



## Chinese damselflies of the genus *Coenagrion* (Zygoptera: Coenagrionidae)

XIN YU<sup>1,2,3</sup> & WENJUN BU<sup>2</sup>

<sup>1</sup>College of Environmental Science and Engineering, Nankai University, Tianjin 300071, China

<sup>2</sup>Institute of Entomology, Life Sciences College, Nankai University, Tianjin, 300071 China

<sup>3</sup>Corresponding author. E-mail: nk\_yuxin@yahoo.cn

### Abstract

We review and update species of *Coenagrion* recorded from China, including distributional information. A key to the males is provided including figures of the genital ligula and caudal appendages. A distributional record of *Coenagrion armatum* is excluded from China. *Coenagrion bifurcatum* Zhu & Ou-yan, 2000, is assigned as a junior synonym of *Coenagrion johanssoni* (Wallengren, 1894). *Coenagrion chusanicum* Navás, 1933 is assigned as a junior synonym of *Paracercion hieroglyphicum* (Brauer, 1865). *Coenagrion dorothea* Fraser, 1924 is newly combined as *Paracercion dorothea* (Fraser, 1924) comb. nov. *Coenagrion impar* Needham, 1930 and *Cercion yunnanensis* Zhu & Han, 2000 are both treated as junior synonyms of *Paracercion dorothea*. *Coenagrion holdereri* (Förster, 1900) is redescribed here based on fresh specimens.

**Key words:** *Coenagrion*, review, China, new synonyms & combination

### Introduction

Forty-two species of *Coenagrion* are recorded globally (Schorr *et al.*, 2009) fourteen of which have been recorded from China, namely *C. aculeatum* Yu and Bu, *C. armatum* (Charpentier), *C. bifurcatum* Zhu and Ou-yan, *C. chusanicum* Navás, *C. dorothea* Fraser, *C. ecornutum* (Selys), *C. glaciale* (Selys), *C. hastulatum* (Charpentier), *C. holdereri* (Förster), *C. hylas* (Trybom), *C. johanssoni* (Wallengren), *C. lanceolatum* (Selys), *C. lunulatum* (Charpentier) and *C. tengchongensis* Yu and Bu. Förster (1900) described *C. holdereri*, a Chinese endemic from Nanshan, China. Fraser (1923) described *C. dorothea* from Yunnan China. Needham (1930) recorded nine *Coenagrion* species from China, which were all transferred to *Paracercion* (Weekers & Dumont, 2004) except for *C. convalescens* Bartenev and *C. dorothea* Fraser. *Coenagrion convalescens* is considered a synonym of *C. johanssoni* (Tsuda, 1991). Navás (1933) described four species, *C. chusanicum*, *C. trilineatum*, *C. admirationis* and *C. needhami*, from Chusan China. According to Chao (1962) *C. trilineatum* and *C. admirationis* are the same species, and both have subsequently been treated as synonyms of *Cercion sexlineatum* (Selys, 1883) by Davies & Tobin (1984), and then Dumont (2004) treated *C. sexlineatum* as synonym of *Paracercion melanotum* (Selys, 1876). Davies & Tobin (1984) assigned *C. needhami* as a synonym of *Ischnura forcipata* Morton. Sui & Sun (1986) listed five species, all of which, except for *C. convalescens*, have subsequently been transferred to *Paracercion*. Yang (1998) provided a key to Coenagrionidae from northern China including six species of *Coenagrion*: *C. concinnum*, *C. hylas*, *C. lanceolatum*, *C. ecornutum*, *C. vernale* and *C. armatum*. According to Wallengren (1894) *C. concinnum* is a primary homonym created by Johanson (1859) who then renamed it *C. johanssoni*. *C. vernale* is the same species as *C. lunulatum* (Mielewczyk, 1974). Zhu & Ou-yan (2000) described *C. bifurcatum* from Heilongjiang, China. Hua (2000) listed fourteen species of *Coenagrion* from China, of which eight are now considered valid, comprising *C. armatum*, *C. chusanicum*, *C. dorothea*, *C. ecornutum*, *C. glaciale*, *C. hylas*, *C. lanceolatum*, and *C. lunulatum*. Dumont (2003) provided a list of Odonata from Inner Mongolia, China, including three species: *C. ecornutum*, *C. lanceolatum* and *C. lunulatum*. Yu & Bu (2007) described *C. aculeatum* and *C. tengchongensis* from southwest China.

Following the establishment of the genus *Paracercion* Weekers & Dumont (2004), Chinese taxa, originally assigned to *Coenagrion*, require reassessment. Since most species of Chinese *Coenagrion* have been diagnosed by body markings (Askew, 2004; Battin, 1993; Belyshev, 1963; Cnypuc, 1964; Dumont, 2003; Hamada & Inoue, 1985; Haritonov, 1986), we provide here a complete synopsis of the Chinese *Coenagrion* focusing on diagnostic characters based on the male genital ligula and caudal appendages.

## Material and methods

**Specimens.** We examined 63 Chinese specimens comprising 47 males and 16 females, including paratypes of *Coenagrion bifurcatum* (provided by Professor Huiqian Zhu of Shanxi University), holotype of *Coenagrion chusanicum* preserved in the Institute of Zoology, Chinese Academy of Sciences, Beijing, China, and 3 Swedish specimens donated by Dr. Rasmus Hovmöller. All the specimens are deposited in Nankai University, Hebei University, and the Institute of Zoology, Chinese Academy of Sciences, China. We also examined photos (including diagnostic features) of the holotype of *Coenagrion holdereri* (provided by Dr. Mark F. O'Brien of the University of Michigan) preserved in the University of Michigan, Museum of Zoology, Michigan, USA. A FEI Quanta 200 environmental scanning electron microscope was used to photograph male caudal appendages in a low vacuum mode. All the figures were drawn with aid of a digital camera, light microscope, and computer. Digital photos from specimens were used as models and rendered using Adobe Photoshop. S= abdominal segment(s).

