

Redescription of *Paraleptophlebia falcula* Traver 1934 with notes on status and composition of *Paraleptophlebia* Lestage 1917 and *Neoleptophlebia* Kluge 1997 (Ephemeroptera: Leptophlebiidae)

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Abstract

The taxon *Paraleptophlebia* Lestage 1917 is accepted here in generic rank, so rank of *Neoleptophlebia* Kluge 1997 is also raised from subgenus to genus, and the following new combinations are proposed: *Neoleptophlebia adoptiva* (McDunnough 1929) **comb. n.**, *N. assimilis* (Banks 1914) **comb. n.**, *N. erratica* (Kang & Yang 1994) **comb. n.**, *N. heteronea* (McDunnough 1924) **comb. n.**, *N. japonica* (Matsumura 1931) **comb. n.** (= *Paraleptophlebia chocolata* Imanishi 1937), *N. mollis* (Eaton 1871) **comb. n.**, *N. memorialis* (Eaton 1884) **comb. n.**, *N. spina* (Kang & Yang 1994) **comb. n.**, *N. swannanoa* (Traver 1932) **comb. n.**, *N. temporalis* (McDunnough 1926) **comb. n.**, *N. vladivostokica* (Kluge 1982) **comb. n.** Larvae, male and female imagoes and eggs of *Paraleptophlebia falcula* Traver 1934 are described based on reared specimens from Siberia and Russian Far East; larvae and eggs are described for the first time. Characters of this species agree with diagnosis of *Paraleptophlebia* in the restricted sense; comparison of larva of *P. falcula* with other known larvae of *Paraleptophlebia* is given. Formerly this species was known as imagoes from limited area in Western Nearctic. According to the new data, it is widely distributed in northern part of Amphipacific Sector of Holarctic, and its area includes Polar Urals (Komi Republic), Siberia (Transbaikalia, Sakha Yakutia and Amurskaya Oblast' of Russia) and west of North America (Oregon, Idaho and Washington states of USA).

Key words: mayflies, *Paraleptophlebia*, taxonomy, morphology, egg, Far East, Siberia, Urals

Introduction

Paraleptophlebia falcula Traver 1934 was originally described based on a single male imago from Oregon. Harper and Harper (1986) gave more detailed drawing of genitals of *P. falcula* and reported its range as Idaho and Oregon; they noted that "The nymph has never been described and the biology of the species is still unknown". McCafferty, Randolph & Jacobus (2012) reported *P. falcula* from Idaho and noted that "This appears to be an insular species within the Columbia River Drainage System, known also from relatively few records from Oregon and Washington (see Meyer and McCafferty 2007a,b). Its presence in nearby Idaho was predictable. This species is generally rare and possibly of environmental concern". Male imagoes collected in Polar Urals, appear to belong to this species, and based on this fact, *P. falcula* is included to the web database "Fauna Europaea" (Kluge 2000).

One of us (T. Tiunova) in 2005–2015 reared imagoes of *P. falcula* from larvae collected in various regions of Siberia and Russian Far East, that allows larvae, female imagoes and eggs of this species to be described for the first time. To compare *P. falcula* with other species of *Paraleptophlebia* Lestage 1917, we have to outline the taxon *Paraleptophlebia*. In the recent literature, this taxon is accepted either as a genus, or as a subgenus of the genus *Leptophlebia* Westwood 1840. Some East Palaearctic and Nearctic species once attributed to the genus or subgenus *Paraleptophlebia*, are actually not related with true *Paraleptophlebia*, and for these species a taxon *Neoleptophlebia* Kluge 1997 was established. Originally, the genus-group name *Neoleptophlebia* was introduced in a subgeneric rank, because both *Neoleptophlebia* and *Paraleptophlebia* were accepted as subgenera of the genus

Leptophlebia s.l. (Kluge 1997). Recently most authors accept *Paraleptophlebia* in a generic rank, that requires to raise the rank of *Neoleptophlebia* to the genus as well. This change of ranks requires to establish new formal binominal combinations, that have not been done yet. So in this paper we repeat definitions of *Paraleptophlebia* and *Neoleptophlebia* and propose new species name combinations. Some species, whose larvae remain to be undescribed, appear to have uncertain systematic position.

Material

Part of material is deposited in the Institute of Biology and Soil Sciences, Far Eastern Branch of Russian Academy of Science, Vladivostok (IBSS); part of material will be permanently deposited in the Zoological Institute of Academy of Sciences, Saint Petersburg (ZIN) and now is temporarily located in the Department of Entomology of Saint Petersburg State University.

For the species mentioned in the text, the following material was examined:

Habroleptoides caucasica Tshernova 1931: imagoes reared from larvae (Kluge 1994) (ZIN).

Habroleptoides pontica Kluge 1994: imagoes reared from larvae (Kluge 1994) (ZIN).

Habroleptoides spp.: larvae (Kluge 1994) (ZIN).

Calliarcys humilis Eaton 1881: Spain: Rio Manzanares, La Padreza (E Madrid), 9.IV.1990, coll. P. Landolt & D. Studemann: 2 ♂im., 1 ♂subim., 1 ♀subim., 2 larvae, 1 larval exuviae; Rio Eresma/Valsain (E Segovia), 15.IV.1990, coll. P. Landolt & D. Studemann: 1 ♂im., 4 larval exuviae (ZIN).

Habrophlebiodes zijinensis Gui *et al.* 1996: China, Shaoxing, stream in Kudiji Mountain Tuorist Holiday Resort, 21–23.V.2012, coll. L. Sheyko: 2 ♂im., 1 ♂subim., 1 ♀im. (all reared from larvae), 1 ♂im. (reared from subimago), larvae (ZIN).

Habrophlebiodes ? *americana* (Banks 1903): USA, Vermont, stream near Wolcott, 27.VI–5.VII.1991, coll. A. Prziboro: 1 ♂subim., 2 larvae (ZIN).

Habrophlebiodes sp.: Indonesia, Sulawesi, 5 km W Mamasa, 15–27.VIII.2009, coll. N. Kluge & L. Sheyko: 1 ♀im., 1 ♀subim., 4 larvae (ZIN).

Neoleptophlebia japonica (Matsumura 1931): Russia: Eastern Siberia and Far East: male and female imagoes reared from larvae (IBSS and ZIN).

