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Source: Florida Entomologist, 97(2) : 605-610

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/024.097.0236

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A STUDY OF LEUCTRIDAE (INSECTA: PLECOPTERA) FROM SHENNONGJIA, HUBEI PROVINCE, CHINA

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ABSTRACT

Plecopteran species of the family Leuctridae were collected and studied from the Shennongjia Nature Reserve, Hubei Province, China. Seven species were collected from Shennongjia belonging to 2 genera, and including 1 new species and 1 new record for the province, both within the genus *Rhopalopsole*. *Rhopalopsole memorabilis* **sp. nov.** is described and a redescription of *R. apicispina* Yang & Yang, 1991 is provided.

Key Words: Leuctridae, new species, redescription, Shennongjia, China

RESUMEN

Se recolectó especies de la familia Leuctridae (Plecoptera) de la Reserva Natural de Shennongjia, provincia de Hubei, China. Siete especies en dos géneros fueron recolectadas de Shennongjia que incluyen una nueva especie y un nuevo registro para la provincia,ambos pertenecientes al género *Rhopalopsole*. Se describe *Rhopalopsole memorabilis* **nov. sp.** y se provee una redescripción de *R. apicispina* Yang y Yang, 1991.

Palabras Clave: Leuctridae, nuevas especies, redescripción, Shennongjia, China

Leuctridae was established by Klapálek (1905) and currently contains 360 valid species (De Walt et al. 2013). It is distributed throughout the Nearctic, Palearctic and Oriental Regions. Leuctrid species were early on recorded from China by workers such as Klapálek (1912), Chu (1928), Wu (1935, 1949, 1973), Claassen (1940), Zwick (1973 & 1977) and Nelson & Hanson (1973). More recent efforts have been contributed by Yang & Yang (1991, 1994, 1995), Yang et al. (2004, 2006, 2009), Du & Sivec (2005), Sivec et al. (2008), Li et al. (2010, 2011) and Qian & Du (2011, 2012a, 2012b, 2013). Currently, 44 species and 3 genera of Leuctridae are known from China (DeWalt et al. 2013).

Shennongjia is located at the western border of Hubei province, China. From 1.5 to 0.025 billion years ago, Shennongjia underwent 5 intermittent tectonic uplifts (He 2007). The Shennongjia uplift form multi-level topographies and became the eastern extension of Daba Mountains after the Yanshan movement-Himalaya uplift. The Shennongjia mountain range roughly runs from east to west and is a watershed of both the Yangtze River and the Hanjiang River. It is known as the roof of central China. The steep topography of the Shennongjia range is protective of many rare, ancient species. Study of this area is important to understand the biodiversity of Chinese insect fauna (He, 2007).

Herein, 7 species of the family Leuctridae were studied from Shennongjia. *Rhopalopsole memorabilis* **sp. nov.** is described and a redescription of *R. apicispina* Yang & Yang, 1991 is provided.

MATERIALS AND METHODS

The materials studied were collected from the Shennongjia, all specimens are preserved in 75% ethanol. If not otherwise stated all type specimens and other materials are deposited in the Institute of Applied Entomology, Yangzhou University, Jiangsu (IAEYU). Other type depositary is Henan Institute of Science and Technology, Xinxiang, Henan (DEPOSITED IN HIST), Dr. Li Wei-Hai's collection. Specimens were examined and illustrated using Leica stereomicroscope-MZAPO.

PARALEUCTRA ORIENTALIS (CHU, 1928)

http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:4277

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— *Leuctra orientalis* Chu, 1928. China J. 9: 87.

— *Leuctra orientalis* Chu: Wu 1935. Cat. Ins. I: 131; 1938. Plecopttera Sinica 161; 1939-1940. Peking Nat. Hist. Bull. 14(2): 153; 1949. Peking Nat. Hist. Bull. 17(4): 251.

