

# A Description of the Larvae of *Cinygmula unicolorata* Tshernova, 1979 and *Cinygmula malaisei* (Ulmer, 1927) (Ephemeroptera, Heptageniidae) from the Russian Far East

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Received July 27, 2015

**Abstract**—The larvae of *Cinygmula malaisei* (Ulmer, 1927) and *Cinygmula unicolorata* Tshernova, 1979 from the Russian Far East are described and illustrated. The larva of *Cinygmula unicolorata* is similar to those of *Cinygmula putoranica* Kluge, 1980 and *Cinygmula uyka* Gorovaya et Tiunova, 2013 but differs from the larva of *C. uyka* in the absence of gill filaments and from that of *C. unicolorata* in the shape of the first gill (tergalia). The upper outer margin of the first gill is rounded in the larva of *C. unicolorata* and almost straight in *C. putoranica*; the gills of *C. unicolorata* are matte and the trachea is poorly expressed, in contrast to the distinctly brown trachea of *C. putoranica*. The larvae of *Cinygmula malaisei* are similar to those of *C. irina* and *C. autumnalis* but differ from the latter in the presence of gill filaments. The larva of *C. malaisei* differs from that of *C. irina* in the rounded outer margin of the first gill, the shape of gills VI and VII, and in the size of the leg segments.

**DOI:** 10.1134/S0013873816040060

The larvae of the mayfly genus *Cinygmula* McDunnough, 1933 are among constant components of the zoobenthos, especially in the montane and submontane streams of the southern part of the Far East (Kocharina et al., 1988; Tiunova, 1993, 2014; Tiunova and Korotenko, 2008; Tiunova et al., 2009, 2010). They constitute a significant part of the diet of fishes, first of all, of salmon fish juveniles (Kokhmenko, 1964; Tiunova and Korotenko, 2008; Tiunova et al., 2008; Teslenko et al., 2010).

At present, 13 species of the genus *Cinygmula* McDunnough, 1933 are known in the Russian Far East: *C. autumnalis* Tiunova et Gorovaya, 2012, *C. brunnea* Tiunova, 1990, *C. cava* (Ulmer, 1927), *C. hirasana* Imanishi, 1935, *C. irina* Tshernova et Belov, 1982, *C. kurenzovi* (Bajkova, 1965), *C. levanidovi* Tshernova et Belov, 1982, *C. malaisei* (Ulmer, 1927), *C. putoranica* Kluge, 1980, *C. saporovensis* (Matsumura, 1904), *C. tetramera* Tiunova et Gorovaya, 2013, *C. unicolorata* Tshernova, 1979, and *C. uyka* Gorovaya et Tiunova, 2013 (Tshernova and Belov, 1982; Belov, 1984; Tshernova et al., 1986; Tiunova, 1989; Kluge, 1997; Tiunova, 2009, 2012; Gorovaya, 2014). However, the larval stages of *C. malaisei* and *C. unicolorata* have not been known until now. Examination of reared material allowed us

to describe the larvae of *C. malaisei* and *C. unicolorata*.

The following abbreviations are used in the study: L, larva; ad, adult; sad, subadult. The collectors are designated as follows: AV, Avramenko; VZh, V. Zherihin; TT, T.M. Tiunova; TN, T.V. Nikulina; NB, N.V. Bazova.

The whole material is deposited in the collections of the Laboratory of Freshwater Hydrobiology of the Institute of Biology and Soil Science of the Far Eastern Branch of the Russian Academy of Sciences, Vladivostok.

