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FOUR NEW SPECIES OF *AMPHINEMURA* (PLECOPTERA: NEMOURIDAE) FROM SICHUAN, CHINA

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ABSTRACT

Four new species of the genus *Amphinemura* (Plecoptera: Nemouridae) were described from Sichuan, China with morphological descriptions and illustrations, i.e., *A. gyracantha* Ji & Du **sp. nov.**, *A. digitata* Ji & Du **sp. nov.**, *A. spinellosa* Du & Ji **sp. nov.**, and *A. qingchengshana* Ji & Du **sp. nov.** *A. gyracantha* is similar to *Amphinemura dispositspina* Du & Wang, 2007 in the epiproct, but the morphology of the lateral arm of the epiproct and the median paraproct lobe of the new species is diagnostic. *A. digitata* is related to *A. sclerotica* Du and Zhou, 2007 in having a similar paraproct in the ventral view, but the epiproct of two new species is distinct. *A. spinellosa* is similar to *A. lii* Zhu and Yang, 2003 in the paraproct, but *A. denticulat* can be easily separated by inner lobe slightly sclerotized and outer lobe separated from median lobe. *A. qingchengshana* is related to *A. claassenia* Wu, 1935 in having a similar epiproct, but they differ mostly in the details of paraproct.

Key Words: Plecoptera, Nemouridae, *Amphinemura*, new species, China

RESUMEN

Cuatro nuevas especies del género *Amphinemura*: *A. gyracantha* de Ji y Du **sp. nov.**, *A. digitata* Ji y Du **sp. nov.**, *A. denticulata* Du y Ji **sp. nov.**, *A. qingchengshana* Ji y Du **sp. nov.** son descritas e ilustradas de Sichuan, China. *Amphinemura gyracantha* es similar a *A. dispositspina* Du y Wang, 2007 en el epiprocto, pero los brazos laterales del epiprocto y el lóbulo paraprocto mediano son diagnósticos y puede ser usados para distinguir *A. gyracantha* de *A. dispositspina*. *Amphinemura digitata* se relaciona con *A.esclerótica* Du y Zhou, 2007 en tener los paraproctos en la vista ventral similares, pero por lo demás sus epiprocts son claramente diferentes. *Amphinemura denticulata* es similar a *A. lii* Zhu y Yang, 2003 en el paraproct, pero *A. denticulata* se puede separar fácilmente por el lóbulo interior poco esclerotizado y su lóbulo exterior separado de su lóbulo medio. *Amphinemura qingchengshana* está relacionada con *A. claassenia* Wu, 1935 en tener un epiprocto similar, pero difieren principalmente en los detalles del paraprocto.

Palabras Clave: Plecoptera, Nemouridae, *Amphinemura*, nuevas especies, China

Amphinemura (Plecoptera: Nemouridae) is the largest genus in the subfamily Amphinemurinae, and at least 175 valid species are known worldwide (DeWalt *et al.*, 2013). Seventy four Chinese *Amphinemura* species have been described by Wu (1935, 1938, 1962, 1973), Yang et al. (2005), Yang et al. (2005), Li et al. (2005), Wang et al. (2006), Wang et al. (2007), Zhu and Yang (2002, 2003), Du & Wang (2007), Du et al. (2007), and Li & Yang (2005, 2006, 2007, 2008a, b, c, d, e, 2011). In this paper, 4 new species of *Amphinemura* are described. All type specimens are deposited at School of Horticulture and Plant Protection & Institute of Applied Entomology, Yangzhou University, China.

MATERIALS AND METHODS

All type specimens were preserved in 75% or 99% ethanol and deposited at the Institute of Applied Entomology and School of Horticulture and Plant Protection, Yangzhou University, China. Specimens were examined and illustrated using Leica stereomicroscope model MZAPO. The abdomens were cut from the bodies, then treated in 5% NaOH, slowly heated to 40-50 for 1-3 min, and then the specimens were cleared rinsing in clean water.

