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A New Species of the Mayfly Genus *Teloganopsis* Ulmer, 1939 (Ephemeroptera, Ephemerellidae) from the South of the Russian Far East

E. A. Gorovaya

Federal Scientific Center of the East Asia Terrestrial Biodiversity, Far Eastern Branch of the Russian Academy of Sciences, Vladivostok, 690022 Russia
e-mail: brouny@mail.ru

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Abstract—All the developmental stages of *Teloganopsis orbicularis* **sp. n.** from the Far East of Russia are described. The male imago of the new species is characterized by the rounded lobes of the penis and by broad hind wings. The larvae have a light medial longitudinal stripe and groups of short setae on the medial longitudinal stripe on tergites IV–IX. The hypopharynx is rounded; the superlinguae are broad, ovate. The maxillae are uniformly broad with a bevel-edged fang-like top; the palpus is missing. The glossae are rounded, broad, and closely approximate. The eggs are ellipsoidal with one polar roundish cap. The chorion surface is covered with a reticulation of broad, gently sloping spongy ridges and deep round tartareous meshes. The systematic position of the new species is discussed.

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The mayflies of the genus *Teloganopsis* Ulmer, 1939 were originally distinguished from all the other Ephemerellidae by the structure of the hind wing: the presence of a costal projection strengthened by a constant crossvein (Ulmer, 1939). This specific character was found only in the tropical species *T. media* Ulmer, 1939 and *T. jinghongensis* Xu et al., 1984 (Kluge, 2004). In the revision of the family Ephemerellidae, a much wider concept of the genus *Teloganopsis* was proposed, and the enlarged apical tooth on the claw of the larva was reported as a distinctive character (Jacobus and McCafferty, 2008: 245). Twelve other species previously attributed to *Uracanthella* Belov, 1979, *Kangella* Sartori, 2004 (objective synonym of *Eburella* Kang et Yang, 1995) and to *Amurella* Kluge, 1997, and also part of the species of the genera *Ephemerella* Walsh, 1862, *Serratella* Edmunds, 1959, and *Torleya* Lestage, 1917 were included in *Teloganopsis* (Jacobus and McCafferty, 2008). *Teloganopsis puigae* Ubero-Pascal et Sartori, 2009 from Borneo was described one year later and, simultaneously, *T. maculocaudata* (Ikonomov, 1961) and *T. mesoleuca* (Brauer, 1957) (Ubero-Pascal and Sartori, 2009) synonymized in the previous revision were resurrected as distinct species. Combination of the names *Ephemerella rufa* Imanishi, 1937 (Ishiwata, 2001) and *E. lenoki* Tshernova, 1952 (Jacobus and McCafferty, 2008) to synonyms of *T. punctisetae* (Matsumura, 1931) also is not substantiated. The presence of clear distinctive characters in the larvae (Tshernova, 1952) implies the independence of these species, and the correctness of their attribution to the genus *Teloganopsis* is beyond doubt (Tiunova, 2009; Tiunova and Bazova, 2010; Tiunova, 2012).

Thus, 17 species distributed in the Holarctic and Indo-Malayan regions are known to date in the genus *Teloganopsis*. In the Russian Far East the genus is represented by three species (Gorovaya, 2014): *T. gracilis* (Tshernova, 1952), *T. lenoki* (Tshernova, 1952), and *T. punctisetae.*

A species of the genus *Teloganopsis*, new to science, is described in this paper based on a number of morphological characters of specimens representing various stages of development and deposited in the collection of the Federal Scientific Center of the East Asia Terrestrial Biodiversity, Far Eastern Branch of the Russian Academy of Sciences (Vladivostok).

MATERIALS AND METHODS

Immature and imago insects were reared from larvae in cages placed in a streamflow in the collecting site of the larvae. The fixed material was stored in 75% ethanol. The measurements accurate to within 0.1 mm were made using an eye-piece micrometer of a MBS-10 binocular microscope. The slides were investigated using an Olympus CH light microscope and also the Evo 40 scanning electron microscope at the Far Eastern Center of Electronic Microscopy of the National Scientific Center of Marine Biology FEB RAS, in Vladivostok. The morphological structures of the eggs are described using the terminology from the following publications: Koss and Edmunds, 1974; Gaino et al., 1989; Studemann and Landlot, 1997; the terminology in the descriptions of the imagoes and larvae follows that by Tshernova et al., 1986, and Kluge, 2004.

