*Евразиатский энтомол. журнал 21(Приложение 1):* 73–89
*doi 10.15298/euroasentj.21.Spl.1.08*



# Review on the fauna and taxonomy of Diamesinae subfamily (Diptera, Chironomidae) from the Republic of Khakassia (Russia), with morphological description and DNA barcoding of the discovered species

# Обзор фауны и таксономии хирономид подсемейства Diamesinae (Diptera, Chironomidae) республики Хакасия (России), с морфологическим описанием и ДНК-анализом обнаруженных видов

**E.A. Makarchenko*, A.A. Semenchenko*, S.V. Dragan****
**Е.А. Макарченко*, А.А. Семенченко*, С.В. Драган****

* Federal Scientific Center of the East Asia Terrestrial Biodiversity, Far East Branch of the Russian Academy of Sciences, Prosp. 100-letiya Vladivostoka 159, 690022 Vladivostok Russia. E-mail: makarchenko@biosoil.ru; semenchenko_alexander@mail.ru.
* Федеральный научный центр биоразнообразия наземной биоты Восточной Азии ДВО РАН, пр. 100-летия Владивостока 159, Владивосток, 690022, Россия.

** N.F. Katanov Khakas State University, Lenina Str. 90, Abakan 655017 Russia. E-mail: dragan_s@mail.ru.
** Хакасский государственный университет им. Н.Ф. Катанова, ул. Ленина 90, Абакан 655017 Россия.

***Key words:*** Diptera, Chironomidae, Diamesinae, fauna, taxonomy, redescription, DNA barcoding, Khakassia, Russia.

***Ключевые слова:*** Diptera, Chironomidae, Diamesinae, фауна, таксономия, переописание, ДНК-анализ, Хакасия, Россия.

***Abstract.*** For the Republic of Khakassia and the bordering territory a literary review of the chironomid investigations have been prepared and for the first time data on the fauna and taxonomy of 8 chironomid species from the subfamily Diamesinae are given. Redescriptions and DNA barcoding of 7 species, *Diamesa baicalensis* Tshernovskij, *D. hamaticornis* Kieffer, *D. khumbugelida* Sæther et Willassen, *D. parancysta* Serra-Tosio, *D. serratosioi* Willassen, *Pseudodiamesa* aff. *nivosa* (Gortghebuer) and *Sympotthastia takatensis* (Tokunaga) by adult males are presented. A total of 15 DNA sequences (658 bp) of partial mitochondrial cytochrome c oxidase subunit I (COI) gene of 15 samples belonging to 7 species and 3 genera are newly obtained in this study. We also reconstruct phylogenetic tree of *Diamesa* using obtained sequences and close relatives from Genbank and BOLD systems data.

***Резюме.*** Подготовлен литературный обзор изученности хирономид республики Хакасия и прилегающей территории, впервые приведены данные по фауне и систематике 8 видов подсемейства Diamesinae. Для 7 видов, *Diamesa baicalensis* Tshernovskij, *D. hamaticornis* Kieffer, *D. khumbugelida* Sæther et Willassen, *D. parancysta* Serra-Tosio, *D. serratosioi* Willassen, *Pseudodiamesa* aff. *nivosa* (Goetghebuer) и *Sympotthastia takatensis* (Tokunaga) даны переописания имаго самцов с результатами ДНК-анализа. Впервые было получено 15 частичных последовательностей цитохромоксидазы субъединицы I (658 п.н.) для 15 особей, принадлежащих к 7 видам и 3 родам. Также было реконструировано филогенетическое дерево рода *Diamesa* с использованием полученных сиквенсов и данных из Генного банка и BOLD systems.

## Introduction

The Republic of Khakassia is located in the south of Siberia, along the left bank of the Yenisei River, and includes the flat western part of the Minusinsk Depression, the eastern slopes of the Kuznetsk Alatau and the northwestern part of the Western Sayan. The mountains occupy two-thirds of the territory of the republic and belong to the Altai-Sayan highlands [Resursy poverkhnostnykh vod SSSR…, 1973], which is considered to be part of the South Siberian mountain region [Sochava, Timofeev, 1968]. The length of the territory from north to south is 450 km, the maximum width in its middle part is 200 km. The area is 61,900 km$^2$. In the north, east and southeast it borders on the Krasnoyarsk Territory, in the south — on the Republic of Tuva, in the southwest — on the Republic of Altai, in the west — on the Kemerovo Region.

The hydrographic network is developed within three hydrological regions: Altai-West-Sayan, Kuznetsk-Alatau and Minusinsk [Resursy poverkhnostnykh vod SSSR…, 1973]. The river network is represented by 6556 rivers, including the Yenisei River (over 295 km),

its left tributary Abakan River, as well as rivers Tom, Chulym, White Iyus and Black Iyus (Ob River basin). On the territory of the republic there are about 500 lakes with a water surface area of more than 10 hectares, including approximately 390 fresh and 110 salt lakes. The total water surface area of all water bodies in Khakassia exceeds 840 km$^2$ [Krutikov, 2008]. At present, the hydrological regime of the upper streams of the Yenisei River. is determined by the influence of the Sayano-Shushenskaya, Mainskaya and Krasnoyarskaya hydroelectric power stations.

Special studies in the field of taxonomy and fauna of chironomids of Khakassia previously have not been carried out. There are studies that are devoted to the investigation of the chironomid fauna of the Yenisei River [Lipina, 1929; Greze, 1957a] and the bays of the Krasnoyarsk Reservoir [Skoptsova, 1987], which cover areas of these water bodies within the boundaries of the region. The earliest, including data on chironomid larvae in the zoobenthos of the Yenisei River, is a short communication by Zvereva [1930] who mentions chironomid larvae from the *thummi* group for the section of the Yenisei River from the mouth of the Mana River to the mouth of the Tuba River.

Most of the studies carried out on the territory of Khakassia are based on material that includes larvae of chironomids. Only for the fauna of Shira Lake, the list includes nine species, which are based on the study of chironomid adults [Borisova et al., 2019].

Among the studied water bodies on the territory of Khakassia, the most studied is the Krasnoyarsk reservoir. As a result of the study of zoobenthos in the reservoir [Vershinin, 1975; Skoptsova, 1987; Gold, Shulepina, 2008; Shulepina, 2008; Gold et al., 2008; Kuznetsova, 2011, 2012, 2017], as well as the nutrition of fish living in it [Romanova, 1975], 181 species and larval forms of chironomids were identified. Of the three reservoirs created in the upper part of the Yenisei, the Mainskoye and Sayano-Shushenskoye remain the least studied. If the Mainskoye reservoir has practically not been studied in relation to hydrofauna, then for the Sayano-Shushenskoye reservoir, 17 larval forms of chironomids are known [Dubovskaya, Gold, 1981; Gold et al., 1985; Burneev, Zadelenov, 1989].

The next in terms of the degree of study is the upper part of the Yenisei River. As a result of the study of zoobenthos, 72 species and larval forms of chironomids were recorded before the creation of a cascade of reservoirs [Zvereva, 1930; Greze, 1957a, b; Greze, Sycheva, 1964]. Later, after the filling of the Krasnoyarsk, Mainskoye and Sayano-Shushenskoye reservoirs, the studies covered sections of the Yenisei riverbed with regulated flow [Andrianova, 2018; Andrianova et al., 2019]. Based on the study of larvae for the upper part of the Yenisei River, namely from the Maina village to the Krasnoyarsk city, 78 species and larval forms of chironomids were identified.

The local chironomid faunas in medium-sized rivers such as the Abakan and Chulym have not been sufficiently studied. In the article by Andrianova [2017], 13 forms of chironomids are given for the section of the Chulym River from the Kopyevo village to the Vladimirovka village. The chironomid fauna in the Abakan River has been studied extremely poorly. Only three forms of chironomids are known from this river [Lipina, 1949; Andrianova, 2018; Andrianova et al., 2019]. In the literature, there are single references to representatives of chironomids from small rivers and streams — tributaries of the Abakan River [Gold, 1976; Ugdyzhekova, 2019]. Gold [1976], in an article devoted to the analysis of the quality of the waters of the small rivers Sora and Byurya, mentioned 7 forms of chironomids.

Among the lakes, the most studied are Bele and Shira, in the fauna of which 21 and 20 species and larval forms are known, respectively [Platonova, 1956; Ozyora Khakasii…, 1976; Romanova, 1989; Rogozin et al., 2011; Tolomeev et al., 2018 ; Andrianova et al., 2015; Borisova et al., 2019]. The remaining reservoirs of Khakassia have been studied unevenly. The total number of chironomid species in the zoobenthos of lakes ranges from 5 to 37, and the published lists include from 1 to 8 of the most widespread forms of chironomids [Maslennikova, Sycheva, 1964; Ozyora Khakasii…, 1976; Skoptsov, 1976; Sharypov, 2011; Andrianova et al., 2015; Kovaleva, 2019].

To date, 250 species and forms of chironomids are known in the fauna of Khakassia, identified mainly on the basis of the determin by chironomid larvae, of which 155 have been identified to the species level, while the rest are listed in the lists up to the species group level and above. Almost all available data on local faunas of chironomids in reservoirs and streams on the territory of Khakassia, despite the long period of study of some of them, require revision and additions.

