ligula) with one pair of setae. Submentum with two or three pairs of setae. Gula without transverse grooves. Antennomeres 3 and 4 without pubescence, ratio A3/A5 = 1.3.

Pronotum. Fig. 6e. Discal region anterior to sub-basal constriction slightly longitudinally ovoid, slightly narrowed anteriorly with base distinctly pedunculate, widest slightly posterior to middle of discal region, ratio PL/PW = 1.2, disk markedly convex; apical, lateral, and basal margination absent; anterior transverse impression shallow, narrowly delineated, punctate in bottom of impression only; median longitudinal impression distinct, but fine and shallowly impressed; posterior transverse impression deep, sharply delineated; anterior region smooth; pronotal base coarsely and densely punctate; one pair of midlateral pronotal setae present, inserted slightly anterior to mid-length of discal region; basolateral pronotal setae absent.

Elytra. Elytral silhouette subovoid, slightly narrowed in basal half, widest distinctly posterior to middle, ratio EL/EW = 1.6, greatest elevation above lateral margin (in lateral view) posterior to middle; humeri distinctly present, roundly obtuse; lateral margins moderately arcuate and nearly straight in anterior half sub-basally; parascutellar striole present, short, distally merged in a distinct jog with free base of stria 1. Eight elytral striae present; stria 1 moderately deeply and sharply impressed, striae 2 to 8 indistinct, obliterated or represented by extremely fine and shallow linear depressions, successively less evident laterally and apically, striae 8 merged with lateral groove throughout its length or nearly so; stria 1 moderately punctate at least in basal half, striae 2 to 8 successively more finely and sparsely punctate or impunctate laterally and apically. Elytral microsculpture effaced. Parascutellar seta at base of stria 2, discal setae absent, umbilicate series comprised of one post-humeral and two preapical setae.

Hindwings. Slightly reduced, incapable of supporting flight.

Thoracic venter. Metepisternum ratio ML/MW = 2.4.

Legs. Hind trochanter asetose. Tarsomeres without dorsal pubescence; tarsomere 5 with two or more pairs of setae ventrally.

Abdomen. Female sternite VI with one pair of apicoparamedial setae.

Male genitalia. Male unknown.

Comments. This is one of six species in the study area members of which have the elytral humeri rounded or slightly angulate but distinct and both the forebody and the elytra with distinct metallic reflection. In two of these, *B. holomarginatum* and *B. purpureum*, the reflection is mainly blue or purple in color, respectively, with some greenish tinges in most specimens of *B. holomarginatum*. In addition to *B. danzhuens*e, three species have the full dorsum of the body with green metallic reflection. *Broscosoma parvum* members are smaller in size, have eyes that are less convex (Fig. 6f), and have the elytral silhouette slightly narrower across the humeri and the greatest width at or very near midlength (distinctly posterior to midlength in *B. danzhuense*). *Broscosoma resbecqi* members have the pronotum with the discal portion relatively shorter and more globose (Fig. 6d) and lateral margination present and nearly complete, interrupted only briefly near basal two-thirds length (Fig. 9b) (absent from *B. danzhuense*), the elytra with their greatest width at or very near midlength, and femora pale rufous (darker in *B. danzhuense*). *Broscosoma ribbei* members have the eyes distinctly more convex, the post-temporal transverse sulcus not or more sparsely punctate, the pronotum with the discal portion relatively shorter and more globose (Fig. 6b) and lateral margination incomplete but present in most specimens, at least in the vicinity of the mid-lateral setae and more extensively in some specimens, elytral microsculpture distinct, deeply to moderately impressed (effaced in *B. danzhuense*), and the metatrochanters unisetose, unilaterally asetose in a few specimens (asetose in *B. danzhuense*).

Among *Broscosoma* species known from outside the study area, only two species, *Broscosoma montreuili* Deuve, 2006 and *Broscosoma tiani* Deuve, 2006 have members in which the elytral humeri are at least faintly evident (although in both they are less evident than in *B. danzhuense*) and the entire dorsum exhibits metallic green reflection. In members of *B. montreuili*, the forebody is a darker, less vividly metallic green than the elytra (both parts equally vivid in *B. danzhuense*), and in both *B. montreuili* and *B. tiani* members the discal portion of the pronotum is more globose (slightly narrower and more elongate in *B. danzhuense*), the elytra are widest at or near midlength and with striae 2 to 8 more faintly defined and finely punctate, and the femora are darker (lighter piceous or brown in *B. danzhuense*).

Habitat distribution. The unique specimen of this species was found under a stone at the edge of a moderate-sized cascading stream descending through mixed coniferous/ broadleaf evergreen forest and shaded during much of the day. The site of collection was at some point within the moderate elevational range of 2720 to 2840 m (Fig. 49), but the precise elevation was not recorded.

Geographical distribution within the Gaoligong Shan. Fig. 17b. This species is known only from the type locality in Gongshan County (see Type material above for exact collection data) on the eastern slope of the range in the southern part of Core Area 2 (Fig. 48).

Overall geographical distribution. This species currently is known only from the northern part of the Gaoligong Shan, in western Yunnan Province, China.

Geographical relationships with other *Broscosoma* species. No other *Broscosoma* species was found syntopic with the type of this species, although *B. ribbei* occurs in the same general area. *Eobroscus bhutanensis* also has been found in the same area and habitat as *B. danzhuense* (Fig. 50).

5. *Broscosoma furvum* Kavanaugh and Liang, sp. nov.

Figures 7a, 10a, 18, 19, 40b, 48-50

Type material. Holotype, a male, in IOZ, labeled: “CASENT 1017819”/ “CHINA, Yunnan,

Fugong County, Lumadeng Township, second cirque S of Shibali Yakou at border post "31", N27.20333º/E098.69303º"/ "3710m, 17 August 2005, Stop #DHK2005-095, H.B. Liang, D.Z. Dong & J.F. Zhang collectors"/ HOLOTYPE *Broscosoma furvum* Kavanaugh & Liang sp. nov. designated 2021" [red label]. Paratypes (a total of 13): five males and seven females (CAS, IOZ) labeled: same as holotype except first label "CASENT 1017818", "CASENT 1017820" to "CASENT 1017823" and "CASENT 1017811" to "CASENT 1017817", respectively/ "CHINA, Yunnan, Fugong County, Lumadeng Township, second cirque S of Shibali Yakou at border post "31", N27.20333º/E098.69303º"/ "3710m, 17 August 2005, Stop #DHK2005-095, H.B. Liang, D.Z. Dong & J.F. Zhang collectors"; one male (CAS) labeled: "CASENT 1020001"/ "CHINA, Yunnan, Fugong County, Lumadeng Township, first cirque S of Shibali Yakou, 3725m"/ "N27.20520º/E098.69590º, 17 August 2005, Stop #DHK2005-094, D.H. Kavanaugh collector". All paratypes also bear the following label: "PARATYPE *Broscosoma furvum* Kavanaugh & Liang, sp. nov. designated 2021" [yellow label].

Type locality. China, Yunnan, Fugong County, Lumadeng Township, second cirque S of Shibali Yakou at border post "31", 27.20333º/98.69303º, 3710m.

Derivation of species name. The species epithet, *furvum*, is an adjective derived from the Latin word, *furvus*, meaning dark or dusky. The name refers to the dark brown to black dorsal body color, with no trace of metallic reflection, of members of this species.

Diagnosis. Adults of this species (Fig. 18a) can be distinguished from those of other species in the region by the following combination of character states: size moderate, BL = 10.6 to 11.1 mm; dorsum of body piceous, without any trace of metallic reflection; antennomeres 3 and 4 glabrous except for apical whorl of setae, distinctly darker than antennomeres 1 and 2; genal ridge evident, extended from base of head to ventral margin of eye (Fig. 10a); pronotum anterior to sub-basal constriction (Fig. 7a) longitudinally slightly ovoid in dorsal view, basolateral setae absent; elytral silhouette ovoid, with humeri indistinct; metatrochanters unisetose; male protarsi with tarsomeres 1 to 3 with ventral pads of adhesive setae; male genitalia as in Fig. 19, with median lobe longer and more slender and with apical lamella distinctly bent ventrally in lateral view.

Description. Fig. 18a. Size medium, BL male = 10.6–11.1 mm, female = 10.6–10.9 mm, ratio EL/PL male = 2.2, female = 2.2–2.3. Body color black or piceous, last visible abdominal sternite black, piceous, or dark brown, antennae with antennomeres 3 and 4 slightly darker brown than antennomeres 1 and 2 and 5 to 11, femora, tibiae, and tarsi dark brown or tarsi lighter brown in some specimens. Head, pronotum, elytra, and venter without metallic reflection.

Head. Fig. 7a. Eyes medium-sized, their diameter slightly greater than length of tempora. Frontal furrows deeply impressed, narrow, short, linear, and distinctly divergent posteriorly, or medium length, arcuate, and slightly convergent anteriorly and posteriorly, extended posteriorly to middle of eyes or less, faintly rugulose, impunctate. Vertex with post-temporal transverse sulcus deep, sharply defined, smooth and impunctate or very sparsely and finely punctate. Tempora obliquely convex. Genal ridges distinctly present, extended from base of head to ventral margins of eyes. Clypeus with one pair of setae. Supraorbital setae present, one pair. Eustipes of maxilla with two setae, the dorsobasal seta distinctly more than half as long as ventrobasal seta. Mentum with tooth present, simple, paramedial region shallowly foveate, one pair of mental setae present. Glosal sclerite (ligula) with one pair of setae. Submentum with one or two pairs of setae. Gula without transverse grooves. Antennomeres 3 and 4 without pubescence, ratio A3/A5 = 1.0–1.1.

Pronotum. Fig. 7a. Disc anterior to sub-basal constriction slightly longitudinally ovoid in dorsal view with base distinctly pedunculate, widest at middle of discal region, ratio PL/PW = 1.2–1.3, disk markedly convex; apical margination absent; lateral margination present, narrow, delineated only on pronotal base; basal margination absent; anterior transverse impression shallow,

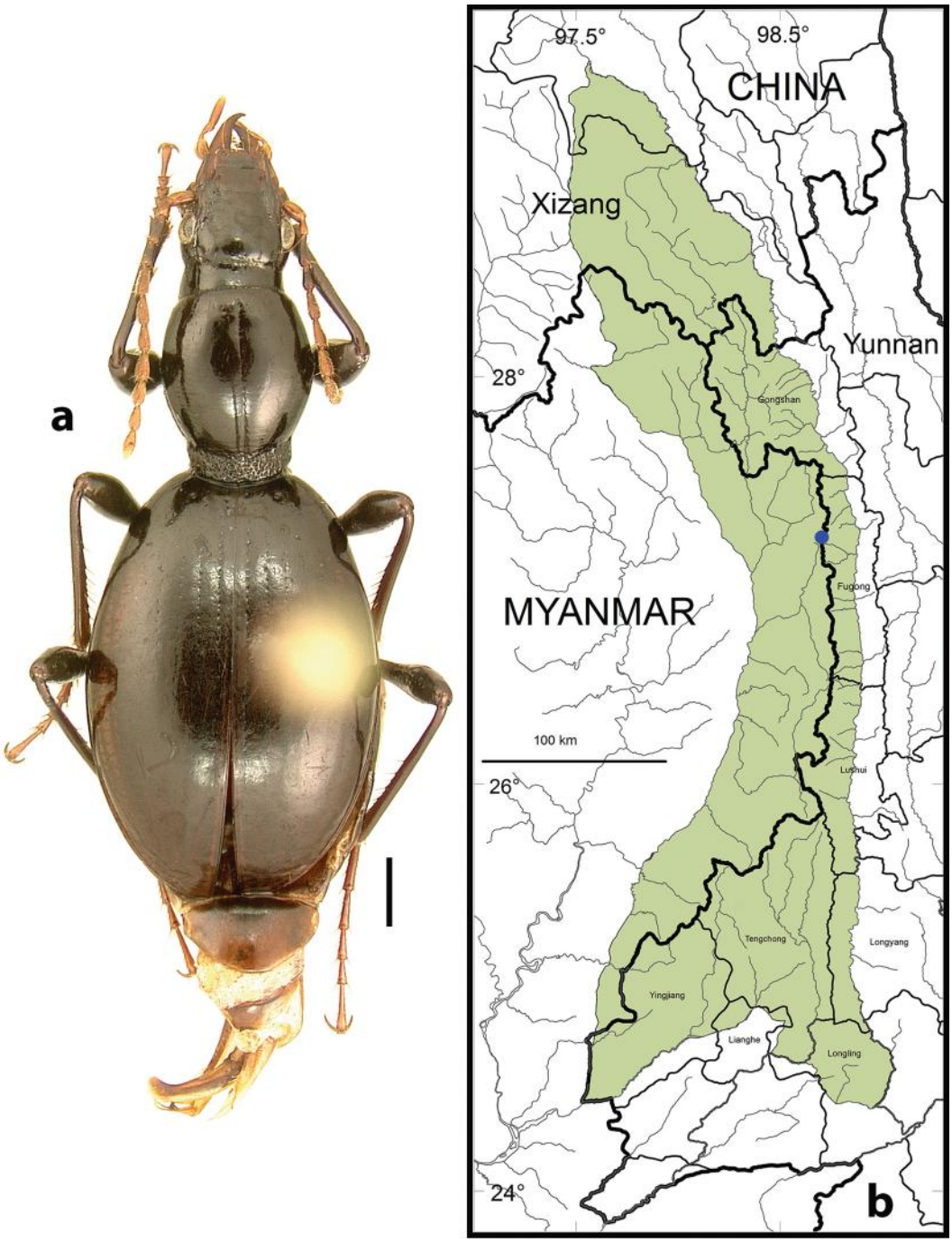


FIGURE 18. *Broscosoma furvum* sp. nov. a. Habitus (CASENT1020001; first cirque S of Shibali Yakou, Fugong County, Yunnan, China), dorsal aspect, scale line = 1.0 mm; b. Map showing locality records (blue circles) for this species in the Gaoligong Shan region, scale line = 100 k.

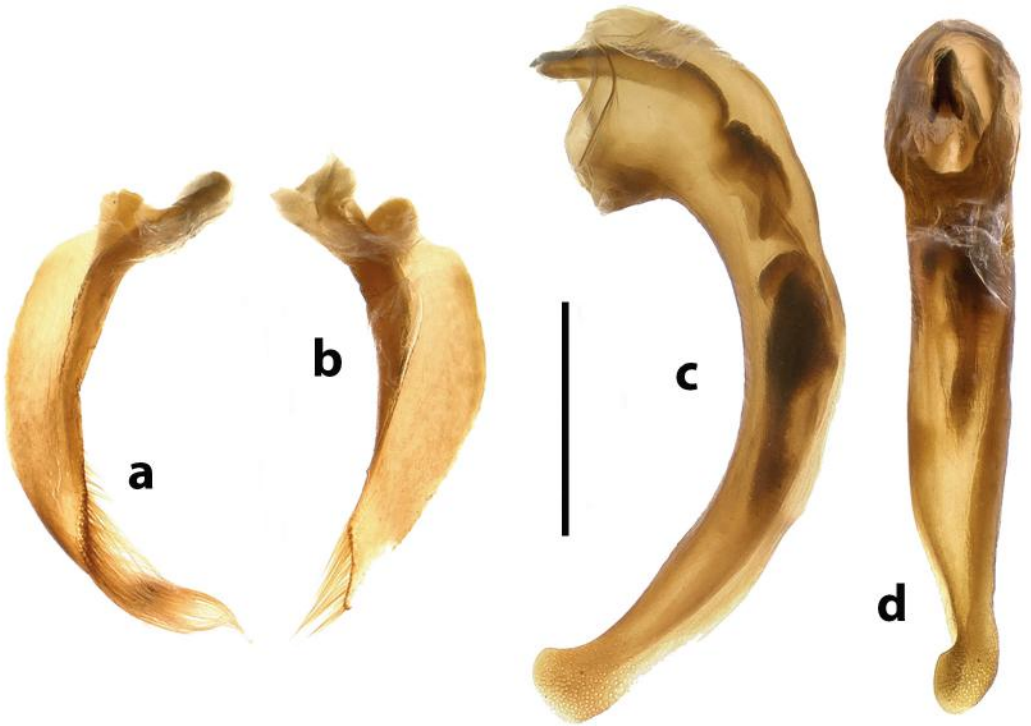


FIGURE 19. Male genitalia, *Broscosoma furvum* sp. nov. (CASENT1023548; 1.0 km E of Shibali Yakou, Lishadi Township, Fugong County, Yunnan, China). a. Right paramere, lateral aspect; b. Left paramere, lateral aspect; c. Median lobe, left lateral aspect; d. Median lobe, ventral aspect; scale line = 1.0 mm.

broad and vaguely delineated, smooth; median longitudinal impression distinct, but finely and shallowly impressed or moderately impressed; posterior transverse impression deep, sharply delineated; anterior region faintly and sparsely rugulose; pronotal base coarsely and densely rugulose; one pair of midlateral pronotal setae present at mid-length of discal region; basolateral pronotal setae absent.

Elytra. Elytral silhouette ovoid, short, widest at middle, ratio EL/EW male = 1.5, female = 1.5–1.6, greatest elevation above lateral margin (in lateral view) posterior to middle; humeri narrow, sloped, indistinct; lateral margins markedly arcuate; parascutellar striole present, short, distally merged in a distinct jog with free base of stria 1. Eight striae present; stria 1 moderately deeply and sharply impressed, striae 2 to 3, 4, or 5 shallowly impressed in basal two-thirds of striae and successively more shallowly impressed to indistinct in apical third, striae 3 to 8 successively more shallowly impressed to indistinct laterally and apically (striae striae 3 or 4 to 8 obliterated or nearly so in some specimens), striae 8 merged with lateral groove throughout its length or nearly so; stria 1 moderately punctate at least in basal half, striae 2 to 3, 4, or 5 moderately punctate in basal two-thirds and successively more shallowly and sparsely punctate in apical third, striae 3 to 8 successively more shallowly and sparsely punctate laterally and apically. Elytral microsculpture evident, comprised of finely impressed isodiametric sculpticells. Parascutellar seta present near base of stria 3 in most specimens (near base of stria 2 in a few specimens), discal setae absent, umbilicate series comprised of one post-humeral and two preapical setae.

Hindwings. Vestigial, incapable of supporting flight.

Thoracic venter. Metepisternum ratio ML/MW = 1.4–1.5.

Legs. Hind trochanters unisetose. Tarsomeres without dorsal pubescence; tarsomere 5 with two or more pairs of setae ventrally; male protarsi with pads of adhesive setae on tarsomeres 1 to 3 ventrally, male mesotarsi with pads of adhesive setae on tarsomeres 1 and 2 ventrally .

Abdomen. Sternite VI of both male and female with one pair of apicoparamedial setae.

Male genitalia. As in Fig. 19.

Comments. This is the only *Broscosoma* species in the study area members of which have the full dorsum of the body without a trace of metallic reflection. Its members are also among the largest of any of the species in the area, overlapping in size only with those of *B. viridicollare* and the largest members of *B. bicoloratum* and *B. ribbei*, all of which have at least the elytra distinctly metallic green or bluish-green.

Among *Broscosoma* species known from outside the study area, only four have members with similar or larger body size and without dorsal metallic reflection at least in most members. The known body size ranges for three of these, *Broscosoma dostali* Deuve, 2006, *Broscosoma herculaneum* Deuve, 2011, and *Broscosoma mourzinei* Deuve, 2011, all known only from Sichuan, are larger and non-overlapping with the size range of *B. furvum* specimens. Members of *B. dostali* also have the eyes and tempora more convex, the pronotum shorter and more globose (more elongate in *B. furvum*), and the median lobe of male genitalia with the apical lamella narrower and more symmetrical in lateral aspect (see Deuve 2006, fig. 9) (broader and distinctly expanded ventrally in *B. furvum*). Members of *B. herculaneum* have the head more generally punctate, the submentum with three pairs of setae (one or two pairs in *B. furvum*), the pronotum with the medial impression distinctly impressed but not extended to the pronotal base (deep and extended well onto the pronotal base in *B. furvum*), the elytra with only stria 1 impressed, the others effaced and represented only by punctures (at least two striae impressed on center of elytral disc in *B. furvum*), and the median lobe of the male genitalia with the apical lamella narrower and slightly less expanded ventrally (see Deuve 2011a, fig. 61). Members of *B. mourzinei* have the eyes less convex and smaller, their diameter about equal to length of the tempora (eyes slightly more convex and their diameter slightly greater than the length of the tempora in *B. furvum*), the submentum with three pairs of setae, the pronotal base finely and densely punctate (base more coarsely punctate in *B. furvum*), the elytra with only stria 1 impressed, and the median lobe of the male genitalia of similar shape except with the apical lamella slightly narrower and more symmetrical in lateral aspect (see Deuve 2011b, fig. 16). Members of the fourth species, *Broscosoma rolex* Morvan, 1995, known from Nepal, are of similar size to *B. furvum* members but have the elytral silhouette more slender (slightly broader in *B. furvum*), elytra with slight metallic reflection in some specimens, and the median lobe of male genitalia distinctly thicker subapically and with the apical lamella narrower and more symmetrically rounded in lateral aspect (see Morvan 1995, fig. 7).

Habitat distribution. Members of this species were collected under large stones on the crest of the range and on the east-facing slope just below it in an area of scattered *Rhododendron* and bamboo thickets interspersed with moist herbaceous meadow vegetation and stabilized talus (Fig. 40b). This species has been found only at high elevation, with our records documenting its occurrence in the 3710 to 3725 m range (Fig. 49).

Geographical distribution within the Gaoligong Shan. Fig. 18b. We examined a total of 14 specimens (seven males and seven females), all from the northcentral part of the Gaoligong Shan in Fugong County on the eastern side of the range in Core Area 3 (Fig. 48) (see Type material above for exact collection data).

Overall geographical distribution. This species currently is known only from the northcentral part of the Gaoligong Shan, in western Yunnan Province, China.

Geographical relationships with other *Broscosoma* species. Members of this species have been found syntopic only with those of *Broscosoma viridicollare* at the type locality (Fig. 50).

6. *Broscosoma gaoligongense* Deuve and Wrase, 2015

Figures 7d, 10b, 20, 21, 44a, 48-50

Broscosoma gaoligongense Deuve and Wrase, 2015:29. Holotype, a male, deposited in DWW. Type locality: China, Yunnan, Gaoligong Shan, pass [Fengxue Yakou] 21 km NW of Liuku, 3150 m, 25.97281°/ 98.68339°.

Diagnosis. Adults of this species (Fig. 20a) can be distinguished from those of other species in the region by the following combination of character states: size moderate, BL male = 9.0–10.0 mm, female = 9.6–10.2 mm; dorsum of head and pronotum black or dark piceous, elytra with bright green or blue-green metallic reflection; genal ridge evident basal to post-temporal constriction but extended only to or slightly anterior to the constriction (Fig. 10b); antennomeres 3 and 4 glabrous except for apical whorl of setae, antennomeres 1 through 4 concolorous, pale rufous; pronotum anterior to sub-basal constriction (Fig. 7d) globose in dorsal view, basolateral setae absent; elytral silhouette ovoid, with humeri indistinct; metatrochanters unisetose; male protarsi with tarsomeres 1 to 3 with ventral pads of adhesive setae; male genitalia as in Fig. 21, with median lobe slightly shorter and thicker and apical lamella more symmetrically rounded in lateral view.

Comments. As noted in the Comments section for *B. bicoloratum*, this is one of four species in the study area members of which have the elytra with distinct metallic reflection but the forebody (head and pronotum) without metallic reflection or with that reflection confined to the pronotal area anterior to the anterior transverse impression. Specimens of *B. gaoligongense* can be distinguished from those of *B. viridicollare* in having the pronotum globose and without a trace metallic reflection (pronotum more elongate and with the area anterior to the anterior transverse impression with a distinct metallic green reflection in *B. viridicollare*), the elytral microsculpture effaced (finely impressed but distinct in *B. viridicollare*), the parascutellare pore puncture inserted near the base of stria 3 (stria 2 in *B. viridicollare*), and the median lobe of the male genitalia shorter and more evenly arcuate (Fig. 21c) (longer and less arcuate in apical third (Fig. 35c) in *B. viridicollare*). They differ from specimens of *B. bicoloratum* in having the metatrochanters unisetose (asetose in most *B. bicoloratum*, but one seta present unilaterally in a few specimens), the parascutellar setiferous pore inserted near the base of stria 3 (near base of stria 2 in most *B. bicoloratum* specimens), the eyes (Fig. 7d) slightly less convex (more convex in *B. bicoloratum* (Fig. 7c)), and the median lobe of male genitalia slightly narrower and with the apical lamella slightly more expanded apically (median lobe slightly thicker and with a slightly narrower apical lamella (Fig. 16c) in *B. bicoloratum*). They differ from members of *B. gongshanense* in having the elytra with a distinct metallic green reflection (metallic reflection distinctly more bluish in *B. gongshanense*), the parascutellar seta inserted at the base of stria 3 (stria 2 in *B. gongshanense*), and the metatrochanter unisetose (asetose *B. gongshanense*).

As noted above in the Comments section for *B. bicoloratum*, among *Broscosoma* species known from outside the study area, only *B. monticola* has members with the forebody lacking metallic reflection and the elytra with markedly metallic reflection as is seen in *B. gaoligongense* specimens. They also also have the parascutellar seta inserted near the base of stria 3; but they have the femora slightly paler and the median lobe of the male genitalia with a large protuberance on the ventral margin (see Habu 1973, fig. 6), which is absent from the median lobe of *B. gaoligongense* males.

Habitat distribution. A few members of this species were found under stones on organic substrate along the edges of the roadcut through bamboo and *Rhododendron* thickets (Fig. 44a) on both

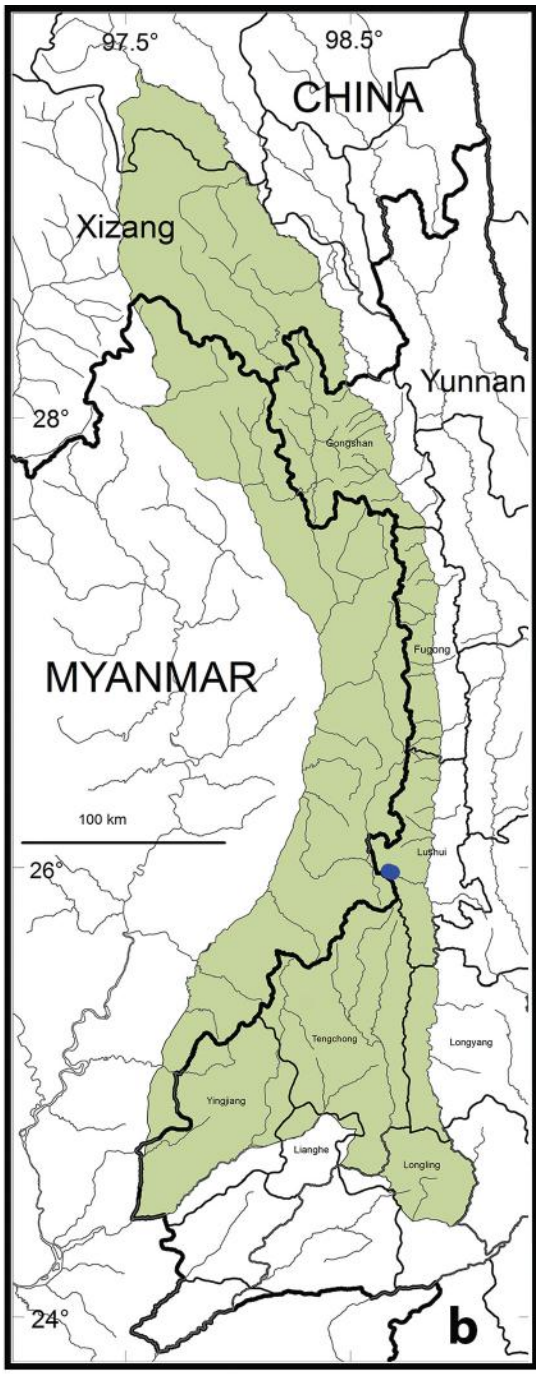


FIGURE 20. *Broscosoma gaoligongense* Deuve and Wrase. a. Habitus (CASENT1027285; just W of Fenxue Yakou, Pianma Township, County, Yunnan, China), dorsal aspect, scale line = 1.0 mm; b. Map showing locality records (blue circles) for this species in the Gaoligong Shan region, scale line = 100 km.

FIGURE 21. Male genitalia, *Broscosoma gaoligongense* Deuve and Wrase. (CASENT1027154; just W of Fenxue Yakou, Pianma Township, County, Yunnan, China). a. Right paramere, lateral aspect; b. Left paramere, lateral aspect; c. Median lobe, left lateral aspect; d. Median lobe, ventral aspect; scale line = 1.0 mm.

sides of the pass (Fengxue Yakou) during the day. The majority of specimens were collected at night, with the aid of headlamps, where they were found active on the surface of the ground, especially on mosses, in thickets and on the banks of the roadcut. This species is found at moderately high elevations, with our records documenting its occurrence in the 3120 to 3150 m range (Fig. 49).

Geographical distribution within the Gaoligong Shan. Fig. 20b. We examined a total of 35 specimens (23 males and 12 females) from the following localities: ***Lushui County:*** Luzhang Township (Pianma road at Fengxue Yakou, 25.97228º/098.68336º, 3150m, 11 May 2005, D.H. Kavanaugh, H.B. Liang, C E. Griswold, D.Z. Dong & K.J. Guo collectors [one male; CAS]; Fengxue Yakou to 0.5 km E on Pianma Road, 25.97288°/98.68336° to 25.97347°/98.68780°, 3130-3150 m, 17 May 2005, D. Kavanaugh, C.E. Griswold, H.B. Liang, & D.Z. Dong collectors [one female, IOZ]); Pianma Township (Fengxue Yakou to 0.6 km W on Pianma Road, 25.97228º/98.68336º to 25.974108º/98.67716º, 3120-3150 m, 17-19 May 2005, D. Kavanaugh, C.E. Griswold, H.B. Liang, D.Z. Dong & K.J. Guo collectors [22 males and 11 females; CAS, IOZ]).

Members of this species were collected only in Lushui County on the crest of the Gaoligong Shan in the southcentral part of the study area, an area that staddles Core Areas 4 and 5 (Fig. 48).

Overall geographical distribution. This species currently is known only from the type locality and its immediate environs in Lushui County on the crest of the southcentral part of the Gaoligong Shan, in western Yunnan Province, China.

Geographical relationships with other *Broscosoma* species. Members of this species have been found syntopic only with those of *Broscosoma ribbei* at and around the type locality (Fig. 50).

7. *Broscosoma gongshanense* Kavanaugh and Liang, sp. nov.
Figures 7e, 22, 23, 42a, 48-50

Type material. Holotype, a male, in IOZ, labeled: "CASENT 1026430"/ "CHINA, Yunnan Province, Gongshan County, Cikai Township, 2.0 airkm S Heipu Yakou in cirque at head of Pula valley, 3350m" / "N27.75442º/E098.45639º, 12 August 2006, Stop #DHK2006-070, D.H. Kavanaugh, J. A. Miller collectors"/ "HOLOTYPE *Broscosoma gongshanense* Kavanaugh & Liang sp. nov. designated 2021" [red label]. Paratypes (a total of five): one male and two females (CAS, IOZ) labeled: same as holotype except first label "CASENT 1026439" and "CASENT 1026439" to "CASENT 1026439", respectively; one male and one female (CAS, IOZ) labeled: "CASENT 1008139" and "CASENT 1006244", respectively/ "CHINA, Yunnan Province, Gaoligong Shan, Nujiang Prefecture, Nujiang State Nature Reserve, Dulong/Gongshan Yakou area, 21 airkm W of Gongshan" / "N27.69655º/E098.45389º, 3300-3680m, 16-17 July 2000, Stop #00-24C, D.H. Kavanaugh, C.E. Griswold, H.-B. Liang, D. Ubick & D.-Z. Dong collectors". All paratypes also bear the following label: "PARATYPE *Broscosoma gongshanense* Kavanaugh & Liang, sp. nov. designated 2021" [yellow label].

