



## A review of the East Palaearctic *Pseudokiefferiella* Zavřel, 1941 (Diptera: Chironomidae: Diamesinae), with description of new species and DNA barcoding of known species

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### Abstract

Chironomids of the genus *Pseudokiefferiella* Zavřel from the East Palaearctic are revised using both morphological characters of adult males and molecular data. Four new species, *P. inopinata* sp. nov., *P. kolchak* sp. nov., *P. krasheninnikovi* sp. nov., and *P. transarctica* sp. nov. are described and figured. The adult males of *P. matafonovi* Makarchenko et Semenchenko and *P. silinka* Makarchenko et Semenchenko from the Amur River basin are briefly redescribed and annotated. A key to the known adult males of *Pseudokiefferiella* from the East Palaearctic is provided. The species delimitation, ASAP analysis, using COI DNA barcodes, assigned new species to unique mOTUs. Molecular data were also used for the reconstruction of the phylogenetic relationships within the genus *Pseudokiefferiella*.

**Key words:** Diptera, Chironomidae, *Diamesinae*, *Pseudokiefferiella*, taxonomy, new species, DNA barcoding, East Palaearctic

### Introduction

The genus *Pseudokiefferiella* was established by Zavřel (1941) and for a long time included only one species, *Pseudokiefferiella parva* (Edwards 1932), distributed in the Holarctic region (Ashe & O'Connor 2009). Recent years' DNA barcoding data on representatives of the genus from different regions, proven that *Pseudokiefferiella* is not monotypic and includes several species, which often are poorly distinguished morphologically (Krasheninnikov et al. 2020; Stur & Ekrem 2020; Makarchenko & Semenchenko 2023). One of the main problems in the taxonomy of this genus was the lack of DNA barcoding data for *P. parva* from the type locality, in Scotland. This made it difficult to establish a reference point for accurately determining other related species.

However, this problem was resolved by Stur and Ekrem (personal message from E. Stur) through the implementation of the project “Biodiversity Genomics Europe” (<https://biodiversitygenomics.eu/>) where a DNA barcode for the syntype of *P. parva* was generated (BOLD Process ID BSNHM1334-24, BIN BOLD: AAH8220). Comparison of the obtained DNA barcodes showed that *P. parva*, in addition to its type locality, lives in Norway (Rondane National Park), Northern Italy (Tovel Lake), and additional new species were found in other regions of Europe (see Figure 38).

In this study, we describe four new species, *P. inopinata* sp. nov., *P. kolchak* sp. nov., *P. krasheninnikovi* sp. nov. and *P. transarctica* sp. nov., along with their DNA barcoding (i.e., 3 species) from the Eastern Palaearctic. Also, adult males of *P. matafonovi* Makarchenko et Semenchenko and *P. silinka* Makarchenko et Semenchenko from the Amur River basin are briefly redescribed. The taxonomic status and position of *Pseudokiefferiella toyamaflexa* (Sasa, 1989) from Japan is discussed. A key to the adult males of the East Palaearctic species of the *Pseudokiefferiella* is provided. Several new species from the Western Palaearctic will be described in separate article in a future study.

## Materials and methods

The adult males were preserved in 70% ethanol for further study of morphology and 96% ethanol for DNA barcoding. The material was slide-mounted in polyvinyl lactophenol. The morphological terminology and abbreviations used below generally follow Sæther (1980). For some structures of the hypopygium, however, the terminology of Hansen & Cook (1976) and Oliver (1989) is used. The photographs were taken using an Axio Lab.A1 (Carl 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.

Holotypes and paratypes of the new species, as well as all other material, are deposited in the Bioresource Collection (reg. number 2797657) of the Federal Scientific Center of the East Asia Terrestrial Biodiversity, Far East Branch of the Russian Academy of Sciences, Vladivostok, Russia (FSCEATB FEB RAS).

Total genomic DNA extraction was performed using the Blood and Tissue Kit (Qiagen, Hilden, Germany) following the manufacturer's instructions with elution of resultant DNA in 100 µl. A fragment of the mitochondrial cytochrome c oxidase subunit I (COI) gene was amplified using the universal primers LCO1490 and HCO2198 (Folmer *et al.* 1994). Amplification products were purified by exonuclease I (ExoI) and alkaline phosphatase (FastAP) (Thermo Fisher Scientific Inc., USA) and bidirectionally sequenced by ABI 3130xl (Applied Biosystems) using reagents BigDye terminator v3.1 cycle kit. More details about PCR regime and sequence can be found in Makarchenko *et al.* (2022, 2023) and Semenchenko & Makarchenko (2025).

To reconstruct a phylogenetic tree and delimit species, we obtained a dataset that included our own DNA barcodes and all available molecular species (according to BOLD) of *Pseudokiefferiella*, including syntype (BOLD process ID BSNHM1334-24). We slightly reduced the resulting dataset by taking only 6 specimens for the species BIN BOLD:ACI9181 from Greenland, Canada, and Norway (14 samples available) and two specimens for BIN BOLD:AAL9436 from Canada (231 samples available).

Species by Automatic Partitioning (ASAP) (Puillandre *et al.* 2021) was used for species delimitation analysis with K2P distances. Settings for searching of best fitting nucleotide substitution models and phylogenetic analysis can be found in Makarchenko *et al.* (2023) and Semenchenko & Makarchenko (2025). The obtained sequences have been deposited in GenBank under numbers PX857805–PX857809.

## Taxonomy

### Genus: *Pseudokiefferiella* Zavřel

*Pseudokiefferiella* Zavřel, 1941: 9

Type species: *Diplomesa lapponica* Zavřel, 1941 [= *Diamesa parva* Edwards, 1932], by original designation and monotypy.

*Pseudokiefferiella* Zavřel; Serra-Tosio 1971: 258; Makarchenko 1985: 64, 2006: 272; Ashe & O'Connor 2009: 306.

*Diplomesa* Pagast, 1947: 539; Zavřel 1941: 6; Thienemann 1941: 190.

**Generic diagnosis** (emended). Based on a new material from the East Palaearctic, the generic diagnosis given by Zavřel (1941), Serra-Tosio (1971), Makarchenko (1985) and Oliver (1989) should be emended as follows.

#### *Adult male*

Total length 2.8–4.8 mm, wing length 2.4–3.9 mm.

Antenna. Pedicel with 0–3 setae. Flagellum with 13 flagellomeres, plumose, sometimes plume reduced; flagellomeres 1–5 or 6 and 13 with sensilla chaetica; terminal flagellomere with 1–2 subapical setae. Antennal ratio 0.8–2.0

Head. Eye bare or pubescent, slightly to moderately elongate dorsomedially. Temporal setae consisting of inner and outer verticals, frontals and postorbitals. Tentorium swollen basally, with microtrichia. Clypeus with 0–6 setae.

Thorax. Anteprenotal lobes separated medially by V- to U-shaped notch. Acrostichals usually absent but sometimes a few setae in the anterior part of mesonotum; dorsocentrals 7–20, erect and uniserial; prealars 3–11, ending over median anepisternum II; scutellars 7–50, in 1–4 rows; preepisternals absent.

Wing. Membrane without setae, with moderate punctation. Anal lobe angular or rounded and moderately produced. Costa moderately produced; R<sub>2+3</sub> ending closer to R<sub>1</sub> than to R<sub>4+5</sub>; FCu proximal to MCu. R<sub>4+5</sub> with setae. Squama fully fringed.

*Legs.* Fore leg without pseudospurs; mid and hind legs with pseudospurs on tarsomeres 1 and 2; tarsomere 4 cordiform, shorter than tarsomere 5. LR<sub>1</sub> 0.66–0.73, BV<sub>1</sub> 3.40–3.80, SV<sub>1</sub> 2.43–2.69.

*Hypopygium.* Anal point narrow, 65–108 µm long, often distally hair-like, sharply pointed, sometimes with 1–3 apical setae. Phallapodeme with expanded anterior apex; aedeagal lobe often finger-shaped, sometimes triangular, wedge-shaped or with narrow apex, hook-shaped, bent forward. Gonocoxite with flat, rounded slightly projecting, dorsally bare basal lobe and small lobe-like median field, which continuing basal lobe posteriorly, slightly indistinct, with few setae. Transverse sternapodeme consisting of a narrow arch, without or with expansion in middle. Pars ventralis absent. Gonostylus often with long crista dorsalis, sometimes short subapical crista dorsalis is present; megaseta small.

