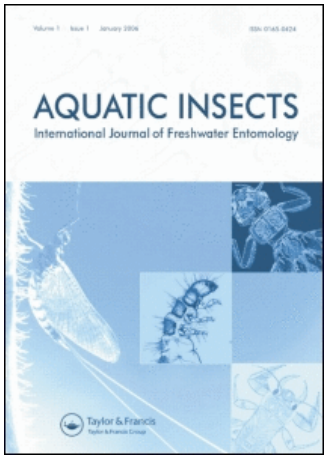

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Limnophyes (Diptera: Chironomidae) from northwestern Russia

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Abstract

Limnophyes angelicae Sæther, 1990; *L. er* Sæther, 1985; and *L. natalensis* (Kieffer, 1914) are recorded from the upper littoral zone in Lake Krivoe in Russian Karelia. All are new records for European Russia. The male of *L. angelicae* from Lake Krivoe and the previously unknown female of *L. er* are described.

Keywords: Chironomidae, *Limnophyes*, Russian Karelia, lake littoral

Introduction

The genus *Limnophyes* Eaton is well defined in all stages. The genus was revised by Sæther (1990). Since then, three species have been described from Europe, *L. roquehautensis* Langton *et* Moubayed and *L. inanispatina* Langton *et* Moubayed from southern France (Langton & Moubayed 2001), and *L. platystylus* Murray from Ireland (Murray 2007), as well as four species from the Russian Far East, *L. okhotensis* Makarchenko *et* Makarchenko, *L. pseudopumilio* Makarchenko *et* Makarchenko, *L. strobilifer* Makarchenko *et* Makarchenko, and *L. vrangelensis* Makarchenko *et* Makarchenko (Makarchenko & Makarchenko 2001, 2003a, 2003b; Makarchenko et al. 2005).

The West Palaearctic and Nearctic fauna is relatively well known. However, although 28 species of *Limnophyes* have been reported from Japan, only four of these are widespread Holarctic species (Yamamoto 2004). Most likely, many of the remaining Japanese names are synonymous with names from other regions, and a revision is desirable.

The larvae of most *Limnophyes* species live in moss, wet earth or wet leaves and often hygropetric in springs, streams, seeps or road cuttings. A few species, however, appear to be truly aquatic, living in the littoral zone of lakes or in small streams. The ecology of *L. er* Sæther was unknown. All three species recorded here, *L. angelicae* Sæther, *L. er* and *L. natalensis* (Kieffer), are present in the shallow littoral zone of lakes.

The female of the peculiar *L. er* was unknown. Here we provide a description together with some additional morphological information on the male of *L. angelicae* and the record of *L. natalensis*.

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Study sites

All the material was collected by A. Przhiboro from the small oligotrophic Lake Krivoe in the Loukhi District, 66°21′N 33°35′E, near the White Sea Biological Station of the Zoological Institute (environs of Cape Kartesh) in the northern part of Russian Karelia. The ecosystem of the lake was studied in detail by Winberg and his associates (Alimov & Winberg 1972; Winberg 1975). Communities of macroinvertebrates in the littoral zone were recently studied by Przhiboro (1999, 2001) and Berezina et al. (2005).

The material of *Limnophyes* was collected from two sites:

Site 1. Upper littoral zone narrow; distance from water margin to a depth of 1 m to about 5 m; sparse stands of *Carex rostrata* (cover ca. 30%); bottom substrate consisting of sand with gravel and pebbles, partially covered with remains of sedge, tree leaves, bark and timber fallen from the shore; site shaded by trees; bottom subject to moderate influence of waves.

Site 2. Upper littoral zone wide and very flat; distance from water margin to a depth of 1 m to about 60 m; very sparse stands of *Phragmites australis* (cover no more than 2%); bottom substrate consisting of sand, at depths greater than 20 cm covered with a 1–5 cm layer of detritus with abundant macroscopic spherical colonies of Cyanobacteria; site not shaded; at depths greater than 30 cm, bottom not subject to any visible influence of waves.