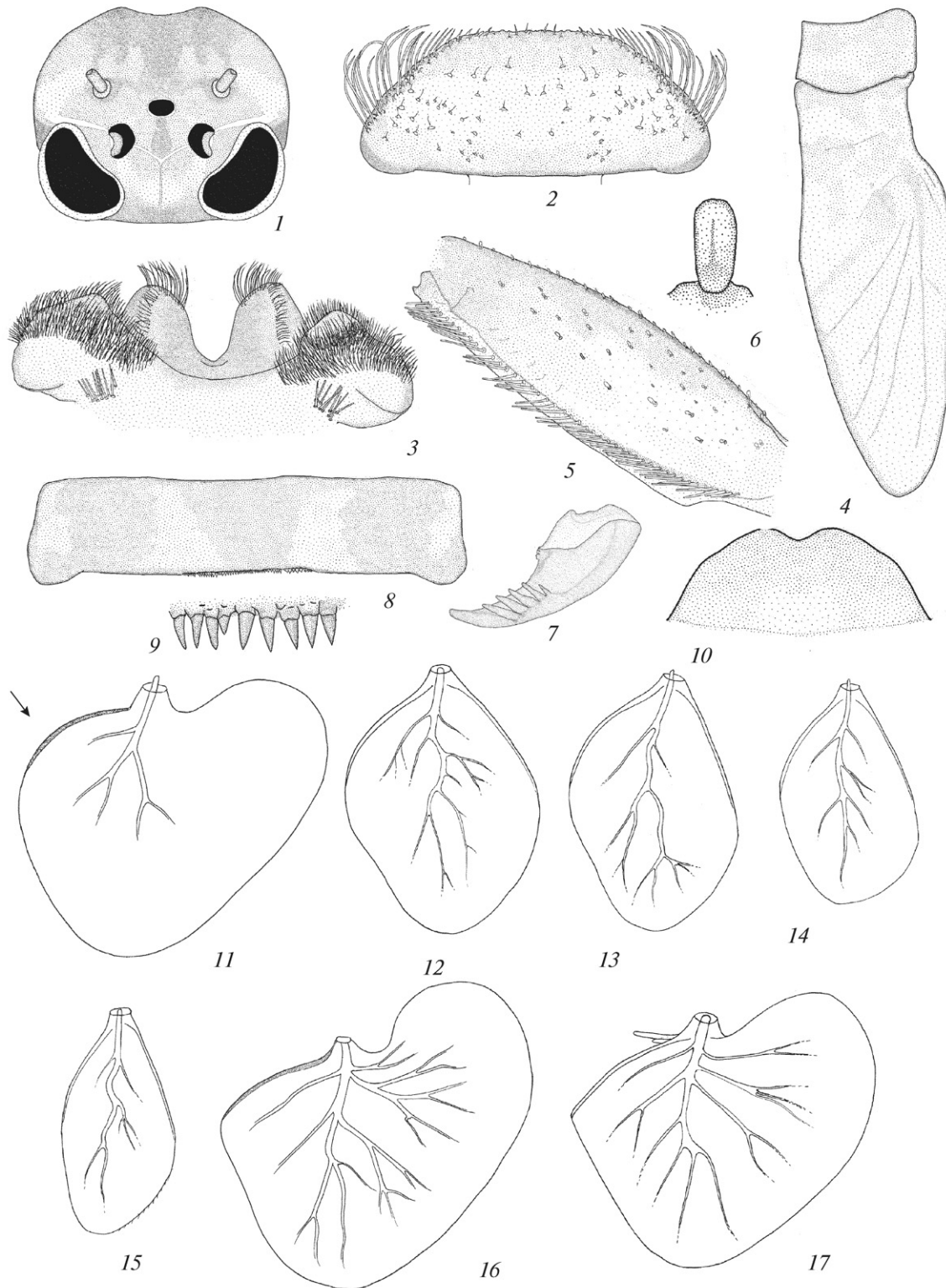
## *Cinygmula unicolorata* Tshernova, 1979 (Fig. 1, 1–15)

*Cinygmula unicolorata*: Tshernova, 1979, 9, fig. 10 (male).

*Cinygmula unicolorata*: Tshernova and Belov, 1982, 291, figs. 31, 46, 53, 64 (male, female).

*Cinygmula unicolorata*: Tshernova et al., 1986, 113, fig. 6.

