

# Taxonomic study of the genus *Cricotopus* (Diptera) from China

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**Abstract:** The genus *Cricotopus*, belonging to the subfamily Orthoclaadiinae of the family Chironomidae, is one of the species-rich groups in this subfamily. In this study, we conducted the identification, description, and revision of domestic specimens of the genus *Cricotopus* collected from various regions across the country over 20 years (1976–2005), comb through 11 species of 4 subgenera of *Cricotopus* in China, including 6 species in subgenus *Cricotopus*, 3 species in *Isocladius*, 1 species in *Nostococcladius*, and 1 species in *Pseudocricotopus*. A key that supplements important basic data for the taxonomic research of this genus is provided.

**Key words:** Cricotopinae; Cricotopini; taxonomy; key

## 中国环足摇蚊属分类研究（双翅目）

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**摘要:** 环足摇蚊属(*Cricotopus* Wulp)隶属于摇蚊科直突摇蚊亚科, 是该亚科中物种丰富度较高的类群之一, 分布在全球各大地理区, 存在于各种各样的生境类型中。本文对 1976–2005 年从全国各地采集的国内环足摇蚊属标本进行鉴定、描述及修订, 梳理了国内环足摇蚊属 4 亚属 11 种, 并编制分种检索表, 为该属分类学研究补充了重要的基础数据。

**关键字:** 环足摇蚊亚科; 环足摇蚊族; 分类; 检索表

## Introduction

The genus *Cricotopus* was established by van der Wulp in 1874, with *Chironomus tibialis* Meigen, 1804 as the type species. *Paratrachoccladius* Santos Abreu (1918) and *Oliveiriella* Weidenbrug & Fittkau (1997) were treated as a subgenus within *Cricotopus* by Cranston & Krosch (2015) and Andersen *et al.* (2013) respectively. Currently, the genus encompasses seven subgenera worldwide: *Cricotopus* van der Wulp, *Isocladius* Kieffer 1909, *Nostococcladius* Ashe and Murray (1980), *Oliveiriella* Weidenbrug & Fittkau 1997, *Pseudocricotopus* Nishida (1987), *Paratrachoccladius* Santos Abreu 1918, and *Maurius* Lehmann (1981). Globally, 254 species

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have been recorded within this genus, including 141 species in the Palaearctic region, 42 in the Oriental region, 62 in the Nearctic region, 22 in the Afrotropical region, 23 in the Neotropical region, and 21 in the Australasian region (Ashe & O'Connor 2012; Drayson *et al.* 2015; Wang *et al.* 2020). In China, five subgenera of *Cricotopus* (excluding *Maurius*) are currently recorded, comprising 33 species (Fu *et al.* 2012; Wang *et al.* 2020). Fu *et al.* (2012) systematically revised the subgenus *Paratrichocladius* for the Sino-Indian region, which is not covered in the current study. Therefore, this study focuses on specimens collected over 20 years from multiple provinces in China, specifically addressing six species of *Cricotopus*, three species of *Isocladius*, one species of *Nostococcladius*, and one species of *Pseudocricotopus*. A total of 11 species are recorded and described, and an identification key is presented.

## Material and methods

All specimens examined and identified in this study, including the voucher specimens that underwent detailed morphological verification and taxonomic identification, are currently deposited and permanently housed in the Biology Specimen Museum, Tianjin Normal University, China.

This study is based on the examination of over 600 specimens in the genus *Cricotopus* collected from 26 regions in China, including Liaoning, Shandong, Henan, Hubei, Sichuan, Shaanxi, Xinjiang, Tianjin, Hebei, Inner Mongolia, Heilongjiang, Zhejiang, Fujian, Jiangxi, Guangdong, Guangxi, Hainan, Guizhou, Yunnan, Gansu, Ningxia, Taiwan, Chongqing, Jiangsu, Qinghai, and Xizang, during the period from 1976 to 2005 (see Appendix Table 1). The adults were primarily collected using light traps, sweep nets, and Malaise traps, and subsequently preserved in 75% ethanol. Microscopic slide preparation followed the procedures outlined by Sæther (1969), while morphological terminology, specimen measurement methods, and species descriptions adhered to the terms and methodologies provided by Sæther (1980) and Sæther (1990). The specimens were prepared for observation, description, and identification through these standardized processes.