In this article, we begin the publication of materials on the fauna and taxonomy of the chironomids from Khakassia, namely of the Diamesinae subfamily. Moreover, in our study we used both morphological data and DNA sequences of the mitochondrial *cytochrome c oxidase subunit I* gene (COI) for species determination. COI-based identification in Diamesinae and the genus *Diamesa* in particular have confirmed the efficiency of DNA barcoding for species delimitation [Montagna et al., 2016, Lencioni et al., 2021, Makarchenko et al., 2022].

## Materials and methods

The material was collected in the water bodies of the upper part of the Yenisei River basin, in particular of Abakan, Askiz, Bolshoi On rivers and their basins (Fig. 1).

Abakan is the middle river, the left tributary of the Yenisei River. The length of the river is 514 km [Resursy poverkhnostnykh vod SSSR…, 1973]. The sources of Abakan (along the Bolshoi Abakan River) are located in the nameless ranges of the junction zone of the Western Sayan with the ranges of the Altai Mountains. The sources are located at altitudes of 2150–2400 m a.s.l. [Gosudarsvennyi doklad…, 2020]. The mouth of the river is located in the Abakan, at an altitude of 244 m a.s.l. The

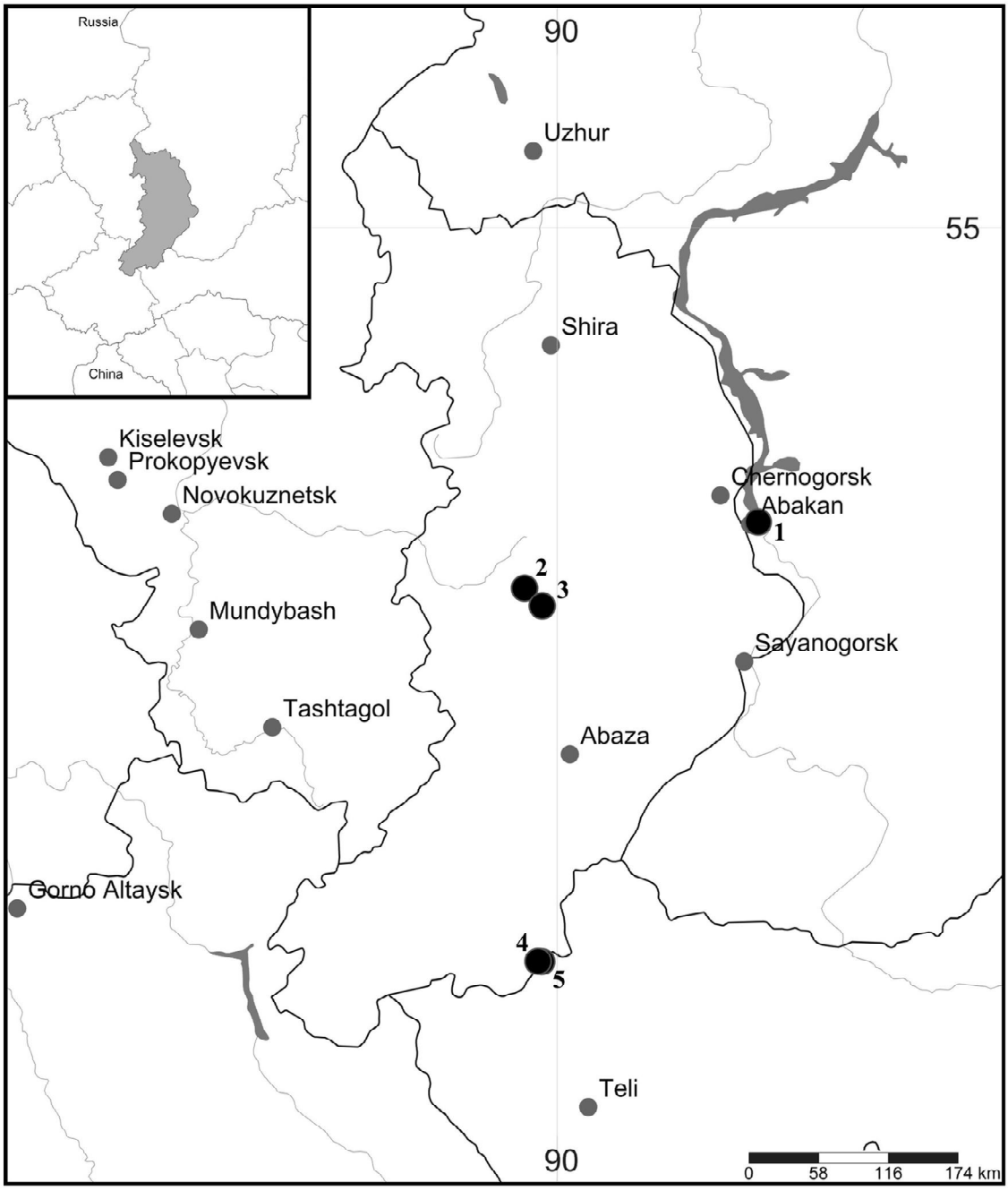



Fig. 1. Map of the Khakassia Republic with places of material collection. 1 — Abakan City, valley of Abakan River; 2 — Askizsky District, Askiz River; 3 — Askizsky District, «Zimnyi» Stream; 4 — Tashtypsky District, unnamed stream in the basin of the Bolshoi On River; 5 — Tashtypsky District, unnamed stream — right tributary of Bolshoi On River.

Рис. 1. Картосхема республики Хакасия с местами сбора материала. 1– г. Абакан, долина р. Абакан; 2 — Аскизский район, р. Аскиз; 3 — Аскизский район, руч. «Зимний»; 4 — Таштыпский район, безымянный ручей в бассейне р. Большой Он; 5 — Таштыпский район, безымянный ручей — правый приток р. Большой Он.

average catchment height is 1045 m a.s.l. The main tributaries of the river are the river. Ona, Tashtyp, Askiz, Uybat [Resursy poverkhnostnykh vod SSSR…, 1973].

Askiz is a small river, the left tributary of the Abakan River. The length of the river is 124 km. The source of the river is located on the slopes of Karlygan (Abakan Range), at an altitude of about 1200 m a.s.l. [Malyshev, 2007]. The river system includes more than 20 tributaries. The river valley is trough-shaped, asymmetrical with convex slopes. The width of the valley is 1.0–2.5 km [Mazhugina, 1998].

Bolshoi On is a small river, the right tributary of the Ona River. The length of the river is 51 km. The source of the river is on the slopes of the ridge. Sailyg-Khem-

Taiga (Western Sayan), at an altitude of 2200 m a.s.l. The mouth of the river is at an altitude of 1150 m a.s.l. in the vicinity Bolshoi On village (Tashtyp District). The river system includes about 60 tributaries [Resursy poverkhnostnykh vod SSSR…, 1973].

The adults of chironomids were collected in traps with ultraviolet lamps of different power — BLB-T5 / 4W and FLU10 T8 G13 / 18W. The trap exposure ranged from 2 to 13 hours, depending on weather conditions. In addition to this method, part of the material was collected with a net by mowing in the floodplain of watercourses and the coastal part of water bodies. Adults of some species were collected directly from snow. Chironomids were preserved in 96 % ethanol. All material was collected by S.V. Dragan. Adult males were slide-mounted in polyvinyl lactophenol.The terminology follows 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 (Karl Zeiss) microscope with an AxioCam ERc5s digital camera and an Olympus SZX16 stereomicroscope with an Olympus DP74 digital camera, and then stacked using Helicon Focus software. The final illustrations were post-processed for contrast and brightness using Adobe® Photoshop® software.

Total DNA was extracted using a Qiagen DNeasy Blood and Tissue Kit (Qiagen, Hilden, Germany), following the manufacturer's instructions. The *COI* fragment was amplified using LCO1490 (5'-GGTCAACAAATCATAAAGATATTGG-3') and HCO2198 (5'-TAAACTTCAGGGTGACCAAAAAATCA-3') [Folmer et al. 1994]. The 10 µl PCR reaction mix contained 3 µl of ultrapure water, 1 µl of DNA template, 0.5 µl of each primer (10 µM), and 5 µl of Go Taq Green Master Mix (Promega Corp, Madison, WI, USA). Thermocycler conditions were as follows: initial denaturation for 3 min at 94 °C followed by 35 cycles of denaturing for 30 s at 94 °C, annealing for 30 s at 48 °C and an extension time of 60 s at 72 °C, with a final extension for 5 min at 72 °C. PCR products were visualized on an 1.5 % agarose gel with Ethidium bromide after electrophoresis. Single bands were purified with Exonuclease I and Thermosensitive Alkaline Phosphatase (ThermoFisher Scientific). Purified PCR products were sequenced directly in both directions using an automated sequencer (ABI 3130xl Genetic Analyzer Sequencer; Applied Biosystems, USA) at department of Cell Biology and Genetics of Far Eastern Federal University.

Sequences were edited and assembled in MEGA 7.0 [Kumar et al. 2016]. Also MEGA 7.0 used to calculate interspecific genetic p-distances. A Bayesian Inferences (BI) was performed to reconstruct phylogenetic tree of several *Diamesa* species using MrBayes v.3.2.7 [Ronquist et al., 2012]. The SYM+G [Zharkikh, 1994], F81+I [Felsenstein, 1981] and HKY+G [Hasegawa et al., 1985] models were defined in PartitionFinder 2.1.1 [Lanfear et al. 2012] and used in BI analysis. Four independent runs were conducted with four Monte Carlo Markov Chains (MCMC) as 5,000,000 generations of witch 25 % were discarded as burn-in. For the phylogenetic analysis, we used our sequences, as well as one conspecific sample for each *Diamesa* species from the BOLD system. Also, we used COI sequences of *Diamesa dragani* from Khakassia [Makarchenko et al., 2022] and *Pseudokiefferiella parva* as out-group. Tree was displayed and rendered with FigTree v1.4.0 [Rambaut 2012]. Sequences were also deposited in GenBank under accession numbers (ON392048–ON392062).

