ACTA ENTOMOLOGICA
MUSEI NATIONALIS PRAGAE
ISSN 1804-6487 (online) – 0374-1036 (print)

2024
64(1): 79–106
doi: 10.37520/aemnp.2024.007
www.aemnp.eu

RESEARCH PAPER

Taxonomy of the *Panorpa issikiana* species group, with descriptions of twenty new species (Mecoptera: Panorpidae)

Ji-Shen WANG[1,2,4] & Can-Jun ZHAO[3]

[1] College of Agriculture and Biological Science, Dali University, Dali, Yunnan 671003, P. R. China; e-mail: wangjishen826@gmail.com
[2] Cangshan Forest Ecosystem Observation and Research Station of Yunnan Province, Dali University, Dali, Yunnan 671003, P. R. China
[3] Biodiversity Conservation and Breeding Center (Dali) of Northwestern Yunnan, Bureau of the Cangshan-Erhai National Nature Reserve, Dali, Yunnan 671000, P. R. China; e-mail: 180389099@qq.com
[4] Corresponding author

Accepted:
12th April 2024

Published online:
15th June 2024

Abstract. Twenty undescribed species of *Panorpa* Linnaeus, 1758 from southwestern China share some morphological similarities such as basally constricted male abdominal segment VII, loss of median process in male gonostyli, and greatly developed female laterotergites IX with the little-known species *Panorpa issikiana* Byers, 1970. Therefore, the *P. issikiana* species group is established to include these species, with descriptions of the new species, a checklist, keys to the species, and a distributional map provided. These new species are: *P. chenyandongi* Wang sp. nov., *P. dalangba* Wang sp. nov., *P. dimaluo* Wang sp. nov., *P. huadianba* Wang & Zhao sp. nov., *P. jinfo* Wang sp. nov., *P. jizushana* Wang sp. nov., *P. leiqilongi* Wang sp. nov., *P. luojishana* Wang sp. nov., *P. maershana* Wang sp. nov., *P. meihuashana* Wang sp. nov., *P. niaodiaoshana* Wang sp. nov., *P. shengyingfeng* Wang & Zhao sp. nov., *P. shimianensis* Wang sp. nov., *P. sicaura* Wang sp. nov., *P. vajra* Wang sp. nov., *P. vajroides* Wang & Zhao sp. nov., *P. weixiensis* Wang sp. nov., *P. wenhai* Wang sp. nov., *P. wolongensis* Wang sp. nov., and *P. yucheni* Wang sp. nov. All of them are distributed in southwestern China, including Chongqing, Guizhou, Sichuan and Yunnan. In addition, their systematic positions are briefly discussed. The historical problems of *P. issikiana*, the systematic position of this group in the genus *Panorpa*, and the relationships among its members are also discussed.

Key words. Mecoptera, Panorpidae, scorpionflies, biodiversity, taxonomy, Chongqing, Guizhou, Sichuan, Yunnan, China, Oriental Region

Zoobank: http://zoobank.org/urn:lsid:zoobank.org:pub:B87622D2-95FB-4692-A76E-ABC00EF184B1

Introduction

The family Panorpidae (Mecoptera) comprises more than 500 extant species (Bicha 2018; Wang & Hua 2021, 2022; Su et al. 2023). They are commonly called scorpionflies due to the enlarged and recurved male genitalia, which superficially resemble the tail of a scorpion. Recently, many species have been described from the mountains of Southwest China (Li & Hua 2020, 2023; Wang 2022, 2023, Wang & Gong 2021), where a high biodiversity of Panorpidae is concentrated but remains largely undetected. In this family, *Panorpa* Linnaeus, 1758 is the largest genus with more than 300 species to date (Li & Hua 2020, 2023; Wang & Gong 2021; Wang & Hua 2022).

The genus *Panorpa* was confirmed to be a large paraphyletic group by both morphological and molecular evidence (Misof et al. 2000, Hu et al. 2015, Miao et al. 2019, Wang & Hua 2021). An informal rank, species group is frequently adopted for local faunas of *Panorpa*. For instance, the Chinese species can be designated into ca. 20 species groups, e.g., *P. waongkehzengi*, *P. kongosana*, *P. amurensis*, *P. japonica*, *P. guttata*, *P. communis*, *P. semifasciata*, *P. cheni*, *P. stigmalis*, *P. deceptor*, *P. cornigera*, and *P. davidi* species groups (Wang & Hua 2021). Some species groups constitute distinct monophyletic clades, and some of them are in a sister group relationship with other groups or genera, e.g., the *P. amurensis* species

group is sister to the *P. japonica* species group, the *P. davidi* species group is sister to *Cerapanorpa* Gao, Ma & Hua, 2016, and the *P. stigmalis* species group is sister to *Sinopanorpa* Cai & Hua, 2009 (Wang & Hua 2021). These results suggest that the paraphyletic *Panorpa* might need to be split into several additional genera, otherwise, all the species in Panorpinae should be lumped under only one generic name, *Panorpa* (Wang & Hua 2021). The first step in resolving the problem of paraphyly of *Panorpa* is a systematical review of these species groups and genera (Wang & Gong 2021, Wang & Suzuki 2022), and finding the phylogenetic position of some enigmatic species, such as *P. issikiana* Byers, 1970.

Panorpa issikiana is a little known species described from Yunnan, China. It does not fit into any of the previously mentioned groups due to its peculiar morphological traits such as lack of a median process in male gonostyli (Byers 1970). In the phylogenetic research conducted by Hu et al. (2015), *P. issikiana* is closely related to *P. bifasciata* Chou & Wang, 1981 (*P. cheni* species group) and *Sinopanorpa*. However, it probably does not belong to the *P. cheni* species group or *Sinopanorpa*, which bear greatly developed wing markings and a median process in male gonostyli (Wang & Hua 2022).

In recent years, 20 undescribed species of the genus *Panorpa* have been collected from several provinces in southwestern China. Morphologically, they closely resemble *P. issikiana* in the wings without markings, black body color, and the structure of the genitalia, making the establishment of a new species group required. We herein present illustrations, descriptions, keys, and a distributional map for these species. We also discuss the historical problems with *P. issikiana*, the systematic position of this group in the genus *Panorpa*, and the relationships among its members.

Materials and methods

All the materials examined in this study are deposited in the Biological Science Museum, Dali University (DALU). Adult scorpionflies were caught with a collecting net or Malaise traps, preserved in 95% ethanol or pinned. Photographs of the insects were taken with a Nikon D850 or D7000 digital camera in conjunction with a Nikkor AF-S Micro 105 mm f/2.8 lens (habitus), or a Canon MP-E 65 mm f/2.8 1–5× macro lens with a handmade mount adapter (the other images). The female habitus in dorsal view were modified to omit the left antenna, wings, and legs, and the male habitus in lateral view were modified to omit all the antennae, wings, and legs. Line art (Figs 1–4) was redrawn after Byers (1970) with Adobe Illustrator CC. The distributional map (Fig. 212) was obtained from ESRI ArcGIS 10.8 and modified with Adobe Illustrator CC. All pictures were adjusted and grouped with Adobe Photoshop CC. The terminology and measurements follow Wang & Hua (2021).

The following abbreviations and acronyms are applied in the main text and in the figure annotations:

A1	first abdominal segment (and so forth for the other segments);
AbL	abdominal length;
Ae	aedeagus;
AtL	antenna length;
Ap	apodeme of axis;
Ax	axis;
BdL	body length (measured from the anterior border of vertex to the extreme ending of male gonostyli or female cerci);
BL	basal lobe;
BP	basal plate;
DBP	dorsal branch of paramere;
DPr	dorsal process;
DV	dorsal valve;
Ep	epandrium;
FL	forewing length;
FW	forewing width;
Gcx	gonocoxite;
GPr	gonocoxal process;
Gs	gonostylus;
HL	hindwing length;
Hml	hamulus;
Hv	hypovalve;
HW	hindwing width;
Ltt	laterotergite;
MP	main plate of medigynium;
ORs	origin of Rs;
PA	posterior arm;
PhG	pheromone gland;
Pm	paramere;
S1	first sternum (and so forth for the other segments);
Sgp	subgenital plate;
StH	stalk of hypandrium;
StP	stalk of paramere;
T1	first tergum (and so forth for the other segments);
VBP	ventral branch of paramere;
VV	ventral valve.

Members of this species group usually have their wing markings extremely reduced or entirely absent. In addition, morphology of the pregenital segments among these species varies little, so it is usually hard to identify a specimen without examining the genitalia. Therefore, we provide detailed morphological descriptions only for the first new species, *P. chenyandongi* Wang sp. nov., and only the diagnosis for the others to avoid redundancy.

Taxonomy

Family Panorpidae Latreille, 1802
Subfamily Panorpinae Latreille, 1802
Genus *Panorpa* Linnaeus, 1758
Panorpa issikiana species group

Diagnosis. This group of species can be differentiated from other groups in the genus *Panorpa* by the combination of the following characters: 1) body mostly black, rostrum with a dark brown stripe in the middle and yellowish brown on sides; 2) wing markings absent or extremely reduced; in males: 3) A7 greatly constricted and stalk-like at base; 4) median process of gonostyli absent; 5) parameres bifurcated; 6) aedeagus with dorsal processes greatly developed; 7) piston of sperm pump reduced; 8) aedeagus with hamulus present and sclerotized; and in females: 9) laterotergites IX greatly developed.

Distribution. China: Chongqing, Guizhou, Sichuan, and Yunnan (Fig. 212).

Species list of the *P. issikiana* species group

Panorpa issikiana Byers, 1970	Yunnan (undetailed)
Panorpa chenyandongi Wang sp. nov.	Yunnan (Luquan)
Panorpa dalangba Wang sp. nov.	Yunnan (Yunlong)
Panorpa dimaluo Wang sp. nov.	Yunnan (Gongshan)
Panorpa huadianba Wang & Zhao sp. nov.	Yunnan (Dali)
Panorpa jinfo Wang sp. nov.	Chongqing (Nanchuan)
Panorpa jizushana Wang sp. nov.	Yunnan (Binchuan)
Panorpa leiqilongi Wang sp. nov.	Yunnan (Gongshan)
Panorpa luojishana Wang sp. nov.	Sichuan (Xichang)
Panorpa maershana Wang sp. nov.	Yunnan (Heqing)
Panorpa meihuashana Wang sp. nov.	Guizhou (Liupanshui)
Panorpa niaodiaoshana Wang sp. nov.	Yunnan (Eryuan)
Panorpa shengyingfeng Wang & Zhao sp. nov.	Yunnan (Dali)
Panorpa shimianensis Wang sp. nov.	Sichuan (Shimian)
Panorpa sicaura Wang sp. nov.	Yunnan (Luquan)
Panorpa vajra Wang sp. nov.	Yunnan (Yunlong)
Panorpa vajroides Wang & Zhao sp. nov.	Yunnan (Dali)
Panorpa weixiensis Wang sp. nov.	Yunnan (Weixi)
Panorpa wenhai Wang sp. nov.	Yunnan (Lijiang)
Panorpa wolongensis Wang sp. nov.	Sichuan (Wolong)
Panorpa yucheni Wang sp. nov.	Yunnan (Lushui)

Key to the males of the *P. issikiana* species group

(21 species)

1 Pleura and coxae greatly melanized, dark brown or black (Figs 47, 129, 189). 2
– Pleura and coxae not melanized, light grayish or yellowish brown (Figs 208, 210). 4
2 Dorsal branch of parameres uncrossed; hamulus of aedeagus greatly projected (Figs 50–52). ..... ***P. jinfo*** Wang **sp. nov.**
– Dorsal branch of parameres crossed; hamulus of aedeagus not projected (Figs 131–133, 192–194). 3
3 Basal lobe longer than basal diameter of gonostyli (Fig. 130); dorsal branch of parameres with inner spines shorter than its diameter; dorsal processes slightly humped, with distal portion curved ventrad and evenly flattened at ventral apex (Figs 131–133). ..... ***P. shimianensis*** Wang **sp. nov.**
– Basal lobe shorter than basal diameter of gonostyli (Fig. 190); dorsal branch of parameres with inner spines longer than its diameter; dorsal processes abruptly humped, with distal portion curved ventrad and truncated at ventral apex (Figs 192–194). ..... ***P. wolongensis*** Wang **sp. nov.**
4 Basal lobe greatly enlarged, wider than middle diameter of gonostyli (Figs 18, 68, 153, 160). 5
– Basal lobe small, not wider than middle diameter of gonostyli (Figs 2, 8, 28, 38, 58, 79, 89, 100, 110, 120, 139, 170, 180, 200). 8
5 Basal lobe bifurcated distally (Figs 18, 68). 6
– Basal lobe simple distally (Figs 153, 160). 7
6 Basal lobe of gonostyli nearly trapezoidal with a hook-like process at caudo-base (Fig. 18). ..... ***P. dalangba*** Wang **sp. nov.**
– Basal lobe of gonostyli oval and lacking process at base (Fig. 68). ..... ***P. leiqilongi*** Wang **sp. nov.**
7 Basal lobe of gonostyli with wavy caudal margin (Fig. 153); ventral branch of parameres long, exceeding apex of ventral valves; dorsal branch crossed (Fig. 152). ..... ***P. vajra*** Wang **sp. nov.**
– Basal lobe of gonostyli with relatively smooth caudal margin (Fig. 160); ventral branch of parameres short, not extending to ventral valves; dorsal branch uncrossed (Fig. 163). ..... ***P. vajroides*** Wang & Zhao **sp. nov.**
8 Dorsal branch of parameres crossed (Figs 2, 30, 122, 200). 9
– Dorsal branch of parameres uncrossed (Figs 10, 20, 40, 50, 60, 70, 81, 91, 104, 112, 141, 174, 184). ... 12
9 Gonocoxites with a terminal plate (Fig. 122); dorsal processes of aedeagus closely aligned without a median cleft; ventral and dorsal valves of aedeagus greatly elongated and columnar (Fig. 124). ..... ***P. shengyingfeng*** Wang & Zhao **sp. nov.**
– Gonocoxites lacking a terminal plate (Figs 2, 30, 200); dorsal process of aedeagus diverged apically to form a median cleft; ventral and dorsal valves of aedeagus short (Figs 2, 32, 203). 10
10 Ventral branch of parameres long and exceeding ventral valves distally (Fig. 2). .... ***P. issikiana*** Byers, 1970
– Ventral branch of parameres short and hook-like (Figs 31, 202). 11
11 Ventral branch of parameres very short, nearly as long as width of parameres; width of dorsal processes approaching their length (Fig. 32). ..... ***P. dimaluo*** Wang **sp. nov.**
– Ventral branch of parameres slightly elongated, longer than width of parameres; width of dorsal processes much shorter than their length (Fig. 203). ..... ***P. yucheni*** Wang **sp. nov.**
12 Gonocoxal processes present (Fig. 99); basal portion of gonostyli greatly enlarged (Fig. 100). ..... ***P. meihuashana*** Wang **sp. nov.**
– Gonocoxal processes absent (Figs 10, 40, 60, 81, 91, 112, 141, 172, 182); basal portion of gonostyli simple (Figs 8, 38, 58, 79, 89, 110, 139, 170, 180). 13
13 Gonostyli relatively straight and slightly expanded in distal half (Fig. 8); dorsal process bifurcated, its inner branch with irregular serration distally (Fig. 12). ..... ***P. chenyandongi*** Wang **sp. nov.**
– Gonostyli simple (Figs 38, 58, 79, 89, 110, 139, 170, 180); dorsal process simple (Figs 42, 62, 83, 93, 114, 143, 174, 184). 14
14 Gonostyli with basal lobe greatly expanded (Fig. 139, 141); dorsal branch of parameres greatly elongated, far exceeding middle of gonostyli (Figs 140–143). ... ***P. sicaura*** Wang **sp. nov.**
– Gonostyli with basal lobe simple (Figs 38, 58, 79, 89, 110, 170, 180); dorsal branch of parameres shorter, not reaching or slightly exceeding middle of gonostyli (Figs 40, 60, 91, 112, 172). 15
15 Dorsal processes of aedeagus nearly truncated at apex (Fig. 93). ..... ***P. maershana*** Wang **sp. nov.**
– Dorsal processes of aedeagus more or less tapering towards apex (Figs 42, 114, 62, 83, 174, 184). 16
16 Gonostyli with apex of basal lobe greatly curved dorsad (Fig. 170); dorsal branch with inner spines longer than diameter of parameres; hamulus greatly developed, as wide as ventral valves (Fig. 174). ..... ***P. weixiensis*** Wang **sp. nov.**

– Gonostyli with apex of basal lobe simple (Figs 38, 58, 79, 89, 110, 180); dorsal branch of parameres with shorter inner spines; hamulus less developed, narrower than ventral valves (Figs 42, 114, 62, 83, 184). 17

17 Basal lobe of gonostyli shortly bifurcated at apex (Fig. 58); dorsal processes with median cleft nearly as wide as ventral branch of parameres (Fig. 62). ..... ***P. jizushana*** Wang **sp. nov.**

– Basal lobe of gonostyli simple (Figs 38, 79, 89, 110, 180); dorsal processes with median cleft much wider than ventral branch of parameres (Figs 42, 114, 83, 184). 18

18 Dorsal processes with irregular serration at apex; ventral branch of parameres short, only reaching middle of ventral valves or shorter; hamulus greatly producing ventrad (Figs 41, 42, 113, 114). 19

– Dorsal processes lacking serration at apex; ventral branch of parameres long, extending to apex of ventral valves; hamulus simple (Figs 83, 184). 20

19 Dorsal branch of parameres slightly exceeding apex of dorsal processes, abruptly tapering towards apex in ventral view, and bearing long spines along dorsal margin but shorter spines on ventral margin (Fig. 42). ..... ***P. huadianba*** Wang & Zhao **sp. nov.**

– Dorsal branch of parameres extending to middle of gonostyli, evenly tapering towards apex in ventral view, and bearing short spines along dorsal margin but longer spines on ventral margin (Fig. 114). ..... ***P. niaodiaoshana*** Wang **sp. nov.**

20 Basal lobe large, nearly as wide as distal portion of gonostyli (Fig. 180); dorsal process each with a small subapical prominence laterally; dorsal branch of parameres nearly extending to apex of dorsal processes (Fig. 184). ..... ***P. wenhai*** Wang **sp. nov.**

– Basal lobe small, much narrower than distal portion of gonostyli (Fig. 79); dorsal processes lacking subapical prominence; dorsal branch of parameres not extending to apex of dorsal processes (Fig. 83). ..... ***P. luojishana*** Wang **sp. nov.**

Key to the females of *P. issikiana* species group

(20 species, female of *P. issikiana* unknown)

1 Pleura and coxae greatly melanized (Fig. 207). 2

– Pleura and coxae not melanized (Figs 209, 211). 4

2 Laterotergites IX broad, at least wider than 1/4 width of subgenital plate (Fig. 53); posterior arms of medigynium longer than main plate (Fig. 54). ..... ***P. jinfo*** Wang **sp. nov.**

– Laterotergites IX narrower than 1/4 width of subgenital plate (Figs 134, 195); posterior arms of medigynium shorter than main plate (Figs 135, 196). 3

3 Subgenital plate widely emarginated at apex (Fig. 134); medigynium with basal half of main plate narrower than distal half (Fig. 135). ..... ***P. shimianensis*** Wang **sp. nov.**

– Subgenital plate simple at apex (Fig. 195); medigynium with basal half distinctly expanded laterally and wider than distal half (Fig. 196). ..... ***P. wolongensis*** Wang **sp. nov.**

4 Laterotergites IX bilobed (Fig. 175). ..... ***P. weixiensis*** Wang **sp. nov.**

– Laterotergites IX simple (Figs 13, 23, 33, 43, 63, 73, 84, 94, 105, 115, 125, 144, 154, 165, 185, 204). 5

5 Laterotergites IX greatly elongated, longer than half length of subgenital plate (Figs 23, 63, 73, 94, 125, 144, 185). 6

– Laterotergites shorter than half length of subgenital plate (Figs 33, 43, 84, 94, 105, 115, 154, 165, 204). 12

6 Laterotergites IX broad, wider than half width of subgenital plate (Figs 23, 73). 7

– Laterotergites IX narrower than half width of subgenital plate (Figs 63, 94, 125, 144, 185). 8

7 Medigynium with posterior arms shorter than main plate; posterior arms and main plate with simple lateral margins (Fig. 24). ..... ***P. dalangba*** Wang **sp. nov.**

– Medigynium with posterior arms nearly as long as main plate; posterior arms (basal half) and main plate (distal half) with lateral margins greatly expanding ventrad (Figs 74, 75). .... ***P. leiqilongi*** Wang **sp. nov.**

8 Subgenital plate at least twice as long as its width (Figs 125, 144). 9

– Subgenital plate shorter than twice its width (Figs 63, 94, 185). 10

9 Laterotergites IX with its outer margin greatly emarginated near distal 1/4 (Fig. 144); medigynium with apodemes of axis concealed in main plate (Fig. 145). ..... ***P. sicaura*** Wang **sp. nov.**

– Laterotergites IX with its outer margin indistinctly emarginated (Fig. 125); medigynium with apodemes of axis extending far beyond basal margin of main plate (Fig. 126). ..... ***P. shengyingfeng*** Wang & Zhao **sp. nov.**