## Taxonomy

### Genus *Cricotopus*

*Cricotopus* van der Wulp, 1874: 132.

Type species. *Chironomus tibialis* Meigen, 1804 (subsequent designation).

### Subgenus *Cricotopus* van der Wulp, 1874

*Cricotopus* van der Wulp, 1874: 132.

Type species: *Chironomus tibialis* Meigen, 1804 (subsequent designation).

#### 1. *Cricotopus* (*Cricotopus*) *annulator* Goetghebuer (Figs. 1A, 1B)

*Cricotopus annulator* Goetghebuer, 1927: 52.

**Specimens examined.** See Appendix Table 1.

**Description.** Adult male ( $n = 21$ ).

Total length 2.36–2.73, 2.56 mm; Wing length 1.38–1.62, 1.48 mm; TL/WL (Total

length/wing length) ratio 1.69–1.8, 1.73; VR (venarum ratio) 1.12–1.16, 1.13; AR (antennal ratio) 1.2–1.36, 1.26.

Coloration (Fig. 1A). Head, thorax, and antenna brown; wing light brown; abdominal tergal bands variable, tergite I and II with light bands, tergite III and IV with narrow light bands anteriorly and posteriorly, tergite V with light band on the anterior 1/2, the rest of tergites brown; fore-, mid- and hind legs with anterior 1/2 of femur light yellow, midsection of tibia light yellow.

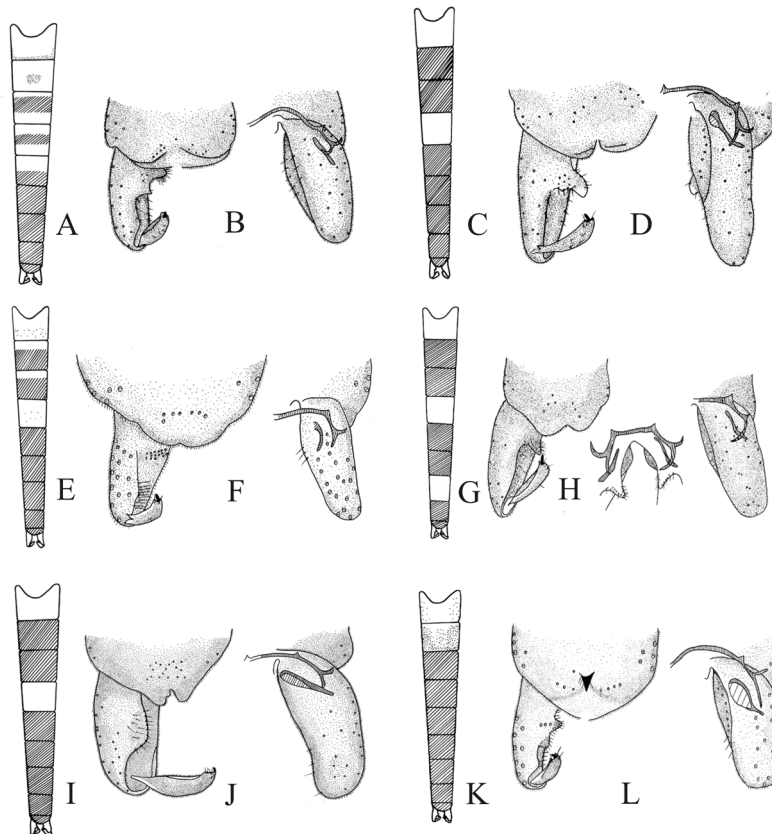


Figure 1. A, B. *C. (C.) annulator*; C, D. *C. (C.) bicinctus*; E, F. *C. (C.) similis*; G, H. *C. (C.) triannulatus*; I, J. *C. (C.) trifascia*; K, L. *C. (C.) tristis*. A, C, E, G, I, K. Tergites; B, D, F, J, L. Hypopygium, dorsal and ventral views; H. Hypopygium, dorsal view, superior volsella and inferior volsella, and ventral view.