Neoleptophlebia vladivostokica (Kluge 1982): imagoes reared from larvae (Kluge 1982) (ZIN). Russia, Promorkiy Kray: bassin of Partizanskaya River, 3rd Tigrovaya River, 15.VII.2014, coll. I. Tiunov & E. Gorovaya: larvae (IBSS); Lazovskiy Natural Reserve, rivers Proselochnaya, Pryamushka and Kievka, 2007 and 2014: larvae and imagoes (IBSS).

Neoleptophlebia adoptiva (McDunnough 1929): USA: Vermont, stream near Wautsfield, 23.VI.1991, coll. A. Prziboro: 2 larvae; Maine, Carrabassett N.P., 27.IV.1986, coll. S.K. Burian: 1 ♂im. (reared from larva) (ZIN).

Neoleptophlebia mollis (Eaton 1871): USA, Maine, Aroostock River, 30.V.1987, coll. S.K. Burian: 2 ♂im. (reared from larva), 5 larvae (ZIN).

Paraleptophlebia cincta (Retzius 1783): Lithuania, Verkne River near Staklishkes, 27.VI.1988, coll. N. Kluge: 1 ♂im. (reared from larva) (ZIN). Russia: Leningrad Province and Komi Republic: imagoes and larvae (ZIN).

Paraleptophlebia guttata (McDunnough 1924): USA, Maine, Sheepscot River, 9.VIII.1992, coll. N. Kluge: ♂im. (reared from larva), 1 larva (ZIN).

Paraleptophlebia packii (Needham 1927): USA, Utah, Provo River, 11.X.1947, coll. G.F. Edmunds: 3 ♂im., 2 larvae (ZIN).

Paraleptophlebia strandii (Eaton 1901): Russia (Murmansk Province, Siberia and Far East) and Mongolia: male and female imagoes reared from larvae (IBSS and ZIN).

Paraleptophlebia submarginata (Stephens 1835): Russia (Leningrad Province, Komi Republic and Novosibirsk Province), Armenia and Kazakhstan: male and female imagoes reared from larvae (ZIN).

Paraleptophlebia werneri Ulmer 1920: Russia (Leningrad Province, Karelia, Vladimir Province, Komi Republic, Ul'anovsk Province), Kazakhstan: male imagoes reared from larvae (ZIN).

Paraleptophlebia falcata Traver 1934: see list of material examined below.

Systematic position, status and composition of the genus *Paraleptophlebia*

The taxon *Leptophlebia*/fg1 (sensu Kluge 2004) is generally accepted as family Leptophlebiidae Banks 1900; it is divided into the plesiomorphon *Leptophlebia*/fg2 and the holophyletic taxon *Atalophleboadentata* Kluge 2009. *Atalophleboadentata* is divided into the holophyletic taxa *Calliarcys*/fg1 (accepted as the genus *Calliarcys* Eaton 1881 and the subfamily *Calliarcyinae* Kluge 2009 at the same time) and *Atalophlebopectinata* Kluge 2009. *Atalophlebopectinata* is divided into the holophyletic taxa *Habrophlebia*/fg1 (accepted here as a subfamily *Habrophlebiinae* Kluge 1994) and *Atalophleboculata* Kluge 2009. *Atalophleboculata* is divided into the holophyletic taxa *Terpides*/fg1 (accepted here as a subfamily *Terpidinae* Kluge 2009) and *Atalophlebomaxillata* Kluge 2009. *Atalophlebomaxillata* is divided into the holophyletic taxa *Castanophlebia*/fg1 (accepted as the genus *Castanophlebia* Barnard 1932 and the subfamily *Castanophlebiinae* Kluge 2009 at the same time) and *Atalophlebolinguata* Kluge 2009 (accepted here as a subfamily *Atalophlebiinae* Peters 1980).

The plesiomorphon *Leptophlebia*/fg2 is accepted here as a subfamily *Leptophlebiinae* in some restricted sense (i.e., sensu Kluge 2009). It includes the following taxa accepted in the present paper in generic ranks: *Leptophlebia* Westwood 1840 (s.str.), *Paraleptophlebia* Lestage 1917, *Neoleptophlebia* Kluge 1997, *Habrophlebiodes* Ulmer 1920, *Dipterophlebiodes* Demoulin 1954 and *Gilliesia* Peters & Edmunds 1970. Among them, the taxon *Neoleptophlebia* was established for a couple of species which were formerly placed to *Paraleptophlebia*; only 4 of these species were listed precisely, being examined by the author: *chocolata* Imanishi 1937 [*Paraleptophlebia*], *vladivostokica* Kluge 1982 [*Paraleptophlebia*], *mollis* Eaton 1871 [*Leptophlebia*] and *adoptiva* McDunnough 1929 [*Leptophlebia*].

Traditionally, the taxa *Leptophlebia* s.str. and *Paraleptophlebia* were treated either as genera, or as subgenera of the genus *Leptophlebia* s.l.; the taxon *Neoleptophlebia* was originally introduced as a subgenus of the genus *Leptophlebia* s.l., which included subgenera *Leptophlebia* s.str. and *Paraleptophlebia*, thus *Neoleptophlebia* and *Paraleptophlebia* had equal ranks (Kluge 1997). Following the ranks most often accepted in recent literature, the taxa *Leptophlebia* s.str. and *Paraleptophlebia* are herein recognized at the genus rank, which require elevating *Neoleptophlebia* also to genus. The following new binomina are proposed: *Neoleptophlebia adoptiva* (McDunnough 1929 [*Leptophlebia*]) **comb. n.**, *N. assimilis* (Banks 1914 [*Leptophlebia*]) **comb. n.**, *N. erratica* (Kang & Yang 1994 [*Paraleptophlebia*]) **comb. n.**, *N. heteronea* (McDunnough 1924a [*Leptophlebia*]) **comb. n.**, *N. japonica* (Matsumura 1931 [*Baetis*]) **comb. n.** (= *Paraleptophlebia chocolata* Imanishi 1937), *N. mollis* (Eaton 1871 [*Leptophlebia*]) **comb. n.**, *N. memorialis* (Eaton 1884 [*Leptophlebia*]) **comb. n.**, *N. spina* (Kang & Yang 1994 [*Paraleptophlebia*]) **comb. n.**, *N. swannanoa* (Traver 1932 [*Leptophlebia*]) **comb. n.**, *N. temporalis* (McDunnough 1926 [*Leptophlebia*]) **comb. n.** and *N. vladivostokica* (Kluge 1982 [*Paraleptophlebia*]) **comb. n.**

The species known only as imagoes and possibly belonging to *Neoleptophlebia* are: *aquilina* Harper & Harper 1986 [*Paraleptophlebia*], *brunneipennis* McDunnough 1924b [*Leptophlebia*], *georgiana* Traver 1934 [*Paraleptophlebia*], *jenseni* McCafferty & Kondratieff 1999 [*Paraleptophlebia*], *kirchneri* Kondratieff & Durfee 1994 [*Paraleptophlebia*], *rufivenosa* Eaton 1884 [*Leptophlebia*], *spinosa* (Ueno 1931 [*Paraleptophlebia*]), *traverae* McCafferty & Kondratieff 1999 [*Paraleptophlebia*] and *vaciva* Eaton 1884 [*Leptophlebia*].

