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Taxonomic review of the genus *Sinopanorpa* Cai & Hua, 2008 (Mecoptera, Panorpidae) with descriptions of two new species

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Abstract

The scorpionfly genus *Sinopanorpa* Cai & Hua, 2008 is endemic to the mountain regions of central China, currently consisting of four species: *Sinopanorpa tincta* (Navás, 1931), *S. digitiformis* Huang & Hua, 2008, *S. nangongshana* Cai & Hua, 2008, and *S. baokangensis* Wang, 2021. Here, the genus is taxonomically reviewed, with descriptions of two new species: *Sinopanorpa minshanicola* **sp. nov.** from the Minshan Mountains and *Sinopanorpa shennongjiaica* **sp. nov.** from the Shennongjia Mountains, increasing the species number of the genus to six. An updated key to species of *Sinopanorpa* is provided.

Key Words

biodiversity, China, Oriental Region, scorpionfly, *Sinopanorpa*, taxonomy

Introduction

The scorpionfly genus *Sinopanorpa* Cai & Hua, 2008 was erected with *Panorpa tincta* Navás, 1931 as its type species (Cai et al. 2008). The genus is mainly characterized by the wing membrane deeply yellow with sooty brown markings, male tergum VI without anal horns, basal part of male abdominal segment VII much thinner, and the gonostylus of male with the basal process modified as a sharp crescent blade.

Since the establishment of *Sinopanorpa*, the biology and morphology of *S. tincta* have been studied in many aspects. It completes one generation per year, with the adults emerging from late June to mid-September (Cai et al. 2008). The ovoid eggs with a ridge network on the chorion are deposited in clusters in a soil cavity (Ma et al. 2009). As in other species of Panorpidae (Byers and Thornhill 1983), the larvae of *S. tincta* are eruciform, with eight pairs of abdominal prolegs in addition to three pairs of thoracic legs (Chen and Hua 2011). The larvae possess a pair of compound eyes on the lateral side of the head, each consisting of approximately 40 ommatidia (Chen and Hua 2011).

The ommatidia of adult compound eyes in *S. tincta* are of the typical apposition type, each retinula consisting of eight retinula cells (Chen et al. 2012). Three dorsal ocelli are located on the vertex of the head, each having a corneal lens, a layer of corneagenous cells, and fused rhabdoms (Wei and Hua 2011). The mandibulate mouthparts are modified to feed on liquid food after the extra-oral digestion with hair brushes on the hirsute epipharynx, galea, labial palps, and hypopharynx (Huang and Hua 2011). The salivary glands exhibit a sexual dimorphism in that the male has six extremely elongate secretory tubules, but the female has only a short less-developed tube (Ma et al. 2011). The well-developed salivary glands of males are associated with their salivary secretions that are served as nuptial gifts to the females during mating. The spermatheca

consists of a bean-shaped spermathecal reservoir and an elongated spermathecal duct (Yang and Hua 2021). The male reproductive system mainly comprises a pair of testes of three follicles, a pair of elongate vasa deferentia, and an ejaculatory sac in addition to the external genitalia. The vas deferens is highly coiled for its distal part into an epididymis and greatly expanded for its middle part into a well-developed seminal vesicle (Lyu and Hua 2017). According to recent phylogenetic analyses (Ma et al. 2012; Hu et al. 2015; Miao et al. 2019; Wang and Hua 2021), *Sinopanorpa* is confirmed to be monophyletic and forms a sister group with part of the paraphyletic genus *Panorpa*.

In this paper, we taxonomically reviewed the genus *Sinopanorpa* in the mountain regions of central China, and described two new species, raising the species number of the genus to six. An updated key to species of *Sinopanorpa* is provided.

Material and method

All the materials examined in this study are deposited in the Entomological Museum, Northwest A&F University, Yangling, Shaanxi, China (NWAU). Specimens were collected with collecting nets from the mountain regions in central China. Some type specimens were spread and pinned, and others were preserved in 75% or 95% ethanol. Specimens were dissected under a Nikon SMZ 1500 stereoscopic zoom microscope. The genitalia were macerated in cold 10% NaOH for 3–5 min and rinsed with distilled water. Habitus and ecological photographs were taken with a Nikon D7100 digital camera. Character images were taken using the scientific digital micrography system ZEISS SteREO Discovery.V20 equipped with the auto-montage imaging system AxioCam IC. All photographs were assembled with Adobe Photoshop CC 2015. A distribution map was generated by ArcGIS v.10.2 (ESRI, Redlands, USA) and was annotated in Adobe Illustrator CC. The localities in the map came from the collection labels of observed specimens and literature (Cai et al. 2008; Wang 2021).

Results

Genus *Sinopanorpa* Cai & Hua, 2008

Sinopanorpa Cai & Hua in Cai et al. 2008: 44.

Type species. *Panorpa tincta* Navás, 1931, by original designation.

Diagnosis. The genus *Sinopanorpa* can be readily distinguished from other genera of Panorpidae by the following characters: wing membrane deeply yellowish-brown with sooty brown markings; vein R_2 generally 3-branched; notal organ on the posterior margin of male tergum III less-developed; tergum VI of male without anal horns; abdominal segment VII much thinner, stalk-like for basal 1/3, but distinctly thicker for distal 2/3; gonostylus in male genitalia greatly elongated with well-developed pointed basal lobe; ventral parameres simple, with spines on inner side, extending over apex of gonocoxite; A6 bearing a bundle of dense hairs on the centre of T6 in males; and female medigynium with extremely elongated thin axis.