## Abbreviations for Collections

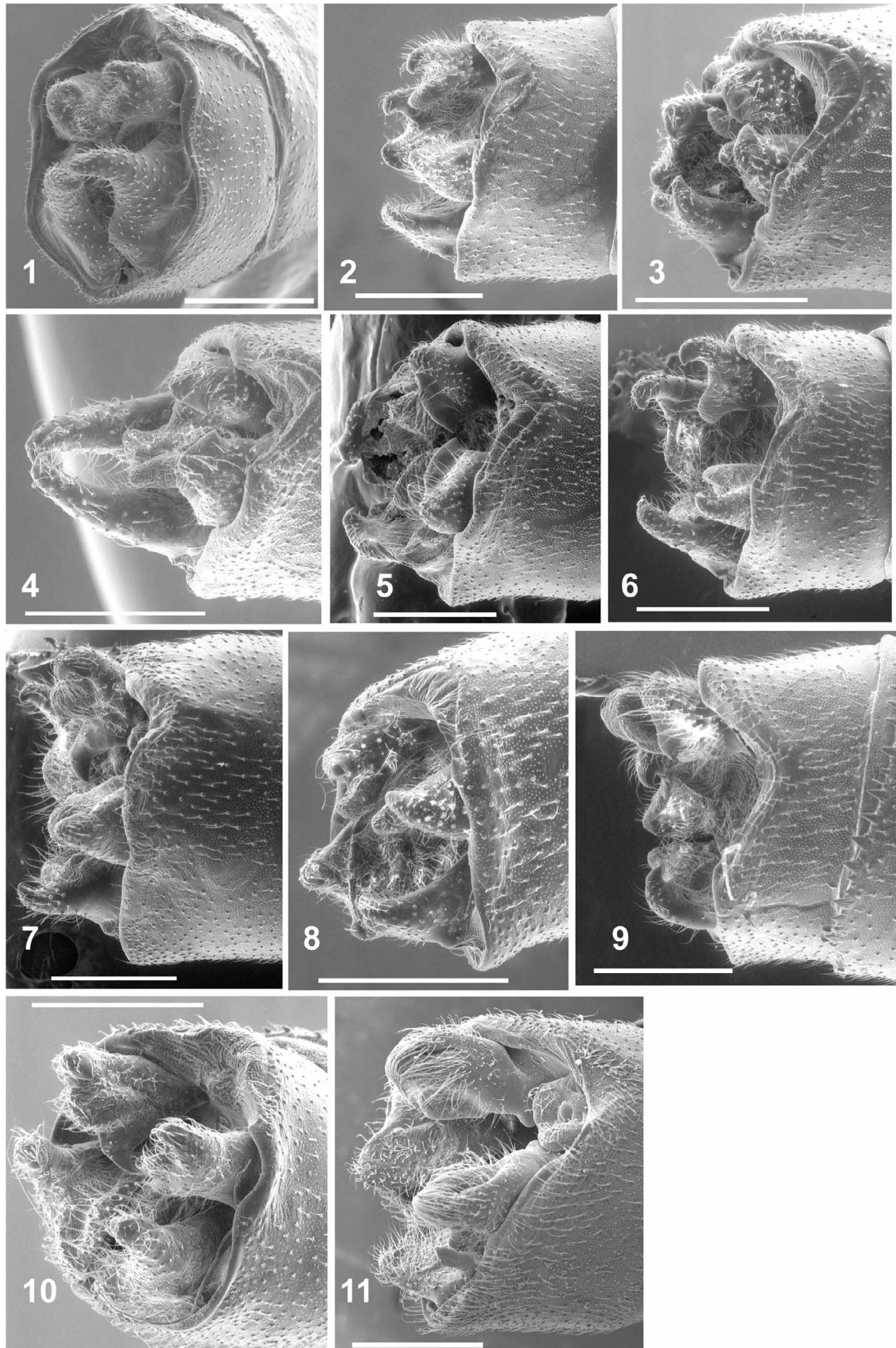
CHU	Hebei University, Life Sciences College, Baoding, Hebei, China
IZAS	Institute of Zoology, Chinese Academy of Sciences, Beijing, China
NKUM	Nankai University, College of Life Sciences, Tianjin, China
UMMZ	University of Michigan, Museum of Zoology, Michigan, USA

