Far Eastern Entomologist

Number 552: 8-20 ISSN 1026-051X (print edition) ISSN 2713-2196 (online edition) July 2026

https://doi.org/10.25221/fee.552.2
https://elibrary.ru/qucson
https://zoobank.org/References/2EAFA26B-ED7A-40F1-AA74-79FE0E75E888

NEW DATA ON TAXONOMY OF THE MAYFLY *CINYGMULA LATIFRONS* TSHERNOVA ET BELOV, 1982 (EPHEMEROPTERA: HEPTAGENIIDAE) FROM THE RUSSIAN FAR EAST

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Summary. The larvae, male and female imagines, and eggs of mayfly *Cinygmula latifrons* Tshernova et Belov, are described and illustrated based on reared specimens from the Russian Far East. The larvae and eggs are described and illustrated for the first time. By the shape of its gills I the larvae of *C. latifrons* is similar to the ones of *C. hirasana* Imanishi, *C. kurenzovi* (Bajkova) and *C. levanidovi* Tshernova et Belov. However, *C. hirasana* and *C. levanidovi* larvae have gill filaments on the gill I, and *C. kurenzovi* do not have thin processes at the ends of IV–VI gills characteristic of *C. latifrons.* The male imago of *C. latifrons* differs from all known Far Eastern *Cinygmula* species except *C. hirasana* in its widely separated eyes. *C. latifrons* differs from *C. hirasana* in the pear-shaped shape of the eyes and the structure of the lateral spine of the penis lobes.

Key words: mayflies, *Cinygmula*, taxonomy, morphology, egg, larvae, imagines, Russia.

Т. М. Тиунова. Новые данные по таксономии поденки *Cinygmula latifrons* Tshernova et Belov, 1982 (Ephemeroptera: Heptageniidae) с Дальнего Востока России // Дальневосточный энтомолог. 2026. N 552. С. 8-20.

Резюме. Приведены описание и иллюстрации личинок, самцов и самок имаго, а также яиц поденки *Cinygmula latifrons* Tshernova et Belov, на основании выведенных экземпляров из водотоков Дальнего Востока России. Личинки и яйца имаго *C. latifrons* описаны и проиллюстрированы впервые. Личинки *C. latifrons* по форме первой жабры близки к *C. hirasana* Imanishi, *C. levanidovi* Tshernova et Belov и *C. kurenzovi* (Bajkova). Однако у личинок *C. hirasana* and *C. levanidovi* на первой и последующих жабрах имеются жаберные нити, а у *C. kurenzovi* на концах IV–VI жабр отсутствуют тонкие отростки характерные для *C. latifrons*. Самец имаго *C. latifrons* отличается от всех известных дальневосточных видов *Cinygmula*, за исключением *C. hirasana*, широко расставленными глазами. Отличить *C. latifrons* от *C. hirasana* можно по грушевидной форме глаз и строению боковых отростков лопастей пениса.

INTRODUCTION

The At present, 13 species of the genus *Cinygmula* McDonough, 1933, are known in the Russian Far East: the East Palaearctic species *Cinygmula cava* (Ulmer, 1927), *C. kurenzovi*

(Bajkova, 1965), *C. latifrons* Tshernova et Belov, 1982, *C. putoranica* Kluge, 1980, C. *sapporensis* (Matsumura, 1904), and *C. unicolorata* Tshernova, 1979, inhabiting watercourses of the Far East and Eastern Siberia; and the East Asian continental species *C. brunnea* Tiunova, 1990, *C. irina* Tshernova et Belov, 1982, *C. levanidovi* Tshernova et Belov, 1982, *C. malaisei* Ulmer, 1927, *C. autumnalis* Tiunova et Gorovaya, 2012, *C. uyka* Gorovaya et Tiunova, 2013, and *C. tetramera* Tiunova et Gorovaya, 2013, inhabiting the watercourses of the mainland of the Far East (Tshernova & Belov 1982; Tshernova et *al*., 1986; Kluge 1997; Tiunova 2007, 2009, 2012; Tiunova & Gorovaya 2013; Gorovaya, 2014a).

Cinygmula latifrons was described by a male and female imago in 1982 from the watercourses of southern Primorye: Kavalerovsky district, Zerkalnaya River basin, and the Matrossky Stream (Tshernova & Belov, 1982). In their work, the authors write that the new species they describe is very close to the Japanese species *C. hirasana* (Imanishi, 1935), which also has widely spaced eyes in the male and similar contours of the penis lobes (Imanishi, 1935). Because of this similarity, until 1982, it was believed that *C. hirasana* lives in the waterways of Primorye. At the same time, the authors pointed out that their extensive material on *C. latifrons* larvae (which have not yet been described in the literature) differs well from *C. hirasana* larvae described by Imanishi (1935). Later, Kluge (1995) considered *C. latifrons* as a junior synonym of *C. hirasana.* And after the publication of the determinant on mayfly larvae (Kluge, 1997), a species called *C. hirasana* began to appear in all studies of the Far Eastern mayfly fauna (Arefina *et al*., 2003; Reznik, 2005; Tiunova, 2008, 2009, 2012, 2014; Potikha, 2014). In 2005, the book "Aquatic Insects of Japan: Manual with Keys and Illustrations" was published, which has a drawing of male genitals (page 113, fig. 9) of *C. hirasana* (Ishiwata, 2005), which clearly shows its differences from *C. latifrons*. This served as the basis for the restoration of *C. latifrons* as an independent species.

In this work, the larvae and eggs of the imago are described for the first time with a redescription of the male and female adult.