All material are deposited in the Federal Scientific Center of the East Asia Terrestrial Biodiversity, Far East Branch of the Russian Academy of Sciences, Vladivostok, Russia (FSCEATB FEB RAS).

# Descriptions

*Diamesa baicalensis* Tshernovskij

Figs 2–5.

*Diamesa baicalensis* Tshernovskij, 1949: 103; Linevich, 1953: 160, 1963: 70; Pankratova, 1970: 88; Makarchenko, 1987: 202; Linevich, Makarchenko, 1989: 32; Linevich et al., 2002: 56.

***Material.*** 5 adult males, Republic of Khakassia, Abakan City, valley of the Abakan River, poplar forest, 53°42'49.5" N, 91°30'19.6" E, alt. 245 m a.s.l., 2−3.IV.2020 (Fig. 29).

***Description.*** *Adult male* (n = 2, except when otherwise stated). Total length 4.5–4.8 mm. Total length/wing length 1.0–1.2.

Coloration. Dark brown to black. Wings grayish to gray, venation brownish.

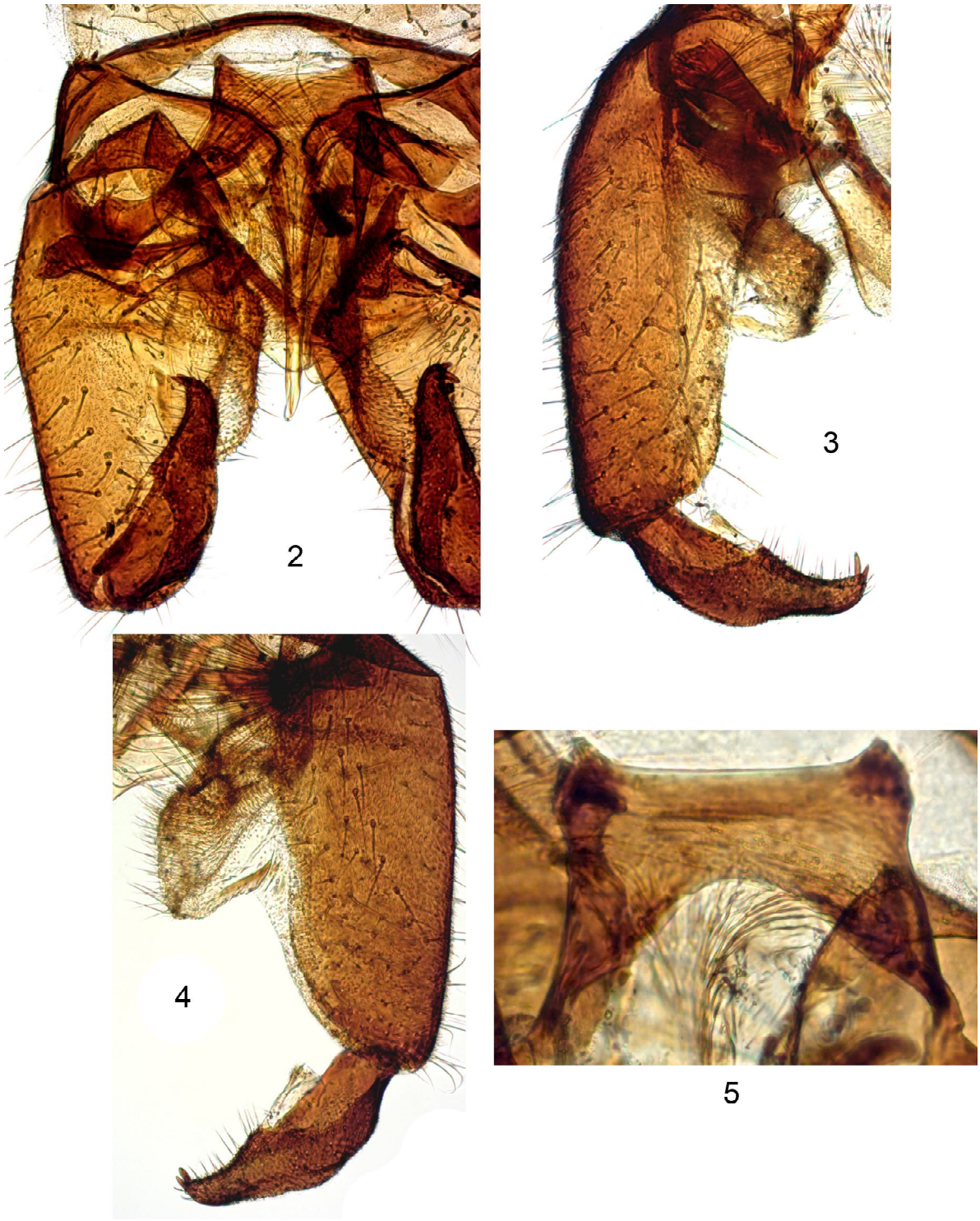
Head. Eyes hairy, reniform. Temporal setae including 5–6 preoculars, 12–15 verticals, 10–14 postorbitals. Clypeus with 5–7 setae. Antenna with 13 flagellomeres and developed plume of setae; terminal flagellomere with 2 setae, 36–40 µm long in subapical and apical area; AR 1.14–1.17. Palpomere length (µm): 52, 48, 116, 148, 156. Palpomere 3 in distal part with sensilla capitata with diameter 16 µm. Head width/palpal length 0.95–1.12.

Thorax. Antepronotum with 6–7 ventrolateral setae. Dorsocentrals 12–13, prealars 6–8. Scutellum with 20–30 setae.

Wing. Length 4.0–4.4 mm, width 1.3–1.4 mm. Anal lobe rounded. Squama with 28–46 setae in 1–2 rows. R and $R_1$ with 25–28 setae, $R_{4+5}$ with 6–7. RM/MCu 2.5–2.6. Costa extension 44 µm long.

Legs. $BR_1$ 2.0–2.5, $BR_2$ 1.3–1.5, $BR_3$ 1.1–2.0. Spur of front tibia 68–72 µm long. Spurs of mid tibia 60 µm and 60–64 µm long. Spurs of hind tibia 100–120 µm and 60–68 µm long. Hind tibial comb with 18 setae. Length (µm) and proportions of leg segments are as in Table 1.

Hypopygium (Figs 2–5). Tergite IX with 13–19 setae from one side and with long anal point, 280–296 µm long, which in subapical part tapering (Fig. 2). Laterosternite IX with 10–12 setae. Transverse sternapodeme (TSA) 60–68 µm high and 180–236 µm wide, with triangular antero-lateral projections (Fig. 5); high TSA/width TSA 0.29–0.33. Phallapodeme 180 µm long, aedeagal lobe 200 µm long. Gonocoxite 340–400 µm long , with large angular inferior volsella, which in distal part densely covered with short setae; basal part of volsella with group of 10–15 strong setae (Figs 2–3). Basimedial setae cluster with 13–20 long and strong setae radiating fan-like (Fig. 4). Gonostylus 196–236 µm long, tapering to distal end, apically with long megaseta (20–22 µm long) and tooth, 12 µm long (Fig. 2). HR= 1.69–1.73




Figs 2–5. Adult male of *Diamesa baicalensis* Tshernovskij. 2 — hypopygium in dorsal view; 3 — gonocoxite and gonostylus in dorsal view; 4 — the same in ventral view; 5 — transverse sternapodeme.

Рис. 2–5. Имаго самец *Diamesa baicalensis* Tshernovskij. 2 — гипопигий, вид сверху; 3 — гонококсит и гоностиль, вид сверху; 4 — то же, вид снизу; 5 — поперечная стернаподема.

Table 1. Lengths (in μm) and proportions of leg segments of *Diamesa baicalensis* Tshernovskij, male (n = 2)
Таблица 1. Длина члеников ног (мкм) и их индексы самца *Diamesa baicalensis* Tshernovskij, (n=2)

| P | f | t | $ta_1$ | $ta_2$ | $ta_3$ | $ta_4$ | $ta_5$ | LR | BV | SV |
|---|---|---|---|---|---|---|---|---|---|---|
| $P_1$ | 1480 | 1880–2000 | 1260–1263 | 607–640 | 410 | 131 | 148 | 0.63–0.67 | 3.52–3.66 | 2.66–2.76 |
| $P_2$ | 1640–1656 | 1680–1689 | 787–800 | 361–426 | 246–279 | 131 | 148 | 0.47-0.48 | 4.33–4.48 | 4.15–4.25 |
| $P_3$ | 1720–1760 | 2000 | 1200–1280 | 623 | 344 | 131–148 | 148 | 0.60–0.64 | 3.90–4.04 | 2.94–3.10 |

***Pupa*** was described by Pankratova [1970], Linevich, Makarchenko [1989].

***Larva*** was described by Tshernovskij [1949], Linevich [1953], Pankratova [1970] and Linevich, Makarchenko [1989].

***Remarks.*** *D. baicalensis* is a rare East Palaearctic species which was previously known only in the Lake Baikal basin. The find of this species in Khakassia is the first one made outside the type habitat, and also for the first time a DNA barkoding was made for this species.