The genus *Paraleptophlebia* differs from the genus *Neoleptophlebia* by three characters: (1) tergalii V-shape, i.e. with two slender lobes separated nearly up to base (Figs 14–22); (2) third segment of labial palp widest near its middle (Fig. 8); (3) penis with a pair of ventral appendages arising from apex of each penis lobe and directed proximally (Figs 26–30).

In contrast to this, *Neoleptophlebia* has larval structure similar to *Habrophlebiodes*, *Dipterophlebiodes* and *Gilliesia* (which are attributed here to the same plesiomorphon—subfamily *Leptophlebiinae*), as well as to the primitive representatives of *Atalophleboadentata*, such as *Calliarcys* Eaton 1881 (subfam. *Calliarcyinae*) and *Habroleptoides* Schoenemund 1929 (subfam. *Habrophlebiinae*): (1) tergalii Y-shape, i.e. with rather long and wide portion proximad of furcation, and (2) third segment of labial palp widest near its base. Various species of *Neoleptophlebia* have diverse penis structure, with or without processes, but always without the pair of ventral processes directed proximally. This conclusion is based on the study of several species of *Neoleptophlebia*, *Habrophlebiodes*, *Calliarcys* and *Habroleptoides* (see list of material examined above) and literature data on other species of *Neoleptophlebia* (e.g., Needham & Christenson 1927, Needham, Traver & Hsu 1935; Kang & Yang 1994; Randolph & McCafferty 1996), *Habrophlebiodes* (e.g., Ulmer 1939; Kang & Yang 1994), *Dipterophlebiodes* (Peters 1972), *Gilliesia* (Boonsoong & Sartori 2015), *Calliarcys* (Godunko *et al.* 2015) and *Habroleptoides*

(Schoenemund 1929). *Neoleptophlebia* is distributed in Nearctic, Eastern Palaearctic and Oriental Region. Possibly, Leptophlebiinae is a paraphyletic group ancestral to Atalophleboadentata, and *Neoleptophlebia*, *Habrophlebiodes*, *Dipterophlebiodes* and *Gilliesia* should be united with Atalophleboadentata to form a higher taxon opposed to *Leptophlebia*+*Paraleptophlebia*. It is also possible, that *Neoleptophlebia* represents a heterogeneous group, which in future will be divided into smaller genera.

Both *Leptophlebia* and *Paraleptophlebia* have penis with a pair of ventral appendages arising from apex of each penis lobe and directed proximally. Possibly, this is their synapomorphy. More grounded conclusions about phylogenetic relationships of the taxa now comprising the subfamily Leptophlebiinae, which would allow to reclassify these taxa, could be done after study of that species, whose larvae are still unknown or poorly known.

Paraleptophlebia in the restricted sense includes more than 30 species in the Recent Holarctic fauna; not less than two extinct species are known from Paleogene of Europe (Kluge 1993).

Genus *Paraleptophlebia* Lestage 1917

Type species: *Ephemera cincta* Retzius 1783.

In circumscription corresponds to subgenus *Paraleptophlebia* sensu Kluge 1997.

Diagnosis. Larva. (1) Third segment of maxillary palp widest in middle part (Fig. 8) (the same in *Leptophlebia*; in contrast to *Neoleptophlebia*, *Habrophlebiodes*, *Dipterophlebiodes* and *Gilliesia*).

(2) Tergalii V-shape, i.e. with two slender lobes separated nearly up to base (Figs 14–22) (in contrast to *Leptophlebia*, whose tergalii II–VII have lobes widened; in contrast to *Neoleptophlebia*, *Habrophlebiodes*, *Dipterophlebiodes* and *Gilliesia*, whose tergalii have lobes less separated).

Male imago. (3) Hind wing fully developed, without costal projection, with Sc terminating near apex (Fig. 23) (the same in *Leptophlebia* and *Neoleptophlebia*; in contrast to *Habrophlebiodes*, *Dipterophlebiodes* and *Gilliesia*).

(4) Penis deeply divided, with a pair of ventral appendages arising from apex of each penis lobe and directed proximally (Figs 26–30) (similar to *Leptophlebia*, possibly synapomorphy).

Distribution. Holarctic.

Paraleptophlebia falcula Traver 1934

(Figs 1–37)

Paraleptophlebia falcula Traver 1934: 190 (male imago); Needham *et al.* 1935: 520 (male imago); Harper & Harper 1986: 1465 (male imago).