**Material.** Khabarovsk Territory: Bureinskii Distr.: 2L, 4 ♂ ad—Bureya River basin, Ulmata River, 25.VII.1994, AV; 25L, 1 ♂ ad—Bureya River basin,



**Fig. 1.** Structure of the larvae of *C. unicolorata* (1–15), *C. putoranica* (16), and *C. uyka* (17), dorsal view (1–2, 4–9, 11–17), ventral view (3, 10) [(1) head; (2) labrum; (3) labium; (4) right half of pro- and mesonotum; (5) fore femur; (6) seta on surface of fore femur; (7) claw of fore leg; (8) abdominal tergite III; (9) teeth at posterior margin of abdominal tergite III; (10) sternite IX of female; (11–17) tergite pairs: (11, 16, 17) I; (12) II; (13) III; (14) VI, (15) VII pair]. Arrow points to the upper outer margin of the tergite.

Chegdomyn River, Chegdomyn Vill., a/bridge, 10–13.VII.2003, TT; Okhotskii Distr.: 8 ♂ ad—Ulia River basin, Khetana River, 7 km from mouth, 29.VII.1985, VZh; 13 ♂ ad 5.VIII.1985, VZh; 1 ♂, 1 ♀ ad—same locality, 31.VII.1985, VZh; 3 ♂ ad—same locality, 13.VIII.1985, VZh; 1 ♂ ad—same locality, 16.VIII.1985, VZh; 1 ♂, 1 ♀ ad—same locality, 18–20.VIII.1985, VZh; 1 ♂ ad—same locality, 23.VIII.1985, VZh; adult males, females—same locality, 28–29.VIII.1985, VZh; 2 ♂, 2 ♀ sad, 2 ♂ ad (reared)—Okhota River, 6 km upstream of mouth, 1–5.VIII.1998, TT; 23L, 3 ♂ ad (reared)—Okhota River, channel, 7 km upstream of mouth, 4.VIII.1998, TT; 11L, adult males, females (swarm)—Okhota River, 30 km upstream of mouth (Zhelokon), 68.VIII.1998, TT; Ayano-Maiskii Distr.: 5 ♂ and 1 ♀ ad (reared)—Dzhugdzhurskii Nature Reserve, Lantar River, about 2.5 km upstream of mouth, 28.VII.1999, TT; 1 ♂ and 1 ♀ sad (reared), adult males, females (swarm)—Aldan River basin, Aimchan River, Chelasin River tributary, 80 km from Nelkan Vill., 4.VIII.1999, TT; adult males, females (swarm)—Aldan River basin, Maya River, about 1 km downstream of Nelkan Vill., 8.VIII.1999, TT; Tuguro-Chumikanskii Distr.: 33L, 6 ♂ and 5 ♀ ad (reared)—Uda River, 4–5 km upstream of mouth, 2–13.VIII.2000; 9 ♂ ad—same locality, 27–29.VIII.2000, TT; 6L, 3 ♂ ad—Uda River, about 140 km upstream of mouth, 15–20.VIII.2000, TT; 23L—Uda River basin, Maya River, mouth, 8–9.VIII.2000, TT; 3 ♂ and 1 ♀ ad (reared)—Tyl River, about 500 m upstream of mouth, 22–26.VIII.2000, TT; 16L, 5 ♂ ad—Tyl River basin, spring flowing into Tyl River, about 300 m upstream of mouth, 25.VIII.2000, TT; 1L, 7 ♂ ad—Tylikachan River, about 200 m upstream of mouth, 24.VIII.2000, TT; Jewish Autonomous Area: 1 ♂ ad—Amur River, Pashkovo Vill., 23.VII.2003, TN; Amurskaya Province: adult males, females (swarm)—Malyi Urkan River, 150 m downstream of a/bridge, B. Never–Tynda route, 23.VII.2006, TT; Republic of Sakha (Yakutia): 3L—Iengra River, downstream of a/bridge, Neryungri–Tynda route, 3.VIII.2006, TT.