***Distribution.*** Species is known from Baikal Lake, Angara, Enisey Rivers and Khakassia.

## *Diamesa dragani* Makarchenko et Semenchenko

*Diamesa dragani* Makarchenko et Semenchenko, 2022 in Makarchenko et al., 2022: 485.

***Material.*** 7 adult males, RUSSIA: Republic of Khakassia, Tashtypskyi District, Sayan Mountains, unnamed stream of Bolshoi On River basin, altitude 2063 m above sea level, 4.X.2020, 51.714667° N, 89.884500° E (Fig. 30).

***Remarks.*** *D. dragani* is described and known only from Khakassia, belonging to *steinboecki* group and closely related to the *D. maisaraensis* Makarchenko et Semenchenko from Pamir and *D. marinskiyi* Makarchenko et Semenchenko from Tian-Shan, and can be separated from them mostly by smaller size, 7 flagellomeres antenna, X-type of anal tergal bands and by some other features of hypopygium.

***Distribution.*** Known only from the type locality in Sayan Mountains.

## *Diamesa hamaticornis* Kieffer

Figs 6–7.

*Diamesa hamaticornis* Kieffer, 1924: 56; Pagast, 1947: 485; Wülker, 1959: 350; Serra-Tosio, 1971: 236; Schmid, 1993: 37; Ashe, O'Connor, 2009: 276.

***Material.*** 1 adult male, Republic of Khakassia, Abakan City, valley of the Abakan River, poplar forest, 53°42'49.5" N, 91°30'19.6" E, alt. 245 m a.s.l., 6.IV.2020 (Fig. 29); 2 adult males, Republic of Khakassia, Askizsky District, Askiz River, from surface of snow, 53°20'21.9" N, 89°53'18.6" E, 5.XI.2020 (Fig. 31).

***Description.*** *Adult male* (n = 1, except when otherwise stated). Total length 3.7 mm. Total length/wing length 1.02.

Coloration. Dark brown to brown. Wings grayish to gray, venation brownish.

Head. Eyes hairy, reniform. Temporal setae including 4 preoculars, 11 verticals. Clypeus with 8 setae. Antenna with 13 flagellomeres and developed plume of setae, 131–426 μm long; terminal flagellomere with 2 subapical setae, 36–44 μm long; AR 0.50–0.61. Palpomere length (μm): 48, 88, 120, 124, 180. Palpomere 3 in distal part with sensilla capitata with diameter 12 μm. Head width/palpal length 1.08.

Thorax. Antepronotum with 11 ventrolateral setae. Dorsocentrals 13–15, prealars 10. Scutellum with 38 setae.

Wing. Length 3.64 mm, width 1.12 mm. Anal lobe rounded. Squama with 22 setae in 1 row. R and $R_1$ with 22 setae, $R_{4+5}$ with 11. RM/MCu 2.7. Costa extension 98 μm long.

Legs. $BR_1$ 2.3–2.5, $BR_2$ 2. 0–2.1, $BR_3$ 2.5–2.7. Spur of front tibia 54 μm long. Spurs of mid tibia 48 μm long. Spurs of hind tibia 84 and 56 μm long. Hind tibial comb with 18 setae. Length (μm) and proportions of leg segments are as in Table 2.

Hypopygium (Figs 6–7). Tergite IX with 15 setae from one side and anal point, 176 μm long (Fig. 6). Laterosternite IX with 13 setae. Transverse sternapodeme (TSA) 60 μm high and 240 μm wide; high TSA/width TSA 0.25. Gonocoxite 360 μm long; inferior volsellae 180 μm long, wide in basal 3/4, narrow and finger-shaped in distal quarter, with long setae along margin (Fig. 6). Basimedial setae cluster with 12–14 long setae (Fig. 7). Gonostylus 320 μm long, almost sickle-shaped, tapering in distal half, along the inward margin with pale short bristles, apically with short megaseta, 8 μm long (Figs 6–7). HR= 1.13.

***Pupa*** was described by Serra-Tosio [1971].

***Larva*** was described by Schmid [1993].

***Remarks.*** *D. hamaticornis* is very close morphologically and genetically to *D. cinerella* Meigen, *D. hyperborea* Holmgren and *D. tonsa* (Haliday) (see below) from which it differs poorly. Apparently, an additional revision of this group of species is needed.

***Distribution.*** Widely distributed in the Western Palearctic [Ashe, O'Connor, 2009].

## *Diamesa khumbugelida* Sæther et Willassen

Figs 8–9.

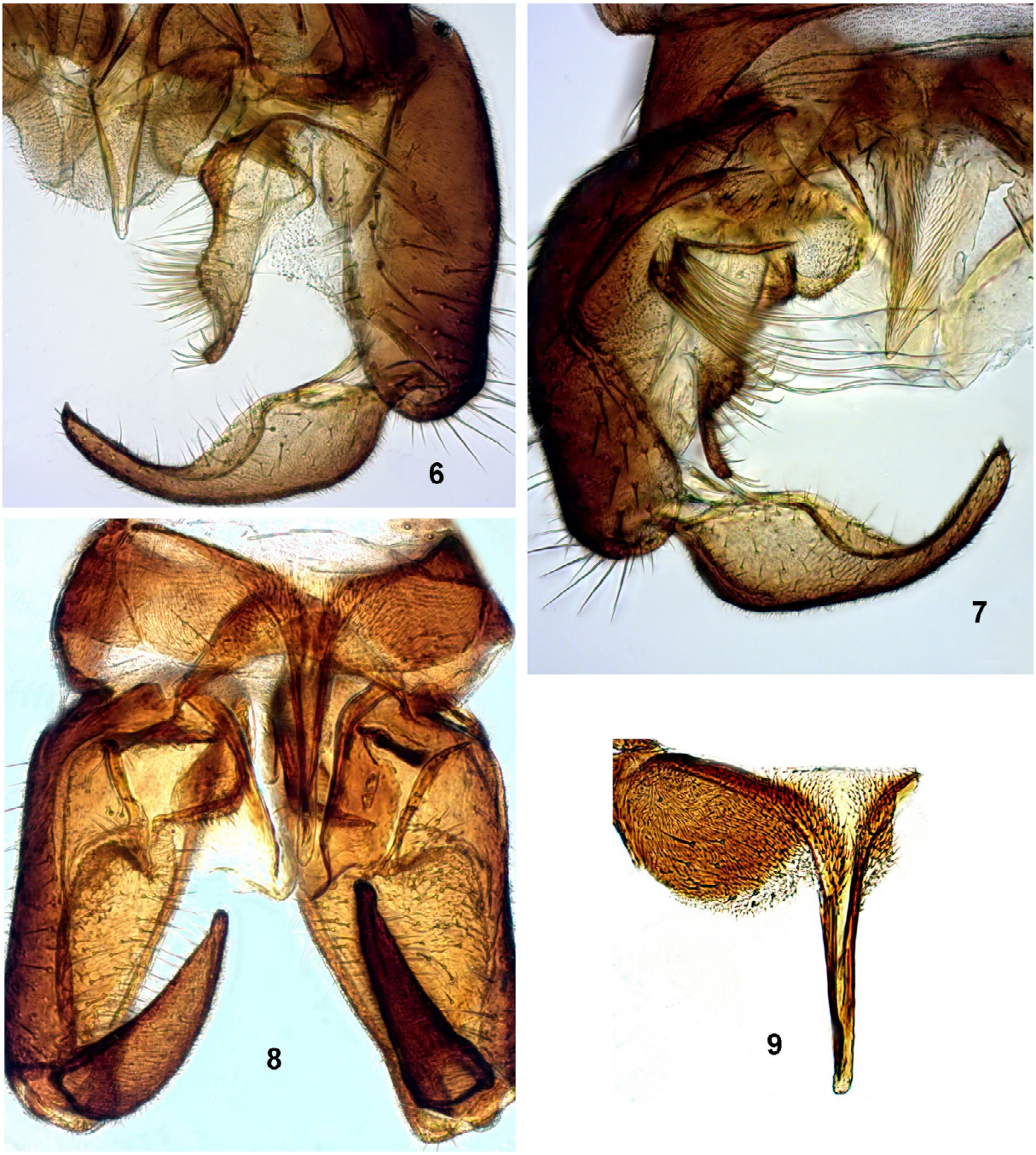
*Diamesa khumbugelida* Sæther et Willassen, 1987: 201; Makarchenko, 1989: 84, 2009: 429; Ashe, O'Connor, 2009: 279.

***Material.*** 1 adult male, Republic of Khakassia, Tashtypsky District, unnamed stream in the basin of the Bolshoy On River, ultraviolet lamp, 51°42'58.2" N, 89°51'25.8" E, alt. 1953 m a.s.l., 08−09.VIII.2020.

