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On the systematics of *Linevitshia* Makarchenko, 1987 (Diptera: Chironomidae, Diamesinae), with the description of *L. yezoensis* Endo, new species

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Abstract. The male and female adults of a new species, *Linevitshia yezoensis* Endo, from Hokkaido, Japan are described. Based on the study of this new species and a critical reexamination of *Linevitshia prima* Makarchenko, the genus *Linevitshia* Makarchenko is provisionally transferred from Podonominae to Diamesinae.

Key words: Diptera, Chironomidae, Diamesinae, *Linevitshia*, new species, Japan

Introduction

The genus *Linevitshia* Makarchenko was established with the description of *L. prima* Makarchenko from the southern Russian Far East (Makarchenko 1987). Makarchenko placed *Linevitshia* in the subfamily Podonominae, partly because vein R_{2+3} seemed to be missing in the original specimens that had just emerged from the pupal exuviae before capture. However, Endo later collected very similar midges in which R_{2+3} is distinct. The male genitalia of these Japanese specimens differ slightly from *L. prima*. Here we describe the adults of this second species as *Linevitshia yezoensis* new species, taking the authorship of Endo. We reconsider the placement of *Linevitshia* in the light of new morphological evidence, particularly with reference to the discovery of females.

Material and methods

The specimens were mounted in either Canada balsam or Euparal. The morphological nomenclature follows Sæther (1980). Measurements are given as ranges, followed by a mean when more than four specimens were measured, followed by the number of specimens measured in parenthesis.

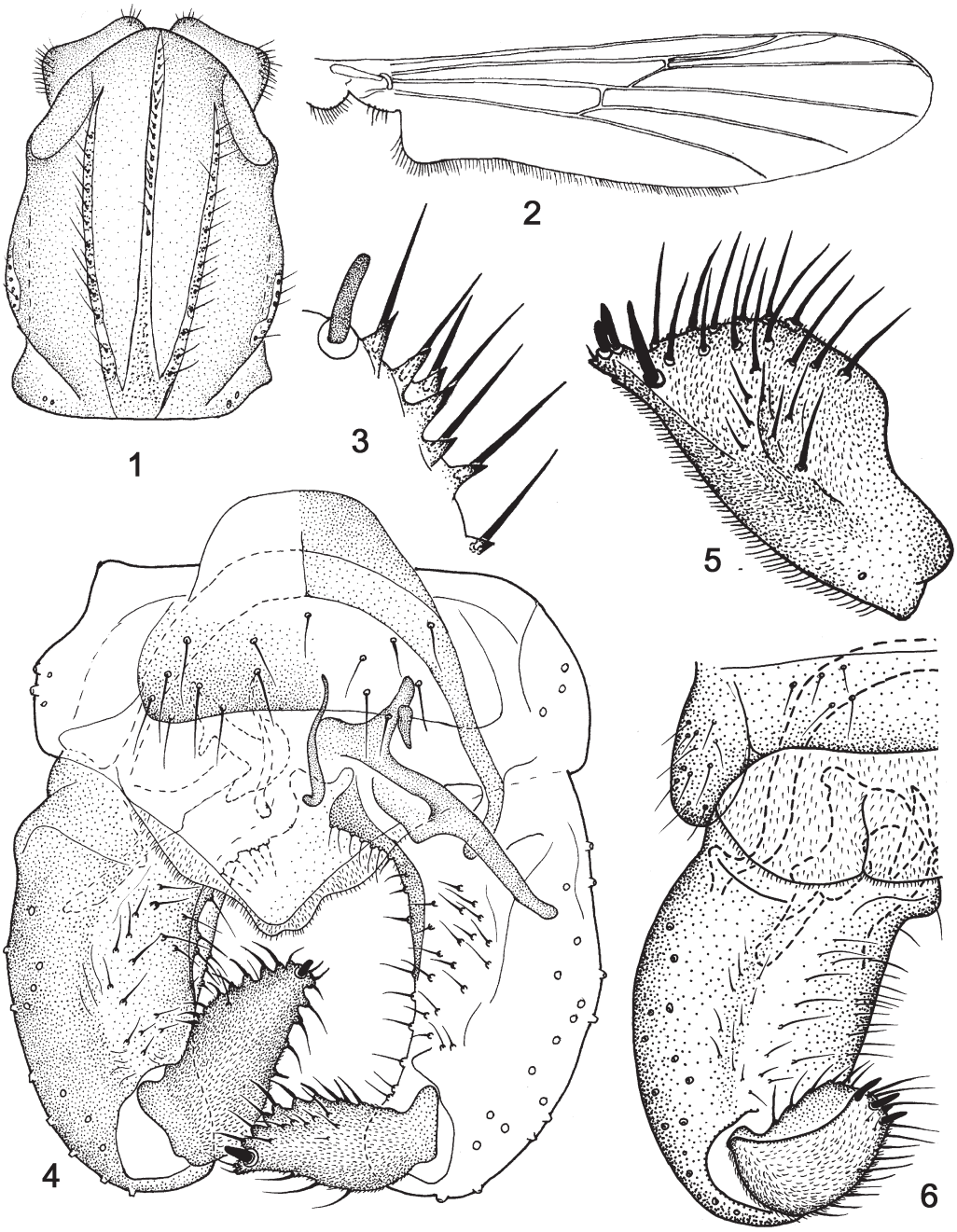
The holotype and paratypes of the new species are deposited in the Laboratory of Entomology, Obihiro University of Agriculture and Veterinary Medicine, Hokkaido, Japan (LEOU). Additional paratypes are deposited in the Institute of Biology and Soil Sciences, Far East Branch of the Russian Academy of Sciences, Vladivostok, Russia (IBSS FEBRAS) and in the Natural History Collections, Bergen Museum, University of Bergen, Norway (ZMBN).