— *Leuctra orientalis* Chu: Claassen 1940. Mem. Agr. Exp. Sta. Cornell Univ. 232: 84.

— *Rhopalopsole orientalis* (Chu): Illies 1966. Das Tierreich 82: 118.

— *Paraleuctra orientalis* (Chu): Wu 1973. Acta Entomol. Sinica 16(2): 98.

— *Paraleuctra orientalis* (Chu): Zwick 1973. Das Tierreich 94: 410.

— *Paraleuctra orientalis* (Chu): Du & Sivec 2005. *In* Yang X. K. [Ed.], Insect Fauna of Middle-west Qinling Range and South Montains of Gansu Province. 40.

— *Paraleuctra orientalis* (Chu): Li, Wang & Yang 2010. Zootaxa 2350: 47.

— *Paraleuctra orientalis* (Chu): Qian & Du 2012. J. Insect Sci. 12:47.

Material Examined

Fourteen ♂♂, 30 ♀♀, CHINA: Hubei Province, Shennongjia, Mt. Shimo, 1550 m, 9–X–2004, Leg. Lu Yan-Yang, Wang Zhi-Jie. 4♂♂, ♀, Wenshui River, 1560 m, 17–X–2004, Leg. Lu Yan-Yang, Wang Zhi-Jie. 8 ♂♂, 2♀♀, Jiulong village, 1550 m, 15–X–2004, Leg. Lu Yan-Yang, Wang Zhi-Jie. All deposited in IAEYU.

Remarks

Paraleuctra orientalis (Chu), 1928 was redescribed by Li *et al.* 2010 and remarked again by Qian & Du (2012).

Distribution

This species was previously known from Gansu, Henan, Shaanxi, Zhejiang, Anhui, Sichuan, Yunan provinces in China. The province of Hubei is now added to that list. It is also known from Siberia, Russia.

RHOPALOPSOLE APICISPINA YANG & YANG, 1991 (FIGS. 1-3)

http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:460091

— *Rhopalopsole apicispina* Yang & Yang, 1991. J. Hubei Univ. (Nat. Sci. Edn.), 13 (4): 369.

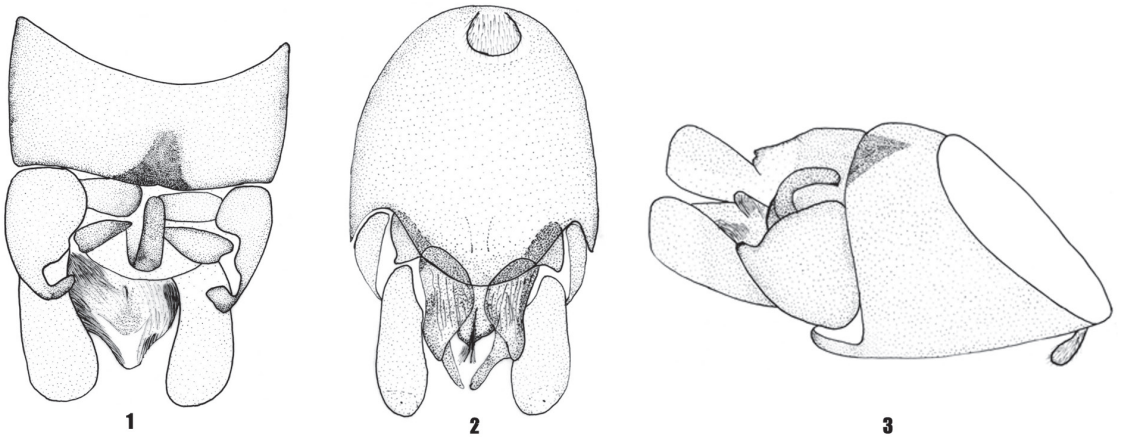
— *Rhopalopsole apicispina* Yang & Yang: Du & Sivec 2005. *In* Yang, X. K. [Ed.], Insect Fauna of Middle-west Qinling Range and South Mountains of Gansu Province. 40.