Hypopygium (Fig. 1B). Tergite IX with 10–14, 11 setae; lateral lobe of tergite IX with 3–5, 4 setae. Gonocoxite 160–183, 172  $\mu\text{m}$  long. Gonostylus 53–70, 62  $\mu\text{m}$  long. Anal point and superior volsella absent. Inferior volsella bifurcate, one lobe with many setae, digitiform, the other lobe triangular, with 10–19, 15 setae. hypopygium ratio (HR) 2.6–3.05, 2.8; hypopygium value (HV) 3.9–4.5, 4.17.

Discussion. The characteristics of the Chinese specimens are generally consistent with those described by Hirvenoja (1973) and Lesage & Harrison (1980). However, there are slight differences in the abdominal tergal banding compared to their descriptions: Chinese specimens have some brownish spots on abdominal tergites I and II. Tergite III has brown on the central

1/2, tergite IV on the central 1/4, and tergite V on the lower 1/2. Tergites VI, VII, and VIII have no bands. This is more similar to Hirvenoja's (1973) description.

Distribution. China (Liaoning, Shandong, Henan, Hubei, Sichuan, Shaanxi, Xinjiang); common in Nearctic; Palaearctic and Oriental region.

## 2. *Cricotopus (Cricotopus) bicinctus* (Meigen) (Figs. 1C, 1D)

*Chironomus bicinctus* Meigen, 1818: 41. Hirvenoja, 1973: 235.

**Specimens examined.** See Appendix Table 1.

Description. Adult male ( $n = 162$ ).

Total length 2.38–2.98, 2.73 mm; Wing length 1.42–1.87, 1.62 mm; TL/WL ratio 1.59–1.82, 1.7; VR 1.08–1.4, 1.2; AR 1.36–1.54, 1.46.

Coloration (Fig. 1C). Head, thorax, antenna brown; wing light brown; tergites I and IV white bands, other tergites brown; fore-, mid-, and hind legs brown, with obvious light yellow band on the mid section of tibia.

Hypopygium (Fig. 1D). Tergite IX with 6–10, 8 setae; lateral lobe of tergite IX with 5–9, 8 setae. Gonocoxite 223–266, 244  $\mu\text{m}$  long. Gonostylus 85–110, 95  $\mu\text{m}$  long; without crista dorsalis; inferior volsella slightly divided, inferior volsella much longer than wide, apex with 12–18, 15 long setae. Megaseta 10–15, 13  $\mu\text{m}$  long. HR 2.41–2.69, 2.53; HV 2.71–3.16, 2.89.

Discussion. The characteristics of the Chinese specimens are generally consistent with those of the species described by Hirvenoja (1973) and Lesage & Harrison (1980). However, the inferior volsella of the Chinese specimens is slightly divided at the lower end.

Distribution. China (Tianjin, Hebei, Inner Mongolia, Heilongjiang, Zhejiang, Fujian, Jiangxi, Shandong, Henan, Guangdong, Guangxi, Hainan, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Ningxia, Xinjiang); widely distributed except in the Afrotropical region.

## 3. *Cricotopus (Cricotopus) similis* Goetghebuer (Figs. 1E, 1F)

*Cricotopus similis* Goetghebuer, 1921: 95, 190. Hirvenoja, 1973: 247.

**Specimens examined.** See Appendix Table 1.

Description. Adult male ( $n = 1$ ).

Total length 2.71 mm; wing length 1.47 mm; TL/WL 1.61; VR 1.16; AR 1.14.

Coloration (Fig. 1E). Head, thorax, and antenna dark brown; wing light brown; abdominal tergites I and IV pale yellow, tergites II and III with pale yellow bands on the anterior 1/5, remaining tergites brown; legs: mid part of fore-, mid-, and hind tibia pale yellow, remaining parts brown.

Hypopygium (Fig. 1F). Tergite IX with 7 setae. Lateral lobe of tergite IX with 4 setae. phallapodeme 43  $\mu\text{m}$  long, transverse sternapodeme 80  $\mu\text{m}$  long, with slight angular projection. Gonocoxite 205  $\mu\text{m}$  long. Superior and inferior volsella absent. Gonostylus 70  $\mu\text{m}$  long. Megaseta 18  $\mu\text{m}$  long. HR 2.93; HV 4.64.

Distribution. China (Zhejiang); a common species in the Palaearctic region.