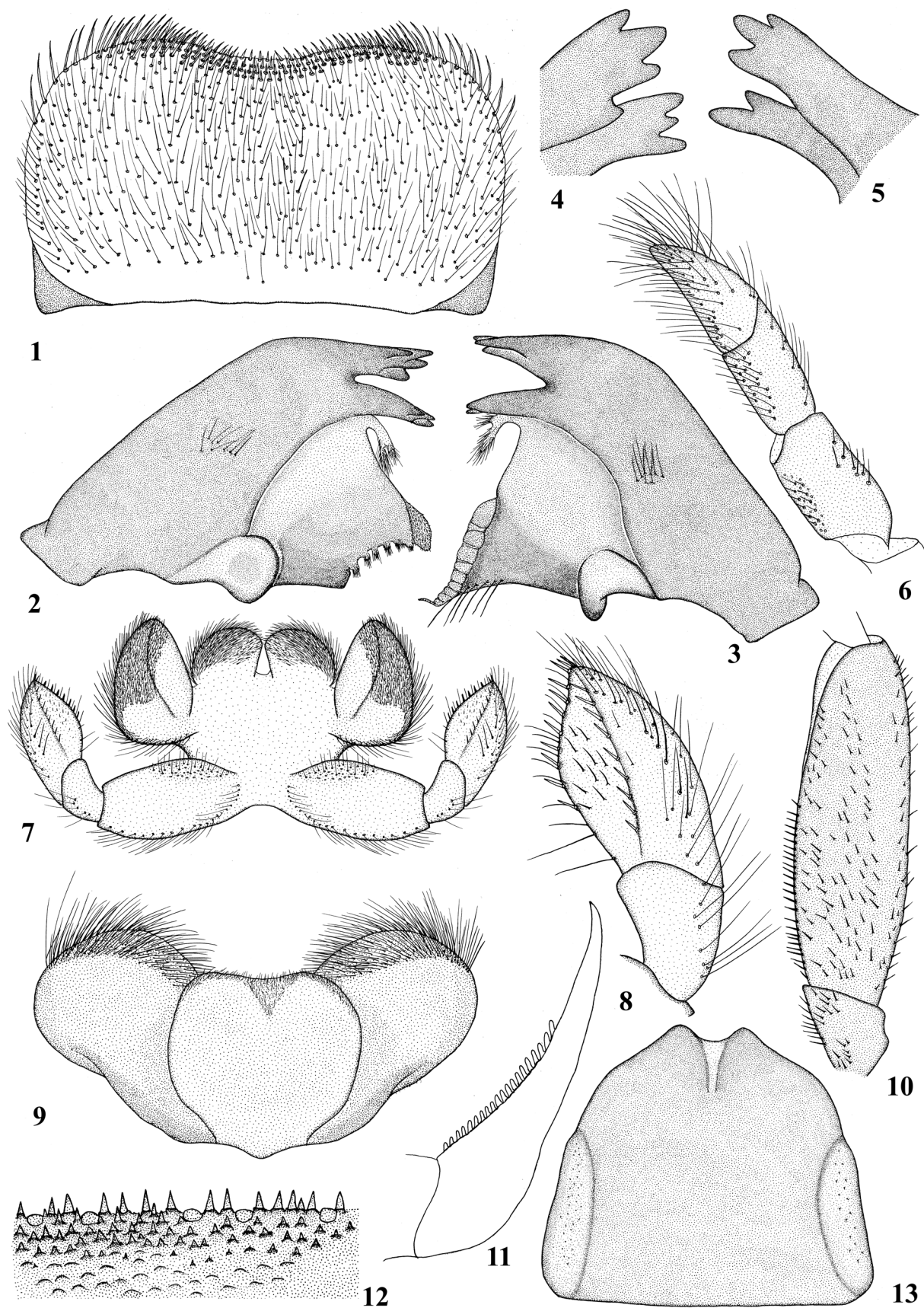
Material. RUSSIAN FEDERATION: AMURSKAYA OBLAST': Zeya River basin: Bolshaya Makcha river, bridge at highway Tygda – Zeya, 28.VI.2013, Coll. T. Tiunova: 1 ♂im., 1 ♀im. (reared from larvae); same place, 28.VI.2015, coll. T. Tiunova: 1 ♂im., 3 ♀im. (reared from larvae), 3 larvae; Allinga river (river system Allinga-Tynda-Dep-Zeya), low bridge at highway Zeya – Snezhnogorsk, 14.VII.2012, coll. T. Tiunova: 1 ♂im., 1 ♀im. (reared from larvae), 8 larvae; same place, 24.VII.2014, coll. T. Tiunova: 10 larvae; Allinga river near mouth, 29–30.VI.2015, coll. T. Tiunova: 5 ♂im., 3 ♀im. (reared from larvae), 11 larvae; Amur river basin, Talali river, upper reaches, about 5 km above Gonzha village, 25.VIII.2004, coll. T. Tiunova: 2 ♂im., 3 ♀im (IBSS). TRANSBAIKAL KRAY, Chasovinka river (tributary of Shilka river) about 300 m above mouth, 24.VII.2005, coll. T. Tiunova: 2 ♂im., 3 ♀im. (reared from larvae), 2 L (IBSS). SAKHA YAKUTIA, Chulman river basin, Amnunnykta river, about 500 m upper mouth, 28.VII.2010, coll. T. Tiunova: 1 ♂subim., 1 larva (IBSS). KOMI REPUBLIC, Vorkuta: Ayach Yaga river (tributary of Vorkuta river), 4.VIII.1958, coll. Chernykh: 3 ♂im.; Sabrey-Yaga river, coll. Iordansky: 1 ♂im. (only styliger on slide made by O. Chernova) (ZIN).

Description. Mature larva. Length (mm): body 5.3–6.8; cerci 4.6–8.2. **Head:** Brown with occipit light brown and pale spots around lateral ocelli and anterior to median ocellus (cuticular coloration). Antennae white. Labrum dark brown; dorsal surface covered with long hair-like setae; anterior margin with shallow emargination and several rows of stout setae (Fig. 1). Mandibles dark brown, with broad band extending parallel to outer edge (Figs 2–3). Left mandible with incisor terminated by 4 denticles and kinetodontium terminated by 3 denticles (Fig. 4),

