European Journal of Taxonomy 997: 275–288
https://doi.org/10.5852/ejt.2025.997.2939

ISSN 2118-9773
www.europeanjournaloftaxonomy.eu
2025 · Xie J. & Wang J.-S.

Research article

urn:lsid:zoobank.org:pub:206B7EAD-A0C6-4491-9571-A96EE473A493

Three new species of Mecoptera (Insecta, Antliophora) from Yunnan, China

Jiao XIE [1,2] & Ji-Shen WANG [1,2,*]

[1,2]College of Agriculture and Biological Science, Dali University, Dali 671003, P.R. China.
[1,2]Cangshan Forest Ecosystem Observation and Research Station of Yunnan Province, Dali University, Dali, Yunnan 671003, P.R. China.

[*]Corresponding author: wangjishen826@gmail.com
[1]Email: xiejiao113@126.com

[1]urn:lsid:zoobank.org:author:54C6E3A0-9D0E-464D-AC9B-8D089E4D6B52
[2]urn:lsid:zoobank.org:author:0C4FE92F-97C9-427C-B5F4-762A93A837EC

Abstract. The hangingflies (Bittacidae Handlirsch, 1906) and the scorpionflies (Panorpidae Latreille, 1802) are the two largest groups within the holometabolous order Mecoptera Packard, 1886. In this paper, a new hangingfly and two new scorpionflies are described: 1) *Bittacus yunlongensis* sp. nov., characterized by the greatly elongated and finger-shaped distal portion of male epandrial lobe, and greatly elongated upper and lower branches of proctiger; 2) *Dicerapanorpa dajinhuang* sp. nov., recognized mainly by the ventral branch of male parameres bearing small barbs on inner margin; and 3) *D. jialiangjiei* sp. nov., characterized by the bifurcated middle branch and sinuate distal portion of dorsal branch of male parameres. These new discoveries enrich the known species number of *Bittacus* Latreille, 1802 from one to two and *Dicerapanorpa* Zhong & Hua, 2013 from twelve to fourteen in Yunnan Province.

Keywords. *Bittacus, Dicerapanorpa,* hangingflies, scorpionflies, taxonomy.

Xie J. & Wang J.-S. 2025. Three new species of Mecoptera (Insecta, Antliophora) from Yunnan, China. *European Journal of Taxonomy* 997: 275–288. https://doi.org/10.5852/ejt.2025.997.2939

Introduction

Yunnan Province is located in the southwestern part of China, bordered by Myanmar to the west, Laos to the south, and Vietnam to the southeast. Due to its complex topography, this region supports a wide range of habitats, and has a high degree of genetic diversity and abundance of endemic species (Yang *et al*. 2004; Yu *et al.* 2022). It is located at the intersection of three global biodiversity hotspots, i.e., Indo-Burma, the mountains of Southwest China, and the eastern Himalayas (Myers *et al*. 2000; Wan *et al*. 2021). Recent studies have highlighted the underestimated diversity of the insect order Mecoptera Packard, 1886 in this region (Wang & Hua 2018; Hu & Hua 2019, 2020; Wang 2021, 2024; Wang & Zhao 2024).

The holometabolous order Mecoptera is generally represented by the hangingflies (Bittacidae) and the scorpionflies (family Panorpidae). The species of Bittacidae Handlirsch, 1906 are widely distributed all over the world, and are predators for having three pairs of raptorial legs and feeding on small invertebrates (Byers & Roggero 1992). They can only hang themselves on the edges of branches or leaves, but are unable to stand or walk on a surface, hence their common name 'hangingflies' (Thornhill 1978; Palmer 2010; Wang & Hua 2022). As they approach a prey, the fifth tarsomere of the middle- and hindlegs folds back against the fourth tarsomere, enabling effective capture. During mating rituals, males of some species of *Bittacus* Latreille, 1802 offer females a prey as a nuptial gift (Thornhill 1978). This family currently comprises 21 extant genera and over 200 described species (Byers 1979; Penny & Byers 1979; Bicha 2018; Machado *et al*. 2018; Savitsky & Timokhov 2021; Midgley & Bellingan 2023; Nakamura & Bicha 2023). Among them, 61 species in three genera have been documented in China, including 47 species in *Bittacus*, five species in *Bicaubittacus* Tan & Hua, 2009, and nine species in *Terrobittacus* Tan & Hua, 2009 (Tan & Hua 2009a, 2009b; Chen *et al*. 2013; Du & Hua 2017; Wang & Hua 2017, 2022; He & Hua 2022, 2023; He *et al*. 2024). The largest genus, *Bittacus*, is likely a paraphyletic group that includes several monophyletic small genera (Whiting 2002).

Panorpidae Latreille, 1802 are the most speciose family in the order Mecoptera, and widely distributed throughout Eurasia and North America (Kaltenbach 1978; Penny & Byers 1979; Byers & Thornhill 1983). They are commonly known as scorpionflies, because their enlarged and recurved male genitalia, which resemble the stinger of scorpions (Byers & Thornhill 1983). The members of Panorpidae are currently assigned in two subfamilies and 13 genera: Panorpinae Latreille, 1802, with nine genera (†*Baltipanorpa* Krzemiński & Soszýnska-Maj, 2012, *Calliopanorpa* Willmann, 2024, *Cerapanorpa* Gao, Ma & Hua, 2016, *Dicerapanorpa* Zhong & Hua, 2013, *Furcatopanorpa* Ma & Hua, 2011, *Mavropanorpa* Willmann, 2024, *Megapanorpa* Wang & Hua, 2019, *Panorpa* Linnaeus, 1758 (type genus of the subfamily and family), and *Sinopanorpa* Cai & Hua, 2008), and Neopanorpinae Wang & Hua, 2021, with four genera (*Leptopanorpa* MacLachlan, 1875, *Neopanorpa* van der Weele, 1909, and probably *Phine* Willmann, 2022 and *Lulilan* Willmann, 2022) (Bicha 2015; Wang & Hua 2019; Willmann 2022, 2024). The main diagnostic character of *Dicerapanorpa* is a pair of finger-like anal horns on the apex of the male T6, the usually trifurcated parameres of the male genitalia, and the concealed axis of the female medigynium (Zhong & Hua 2013). The anal horns are utilized to clasp the female's terminal abdomen during copulation (Zhong & Hua 2015). This genus currently comprises 26 species, all of which are endemic to China (Zhong & Hua 2013; Wang 2022; Wang & Hua 2022).