10 Medigynium with apodemes of axis short, only slightly extending beyond basal margin of main plate (Fig. 95). ..... ***P. maershana*** Wang **sp. nov.**

– Medigynium with apodemes of axis long, far beyond basal margin of main plate (Figs 64, 186). 11

11 Subgenital plate tapering towards apex basal to its transversal midline (Fig. 63). ..... ***P. jizushana*** Wang **sp. nov.**

– Subgenital plate tapering towards apex beyond its transversal midline (Fig. 185). ..... ***P. wenhai*** Wang **sp. nov.**

12 Laterotergites IX broad, nearly as wide as apical prominence of subgenital plate (Figs 154, 165, 204). 13

– Laterotergites IX narrower than apical prominence of subgenital plate (Figs 33, 43, 84, 94, 105, 115). ... 15

13 Laterotergites IX with caudal margin smooth (Fig. 204); medigynium with posterior arms shorter than half length of main plate (Fig. 205). ..... ***P. yucheni*** Wang **sp. nov.**

– Laterotergites IX with caudal margin irregular (Figs 154, 165); medigynium with posterior arms longer than half length of main plate (Figs 155, 166). 14

14 Subgenital plate with apical prominence short and emarginated at apex (Fig. 154); medigynium with main plate broad and greatly protuberated ventrad (Figs 155, 156). ..... ***P. vajra*** Wang **sp. nov.**

– Subgenital plate with apical prominence long and indistinctly emarginated at apex (Fig. 165); medigynium with main plate greatly constricted in basal portion (Fig. 166). ..... ***P. vajroides*** Wang & Zhao **sp. nov.**

15 Medigynium with apodemes of axis extremely short, concealed in main plate (Fig. 106). ..... ***P. meihuashana*** Wang **sp. nov.**

– Medigynium with apodemes of axis long, extending beyond basal margin of main plate (Figs 14, 34, 44, 85, 116). 16

16 Medigynium with main plate constricted at basal 1/3, forming distinct basal plate (Fig. 85). ..... ***P. luojishana*** Wang **sp. nov.**

– Medigynium lacking distinct basal plate (Figs 14, 34, 44, 116). 17

17 Subgenital plate rounded at apex; laterotergites IX broad (Figs 43, 115). 18

– Subgenital plate distinctly emarginated at apex; laterotergites IX very small (Figs 13, 33). 19

18 Laterotergites IX shorter than half length of subgenital plate (Fig. 43); medigynium with apex of posterior arms rounded (Fig. 44). ..... ***P. huadianba*** Wang & Zhao **sp. nov.**

– Laterotergites IX longer than half length of subgenital plate (Fig. 115); medigynium with apex of posterior arms acute (Fig. 116). ..... ***P. niaodiaoshana*** Wang **sp. nov.**

19 Medigynium with main plate nearly as long as its width (Fig. 14). ..... ***P. chenyandongi*** Wang **sp. nov.**

– Medigynium with main plate longer than its width (Fig. 34). ..... ***P. dimaluo*** Wang **sp. nov.**

Descriptions of species

Panorpa issikiana Byers, 1970

(Figs 1–4)

Diagnosis (according to Byers 1970). This species can be recognized by the combination of the following characters: in males, 1) gonostyli lacking median process with basal lobe slightly elongated and acute (Fig. 2); 2) parameres bifurcated, with ventral branch slightly shorter than half length of dorsal branch, extending beyond ventral valves of aedeagus, and enlarged subdistally (Figs 2, 3); 3) dorsal branch of parameres crossed posterior to ventral valves of aedeagus (Figs 2, 3); 4) dorsal processes of aedeagus diverged in distal 1/3 and forming median cleft (Fig. 2). The female is unknown.

Comments. This species was described with a single male holotype, collected by Handel-Mazzetti from Yunnan, China without detailed information (Byers 1970). The shape of the epandrium (T9, Fig. 1) shows no significant differences to that of many species of *Panorpa*. Despite the unknown female, the lack of median process in male gonostyli, bifurcated parameres, and greatly sclerotized dorsal processes in aedeagus (Figs 2, 3) suggest that this species is closely related to the following 20 new species, although Byers (1970) did not mention whether the male A7 is stalk-like at base or not.

Distribution. China: Yunnan (no details) (Byers 1970).

Panorpa chenyandongi Wang sp. nov.

(Figs 5–14)

Type material. Holotype (CN22Piskcyd001): **CHINA: Yunnan:** ♂, Kunming Prefecture, Luquan County, Jiaozi (palanquin) Snow Mountain, Youxue Mountain Villa, 26°02′22″N, 102°49′22″E, 2960 m, 3–5.vi.2022, leg. Yan-Dong Chen (DALU). Paratypes: 4 ♂♂ 4 ♀♀ (CN22Piskcyd002–009), same data (DALU).

Diagnosis. This new species can be differentiated from the other members of this group by the combination of the following characters: in males, 1) gonostyli nearly straight in distal half and greatly curved at apex (Fig. 8); 2) parameres with ventral branch nearly 4/5 as long as dorsal branch (Figs 11, 12); 3) dorsal branch of parameres slightly exceeding outer lobes of dorsal processes of aedeagus, and bearing stout spines on distal half of outer margin (Figs 11, 12); 4) dorsal processes of aedeagus bilobed basally with inner lobe irregularly serrate at apex, and outer lobe obliquely truncated (Fig. 12); in females, 5) laterotergites IX small and finger-like (Fig. 13); and 6) medigynium with main plate nearly as long as its width (Fig. 14).

Measurements (mm). *Male* (n = 5): AtL 10.5–10.8, AbL 9.0–9.2, BdL 12.5–13.0, FL 12.6–13.0, FW 2.9–3.0, HL 11.5–11.8, HW 2.8–2.9. *Female* (n = 4): AtL 11.0–11.2, AbL 5.6–6.0, BdL 9.5–9.9, FL 12.2–13.0, FW 2.9–3.1, HL 11.3–12.0, HW 2.8–3.0.

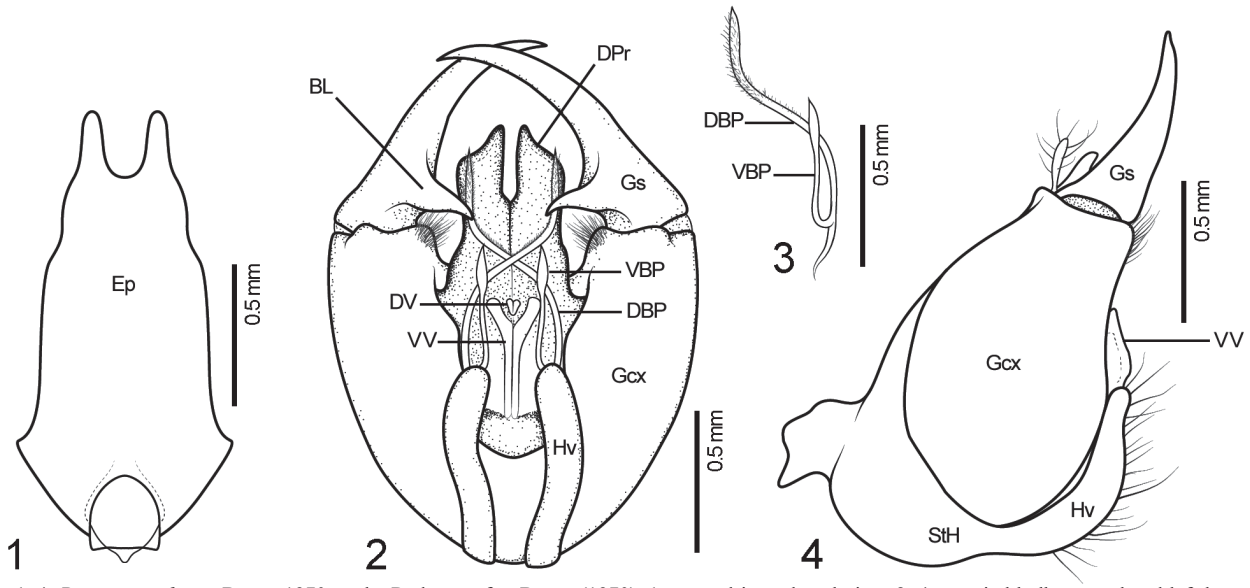
Description. ***Male.*** *Head* (Fig. 5). Vertex black. Rostrum with broad, dark brown median stripe, and light yellowish brown on sides. Antennal scape and pedicel black, flagellum dark brown with 39–42 flagellomeres.

Thorax (Fig. 5). Nota black. Pleura and legs light yellowish brown.

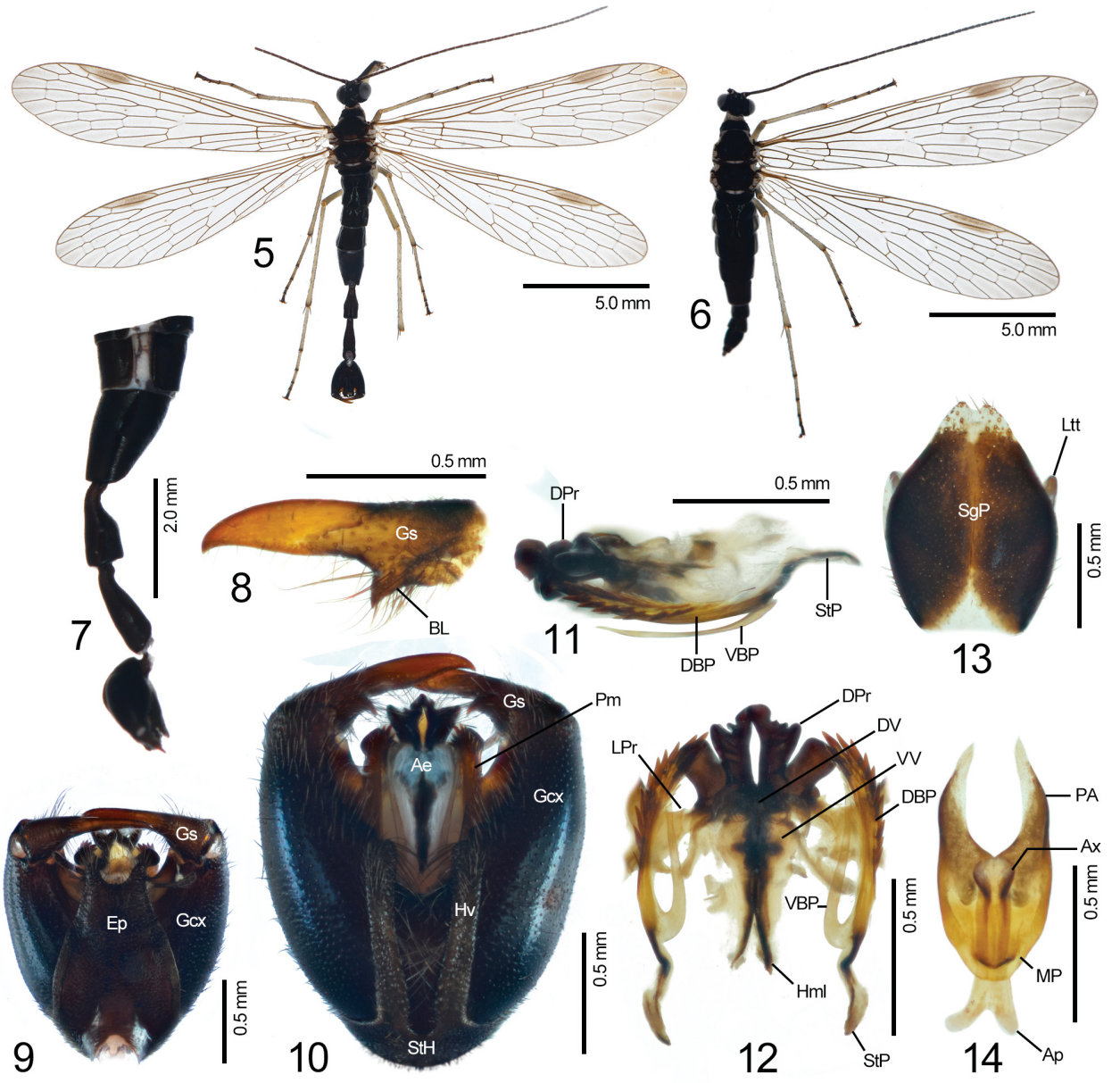
Wings (Fig. 5). Membrane grayish and hyaline. Markings greatly reduced with only a few cloudy stripes on apical cells. Pterostigma brown. Forewings with Rs five-branched, 1A ending beyond ORs, two cross-veins between 1A and 2A.

Abdomen (Figs 5, 7). Terga and sterna black, intersegmental membrane in A2–A5 grayish brown with black textures. A6 slightly tapering towards obliquely truncated apex. A7 greatly constricted basally and greatly thickened towards apex, forming distinct basal stalk. A8 constricted basally and evenly thickened towards apex.

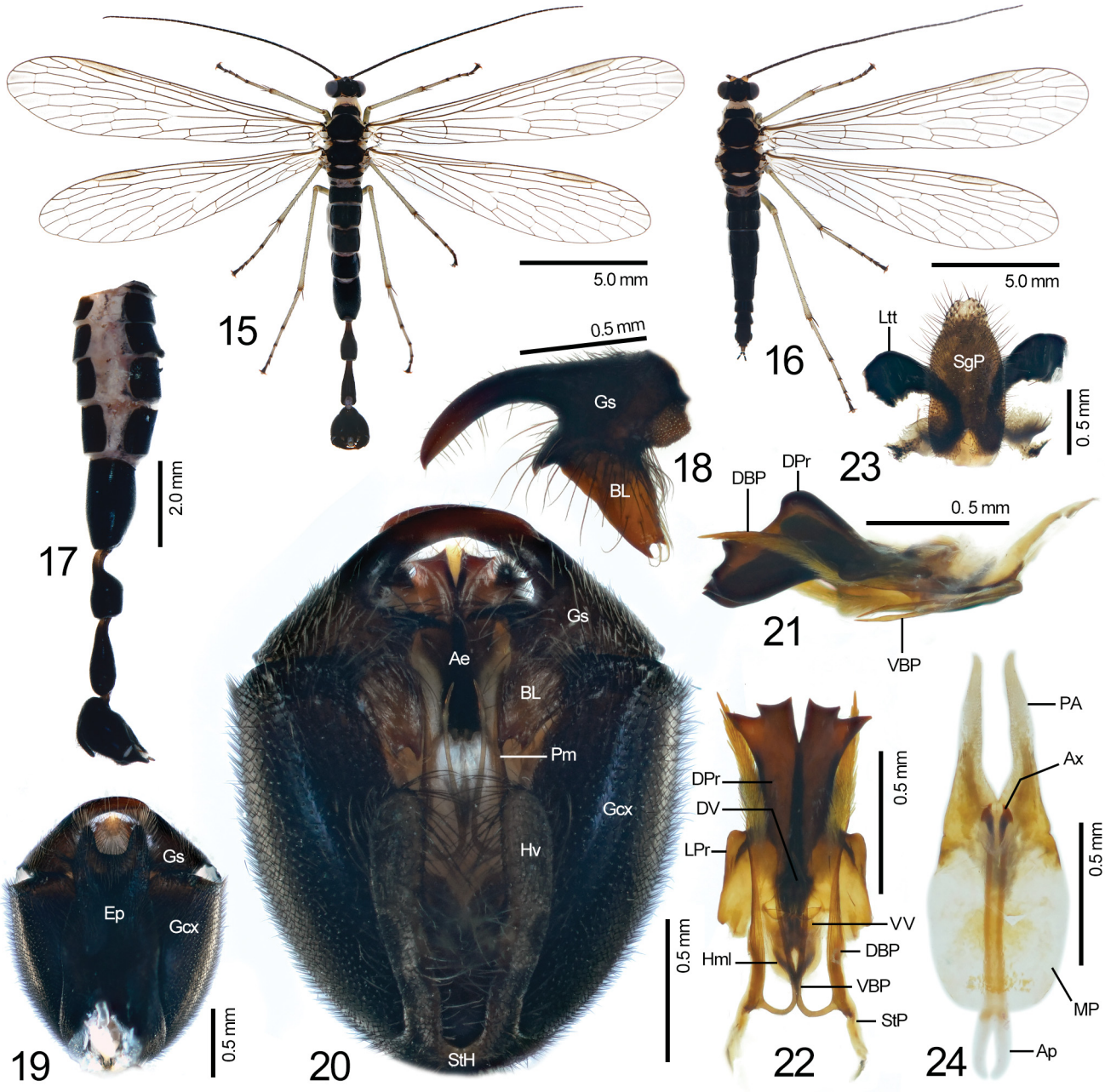
Male genitalia (Figs 8–12). Genital bulb bold oval. Epandrium (T9) broad, deeply emarginated terminally and forming pair of finger-like processes laterally. Hypandrium (S9) split into pair of long, stripe-like hypovalves. Hypovalve extending slightly beyond bottom of gonocoxal concavity with row of long stout bristles along inner margin. Gonostyli shorter than gonocoxites, with acute basal lobe and lacking median process. Distal half of gonostyli nearly straight, with only apex greatly curved inward. Parameres bifurcate: ventral branch slender, glabrous, and nearly 4/5 as long as dorsal branch; dorsal branch bearing stout spines on distal half of outer margin. Ventral valves columnar; dorsal valves small and indistinct; dorsal processes greatly sclerotized and extending beyond basal lobe of gonostyli, bilobed basally with inner lobe irregularly serrate at apex, and outer lobe obliquely truncated. Hamulus slender, basally extending beyond bifurcation of parameres. Piston of sperm pump reduced and indistinct.



Figs 1–4. *Panorpa issikiana* Byers, 1970, male. Redrawn after Byers (1970). 1 – epandrium, dorsal view. 2, 4 – genital bulb, ventral and left-lateral views, respectively. 3 – right paramere, ventral view.



Figs 5–14. *Panorpa chenyandongi* Wang sp. nov. 5, 7–12 – male. 6, 13, 14 – female. 5, 6 – habitus, dorsal view. 7 – terminal abdomen, left-lateral view. 8 – right gonostylus, ventral view. 9, 10 – genital bulb, dorsal and ventral views, respectively. 11, 12 – aedeagal complex, right-lateral and ventral views, respectively. 13 – subgenital plate, ventral view. 14 – medigynium, ventral view.



Figs 15–24. *Panorpa dalangba* Wang sp. nov. 15, 17–22 – male. 16, 23, 24 – female. 15, 16 – habitus, dorsal view. 17 – abdomen, left-lateral view. 18 – right gonostylus, ventral view. 19, 20 – genital bulb, dorsal and ventral views, respectively. 21, 22 – aedeagal complex, right-lateral and ventral views, respectively. 23 – subgenital plate, ventral view. 24 – medigynium, ventral view.

Female. Habitus (Fig. 6) similar to males. Subgenital plate (Fig. 13) broad oval, its apical prominence less sclerotized and membranous, bearing long stout setae, and emarginated in V-shape terminally. Laterotergites IX (Fig. 13) small and finger-like. Medigynium (Fig. 14) with main plate nearly as long as its width; posterior arms nearly as long as main plate, curving inward in distal half, and tapering towards acute apex; apodemes of axis extending beyond basal margin of main plate, and widely divergent.
Etymology. Dedicated to Yan-Dong Chen for collecting and donating specimens. Noun in the genitive case.
Distribution. China: Yunnan: Luquan: Jiaozi Snow Mountain (Fig. 212).

Panorpa dalangba Wang sp. nov.

(Figs 15–24)

Type material. Holotype: ♂ (CN23Piskdlb001), **China: Yunnan:** Dali Bai Autonomous Prefecture, Yunlong County, Shuchang Village, Dalangba, 25°51′08″N, 99°15′09″E, 2560 m, 3.vi.2022, leg. Liang-Jie Jia, Jia-Ling Li, Jiao Xie, Chun-Mei Liao & Ji-Shen Wang (DALU). Paratypes: 15 ♂♂ 20 ♀♀ (CN23Piskdlb002–036), same data except 3–5.vi.2023 (DALU).

Diagnosis. This new species can be differentiated from the other members of this group by the combination of the following characters: in males, 1) basal lobe of gonostyli greatly enlarged with apex slightly bifurcated and hook-like basal process caudo-basally (Fig. 18); 2) dorsal processes of aedeagus each with three acute processes apically, and

greatly humped in middle (Figs 21, 22); in females, 3) laterotergites IX broader than apical prominence of subgenital plate with basal half membranous and distal half sclerotized (Fig. 23); and 4) medigynium with main plate broad oval, posterior arms slender and slightly shorter than main plate, and apodemes slightly extending beyond main plate (Fig. 24).

Measurements (mm). *Male* (n = 16): AtL 10.0–10.8, AbL 10.8–11.0, BdL 14.0–15.5, FL 12.6–13.2, FW 3.0–3.2, HL 11.2–12.0, HW 2.9–3.0. *Female* (n = 20): AtL 10.8–11.5, AbL 7.5–8.0, BdL 10.6–11.0, FL 13.0–13.8, FW 3.0–3.2, HL 12.0–12.6, HW 2.9–3.0.

Etymology. Named after the type locality, Dalangba. Noun in apposition.