Distribution. China (Chongqing, Gansu, Hubei, Shaanxi, and Sichuan provinces) (Fig. 1).

Sinopanorpa tincta (Navás, 1931)

Panorpa tincta Navás, 1931: 75; Cheng 1957: 50; Chou et al. 1981: 2; Nie and Hua 2004: 190. Type locality: Huixian County, Gansu.
Panorpa statura Cheng, 1949: 148; Cheng 1957: 56. Synonymized by Hua and Peng 2005: 123. Type locality: Mt. Taibaishan, Shaanxi.
Sinopanorpa tincta, Cai et al., 2008: 45.

Diagnosis. This species differs from its congeners by the following characters: 1) gonostylus of male with median tooth blunt, and prominent basal lobe crescent spatula in shape; 2) ventral parameres shortened, only extending over apex of gonocoxite, with long comb-like spines along mesal margin on distal half; and 3) female medigynium narrow, with main plate nearly rectangular for basal 2/3, axis extending over 1/3 of its length beyond main plate.

Distribution. China (Gansu and Shaanxi provinces) (Fig. 1).

Sinopanorpa digitiformis Huang & Hua, 2008

Sinopanorpa digitiformis Huang & Hua in Cai et al. 2008: 48. Type locality: Shennongjia Mountains.

Diagnosis. This species can be differentiated from its congeners by the following characters: 1) abdominal segment VI of male markedly tapering towards apex in distal half; 2) basal lobe of gonostylus well-developed, with two acute distal hooks; 3) ventral parameres elongate, extending distinctly over basal lobe of gonostylus; and 4) main plate in female medigynium much shorter, only slightly longer than wide, with axis extending over half its length beyond main plate.

Distribution. China (Chongqing, Hubei, and Shaanxi provinces) (Fig. 1).

Sinopanorpa nangongshana Cai & Hua, 2008

Sinopanorpa nangongshana Cai & Hua in Cai et al. 2008: 51. Type locality: Mt. Nangongshan.

Diagnosis. This species can be readily differentiated from its congeners by the following characters: 1) posterior abdomen and male genitalia dark blackish brown; 2) ventral parameres greatly elongated, extending distinctly over median tooth of gonostylus; 3) basal lobe of gonostylus much narrower, with two short acute teeth at apex; and 4) main plate in female medigynium elongate, with thick axis extending half its length beyond main plate.