In this paper, one new species of *Bittacus* and two new species of *Dicerapanorpa* are described from Yunnan, China. These new discoveries enrich the known species number of *Bittacus* from one to two and *Dicerapanorpa* from twelve to fourteen in Yunnan Province.

Material and methods

All the material examined in this study is deposited in the Biological Science Museum, Dali University (BMDU). Adult insects were caught with a collecting net, preserved in 95% ethanol or pinned. Photographs were taken with a Nikon D850 digital camera in conjunction with a Nikkor AF-S Micro 105 mm f/2.8 lens (habitus), or a Canon R5 digital camera in conjunction with a Canon MP-E 65 mm f/2.8 1-5× macro lens (the other images). The female habitus in dorsal view were modified to omit the left antenna, wings, and legs. All pictures were adjusted and grouped with Adobe Photoshop CC. The terminology and measurements follow Wang & Hua (2021).

The following acronyms are applied in the main text:

1A = first anal vein (and so forth for other anal vein)
A1 = first abdominal segment (and so forth for other segments)

AbL = abdomen length
AtL = antenna length
Av = anal crossvein
BL = body length
FL = forewing length
FM = fork of media
FRs = fork of radial sector
FW = forewing width
HL = hindwing length
HW = hindwing width
Pcv = pterostigmal crossvein
S1 = first sternum (and so forth for other sterna) (also on figures)
Sc = subcosta
Scv = subcostal crossvein
T1 = first tergum (and so forth for other terga) (also on figures)

The following abbreviations are used in the figures:

Ae = aedeagus
Ax = axis
Ce = cercus
DBP = dorsal branch of paramere
DV = dorsal valve
EL = epandrial lobes
Ep = epandrium
Gcx = gonocoxites
Gs = gonostylus
Hv = hypovalve
LBP = lower branch of proctiger
MBP = middle branch of paramere
MP = main plate
PA = posterior arm
Pf = penisfilum
SgP = subgenital plate
StH = stalk of hypandrium
UBP = upper branch of proctiger
VBP = ventral branch of paramere
VV = ventral valve

Results

Taxonomy

Class Insecta Linnaeus, 1758
Order Mecoptera Packard, 1886
Suborder Pistillifera Willmann, 1987
Infraorder Raptipedia Willmann, 1987
Family Bittacidae Handlirsch, 1906
Genus *Bittacus* Latreille, 1802

Bittacus yunlongensis sp. nov.
urn:lsid:zoobank.org:act:14A27284-EE50-4B95-BDBC-96AE6F7354BB
Figs 1–2

Diagnosis

This new species is most similar to *Bittacus vexilliferus* Byers, 1970 among its congeners, but differs from the latter by the following features: in males, 1) T8 with triangular protrusion laterally (Fig. 2D, vs lacking) and a black biconical marking at middle (Fig. 2D, vs lacking); 2) epandrial lobe with basal portion subtrapezoidal and distal half elongated, finger-shaped, and greatly curved dorsad (Fig. 2D, F, vs epandrial lobes long and rectangular); and 3) aedeagus with base stout and with rounded flanks (Fig. 2D, F, vs with a broad, thin, apically indented lobe at each side of the base).

Etymology

The new species is named after the type locality, Yunlong County. Adjective.

Fig. 1. *Bittacus yunlongensis* sp. nov. Living male from Yunlong.

Type material

Holotype

CHINA – **Yunnan Province** • ♂; Dali Bai Autonomous Prefecture, Yunlong County; 25°51′08″ N, 99°15′09″ E; 2560 m a.s.l.; 20 Jul. 2023; L.-J. Jia, J.-L. Li and J.-S. Wang leg.; BMDU, CNYL23Bi001.

Paratype

CHINA – **Yunnan Province** • 1 ♀; same data as for holotype; BMDU, CNYL23Bi002.

Description

Measurements (mm). Male (holotype). AtL 9.1, AbL 12.2, BL 17.3, FL 22.7, FW 5.5, HL 20.3, HW 4.7. Female (paratype). AtL 9.0, AbL 13.0, BL 18.0, FL 23.0, FW 5.6, HL 21.0, HW 4.8.