Methods

All adults were collected with field emergence traps installed at two sites in the shallow littoral zone (depth 0.3–1.0 m). A trap construction similar to those proposed by Sublette and Dendy (1959) and Lammers (1977) (both cited by Davies 1984) was used; each emergence trap was supplied with a sample beaker containing 50–70% ethanol with additions of glycerin and formalin. The traps were used during two seasons, late July until late September 1996 and mid-June until mid-August 1997. The material was stored in 70% ethanol and slide-mounted in Canada balsam. The technique of clearing and mounting mainly followed Pinder (1989).

The terminology and measurements mainly follow Sæther (1980). Measurements are given as ranges, generally followed by the mean. If *n* exceeds 4 (i.e. equals 6 or 8), this means that the measurements were taken from both body sides each of three or four specimens measured, e.g. from both wings.

The material of all species is deposited in the Zoological Institute, Russian Academy of Sciences, St. Petersburg (ZIN), two males and two females of *Limnophyes er*, in the Museum of Zoology, University of Bergen (ZMB).

Limnophyes angelicae Sæther, 1990

Material examined. Lake Krivoe, shallow littoral zone, site 1, emergence trap 1 (depth 0.3–0.4 m), 1 ♂, 7 vii 1997 (slide "Chironomidae-56", ZIN).

The original description of the species was based on the holotype only. Later publications do not include additional morphological information on the adult stage. The specimen from Russia is in good agreement with the original description and the re-examined holotype. However, it differs in some details.

Male (n = 1)

Total length 2.3 mm. Wing length 1.34 mm. Total length/wing length 1.72. Wing length/length of profemur 2.82. Coloration dark brown, wings with brownish tinge.

Head. Antenna with 13 flagellomeres. Ultimate flagellomere 270 μm long. AR 0.62. Temporal setae 6 including 1 inner vertical, 1 outer vertical, and 4 postorbitals. Clypeus 120 μm wide, with 12 setae. Tentorium 140 μm long, 20 μm wide at posterior tentorial pit. Palpomere lengths (in μm): 25, 40, 80, 70, 115. Fifth palpomere/third palpomere 1.44.

Thorax. Antepronotum with 2 larger median and 4 small lateral setae. Acrostichals 8, all in second one-fourth of scutum length; dorsocentrals 36, including 11 lanceolate humerals (anterior one standing apart from others), 6 non-lanceolate humerals medial to them, and 7 broadly lanceolate prescutellars (dorsocentrals mostly in double row in posterior half of scutum, mostly in single row behind parapsidal suture); 9 prealars; 1 supraalar; 6 scutellars; 3 preepisternals, all in anterior row; posterior anepisternum II with 2 setae.

Wing. VR 1.31. Brachiolum with 1 seta near centre, 42 μm long. Veins other than C and R without setae. R with 5 setae: 4 in basal one-third, 1 just after the middle. Squama with 3 setae, in the middle. C extension 80 μm long. Cu_1 distinctly S-shaped in apical half.

Legs. Spur on foretibia 60 μm long, those of midtibia 20 μm and 18 μm, of hind tibia 56 μm and 20 μm long. Comb of hind tibia consisting of 11 setae, 20–52 μm long. Width at apex of foretibia 32 μm, of midtibia 32 μm, of hind tibia 40 μm. Sensilla chaetica absent. Lengths and proportions of legs as in Table I.

Hypopygium. "Anal point" with about 20 setae. Laterosternite IX with 2 setae at either side. Transverse sternapodeme 75 μm long; phallapodeme 93 μm long. Virga 35 μm long. Gonocoxite 152 μm long. Gonostylus 89 μm long; megaseta 23 μm long. HR 1.71, HV 2.58.

Remarks

In comparison with the holotype, our specimen has the following main distinctions:

Lower total length/wing length; higher wing length/length of profemur; antepronotum with 4 lateral setae instead of 2; total number of dorsocentrals much higher but lanceolate setae almost the same in number; VR higher; R setae more numerous. All these character states are close to those in the holotype of *L. cranstoni* Sæther and/or within the variation of *L. pentaplastus* (Kieffer). In addition, the shape of inferior volsella is close to that in *L. cranstoni* Sæther: distinctly digitiform, not clearly tapering along entire length and not distinctly pointed to apex as in the holotype of *L. angelicae* Sæther. These characters were mentioned in

Table I. Lengths (in μm) and proportions of legs in *Limnophyes angelicae* Sæther (male from NW Russia).