Type locality. China, Yunnan Province, Gongshan County, Cikai Township, Heipu Yakou area.

Derivation of species name. The species epithet, *gongshanense*, is an adjective derived from the name of the county, Gongshan, in which all members of the type series were collected, and the Latin suffix, *-ensis*, denoting place.

Diagnosis. Adults of this species (Fig. 22a) can be distinguished from those of other species in the region by the following combination of character states: size moderate, BL = 9.5 to 9.9 mm; head and pronotum black to piceous, without a trace of metallic reflection; head with tempora straight or only slightly convex behind eyes; genal ridge evident, extended from base of head to ventral margin of eye (as in Fig. 10a); antennomeres 3 and 4 glabrous except for apical whorl of setae; pronotum anterior to sub-basal constriction slightly longitudinally ovoid in dorsal view (Fig. 7e), lateral margination absent or developed only posterior to sub-basal constriction, basolateral setae absent; elytral silhouette ovoid, with humeri indistinct, elytral microsculpture effaced; metatrochanter asetose; male protarsi with tarsomeres 1 to 3 with ventral pads of adhesive setae; male genitalia as in Fig. 23.

Description. Fig. 22a. Size medium, BL male = 9.5–9.8 mm, female = 9.5–9.9 mm, ratio EL/PL male = 2.1, female = 2.2–2.3. Body color black or dark piceous, last visible abdominal sternite dark brown or rufous brown, antennae with antennomeres 3 and 4 black or piceous, antennomeres 1 and 2 and 5 to 11 rufous brown. Femora and tibiae piceous or dark brown, tarsi rufous brown. Head and pronotum without metallic reflection, elytra with distinct blue or greenish-blue metallic reflection, venter without metallic reflection.

Head. Fig. 7e. Eyes medium-sized, their diameter equal to or slightly greater than length of tempora. Frontal furrows deeply impressed, narrow, short, linear, distinctly divergent posteriorly, and extended posteriorly to middle of eyes, or medium length, arcuate, slightly convergent anteriorly and posteriorly, and extended posteriorly beyond middle of eyes, faintly rugulose, impunctate. Vertex with post-temporal transverse sulcus deep, sharply defined, moderately or sparsely and finely punctate. Tempora obliquely convex. Genal ridges distinctly present from posterior region of head to ventral margins of eyes. Clypeus with one pair of setae. Supraorbital setae present, one pair. Eustipes of maxilla with two setae, the dorsobasal seta distinctly more than half as long as ventrobasal seta. Mentum with tooth present, simple, paramedial region shallowly foveate, one pair of mental setae present. Glosal sclerite (ligula) with one pair of setae. Submentum with one or two

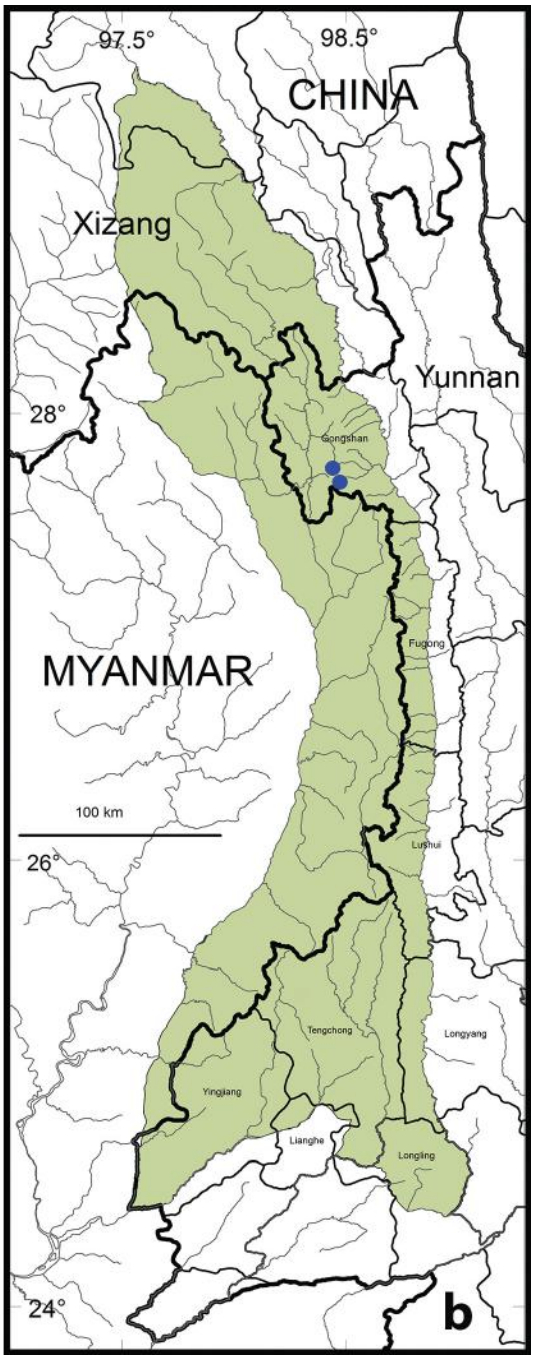


FIGURE 22. *Broscosoma gongshanense* sp. nov. a. Habitus (CASENT1008139; Dongshaofang area, Gongshan County, Yunnan, China), dorsal aspect, scale line = 1.0 mm; b. Map showing locality records (blue circles) for this species in the Gaoligong Shan region, scale line = 100 km.

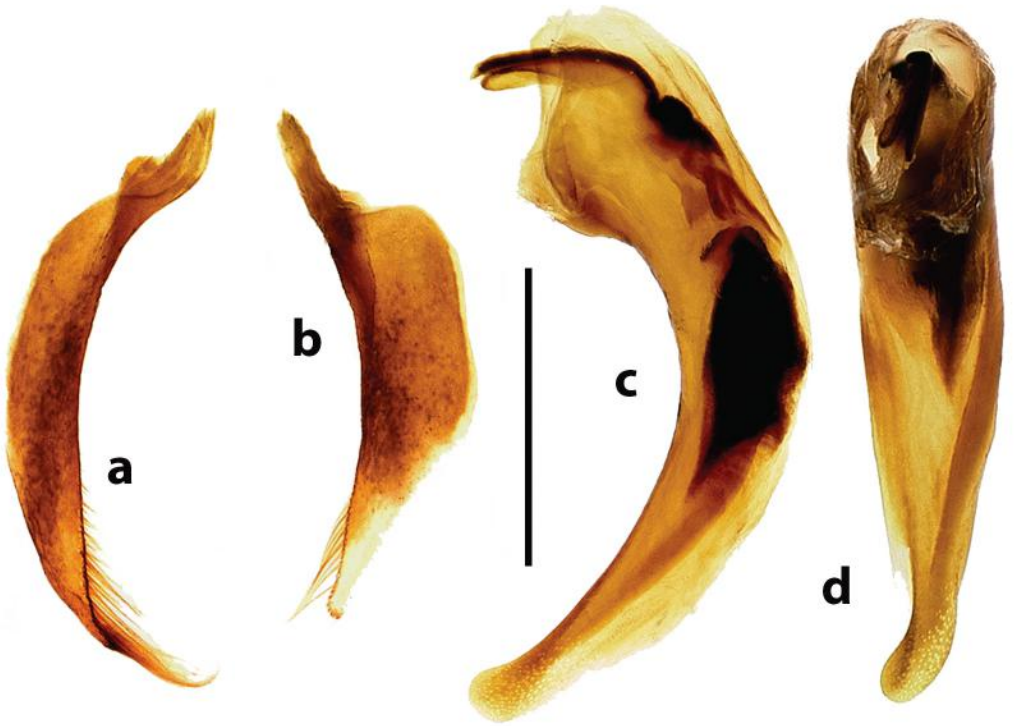


FIGURE 23. Male genitalia, *Broscosoma gongshanense* sp. nov. (CASENT1026429; 2.0 km S of Heipu Yakou, Cikai Township, Gongshan County, Yunnan, China). a. Right paramere, lateral aspect; b. Left paramere, lateral aspect; c. Median lobe, left lateral aspect; d. Median lobe, ventral aspect; scale line = 1.0 mm.

pairs of setae. Gula without transverse grooves. Antennomeres 3 and 4 without pubescence, ratio A3/A5 = 1.1–1.2.

Pronotum. Fig. 7e. Globose anterior to sub-basal constriction with base distinctly pedunculate, widest at middle of discal region, ratio PL/PW = 1.2–1.3, disk markedly convex; apical margination absent, lateral margination present, narrow, delineated only on base; basal margination absent; anterior transverse impression absent or shallow and indistinct; median longitudinal impression distinct, but fine and shallowly impressed; posterior transverse impression deep, sharply delineated; anterior region smooth; pronotal base coarsely punctate and rugulose; one pair of midlateral pronotal setae present at mid-length of discal region; basolateral pronotal setae absent.

Elytra. Elytral silhouette ovoid, widest at middle, ratio EL/EW male = 1.4–1.5, female = 1.5–1.6, greatest elevation above lateral margin (in lateral view) posterior to middle; humeri narrow, sloped, indistinct; lateral margins markedly arcuate or markedly arcuate and faintly angulate subbasally; parascutellar striole present, short, distally merged in a distinct jog with free base of stria 1. Eight striae present; stria 1 moderately deeply and sharply impressed, striae 2 to 3, 4, or 5 moderately impressed in basal two-thirds of striae and successively more shallowly impressed in apical third, striae 2 to 8 successively more shallowly impressed laterally and apically, striae obliterated apical and laterally in some specimens, striae 8 merged with lateral groove throughout its length or nearly so; stria 1 coarsely and moderately densely punctate, striae 2 and 3 or 4 moderately to coarsely punctate in basal half and successively more shallowly and sparsely punctate in

apical half, striae 4 or 5 to 8 successively more finely punctate or impunctate laterally and apically. Elytral microsculpture effaced. Parascutellar seta present at base of stria 2, discal setae absent, umbilicate series comprised of one post-humeral and two preapical setae.

Hindwings. Vestigial, incapable of supporting flight.

Thoracic venter. Metepisternum ratio ML/MW = 1.5–1.9.

Legs. Hind trochanter asetose. Tarsomeres without dorsal pubescence; tarsomere 5 with two or more pairs of setae ventrally; male protarsi with pads of adhesive setae on tarsomeres 1 to 3 ventrally, male mesotarsi with pads of adhesive setae on tarsomeres 1 and 2 ventrally.

Abdomen. Sternite VI of male with two or three pairs of apicoparamedial setae, female with one pair of setae.

Male genitalia. As in Fig. 23.

Comments. As noted in the Comments section for *B. bicoloratum*, this is one of four species in the study area members of which have the elytra with distinct metallic reflection but the forebody (head and pronotum) without metallic reflection or with that reflection confined to the pronotal area anterior to the anterior transverse impression. Its members can be distinguished from those of *B. viridicollare* in having smaller body size, the eyes less convex and tempora straight or faintly convex (distinctly convex, subangulate *B. viridicollare*), the pronotum without a trace of metallic reflection (band of metallic green reflection present anterior to anterior transverse impression *B. viridicollare*), the elytral microsculpture effaced (finely but distinctly impressed in *B. viridicollare*), and the median lobe of the male genitalia shorter and more evenly arcuate. They differ from members of *B. bicoloratum* in having the eyes less convex, the tempora shorter and nearly straight (tempora longer and distinctly more convex in *B. bicoloratum*), and the discal portion of the pronotum very slightly more elongate (more globose *B. bicoloratum*). They differ from members of *B. gaoligongense* in having the tempora slightly less convex, the parascutellar seta inserted near the base of stria 2 (stria 3 in *most B. gaoligongense*), the metatrochanter asetose (unisetose *B. gongshanense*), and the median lobe of the male genitalia relatively shorter and with sclerites of the internal sac of different shapes.

As noted above in the Comments sections for *B. bicoloratum* and *B. gaoligongense*, among *Broscosoma* species known from outside the study area, only *B. monticola* has members of similar size and with the forebody lacking metallic reflection and the elytral with markedly metallic reflection as is seen in *B. gongshanense* specimens. However, they have the parascutellar seta inserted near the base of stria 3 (stria 2 in *B. gongshanense*), the femora slightly paler, and the median lobe of the male genitalia with a large protuberance on the ventral margin (see Habu 1973, fig. 6), which is absent from the median lobe of *B. gongshanense* males.

Habitat distribution. Members of this species have been found under stones along trails through bamboo and *Rhododendron* thickets and in moist alpine meadow areas (Fig. 42a) at or near the crest of the range. Our records document occurrence of this species at moderately high elevations in the 3350 to 3680 m range (Fig. 49).

Geographical distribution within the Gaoligong Shan. Fig. 22b. We examined a total of six specimens (three males and three females), all from at or near the crest of the range in Gongshan County. We recorded this species only from the crest and adjacent slopes to the east in Core Area 2 (Fig. 48), but it probably also occurs on the western side at equivalent elevations in Core Area 1.

Overall geographical distribution. This species currently is known only from the northcentral part of the Gaoligong Shan, in western Yunnan Province, China.

Geographical relationships with other *Broscosoma* species. Members of this species have been found together only with those of *Broscosoma bicoloratum* at one or more sites (Fig. 50). *Broscosoma ribbei* occurs in the same general area but mainly at lower elevations.

8. *Broscosoma holomarginatum* Kavanaugh and Liang, sp. nov.
Figures 6a, 9a, 24, 25, 44b, 47-50

Type material. Holotype: a male, in IOZ, labeled: "CASENT 1015162"/ "CHINA, Yunnan, Gongshan County, Dulongjiang Township, Kongdang, 1525 m, N27.87696°/E098.33587°,"/ "5 November 2004, Stop # LHB-2004-047, H.-B. Liang collector"/ "HOLOTYPE *Broscosoma holomarginatum* Kavanaugh & Liang sp. nov. designated 2021" [red label]. Paratypes (a total of 19): two females (CAS, IOZ), labeled: same as holotype except first label: "CASENT 1015163" and "CASENT 1015164", respectively; one female (IOZ) labeled: "CASENT 1016688"/ "CHINA, Yunnan, Gongshan County, Dulongjiang Township, 0.5km N of Kongdang, 1500m, N27.88111º/E098.34063º, 25 October 2004"/ "Stop #DHK-2004-057B, D.H. Kavanaugh, H.-B. Liang, & D.-Z. Dong collectors"; two males (CAS, IOZ) labeled: "CASENT 1014588" and "CASENT 1014589", respectively/ "CHINA, Yunnan, Gongshan County, Dulongjiang Township, 0.5km N of Kongdang, 1500m, N27.88111º/E098.34063º, 25 October 2004"/ "Stop #DHK-2004-057C, D.H. Kavanaugh, Q.B. Hou, H.B. Liang, D.Z. Dong & G. Tang collectors"; one male and four females (CAS, IOZ) labeled: "CASENT 1016748" and "CASENT 1016744" to "CASENT 1016747", respectively/ "CHINA, Yunnan, Gongshan County, Dulongjiang Township, 0.5km N of Kongdang, 1500m, N27.88111º/E098.34063º, 25 October 2004"/ "Stop #DHK-2004-057D, D.H. Kavanaugh, Q.B. Hou, H.B. Liang collectors"; one male (CAS) labeled: "CASENT 1025538"/ "CHINA, Yunnan, Gongshan County, Dulongjiang Township, Maku village along old road through village, N27.68804º/E098.30758º"/ "1615m, 3 September 2006, Stop DHK-2006-120, D.H. Kavanaugh, Y. Liu, S.Z Ma & P. Hu collectors"; four males and three females (CAS, IOZ) labeled: "CASENT 1000600" to "CASENT 1000603" and "CASENT 1000604" to "CASENT 1000606", respectively/ "CHINA, Yunnan Province, Gaoligongshan Mountains, Nujiang Prefecture, Gangfang Sancha Lukou, 26º073´N/98º34.5´E"/ "1500m, 14-15 October 1998, Stop #98-117C, D.H. Kavanaugh, C.E. Griswold, C. Ferraris & C.-L. Long collectors"; one male (IOZ) labeled: "China, Tibet, Medog, 81.5km on Medog road, N29.65650, E95.49348"/ "2023m, 2020.9.17 N, Liang H.B, Xu Y. coll., Inst. Zool., Chinese Acad. Sci.". All paratypes also bear the following label: "PARATYPE *Broscosoma holomarginatum* Kavanaugh & Liang, sp. nov. designated 2021" [yellow label].

Type locality. CHINA, Yunnan, Gongshan County, Dulongjiang Township, Kongdang.

Derivation of species name. The species epithet, *holomarginatum*, is an adjective derived from the Greek word, *holos*, meaning whole or entire, and the Latin word, *marginatus*, meaning bordered or enclosed with a border. The name refers the complete lateral margination (or lateral bead) of the pronotum found in members of this species.

Diagnosis. Adults of this species (Fig. 24a) can be distinguished from those of other species in the region by the following combination of character states: size moderate, BL = 8.1 to 9.5 mm; dorsal surface with distinct blue or blue-green luster, legs pale rufous; antennomeres 3 and 4 glabrous except for apical whorl of setae; pronotum with lateral margination (lateral bead) complete between apical and basal margins (Fig. 9a), basolateral setae absent; elytral silhouette subparallel to subovoid, with humeri distinct, elytral microsculpture distinct, comprised of isodiametric to slightly longitudinally stretched sculpticells; male protarsi with tarsomeres 1 to 3 with ventral pads of adhesive setae; male genitalia as in Fig. 25.

Description. Fig. 24a. Size small to medium, BL male = 8.5–9.3 mm, female = 8.1–9.5 mm, ratio EL/PL male = 2.1–2.3, female =2.1–2.3. Body color black or dark piceous, last visible abdominal sternite rufous brown, or rufous basally graded to pale yellow apically, antennae with all antennomeres pale rufous, femora, tibiae and tarsi pale rufous. Head with green, pronotum with blue or

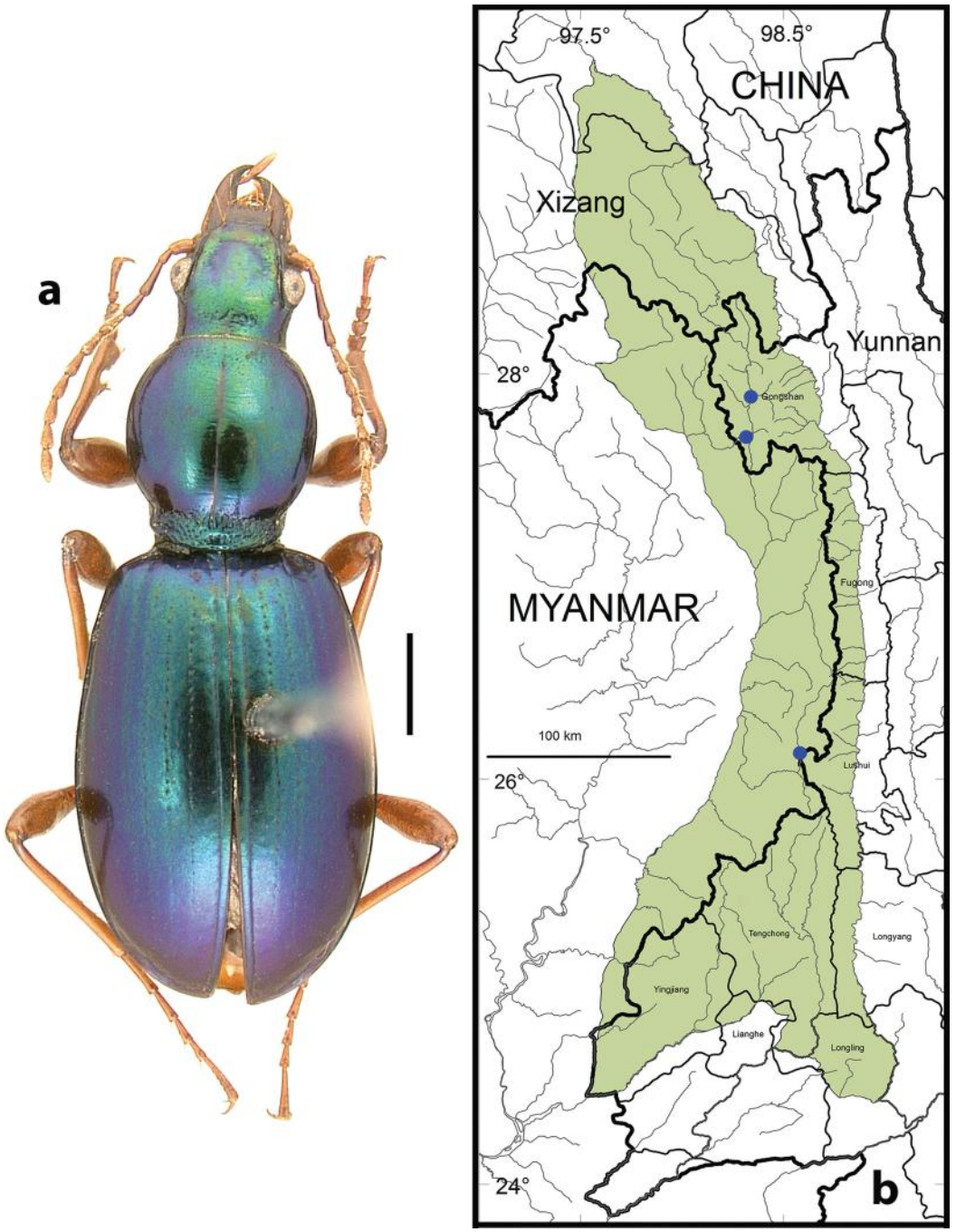


FIGURE 24. *Broscosoma holomarginatum* sp. nov. a. Habitus (CASENT1015162; 0.5 km N of Kongdang, Dulongjiang Township, Gongshan County, Yunnan, China), dorsal aspect, scale line = 1.0 mm; b. Map showing locality records (blue circles) for this species in the Gaoligong Shan region, scale line = 100 km.

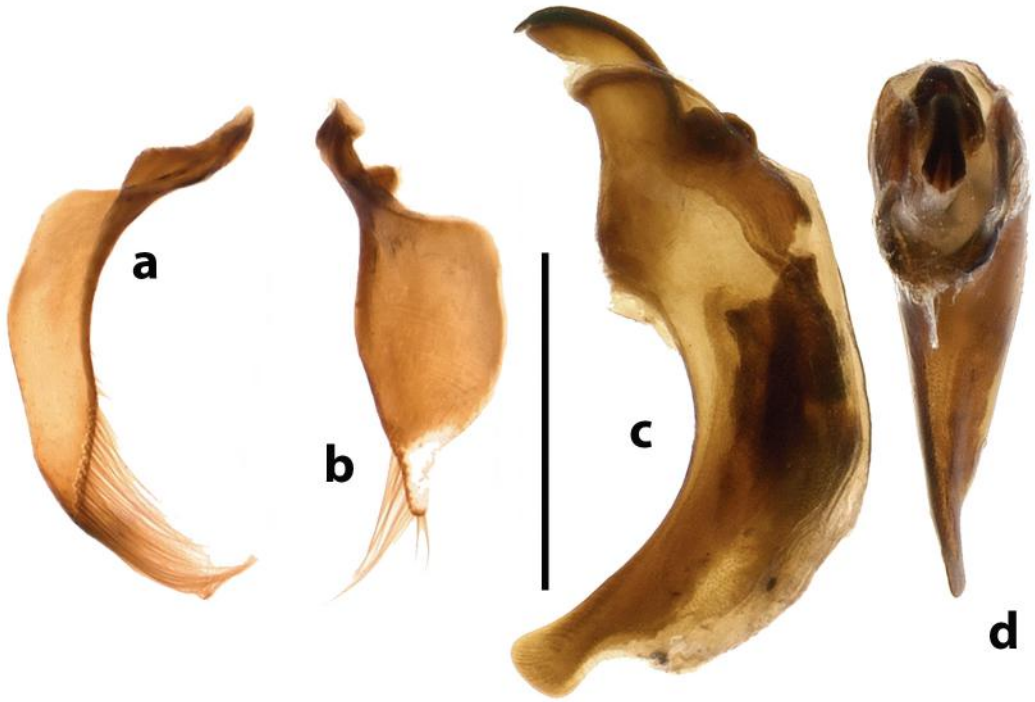


FIGURE 25. Male genitalia, *Broscosoma holomarginatum* sp. nov. (CASENT1016743; 0.5 km N of Kongdang, Dulongjiang Township, Gongshan County, Yunnan, China). a. Right paramere, lateral aspect; b. Left paramere, lateral aspect; c. Median lobe, left lateral aspect; d. Median lobe, ventral aspect; scale line = 1.0 mm.

bluish-green, and elytra with marked blue metallic reflection, venter with metallic reflection absent or only faintly present.

Head. Fig. 6a. Eyes large, convex, their diameter slightly greater than length of tempora. Frontal furrows deeply impressed, narrow, arcuate, slightly convergent anteriorly and posteriorly, medium length, extended posteriorly to middle of eyes, rugulose and sparsely and coarsely punctate. Vertex with post-temporal transverse sulcus shallow, densely and coarsely punctate. Tempora straight, not convex. Genal ridges present, restricted to head region distinctly behind post-temporal constriction. Clypeus with one pair of setae. Supraorbital setae present, one pair. Eustipes of maxilla with two setae, the dorsobasal seta distinctly more than half as long as ventrobasal seta. Mentum with tooth present, simple, paramedial region shallowly foveate, one pair of mental setae present. Glossal sclerite (ligula) with one pair of setae. Submentum with one or two pairs of setae. Gula without transverse grooves. Antennomeres 3 and 4 without pubescence, ratio A3/A5 = 1.2–1.3.

Pronotum. Fig. 6a. Globose anterior to sub-basal constriction with base distinctly pedunculate, widest at middle of discal region, PL/PW = 1.1, disk markedly convex; apical margination absent; lateral margination present, narrow, distinctly delineated throughout pronotal length (Fig. FX09a); basal margination absent; anterior transverse impression shallow, broad and vaguely delineated, coarsely punctate both at bottom and on slopes of depression; median longitudinal impression moderately impressed; posterior transverse impression deep, sharply delineated; anterior region moderately to densely and coarsely punctate; pronotal base coarsely punctate and rugulose; one

pair of midlateral pronotal setae present at mid-length of discal region; basolateral pronotal setae absent.

Elytra. Elytral silhouette subovoid, slightly narrowed in basal half, widest at or slightly posterior to middle, ratio EL/EW in males = 1.5, in female = EL/EW 1.6, greatest elevation above lateral margin (in lateral view) posterior to middle; humeri distinctly present, roundly obtuse; lateral margins moderately arcuate and nearly straight in anterior half sub-basally; parascutellar striole present, short, distally merged in a distinct jog with free base of stria 1. Eight elytral striae present; stria 1 deeply and sharply impressed, striae 2 to 8 indistinct, obliterated or represented by extremely fine and shallow linear depressions, successively less evident laterally and apically, striae 8 merged with lateral groove throughout its length or nearly so; stria 1 moderately punctate at least in basal half, striae 2 to 8 densely and moderately punctate, but with punctures increasingly shallower and sparser laterally and apically. Elytral microsculpture comprised of distinct, deeply to shallowly impressed isodiameteric sculpticells. Parascutellar seta present at base of stria 2, discal setae absent, umbilicate series comprised of one post-humeral and two preapical setae.

Hindwings. Full-sized, functional.

Thoracic venter. Metepisternum ratio ML/MW = 2.2–2.3.

Legs. Hind trochanter asetose. Tarsomeres without dorsal pubescence; tarsomere 5 with two or more pairs of setae ventrally; male protarsi with pads of adhesive setae on tarsomeres 1 to 3 ventrally, male mesotarsi with pads of adhesive setae on tarsomeres 1 and 2 ventrally.

Abdomen. Sternite VI of both male and female with one pair of apicoparamedial setae.

Male genitalia. As in Fig. 25.

Comments. This is apparently the only species in genus *Broscosoma* in which members have the pronotum with complete and well-defined lateral margination (Fig, 9a). Lateral margination is also present *B. resbecqi*, in which it is nearly complete but interrupted in the basal one-third of the discal region (Fig, 9b), and in most specimens of *B. ribbei*, in which it is present in the area of insertion of the midlateral seta and extended slightly anteriorly and posteriorly in a some specimens (Fig, 9b). Members of both of these species have the dorsum with vivid green metallic reflection, whereas *B. holomarginatum* members are distinctly blue or greenish-blue dorsally. The left paramere of the male genitalia (Fig. 25b) is unusual for a *Broscosoma* species and similar only to that of *B. resbecqi* males among species of the region.

Habitat distribution. Within the study area, members of this species have been found under stones on the upper sandy beaches of rivers (Fig. 44b) and along roadcuts with sandy soil during daytime. Adults are active on the surface at night, along roadcuts on moist sandy substrate stabilized by mosses and on open, sandy river beaches, where they congregate near or on boulders surrounded by sand, especially on boulders covered with mosses. Most of these sandy flats have little cover under which these beetles can hide during the day, so it seem likely that many spend daylight hours burrowed in the sand itself. Within the Gaoligong Shan region, this species occurs at relatively low elevations, with our records documenting its occurrence in the 1500 to 1615 m range (Fig. 49). The record from Medog (Tibet) is from a slightly higher elevation of 2023 m.

Geographical distribution within the Gaoligong Shan. Fig. 24b. We examined a total of 20 specimens (ten males and ten females) from the northern and southcentral parts of the Gaoligong Shan in Gongshan and Lushui Counties. Our records from both areas are on the western side of the range (in Core Areas 1 and 4, respectively (Fig. 48) (see Type material above for exact collection data).

Overall geographical distribution. Fig. 47. This species has been recorded only from Gongshan and Lushui Counties in Yunnan and Medog County in Xizhang (Tibet). Its occurrence in the study area represents the southern part its geographical range.

Geographical relationships with other *Broscosoma* species. Within the study area, members of this species have been found together with those of *Broscosoma purpureum* (described below) and *B. ribbei* at one or more sites (Fig. 50). In Medog County, Xizang (Tibet), they have been found syntopic with members of *B. ribbei* and another (undescribed) *Broscosoma* species.

9. *Broscosoma parvum* Kavanaugh and Liang, sp. nov.
Figures 6f, 26, 27, 45a, 48-50

Type material. Holotype, a male, in IOZ, labeled: "CASENT 1022788"/ "CHINA, Yunnan, Fugong County, Lumadeng Township, 8.5 km above Shibali on Shibali road, North Fork of Yamu He" / "N27.18326º/E098.72002º, 3100m, 9 May 2004, Stop #DHK2004-042, D.H. Kavanaugh & H.B. Liang collectors"/ HOLOTYPE *Broscosoma furvum* Kavanaugh & Liang sp. nov. designated 2021" [red label]. Paratypes (a total of 6): one female (IOZ) labeled: same as holotype except first label "CASENT 1022789"; one male (CAS) labeled: "CASENT 1023771"/ "CHINA, Yunnan, Fugong County, Lumadeng Township, 8.5 km above Shibali on Shibali road, North Fork of Yamu He" / "N27.18326º/E098.72002º, 3100m, 7 May 2004, Stop #DHK2004-038B, D.H. Kavanaugh collectors"; one male and one female (CAS, IOZ) labeled: "CASENT 1019759" and "CASENT 1019754", respectively "CHINA, Yunnan, Fugong County, Lumadeng Township, 8.5 km W of Shibali on Shibali road, south bank of North Fork Yamu He" / "N27.18315º/E098.71921º, 3100-3200m, 16 August 2005, Stop #DHK2005-090, D.H. Kavanaugh & H.B. Liang collectors"; one female (CAS), "CHINA, Yunnan, Fugong County, Lumadeng Township, 8.5 km W of Shibali on Shibali road, south bank of North Fork Yamu He, N27.18326º/E098.72002º" / "3100m, 8 August 2005, Stop #DHK2005-067B, D.H. Kavanaugh & H.B. Liang, D.Z. Dong & J.F. Zhang collectors"; one male (CAS) labeled: "CASENT1023565"/ "CHINA, Yunnan, Fugong County, Lishadi Township, 11.5 km above Shibali on Shibali road, N27.20676º/E098.71763º"/ "3290m, 6 May 2004, Stop #DHK-2004-036, D.H. Kavanaugh, C. E. Griswold, Liang H.-B., Li X.-Y. & Zhu B.-X. collectors". All paratypes also bear the following label: "PARATYPE *Broscosoma parvum* Kavanaugh & Liang, sp. nov. designated 2021" [yellow label].