right mandible with incisor terminated by 3 denticles and kinetodontium terminated by 3 denticles (Fig. 5). Both mandibles with extensive patches of setae on dorsal surface in middle area. Right mandible with row of long hair-like setae proximal of molar surface (Fig. 3). 1st segment of maxillary palp with several spine-like setae along outer margin and small thin setae along inner margin; 2nd segment with long hair-like setae on both margins; 3rd segment almost completely covered with very long, thin hair-like setae (Fig. 6). Maxillary palp with 2nd and 3rd segments subequal in length, together 1.55 times longer than 1st segment. Labium as in Fig. 7; apical part of dorsal surface of glossae densely covered with stout hair-like setae; among them small stout setae located nearer to inner edge; dorsal surface of paraglossae covered with small stout setae and long hair-like lateral setae (Fig. 7); 3rd segment of labial palp with rows of stout variably spaced setae (Fig. 8). Labial palp with 2nd segment shorter than 3rd segment, 2nd and 3rd segments together longer than 1st segment. Hypopharynx slightly emarginated apically (Fig. 9). **Thorax:** Pronotum brown with white lateral margins and wide pale stripe along posterior margin; mesonotum brown with diffuse pale spots anteriorly and between proptera (cuticular coloration) (Fig. 14). Legs grayish. Forefemora with row of stout setae on inner edge; anterior side of forefemora covered with stout setae of identical form and size (Fig. 10). Claw with single row of denticles, reaching middle of claw; apex of claw elongate (Fig. 11). Ratio of length femur/tibia and tibia/tarsus: fore and middle legs 1.3–1.2 and 1.4–1.5; hind leg 1.4–1.2 and 1.4–1.7. **Abdomen:** Terga brown with light spots; lateral edges pale; terga II–III with small triangular light spot on median part of posterior margin; terga IV–VI with a toothed light spot occupying about half of tergum length, on terga VII–IX reaching anterior margin; tergum X light with brown lateral edges (cuticular coloration) (Fig. 14). Abdominal terga III–IX with regular row of triangular stout spines on posterior margin and irregular rows of small spines anteriorly of it (Fig. 12). Posterolateral spines on abdominal segment IX longer than on segment VIII. Abdominal sterna light brown with brown band on anterior margin, lateral edges pale; sterna VIII–IX pale, yellowish; sternum X pale, yellowish with brown lateral angles (cuticular coloration) (Fig. 15). Sterna I–VII with ganglion spots. Sternum IX of female with postero-median emargination (Fig. 13). All tergali hairy (Figs 16–22); hairs very thin, pale, and break off easily; well visible only on a dark background. Cerci pale, grayish, darker at base.

Male imago (in alcohol). Length (mm): body 6.0–8.5; forewings 6.8–8.5; cerci 7.7–9.5. **Head:** General color dark brown to dark. Antennae brown; ocelli whitish apically and black basally. Upper portion of compound eyes light brown to yellowish or grayish-brown; low portion dark (Figs 23–24); compound eyes contiguous (Fig. 24). **Thorax:** General color dark brown. Medioscutum and submedioscutum dark brown (Fig. 24); posterior scutal protuberance dark with small light spot on lateral sides; sublateroscutum brown to light brown. Wings pale, hyaline; all veins pale, almost invisible; veins C and Sc slightly darker and visible; pterostigma milky (Fig. 23). Femora and tibia of forelegs whitish or yellowish, joints brown; tarsal segments pale or whitish. Middle and hind legs grayish, femur slightly darker. Ratio of length of femur/tibia 0.8–0.9; ratio of tarsal segments length 0.95:1.5:2.8:3.3. **Abdomen:** Terga with contrasting pattern (Fig. 24): tergum I dark brown; tergum II light brown or brownish; terga III–VI dirty yellowish, translucent, posterior margins darker; lateral sides with dark tracheal trunk; tergum VII dirty brownish with pair of darker stripes in middle area, with posterior margin dark brown; terga VIII–IX dark. Abdominal sterna with contrasting pattern: sternum I dark brown; sternum II brownish; sterna II–VI yellowish, translucent; sternum VIII dirty gray or dark brown; sternum IX dark brown with light central area. Nerve ganglia brown, visible on segments II–VII (Fig. 25). Cerci white. **Genitalia:** Styliger brown, somewhat lighter in posterior area, gonostyli yellowish. Styliger deeply concave medially, with U-shaped incision and two long slightly curved processes reaching bases of ventral processes of penis (Figs 26, 29, 30). Gonostylus with 1st+2nd segment widest at middle, bent ventrally near base; 3rd segment slightly widened apically; 4th segment smallest (Fig. 26). Penis lobes separated by U-shaped cleft reaching middle of penis length; each penis lobe with triangular widening, with apex pointed and curved inwards, ventrally with long crescent-shaped pointed process directed proximally and reaching proximal 1/3 of penis (Figs 27, 30).

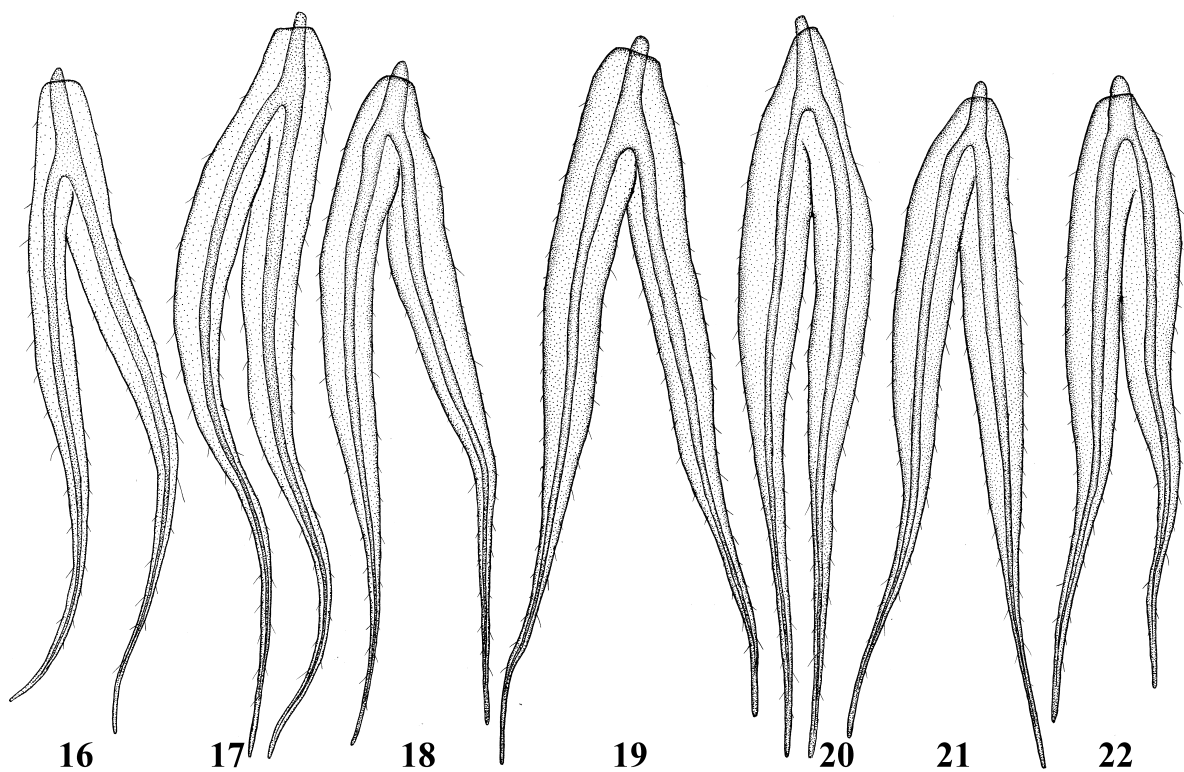
Female imago (in alcohol). Length (mm): body 7.3–8.1; forewing 8.0–9.0; cerci 7.5–8.5. **Head:** General color dark brown. Antennae brown; ocelli whitish apically, black basally. **Thorax:** General color dark brown (Fig. 31). Medioscutum and submedioscutum from brown; posterior scutal protuberance dark; sublateroscutum brown with white maculation; scuto-scutellar impression dirty brownish or dirty whitish. Wings pale, hyaline; longitudinal veins of forewing light brown, visible; hind wing colorless; all cross veins colorless, poorly visible. Legs light brown, femur slightly darker. Ratio of length femur/tibia and tibia/tarsus on forelegs 1.0–0.9 and 1.3–1.4. **Abdomen:** Terga and sterna dark brown (Fig. 31). Subanal plate with deep V-shaped incision (Fig. 32). Cerci yellowish or whitish.