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
p_1	475	615	328	205	140	82	65	0.53	2.88	3.33	2.44
p_2	517	550	270	140	98	57	57	0.49	3.79	3.94	2.40
p_3	533	630	370	180	148	70	65	0.58	3.31	3.16	3.60

the original description of *L. angelicae* among the distinguishing ones, but apparently are more variable.

However, many other important features of the new specimen from NW Russia are similar to those of the holotype of *L. angelicae*, and can be treated as diagnostic for the species. These include the number of flagellomeres (13), the leg proportions (LR_1, LR_2, LR_3, BV_1, SV_1, SV_2, SV_3), the numbers of lanceolate dorsocentrals and preepisternals, and details of the gonostyle (its shape, setation, and position of the megaseta).

Distribution and habitat

Limnophyes angelicae has been described from central Germany (Sæther 1990), and later recorded from Great Britain (Chandler 1998; Langton & Visser 2003) and Ireland (Murray & Murray 2003). Langton and Visser (2003) were the first who indicated the larval habitat (lakes and their outflow rivers) and described the pupa of this species. In the present paper, *L. angelicae* is recorded for the first time from Russia and from northern Europe.

Limnophyes er Sæther, 1985

Material examined. A total of 5 ♂ and 4 ♀: Lake Krivoe, shallow littoral zone, site 1, emergence trap 2 (depth 0.5 m), 1 ♀, 21 vii 1997 (slide "Chironomidae-239", ZIN); same locality and site, emergence trap 3 (depth 0.6 m), 1 ♀, 9 viii 1997 (slide "Chironomidae-240", ZMB); same locality, site 2, emergence trap 2 (depth 0.8 m), 1 ♂, 7 vii 1997 (slide "Chironomidae-9", ZIN); same locality and site, emergence trap 2 (depth 0.8 m), 2 ♂, 1 ♀, 29 vii 1997 (slides "Chironomidae-155", "−242", ZIN; "−241", ZMB); same data but emergence trap 3 (depth 1.0 m), 1 ♂, (slide "Chironomidae-152", ZMB); same locality and site, emergence trap 1 (depth 0.6 m), 1 ♂, 1 ♀, 9 viii 1997 (slides "Chironomidae-243", ZIN; "−244", ZMB).

This distinctive species was described from two males collected in northern Finland (Sæther 1985). Later, one additional male was collected in western Norway (Schnell 1988). Some additions to the description of the male were made by Sæther (1990). The female of *Limnophyes er* was unknown.