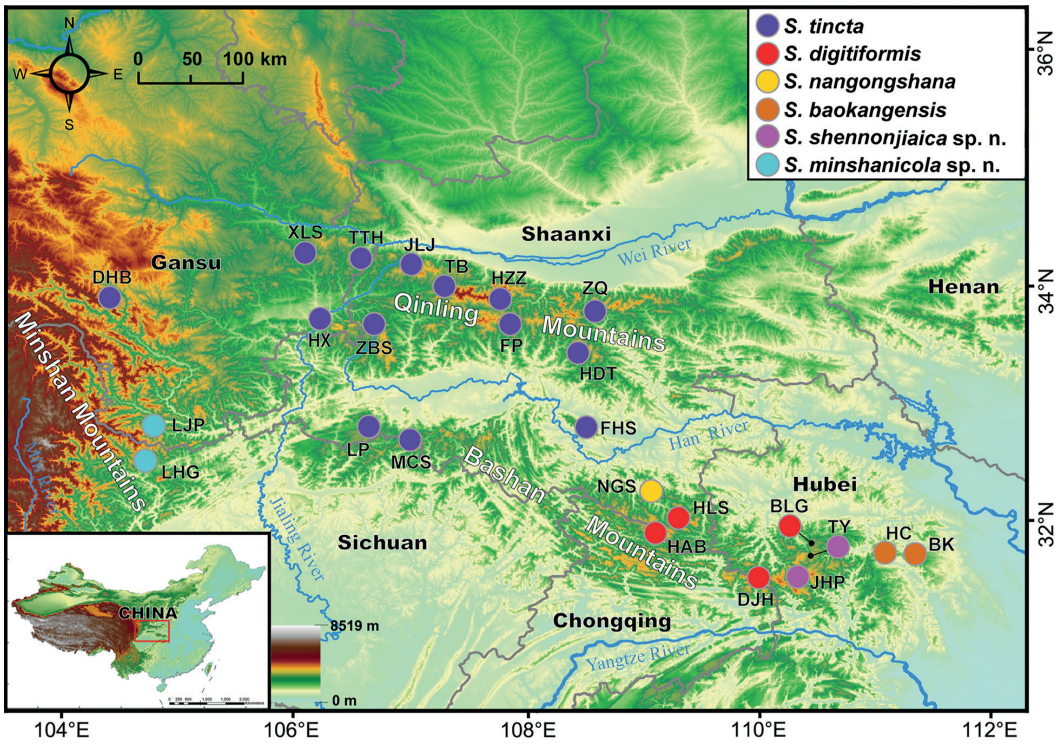

Figure 1. Species distribution map of the genus *Sinopanorpa* Cai & Hua, 2008. BK, Baokang (Hubei); BLG, Baligou (Hubei); DHB, Daheba Forest Park (Gansu); DJH, Dajiuhu (Hubei); FHS, Fenghuangshan (Shaanxi); FP, Foping (Shaanxi); HAB, Huang'anba (Chongqing); HC, Hengchong Nature Reserve (Hubei); HDT, Huoditang (Shaanxi); HLS, Hualongshan (Shaanxi); HX, Huixian (Gansu); HZZ, Houzhenzi (Shaanxi); JHP, Jiuhuping (Hubei); JLJ, Jialing River (Shaanxi); LHG, Laohegou (Sichuan); LJP, Liujiaping (Gansu); LP, Liping (Shaanxi); MCS, Micangshan (Sichuan); NGS, Nangongshan (Shaanxi); TB, Taibai (Shaanxi); TTH, Tongtianhe Forest Park (Shaanxi); TY, Tianyan (Hubei); XLS, Xiaolongshan (Gansu); ZBS, Zibaishan (Shaanxi); ZQ, Zhuque Forest Park (Shaanxi).

Distribution. China (Shaanxi Province) (Fig. 1).

Sinopanorpa baokangensis Wang, 2021

Sinopanorpa baokangensis Wang, 2021: 1. Type locality: Baokang, Hubei.

Diagnosis. This species can be distinguished from its congeners by the following characters: 1) male gonostylus with greatly developed simple acute basal lobe, extending beyond median tooth; 2) male ventral parameres moderately elongate, extending over base of basal lobe; and 3) female medigynium with main plate slightly longer than wide, with axis slender, two times as long as main plate.

Distribution. China (Hubei Province) (Fig. 1).

Sinopanorpa minshanicola sp. nov.

https://zoobank.org/56273B3C-54B7-41F3-9565-AB22F8B72F09

Figs 2, 3

Type specimens. ***Holotype*** ♂ (NWAU), **China**, Sichuan Province, Pingwu County, Laohegou (32°29'17"N, 104°43'17"E, 1800 m), 20 July 2017, leg. Yuan Hua & Kai Gao. ***Paratypes*****:** 3♂ 2♀ (NWAU), **China**, Sichuan Province, Pingwu County, Laohegou (32°29'17"N, 104°43'17"E, 1800 m), 14 July 2022, leg. Yuan Hua; 2♂ 2♀ (NWAU), **China**, Sichuan Province, Pingwu County, Laohegou (32°29'17"N, 104°43'17"E, 1650–1900 m), 6 July 2021, leg. Yuan Hua; 3♂ 5♀(NWAU), **China**, Gansu Province, Wenxian County, Liujiaping (32°48'30"N, 104°46'43"E, 2080 m), 25 June 2019, leg. Kai Gao & Zhi-Chao Jia.

Diagnosis. The new species can be readily recognized from its congeners by the following characters: 1) vertex with a dark transverse band across ocellar triangle; 2) ventral parameres of male shortened, only extending slightly over basal lobe of gonostylus; 3) basal process of gonostylus short, simple, acute, but non-furcated; and 4) female medigynium elongate, with axis half its length out of main plate.

Etymology. The specific epithet is derived from the type locality, Minshan, and the Latin *-cola* (dwell).

Description. Male (Fig. 2A). Head mostly yellowish brown. Rostrum faint yellow, with a pair of darkish longitudinal stripes laterally. Maxillary and labial palps yellowish brown, with distal segment dark brown. Antenna filiform, blackish brown. Ocellar triangle black. A dark transverse band across ocellar triangle to eyes (Fig. 2C).

Pronotum dark brown, with short black setae along anterior margin (Fig. 2D). Meso- and metanotum blackish brown. Pleura and sterna pale. Legs yellowish brown, with distal parts of tarsomeres dark brown.

Forewing length 15.96–16.70 mm, width 3.84–3.92 mm. Forewing membrane light yellow, with markings pale brown; pterostigma prominent, orange yellow; apical band broad, covering whole apical part; pterostigmal band complete, with basal and distal branches equal