## Results

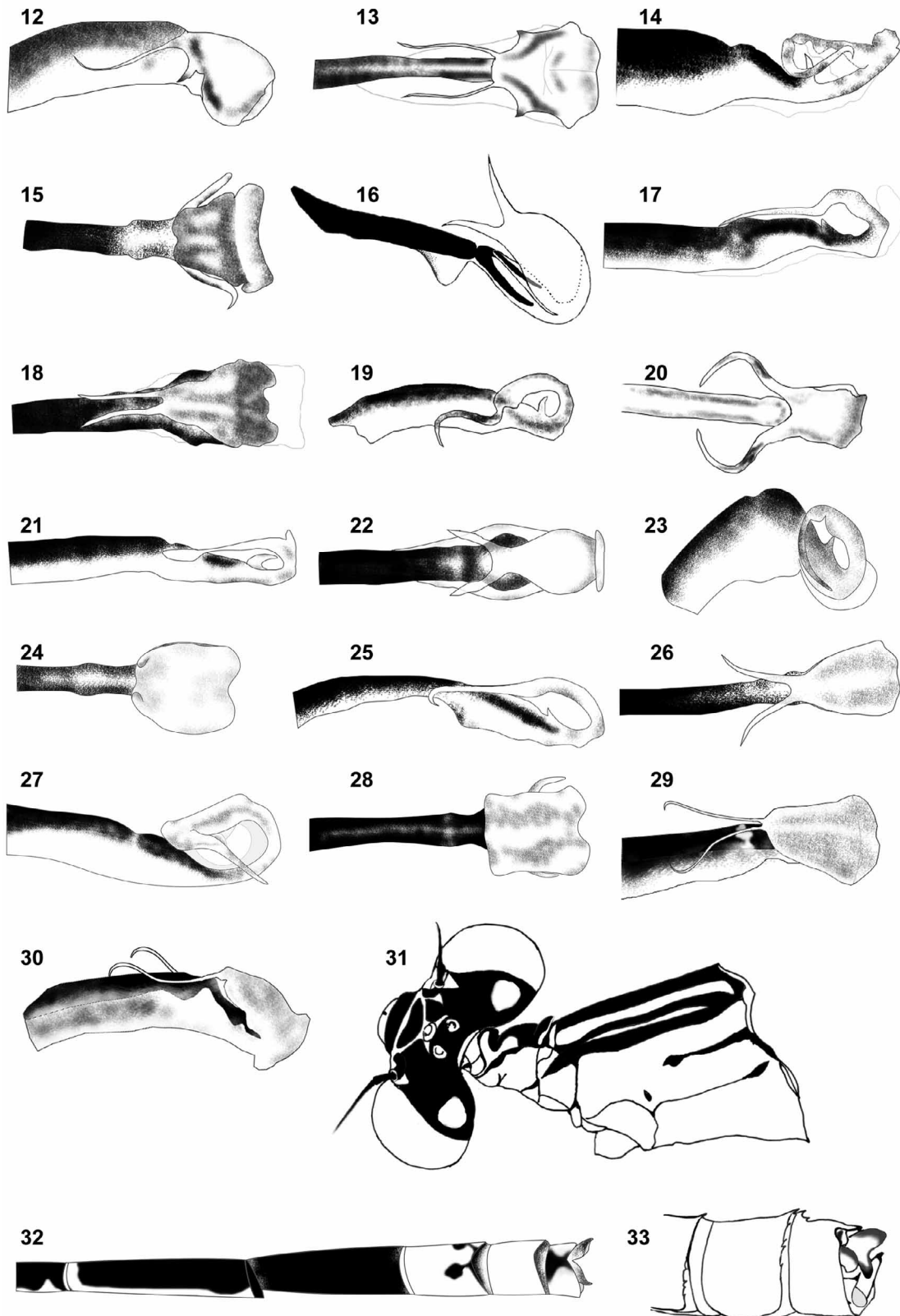
### Taxonomy

#### Key to Chinese *Coenagrion* species

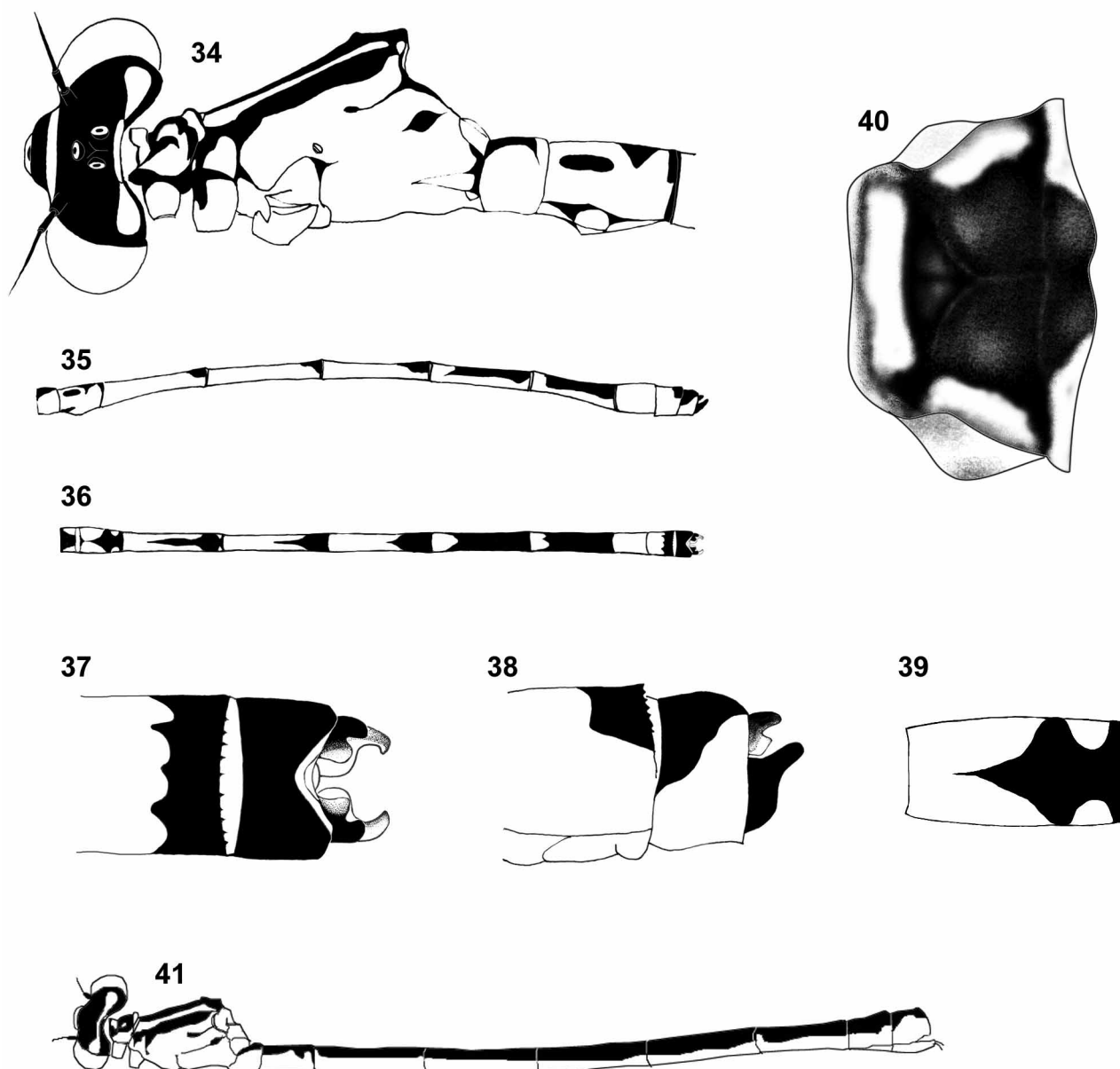
1	Strong basal teeth of cerci present (Figs. 1, 7, 10) . . . . .	2
-	No basal teeth on cerci . . . . .	5
2	Abdomen blue laterally; paraprocts bifurcate with the upper branches slim, as long as the lower ones, truncated apically (Fig. 11) . . . . .	<i>C. lumulatum</i>
-	Abdomen black laterally; paraprocts not bifurcate . . . . .	3
3	Paraprocts longer than cerci; apical segment of genital ligula with a pair of flagella-like apical lobes and a pair of short spine-like lateral lobes (Figs. 12–13) . . . . .	<i>C. aculeatum</i>
-	Paraprocts subequal than cerci; apical segment of genital ligula with only one pair of apical lobes . . . . .	4
4	Blue occipital bar present; thorax black ventrally; apical lobes of genital ligula leaf-like (Figs. 21–22) . . . . .	<i>C. hylas</i>
-	Occipital bar absent; thorax pale ventrally; apical lobes of genital ligula flagella-like (Figs. 29–30) . . . . .	<i>C. tengchongensis</i>
5	Stout apical teeth present on upper branch of bifurcate cerci (Figs. 4–5) . . . . .	6
-	No apical teeth on upper branch of bifurcate cerci . . . . .	9
6	Cerci less than 0.5 length of paraprocts . . . . .	.7
-	Cerci longer than 0.5 to approximately as long as paraprocts . . . . .	.8
7	Apical segment of genital ligula ovoid, poorly sclerotized, with one pair of short leaf-like apical lobes (Fig. 16) . . . . .	<i>C. glaciale</i>
-	Apical segment of genital ligula shield-like, strongly sclerotized, with one pair of flagella-like apical lobes (Figs. 17–18) . . . . .	<i>C. hastulatum</i>
8	Postocular spots narrow, comma-like; apical segment of genital ligula shield-like with one pair of curled flagella-like apical lobes (Figs. 14–15) . . . . .	<i>C. ecornutum</i>