## 4. *Cricotopus (Cricotopus) triannulatus* (Macquart) (Figs. 1G, 1H)

*Chironomus triannulatus* Macquart, 1826: 202. Hirvenoja, 1973: 208.

**Specimens examined.** See Appendix Table 1.

Description. Adult male ( $n = 138$ ).

Total length 2.28–2.73, 2.54 mm; wing length 1.21–1.53, 1.5 mm; TL/WL 1.47–1.88, 1.71; VR 1.17–1.19, 1.18; AR 1.07–1.28, 1.19.

Coloration (Fig. 1G). Head, thorax, and antenna brown; wing light brown; tergite I with white band, tergite II with white band on the anterior 1/3, tergite III with white band on the anterior 1/5, tergite IV with white band on the anterior 5/6, tergite V with white band on the anterior 5/6, remaining tergites brown; fore-, mid-, and hind legs brown, with a distinct pale yellow band on the mid part of tibiae.

Hypopygium (Fig. 1H). Tergite IX with 8–19, 13 setae; lateral lobe of tergite IX with 4–5, 5 setae. Phallapodeme 40–55, 50  $\mu\text{m}$  long; transverse sternapodeme 85–115, 103  $\mu\text{m}$  long; with angular projection. Gonocoxite 140–163, 152  $\mu\text{m}$  long; superior volsella covered with microsetae, semicircular. Gonostylus 53–68, 60  $\mu\text{m}$  long; inferior volsella with notch in middle, with 8–11, 10 setae. Megaseta 10–15, 13  $\mu\text{m}$  long. HR 2.07–2.86, 2.56; HV 3.81–4.68, 4.26.

Distribution. China (Tianjin, Hebei, Inner Mongolia, Liaoning, Heilongjiang, Zhejiang, Jiangxi, Henan, Hubei, Guangxi, Sichuan, Chongqing, Guizhou, Yunnan, Shaanxi, Xinjiang); common species in the Nearctic and Palaearctic regions.

##### 5. *Cricotopus (Cricotopus) trifascia* Edwards (Figs. 1I, 1J)

*Cricotopus trifascia* Edwards, 1929: 322.

**Specimens examined.** See Appendix Table 1.

Description. Adult male ( $n = 139$ ).

Total length 3.57–3.9, 3.76 mm; wing length 1.75–2.18, 1.9 mm; TL/WL 1.79–2.15, 1.99; VR 1.08–1.23, 1.14; AR 1.46–1.65, 1.58.

Coloration (Fig. 1I). Head, thorax, and antenna brown; wing light brown; tergites I and IV with white bands, other tergites brown; fore-, mid-, and hind legs brown, with a distinct pale yellow band on the mid part of tibiae.

Hypopygium (Fig. 1J). Tergite IX with 12–20, 15 setae; lateral lobe of anal point with 2–3, 3 setae. Phallapodeme 75–98, 89  $\mu\text{m}$  long; transverse sternapodeme 105–143, 88  $\mu\text{m}$  long, with angular projection. Gonocoxite 240–265, 252  $\mu\text{m}$  long, superior volsella absent, inferior volsella simple, arc-like shape. Gonostylus 110–155, 120  $\mu\text{m}$  long. Megaseta 13  $\mu\text{m}$  long. HR 1.86–2.29, 2.12; HV 2.74–3.64, 3.18.

Distribution. China (Liaoning, Zhejiang, Hubei, Guangxi, Sichuan, Yunnan, Shaanxi, Xinjiang); a common species in the Nearctic and Palaearctic regions.

##### 6. *Cricotopus (Cricotopus) tristis* Hirvenoja (Figs. 1K, 1L)

*Cricotopus tristis* Hirvenoja, 1973: 196.

**Specimens examined.** See Appendix Table 1.

Description. Adult male ( $n = 1$ ).

Total length 3.41 mm; wing length 2.12 mm; TL/WL 1.61; AR 1.30; VR 1.13.

Coloration (Fig. 1K). Head and thorax dark brown; wing light brown; abdominal tergites I and II pale, remaining tergites brown; legs: mid part of fore-, mid-, and hind tibia pale yellow, remaining parts brown.