Type locality. China, Yunnan, Fugong County, Lumadeng Township, 8.5 km W of Shibali on Shibali road, North Fork of Yamu He, 27.18326º/98.72002º, 3100m.

Derivation of species name. The species epithet, *parvum*, is an adjective derived from the Latin word, *parvus*, meaning small. The name refers to the relatively small body size of members of this species.

Diagnosis. Adults of this species (Fig. 26a) can be distinguished from those of other species in the region by the following combination of character states: size small, BL = 7.5 to 8.5 mm; dorsum with distinct metallic reflection, green on head, green or blue-green on pronotum, blue-green on elytra; antennomeres 3 and 4 glabrous except for apical whorl of setae; eyes (Fig. 6f) less convex, slightly flattened in some specimens; pronotum with basolateral setae absent; elytral silhouette ovoid, with greatest width at or near midlength, with humeri rounded yet slightly evident, two or more elytral striae impressed, all striae punctate with punctures diminishing in size and depth laterally and posteriorly, medial two or more elytral intervals very slightly to moderately convex; male protarsi with tarsomeres 1 to 3 with ventral pads of adhesive setae; male genitalia as in Fig. 27.

Description. Fig. 26a. Size small, BL male = 7.5-7.7 mm, female = 7.9-8.5 mm, ratio EL/PL male 2.2-2.4, female 2.3. Body color black or piceous, last visible addominal sternite dark brown or rufous brown, antennae with all antennomeres rufous brown, femora black or dark piceous, tibiae and tarsi rufous brown. Dorsum with distinct metallic reflection, green on head, green or blue-green on pronotum, and blue-green on elytra, venter without metallic reflection.

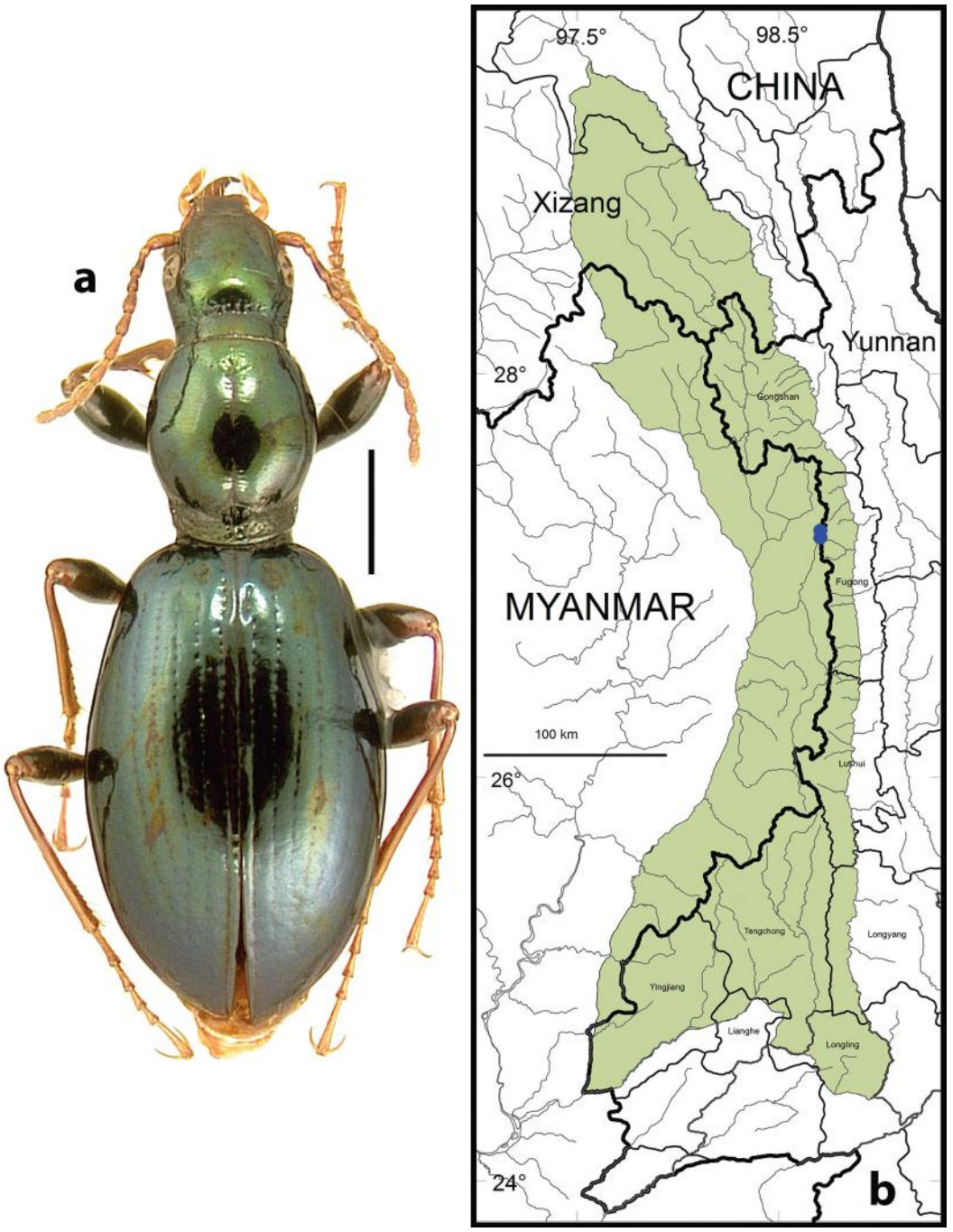


FIGURE 26. *Broscosoma parvum* sp. nov. a. Habitus (CASENT1020001; first cirque S of Shibali Yakou, Lumadeng Township, Fugong County, Yunnan, China), dorsal aspect, scale line = 1.0 mm; b. Map showing locality records (blue circles) for this species in the Gaoligong Shan region, scale line = 100 km.

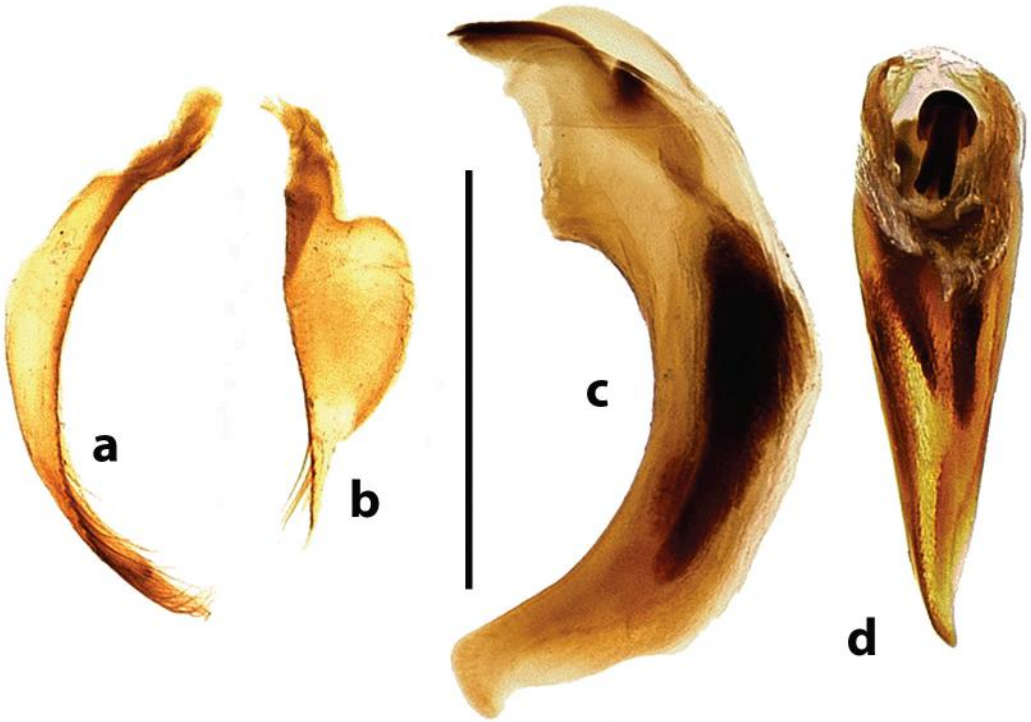


FIGURE 27. Male genitalia, *Broscosoma parvum* sp. nov. (CASENT1023565; 11.5 km above Shibali, Lishadi Township, Fugong County, Yunnan, China). a. Right paramere, lateral aspect; b. Left paramere, lateral aspect; c. Median lobe, left lateral aspect; d. Median lobe, ventral aspect; scale line = 1.0 mm.

Head. Fig. 6f. Eyes only slightly convex, slightly flattened, small, their diameter slightly less than length of tempora. Frontal furrows deeply impressed, narrow, linear, slightly divergent posteriorly, medium length, extended posteriorly to middle of eyes, smooth or faintly rugulose, impunctate. Vertex with post-temporal transverse sulcus deep, sharply defined, moderately punctate. Tempora straight, oblique. Genal ridges absent or restricted to head region distinctly posterior to post-temporal constriction. Clypeus with one pair of setae. Supraorbital setae present, one pair. Eustipes of maxilla with two setae, the dorsobasal seta distinctly more than half as long as ventrobasal seta. Mentum with tooth present, simple, paramedial region deeply foveate, one pair of mental setae present. Glosal sclerite (ligula) with one pair of setae. Submentum with two or three pairs of setae. Gula without transverse grooves. Antennomeres 3 and 4 without pubescence, ratio A3/A5 = 1.2.

Pronotum. Fig. 6f. Disc anterior to sub-basal constriction slightly narrow, slightly longitudinally ovoid in dorsal view with base distinctly pedunculate, widest at middle of discal region, ratio PL/PW = 1.2–1.3, disk markedly convex; apical, lateral, and basal margination absent; anterior transverse impression shallow, broad and vaguely delineated, impunctate or sparsely and coarsely punctate; median longitudinal impression moderately impressed; posterior transverse impression deep, sharply delineated; anterior region smooth; pronotal base coarsely and sparsely to densely punctate; one pair of midlateral pronotal setae inserted slightly anterior to mid-length of discal region; basolateral pronotal setae absent.

Elytra. Elytral silhouette subovoid, slightly narrowed in basal half, widest at or near middle, ratio EL/EW male and female = 1.6, greatest elevation above lateral margin (in lateral view) pos-

terior to middle; humeri faintly present, roundly obtuse; lateral margins moderately arcuate and nearly straight in anterior half sub-basally; parascutellar striole present, short, distally merged in a distinct jog with free base of stria 1. Eight striae present; stria 1 moderately deeply and sharply impressed, striae 2 to 3, 4, or 5 shallowly impressed in basal two-thirds of striae and successively more shallowly impressed to indistinct in apical third, striae 3 to 8 successively more shallowly impressed to indistinct or obliterated laterally and apically, striae 8 merged with lateral groove throughout its length or nearly so; stria 1 coarsely and moderately densely punctate at least in basal half, striae 2 to 3, 4, or 5 moderately punctate in basal two-thirds and successively more shallowly and sparsely punctate in apical third, striae 3 to 8 successively more shallowly and sparsely punctate laterally and apically. Elytral microsculpture comprised of very faintly impressed, nearly effaced isodiametric sculpticells. Parascutellar seta present at base of stria 2, discal setae absent, umbilicate series comprised of one post-humeral and two preapical setae.

Hindwings. Vestigial, incapable of supporting flight.

Thoracic venter. Metepisternum ratio ML/MW = 1.8–2.2.

Legs. Hind trochanters asetose. Tarsomeres without dorsal pubescence; tarsomere 5 with two or more pairs of setae ventrally; male protarsi with pads of adhesive setae on tarsomeres 1 to 3 ventrally, male mesotarsi with pads of adhesive setae on tarsomeres 1 and 2 ventrally.

Abdomen. Sternite VI of both male and female with one pair of apicoparamedial setae.

Male genitalia. As in Fig. 27.

Comments. Only four species in the study area have the full dorsum of the body with green metallic reflection. Members of *B. danzhuens*e are larger in size, have eyes that are more convex (Fig. 6e), the elytral silhouette slightly broader across the humeri and their greatest width distinctly posterior to midlength (at or very near midlength in *B. parvum*), elytra striae that are more finely punctate, and elytral intervals that are flat (at least some intervals slightly convex in *B. parvum*). The holotype of *B. resbecqi* is larger and has the pronotum with the discal portion relatively shorter and more globose (Fig. 6d) and lateral margination present and nearly complete (Fig. 9b) (absent from *B. parvum*), the femora pale rufous (darker in *B. parvum*), and the median lobe of the male genitalia much thicker (Fig. 31c) and with the apical lamella short and tapered to a narrowly rounded tip in lateral aspect (median lobe much thinner and the apical lamella slightly hooked dorsally in *B. parvum*). Members of *B. ribbei* are generally much larger and have the eyes distinctly more convex, the pronotum with the discal portion relatively shorter and more globose (Fig. 6b) and lateral margination incomplete but present in most specimens, at least in the vicinity of the midlateral setae and more extensively in some specimens, elytral microsculpture distinct, deeply to moderately impressed (very faintly impressed or effaced in *B. parvum*), the metatrochanters unisetose (unilaterally asetose in a few specimens) (asetose in *B. parvum*), and the median lobe of the male genitalia much longer, thinner, and with the apical lamella more symmetrically rounded in lateral aspect.

As noted in the Comments section for *B. danzhuense*, only two *Broscosoma* species known from outside the study area have members in which the elytral humeri are at least faintly evident (although in both they are less evident than in *B. parvum*) and the entire dorsum exhibits metallic green or bluish-green reflection. In members of *B. montreuili*, the forebody is a darker, less vivid metallic green than the elytra (both parts equally vivid or forebody lighter and more vivid in *B. parvum*), and in both *B. montreuili* and *B. tiani* body size is larger, the discal portion of the pronotum is more globose (narrower and more elongate in *B. parvum*), the elytra have striae 2 to 8 more faintly defined and finely punctate, and the median lobe of the male genitalia is longer, less arcuate and with the apical lamella either rounded apically or hooked ventrally (hooked dorsally in *B. parvum*).

Habitat distribution. Members of this species have been found under stones along small to medium-sized streams on moist organic substrate. Half of the specimens collected were found along a small snowmelt stream on a steep, north-facing slope (Fig. 45a). This species is found at moderately high elevations, with our records documenting its occurrence in the 3100 to 3290 m range (Fig. 49).

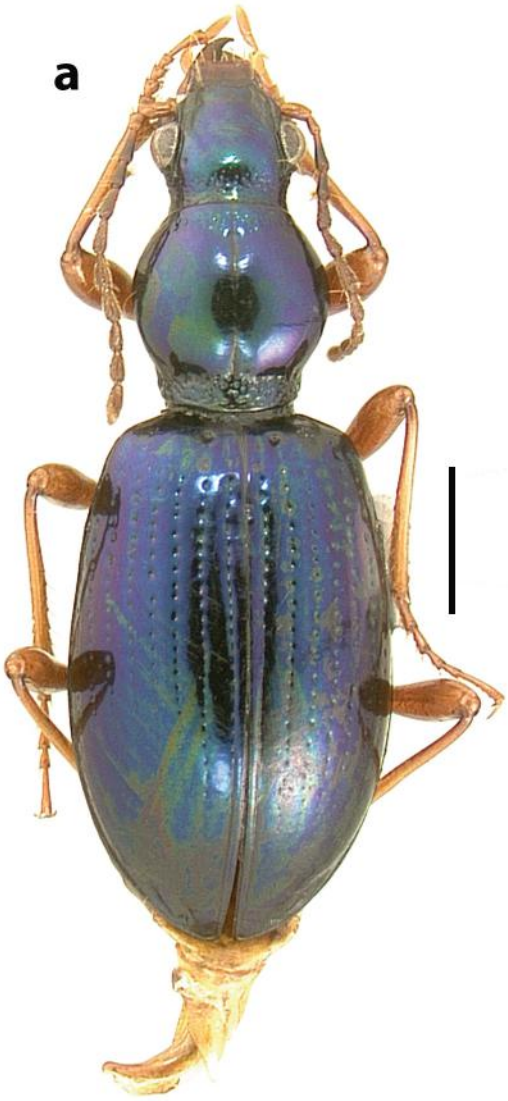
Geographical distribution within the Gaoligong Shan. Fig. 26b. We examined a total of seven specimens (four males and three females), all from the northcentral part of the Gaoligong Shan in Fugong County on the eastern side of the range in Core Area 3 (Fig. 48) (see Type material above for exact collection data).

Overall geographical distribution. This species currently is known only from the northcentral part of the Gaoligong Shan, in western Yunnan Province, China.

Geographical relationships with other *Broscosoma* species. Members of this species have been found together (syntopic) only with those of *B. viridicollare* at one or more sites (Fig. 50).

10. *Broscosoma purpureum* Kavanaugh and Liang, sp. nov.
Figures 6c, 9d, 10c, 28, 29, 45b, 48-50

Type material. Holotype, a male, in IOZ, labeled: "CASENT 1015338"/ "CHINA, Yunnan, Gongshan County, Dulongjiang Township, 0.5km N of Kongdang, 1500m, N27.88111º/E098.34063º,"/ "25 October 2004"/ "Stop #DHK-2004-057A, D.H. Kavanaugh collector"/ "HOLOTYPE *Broscosoma purpureum* Kavanaugh & Liang sp. nov. designated 2021" [red label]. Paratypes (a total of 52): one male and three females (CAS,IOZ) labeled: same as holotype except first label "CASENT 1015337" and "CASENT 1015339" to "CASENT 1015341", respectively; 18 males and eight females (CAS, IOZ) labeled: "CASENT 1014590" to "CASENT 1014602", "CASENT 1016705" to "CASENT 10116708" and "CASENT 10116730" and "CASENT 1014603" and "CASENT 1016709" to "CASENT 10116715", respectively/"CHINA, Yunnan, Gongshan County, Dulongjiang Township, 0.5km N of Kongdang, 1500m, N27.88111º/E098.34063º, 25 October 2004"/ "Stop #DHK-2004-057C, D.H. Kavanaugh, Q.-B. Hou, H.-B. Liang, D.-Z. Dong & G. Tang collectors"; three females (CAS, IZO) labeled: "CASENT 1017017" to "CASENT 1017019", respectively/ "CHINA, Yunnan, Gongshan County, Dulongjiang Township, 0.6 km N of Dizhengdang village on Dulong Jiang, N28.08442º/E098.32652º"/ "1880m, 29 October 2004, Stop #DHK-2004-061B, D.H. Kavanaugh, G. Tang & D.-Z. Dong collectors"; three males and three females (CAS, IOZ) labeled: "CASENT 1014626" to "CASENT 1014628" and "CASENT 1014629" to "CASENT 1014631", respectively/ "CHINA, Yunnan, Gongshan County, Dulongjiang Township, Bapo, 1412m, N27.73902º/E098.34975º"/ "26 October 2004, Stop #LHB-2004-033, H.-B. Liang collector"; one female (IOZ) labeled: "CASENT 1015009"/ "CHINA, Yunnan, Gongshan County, Dulongjiang Township, Bapo, Mulangdang, 1355m, N27.75256º/E098.34745º"/ "4 November 2004, Stop #LHB-2004-046, H.-B. Liang collector"; three males and two females (CAS, IOZ) labeled: "CASENT 1016094" to "CASENT 1016096" and "CASENT 1016097" to "CASENT 1016098", respectively/ "CHINA, Yunnan, Gongshan County, Dulongjiang Township, west bank of Dulongjiang at Elideng village, 1640m, N28.00287º/E098.32145º" / "3 November 2004, Stop #DHK-2004-073, D.H. Kavanaugh, G. Tang & D.-Z. Dong collectors"; two male and four females (CAS, IOZ) labeled: "CASENT 1015868" to "CASENT 1015869" and "CASENT 1015870" to "CASENT 10115874", respectively/ "CHINA, Yunnan, Gongshan County, Dulongjiang Township, Moqie Wang at Gongshan/Dulongjiang Road Km 91, 1550m, N27.90085º/E098.34721º" / "6 November 2004, Stop #DHK-2004-077, D.H. Kavanaugh & H.-B. Liang collectors"; 1 male,



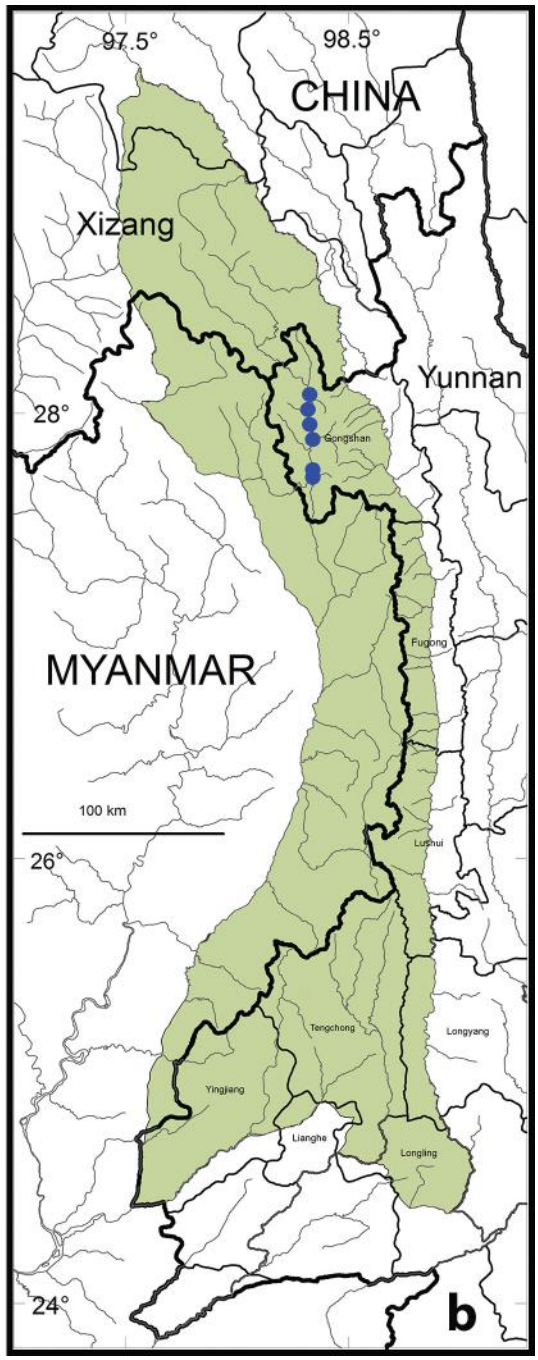


FIGURE 28. Broscosoma purpureum sp. nov. a. Habitus (CASENT1015338; 0.5 km N of Kongdang, Dulongjiang Township, Gongshan County, Yunnan, China), dorsal aspect, scale line = 1.0 mm; b. Map showing locality records (blue circles) for this species in the Gaoligong Shan region, scale line = 100 km.

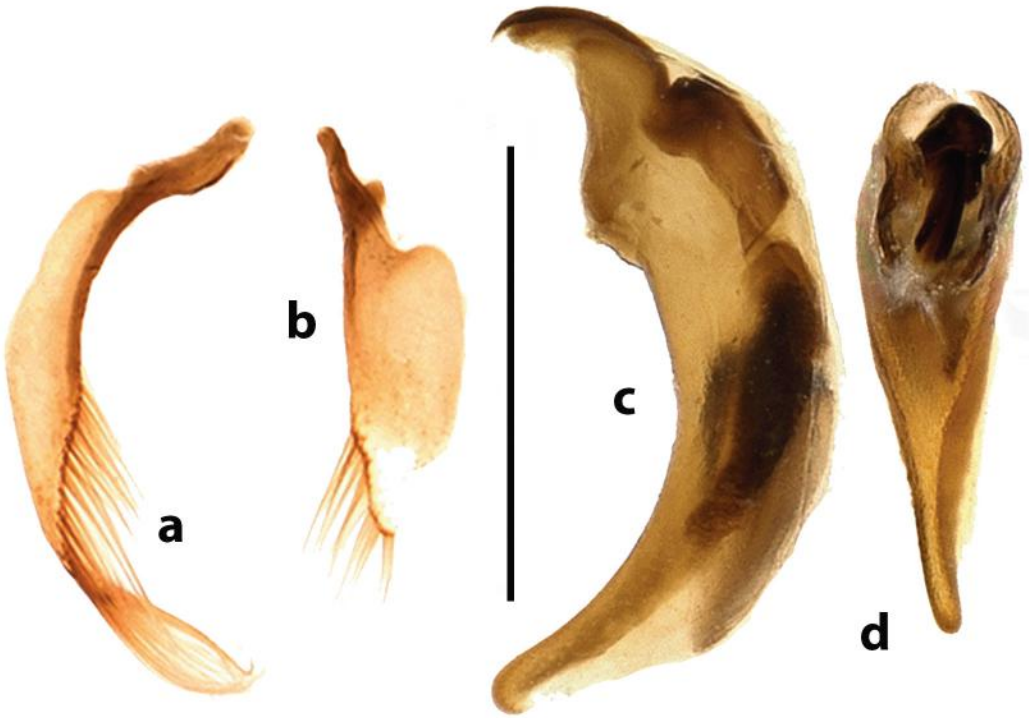


FIGURE 29. Male genitalia, *Broscosoma purpureum* sp. nov. (CASENT1015869; Moqie Wang, Dulongjiang Township, Gongshan Yunnan, China). a. Right paramere, lateral aspect; b. Left paramere, lateral aspect; c. Median lobe, left lateral Maspect; d. Median lobe, ventral aspect; scale line = 1.0 mm.

"CHINA, Yunnan, Gongshan County, Dulongjiang Township, Dulongjiang at Xianjiudang village, 1580m, N27.94092º/E098.33340º, 4 November 2004"/ "Stop #DHK-2004-074, D.H. Kavanaugh, M.A. Dixon, G. Tang & D.-Z. Dong collectors". All paratypes also bear the following label: "PARATYPE *Broscosoma purpureum* Kavanaugh & Liang, sp. nov. designated 2021" [yellow label].

Type locality. China, Yunnan, Gongshan County, Dulongjiang Township, Kongdang area, 1500m.

Derivation of species name. The species epithet, *purpureum*, is an adjective derived from the Latin word, *purpureus*, meaning purple. The name refers to the purple or bluish-purple metallic reflection of the dorsum in members of this species.

Diagnosis. Adults of this species (Fig. 28a) can be distinguished from those of other species in the region by the following combination of character states: size small, BL = 7.4 to 8.1 mm; dorsal surface of body bright metallic blue or bluish-purple, head with greenish hue in some specimens, legs (including femora) pale rufous; antennomeres 3 and 4 glabrous except for apical whorl of setae; pronotum with lateral margination absent or present only at or posterior to sub-basal constriction (Fig. 9d), basolateral setae absent; elytral silhouette subparallel to subovoid, with humeri distinct, angulate, elytral microsculpture effaced, elytral striae coarsely punctate; metatrochanters asetose in most specimens (a few specimens with one or both metatrochanters unisetose); male protarsi with tarsomeres 1 to 3 with ventral pads of adhesive setae; male genitalia as in Fig. 29.

Description. Fig. 28a. Size small, BL male = 7.4–8 mm, female = 7.9–8.1 mm, ratio EL/PL male = 2.4–2.5, female = 2.6. Body color black or dark piceous, last visible abdominal sternite

rufous basally graded to pale yellow apically, antennae with antennomeres 1 and 2 and base of 3 pale rufous, other antennomeres rufous brown, femora, tibiae, and tarsi pale rufous. Dorsum with bright blue or bluish-purple metallic reflection, head with greenish hue on some specimens, venter (except epipleurae) without metallic reflection.

Head. Fig. 6c. Eyes large, convex, their diameter twice the length of the tempora. Frontal furrows moderately impressed, broad or narrow, arcuate, slightly convergent anteriorly and posteriorly, long, extended posteriorly beyond middle of eyes, faintly rugulose, impunctate or sparsely punctate. Vertex with post-temporal transverse sulcus broadly defined, densely and coarsely punctate. Tempora obliquely convex. Genal ridges present, restricted to head region distinctly behind post-temporal constriction (Fig. 10c). Clypeus with one pair of setae. Supraorbital setae present, one pair. Eustipes of maxilla with two setae, the dorsobasal seta distinctly more than half as long as ventrobasal seta. Mentum with tooth present, simple, paramedial region shallowly foveate, one pair of mental setae present. Glosal sclerite (ligula) with one pair of setae. Submentum with one or two pairs of setae. Gula without transverse grooves. Antennomeres 3 and 4 without pubescence, ratio A3/A5 = 1.1–1.2.

Pronotum. Fig. 6c. Discal region anterior to basal constriction ovoid, slightly narrowed anteriorly with base distinctly pedunculate, widest at middle of discal region, ratio PL/PW = 1.1, disk markedly convex; apical, lateral, and basal margination absent; anterior transverse impression shallow, broad and vaguely delineated, coarsely and sparsely punctate; median longitudinal impression moderately impressed; posterior transverse impression deep, sharply delineated; anterior region sparsely punctate; pronotal base coarsely and densely punctate; one pair of midlateral pronotal setae present at mid-length of discal region; basolateral pronotal setae absent.

Elytra. Elytral silhouette subovoid, slightly narrowed in basal half, widest at middle, or slightly posterior to middle, ratio EL/EW male and female = 1.6–1.7, greatest elevation above lateral margin (in lateral view) posterior to middle; humeri distinctly present, roundly obtuse; lateral margins moderately arcuate and nearly straight in anterior half sub-basally; parascutellar striole present, short, distally merged in a distinct jog with free base of stria 1. Eight striae present; stria 1 moderately deeply and sharply impressed, striae 2 to 8 indistinct, obliterated or represented by extremely fine and shallow linear depressions between punctures, successively less evident laterally and apically, stria 8 merged with lateral groove throughout its length or nearly so; stria 1 coarsely and moderately densely punctate, striae 2 to 3, 4, or 5 coarsely and densely punctate in basal two-thirds and successively more shallowly and sparsely punctate in apical third, striae 3 to 8 successively more shallowly and sparsely punctate laterally and apically. Elytral microsculpture effaced. Parascutellar seta present at base of stria 2, discal setae absent, umbilicate series of elytral setae comprised of one post-humeral and two preapical setae.

Hindwings. Full-sized, functional.

Thoracic venter. Metepisternum ratio ML/MW = 2.1–2.4.

Leg. Hind trochanter asetose. Tarsomeres without dorsal pubescence; tarsomere 5 with two or more pairs of setae ventrally; male protarsi with small pads of adhesive setae on tarsomeres 1 to 3 ventrally, male mesotarsi with small pads of adhesive setae on tarsomeres 1 and 2 ventrally.

Abdomen. Sternite VI of both male and female with one pair of apicoparamedial setae.

Male genitalia. As in Fig. 29.

Comments. Members of this species and *B. parvum* have the smallest body size of any *Broscosoma* species in the study area. In the field, they could be mistaken for a species of *Ardistomis*, a scaritine genus of the New World fauna. They can be distinguished from members of all other species in the region by their very shiny and brilliant purple or blue dorsum (although some individuals have the forebody greenish-blue rather than the purple or blue seen on the elytra), large

and convex eyes, pronotum without lateral margination, and elytra with elytral striae (especially striae 1-3) very coarsely punctate, at least at and anterior to midlength, and elytral microsculpture effaced. The only species with which *B. purpureum* might be confused is *B. holomarginatum*, members of which are larger, have complete lateral margination on the pronotum, slightly smaller eyes, and elytral microsculpure distinctly impressed.