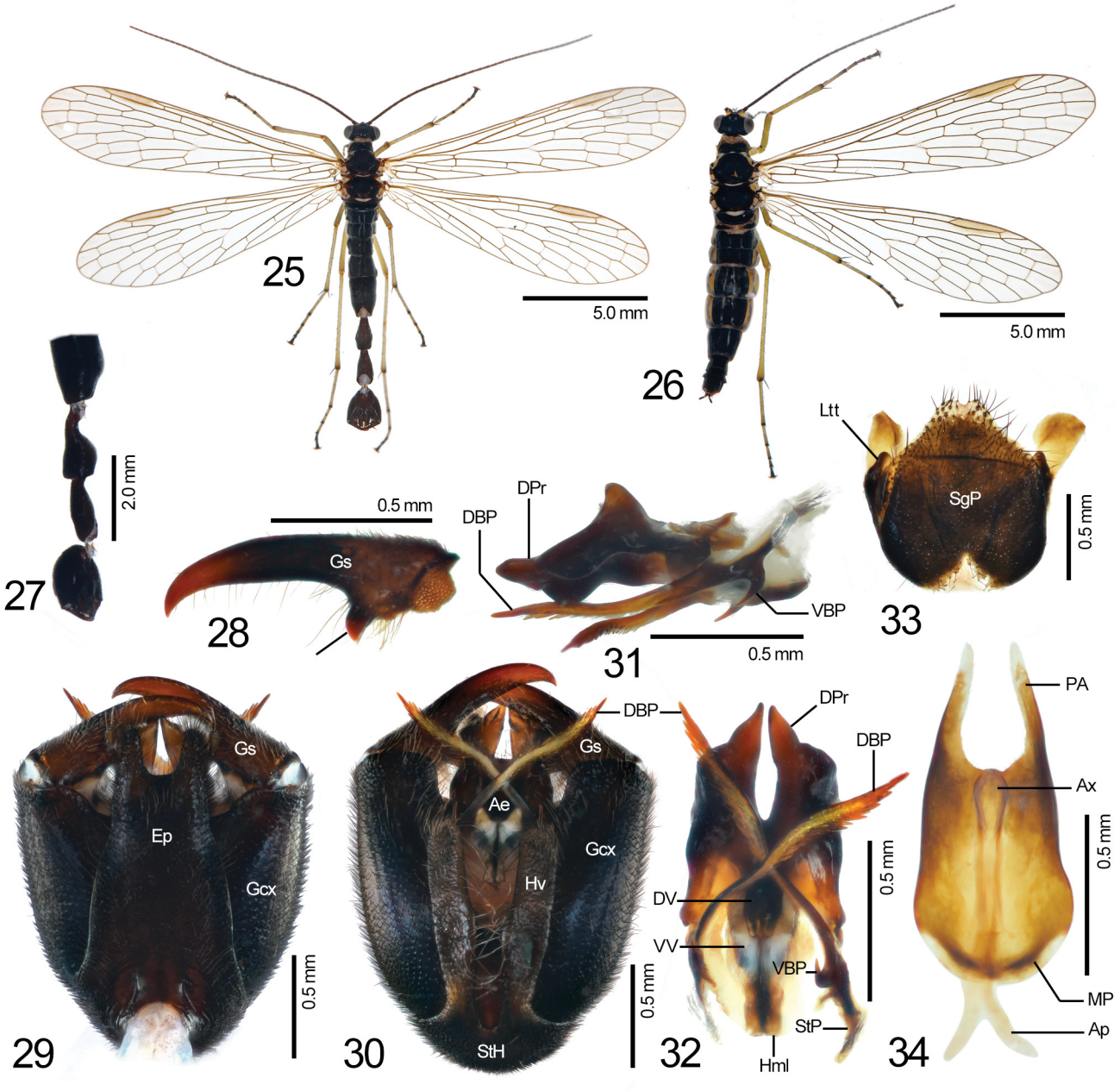
Distribution. China: Yunnan: Yunlong (Fig. 212).

Panorpa dimaluo Wang sp. nov.

(Figs 25–34)

Type material. Holotype: ♂ (CN21Piskdml001), **China: Yunnan:** Nujiang Lisu Autonomous Prefecture, Gongshan County, Kongque (Peacock) Mountain, near Dimaluo River, 28°03′28″N, 98°43′56″E, 2750 m, 13.vii.2021, leg. Ji-Shen Wang (DALU). Paratypes: 1 ♂ (CN21Piskdml002), same data except 15.vii.2021; 1 ♀ (CN23Piskdml001), same locality, 15.viii.2023, leg. Chun-Mei Liao & Ji-Shen Wang (DALU).

Diagnosis. This new species can be differentiated from the other members of this group by the combination of the following characters: in males, 1) parameres with dorsal branch extending beyond basal lobe of gonostyli, and crossed posterior to ventral valves of aedeagus (Figs 30–32); 2) dorsal processes divergent basally and forming deep median cleft, with acute and elongated apices slightly



Figs 25–34. *Panorpa dimaluo* Wang sp. nov. 25, 27–32 – male. 26, 33, 34 – female. 25, 26 – habitus, dorsal view. 27 – terminal abdomen, left-lateral view. 28 – right gonostylus, ventral view. 29, 30 – genital bulb, dorsal and ventral views, respectively. 31, 32 – aedeagal complex, right-lateral and ventral views, respectively. 33 – subgenital plate, ventral view. 34 – medigynium, ventral view.

convergent (Fig. 32); 3) dorsal processes greatly projecting dorsad subbasally (Fig. 31); in females, 4) laterotergites IX small and subacute apically (Fig. 33); and 5) medigynium with broad main plate, slender posterior arms shorter than main plate, and apodemes of axis extending beyond main plate and widely divergent (Fig. 34).

Measurements (mm). *Male* (n = 2): AtL 10.0–10.2, AbL 8.6–8.8, BdL 12.0–12.5, FL 12.4–12.5, FW 3.0, HL 11.2–11.5, HW 2.9. *Female* (n = 1): AtL 10.3, AbL 7.4, BdL 11.7, FL 13.8, FW 3.2, HL 11.0, HW 3.1.

Etymology. Named after the type locality, Dimaluo River. Noun in apposition.

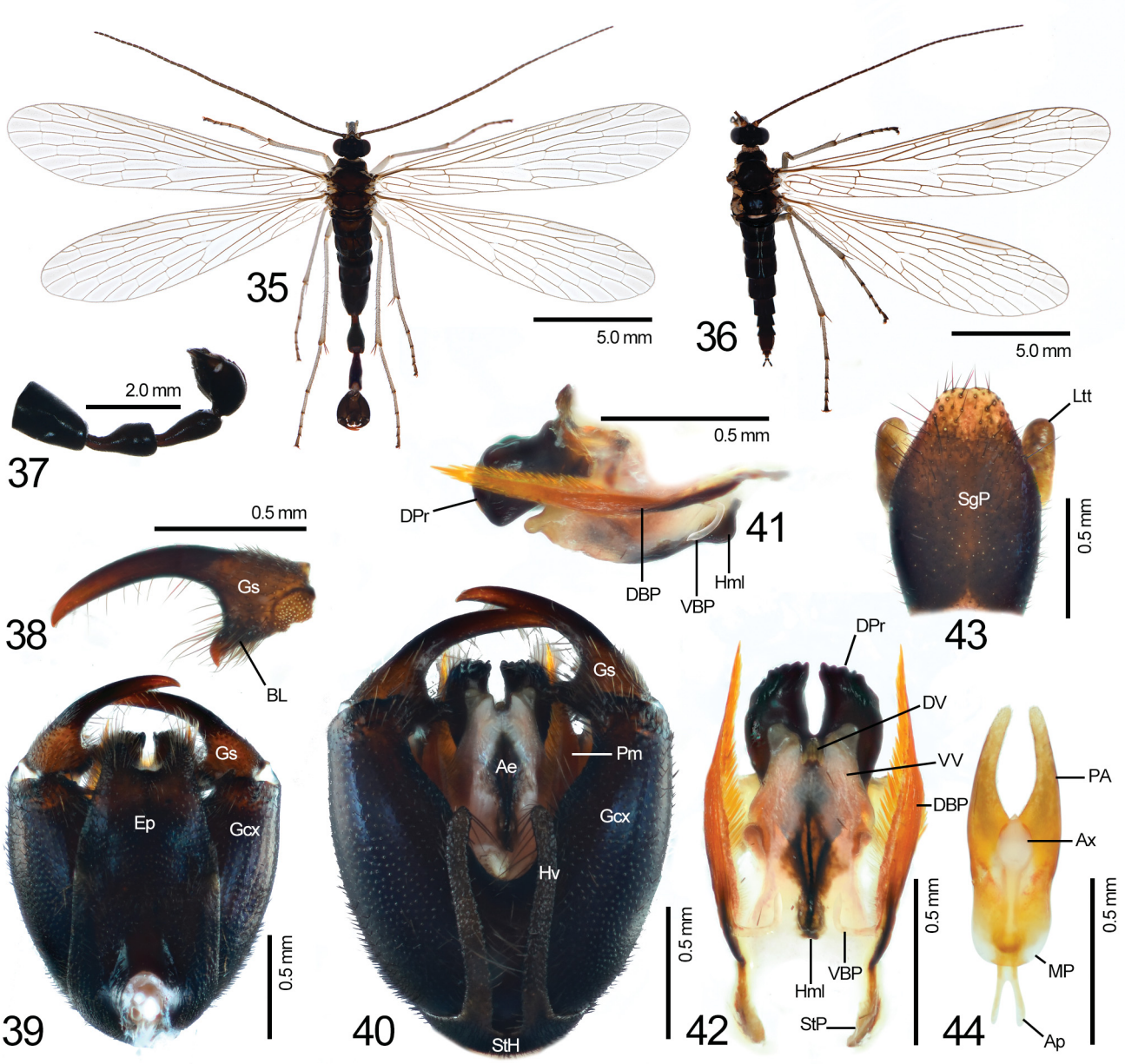
Distribution. China: Yunnan: Gongshan: Kongque Mountain (Fig. 212).

Panorpa huadianba Wang & Zhao sp. nov.

(Figs 35–44, 206)

Type material. Holotype: ♂ (CN21Piskhdb001), **China: Yunnan:** Dali Bai Autonomous Prefecture, Dali City, northern slope of the Cangshan Mountain, Huadianba (flower meadowland), 25°52′47″N, 100°00′53″E, 2930 m, 2.vi.2021, leg. Ji-Shen Wang (DALU). Paratypes: 10 ♂♂ 10 ♀♀ (CN21Piskhdb002–021), same data (DALU).

Diagnosis. This new species can be differentiated from the other members of this group by the combination of the following characters: in males, 1) parameres with dorsal branch abruptly narrowing towards apex in distal portion in ventral aspect (Fig. 42); 2) ventral branch of parameres translucent, short, and greatly curving caudad near middle (Figs 41, 42); 3) ventral valves of aedeagus each with papillar prominence apically in lateral view (Fig. 41);



Figs 35–44. *Panorpa huadianba* Wang & Zhao sp. nov. 35, 37–42 – male. 36, 43, 44 – female. 35, 36 – habitus, dorsal view. 37 – terminal abdomen, left-lateral view. 38 – right gonostylus, ventral view. 39, 40 – genital bulb, dorsal and ventral views, respectively. 41, 42 – aedeagal complex, right-lateral and ventral views, respectively. 43 – subgenital plate, ventral view. 44 – medigynium, ventral view.

4) hamulus of aedeagus greatly projecting ventrad (Fig. 41); in females, 5) subgenital plate rounded at apex and finger-like (Fig. 43); and 6) medigynium with posterior arms shorter than main plate, and rounded at apex (Fig. 44).

Measurements (mm). *Male* (n = 11): AtL 11.0–12.5, AbL 9.0–10.5, BdL 12.0–13.4, FL 13.0–13.8, FW 3.0–3.3, HL 11.8–12.6, HW 2.9–3.2. *Female* (n =10): AtL 12.5–13.0, AbL 6.2–7.5, BdL 10.0–11.2, FL 13.0–14.2, FW 3.0–3.2, HL 11.7–13.0, HW 2.9–3.0.

Etymology. Named after the type locality, Huadianba. Noun in apposition.

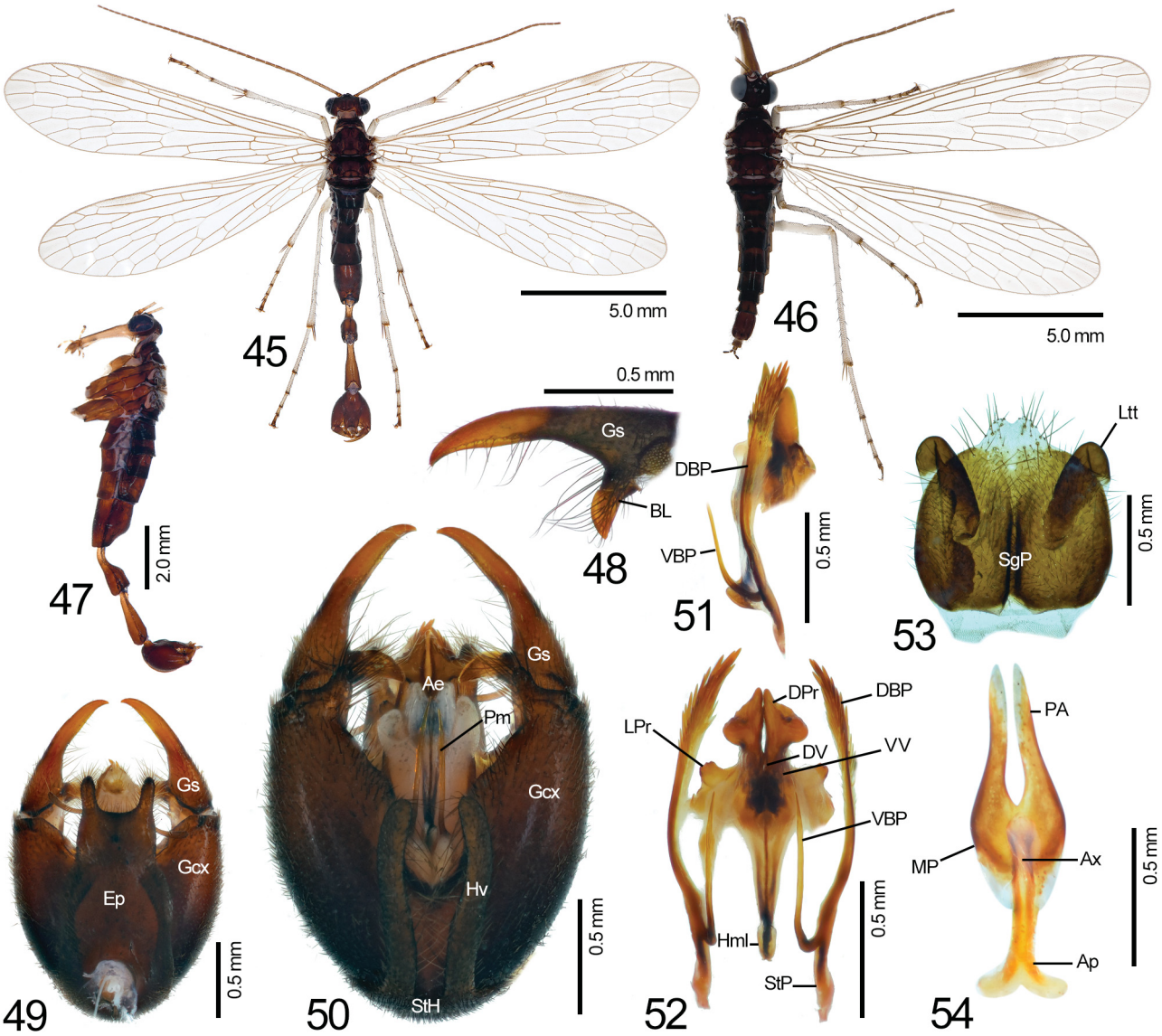
Distribution. China: Yunnan: Dali: Cangshan Mountain (Fig. 212).

Panorpa jinfo Wang sp. nov.

(Figs 45–54, 207)

Type material. Holotype: ♂ (CN22Piskjfo001), **CHINA: Chongqing:** Nanchuan District, Jinfo (Golden Buddha) Mountain, 29°02′00″N, 107°11′30″E, 2230 m, 22.vi.2022, leg. Dan-Chen Zhu (DALU). Paratypes: 10 ♂♂ 10 ♀♀ (CN22Piskjfs002–021), same data (DALU).

Diagnosis. This new species can be differentiated from the other members of this group by the combination of the following characters: 1) pleura and coxae greatly melanized (vs. mostly light grayish or yellowish brown) (Figs 47, 207); in males, 2) gonostyli with basal lobe straight along basal margin and arched in caudal margin (Fig. 48); 3) ventral valves of aedeagus bilobed, with inner lobe longer than lateral lobe (Fig. 50); 4) dorsal processes of aedeagus greatly constricted and stalk-like in basal 1/3, and subtriangularly enlarged in distal 2/3 (Fig. 52); 5) hamulus of aedeagus greatly projecting ventrad (Fig. 51); in females, 6) laterotergites IX broad with longitudinal wrinkle (Fig. 53); and 7) medigynium with slender posterior arms greatly convergent and longer than main plate, and apodemes of axis greatly exceeding main plate and shortly but widely



Figs 45–54. *Panorpa jinfo* Wang sp. nov. 45, 47–52 – male. 46, 53, 54 – female. 45, 46 – habitus, dorsal view. 47 – habitus, left-lateral view. 48 – right gonostylus, ventral view. 49, 50 – genital bulb, dorsal and ventral views, respectively. 51, 52 – aedeagal complex, right-lateral and ventral views, respectively. 53 – subgenital plate, ventral view. 54 – medigynium, ventral view.

divergent at base (Fig. 54).

Measurements (mm). *Male* (n = 11): AtL 9.0–10.0, AbL 8.9–9.6, BdL 12.0–13.2, FL 11.3–12.0, FW 3.0–3.1, HL 10.2–11.0, HW 2.9–3.0. *Female* (n = 10): AtL 9.2–10.5, AbL 6.5–7.0, BdL 10.0–10.6, FL 12.5–13.2, FW 3.0–3.2, HL 11.0–12.1, HW 2.9–3.1.

Etymology. Named after the type locality, Jinfo Mountain (Jinfo Shan in Chinese). Noun in apposition.

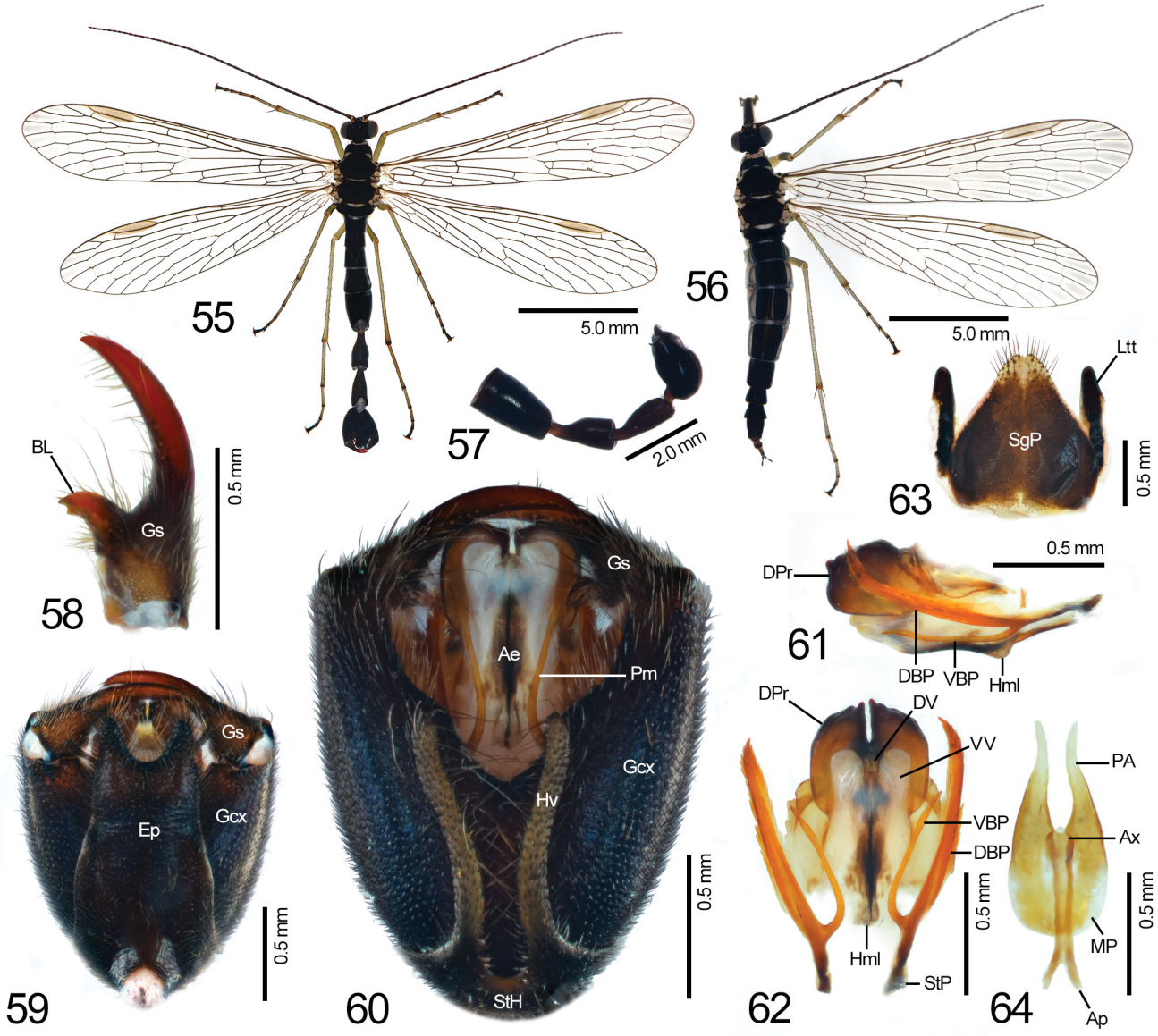
Distribution. China: Chongqing: Jinfo Mountain (Fig. 212).