**Description. Mature larva.** Body length 6.9–7.7 mm; length of caudal filaments 6.2–8.0 mm. Body yellowish to pale brown. Head pale brown with darkened area along rounded emargination above labrum (Fig. 1, 1). Labrum pale brown, 2.3 times as wide as long (Fig. 1, 2). Paraglossae rounded, with lowered lateral margin; glossae widely spaced, rounded, with triangular apices (Fig. 1, 3). Thorax: pronotum pale

brown with darkened anterior margin; mesonotum pale brown with vague paler pattern; midline inconspicuous (Fig. 1, 4). Femora pale brown with large pale spot at basal margin (Fig. 1, 5). Surface of femora with strong brown setae (Fig. 1, 6). Claws of fore leg with 5 teeth at inner margin (Fig. 1, 7). Femur to tibia length ratio and tibia to tarsus length ratio 1.2–1.0 and 2.6–2.7 for fore leg, 1.1–1.2 and 2.8 for middle leg, and 1.2–1.3 and 2.8 for hind leg. Abdomen: tergites pale brown with pattern formed by diffuse pale spots (Fig. 1, 8). Posterior margins of tergites with areas of small pointed teeth (Fig. 1, 9). Sternites pale brown with whitish triangular areas along lateral margin. Subanal plate trapeziform, with shallow emargination and with pair of projections at sides (Fig. 1, 10). Tergaliae whitish without distinct tracheation. Tergalia I wide, with attenuate inner margin, nearly as wide as long (Fig. 1, 11); gill filaments absent; tergalia II wide, roundly diamond-shaped (Fig. 1, 12); tergaliae III–V similar in shape and size, narrower than tergalia II (Fig. 1, 13); tergalia VI more distinctly rounded (Fig. 1, 14); tergalia VII long and narrow, half as wide as long (Fig. 1, 15). Caudal filaments yellowish.