***Description.*** *Adult male* (n = 1). Total length 4.0 mm. Total length/wing length 1.06.

Table 2. Lengths (in μm) and proportions of leg segments of *Diamesa hamaticornis* Kieffer, male (n = 2)
Таблица 2. Длина члеников ног (мкм) и их индексы самца *Diamesa hamaticornis* Kieffer, (n = 2)

| P | f | t | $ta_1$ | $ta_2$ | $ta_3$ | $ta_4$ | $ta_5$ | LR | BV | SV |
|---|---|---|---|---|---|---|---|---|---|---|
| $P_1$ | 1600–1840 | 1720–2160 | 1020–1260 | 541–623 | 369–426 | 148–164 | 164 | 0.58–0.59 | 3.51–3.86 | 3.17–3.25 |
| $P_2$ | 1640–1860 | 1520–1780 | 680–780 | 394–459 | 221–295 | 115–131 | 131–148 | 0.44-0.45 | 4.28–4.50 | 4.65–4.67 |
| $P_3$ | 1800–2020 | 1620–2160 | 1140–1320 | 623–754 | 344–402 | 148–164 | 156–164 | 0.61–0.70 | 3.59–3.71 | 3.0–3.17 |




Figs 6–9. Adult male of *Diamesa hamaticornis* Kieffer (6–7) and *D. khumbugelida* Sæther et Willassen (8–9). 6, 8 — hypopygium in dorsal view; 7 — hypopygium in ventral view; 9 — part of tergite IX with anal point.

Рис. 6–9. Имаго самец *Diamesa hamaticornis* Kieffer (6–7) и *D. khumbugelida* Sæther et Willassen (8–9). 6, 8 — гипопигий, вид сверху; 7 — гипопигий, вид снизу; 9 — часть тергита IX с анальным отростком.

Coloration. Dark brown to black. Legs brown. Wings grayish, venation brownish.

Head. Eyes hairy, reniform. Temporal setae including 5 preoculars, 13 verticals. Clypeus with 4 setae. Antenna with 13 flagellomeres and slightly reduced plume of seta; terminal flagellomere with 2 subapical setae, 32 µm long; AR 0.72. Palpomere length (µm): 44, 116, 176, 284, 128. Palpomere 3 in distal part with sensilla capitata with diameter 24 µm. Head width/palpal length 1.08.

Thorax. Antepronotum with 5–6 ventrolateral setae. Dorsocentrals 10–11, prealars 8. Scutellum with 16 setae.

Wing. Length 3.76 mm, width 1.16 mm. Anal lobe ungular. Squama with 27 setae in 1 row. R and $R_1$ with 36 setae, $R_{4+5}$ with 3 subapically. RM/MCu 2.6. Costa extension 56–60 µm long.

Legs. Spur of front tibia 60 µm long. Spurs of mid tibia 48 µm long. Spurs of hind tibia 92 and 52 µm long. Hind tibial comb with *ca* 20 setae. Length (µm) and proportions of leg segments are as in Table 3.

Table 3. Lengths (in μm) and proportions of leg segments of *Diamesa khumbugelida* Sæther et Willassen, male (n = 1)
Таблица 3. Длина члеников ног (мкм) и их индексы самца *Diamesa khumbugelida* Sæther et Willassen (n = 1)

| P | f | t | $ta_1$ | $ta_2$ | $ta_3$ | $ta_4$ | $ta_5$ | LR | BV | SV |
|---|---|---|---|---|---|---|---|---|---|---|
| $P_1$ | 1760 | 1980 | 1200 | 672 | 443 | 139 | 148 | 0.61 | 3.52 | 3.12 |
| $P_2$ | 1880 | 1760 | 900 | 508 | 312 | 131 | 148 | 0.51 | 4.13 | 4.04 |
| $P_3$ | 2040 | 2000 | 1360 | 705 | 410 | 131 | 148 | 0.68 | 3.87 | 2.97 |

Hypopygium (Figs 8–9). Tergite IX with 11–14 setae from one side and anal point, 296 μm long, with strong anteriorly directed microtrichia in basal half and on tergite IX (Fig. 9). Laterosternite IX with 8 setae. Transverse sternapodeme (TSA) triangular with rounded apex, 68 μm high and 240 μm wide; high TSA/width TSA 0.28. Phallapodeme 230 μm long. Gonocoxite 404 μm long, in basal half dorsally with coracoid protrusion; inferior volsella reduced; superior volsella low. Basimedial setae cluster absent. Gonostylus tapering, 232 μm long, with megaseta, 12 μm long (Fig 8). HR = 2.0.

***Pupa*** and ***larva*** unknown.

***Distribution.*** Known from Nepal, Tadzhikistan, Baikal Lake basin and Khakassia.

## *Diamesa parancysta* Serra-Tosio

Figs 10–11.

*Diamesa parancysta* Serra-Tosio, 1983: 15; Willassen et al., 2005: 71; Ashe, O'Connor, 2009: 282; Krasheninnirkov, 2009: 66.

*Diamesa corrupta* Makarchenko, 1988: 54.

***Material.*** 1 adult male, Republic of Khakassia, Abakan City, valley of the Abakan River, poplar forest, ultraviolet lamp, 53°42'49.5" N, 91°30'19.6" E, alt. 245 m a.s.l., 2–3.IV.2020; 2 adult males the same data, 6.IV.2020 (Fig. 29).

***Description.*** *Adult male* (n = 2). Total length 4.5–5.1 mm. Total length/wing length 1.06–1.07.

Coloration. Dark brown to brown. Wings grayish, venation brownish.

Head. Eyes hairy, reniform. Temporal setae including 9–10 preoculars, 7–9 verticals. Clypeus with 12–14 setae. Antenna with 13 flagellomeres and developed plume of seta; terminal flagellomere with 1 subapical setae, 36–48 μm long; AR 2.17–2.27. Palpomere length (μm): 52–64, 116–120, 140–164, 132–148, 172–200. Palpomere 3 in distal part with sensilla capitata with diameter 14–16 μm. Head width/palpal length 1.27–1.45.

Thorax. Antepronotum with 8–15 ventrolateral setae. Dorsocentrals 11–13, prealars 10. Scutellum with *ca* 30 setae.

Wing. Length 4.2 mm, width 1.2 mm. Anal lobe rounded, slightly protrube. Squama with 36–53 setae in 1–2 rows. R and $R_1$ with 23–28 setae, $R_{4+5}$ with 4–5 setae. RM/MCu 2.67. Costa extension 114 μm long.

Legs. $BR_1$ 2.8–3.6, $BR_2$ 1.8–2.5, $BR_3$ 3.5–4.1. Spur of front tibia 76–88 μm long. Spurs of mid tibia 60–68 and 52–64 μm long. Spurs of hind tibia 92–112 and 56–72 μm long. Hind tibial comb with 18– 20 setae. Length (μm) and proportions of leg segments are as in Table 4.

Hypopygium (Figs 10–11). Tergite IX with distinct tergal bands, 9–19 setae from one side and anal point, 272–328 μm long which has terminal dorsal keel and apical setiform sensilla. Laterosternite IX with 8–10 setae. Transverse sternapodeme (TSA) straight or sometimes concave, with strongly projecting anterolateral corners (Fig. 10), 80 μm high and 200 μm wide; high TSA/width TSA 0.40. Gonocoxite 340–372 μm long, with large inferior volsella, broad and prominent basal plate. Basimedial setae cluster well developed, with 16–18 long yellowish setae, 160–200 μm long (Fig. 11). Gonostylus gently curved and relatively broad, 236–240 μm long, with megaseta, 12 μm long and apical tooth, 10 μm long (Fig. 10). HR= 1.44–1.55.

***Pupa*** and ***larva*** unknown.

***Distribution.*** Known from Mongolia, Norway, Ural Region, Baikal Lake basin and Khakassia.

## *Diamesa serratosioi* Willassen

Figs 12–14.

*Diamesa serratosioi* Willassen, 1986: 116; Ashe, O'Connor, 2009: 284.

***Material.*** 3 adult males, Republic of Khakassia, Tashtypsky District, unnamed stream in the basin of the Bolshoy On River, ultraviolet lamp, 51°42'58.2" N, 89°51'25.8" E, altitude 1953 m a.s.l., 8–9.VIII.2020.

***Description.*** *Adult male* (n = 3, except when otherwise stated). Total length 2.3–3.0 mm. Total length/wing length 0.82–1.0.

Coloration. Dark brown to brown. Legs brown but basal 1/3 of femur brownish-yellow. Wings grayish to gray, venation brownish.

Head. Eyes hairy, reniform. Temporal setae including 3–4 preoculars, 5–6 verticals. Clypeus with 2–7 setae. Antenna with 8 flagellomeres and reduced plume of setae; terminal flagellomere with 2 setae, 24–32 μm long in subapical and apical area. Length of 1–8 flagellomeres (μm): 100–104, 40–48, 36–40, 28–30, 32, 24–28, 28–30, 108–116; AR 0.38. Palpomere length (μm): 44–48, 48, 104–116, 84–100, 152–156. Palpomere 3 in distal part with sensilla capitata with diameter 12–16 μm. Head width/palpal length 1.09–1.17. Antennal length/palpal length 0.90–0.95.