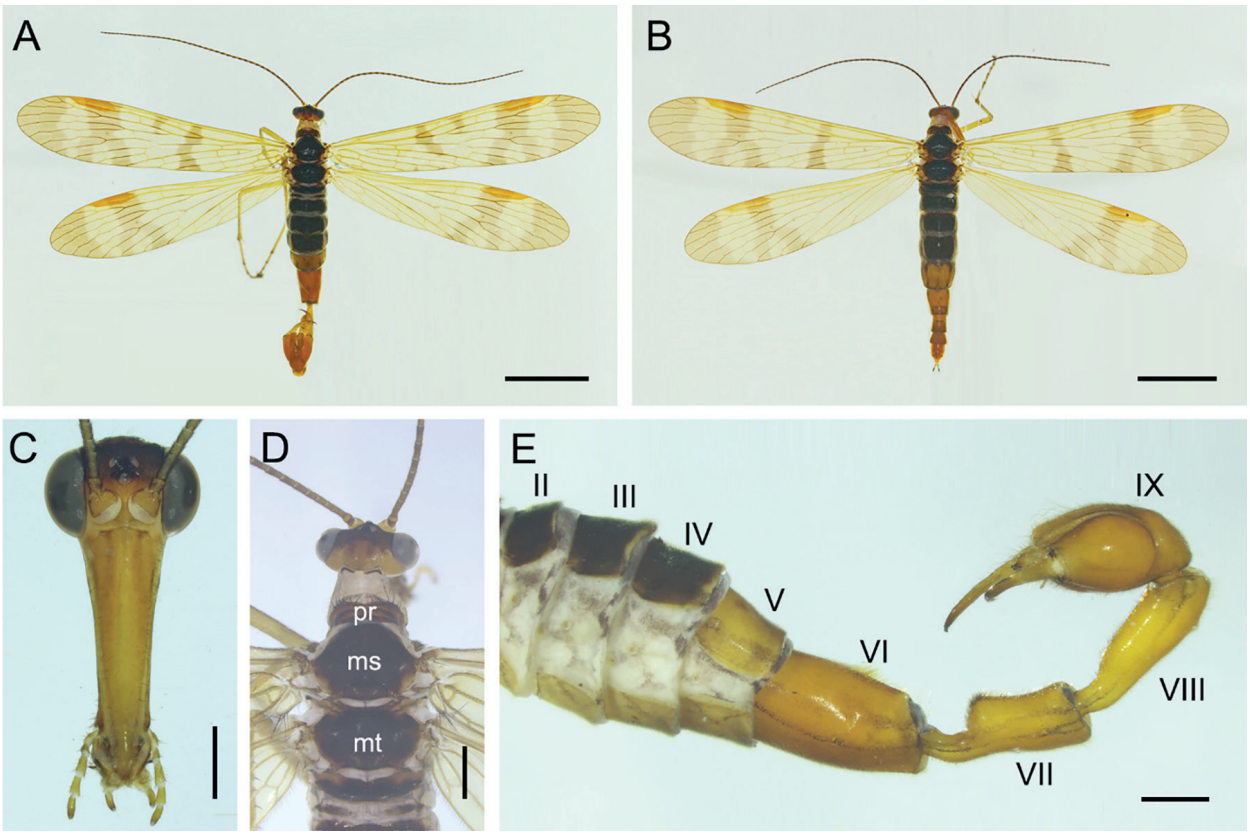

Figure 2. *Sinopanorpa minshanicola* sp. nov. **A.** Male adult, dorsal view; **B.** Female adult, dorsal view; **C.** Male head, frontal view; **D.** Male head and thorax, dorsal view; **E.** Male abdomen, lateral view. Scale bars: 5 mm (**A, B**); 1 mm (**C–E**). **ms**, mesonotum. **mt**, metanotum. **pr**, pronotum.

in width; marginal spot elongate-rectangular, extending from costa to R_{4+5}; basal band almost complete, across whole wing; basal spot absent; R_2 three-branched; R_3 arising from middle of pterostigmal band (Fig. 2A). Hindwing similar to forewing in pattern, but marginal spot and basal band absent. Forewings with 7–9 jugal bristles, hindwings with 2–3 frenular bristles.

Abdominal segments I–IV (A1–A4) black in terga, pale yellow in sterna, and pale in pleura with spiracles clearly visible. Notal organ on posterior margin of tergum III (T3) less-developed, with postnatal organ on tergum IV very small near anterior margin. A5 pale yellow. A6 reddish yellow, greatly elongated, two times as long as A5, without anal horns. A patch of golden hairs along mid T6. A7 much thinner in basal 1/3 than in distal 2/3, with a cluster of hairs on anterio-dorsal corner of distal part (Fig. 2E). A8 longer than A7, slightly constricted for basal 1/4.

Genital bulb long elliptic (Fig. 3A–C). Epandrium (tergum IX) broad at base, narrowing towards apex with a shallow apical emargination; a pair of cerci protruding subapically from under epandrium (Fig. 3C). Hypandrium (sternum IX) almost without basal stalk; hypovalves broad, extending beyond apex of gonocoxites, mesal margin of distal half bearing numerous barb spines. Two hypovalves almost parallel, with apex blunt (Fig. 3A). Gonocoxite with two small dark apical spots. Gonostylus elongate, slender, longer than gonocoxite, smoothly curved outwards; median tooth blunt, roughly at basal 1/3; basal lobe extremely developed, prominent, strongly sclerotized in apical half, assuming a stout elongate spine (Fig. 3E). Ventral parameres slender, finger-like, extending over basal lobe of gonostylus, distal half with dense long spines along mesal margins, shorter towards apical part. Aedeagus simple, with paired ventral and dorsal valves (Fig. 3B).

Female (Fig. 2B). Head dark yellow. Thorax dark black dorsally, light yellow laterally. Forewing length 16.30–16.76 mm, width 3.88–4.00 mm. Wing pattern similar to that of male, but markings vaguer, marginal spot absent. In hindwings, markings indistinct, basal band completely absent. A1–A4 dark black in terga, light yellow in sterna; A5–A7 yellowish brown dorsally, with a longitudinal thin mesal line.

Subgenital plate broad at base, gradually narrowing towards apex, with bluntly rounded apex, apical part bearing long setae (Fig. 3D). Medigynium (genital plate) very broad, main plate longer than wide, with a pair of posterior arms roughly forming a broad U-shape; axis elongate, extending half its length beyond main plate (Fig. 3F, G).

Distribution. China (The Minshan Mountains in Gansu and Sichuan provinces).