The following abbreviations are used in the work: collectors: T. Arefina – TA, D. Matafonov – DM, M. Omelko – MO, E. Poticha – EP, T. Tiunova – TT, I. Tiunov – IT, M. Tiunov – MT, V. Teslenko – VT; O. Zorina – OZ, N. Yavorskaya – NY; larvae – lar, imago – im, subimago – sim; village – vil.

MATERIAL AND METHODS

All samples used in this work were previously fixed in 80 % ethanol. The eggs for SEM study were extracted from female imagines. Egg were cleaned using a Branson 3510 digital ultrasonic cleaner for 5–7 seconds. After cleaning, egg were placed in 99 % ethanol for 24 hours and examined on a Merlin 62–15 scanning electron microscope. In describing the morphological structure of egg, we used the terminology proposed by Koss & Edmunds (1974) and Ubero-Pascal & Puig (2007).

All materials are deposited in the collection of the Federal Scientific Center of the East Asia Terrestrial Biodiversity, Far Eastern Branch, Russian Academy of Sciences, Vladivostok, Russia.

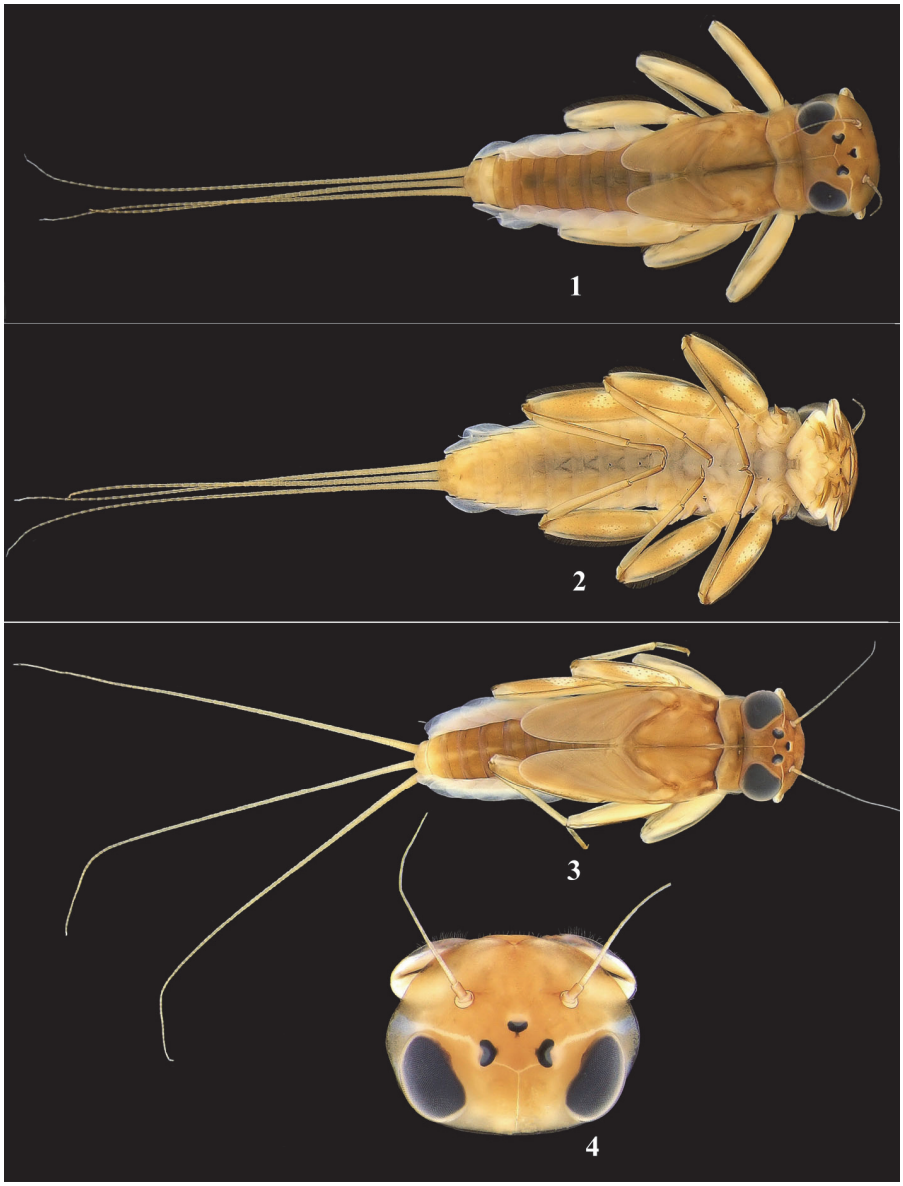
RESULTS

***Cinygmula latifrons* Tshernova et Belov, 1982**
Figs 1–42

Cinygmula latifrons Tshernova & Belov 1982: 287, figs14–17, 61 (holotype – male adult); Tshernova *et al*. 1986:112, fig. 49.*3, 4*.