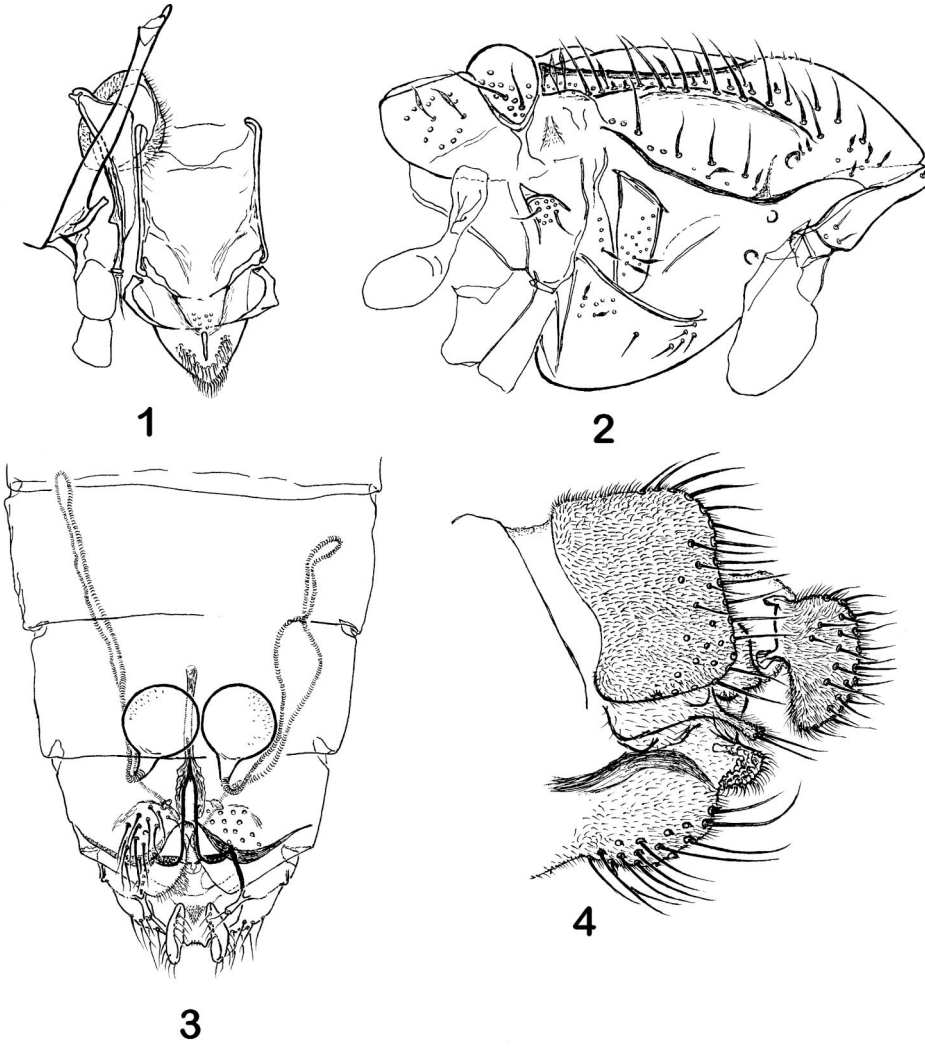
Female (n = 4, unless otherwise stated)

Total length 1.85–2.26, 2.04 mm. Wing length 1.17–1.34, 1.25 mm (8). Total length/wing length 1.46–1.85, 1.64. Wing length/profemur length 2.77–2.98, 2.88. Coloration intensely brown to dark brown, with the following parts paler (yellow-brown to light brown): scutellum, median scar of scutum, trochanters, abdominal segments I–VII, and, in some specimens, tibiae and tarsi. Setae of body almost black. Wing distinctly darkened, smoky, with brown veins.

Head. Antenna with five flagellomeres, AR 0.47–0.55, 0.50 (8). Pedicel 44–52, 48 μm long (8). Flagellomere lengths (in μm, $n = 8$): 46–52, 50; 34–40, 37; 36–40, 38; 32–40, 36; 72–88, 80. Flagellomeres 2–5 with sensilla chaetica; on segments 2–4 usually situated near apex (when two on segment, opposite to each other), on segment 5, beyond apex, commonly 2–3 on same side. Numbers of sensilla chaetica on flagellomeres ($n = 8$): on 2nd, 2–5, 3; on 3rd, 2–3, 2; on 4th, 1–2, 2; on 5th, 2–4, 3. All flagellomeres with two strong curved opposite setae near middle. Longest antennal seta 58–75, 65 μm (8). Temporal setae 4–7, 5 (8), including 1–2, 1 outer verticals and 3–6, 4 postorbitals. Clypeus 125–155, 139 μm wide, with 24–36, 28 setae distributed over clypeal surface except median bare stripe.

Tentorium (Figure 1) 115–150, 133 μm long, 8–12, 10 μm wide (8). Stipes (Figure 1) 95–100 μm long, 20 μm wide (2). Palpomere lengths (in μm): 24–32, 29 (6); 25–32, 30 (6); 39–48, 45 (8); 42–52, 48 (8); 80–88, 83 (6). Ratio of palpomeres 5/3 1.79–2.05, 1.92 (5). Third palpomere with 1 sensillum clavatum before apex. Coronal suture complete, 105–132, 119 μm. Eye without dorsomedian extension.