Among *Broscosoma* species known from outside the study area, only three have some or all members with distinct blue metallic reflection on the dorsum. As noted above in the Comments section for *B. bicoloratum*, *B. monticola* members have the elytra with shiny blue metallic reflection, but the pronotum is black, without metallic reflection, the humeri are obliterated and hindwings reduced (humeri distinct, subangulate and hindwings full-sized and functional in *B. purpureum*), and the median lobe of the male genitalia has a large protuberance on the ventral margin. Members of *Broscosoma semenovi* Belousov and Kataev, 1990 from the Caucasus region also have the dorsum bright metallic blue and are similar in size to *B. purpureum* members, but they have the apical part of antennomere 4 pubescent (glabrous in *B. purpureum*), the pronotum more elongate, the elytra with the humeri obliterated and striae only faintly punctate, and the median lobe of the male genitalia with the apical lamella broader in lateral aspect (see Belousov and Kataev 1990, fig. 2). Some members of the third species, *Broscosoma sichuanum* Deuve, 1990 also have the dorsum of the body with metallic blue reflection. However, members of that species have the eyes much smaller and less convex, the elytra with humeri indistinct, only stria 1 distinctly impressed (two or more striae impressed in *B. purpureum*) and striatal punctures smaller, less coarse, the metatrochanters unisetose (asetose *B. purpureum*, unisetose unilaterally in very few specimens), and the median lobe of the male genitalia more slender (see Deuve 1990, fig. 11).

Habitat distribution. Members of this species have been found under deeply embedded stones on the upper sandy beaches of rivers (Fig. 45b) and along roadcuts with sandy soil during daytime. Adults are active on the surface at night, along roadcuts on moist sandy substrate stabilized by mosses and on open, sandy river beaches, where they congregate near or on boulders surrounded by sand, especially on boulders covered with mosses. Most of these sandy flats have little cover under which these beetles can hide during the day, so it seem likely that many spend daylight hours burrowed in the sand itself. This species is restricted to relatively low elevations, with our records documenting its occurrence in the 1355 to 1880 m range (Fig. 49).

Geographical distribution within the Gaoligong Shan. Fig. 28b. We examined a total of 53 specimens (29 males and 24 females) from the northwestern part of the Gaoligong Shan in Gongshan County. Our records are all from the Dulong Jiang valley at the base of the western slope of the range in Core Area 1 (Fig. 48) (see Type material above for exact collection data).

Overall geographical distribution. This species has been recorded only from the northwestern part of the Gaoligong Shan in Gongshan County in western Yunnan Province China.

Geographical relationships with other *Broscosoma* species. Members of this species have been found together only with those of *Broscosoma holomarginatum* at one or more sites (Fig. 50). *Broscosoma ribbei* occurs in the same general area but has not been found syntopic with *B. purpureum*.

11. *Broscosoma resbecqi* Kavanaugh and Liang, sp. nov.

Figures 6d, 9b, 30, 31, 46a, 48-50

Type material. Holotype, a male, in IOZ, labeled: " CASENT 1016251"/ "CHINA, Yunnan, Gongshan County, Dulongjiang Township, Siran Wang, 0.2 km above confluence with Dulong Jiang, N28.01347°/ E098.32117°,"/ "1720 m, 1 November 2004, Stop # DHK-2004-066, D.H.

Kavanaugh & D.-Z. Dong collectors"/ "HOLOTYPE *Broscosoma resbecqi* Kavanaugh & Liang sp. nov. designated 2021" [red label].

Type locality. China, Yunnan, Gongshan County, Dulongjiang Township, Siran Wang, 0.2. km above confluence with Dulong Jiang, 1720 m.

Derivation of species name. We take pleasure in naming this new species in honor of our colleague, known professionally as Thierry Deuve, but officially as Thierry de Resbecq, in recognition of his many contributions to our knowledge of the broscine fauna of Asia and for his help with this and other research projects. The species epithet, *resbecqi*, is the Latinized form of his surname (in the genitive case).

Diagnosis. Adults of this species (Fig. 30a) can be distinguished from those of other species in the region by the following combination of character states: size moderate, BL = 9.0 mm; dorsal surface of head and pronotum vivid metallic green, elytra darker blue-green, legs pale rufous; vertex of head with post-temporal transverse sulcus relatively shallow and broadly and densely punctate (Fig. 6d); antennomeres 3 and 4 glabrous except for apical whorl of setae; pronotum with lateral margination present but interrupted briefly in basal half (Fig. 9b), basolateral setae absent; elytral silhouette subovoid, with humeri rounded but evident, elytral microsculpture effaced; metatrochanter asetose; male protarsi with tarsomeres 1 to 3 with ventral pads of adhesive setae; male genitalia as in Fig. 31.

Description. Fig. 30a. Size medium. BL male = 9.0 mm, ratio EL/PL = 2.5. Body color black or dark piceous, last visible abdominal sternite dark rufous brown, all antennomeres, femora, tibiae, and tarsi pale rufous. Head and pronotum with brilliant green metallic reflection, elytra with darker bluish-green metallic reflection, venter without metallic reflection.

Head. Fig. 6d. Eyes medium-sized, their diameter slightly greater than length of tempora. Frontal furrows moderately impressed, narrow, arcuate, slightly convergent anteriorly and posteriorly, long, extended posteriorly beyond middle of eyes, rugulose and sparsely and coarsely punctate. Vertex with post-temporal transverse sulcus densely and coarsely punctate. Tempora straight, oblique. Genal ridges present, restricted to head region distinctly posterior to post-temporal constriction. Clypeus with one pair of setae. Supraorbital setae present, one pair. Eustipes of maxilla with two setae, the dorsobasal seta distinctly more than half as long as ventrobasal seta. Mentum with tooth present, simple, paramedial region shallowly foveate, one pair of mental setae present. Glosal sclerite (ligula) with one pair of setae. Submentum with two pairs of setae. Gula without transverse grooves. Antennomeres 3 and 4 without pubescence, ratio A3/A5 = 1.1.

Pronotum. Fig. 6d. Globose anterior to sub-basal constriction, with base distinctly peduncular, widest at middle of discal region, PL/PW = 1.1, disk markedly convex; apical margination absent; lateral margination present, narrow, distinctly delineated from apical margin to just posterior of midlateral seta, thence slightly interrupted and then evident again at and posterior to the subbasal constriction; basal margination absent; anterior transverse impression shallow, broad and vaguely delineated, coarsely punctate both at bottom and on slopes of depression; median longitudinal impression moderately impressed; posterior transverse impression deep, sharply delineated; anterior region sparsely punctate; pronotal base coarsely and densely punctate; one pair of midlateral pronotal setae present, inserted at mid-length of discal region; basolateral pronotal setae absent.

Elytra. Elytral silhouette subovoid, slightly narrowed in basal half, widest at middle, ratio EL/EW = 1.6, greatest elevation above lateral margin (in lateral view) posterior to middle; humeri distinctly present, roundly obtuse; lateral margins moderately arcuate and nearly straight in anterior half sub-basally; parascutellar striole present, short, distally merged in a distinct jog with free base of stria 1. Eight striae present; stria 1 moderately deeply and sharply impressed, striae 2 to 8

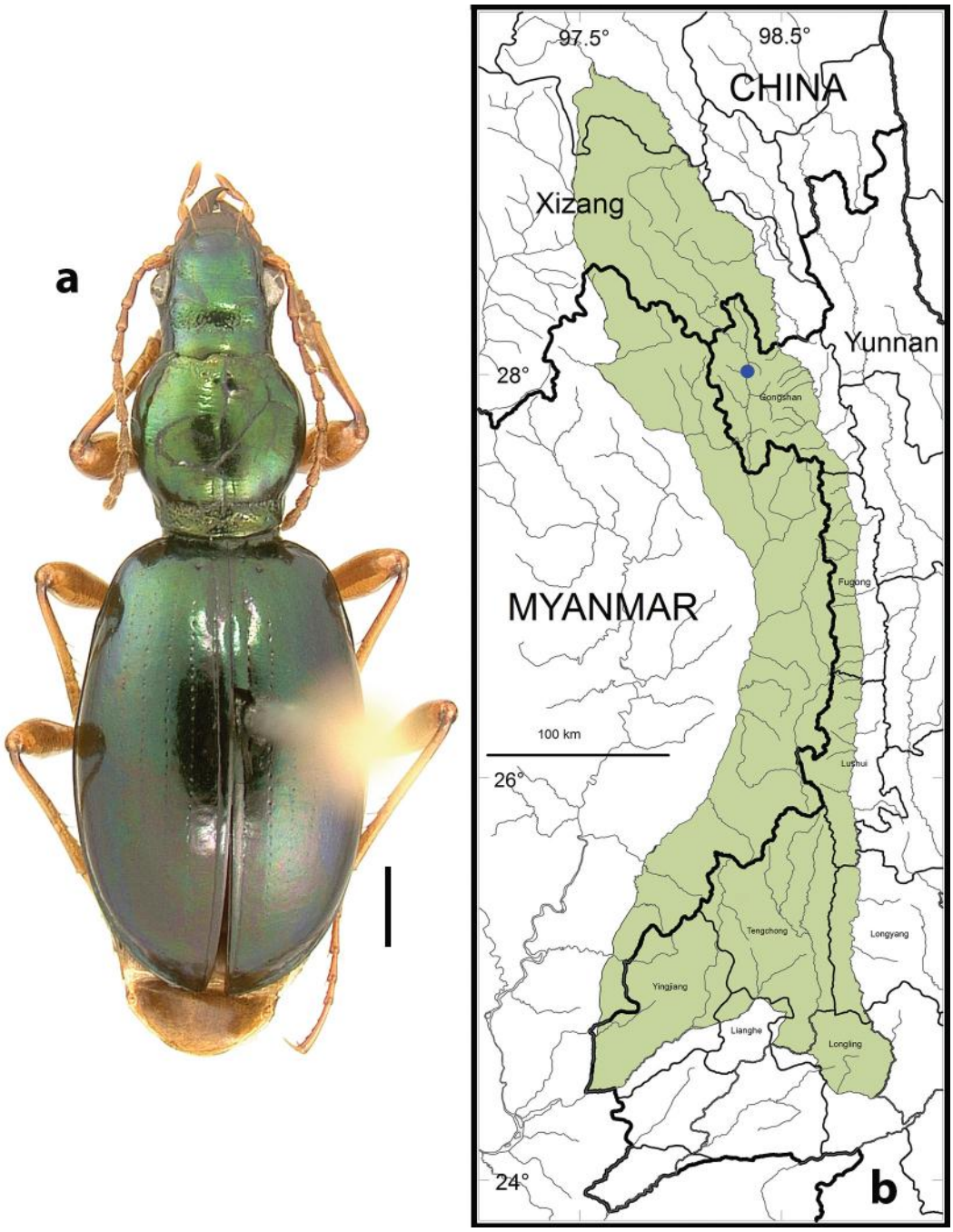


FIGURE 30. *Broscosoma resbecqi* sp. nov. a. Habitus (Holotype; Siran Wang, Dulongjiang Township, Gongshan County, Yunnan, China), dorsal aspect, scale line = 1.0 mm; b. Map showing locality records (blue circles) for this species in the Gaoligong Shan region, scale line = 100 km.

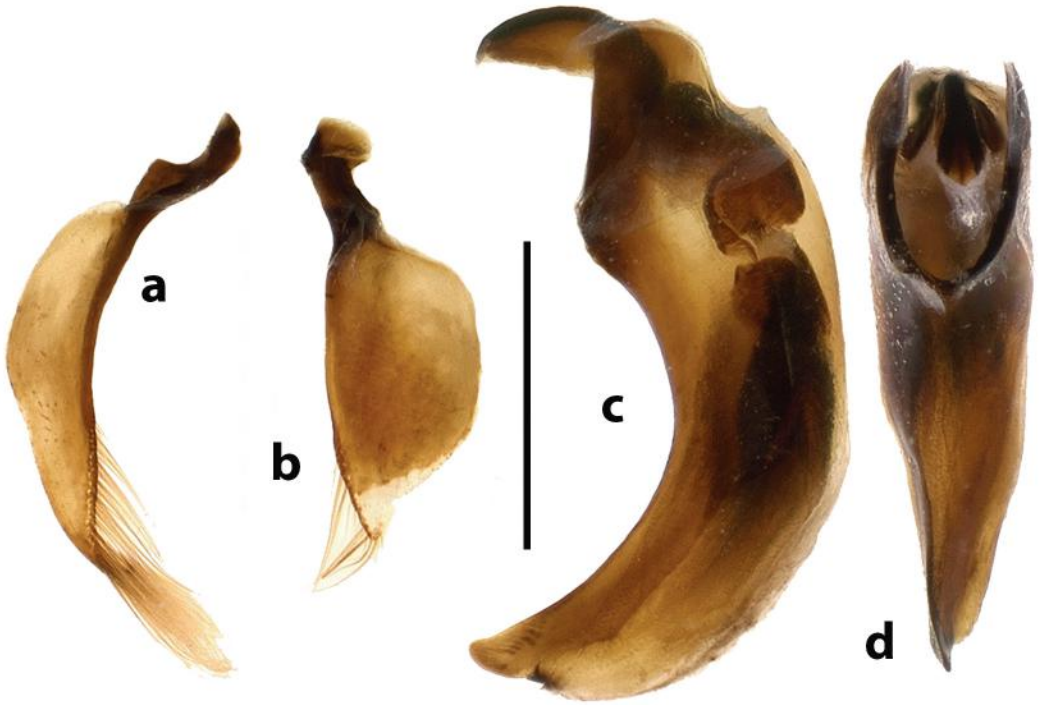


FIGURE 31. Male genitalia, *Broscosoma resbecqi* sp. nov. (Holotype; Siran Wang, Dulongjiang Township, Gongshan County, Yunnan, China). a. Right paramere, lateral aspect; b. Left paramere, lateral aspect; c. Median lobe, left lateral aspect; d. Median lobe, ventral aspect; scale line = 1.0 mm.

indistinct, obliterated or represented by extremely fine and shallow linear depressions, successively less evident laterally and apically, stria 8 merged with lateral groove throughout its length or nearly so; stria 1 moderately punctate at least in basal half, stria 2 moderately punctate in basal two-thirds and successively more shallowly and sparsely punctate in apical third, striae 3 to 8 successively more shallowly and sparsely punctate laterally and apically. Elytral microsculpture effaced. Parascutellar seta present at base of stria 2, discal setae absent, umbilicate series of elytral comprised of one post-humeral and two preapical setae.

Hindwings. Slightly reduced, incapable of supporting flight.

Thoracic venter. Metepisternum ratio ML/MW = 1.8.

Legs. Hind trochanter asetose. Tarsomeres without dorsal pubescence; tarsomere 5 with two or more pairs of setae ventrally; male protarsi with pads of adhesive setae on tarsomeres 1 to 3 ventrally, male mesotarsi with pads of adhesive setae on tarsomeres 1 and 2 ventrally.

Abdomen. Male sternite VI with one pair of apicolateral setae. Female unknown.

Male genitalia. As in Fig. 31.

Comments. As noted above, *B. resbecqi* is one of four species in the study area members of which have the entire dorsum of the body with metallic green reflection. Features distinguishing members of this species from those of *B. danzhuense* and *B. parvum* have been addressed above in the Comments sections for each of those species. At first glance, *B. resbecqi* could be mistaken for a small specimen of *B. ribbei*, but several features distinguish members of these taxa. The holotype of *B. resbecqi* has the metallic reflection of the elytra a darker bluish-green, contrasting with the

brighter green of the forebody, and the femora pale like the tibiae and tarsi. In *B. ribbei* members, the metallic reflection of the forebody and elytra are both a bright green, golden green, or blue-green and the femora are distinctly darker than the tibiae and tarsi. The eyes are more convex, the tempora longer and are less convex, and the post-temporal transverse sulcus more broadly and densely punctate in *B. resbecqi* (Fig. 6d) than in *B. ribbei* (Fig. 6b) members. The lateral margination of the pronotum in *B. resbecqi* (Fig. 6d) is better developed and nearly complete, whereas it is restricted to the area of the midlateral seta in most specimens *B. ribbei*, extended further anteriorly and posteriorly in some (Fig. 6b), and not at all distinct in a very few specimens. The metatrochanters are asetose in the *B. resbecqi* holotype but unisetose in most *B. ribbei* members, unilaterally asetose in a few. The median lobe of the male genitalia in much shorter, thicker, more arcuate and the apical lamella of very different shape in *B. resbecqi* (Fig. 31c) compared with that in *B. ribbei* males.

Among *Broscosoma* species known from outside the study area, none have members with the lateral margination of the pronotum evident, so none can be confused with *B. resbecqi* members.

Habitat distribution. The unique specimen of this species was found under a stone about 4 m back from the edge of a moderate-sized, cold, and fast-flowing stream descending through mixed coniferous/ broadleaf evergreen forest (Fig. 46a). The banks of the stream were largely overgrown with vegetation and shaded during most if not all of the day. The site of collection was at the relatively low elevation of 1720 m (Fig. FX49).

Geographical distribution within the Gaoligong Shan. Fig. 30b. This species is known only from the type locality in Gongshan County (see Type material above for exact collection data) on the western slope of the range in Core Area 1 (Fig. 48).

Overall geographical distribution. This species currently is known only from the northwestern part of the Gaoligong Shan, in western Yunnan Province, China.

Geographical relationships with other *Broscosoma* species. No other *Broscosoma* species has been found syntopic with the unique type of this species (Fig. 50), although *Brososoma ribbei* occurs in the same general area.

12. *Broscosoma ribbei* Putzeys, 1877

Figures 6b, 8d, 9c, 32, 33, 41b, 46b, 47-50

Broscosoma ribbei Putzeys, 1877:100. Holotype, a male, deposited in RBINS. Type locality: India, West Bengal, Darjeeling.

Broscosoma ribbei rougeriei Deuve and Tian, 2002:395. Holotype, a female, deposited in SCAU. Type locality: China, Yunnan, Ailao Shan, Fengshuiling Reserve, 2200 m. **NEW SYNONYMY**

Notes on nomenclature and types. Deuve and Tian (2002), Sciaky and Facchini (2005), and Jiang et al. (2021) have suggested that *B. ribbei* and *B. rougeriei* are conspecific, based on similar male genitalia and relatively minor differences in external features, and considered them as different subspecies. Indeed, specimens from central Yunnan (type area of *B. r. rougeriei*) exhibit a brighter green or golden-green metallic reflection compared with the darker blue-green or green reflection seen in most specimens from Nepal and northeastern India (type area for *B. ribbei* s. str.). They also tend to have very slightly larger eyes, slightly broader pronota, and more deeply impressed pronotal and elytral microsculpture than specimens of *B. ribbei* s. str. from its type area. Records available to these authors showed a disjunction of at least 600 km separating the ranges of these two nominal taxa, thus potentially supporting their taxonomic distinction.

We have compared more than 600 specimens from throughout the study area with good images of the holotypes of both *B. ribbei* and *B. rougeriei* and also with newly-acquired specimens from Medong and Cona counties in Xizang (Tibet), which serve to fill in the former geographical

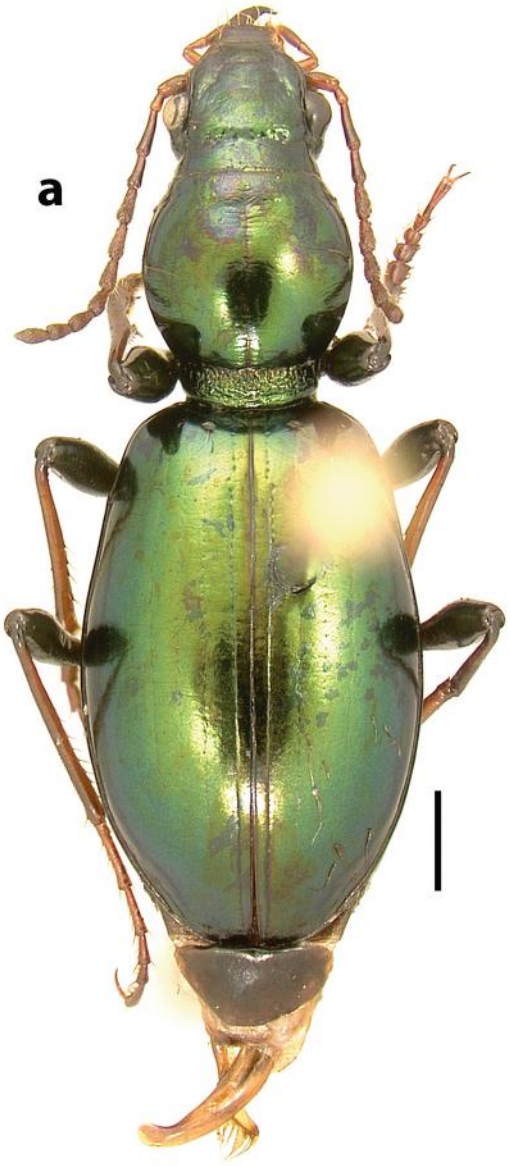
gap region. Within this sample, we observed overlapping variation in all of the features previously cited as differentiating the two nominal taxa. Among these were dorsal coloration (metallic reflection), punctation of the head and pronotum, pronotal shape and convexity, elytral shape, depth of impression of the elytral microsculpture, and depth and punctation of the elytral striae. Although most specimens from the eastern and western extremes of the range of this species may differ slightly in some or all of these features, we conclude that no clear morphological or geographical distinction exists between these nominal taxa and treat them all simply as *B. ribbei*. Whether or not there is any phylogeographic structure within *B. ribbei* can only be established with appropriate analysis of DNA data, which remains a project for the future.

Diagnosis. Adults of this species (Fig. 32a) can be distinguished from those of other species in the region by the following combination of character states: size moderate, BL male = 9.3.0–11.8 mm, female = 8.9–11.9 mm; entire dorsum of body bright golden-green, green (Fig. 32a), or blue-green; vertex of head with post-temporal transverse sulcus relatively shallow and narrowly and sparsely punctate (Fig. 6b); antennomeres 3 and 4 glabrous except for apical whorl of setae; pronotum globose anterior to sub-basal constriction as in Fig. 6b, in most specimens with lateral margination present in region of midlateral seta and also basal to sub-basal constriction and/or extended further anterior to midlateral seta (Fig. 9c) in some specimens (absent entirely from a few specimens), basolateral setae absent; elytral silhouette subovoid, with humeri rounded by evident, elytral microsculpture distinct, comprised of moderately impressed isodiametric sculpticells; metatrochanters unisetose (except asetose unilaterally in a few specimens); male protarsi with tarsomeres 1 to 3 with ventral pads of adhesive setae; male genitalia as in Fig. 33.

Comments. Features distinguishing members of this species from those of the three other species with evident elytral humeri and metallic green reflection over the entire dorsum (namely, *B. danzhuense*, *B. parvum*, and *B. resbecqi*) have been addressed above in the Comments sections for each of those species.

As noted in the Comments section for *B. danzhuense*, only two *Broscosoma* species known from outside the study area have members in which the elytral humeri are at least faintly evident (although in both they are much less evident than in *B. ribbei*) and the entire dorsum exhibits metallic green or bluish-green reflection. In members of *B. montreuili*, the forebody is a darker, less vivid metallic green than the elytra (both parts equally vivid in *B. ribbei*), the eyes less convex, the post-temporal transverse sulcus more densely punctate (not or only more sparsely punctate in *B. ribbei*), and the median lobe of the male genitalia has the apical lamella slightly narrower in lateral aspect (see Deuve 2006b, fig. 10). Members of *B. tiani* have the eyes more reduced in size and convexity, the tempora slightly longer and less convex, the post-temporal transverse sulcus more densely punctate, and the median lobe of the male genitalia with the apical lamella distinctly hooked ventrally in lateral aspect (see Deuve 2006b, fig. 9). We must also mention here *Broscosoma sehnali* Deuve, 2006a, also from Sichuan like these other two species. Although most members of this species are slightly smaller and have the humeri indistinct and the elytral microsculpture effaced (well impressed in *B. ribbei*), they nonetheless present a very similar habitus to that of *B. ribbei* specimens and have a generally similar form of the median lobe of the male genitalia (see Deuve 2006a, fig. 11).

Habitat distribution. Within the study area, members of this species are typically found in disturbed habitats, usually on bare or sparsely vegetated ground, at all elevations and within all vegetation types. They are found hiding under stones during daylight hours but are active on the substrate surface at night. Areas in which they are most easily found include forest clearings, road and trail cutbanks (Fig. 41b), dry meadows, and other types of waste areas (Fig. 46b). At night, they are also found on the mossy banks of roadcuts, but they appear to prefer bare granitic sandy sub-



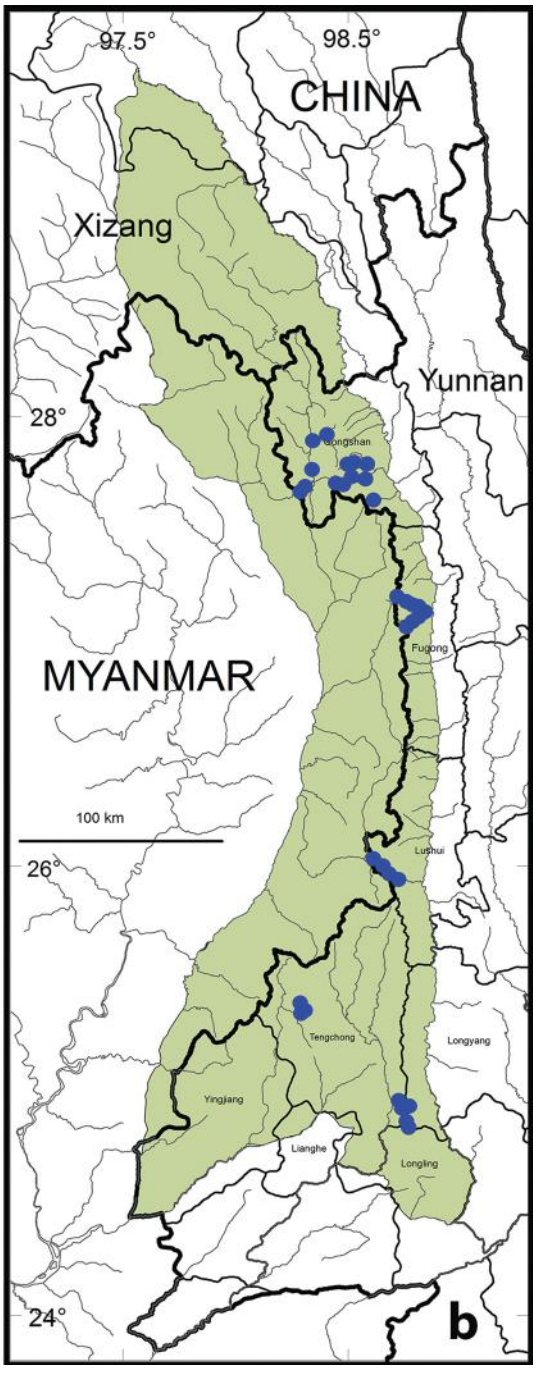


FIGURE 32. *Broscosoma ribbei* Putzeys. a. Habitus (CASENT1021037; 2.8 km above Shibali, Lishadi Township, Fugong County, Yunnan, China), dorsal aspect, scale line = 1.0 mm; b. Map showing locality records (blue circles) for this species in the Gaoligong Shan region, scale line = 100 km.

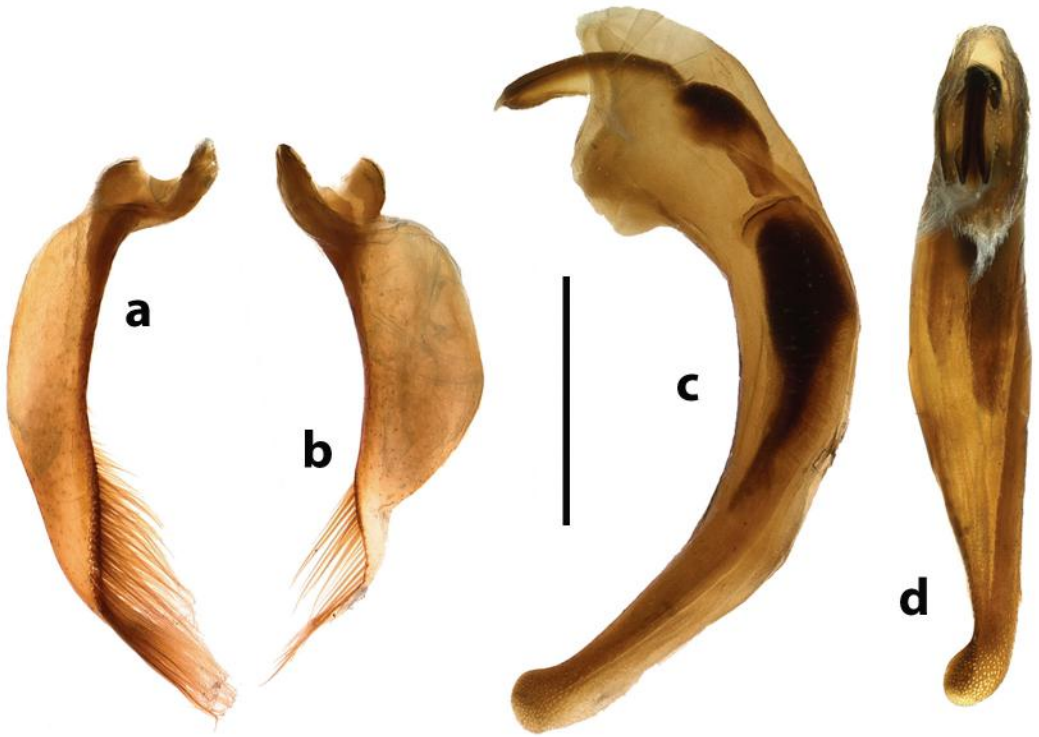


FIGURE 33. Male genitalia, *Broscosoma ribbei* Putzeys (CASENT1025422; 0.5 km WSW of Maku village, Dulongjiang Township, Gongshan County, Yunnan, China). a. Right paramere, lateral aspect; b. Left paramere, lateral aspect; c. Median lobe, left lateral aspect; d. Median lobe, ventral aspect; scale line = 1.0 mm.

strate. They often occur in the company of a group of other carabid species, including *Paropisthius indicus* (Chaudoir), *Broscus punctatus* (Dejean), *Nirmala odelli* Andrewes, *Aristochroa yuae* Kavanaugh & Liang, *Amara chalciop*e (Bates) and *Xestopus cyaneus* Sciaky and Facchini. Within the Gaoligong Shan region, this species occupies a broad elevational range, with our records documenting its occurrence from 1500 to 3300 m (Fig. 49).