— *Rhopalopsole apicispina* Yang & Yang: Sivec, Harper & Shimizu 2008. Scopolia 64: 85.

— *Rhopalopsole jialingensis* Sivec & Harper, 2008: Sivec, Harper & Shimizu 2008. Scopolia 64: 83. **New Synonymy.**

Material Examined

Rhopalopsole apicispina Yang & Yang, 1991: HOLOTYPE ♂ CHINA: Hubei Province, Shen-



Figs. 1-3. *Rhopalopsole apicispina* Yang & Yang male structures. 1. Terminal abdominal segments of male, dorsal view; 2. Terminal abdominal segments of male, ventral view; 3. Terminal abdominal segments of male, lateral view.

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nongjia, Dayanwu, 1700 m, 29-VI-1984, Leg. Yang Ji-Kun, Wang Xin-Li. (DEPOSITED IN HIST).

Rhopalopsole jialingensis Sivec & Harper, 2008: HOLOTYPE ♂ CHINA: Shanxi Province, Qingling Mountain Range, Mt. Tiantai, south tributary of source of Jialing River, 1800 m, 10–VI–1998, Leg. Du Yu-Zhou. Deposited deposited in IAEYU.

Adult Habitus

Head brown or light brown, wider than prothorax, three ocelli with hind ocelli much closer to the eyes than to each other, antennae and palpi yellowish. Prothorax light brown, subquadrate, angles rounded with some rugosities on it. Legs light brown. Wings light brown and hyaline, veins light brown.

Male

Body length 5.0-6.0 mm, forewing length 4.5-5.0 mm. Tergum 9 slightly sclerotized with a dark triangular, mid-posterior margin (Fig. 1). Sternum 9 longer than wide with ventral lamella broad and rounded, densely hirsute (Fig. 2). Tergum 10 with lateral processes sclerotized, appearing a short, triangular in lateral view (Fig. 3). Lateral processes dorsal view dramatically narrowed with the apex forming a C-shaped hook medially (Fig. 1). Two pair of transverse sclerites present (Fig. 2). Anterior pair ovoid, posterior pair subtriangular with the medial tip being heavily sclerotized (Fig. 1). Epiproct thick and elongate, C-shaped in lateral view, tip rounded (Fig. 3). Subanal lobe bases sclerotized with apex membranous, a pair of lateral lobes present with base broad, apices short and blunt in ventral view (Fig. 2). Middle lobe narrowly split at it apex with short hairs emerging from the split (Fig. 2). Cercal length 2.5X width, cylindrical, widest subapically, slightly upturned in lateral view, spine lacking.

Remarks

Yang (1991) did not describe *R. apicispina* in detail, and Sivec et al. (2008) did not have access to the holotype. We examined the holotypes of *R. apicispina* (deposited in HIST) and *R. jialingensis* Sivec & Harper, 2008, deposited in IAEYU, and found that the 2 species are identical.

Distribution

The species is known from Gansu, Hubei, and Shaanxi provinces of China.

Rhopalopsole Flata Yang & Yang, 1995

http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:460258

— *Rhopalopsole flata* Yang & Yang, 1995. *In* Wu H. [Ed.], Insects of Baishanzu Mountain, Eastern China. 61.

— *Rhopalopsole flata* Yang & Yang: Harrison & Stark 2008. Illiesia, 4:79.

— *Rhopalopsole flata* Yang & Yang: Sivec, Harper & Shimizu 2008. Scopolia, 64: 105.

Material Examined

Four ♂♂, 7♀♀, CHINA: Hubei Province, Shennongjia, Hongping, 1800 m, 19-Jul-1997, Leg. Du Yu-Zhou. Deposited in IAEYU.