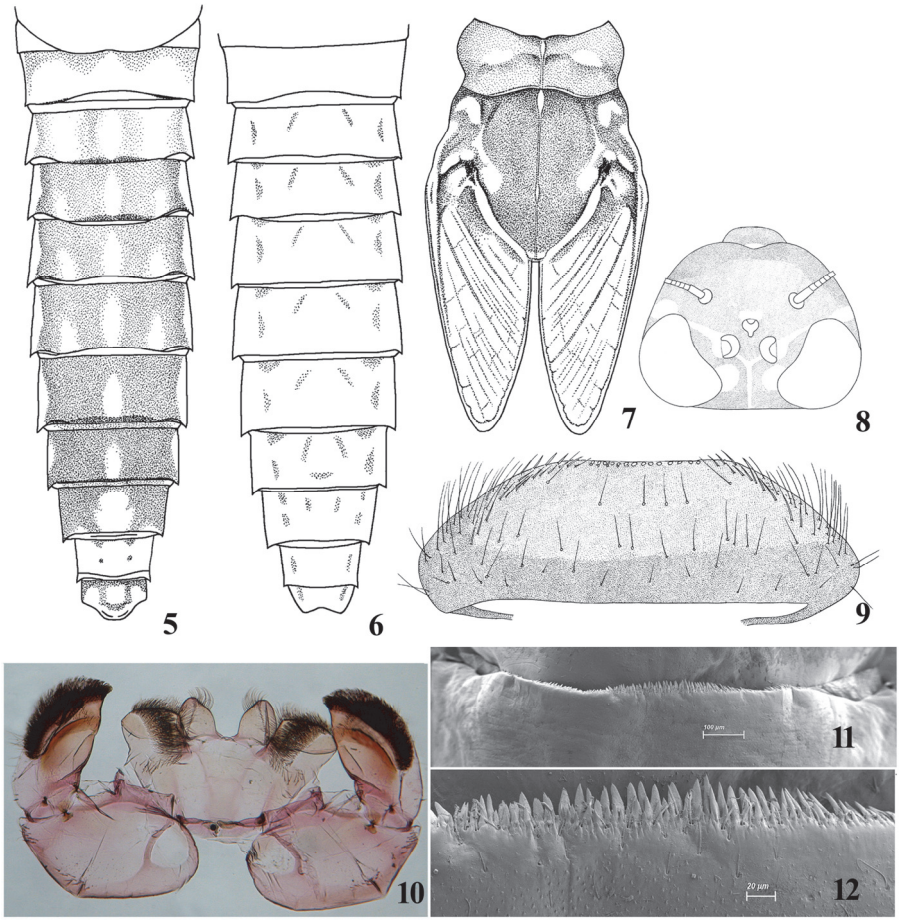
Rhithrogena (*Cinygmula*) *hirasana* (Imanishi, 1935), Kluge 1997: 321, table 16, fig. 13.

Cinygmula hirasana: Kluge 2022: 169, fig. 9.



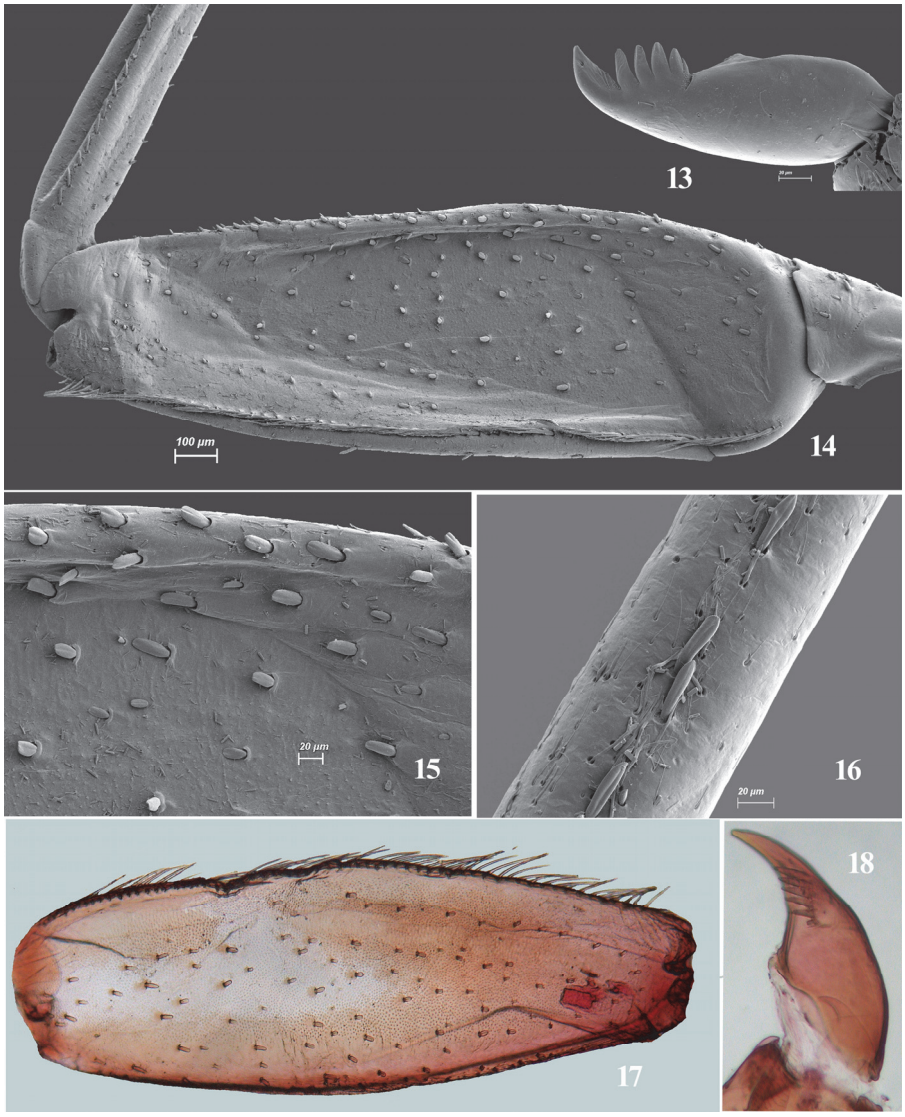
Figs 1–4. *Cinygmula latifrons*, larvae: 1– female; 2 – female, ventral view; 3 – male; 4 – head of female. 1, 3–4, dorsal view.