Geographical distribution within the Gaoligong Shan. Fig. 32b. We examined a total of 628 specimens (342 males and 285 females) from the following localities: ***Fugong County:*** Lishadi Township (Shibali area, 27.16536°/98.78003°, 2535 m, 4-5 August 2005, H.B. Liang collector [three males and four females; CAS, IOZ], 4-17 August 2005, D.H. Kavanaugh, H.B. Liang, P. Paquin, & D.Z. Dong collectors [seven males and six females; CAS, IOZ], 5-6 August 2005, D.H. Kavanaugh, H.B. Liang, P. Paquin, & D.Z. Dong collectors [24 males and 13 females; CAS, IOZ], 18 August 2005, D. H. Kavanaugh & P. Paquin collectors [four males; CAS, IOZ], 4-5 October 2007, D.H. Kavanaugh, H.B. Liang, & H.L. Shi collectors [two females; CAS, IOZ]), (Shibali Road at Shibali, 27.16786°/98.77741°, 2560 m, 1 May 2004, D.H. Kavanaugh & C. E. Griswold collectors [two males and four females; CAS, IOZ]), (1.0 km above Shibali on Shibali Road, 27.16791°/98.77655°, 2580 m, 2 May 2004, D.H. Kavanaugh & C. E. Griswold collectors [two males; CAS, IOZ]), (2.0 to 4.3 km above Shibali on Shibali Road, 27.17262°/98.76943° to 27.17772°/98.75485°, 2700-2826 m, 3 May 2004, D.H. Kavanaugh, H.B. Liang & C. E. Griswold collectors [21 males and 17 females; CAS, IOZ]), (11 km above Nu Jiang on Shibali Road at Shi-

mowa village, 27.13839°/98.82147°, 1850-1928 m, 25 April 2004, H.B. Liang collector [one female; IOZ]), (11 km W of Shibali on Shibali Road, 27.20654°/98.71772°, 3280 m, 6 August 2005, D. Z. Dong collector [two males; CAS, IOZ]), (1.5 km below Shibali on Shibali Road, 27.16284°/98.78989°, 2420 m, 2 May 2004, H.B. Liang & G.X. Peng collectors [one male and four females; CAS, IOZ]), (Shibali Road from Galadi village to 2.5 km W, 27.13863°/98.82174° to 27.14286°/98.82001°, 1845-1940 m, 9 August 2005, D.H. Kavanaugh, H.B. Liang, & D. Z. Dong collectors [eight males; CAS, IOZ]), (0 to 2 km W of Shibali on Shibali Road, 27.16536°/98.78003° to 27.16100°/98.79370°, 2300-2530 m, 18 August 2005, D. Z. Dong collector [three males and one female; CAS, IOZ]), (2.8 km W of Shibali on Shibali Road, 27.17405°/98.76722°, 2750 m, 6 August 2005, D. Garfield collector [one male; CAS], 9 August 2005, D. Z. Dong collector [eight males and eight females; CAS, IOZ], 10 August 2005, D. Z. Dong collector [nine males and eight females; CAS, IOZ]), (4.0 km W of Shibali on Shibali Road, 27.17740°/98.75490°, 2800 m, 16 August 2005, D. Z. Dong collector [three males and one female; CAS, IOZ]), (8.4 to 9.5 km W of Shibali on Shibali Road, 27.18740°/98.71936° to 27.19438°/98.71486°, 3160-3195 m, 14 August 2005, D.H. Kavanaugh, H.B. Liang, & D.Z. Dong collectors [one male; CAS]), (9.5 to 10.0 km W of Shibali on Shibali Road, 27.19438°/98.71486° to 27.19980°/98.71375°, 3195-3200 m, 12 August 2005, D.H. Kavanaugh, H.B. Liang, & D.Z. Dong collectors [two males; CAS, IOZ]), (4 km E of Shibali on Shibali Road, 27.15727°/98.79784°, 2280 m, 11 August 2005, D. Z. Dong collector [nine males and five females; CAS, IOZ]), (Shibali Road from confluence of North and South Forks of Yamu He to Galadi village, 27.13086°/98.83874° to 27.13863°/98.82174°, 1630-1845 m, 15 August 2005,D.H. Kavanaugh, H.B. Liang, P. Paquin, & D. Z. Dong collectors [three females; CAS, IOZ]); Lumadeng Township (Lao Shibali Road, 27.08263°/98.74621°, 3085 m, 13 August 2005, D.H. Kavanaugh & P. Paquin collectors [one female; CAS]), (Lao Shibali Yakou, 27.06429°/98.75123°, 3270 m, 13 August 2005, D.H. Kavanaugh, H.B. Liang, & D.Z. Dong collectors [one male; IOZ]), (South Fork of Yamu He, 1.6 km E of Lao Shibali on Lao Shibali Road, 27.08260°/98.78877°, 2240 m, 21 August 2005, D.H. Kavanaugh collector [one male; CAS]), (4 km E of Lao Shibali on Lao Shibali Road, 27.09700°/98.80570°, 2120 m, 21 August 2005, D. Z. Dong collector [two males; CAS, IOZ]), (1.5 km above confluence of North and South Forks of Yamu He on Lao Shibali Road, 27.11992°/98.83150°, 1825 m, 15 August 2005, H.B. Liang collector [one male; IOZ]). ***Gongshan County:*** Cikai Township (Danzhu He drainage, 13.5-15.7 airkm SSW of Cikai, 27.63063°/98.62074° to 27.62705°/98.59204°, 2700-3100m, 30 June- 5 July 2000, D.H. Kavanaugh, C.E. Griswold, H.B. Liang, D. Ubick, & D.Z. Dong collectors [seven males and 14 females; CAS, IOZ]), (Dong Shao Fang area, 18-20 airkm W of Cikai, 27.69504°/98.48433°, 3230-3300m, 16-17 July 2000, D.H. Kavanaugh, C.E. Griswold, H.B. Liang, D. Ubick, & D.Z. Dong collectors [four males and five females; CAS, IOZ]), (No. 12 Bridge Camp area, 16.3 airkm W of Cikai, 27.71503°/E98.50244°, 2775m, 15-19 July 2000, D.H. Kavanaugh, C.E. Griswold, H.B. Liang, D. Ubick, & D.Z. Dong collectors [ten males and one females; CAS, IOZ]), (Qiqi He, 27.75748°/98.66073°, 1500 m, 25 September 2007, H.B. Liang & H.L. Shi collectors [one male; IOZ]), (Qiqi area, 10.3 airkm W of Cikai, 27.71542°/98.56529°, 2010m, 9-14 July 2000, D.H. Kavanaugh, C.E. Griswold, Liang H.-B., D. Ubick, & D.Z Dong collectors [two males and one female; CAS, IOZ]), (Dabadi, 40 km W of Cikai on Dulong Valley Road, 27.79619°/ 98.51867°, 2900 m, 29 September 2002, H.B. Liang collector [three males and three females; CAS, IOZ]), (Dabadi, 41 km W of Cikai on Dulong Valley Road, 27.79655°/98.50562°, 3000 m, 27 September to 6 October 2002, D.H. Kavanaugh , P.E. Marek, H.-B. Liang, D.Z. Dong & X.C. Li collectors [eight males and 11 females; CAS, IOZ]), (Heiwadi, 16.8 km W of Cikai on Dulong Valley Road, 27.79584°/98.58443°, 2150 m, 10 October 2002, D. H. Kavanaugh , P.E. Marek, H.-B. Liang, &

D.-Z. Dong collectors [seven males and seven females; CAS, IOZ]), (Heiwadi Nature Reserve Managing Station, 15 km W of Cikai on Dulong Valley Road, 27.79433°/98.58908°, 4 October 2002, H.B. Liang & C.G. Jin collectors [four males and four females; CAS, IOZ]), (South Fork of Qiqi He, 27.70393º/98.49585º, 2975 m, 27-28 September 2007, H.B. Liang & H.L. Shi collectors [one male; IOZ]); Dulongjiang Township (Dulong Jiang, 2 km N of Bapo, 27.76000°/ 98.34611°, 1510 m, 16-17 July 2000, P. Thomas & Z.L. Wang collectors [two males and four females; CAS, IOZ]), (Kongdang, 0.5 km N, 7.88111°/98.34063°, 1500 m, 25 October 2004, D.H. Kavanaugh, Q.B. Hou & H.B. Liang collectors [one female; IOZ]), (Maku, 27.68553°/98.30425°, 1823 m, 2 November 2004, H.B. Liang collector [three males and one female; CAS, IOZ]), (Maku village, 27.68498°/98.30299°, 1800 m, 28 August 2006, D.H. Kavanaugh, J.A. Miller, & D.Z. Dong collectors [four males and four females; CAS, IOZ]), 27.67775°/98.29771°, 1815 m, 29 August 2006, D.Z. Dong & P. Hu collectors [11 males and four females; CAS, IOZ], 2 September 2006, Y. Liu & D. Z. Dong collectors [three males and four females; CAS, IOZ]), (0.5 airkm WSW of Maku village on trail to Maku Yakou, 27.68310°/98.30038°, 1845 m, 29 August 2006, D.H. Kavanaugh, J.A. Miller, D.Z. Dong & Y. Liu collectors [five males and eight females; CAS, IOZ]), (North Fork of Moqie Wang at Gongshan-Dulong Road Km 77, 27.90085°/98.34721°, 1550 m, 8 November 2004, D.H. Kavanaugh & M.A. Dixon collectors [one male; CAS]), (Xishaofang, 27.70400°/98.43864°, 3110 m, 30 October 2004, V. F. Lee collector [one male; CAS]). ***Longling County:*** Longjiang Township (small stream along road below Xiaoheishan Forest Reserve, Guchengshan, 24.82888°/98.76001°, 2020 m, 25 May 2005, D.Z. Dong & H.B. Liang collectors [two females; CAS, IOZ]). ***Longyang County:*** Lujiang Township (Baoshan-Tengchong Road Km 36-37, 24.93417°/98.76667°, 2150 m, 12 October 2003, H.B. Liang & X.C. Shi collectors [one female; IOZ]), (Baoshan-Tengchong Road Km 40-41, 24.92694°/98.75000°, 2404 m, 12 October 2003, H.B. Liang & X.C. Shi collectors, LHB-03-03 [three females; CAS, IOZ]), (Baoshan-Tengchong Road Km 41, 24.93194°/98.76111°, 2440 m, 15 October 2003, H.B. Liang & J. Yang collectors [one male and one female; CAS, IOZ]); Luoshuidong area (24.94833°/98.75667°, 2300 m, 26-31 October 1998, D.H. Kavanaugh, C.E. Griswold, C.-L. Long & H.X. He collectors [five males and two females; CAS, IOZ]), (Sancha He, 24.94849°/98.75699°, 2300 m, 3 June 2005, D.H. Kavanaugh, C.E.Griswold, H.B. Liang, D.Z. Dong & H.M. Yan collectors [three males and three females; CAS, IOZ]); Nankang Forest Station (24.82444°/98.76667°, 2085 m, 27 October 2003, H.B. Liang & X.C. Shi collectors [five males and six females; CAS, IOZ]), (Route S317 at KM 19.8, 24.82284°/98.78207°, 2060 m, 23 May 2005, D.H. Kavanaugh, C.E. Griswold, H.B. Liang, D.Z. Dong, H.M.Yan & K.J. Guo collectors [four males and three females; CAS, IOZ]); Nankang Yakou (24.83167°/98.76667°, 2130 m, 4-7 November 1998, D.H. Kavanaugh, C.E. Griswold, C.L. Long, R. Li & H.X. He collectors [31 males and 35 females; CAS, IOZ]), (24.82583°/98.76667, 2130 m, 26 October 2003, H.B. Liang & X.C. Shi collectors [four males; CAS; IOZ], D.Z. Dong collector [one female; IOZ]), (24.82587°/98.76832°, 2148 m, 22 May 2005, H.B. Liang collector [four males and nine females; CAS, IOZ]), (Nankang Yakou, just N of pass, 24.83178°/98.76472°, 2180 m, 22 May 2005, D.H. Kavanaugh, C.E. Griswold & D.Z. Dong collectors [15 males and 16 females; CAS, IOZ], 25 May 2005, D.H. Kavanaugh & C.E. Griswold collectors [three males and one female; CAS, IOZ], 26 May 2005, D.Z. Dong & H.B. Liang collectors [one female; IOZ]). ***Lushui County:*** Luzhang Township (Fengxue Yakou to 0.5 km E on Pianma Road, 25.97288°/98.68336° to 25.97347°/98.68780°, 3130-3150 m, 17 May 2005, D.H. Kavanaugh, C.E. Griswold, H.B. Liang & D.Z. Dong collectors [seven males and three females; CAS, IOZ]), (Yaojiaping Forestry Station, 25.96911°/098.70713°, 2586 m, 18 May 2005, D.H. Kavanaugh & Y.H. San collectors [one male and two females; CAS, IOZ]), (Yaojiaping He at Pianma Road, 25.97722°/98.71091°, 2527 m, 20 May 2005, D.H. Kavanaugh & D.Z. Dong collectors

[one male and one female; CAS, IOZ]); Pianma Township (7 km N of Pianma at Gangfang Yakou, 26.03672°/98.62026°, 2250 m, 12 May 2005, H.B. Liang collector [one female; IOZ]), (9 km ESE of Pianma, 26.12167°/98.57500°, 2450 m, 15-18 October 1998, D.H. Kavanaugh, C.E. Griswold, C. Ferraris, & C.L. Long collectors [one male and one female; CAS, IOZ]), (9 km ESE of Pianma at Pianma Road bridge over Changyan He, 25.99414°/98.66336°, 2454 m, 14 May 2005, H.B. Liang collector [two males; CAS, IOZ]), (Fengxue Yakou to 0.6 km W on Pianma Road, 25.97288°/98.68336° to 25.97410°/98.67716°, 3120-3150 m, 19 May 2005, D.H. Kavanaugh, C.E. Griswold, H.B. Liang, D.Z. Dong & K.J. Guo collectors [seven males and nine females; CAS, IOZ]). ***Tengchong County:*** Houqiao Township (4.4 airkm NE of Houqiao near power station, N5.35746°/98.30364°, 1885 m, 28 May 2006, D.H. Kavanaugh, R.L. Brett, H.B. Liang, & Z.C. Liu collectors [five males and one female; CAS, IOZ]), (5.9 airkm NE of Houqiao near Guyong Forestry Station, 25.36562°/98.31610°, 2030 m, 27 May 2006, D.H. Kavanaugh, R.L. Brett, H.B. Liang, Z.C. Liu, & D.Z. Dong collectors [two males and two females; CAS, IOZ]), (8.5 airkm NNE of Houqiao at Gaoshidong, 25.39858°/98.30533°, 2580 m, 27 May 2006, D.H. Kavanaugh, R.L. Brett, & D.Z. Dong collectors [one male and two females; CAS, IOZ]); Nankang Yakou (5 km W, 24.83167°/98.765000°, 2100 m, 23 October 1998, D.H. Kavanaugh collector [three males and three females; CAS, IOZ]); Shangying Township (Baoshan-Tengchpng Road Km 41-46 d, 24.95361/98.73333°, 2290 m ,17 October 2003, H.B. Liang collector [31 males and 11 females; CAS, IOZ]), (Baoshan-Tengchpng Road Km 42 km at Sanchawa, 24.93278°/98.75333°, 2300 m, 13 October 2003, H.B. Liang & X.C. Shi collectors [two females; CAS, IOZ]), (Baoshan-Tengchpng Road Km 42-46, 24.95361°/98.73333°, 2290 m, 14 October 2003, H.B. Liang & X.C. Shi collectors [four females; CAS, IOZ]), (Baoshan-Tengchpng Road Km 46-51, 24.95722°/98.73333°, 2220 m, 17 October 2003, H.B. Liang & X.C. Shi collectors [three males and two females; CAS, IOZ]), (Baoshan-Tengchong Road Km 48-51, 24.97556°/98.71667°, 2014 m , 18 October 2003, H.B. Liang collector [six males and three females; CAS, IOZ]), (Dahaoping, 24.96976°/98.3142°, 2040 m, 31 May 2005, D.Z. Dong & H.B. Liang collectors [one male; CAS]), (Dahaoping Forest Station, 24.97333°/98.72972°, 2014 m, 19 October 2003, G. Tang collector [two males and three females; CAS, IOZ]); Wuhe Township (Xiaodifang He at Km 24.7 on Route S317, 24.84868°/98.75913°, 2040 m, 26 May 2005, H.B. Liang collector [one male and one female; CAS, IOZ]), (Xiaoheishan Forest Station, 24.82889°/98.75000°, 2025 m, 29 October 2003, H.B. Liang collector [one male; IOZ]).

Members of this species have been collected throughout the Gaoligong Shan region, in all seven Core Areas. This is the only broscine species so widely recorded (Fig. 48).

Overall geographical distribution. Fig. 47. This species has been recorded from India (Sikkim, West Bengal), Nepal, and Xizang (Tibet) along the southern slope of the Himalaya and from the western half of Yunnan Province. We have not been able to confirm the record from Pakistan (Häckel et al. 2010). The occurrence of *B. ribbei* in the study area is near the southern and eastern limits of its geographical range.

Geographical relationships with other *Broscosoma* species. Within the study area, members of this species have been found together (syntopic) with those of *B. gaoligongense* and *B. viridicollare* (described below) at one or more sites (Fig. 50). In Medog County, Xizang (Tibet), they have been found together with members of *B. holomarginatum*. They also have been found syntopic with specimens of *Broscodera gaoligongensis*, *Broscus punctatus* and *Eobroscus bhutanensis* in the study area.

13. *Broscosoma viridicollare* Kavanaugh and Liang, sp. nov.
Figures 7b, 34, 35, 40b, 48-50

Type material. Holotype, a male, in IOZ, labeled: "CASENT 1017935"/ "CHINA, Yunnan, Fugong County, Lishadi Township, 9.5-10.0 km W of Shibali on Shibali Road, N27.19438º/E098.71486º to N27.19807º/"/ "E098.71375º, 3195-3200m, 12 August 2005, Stop #DHK2005-078, D.H. Kavanaugh, H.B. Liang, D.Z. Dong collectors"/ "HOLOTYPE *Broscosoma viridicollare* Kavanaugh & Liang sp. nov. designated 2021" [red label]. Paratypes (a total of 20): two males and one female (CAS, IOZ) labeled: same as holotype except first label "CASENT 1017933" to "CASENT 1017934" and "CASENT 1017936", respectively; one female (IOZ) labeled: "CASENT 1018722" "CHINA, Yunnan, Fugong County, Lishadi Township, headwaters of North Fork Yamu He just E of Shibali Yakou, 3450m"/ "N27.21034º/E098.70141º, 7 August 2005, Stop #LHB-05-52, H.B. Liang & J.F. Zhang collectors"; one male and one female (CAS, IOZ) labeled: "CASENT 1018602" and "CASENT 1018603", respectively/ "CHINA, Yunnan, Fugong County, Lishadi Township, headwaters of North Fork Yamu He just E of Shibali Yakou, 3450m"/ "N27.21034º/E098.70141º, 12 August 2005, Stop #LHB-05-54, H.B. Liang & J.F. Zhang collectors"; one male (CAS) labeled: "CASENT 1019520"/ "CHINA, Yunnan, Fugong County, Lishadi Township, 10.1 to 11.5 km above Shibali on Shibali road, N27.20049º/E098.71354º to N27.20676º/E098.71763º,"/ "3225-3290m, 8 May 2004, Stop #DHK-2004-041, D.H. Kavanaugh, C. E. Griswold, Liang H.-B., Li X.-Y. & Zhu B.-X. collectors"; one male and two females (CAS, IOZ) labeled: "CASENT 1018889" and "CASENT 1018890" to "CASENT 1018891", respectively/ "CHINA, Yunnan, Fugong County, Lishadi Township, Shibali Yakou, 3612m, N27.21231º/E098.69575º, 5 August 2005" / "Stop #DHK2005-060, D.H. Kavanaugh, H.B. Liang, P. Paquin, D.Z. Dong & J.F. Zhang collectors"; one male and one female (CAS, IOZ) labeled: "CASENT 1020868" and "CASENT1020869", respectively/ "CHINA, Yunnan, Fugong County, Lishadi Township, Shibali Yakou, 3612m, N27.21231º/E098.69575º, 7 August 2005",/ "Stop #DHK2005-066, D.H. Kavanaugh, H.B. Liang, P. Paquin & D.Z. Dong collectors"; one male and two females (CAS, IOZ) labeled: "CASENT 1021213" to "CASENT 1021214" and "CASENT 1021215" , respectively/ "CHINA, Yunnan, Fugong County, Lishadi Township, 0.5 km NE of Shibali Yakou, N27.21447º/E098.70064º" / "3460m, 12 August 2005, Stop #DHK2005-077, D.H. Kavanaugh, P. Paquin & D.Z. Dong collectors"; one male (CAS) labeled: "CASENT 1023548"/ "CHINA, Yunnan, Fugong County, Lishadi Township, 1.0 km E of Shibali Yakou on Shibali road, N27.20854º/E098.71174º" / "3506m, 6 May 2004, Stop #DHK2004-035, D.H. Kavanaugh, H.B. Liang, & C.E. Griswold collectors"; two males (CAS, IOZ) labeled: "CASENT 1022786" and "CASENT 1022787", respectively/ "CHINA, Yunnan, Fugong County, Lumadeng Township, 8.5 km above Shibali on Shibali road, North Fork of Yamu He" / "N27.18326º/E098.72002º, 3100m, 9 May 2004, Stop #DHK2004-042, D.H. Kavanaugh & H.B. Liang collectors"; one male (CAS) labeled: "CASENT 1029941"/ "CHINA, Yunnan, Fugong County, Lumadeng Township, 8.5 km W of Shibali on Shibali road, south bank of North Fork Yamu He,"/ "N27.18315º/E098.71921º, 3100-3200m, 16 August 2005, Stop #DHK2005-090, D.H. Kavanaugh & H.B. Liang collectors"; one male (IOZ) labeled: "CASENT 1017824"/ "CHINA, Yunnan, Fugong County, Lumadeng Township, second cirque of Shibali Yakou at border post "31", N27.20333º/E098.69303º"/ "3710m, 17 August 2005, Stop #DHK2005-095, D.H. Kavanaugh, H.B. Liang, D.Z. Dong & J.F. Zhang collectors". All paratypes also bear the following label: "PARATYPE *Broscosoma viridicollare* Kavanaugh & Liang, sp. nov. designated 2021" [yellow label].

Type locality. CHINA, Yunnan, Fugong County, Lishadi Township, 9.5-10.0 km W of Shibali on Shibali Road, 3195-3200 m.

Derivation of species name. The species epithet, *viridicollare*, is an adjective derived from the Latin words, *viridis*, meaning green, and *collare*, meaning collar. The name refers the distinct band of metallic green reflection along the anterior border of the otherwise black pronotum in members of this species.

Diagnosis. Adults of this species (Fig. 34a) can be distinguished from those of other species in the region by the following combination of character states: size moderate, BL = 10.0 to 12.7 mm; head and pronotum black to piceous but with distinct metallic green band across anterior part of pronotum (Fig. 7b) anterior to anterior transverse impression; head with tempora slightly inflated, sharply convex or vaguely angulate; antennomeres 3 and 4 glabrous except for apical whorl of setae; pronotum anterior to sub-basal constriction slightly to moderately longitudinally ovoid in dorsal view, basolateral setae absent; elytral silhouette ovoid, with humeri indistinct, elytral microsculpture distinct, comprised of moderately impressed isodiametric sculpticells; metatrochanter asetose; male protarsi with tarsomeres 1 to 3 with ventral pads of adhesive setae; male genitalia as in Fig. 35, with median lobe slightly longer and apical lamella broader in lateral view.

Description. Fig. 34a. Size medium, BL male = 10.1–12 mm, female = 10.0–12.7 mm, ratio EL/PL male = 2.2, female = 2.2–2.3. Body color black or dark piceous, last visible abdominal sternite dark brown or rufous brown, antennae with antennomeres 3 and 4 slightly darker brown than antennomeres 1 and 2 and 5 to 11, femora black or dark piceous, tibiae and tarsi rufous brown. Head black, pronotum black except for distinct green metallic reflection anterior to anterior transverse impression, elytra with bluish green metallic reflection, venter without metallic reflection.

Head. Fig. 7b. Eyes medium-sized, their diameter slightly greater than length of tempora. Frontal furrows moderately impressed, narrow, arcuate, distinctly divergent posteriorly, extended posteriorly to or slightly beyond middle of eyes, faintly rugulose, impunctate. Vertex with post-temporal transverse sulcus deep and well-defined, sparsely and moderately to coarsely punctate. Tempora slightly inflated, sharply convex or vaguely angulate. Genal ridges distinctly present posteriorly, extended anteriorly to anterior margin of post-temporal constriction and further extended as the edge of a vague depression anteriorly to ventral margins of eyes. Clypeus with one pair of setae. Supraorbital setae present, one pair. Eustipes of maxilla with two setae, the dorsobasal seta distinctly more than half as long as ventrobasal seta. Mentum with tooth present, simple, paramedial region shallowly foveate, one pair of mental setae present. Glosal sclerite (ligula) with one pair of setae. Submentum with one or two pairs of setae. Gula without transverse grooves. Antennomeres 3 and 4 without pubescence, ratio A3/A5 = 1.1–1.2.

Pronotum. Fig. 7b. Disc anterior to sub-basal constriction slightly to moderately longitudinally ovoid in dorsal view with base distinctly pedunculate, widest at or slightly posterior to middle of discal region, ratio PL/PW = 1.2–1.3, disk markedly convex; apical margination absent; lateral margination present, narrow, delineated only on base; basal margination absent; anterior transverse impression shallow, broad and vaguely delineated, smooth or finely and very sparsely punctate; median longitudinal impression moderately impressed; posterior transverse impression deep, sharply delineated; anterior region faintly and sparsely rugulose; pronotal base coarsely and sparsely to densely punctate; one pair of midlateral pronotal setae present at mid-length of discal region; basolateral pronotal setae absent.

Elytra. Elytral silhouette ovoid, short, widest at middle, ratio EL/EW male and female = 1.5, greatest elevation above lateral margin (in lateral view) posterior to middle; humeri narrow, sloped, indistinct; lateral margins markedly arcuate, or markedly arcuate and faintly angulate sub-basally; parascutellar striole present, short, distally merged in a distinct jog with free base of stria 1. Eight striae present; stria 1 moderately deeply and sharply impressed, striae 2 to 3, 4, or 5 moderately impressed in basal two-thirds of striae and successively more shallowly impressed in apical third,

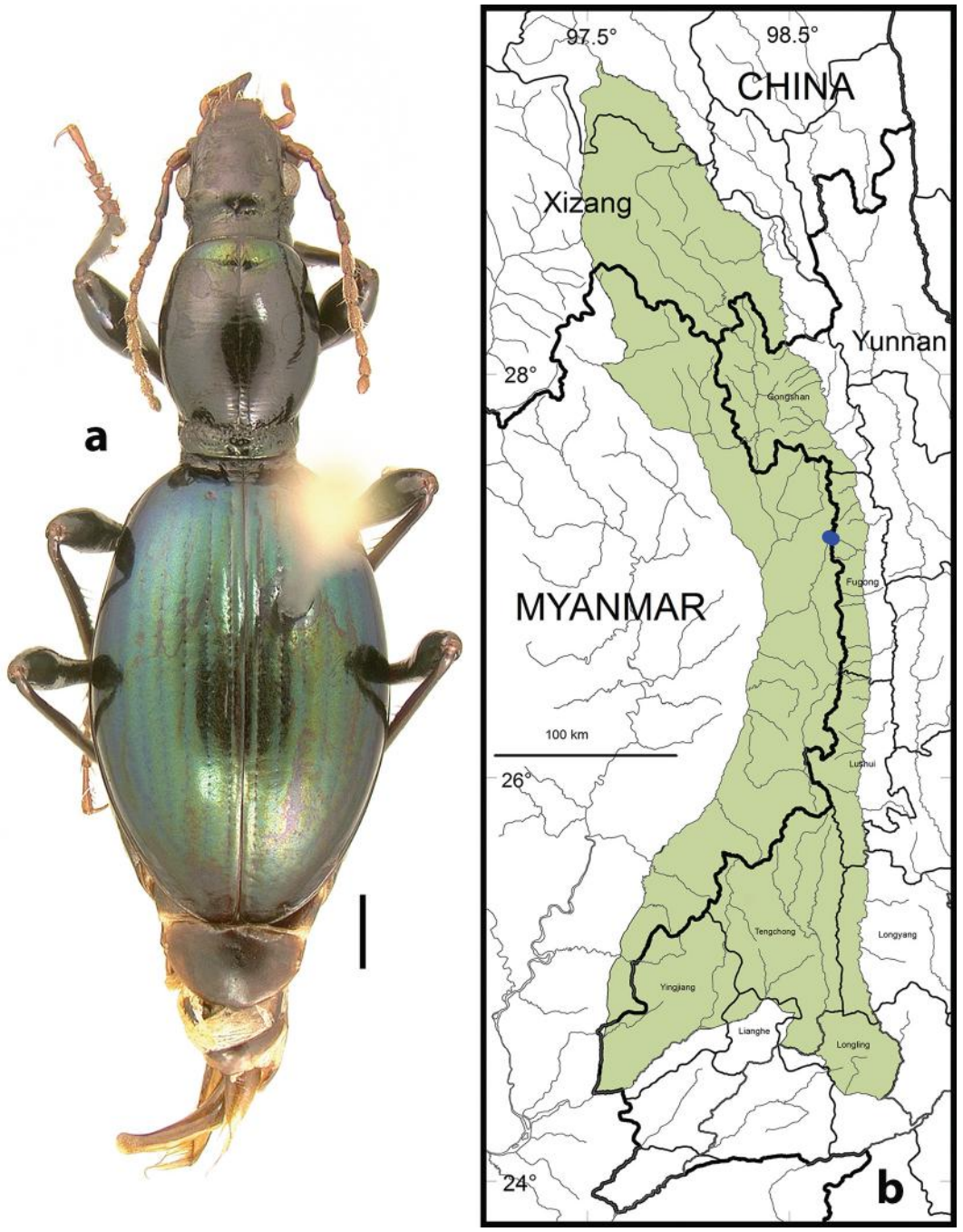


FIGURE 34. *Broscosoma viridicollare* sp. nov. a. Habitus (CASENT1022787; 8.5 km above Shibali, Lishadi Twonship, Fugong County, Yunnan, China), dorsal aspect, scale line = 1.0 mm; b. Map showing locality records (blue circles) for this species in the Gaoligong Shan region, scale line = 100 km.

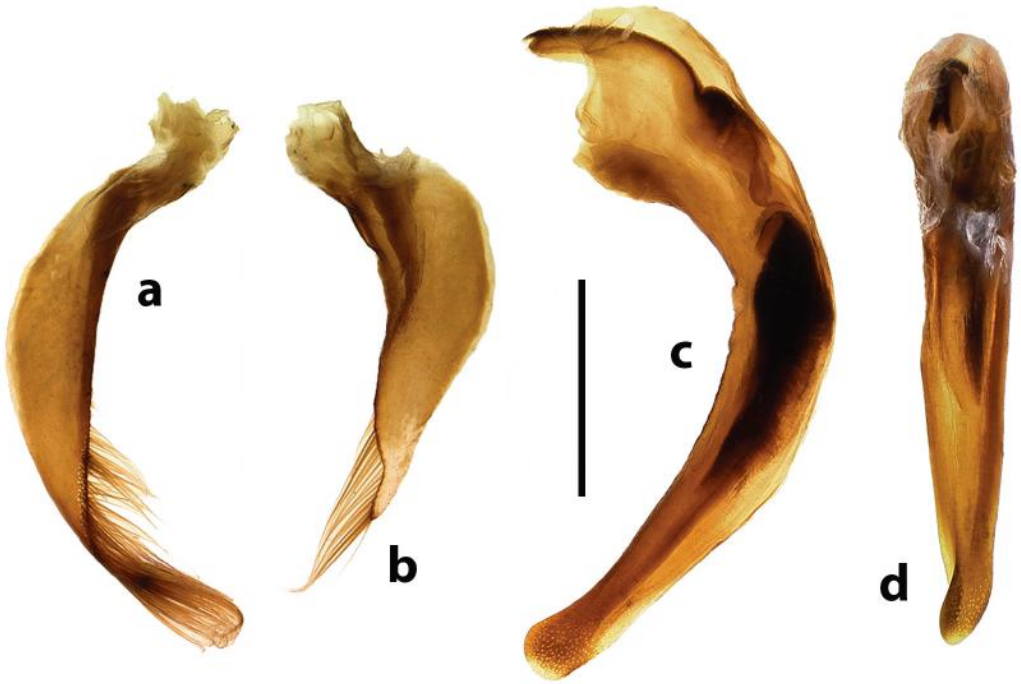


FIGURE 35. Male genitalia, *Broscosoma viridicollare* sp. nov. (CASENT1017820; second cirque S of Shibali Yakou, Lumadeng Township, Fugong County, Yunnan, China). a. Right paramere, lateral aspect; b. Left paramere, lateral aspect; c. Median lobe, left lateral aspect; d. Median lobe, ventral aspect; scale line = 1.0 mm.

striae 3 to 8 successively more shallowly impressed laterally and apically, striae 8 merged with lateral groove throughout it length or nearly so; stria 1 moderately punctate at least in basal half, 2 to 3, 4, or 5 moderately punctate in basal two-thirds and successively more shallowly and sparsely punctate in apical third, striae 3 to 8 successively more shallowly and sparsely punctate laterally and apically. Elytral microsculpture distinct, comprised of moderately impressed isodiametric sculpticells. Parascutellar seta present at base of stria 2, discal setae absent, umbilicate series comprised of one post-humeral and two preapical setae.

Hindwings. Vestigial, incapable of supporting flight.

Thoracic venter. Metepisternum ratio ML/MW = 1.4–1.6.