## Key to species of *Pseudokiefferiella* Zavřel of the East Palaearctic

### Adult males

1. Scutellum with 40–50 setae in 3–4 rows. AR 1.96. Gonostylus with short and rounded crista dorsalis and a thorn back to it (Fig. 4) . . . . . *P. inopinata* sp. nov.
- Scutellum with 8–20 setae in 1–2 rows. AR 0.81–1.69. Gonostylus with long crista dorsalis and without any thorns . . . . . 2
2. Transverse sternapodema with expansion in middle . . . . . 3
- Transverse sternapodema without expansion in middle . . . . . 4
3. Transverse sternapodema with triangular expansion in middle; apex of aedeagal lobe narrow, hook-shaped, bent forward, apically uncinat (Figs 32–37). Clypeus with 2 setae. AR 1.33–1.56 . . . . . *P. transarctica* sp. nov.
- Transverse sternapodema with oval expansion in middle; aedeagal lobe finger-shaped (Fig. 12). Clypeus without setae. AR 0.97–1.24 . . . . . *P. krashennikov* sp. nov.
4. Anal point with 3 apical setae (Fig. 19) . . . . . *P. matafonovi* Makarchenko et Semenchenko
- Anal point without apical setae . . . . . 5
5. Total length 4.6–4.8 mm. Dorsocentrals 14–20. Aedeagal lobe 136–144 µm long, finger-shaped; basal lobe rounded, without setae (Fig. 7) . . . . . *P. kolchak* sp. nov.
- Total length 2.8 mm. Dorsocentrals 7–10. Aedeagal lobe 68 µm long, wedge-shaped (Fig. 23); basal lobe in the form of rounded or rounded triangular tubercle, with 3–4 setae (Fig. 24) . . . . . *P. silinka* Makarchenko et Semenchenko

### Descriptions

#### *Pseudokiefferiella inopinata* Makarchenko et Semenchenko, sp. nov.

urn:lsid:zoobank.org:act:A8382531-1DF2-43F0-83B3-7D72FAE9A039

(Figs 1–5)

**Type material.** Holotype: adult male, *Russia*, Chukotka Autonomous Okrug, Iultinsky District, Wrangel Island, middle reaches of the Neozhidannaya River, N 71.0167, E 179.1500, 8–9.VII.2019, leg. O. Khruleva. Paratype: 1 adult male, the same data as holotype.

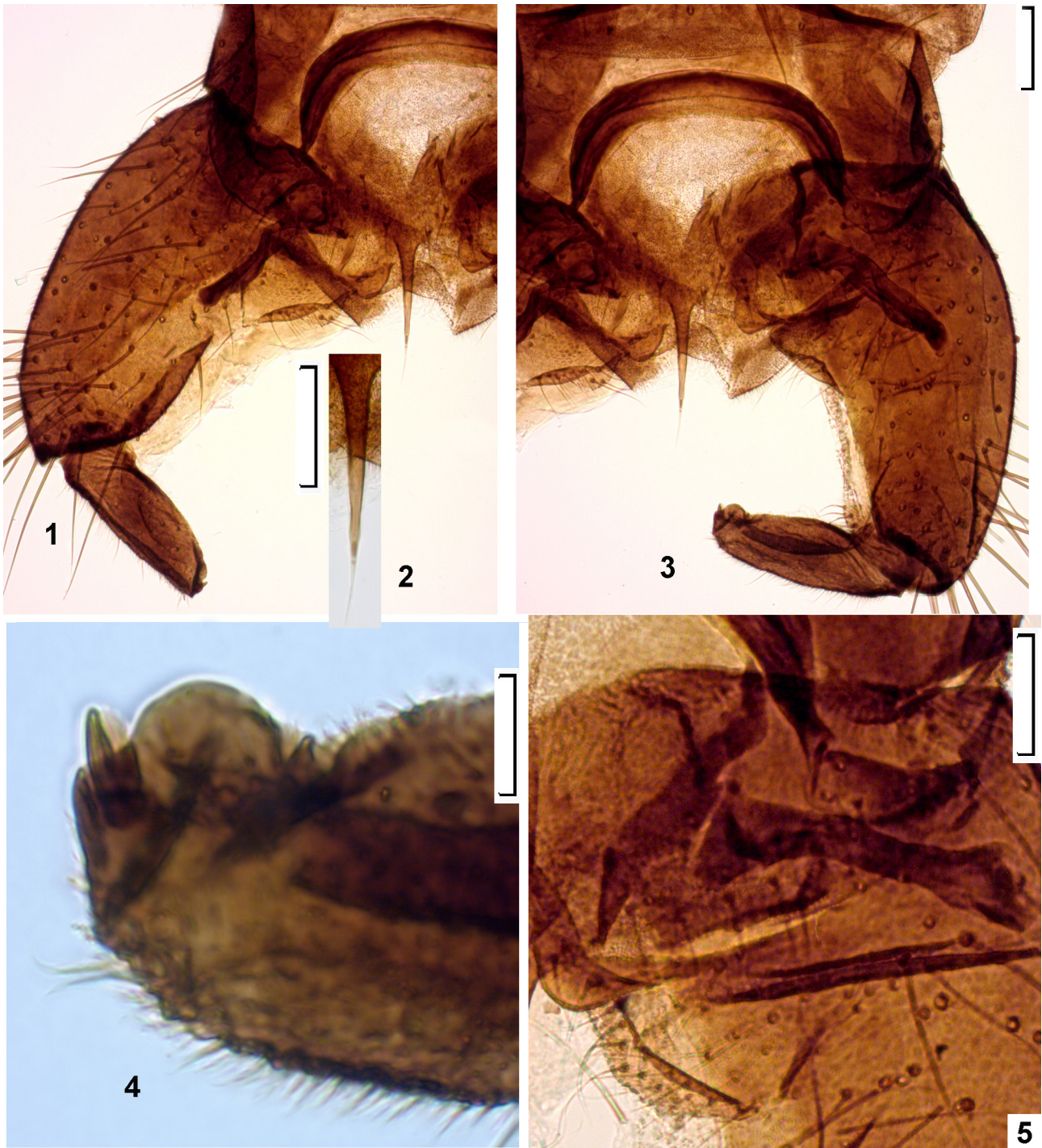
**Derivatio nominis.** The species is named *inopinata* after the type locality in Neozhidannaya River, which is translated from the Russian word for “unexpected”.

### Description

**Adult male** (n = 2, except when otherwise stated). Total length 4.2–4.3 mm. Total length/wing length 1.1–1.17.

**Coloration.** Dark brown. Antennae brown. Wings grayish, with light brown veins.

**Head.** Eyes bare, slightly elongate dorsomedially. Temporal setae including 10–11 verticals and 10 frontals. Clypeus with 2 setae, 60 µm long. Antenna with 13 flagellomeres and well developed plume of setae; maximal length of these setae on flagellomeres 738 µm; terminal flagellomere with 1 subapical setae, ca 50 µm long; pedicel with 2 setae, 60–68 µm long. AR 1.96. Palpomere length (µm): 48–52, 80, 140–168, 104–152, 180–196. Palpomere 3 in distal part with sensilla capitata with diameter 12 µm. Head width/palpal length 1.07–1.30.



**FIGURES 1–5.** Adult male of *Pseudokiefferiella inopinata* sp. nov. **1, 3**, hypopygium in dorsal view; **2**, anal point; **4**, distal part of gonostylus; **5**, endoskeleton, basal lobe, and median field of gonocoxite. Scale bars: 50  $\mu$ m.

Thorax. Anteprenotum with 6–8 ventrolateral setae. Dorsocentrals 11, prealars 5. Scutellum with *ca* 40–50 setae in 3–4 rows.

Wings. Length 3.6–3.9 mm, width 1.2 mm. Anal lobe developed and rounded. Squama with *ca* 60 setae, 84–120  $\mu$ m long. R and R<sub>1</sub> with 23–43 setae, R<sub>4+5</sub> with 0–2 setae in distal part. RM/MCu 3.0.

Legs. Spur of front tibia 96  $\mu$ m long. Spurs of mid tibia 64  $\mu$ m and 72  $\mu$ m long. Spurs of hind tibia 96  $\mu$ m and 56  $\mu$ m long. Hind tibial comb with 12 setae. Length ( $\mu$ m) and proportions of leg segments are as in Table 1.

**TABLE 1.** Lengths (in  $\mu\text{m}$ ) and proportions of leg segments of *Pseudokiefferiella inopinata* sp. nov., male (n = 1).

	fe	ti	ta <sub>1</sub>	ta <sub>2</sub>	ta <sub>3</sub>	ta <sub>4</sub>	ta <sub>5</sub>	LR	BV	SV	BR
P <sub>1</sub>	1197	1574	1099	525	328	115	148	0.70	3.47	2.52	4.7
P <sub>2</sub>	1427	1427	705	394	213	98	131	0.49	4.26	4.79	2.8
P <sub>3</sub>	1656	1755	1066	558	328	115	148	0.61	3.90	2.98	4.5

Hypopygium (Figs 1–5). Tergite IX with 19–20 setae from one side, 24–28  $\mu\text{m}$  long and with anal point, 92–108  $\mu\text{m}$  long, distally hair-like (Fig 2). Laterosternite IX with 7 setae, 60–92  $\mu\text{m}$  long. Transverse sternopodeme narrow, slightly curved, 216  $\mu\text{m}$  long, 44  $\mu\text{m}$  wide, without expansion in middle. Aedeagal lobe 112–132  $\mu\text{m}$  long, distally triangular, with pointed apex (Fig 5); phallapodeme 136  $\mu\text{m}$  long. Gonocoxite 328–340  $\mu\text{m}$  long, basal lobe rounded, dark brown, without setae, median field light brown, with 10–15 setae, 28–40  $\mu\text{m}$  long (Figs 3, 5). Gonostylus massive, 168  $\mu\text{m}$  long, subapical with short and rounded crista dorsalis and the thorn that is behind it (Fig. 4), apex with macroseta, 12  $\mu\text{m}$  long; HR 1.36–1.40.