Hypopygium (Fig. 1L). Tergite IX with 8 setae. Lateral lobe of anal point with 5 setae. Phallapodeme 80  $\mu\text{m}$  long, transverse sternapodeme 145  $\mu\text{m}$  long, with angular projection. Gonocoxite 220  $\mu\text{m}$  long, superior volsella flattened. Gonostylus 70  $\mu\text{m}$  long, inferior volsella

bifurcated, with 19 long setae. Megaseta 15  $\mu\text{m}$  long. HR 3.14; HV 4.87.

Distribution. China (Liaoning); Canada, widely distributed in the Palaearctic region.

### Subgenus *Isocladius* Kieffer, 1909

*Isocladius* Kieffer, 1909: 44. Type species: *Isocladius albipes* Kieffer, 1909 (by original designation).

#### 1. *Cricotopus (Isocladius) reversus* Hirvenoja (Figs. 2A, 2B)

*Cricotopus reversus* Hirvenoja, 1973: 305.

**Specimens examined.** See Appendix Table 1.

Description. Adult male ( $n = 1$ ).

Total length 3.38 mm; wing length 2.37 mm; TL/WL 1.43; VR 1.06; AR 1.35.

Coloration (Fig. 2A). Body entirely brown, tergites and legs without bands.

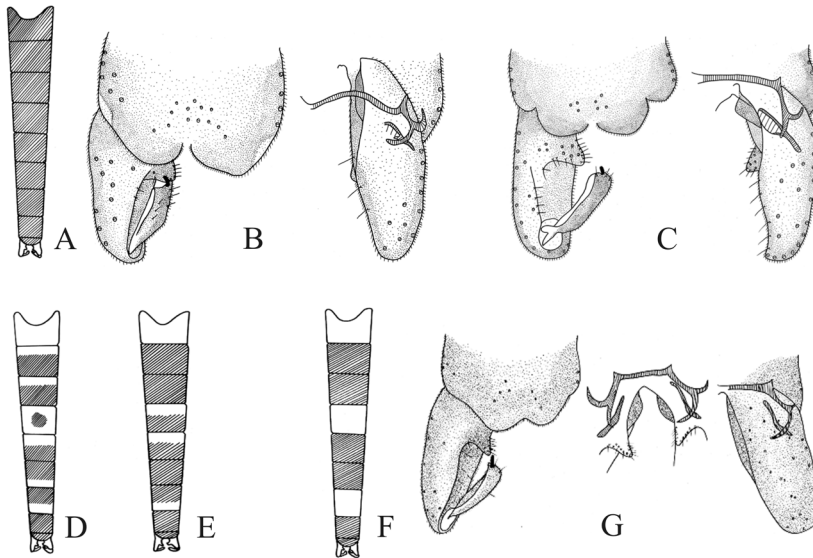


Figure 2. A, B, C. *I. reversus*; C–E. *C. sylvestris*; F, G. *C. trifasciatus*. A, D–F. Tergites; B, C. Hypopygium, dorsal and ventral views; G. Hypopygium, dorsal view, superior volsella and inferior volsella, and ventral view.

Hypopygium (Fig. 2B). Tergite IX with 13 setae. Lateral lobe of tergite IX with 6 setae. Phallapodeme 58  $\mu\text{m}$  long, transverse sternapodeme 113  $\mu\text{m}$  long, with angular projection. Gonocoxite 250  $\mu\text{m}$  long, inferior volsella densely covered with microtrichia, with 5 long setae. Gonostylus 118  $\mu\text{m}$  long; superior volsella rounded. Megaseta 15  $\mu\text{m}$  long. HR 2.13; HV 2.88.

Distribution. China (Xinjiang); widely distributed in the Palaearctic region.

#### 2. *Cricotopus (Isocladius) sylvestris* (Fabricius) (Figs. 2C–E)

*Tripula sylvestris* Fabricius, 1794: 252. Hirvenoja, 1973: 277.

**Specimens examined.** See Appendix Table 1.

Description. Adult male ( $n = 76$ ).

Total length 2.38–3.22, 3.00 mm; wing length 1.30–1.80, 1.56 mm; TL/WL 1.53–2.15, 1.84; VR 1.04–1.12, 1.08; AR 1.13–1.49, 1.27.