Panorpa jizushana Wang sp. nov.

(Figs 55–64)

Type material. Holotype: ♂ (CN23Piskjzs001), **China: Yunnan:** Dali Bai Autonomous Prefecture, Binchuan County, Jizu (Chicken Foot) Mountain, 25°58′15″N, 100°22′55″E, 2800 m, 28.vi.2023, leg. Liang-Jie Jia & Ji-Shen Wang (DALU). Paratypes: 1 ♂ 3 ♀♀ (CN22Piskjzs002–005), same data (DALU).

Diagnosis. This new species can be differentiated from the other members of this group by the combination of the following characters: in males, 1) gonostyli with basal lobe shortly bifurcated at apex (Fig. 58); 2) parameres not exceeding aedeagus (Figs 60–62); 3) ventral branch of parameres slender and nearly 2/3 as long as dorsal branch (Figs 61, 62); 4) dorsal branch of parameres bearing short stout spines along dorsal margin (Figs 61, 62); 5) dorsal processes of parameres with serrate distal margin and narrow median cleft (Fig. 62); 6) aedeagus with hamulus projecting ventrad (Fig. 61); in females, 7) laterotergites IX slender and finger-like, longer than half length of subgenital plate (Fig. 63); 8) subgenital plate subtriangular, with apical prominence slightly emarginated terminally (Fig. 63); and 9) medigynium with main plate broad, posterior arms approximately as long as main plate and slightly divergent in distal portion (Fig. 64).



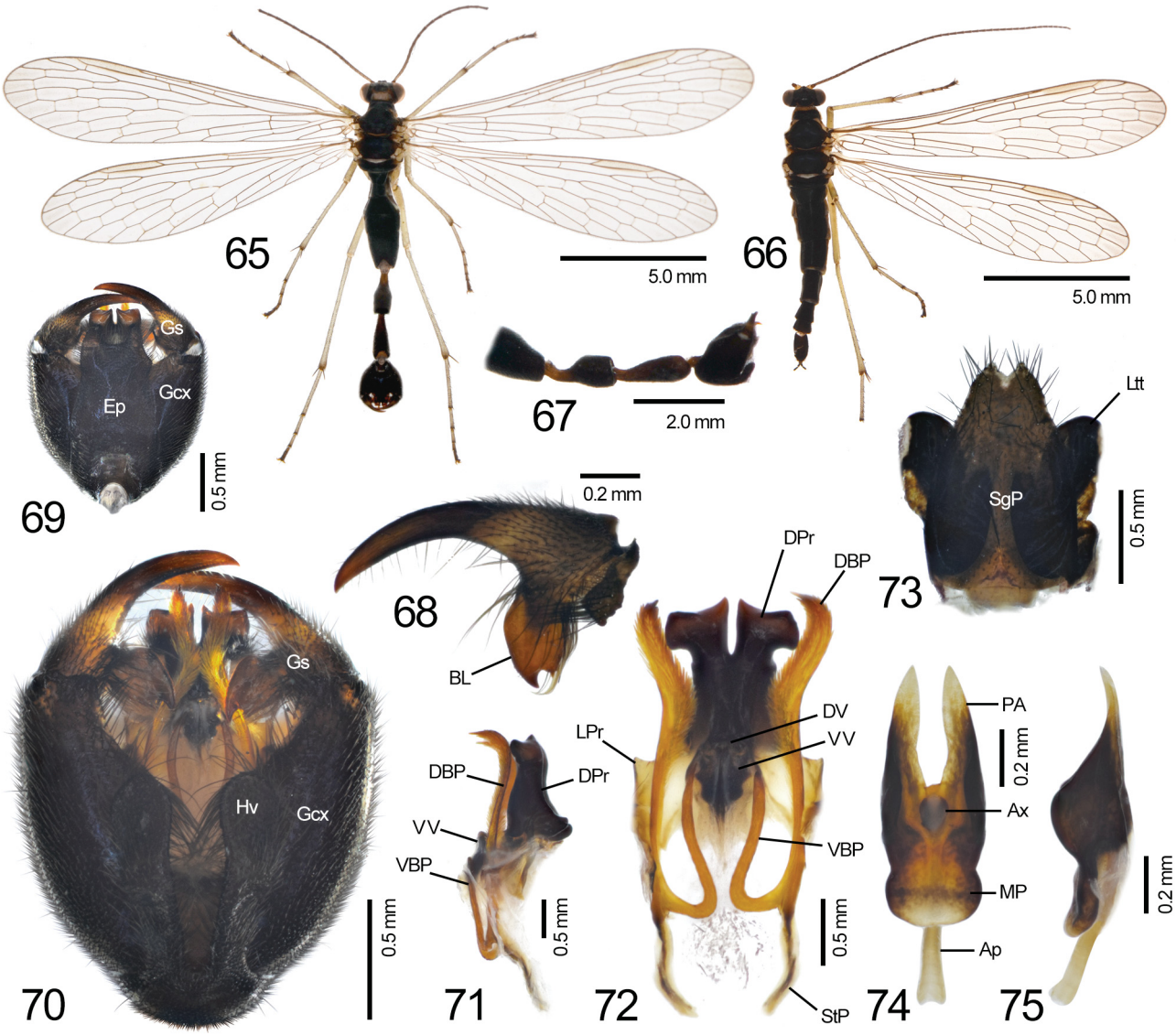
Figs 55–64. *Panorpa jizushana* Wang sp. nov. 55, 58–62 – male. 56, 63, 64 – female. 55, 56 – habitus, dorsal view. 57 – terminal abdomen, left-lateral view. 58 – right gonostylus, ventral view. 59, 60 – genital bulb, dorsal and ventral views, respectively. 61, 62 – aedeagal complex, right-lateral and ventral views, respectively. 63 – subgenital plate, ventral view. 64 – medigynium, ventral view.

Measurements (mm). *Male* (n = 2): AtL 11.2–12.0, AbL 10.2–10.5, BdL 14.4–14.5, FL 13.5–13.6, FW 3.0–3.1, HL 12.5–12.6, HW 2.9–3.0. *Female* (n = 3): AtL 13.5–14.0, AbL 9.8–10.5, BdL 13.0–14.6, FL 14.0–14.7, FW 3.1–3.3, HL 12.8–13.5, HW 3.0–3.2.
Etymology. Named after the type locality, Jizu Mountain (Jizu Shan in Chinese). Adjective.
Distribution. China: Yunnan: Jizu Mountain (Fig. 212).

Panorpa leiqilongi Wang sp. nov.
(Figs 65–75)

Type material. Holotype: ♂ (CN19Pisklql001), **China: Yunnan:** Nujiang Lisu Autonomous Prefecture, Gongshan County, Baihanluo, 27°57′19″N, 98°42′51″E, 2630 m, 6.vii.2019, leg. Yan-Dong Chen & Qi-Long Lei (DALU). Paratype: 1 ♀ (CN19Pisklql002), same data (DALU).

Diagnosis. This new species can be differentiated from the other members of this group by the combination of the following characters: in males, 1) basal lobe of gonostyli greatly enlarged and plate-like, with apex slightly bifurcated (Fig. 68); 2) ventral branch of parameres extending to apex of ventral valves (Figs 71, 72); 3) dorsal branch of parameres curved inward in distal 1/3 and greatly curved ventrad distally (Figs 71, 72); 4) dorsal processes of aedeagus greatly enlarged and axe-shaped distally (Fig. 72); in females, 5) subgenital plate with apical prominence greatly emarginated in V-shape (Fig. 73); 6) laterotergites IX broad (Fig. 73); and 7) medigynium with lateral margins of main plate (distal half) and posterior arms (basal half) greatly expanding ventrad (Figs 74, 75).
Measurements (mm). *Male* (n = 1): AtL (broken), AbL 8.6, BdL 11.7, FL 12.1, FW 2.9, HL 11.2, HW 2.8. *Female* (n = 1): AtL 9.4, AbL 6.7, BdL 10.0, FL 11.7, FW 2.8, HL 10.5, HW 2.7.
Etymology. Dedicated to one of the collectors, Qi-Long Lei. Noun in the genitive case.
Distribution. China: Yunnan: Gongshan (Fig. 212).



Figs 65–75. *Panorpa leiqilongi* Wang sp. nov. 65, 67–72 – male. 66, 73–75 – female. 65, 66 – habitus, dorsal view. 67 – terminal abdomen, left-lateral view. 68 – right gonostylus, ventral view. 69, 70 – genital bulb, dorsal and ventral views, respectively. 71, 72 – aedeagal complex, right-lateral and ventral views, respectively. 73 – subgenital plate, ventral view. 74, 75 – medigynium, ventral and right-lateral views, respectively.

Panorpa luojishana Wang sp. nov.

(Figs 76–85)

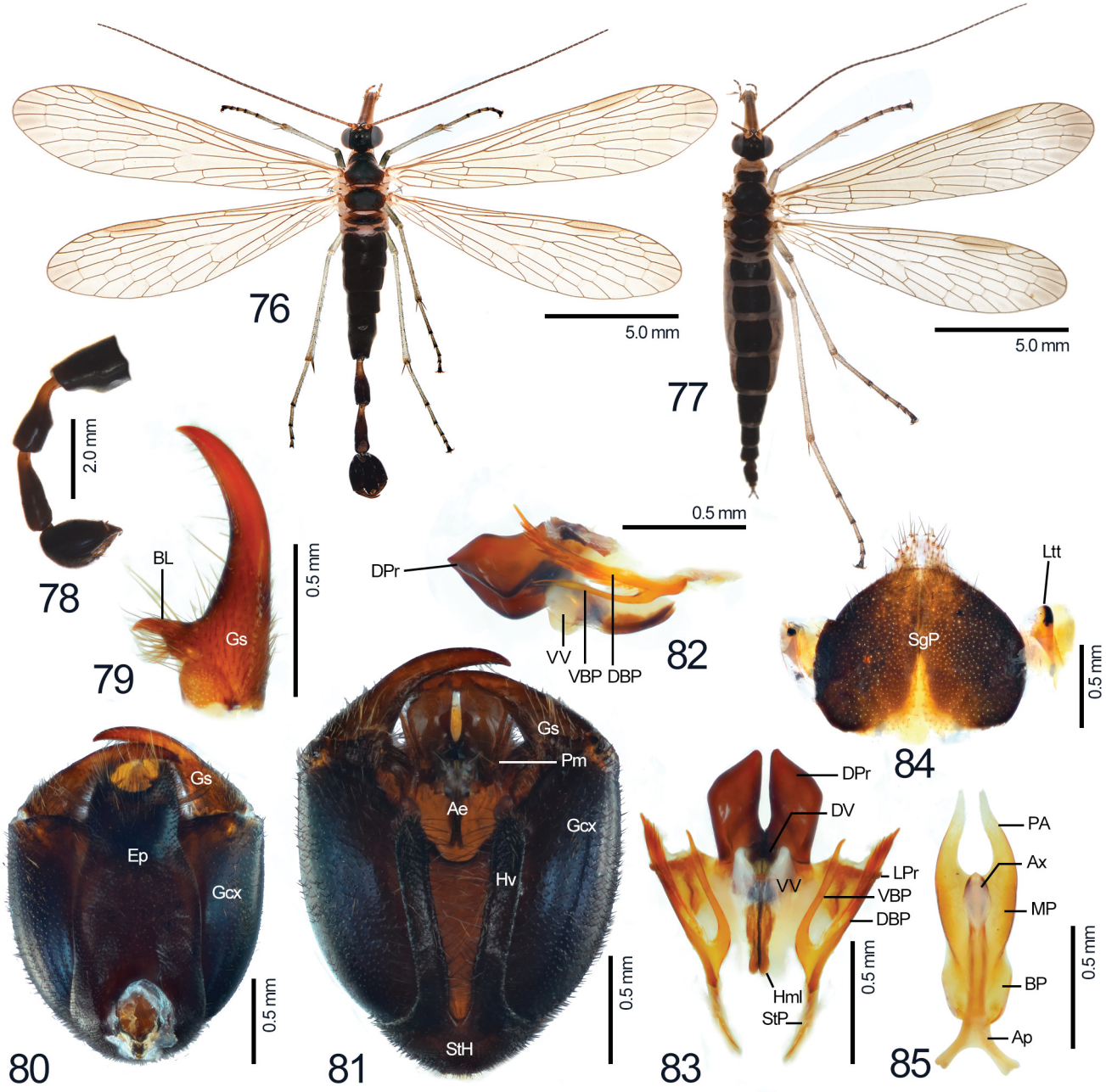
Type material. Holotype: ♂ (CN22Piskljs001), **China: Sichuan:** Liangshan Yi Autonomous Prefecture, Xichang City, Huangshui (yellow water) Township, western slope of the Luoji Mountain, 27°35′14″N, 102°14′22″E, 2000 m, 30.vi.2022, leg. Dan-Chen Zhu (DALU). Paratypes: 1 ♂ 3 ♀♀ (CN22Piskljs002–005), same data (DALU).

Diagnosis. This new species can be differentiated from the other members of this group by the combination of the following characters: in males, 1) parameres short, extending only to middle portion of dorsal processes of aedeagus (Figs 82, 83); 2) ventral branch of parameres nearly 4/5 as long as dorsal branch (Figs 82, 83); 3) dorsal processes of aedeagus divergent and forming median cleft, with smooth surface (Fig. 83); in females, 4) subgenital plate with apical prominence distinct and lacking terminal emargination (Fig. 84); 5) laterotergites IX minute (Fig. 84); and 6) medigynium greatly constricted at basal 1/3 and forming distinct basal plate (Fig. 85).

Measurements (mm). *Male* (n = 2): AtL 10.1–10.2, AbL 10.1–10.2, BdL 9.3–9.4, FL 12.5–12.6, FW 3.0, HL 11.4–11.5, HW 2.9. *Female* (n = 3): AtL 11.5–12.0, AbL 12.0–12.6, BdL 13.0–14.0, FL 12.0–12.4, FW 3.0–3.1, HL 11.0–11.5, HW 2.9–3.0.

Etymology. Named after the type locality, Luoji Mountain (Luoji Shan in Chinese). Adjective.

Distribution. China: Sichuan: Xichang: Luoji Mountain (Fig. 212).



Figs 76–85. *Panorpa luojishana* Wang sp. nov. 76, 78–83 – male. 77, 84, 85 – female. 76, 77 – habitus, dorsal view. 78 – terminal abdomen, left-lateral view. 79 – right gonostylus, ventral view. 80, 81 – genital bulb, dorsal and ventral views, respectively. 82, 83 – aedeagal complex, right-lateral and ventral views, respectively. 84 – subgenital plate, ventral view. 85 – medigynium, ventral view.

Panorpa maershana Wang sp. nov.

(Figs 86–95)

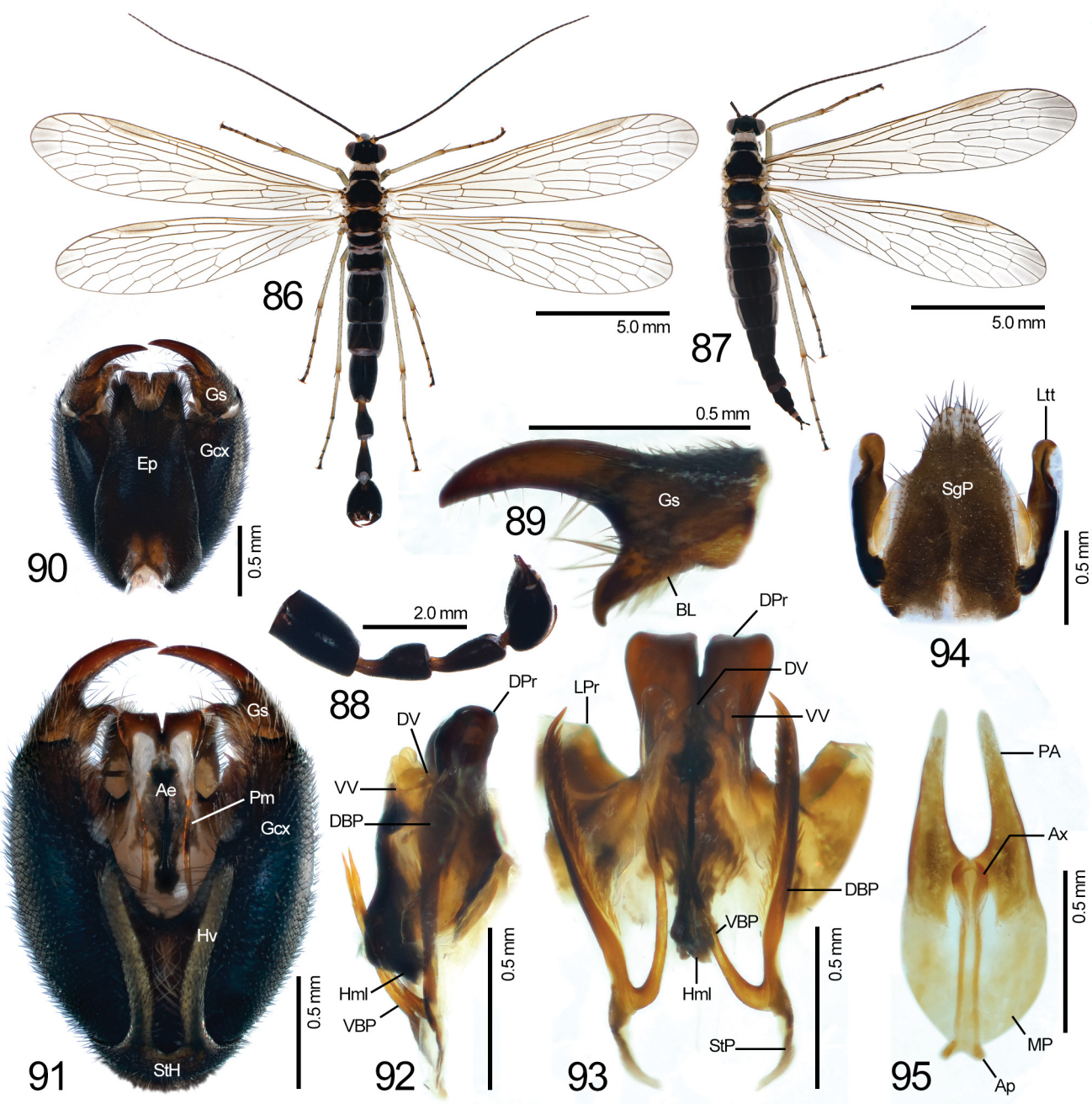
Type material. HOLOTYPE: ♂ (CN23Piskmes001), **CHINA: YUNNAN:** Dali Bai Autonomous Prefecture, Heqing County, eastern slope of the Ma'er (Horse Ear) Mountain, 26°15′35″N, 100°08′43″E, 2650 m, 7.vii.2023, leg. Ji-Shen Wang (DALU). PARATYPES: 1 ♂ 7 ♀♀ (CN23Piskmes002–009), same data (DALU).

Diagnosis. This new species can be differentiated from the other members of this group by the combination of the following characters: 1) wings with greatly reduced apical band in both sexes (Figs 86, 87), in males, 2) dorsal branch of parameres extending nearly to apex of ventral valves of aedeagus (Figs 92, 93); 3) ventral branch of parameres approximately 2/3 as long as dorsal branch (Figs 92, 93); 4) dorsal processes of aedeagus nearly truncated apically with shallow median cleft (Fig. 93); in females, 5) subgenital plate with its apical prominence lacking emargination terminally (Fig. 94); 6) laterotergites IX greatly elongated, approximately 3/4 as long as subgenital plate, and with membranous region latero-subapically (Fig. 94); and 7) medigynium with apodemes of axis only slightly extending beyond main plate and widely divergent (Fig. 95).

Measurements (mm). *Male* (n = 2): AtL 9.8–10.0, AbL 11.2–11.4, BdL 14.8–14.9, FL 11.7–11.8, FW 2.9, HL 10.5–10.6, HW 2.8. *Female* (n = 7): AtL 10.0–10.8, AbL 8.2–8.8, BdL 12.0–12.7, FL 12.0–12.4, FW 3.0–3.1, HL 11.0–11.3, HW 2.9–3.0.

Etymology. Named after the type locality, Ma'er Mountain (Ma'er Shan in Chinese). Adjective.

Distribution. China: Yunnan: Heqing: Ma'er Mountain (Fig. 212).