*Pupa* and *larva* unknown.

**Diagnosis.** Total length 4.2–4.3 mm. Wing length 3.6–3.9 mm Clypeus with 2 setae. AR 1.96. Dorsocentrals 11, prealars 5. scutellars ca 40–50 (in 3–4 rows). LR<sub>1</sub> 0.70, BV<sub>1</sub> 3.47, SV<sub>1</sub> 2.52. Anal point 92–108  $\mu\text{m}$  long, distally hair-like. Aedeagal lobe 112–132  $\mu\text{m}$  long, distally triangular, with pointed apex. Basal lobe of gonocoxite rounded, dark brown, without setae, median field light brown, with 10–15 setae. Gonostylus subapical with short and rounded crista dorsalis. HR 1.36–1.40. The adult male of *P. inopinata* sp. nov. differs from all known species of the genus by its high AR value (1.96), large number of setae on scutellum (40–50), arranged in 3–4 rows, short subapical rounded crista dorsalis of gonostylus and some other characters listed in Table 5 and key.

**Distribution.** Known only from the type locality in Wrangel Island.

### *Pseudokiefferiella kolchak* Makarchenko, sp. nov.

urn:lsid:zoobank.org:act:7914AD72-63C1-4CB5-A54C-01D8607FD4F5

(Figs 6–10)

*Pseudokiefferiella parva* sensu Zelentsov & Shilova 1996: 55.

**Type material.** Holotype: adult male, **Russia**, Republic of Sakha (Yakutia), Bulunsky District, spurs of the Kharaulakh Ridge, Ust-Lensky State Nature Reserve, Lena River Delta, kordon Belaya Scala, 29.VI.1990, leg. N. Zelentsov. Paratypes: 2 adult males, the same data as holotype.

**Derivatio nominis.** The species is named in honor and memory of the organizer and participant of polar expeditions, Arctic explorer Alexander Vasilyevich Kolchak. The name is a noun in apposition.

## Description

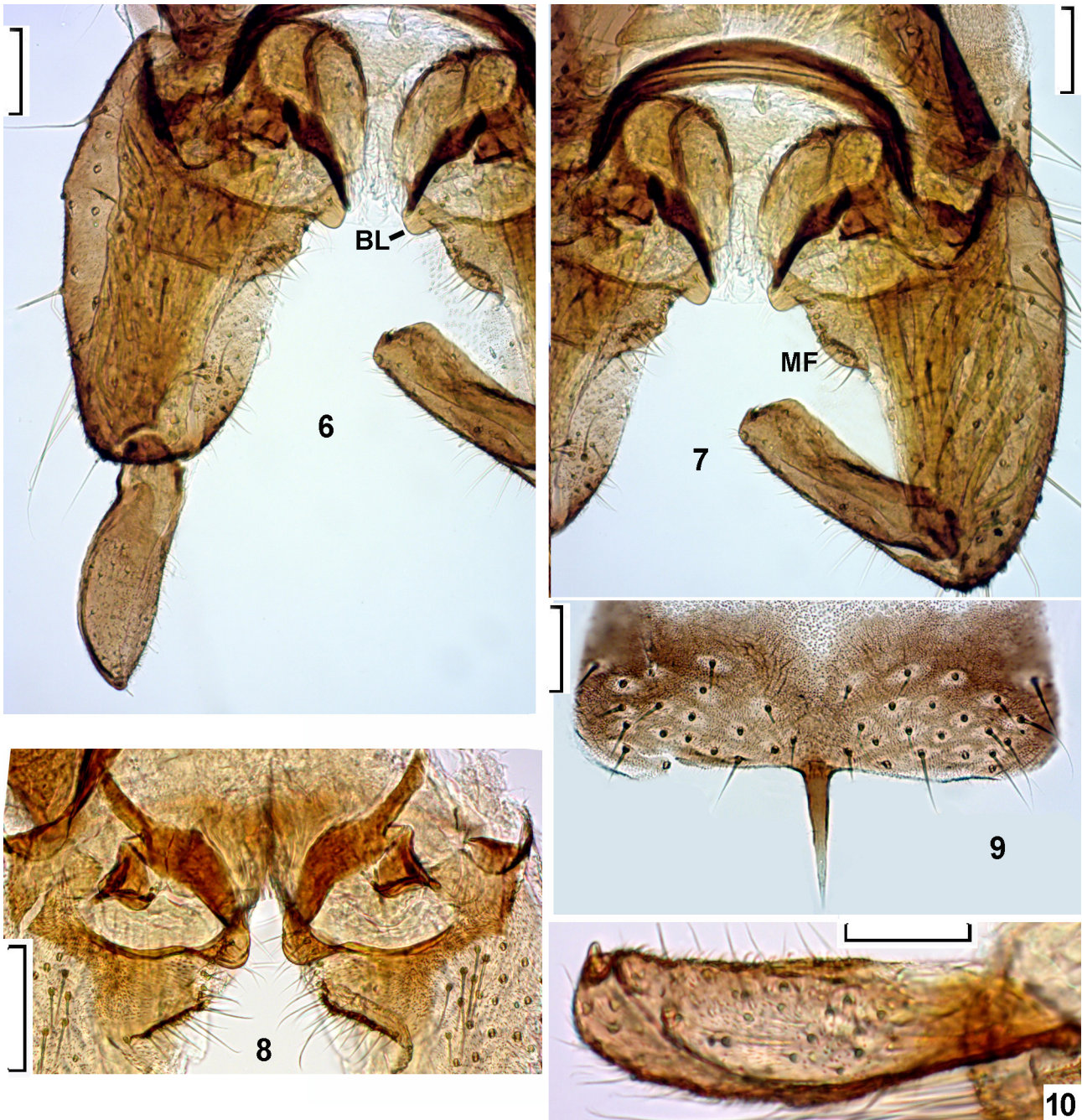
**Adult male** (n = 2, except when otherwise stated). Total length 4.6–4.8 mm. Total length/wing length 1.23–1.35.

Coloration. Brown, dark brown. Wings white, with brownish veins.

Head. Eyes bare, slightly elongate dorsomedially. Temporal setae including 6 verticals and 7–8 frontals. Clypeus with 4 setae, 40–64  $\mu\text{m}$  long. Antenna with 13 flagellomeres and well developed plume of setae; maximal length of these setae on flagellomeres 620  $\mu\text{m}$ ; terminal flagellomere with 1 subapical seta, 28  $\mu\text{m}$  long; pedicel with 2 setae, 100–116  $\mu\text{m}$  long. AR 1.58–1.69. Palpomere length ( $\mu\text{m}$ ): 44–60, 76–100, 156–160, 132–140, 192–204. Palpomere 3 in distal part with sensilla capitata with diameter 12  $\mu\text{m}$ . Head width/palpal length 1.07–1.30.

Thorax. Anteprepronotum with 8–12 ventrolateral setae. Dorsocentrals 14–20, prealars 5. Scutellum with 20–25 setae in 1–2 rows.

Wings. Length 3.5–3.9 mm, width 1.2 mm. Anal lobe developed and rounded. Squama with 60–64 setae, 48–80  $\mu\text{m}$  long. R and R<sub>1</sub> with 30 setae, R<sub>4+5</sub> with 4 setae in distal part. RM/MCu 3.0–3.2.



**FIGURES 6–10.** Adult male of *Pseudokiefferiella kolchak* sp. nov. 6–7, hypopygium without tergite IX, in dorsal view; 8, endoskeleton, basal lobe and median field of gonocoxite; 9, tergite IX; 10, gonostylus. BL – basal lobe, MF – median field. Scale bars: 50  $\mu$ m.

Legs. Spur of front tibia 60–96  $\mu$ m long. Spurs of mid tibia 60  $\mu$ m and 64  $\mu$ m long. Spurs of hind tibia 96–108  $\mu$ m and 56–72  $\mu$ m long. Hind tibial comb with 16–18 setae. Length ( $\mu$ m) and proportions of leg segments are as in Table 2.