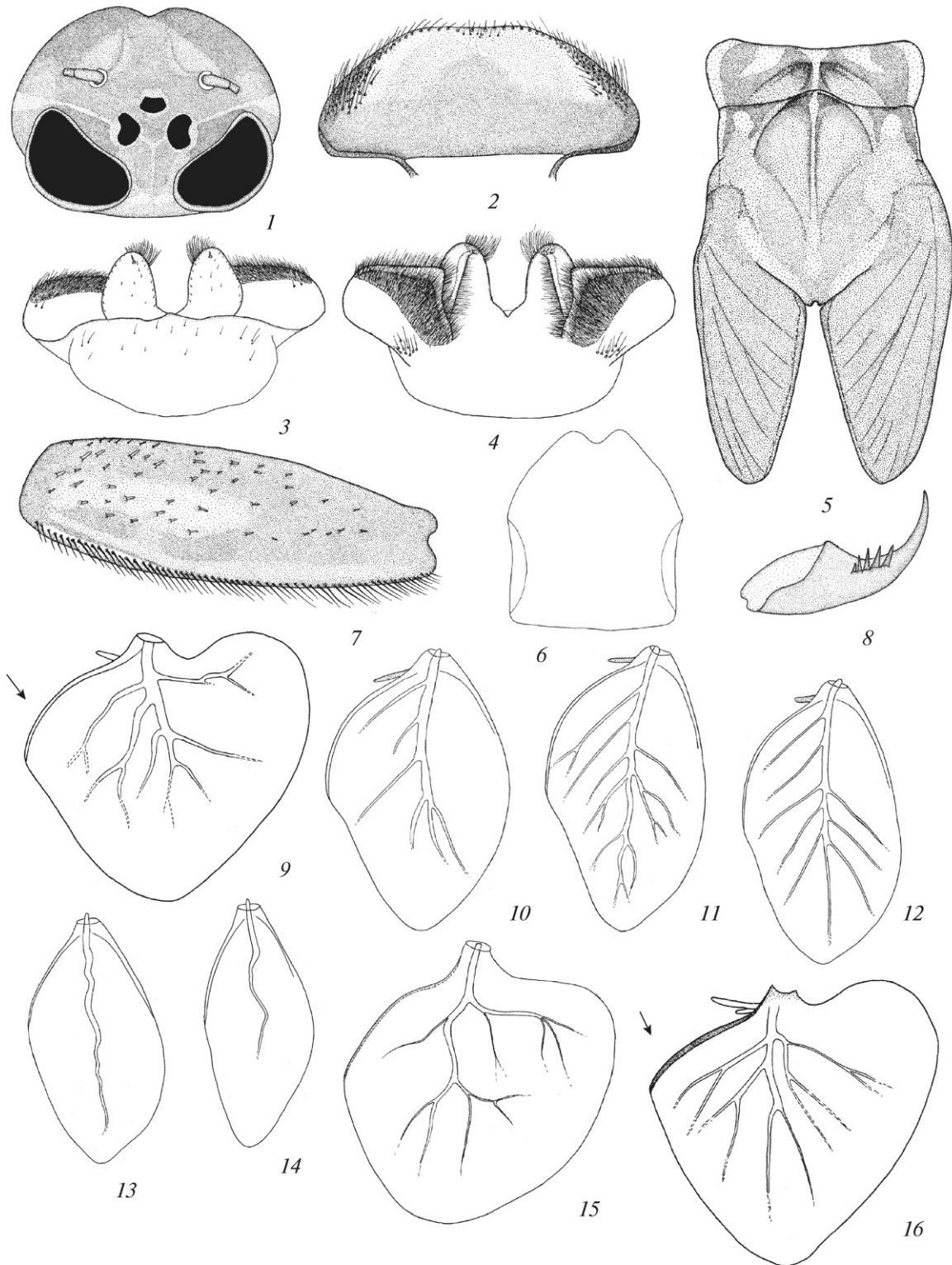
**Differential diagnosis.** In the shape of tergalia I, the larva of *C. unicolorata* is similar to those of *C. putoranica* and *C. uyka* but differs from the larva of *C. uyka* in the absence of gill filaments (Fig. 1, 17) and from that of *C. putoranica* in the shape of the tergalia. In *C. unicolorata*, the upper outer margin of the tergalia is slanting and rounded (Fig. 1, 11); in *C. putoranica*, it is nearly straight and the inner margin is more strongly attenuate (Fig. 1, 16); the tergaliae of *C. unicolorata* are matte, with an inconspicuous tracheation, in contrast to those of *C. putoranica* which have a distinct brown tracheation.

**Distribution.** The species was described from an adult male (Tshernova, 1979) collected in the Chukchi Autonomous Area on the Omolon River (the Kolyma River basin). It is also known from the upper course of the Amguema and Khasyn rivers (Magadan Prov.) (Tshernova and Belov, 1982). According to our data, the species inhabits the streams of Khabarovsk Territory (Tiunova and Tiunov, 2007), Southern Yakutia (Tiunova et al., 2009), and Amurskaya Province (Tiunova and Tiunov, 2010).

*Cinygmula malaisei* (Ulmer, 1927)

(Fig. 2, 1–14)

*Cinygma malaisei*: Ulmer, 1927, 14, figs. 13–15 (male).



**Fig. 2.** Structure of the larvae of *C. malaisei* (1–14), *C. autumnalis* (15), and *C. irina* (16), dorsal view (1 2, 4–5, 7–16), ventral view (3, 6) [(1) head; (2) labrum; (3, 4) labium; (5) pro- and mesonotum; (6) sternite IX of female; (7) fore femur; (8) claw of fore leg; (9–16) tergite I; (10) II; (11) III; (12) IV; (13) VI; (14) VII pair]. Arrow points to the upper outer margin of the tergite.

*Cinygmula andrianovae*: Tshernova et Belov, 1982, 283, figs. 4–7, 35, 38, 50, 54, 58 (male, female).