Figs 86–95. *Panorpa maershana* Wang sp. nov. 86, 88–93 – male. 87, 94, 95 – female. 86, 87 – habitus, dorsal view. 88 – terminal abdomen, left-lateral view. 89 – right gonostylus, ventral view. 90, 91 – genital bulb, dorsal and ventral views, respectively. 92, 93 – aedeagal complex, right-lateral and ventral views, respectively. 94 – subgenital plate, ventral view. 95 – medigynium, ventral view.

Panorpa meihuashana Wang sp. nov.

(Figs 96–106)

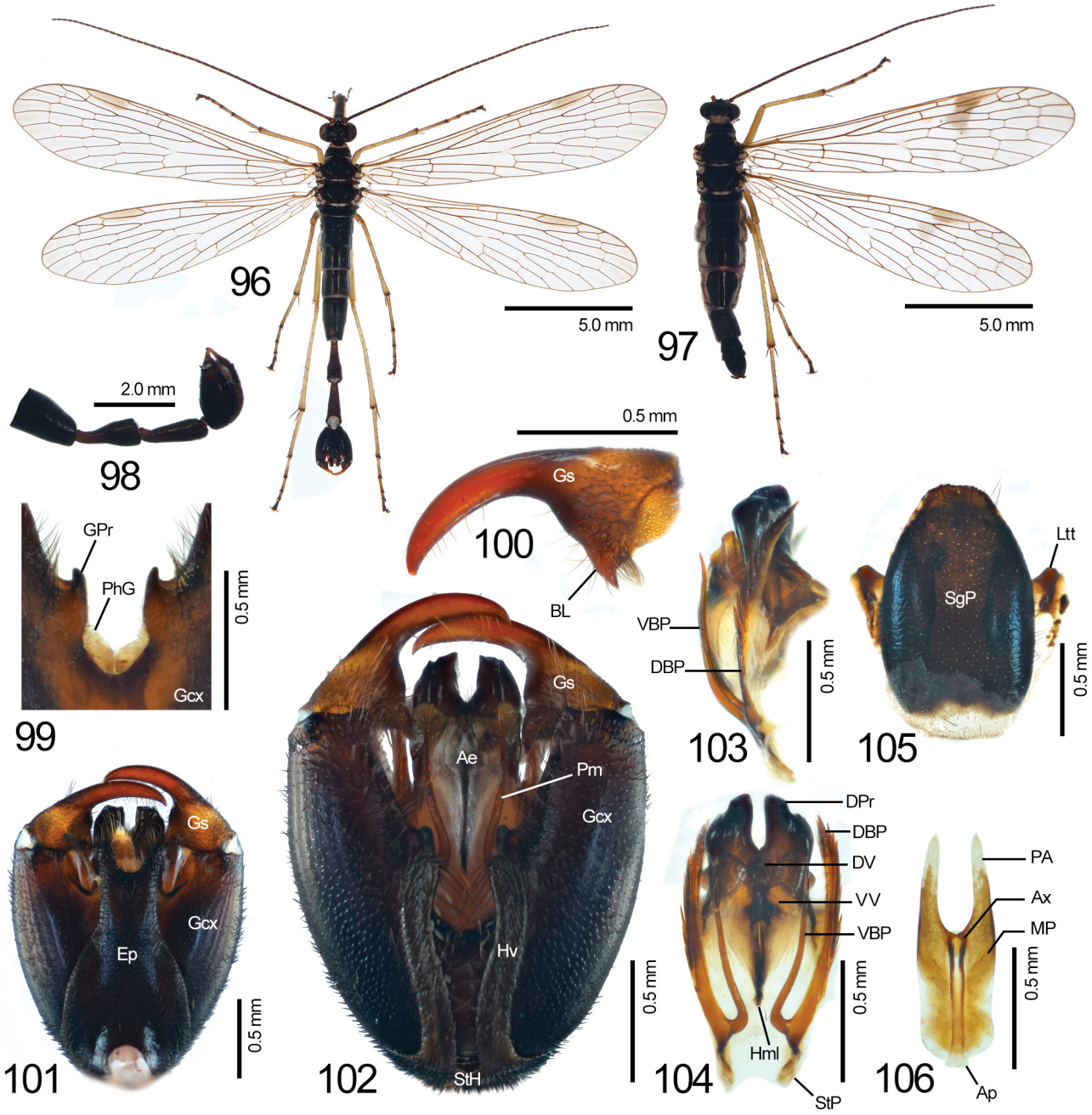
Type material. Holotype: ♂ (CN22Piskmhs001), **China: Guizhou:** Liupanshui City, Meihua (plum blossom) Mountain, 26°38′10″N, 104°44′05″E, 2440 m, 12.vii–28.viii.2022, leg. Gui-Qiang Huang by Malaise trap (DALU). Paratypes: 10 ♂♂ 10 ♀♀ (CN22Piskmhs002–021), same data (DALU).

Diagnosis. This new species can be differentiated from the other members of this group by the combination of the following characters: in males, 1) gonocoxal processes present posterior to pheromone glands (Fig. 99); 2) gonostyli greatly enlarged at base with short and acute basal lobe (Fig. 100); 3) dorsal processes of aedeagus with a wide median cleft (Fig. 104); in females, 4) wing markings represented by dense pterostigmal band extending from pterostigma to R_5 (Fig. 97); 5) subgenital plate with apical prominence sclerotized as other parts and lacking terminal emargination (Fig. 105); 6) laterotergites IX minute (Fig. 105); and 7) medigynium with apodemes of axis only slightly extending beyond main plate and slightly divergent (Fig. 106).

Measurements (mm). *Male* (n = 11): AtL 11.2–11.6, AbL 10.2–11.0, BdL 14.0–14.5, FL 12.2–12.6, FW 3.0–3.1, HL 11.0–11.4, HW 2.9–3.0. *Female* (n = 10): AtL 13.0–13.5, AbL 8.0–9.0, BdL 11.0–12.6, FL 13.0–13.5, FW 3.0–3.2, HL 12.0–12.2, HW 2.9–3.0.

Etymology. Named after the type locality, Meihua Mountain (Meihua Shan in Chinese). Adjective.

Distribution. China: Guizhou: Liupanshui: Meihua Mountain (Fig. 212).



Figs 96–106. *Panorpa meihuashana* Wang sp. nov. 96, 98–104 – male. 97, 105, 106 – female. 96, 97 – habitus, dorsal view. 98 – terminal abdomen, left-lateral view. 99 – gonocoxal concavity, ventral view. 100 – right gonostylus, ventral view. 101, 102 – genital bulb, dorsal and ventral views, respectively. 103, 104 – aedeagal complex, right-lateral and ventral views, respectively. 105 – subgenital plate, ventral view. 106 – medigynium, ventral view.

Panorpa niaodiaoshana Wang sp. nov.

(Figs 107–116)

Type material. Holotype: ♂ (CN22Piskndsl001), **China: Yunnan:** Dali Bai Autonomous Prefecture, Eryuan County, Niaodiao Mountain, 25°59′26″N, 99°52′27″E, 3000 m, 30.vii.2023, leg. Ji-Shen Wang & Yu-Fei Li (DALU). Paratype: 1 ♀ (CN22Piskndsl002), same data (DALU).

Diagnosis. This new species superficially resembles *P. huadianba* Wang & Zhao sp. nov., but can be differentiated from the latter by the following characters: in males, 1) parameres evenly tapering towards apex in distal portion in ventral aspect (Fig. 114 vs. abruptly tapering in Fig. 42), with its dorsal branch extending beyond basal lobe of gonostyli (Fig. 114 vs. slightly extending beyond aedeagus in Fig. 42); 2) ventral valves of aedeagus each with indistinct prominence apically in lateral view (Fig. 113 vs. distinct in Fig. 41); and in females, 3) medigynium with posterior arms acute at apex (Fig. 116 vs. rounded in Fig. 44).

Measurements (mm). *Male* (n = 1): AtL 13.0, AbL 10.6, BdL 14.4, FL 13.9, FW 3.2, HL 12.6, HW 3.1. *Female* (n = 1): AtL 13.1, AbL 10.2, BdL 15.3, FL 15.2, FW 3.3, HL 14.0, HW 3.2.

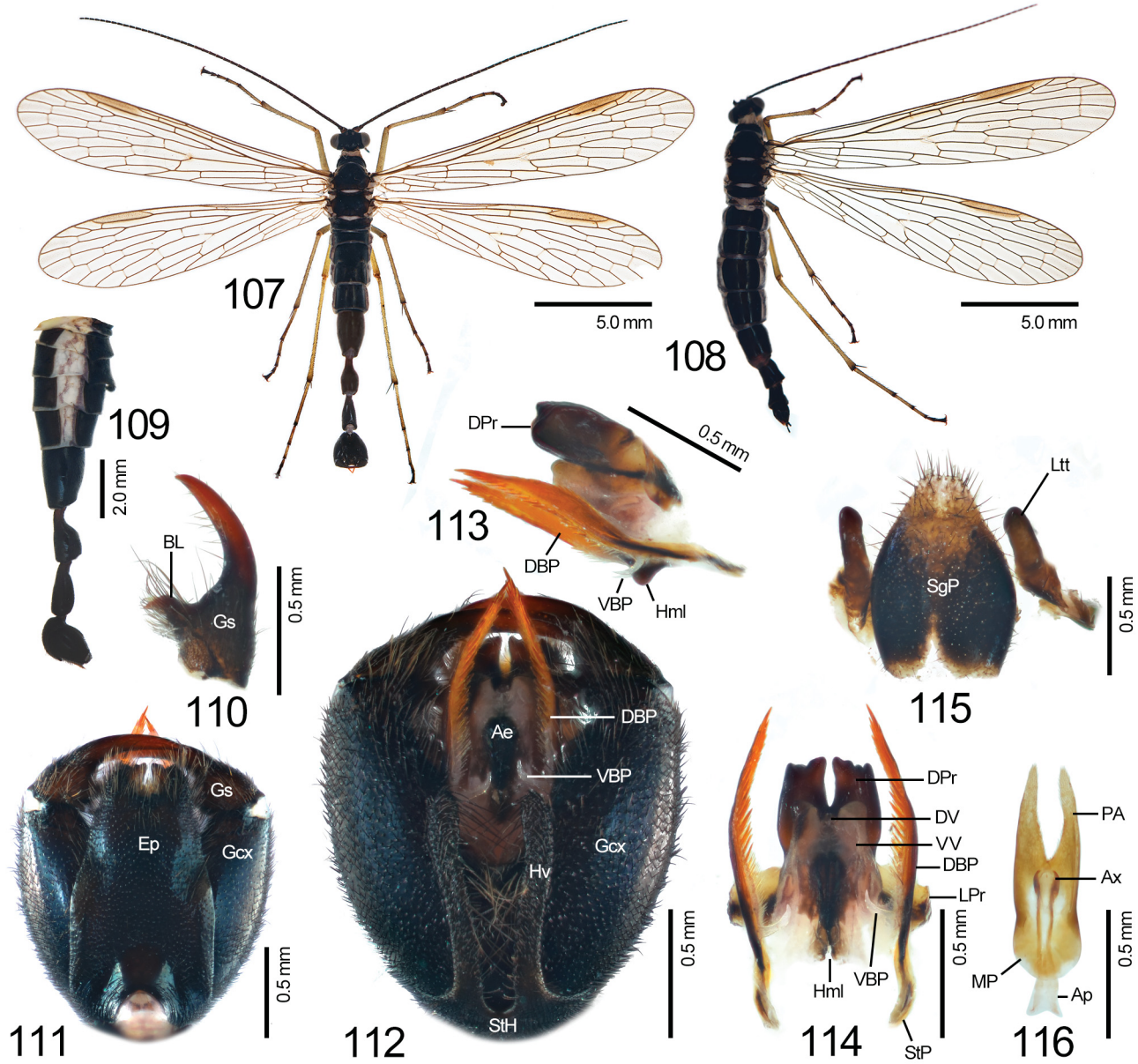
Etymology. Named after the type locality, Niaodiao Mountain (Niaodiao Shan in Chinese). Adjective.

Distribution. China: Yunnan: Eryuan: Niaodiao Mountain (Fig. 212).

Panorpa shengyingfeng Wang & Zhao sp. nov.

(Figs 117–126, 208, 209)

Type material. Holotype: ♂ (CN21Pisksyf001), **China: Yunnan:** Dali Bai Autonomous Prefecture, Dali City, eastern slope of the Cangshan Mountain, road to Shengying Peak (Shengying Feng in Chinese), 25°38′36″N, 100°09′18″E, 2600 m, leg. Ji-Shen Wang (DALU). Paratypes: 5 ♂♂ 5 ♀♀ (CN21Pisksyf002–011), same data (DALU).



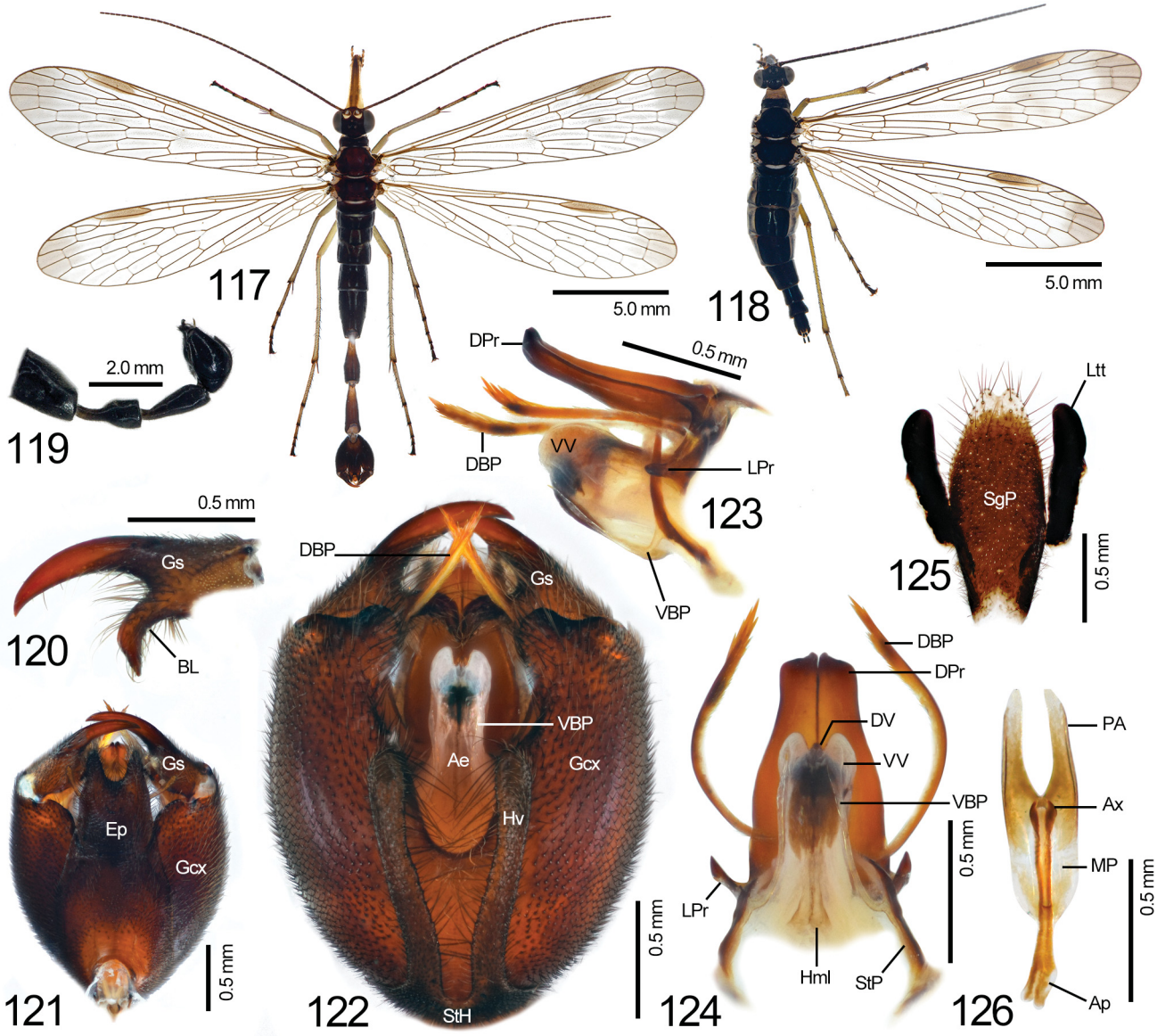
Figs 107–116. *Panorpa niaodiaoshana* Wang sp. nov. 107, 109–114 – male. 108, 115, 116 – female. 107, 108 – habitus, dorsal view. 109 – terminal abdomen, left-lateral view. 110 – right gonostylus, ventral view. 111, 112 – genital bulb, dorsal and ventral views, respectively. 113, 114 – aedeagal complex, right-lateral and ventral views, respectively. 115 – subgenital plate, ventral view. 116 – medigynium, ventral view.

Diagnosis. The new species is peculiar in this group due to the prominent pterostigma and the densest wing markings: apical band dark gray with vague inner margin in both sexes (Figs 117, 118, 208, 209), pterostigmal band almost absent in males but weak on female forewings (Fig. 118). It can also be differentiated from the other members of this group by the combination of the following characters: in males, 1) A7 with basal stalk narrow and long (Fig. 119 vs. usually thicker); 2) gonocoxites each with terminal plate ventro-medially (Fig. 122); 3) gonostyli with basal lobe greatly elongated, as wide as distal portion of gonostyli, and greatly curved in distal half (Fig. 120); 4) ventral branch of parameres slender, membranous and translucent, and closely aligned with ventral valves of aedeagus (Figs 122–124); 5) dorsal branch of parameres crossed between columnar ventral + dorsal valves and dorsal processes of aedeagus (Figs 123, 124); 6) dorsal processes of aedeagus closely aligned, flat plate-like, without median cleft but only slightly diverged at pointed inner apex (Figs 123, 124); in females, 7) subgenital plate long oval, with V-shaped terminal emargination in its membranous apical prominence (Fig. 125); and 8) medigynium with apodemes of axis long and closely aligned (Fig. 126).

Measurements (mm). *Male* (n = 6): AtL 12.0–12.5, AbL 12.3–12.8, BdL 16.0–17.0, FL 13.5–14.0, FW 3.0–3.2, HL 12.2–13.0, HW 2.9–3.1. *Female* (n = 5): AtL 11.7–12.0, AbL 8.2–8.5, BdL 12.8–13.2, FL 14.5–15.0, FW 3.0–3.3, HL 13.0–14.0, HW 2.9–3.2.

Etymology. Named after the type locality, Shengying Peak of the Cangshan Mountain. Noun in apposition.

Distribution. China: Yunnan: Dali: Cangshan Mountain (Fig. 212).



Figs 117–126. *Panorpa shengyingfeng* Wang & Zhao sp. nov. 117, 119–124 – male. 118, 125, 126 – female. 117, 118 – habitus, dorsal view. 119 – terminal abdomen, left-lateral view. 120 – right gonostylus, ventral view. 121, 122 – genital bulb, dorsal and ventral views, respectively. 123, 124 – aedeagal complex, right-lateral and ventral views, respectively. 125 – subgenital plate, ventral view. 126 – medigynium, ventral view.

Panorpa shimianensis Wang sp. nov.