MATERIAL EXAMINED**.** Russia**: Primorsky Krai:** *Vladivostok city district*: Tikhaya – Shamora highway, stream above a/bridge of the Energetic recreation center, 16.VI 2014, 9♂, 22♀ im, 1♂sim, (all reared), 6 lar, TT; Bogataya River (until 1972, Lancikhe), 20.VI 1992,



Figs 5–12. *Cinygmula latifrons*, larva: 5 – abdominal terga; 6 – abdominal sterna, ventral view; 7 – pro- and mesonotum; 8 – head of male; 9 – labrum; 10 – labium; 11–12 – teeth at the posterior margin of abdominal tergite VI. 5, 7–12, dorsal view.

1♂, 1♀ im (reared), TT; *Khasansky district*: "Kedrovaya pad" reserve, Kedrovaya River: reserve base, 04.VI 1990, 1♂, 1 ♀im (reared); Kedrovaya River basin, Goraisky Stream, mouth, 04.VI 1990, 10♂im (reared), 12 lar; 27.VII 1990, 7♂, 25♀ im (reared); 28.VII 1990, 4♂, 8♀im (reared); Marine Reserve, eastern part, Nerpichya Bay, unnamed stream, 20.VIII 1996, 1♂, 1♀im (reared), 13 lar, TT; *Shkotovsky district*: Artemovka River basin (Maikhe), Suvorovka River (Peishula), 31.V 1996, 16♂, 17♀im, 3♂, 6♀sim (all reared), TT; Sukhodol River, Anisimovka vil., 13-15.VII 2016, 12♂, 15♀im (light trap), MO; *Lazovsky district*: Kievka River basin: Lazovka River, after pass to the Lazo vil., 13.VI 1998, 6 lar, TT; Yelamovsky stream, Benevsky waterfalls, 23.VI 1998, 1♂im, 14 lar, TT; Lazovsky Nature Reserve, Perekatnaya River, cordon "America", 07.VII 2007, 8♂im, OZ; Perekatnaya River, 1 km from cordon "America", 10.VII 2007, 2♂, 2♀im, OZ; *Olginsky district*: Malaya Margaritovka

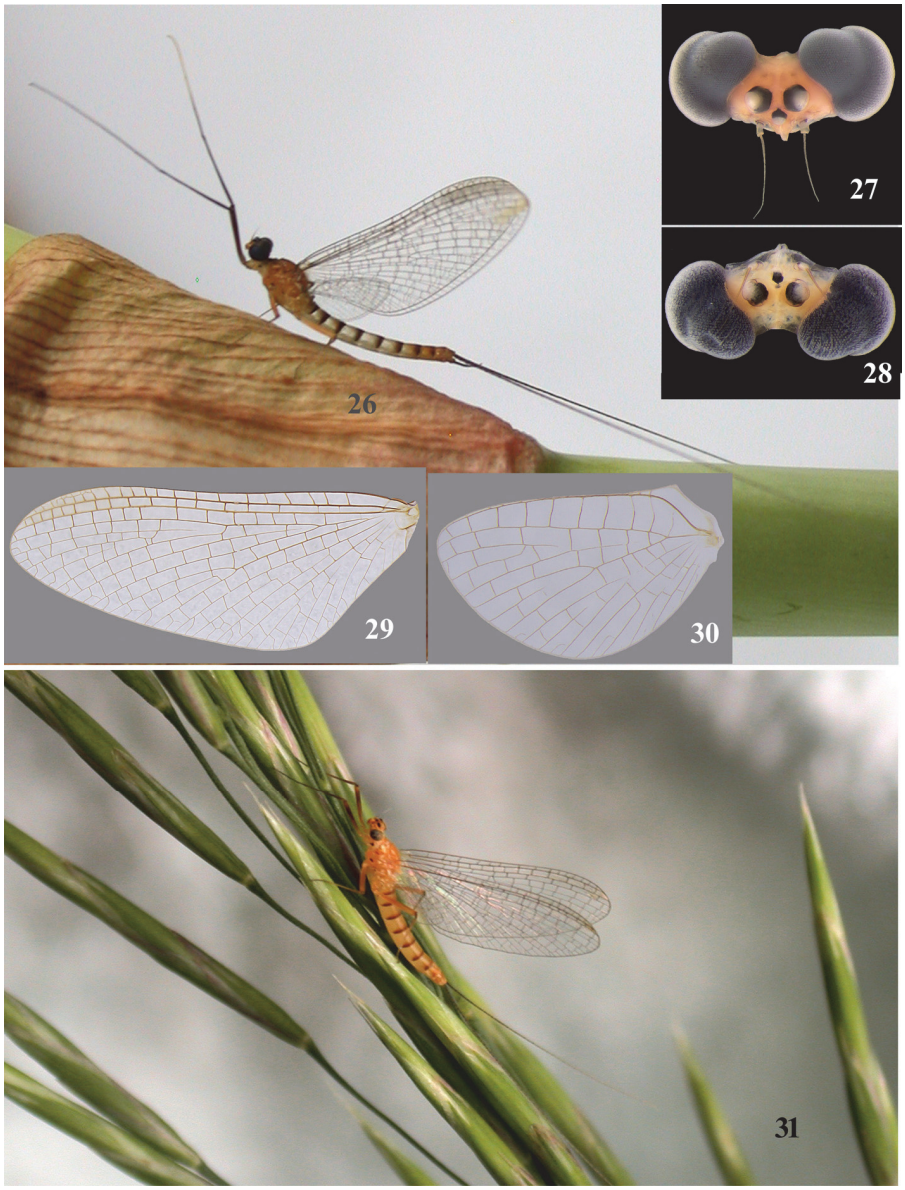


Figs 13–18. *Cinygmula latifrons*, larvae: dorsal view. 13, 18 – tarsal claw of the foreleg; 14, 17 – femur of the foreleg; 15 – setae on the dorsal surface of the fore femur; 16 – setae on the surface of the fore tibia.