Teloganopsis orbicularis Gorovaya, sp. n.
Figs. 1–37

= *Uracanthella*/g1 sp. U3: Kluge, 2004 : 315.

Material. Holotype, ♂ imago (reared from larva): **Russia**: *Primorskii Territory*, Ussuri River basin, Kabarga River, downstream from bridge on Vladivostok–Khabarovsk highway, 28–30.VII.1998 (T. Tiunova). Paratypes: same locality, 28–30.VII.1998, 15 ♂ and 34 ♀ imagoes (reared), 18 subimagoes, 15 mature larvae; 7.VIII.1997, 1 ♂ and 1 ♀ imagoes (reared), 17 larvae (2 mature); 13.VIII.1997, 4 larvae; 14.VII.2000, 20 ♂ and 2 ♀ imagoes, 9 subimagoes, 1 larva; 9.VIII.20021, 1 ♂ and 1 ♀ imagoes; 25.VII.2003, 12 ♂ imagoes (T. Tiunova).

Description. Male imago (Fig. 1). Body generally pale orange, slightly brownish. Length (mm): body 5.4–6.0; fore wing 5.6–6.3; cerci 5.6–8.3. Head beige. Eyes contiguous; upper part beige, lower one black. Ocelli beige. Antennae fine, pale beige. Thorax: medial part (mediascutum, submediascutum) beige; other parts pale orange; anterolateral scutal carina and all lateral contours orange-brown. Wings hyaline, slightly whitish. Pterostigma and area between subcosta and radius below pterostigma matte-white against black background (Fig. 2). Veins inconspicuous, matte, whitish. Hind wings broad (length to width ratio 3 : 2), rounded, with distinct costal projection (Fig. 3). All femora, tibiae, and tarsomeres pale beige, tartareous; coxae and trochanters pale orange. Each femur with orange-brown ring near articulation with tibia. On all legs, one claw obtuse, other sharp (Fig. 4). Length (mm) of segments of fore leg: femur 1.2–1.6; tibia 1.8–2.2; tarsomeres 0.3–0.5, 0.3–0.4, 0.2–0.3, 0.15–0.20, and 0.1 (Fig. 5). Abdominal tergites translucent: tergites I–IV beige with small indistinct paired whitish spots at sides of midline, orange-brown strokes along center, and orange-brown triangles along sides; tergites V–IX pale orange with similar orange-brown strokes and triangles. Sternites semitransparent: sternites I–V pale beige with brownish pattern of vague paired strokes along midline and triangular spots at sides, VI–IX beige with similar but more distinct orange-brown pattern. Styliger beige, broad, with conical projection at posterior margin, tartareous. Gonostyli and penis beige. Gonostyli tartareous, with papillae on inner surface (Figs. 6, 7); their 2nd segment wide at base and narrowed distally, 3rd segment oval. Penis subrectangular. Lobes of penis separated along 1/3, wide, each with triangular apex. Dorsally, lobes of penis rounded, funnel-shaped, with thickened margins (Fig. 8, 9). Ventrally, bases of lobes separated by wide furrow (Figs. 10, 11). Cerci and paracercus subequal in length, pale beige with brownish articulations.

Female imago. Length (mm): body 5.6–5.8; fore wing 6.2–6.7; cerci 6.0–7.1. Body generally beige, slightly pinkish. Thorax beige with pink tint. All legs pale beige. Length of segments of fore leg (mm): femur 0.8–1.0; tibia 0.8–1.0; tarsus 0.6–0.7. Coloration of wings as that in male. Abdomen colored as that in male, brown with eggs. Subanal plate conical, with shallow emargination (Fig. 12).

Submale imago. Body generally brown-orange. Eyes as those in male imago. Coloration of thorax similar to that of male imago but brighter, brown-orange. Legs pale brown; rings on femora brown. Wings pale brown. Veins brown. Pterostigma and area between subcosta and radius below pterostigma matte, brown-white. Tergites brown-orange with white tint; sternites slightly darker. Pattern on abdomen similar to that in male imago. Caudal filament matte-white; articulations brown.