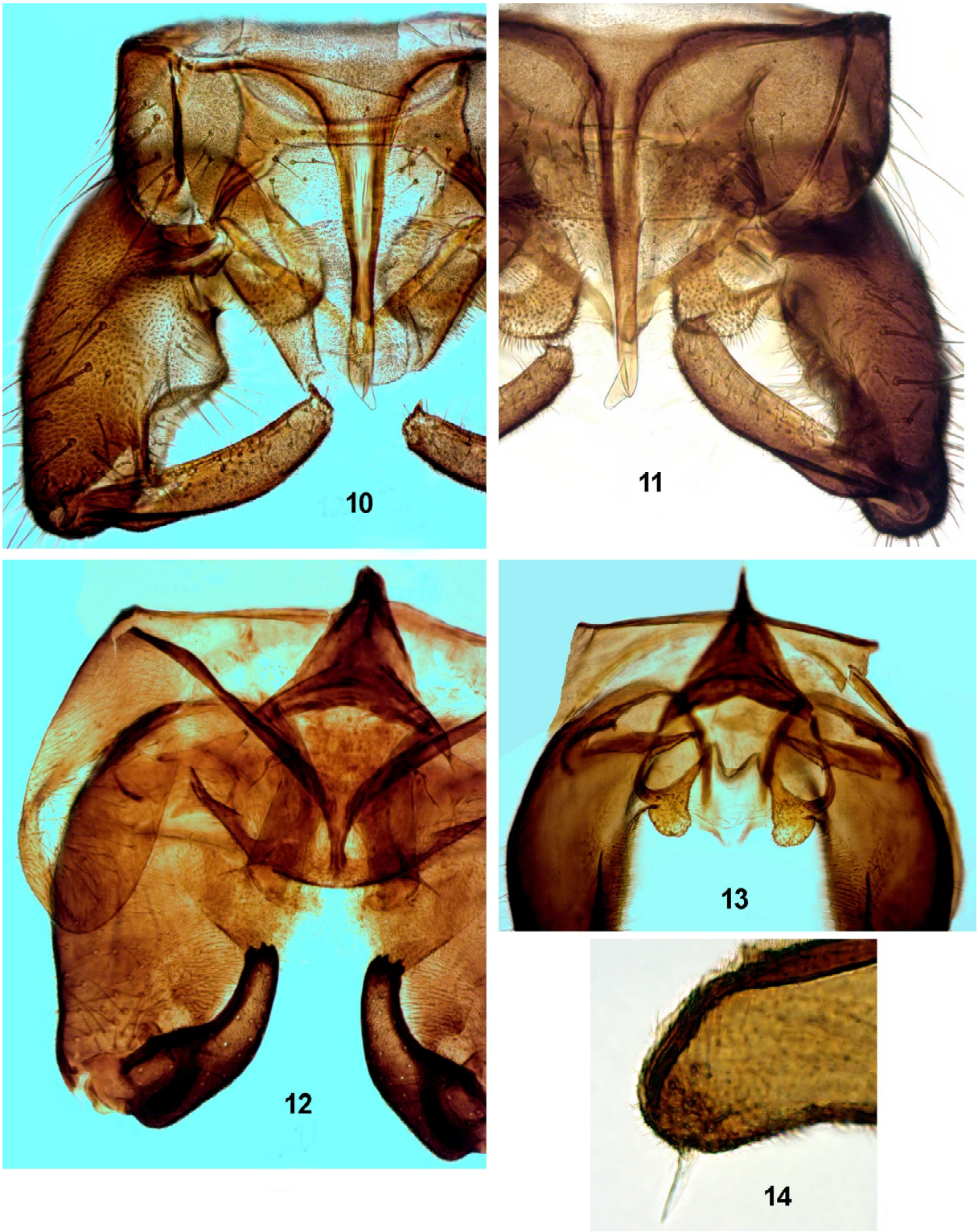
Thorax. Antepronotum with 11–12 ventrolateral setae. Dorsocentrals 10–12, prealars 4. Scutellum with 30–35 setae.

Wing. Length 2.8–3.0 mm, width 1.0–1.1 mm. Anal lobe round-angular. Squama with 15–25 setae, 52–88 μm long. R and $R_1$ with 17–22 setae, $R_{4+5}$ with 5–7. RM/MCu 2.3–2.5.

Legs. $BR_1$ 1.1–2.0, $BR_2$ 1.0–1.3, $BR_3$ 1.1–2.0. Spur of front tibia 28–36 μm long. Spurs of mid tibia 36 μm and 32–36 μm long. Spurs of hind tibia 64–84 μm and 32–40 μm long. Hind tibial comb with 18 setae. Length (μm) and proportions of leg segments are as in Table 5.

Table 4. Lengths (in μm) and proportions of leg segments of *Diamesa parancysta* Serra-Tosio, male (n = 3)
Таблица 4. Длина члеников ног (мкм) и их индексы самца *Diamesa parancysta* Serra-Tosio, (n = 3)

| P | f | t | $ta_1$ | $ta_2$ | $ta_3$ | $ta_4$ | $ta_5$ | LR | BV | SV |
|---|---|---|---|---|---|---|---|---|---|---|
| $P_1$ | 1279–1440 | 1620–1673 | 1160–1164 | 560–607 | 328–344 | 139–148 | 156–164 | 0.70–0.72 | 3.30–3.52 | 2.54–2.64 |
| $P_2$ | 1525–1640 | 1525–1760 | 787–880 | 459–492 | 246–312 | 115–164 | 148–164 | 0.50–0.52 | 3.73–3.96 | 3.86–3.88 |
| $P_3$ | 1673–1840 | 1804–2120 | 1197–1400 | 664–705 | 344–394 | 148–164 | 148–180 | 0.66 | 3.58–3.71 | 2.83–2.90 |




Figs 10–14. Adult male of *Diamesa parancysta* Serra-Tosio (10–11) and *D. serratosioi* Willassen (12–14). 10–12 — hypopygium in dorsal view; 13 — basal part of hypopygium without tergite IX in dorsal view; 14 — anal point in lateral view.

Рис. 10–14. Имаго самец *Diamesa parancysta* Serra-Tosio (10–11) и *D. serratosioi* Willassen (12–14). 10–12 — гипопигий, вид сверху; 13 — базальная часть гипопигия без тергита IX, вид сверху; 14 — анальный отросток, вид сбоку.

Table 5. Lengths (in μm) and proportions of leg segments of *Diamesa serratosioi* Willassen, male (n = 3)
Таблица 5. Длина члеников ног (мкм) и их индексы самца *Diamesa serratosioi* Willassen (n = 3)

| P | f | t | $ta_1$ | $ta_2$ | $ta_3$ | $ta_4$ | $ta_5$ | LR | BV | SV |
|---|---|---|---|---|---|---|---|---|---|---|
| $P_1$ | 1525–1574 | 1558–1681 | 1033–1082 | 476–492 | 279–287 | 98–115 | 131 | 0.64–0.66 | 4.18–4.23 | 2.98–3.07 |
| $P_2$ | 1525–1558 | 1378–1509 | 640–689 | 295–312 | 197–213 | 98–115 | 131 | 0.46 | 4.80–4.98 | 4.45–4.54 |
| $P_3$ | 1574–1640 | 1591–1738 | 1017–1099 | 541–549 | 262–295 | 82–115 | 115–131 | 0.63–0.64 | 3.99–4.30 | 3.07–3.11 |

Hypopygium (Figs 12–14). Laterosternite IX extending beyond posterior margin of tergite IX by 56–80 μm, with weak 18–20 setae, 40–52 μm long (Fig. 12). Tergite IX with 16–18 setae, 20–32 μm long and with pale hyaline anal point, 26–28 μm long, which is not visible from above, in lateral view pointing down (Fig. 14); posterior margine of tergite IX rounded; tergal bands Y-type (Fig. 12). Transverse sternopodeme (TSA) triangular, peaked, 120–140 μm high, 160–168 μm wide at the base; TSA height/TSA width 0.75–0.83. Aedeagal lobe as in Figs. 13, weakly chitinized. Gonocoxite 372–380 μm long, superior volsellae in the form of a small cone covered with microtrichia and short setae (Fig. 13). Gonostylus 200–204 μm long, curved, broad at base, with megaseta, 4–5 μm long, 3 api-cal teeth and 2 subterminal setae. HR 1.82–1.86.

***Pupa*** and ***larva*** unknown.

***Remarks.*** *D. serratosioi* is belonging to *davisi* group and males of this species from Norway and Sweden were previously described as *D. davisi* Edwards by Serra-Tosio [1971]. It is the first record of *D. serratosioi* for Russia.

***Distribution.*** Species is known from Finland, Norway, Sweden [Ashe, O'Connor, 2009] and Khakassia.

## *Pseudodiamesa* aff. *nivosa* (Goetghebuer)

Figs 15–20.

*Syndiamesa nivosa* Goetghebuer, 1928: 126;

*Pseudodiamesa nivosa* (Goetghebuer); Pagast, 1947: 510; Reiss, 1968: Fig. 6; Serra-Tosio, 1964: Fig. 1A–1C, 1971: 69, 1976: 126; Ashe, O'Connor, 2009: 305.

***Material.*** 8 adult males, Republic of Khakassia, Askizsky District, «Zimnyi» Stream, Askiz River basin, 53°25'07.5" N, 89°45'22.6" E, alt. 646 m a. s. l., 1.VIII.2020 (Fig. 32).

***Description.*** *Adult male* (n = 3). Total length 5.9–6.3 mm. Total length/wing length 1.08–1.13.

Coloration. Head, thorax, legs, and abdomen dark brown to black; antennae brown to dark brown; wings greyish.

Head. Eyes bare and extended dorsomedially. Temporal setae including 14–15 preoculars, 6–8 verticals and 7–9 postorbitals. Clypeus with 34–36 setae. Antenna with 13 flagellomeres and developed plume; pedicel without setae; terminal flagellomere with 1–2 subapical setae 36–40 μm long; AR 3.22–3.82. Palpomere lengths (in μm): 68–72; 172–188; 248–250; 192–228; 252–272. Palpomere 3 distally with sensilla capitata (diameter 16 μm). Palpomeres 1–5 length/head width 0.91–1.0.