River, about 10 km above mouth, 14.VI 1998, 2♂, 2♀sim (all reared), 1 lar, TT; *Chuguevsky district*: Ussuri River basin, Zubkin stream, left tributary of Ussuri River, 27.V 1992, 7 lar, TT; Ussuri River, pass Ussuri-Margaritovka rivers, 15.VI 1998, 11 lar, TT; *Pogranichny district*: Komissarovka River, Reshetnikovsky forestry estate, 13-18.VI 1988, 2♂, 2♀ (all reared), TT; *Krasnoarmeysky Municipal district:* Bolshaya Ussurka River basin: Golodny

Figs 19–25. *Cinygmula latifrons*, larvae: Gills of I–VII pairs**,** dorsal view.

stream, left tributary Armu River, 14.VI 1990, 2♂, 6♀im, 3♂ sim (all reared), 9 lar, TT; *Terneysky district:* Sikhote-Alinsky Nature Reserve, Bei River, source, Abrek tract, 25.VI 1995, 8♂, 2♀ im, EP; Dzhigitovka River basin, Kabaniy stream, 03.VII 1990, 10♂, 10♀im, EP; Kabaniy stream, 03.VIII 1997, 14♂, 5♀im, 1♂sim (all reared), 5 lar, TT; *Dalnerechensky district*, Bolshaya Ussurka River basin, Malinovka River, Pozhiga vil., 17.VI 1998, 2♀im (reared), 5 lar, TT; Perevalnaya River basin, Rogaty stream, 17.VI 1998, 3♂im, 3♂sim, TT; *Pozharsky district*: Bikin River basin: Zeva River, 1st right stream in the area of the Zevsky rocks, 19.VII 1995, 3♂, 1♀im,3♂sim (all reared), 17 lar, TT; **Khabarovsky Kray**: *District Imeni Lazo*: Khor River basin, Verkhnee Buge River, mouth, 09.VI 1995, 2♀im, 2♂sim, (all reared),7 lar, TT; Voenniy stream, left tributary Khor River, 15.VI 1995, 1♂, 8♀im, 2♀sim (all reared), 6 lar, TT; *Khabarovsky district*: Bolshekhektsirsky Nature Reserve: Polovinka River, 15.VI 2025, 3♂, 4♀im, NY; *Nanaysky district*: basin upper reaches of Anyui River, Manoma River, unnamed stream, 30 m upper bridge, highway to Sevgavan vil., 28.VII 1996, 4♂, 4♀im (reared), 16 lar, TT; same place, 18-19.VIII 1998, 2♂, 2♀ im (all reared), 11 lar, TT; *Sovetsko-Gavansky district*: Botchinsky Nature Reserve, Mulpa River basin, Solonchakovy stream, 18-20.VI 2001, 1♂, 3♀im, 1♂, 2♀sim,13lar, MT; *Komsomolsky district*: tributary of