Habitat. Numerous adults of the new species were collected from late June to the end of July at the edges of coniferous and broad-leaf mixed forests, with dense subshrubs in the Minshan Mountains. At the type locality, adults are often found in moist microhabitats, especially rich on the alpine shrub or understory in broad-leaved

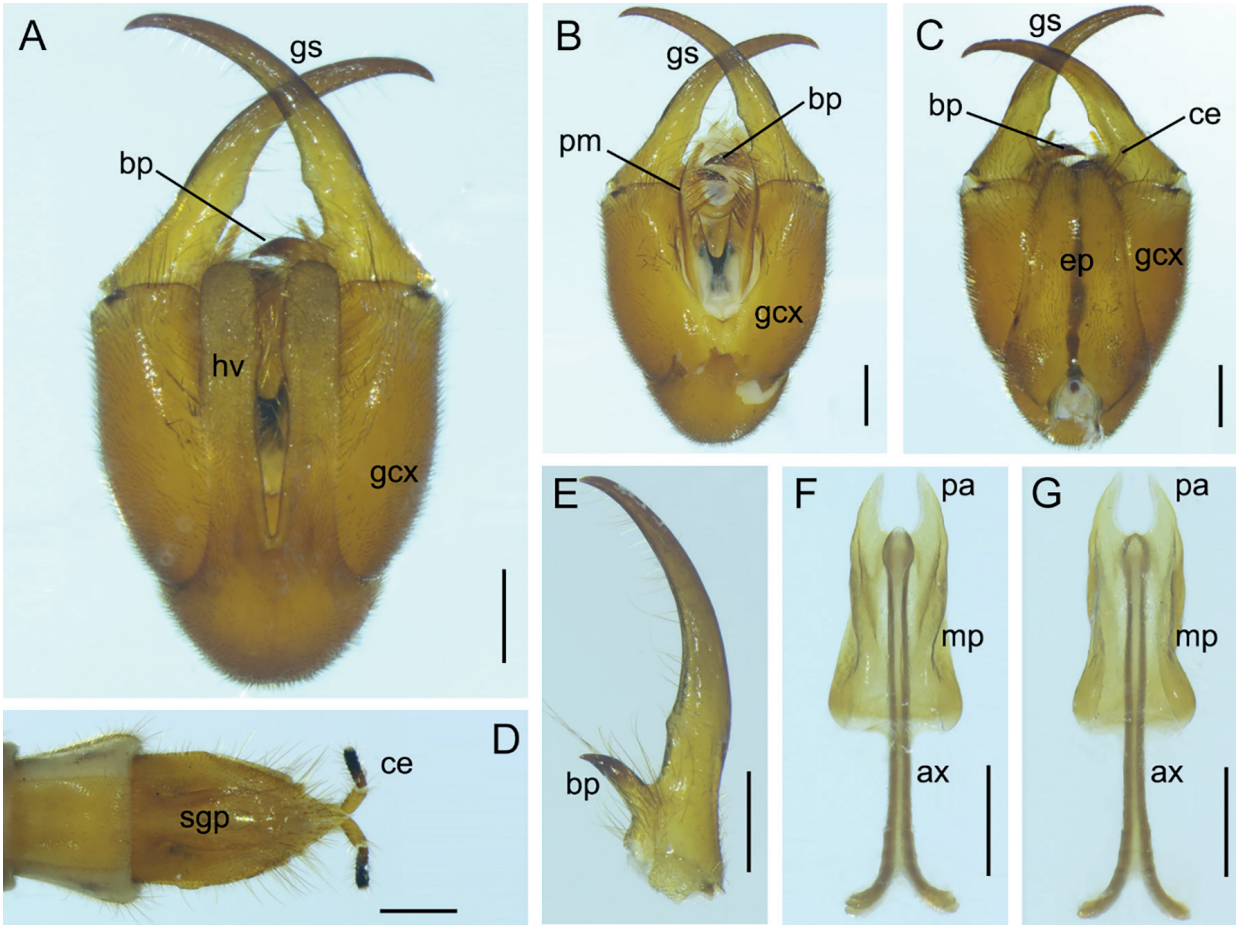

Figure 3. *Sinopanorpa minshanicola* sp. nov. **A.** Male genitalia, ventral view; **B.** Male genitalia, with hypovalves removed, ventral view; **C.** Male genitalia, dorsal view; **D.** Female terminalia, ventral view; **E.** Male gonostylus, dorsal view; **F, G.** Female medigynium, ventral and dorsal views. Scale bars: 0.5 mm. **ax**, axis. **bp**, basal process. **ce**, cercus. **ep**, epandrium. **gcx**, gonocoxite. **gs**, gonostylus. **hv**, hypovalve. **mp**, main plate. **pa**, posterior arm. **pm**, paramere. **sgp**, subgenital plate.

forests with an altitude ranging from 1600 to 2100 m above sea level (Fig. 1).