Linevitshia yezoensis Endo, new species
(Figs. 1–4, 7–13)

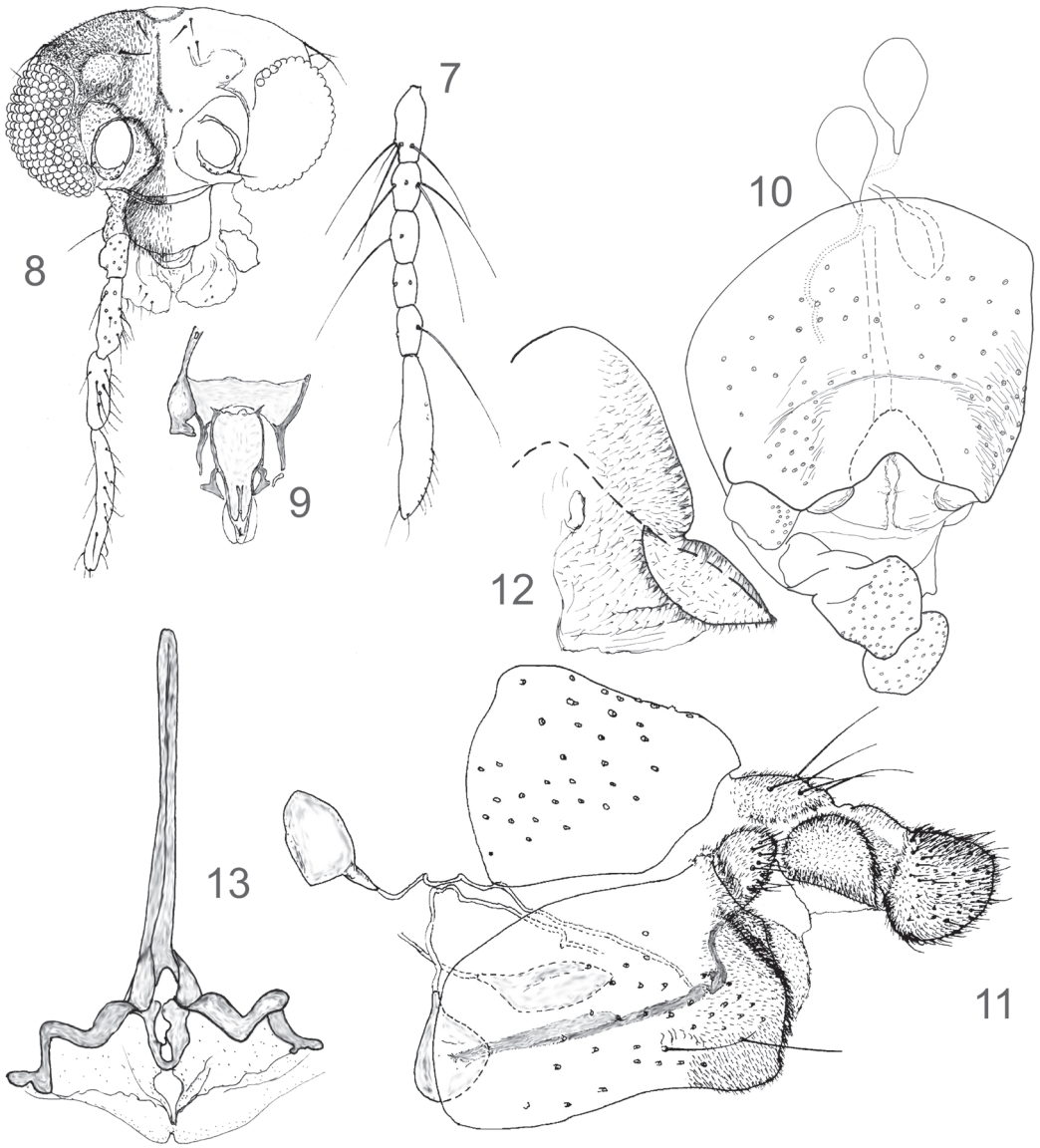
Type material. Holotype male. JAPAN: Hokkaido, Obihiro, Taisho, Nuppuku River, 4–11.x.1999, Malaise trap, K. Umemura (LEOU). Paratypes: 1 male, JAPAN: Hokkaido, Obihiro, Taisho, Nuppuku River, 12–13.x.1998, Malaise trap, K. Umemura; 2 males, as previous except 8.x.2000, K. Endo; 5 males, as previous except 12.x.2000; 2 males, as previous except

16.x.2000; 3 females, as previous except 4.x.2001; 1 female, Hokkaido, Shintoku,Yutomuraushi River, 700 m a.s.l., 23.ix.–1.x.1999, Malaise trap, K. Endo; 1 female, as previous except 1–11.x.1999; 2 females, Hokkaido, Kutchan, spring-brook near Mount Yotei, 7.x.2001, K. Endo; 1 female, as previous except 14.x.1999, (LEOU); 1 male, Hokkaido, Taiki, stream at Oda, 22.x.1997, K. Endo; 1 male, Hokkaido, Obihiro, Taisho, Nuppuku River, 7.x.2000, K. Endo; 1 female, Hokkaido, Shintoku, Yutomuraushi River, 700 m a.s.l., 1–11.x.1999, Malaise trap, K. Endo, (IBSS FEBRAS); 1 female, as previous, (ZMBN); 1 female, Hokkaido, Obihiro, Taisho, Nuppuku River, 5.x.2000, K. Endo; 3 females, as previous except 12.x. 2000; 1 female, as previous except 16.x. 2000, (ZMBN).

Etymology. The species name refers to the old name for Hokkaido Island: Yezo.



Figs. 1–6. *Linevitshia yezoensis* Endo, new species (1–4) and *L. prima* Makarchenko (5–6), males. 1. – Antepronotum and scutum. 2. – Wing. 3. – Subapical part of gonostylus. 4. – Hypopygium, dorsal view. 5. – Gonostylus. 6. – Part of hypopygium, dorsal view.



Figs. 7–13. *Linevitshia yezoensis* Endo, new species, female. 7. – Antenna. 8. – Head. 9. – Tentorium and mouth parts. 10. – Genitalia, ventral view. 11. – Genitalia, lateral view. 12. – Detail of genital chamber, ventral view, broken line indicates posterior margin of the ventral "floor". 13. – Notum, rami, coxosternapodeme and labia, ventral view.