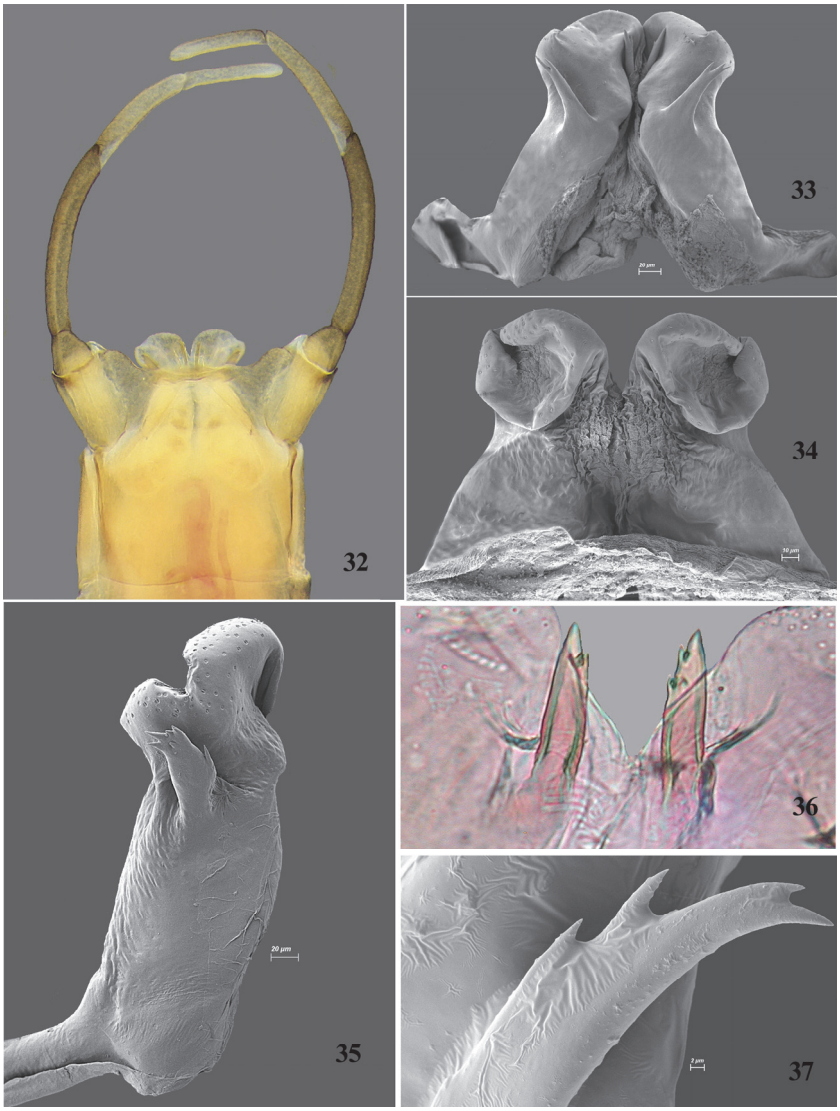


Figs 26–31. *Cinygmula latifrons*, male (26–30) and female. 26 – male, lateral view; 27–28 – head of male, dorsal view; 29 – forewing; 30 – hindwing; 31 – female, lateral view.

Amur River, Gorin River, left bank near the spring, unnamed stream, 03.VIII 2021, 4♂, 3♀im, NY; *Vaninsky district*: Tumnin River basin, Asekta stream, 160 m upper mouth, 29.VI 1997, 5♂, 14♀im, 9♂, 7♀sim (all reared),18 lar, TT; *Ulchsky district*: unnamed stream, tributary of

Amur River, behind of Susanino vil., nizina, 26.VI 2000, 7♂, 3♀im,1♀sim (all reared), 15 lar, TT; Chikhacheva Bay, highway to Lazarevo vil., Tatarka River, mouth, De-Kastri vil., 19.VI 2005, 4♂im, 1♂sim, 17 lar, TT; Bolshoy Somon River, bridge, N 51°27'50.4" E 140°41'45.3", 11.VI 2007, 1♂im, 10 lar, IT; *Nikolaevsky district:* unnamed stream, 100 m from Bezymyannaya River, about 8 km north of Lazarevo vil., 23.VI 2005, 7♂, 6♀im, (reared), 18 lar, TT; Left–bank tributaries of Amur River, Kamora River, Nikolaevsk-Vlasevo highway, about 4 km above the city of Nikolaevsk-on-Amur, 14.VII 2000, 1♂im, ♂sim, 9 lar, TT; unnamed stream, near Mago vil., 24.VI 2006, 1♂im, 2♂, 3♀sim, IT; *Verkhnebureinsky municipal district*, Badjalsky nature Reserve, Badjal Rriver basin, unnamed stream, 20.VII 2023, 5 lar, NY; *Shantarskie Islands:* Maly Shantar, north-west coast, bay south of Cape Gorbaty, estuary section of stream, 12.VIII 2010, 15 lar, VB; Bolshoy Shantar, Yakshina Bay, Yakshina River, about 1.5 km above mouth, 15.VIII 2010, 9 lar, VB; *Tuguro-Chumikansky district*: Tugursky Bay, Tugur River basin, unnamed stream Konin River, 14.VIII 2018, 5 lar, Kulbachny; Inakan River, bridge, N 53°68489 E 137°29346, 15.VII 2022, 11 lar, IT; *Ayano-Maysky district*: Uika River basin, left tributary, about 2 km above mouth, 22.VII 1999, 24♂, 20♀im, 2♂, 8♀sim (all reared),TT; Unichya River, about 1 km above mouth, 23.VII 1999, 2♂, 2♀im (all reared), TT; Dzhugdzhursky Nature Reserve: Anikey stream, about 500 m from Cape Lantarsky, 28.VII 1999, 9 lar, TT; *Okhotsky district*: stream Stariy Vodozabor, about 2 km from Okhotsk city, 03.VII 1999, 6 lar, TT; unnamed stream before mountain Tri Brata, 04.VII 1999, 3 lar, TT; **Jewish Autonomous Region**: *Oktyabrsky district*, Manchurka River, Outpost Soyuznoye, 06.VIII 2003, 2♂im, TT; *Obluchensky district*, Khingan River, above Obluchye vil., 26.VI 2004, 9 lar, TT; Kuldur River basin: Stanolir River, 12.VIII 2023, 2 lar; 13.VIII 2024, 7 lar, NY; *Birobidzhansky district*, Bastak Nature Reserve, Egersky stream, 39th cordon, 20.VI 2024, 4 lar, NY. **Amurskaya Oblast**: *Zeisky district:* Allinga River, right tributary of Tynda – Dep river system, 14.VII 2012, 11 lar, TT; Zeya River basin, Zeya reservoir basin, bridge, highway Zeya – Verkhnezeysk, Bolshoy Dess River, 21.VI 2004, 27 lar, TT; highway to Zolotaya Gora vil., Bolshaya Erakingra River, bridge, 06.VII 2013, 19 lar, TT; Zeisky Nature Reserve: Bolshaya Erakingra River, 52nd km, cordon, 3–4.VII 2015, 3♂im, 3♂, 2♀sim (reared), 35 lar, TT. **Sakhalinskaya Oblast:** *Yuzhno-Kurilsky district*, Kunashir Island: Alyokhina Bay, Alyokhina River, about 1 km above the mouth, 9.VIII 1999, 2 lar, VT. **Republic of Sakha (Yakutia)**: *Neryungrinsky district*, Timpton River basin, Atyr River, left tributary, 29.VII 2010, 3 lar, MT. **Republic of Buryatia**: *Kabansky district*, Southern Baikal, Mishikha River, below bridge, 17.V 2005, 1 lar, DM.