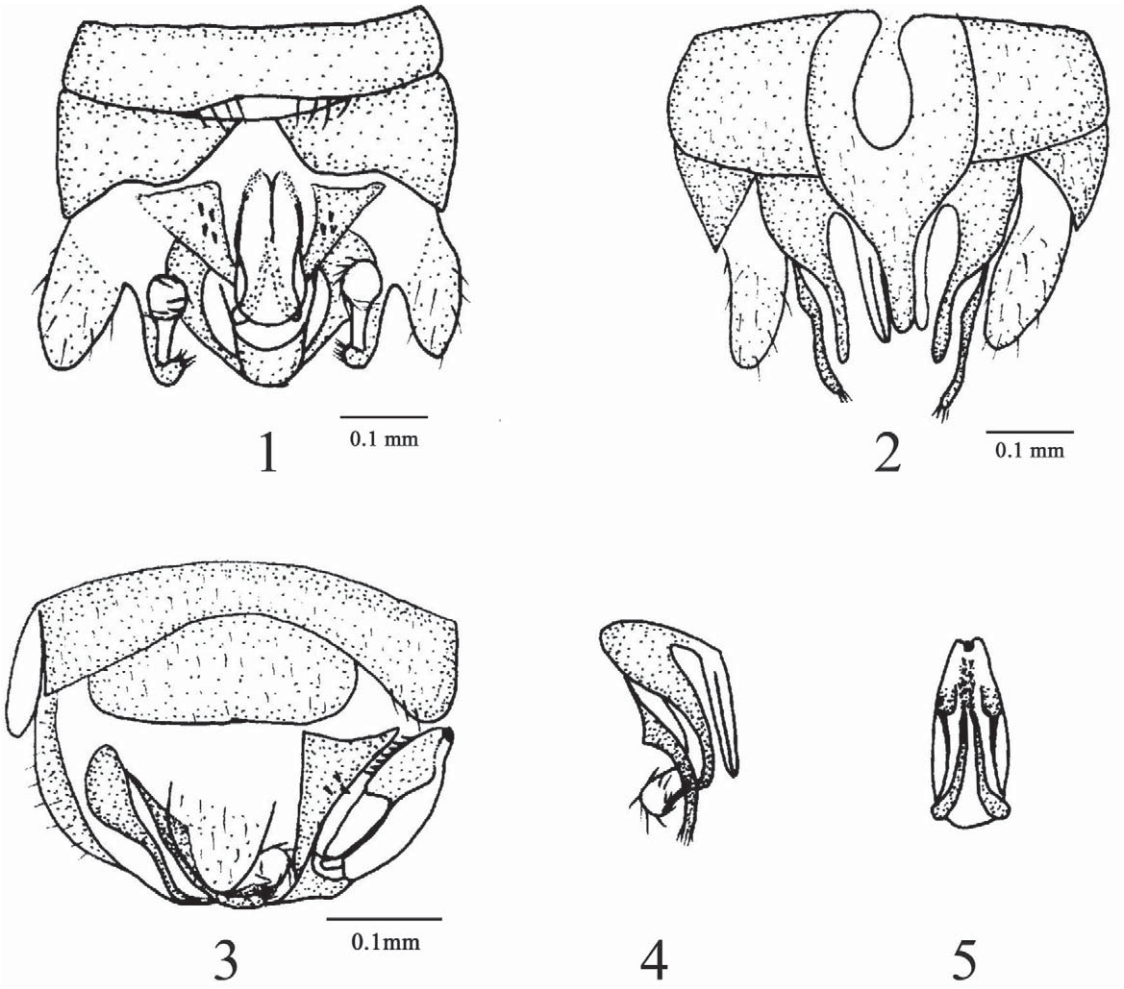
TAXONOMY

Amphinemura gyracantha Ji & Du, **sp. nov.** (Figs. 1-5)

Material Examined

HOLOTYPE ♂, China: Sichuan Province, Pingwu County, Laohegou Natural Reserves, 1784m, 104.700670° E 32.514265° N, 25 May 2012, Ji Xiao-Yu. PARATYPES: 4 ♂♂, the same

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Figs. 1–5. *Amphinemura gyracantha* **sp. nov.** male structures 1. terminalia, dorsal view; 2. terminalia, ventral view; 3. terminalia, lateral view; 4. paraproct (left); 5. epiproct, ventral view.

data as holotype; 2 ♂♂, China: Laohegou Natural Reserves, 1989m, 104.685892° E 32.523474° N, 27 May 2012, Tang Xiao-Tian.

Adult Habits

Head dark brown, antennae brown; head wider than pronotum. Pronotum dark brown, subquadrate. Wings hyaline and veins brown. Legs brown.