Coloration (Figs. 2D, 2E). Head and thorax dark brown; wing light yellow, nearly transparent; abdominal tergite I pale yellow, II, III brown, IV, V with pale yellow on anterior

1/3, tergite VI brown, VII with pale yellow on posterior 1/2, or tergite I pale yellow, II, III with pale yellow on anterior 1/3, tergite VI pale yellow with a brown dot in the middle, tergite V with pale yellow band on anterior part, tergites VI, VII with pale yellow band on posterior part, remaining tergites brown; legs with bands: fore legs darker than mid- and hind legs, fore femur with pale yellow on anterior 1/2, tibia with pale yellow in most of the middle, remainder brown; mid- and hind femur and tibia similar to fore legs, but the anterior portions of the I and II tarsomeres are mostly pale yellow, with the remaining portions brown.

Hypopygium (Fig. 2C). Tergite IX with 7–8, 7 setae. Lateral lobe of tergite IX with 2–5, 3 setae. Phallapodeme 48–88, 64  $\mu\text{m}$  long, transverse sternapodeme 90–118, 102  $\mu\text{m}$  long, with angular projection. Gonocoxite 195–230, 209  $\mu\text{m}$  long, superior volsella almost triangular, apex relatively rounded. Gonostylus 93–115, 100  $\mu\text{m}$  long, inferior volsella simple, with 12–16, 14 long setae. Megaseta 10–15, 13  $\mu\text{m}$  long. HR 2–2.19, 2.1; HV 2.54–3.24, 3.01.

Distribution. China (Tianjin, Hebei, Inner Mongolia, Liaoning, Jiangsu, Zhejiang, Fujian, Shandong, Hubei, Sichuan, Guizhou, Yunnan, Gansu, Qinghai, Ningxia, Taiwan); widely distributed in the Neotropical, Nearctic, Palaearctic, and Oriental regions.

### 3. *Cricotopus (Isocladius) trifasciatus* (Meigen) (Figs. 2F, 2G)

*Chironomus trifasciatus* Meigen, 1818: 42. Hirvenoja, 1973: 290.

**Specimens examined.** See Appendix Table 1.

Description. Adult male ( $n = 91$ ).

Total length 2.66–3.58, 3.14 mm; wing length 1.50–1.70, 1.63 mm; TL/WL 1.77–1.89, 1.84; VR 0.90–1.10, 1.05; AR 1.24–1.77, 1.40.

Coloration (Fig. 2F). Head and thorax dark brown; wing light yellow, nearly transparent; tergites with varying stripes, I, IV, and VII often with pale yellow stripes. Legs with stripes: fore femur with pale yellow on basal 1/2, fore tibia with mostly pale yellow in middle, remainder brown; mid- and hind femur and tibia similar to fore legs, but the anterior portions of the I and II tarsomeres are mostly pale yellow, the remainder brown.

Hypopygium (Fig. 2G). Tergite IX with 7–12, 9 setae. Lateral lobe of tergite IX with 3–5, 4 setae. Phallapodeme 50–75, 68  $\mu\text{m}$  long, transverse sternapodeme 80–100, 90  $\mu\text{m}$  long, with angular projection. Gonocoxite 195–245, 223  $\mu\text{m}$  long, superior volsella almost triangular, apex relatively rounded. Gonostylus 75–105, 92  $\mu\text{m}$  long, inferior volsella simple, with 9–17, 13 setae. Megaseta 13–15, 15  $\mu\text{m}$  long. HR 2.05–2.87, 2.45; HV 2.80–4.16, 3.47.

Distribution. China (Tianjin, Inner Mongolia, Jiangsu, Zhejiang, Fujian, Jiangxi, Shandong, Hubei, Guangxi, Yunnan, Xizang Ningxia); common species in the Nearctic and Palaearctic regions.

### Subgenus *Nostococladius* Ashe & Murray, 1980

*Nostococladius* Ashe & Murray, 1980: 105. Type species: *Cricotopus lygropis* Edwards, 1929 (by original designation).

#### *Cricotopus (Nostococladius) lygropis* Edwards (Figs. 3A, 3B)

*Cricotopus lygropis* Edwards, 1929: 325. Hirvenoja, 1973: 212.