Remarks

Rhopalopsole flata was redescribed by Sivec *et al.* 2008. We have compared our specimens with the holotype of *R. flata* (deposited in HIST) and found that the subanal lobes were narrow at base and broadly and rounded apically**.**

Distribution

The species is presently known from the Zhejiang, Guangdong, Guangxi, Henan, and Anhui province of China. The province of Hubei is now added to this list.

Rhopalopsole Sinensis Yang & Yang, 1993

http://plecoptera.speciesfile.org/Common/basic/Taxa.aspx?TaxonNameID=1155181

— *Rhopalopsole sinensis* Yang & Yang, 1993. Entomotaxonomia 15(4): 236.

— *Rhopalopsole sinensis* Yang & Yang: Yang, Zhu & Li 2006. Entomological News 117(4): 435.

— *Rhopalopsole sinensis* Yang & Yang: Harrison & Stark 2008. Illiesia, 4(7): 77.

— *Rhopalopsole sinensis* Yang & Yang: Qian & Du 2012. J. Insect Sci. 12(47):5.

Material Examined

Sixteen ♂♂, CHINA: Hubei Province, Shennongjia, Hongping, 1800 m, 19-VII-1997, Leg. Du Yu-Zhou. 8 ♀♀, Mt. Shimo, 800-900 m, 14-X-2004, Leg. Lu Yan-Yang, Wang Zhi-Jie. All in IAEYU.

Remarks

Qian & Du (2012) discussed the difference among *R. furcata*, *R. sinensis* and *R. furcospina*.

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Distribution

The species is presently known from the Guizhou, Hubei, Zhejiang, Jiangxi, Fujian, Hunan, Henan, Guangdong, Guangxi, Yunnan, Sichuan, Ningxia, and Shaanxi provinces of China. It is also known from Vietnam.

Rhopalopsole Hongpingana Sivec & Harper, 2008

http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:459856

— *Rhopalopsole hongpingana* Sivec & Harper, 2008. Sivec, Harper & Shimizu 2008. Scopolia 64: 81.

Material Examined

HOLOTYPE ♂, CHINA: Hubei Province, Shennongjia, Hongping, 1800 m, 19-VII-1997, Leg. Du Yu-Zhou. Deposited in IAEYU.

Remarks

This species is known by the holotype male only.

Distribution

Hubei, China.

Rhopalopsole Qinlinga Sivec And Harper, 2008

http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:460738

— *Rhopalopsole qinlinga* Sivec & Harper, 2008. Sivec, Harper & Shimizu 2008. Scopolia 64: 77.

Material Examined

Two ♂, CHINA: Hubei Province, Shennongjia, Banqiao, 1700 m, 11–VIII-1997, Leg. Yang Mao-Fa. Deposited in IAEYU.

Remarks

The two males listed above constitute a new provincial record for the species in China.

Distribution

Hubei and Shaanxi provinces, China.

Rhopalopsole Memorabilis Qian & Du, **sp. nov.** (Figs 4-6)

http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:463819

Material Examined

HOLOTYPE ♂, CHINA: Hubei Province, Shennongjia, Mt. Shimo, 800-900 m, 14-X-2004, Leg. Lu Yan-Yang, Wang Zhi-Jie. PARATYPE ♂, same data as holotype. All deposited in IAEYU.

Diagnosis

This species is characterized by the following unique morphology.

Adult Habitus

Head dark brown, wider than prothorax, 3 ocelli and hind ocelli much closer to compound eyes than to each other, antennae and palpi dark brown. Prothorax brown, subquadrate, angles rounded with some rugosities on it. Legs brown. Wings light brown and hyaline, veins light brown.