Sinopanorpa shennongjiaica sp. nov.

https://zoobank.org/F361CD43-9169-4FE0-AAC1-7E41EE040CCA

Figs 4, 5

Type specimens. ***Holotype*** ♂ (NWAU), **China**, Hubei Province, Shennongjia Nature Reserve, Tianyan (31°42'58"N, 110°21'35"E; 1800 m), 1 July 2018, leg. Kai Gao & Yu-Ru Yang. ***Paratypes*****:** 1♂ 2♀ (NWAU), **China**, same data as for the holotype; 2♀ (NWAU), **China**, Hubei Province, Shennongjia, Dalongtan (31°29'39"N, 110°18'10"E; 2200 m), 3 July 2018, leg. Kai Gao & Yu-Ru Yang; 8♂ 6♀ (NWAU), **China**, Hubei Province, Shennongjia, Jiuhuping (31°30'32"N, 110°20'57"E; 1850 m), 3 July 2018, leg. Kai Gao & Yu-Ru Yang; 2♀ (NWAU), **China**, Hubei Province, Shennongjia, Jiuhuping (31°30'32"N, 110°20'57"E; 2200 m), 4 July 2018, leg. Kai Gao & Yu-Ru Yang; 6♂ 6♀ (NWAU), **China**, Hubei Province, Shennongjia, Jiuhuping (31°30'32"N, 110°20'57"E, 1900 m), 18 July 2019, leg. Kai Gao.

Diagnosis. The new species can be differentiated from its congeners by the following characters: 1) vertex with ocellar triangle black, but without transverse band; 2) male tergum VI and female terga VI–IV orange; 3) ventral parameres of male greatly elongated, extending distinctly over median tooth of gonostylus to apical forth; 4) gonostylus with basal lobe well-developed and split into two separate acute elongate hooks; and 5) female subgenital plate with X-shaped ridge over whole length, and medigynium with slender axis non-expanded anteriorly.

Etymology. The specific epithet is derived from the type locality, *Shennongjia*, by using the adjective form of the locality name with the fuffix *-ica*.

Description. Male (Fig. 4A). Head yellowish brown; eyes dark; ocellar triangle black; vertex and frons yellowish brown. Antennae darkish brown, filiform with 44–45 segments. Rostrum, labrum, and maxillae light brown; mandibles reddish brown with tips dark brown; maxillary palp light yellow except apical part dark brown.

Thorax blackish brown dorsally, pale yellow or yellowish brown laterally. Pronotum with 12 setae along anterior margin. Legs yellow, except joints from tibia to claws dark brown to black, claws serrate with six teeth.

Forewing length 15.32–16.34 mm, width 3.78–3.94 mm. Forewing membrane deeply yellow, with markings faint grayish brown; pterostigma prominent,

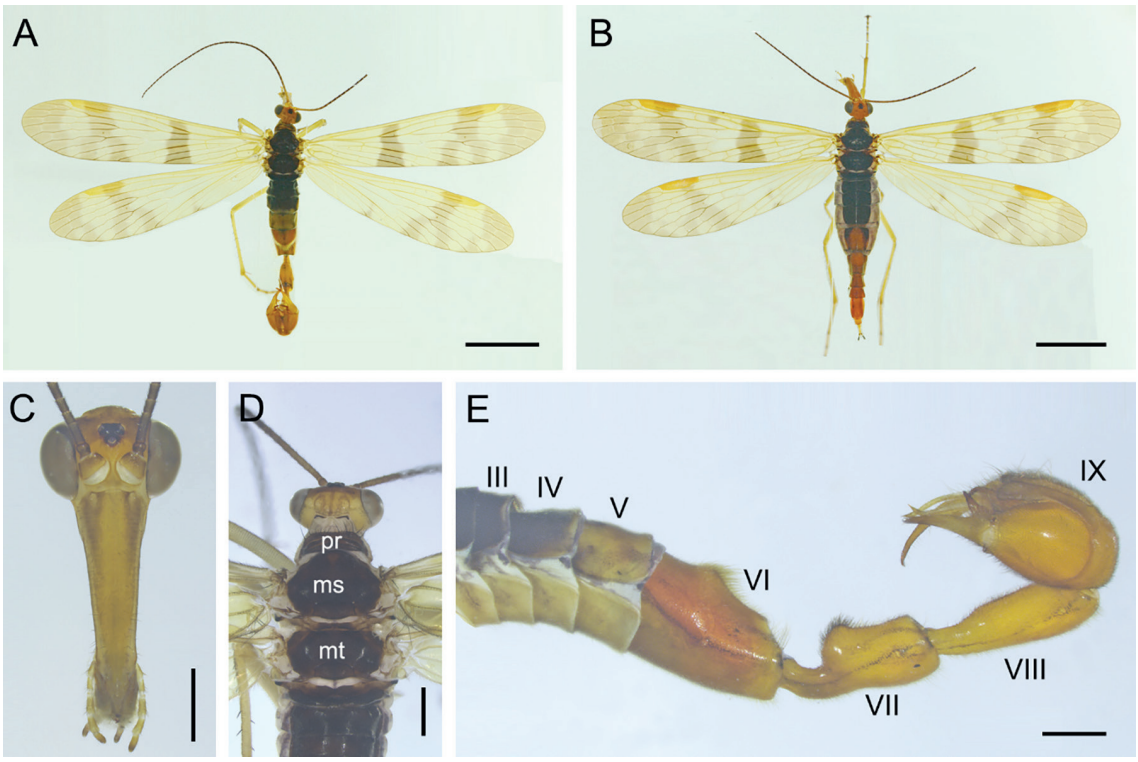

Figure 4. *Sinopanorpa shennongjiaica* sp. nov. **A.** Male adult, dorsal view; **B.** Female adult, dorsal view; **C.** Male head, frontal view; **D.** Male head and thorax, dorsal view; **E.** Male abdomen, lateral view. Scale bars: 5 mm (**A, B**); 1 mm (**C–E**). **pr**, pronotum. **ms**, mesonotum. **mt**, metanotum.