**Specimens examined.** See Appendix 1.

Description. Adult male ( $n = 3$ ).

Total length 3.03–3.20, 3.14 mm; Wing length 1.58–1.80 mm, 1.73; TL/WL 1.78–1.92,

1.83; VR 1.14–1.25, 1.18; AR 1.08–1.13, 1.11.

Coloration (Fig. 3A). Body entirely brown.

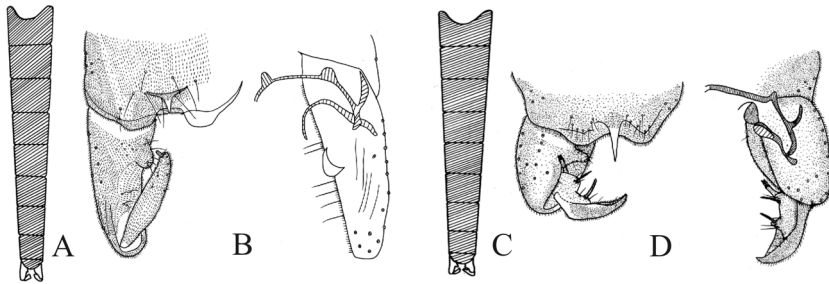


Figure 3. A, B. *C. (N.) lygropis*; C, D. *C. (P.) montanus*. A, C. Tergites; B, D. Hypopygium, dorsal and ventral views.

Hypopygium (Fig. 3B). Tergite IX with 12–20, 16 setae. Latero sternite IX with 3–6, 5 setae. Anal point length 22–23, 22  $\mu\text{m}$ , width 21–22, 22  $\mu\text{m}$ , densely covered with microtrichia, apex bare. Phallapodeme 90–100, 94  $\mu\text{m}$  long, transverse sternapodeme 68–85, 77  $\mu\text{m}$  long, with angular projections that are rounded. Gonocoxite 243–265, 254  $\mu\text{m}$  long, densely covered with microtrichia on the inferior volsella, bearing 5–10, 8 long setae. Gonostylus 120–130, 124  $\mu\text{m}$  long, without crista dorsalis. Megaseta 8–10, 9  $\mu\text{m}$  long. HR 1.96–2.21, 2.05; HV 2.46–2.67, 2.53.

Distribution. China (Zhejiang); widely distributed in the Palearctic region.

### Subgenus *Pseudocricotopus* Nishida, 1987

*Pseudocricotopus* Nishida, 1987: 460. Type species: *Cricotopus montanus* Tokunaga, 1936 (by original designation).

#### *Cricotopus (Pseudocricotopus) montanus* Tokunaga (Figs. 3C, 3D)

*Cricotopus montanus* Tokunaga, 1936: 29.

**Specimens examined.** See Appendix 1.

**Description.** Adult male ( $n = 21$ ).

Total length 2.74–3.4, 2.86 mm; wing length 1.95–2.25, 2.07 mm; TL/WL 1.4–1.51, 1.44; VR 1.17–1.23, 1.2; AR 1.07–1.18, 1.12.

Coloration (Fig. 3C). Head, thorax, and antennae brown; wings brown; abdominal tergites without bands; fore-, mid-, and hind tibiae yellow, the remaining femora and tarsomeres brown.

Hypopygium (Fig. 3D). Tergite IX with 8–18, 14 setae. Laterosternite IX with 3–7, 5 setae. Phallapodeme 65–112, 96  $\mu\text{m}$  long, transverse sternapodeme 95–125, 112  $\mu\text{m}$  long, with angular projections. Gonocoxite 118–170, 149  $\mu\text{m}$  long, superior volsella small, approximately triangular. Gonostylus 85–108, 94  $\mu\text{m}$  long, with a distinctive appendage, without crista dorsalis. Anal point bare, 38–48, 45  $\mu\text{m}$  long. HR 1.34–1.85, 1.59; HV 3.12–3.34, 3.21.

Distribution. China (Zhejiang, Sichuan, Shaanxi, Gansu, Ningxia); Japan; Russia (Far East).