(Figs 127–135)

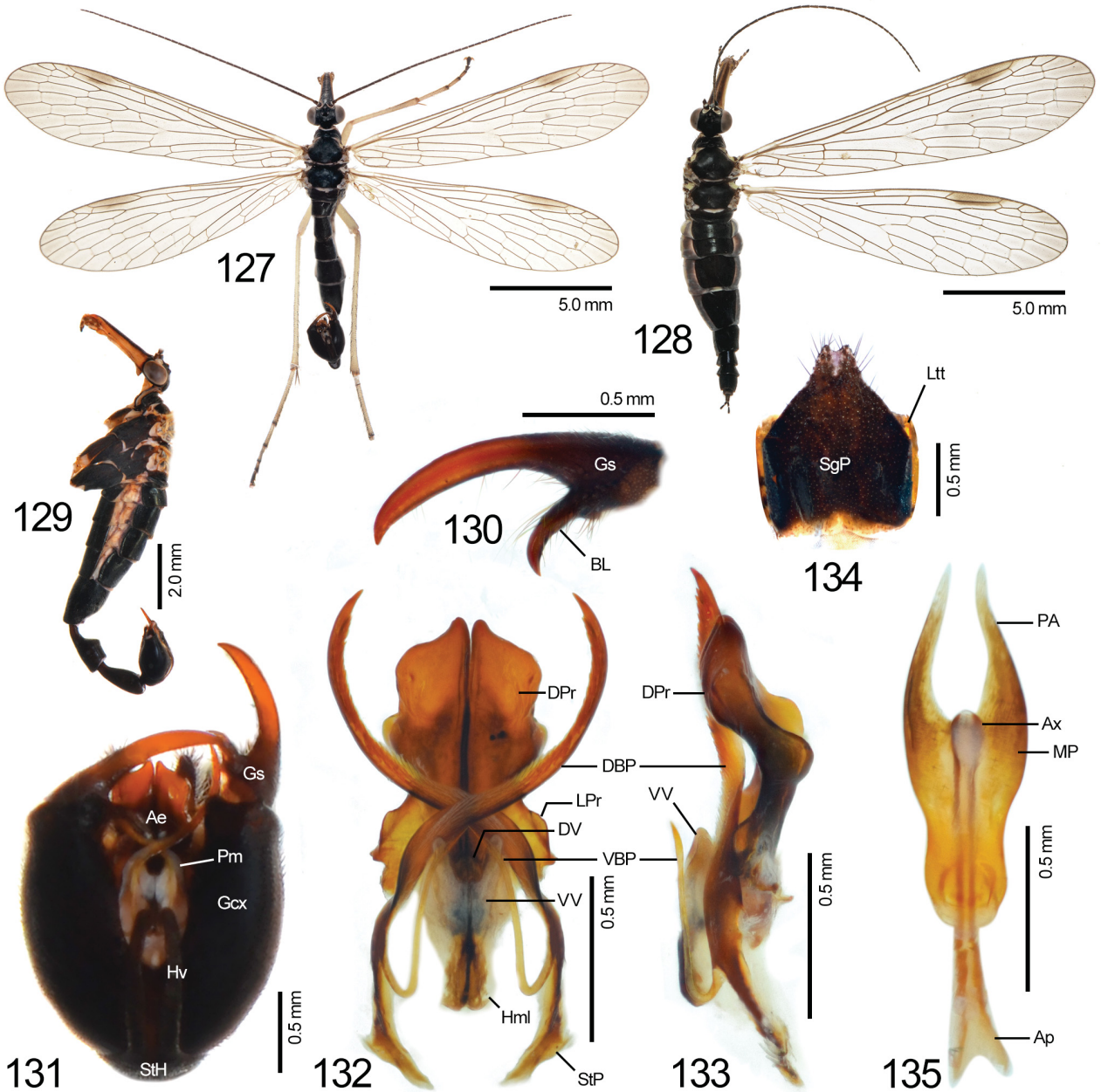
Type material. HOLOTYPE: ♂ (CN22Piskshm001), **CHINA: SICHUAN:** Ya'an Prefecture, Shimian County, Liziping Township, 28°59′39″N, 102°24′31″E, 2520 m, 20.vii.2022, leg. Dan-Chen Zhu (DALU). PARATYPES: 10 ♀♀ (CN22Piskshm002–011), same data (DALU).

Diagnosis. This new species can be differentiated from the other members of this group by the combination of the following characters: 1) pleura and coxae greatly melanized (Fig. 129 *vs.* mostly light grayish or yellowish brown in Figs 208–211); in males, 2) gonostyli with basal lobe greatly elongated, thinner than distal portion of gonostyli, and evenly curved (Fig. 130); 3) ventral branch of parameres slender and extending slightly beyond ventral valves of aedeagus, directing inner-basally at base but abruptly curved caudad (Figs 132, 133); 4) dorsal branch of parameres crossed posterior to ventral valves of aedeagus, and exceeding apex of dorsal processes (Fig. 132); 5) dorsal processes slightly humped in middle and each with rounded dorsal process (Fig. 133); in females, 6) apical prominence of subgenital plate with wide semicircular emargination terminally (Fig. 134); 7) laterotergites IX minute (Fig. 134); and 8) medigynium with basal half of main plate distinctly narrower than distal half, axis with apodemes extending far beyond main plate and slightly divergent (Fig. 135).

Measurements (mm). *Male* (n = 1): AtL 10.8, AbL 9.0, BdL 13.0, FL 12.2, FW 3.2, HL 11.3, HW 3.1. *Female* (n = 10): AtL 10.5–11.0, AbL 7.2–8.5, BdL 11.0–12.8, FL 13.5–15.0, FW 3.0–3.4, HL 12.0–14.0, HW 3.0–3.3.

Etymology. Named after the type locality, Shimian County. Adjective.

Distribution. China: Sichuan: Shimian: Liziping (Fig. 212).



Figs 127–135. *Panorpa shimianensis* Wang sp. nov. 127, 129–133 – male. 128, 134, 135 – female. 127, 128 – habitus, dorsal view. 129 – habitus, left-lateral view. 130 – right gonostylus, ventral view. 131 – genital bulb, ventral view. 132, 133 – aedeagal complex, ventral and right-lateral views, respectively. 134 – subgenital plate, ventral view. 135 – medigynium, ventral view.

Panorpa sicaura Wang sp. nov.

(Figs 136–145)

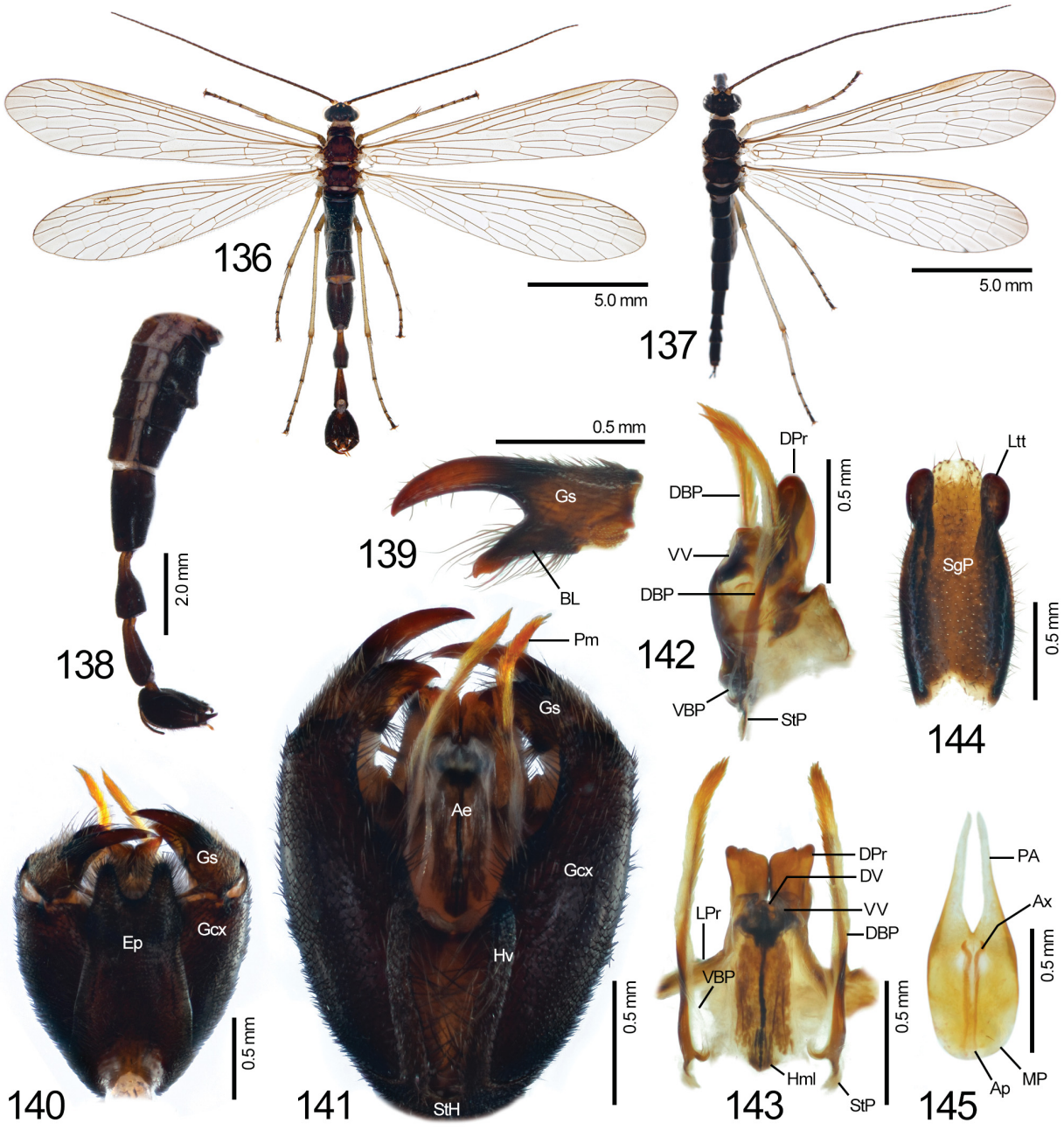
Type material. Holotype: ♂ (CN20Pisksic001), **China: Yunnan:** Kunming Prefecture, Luquan Yi and Miao Autonomous County, Jiaozi Snow Mountain, Xianiuyandong Village, 26°02′59″N, 102°48′40″E, 2550 m, 5.viii.2020, leg. Zheng Zhou (DALU). Paratype: 1 ♀ (CN20Pisksic002), same data (DALU).

Diagnosis. This new species can be differentiated from the other members of this group by the combination of the following characters: in males, 1) basal lobe of gonostyli with dorsal margin greatly expanded dorsad in ventro-anterior aspect (Fig. 141); 2) parameres with ventral branch approximately half as long as dorsal branch, very weakly sclerotized, and dorsal branch greatly elongated and exceeding basal lobe of gonostyli (Figs 142, 143); 3) ventral valves with ventro-median portion sclerotized and forming dark brown, rectangular region (Figs 141, 143); 4) dorsal processes of aedeagus closely aligned without distinct median cleft, and each bearing small triangular process at outer 1/3 of beveled distal margin (Fig. 143); in females, 5) subgenital plate long oval, with membranous apical prominence rounded (Fig. 144); 6) laterotergites IX greatly developed, nearly as long as subgenital plate, and with outer margin notched subapically (Fig. 144); and 7) medigynium with apodemes of axis concealed in main plate, and slender posterior arms slightly convergent towards apex (Fig. 145).

Measurements (mm). *Male* (n = 1): AtL 10.3, AbL 11.2, BdL 15.2, FL 13.6, FW 2.9, HL 12.8, HW 2.9. *Female* (n = 1): AtL 12.9, AbL 7.8, BdL 12.6, FL 13.8, FW 2.9, HL 12.5, HW 2.9.

Etymology. Named after the Reptile Pet Association of Sichuan Agriculture University (abbreviated as *sicaura*). The collector, Zheng Zhou was once the leader of the association. Noun in apposition.

Distribution. China: Yunnan: Luquan: Jiaozi Snow Mountain (Fig. 212).



Figs 136–145. *Panorpa sicaura* Wang sp. nov. 136, 138–143 – male. 137, 144, 145 – female. 136, 137 – habitus, dorsal view. 138 – abdomen, left-lateral view. 139 – right gonostylus, ventral view. 140, 141 – genital bulb, dorsal and ventral views, respectively. 142, 143 – aedeagal complex, right-lateral and ventral views, respectively. 144 – subgenital plate, ventral view. 145 – medigynium, ventral view.

Panorpa vajra Wang sp. nov.

(Figs 146–156)

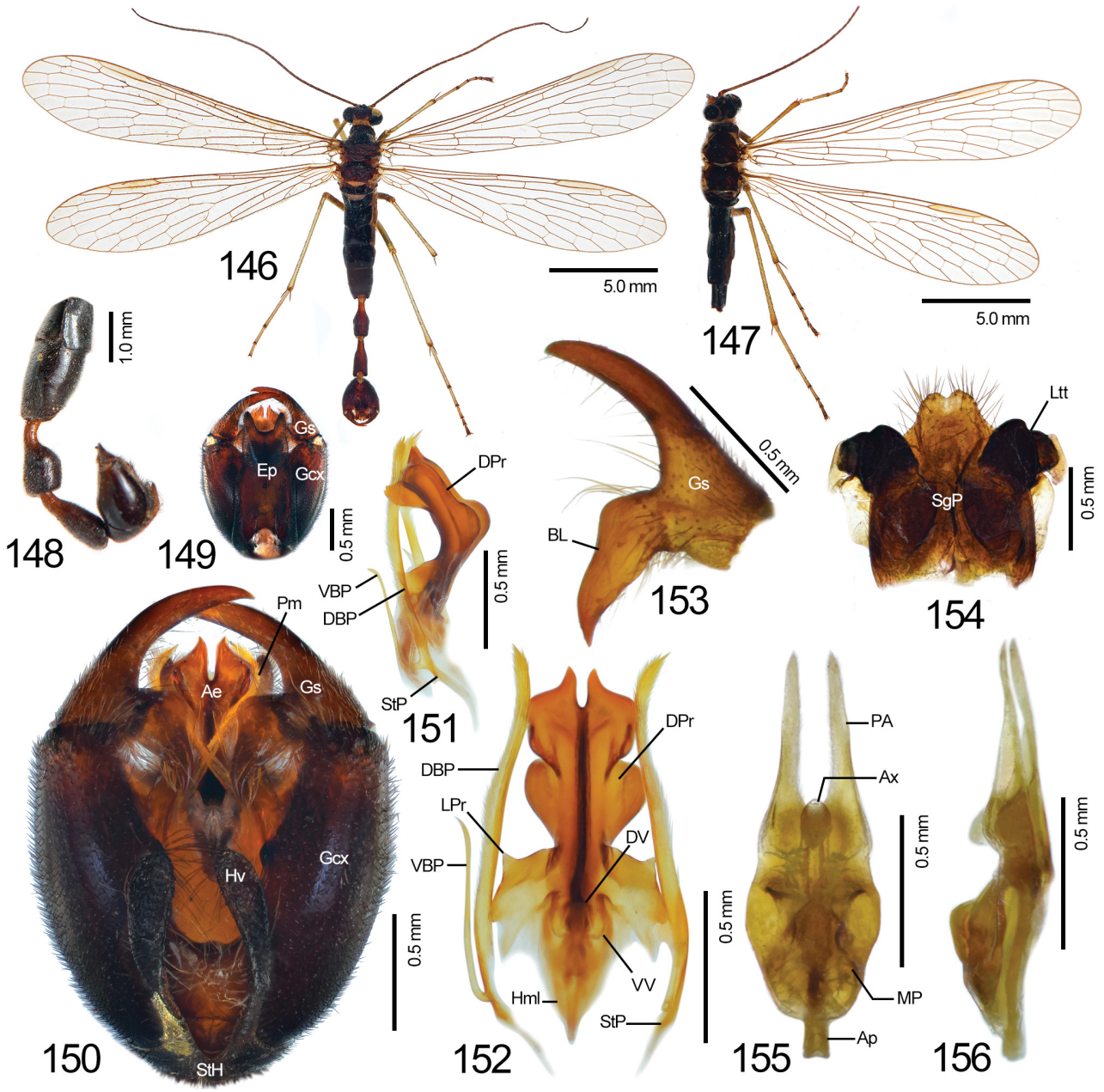
Type material. Holotype: ♂ (CN22Piskvaj001), **China: Yunnan:** Dali Bai Autonomous Prefecture, Yunlong County, Caojian Town, eastern slope of the Zhiben Mountain, 25°42′32″N, 99°07′22″E, 2580 m, 3.viii.2022, leg. Dan-Chen Zhu (DALU). Paratypes: 2 ♀♀ (CN22Piskvaj002, 003), same data (DALU).

Diagnosis. This new species can be differentiated from the other members of this group by the combination of the following characters: in males, 1) gonostyli with basal lobe greatly enlarged and wider than distal portion of gonostyli (Fig. 153); 2) ventral branch of parameres slender and weakly sclerotized, nearly half as long as dorsal branch (Figs 151, 152); 3) dorsal branch of parameres crossed posterior to ventral valves of aedeagus (Fig. 150); 4) dorsal processes of aedeagus greatly elongated with shallow median cleft, and greatly humped in middle (Figs 151, 152); in females, 5) subgenital plate broad with apical prominence emarginated in V-shape terminally (Fig. 154); 6) laterotergites IX broad with irregular caudal margin (Fig. 154); and 7) medigynium with main plate broad and greatly projecting ventrad (Figs 155, 156).

Measurements (mm). *Male* (n = 1): AtL 12.0, AbL 10.6, BdL 14.6, FL 14.4, FW 3.1, HL 13.3, HW 3.0. *Female* (n = 2): AtL (broken), AbL 7.0, BdL 11.0–11.5, FL 14.5–14.8, FW 3.0–3.1, HL 13.3–13.5, HW 3.0.

Etymology. The specific epithet, *vajra*, is derived from the Sanskrit वज्र (vájra), a Buddhist ceremonial mace and also an ancient weapon that the male aedeagus greatly resembles to. Noun in apposition.

Distribution. China: Yunnan: Yunlong: Zhiben Mountain (Fig. 212).



Figs 146–156. *Panorpa vajra* Wang sp. nov. 146, 148–153 – male. 147, 154–156 – female. 146, 147 – habitus, dorsal view. 148 – terminal abdomen, left-lateral view. 149, 150 – genital bulb, dorsal and ventral views, respectively. 151, 152 – aedeagal complex, right-lateral and ventral views, respectively (in 151, parameres are moved aside to show the aedeagus). 153 – right gonostylus, ventral view. 154 – subgenital plate, ventral view. 155, 156 – medigynium, ventral and right-lateral views, respectively.

Panorpa vajroides Wang & Zhao sp. nov.

(Figs 157–166, 210, 211)

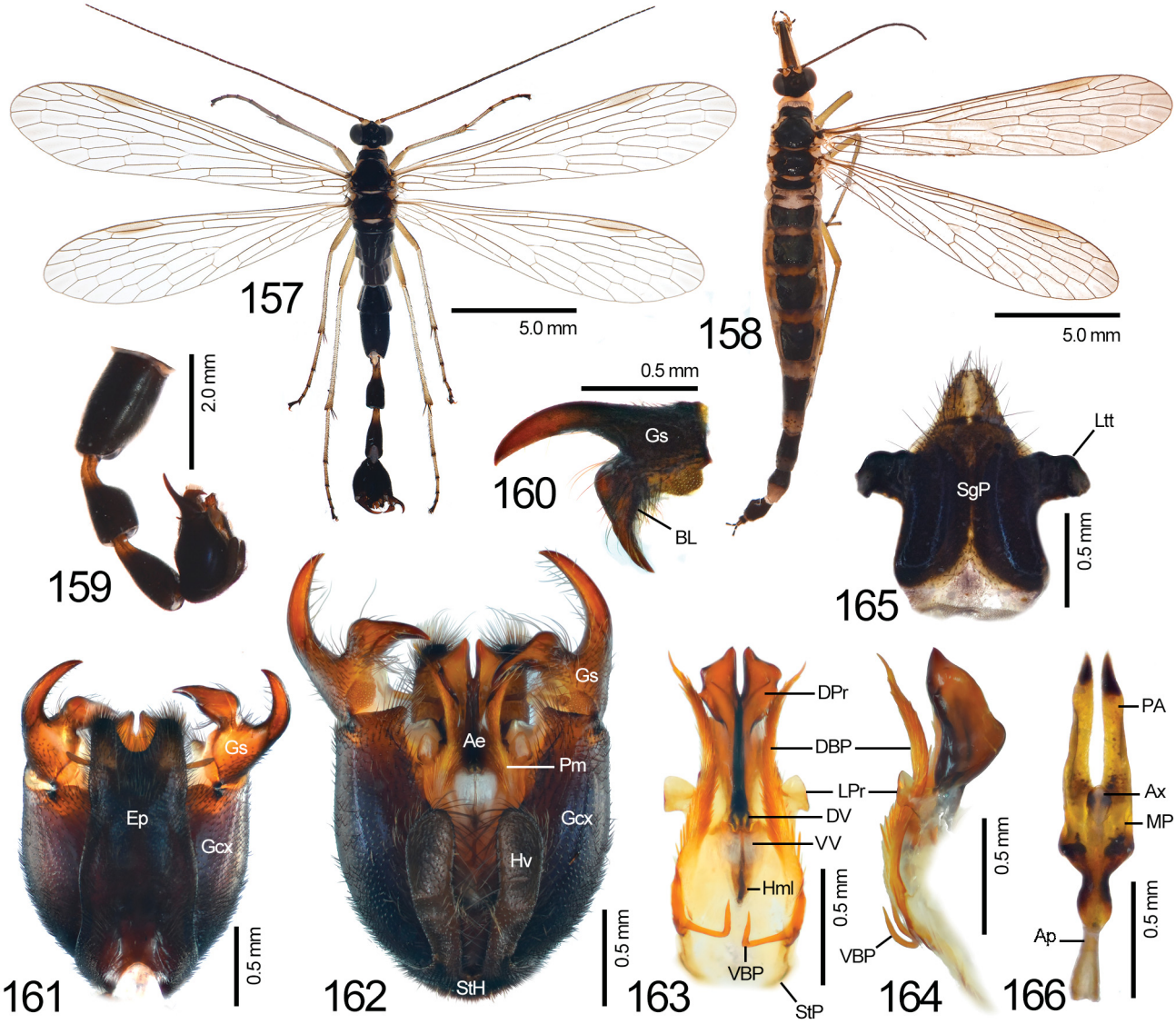
Type material. Holotype: ♂ (CN20Piskvjr001), **China: Yunnan:** Dali Bai Autonomous Prefecture, Dali City, eastern slope of the Cangshan Mountain, forest near Wuwei Temple, 25°43′30″N, 100°06′25″E, 2550 m, leg. Ji-Shen Wang (DALU). Paratypes: 10 ♂♂ 10 ♀♀ (CN21Piskvjr002–021), same data (DALU).