Male

Forewing length 5.4-5.9 mm, hind wing length 4.5-4.8 mm. Tergum 9 slightly sclerotized but sclerotized along posterior margin, bearing paired areas of 3-4 multiple long hairs posteriorly. Tergum 10 slightly sclerotized, with a large, flat plate below the epiproct, bearing a few small denticles either side of the epiproct. Hypoproct broad basally and tapering dramatically to a rounded tip; vesicle short and a little fat, length 2 × width (Fig. 2). Paraproct divided into 3 lobes; inner lobe slightly sclerotized, slender, with a short darkly sclerotized line medially; median lobe slightly sclerotized and broad basally, narrowed to apex, the narrow portion sclerotized, a membranous portion accreted on the narrow portion, bearing some long strong spines on the apex of both membranous portion and narrow sclerotized portion, long strong spines appear circular distribution; outer lobe darkly sclerotized, shorter than median lobe, basal slender, medial broad and flat, narrowed to apex, with several strong, black spines on the tip (Fig. 4). Epiproct slender in the dorsal view; narrowed to the apex; dorsal sclerite mostly membranous, concaving at tip, and with a notch near apex; lateral arms slender, sclerotized, extending ventrally forming trapezoi-

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dal sclerite near the tip; ventral sclerite forming a keel-shaped ridge, bearing many black spines ventrally (Fig. 5).

Female

Unknown.

Distribution

CHINA (Sichuan Province).