Thorax flattened dorsally, slightly depressed dorsoventrally. Median line of scutum in lateral view characteristic (Figure 2), shallowly convex in anterior half, slightly concave in posterior half. Except for anterior one-fourth, scutum with dark brown median keel higher near scutellum. Sides of scutum in posterior half slightly upturned, surfaces between them and median keel shallowly concave. Dorsal surface of scutum densely covered with fine hairs having stout bases, thus looking coarsely granulate. Humeral pit small, rounded to



Figures 1–4. *Limnophyes er* Sæther, female. (1) Tentorium, stipes, pedicel and cibarial pump; (2) thorax; (3) genitalia, ventral view; (4) genitalia, lateral view.

transversely broad-oval, with medial margin sclerotised. Antepronotum with 2–7, 5 smaller lateral setae (8) and 2–3 larger median setae. Dorsocentrals 43–54, 48 (8), including 4–7, 6 small lanceolate humerals; 13–19, 17 small and medium-sized lanceolate prescutellars; and 21–32, 26 very long and stout bristle-like setae (to 80 μm long, to 3–4 μm wide at base). Lanceolate humerals arranged as one group anterior to humeral pit; bristle-like setae mostly in double row, starting close to anterior margin of scutum and usually not reaching scutellum; lanceolate prescutellars in single or double row medial to bristle-like setae, starting in middle of scutum and reaching scutellum. Acrostichals 8–10, 9. Prealars 11–16, 14 (8), including 3–6, 4 small lanceolate setae in lateral row and 8–12, 10 large bristle-like setae in medial row. Supraalars 0–1. Median anepisternum II with 13–21, 17 short lanceolate setae (8); posterior anepisternum II with 3–5, 4 short lanceolate setae (8); epimeron II with 9–18, 12 short stout bristle-like setae (8) in upper half. Preepisternum with 10–15, 13 setae in upper half (8), including anterior simple or double diagonal row of 4–6, 5 short bristle-like setae; 0–2, 1 bristle-like setae near centre; and group of 3–8, 6 lanceolate setae in upper posterior corner. Scutellum with 25–35, 29 setae only in lateral areas. Postnotum with 20–28, 25 medium-sized or long lanceolate setae on entire surface except median area.

Wing. Cuneiform. Wing surface densely covered with coarse microtrichia. Along posterior margin, wing fringed with rather long setae, their length increasing from wing apex to its base (from 20–30 μm to 70–85 μm). Fringe ending at about 120 μm from alula. M 450–525, 495 μm (8); Cu 580–705, 648 μm (8). VR 1.27–1.34, 1.31 (8). C extension 50–80, 63 μm long (8), usually with posterior widening near middle. Brachiolum with 2 setae near middle (8), proximal seta 15–50 μm long, distal one 55–70 μm long. R with 4–7, 6 setae (8); R_1 with 2–4, 3 setae (8); R_{4+5} with 4–8, 6 setae (8) in apical half only; C extension with 0–2, 1 seta (8). Squama without setae (8).

Legs. Spur on foretibia 30–35, 32 μm long; spurs on midtibia 24–35, 30 μm and 20–28, 23 μm long; those on hind tibia 52–57, 55 μm and 20 μm long. Width at apex of foretibia 37, 34–39 μm; of midtibia 35–39, 38 μm; of hind tibia 43–52, 47 μm. Comb with 12–13, 12 setae; shortest seta 24–28, 27 μm long, longest seta 36–44, 40 μm long. Sensilla chaetica of front tarsus: ta_1 0–2, 2; ta_2 0–1, 1; ta_3 0–1. Sensilla chaetica of middle tarsus: ta_1 1–5, 3; ta_2 1–2, 1; ta_3 0–1, 0. Sensilla chaetica of hind tarsus: ta_1 1–3, 2; ta_2 2; ta_3 1–2, 1. All sensilla chaetica situated ventrally in apical half of tarsomeres. In addition, in two specimens ta_5 of all legs ventrally in middle with seta looking as a sensillum chaeticum but with a larger apical curve, thinner apex, and curved in distal direction (not in proximal direction, as in true sensilla chaetica). Pulvilli short, empodium long. Lengths and proportions of legs as in Table II.

Abdomen. Number of setae on tergites I–VIII as: 40–49, 44; 31–49, 39; 36–49, 41; 36–51, 41; 42–49, 45; 34–44, 39; 26–42, 34; 19–36, 29. Number of setae on sternites I–VII

Table II. Lengths (in μm) and proportions of legs in *Limnophyes er* Sæther (females from NW Russia).