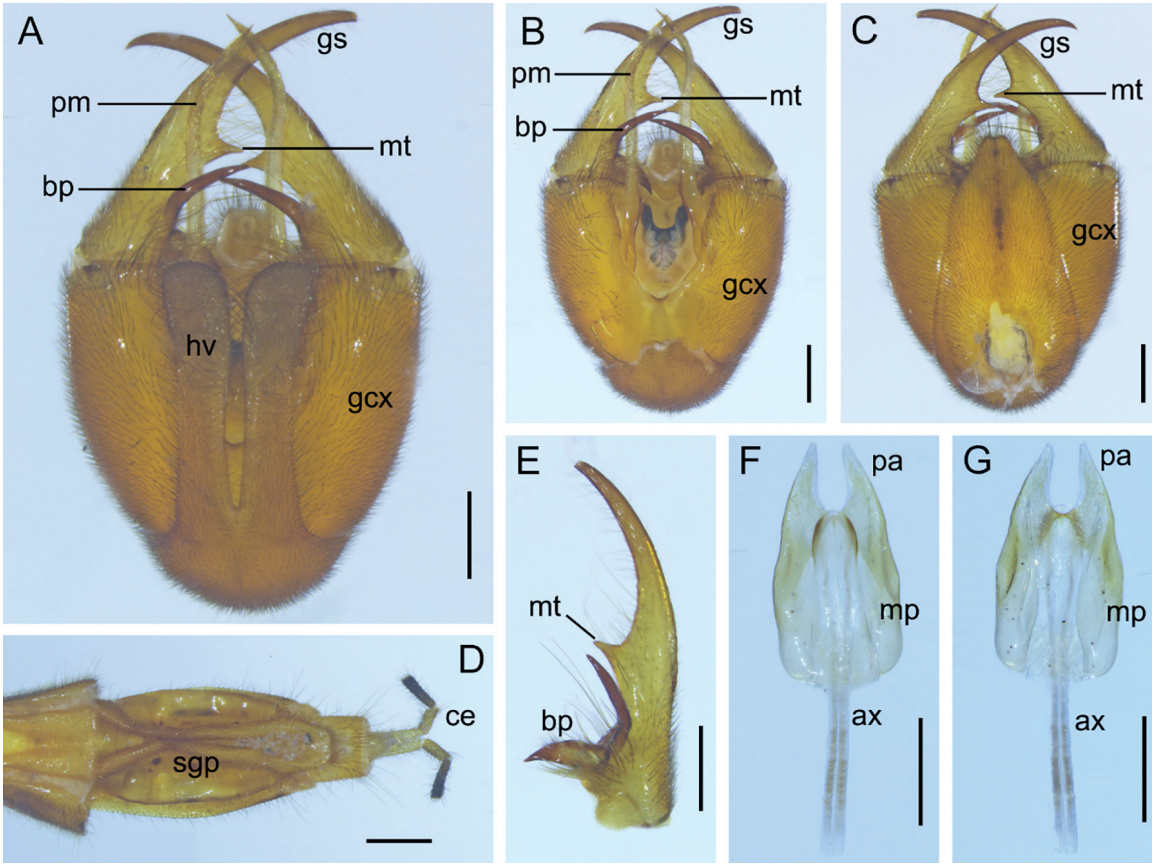

Figure 5. *Sinopanorpa shennongjiaica* sp. nov. **A.** Male genitalia, ventral view; **B.** Male genitalia, with hypovalves removed, ventral view; **C.** Male genitalia, dorsal view; **D.** Female terminalia, ventral view; **E.** Male gonostylus, dorsal view; **F, G.** Female medigynium, ventral and dorsal views. Scale bars: 0.5 mm. **ax**, axis. **bp**, basal process. **ce**, cercus. **ep**, epandrium. **gcx**, gonocoxite. **gs**, gonostylus. **hv**, hypovalve. **mp**, main plate. **pa**, posterior arm. **pm**, paramere. **sgp**, subgenital plate.

orange. Apical band broad; pterostigmal band prominent, with complete basal and distal branches equal in width; marginal spot absent or elongate, extending from R_1 to R_{2+3}; basal band complete, broad; basal spot absent. R_2 3-branched. Hindwings similar to forewings, but marginal spot and basal band absent (Fig. 4A).

Terga I–IV blackish brown, A5 yellowish brown; A6 orange reddish brown, A7–A9 yellowish brown. Sterna I–V pale yellow, pleura pale with dark longitudinal stripes. Notal organ on posterior margin of T3 less-developed. A6 subcylindrical, at least two times as long as A5, with a cluster of hairs on mid protuberance of tergum, without anal horns. A7 prominently thinner for basal 1/3, then suddenly swollen dorsad for distal 2/3, with a cluster of short hairs along anterodorsal corner of distal part (Fig. 4E).