Male

Body length 7.0 mm, forewing length 8.0 mm. Tergum 9 sclerotized with a large, medial membranous area, a sclerotized, semicircular process present posteromedially (Fig. 4), an obvious ridge transverses through the middle part of the process (Fig. 6). Sternum 9 as wider as long, forming a rounded projection apically that is no wider than the subanal lobe bases, the ventral lamella somewhat broadly circular and densely hairy (Fig. 5). Sclerotized lateral processes of tergum 10 acutely bifurcate apically in lateral view (Fig. 6). Mid-anterior process sclerotized, distinctly wider than long and bearing two short obtuse lateral processes. Posterior transverse sclerites rectangular with posterior angles somewhat rounded (Fig. 4). Epiproct thick with erect, hook-like portion curved dorsally (Fig. 4). Subanal lobe strongly sclerotized at base and margin, membranous distally, overall appearance is trident-like, the lateral arms short and less massive than the medial section (Fig. 5). Cerci long and cylindrical, in lateral view the gently curve dorsally, a small, subapical, medially-directed spine present.

Female

Unknown

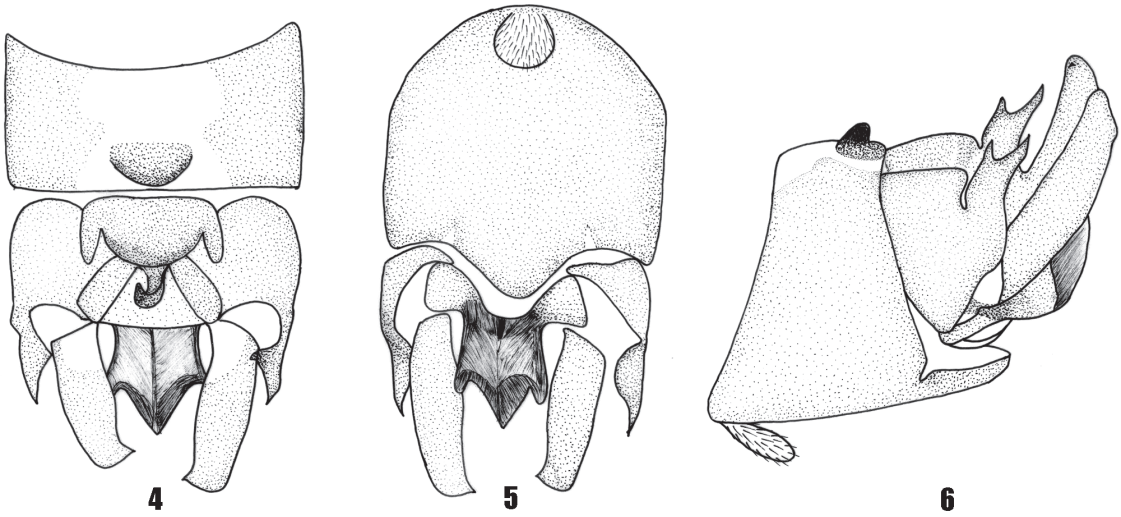
Etymology

This species was named *memorabilis* to commemorate the friendship between Qian Yu-Han and Miss Wang, also to celebrate the former's PhD.

Remarks

This new species is similar members of the *R. vietnamica* group (Sivec et al. 2008), its clos-

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Figs. 4-6. *Rhopalopsole memorabilis* Qian & Du, **sp. nov.** male structures. 4. Terminal abdominal segments of male, dorsal view; 5. Terminal abdominal segments of male, ventral view; 6. Terminal abdominal segments of male, lateral view.

est relative based on similarity of the trident-shaped subanal lobes is *R. ampulla* Du & Qian, 2011. The new species has a large semicircular process posteromedially on tergum 9 that bears a distinct transverse ridge medially, the lateral lobe of tergum 10 is bifurcate apically, and cerci exhibit a small, sessile spine subapically. In *R. ampulla*, the process on tergum 9 is much less massive without such a distinctive transverse ridge, the lateral lobes are acute apically, but not bifurcate, and the cerci are distinctly hooked medially with small spine apically and medially.

Acknowledgment

This research was supported by Science Foundation of Southwest Forestry University Grant No. 111404.

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