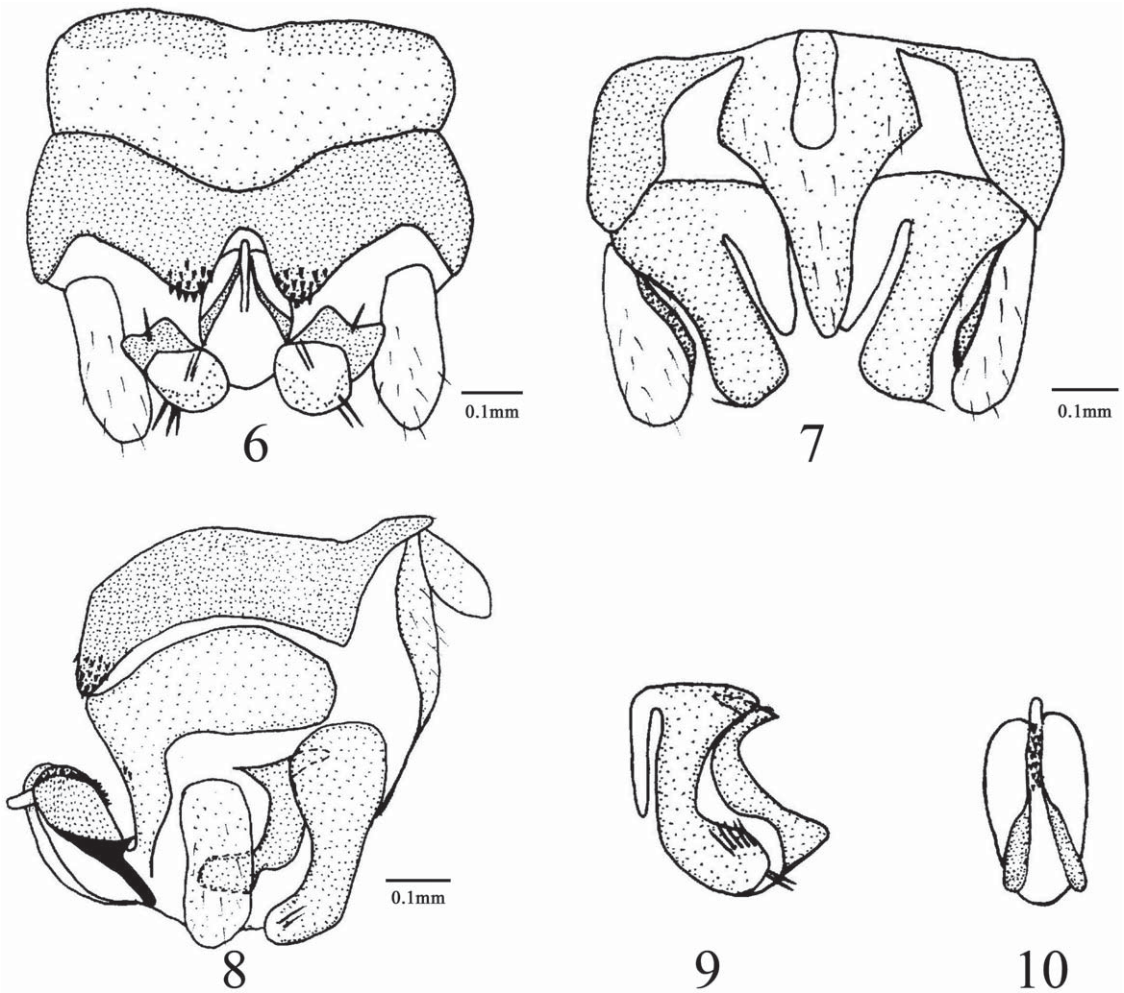
Etymology

The Latin "*gyracantha"* means circular spines, refers to long strong spines appear circular distribution on the apex of median lobe.

Remarks

The epiproct of the new species is similar to that of *A. dispositspina* Du & Wang (Du and Wang, 2007). The lateral arms of the epiproct and the median paraproct lobe are diagnostic and distinguish *A. gyracantha* from *A. dispositspina* and other known congeners. The outer lobe of the paraproct is longer than the median lobe in *A.* gyracantha, while in *A.* dispositspina, the outer lobe does not exceed the length of the median lobe. The lateral arms of the epiproct ventrally forming a trapezoidal sclerite near the tip in *A. gyracantha* but without this characteristic in *A. dispositspina*.

Amphinemura digitata Ji & Du, **sp. nov.** (Figs. 6-10)



Figs. 6–10. *Amphinemura digitata* **sp. nov.** male structures 6. terminalia, dorsal view; 7. terminalia, ventral view; 8. terminalia, lateral view; 9. paraproct (right); 10. epiproct, ventral view.

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Material Examined

HOLOTYPE ♂, China: Sichuan Province, Pingwu County, Laohegou Natural Reserves, 1784m, 104.700670° E 32.514265° N, 25 May 2012, Ji Xiao-Yu.. PARATYPES: 2 ♂♂, the same data as Holotype; 1 ♂, China: Laohegou Natural Reserves, 1979m, 104.686176° E 32.525718° N, 6 May 2013, Chen Zhi-Teng.

Adult Habits

Head dark brown, antennae brown. Pronotum brown, subquadrate, angles blunt rounded. Wings hyaline and veins brown. Legs brown.

Male