### Key to *Cricotopus* Species from China

1. Gonostylus with appendages at base ..... *C. (P.) montanus*  
 -. Gonostylus without appendages at base ..... 2

2. Anal point distinct, extending to tergite IX, apex rounded ..... *C. (N.) lygropis*  
 -. Anal point absent, or if present, small, apex pointed ..... 3
3. Superior volsella absent or flattened ..... 4  
 -. Superior volsella distinct, elevated or rounded ..... 9
4. Anal point present ..... *C. (C.) tristis*  
 -. Anal point absent ..... 5
5. Superior and inferior volsellae both absent ..... *C. (C.) similis*  
 -. Superior and inferior volsellae not both absent, either separately or both present ..... 6
6. Superior volsella semicircular, inferior volsella acute ..... *C. (C.) triannulatus*  
 -. Superior volsella absent, inferior volsella divided into lobes, or flattened ..... 7
7. Inferior volsella simple, arc-like shape ..... *C. (C.) trifascia*  
 -. Inferior volsella divided into two lobes ..... 8
8. Inferior volsella with upper and lower lobes closely appressed ..... *C. (C.) bicinctus*  
 -. Inferior volsella with upper lobe well-developed, both lobes distinctly separated ..... *C. (C.) annulator*
9. Tergites without bands ..... *C. (I.) reversus*  
 -. Tergites with bands ..... 10
10. Tergites I, IV, V, VII often with pale bands or tergites II, III, V, VI, VII with pale bands, tergite IV with circular dark spots ..... *C. (I.) sylvestris*  
 -. Tergites I, IV, VII often with pale bands ..... *C. (I.) trifasciatus*

## Discussion

The genus *Cricotopus* was initially described by van der Wulp in 1874 based on eight male adult species from the Palaearctic region. This early work primarily relied on the morphology of adults, laying the preliminary foundation for the genus' classification. Hirvenoja's authoritative revision of the Palaearctic Chironomidae in 1973, based on morphological characteristics, included detailed descriptions of male adults, pupae, and larvae, dividing the genus into two subgenera, *Cricotopus* and *Isocladius*. Subsequently, researchers proposed four additional subgenera, such as *Nostococladius* by Ashe and Murray in 1980 and *Pseudocricotopus* by Nishida in 1987. The taxonomic identification of this genus relies on diverse life stage characteristics. For instance, larval morphology is of significant value in identification, with key diagnostic features including the unique L4 setal tuft on abdominal segments, as well as the shape and dentition of the mentum and mandible. However, these features are not always stable within the genus (Cuppen & Tempelman 2018). Fine structures such as the anal point and superior volsella of the male hypopygium provide decisive evidence for species identification. Nevertheless, this traditional reliance on adult males has resulted in a lack of morphological descriptions for many species' larval and pupal stages, posing significant challenges for freshwater biologists who rely on larvae for their research. Cranston and Krosch (2015) utilized molecular data to revise Australian species, indicating that the genus *Cricotopus* is paraphyletic. This finding is due to the nesting of an independent monophyletic group, the genus *Paratrachocladius*, within *Cricotopus*. Currently, *Paratrachocladius* is treated as a subgenus of *Cricotopus*. Consequently, the long-standing issues of synonymy and uncertainty regarding subgeneric status within the genus persist. Future research should

combine multi-gene loci with morphological characteristics across multiple life stages, focusing on a comprehensive systematic revision of *Cricotopus* and its closely related genera, to address issues such as closely related species and paraphyly, thereby thoroughly resolving the classification problems of this genus.

Furthermore, the genus *Cricotopus* is also of significant agricultural concern. Wang *et al.* (1989) reported that larvae of *Cricotopus trifascia* feed on the leaves of the aquatic plant *Brasenia schreberi* (water shield), a valuable vegetable listed as a national first-class protected wild plant in China. Some scholars have also reported that *Cricotopus* larvae and adults seriously infest rice, and early instar larvae can harm fish fry (Darby 1962; Lange & Grigarick 1970; Ree & Kim 1998; Li *et al.* 2010; Wang *et al.* 2011). Therefore, taxonomic research on this genus provides relatively comprehensive basic data for understanding its distribution patterns, aquaculture, and aquatic crop pest control.

### Supplementary data

Appendix 1 to this article can be found online at Baidu Netdisk: <https://pan.baidu.com/s/15WUit-LLD-7tl4RnzHIwUA?pwd=67ch>

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