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FIRST FINDING OF THE ARCHAIC NYMPHOMYIID FLIES (DIPTERA: NYMPHOMYIIDAE) IN THE ALTAI MOUNTAINS OF RUSSIA

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Summary. During of hydrobiological studies of the watercourses of the Altai Mountainous Country in Russia, the larvae of archaic Nymphomyiidae (Diptera) which closely related to *Nymphomyia* cf. *rohdendorfi* were found for the first time. A morphological description of the larvae and the ecological conditions of their habitats are given.

Key words: *Nymphomyia* cf. *rohdendorfi*, larvae, morphology, fauna, Russian Altai.

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Резюме. При проведении гидробиологических исследований водотоков Алтайской горной страны на территории России впервые были обнаружены личинки архаичных двукрылых нимфомийид близких *Nymphomyia* cf. *rohdendorfi*. Приведено морфологическое описание личинок и экологические условия их мест обитания.

INTRODUCTION

The family Nymphomyiidae was separated by famous Japanese dipterologist M. Tokunaga after describing *Nymphomyia alba* Tokunaga from Central Honshu of Japan (Kibune Stream in Kyoto) (Tokunaga, 1932). At the present time nine species of the single genus *Nymphomyia* Tokunaga are known in the world: *N. alba* Tokunaga, 1932 (Japan, Russian Far East: Kunashir Island), *N. walkeri* Ide, 1964 (East Canada and USA), *N. brundini* Kevan, 1970 (East Himalaya), *N. levanidovae* Rohdendorf et Kalugina, 1974 (Russian Far East: south part of Primorsky Krai and upper streams of Bikin River), *N. rohdendorfi* Makarchenko, 1979 (Russian Far East: Primorsky Krai, Amur River basin, Kolyma River basin, Chokotka Region), *N. dolichopeza* Courtney, 1994 (Eastern USA), *N. holoptica* Courtney, 1994 (Hong Kong), *N. kaluginae* Makarchenko, 2013 (Russian Far East: Zeya River basin of Amur River basin), *N. kannasatoi* Makarchenko et Gunderina, 2014 (Japan – Honshu, Russian Far East: South Sakhalin) (Courtney, 1994; Makarchenko, 2013, 2022; Makarchenko *et al*., 2014; Yavorskaya

& Makarchenko, 2015; Makarchenko & Gunderina, 2019). Additionally, exuviae of *Nymphomyia* sp. pupae recently discovered in Northern Mongolia, Altai (Hayford & Bouchard, 2012). Also two fossil species, *N. succina* Wagner, Hoffeins et Hoffeins, 2000 from the Eocene (Baltic amber) (Wagner *et al*., 2000) and *Nymphomyia alissae* Wagner et Müller, 2020 from Cretaceous (Burmese amber) (Wagner, Müller, 2020), are known, as well as subfossil larvae of *N.* gr. *rohdendorfi* from Oron Lake of Irkutsk Region (Enushenko & Makarchenko, 2019).

MATERIAL AND METHODS

In April–May 2022, macroinvertebrates were collected from 21 small watercourses of 10–24 km long, with a relatively high (0.5–1.0 m/s) flow velocity and rocky substrates in the basins of rivers Biya and Katun (tributaries of the Upper Ob). The studied sections of these streams are located at different altitude (300–2400 m a.s.l.). Macroinvertebrates were collected using a Surber sampler (frame: 0.2x0.2 m, mesh size: 220x220 microns). Macroinvertebrates from 10 samples taken from different sections of each river were fixed with 70% ethyl alcohol.

Simultaneously with macroinvertebrate sampling, we also measured flow velocity, river width and depth, assessed river shading (%), COD, BOD_5, nutrient concentration (phosphates, ammonium, nitrites). Additionally, a multi-parameter probe YSI 6600 V2-03 measured water temperature, transparency, oxygen concentration and saturation, total mineralization, electrical conductivity, redox potential (ORP), and pH of water. Substrate types were determined by visually estimating percent cover with sand (particles with a diameter 0.25–2 mm), gravel (2–16 mm), pebble (16–64 mm), cobble (64–256 mm), and boulder (256–1024 mm). To assess the biotic condition in each river, the projective cover (%) of stones covered with moss, phytoperiphyton (in washings from three stones) and phytoplankton (by chlorophyll *a* content in the acetone extract) were estimated.

The larvae were slide-mounted in the polyvinyl lactophenol. The morphological terminology used below generally follow Courtney (1994). The photographs were taken using an Axio Lab.A1 (Karl Zeiss) microscope with an AxioCam ERc5s digital camera, and then stacked using Helicon Focus software. The final illustrations were post-processed for contrast and brightness using Adobe® Photoshop® software.