Genital bulb rounded (Fig. 5A–C). Epandrium (tergum IX) broad at base, gradually narrowing towards apex, with apex shallowly emarginated; a pair of cerci protruding subapically from under epandrium (Fig. 5C). Hypandrium (sternum IX) with basal stalk very short; hypovalves broad, split from base of hypandrium, extending to apex of gonocoxite, almost parallel, bearing long setae on inner margin of distal half (Fig. 5A). Gonocoxites yellowish brown, with two black spots at apex. Gonostylus elongate, curved outwards, almost as long as gonocoxite, with one pointed mesal tooth and two prominent acute basal lobes (Fig. 5E). Ventral parameres greatly elongate, extending distinctly over median tooth to distal forth of gonostlylus, without distinct spines along inner margins, with apices slightly convergent. Aedeagus black (Fig. 5B).

Female. Forewing length 16.64–17.12 mm, width 3.94–4.10 mm. Wings generally similar to those of male, but marginal spot present (Fig. 4B). Terga I–III black, corresponding sterna pale; T4 reddish brown, with lateral margins black; T5–T9 reddish brown.

Subgenital plate narrow, with an X-shaped ridge (Fig. 5D). Medigynium broad, nearly rectangular from above; main plate two times as long as wider, with a pair of posterior arms in U-shape. Axis elongate, slender, extending half its length beyond main plate, not expanded at anterior end (Fig. 5F, G).

Distribution. China (Hubei Province).

Habitat. This species is distributed in the Shennongjia Mountains. In the type locality, all specimens were captured on herbaceous groundcover, with elevations ranging from 1800 to 2200 m. Suitable microhabitats are moist and cool valleys during the imaginal flight period.

Key to species of *Sinopanorpa* Cai & Hua, 2008

Updated from Cai et al. 2008 and Wang 2021.

1 Male ventral parameres short, extending slightly over apex of gonocoxites at most 2
– Male ventral parameres elongate, extending distinctly beyond median tooth of gonostylus 3
2 Basal process of male gonostylus with distal tooth smaller than basal tooth; paramere with long comb-like spines on inner margin; female medigynium with axis greatly divergent at base ..... *S. tincta*
– Male gonostylus with basal process simple, not furcated distally; female medigynium elongate, with axis half its length out of main plate ..... *S. minshanicola* sp. nov.
3 Male gonostylus with basal process bifurcated basally 4
– Male gonostylus with basal process simple, not bifurcated basally 5
4 Basal process of male gonostylus with two teeth almost equal in size; female medigynium with axis slightly divergent; female medigynium with apodemes of axis divergent apically ..... *S. digitiformis*
– Basal process of male gonostylus separate completely as two lobes from base; median tooth of gonostylus acute; female subgenital plate with X-shaped ridge over whole length, and medigynium with slender axis not expanded anteriorly ..... *S. shennongjiaica* sp. nov.
5 Basal process of male gonostylus well-developed, pointed, median tooth indistinct; female medigynium with stout posterior arms longer than half length of main plate ..... *S. baokangensis*
– Male gonostylus with basal process only slightly developed, bifurcated distally; female medigynium with posterior portion wider than half width of main plate ..... *S. nangongshana*

Discussion

Species of the genus *Sinopanorpa* are found in high elevation habitats ranging from 1600 to 2200 m above sea level in the Qingling, Minshan, Bashan, and Shennongjia mountains. Numerous adults were often found in the summer on the alpine shrub or understory at the edges of coniferous and broad-leaf mixed forests, with dense subshrubs. Their microhabitats are usually situated in considerably cool and moist valleys in the mountain top regions with high elevation and high precipitation. Therefore, we assume that they are typical cool-adapted insects. The cool-adapted preference of *Sinopanorpa* species is similar to that of *Cerapanorpa*, which has been reported as a cold-adapted genus of Panorpidae (Gao and Hua 2019, 2021; Gao et al. 2020, 2022). The cool-adapted preference makes the genus *Sinopanorpa* an ideal model to investigate the speciation and phylogeographic pattern of cold-adapted insects. In an ongoing study, we are investigating the distribution patterns of the Panorpidae in China,

trying to discover the centers of biodiversity, and areas of endemism, and exploring the key factors in the speciation.

The discovery of *Sinopanorpa minshanicola* sp. nov. and *S. shennongjiaica* sp. nov. increases the species number of the genus to six. The six species are disproportionately distributed in central China's mountain regions, including the Qinling, Minshan, Bashan, and Shennongjia mountains (Fig. 1). The widespread species *Sinopanorpa tincta* (Navás, 1931) is located in the Qinling, Bashan and Minshan mountains. It is noteworthy that the specimens of *Sinopanorpa* from Sichuan and southern Gansu provinces previously identified as *S. tincta* by Wang (2021) are treated as *S. minshanicola* sp. nov. herein. Nevertheless, the other species are all geographically restricted. *Sinopanorpa minshanicola* sp. nov. is likely endemic to the Minshan Mountains, whereas *S. digitiformis* Huang & Hua, 2008, *S. nangongshana* Cai & Hua, 2008, *S. baokangensis* Wang, 2021 and *S. shennongjiaica* sp. nov. are all distributed in the microhabitats of eastern Bashan Mountains, including Shenongjia. Further phylogeographic analyses are needed to clarify the causes of the disproportionate distribution pattern of *Sinopanorpa*.

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