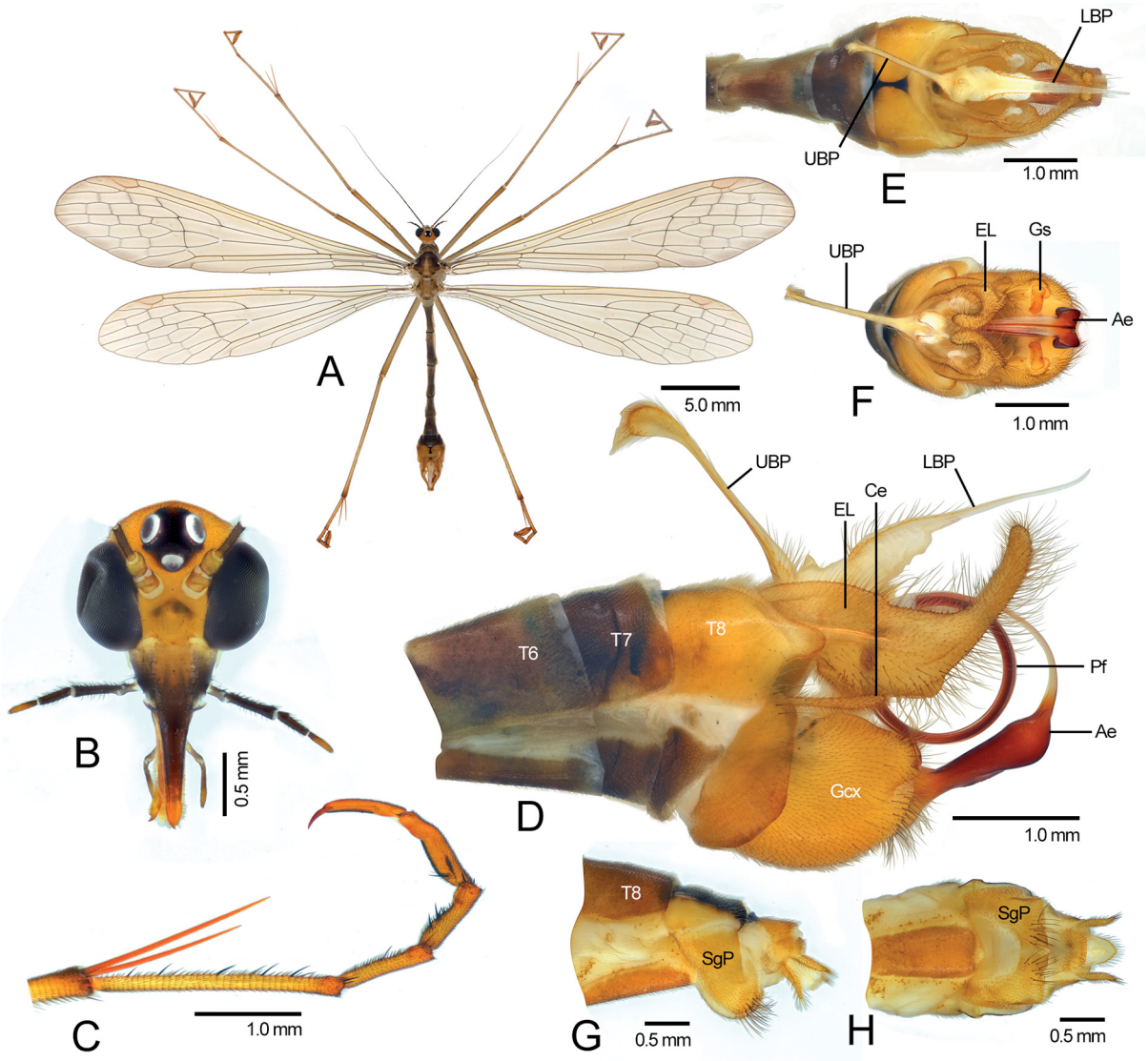

Fig. 2. *Bittacus yunlongensis* sp. nov. **A–F**. Holotype, ♂ (BMDU, CNYL23Bi001). **G–H**. Paratype, ♀ (BMDU, CNYL23Bi002). **A**. Habitus, dorsal view. **B**. Head, dorsal view. **C**. Articulation of basitarsus and tibia, and tarsomeres I–V. **D**. Male terminalia, right-lateral view. **E–F**. Male terminalia, dorsal view. **G**. Female terminalia, lateral view. **H**. Female terminalia, ventral view. Abbreviations: see Material and methods.

Male

Head (Fig. 2B). Vertex uniformly orange-yellow. Ocellar triangle black. Compound eyes blackish brown. Rostrum three times as long as wide. Fifth segment of maxillary palp orange-yellow. Labial palps light brown, with second segment twice as long as first.

Thorax (Fig. 2A, C). Pronotum dark brown, with light brown crescent-shaped area on anterior margin. Mesonotum and mesoscutellum blackish brown marginally and light brown at middle. Legs light brown. Tibia orange with two apical spurs. Tarsomeres I–III lined with long black setae and also with several shorter setae. Tarsomeres I–IV with one to two black setae apically, and tarsomeres III–V with more short setae on ventral part.

Wings (Fig. 2A). Wing membrane hyaline, tinged with yellowish brown. Pterostigma yellowish brown and prominent; thyridium conspicuous with pale border at FM; 1A terminating beyond FM; Sc ending beyond level of FRs. With one Scv and Av absent. Its left wings with one Pcv, while right with two Pcv.

Abdomen (Fig. 2A, D). T2–T5 unevenly dark brown, each with narrow black antecosta, forming distinct light and dark patterns. T8 with triangular protrusion caudo-laterally and black biconical marking at dorsal portion.

Genitalia (Fig. 2D–G). Epandrial lobes approximately twice as long as gonocoxites, with basal portion subtrapezoidal and distal half elongated, finger-shaped, and greatly curved dorsad. Gonocoxites enlarged with cluster of slender bristles terminally. Gonostyli short and blunt distally. Aedeagus with stout base and rounded flanks. Penisfilum greatly elongated and coiled into loop wider than epandrial lobes. Upper branch of proctiger slightly longer than epandrial lobes, and enlarged apically in goose head-shape with tuft of long setae. Lower branch of proctiger slender and rather straight, slightly longer than upper branch of proctiger. Cerci slender and rod-shaped.

Female

Habitus similar to males.

Genitalia (Fig. 2G–H). Subgenital plate greatly inflated with thick long setae apically. Cerci slender and acute terminally.

Distribution

China: Yunnan (Yunlong).

Infraorder Opisthogonopora Willmann, 1987
Superfamily Panorpoidea Latreille, 1802
Family Panorpidae Latreille, 1802
Subfamily Panorpinae Latreille, 1802
Genus *Dicerapanorpa* Zhong & Hua, 2013

Dicerapanorpa dajinhuang sp. nov.
urn:lsid:zoobank.org:act:D237C065-F26C-4DC7-B2A1-A0DD504244FA
Figs 3–4

Diagnosis

The new species can be differentiated from its congeners by the following combination of characters: in males, 1) paramere with ventral branch greatly elongated and bearing small barbs on subbasal portion of inner margin (Fig. 4H–I); and in females, 2) medigynium with broad basal plate and slender posterior arms (Fig. 4L).