**TABLE 2.** Lengths (in  $\mu$ m) and proportions of leg segments of *Pseudokiefferiella kolchak* sp. nov., male (n = 1).

	fe	ti	ta <sub>1</sub>	ta <sub>2</sub>	ta <sub>3</sub>	ta <sub>4</sub>	ta <sub>5</sub>	LR	BV	SV	BR
P <sub>1</sub>	1148	1460	968	459	279	98	131	0.66	3.70	2.69	-
P <sub>2</sub>	1312	1279	590	312	197	98	131	0.46	4.31	4.39	-
P <sub>3</sub>	1428	1476	951	492	270	98	131	0.64	3.86	3.05	-

Hypopygium (Figs 6–10). Tergite IX with 16–22 setae from one side, 40–100  $\mu\text{m}$  long and with anal point, 96–104  $\mu\text{m}$  long, distally hair-like (Fig. 9). Laterosternite IX with 8–18 setae, 60–136  $\mu\text{m}$  long. Transverse sternopodeme consisting of a narrow arch 240–260  $\mu\text{m}$  long, 28–36  $\mu\text{m}$  wide. Aedeagal lobe 136–144  $\mu\text{m}$  long, with long finger-shaped distal part (Figs 6–8); phallapodeme 150–156  $\mu\text{m}$  long. Gonocoxite 336–348  $\mu\text{m}$  long, basal lobe rounded, without setae, median field with 20–21 setae, 32–36  $\mu\text{m}$  long (Figs 6–8). Gonostylus massive, 168–200  $\mu\text{m}$  long, 64  $\mu\text{m}$  wide, with long and low crista dorsalis, which occupies about half length of gonostylus; apex with macroseta, 8–12  $\mu\text{m}$  long (Figs 6–7, 10); HR 1.74–2.0.

*Pupa and larva* unknown.

**Diagnosis.** Total length 4.6–4.8 mm. Wing length 3.5–3.9 mm Clypeus with 4 setae. AR 1.58–1.69. Dorsocentrals 14–20, prealars 5, scutellars 20–25 (in 1–2 rows). LR<sub>1</sub> 0.66, BV<sub>1</sub> 3.70, SV<sub>1</sub> 2.69. Anal point 96–104  $\mu\text{m}$  long, distally hair-like. Aedeagal lobe 136–144  $\mu\text{m}$  long, with long finger-shaped distal part. Basal lobe of gonocoxite rounded, without setae, median field with 20–21 setae. Gonostylus with long and low crista dorsalis, which occupies about half length of gonostylus. HR 1.74–2.0. The adult male of *P. kolchak* **sp. nov.** differs from all known species of the genus by larger sizes (4.6–4.8 mm), number of clypeals (4) and dorsocentrals (14–20), length of aedeagal lobe (136–144  $\mu\text{m}$ ) and some other characters listed in Table 5 and key.

**Distribution.** Known only from the type locality in Ust-Lensky State Nature Reserve of Sakha (Yakutia), Lena River Delta.

### *Pseudokiefferiella krasheninnikovi* Makarchenko *et* Semenchko, **sp. nov.**

urn:lsid:zoobank.org:act:FDB98EDB-25E1-4FDC-A89D-93494705A2C6

(Figs 11–17)

**Type material.** Holotype: adult male, *Russia*, Magadan Region, Susuman District, Okhandya Ridge, unnamed stream in the Yug Lake basin, 17.VII.2024, N 63.79986, E 147.68961, alt. 1137 m a.s.l., leg. A. Krasheninnikov. Paratypes: 8 adult males, the same data as holotype.

**Derivatio nominis.** The species is named in honor of Russian chironomidologist Dr. Andrei Borisovich Krasheninnikov (Institute of Biological problems of North FEBRAS, Magadan, Russia) who collected type material of new species.

## Description

**Adult male** (n = 4, except when otherwise stated). Total length 3.6–4.1 mm. Total length/wing length 1.23–1.59.

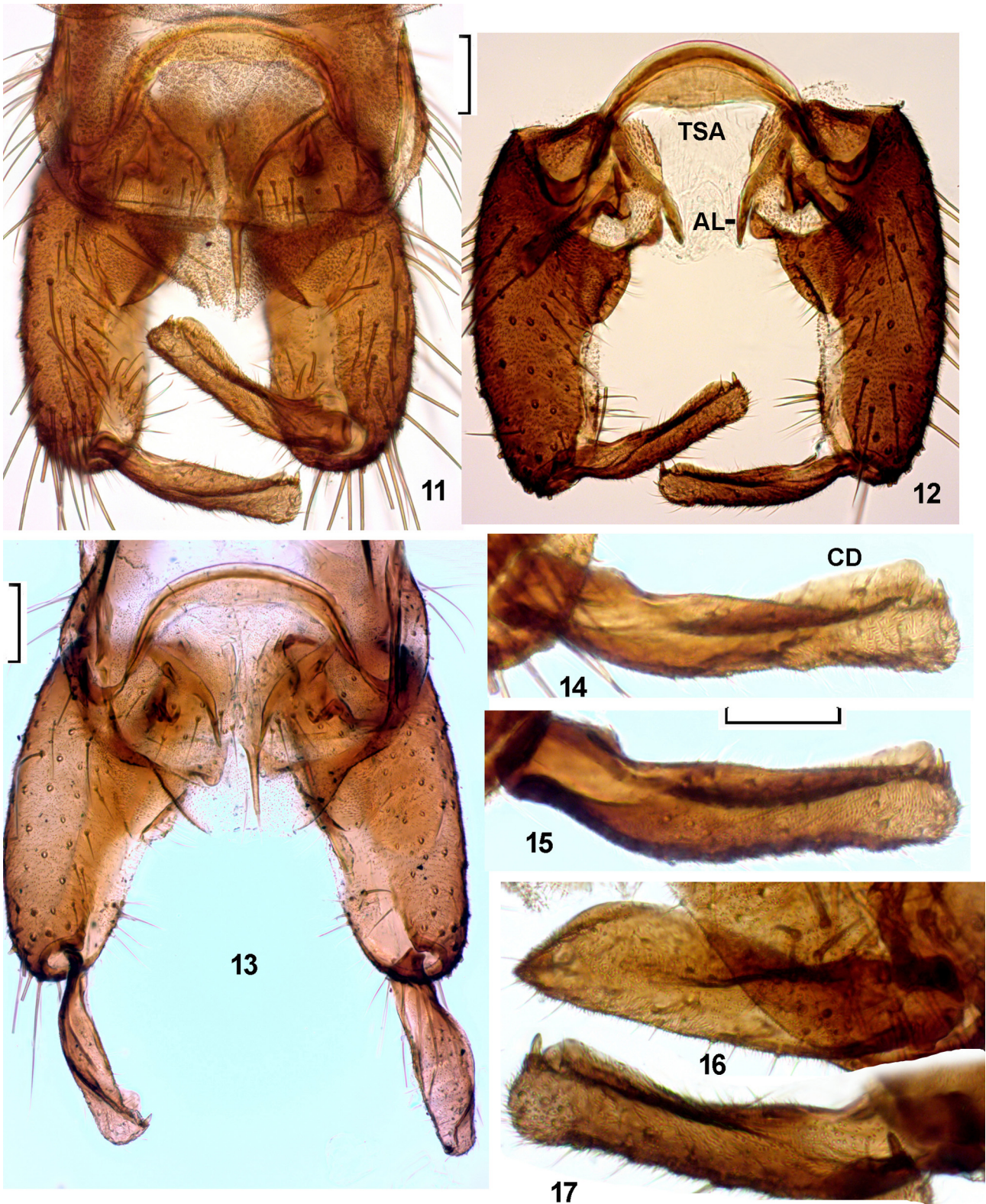
**Coloration.** Brown, dark brown. Antennae brownish grey. Wings grayish.

**Head.** Eyes bare, slightly elongate dorsomedially. Temporal setae including 4–10 verticals and 7–9 frontals. Clypeus without setae. Antenna with 13 flagellomeres and well developed plume of setae; maximal length of these setae on flagellomeres 560  $\mu\text{m}$ ; terminal flagellomere with 1–2 subapical setae, 52–60  $\mu\text{m}$  long; pedicel with 2 setae, 60–68  $\mu\text{m}$  long. AR 0.97–1.24. Palpomere length ( $\mu\text{m}$ ): 40–44, 60–73, 146–156, 108–128, 160–184. Palpomere 3 in distal part with sensilla capitata with diameter 16  $\mu\text{m}$ . Head width/palpal length 1.38.

**Thorax.** Anteprepronotum with 4–6 ventrolateral setae. Dorsocentrals 9–13, prealars 5–7. Scutellum with 8–10 setae in 1 row.

**Wings.** Length 2.8–2.9 mm, width 0.84–0.88 mm. Anal lobe developed and rounded. Squama with 18–22 setae, 40–80  $\mu\text{m}$  long. R and R<sub>1</sub> with 21–23 setae, R<sub>4+5</sub> with 3–4 setae in distal part. Costal extension 90–98  $\mu\text{m}$ . RM/MCu 3.0–3.2.