DESCRIPTION OF LARVA

***Nymphomyia* cf. *rohdendorfi* Makarchenko, 1979**
Figs 1–4

MATERIAL. Russia: Republic of Altai, Kosh-Agachsky District, Mukhor-Tarkhatinsky rural settlement: 6 larvae, Kuruk River (Katun River basin), alt. 2273 m, 49.58278 N, 88.42767 E, 28.V 2022; 1 larva, the same data except Kalanegir River (Katun River basin), alt. 2200 m, 49.64237 N, 88.47350 E, 28.V 2022 leg. L. Yanygina.

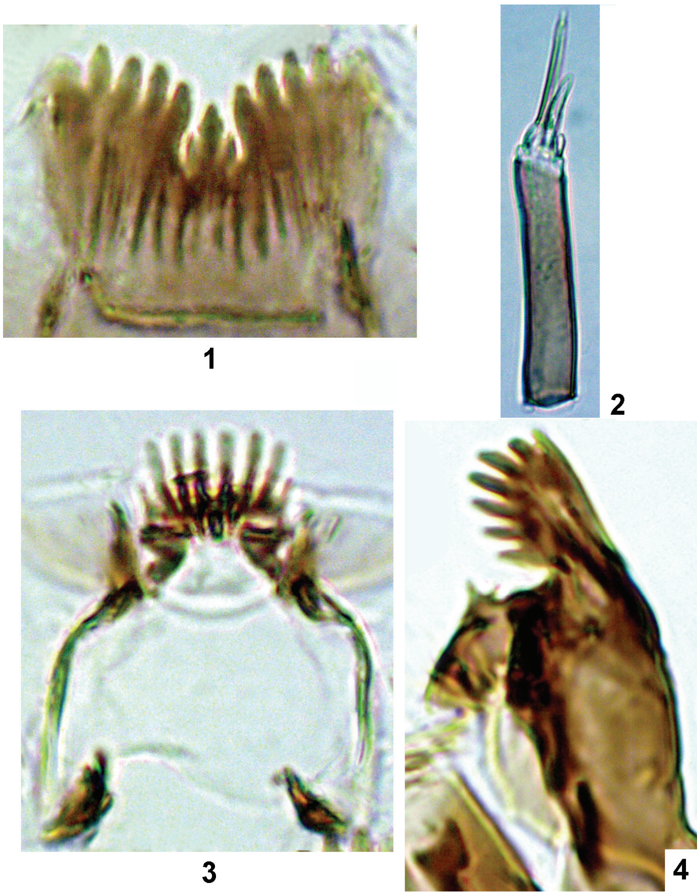
DESCRIPTION. LARVA (n=7). Total length 1.7–1.9 mm. Head length 164–168 μm, head width 88–92 μm.

Coloration. White or greyish, head pale brown, brown.

Antenna (Fig. 2). Basal antennal segment 41–44 μm long, pointed antennal seta 18–21 μm long, flat antennal seta 10–13 μm long.

Mandible (Fig. 4). With 7 teeth, inner seta composed of 6–8 pinnate branches, seta subdentalis wedge-shaped.

Mentum (Fig. 1) Median tooth shorter than adjacent lateral teeth and with two pairs of lateral serrations; lateral teeth without lateral serrations; notch between lateral teeth 1 and 2 as deep as notches separating other teeth; 4 pairs lateral teeth of more or less uniform size and shape; fifth pair slightly lower and wider than other lateral teeth.



Figs 1–4. Larva of *Nymphomyia* cf. *rohdendorfi* Makarchenko. 1 – mentum; 2 – antenna; 3 – hypopharinx; 4 – mandible.

Hypopharynx (Fig. 3). Wide at the base, with a ridge of 8 long and narrow teeth at the apex, of which the extreme teeth are almost two times lower than the other teeth.

Abdomen. Typical for nymphomyiid larvae. Nine-segmented, segments I–VII and IX each with paired, elongate, eversible, ventral prolegs. Anal papillae of four thick, exsertile, digitiform lobes between procercus and anal prolegs; dorsal pair markedly larger than ventral pair.

COMMENTS. Nymphomyiid larvae are very similar of each other, but we bring the larva from Altai Mountains closer to that of *N. rodendorfi* and place it in the group of *N. rohdendorfi* species. This group is characterized by the presence in mentum lateral teeth which of more or less uniform size and shape while mentum of *N. levanodovae* group with first and second lateral teeth united basally, second tooth extended anteriorly beyond apices of others.