Etymology

The specific epithet *dajinhuang* is a Chinese compound word depicting things 'big and yellow'. Treated as a noun in apposition.

Type material

Holotype

CHINA – **Yunnan Province** • ♂; Dali Bai Autonomous Prefecture, Yunlong County; 25°51′08″ N, 99°15′09″ E; 2560 m a.s.l.; 1 Jul. 2024; L.-J. Jia, J.-L. Li and J.-S. Wang leg.; BMDU, CNYL24Di001.

Paratypes

CHINA – **Yunnan Province** • 1 ♂; same data as for holotype; BMDU, CNYL24Di002 • 11 ♀♀; same data as for holotype; BMDU, CNYL24Di003 to CNYL24Di013.

Description

Measurements (mm). Male (holotype and paratype, n = 2). AtL 13.4–13.6, AbL 12.9–13.1, BL 17.9–18.0, FL 15.8–16.1, FW 3.7–3.8, HL 14.0–14.2, HW 3.6–3.7. Female (paratypes, n = 11). AtL 13.0–14.0, AbL 7.5–8.0, BL 13.0–14.0, FL 15.0–17.5, FW 3.8–4.0, HL 13.5–14.0, HW 3.6–3.8.

Males

Head (Fig. 4A). Vertex unevenly yellow without black spots. Ocellar triangle enclosed by large black arrow-shaped pattern. Rostrum yellow with pair of black frontal stripes.

Thorax (Fig. 4A). Pronotum with five thick setae along each side of anterior margin. Meso- and metanotum black laterally, with broad yellow median stripe. Pleura and coxae yellow, rest parts of legs dark brown to black.

Fig. 3. *Dicerapanorpa dajinhuang* sp. nov. Living female from Yunlong.

Wings (Fig. 4A). Membrane hyaline, lacking distinct markings except speckled apical band. Pterostigma light yellowish brown.

Abdomen (Fig. 4A, C). T2–T5 black laterally with broad, yellow, median stripe. A6 yellowish brown with pair of obtuse-rounded and divergent anal horns on dorsal apex. A7 and A8 greatly constricted at base, yellowish brown. A7 almost as long as A8. Epandrium broad, deeply emarginated terminally and forming pair of finger-like processes laterally. Hypandrium split into pair of long, stripe-like hypovalves with extremely short basal stalk. Hypovalve slightly broadening towards rounded apex, with row of long stout bristles along inner margin.