**Legs.** Spur of front tibia 60–68  $\mu\text{m}$  long. Spurs of mid tibia 40–48  $\mu\text{m}$  and 44–56  $\mu\text{m}$  long. Spurs of hind tibia 56–68  $\mu\text{m}$  and 32–48  $\mu\text{m}$  long. Hind tibial comb with 14–16 setae. Ta4 cardioform. Length ( $\mu\text{m}$ ) and proportions of leg segments are as in Table 3.



**FIGURES 11–17.** Adult male of *Pseudokiefferiella krasheninnikovi* sp. nov. **11, 13**, hypopygium in dorsal view; **12**, the same, without tergite IX; **14–17**, gonostylus in different positions. TSA–transverse sternapodema, AL – aedeagal lobe, CD – crista dorsalis. Scale bars: 50  $\mu$ m.

**TABLE 3.** Lengths (in  $\mu\text{m}$ ) and proportions of leg segments of *Pseudokiefferiella krasheninnikovi* sp. nov., male (n = 4).

	fe	ti	ta <sub>1</sub>	ta <sub>2</sub>	ta <sub>3</sub>	ta <sub>4</sub>	ta <sub>5</sub>
P <sub>1</sub>	951–1066	1263–1443	853–935	394–410	279	98–115	131–148
P <sub>2</sub>	1033–1197	1164–1312	558–623	312–328	197–213	82–98	115–148
P <sub>3</sub>	1197–1361	1279–1558	754–902	394–492	230–279	98–115	148

**TABLE 3.** (Continued)

	LR	BV	SV	BR
P <sub>1</sub>	0.65–0.68	3.40–3.62	2.60–2.68	2.3–2.4
P <sub>2</sub>	0.47–0.48	3.90–3.98	3.67–3.94	2.0–2.1
P <sub>3</sub>	0.58–0.60	3.70–4.04	3.24–3.28	2.3–2.5

Hypopygium (Figs 11–17). Tergite IX with 8–17 setae from one side, 36–56  $\mu\text{m}$  long and with anal point, 72–92  $\mu\text{m}$  long, distally hair-like (Figs 11, 13) sometimes with 1 apical seta, 26  $\mu\text{m}$  long. Laterosternite IX with 5–8 setae, 60–80  $\mu\text{m}$  long. Transverse sternopodeme 172–200  $\mu\text{m}$  long, 40–60  $\mu\text{m}$  wide, with oval expansion in middle (Fig. 12). Aedeagal lobe 100–118  $\mu\text{m}$  long, distal part finger-shaped, sometimes with pointed apex (Fig. 12); phallapodeme 100–120  $\mu\text{m}$  long. Gonocoxite 276–324  $\mu\text{m}$  long, basal lobe rounded, with 1–4 setae, 20–28  $\mu\text{m}$  long, median field narrow, with 6–8 setae, 28–48  $\mu\text{m}$  long (Fig. 12). Gonostylus is long, narrow and almost straight, 148–184  $\mu\text{m}$  long, 32  $\mu\text{m}$  wide, with long crista dorsalis which occupies about two-thirds of gonostylus; apex with macroseta, 8–12  $\mu\text{m}$  long (Figs 11, 14–17); HR 1.54–1.88.

*Pupa and larva* unknown.

**Diagnosis.** Total length 3.6–4.1 mm. Wing length 2.8–2.9 mm. Clypeus without setae. AR 0.97–1.24. Dorsocentrals 9–13, prealars 5–7, scutellars 8–10 (in 1 row). LR<sub>1</sub> 0.65–0.68, BV<sub>1</sub> 3.40–3.62, SV<sub>1</sub> 2.60–2.68. Anal point 72–92  $\mu\text{m}$  long, distally hair-like, sometimes with 1 apical seta. Transverse sternopodeme with oval expansion in the middle. Aedeagal lobe 100–118  $\mu\text{m}$  long, with long, finger-shaped distal part. Basal lobe rounded, with 1–4 setae, median field narrow, with 6–8 setae. Gonostylus as in Figs. 14–17, long, narrow, and almost straight, with long crista dorsalis that occupies about two-thirds of gonostylus; apex with macroseta. HR 1.74–2.0. The adult male of *P. krasheninnikovi* sp. nov. differs from all known species of the genus by absence of setae on the clypeus, presence of oval expansion in the middle of transverse sternopodema, 1–4 setae on basal lobe of gonocoxure and long narrow gonostylus with long crista dorsalis that occupies about two-thirds of gonostylus. Some other characters listed in Table 5 and key.

**Distribution.** Known only from the type locality in the upper stream of Kolyma River.

### *Pseudokiefferiella matafonovi* Makarchenko et Semenchenko

(Figs 18–21)

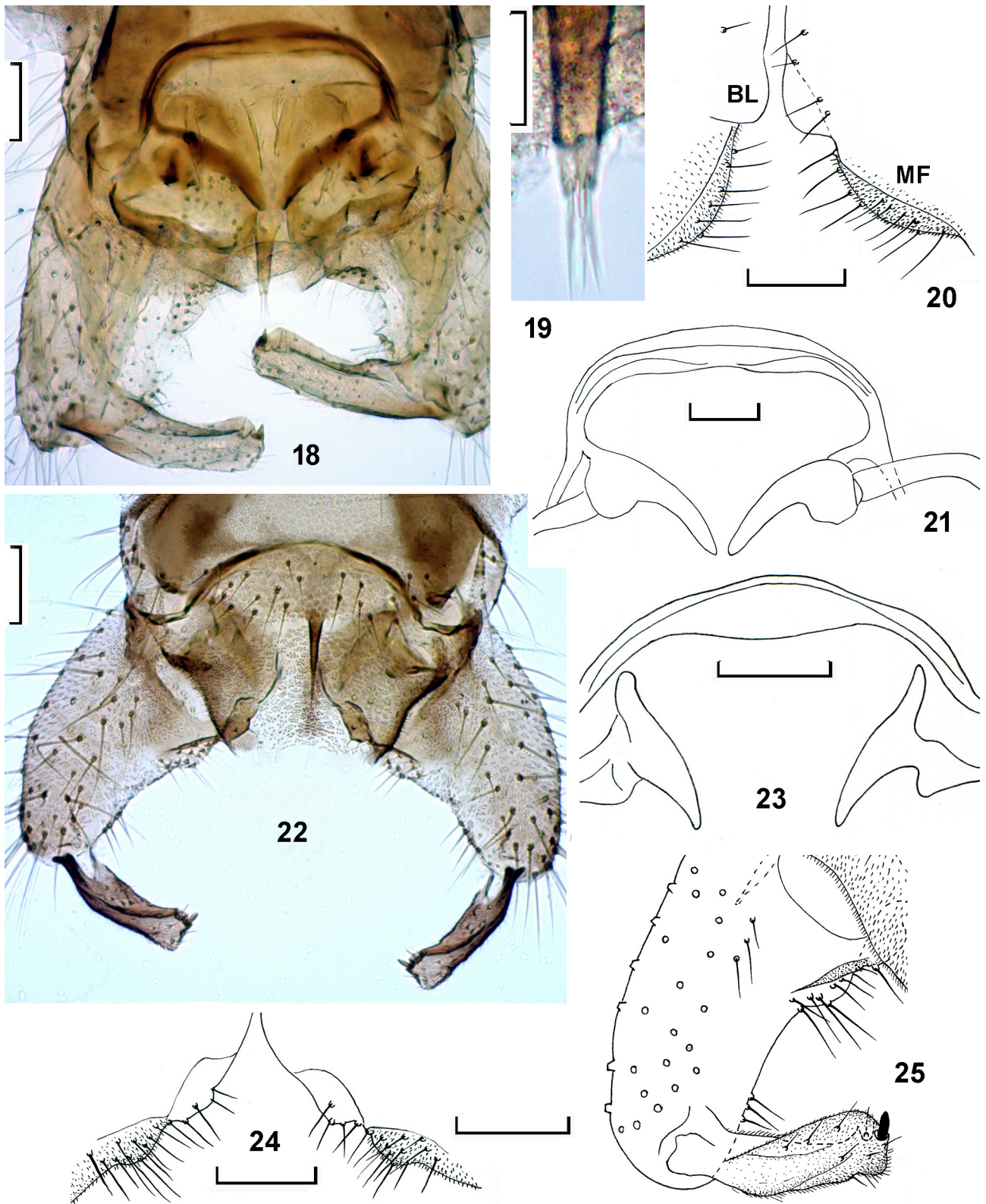
*Pseudokiefferiella matafonovi* Makarchenko et Semenchenko, 2023: 482.