DISCRIPTION. **Mature larva**. Length (mm): body 6.3– 9.5; cerci 5.1–8.0. *Head*: brown or dark brown, with shallow apical incision (Figs 4, 8) and usually without light spot in the middle (Figs 1, 3–4); antennae yellowish or brownish. Labrum brown, anterior area lighter (Fig. 9). Glossae with rounded tops (Fig. 10). *Thorax*: pronotum and mesonotum brown; pronotum with a pair of light spots (Fig. 7); longitudinal stripe narrow and brownish; mesonotum with a large white spot at the base of wing pads (Figs 1, 3, 7). Femora of all legs brown with a wide white longitudinal spot from posterior margin to the middle (Fig 2, 17); femur surface relatively rarely covered with strong flattened brown setae of various sizes (Figs14–15, 17). Tibia brownish with a regular longitudinal row of strong, elongated, and flattened setae (Fig. 16). Tarsus brownish or brown, tips darker. Claws of foreleg with five or six subapical denticles (Figs 13, 18). Length (mm) of leg segments as follows. Foreleg: femur 1.6–2.1; tibia1.4–1.9; and tarsus 0.6–0.9. Middle leg: femur 1.6–2.1; tibia 1.3–1.8; and tarsus 0.55–0.7. Hind leg: femur 1.8–2.5; tibia 1.4–2.0; and 0.5–0.7. *Abdomen:* larvae can have different colors. First (Figs 1, 3): terga brown; tergum I yellowish; terga II–VIII brown with a pair of light spots on the lateral sides; posterior margins black; terga IX–X brownish.



Figs 32–37. *Cinygmula latifrons*, genitalia of male imago: 32 – genitalia; 33 – penis; 34 – penis, dorsal view; 35 – penis, lateral view; 36 – titillators; 37 – apex of lateral spine. 32–33, 36–37, ventral view.

Posterior margins of terga with a row of large and chaotically located small pointed teeth behind it (Figs 11–12). Sterna brownish with diffuse light maculation (Fig. 2); abdominal sternum IX with deep posteromedian emargination. Second (Fig. 5): tergum I almost entirely light, only brownish at the anterior margin; terga II–VIII brown or light brown with an oval light spot along the longitudinal line; terga II–VII with light lateral areas; tergum IX almost

entirely light; tergum X light with a brownish maculation (Fig. 5). Sterna brownish with an unclear maculation of darker streaks and dots (Fig. 6). Gills white, matte (Figs 19–25); sometimes the inner half of the gills tinged gray or dirty pink; all gills without gill filaments; gill I a regular heart shape, its maximum width equal to its length (Fig. 19); gills II–V the same shape and size, 1.46–1.57 times longer than the wide (Figs 20–22); gills IV–VI with a thin process at the tip that often breaks (Figs 22–24); gill VI narrow than previous (Fig. 24); gill VII narrow, length is about 2.5 times width (Fig. 25). Cerci brown or brownish (Figs 1–3).

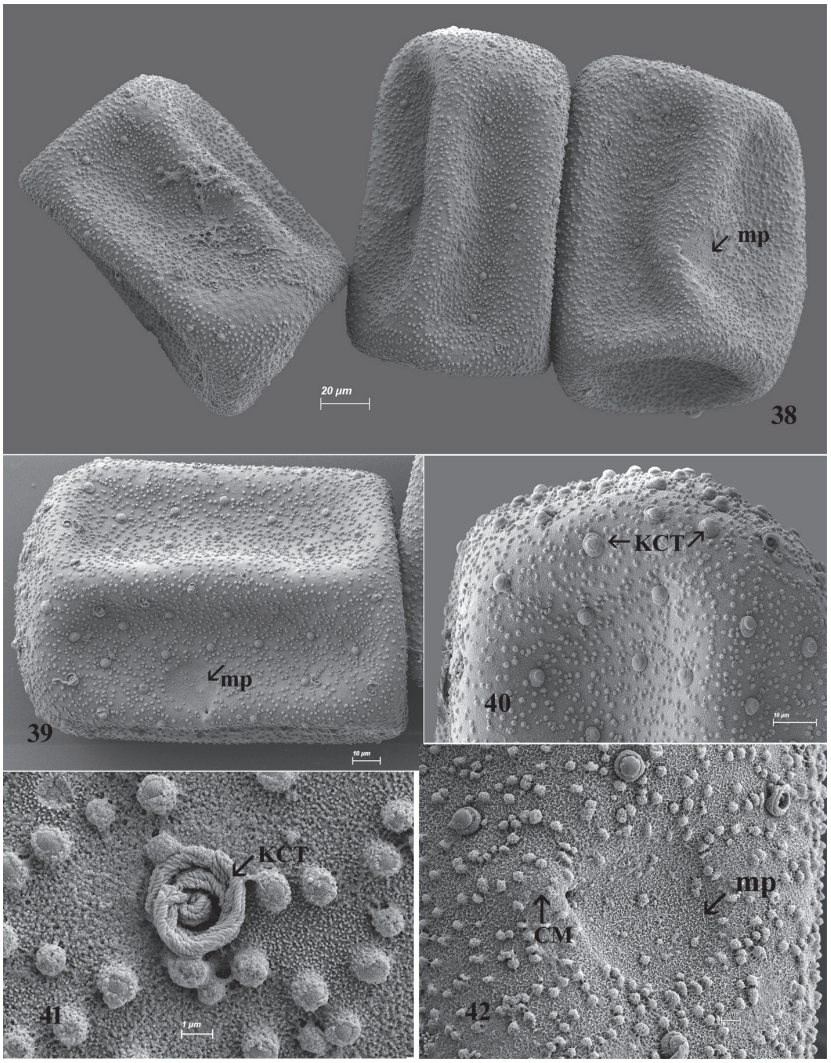
Male imago (in alcohol). Length (mm): body 6.6–9.0; forewings 8.0–9.8; cerci 13.4–25.0. *Head:* light brown with a white granular coating; eyes pear-shaped and widely spaced (Figs 27–28). *Thorax*: Medioscutum, submedioscutum and anteronotal protuberance yellowish tinged brownish; anterior phragma brownish; mesonotal suture light brown; medial longitudinal suture narrow and brownish. Scutellum pale tinged grayish; scuto-scutellar impression brownish. Forelegs brown (Fig. 26); middle and hind legs yellowish; joints and tarsal segments middle and hind legs tinged brownish. Length (mm) of foreleg segments: femora 1.8–2.4; tibia 2.5–3.5; tarsal segments 0.8–1.2; 1.2–1.7; 1.3–1.7; 1.0–1.6; and 0.3–0.5. Wings hyaline, all veins brown; pterostigma matte (Figs 26, 29, 31). *Abdomen*: Tergum I brownish; terga II–VIII brownish, translucent, posterior margin with a narrow, contrasting black stripe; terga IX–X brownish (Fig. 26). Sterna I–VIII pale, translucent; sterna VIII–IX white, opaque. Styliger brownish; first and second segments of gonostylus brown or dark brown; third segment lighter, and last lightest, brownish or yellowish (Fig. 32). Penis lobes brownish, relatively short and wide; shallowly separated, with rounded tops (Figs 32–34); outer margin with a notched in the middle (Fig. 33, 35). Each penis lobe with wide and strong lateral spine (Figs 33, 35); tips of spines with 3–7 pointed teeth (Figs 33, 35, 37). Titillators thin, with jagged tips (Figs 33, 36). Cerci brownish at the base to yellowish at the tips; joints dark.