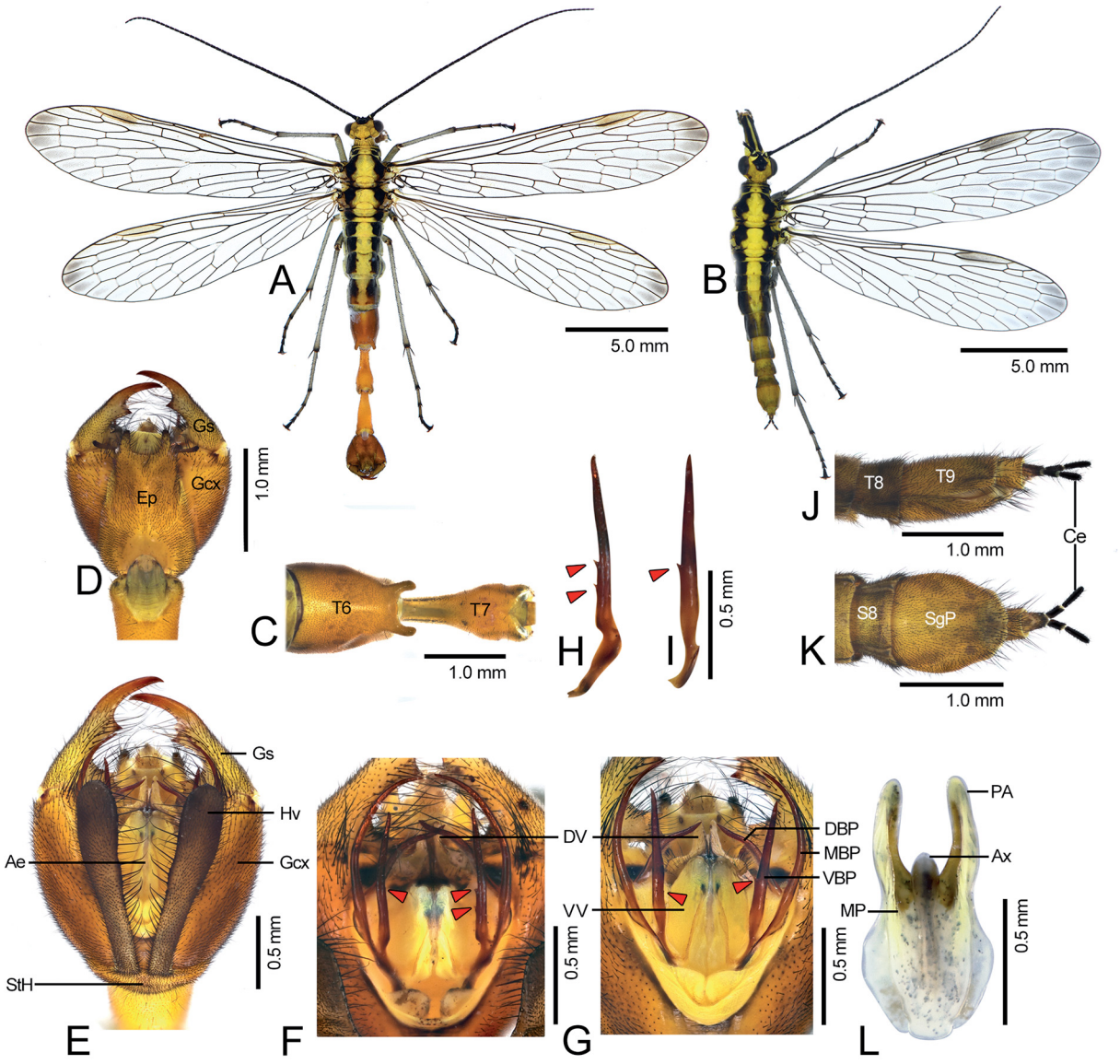

Fig. 4. *Dicerapanorpa dajinhuang* sp. nov. **A, C, F, H**. Holotype, ♂ (BMDU, CNYL24Di001). **B, J–L**. Paratype, ♀ (BMDU, CNYL24Di002). **D–E, G, I**. Paratype, ♂ (BMDU, CNYL24Di003). **A–B**. Habitus, dorsal view. **C**. Male T6–T7, dorsal view. **D**. Genital bulb, dorsal view. **E–G**. Genital bulb, ventral view. **H–I**. Right paramere, ventral view. **J**. Female terminalia, lateral view. **K**. Female terminalia, ventral view. **L**. Medigynium, ventral view. Abbreviations: see Material and methods. Red arrowheads indicate small barbs on ventral branch of parameres.

Genitalia (Fig. 4D–I). Gonostyli shorter than gonocoxites, with well-developed basal lobe and elongated, acute middle tooth; basal lobe bifurcated into acute apexes. Paramere trifurcate: ventral branch long and straight with one-two small barbs on subbasal portion of inner margin; median branch longest and curved inward; dorsal branch greatly curved inward and slightly curved caudad distally. Ventral valves of aedeagus membranous and greatly protruded; dorsal valves bearing long setae basally with greatly elongated dorsal processes.

Females

Habitus (Fig. 4B) similar to males except for denser markings.

Genitalia (Fig. 4J–L). Subgenital plate oval and bearing long stout setae apically. Medigynium (Fig. 4L) with broad basal plate; main plate broader than base of posterior arms; posterior arms slender and slightly shorter than main plate, rounded terminally.

Distribution

China: Yunnan (Yunlong).

Dicerapanorpa jialiangjiei sp. nov.
urn:lsid:zoobank.org:act:3FCC5DA7-A857-47DF-99AB-E834BB3E04FB
Fig. 5

Diagnosis

The new species greatly resembles *D. tjederi* (Carpenter, 1938) in the bifurcated middle branch of the male parameres (Fig. 5F). However, it can be differentiated from the latter by the following characters: in males, 1) median tooth and basal lobe of gonostyli widely separated (Fig. 5E–F, vs closely adjoined); 2) ventral valves of aedeagus short and subtriangular (Fig. 5E–F, vs elongated and rounded); and in females, 3) medigynium with posterior arms rounded terminally (Fig. 5B, I, vs rather truncated).

Etymology

Named after its discoverer and collector, Liang-Jie Jia. Noun in the genitive case.

Type material

Holotype

CHINA – **Yunnan Province** • ♂; Lijiang Prefecture, Yulong Naxi Autonomous County, Shitou Bai Township; 26°48′23.62″ N, 99°36′39.11″ E; 2840 m a.s.l.; 8 Jul. 2024; L.-J. Jia leg.; BMDU, CNYLNX24Di001.

Paratype

CHINA – **Yunnan Province** • 1 ♀; same data as for holotype; BMDU, CNYLNX24Di002.

Description

Measurements (mm). Male (holotype). AtL 12.7, AbL 10.5, BL 14.3, FL 14.0, FW 3.4, HL 12.5, HW 3.3. Female (paratype). AtL 11.6, AbL 9.8, BL 15.7, FL 15.2, FW 3.8, HL 14.1, HW 3.7.

Male

Head (Fig. 5A). Vertex yellow with black spots. Ocellar triangle enclosed by large black arrow-shaped pattern.

Thorax (Fig. 5A). Pronotum with six black thick setae along each side of anterior margin. Meso- and metanotum black laterally, with broad yellow median stripe half as wide as nota.

Wings (Fig. 5A). Membrane hyaline, lacking distinct markings. Pterostigmal band represented by indistinct triangular spots in forewings. Pterostigma dark gray.

Abdomen (Fig. 5A, C). T2–T4 black laterally with broad yellow median stripe, T5 mostly yellow. A6 yellowish brown with pair of divergent and finger-shaped anal horns on dorsal apex. A7 and A8 yellowish brown, constricted greatly at base. A8 slightly longer than A7. Epandrium broad, emarginated terminally and forming pair of stout processes laterally. Hypandrium split into pair of long, stripe-like hypovalves. Hypovalves slightly broadening towards apex, with row of long stout and short dense bristles spaced along inner margin.