-	Postocular spots almost circular; Head of genital ligula shield-like with one pair of linear flagella-like apical lobes (Figs. 25–26) . . . . .	<i>C. lanceolatum</i>
9	Apical lobes of genital ligula broad and long, longer than apical segment of genital ligula (Figs. 19–20) . . . . .	<i>C. holdereri</i>
-	Apical lobes of genital ligula narrow and short (Figs. 23–24), shorter than apical segment of genital ligula . . . . .	<i>C. johanssoni</i>



**FIGURES 1–11.** SEM photos for male caudal appendages: (1) *C. aculeatum*; (2) *C. bifurcatum*; (3) *C. ecornutum*; (4) *C. glaciale*; (5) *C. hastulatum*; (6) *C. holdereri*; (7) *C. hylas*; (8) *C. johanssoni*; (9) *C. lanceolatum*; (10) *C. lunulatum*; (11) *C. tengchongensis*.



**FIGURES 12–33.** male genital ligula: (12) *C. aculeatum*, lateral; (13) *C. aculeatum*, ventral; (14) *C. ecornutum*, lateral; (15) *C. ecornutum*, ventral; (16) *C. glaciale*; (17) *C. hastulatum*, lateral; (18) *C. hastulatum*, ventral; (19) *C. holdereri*, lateral; (20) *C. holdereri*, ventral; (21) *C. hylas*, lateral; (22) *C. hylas*, ventral; (23) *C. johanssoni*, lateral; (24) *C. johanssoni*, ventral; (25) *C. lanceolatum*, lateral; (26) *C. lanceolatum*, ventral; (27) *C. lunulatum*, lateral; (28) *C. lunulatum*, ventral; (29) *C. tengchongensis*, ventral; (30) *C. tengchongensis*, lateral. 31–33. holotype specimen of *C. chusanicum*: (31) thorax; (32) caudal appendages; (33) end of abdomen.



**FIGURES 34–41.** *C. holdereri*, 34–40. male: (34) head and thorax; (35) abdomen, lateral; (36) abdomen, dorsal; (37) appendages, dorsal; (38) appendages, lateral; (39) second abdomen segment, dorsal; (40) pronotum, dorsal; (41) female body, lateral.