Thorax. Antepronotum with 7–8 lateral setae. Acrostichals absent, dorsocentrals 29–39 (in 2–3 rows), prealars 32–34, scutellars *ca* 58–60.

Wing. Length 5.48–5.56 mm; width 1.32–1.44 mm. Membrane without setae. R and $R_1$ with 26–29 setae, $R_{4+5}$ with 1–3 setae on apex. Costa extension 148–150 μm long. RM length/MCu length 2.5. $R_{2+3}$ visible only in basal 140–180 μm. MCu flows into $Cu_1$ distally of fork FCu at 230–246 μm (Fig. 18). Anal lobe developed, outline rounded. Squama with *ca* 80 setae in 2–3 rows. VR 0.90–0.91.

Legs. $BR_1$ 5.40–5.46, $BR_2$ 2.90–3.0, $BR_3$ 4.58–5.0. Spur of fore tibia 120–132 μm long; spurs of mid tibia 76–84 μm and 76–84 μm; of hind tibia 120–144 μm and 80–92 μm long. Hind tibial comb with 16–18 setae. Lengths and proportions of leg segments as in Table 6.

Hypopygium (Figs 15–17, 10–20). Tergite IX with 18–26 setae on each side. Anal point wide in basal part, tapering to apex and often distally setiform, 72–100 μm long (Figs 15, 19–20). Laterosternite IX with 10–12 setae. Gonocoxite 388–412 μm long; basal lobe of large size, wedge-rounded, with some long setae at inner part (Figs 16–17). Gonostylus 238–244 μm long, in dorsal view with large lobe on the outer edge (Figs. 15–17); apically with short pale megaseta, 14–16 μm long. Transverse sternapodeme trapezoidal, 272–308 μm wide and 48–64 μm high (Fig. 16). Phallapodeme 184 μm long, with lateral aedeagal lobe 220–260 μm long, which more wide in basal 1/4 and narrow in distal 3/4, elongated in rounded apex (Figs 16–17). HR 1.61–1.63.

***Remarks.*** The *Pseudodiamesa* species which found in Khakassia belongs to *nivosa* group and is most similar to the *Ps. nivosa*, but differences in the shape of the gonostylus, as well as DNA barcoding data, do not allow us to confidently attribute this species to *Ps. nivosa*.

## *Sympotthastia takatensis* (Tokunaga)

Figs 21–28.

*Syndiamesa takatensis* Tokunaga, 1936: 531; 1937: 49.

*Sympotthastia toyamayezea* Sasa, 1996: 44.

*Sympotthastia khorensis* Makarchenko, 1984: 91, 1985: 60.

*Sympotthastia takatensis* (Tokunaga); Makarchenko, 1994: 51, 2006: 276; Wang, 2000: 634; Kobayashi, Endo, 2008: 58; Ashe, O'Connor, 2009: 331; Liu et al., 2016: 428.

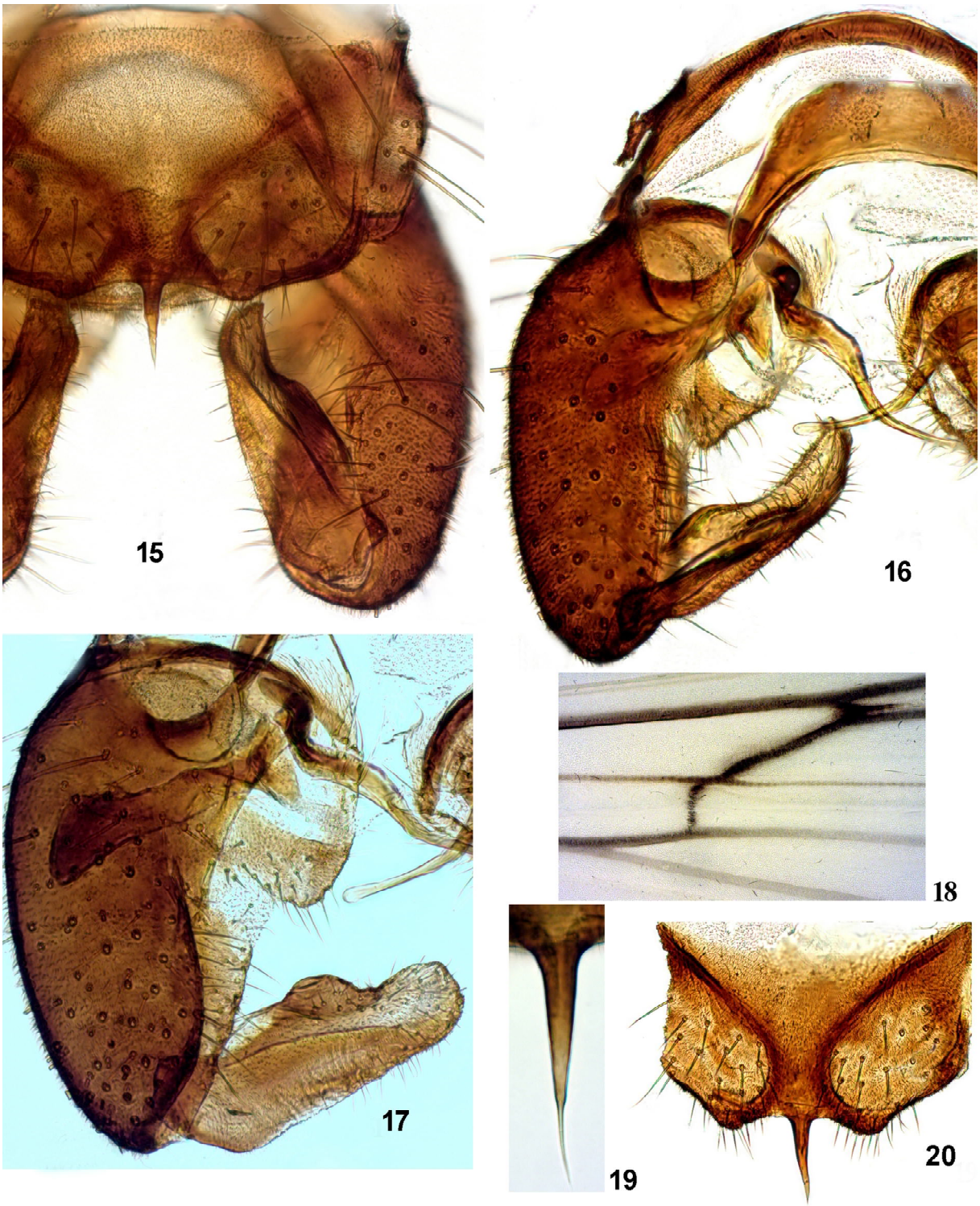
***Material.*** 1 adult male, Republic of Khakassia, Abakan City, valley of the Abakan River, poplar forest, ultraviolet lamp, 53°42'49.5" N, 91°30'19.6" E, alt. 245 m a.s.l., 30.IV.2020; 2 adult males the same data, 10−11.V.2020; 1 adult male, the same data, 8−9.VII.2020 (Fig. 29).

***Description.*** *Adult male* (n = 3). Total length 4.5–5.9 mm. Total length/wing length 1.09–1.16.

Coloration. Head, thorax, legs, and abdomen dark brown to black; antennae brown to dark brown; wings grayish, squama grey, venation brown.

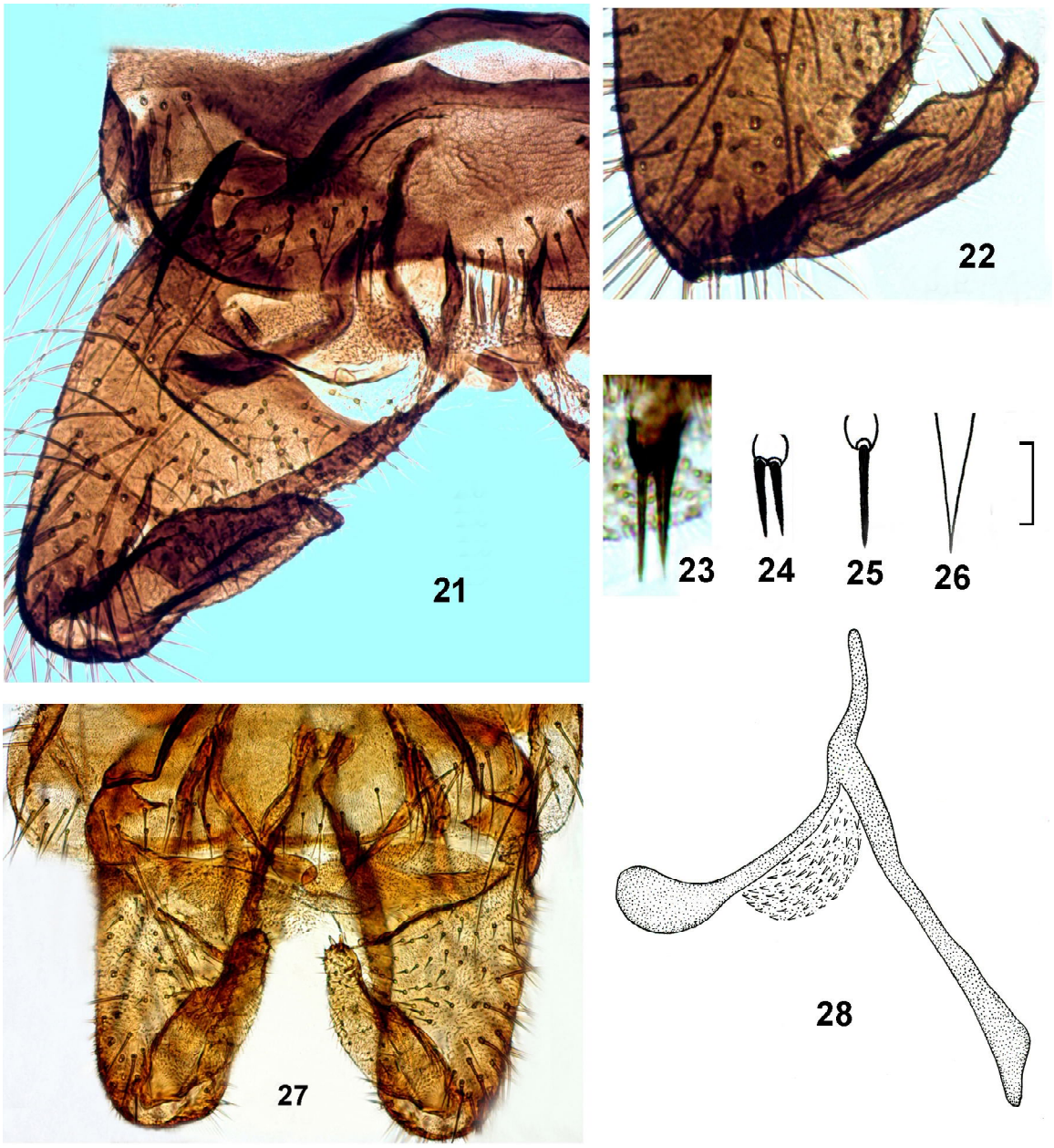
Table 6. Lengths (in μm) and proportions of leg segments of *Pseudodiamesa* aff. *nivosa* (Goetghebuer), male (n = 3)
Таблица 6. Длина члеников ног (мкм) и их индексы самца *Pseudodiamesa* aff. *nivosa* (Goetghebuer) (n = 3)