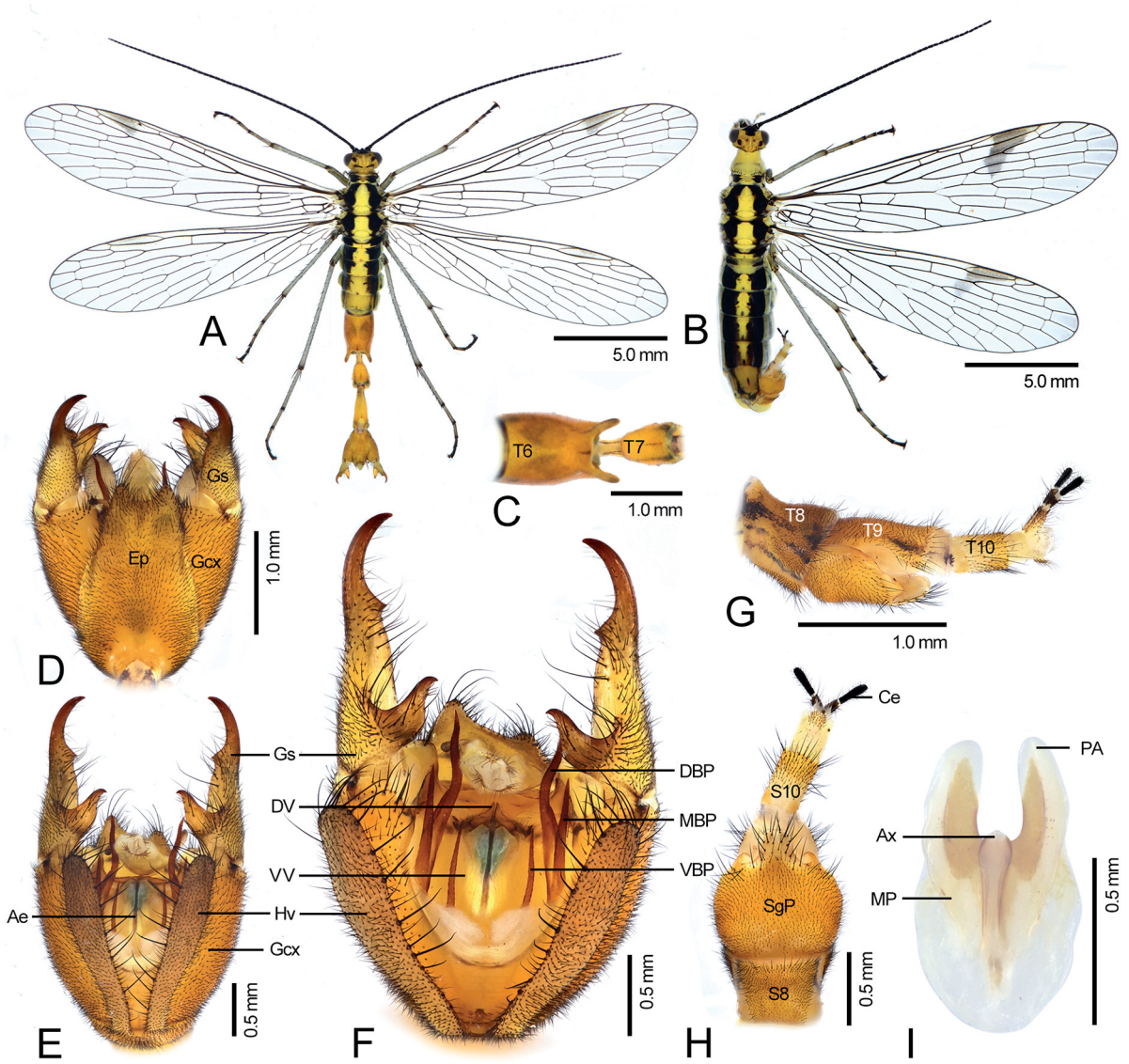

Fig. 5. *Dicerapanorpa jialiangjiei* sp. nov. **A, C–F**. Holotype, ♂ (BMDU, CNYLNX24Di001). **B, G–I**. Paratype, ♀ (BMDU, CNYLNX24Di002). **A–B**. Habitus, dorsal view. **C**. Male T6–T7, dorsal view. **D**. Genital bulb, dorsal view. **E–F**. Genital bulb, ventral view. **G**. Female terminalia, lateral view. **H**. Subgenital plate, ventral view. **I**. Medigynium, ventral view. Abbreviations: see Material and methods.

Genitalia (Fig. 5D–F). Gonostyli and gonocoxites approximately same length. Gonostyli with greatly developed and hook-like basal process and short, acute middle tooth. Parameres trifurcate: ventral and median branch straight, ventral branch shorter than median branch; middle branch bifurcated subapically; distal portion of dorsal branch sinuate. Ventral valves of aedeagus membranous and subtriangular; dorsal valves with slightly elongated dorsal processes.

Female

Habitus (Fig. 5B) generally similar to males except for denser wing markings represented by subtriangular pterostigmal bands in fore- and hindwings.

Genitalia (Fig. 5G–I). Subgenital plate with prominent terminal protuberance, and bearing long stout setae apically. Laterotergites subtriangular. Medigynium with broad basal plate; main plate wider than base of posterior arms; posterior arms slightly shorter than main plate with rounded apex.

Distribution

China: Yunnan (Lijiang).

Discussion

Hangingflies are known for their unique belly-to-belly mating posture while hanging (Wei *et al*. 2020). In this study, the male of *B. yunlongensis* sp. nov. exhibits greatly elongated upper and lower branches of the proctiger, and a long, coiled penisfilum that forms a loop wider than the epandrial lobes (Fig. 5D–F). According to Wei *et al*. (2020), the upper and lower branches of the proctiger facilitate the insertion of the male penisfilum into the female copulatory pore during copulation in *Terrobittacus implicatus* (Huang & Hua, 2006). Consequently, we hypothesize that the exceptionally elongated upper and lower branches of the proctiger also serve a similar function in facilitating the insertion of the penisfilum in *B. yunlongensis*. However, the mating behavior of this species remains unobserved, and the exact function of these structures awaits further research.

Unlike other scorpionflies that prefer mesic forests, *D. dajinhuang* sp. nov. and *D. jialiangjiei* sp. nov. typically inhabit open grassland with abundant shrubs. To avoid excessive solar radiation, they often seek refuge among stems and leaves. This preference is very similar to those reported for *D. triclada* (Qian & Zhou, 2001) and *D. tjederi* by Wang (2021). During our field surveys, we observed that both *D. dajinhuang* and *D. jialiangjiei* exhibited a 'feigning death' behavior: upon being disturbed, they immediately play dead and fall into the grass. Despite its larger body size compared to the other sympatric scorpionflies (such as *Neopanorpa pendula* Qian & Zhou, 2001 and *Panorpa dalangba* Wang, 2024), *D. dajinhuang* is relatively timid: they flee immediately when approached by other individuals (whether of the same or different species) during feeding. When attracted to the same food source as other scorpionflies, they linger around and are difficult to approach.