Legs. Hind trochanters asetose. Tarsomeres without dorsal pubescence; tarsomere 5 with two or more pairs of setae ventrally; male protarsi with pads of adhesive setae on tarsomeres 1 to 3 ventrally, male mesotarsi with pads of adhesive setae on tarsomeres 1 and 2 ventrally.

Abdomen. Sternite VI of both male and female with one pair of apicoparamedial setae.

Male genitalia. As in Fig. 35.

Comments. Features distinguishing members of this species from those of the three others (namely, *B. bicoloratum*, *B. gaoligongense*, and *B. gongshanense*) with indistinct elytral humeri and distinct metallic reflection on the elytra but with the forebody (head and pronotum) without metallic reflection (or with that reflection confined to the pronotal area anterior to the anterior transverse impression) have been addressed above in the Comments sections for each of those species.

No *Broscosoma* species known from outside of the study area has members with a distinct band of green metallic reflection on the apical portion of an otherwise dark and non-metallic prono-

tum such as is seen in *B. viridicollare* members. This feature, in combination with their relatively large size, head with the tempora enlarged and subangulate, and elytral microsculpture finely impressed but distinct, distinguishes them from those of all other described species, including *B. montreuille* and *B. tiani*.

Habitat distribution. In daytime, members of this species have been found under stones along roadcuts and trails through bamboo and *Rhododendron* thickets (Fig. 40b), in scattered stands of *Abies* sp. with sparse understory, in moist alpine meadow areas and stable talus slopes, and along small to medium-sized streams. The beetles are active on the surface at night in the same areas. This species is found at moderately high elevations, with our records documenting its occurrence in the 3100 to 3710 m range (Fig. 49).

Geographical distribution within the Gaoligong Shan. Fig. 34b. We examined a total of 21 specimens (13 males and 8 females), all from the northcentral part of the Gaoligong Shan in Fugong County on the eastern side of the range in Core Area 3 (Fig. 48) (see Type material above for exact collection data).

Overall geographical distribution. This species currently is known only from the northcentral part of the Gaoligong Shan, in western Yunnan Province, China.

Geographical relationships with other *Broscosoma* species. Members of this species have been found together (syntopic) with those of *B. ribbei, B. furvum* and *B. parvum* at one or more sites (Fig. 50). They have been found syntopic also with specimens of *Broscodera chukuai.*

Genus *Broscus* Panzer, 1813

Cephalotes Bonelli, 1810: Tabula Synoptica (junior homonym). Type species: *Carabus cephalotus* Linnaeus, 1758:414.

Broscus Panzer, 1813:62 (replacement name). Type species: *Carabus cephalotus* Linnaeus, 1758:414.

Nepalobroscus Habu, 1973:85. Type species *Broscus bipilifer* Andrewes, 1927:71

Diagnosis. Members of this genus can be distinguished from those of other broscine genera in the region by the following combination of character states: body size large, BL > 15.0 mm; head with one pair of supraorbital setae, vertex with shallower, broader, and distinctly punctate transverse sulcus between tempora; genal ridge present, extended from posterior region of head to ventral margin of eye; gula without deep transverse grooves on either side; maxillae with two setae on eustipes; mentum with one pair of setae; submentum with three pairs of setae; antennomere 3 with apical whorl of fixed setae only, antennomere 4 with or without pubescence on apical one-half; pronotum with basolateral setae present; elytra with parascutellar setae present; male protarsi with tarsomeres 1 to 3 with ventral pads of adhesive setae, all male mesotarsomeres lacking ventral pads of adhesive setae.

Diversity and geographical distribution. This genus includes 25 described species and two additional subspecies (Häckel et al. 2010). Its geographical range extends across the Palearctic Region, from the Canary Islands eastward to Japan. A single species, *B. cephalodes* (Linnaeus), is adventive in eastern North America (Cape Breton Island and Prince Edward Island in Canada) (Larochelle and Larivière 1989).

14. *Broscus punctatus* (Dejean), 1828

Figures 5b, 36, 37, 46b, 47-50

Cephalotes punctatus Dejean, 1828:431. Holotype, a female, deposited in MNHN. Type locality: Egypt, Mt. Sinai.

Percus nepalensis Hope, 1831:21. Type deposited in OUMNH. Type localiy: Nepal.

Broscus limbatus Ballion, 1871:327. Type locality: Tajikistan, Mogol-Tau.

Broscus davidianus Fairmaire, 1888:7. Types deposited in MNHN. Type areas: China, Yunnan and Hong Kong.

Broscus batesi Semenov, 1891:276. Holotype, a female, deposited in ZIN. Type locality: India, Assam.

Diagnosis. Fig. 36a. Because *B. punctatus* is the only species of the genus in the region, the generic diagnosis serves also to distinguish members of this species.

Habitat distribution. Within the study area, members of this species were collected in daytime from under stones, logs and other cover in open roadside and disturbed waste areas, in heavily grazed meadows with scattered grasses and shrubs (Fig. 46b), at the edges of agricultural fields, including wet and dry rice paddies, and on the upper open sandy banks of large streams. At night, beetles were found active on the bare substrate surface in these same habitats.

Within the Gaoligong Shan region, this species occurs at relatively low to moderate elevations, with our records documenting its occurrence in the 1185 to 2506 m range (Fig. 49).

Geographical distribution within the Gaoligong Shan. Fig. 36b. We examined a total of 466 specimens (250 males and 216 females) from the following localities: ***Fugong County:*** LumadengTownship (Nu Jiang at Yaping Bridge, 27.12957°/98.87596°, 1250 m, 30 April 2004, H.B. collector [one male and one female; CAS; IOZ]); Maji Township (Majimi village, 27.39828°/98.82650°, 1350 m, 23 April 2004, H.B. Liang, X.Y. Li & M. Xie collectors [two males; CAS, IOZ]; Pihe Township (Zhiziluo village, 26.54657°/98.915731° to 26.54415°/98.92677°, 1990-2285m, 20 August 2005, D.H. Kavanaugh & H.B. Liang collectors [one female; CAS]); Shangpa Township (west bank of Nu Jiang, 1185 m, 26.90668°/98.86339°, 13 October 2002, D. H. Kavanaugh, P. E. Marek, H.-B. Liang, & D.-Z. Dong collectors [one female; IOZ], (Nu Jiang, along road on west bank south of vehicle bridge, 26.88952°/98.86539°, 1223 m, 22 April 2004, D.H. Kavanaugh & C. E. Griswold collectors [one female; CAS], 27 April 2004, D.H. Kavanaugh & C. E. Griswold collectors [one female; CAS], 12 May 2004, D.H. Kavanaugh collector [one male; CAS]); Shibali Road (above Shilajia village, North Fork of Yamu He, 27.13419°/98.82641° to 27.13947°/98.82184°, 1800-1900 m, 25 April 2004, D.H. Kavanaugh & C. E. Griswold collectors [one female; CAS]). ***Gongshan County:*** (10-20 May 2001, W.D. Ba collector [one male; IOZ]); Bingzhongluo Township (Bingzhongluo, 28.01986°/98.62297°, 1749 m, 7 October 2002, H.-B. Liang & W.-D. Ba collectors [one male and five females; CAS, IOZ]), (34 km N of Cikai at junction of Shuangla He and Nu Jiang, 27.96606°/98.66092°, 1550 m, 24 September 2002, H.-B. Liang & W.-D. Ba collectors [one male; IOZ], 25 September 2002, H.-B. Liang collector [one female; IOZ], 27.96918°/98.66198°, 1550 m, 9 October 2002, D. H. Kavanaugh, H.-B. Liang, & W.-D. Ba collectors [one male and two females; CAS; IOZ], 22 October 2004, D. H. Kavanaugh & D.-Z. Dong collectors [one female; CAS]), (Gongdangshenshan, 27.99725°/98.662003°, 2489 m, 12 November 2004, H.-B. Liang collector [one male; IOZ]), (Gongdong, 2506 m, 27.99858°/98.61933°, 9 October 2002, P. E. Marek & D.-Z. Dong collectors [one female; CAS]); Cikai Township (Heiwadi, 15 km W of Cikai on Dulong Valley Road, 2022 m, 27.79584°/98.58443°, 4 October 2002, H.-B. Liang, W.-D. Ba, & C.-G. Jin collectors [one male; IOZ], 10 October 2002, D. H. Kavanaugh, P.E. Marek, H.-B. Liang, & D.-Z. Dong [one male; CAS]), (15 km W of Cikai on Dulong Valley Road at Heiwadi Nature Reserve Managing Station, 2018 m, 27.79433°/98.58908°, 4 October 2002, H.-B. Liang & C.-G. Jin collectors [one female; IOZ]), (Heiwadi, 16.8 km W of Cikai on Dulong Valley Road, 27.79584°/98.58443°, 2020-2150 m, 23 September 2002, D. H. Kavanaugh, P.E. Marek, & D.-Z. Dong collectors [one male; CAS]), (Nu Jiang in Cikai, 27.73845°/98.67092°, 1430 m, 8-9 October 2002, D. H. Kavanaugh & P. E. Marek collectors [four males and three females; CAS, IOZ]), (Nu Jiang at Dashaba, 27.73845°/98.67092°, 1430 m, 10 November 2004, H.-B. Liang collector [one male; IOZ]), (Pula He, 3.0 airkm N of Cikai, 1510 m, 27.76883°/98.65325°, 21 September 2002, H.-B. Liang collec-

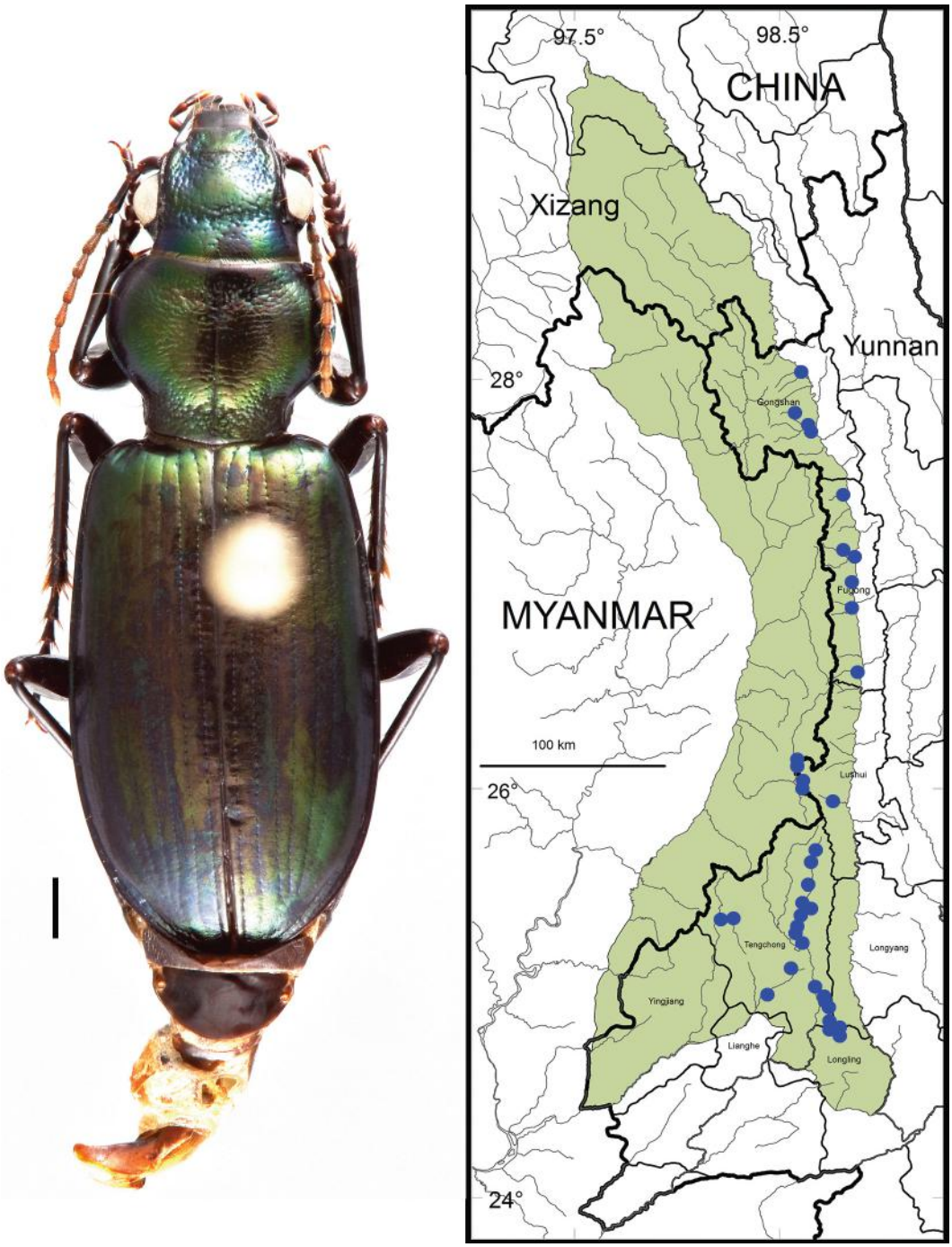


FIGURE 36. *Broscus punctatus* (Dejean). a. Habitus (CASENT1010276; Heiwadi, Cikai Township, Gongshan County, Yunnan, China), dorsal aspect, scale line = 1.0 mm; b. Map showing locality records (blue circles) for this species in the Gaoligong Shan region, scale line = 100 km.

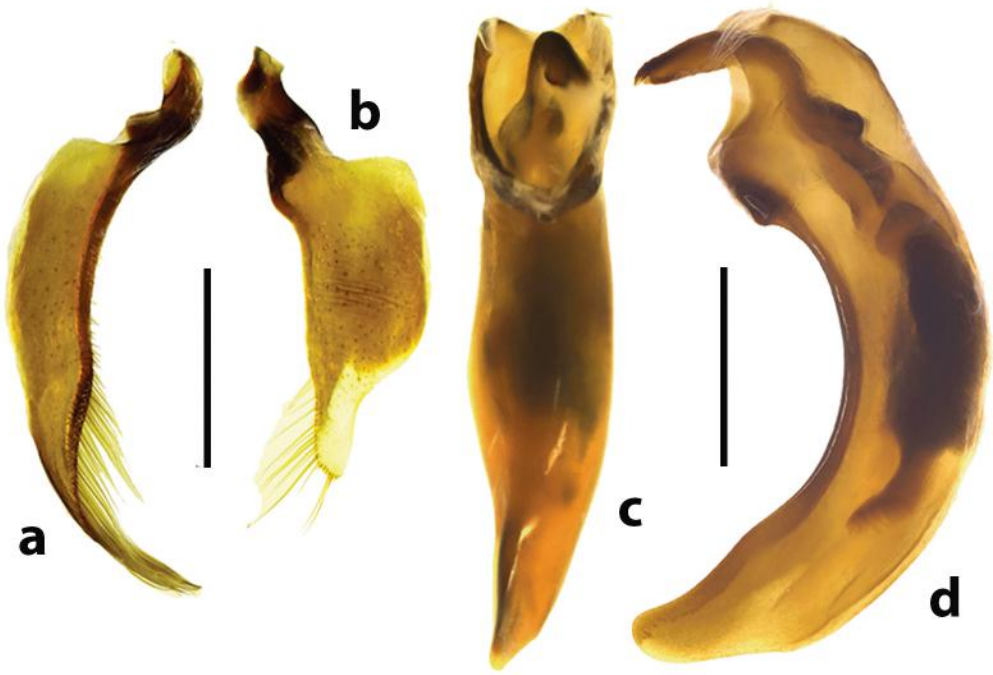


FIGURE 37. Male genitalia, *Broscus punctatus* (Dejean) (CASENT1011066; Heiwadi, Cikai Township, Gongshan County, Yunnan, China). a. Right paramere, lateral aspect; b. Left paramere, lateral aspect; c. Median lobe, left lateral aspect; d. Median lobe, ventral aspect; scale line = 1.0 mm.

tor [one male; IOZ]), (Pula He just above Nu Jiang Road, 27.74861°/98.66675°, 1440 m, 23 October 2004, D.H. Kavanaugh, H.-B. Liang & D.-Z. Dong collectors [four males and two females; CAS, IOZ], 11 November 2004, D.H. Kavanaugh , G. Tang, H.-B. Liang & D.-Z. Dong collectors [one female; IOZ]). ***Longling County:*** Longjiang Township (Xiaoheishan Forest Reserve, Guchengshan, 24.82888°/98.76001°, 2020 m, 26 May 2005, D.H. Kavanaugh, C.E. Griswold & H.B. Liang collectors [three males and one female; CAS, IOZ], 27 May 2005, D.Z. Dong collector [six males and five females; CAS, IOZ]), (small stream along road below Xiaoheishan Forest Reserve, Guchengshan, 24.82888°/98.76001°, 2020 m, 25 May 2005, D.H. Kavanaugh, H.B. Liang & D.Z. Dong collectors [seven males and four females; CAS, IOZ]). ***Longyang County:*** Lujiang Township (Dasheyao Forestry Station, Km 39.9 on Baoshan-Tenchong Road, 24.92994°/98.75850°, 2325 m, 3 June 2005, D.H. Kavanaugh & D.Z. Dong collectors [two males and one female; CAS, IOZ], Km 40, 24.92944°/98.75861°, 2320 m, 6 June 2005, J.J. Yang collector [two males; CAS, IOZ]), (Baoshan-Tenchong Road Km 24, 24.83917°/98.75000°, 2008 m, 29 October 2003, N.D. Penny, T.S. Briggs, H.B. Liang, D.Z. Dong, R. Li, & G. Tang [three males and two females; CAS, IOZ]), (Baoshan-Tenchong Road Km 29-35, 24.92916°/98.75861°, 2000-2350 m, 12 October 2003, D.Z. Dong collector [one female; IOZ]), (Baoshan-Tenchong Road Km 36-37, 24.93417°/98.76667°, 2150 m, 12 October 2003, H.B. Liang & X.C Shi collectors [three males and two females; CAS, IOZ]), (Baoshan-Tenchong Road KM 40, 24.92944°/98.75861°, 2320 m, 16 October 2003, H.B. Liang & X.C Shi collectors [three males and one female; CAS, IOZ]), (Baoshan-Tenchong Road Km 40-41 (24.92694°/98.75000°, 2404 m, 12 October 2003, H.B. Liang & X.C Shi collectors [five males and three females; CAS, IOZ]), (Baoshan-Tenchong Road Km 41, 24.93194°/98.76111°, 2440 m, 15 October 2003, H.B. Liang & X.C Shi collectors [two males

and two females; CAS, IOZ]); Luoshuidong area (24.94833°/98.75667°, 2300 m, 26-31 October 1998, D.H. Kavanaugh, C.E. Griswold, C.-L. Long & H.X. He collectors [two females; CAS, IOZ], 30 May 2005, D.Z. Dong collector [two females; CAS, IOZ]), (24.93278°/98.75333°, 2300-2480 m, 13 October 2003, D.Z. Dong collector [one female; IOZ]), (Sancha He, 24.94865°/98.75193°, 2350 m, 30 May 2005, H.B. Liang & J.J. Yang collectors [two males and one female; CAS, IOZ]); Mangkuan Township (Baihualing Nature Reserve work station, 25.29560°/98.80298°, 1520 m, 9-12 October 2007, H. B. Liang collector [one female; IOZ]; Nankang Forest Station (24.82444°/98.77889°, 2085 m, 27 October 2003, H.B. Liang & X.C. Shi collectors [four males and one female; CAS, IOZ]), (24.82284°/98.78207°, 2060 m, 23 May 2005, D.H. Kavanaugh, C.E. Griswold, H.B. Liang, D.Z. Dong, H.M. Yan & K.J. Guo collectors [one female; CAS]); Nankang Yakou (24.83167°/98.76667°, 2130 m, 4-7 November 1998, D.H. Kavanaugh, C.E. Griswold, C.-L. Long, R. Li, & H.-X. He collectors [48 males and 33 females; CAS, IOZ]), (24.82583°/E098.77222°, 2130 m, 26 October 2003, H.B. Liang & X.C. Shi collectors [four males and two females; CAS; IOZ], 26 October 2003, D.Z. Dong collector [one male and two females; CAS, IOZ]), (24.81944°/98.77111°, 2130 m, 27 October 2003, D.Z. Dong collector [one male; IOZ], 31 October 2003, D.Z. Dong collector [one female; IOZ]), (24.82587°/98.76832°, 2148 m, 22 May 2005, H.B. Liang collector [four males and two females; CAS, IOZ]), (just N of Nankang Yakou, 24.83178°/98.76472°, 2180 m, 22 May 2005, D.H. Kavanaugh, C.E. Griswold & D.Z. Dong collectors [four males; CAS, IOZ]), (mountain near Nankang, 24.83250°/98.76667°, 2245 m, 27 October 2003, H.B. Liang & X.C. Shi collectors [one male and one female; CAS, IOZ]). ***Lushui County:*** Luzhang Township (Langbazhai, Lusai He, 25.96378°/98.770321°, 1873 m, 20 May 2005, D.Z. Dong & H.B. Liang collectors [five males and three females; CAS, IOZ]; Pianma Township (Gangfang village, 26.10403°/98.58059°, 1563 m, 13 May 2005, D.Z. Dong collector [two males and three females; CAS, IOZ]), (Gangfang He at Gulang village, 26.10321°/98.58094°, 1590 m, 13 May 2005, H.B. Liang & Y.H. San collectors [one male and two females; CAS, IOZ]), (Gangfang Yakou, 7 km N of Pianma, 26.03672°/98.62026°, 2250 m, 12 May 2005, H.B. Liang collector [two males; CAS, IOZ], (Gangfang Sancha Lukou (26.12167°/98.57500°, 1500 m, 12 October 1998, D. H. Kavanaugh collector [three males; CAS, IOZ]; 14-15 October 1998, D.H. Kavanaugh, C.E. Griswold, C. Ferraris, & C.-L. Long collectors [14 males and seven females; CAS, IOZ]), (Gulang village, 26.09028°/98.58584°, 1535 m, 14 May 2005, D.Z. Dong, H.B. Liang & Y.H. San collectors [one male; IOZ]), (0 to 4.0 km E of Sancha Lukou, 26.12218°/98.57546° to 26.11750°/98.59509°, 1625-1785 m, 16 May 2005, D.H. Kavanaugh, C.E. Griswold, D.Z. Dong & K.J. Guo collectors [13 males and 15 females; CAS, IOZ], (Xiapianma village, 26.01137°/98.61788°, 1850 m, 13 May 2005, H.B. Liang collector [one female; IOZ]). ***Tengchong County:*** Beihai Township (15.2 airkm NNE of Tengchong at Qing Hai (lake), 25.13408°/98.57144°, 1842 m, 7 June 2006, D.H. Kavanaugh, R.L. Brett, H.B. Liang, Z.C. Liu, & D.Z. Dong collectors [one male; CAS]); Houqiao Township (5.9 airkm NE of Houqiao near Guyong Forestry Station, 25.36562°/98.31610°, 2030 m, 27 May 2006, D.H. Kavanaugh, R.L. Brett, H.B. Liang, Z.C. Liu, & D.Z. Dong collectors [two males and two females; CAS, IOZ]), (3.5 airkm NW of Houqiao at Xiajie village, 25.34885°/98.25266°, 1720 m, 28 May 2006, D.Z. Dong collector [one male; IOZ]); Jietou Township (Dahetou Lingganjiao, 25.73947°/98.69630°, 2010 m, 14-15 May 2006, D.H. Kavanaugh, R.L. Brett, & H.B. Liang collectors [18 males and nine females; CAS, IOZ], 16 May 2006, D. H. Kavanaugh collector [seven males and three females; CAS, IOZ], 25.67125°/98.68016° to 25.73947°/98.69630°, 1838 - 2010 m, 14 May 2006, D.Z. Dong & X.P. Wang collectors [one male and one female; CAS, IOZ], along Longtang He, 25.73947°/98.69630°, 2010 m, 18 May 2006, D.H. Kavanaugh & R.L. Brett collectors [seven males and one female; CAS, IOZ], 19 May 2006, D.H. Kavanaugh, R.L. Brett, & D.Z. Dong collectors [four males and

seven females; CAS, IOZ]), (0.75 km N of Dahetou Lingganjiao at Longtang He, 25.74622°/98.69612°, 2030 m, 18 May 2006, D.H. Kavanaugh & R.L. Brett collectors [one female; CAS]), (0.3 km S of Dahetou Lingganjiao in valley of Longchuan Jiang, 25.73678°/98.69639°, 2005 m, 18 May 2006, D. Z. Dong collector [six males and 11 females; CAS, IOZ], 20 May 2006, D. Z. Dong collector [one female; IOZ]), (Datang Village, Maluchong, 25.58194°/98.67583°, 1740 m, 24 October 2003, H.B. Liang collector [one female; IOZ]), (Jietou, stream 0.7 km N, 25.43128°/98.64773°, 1564 m, 22 May 2006, D.H. Kavanaugh, R.L. Brett, H.B. Liang, & D.Z. Dong collectors [three females; CAS, IOZ]), (Shaba Village, 25.39639°/98.70000°, 1850 m, 23 October 2003, H.B. Liang & X.C. Shi collectors [one male and one female; CAS, IOZ], Cha He at Shaba village, 25.39256°/98.70488°, 1840 m, 25 May 2006, D.H. Kavanaugh, R.L. Brett, & D.Z. Dong collectors [one female; CAS]), (Shabadi, 25.39416°/98.64686°, 1500 m, 25 October 1998, D.H. Kavanaugh collector [one male; CAS]), (Yong'anqiao, 25.32556°/98.60944°, 1500 m, 22 October 2003, H.B. Liang & X.C. Shi collectors [two males and two females; CAS, IOZ]), (Zhoujiapo Village, 25.33222°/98.67611°, 1740 m, 24 October 2003, D.Z. Dong collector [one female; IOZ], 25.53476°/98.66897°, 1610 m, 13 May 2006, H.B. Liang, R.L. Brett, & D.Z. Dong collectors [one male and three females; CAS, IOZ]); Qushi Township (Longchuan Jiang at Longkou village, 25.28175°/98.59246°, 1500 m, 6 June 2006, D.H. Kavanaugh, R.L. Brett, H.B. Liang, & D.Z. Dong collectors [one male; CAS]), (Xiaojiangqiao, 25.23944°/98.62722°, 1445 m, 21 October 2003, H.B. Liang & X.C. Shi collectors [six males and two females; CAS, IOZ]; Shangying Township (Baoshan-Tenchong Road Km 42 at Sanchawa, 2300 m, 24.93278°/98.75333°, 14 October 2003, H.B. Liang & X.C Shi collectors [two females; CAS, IOZ]), (Baoshan-Tenchong Road Km 42-46, 24.95361°/98.73333°, 2290 m, 14 October 2003, H.B. Liang & X.C. Shi collectors [five males and six females; CAS, IOZ], 17 October 2003, H.B. Liang collector [one male and six females; CAS, IOZ]), (Baoshan-Tenchong Road Km 46-51 near Dahaoping Forest Station, 24.95722°/98.73333°, 2220 m, 17 October 2003, H.B. Liang & X.C Shi collectors [two males and three females; CAS, IOZ], D.Z. Dong collector [one female; IOZ], 18 October 2003, H.B. Liang & X.C Shi collectors [one male; IOZ]), (Baoshan-Tenchong Road Km 63, 25.02917°/98.66667°, 1360 m, 19 October 2003, H.B. Liang X.C. Shi and G. Tang collectors, [one male; IOZ]), (Km 65, 25.04167°/98.66667°, 1335 m, 19 October 2003, H.B. Liang & X.C. Shi collectors [one male and one female; CAS, IOZ]), (small road near Dahaoping Forest Station, 24.95722°/98.73333°, 2170 m, 18 October 2003, H.B. Liang & X.C. Shi collectors [one male; IOZ]), (Longwen Bridge at Baoshan-Tengchong Road, 25.02222°/98.66667°, 1290 m, 19 October 2003, D.Z. Dong collector [four females; CAS, IOZ], 20 October 2003, H.B. Liang & X.C. Shi collectors [one male and one female; CAS, IOZ]); Tengyue Township (Laifeng Shan, 25.01734°/98.47719°, 1920 m, 1 June 2006, D.H. Kavanaugh, R.L. Brett, H.B. Liang, & D.Z. Dong collectors [two females; CAS, IOZ]); Wuhe Township (1 km S of Picaohe Village, 24.86972°/98.70000°, 1600 m, 28 October 2003, N.D. Penny collector [one female; CAS]), (Xiaodifang Village, 24.85722°/98.75917°, 2150 m, 29 October 2003, H.B. Liang & X.C. Shi collectors [one female; IOZ], D.Z. Dong collector [three males and three females; CAS, IOZ]), (Xiaoheishan Forest Station, 24.82889°/98.76000°, 2025 m, 29 October 2003, H.B. Liang & X.C. Shi collectors [four males and three females; CAS, IOZ]); (Zhengding Forestry Station, Km 28.8 on Route S317, 24.85450°/98.73761°, 1834 m, 23 May 2005, D.Z. Dong & H.M. Yan collectors [two females; CAS, IOZ]).

Members of this species were collected in all parts of the study area except for Core Area 1, in the northwestern part of the study area (Fig. 48). However, the relatively broad geographical range of this species overall (see below) suggests that it probably occurs in that core area as well but has not yet been recorded there.

Overall geographical distribution. Fig. 47. The geographical range of this species spans nearly the entire Asian mainland, from eastern Egypt to eastern China, in a band more or less between about 15° and 40° North latitudes, with the most southly part of the range in the Middle East and the northernmost part in central Asia. The species has been recorded from the following areas: Afghanistan, China (Fujian, Guangxi, Hong Kong, Sichuan, Yunnan), Egypt (Mt. Sinai), India (Assam, Uttarakhand), Iraq, Iran, Kyrgyzstan, Kuwait, Myanmar, Nepal, Saudi Arabia, Tajikistan, United Arab Emirates, Uzbekistan, Vietnam, and Yemen (Häckel et al 2010). Its occurrence in the study area is about at the eastern one-fourth of it known east/west range and near the center of its north/south geographical range.

Geographical relationships with other *Broscus* species. Representatives of no other *Broscus* species have been recorded from within the study area or in any adjacent areas at similar elevations (Fig. 50). The nearest other *Broscus* species occur in the Himalayan ranges and typically at higher elevations (Schmidt and Arndt 2000).

Genus *Eobroscus* Kryzhanovskij, 1951

Eobroscus Kryzhanovskij, 1951:538. Type species: *Eobroscus richteri* Kryzhanovskij, 1951:538 (= *Broscus lutshniki* Roubal, 1928:90).

Tosawabroscus Uéno, 1953:49. Type species: *Tosawabroscus amabilis* Uéno, 1953:49.

Orobroscus Morita. 1990:159. Type species: *Eobroscus masumotoi* Morita, 1990:160 (synonymized by Schmidt et al. 2013:15).

Diagnosis. Members of this genus can be distinguished from those of other broscine genera in the region by the following combination of character states: body size large, BL > 15.0 mm; head with one pair of supraorbital setae; vertex with very deep, sharply defined and impunctate cleft between tempora; gula with two deep transverse grooves on each side; maxillae with two setae on eustipes; mentum with one pair of setae; submentum with three pairs of setae; antennomere 3 with apical whorl of fixed setae only, antennomere 4 with pubescence on apical one-third; pronotum with basolateral setae present; elytra with parascutellar setae present; male pro- and mesotarsi with ventral pads of adhesive setae on tarsomeres 1 and 2.

Diversity and geographical distribution. This genus is represented by only three species (Schmidt et al. 2013): *Eobroscus lutshniki* (Roubal), restricted to the northeastern China, the Russian Far East, and Japan; *Eobroscus masumotoi* Morita, 1990, restricted to Taiwan; and *Eobroscus bhutanensis*, treated below.

15. *Eobroscus bhutanensis* Morvan, 1982

Figures 5a, 38, 39, 43, 47-50

Eobroscus bhutanensis Morvan, 1982:77. Holotype, a male, deposited in NHMB. Type locality: Bhutan, near Thimphu.

Eobroscus uenoi Morita, 1995:8. Holotype, a male, deposited in NSMT. Type locality: Vietnam, Lào Cai, Hoang Lien Son Moutains, N of Mt. Fan Si Pan, 1840 m (synonymized by Schmidt et al. 2013:15).