### *Coenagrion aculeatum* Yu & Bu, 2007

*Coenagrion aculeatum* Yu & Bu, 2007: 55–59, “jiangjin, Chongqing, China”.

**Material.** 1 ♂, jiangjin, Chongqing, China, 23-V-2001, Yan leg. [Holotype] (NKUM); 1 ♂, jiangjin, Chongqing, China, 21-V-2001, same data. (NKUM)

**Distribution.** A southern species occurring from Chongqing east to Anhui and Zhejiang provinces, China.

### *Coenagrion armatum* (Charpentier, 1840)

*Agrion armatum* Charpentier, 1840: 164.

*Coenagrion armatum* Kirby, 1890: 149; Yang, 1998: 61; Hua, 2000: 8; Askew, 2004: 77–79.

**Remarks.** *Coenagrion armatum* was only recorded by Yang (1998) without any detail specimen information, description and figures. According to Bridges (1994) and Tsuda (2000) *C. armatum* is distributed mainly across northern Europe, and this species was not recorded by Dumont (2003). Therefore, we doubt the occurrence of *C. armatum* in China.

### *Coenagrion ecornutum* (Selys, 1872)

*Agrion ecornutum* Selys, 1872: 44.

*Coenagrion ecornutum*: Kirby, 1890: 150; Hamada & Inoue, 1985: 162, pl. 8; Haritonov, 1986: 151–153, figs. 68(9), 69(7), 70(11, 28); Yang, 1998: 60; Hua, 2000: 8; Dumont, 2003: 134.

**Material.** 1 ♂, Heilongjiang, Dedu, 16-VII-1971, Shengqiao Jiang leg., IOZ(E)617250 (IZAS); 1 ♂, Heilongjiang, Aihui, 3-VII-1971, Xuezhong Zhang leg., IOZ(E)617206 (IZAS); 1 ♀, same data, Shengqiao Jiang leg., IOZ(E)617205 (IZAS); 1 ♂, 1 ♀, Hebei, Weichang, Saihanba forestry centre, 1500m, 23-VII-1985, Hongguo Sun leg., IOZ(E)830463 (IZAS).

**Distribution.** In China this species occurs from Hebei to Heilongjiang. It is also recorded from Japan, Korea, and Russia.

### *Coenagrion glaciale* (Selys, 1872)

*Agrion glaciale* Selys, 1872: 41.

*Coenagrion glaciale*: Kirby, 1890: 149; Haritonov, 1986: 151–153, figs. 68(12), 69(10), 70(14, 28); Hua, 2000: 8.

**Material.** 1 ♂, Heilongjiang, Hulin, 12-VI-1971, Xuezhong Zhang leg., IOZ(E)617255 (IZAS).

**Distribution.** A Palearctic species known in China from Heilongjiang and also known from Russia.

### *Coenagrion hastulatum* (Charpentier, 1825)

*Agrion hastulatum* Charpentier, 1825: 20; Belyshev, 1963: 3, fig. 9(b).

*Coenagrion hastulatum*: Kirby, 1890: 149; Cnypuc, 1964: 146, 148–149, figs. 67(9), 69(3, 8), 70(4, 14); Askew, 2004: 77–79, figs. 75, 88, 105–106.

**Material.** 1 ♂, Jilin, Manjiang, 22-VI-1955, Zhiyin Li leg., IOZ(E)617249 (IZAS); 1 ♂, same data, 18-VI-1955, Zhiyin Li leg., IOZ(E)617204 (IZAS); 1 ♂, 1 ♀, Jilin, Mt. Changbai, 11-VII-2003, Xiujuan Yang leg. (CHU).

**Distribution.** In China this species known occurs in Jilin; also known from Austria, Belgium, Bulgaria, Switzerland, the Czech Republic, Slovakia, Germany, Denmark, Spain, Estonia, Finland, France, Great Britain, Hungary, Italy, Lithuania, Luxembourg, Latvia, Netherlands, Norway, Poland, Romania, Russia, Slovenia, Sweden, Turkey and Ukraine.

### *Coenagrion holdereri* (Förster, 1900)

*Agrion holdereri* Förster, 1900: 264–267, figs 1–4; Schmidt, 1963: 22–24, figs 1–6.

*Coenagrion holdereri*: Davies and Tobin, 1984: 59.

**Material.** 1 ♂, China, Nanshan, 10-VI-1898 [photos of the holotype] (UMMZ); 5 ♂, 6 ♀, Shalingzi, Hebei, China, 2-VII-2006, Xin Yu leg. (NKUM).

**Description.** Male. Labium pale yellow; labrum, bases of mandibles, anteclypeus, genae and frons blue; base of anteclypeus and postclypeus black; top of head, including antennae, entirely black; postocular spots blue, pear-shaped; occipital bar blue, almost connecting with postocular spots. Prothorax black, with blue lateral marks; synthorax black dorsally, with narrow blue antehumeral stripes. Sides of synthorax blue (Fig. 34). Legs pale blue with

extensor surfaces of femora black. Wings hyaline, pterostigma brown, braced, each covering one cell. Abdomen blue with black marks as follows: S1 with a longitudinal broad dorsal mark, S2 with a big spade-shaped dorsal mark and short lateral stripes on each side (Fig. 35–36, 39), dorsally apical 0.30 of segments 3–5, 0.80 of segments 6–7, 0.30 of S9 black, S10 entirely black dorsally (Fig. 35–36). Caudal appendages black, as figured in Figures 37–38. Paraproct as long as S10, a little longer than cercus. Genital ligula (Figs. 19–20) with shield-like head and apical lobes in the form of a pair of strong flagella.