Female imago. Length (mm): 7.0–8.8; forewings 8.5–10.5; cerci 10.2–14.2. *Head:* yellowish or whitish. *Thorax*: Medioscutum, submedioscutum and anteronotal protuberance yellowish. Scutellum yellowish; scuto-scutellar impression brownish. Forelegs dirty brownish (Fig. 30); middle and hind legs yellowish with brownish joints. Length (mm) of foreleg segments: femora 1.7–2.2; tibia 1.7–2.2; tarsus 1.4–1.9. Color of wings and veins as in male (Fig. 30). *Abdomen:* Terga yellow; posterior margin with a narrow, contrasting black stripe (Fig. 30). Sterna light brown without maculation; translucent (abdomen without egg) and not transparent (with egg) (Fig. 30). Cerci brownish at the base and yellowish or pale at the ends; joints dark.

EGG DESCRIPTION. General form cylindrical, with a length of 127–162 μm and a width of 76–111 μm (Figs 38–39). Surface of the chorion rugose and covered numerous small granules (Fig. 38–40). KCT (knob-terminated coiled thread) attachment structures rarely scattered over the chorion surface (Figs 38–40), sometimes slightly more of them at one of the poles (fig. 40). One or two round micropyles located in the equatorial area (figs 38–39); sperm guide round, with a length of 15.3–22.4 μm and a width of 13.376–18.8 μm (Figs 39, 42) and poorly expressed (fig. 42); micropylar canal relatively short, 8.5–13.5 μm in length, and slightly protrudes above the surface of the chorion (Fig. 42).

DISTRIBUTION AND BIOLOGY. *Cinygmula latifrons* is an East Palaearctic species that is distributed in the Russian Far East and Buryatia.

Larvae of this species are associated with stones, gravel, and pebbles in small rivers or streams, which are characterized as cold and moderately cold rivers. According to the duration of adult flight, *C. latifrons* belongs to species with a prolonged summer period (Gorovaya, 1914b). The first imagos of this species were noted by us in the last days of May–in early June, the last–in late August. The main flight of imago *C. latifrons* falls in June.



Figs 38–42. *Cinygmula latifrons*, egg: 38–39 – general view; 40–41 – structure of chorion; 42 – micropyle. The arrows show the micropyles (mp); knob-terminated coiled threads (KCT); micropylar canal (CM).

REMARKS. The larva of *C. latifrons* is similar to the one of *C. hirasana, C. kurenzovi* and *C. levanidovi*, but it can be distinguished from these species and from all other Far Eastern *Cinygmula* by the shape of first gill, which is almost symmetric and heart-shape. The first gill of *C. hirasana,* C. *levanidovi* and *C. kurenzovi* has a similar shape, but *C. hirasana* and *C. levanidovi* there are gills filaments on the first and on the other gills. *C. kurenzovi* gill do not have gills filaments, but they also lack thin processes at the ends of VI–VI gills characteristic of *C. latifrons.*

The male imago of *C. latifrons* differs from all known Far Eastern *Cinygmula* species except *C. hirasana* in its widely separated eyes. *C. latifrons* differs from *C. hirasana* in the pear-shaped shape of the eyes and the structure of the lateral spine of the penis lobes.

ACKNOWLEDGEMENTS

The scanning electron micrographs were prepared with the help of Vitaliy Kazarin (Federal Scientific Center of the East Asia Terrestrial Biodiversity Far Eastern Branch, Russian Academy of Sciences, Vladivostok). The research was carried out within the state assignment of Ministry of Science and Higher Education of the Russian Federation (theme No. 124012400285-7).

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