Eggs ellipsoidal, length 156–164 μm, width 101–105 μm, with one rounded polar cap 58–64 μm in diameter (Fig. 13). Entire surface of chorion covered with reticulation of broad sloping ridges with spongy surface and with round deepened, slightly tartareous

Fig. 1. *Teloganopsis orbicularis* sp. n., male imago (photograph of M.P. Tiunov).

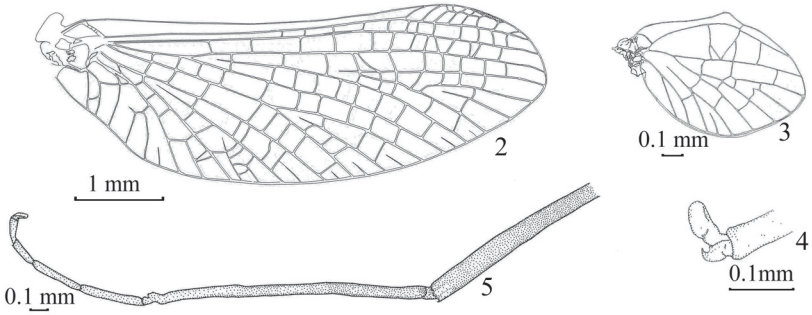

Fig. 2–5. *Teloganopsis orbicularis* sp. n., male imago: (2) fore wing, (3) hind wing, (4) claw of middle leg, (5) fore leg.

meshes about 12 μm in width. Knob-terminated coiled threads (KCT) not numerous (3 or 4 on visible side of egg). Terminal disks of these threads elongate, oviform. Micropyles situated in central (equatorial) part of egg (1 or 2 on visible side).

Larva (mature). Length (mm): body 4.9–5.7; cerci 3.0–4.3. Body generally brown with orange tint; thorax and abdomen with distinct pale yellow medial stripe.

Head without tubercles or projections, brown, with small pale area around eyes (Fig. 14). Labrum dark brown, densely covered with setae; length to width ratio 2 : 3 (Fig. 15). Hypopharynx rounded; superlinguae wide, oviform, with long thick setae along anterior and inner margins (Fig. 16). Mandible (Fig. 17, 18) broad; its base dorsally with distinct zones bearing long fine sparse fragile setae; left incisor (Fig. 19) with 4, right (Fig. 20), with 3 teeth. Maxilla with slanting caniniform apex covered with numerous dense long fine setae (Fig. 21). Inner margin of maxilla with a pair of dentisetae, with 2 parallel rows of thick and strong setae distally, and with 8 similar setae forming 2 longitudinal rows on inner side of base of maxilla. Maxillary palpus missing. Labium wide, oval, densely pubescent (Fig. 22). Glossae rounded, wide, closely approximate. Labial palpus 3-segmented. 1st and 2nd segments of labial palpus relatively wide but without obvious thickenings; 3rd segment elongate, conical, distinctly separated because of its base considerably narrower than distal part of 2nd segment.

Thorax. Pronotum and anterior half of mesonotum with wide pale yellow medial stripe bounded at sides by wide dark brown lines (Fig. 23). Lateral margins of pronotum with paired falcate brown spots. Rudiments of fore wings with wide pale yellow spots. Legs pale yellow, with orange-brown rings in proximal and distal parts of tibia and in middle of tarsus; basal part of femur brown (Figs. 24–26). Length (mm) of segments of legs (femur, tibia, tarsus): fore: 0.9–1.0, 0.9–1.0, 0.5–0.6; middle: 0.9–1.1, 1.0–1.1, 0.5–0.6; hind: 1.0–1.3, 1.3–1.5, 0.6–0.7. All femora equally wide, with long strong clavate setae (Fig. 27). Dorsal surface of fore femur with 2–4 long strong setae (Fig. 28) forming indistinct