**Material examined.** 2 adult males, 1 pupa (male), 4 pupal exuviae, 7 larvae **Russia**, Trans-Baikal Territory, environs of the Chita City, Kaydalovka River, upper stream, N 52.039058, E 113.560243, 18.VIII 2003, leg. P. Matafonov; 8 larvae, the same data, except 31.V. 2022, N 52.039988, E 113.562473, leg. P. Matafonov; 1 larva, the same data, except Karpovskyi Stream, 2.VII.2004, leg. O. Klishko.

### Description

**Adult male** (n = 2, except when otherwise stated). Total length 3.6–3.9 mm. Total length/wing length 1.06–1.16.

**Coloration.** Brown, dark brown. Head, thorax, and abdomen with hypopygium brown or dark brown. Legs yellowish brown. Wings greyish.



**FIGURES 18–25.** Adult male of *Pseudokiefferiella matafonovi* Makarchenko *et* Semenchenko (18–21) and *P. silinka* Makarchenko *et* Semenchenko (22–25). 18, 22, hypopygium in dorsal view; 19, anal point; 20, 24, basal lobe and median field of gonocoxite; 21, 23, endoskeleton; 25, gonocoxite and gonostylus. BL – basal lobe, MF – median field. Scale bars: 50  $\mu$ m.

Head. Eyes pubescent, slightly elongate dorsomedially. Temporal setae including 13–19 verticals and 12–13 postorbitals. Clypeus with 2–5 setae. Antenna with 13 flagellomeres and well developed plume of setae; maximal length of these setae on flagellomeres 540  $\mu\text{m}$ ; terminal flagellomere with 1 subapical seta, 60–64  $\mu\text{m}$  long; pedicel with 2 setae, 60–72  $\mu\text{m}$  long. AR 1.35–1.57. Palpomere length ( $\mu\text{m}$ ) (n=1): 44, 84, 156, 120, 156. Palpomere 3 in distal part with sensilla capitata with diameter 8  $\mu\text{m}$ . Head width/palpal length 1.0.

Thorax. Anteprepronotum with 7 ventrolateral setae. Dorsocentrals 12–13, prealars 5–6. Scutellum with 9–18 setae in 1 row.

Wings. Length 3.3–3.4 mm, width 0.92 mm. Anal lobe developed and rounded. Squama with 30–46 setae, 75–100  $\mu\text{m}$  long. R and R<sub>1</sub> with 18–20 setae, R<sub>4+5</sub> with 4–5 setae in distal part. RM/MCu 2.3–2.5.

Legs. Spur of front tibia 76–84  $\mu\text{m}$  long. Spurs of mid tibia 60–64  $\mu\text{m}$  and 64  $\mu\text{m}$  long. Spurs of hind tibia 84–96  $\mu\text{m}$  and 60–64  $\mu\text{m}$  long. Hind tibial comb with 16 setae. LR<sub>1</sub> 0.71, BV<sub>1</sub> 3.53–3.56, SV<sub>1</sub> 2.43–2.46.

Hypopygium (Figs 18–21). Tergite IX with 17–18 setae from one side, 32–36  $\mu\text{m}$  long, and with anal point, 80  $\mu\text{m}$  long and 16  $\mu\text{m}$  wide in base, apically with 3 setae, 24–26  $\mu\text{m}$  long (Fig. 19). Laterosternite IX with 8 setae, 64–76  $\mu\text{m}$  long. Transverse sternopodeme consisting of a narrow arch 216–240  $\mu\text{m}$  long. Aedeagal lobe 116–132  $\mu\text{m}$  long, wide in basal third and narrow finger-shaped in distal two-thirds (Fig. 21); phallapodeme 120  $\mu\text{m}$  long. Gonocoxite 308–310  $\mu\text{m}$  long, basal lobe rounded, with 2–4 setae, median field with 7–10 long setae (Fig. 20). Gonostylus massive, 168–176  $\mu\text{m}$  long and 56–60  $\mu\text{m}$  wide, with long crista dorsalis which occupies about two-thirds length of gonostylus; apex with macroseta, 16  $\mu\text{m}$  long (Fig. 18); HR 1.75–1.76.

**Pupa and larva** were described by Makarchenko & Semenchenko (2023).

**Remarks.** Adult male of *S. matafonovi* differs from all known species of the genus by the presence of three setae in apex of anal point and some other characters listed in Table 5 and key.

### ***Pseudokiefferiella silinka* Makarchenko et Semenchenko**

(Figs 22–25)

*Pseudokiefferiella silinka* Makarchenko et Semenchenko, 2023: 487.

**Material examined.** 2 adult males, **Russia**, Khabarovsk Territory, Solnechnyi District, environs of Gornyi Village, Miao Chan Ridge, valley of the Levaya Silinka River, Amur River basin, 27.VII.2006, N 50.710861, E 136.365278, light trap, leg. E. Makarchenko.

### **Description**

**Adult male** (n = 2, except when otherwise stated). Total length 2.7–2.8 mm. Total length/wing length 1.16.

Coloration. Grayish brown. Head, thorax, and abdomen with hypopygium grayish brown or brown. Legs brownish gray. Wings greyish.

Head. Eyes pubescent, slightly elongate dorsomedially. Temporal setae including 7–8 verticals and 12 postorbitals. Clypeus with 2 setae, 52–68  $\mu\text{m}$  long. Antenna with 13 flagellomeres and well developed plume of setae; maximal length of these setae on flagellomeres 558  $\mu\text{m}$ ; terminal flagellomere with 1 subapical seta, 36  $\mu\text{m}$  long; pedicel with 2 setae. AR 0.81. Palpomere length ( $\mu\text{m}$ ): 32–40, 48–56, 88–108, 92–96, 132–160. Palpomere 3 in distal part with sensilla capitata with diameter 8  $\mu\text{m}$ . Head width/palpal length 1.0.

Thorax. Anteprepronotum with 2–4 ventrolateral setae, 32–40  $\mu\text{m}$  long. Dorsocentrals 7–10, 84–88  $\mu\text{m}$  long, prealars 3–4, 72–80  $\mu\text{m}$  long. Scutellum with 7–8 setae in 1 row.

Wings. Length 2.3–2.4 mm, width 0.64 mm. Anal lobe developed and rounded. Squama with 14 setae, 52–68  $\mu\text{m}$  long. R and R<sub>1</sub> with 17 setae, R<sub>4+5</sub> with 5 setae in distal part. RM/MCu 2.5.

Legs. Spur of front tibia 40–60  $\mu\text{m}$  long. Spurs of mid tibia 40–44  $\mu\text{m}$  and 40  $\mu\text{m}$  long. Spurs of hind tibia 56–60  $\mu\text{m}$  and 40–44  $\mu\text{m}$  long. Hind tibial comb with 14–15 setae. LR<sub>1</sub> 0.66, BV<sub>1</sub> 3.51, SV<sub>1</sub> 2.68.

Hypopygium (Figs 22–25). Tergite IX with 12–14 setae, from one side, 28–40  $\mu\text{m}$  long and with narrow, sharply pointed anal point, 68–80  $\mu\text{m}$  long (Fig. 22). Laterosternite IX with 5–8 setae, 60–72  $\mu\text{m}$  long. Transverse sternopodeme consisting of a narrow arch 176  $\mu\text{m}$  long, slightly expanded in the middle (Fig. 23). Aedeagal lobe

wedge-shaped, 68  $\mu\text{m}$  long (Fig. 23). Gonocoxite 212  $\mu\text{m}$  long, with basal lobe in the form of rounded or rounded triangular tubercles, with 3–4 setae; median field with microtrichia and 10–12 long setae (Fig. 24). Gonostylus narrow, 100–104  $\mu\text{m}$  long, with long and low crista dorsalis which occupies about half length of gonostylus; apex with short macroseta, 8–12  $\mu\text{m}$  long (Figs 22, 25); HR 1.9–2.2.

*Pupa* and *larva* unknown.

**Remarks.** Adult male of *S. silinka* differs from all known species of the genus by the wedge-shaped aedeagal lobe, structure of the basal lobe, and median field which is in the form of rounded or rounded triangular tubercles. Other distinguishing characters are listed in Table 5 and the key.

***Pseudokiefferiella transarctica* Makarchenko et Semenchko, sp. nov.**

urn:lsid:zoobank.org:act:E85E5E54-6B1C-4090-8B3B-9DB71404951B

(Figs 26–37)

*Pseudokiefferiella parva* (Edwards), adult male, BOLD process ID: CHIFI576-16, GenBank accession number MZ659124, Roslin *et al.* 2021.

**Type material.** Holotype: adult male, **Russia**, Chukotka Autonomous Okrug, Iultinsky District, Wrangel Island, Rogers Bay area, vicinity of Atherton Mount, 13.VII.2019, N 70.983, E.178.683, leg. O. Khruleva. Paratypes: 3 adult males, the same data, except Lavrentiya Village, 1800 m from the village, 26.VI.1972, N 65.586470, W 171.046964, leg. I. Chereshev; 1 adult male, the same data, except 17.VII.1981, leg. E. Makarchenko; 3 adult males, the same data, except Chegitun River, 31.VII.1981, N 66.563333, W 171.078611, leg. E. Makarchenko; 4 adult males, Krasnoyarsk Territory, urban settlement of Dikson, Taimyr Dolgano-Nenets municipal district, Ragozinka River, 5–7.VII.1990, leg.V. Lantsov; 3 adult males, Novaya Zemlya archipelago, Yuzhny Island, Sakhanin Peninsula, 03.VIII.2015, N 70.628111, E 54.992722, leg. A. Krashennnikov.