Diagnosis. This species superficially resembles *P. vajra* Wang sp. nov., but can be differentiated from the latter by: in males, 1) basal lobe of gonostyli with caudal margin relatively straight (Fig. 160 vs. wavy in Fig. 153); 2) ventral branch of parameres short, not extending to apex of ventral valves of aedeagus (Figs 163, 164 vs. exceeding ventral valves in Figs 151, 152); 3) dorsal branch of parameres uncrossed (Figs 162, 163 vs. crossed in Fig. 150); in females, 4) subgenital plate subtriangular, without emargination in apical prominence (Fig. 165 vs. broad with distinct V-shaped emargination in Fig. 154); and 5) medigynium with main plate greatly constricted in basal portion (Fig. 166 vs. not constricted in Fig. 155).

Measurements (mm). *Male* (n = 11): AtL 11.0–13.0, AbL 11.0–12.5, BdL 13.0–16.0, FL 13.0–14.5, FW 2.8–3.1, HL12.0–13.2, HW 2.7–3.0. *Female* (n = 10): AtL 11.2–12.8, AbL 8.0–14.0, BdL 13.0–20.0, FL 13.0–15.0, FW 2.8–3.2, HL 11.6–14.0, HW 2.8–3.1.

Etymology. Combined from *vajra* and *-oides* (a suffix denoting likeness), suggesting the great resemblance between this species and *P. vajra* Wang sp. nov. Adjective.

Distribution. China: Yunnan: Dali: Cangshan Mountain (Fig. 212).



Figs 157–166. *Panorpa vajroides* Wang & Zhao sp. nov. 157, 159–164 – male. 158, 165, 166 – female. 157, 158 – habitus, dorsal view. 159 – terminal abdomen, left-lateral view. 160 – right gonostylus, ventral view. 161, 162 – genital bulb, dorsal and ventral views, respectively. 163, 164 – aedeagal complex, ventral and right-lateral views, respectively. 165 – subgenital plate, ventral view. 166 – medigynium, ventral view.

Panorpa weixiensis Wang sp. nov.

(Figs 167–176)

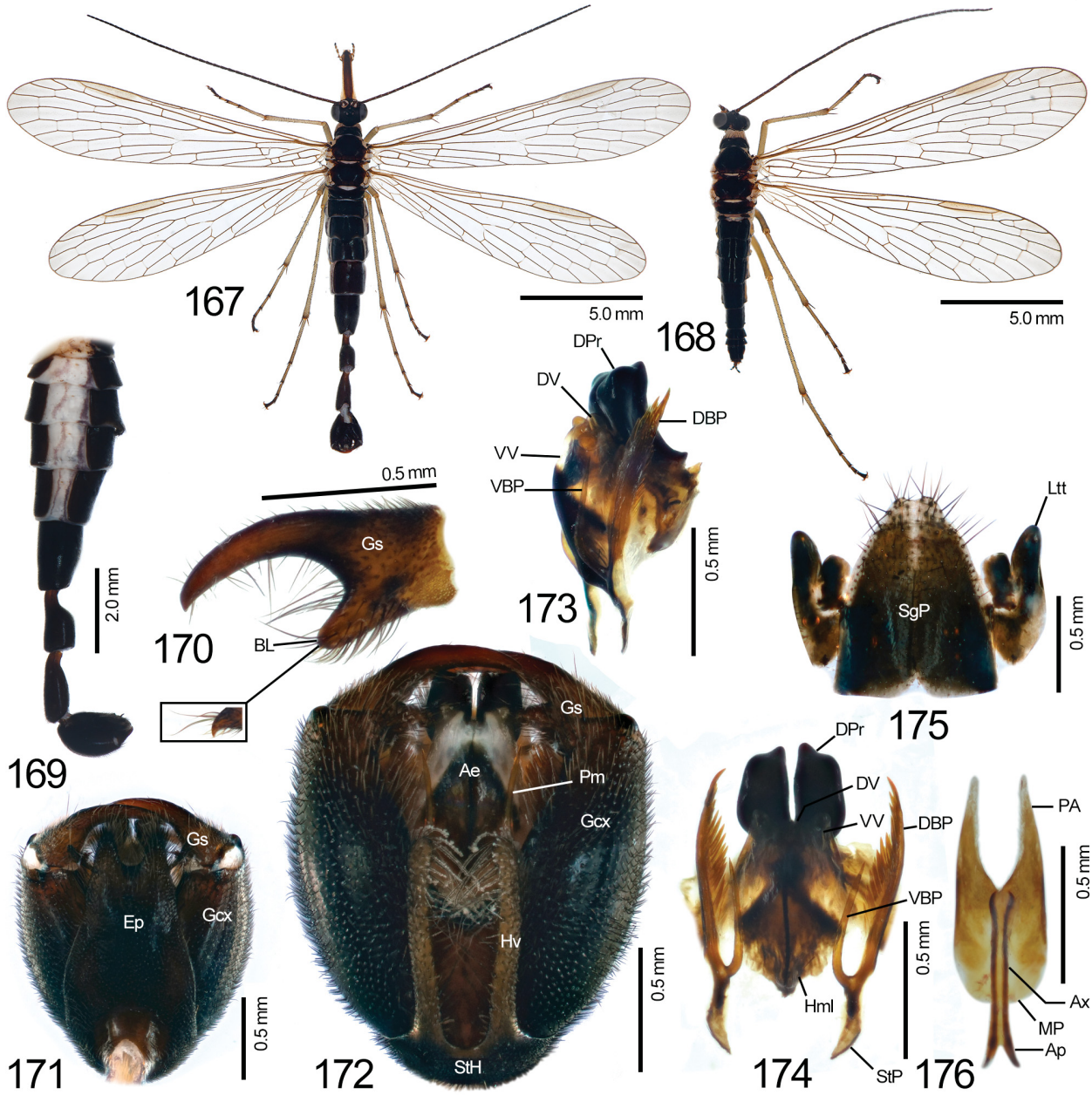
Type material. Holotype: ♂ (CN21Piskwei001), **China: Yunnan:** Diqing Zang Autonomous Prefecture, Weixi Lisu Autonomous County, Jigeji Village, 27°20′42″N, 99°15′30″E, 2800 m, 16.vii.2021, leg. Lu Qiu, Hao Xu, Guo-Cong Huang & Ji-Shen Wang (DALU). Paratypes: **China: Yunnan:** 2 ♀♀ (CN21Piskwei002, 003), same data; 1 ♂ 1 ♀ (CN21Piskwei004, 005), Zhazi Village, 27°20′59″N, 99°18′11″E, 2930 m, 17.vii.2021, leg. Lu Qiu, Hao Xu, Guo-Cong Huang & Ji-Shen Wang; 1 ♀ (CN23Piskwei001), same data except 10.viii.2023, leg. Chun-Mei Liao & Ji-Shen Wang (all DALU).

Diagnosis. This new species can be differentiated from the other members of this group by the combination of the following characters: in males, 1) basal lobe of gonostyli looking blunt because its acute apex greatly curved dorsad and unobservable from ventral aspect (Fig. 170 vs. observable in other species); 2) dorsal branch of parameres with inner spines longer than diameter of parameres (Fig. 174); 3) hamulus of aedeagus greatly developed, subtriangular, as wide as ventral valves (Figs 172, 174); 4) dorsal processes of aedeagus with narrow median cleft and each bearing pointed inner apex (Fig. 174); in females, 5) subgenital plate subtriangular, with its membranous apical prominence shallowly emarginated terminally (Fig. 175); 6) laterotergites IX bilobed with shorter inner lobe and much larger and longer outer lobe (Fig. 175); and 7) medigynium with posterior arms approximately as long as main plate, and apodemes of axis extending beyond main plate and slightly divergent (Fig. 176).

Measurements (mm). *Male* (n = 2): AtL 10.6–10.8, AbL 11.0–11.2, BdL 14.5–14.6, FL 13.2–13.3, FW 3.0, HL 11.9–12.0, HW 3.0. *Female* (n = 4): AtL 11.0–12.2, AbL 6.5–7.0, BdL 11.0–11.5, FL 13.0–13.8, FW 3.0–3.2, HL 11.8–12.5, HW 3.0–3.1.

Etymology. Named after the type locality, Weixi. Adjective.

Distribution. China: Yunnan: Weixi (Fig. 212).



Figs 167–176. *Panorpa weixiensis* Wang sp. nov. 167, 169–174 – male. 168, 175, 176 – female. 167, 168 – habitus, dorsal view. 169 – abdomen, left-lateral view. 170 – right gonostylus, ventral view with apex of basal lobe in left-lateral view. 171, 172 – genital bulb, dorsal and ventral views, respectively. 173, 174 – aedeagal complex, right-lateral and ventral views, respectively. 175 – subgenital plate, ventral view. 176 – medigynium, ventral view.

Panorpa wenhai Wang sp. nov.

(Figs 177–186)

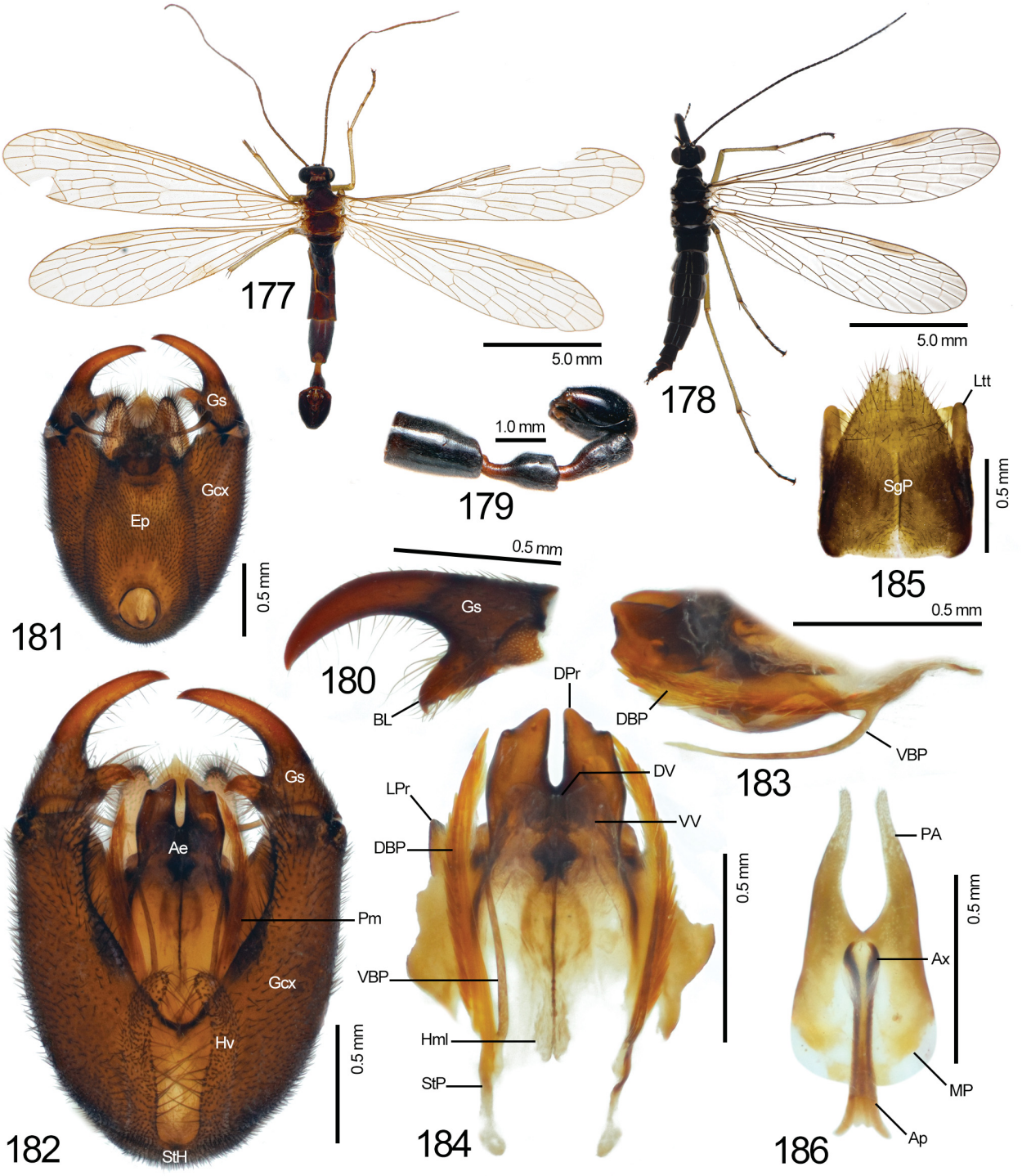
Type material. HOLOTYPE: ♂ (CN23Piskwen001), **CHINA: YUNNAN:** Lijiang Prefecture, southern slope of the Yulong (Jade Dragon) Snow Mountain, road to Wenhai, 26°56′59″N, 100°11′15″E, 2900 m, 9.viii.2023, leg. Chun-Mei Liao & Ji-Shen Wang (DALU). PARATYPES: 1 ♂ 9 ♀♀ (CN23Piskwen002–011), same data (DALU).

Diagnosis. This species superficially resembles *P. niaodiaoshana* Wang sp. nov., but can be differentiated from the latter by: in males, 1) parameres with dorsal branch short, not extending beyond aedeagus (Fig. 182 vs. longer, exceeding aedeagus in Figs 112–114); 2) ventral branch of parameres longer than half length of dorsal branch (Figs 183, 184 vs. short and hook-like in Figs 113, 114); in females, 3) medigynium with basal portion of main plate much broader than distal portion (Fig. 186 vs. nearly rectangular in Fig. 116).

Measurements (mm). *Male* (n = 2): AtL 10.0–10.3, AbL 9.5–9.6, BdL 13.1–13.3, FL 13.1–13.3, FW 3.2, HL 12.0–12.1, HW 3.1. *Female* (n = 9): AtL 10.0–11.4, AbL 6.6–7.0, BdL 10.0–12.0, FL 12.0–13.5, FW 2.9–3.2, HL 11.0–12.2, HW 2.9–3.1.

Etymology. Named after Wenhai, an alpine lake near the type locality. Noun in apposition.

Distribution. China: Yunnan: Lijiang: Yulong Snow Mountain (Fig. 212).



Figs. 177–186. *Panorpa wenhai* Wang sp. nov. 177, 179–184 – male. 178, 185, 186 – female. 177, 178 – habitus, dorsal view. 179 – terminal abdomen, left-lateral view. 180 – right gonostylus, ventral view. 181, 182 – genital bulb, dorsal and ventral views, respectively; 183, 184 – aedeagal complex, right-lateral and ventral views, respectively. 185 – subgenital plate, ventral view. 186 – medigynium, ventral view.

Panorpa wolongensis Wang sp. nov.

(Figs 187–196)

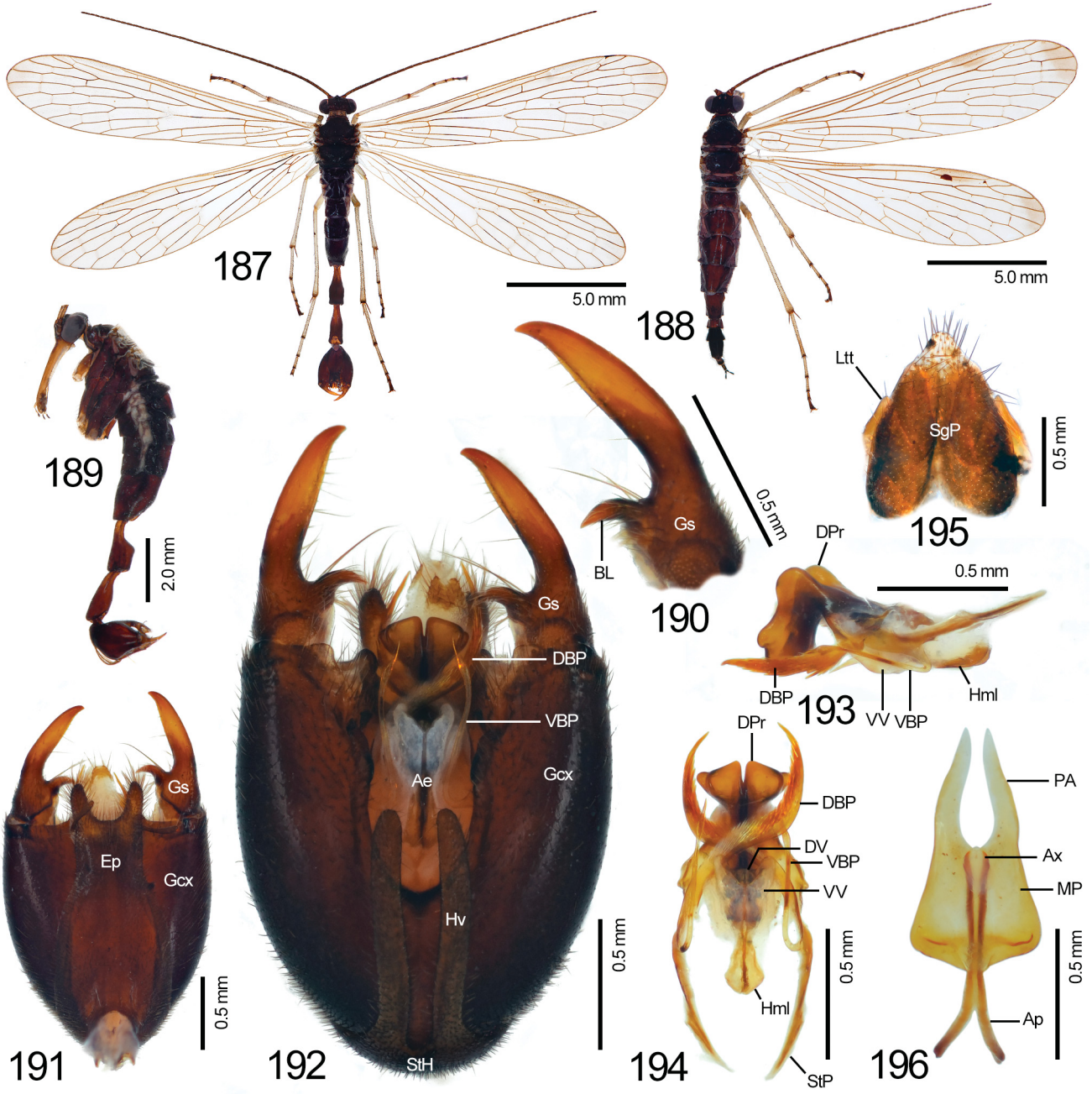
Type material. Holotype: ♂ (CN22Piskwol001), **China: Sichuan:** Aba Zang-Qiang Autonomous Prefecture, Wenchuan County, Wolong Town, 31°01′56″N, 103°07′35″E, 2550 m, 26.vi.2022, leg. Dan-Chen Zhu (DALU). Paratypes: 6 ♂♂ 1 ♀ (CN22Piskwol002–008), same data (DALU).

Diagnosis. This new species superficially resembles *P. luojishana* Wang sp. nov. by the melanized pleura and coxae, and the crossed dorsal branch of parameres, but can be differentiated from the latter by: in males, 1) distal portion of gonostyli expanded along inner margin (Fig. 190 vs. simple and slender in Fig. 130); 2) shorter basal lobe of gonostyli (Fig. 190 vs. longer than basal diameter of gonostyli in Fig. 130); 3) ventral branch of parameres far exceeding ventral valves (Figs 193, 194 vs. only slightly exceeding in Figs 132, 133); 4) dorsal processes abruptly humped with distal portion curved ventrad and truncated at ventral apex (Fig. 193 vs. slightly humped without truncated ventral apex in Fig. 133); and in females, 5) wing markings represented by semicircular apical band between R_{2a} and R_5; 6) subgenital plate with apical prominence rounded terminally (Fig. 195 vs. emarginated in Fig. 134); and 7) medigynium with basal half distinctly expanded laterally and wider than distal half (Fig. 196 vs. basal half narrower in Fig. 135).

Measurements (mm). *Male* (n = 7): AtL 11.0–12.0, AbL 9.0–10.0, BdL 12.0–13.4, FL 12.8–13.2, FW 3.0–3.1, HL 11.5–12.0, HW 2.9–3.0. *Female* (n = 1): AtL 12.0, AbL 8.3, BdL 12.6, FL 14.3, FW 3.3, HL 13.3, HW 3.2.

Etymology. Named after the type locality, Wolong town. Adjective.

Distribution. China: Sichuan: Wenchuan: Wolong (Fig. 212).



Figs 187–196. *Panorpa wolongensis* Wang sp. nov. 187, 189–194 – male. 188, 195, 196 – female. 187, 188 – habitus, dorsal view; 189 – habitus, left-lateral view. 190 – right gonostylus, ventral view. 191, 192 – genital bulb, dorsal and ventral views, respectively; 193, 194 – aedeagal complex, right-lateral and ventral views, respectively; 195 – subgenital plate, ventral view; 196 – medigynium, ventral view.

Panorpa yucheni Wang sp. nov.