Male (n = 10, except when otherwise stated)
Total length 3.48–4.14, 3.72 mm. Wing length 2.12–2.34, 2.21 mm. Total length / wing length 1.30–1.52 (4). Coloration of dry specimen: body largely brown to dark brown; head and thorax more or less grayish.

Head. Antenna with 13 flagellomeres and well-developed plume; ultimate flagellomere with 2 subapical setae, pedicel with 2–3 setae, scape without setae. AR 1.00–1.11, 1.04. Frons with weak protrusions near dorsomesal corner of eye. Temporal setae composed of 0–1 weak and short inner verticals and 3–5 stronger postorbitals. Eyes reniform with weak microtrichia between ommatides. Clypeus without setae. Length / width (in μm) of palp segments 1–5: 40–48, 44 / 41–45, 43; 61–79, 70 / 39–43, 41; 112–141, 125 / 34–40, 37; 127–146, 139 / 32–36, 34; 192–225, 205 / 25–31, 27. Palpal stoutness 3.64–4.13, 3.91.

Thorax (Fig. 1). Antepronotum with U-shaped notch in frontal view, with 4–9 dorsal and 14–21 lateral setae. Acrostichals 17–33, dorsocentrals 11–16, prealars 6–9, supralars 1–3. Scutellum with 10–16 setae. Posterior anepisternum II with 3–5 setae, epimeron II with 3–8 setae, preepisternum without setae.

Wing (Fig. 2). Width 0.56–0.66, 0.62 mm. Costa produced well beyond R_{4+5}, costal extension 60–80 (4) µm long; R_{2+3} weak, but distinct. Anal lobe weakly developed. Membrane without macrotrichia. Brachiolum with 3–5 setae. R with 22–28 setae, R_1 with 5–11 setae, R_{4+5} with 6–11 setae. Alula with 4–9 setae. Squama with 18–25 setae.

Legs. Spurs of foretibia 70–79, 75 µm; of midtibia 67–78, 72 and 66–75, 70 µm; of hind tibia 81–90, 86 and 65–73, 69 µm long. Hind tibial comb of 9–11 setae. Tarsi 1–3 with the following numbers of apical / preapical pseudospurs: 1 / 0, 0 / 0, 0 / 0 on p_1; 2 / 5–7, 2 / 1–3, 0 / 0 on p_2; 2 / 4–7, 2 / 0–2, 0 / 0 on p_3. Tarsal sensilla chaetica absent. Ta_4 cylindrical; ta_5 slightly curved; pulvilli small; tip of claws serrate, with approximately 5 teeth. Lengths and proportions of legs as in Table 1.

Hypopygium (Figs. 3–4). Tergite IX with 9–14 setae. Anal point absent. Laterosternite IX with 8–11 setae. Gonocoxite simple, 160–180 (4) µm long. Sternapodeme broadly arched, 128–140 (4) µm long. Phallapodeme 96–120 (4) µm long; aedeagal lobe large, forked distally. Gonostylus 92–96 (4) µm long; in distal part with 12–22 µm long, strong setae and single apical megaseta, 12–14 (4) µm long (Fig. 3). HR 1.70–2.40.

Female (n = 1–2)

Total length not measured. Wing length 2.62–2.87 mm. Coloration as in male.

Head (Figs. 7–9). Antenna (Fig. 7) with 6 flagellomeres. AR 0.52–0.54. Scape with 5–6 setae; pedicel without setae; flagellomeres 1–5 with following numbers of setae: 7–8, 6–9, 7, 4, 3–4; ultimate flagellomere with 2 weak apical setae. Dorsal sensilla coeloconica on flagellomeres 1–2. Coronal suture weak and discontinuous. Frons with conspicuous protrusions near dorsomesal corner of eye. Temporal setae composed of 4–7 relatively weak verticals and 4–5 stouter dorsal postorbitals. Eyes reniform, with sparse microtrichia not reaching beyond ommatid lenses. Clypeus without setae. Length / width (in µm, n = 1) of palp segments 2–5: 63 / 44, 126 / 41, 120 / 38, 227 / 28. Palpal stoutness 3.54. First palpomere with setae, third palpomere without sensory pit. Tentorium and cibarial pump as in Figure 9. Stipes occasionally fused mesally.