These new discoveries enrich the known species number of *Bittacus* from one to two and *Dicerapanorpa* from twelve to fourteen in Yunnan Province.

Acknowledgments

We would like to express our sincere thanks to Jia-Ling Li and Liang-Jie Jia for collecting the precious specimens. We also thank the anonymous reviewers for their insightful comments on the manuscript. This research was financially supported by the Starting Foundation for the High-level Talents, Dali University (grant number KY2096124040), and the Project of the Cangshan Forest Ecosystem Observation and Research Station of Yunnan Province, Yunnan Provincial Department of Science and Technology (grant number 202305AM070003).

References

Bicha W.J. 2015. The scorpionflies (Mecoptera) of Indochina with the description of new species of *Bittacus* and *Neopanorpa*. *Proceedings of the Entomological Society of Washington* 117 (4): 435–451. https://doi.org/10.4289/0013-8797.117.4.435

Bicha W.J. 2018. Biodiversity of Mecoptera. *Insect Biodiversity: Science and Society* 2: 705–720. https://doi.org/10.1002/9781118945582.ch23

Byers G.W. 1979. *Hylobittacus*, a new genus of North American Bittacidae (Mecoptera). *Journal of the Kansas Entomological Society* 52 (2): 402–404.

Byers G.W. & Roggero R.J. 1992. Hanging-flies of Panama (Mecoptera: Bittacidae). *In*: Quintero D. & Aiello A. (eds) *Insects of Panama and Mesoamerica: Selected Studies*: 594–599. Oxford University Press, Oxford, USA. https://doi.org/10.1093/oso/9780198540182.003.0039

Byers G.W. & Thornhill R. 1983. Biology of the Mecoptera. *Annual Review of Entomology* 28: 203–228. https://doi.org/10.1146/annurev.en.28.010183.001223

Carpenter F.M. 1938. Mecoptera from China, with descriptions of new species. *Proceedings of the Entomological Society of Washington* 40 (9): 267–281.
Available from https://www.biodiversitylibrary.org/page/57052483 [accessed 3 Jun, 2025].

Chen J., Tan J.-L. & Hua B.-Z. 2013. Review of the Chinese *Bittacus* (Mecoptera: Bittacidae) with descriptions of three new species. *Journal of Natural History* 47: 1463–1480. https://doi.org/10.1080/00222933.2012.763065

Du W. & Hua B.-Z. 2017. Two new species of the genus *Terrobittacus* Tan & Hua, 2009 (Mecoptera: Bittacidae) from southwestern China with a key to species. *European Journal of Taxonomy* 294: 1–13. https://doi.org/10.5852/ejt.2017.294

He L.-L. & Hua B.-Z. 2022. A review of Bittacidae (Mecoptera) in Guizhou, China with descriptions of three new species. *European Journal of Taxonomy* 839: 103–119. https://doi.org/10.5852/ejt.2022.839.1935

He L.-L. & Hua B.-Z. 2023. Two new species of the genus *Terrobittacus* Tan & Hua 2009 (Mecoptera, Bittacidae). *ZooKeys* 1148: 29–39. https://doi.org/10.3897/zookeys.1148.97997

He L.-L., Zhang J., Wu Y.-L. & Hua B.-Z. 2024. Three new species of Chinese Bittacidae (Mecoptera). *Entomotaxonomia* 46 (2): 1–10. https://doi.org/10.11680/entomotax.2024013

Hu G.-L. & Hua B.-Z. 2019. Two new species of the genus *Dicerapanorpa* (Mecoptera: Panorpidae) from Sichuan, China. *Entomotaxonomia* 41: 73–79. https://doi.org/10.11680/entomotax.2019010

Hu G.-L. & Hua B.-Z. 2020. Review of the scorpionfly genus *Dicerapanorpa* Zhong & Hua (Mecoptera: Panorpidae), with descriptions of two new species. *European Journal of Taxonom*y 711: 1–13. https://doi.org/10.5852/ejt.2020.711

Kaltenbach A. 1978. Mecoptera. *Handbuch der Zoologie* 4: 1–111.

Machado R.J.P., Mendes D.M.D.M. & Rafael J.A. 2018. The genus *Bittacus* Latreille (Insecta: Mecoptera) in Brazil: key to species, distribution maps, new synonym, and three new species. *Zootaxa* 4526 (3): 303–330. https://doi.org/10.11646/zootaxa.4526.3.2

Midgley J.M. & Bellingan T.A. 2023. Notes on the *Bittacus* (Mecoptera, Bittacidae) of Mozambique, with the description of a new species. *African Invertebrates* 64 (2): 95–107. https://doi.org/10.3897/AfrInvertebr.64.85542

Myers N., Mittermeier R.A., Mittermeier C.G., da Fonseca G.A.B. & Kent J. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403 (6772): 853–858. https://doi.org/10.1038/35002501

Nakamura T. & Bicha W. 2023. A new genus and eight new species of Japanese hangingflies (Mecoptera: Bittacidae). *Japanese Journal of Systematic Entomology* 29 (2): 297–315.

Palmer C.M. 2010. Diversity of feeding strategies in adult Mecoptera. *Terrestrial Arthropod Reviews* 3: 111–128. https://doi.org/10.1163/187498310x519716

Penny N.D. & Byers G.W. 1979. A check-list of the Mecoptera of the world. *Acta Amazonica* 9: 365–388. https://doi.org/10.1590/1809-43921979092365

Qian Z.-X. & Zhou W.-B. 2001. Three new species of Mecoptera from Yunnan. *Journal of Zhejiang Forestry College* 18: 297–300.