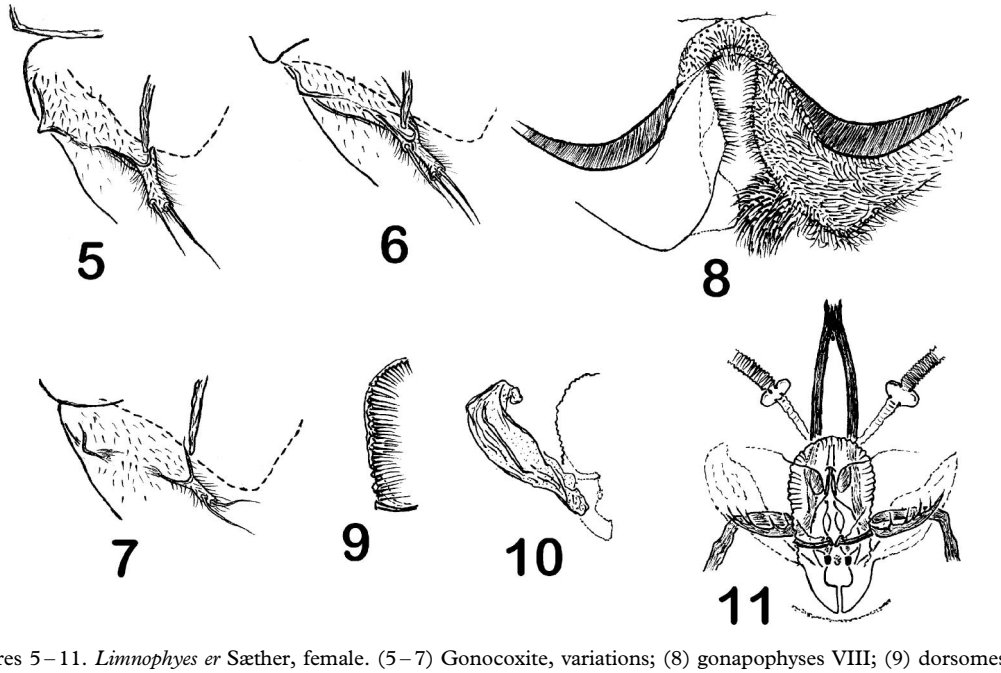
	fe	Ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
p_1	410–459, 435	500–558, 529	221–238, 230	98–107, 103	66–74, 72	41–49, 43	66–82, 74	0.43–0.44, 0.44	3.94–4.24, 4.10	4.11–4.28, 4.20	1.23–1.45, 1.33
p_2	443–500, 472	459–517, 488	156–172, 164	74–86, 81	49–66, 57	33–41, 38	57–66, 63	0.33–0.34, 0.34	4.61–4.85, 4.73	5.79–5.90, 5.85	1.23–1.35, 1.29
p_3	467–517, 496	566–615, 587	238–262, 252	107–123, 115	107–115, 109	41–53, 44	72–74, 74	0.42–0.44, 0.43	3.82–4.10, 3.92	4.25–4.34, 4.29	1.30–1.48, 1.39

as: 3–5, 4; 10–22, 15; 16–45, 26; 25–55, 39; 27–60, 43; 37–62, 45; 30–56, 38. Sternite VIII with 15–23, 19 setae (8) on each side of median line; bases of these setae posteriorly reaching gonacoxapodeme VIII. Setae on median parts of tergites I–IV very long and stout, reaching 90 μm in length and 4–5 μm in width; setae on lateral parts and on posterior tergites smaller. Setae on sternites I–II occupying only centre of sternite; on sternites IV–VII and on tergites covering entire surface.