Forewing length 6.1-6.5 mm, hind wing length 5.2-5.4 mm. Tergum 8 mostly membranous, sclerotized at sides of anterior margin. Tergum 9 darkly sclerotized, concave anteriorly, posteriorly with a narrow medial cleft, a paired field of spinules at both sides of the cleft (Fig. 6). Tergum 10 mostly membranous with few small spines laterally. Hypoproct widest basally, attenuating to form a rounded tip, vesicle slender, length 3 × width. Paraproct divided into 3 lobes; inner lobe simple and membranous; median lobe sclerotized, inner surface membranous, broad basally, bearing 1-2 strong, long spines on the membranous rounded tip, and several strong, long spines on subapical the sclerotized part of the tip; outer lobe sclerotized, base slender, middle wide and bending to the dorsal surface, forming a bowtie shape projection at tip from dorsally view, connecting with membranous portion of median lobe, a fragile thorn usually present near the apex (Fig. 9). Epiproct with a finger-shaped projection protruding from a deep V-shaped notch in dorsal view; dorsal sclerite mostly membranous, with a deep V-shaped notch apically; lateral arms darkly sclerotized, extending to ventral surface at midpoint forming a long projection, which is more distinct in lateral view, then curving to midline of dorsal sclerite, which is more distinct in dorsal view; ventral sclerite forming a keel-shaped ridge, bearing rows of black spines ventrally (Fig. 10).

Female

Unknown.

Distribution

CHINA (Sichuan Province).

Etymology

The Latin "*digitata*" refers to the long, finger-shaped projection at the tip of the epiproct.

Remarks

The new species is quite distinct from other known species on that outer lobe forming a bowtie shape projection at tip dorsally view, connecting with membranous portion of median lobe.