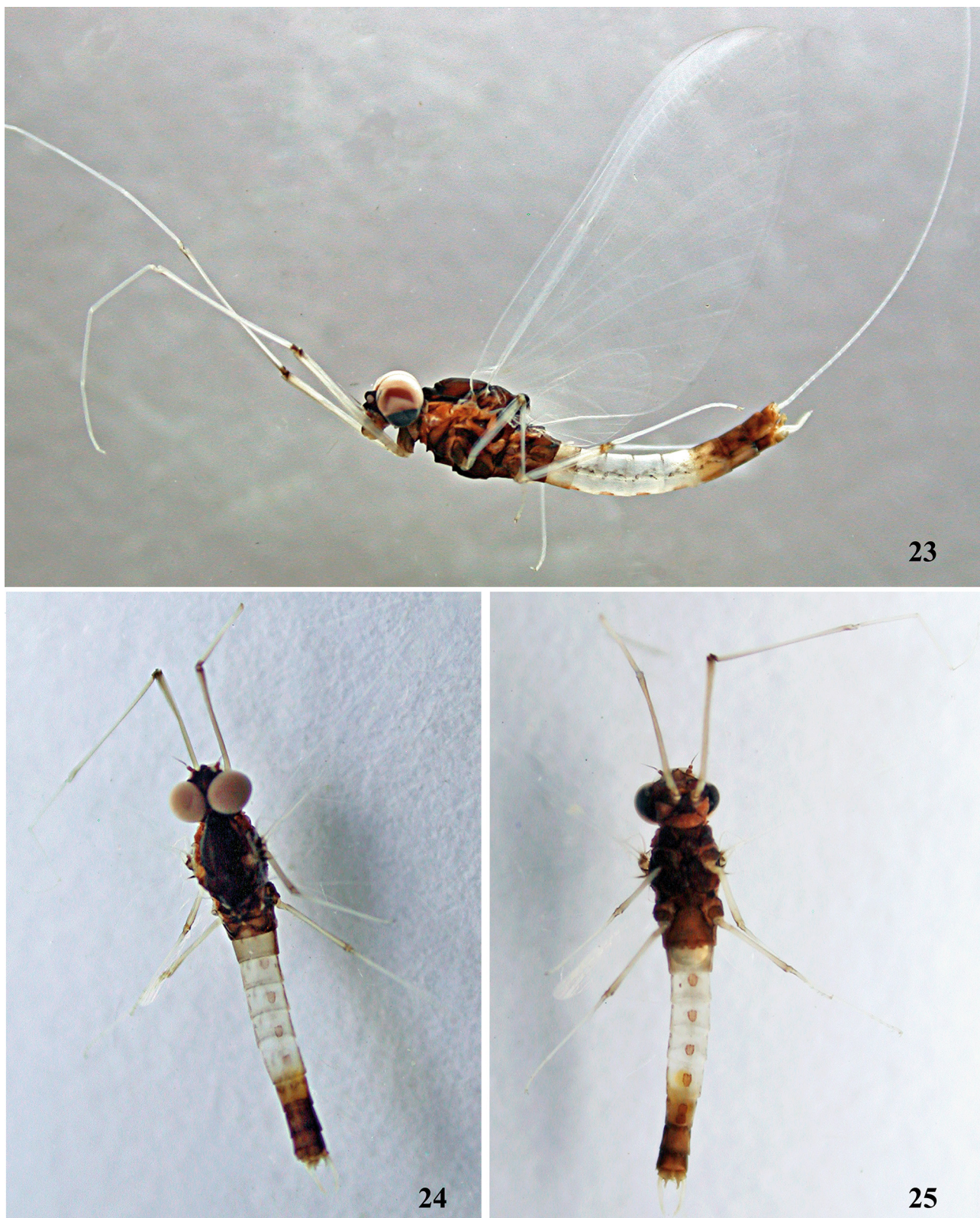
FIGURES 1–13. *Paraleptophlebia falcata*, larvae. 1, labrum, dorsal view; 2, 3, left and right mandibles, dorsal view; 4, 5, incisors and kinetodonts of left and right mandibles; 6, maxillary palp, ventral view; 7, labium, dorsal view; 8, segments 2 and 3 of labial palp; 9, hypopharynx and superlinguae, dorsal view; 10, femur of foreleg; 11, foreclaw, dorsal view; 12, posterior margin of abdominal tergum IV; 13, abdominal sternum IX, female.



FIGURES 14–15. *Paraleptophlebia falcata*, larvae, habitus. 14, dorsal view; 15, ventral view.