Genitalia (Figures 3–11). Gonocoxite IX 80–100, 94 μm long (8), very distinctive in shape (Figures 4–7): consisting of broad basal part hardly separated dorsally from tergite IX, usually with short obtuse lateral tooth, and narrow stick-shaped distal projection directed distomedially; projection 20–45, 34 μm long (8), 5–10, 8 μm wide in middle (8), with two long apical setae (20–35 μm and 12–30 μm long, respectively) and sometimes with long subbasal seta (35–40 μm long) (Figure 6). Stick-shaped part mostly slightly narrowed in middle and widened to apex. Tergite IX undivided, with 28–39, 33 setae. Cercus 57–80, 69 μm long (8). Seminal capsule round, 95–100 μm in diameter (6), not including elongate-triangular neck 20–28 μm long (6); seminal capsules and necks dark brown, heavily sclerotised, with microtrichia. Spermathecal ducts unusually long, their loops reaching far anterior of seminal capsules and to segment V; ducts 4–6 μm wide, with abrupt bulbous swelling about 20 μm before end (Figure 11). Notum 120–128, 122 μm long.

Remarks

In the key to the females of *Limnophyes* provided by Sæther (1990), *L. er* runs to couplet 9, i.e. to *L. pumilio* (Holmgren). However, it differs easily from all known females of



Figures 5–11. *Limnophyes er* Sæther, female. (5–7) Gonocoxite, variations; (8) gonapophyses VIII; (9) dorsomesal lobe; (10) apodeme lobe; (11) details of rami, gonocoxapodemes, spermathecal ducts and eminence, accessory gonopore and labia.

Limnophyes in the peculiar shape of gonocoxite IX, the narrow darkened wing without anal lobe, and in the postnotum with numerous lanceolate setae. Other uncommon features are the flattened scutum with median keel, the median anepisternum with numerous lanceolate setae, and the extremely long spermathecal ducts. In the elongate apical part of the gonocoxite, *L. er* bears a distant resemblance to *L. habilis* (Walker) and *L.* sp. A (Sæther 1990), whose gonocoxites are stick-shaped. However, all other above-mentioned features are totally different.

In most characters, the female of *L. er* is very similar to the male as described by Sæther (1985, 1990). There are only a few considerable differences other than those in the abdominal apex: in the female, all LR are lower, all SV are higher, and sensilla chaetica are usually developed on all tarsi. Several smaller differences also occur: the female is characterised by a lower ratio of total length to wing length, a higher ratio of wing length to profemur length, fewer outer verticals, lower ratio of palp segments 5/3, higher number of acrostichals and scutellars, lower number of setae on preepisternum and on posterior anepisternum II, the brachiolum with two setae instead of one, higher numbers of setae on R_1, R_{4+5} and in tibial comb, and shorter ta_2 of p_2.

It should also be mentioned that in our material all the males have five flagellomeres, and the scape has no seta in either sex. The shape and details of the antenna, the shapes of the thorax and wing were the same in male and female.

These details, along with only minute external distinctions and strikingly similar general appearance of male and female, should be due to a high degree of feminisation in males of this species (see also Sæther 1985, 1990). Such feminisation apparently is connected with non-swarming behavior and ground mating. The tendency in chironomids to copulate on the ground instead of swarming is mostly an adaptation to windblown localities. This adaptation often leads to extensive changes in nearly all external characters of the imago. The antennae, palps, and wings may be reduced, the thorax flattened, the legs shortened and broadened, the genitalia enlarged etc. There is no strict connection between these morphological changes. One species may have reduced antennae, but normal wings and hypopygium, and vice versa (Sæther 1968, 1986; Ferrington & Sæther 1987; Sæther & Willassen 1987).

Distribution and habitat

In the present paper, *Limnophyes er* is recorded from Russia for the first time. The larval habitat is indicated for the first time as well. The emergence period was from early July until mid-August.

Limnophyes natalensis (Kieffer, 1914)

Material examined. Lake Krivoe, shallow littoral zone, site 2, emergence trap 2 (depth 0.8 m), 1 ♂, 7 vii 1997 (slide "Chironomidae-166", ZIN).

L. natalensis is recorded from European Russia for the first time. The species is widespread in Europe (Sæther & Spies 2004). Recently, it was found also in Asian Russia: Polar Siberia (Zelentzov & Shilova 1996), the Kamchatka Peninsula (Makarchenko & Makarchenko 2000) and Sakhalin Island in the Russian Far East (Makarchenko et al. 2005).

The lake littoral zone is indicated as a larval habitat of *L. natalensis* for the first time. Previously, the species was recorded from rivers and streams (Sæther 1990; Langton 1991), and from semiaquatic *Sphagnum* habitats (Langton 1991).

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