Amphinemura spinellosa Du & Ji **sp. nov.** (Figs. 11-15)

Material Examined

HOLOTYPE ♂, China: Shaanxi province, Zhouzhi county, Houzhenzi town, Hougou, 1466m, 107.818383° E 33.861957° N, 3 Jun 1998, Du Yu-Zhou. PARATYPES: 7 ♂♂, same data as the holotype; 5 ♂♂, China: Shaanxi province, Qinling Mountains, East of Jialing River Source Scenic Spot, 1575 m, 106.940637° E 34.244756° N, 8 Jun 1998, Du Yu-Zhou; 1♂, Yunnan province, Tiger Leaping Gorge, 2095 m, 100.098854° E 27.172890° N, 26 May 1996, Du Yu-Zhou; 1 ♂, Sichuan Province, Pingwu County, Laohegou Natural Reserves, 1673 m, 104.720655° E 32.512076° N, 23 May 2012, Ji Xiao-Yu.

Adult Habits

Head dark brown, antennae brown; Pronotum brown, subquadrate, angles blunt rounded; Wings hyaline and veins brown. Legs brown.

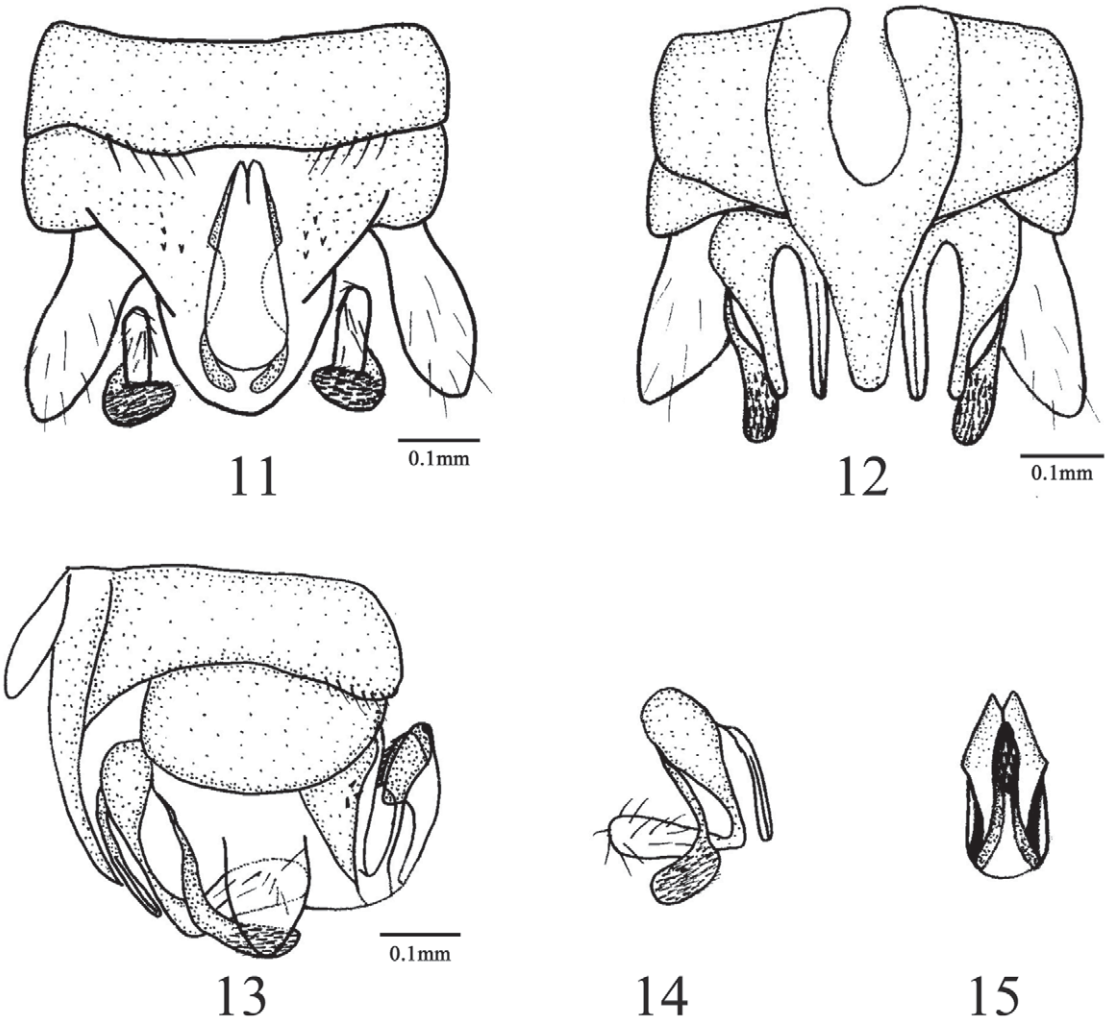
Male

Forewing length 5.8- 6.2 mm, hind wing length 4.8- 5.1 mm. Tergum 9 sclerotized, bearing two areas of long hairs on posterior margin. Tergum 10 slightly sclerotized, with a small concavity below epiproct, a few small spines present on either side of the concavity. Hypoproct elliptical basally, tapering toward a rounded tip, vesicle plump, length 2 × width. Paraproct divided into 3 lobes; inner lobe slightly sclerotized, slender, with a short darkly sclerotized line medially; median lobe slightly sclerotized and broad basally, slender medially, and bending to the dorsal surface thereafter, bearing several long spines on the membranous apex; outer lobe sclerotized, shorter than median lobe, slender basally, rows of finer spines on the olive-shaped apical portion (Fig. 14). Epiproct slender, narrowed to the apex; dorsal sclerite mostly membranous, with a notch near apex; lateral arms slender, sclerotized, extending ventrally forming trapezoidal sclerite near the tip; ventral sclerite forming a keel-shaped ridge, bearing rows of black spines ventrally (Fig. 15).

Female

Unknown.

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Figs. 11–15. *Amphinemura spinellosa* **sp. nov.** male structures 11. terminalia, dorsal view; 12. terminalia, ventral view; 13. terminalia, lateral view; 14. paraproct (left); 15. epiproct, ventral view.

Distribution

CHINA (Shanxi Province, Shaanxi Province, Sichuan Province, Yunnan Province).

Etymology

The Latin "*spinellosa*" refers to rows of fine spines on the olive-shaped apical portion of the outer lobe of the paraproct.

Remarks

The paraproct of the new species is similar to that of *A. lii* Zhu and Yang, 2003 in the apical spines of the outer and median lobes, but *A. denticulat* can be easily separated by the inner lobe being slightly sclerotized and outer lobe separated from median lobe. In *A. lii*, the inner lobe is membranous, and outer lobe linked to median lobe.

Amphinemura qingchengshana Ji & Du **sp. nov.**
(Figs. 16-20)