(Figs 197–205)

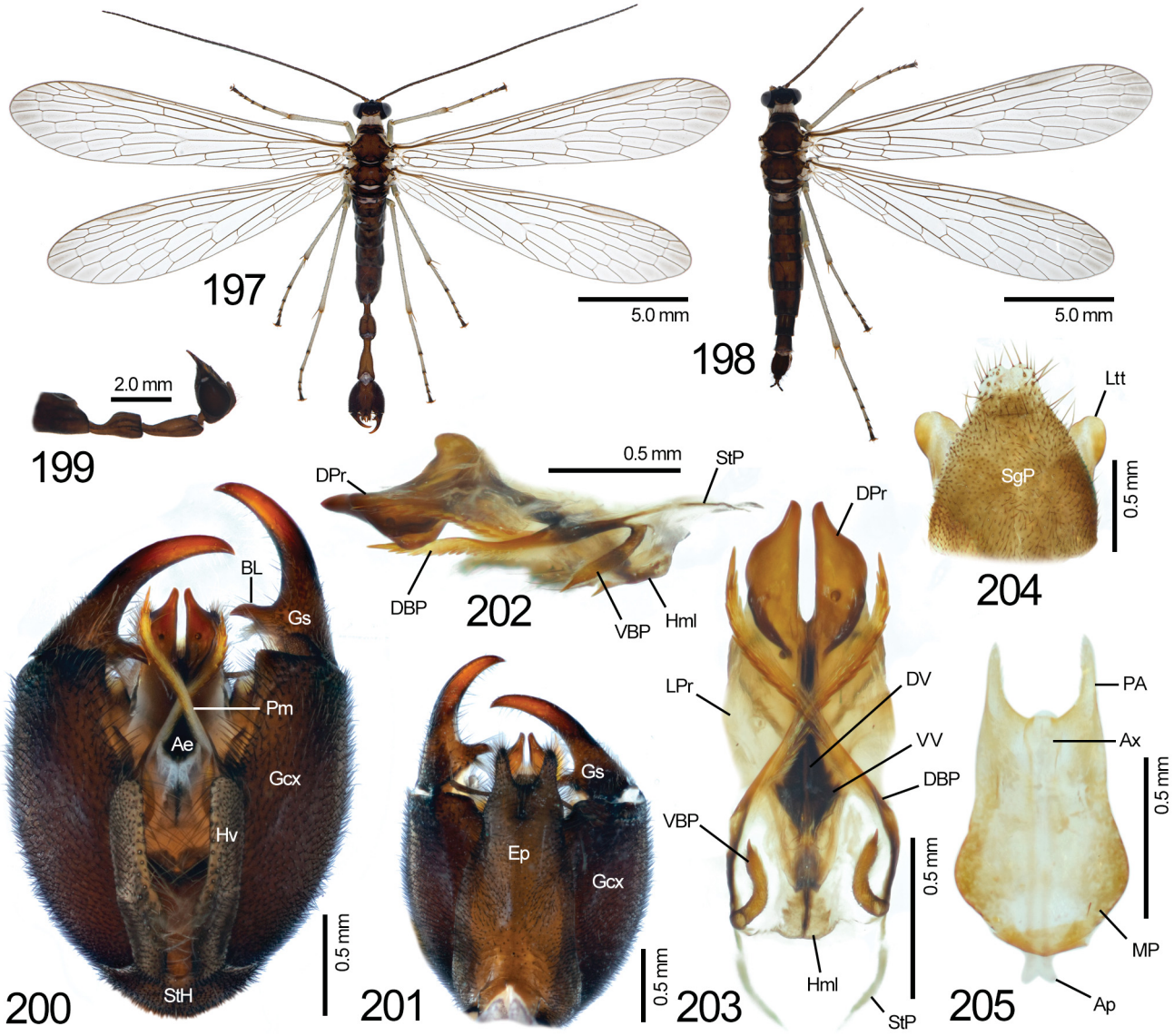
Type material. Holotype: ♂ (CN20Piskyuc001), **China: Yunnan:** Nujiang Lisu Autonomous Prefecture, Lushui City, Gaoligong Mountains, Yaojiaping, 25°57′30″N, 98°42′52″E, 2240 m, 13.v.2020, leg. Yu-Chen Zheng (DALU). Paratype: 1 ♀ (CN20Piskyuc002), same data (DALU).

Diagnosis. This species resembles *P. issikiana* in the male genitalia, especially in the crossed dorsal branch of parameres and the median cleft of dorsal processes of aedeagus. However, it can be readily differentiated from the latter by: 1) ventral branch of parameres not extending to apex of ventral valves (Figs 202, 203 vs. exceeding ventral valves in Fig. 2); 2) distal portion of ventral branch of parameres tapering towards apex (Figs 202, 203 vs. enlarged subdistally in Figs 2, 3); 3) dorsal processes of aedeagus with apex much elongated (Fig. 203 vs. shorter in Fig. 2); and 4) median cleft of dorsal processes with its length longer than width of dorsal processes (Fig. 203 vs. shorter in Fig. 2). It can also be differentiated from other members in the group by female genitalia: 1) laterotergites IX broad, with caudal margin rounded (Fig. 204); 2) medigynium with posterior arms shorter than half length of main plate (Fig. 205); and 3) main plate of medigynium slightly expanded laterally in basal 1/3 (Fig. 205).

Measurements (mm). *Male* (n = 1): AtL 12.8, AbL 10.6, BdL 15.0, FL 15.2, FW 3.4, HL 14.0, HW 3.3. *Female* (n = 1): AtL (broken), AbL 9.4, BdL 13.8, FL 15.8, FW 3.6, HL 14.4, HW 3.4.

Etymology. Dedicated to Yu-Chen Zheng, who collected and donated the specimens. Noun in the genitive case.

Distribution. China: Yunnan: Lushui: Gaoligong Mountains (Fig. 212).



Figs 197–205. *Panorpa yucheni* Wang sp. nov. 197, 199–203 – male. 198, 204, 205 – female. 197, 198 – habitus, dorsal view. 199 – terminal abdomen, left-lateral view. 200, 201 – genital bulb, ventral and dorsal views, respectively. 202, 203 – aedeagal complex, right-lateral and ventral views, respectively. 204 – subgenital plate, ventral view. 205 – medigynium, ventral view.

Figs 206–211. New species in the wild. 206 – *Panorpa huadianba* Wang & Zhao sp. nov., male. 207 – *P. jinfo* Wang sp. nov., female. 208, 209 – *P. shengyingfeng* Wang & Zhao sp. nov., male and female, respectively. 210, 211 – *P. vajroides* Wang & Zhao sp. nov., male and female, respectively.

Discussion

Type locality and identification of *Panorpa issikiana*. The Austrian botanist Heinrich von Handel-Mazzetti (1882–1940) was best known for his many publications on the flora of China and his botanical explorations. He traveled to China and arrived to Kunming in February 1914. During 1914–1917, he was able to visit Huili, Xichang, Yanyuan in Sichuan Province, and Chuxiong, Dali, Lijiang, and Zhongdian (now Shangri-La) in Yunnan Province (Handel-Mazzetti 1996). Based on the limited information, "Yünnan, Handel-Mazzetti" (Byers 1970), we are unable to determine the detailed type locality and distributional range of *P. issikiana* for now.

Although Hu et al. (2015) sequenced the *cox1*, *cox2*, and 28s gene fragments of *P. issikiana* from Zhongdian (now Shangri-La), it is difficult to determine whether these belong to the true *P. issikiana* or not, because the voucher specimens are currently unavailable to us. The locality reported by Hu et al. (2015) is 3500 m above the sea level, also raising doubts because no specimen in our study was collected at this altitude (usually between 2000–3000 m). In the group, *P. issikiana* mostly resembles *P. dimaluo* Wang sp. nov. and *P. yucheni* Wang sp. nov., originating from the Biluo Snow Mountain and the Gaoligong Mountains in northwestern Yunnan, respectively, suggesting that they might have had the closest common ancestor and diversified owing to the geographical isolation and climate fluctuations in the Hengduan Mountains. Therefore, further surveys in northwestern Yunnan, and probably also adjacent regions such as Guizhou and Sichuan are necessary to rediscover this little-known species.

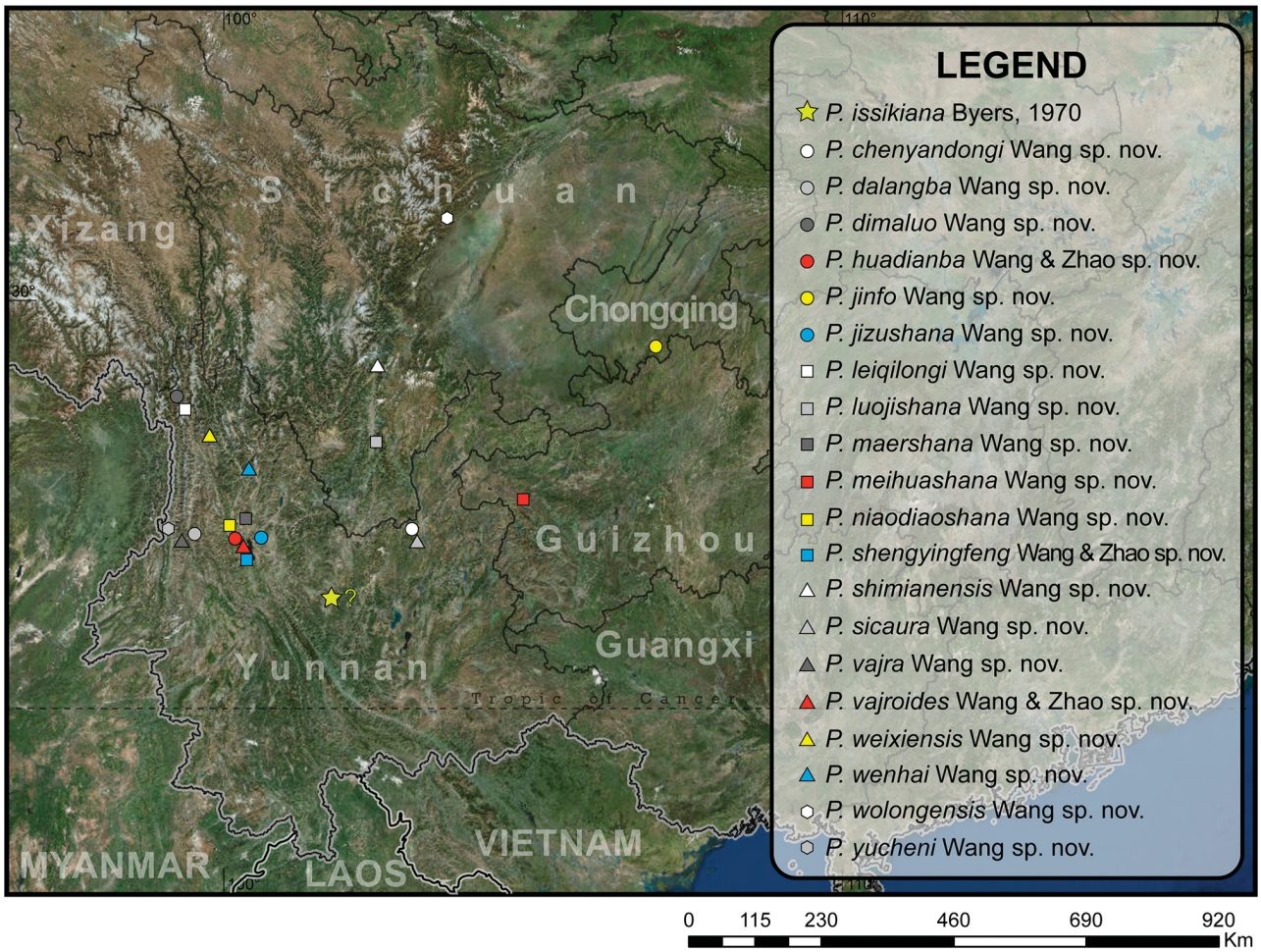


Fig. 212. Distributional map of the *Panorpa issikiana* species group. The question mark indicates an uncertain location of *Panorpa issikiana* Byers, 1970 in Yunnan (based on Byers 1970).

Systematic position of the *P. issikiana* species group. The traditionally used criteria, 1A ending beyond the level of ORs, and two cross-veins between 1A and 2A (Byers 1970) fail in the assignment of some species into the genus *Panorpa.* For instance, *P. vajra* Wang sp. nov. bears a short 1A ending approximately at the level of ORs, and only one cross-vein between 1A and 2A (Figs 146, 147). Therefore, more comprehensive characters such as the genitalia are needed to make a confident generic assignment for these species. Distinct similarities, such as the constricted and stalk-like base of male A7, lack of the median process in the male gonostyli, the bifurcated male parameres, the greatly sclerotized and elongated dorsal processes of the aedeagus, presence of the aedeagal hamulus, reduction of the piston of sperm pump, and the well-developed female laterotergites IX, all convincingly suggest that these 21 species constitute a monophyletic clade.

Presuming that the specimens analyzed by Hu et al. (2015) were correctly identified and sequenced, then according to the phylogenetic trees, *P. issikiana* is closely related to *P. bifasciata* (a member of the *P. cheni* species group) and the genus *Sinopanorpa*. Otherwise, if these voucher specimens belong to another similar species of the *P. issikiana* species group, it can also be interpreted that this group is closely related to the *P. cheni* species group and *Sinopanorpa.* In a phylogenetic analysis based on the morphological data, however, the closest relative to *Sinopanorpa* is supported to be the *P. stigmalis* species group, which still lacks available genetic data (Wang & Hua 2021). Therefore, a more comprehensive analysis combining both morphological and molecular data is needed to elucidate the evolutionary position of the *P. issikiana* species group.

Panorpa guidongensis Chou & Li, 1987 is also an enigmatic species lacking the median process in the male gonostyli. However, the lighter body coloration, greatly developed wing markings, evenly constricted base of A7, the weakly developed dorsal processes of aedeagus, and lacking laterotergites IX (Wang & Hua 2022), rule out its close relationship with the *P. issikiana* species group but support its possible affinity to the *P. deceptor* species group.

Another species, *P. malaisei* Byers, 1999, is only known from Kambaiti, northern Myanmar (neighboring western Yunnan, China) based only on the single female holotype. Its dark brown median stripe and yellowish brown sides of the rostrum, black nota, and grayish brown wings without markings (Byers 1999) are all similar to the members of the *P. issikiana* species group.

Its subgenital plate (Byers 1999: fig. 62) superficially also resembles that of some species of the *P. issikiana* species group, e.g., *P. chenyandongi* Wang sp. nov., in the membranous and emarginated apical prominence (Fig. 13), and its medigynium (Byers 1999: fig. 63) is similar to that of *P. luojishana* Wang sp. nov. in the distinct basal plate (Fig. 85). However, Byers (1999) did not mention whether laterotergites IX are present or not. Therefore, the systematic position of this species requires further research, especially examination of the male genitalia.

Relationships among members of the *P. issikiana* species group. Twenty-one species of the *P. issikiana* species group live among the mountainous regions in southwestern China (Fig. 212), involving the Hengduan Mountains in western Sichuan and northwestern Yunnan, the Wumeng Mountains connecting eastern Yunnan and western Guizhou, and the Dalou Mountains between Chongqing, Guizhou, and Sichuan. This pattern is very similar to the scenarios reported for *Dicerapanorpa* Zhong & Hua, 2013 (Hu et al. 2019, Wang 2022), *Megapanorpa* Wang & Hua, 2019 (Wang & Hua 2019), and the *Panorpa guttata* species group (Wang & Gong 2021), supporting that the uplift of the Qinghai-Tibet Plateau and the orogeny of the Hengduan Mountains in the Miocene were the probable driving forces of the diversification of the cool-climate preferring scorpionflies in southwestern China (Hu et al. 2019, Wang 2022).

Several species in this group are morphologically closer to each other than the others. For instance, *P. vajra* Wang sp. nov. and *P. vajroides* Wang & Zhao sp. nov. are obviously close relatives documented by the enlarged basal lobe of male gonostyli, *P. jinfo* Wang sp. nov., *P. luojishana* Wang sp. nov., and *P. wolongensis* Wang sp. nov. are similar to each other by the melanized pleura and coxae, and *P. huadianba* Wang & Zhao sp. nov. and *P. niaodiaoshana* Wang sp. nov. share an extreme resemblance. *Panorpa shengyingfeng* Wang & Zhao sp. nov., however, is likely an isolated species by the distinct wing markings, the terminal plate in male gonocoxites, and the flat plate-like dorsal processes of aedeagus without a median cleft (Figs 117–124). Due to the barely variable pregenital segments and the complexity of genitalia in these species, analyses based on DNA sequences are expected to satisfactorily unravel their phylogenetic relationships in future works.

Acknowledgements

The authors would like to express their sincere thanks to Yan-Dong Chen, Gui-Qiang Huang, Guo-Cong Huang, Liang-Jie Jia, Qi-Long Lei, Jia-Ling Li, Yu-Fei Li, Lu Qiu, Jiao Xie, Hao Xu, Zheng Zhou, Yu-Chen Zheng, and Dan-Chen Zhu for collecting and donating the precious specimens. We also thank Libor Dvořák and an anonymous reviewer for their thorough and valuable comments, which greatly improved the quality of the manuscript. Special thanks are due to the first author's wife, Chun-Mei Liao for driving him around all the wild surveys because he hasn't got the driving license yet. This research was financially supported by the Starting Foundation for the High-level Talents, Dali University (Grant No. KY2096124040), the Project of the Integrated Scientific Expedition of the Cangshan-Erhai National Nature Reserve (funded by the Bureau of the Cangshan-Erhai National Nature Reserve), and the Project of the Cangshan Forest Ecosystem Observation and Research Station of Yunnan Province, Yunnan Provincial Department of Science and Technology (Grant No. 202305AM070003).

References

BICHA W. 2018: Biodiversity of Mecoptera. Pp. 705–720. In: FOOTTIT R. G. & ADLER P. H. (eds). *Insect biodiversity: science and society. Vol. II.* 1st Edition. John Wiley & Sons, Hoboken, New Jersey, 1024 pp.

BYERS G. W. 1970: New and little known Chinese Mecoptera. *Journal of the Kansas Entomological Society* **43**: 383–394.

BYERS G. W. 1999: Thirteen new Panorpidae (Mecoptera) from northern Burma. *Entomologica Scandinavica* **30**: 197–218.

HANDEL-MAZZETTI H. 1996. *A botanical pioneer in South West China: Experiences and impressions of an Austrian botanist during the First World War.* Alpine Garden Society Publications, Pershore, Worcestershire, 192 pp. [Translated by D. Winnstanley from the German original *Naturbilder aus Südwest-China* (1927)].

HU G.-L., GAO K., WANG J.-S., HERBERT P. D. N. & HUA B.-Z. 2019: Molecular phylogeny and species delimitation of the genus *Dicerapanorpa* (Mecoptera: Panorpidae). *Zoological Journal of the Linnean Society* **187**: 1173–1196.

HU G.-L., YAN G., XU H. & HUA B.-Z. 2015: Molecular phylogeny of Panorpidae (Insecta: Mecoptera) based on mitochondrial and nuclear genes. *Molecular Phylogenetics and Evolution* **85**: 22–31.

LI N. & HUA B.-Z. 2020: Two new species of *Panorpa* (Mecoptera, Panorpidae) from the Hengduan Mountains in Yunnan, China. *Journal of Asia-Pacific Entomology* **23**: 138–145.

LI Y.-L. & HUA B.-Z. 2023: Two new species and one newly recorded species in the genus *Neopanorpa* van der Weele (Mecoptera: Panorpidae) from southwestern China. *Entomotaxonomia* **45**: 123–132.

MIAO Y., WANG J.-S. & HUA B.-Z. 2019: Molecular phylogeny of the scorpionflies Panorpidae (Insecta: Mecoptera) and chromosomal evolution. *Cladistics* **35**: 385–400.

MISOF B., ERPENBECK D. & SAUER K. P. 2000: Mitochondrial gene fragments suggest paraphyly of the genus *Panorpa* (Mecoptera, Panorpidae). *Molecular Phylogenetics and Evolution* **17**: 76–84.

SU J., LIU W.-J., HU F.-C., MIAO P.-P., XING L.-X. & HUA Y. 2023: The distribution pattern and species richness of scorpionflies (Mecoptera: Panorpidae). *Insects* **14 (332)**: 1–20.

WANG J.-S. 2022: New and little-known species of the genus *Dicerapanorpa* from northwestern Yunnan, China (Mecoptera: Panorpidae). *Acta Entomologica Musei Nationalis Pragae* **62 (1)**: 1–13.

WANG J.-S. 2023: Evolving longer for a mate: A new scorpionfly (Mecoptera: Panorpoidea: Panorpidae) with exaggeratedly elongated male abdominal segments. *Zootaxa* **5264**: 109–118.

WANG J.-S. & GONG Y.-J. 2021: Taxonomy of the *Panorpa guttata* group (Mecoptera: Panorpidae), with descriptions of fourteen new species from China. *Zootaxa* **4981**: 241–274.

WANG J.-S. & HUA B.-Z. 2019: *Megapanorpa*, a new genus with a single anal horn in males from Oriental China (Mecoptera: Panorpidae). *Entomological Science* **22**: 64–79.

WANG J.-S. & HUA B.-Z. 2021: Morphological phylogeny of Panorpidae (Mecoptera: Panorpoidea). *Systematic Entomology* **46**: 526–557.

WANG J.-S. & HUA B.-Z. 2022: *A color atlas of the Chinese Mecoptera*. Springer Nature Singapore, Singapore, 354 pp.

WANG J.-S. & SUZUKI T. 2022: Review of the *Panorpa wormaldi* group (Mecoptera: Panorpidae), with descriptions of two new species. *European Journal of Taxonomy* **794**: 18–39.