Savitsky V.Y. & Timokhov A.V. 2021. New data on the distribution of species of the genus *Bittacus* (Mecoptera, Bittacidae) in European Russia and Kazakhstan, with notes on their diagnoses. *Zoologicheskii Zhurnal* 100 (8): 885–896. https://doi.org/10.1134/s0013873821050067

Tan J.-L. & Hua B.-Z. 2009a. *Bicaubittacus*, a new genus of the Oriental Bittacidae (Mecoptera) with descriptions of two new species. *Zootaxa* 2221 (1): 27–40.
https://doi.org/10.11646/zootaxa.2221.1.2

Tan J.-L. & Hua B.-Z. 2009b. *Terrobittacus*, a new genus of the Chinese Bittacidae (Mecoptera) with descriptions of two new species. *Journal of Natural History* 43 (45–48): 2937–2954.
https://doi.org/10.1080/00222930903359628

Thornhill R. 1978. Sexually selected predatory and mating behavior of the hangingfly, *Bittacus stigmaterus* (Mecoptera: Bittacidae). *Annals of the Entomological Society of America* 71: 597–601.
https://doi.org/10.1093/aesa/71.4.597

Wan T., Oaks J.R., Jiang X.-L., Huang H. & Knowles L.L. 2021. Differences in Quaternary co-divergence reveals community-wide diversification in the mountains of southwest China varied among species. *Proceedings of the Royal Society B* 288 (1942): 20202567.
https://doi.org/10.1098/rspb.2020.2567

Wang J.-S. 2021. *Neopanorpa* (Mecoptera: Panorpidae) from the Himalayas and adjacent regions, with descriptions of three new species. *Acta Entomologica Musei Nationalis Pragae* 61: 203–212.
https://doi.org/10.37520/aemnp.2021.010

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: 1–13.
https://doi.org/10.37520/aemnp.2022.001

Wang J.-S. 2024. Taxonomy of the *Panorpa semifasciata* group (Mecoptera: Panorpidae: *Panorpinae*), with descriptions of fourteen new species from China. *Annales de la Société entomologique de France (N.S.)* 60 (3): 1–30. https://doi.org/10.1080/00379271.2024.2353087

Wang J.-S. & Hua B.-Z. 2017. An annotated checklist of the Chinese Mecoptera with description of male *Panorpa guttata* Navás, 1908. *Entomotaxonomia* 39: 24–42.
https://doi.org/10.11680/entomotax.2017003

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 (1): 64–79.
https://doi.org/10.1111/ens.12336

Wang J.-S. & Hua B.-Z. 2021. Morphological phylogeny of Panorpidae (Mecoptera: Panorpoidea). *Systematic Entomology* 46 (3): 526–557. https://doi.org/10.1111/syen.12474

Wang J.-S. & Hua B.-Z. 2022. *A Color Atlas of the Chinese Mecoptera*. Springer Nature Singapore, Singapore. https://doi.org/10.1007/978-981-16-9558-2

Wang J.-S. & Zhao C.-J. 2024. Taxonomy of the *Panorpa issikiana* species group, with descriptions of twenty new species (Mecoptera: Panorpidae). *Acta Entomologica Musei Nationalis Pragae* 64 (1): 79–106. https://doi.org/10.37520/aemnp.2024.007

Wang M. & Hua B.-Z. 2018. High species diversity of the genus *Neopanorpa* (Mecoptera: Panorpidae) in Yunnan Province, China. *Zootaxa* 4483 (1): 36–66. https://doi.org/10.11646/zootaxa.4483.1.2

Wei Z., Tong X., & Hua B.-Z. 2020. How does the male penisfilum enter the female copulatory pore in hangingflies?. *Insects* 11 (2): 123. https://doi.org/10.3390/insects11020123

Whiting M.F. 2002. Mecoptera is paraphyletic: multiple genes and phylogeny of Mecoptera and Siphonaptera. *Zoologica Scripta* 31 (1): 93–104. https://doi.org/10.1046/j.0300-3256.2001.00095.x

Willmann R. 2022. Neue Skorpionsfliegen (Mecoptera, Panorpidae) aus Nepal. *Contributions to Entomology* 72 (2): 309–320. https://doi.org/10.3897/contrib.entomol.72.e97277

Willmann R. 2024. Phylogeny and evolutionary history of *Mavropanorpa* n. gen. (Mecoptera: Panorpidae). *Zoologischer Anzeiger* 311: 69–87. https://doi.org/10.1016/j.jcz.2024.05.003

Yang Y., Tian K., Hao J., Pei S. & Yang Y. 2004. Biodiversity and biodiversity conservation in Yunnan, China. *Biodiversity & Conservation* 13: 813–826. https://doi.org/10.1023/b:bioc.0000011728.46362.3c

Yu T.-T., Chang Z., Dong Z.-W., Li K.-Q., Ma F.-Z., Wang W. & Li X.-Y. 2022. A glimpse into the biodiversity of insects in Yunnan: An updated and annotated checklist of butterflies (Lepidoptera, Papilionoidea). *Zoological Research* 43 (6): 1009. https://doi.org/10.24272/j.issn.2095-8137.2022.313

Zhong W. & Hua B.-Z. 2013. *Dicerapanorpa*, a new genus of East Asian Panorpidae (Insecta: Mecoptera: Panorpidae) with descriptions of two new species. *Journal of Natural History* 47 (13–14): 1019–1046. http://doi.org/10.1080/00222933.2012.752540

Zhong W., Ding G. & Hua, B.-Z. 2015. The role of male's anal horns in copulation of a scorpionfly. *Journal of Zoology* 295 (3): 170–177. https://doi.org/10.1111/jzo.12194

Manuscript received: 13 November 2024
Manuscript accepted: 1 April 2025
Published on: 24 June 2025
Topic editor: Tony Robillard
Section editor: Frédéric Legendre
Desk editor: Pepe Fernández