Diagnosis. Fig. 38a. Because *E. bhutanensis* is the only species of the genus in the region, the generic diagnosis serves also to distinguish members of this species.

Habitat distribution. Within the study area, members of this species were collected mainly under large stones at the edges small streams (Fig. 43), however one specimen was found under a stone along a roadcut though mixed broadleaf evergreen and conifer forest.

Within the Gaoligong Shan region, this species occurs at moderate elevations, with our records documenting its occurrence in the 2527 to 3100 m range (Fig. 49).

Geographical distribution within the Gaoligong Shan. Fig. 38b. We examined a total of

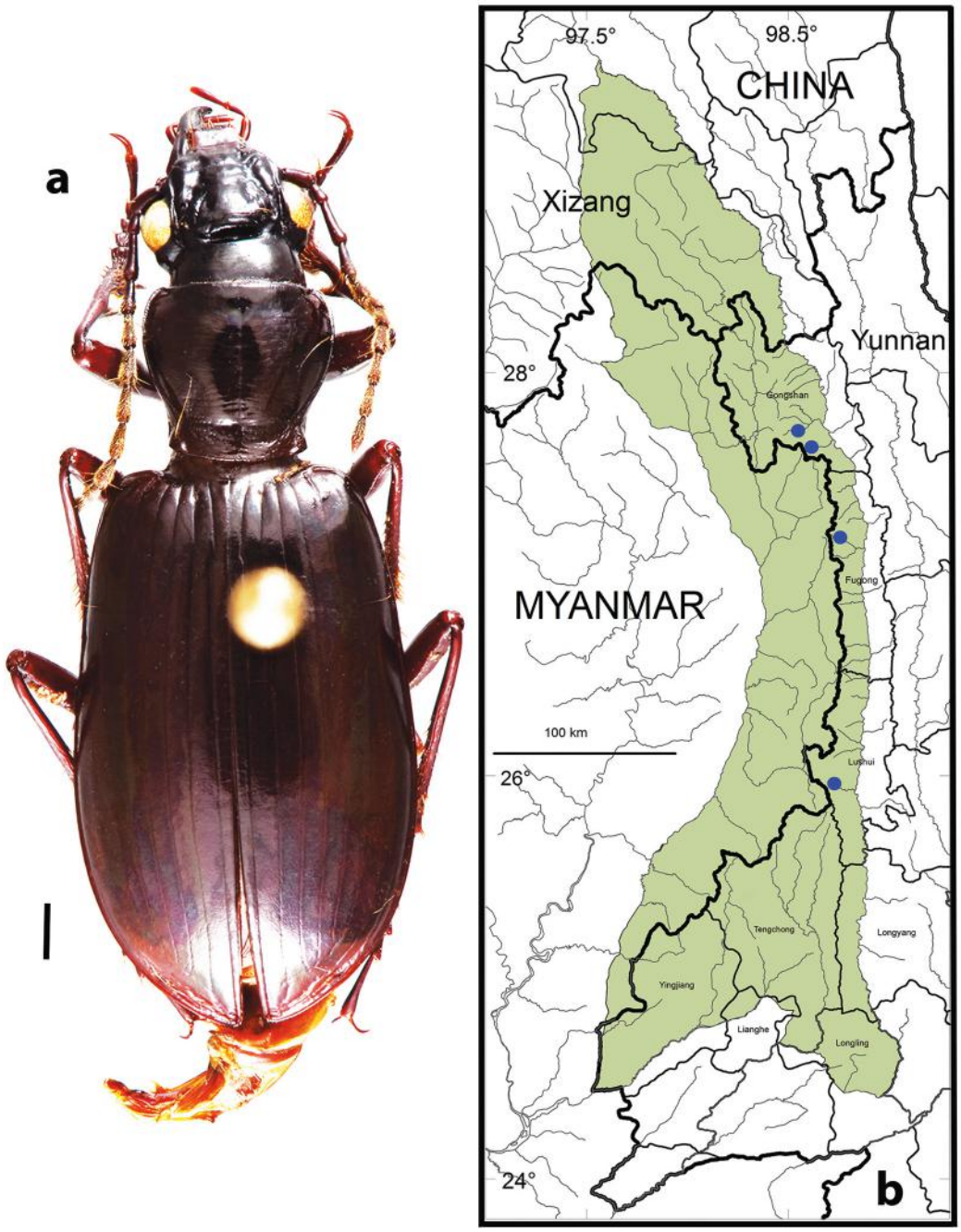


FIGURE 38. *Eobroscus bhutanensis* Morvan. a. Habitus (CASENT1019340; Lishadi Township, Fugong County, Yunnan, China), dorsal aspect, scale line = 1.0 mm; b. Map showing locality records (blue circles) for this species in the Gaoligong Shan region, scale line = 100 km.

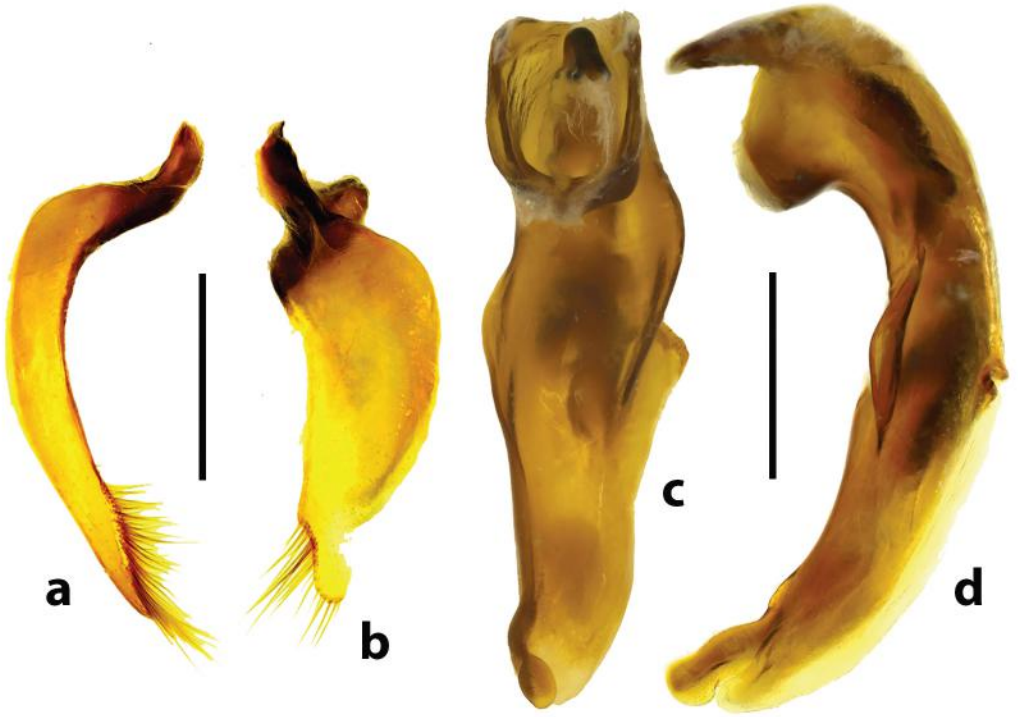


FIGURE 39. Male genitalia, *Eobroscus bhutanensis* Morvan (CASENT1001452; Danzhu He drainage, Gongshan County, Yunnan, China). a. Right paramere, lateral aspect; b. Left paramere, lateral aspect; c. Median lobe, left lateral aspect; d. median lobe, ventral aspect; scale line = 1.0 mm.

nine specimens (seven males and two females) from the following localities: ***Fugong County*:** Lishadi Township (2.0 to 4.3 km above Shibali on Shibali Road, 27.17262°/98.76943° to 27.17772°/98.75485°, 2700-2826 m, 3 May 2004, D.H. Kavanaugh, H.B. Liang & C.E. Griswold collectors [one male; CAS]). ***Gongshan County*:** Cikai Township (Danzhu (27.63056°/98.62056°, 2600 m, 14 April 2002, H.B. Liang & W.D. Ba collectors [one male; IOZ]), (Danzhu He (13.5-13.8 airkm SSW of Cikai, 27.63267°/98.60861° to 27.63331°/98.60356°, 2720-2840 m, 30 June – 5 July 2000, D.H. Kavanaugh, C.E. Griswold, H.B. Liang, D. Ubick & D.Z. Dong collectors [five males; CAS, IOZ]), (No. 12 Bridge Camp area (16.3 airkm W of Cikai, 27.71503°/98.50244°, 2775 m, 15-19 July 2000, D.H. Kavanaugh, C.E. Griswold, H.B. Liang, D. Ubick & D.Z. Dong collectors [one male; CAS]). ***Lushui County*:** Luzhang Township (Yaojiaping He at Pianma Road, 25.97722°/98.71091°, 2527 m, 19 May 2005, D.H. Kavanaugh, H.B. Liang & D.Z. Dong collectors [one female; IOZ]).

Members of this species were collected only in the northern two-thirds of the study area, in Core Areas 2, 3 and 5 (Fig. 48), and only on the eastern side of the mountain range. However, the relatively broad geographical range of this species overall (see below) suggests that it probably occurs in the other cores areas as well but has not yet been recorded from them.

Overall geographical distribution. Fig. 47. This species has been recorded from Bhutan, China (Gansu, Shaanxi, Sichuan, Xizang (Tibet), Yunnan), India (Arunachal Pradesh), Myanmar, Nepal, and northern Vietnam. Its occurrence in the study area is near the midpoint of both its known east/west and north/south geographical ranges.

Geographical relationships with other *Eobroscus* species. Representatives of neither of the other *Eobroscus* species have been recorded from within the study area or from any other area where *E. bhutanensis* has been found with one exception. A single specimen of *E. lutshniki* (in IOZ) that we examined is labeled [in Chinese characters] as from Lazikou, Gansu Province, China, an area about 2500 km SW of the nearest verified localities for that species. A specimen of *E. bhutanensi*s (also in IOZ) bears the same locality label. It is most likely that the specimen of *E. lutshniki* was mislabeled; but if not, then this would represent the only known instance of sympatry of species in the genus.

Within the study area, *E. bhutanensis* has been found in the same area and habitat as two other broscine species, *Broscosoma danzhuense* and *B. ribbei* (Fig. 50).

FIGURE 40. Photographs of habitats for broscine species in the Gaoligong Shan region. a. SW slope of Kawakarpu Shan on slope NE of Chukuai Lake, 3950 m, 27.982°/098.480°, Bingzhongluo Township, Gongshan County, Yunnan (habitat for *Brosocodera chukuai* sp. nov.); b. Second cirque S of Shibali Yakou at border post "31", 3710 m, 27.203°/098.693°, Lumadeng Township, Fugong County, Yunnan (habitat for *Brosocodera chukuai* sp. nov., *Broscosoma furvum* sp. nov., and *Broscosoma viridicollare* sp. nov.). Photos by David H. Kavanaugh.

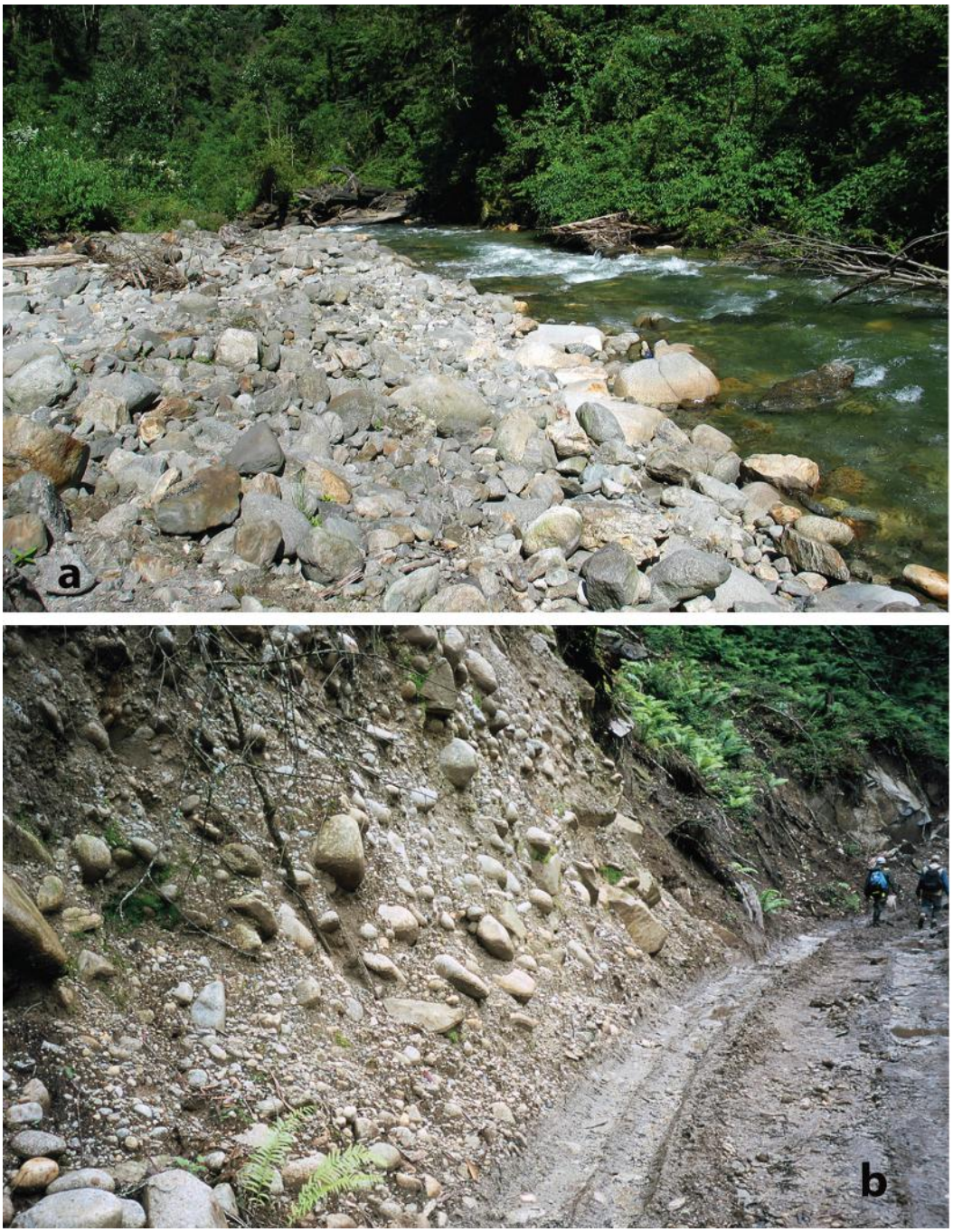


FIGURE 41. Photographs of habitats for broscine species in the Gaoligong Shan region. a. 1.3 km E of Lao Shibali, South Fork of Yamu He, 2250 m, 27.082°/98.787°, Lumadeng Township, Fugong County, Yunnan (habitat for *Brosocodera gaoligongensis* sp. nov.; b. Danzhu He drainage, 2700 m, 27.631°/98.621°, Gongshan County, Yunnan (habitat for *Broscodera gaoligongensis* sp. nov. and *Broscosoma ribbei* Putzeys). Photos by David H. Kavanaugh.

FIGURE 42. Photographs of habitats for *Broscosoma* species in the Gaoligong Shan region. a. Dulong/Gongshan Yakou area, 3300-3680m, 27.697º/098.454º, Gongshan County, Yunnan (habitat for *Broscosoma bicoloratum* sp. nov. and *B. gongshanense* sp. nov.); b. Southeastern slope of Heipu Yakou, 3365m, 27.770º/098.447º, Cikai Township, Gongshan County, Yunnan (habitat for *Broscosoma bicoloratum sp.* nov.). Photos by David H. Kavanaugh.

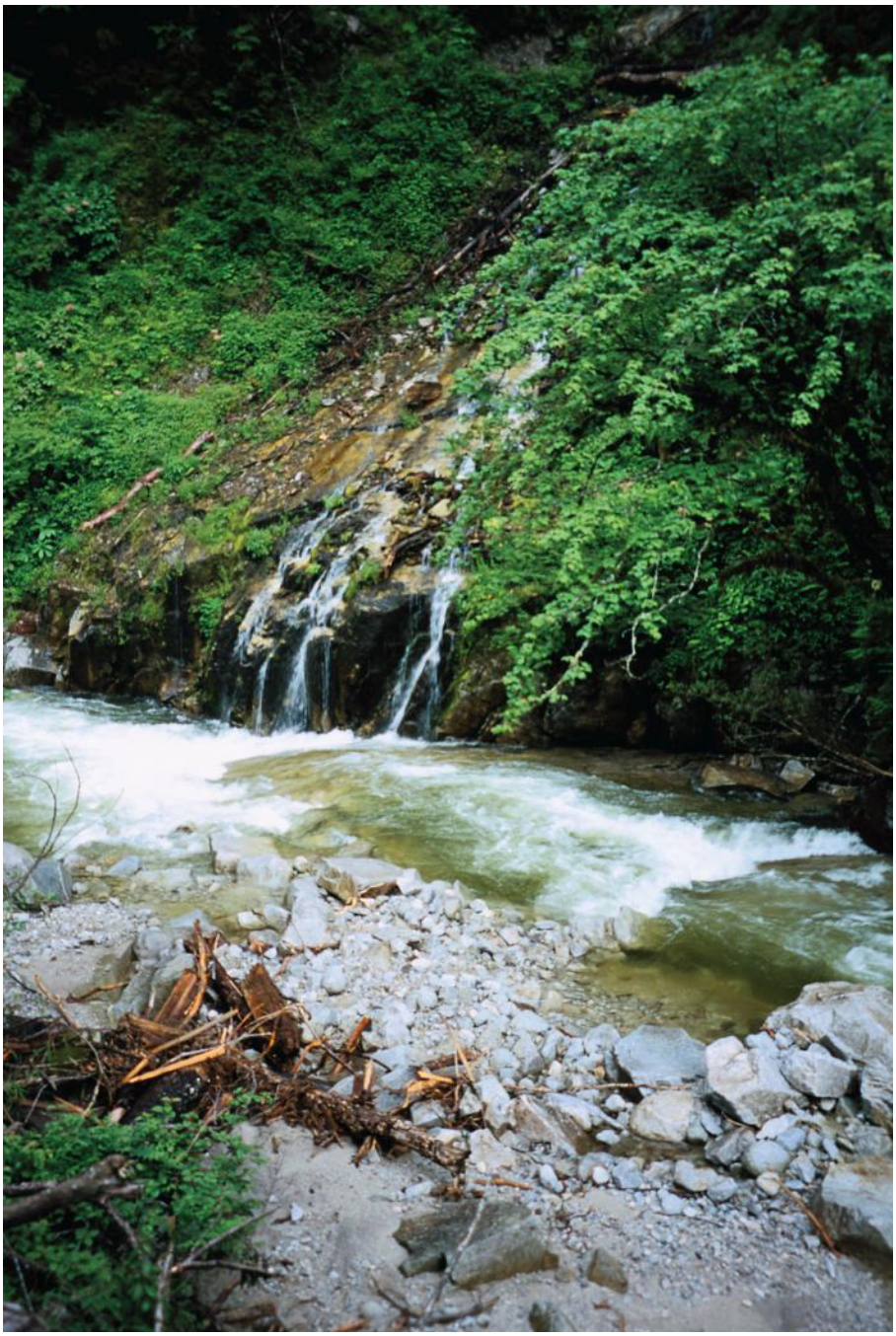


FIGURE 43. Photographs of habitat for broscine species in the Gaoligong Shan region; a. Danzhu He drainage, 2840 m, 27.633°/98.604°, Cikai Township, Gongshan County, Yunnan (habitat for *Broscosoma danzhuense* sp. nov. and *Eobroscus bhtanensis* Morvan). Photo by David H. Kavanaugh.

FIGURE 44. Photographs of habitats for *Broscosoma* species in the Gaoligong Shan region. a. 0.5 km E of Fengxue Yakou, 3150 m, 25.972º/098.683 º, Luzhang Township, Lushui County, Yunnan (habitat for *Broscosoma gaoligongense* sp. nov.); b. Xiao Jiang at Gangfang Sancha Lukou, 1500 m, 26.122º/98.573º, Lushui County, Yunnan (habitat for *Broscosoma holomarginatum* sp. nov.). Photos by David H. Kavanaugh.

FIGURE 45. Photographs of habitats for *Broscosoma* species in the Gaoligong Shan region. a. Snowmelt stream on north-facing slope above North Fork of Yamu He, 8.5 km W of Shibali, 3100-3200 m, 27.18315º/098.71921º, Lumadeng Township, Fugong County, Yunnan (habitat for *Broscosoma parvum* sp. nov.); b. 0.6 km N of Dizhengdang village on Dulongjiang, 1880 m, 28.084º/098.327º, Dulongjiang Township, Gongshan County, Yunnan (habitat for *Broscosoma purpureum* sp. nov.). Photos by David H. Kavanaugh

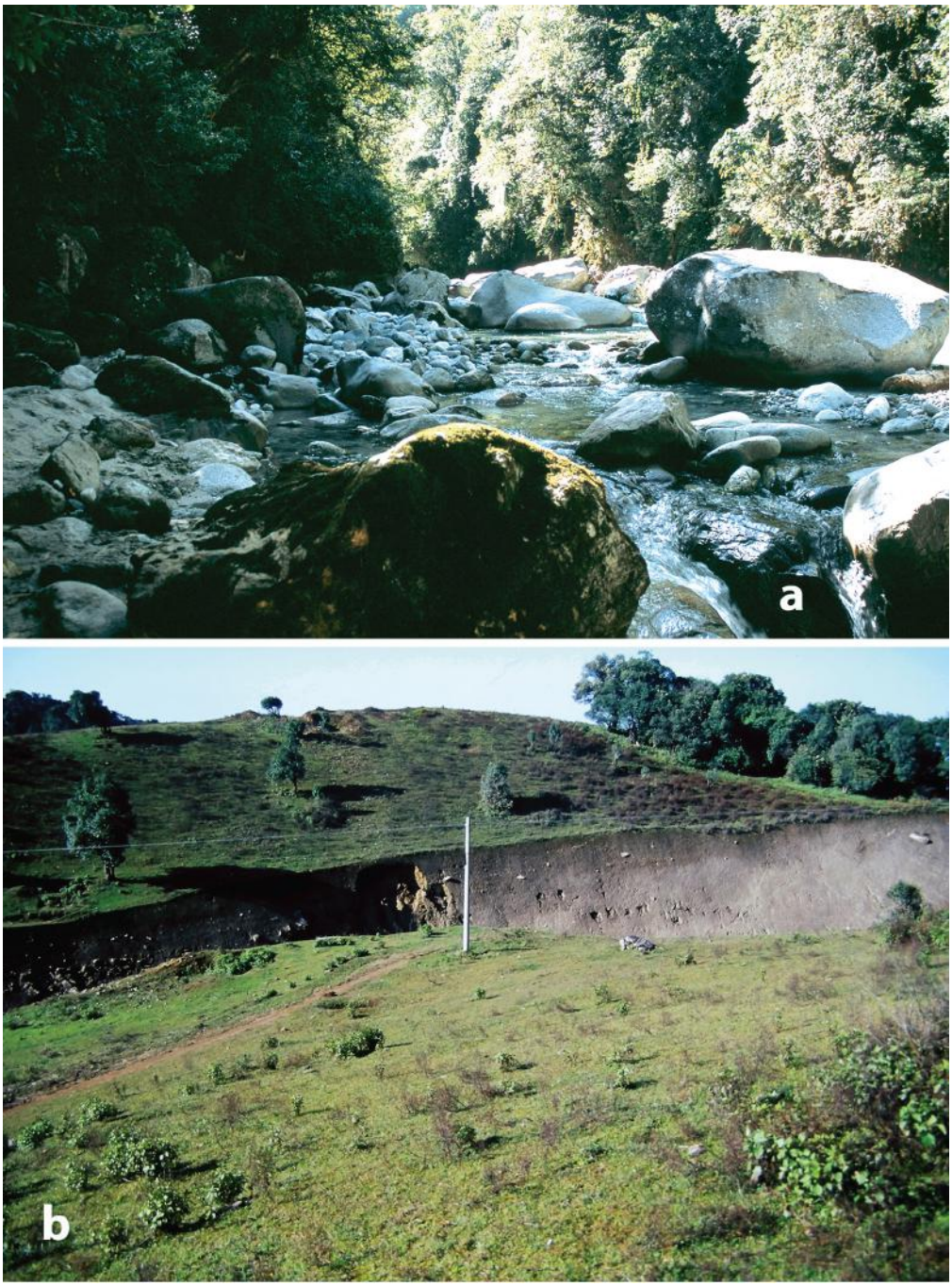


FIGURE 46. Photographs of habitats for broscine species in the Gaoligong Shan region. a. Siran Wang, 0.2 km above confluence with Dulong Jiang, 1720 m, 28.013°/ E098.321º, Dulongjiang Township, Gongshan County, Yunnan (habitat for *Broscosoma resbecqi* sp. nov.); b. Nankang Yakou, 2130 m, 24.828°/98.767°, Longyang County, Yunnan (habitat for *Broscosoma ribbei* Putzeys and *Broscus punctatus* (Dejean). Photos by David H. Kavanaugh.

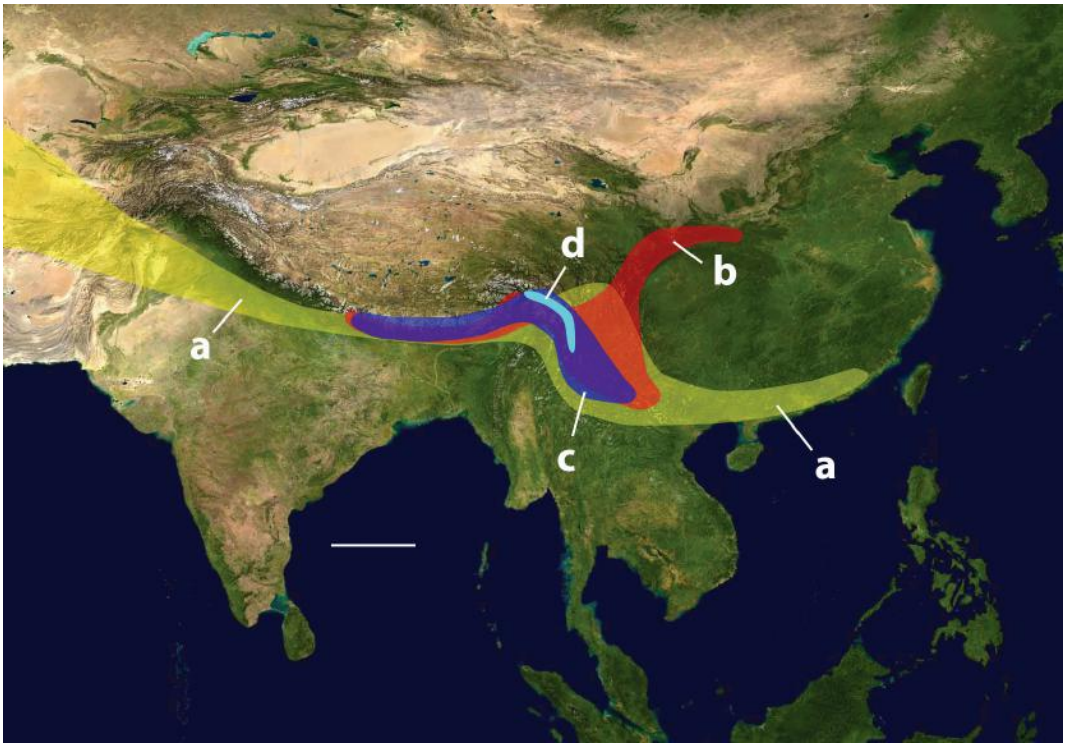


FIGURE 47. Map showing approximate known overall geographical distributions of *broscine* species occurring in the Gaoligong Shan region as well as outside the study area. a. *Broscus punctatus* (Dejean); b. *Eobroscus bhutanensis* Morvan; c. *Broscosoma ribbei* Putzeys; d. *Broscosoma holomarginatum* sp. nov. Modified from Wikimedia Commons, World Atlas of the World, at URL: http://upload.wikimedia.org/wikipedia/commons/8/8f/Whole_world_-_land_and_oceans_12000.jpg. Scale line = 500 k

species	Core Area 1	2	3	4	5	6	7
Broscodera chukwai		X	X				
Broscodera gaoligongensis		X	X	X	X		
Broscosoma bicoloratum	X	X					
Broscosoma danzhuense		X					
Broscosoma furvum			X				
Broscosoma gaoligongense				X	X		
Broscosoma gongshanense		X					
Broscosoma holomarginatum	X			X			
Broscosoma parvum			X				
Broscosoma purpureum	X						
Broscosoma resbecqi	X						
Broscosoma ribbei	X	X	X	X	X	X	X
Broscosoma viridicollare			X				
Broscus punctatus		X	X	X	X	X	X
Eobroscus bhutanensis		X	X		X		

FIGURE 48. Chart showing the representation of broscine species in project-designated Core Areas (see Fig. 3) in the Gaoligong Shan region.

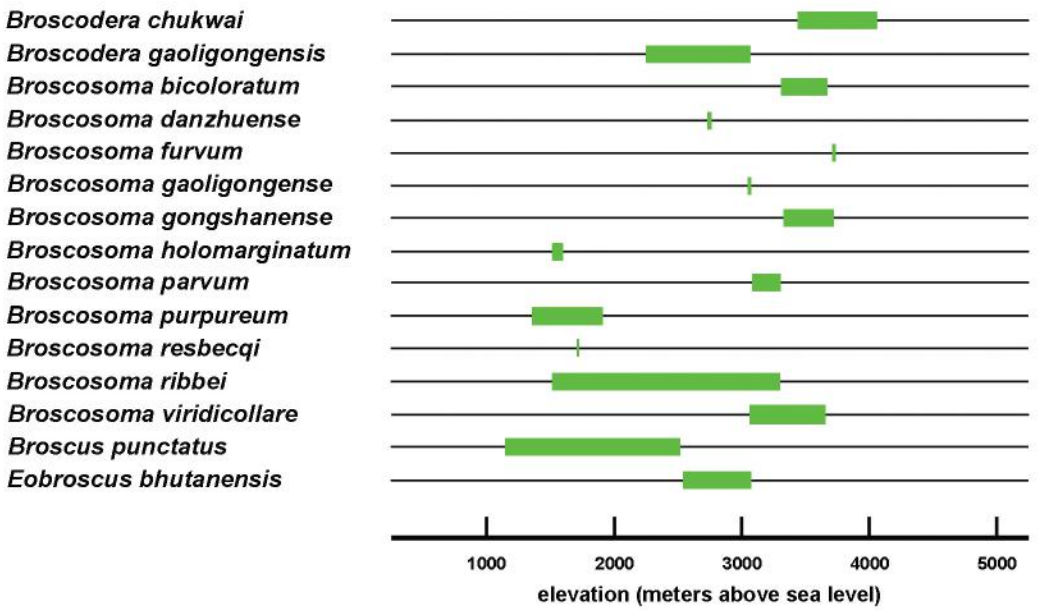


FIGURE 49. Chart illustrating the altitudinal ranges of broscine species represented in the Gaoligong Shan region. Green bars mark the elevational range recorded for each species.