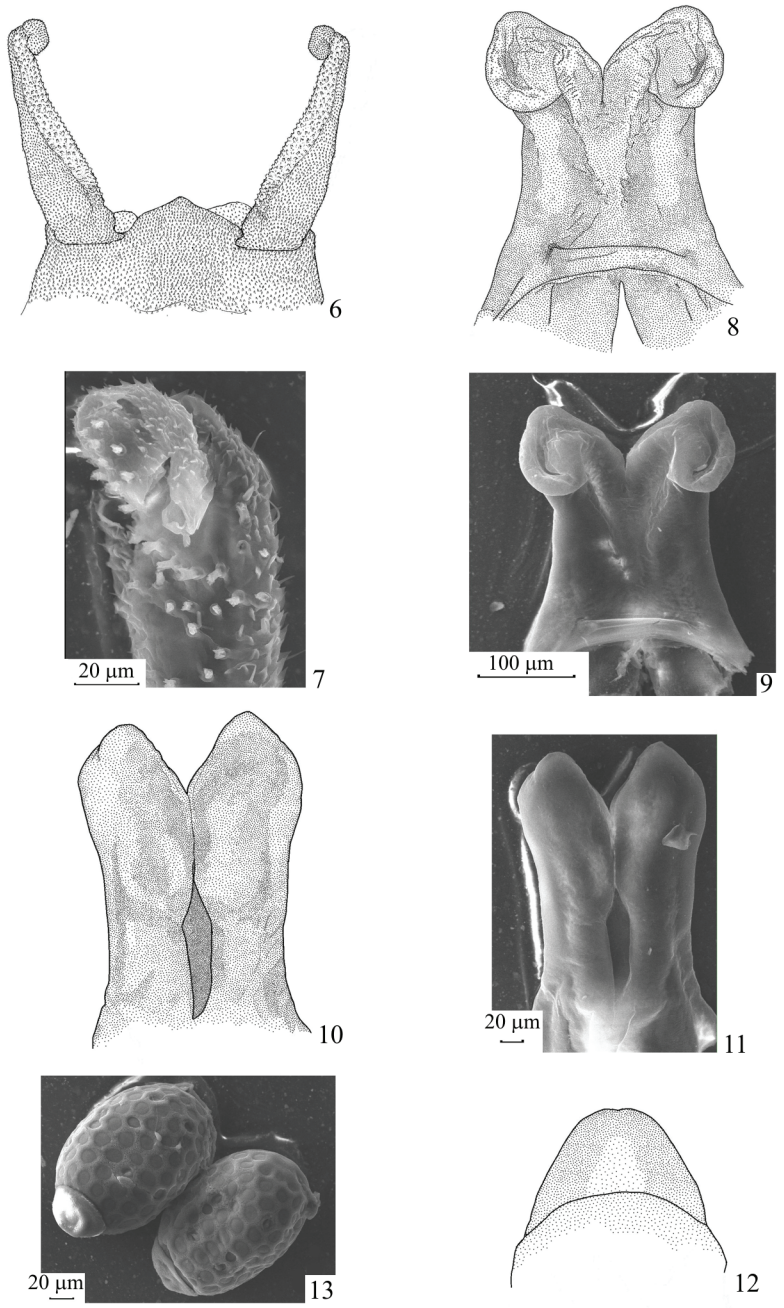

Fig. 6–13. *Teloganopsis orbicularis* sp. n. (6–11) male imago, (12) female imago, (13) sculpture of chorion: (6) forcepses, (7) papillae on distal fragment of forcepses, (8–11) penis [(8, 9) dorsal view, (10, 11) ventral view)], (12) postgenital plate.

row perpendicular to longitudinal axis of femur near its articulation with tibia. Dorsal side along entire length of middle and hind femora with medial areas bearing strong, moderately long setae (Fig. 29) and, near articulation with tibia, with areas bearing single long strong setae. Fore tibia and tarsus with sparse hairs on outer side, middle and hind ones with sparse long strong setae. Inner margin of all tibiae and tarsi with rows of numerous pointed setae (Fig. 30). All claws with 1 row of teeth and with 1 subapical tooth similar in size to apical tooth (Fig. 31).

Abdomen. Tergites brown with orange tint and pale yellow area of elongate spots along midline (Fig. 32); these spots paired on tergites I–IV and merged on terg-