Female. More robust than male, body color bluish green, much similar as male on body marks except longitudinal broad black dorsal mark although abdomen. Caudal appendages short, vulvar spine robust, extending to the end of abdomen as shown in Figure 41.

**Measurements** (mm): abdomen + appendage 23.5; hind wing 18.5.

**Remarks.** According to Förster (1900), the holotype of *C. holdereri* is a unique individual he collected from Nanshan (located in Xinjiang, China) which survived an accident. Förster (1900) believed *C. holdereri* indicates that Nanshan is the eastern border of Central Asia fauna of Odonata. After carefully comparing our specimens with the holotype photos provided by Dr. Mark F. O'Brien and figures in Schmidt (1963), which include all diagnostic characters, we believe our Hebei specimens are the same species as *C. holdereri*. The holotype of *Coenagrion holdereri*, preserved in the University of Michigan, Museum of Zoology, Michigan, USA, is broken and the genital ligula is missing.

**Distribution.** This little-known Chinese endemic is only known from Xinjiang and Hebei. The habitat in Hebei is now endangered due to drought and pollution.

### *Coenagrion hylas* (Trybom, 1889)

*Agrion hylas* Trybom, 1889: 12.

*Coenagrion hylas*: Lieftinck, 1964:159; Hamada & Inoue, 1985: 163, pl. 8; Haritonov, 1986: 151–153, figs. 68(6), 69(4), 70(5–6, 19–20); Yang, 1998: 60; Hua, 2000: 8; Askew, 2004: 77–79, figs. 81, 93, 119–120.

**Material.** 1 ♂, Heilongjiang, Dailing, 19-VI-1971, Xuezhong Zhang leg., IOZ(E)617228 (IZAS); 1 ♂, Jilin, Manjiang, 18-VI-1955, Zhiyin Li leg., IOZ(E)617248 (IZAS); 1 ♂, same data, 8-VII-1955, Zhiyin Li leg., IOZ(E)617203 (IZAS).

**Distribution.** In China this species occurs in Heilongjiang and Jilin, and its further distribution includes Japan, Mongolia and Russia.

### *Coenagrion johanssoni* (Wallengren, 1894)

*Agrion johanssoni* Wallengren, 1894: 267.

*Agrion concinnum* Belyshev, 1963: 3, fig. 9(c).

*Coenagrion concinnum*: Wallengren, 1894: 267; Haritonov, 1986: 151–153, figs. 68(5), 69(3), 70(7–8, 21–22); Yang, 1998: 60.

*Coenagrion convalescens*: Needham, 1930: 267; Sui & Sun, 1986: 255–256, fig. 169.

*Coenagrion johanssoni*: Longfield, 1954:145; Askew, 2004: 77–79, figs. 80, 92, 117–118.

*Coenagrion bifurcatum* Zhu and Ou-yan, 2000: 365–368, figs 1–10. **Syn. nov.**

**Material.** 1 ♂, Heilongjiang, Sunwu, Yaotun, 10-VII-1971, Xuezhong Zang leg., IOZ(E)617246 (IZAS); 2 ♂, 1 ♀, Heilongjiang, Mudanjiang, 27-VII-2007, Haomiao Zhang leg., (NKUM); 1 ♂, 1 ♀, Heilongjiang, Jingbo lake, 15-VII-1999 [paratypes of *C. bifurcatum*] (NKUM); 3 ♂, Sweden, Ore, Nässet, 10-VII-2003, T. Kronestedt leg. (NKUM).

**Remarks.** After comparing Heilongjiang specimens with those from Sweden, we found no significant differences in body markings, genital ligulae, and caudal appendages (Fig. 2), except for a slightly smaller body size for European specimens. Examination of paratypes of *C. bifurcatum* showed them to be identical to *C. johanssoni*. Consequently we consider *C. bifurcatum* a junior synonym of *C. johanssoni*.

**Distribution.** In China this species appears in Heilongjiang. It also occurs in Belarus, Estonia, Finland, South Korea, Lithuania, Latvia, Mongolia, Norway, Korea, Russia and Sweden.

***Coenagrion lanceolatum* (Selys, 1872)**

*Agrion lanceolatum* Selys, 1872: 43.

*Coenagrion lanceolatum*: Kirby, 1890: 149; Haritonov, 1986: 151–153, figs. 68(8), 69(6), 70(10, 24); Hamada & Inoue, 1985: 162, pl. 7; Yang, 1998: 60; Hua, 2000: 8; Dumont, 2003: 134.

**Material.** 1 ♂, 1 ♀, Jilin, Mt. Changbai, 26-VII-1981, Shufang Wang leg., IOZ(E)617257 (IZAS); 1 ♂, Jilin, Liuhe, 16-VII-1981, IOZ(E)617258 (IZAS); 1 ♂, 1 ♀, Hebei, Weichang, Saihanba forestry centre, 1500m, 23-VII-1985, Hongguo Sun leg., IOZ(E)830464 (IZAS); 5 ♂, 1 ♀, Heilongjiang, Mudanjiang, 27-VII-2007, Haomiao Zhang leg. (NKUM).

**Distribution.** In China this species occurs from Hebei north to Jilin and Heilongjiang. It also occurs in Japan, South Korea and Russia.

***Coenagrion lunulatum* (Charpentier, 1840)**

*Agrion lunulatum* Charpentier, 1840: 162.