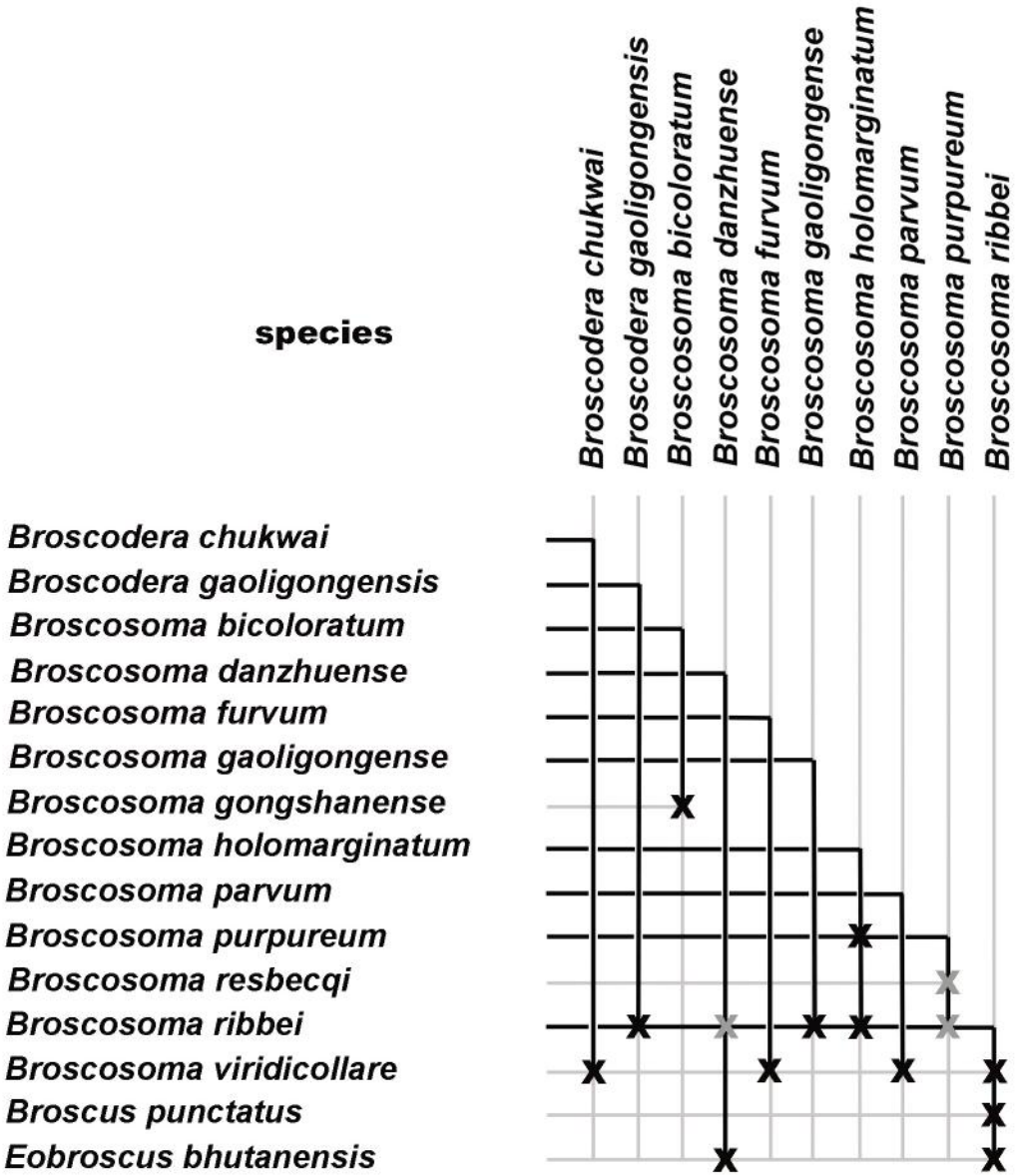


FIGURE 50. Chart illustrating the co-occurence (syntopy) of broscine species in samples from the same habitats and at the same sites in the Gaoligong Shan region. Incidents of syntopy marked in black represent confirmed co-occurrence, those marked in grey not confirmed by records but likely.

Discussion

The Gaoligong Shan region is a key component of one of the world's biodiversity hotspots (Myers et al. 2000), where faunal elements from the Palearctic and Oriental Regions meet. These elements augment a distinct regional, largely precinctive element, probably of mixed Palearctic/Oriental origin (Deuve 2013), which either became isolated and evolved independently within the region or has been replaced elsewhere by present-day Palearctic and/or Oriental elements. Among the four groups studied in detail to date, the trechines and broscines are the most diverse precinctive elements in the fauna, with 25 of 29 trechine species (86%) and 11 of 15 broscine species (73%) known from nowhere else. We have found no precinctive species among either the omophronines (three species) or the zabrines (13 species).

Relative to the diversity of faunas in other areas of comparable size, the broscine fauna of the Gaoligong Shan region is exceptionally diverse and previously poorly known. Of the 15 species from the area recorded here, 11 are described as new and one additional species, *Broscosoma gaoligongense,* which we also had represented in our samples as new, was only recently described by Deuve and Wrase (2015). This diversity includes not only taxonomic diversity, but also exceptional diversity in morphological features, particularly within the genus *Broscosoma*, but also in *Broscodera* to a lesser degree.

No other comparable region is known to harbor two species of *Broscodera*. Their geographical ranges overlap in part but they appear to occupy different elevational ranges and are also non-overlapping in their respective body size ranges. Members of *Broscodera chukuai* are the smallest members of the genus known to date, with their size range outside the ranges of any of the other congeneric species and subspecies. Whether the differences in body size and elevational range between *B. chukuai* and *B. gaoligongensis* represent character displacement in these morphological and ecological features or have instead resulted from some other historical cause or causes will remain unclear until phylogenetic relationships among *Broscodera* species are better understood.

There appears to us to be at least as much morphological diversity within the *Broscosoma* fauna of the Gaoligong Shan region as is found within the genus throughout the remainder of its entire range. All species with members having lateral margination of the pronotum present, whether distinct on at least part of the pronotal margin, as in *B. resbecqi* and *B. ribbei*, or complete, as in *B. holomarginatum*, are found in this region. *Broscosoma rebecqi* is known only from this region, *B. holomarginatum* also occurs in the adjacent southeastern part of Xizhang (Tibet), and only *B. ribbei* is more widely distributed. No other area has as many species with the elytra humeri more or less distinct. In fact, the number of species with distinct humeri in the Gaoligong Shan region (six) is double the number (three) within the remainder of the genus. Diversity in the presence and distribution of metallic reflection on the dorsum of the body is also exceptional. For example, no described species from any another area has members which have the pronotum without metallic reflection except for the area anterior to the anterior transverse impression, where it is distinctly present in *B. viridicollare* members and faintly present in some members of *B. bicoloratum* as well. Finally, there is exceptional diversity in the genitalic structures of males in the region, particularly in the shape of the median lobe and the sclerites of its internal sac and in the shape of the left paramere. Clearly, the Gaoligong Shan region is and has been a very important area in the evolutionary history of this genus. Better understanding of that history will require phylogenetic analyses of both morphological and DNA data for the genus as a whole.

Broad geographical distribution patterns.

The overall geographical ranges of the four broscine species known to occur both within and outside of the Gaoligong Shan region are graphically approximated, superimposed on one another, in Fig. 47. Among the geographical ranges of these species, three general range patterns are apparent. The first is that shown by two of the four species, *Broscosoma ribbei* and *B. holomarginatum*, with geographical ranges that mainly include the Gaoligong Shan region and a narrow swath along the southern slope of the Qinghai-Xizang (Tibetan) Plateau in southeasternmost Xizhang (Tibet) and the Himalayan Range. This pattern has been seen also among omophronines (Kavanaugh et al. 2021), trechines (Deuve et al. 2016), and zabrines (Kavanaugh et al. 2014), with the western extent of the ranges of different species varied, some extended west as far as Pakistan. The range of *B. holomarginatum* extends only slightly northwest from the Gaoligong Shan to southeasternmost Xizhang, whereas that of *B. ribbei* extends westward to central Nepal. The latter species is somewhat unusual in that its range also extends slightly further southeast into southcentral Yunnan instead of northeast into Sichuan or farther east along the southeastern edge of the Qinghai-Xizang (Tibetan) Plateau as is seen in several species of zabrines and trechines. The second pattern is that shown by *Eobroscus bhutanensis* with a known geographical range that includes the Gaoligong Shan region as well as areas toward both the northwest (as in the first pattern) and the northeast along the southern edge of the Qinghai-Xizang (Tibetan) Plateau through Sichuan and southern Gansu. This pattern also has been seen among trechines and zabrines, although the range of *E. bhutanensis* extends farther southeast (to northern Vietnam) than those of other species with this range pattern. Finally, the fourth species, *Broscus punctatus*, shows a pattern not seen among the ranges of any species of the other groups studied to date, namely one extended from the Middle East eastward to the southern slope of the Himalayan Range, the Gaoligongshan region, and then across southern China to Hong Kong and Fujian. In the Gaoligong Shan region, members of this species were found occasionally on the upper sandy banks of the larger rivers (as noted by Schmidt and Arndt (2000) for this species elsewhere), but were far more abundant in other highly disturbed habitats, often in association with human habitation and agricultural or waste areas far from water courses. This geographical range pattern is shared with the platynine, *Orthotrichus cymindoides* (Dejean), 1831, although that species may not share such a close association with some forms of human disturbance (e.g., agriculture) (J. Schmidt, personal communication).

All four of these broscine species with ranges extended outside the Gaoligong Shan region have adults with full-sized, functional hindwings. The ability to fly undoubtedly supports the occupation and maintenance of larger geographical ranges as well as greater potential for dispersal to new areas. Within the broscine fauna of the region, two additional species, *Broscodera gaoligongensis* and *Brososoma purpureum*, have fully-winged adults but are currently known only from the study area. Their discovery elsewhere at some time in the future would not be surprising, whereas the remaining nine species, all of which have flightless adults, are unlikely to be found anywhere else, except perhaps in the northern extension of the same mountainous region in adjacent parts of southeasternmost Xizhang (Tibet).

With 73% of the species in the broscine fauna of the study area occurring nowhere else, the overall distributions of their genera can provide a broader geographic context for understanding the development of this fauna. The geographical range of *Broscodera*, subgenus *Sinobrosculus*, extends from eastern Nepal to northeastern Sichuan, with the Gaoligong Shan area occupying the approximate midpoint of that range. The combined range of the five species, including the two described here as new, fits the second overall pattern described above. Genus *Broscus* is widespread in Eurasia, but mainly west and northwest of the Gaoligongshan region. In addition to *B.*

punctatus, only one species, *Broscus koslovi* Kryzhanovskij, 1995, occurs north of the study area (in Nei Monggol). Conversely, *Eobroscus* is distributed mainly east of the Gaoligong Shan region, with one species in Taiwan and a second in Japan, North and South Korea, and the Russian Far East. The sequentially disjunct geographical range of *Broscosoma* includes what appear to be three distinct assemblages, distributed more or less from west to east, across Eurasian. These assemblages not only occupy discrete areas but also share morphological features unique to them, although the monophyly of these assemblages has not yet been tested through phylogenetic analyses. The first assemblage includes two species from the Alps of northern Italy and probably a third species, *B. semenovi*, from the Caucasus region (Belousov and Kataev 1990). The second assemblage includes six described species with a combined geographical range extended from Japan and Taiwan to the Chinese mainland in Fujian and west to Chongqing Municipality. The third assemblage, by far the most diverse, now includes 45 species (including the nine described here as new). The geographical range of this assemblage extends from central Nepal in the west eastward along the Greater Himalayan Range and the eastern margin of the Qinghai-Xizang (Tibetan) Plateau to Shaanxi Province in the east. Just as for *Broscodera*, the combined range of these 45 *Broscosoma* species fits the second overall pattern described above and, again, with the Gaoligong Shan region at the midpoint of that pattern.

Based initially on distributional data provided by the zabrine fauna and on geologic evidence of the relative ages of the Gaoligong Shan region and the Himalayan Ranges and Qinghai-Xizang (Tibetan) Plateau as summarized by Chaplin (2005), Kavanaugh et al. (2014) suggested that the Gaoligong Shan region may have been an area of differentiation, speciation and origin of montane elements from which, rather than to which, at least some of the species that now range more broadly subsequently spread. Evidence provided by the trechine fauna (Deuve et al. 2016), including the occurrence of four precinctive genera, one apparently precinctive subgenus, and several precinctive species in the region, provided additional support for this hypothesis. The broscine fauna also contributes additional evidence in the form of 11 precinctive species, exceptional morphological diversity, and, again, placement of the Gaoligong Shan region near the geographical center of broscine diversity in southcentral central Asia. These findings confirm that the high diversity of the region is not merely the result of the overlap of widespread Palearctic and Oriental faunal elements but also has involved differentiation and diversification within the region. However, just what role, if any, the the Gaoligong Shan local fauna has played over time in the development of the carabid fauna of central or southcentral Asia, and of the Himalayan mountain system and/or Qinghai-Xizang (Tibetan) Plateau faunas in particular, remains to be determined. Only through phylogenetic analyses for each of these groups, such as that done for the *Ethira* clade of genus *Pterostichus* based on DNA data (Schmidt et al 2012), can we begin to answer this question.

Regional geographical and altitudinal distribution patterns

The chart in Fig. 48 summarizes the recorded regional distributions of the species with respect to our project-designated Core Areas (see Fig. 3); and the recorded altitudinal ranges for each species are shown in Fig. 49. These charts clearly demonstrate the relatively narrow geographical and altitudinal ranges of a majority of the broscine species occurring in the region compared with the ranges of zabrine species in the fauna (see Kavanaugh et al. 2014, figs. 28 and 29). However, they are slightly less restricted on average than the trechines in the fauna (see Deuve et al. 201, figs. 46 and 47). These differences may be expected, based at least in part on differences in flight capability among members of the three groups. Among trechines, 72% of the species have flightless adults compared with 60% of broscine species and no flightless zabrines represented in the fauna.

Only one broscine species, *Broscosoma ribbei*, was recorded from all seven Core Areas and one species, *Broscus punctatus*, was found in six of the seven Core Areas. In contrast, no trechine species was recorded from more than four Core Areas and only two species out of 29 were found in more than two Core Areas. Six broscine species were recorded from a single Core Area and three more only from two adjacent Core Areas, whereas 18 trechines were recorded from a single Core Area and six more only from two adjacent Core Areas. The gap in our sampling on the western slope of the Gaoligong Shan between Core Areas 1 and 4, an area that is part of Myanmar and thus was not open to our study for sampling, confounds our understand of which species occur in that part of the region. For example, we suspect that *Broscosoma holomarginatum*, recorded from Core Areas 1 and 4, also occurs in the gap area between them in Myanmar. Similarly, *Broscosoma furvum*, *B. parvum*, and *B. viridicollare*, all recorded only from Core Area 3 but at or near the crest of the Gaoligong Shan in that area, probably occur also on the western side of the crest in that same gap area in Myanmar.

Comparing broscine diversity recorded among the Core Areas, we find that each of them is occupied by at least two species, with highest diversity in Core Areas 2 and 3 (with eight species in each) and lowest diversity in Core Areas 6 and 7 (with only two species in each). Among trechines, highest diversity was found also in Core Area 2 and second highest in Core Area 3 (Deuve et al. 2016). Further sampling may confirm the occurrence of *Broscosoma gongshanense* in Core Area 1 because that species inhabits high elevation habitats near the crest of the range in Core Area 2. Its discovery there would raise the diversity in Core Area 1 to six species. Core Areas 1 and 2, 2 and 3, and 4 and 5 each uniquely share one broscine species. *Eobroscus bhutanensis* is recorded only from Core Areas on the eastern side of the range but is likely to occur also in those on the western side based on its overall geographical distribution.

Three of the seven Core Areas are occupied by at least one species recorded as unique to them. Core Area 3 has three such species and Core Areas 1 and 2 each has two. Comparing species diversity in relation to the north/south axis of the range, we find a distinct pattern. Highest diversity is in the northern region (Core Areas 1 and 2), with 11 of the 15 broscine species found in this region and five of these restricted to it. Eight species occur in the northcentral region (Core Area 3) with three of these restricted to it. Four species occur in the southcentral region (Core Areas 4 and 5) with one of these found only there; and only two species occur in the southern region (Core Areas 6 and 7), both widespread through the study area. Comparing west and east versants of the range, we find eight broscine species recorded from the western side (Core Areas 1, 4, and 6), including two species unique to that side, and 12 species on the eastern side (Core Areas 2, 3, 5, and 7), including four species unique to that side.

The recorded altitudinal ranges of broscine species in the Gaoligong Shan region (Fig. 49) extend from 1185 to 4035 m. Whereas highest trechine diversity is concentrated in a broad zone between about 2250 m and 3750 m, with 27 of the 29 species occurring within this zone (Deuve et al. 2016), and peak diversity among zabrines is at about 2000 m (Kavanaugh et al. 2014), the ranges of broscine species are more dispersed along the altitudinal gradient. Seven species have their known altitudinal ranges restricted to areas above 3000 m and all of these have reduced hindwings and are flightless. Three more species (*Broscodera gaoligonensis*, *Broscosoma ribbei*, and *Eobroscus bhutanensis*) have altitudinal ranges that extend above the 3000 m range and all of these have full-sized wings. Of the eight species that have known ranges that extend below the 3000 m level or are restricted to lower elevations, six are fully winged and only two (*Broscosoma danzhuense* and *B. resbecqi*) have their hindwings slightly or markedly reduced and are flightless. The average difference between highest and lowest recorded elevations for each of the 13 broscine species for which more than one elevational record was obtained was 563 m. The most restricted

species, *Broscosoma furvum*, had only a 15 m recorded range (which is undoubtedly an underestimate of its actual range) and the least restricted, *B. ribbei*, had an 1800 m recorded range. These ranges approximate those for trechines in the fauna, which averaged 500 m ranges and had the most restricted species with only a 20 m recorded range and the least restricted with a 1300 m range. These figures contrast sharply with those for zabrines species, which were found to occupy relatively broader altitudinal ranges (with an average range of 1193 m, a 225 m range for the most restricted species and a 2111 m range for the least restricted. Kavanaugh et al. 2014 suggested that this broader range among zabrines is likely due mainly to their preference for open habitats, including those created by humans, which now occur at virtually all elevations in the study area.

Syntopy of species in the regional fauna. Records of the co-occurrence of different broscine species at the same site and in the same habitat (i.e., syntopic) within the study area are summarized in Fig. 50. Syntopy appears to be relatively rare among broscines of the region, especially among congeneric species. As should be expected from its broad geographical and altitudinal ranges within the study area, *Broscosoma ribbei* has been found syntopic at one or more sites with three other *Broscosoma* species and is likely syntopic with two more. It also has been found with *Broscodera gaoligongense*, *Broscus punctatus*, and *Eobroscus bhutanensis* at one or more sites. Aside from this species, few other instances of congeneric syntopy were recorded (see Fig. 50). As noted above, the geographical ranges of *Broscodera chukuai* and *B. gaoligongensis* overlap in part, but their altitudinal ranges apparently do not, so they are not considered as syntopic.

The level of syntopy found among broscines is more similar to that seen among trechines than among zabrines but intermediate between them. Seven of 29 trechines were not found syntopic with any other trechine species and only one species was found syntopic with five other species (Deuve et al. 2016). This contrasts sharply with syntopy found among zabrines. All of the 13 *Amara* species in the fauna were found syntopic with at least one other congeneric species, three of them with seven other congeners, and four of them with eight other *Amara* species (Kavanaugh et al. 2014). Again, these differences can be expected when comparing groups with many flightless members and requiring minimally altered habitats with a group most or all members of which are capable of flight and thrive in habitats created my humans.

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Literature Cited

Akciz, S., B.C. Burchfiel, J.L. Crowley, J.Y. Yin, and L.Z. Chen. 2008. Geometry, kinematics, and regional significance of the Chong Shan shear zone, Eastern Himalayan Syntaxis, Yunnan, China. *Geosphere* 4:292-314.

Ballion, E. E. 1871. Eine Centurie neuer Käfer aus der Fauna des russischen Reiches. *Bulletin de la Société Impériale des Naturalistes de Moscou* 43:320-353.

Belousov I. A. & Kataev, B. M. 1990. *Broscosoma semenovi*, sp. n. a representative if a ground beetle genus new to the USSR fauna (Coleoptera, Carabidae) [in Russian]. *Entomologicheskoe Obozrenie* 69: 387-390

Bolivar y Pieltain, C. 1914. Diagnosis de un nuevo "*Broscus*" de Persia (Col. Car.). *Boletin de la Real Sociedad Espanola de Historia Natural* 14:456-457.

Bonelli, F.A. 1810. *Observations entomologiques. Première partie (cïcindélétes et portion des carabiques)* [with the "Tabula synoptica exhibens genera carabicorum in sectiones et stirpes disposita"]. Turin. 58 pp. + 1 table.

Chaplin, G. 2006. Physical geography of the Gaoligong Shan area of Southwest China in relation to biodiversity. *Proceedings of the California Academy of Sciences* (Series 4) 56:527-556.

Colwell, R.K. 2102. Biota: the biodiversity database manager. Version 3.0.0. Colwell RK, Storrs, CT 06269-3043, USA.

Davidson R.L., and G. E. Ball. 1998. The tribe Broscini in Mexico: *Rawlinsius papillatus*, new genus and new species (Insecta: Coleoptera: Carabidae) with notes on natural history and evolution. *Annals of Carnegie Museum* 67:349-378.

Dejean, 1828. *Species général des coléoptères, de la collection de M. le Comte Dejean. Tome troisième.* Méquignon-Marvis, Paris, vii + 556 pp.

Deuve, T. 1990. Nouveaux Carabidae et Broscidae des montagnes tibeto-himalayennes (Coleoptera). *Revue Francaise d'Entomologie* (N. S.) 12:183-190.

Deuve, T. 1998. Note sur le genre *Broscodera* Lindroth, répandu depuis l'Himalaya jusqu'à l'Amerique du Nord (Coleotera, Broscidae). *Nouvelle Revue d'Entomologie* (N.S.) 14:227-228.

Deuve, T. 2004. Nouveaux Broscidae de la region Himalayano-Tibétaine [Coleoptera, Caraboidea]. *Revue Française d'Entomologie* (N.S.) 26:141-142.

Deuve, T. 2006a. Nouveaux *Carabus*, *Cychrus* et *Broscosoma* de Chine (Coleoptera, Carabidae et Broscidae). *Coléoptères* 12:383-398.

Deuve, T. 2006b. Nouveaux *Carabus* et *Broscosoma* de Chine (Coleoptera, Carabidae et Broscidae). *Coléoptères* 12:415-425.

Deuve, T. 2011a. Nouveaux Nebriidae, Broscidae et Trechidae de Chine et d'Iran (Coleoptera, Caraboidea). *Revue Française d'Entomologie* (N.S.) 32:1-24.

Deuve, T. 2011b. Nouveaux *Leistus* et *Broscosoma* de Chine et du Népal (Coleoptera, Caraboidea). *Nouvelle Revue d'Entomologie* (N.S.) 27:151-161.

Deuve, T. 2013. *Cychrus, Calosoma et Carabus de Chine.* Pensoft Publishers, Sofia, viii + 307 pp.

Deuve, T., D.H. Kavanaugh and H.B. Liang. 2016. Inventory of the Carabid Beetle Fauna of the Gaoligong Mountains, Western Yunnan Province, China: species of the tribe Trechini (Coleoptera: Caraboidea), with descriptions of four new genera, one new subgenus and 19 new species. *Proceedings of the California Academy of Sciences* (Series 4) 63:341-455.

Deuve, T., and M.Y. Tian. 2002. Un nnouveau *Broscosoma* de la Chine subtropicale (Col. Broscidae). *Bulletin de la Société Entomologique de France* 107:395-396.

Deuve, T., and D.W. Wrase. 2015. Description d'un nouveau *Broscosoma* du Yunnan, Chine (Coleoptera, Caraboidea, Broscidae). *Bulletin de la Société Entomologique de France* 120:25-29.

Eschscholtz, J.F. 1830. Nova genera coleopterorum faunae Europeae. *Bulletin de la Societe Imperiale des Naturalistes de Moscou* 2:63-66.

Fairmaire, L. 1888. Coléoptères de l`interieur de la Chine. (suite). *Annales de la Sociéte Entomologique de Belgique* 32:7-46.

Habu, A. 1973. On a collection of Carabidae from Nepal made by the Hokkaido University Scientifi c Exedition to Nepal Himalaya, 1968 (I). *The Bulletin of the National Institute of Agricultural Sciences* (C) 27:81-132.

Häckel, M., J. Farkač and D.W. Wrase. 2010. A check-list of the tribe Broscini Hope, 1838 of the World (Coleoptera: Carabidae). *Studies and Reports, Taxonomical Series* 6:43-84.

Holdhaus, K. 1954. Die Spuren der Eiszeit in der Tierwelt Europas. *Abhandlungen der Zoologisch-Botanischen Gesellschaft in Wien* 18:1-493

Hope, F.W. 1831. Synopsis of the new species of Nepal insects in the collection of Major General Hardwicke. Pages 21-32 *in* J.E. Gray, ed., *The Zoological Miscellany. To Be Continued Occasionally. Volume 1.* Treuttel, Wurtz & Co., London, 40 pp.

Hope, F.W. 1838. The coleopterist's manual, part the second, containing the predaceous land and water beetles of Linneus and Fabricius. Henry G. Bohn, London, xvi + 168 pp. + 3 pls.

Jeannel, R. 1941. *Coléopteres carabiques. Premiere partie.* Faune de France 39. Paul Lechevalier et Fils, Paris, 571 pp.

Jiang, R.X, Q. Feng and S. Wang. 2020. Two new species of the genus *Broscosoma* Rosenhauer, 1846 (Coleoptera, Carabidae, Broscinae) from China. *Zootaxa* 4821:173-180.

Jiang, R.X., X.F Liu and S. Wang. 2021. New species and new distributional record of the genus *Broscosoma* Rosenhauer, 1846 (Coleoptera, Carabidae, Broscinae) from China. *Zootaxa* 4951:137-146.

Kavanaugh, D.H., R.L. Brett and H.B. Liang. 2021. Inventory of the carabid beetle fauna of the Gaoligong Mountains, western Yunnan Province, China: species of the tribe Omophronini (Coleoptera: Carabidae), with a key and review for all species recorded from China. *Proceedings of the California Academy of Sciences* (Series 4) 67:21-54.

Kavanaugh, D.H., F. Hieke, H.B. Liang, and D.Z. Dong. 2014. Inventory of the carabid beetle fauna of the Gaoligong Mountains, western Yunnan Province, China: species of the tribe Zabrini (Coleoptera: Carabidae). *ZooKeys* 407:55-119.

Kryzhanovskij, O.L. 1951. *Eobroscus*, novyi rod zhuzhelits (Coleoptera, Carabidae) iz Primorskogo Kraya i iz Kitaya. *Entomologicheskoe Obozrenie* 31 [1950-51]:538-540.

Kryzhanovskij, O.L. 1995. New and poorly known Carabidae from North, Central and East Asia (Coleoptera). *Zoosystematica Rossica* 3:265-272.

Larochelle, A., and M.-C. Larivière. 1989. First records of *Broscus cephalotes* (Linnaeus) (Coleoptera: Carabidae: Broscini) for North America. T*he Coleopterists Bulletin* 43:69-73.

LeConte, J.L. 1869. List of Coleoptera collected in Vancouver's Island by Henry and Joseph Matthews, with description of some new species. *Annals and Magazine of Natural History* (Ser. 4) 4:369-385.

Li, H., H.J. Guo, and Z.L. Dao. 2000. *Flora of Gaoligong mountains.* Science Press, Beijing, xxiii + 1344 pp.

Lindroth, C.H. 1945. Die fennoskandischen Carabidae. Einer Tiergeographische Studie. I. Spezieller Teil. *Göteborgs Kungliga Vetenskaps och Vitterhets-Samhälles Handlingar* 4:1-709.

Lindroth, C.H. 1961. The ground-beetles (Carabidae, excl. Cicindelinae) of Canada and Alaska. Part 2. *Opuscula Entomologica Supplementum 20,* 200 pp.

Linnaeus, 1758. *Systema naturale per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Edito decima, reformata. Tomus I.* Laurentii Salvii, Stockholm, iv + 824 pp.

Mannerheim, C.G. von. 1852. Zweiter Nachtrag zur Kaefer-Fauna der nord-amerikanischen Laender des russischen Reiches. *Bulletin de la Société Impériale des Naturalistes de Moscou* 25 (2):283-387.

Morita, S. 1990. Broscine carabid beetles of the genus *Eobroscus* (Coleoptera, Carabidae). *Elytra* 18:155-165.

Morita, S. 1995. A new species of the genus *Eobroscus* (Coleoptera, Carabidae) from northern Vietnam. *Bulletin of the Natural Sciences Museum* (Series A) 21:7-11.

Morvan, P. 1982. Quatre nouveaux Carabiques du Bhoutan (4e note) (Coleoptera: Carabidae, Broscini, Pterostichini, Anchomenini. *Entomologica Basiliensia* 7:77-88.

Morvan, P. 1995. Carabiques nouveaux de Nepal et du Bhutan (Coleoptera, Caraboidea). *Nouvelle Revue d'Entomologie* (N.S.), 12:47-55.

Myers, N., R.A Mittermeier, G.A. Mittermeier, G.A.B. de Fonseca, and J. Kent. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403:853-858.

Panzer, 1813. *Index entomologicus, sistens omnes insectorum species in G. W. F. Panzeri Fauna Insectorum Germanica descriptas atque delineatas secundum methodum Fabricianam: adjectis emendationibus, observationibus. Pars I. Eleutherata*. Felssecker, Norimbergae, viii + 216 pp.

Putzeys, J.A.A.H. 1877. Carabiques nouveaux du nord de l'Inde (Darjeling). *Stettiner Entomologische Zeitung* 38:100-103.

Roig-Juñent, S.A. 2000. The subtribes and genera of the tribe Broscini (Coleoptera: Carabidae): cladistic analysis, taxonomic treatment and biogeographical considerations. *Bulletin of the American Museum of Natural History* 255:1-90.

Rosenhauer, W.G. 1846. *Broscosoma und Laricobius, zwei neue Käfergattungen*. T. Blaesing, Erlangen, 429 pp.

Roubal, 1928. *Broscus lutshniki* sp. n. (Coleopt. Carab.) *Wiener Entomologische Zeitung* 45: 90-91.

Schaum, H.R. 1863. Beitrage zur Kenntniss einiger Carabicinen-Gattungen. *Berliner Entomologische Zeitschrift* 7: 67-92.

Schmidt, J., and E. Arndt. 2000. Die Gattung *Broscus* Panzer im Zentral-Himalaya (Insecta: Coleoptera: Carabidae: Broscini). *Entomologische Abhandlungen Staaliches Mseum für Tierkunde Dresden* 59:55-71.

Schmidt, J., L. Opgenoorth, S. Höll, and R. Bastrop. 2012. Into the Himalayan exile: the phylogeography of the ground beetle *Ethira* clade supports the Tibetan origin of forest-dwelling Himalayan species groups. *PLOS ONE*, 7:1-15.

Schmidt, J., D.W. Wrase, and R. Sciaky. 2012. Description of *Kashmirobroscus* gen. n. with two new species from the Northwest Himalaya, and remarks on the East Asian genus *Eobroscus* Kryzhanovskij, 1951 (Coleoptera: Carabidae, Broscinae). *Journal of Natural History* 47:2671-2689.

Sciaky, R., and S. Facchini. 2005. Revision of the Chinese *Broscosoma* Rosenhauer, 1846, with descriptions of two new species (Coleoptera: Carabidae, Broscinae). *Koleopterologische Rundschau* 75:1-12.

Semenov, A. P. 1891. Diagnoses Coleopterorum novorum ex Asia centrali et orientali. III. *Horae Societatis Entomologicae Rossicae* 25:262-382.

Semenov, A.P. 1900. Rod´ *Pseudobroscus* Sem. (Coleoptera, Carabidae), ego geneticheskiia sviazi i znachenie v´ turanskoy faune. *Horae Societatis Entomologicae Rossicae* 34:41-5

Stattersfield, A.J., M.J. Crosby, A.J. Long, and D.C.Wege. 1998. *Endemic bird areas of the world: priorities for biodiversity and conservation. Bird Life Conservation Series, No. 7.* BirdLife International, Cambridge, United Kingdom, 846 pp.

Uéno, S.I. 1953. The Coleoptera of Japan [10]. *Shin Konchû* 6(7):43-49.

UNESCO. 2003. *Three Parallel Rivers of Yunnan Protected Area (Paragraph 27, Communique 8C.4)* World Heritage. United Nations Educational, Scientific and Cultural Organization, Paris.

Wrase, D.W. 1995. Taxonomische und faunistische Bemerkungen über einige paläarktische Carabiden-Arten (Coleoptera, Carabidae). *Linzer Biologische Beiträge* 27:337-366.