Thorax. Antepronotum with 7–8 dorsal and 17–23 lateral setae. Acrostichals 25–31, dorsocentrals 15–20 in single row, prealars 6–9, supralar 0–1. Scutellum with 10–17 setae. Posterior anepisternum II with row of 4–5 stout setae, epimeron II with cluster of 6 setae, preepisternum without setae.

Wing. Costa produced well beyond R_{4+5}. R_1 curved. R_{2+3} occasionally faint but usually distinct from base to margin of costa. MCu proximal to RM and clearly distal to FCu. VR 0.80. Anal lobe obtuse. Wing membrane without setae, microtrichia distinct under 125x magnification. Brachiolum with 4–5 setae. R with 25–33 setae, R_1 with 15–19, R_{2+3} with 0–1, and R_{4+5} with 25–42 setae. Alula with 4–6 setae. Squama with 18–21 setae. Subcosta with 4 sensilla campaniformia, R_1 with 1, R_{2+3} with 1 at base, R_{4+5} without sensilla campaniformia.

Legs. Spurs of foretibia 73 µm, of midtibia 79 and 63 µm, of hind tibia 95 and 79 µm long. Width at apex of foretibia 47 µm, of midtibia 60 µm, of hind tibia 70 µm. Hind tibia with triangular group of stiff setae, apically terminating in

Table 1. Lengths (in µm) and proportions of legs of *Linevitshia yezoensis* Endo, new species, male (n = 10).

	fe	ti	ta_1	ta_2	ta_3	ta_4
p_1	1060–1172, 1113	1165–1285, 1225	816–980, 879	381–461, 408	254–293, 269	161–181, 170
p_2	1010–1159, 1075	1031–1170, 1088	462–553, 500	259–303, 280	175–199, 187	115–125, 121
p_3	1245–1381, 1305	1354–1504, 1432	702–843, 764	367–436, 402	224–263, 246	132–156, 148

	ta_5	LR	BV	SV	BR
p_1	132–145, 140	0.66–0.76, 0.72	3.18–3.40, 3.27	2.51–2.90, 2.67	3.29–3.51, 3.38
p_2	125–139, 131	0.43–0.48, 0.46	3.60–3.83, 3.71	4.12–4.62, 4.33	3.04–3.44, 3.25
p_3	132–153, 146	0.52–0.56, 0.53	3.63–3.86, 3.72	3.42–3.73, 3.59	3.18–4.04, 3.51

Table 2. Lengths (in µm) and proportions of legs of *Linevitshia yezoensis* Endo, new species, female (n = 2).

	fe	ti	ta_1	ta_2	ta_3	ta_4
p_1	1134–1148	1323–1267	911–945	396–398	256–264	160–171
p_2	1087–1129	1148–1181	515–543	277–284	184–189	120–123
p_3	1323–1346	1583–1604	792–827	417–455	256	152

	ta_5	LR	BV	SV	BR
p_1	136–152	0.71–0.72	3.48–3.49	2.60–2.65	2.7–2.8
p_2	123–128	0.45–0.46	3.90–3.94	4.17–4.42	2.0–2.7
p_3	152	0.49–0.52	3.69–3.86	3.51–3.72	2.7–3.0

irregular comb of 10 setae, 16–25 µm long. Tarsi 1–3 with the following numbers of apical / preapical pseudospurs: 2 / 0, 0 / 0, 0 / 0 on p_1; 2 / 4–6, 2 / 1–2, 0 / 0 on p_2; 2 / 4–5, 2 / 1–3, 0 / 0 on p_3. Middle and hind ta_1 with 5–10 sensilla chaetica basally. Ta_4 cylindrical; ta_5 curved; pulvilli distinct at 100x magnification; claws long and pointed. Lengths and proportions of legs as in Table 2.