The localities of finds of nymphomyid larvae in Altai Mountains of Russia and pupal exuvia in Mongolia (Hayford & Bouchard, 2012) are not far from each other (Fig. 5) and most likely we are dealing with the same species that lives in mountain streams at altitudes of 1694–2798 m.

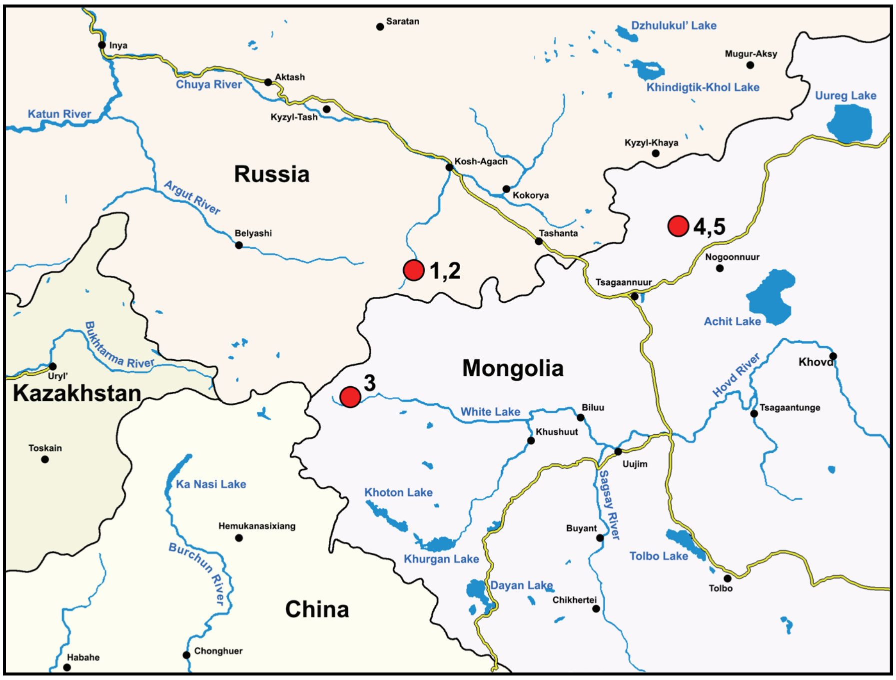


Fig. 5. Finding sites of Nymphomyiidae in Altai Mountains. 1, 2 – *Nymphomyia* cf. *rohdendorfi* Makarchenko in Russia (original data); 3–5 – *Nymphomyia* sp. in Mongolia (after Hayford & Bouchard, 2012).

ECOLOGY

Nymphomyiid larvae were found in the moderately cold-water streams (Fig. 6) (water temperature during sampling made up 11.0–11.9°C). In sampling sites, width of rivers Kuruk and Kalanegir was 14 and 20 m, respectively, and depth – 0.25 m. Bottom sediments were mainly formed by pebbles (50–65% of the bottom area). The studied waters were weakly alkaline (pH 8.1–8.4) and low-mineralized (0.09–0.12 ppt). The content of nutrients (below detection limits) and organic substances (BOD_5 0.54–0.86 mgO/dm^3) was low. Relatively high COD values (28–33 mgO/dm^3) were noted, probably, due to a partially waterlogged catchment area. Phytoplankton (concentration of chlorophyll *a* in water 0.5–1.2 mg/m^3) and phytoperiphyton (concentration of chlorophyll *a* in washouts from pebbles 8.4–13.8 mg/m^2) were low. Unlike most species recorded in aquatic moss mats, nymphomyids in rivers Kuruk and Kalanegir lived on moss-free stones, similar to *N. alba* in Japanese rivers (Takemon & Tanida, 1994). Perhaps, the absence of moss mats and poor periphyton development determined low abundance of nymphomyiids in the studied rivers of the Russian Altai.

A common feature of the nymphomyiids ecology of the Russian and Mongolian Altai is their habitat in streams running through free from tree vegetation landscapes, in contrast to most other species recorded in rivers with well-developed coastal vegetation (Harper & Lauzon, 1989; Saigusa *et al*., 2009; Hayford & Bouchard, 2012; Makarchenko *et al*., 2014).

Fig. 6. Locality of *Nymphomyia* cf. *rohdendorfi* Makarchenko. Republic of Altai, Kosh-Agachsky District, Mukhor-Tarkhatinsky rural settlement, Kalanegir River (Katun River basin), alt. 2200 m. (Photo by A.V. Kotovshchikov).

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