*Coenagrion lunulatum*: Cnypuc, 1964: 146, 148–149, figs. 67(8), 69(2, 7), 70(3, 13); Mielewczyk, 1974: 267–268; Haritonov, 1986: 151–153, figs. 68(10), 69(8), 70(12, 26); Hua, 2000: 8; Dumont (2003): 134–137, figs. 2–8; Askew, 2004: 75–76, key; 77–79, figs. 76, 89, 108–109.

*Coenagrion vernale*: Mielewczyk, 1974: 267–268; Yang, 1998: 61.

**Material.** 1 ♂, 1 ♀, Hebei, Weichang, Saihanba forestry centre, 1500m, 24-VII-1985, Hongguo Sun leg., IOZ(E)830483 (IZAS); 1 ♂, same data, IOZ(E)830474 (IZAS); 1 ♂, same data, IOZ(E)830482 (IZAS); 1 ♂, same data, IOZ(E)830478 (IZAS); 1 ♂, same data, IOZ(E)830475 (IZAS); 1 ♂, same data, IOZ(E)830480 (IZAS); 1 ♂, same data, IOZ(E)830481 (IZAS); 1 ♂, same data, IOZ(E)830479 (IZAS); 1 ♂, same data, IOZ(E)830472 (IZAS); 1 ♂, same data, 22-VII-1985, Hongguo Sun leg., IOZ(E)830469 (IZAS); 1 ♂, same data, IOZ(E)830470 (IZAS); 1 ♂, same data, IOZ(E)830468 (IZAS); 1 ♂, same data, IOZ(E)830467 (IZAS); 1 ♀, same data, IOZ(E)830465 (IZAS).

**Remarks.** Typically, the black marks on the dorsum of S2 for this species comprise three separated stripes, however we found three of our 13 males to have a continuous U-shape stripe.

**Distribution.** In China this species occurs in northern Hebei and from north Huhehaote to Manzhouli of Inner Mongolia. It also occurs in Austria, Belgium, Belarus, Switzerland, the Czech Republic, Slovakia, Germany, Denmark, Estonia, Finland, France, Great Britain, Hungary, Ireland, Lithuania, Luxembourg, Latvia, Mongolia, Netherlands, Norway, Poland, Romania, Russia, Sweden, Turkey and Ukraine.

***Coenagrion tengchongensis* Yu & Bu, 2007**

*Coenagrion tengchongensis* Yu & Bu, 2007: 55–59.

**Material.** 1 ♂, Zhengdingi, Tengchong, Yunnan, 15-VIII-2006, Xin Yu leg. (NKUM); 2 ♂, Xigong Lake, Motuo, Xizang, 9-V-1983, 1450m, Yinheng Han leg.; same data, 11-V-1983, 1450m, Zhou Lin leg. (IZAS)

**Distribution.** Hitherto, this southern species is known only in mountainous areas in western Yunnan province and Xizang, China.

***Paracercion dorothea* (Fraser, 1924) comb. nov.**

*Coenagrion dorothea* Fraser, 1924: 461–463, figs. 8, 8a–8c.

*Paracercion impar* Dumont, 2004: 366, figs. 22–24, 33. **syn. nov.**

*Coenagrion impar* Needham, 1930: 271–272, pl. 20, fig. 1.

*Cercion yunnanensis* Zhu & Han, 2000: 163–166, figs. 1–10. **syn. nov.**



**Remarks.** According to the original description, figures and type locality we believe *Coenagrion dorothea* is the same species as *Paracercion impar*. We propose a new combination for *Paracercion dorothea* (Fraser, 1924) and treat *P. impar* (Needham, 1930) as a junior synonym of *P. dorothea*. We discussed the status of *Cercion yunnanensis* with the late H. Q. Zhu in 2005, and she agreed with us in considering *Cercion yunnanensis* a junior synonym of *Paracercion impar*. Thus *C. yunnanensis* is also a new junior synonym of *P. dorothea*.

### *Paracercion hieroglyphicum* (Brauer, 1865)

*Coenagrion chusanicum* Navás, 1933: 4. **syn. nov.**

**Remarks.** The holotype specimen of *C. chusanicum* has its synthoracic black stripe along second lateral suture (Fig. 31) paler inwards and its cercus is longer than its paraproct (Figs 32–33), which are the typical characters for *Paracercion* rather than *Coenagrion*. The structure of the caudal appendages of *C. chusanicum* are identical to *P. hieroglyphicum*. Accordingly, we treat *C. chusanicum* as a junior synonym of *P. hieroglyphicum*.

### Acknowledgements

We would like to acknowledge Prof. Qiao Gexia (the Institute of Zoology Chinese Academy of Sciences) for providing the materials. We are also grateful to Prof. Huiqian Zhu (Shanxi University, China) and Dr. Rasmus Hovmöller (Swedish Museum of Natural History) for providing valuable literature and specimens. We also thank Dr. Mark F. O'Brien of the University of Michigan for providing photos of the type specimens of *C. holdereri*. This project was supported by the National Education Project in Basic Science for Special Subjects (Insect Systematics, No. 30725005) of National Natural Science Foundation of China.