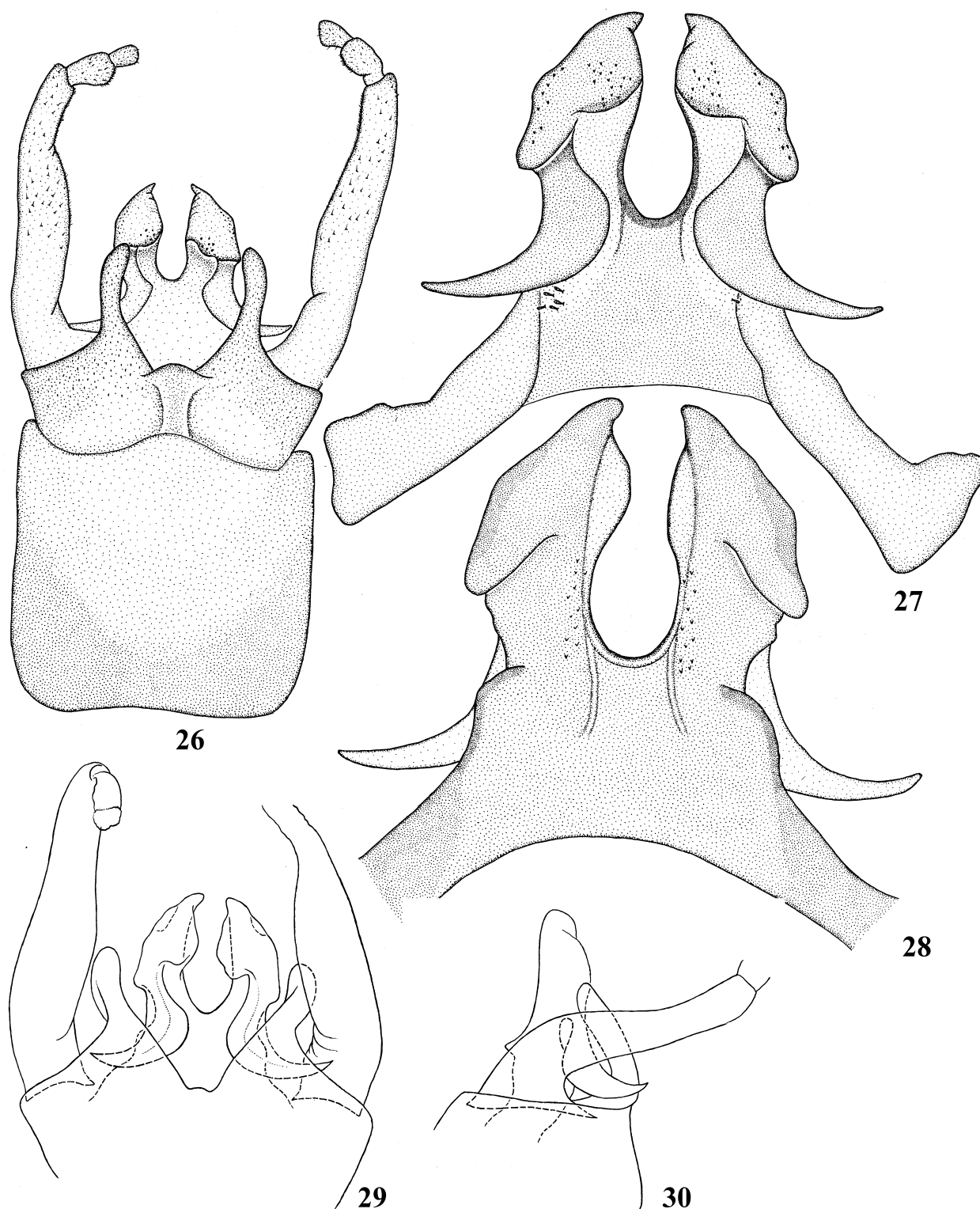
FIGURES 16–22. *Paraleptophlebia falcata*, larvae, tergalii of I, II, III, IV, V, VI and VII pairs.



FIGURES 23–25. *Paraleptophlebia falcata*, male imago. 23, lateral view; 24, dorsal view; 25, ventral view.

Eggs. General form oval 190–214 μm length and 85–118 μm width (Fig. 33). Chorion rugose, with broad and deep folds (Fig. 34), with small flower-shape KCT sparsely arranged (Figs 33, 35). Two or three small round micropyles in middle area (Fig. 33). Sperm guide absent (Figs 36–37).

Comparison. Male imago of *P. falcata* differs from all other species by presence of long processes on styliger (Figs 26, 29, 30).



FIGURES 26–30. *Paraleptophlebia falcula*, genitals of male imago. 26–28, specimens from Transbaikial Kray; 29, 30, specimen from Komi Republic. 26, 29, ventral view; 27, penis, ventral view; 28, penis, dorsal view, 30, lateral view.

Among species of *Paraleptophlebia* with available larval descriptions, *P. falcula* differs from Nearctic species *P. bicornuta* (McDunnough 1926), *P. helena* Day 1952, *P. packii* (Needham 1927) and *P. zayante* Day 1952 by absence of tusk-like elongation of mandibular incisor; from *P. altana* Kilgore & Allen 1973 and *P. cachea* Day 1954 it differs by non-widened lobes of tergalii without dark lateral branches of main trachea. The same is known for the following species of *Paraleptophlebia*: *P. calcarica* Rowbotham & Allen 1988 (Jacobus & McCafferty

2004), *P. cincta* (Retzius 1783) (Macan 1952; Landa 1969), *P. debilis* (Walker 1853) (Ide 1930; Gordon 1933), *P. guttata* (McDunnough 1924a) (Ide 1930; Gordon 1933), *P. jeanae* Berner 1955 (Randolph & McCafferty 1996), *P. lacustris* Ikononov 1962 (Ikononov 1962), *P. moerens* (McDunnough 1924a) (Gordon 1933; Burks 1953), *P. ontario* (McDunnough 1926) (Needham, Traver & Hsu 1935; Burks 1953), *P. praepedita* (Eaton 1884) (Gordon 1933; Burks 1953), *P. quisquilia* Day 1952 (Day 1952), *P. ruffoi* Biancheri 1956 (Belfiore & Giangrande 1979), *P. strandii* (Eaton 1901) (Tiensuu 1939), *P. strigula* McDunnough 1932 (McDunnough 1932), *P. submarginata* (Stephens 1835) (Komarek 1921; Macan 1952; Landa 1969; Belfiore & Giangrande 1979), *P. volitans* (McDunnough 1924a) (Ide 1930; Gordon 1933), *P. wernerii* Ulmer 1920 (Landa 1969) and *P. westoni* Imanishi 1937 (Gose 1979–1980).