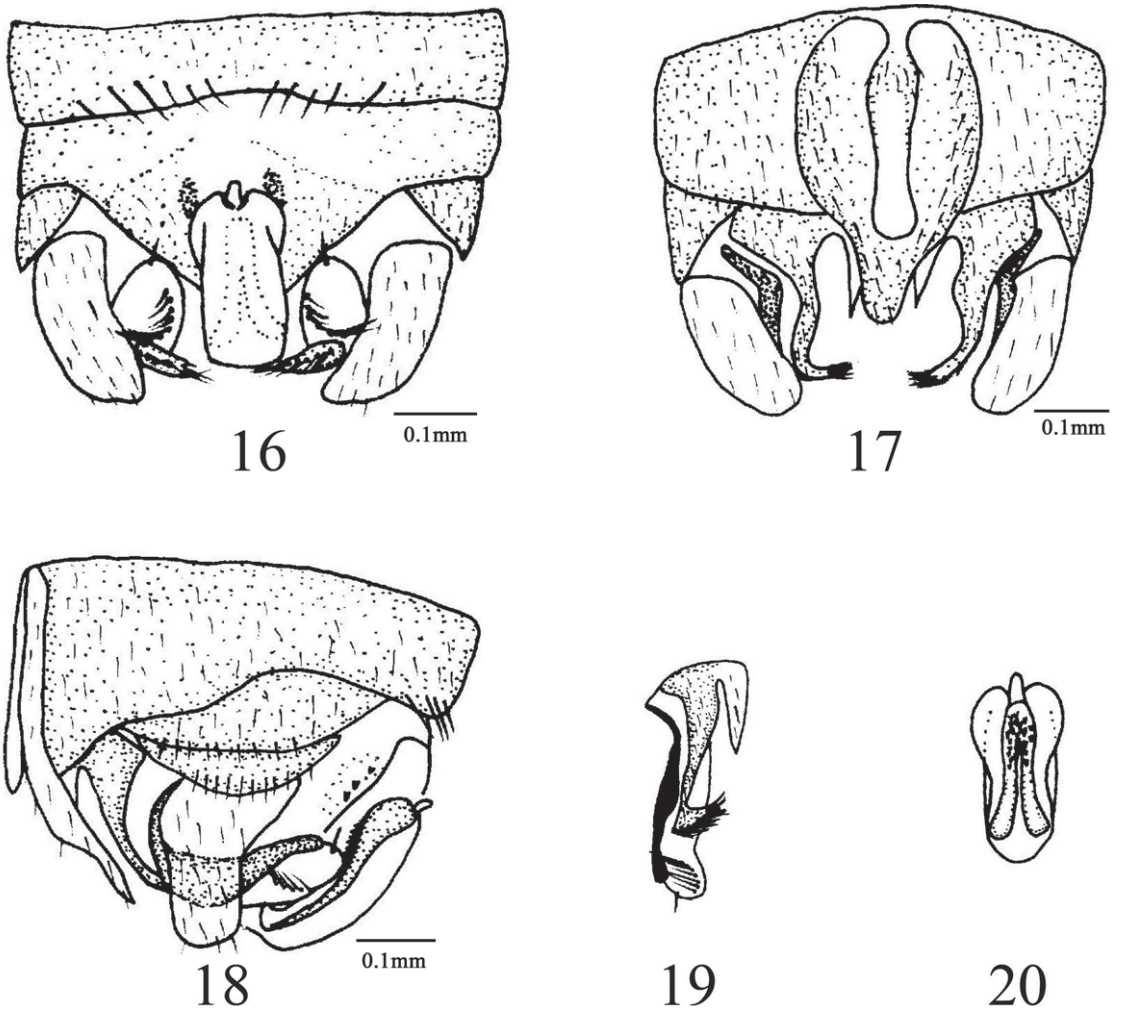
Material Examined

HOLOTYPE ♂, Sichuan Province, Dujiangyan city, Qingcheng Mountain, 1027 m, 103.483621° E 30.828280° N, 12 Jun 2012, Ji Xiao-Yu; PARATYPES: 8 ♂♂, the data same as holotype.

Adult Habits

Head and antennae brown; Pronotum slightly brown, subquadrate; Wings hyaline and veins brown. Legs slightly brown.

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Figs. 16–20. *Amphinemura qingchengshana* **sp. nov.** male structures 16. terminalia, dorsal view; 17. terminalia, ventral view; 18. terminalia, lateral view; 19. paraproct (left); 20. epiproct, ventral view.

Male

Forewing length 6.4-6.9 mm, hind wing length 5.3-5.7 mm. Tergum 9 slightly sclerotized and slightly concave at posteromedial margin where it bears several long hairs. Tergum 10 mostly membranous, forming a small concavity below epiproct, and a few small spines on either side of the concavity. Hypoproct elliptical, tapering toward a rounded tip, vesicle slender, length 4 × width, slightly inflated near base and at apex (Fig. 17). Paraproct divided into 3 lobes; inner lobe triangular and slightly sclerotized; median lobe slightly sclerotized, broad basally, narrowed medially and sinuous, forming a triangular tip, with an apical tuft of long spines; outer lobe longer than median lobe, slender and sclerotized basally, middle broad and bending to the dorsal surface, outer margin sclerotized, inner margin membranous, a row of recurved spines on the rounded membranous tip, and bearing a strong spine on the apex (Fig. 19). Epiproct quadrangular, enlarged apically, an elongate finger-shaped projection protruding from a V-shaped notch in dorsal view; dorsal sclerite mostly membranous, with a deep V-shaped notch apically; lateral arms slender, sclerotized; ventral sclerite forming a flat ridge, bearing rows of black spines ventrally (Fig. 20).

Female

Unknown.

Distribution

CHINA (Sichuan Province).

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Etymology

The specific epithet refers to the type locality, Mt. Qingcheng.

Remarks

The new species is related to *A. flavicollis* Klapálek, 1912 (Shimizu 1997) in having a similar epiproct. It differs mostly in the details of paraproct. In *A. qingchengshana*, the inner paraproct lobe triangular, with a pointed tip, but the inner lobe with a rounded tip in *A. claassenia*. In *A. qingchengshana*, the median paraproct lobe forming a triangular tip, while *A. flavicollis* with a rounded and weakly swollen apex.

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