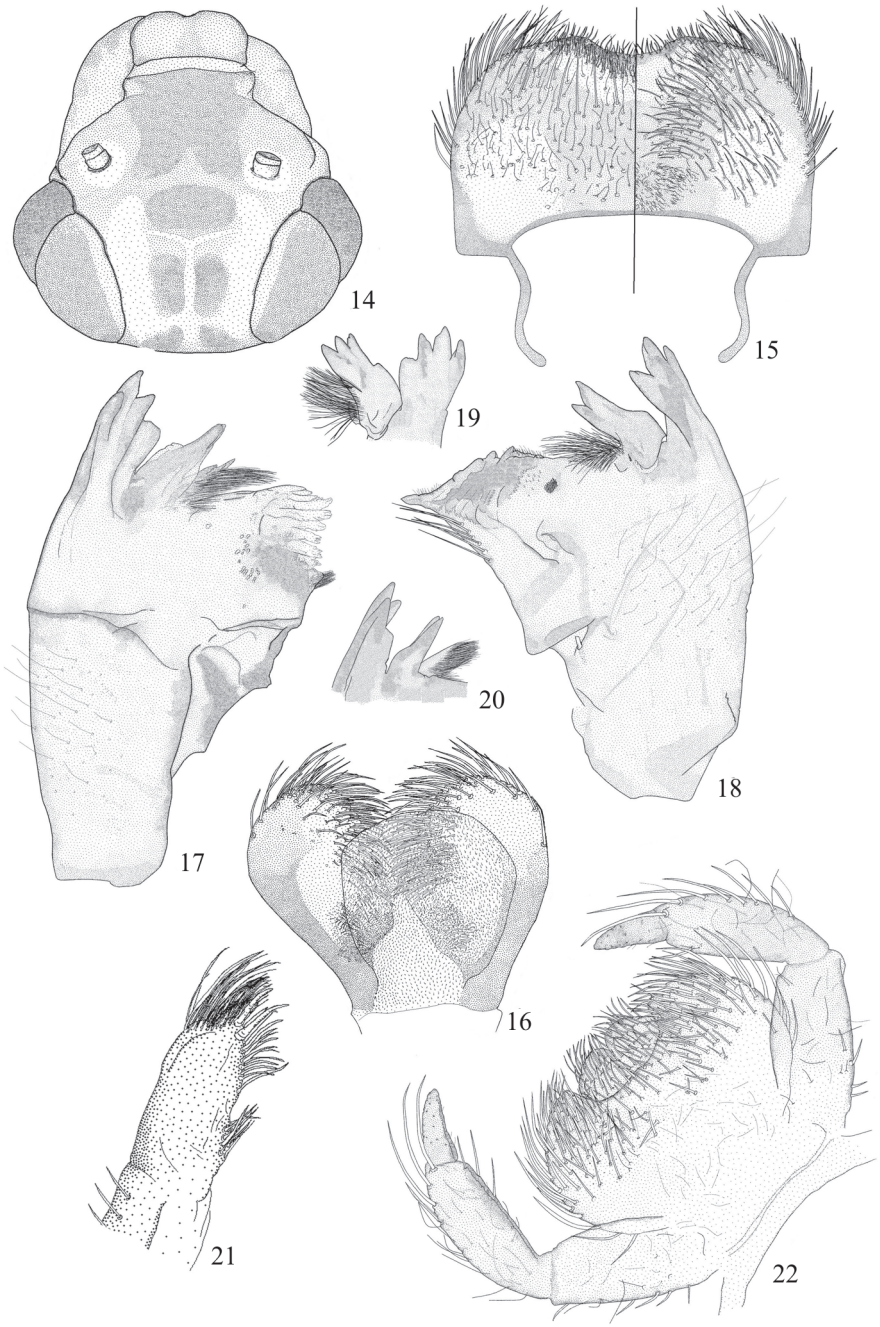

Fig. 14–22. *Teloganopsis orbicularis* sp. n., mature larva: (14) head; (15) labrum; (16) hypopharynx and superlinguas; (17, 18) mandibles, dorsal view [(17) left, (18) right]; (19, 20) incisors, ventral view [(19) left, (20) right]; (21) maxilla; (22) labium.

ites V–X. Small singular pale brown spots present near places of insertion of tergaliae. Lateral parts of all tergites pale brown, with very fine rounded setae appearing as numerous black dots. Tergites IV–IX with groups of short setae along midline (Fig. 33). Caudal margin of tergites II–VII with short, and that of tergites VIII and IX with long line of strong oval setae (Fig. 34). Lateral margins and caudal corners with slightly pointed strong setae (Fig. 35). Sternites brown, with paler midline and spots at lateral corners, with row of dark brown strokes at sides of midline. Tergaliae pointed, with bifurcate ventral lamella: length of tergaliae of pairs II–V 5 mm (Fig. 36), triple as long as tergaliae of I pair. Caudal filament pale yellow at base and beyond 3/5