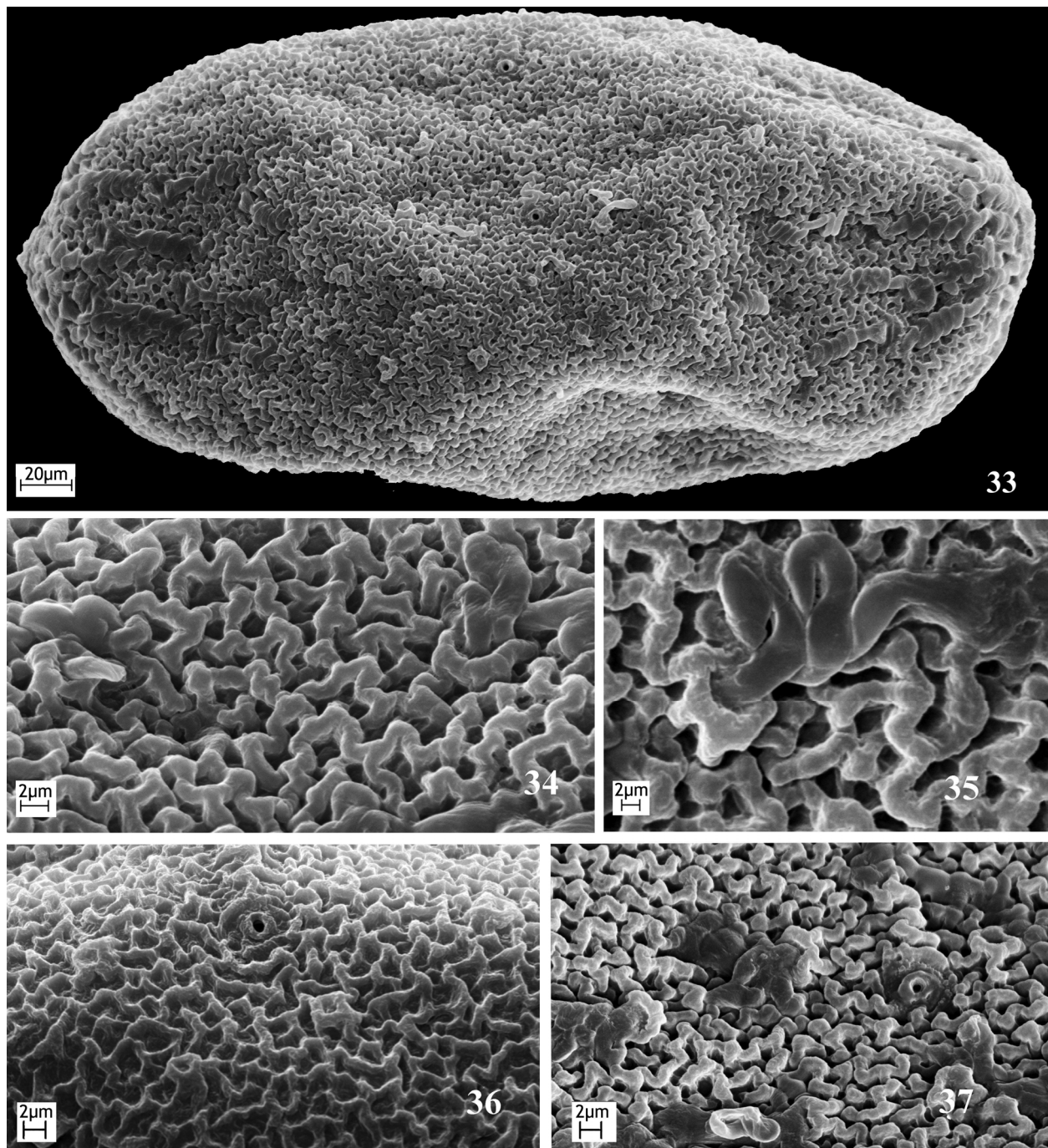
FIGURES 31–32. *Paraleptophlebia falcata*, female imago. 31, lateral view; 32, subanal plate, ventral view.

Mature larvae of *P. falcata* can be distinguished by the following features: thorax is not hairy (in contrast to *P. volitans*); hypopharynx is slightly emarginated apically (Fig. 9) (*P. strandii* has medioapical cleft); maxillary palp segments 2 and 3 are subequal in length, and together 1.55 times longer than segment 1 (Fig. 6) (in *P. debilis* and *P. moerens* segments 2 and 3 together are equal to segment 1); labial palp segments 2 is shorter than segment 3, and together are longer than segment 1 (Figs 7, 8) (in *P. calcarica*, *P. lacustris* and *P. strandii* segments 2 and 3 together are shorter or equal to segment 1); legs have no brown band (Figs 14, 15) (in contrast to *P. debilis* and *P. jeanae*); row of denticles reaches middle of claw (Fig. 11) (in *P. lacustris*, *P. submarginata*, *P. ruffoi*, *P. wernerii* and *P. westoni* row of denticles occupies more than half of claw); abdominal segment 8 with posterolateral spines, which are shorter than spines on segment 9 (Fig. 15) (in *P. guttata* and *P. strigula* lateral spines are present on segment 9 only).

Habitat. Larvae and adults of *P. falcata* were collected in the Trans-Baikal Region, Sakha Yakutia and Amurskiy Region at the end of June – beginning of July. The larvae were collected in small rivers (width 10–20 m, average depth 0.15–0.80 m in mean water). The water temperature in this period did not exceed 13°C. The bottom substratum was rocky and gravel. The rivers of the Bolshaya Makcha and Amnunnykta have aquatic vegetation (Figs 38–39). The larvae inhabited gravel substratum with detritus in the slow flow.

Distribution. Range of *P. falcata*, as revealed by this study, well agrees with the concept of Amphipacific sector of Holarctic as defined by Levanidova (1982). Area of distribution of *P. falcata* includes Eastern Palaearctic (known from certain localities in Transbaikal Kray, Sakha Yakutia and Amurskaya Oblast') and West Nearctic

(known from certain localities in states Washington, Oregon and Idaho of the USA). As well as areas of some other amphipacific species, area of *P. falcula* is stretched to the west at the north, so that includes north of the Urals.



FIGURES 33–37. *Paraleptophlebia falcula*, eggs.

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FIGURES 38–39. *Paraleptophlebia falcula*, localities. 38, Bolshaya Makcha river (Amurskiy Region); 39, Amnunnykta river (Sakha Yakutia).

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