### References

- Askew, R.R. (2004) *The dragonflies of Europe (revised edition)*. Harley Books, Colchester, 308 pp.
- Battin, T.J. (1993) Revision of the *puella* group of the genus *Coenagrion* Kirby, 1890 (Odonata, Zygoptera), with emphasis on morphologies contributing to reproductive isolation. *Hydrobiologia*, 262, 13–29.
- Belyshev, B.F. (1963) *Key to imagoes and larvae of dragonflies in Siberia*. Moscow: Academy of Sciences of the USSR, 3, 3. [In Russian]
- Bridges, C.A. (1994) Catalogue of the family-group, genus-group and species-group names of the Odonata of the world (Third Edition). The Author: Urbana, Illinois, USA. 951 pp., 824 figs.
- Chao, H.f. (1962) A study on Navásian types of Chinese dragonflies (Odonata). *Acta Entomologica Sinica*, 11, 25–31.
- Cnypuc, Z.D. (1964) Odonatoptera (Odonata). In: Bei-Bienko G.Y. (Ed.), *Key to the insects of the European part of the USSR*. Moscow: Nauka, 5(1), 146–149. [In Russian]
- Davies, D.A.L. & Tobin, P. (1984) *The dragonflies of the world: a systematic list of extant species of Odonata. Vol. 1 Zygoptera, Anisozygoptera*. Societas Internationalis Odonatologica Rapid Communications (Supplements), No. 3, Utrecht.
- Dumont, H.J. (2003) Odonata from the Republic of Mongolia and from the Autonomous Region of Inner Mongolia. *International Journal of Odonatology*, 6(2), 127–146.
- Dumont, H.J. (2004) Distinguishing between the East-Asiatic representatives of *Paracercion* Weekers & Dumont (Zygoptera: Coenagrionidae). *Odonatologica*, 33(4), 361–370.
- Förster, F. (1900) Libellen, gesammelt in Jahre 1898 in Central-Asien van Dr. J. Holderer. *Wiener entomologische Zeitung*, 19, 264–267.
- Fraser, F.C. (1924) Zoological results of the Percy Sladen Trust Expedition to Yunnan under the leadership of Professor J.W. Gregory, F.R.S (1922). *Journal of the Asiatic Society of Bengal, Pt II*, 19, 447–463.
- Hamada, K. & Inoue, K. (1985) *The dragonflies of Japan in colour*. Koshanda, Tokyo, Vol. 2, 129–291, 367–371.
- Haritonov, A.Y. (1986) Odonata. In: Lepa, P. A. (Ed.), *Key to the Insects for the Far East of Russia*. Moscow: *Nauka*, 6(1), 150–155. [In Russian]
- Hua, L. (2000) *List of Chinese insects*. Vol. 1. Zhongshan University Press, Guangzhou.
- Johanson, C.H. (1859) *Odonata Sueciae. Sveriges Trollsländor*. Westerås, Bergh, 123 pp.
- Kirby, W.F. (1890) A synonymic Catalogue of Neuroptera Odonata, or Dragonflies. Gurney & Jackson, London, UK.
- Lieftinck, M.A. (1964) Aantekeningen over *Coneagrion hylas* (Trybom) in Midden-Europa (Odonata, Coenagrionidae). *Tijdschrift voor Entomologie*, 107(3), 159–166.

- Longfield, C.E. (1954) Nomenclature of the European species of Odonata (dragonflies). *Entomologists' monthly Magazine*, 1954, 145.
- Mielewczyk, S. (1974) Bemerkungen über die Synonymie von *Coenagrion lunulatum* (Charpentier, 1840) – *C. vernale* (Hagen, 1839, nomen nudum) Zygoptera: Coenagrionidae). *Odonatologica*, 3(4), 267–268.
- Navás, R.R.L. (1933) Névroptères et insectes voisins. Chine et pays environnants. *Quatrième série. Notes D'entomologie Chinoise*, 1(9), 4.
- Needham, J.G. (1930) *A manual of the dragonflies of China*. The Fan Memorial Institute of Biology, Peiping, 266–276.
- Schmidt, E. (1963) Ueber das *Agrion holdereri* Förster, 1900. *Tombo*, 5(3–4), 22–24.
- Schorr, M., Lindeboom, M. & Paulson, D.R. (2009) *List of Odonata of the world (Part 1, Zygoptera and Anisozygoptera)* [Online]; Available from: URL: <http://www.ups.edu/x6145.xml>, accessed July 29, 2009.
- Sui, J-Z. & Sun, H-G. (1986) *Common species of dragonflies from China*. Agriculture Publishing House, Beijing, 253–258.
- Tsuda, S. (1991) *A distributional list of world Odonata*. Privately published, Osaka, 362 pp.
- Tsuda, S. (2000) *A distributional list of world Odonata*. Privately published, Osaka, 430 pp.
- Wallengren, H.D.J. (1894) Öfversikt af Skandinaviens Pseudoneuroptera. *Entomologisk Tidsskrift*, 15, 235–272.
- Weekers, P.H.H. & Dumont, H.J. (2004) A molecular study of the relationships between the coenagrionid genera *Erythromma* and *Cercion*, with the creation of *Paracercion* gen. nov. for the East Asiatic. *Odonatologica*, 33(2), 181–188.
- Yang, Z.D. (1998) The damselflies in the north of China. *Journal of Hanzhong Teachers College (Nature Science)* 16(1), 57–61.
- Yu, X. & Bu, W.J. (2007) Two new species of *Coenagrion* Kirby, 1890, from China (Odonata: Zygoptera: Coenagrionidae). *Zootaxa*, 1664, 55–59.
- Zhu, H.Q. & Han, F.Y. (2000) *Cercion yunnanensis* spec. nov., a new damselfly from Yunnan, China (Zygoptera: Coenagrionidae). *Odonatologica*, 29(2), 163–166.
- Zhu, H.Q. & Ou-yang, J. (2000) *Coenagrion bifurcatum* spec. nov., a new damselfly from Heilongjiang, China (Zygoptera: Coenagrionidae). *Odonatologica*, 29(4), 365–368.