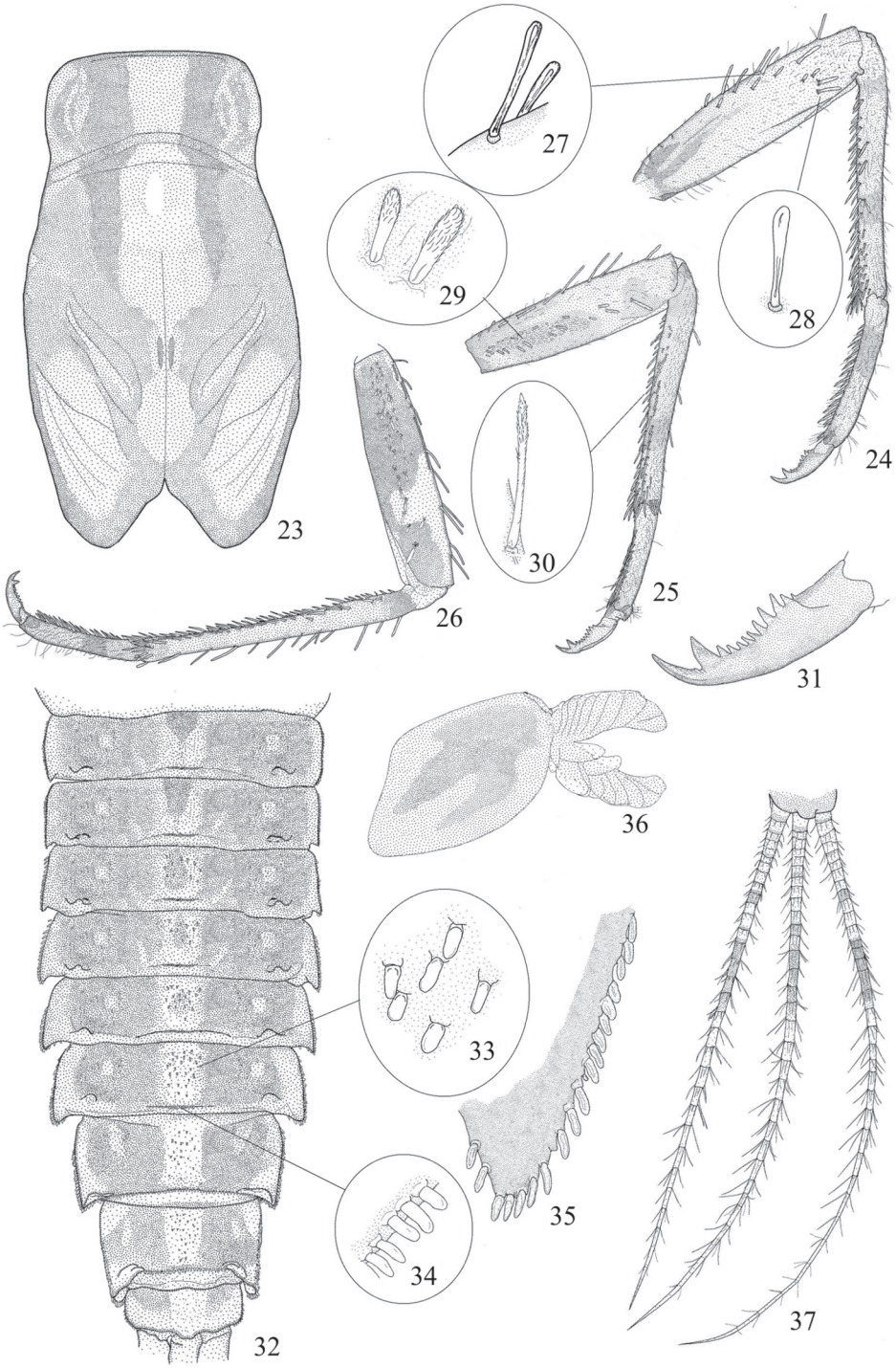

Fig. 23–37. *Teloganopsis orbicularis* sp. n., mature larva: (23) pro- and mesonotum, (24–26) legs [(24) fore, (25) middle, (26) hind], (27) cranial setae of fore femur, (28) seta of transverse row on dorsal surface of fore femur, (29) median setae on dorsal surface of middle and hind femora, (30) caudal seta of tibia, (31) claw, (32) abdominal tergites II–X, (33) setae from middle line on tergites IV–IX, (34) setae of caudal margin of tergites, (35) setae of lateral margins and caudal corners of tergites, (36) right tergalia of II pair, (37) caudal filaments.

from base, brown in middle part (2/5 from base) (Fig. 37). Cercus and paracercus equal in length.