**Derivatio nominis.** The species is named for its transarctic distribution.

**Description**

**Adult male** (n = 5, except when otherwise stated). Total length 3.7–4.0 mm. Total length/wing length 1.25–1.41.

Coloration. Brown, dark brown. Antennae brownish grey. Wings white to grayish, with brownish veins.

Head. Eyes bare, slightly elongate dorsomedially. Temporal setae including 8–12 verticals and 5–14 frontals and 8–9 postorbitals. Clypeus with 2 setae, 44–52  $\mu\text{m}$  long. Antenna with 13 flagellomeres and well developed plume of setae; maximal length of these setae on flagellomeres 705  $\mu\text{m}$ ; terminal flagellomere with 2 subapical setae, 32–44  $\mu\text{m}$  long; pedicel with 2 setae, 66–80  $\mu\text{m}$  long. AR 1.33–1.56. Palpomere length ( $\mu\text{m}$ ): 36–44, 60–76, 116–140, 100–108, 120–164. Palpomere 3 in distal part with sensilla capitata with diameter 12  $\mu\text{m}$ . Head width/palpal length 1.11–1.22.

Thorax. Anteprepronotum with 4–9 ventrolateral setae. Acrostichals 2 (n=1), dorsocentrals 10–12, prealars 6–11. Scutellum with 10–18 setae in 1 row.

Wings. Length 2.76–2.96 mm, width 0.68–0.84 mm. Anal lobe developed and rounded. Squama with 24–36 setae, 40–104  $\mu\text{m}$  long. R and R<sub>1</sub> with 14–35 setae, R<sub>4+5</sub> with 5–20 setae. Costal extension 68–96  $\mu\text{m}$  long. RM/MCu 3.2–3.5.

Legs. Spur of front tibia 68–80  $\mu\text{m}$  long. Spurs of mid tibia 44–52  $\mu\text{m}$  and 44–68  $\mu\text{m}$  long. Spurs of hind tibia 72–84  $\mu\text{m}$  and 40–56  $\mu\text{m}$  long. Hind tibial comb with 13–16 setae. Ta<sub>4</sub> cardioform. Length ( $\mu\text{m}$ ) and proportions of leg segments are as in Table 4.

**TABLE 4.** Lengths (in  $\mu\text{m}$ ) and proportions of leg segments of *Pseudokiefferiella transarctica* sp. nov., male (n = 4).

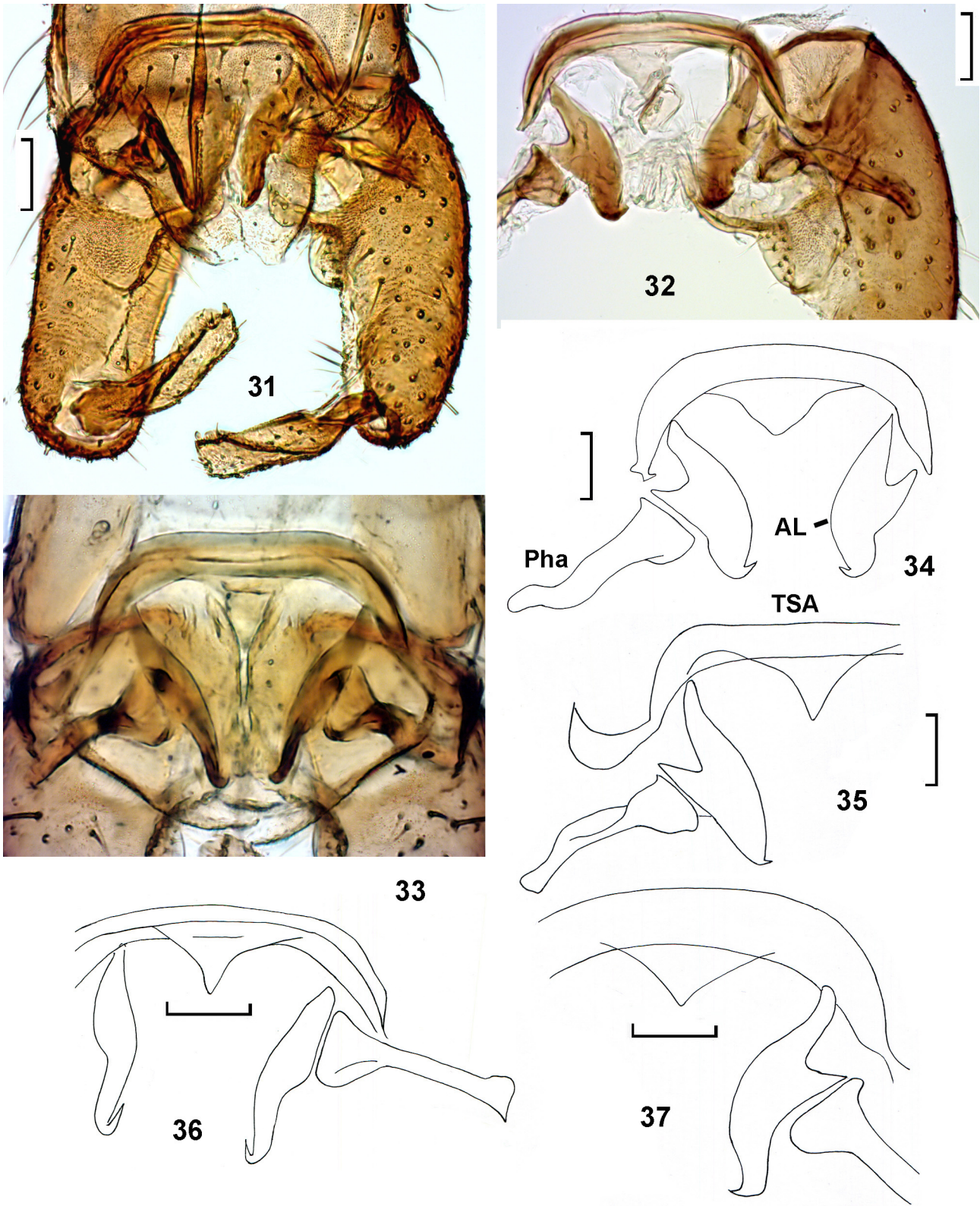
	fe	ti	ta <sub>1</sub>	ta <sub>2</sub>	ta <sub>3</sub>	ta <sub>4</sub>	ta <sub>5</sub>
P <sub>1</sub>	918–1050	1164–1279	853–910	394–410	230–279	82	66–131
P <sub>2</sub>	968–1099	984–1148	476–492	279–295	180	82	66–131
P <sub>3</sub>	1132–1263	1288–1378	705–787	410–426	213–246	66–82	66–131

TABLE 4. (Continued)

	LR	BV	SV	BR
P <sub>1</sub>	0.68–0.73	3.76–3.80	2.44–2.69	2.5–2.7
P <sub>2</sub>	0.43–0.48	3.95–4.33	4.40–4.92	2.7–2.8
P <sub>3</sub>	0.54–0.61	3.75–4.12	3.07–3.65	2.8



FIGURES 26–30. Adult male of *Pseudokiefferiella transarctica* sp. nov. from Wrangel Island (26), West Taimyr (Ragozinka River) (27–29), and Novaya Zemlya (30). 26–27, 30, hypopygium in dorsal view; 28, hypopygium without tergite IX; 29, anal point. Scale bars: 50  $\mu$ m.



**FIGURES 31–37.** Adult male of *Pseudokiefferiella transarctica* sp. nov. from Lavrentia Village (31–32, 35), Chegитun River (33–34), Ragozinka River (36), and Wrangel Island (37). 31, hypopygium in dorsal view; 32–37, endoskeleton. Scale bars: 50  $\mu$ m.

Hypopygium (Figs 26–37). Tergite IX with 9–12 setae from one side, 32–40  $\mu$ m long and with anal point, 76–80  $\mu$ m long, distally hair-like (Figs 27, 29). Laterosternite IX with 12 setae, 96–136  $\mu$ m long. Transverse sternopodeme 176–224  $\mu$ m long, with triangle outgrowth expansion in middle (Figs 28, 32–37). Aedeagal lobe 112–124  $\mu$ m long,

as in Figs. 28, 32, 33–37, apex narrow, hook-shaped, bent forward, apically uncinata; phallapodeme 104–144  $\mu\text{m}$  long. Gonocoxite 252–276  $\mu\text{m}$  long, basal lobe rounded, with 1–2 setae, 20–28  $\mu\text{m}$  long, median field narrow, with 14–21 setae, 32–56  $\mu\text{m}$  long (Figs 28, 31–32). Gonostylus 153–160  $\mu\text{m}$  long, 32  $\mu\text{m}$  wide, in position pressed against gonocoxite, it is slightly curved in middle, with long and high crista dorsalis which occupies about two-thirds of gonostylus; apex with macroseta, 8–12  $\mu\text{m}$  long (Figs 26, 28, 30–31); HR 1.66–1.98.