Genitalia (Figs. 10–13). Sternite VIII with 70–80 setae. Gonocoxapodeme not visible. Gonapophyses VIII joined mesally to form a "floor" at the anterior of genital chamber, caudolaterally with narrow flap covering base of ventrolateral lobe and gonocoxite IX (Figs. 10, 12). Seminal capsules about 110 µm long including long neck with indication of annulations; capsule surface with weak granulation. Seminal ducts long and slightly winded. Gonocoxite IX broad and rounded, with 10–16 setae near caudoventral margin. Tergite IX undivided with 20–25 setae. Segment X long, devoid of setae. Postgenital plate present. Cerci small.

Remarks

Reexamination of *L. prima* shows that costa extends beyond R_{4+5} so that the couplet in the keys by Brundin (1989) and his comments on the peculiarities of costa actually do not apply. Males of *L. yezoensis* differ from *L. prima* in the shape of gonostylus and the sternapodeme. *L. yezoensis* has one apical megaseta whereas *L. prima* has three to four (Figs. 5–6). The female of *L. prima* is unknown, but similarity to *L. yezoensis* is expected.

Discussion

Linevitshia prima was placed originally with some doubt in the subfamily Podonominae (Makarchenko 1987). In a subsequent study of the Podonominae, Cranston and Edwards (1998) were unable to find much phylogenetic structure in a character matrix coded from adults including *Linevitshia*. They reiterated Makarchenko's caution concerning the phylogenetic placement of *Linevitshia* since the immature stages were unknown. Wing vein R_{2+3} is absent in Podonominae. The discovery of *Linevitshia* specimens with a distinct R_{2+3} suggests that a more appropriate placement of this genus is in the subfamily Diamesinae, because the combined presence of R_{2+3} and crossvein MCu is characteristic of most Diamesinae wings.

Linevitshia shares some features with *Protanypus* in the configuration of thorax: the antepronotals are in separate median and lateral clusters, the acrostichal and dorsocentral stripes are connected posteriorly, and setae are present on posterior anepisternum II and epimeron II. Also, the males have setae on the alula of the wing. Because at least some of these features are found also in the Podonominae, they do not represent very strong evidence of phylogenetic relatedness. When comparing the female genitalia of *Linevitshia* and *Protanypus* there is no particularly striking similarity. However, *Linevitshia* lacks a ninth gonotergite, a structure that represents a fusion of tergite and gonocoxite, regarded by Sæther (1977) as a synapomorphy of the semifamily Tanypodoinae which includes subfamily Podonominae (Sæther 1983). Absence of a gonotergite suggests that

Linevitshia belongs in the other main group of chironomids, the semifamily Chironomoinae. The external components of segment VIII are peculiar in *Linevitshia* and it is not obvious how the different lobes compare with the dorsomesal lobe and ventrolateral lobes (Sæther 1977) seen in Chironomoinae. Still, the divided gonapophysis observed in *Linevitshia* may be taken as an additional indication of affiliation with the Chironomoinae. Hence *Linevitshia* probably belongs in this semifamily and the diagnostics of the current subfamilies seem to exclude all alternatives but the Diamesinae.

The placement in Diamesinae must be regarded as provisional because the immature stages are as yet unknown and pupal and larval character states are important in the present understanding of chironomid systematics (Cranston & Edwards 1998; Sæther 2000). Moreover, although attempts have been made to define the Diamesinae in terms of synapomorphies (Brundin 1966; Sæther 1977), uniquely derived characters have been hard to find and it is possible that the "typical Diamesinae wing" with MCu and R_{2+3} present represents common features of a paraphyletic or even polyphyletic group of midges that are simply neither Buchonomyinae nor Prodiamesinae. If so, the Diamesinae would turn out to be a taxonomic wastebasket rather than a monophyletic group. We anticipate new evidence coming from immature stages of *Linevitshia* and hopefully from emerging DNA studies on the phylogeny of Chironomidae.

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