*Cinygmula malaisei*: Belov, 1983, 388 (= *Cinygmula andrianovae*)

**Material.** Khabarovsk Territory: Okhotskii District: 27L, 8 ♂, 13 ♀ sad (reared), 1 ♂, 1 ♀ ad (reared)—Bulginka River, turning to Bulgino Vill., 26.VI.1999, TT; 28L, 2 ♂ and 3 ♀ sad, 8 ♂ and 1 ♀ ad (reared)—same locality, 3.VII.1999, TT; 18L, 3 ♂ ad (reared)—Amurskaya Province, Zeiskii Distr., Allinga River, bridge, 42 km from Zeya, Zeya—Snezhnogorskii Vill. motorway, 29–30.VI.2015, TT.

**Description. Mature larva.** Body generally pale brown. Length of body 8.4–11.8 mm; length of caudal filaments 7.0–9.0 mm. Head pale brown, with deep emargination at anterior edge, with darker margins at both sides of emargination (Fig. 2, 1). Labrum pale with brown base and lateral margins, 2.4 times as wide as long (Fig. 2, 2). Part of maxillary palpus projecting beyond margins of head brown. Paraglossae pointed; glossae rounded, with V-shaped emargination (Fig. 2, 3–4). Pronotum pale brown with pale margins, with darker sides, with pair of pale drop-shaped curved spots frequently connected by pale stripe at anterior margin (Fig. 2, 5). Mesonotum pale brown, with diffuse pale spots at bases of proptera and between them; lateral corners at anterior margin brown, with rounded pale spots (Fig. 2, 5). Tergites I–IV whitish or pale brown, with pale lateral corners, with diffuse whitish sides, and with pale spot in middle part. Tergites V–IX brown, darker than tergites I–IV, with lateral margins occasionally slightly paler; whitish spots in middle part of base inconspicuous. Tergites II–VI each with pair of oblique strokes.

Sternites I–III or I–IV whitish, with pale brown paired strokes at bases; sternites V–X pale brown, with paired pale strokes at bases; lateral margins pale; sternite X with smooth deep emargination (Fig. 2, 6).

All femora with elongate pale spot at base (Fig. 2, 7), their surface covered with strong brown setae as in Fig. 1, 6. Femur to tibia length ratio and tibia to tarsus length ratio 1.2–1.0 and 2.4–2.3 for fore leg, 1.25–1.2 and 2.3–2.5 for middle leg, and 1.3–1.2 and 2.4–2.6 for hind leg. Claw of fore leg with 5 teeth at inner margin (Fig. 2, 8).

Tergaliae wide, brownish or grayish white, with inconspicuous tracheation and with fine gill filament on pairs I–V. Tergalia I with slightly attenuate inner mar-

gin, nearly as wide as long (Fig. 2, 9); tergaliae II–V similar in shape, with fine gill filament, oval, with small projection in half of inner margin (Fig. 2, 10); tergalia VI elongate, without projection, nearly twice as long as wide (Fig. 2, 11); tergalia VII narrow, more than twice as long as wide (Fig. 2, 12).

Caudal filaments whitish or yellowish, one-color.

**Notes.** The species was described by Ulmer (1927) from Kamchatka, based on an adult male. Later, it was described from the Khasyn River (Magadan Prov.) as a new species, *Cinygmula andrianovae* Tshernova et Belov, 1982 (Tshernova and Belov, 1982). However, Belov's (1983) examination of the paratype deposited in the Zoological Museum in Hamburg has shown that *C. andrianovae* is a synonym of *C. malaisei*.

**Diagnosis.** The larva of *Cinygmula malaisei* is most similar to that of *C. irina* and *C. autumnalis* in the shape of tergalia I. It differs from the larva of *C. autumnalis* in the presence of gill filaments on the tergaliae (Fig. 2, 13) and from *C. irina*, in a rounded outer upper margin of tergalia I (Fig. 2, 14), in the shape of tergaliae VI and VII, and in the proportions of the segments of the fore leg. In particular, the femur to tibia length ratio and the tibia to tarsus length ratio are 1.2–1.0 and 2.4–2.3 in *C. malaisei*, 1.0 and 2.1–2.2 in *C. irina*, and 1.2–1.1 and 3.3–2.8 in *C. autumnalis*, respectively.

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