**Pupa and larva** unknown.

**Diagnosis.** Total length 3.7–4.0 mm. Wing length 2.76–2.96 mm Clypeus with 2 setae. AR 1.33–1.56. Dorsocentrals 10–12, prealars 6–11, scutellars 10–18 (in 1 row).  $\text{LR}_1$  0.68–0.73,  $\text{BV}_1$  3.50–3.80,  $\text{SV}_1$  2.44–2.69. Anal point 76–80  $\mu\text{m}$  long, distally hair-like. Transverse sternopodeme with triangular outgrowth expansion in the middle. Aedeagal lobe 112–124  $\mu\text{m}$  long, apex narrow, hook-shaped, bent forward, apically uncinata. Basal lobe rounded, with 1–2 setae, median field narrow, with 14–21 setae. Gonostylus in position pressed against gonocoxite is slightly curved in middle, with long and high crista dorsalis which occupies about two-thirds of gonostylus. HR 1.74–2.0. The adult male of *P. transarctica* **sp. nov.** differs from all known species of the genus by aedeagal lobe, which with narrow apex, hook-shaped, bent forward, apically uncinata. Other distinguishing characters are listed in Table 5 and the key.

### *Pseudokiefferiella toyamaflexa* (Sasa)

*Diamesa toyamaflexa* Sasa, 1989:159.

*Pseudokiefferiella toyamaflexa* (Sasa); Sasa & Kikuchi 1995: 207, Fig. 88B; Sæther *et al.* 2000: 147.

*Potthastia longimanus* Kieffer; Yamamoto & Yamamoto 2014: 250.

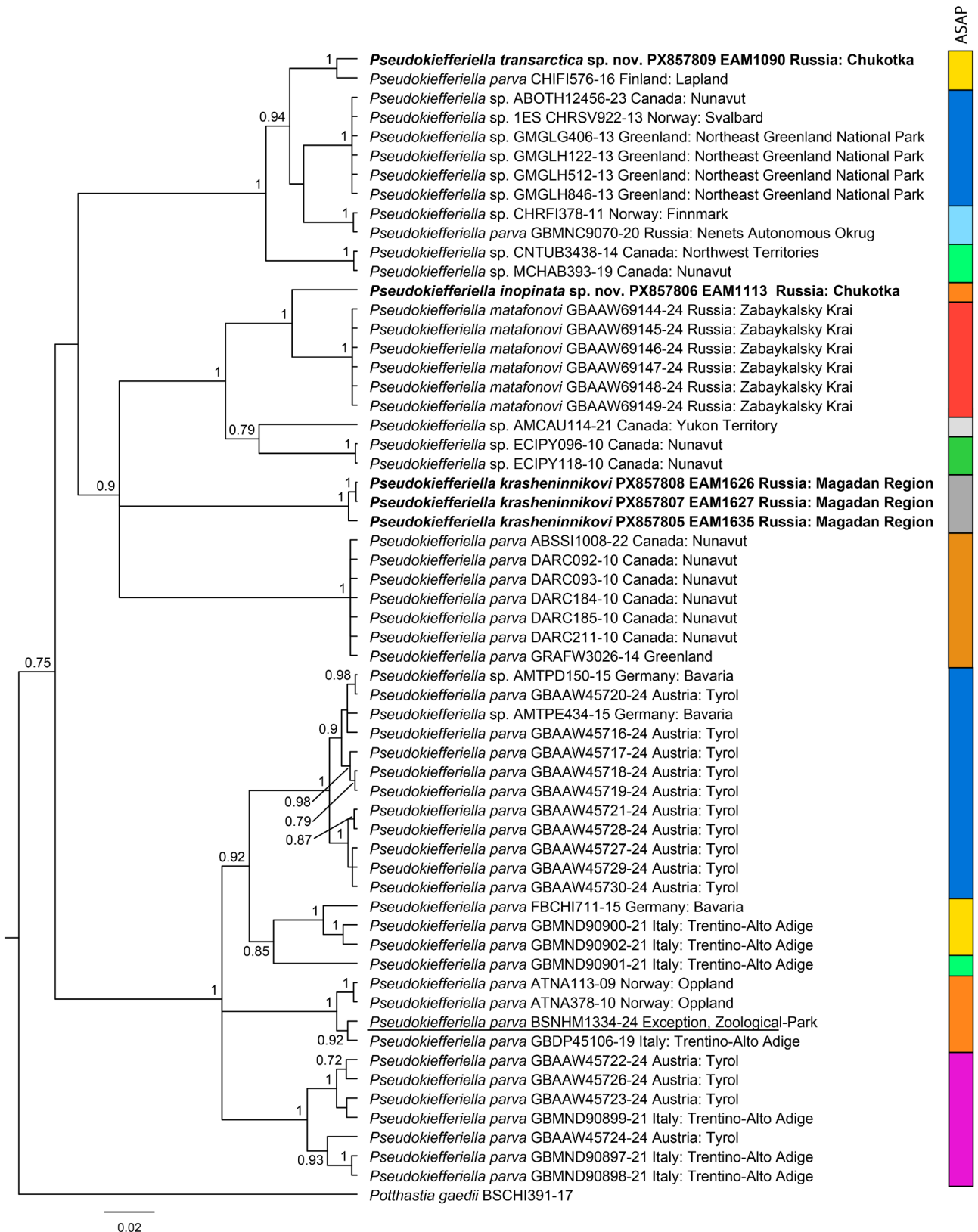
**Remarks.** Based on several characters, it does not correspond to the diagnosis of the genus *Pseudokiefferiella*. These features include the absence of anal point on tergite IX, a different shape of the gonostylus and transverse sternapodema, and the structure of the gonocoxite. We agree with opinion of Yamamoto & Yamamoto (2014) that this species is closely related to *Potthastia longimanus* Kieffer but further comparative studies of the adult males of these species are needed.

**Distribution.** Japan, Honshu.

### Results of DNA barcoding

We have sequenced fragments of the cytochrome oxidase subunit I (606–658 bp in length) of five specimens. One sequence was obtained for each *P. transarctica* **sp. nov.**, and *P. inopinata* **sp. nov.** and three sequences for *P. krasheninnikovi* **sp. nov.** (Fig. 38). The mean intraspecific K2P distances of *P. krasheninnikovi* **sp. nov.** were 0.41%. Intraspecific K2P distances between three species were within 13.47%–14.41% which significantly exceeds the species threshold for genus *Pseudokiefferiella* (Makarchenko & Semenchenko 2023). The ASAP analysis confirmed that each of the new species belonged to a separate molecular operational taxonomic unit (mOTU). Moreover, according to ASAP, the sequence of *P. transarctica* **sp. nov.** (specimen EAM1090) was found to be conspecific with sample *P. parva* CHIF1576-16 collected from Lapland of Finland. The K2P distances between the two specimens were 1.34%, which is below the interspecific threshold (Makarchenko & Semenchenko 2023), so we consider them to be the same species. The adult male is stored in the Zoological Museum of the University of Oulu (Museum ID: ZMUO.025987), so a morphological description is recommended to confirm their conspecificity.

A Bayesian phylogeny placed the *P. transarctica* **sp. nov.** in a one clade (Bayesian posterior probability, BPP=1) with three transarctic species collected from Greenland, Canada, Norway, and Russia. The second species from Wrangel Island, *P. inopinata* **sp. nov.** was sister to recently described *P. matafonovi* (BPP=1). Thus, on the relatively small Wrangel Island (area 7670  $\text{km}^2$ ), at least two species of *Pseudokiefferiella* from different lineages are distributed, based on the obtained phylogeny. The third species *P. krasheninnikovi* **sp. nov.** formed a separate branch of the polytomous clade (BPP=0.9), that also included several species from Canada, *P. matafonovi* and *P. inopinata* **sp. nov.** The remaining species, most of which are distributed in the Alps, including the syntype of *P. parva*, formed a third clade (BPP=1).



**FIGURE 38.** Ultrametric Bayesian inference (BI) tree based on the cytochrome c oxidase I (COI) nucleotide sequence data of the genus *Pseudokiefferiella* Zavřel and *Potthastia gaedii* (Meigen) as outgroup. Bayesian posterior probabilities (higher than 0.7) are given above the tree nodes. The syntype of the *P. parva* is underlined. Specimens obtained in this study are in bold.

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