Etymology. The name of the species is associated with the rounded funneled penis lobes and hind wings in imagoes.

Distribution and biology. The larvae were collected in calm areas with a coarse sandy soil on wood debris submerged in water. To date the species is known only from the Kabarga River.

DISCUSSION

The species described possesses a set of the main morphological characters specific to the genus *Teloganopsis* (Jacobus and McCafferty, 2008).

The male imago of *T. orbicularis* sp. n. is very similar in habitus to the Western Palaearctic *T. albai* (Gonzalez del Tango et Garcia de Jalon, 1983) and to *T. jinghongensis* (Xu et al., 1984) [= *Serratella albostriata* (Tong et Dudgeon, 2000), after Zhou et al., 2006] distributed in the Eastern Palaearctic and Indo-Malayan regions, but the hind wings in the species listed are narrower: the length to width ratio is 2 : 1 (Studemann et al., 1989; Tong and Dudgeon, 2000), and the basal part of the fore wing in the male imago of *T. jinghongensis* is brownish (Tong and Dudgeon, 2000).

The rounded funnel-shaped lobes and the absence of any formation on the penis surface in *T. orbicularis* sp. n. clearly distinguish it from *T. albai* and *T. jinghongensis*, from the Eastern Palaearctic *T. changbaishanensis* (Su et You, 1988), *T. lenoki*, and *T. punctisetae*, and from the Nearctic *T. deficiens* (Morgan, 1911). In these species, the proximal margin of the apical part of the penis lobes is attenuate triangular (Palaearctic species) (Ishivata, 1987; Studemann et al., 1989; Tong, Dudgeon, 2000; Klyuge, 2003) or rectangular (Nearctic species) (Edmunds, 1959) in dorsal view. In the male *i*magos of *T. changbaishanensis* and *T. punctisetae*, the penis lobes bear spines in the apical part.

Among the species whose larvae have no maxillary palpus, the mature larva of *T. orbicularis* sp. n. is most similar to *T. gracilis* and *T. jinghongensis* which also have a wide pale medial stripe on the dorsal side of the body. However, in the larvae of *T. gracilis* "each of tergites 1–7 has one small spine along the midline" (Tshernova, 1952) which is missing in the larvae of the new species. In addition, the hind pair of legs of *T. orbicularis* sp. n. does not differ in size; the tergalia of the first pair are not more than 1.5 times as long as the abdominal segments; the apex of the maxilla has no sharp tooth. The larvae of the species described differ from those of *T. jinghongensis* in a pale medial stripe which is present on the abdominal tergites and is interrupted on the thoracic segment, in the groups of short setae on tergites IV–IX arranged in one row along the midline, and also in the uniform width of the maxilla.

While the larva of the new species clearly differs in the coloration of the body, it demonstrates a considerable similarity to *T. puigae* (distributed from the Indo-Malayan Region) and to the Western Palaearctic *T. hispanica* (Eaton, 1887). *Teloganopsis puigae* differs from *T. orbicularis* sp. n. in a fewer number of the teeth on the claw, in a depressed anterior margin of the hypopharynx, and also in an inconspicuous junction between the 2nd and 3rd segments of the labial palpus; in *T. hispanica*, the weakly curved claw has 2 large subapical teeth, the abdominal tergites have 2 rows of groups of setae, and the divided hypopharynx is subrectangular (Gonzalez del Tanago and Garcia de Jalon, 1983; Eaton, 1887).

In the structure of the egg, *T. orbicularis* sp. n. is similar to the Indo-Malayan *T. puigae* and *T. brocha* (Kang and Yang, 1995) (the latter species is also distributed in the Eastern Palaearctic Region). However, the eggs are ellipsoidal in the new species and oviform in *T. puigae* (Ubero-Pascal and Sartori, 2009). The structure of the reticular ridges of the chorion is granular in *T. brocha* and spongy in *T. orbicularis* sp. n.; the passage from the ridge to the mesh in the new species is smooth, without additional formations.

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