| P | f | t | $ta_1$ | $ta_2$ | $ta_3$ | $ta_4$ | $ta_5$ | LR | BV | SV |
|---|---|---|---|---|---|---|---|---|---|---|
| $P_1$ | 1800–1820 | 2000–2080 | 1320–1440 | 738–787 | 476–623 | 271–287 | 230–238 | 0.66–0.69 | 2.19–2.97 | 2.69–2.88 |
| $P_2$ | 1960–2040 | 2100–2160 | 1040–1120 | 607–640 | 394–476 | 230–246 | 213–230 | 0.49–0.52 | 3.27–3.61 | 3.71–4.0 |
| $P_3$ | 2320–2400 | 2760–2800 | 1300–1520 | 820–886 | 459–508 | 295–312 | 230–279 | 0.47–0.54 | 3.42–3.61 | 3.42–3.97 |




Figs 15–20. Adult male of *Pseudodiamesa* aff. *nivosa* (Goetghebuer). 15 — hypopygium in dorsal view; 16–17 — hypopygium without tergite IX in dorsal view; 18 — gonostylus; 19 — anal point; 20 — tergite IX.

Рис. 15–20. Имаго самец *Pseudodiamesa* aff. *nivosa* (Goetghebuer). 15 — гипопигий, вид сверху; 16–17 — гипопигий без тергита IX, вид сверху; 18 — гоностиль; 19 — анальный отросток; 20 — тергит IX.




Figs 21–28. Adult male of *Sympotthastia takatensis* (Tokunaga). 21, 27 — hypopygium in dorsal view; 22 — gonostylus; 23–26 — anal point; 27 — lateral endomere and fallapodeme.

Рис. 21–28. Имаго самец *Sympotthastia takatensis* (Tokunaga). 21, 27 — гипопигий, вид сверху; 22 — гоностиль; 23–26 — анальный отросток; 28 — латеральная эндомера и фаллаподема.

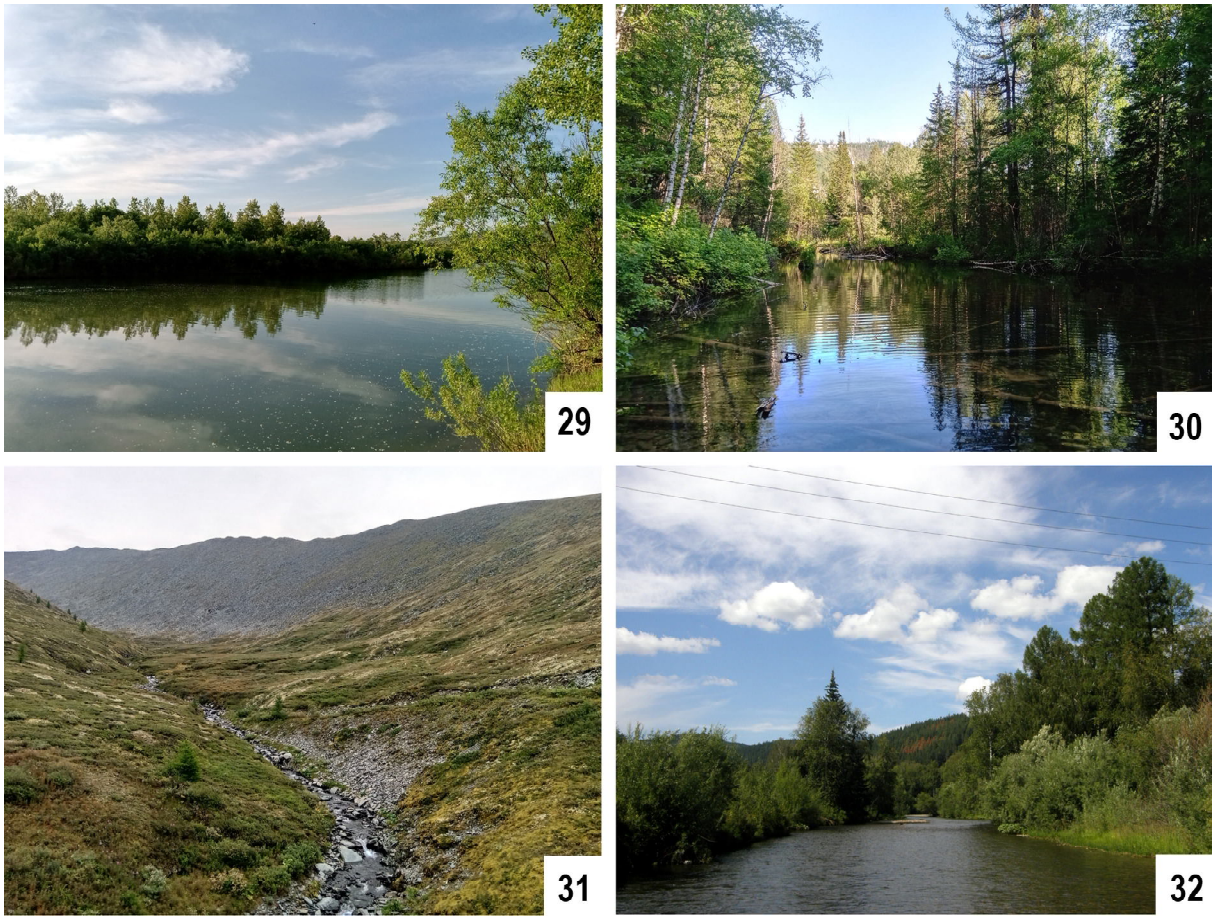
Head. Eyes bare and extended dorsomedially. Temporal setae including 5–7 verticals and 10–12 postorbitals. Clypeus with 11–14 setae. Antenna with 13 flagellomeres and developed plume; terminal flagellomere with 1–2 subapical setae 40–42 µm long; AR 2.76–2.81. Palpomere lengths (in µm): 48; 100; 228; 240; 248. Palpomere 3 distally with sensilla capitata (diameter 12 µm) and with projection apically. Palpomeres 1–5 length/head width 1.85–1.91.

Thorax. Antepronotum with 5–7 lateral setae. Acrostichals absent, dorsocentrals 18–19 (in 2 rows), prealars 20–25 (in 2 groups), scutellars *ca* 35.

Wing. Length 4. 8–5.4 mm; width 1.24–1.40 mm. R and $R_1$ with 22–23 setae, $R_{4+5}$ without setae. Costa extension 115–148 µm long. RM length/MCu length 2. Anal lobe developed, rounded and protrudes forward. Squama with 60–65 setae in 2–3 rows.

Legs. $BR_1$ 4.1–7.5, $BR_2$ 3.0–6.2, $BR_3$ 4.3–6.5. Spur of fore tibia 116–140 µm long; spurs of mid tibia 68–72 µm and 68–72 µm; of hind tibia 116–140 µm and 68 µm long. Hind tibial comb with 16–18 setae. Lengths and proportions of leg segments as in Table 7.

Hypopygium (Figs 21–28). Tergite IX with 12–16 setae on each side. anal point variable, often in the form of one or two setae, 20–28 µm long located on the tubercle, 8 µm long (Figs 23–25), but may be of the usual structure, wider basally and tapering to a pointed apex, 44 µm long (Fig. 26). Lateros-




Figs 29–32. Localities of some Diamesinae from Khakassia. 29 — Abakan City, channel of the Abakan River, poplar forest; 30 — unnamed stream of Bolshoi On River basin, altitude 2063 m above sea level; 31 — Askiz River; 32 — "Zimnyi" Stream of Askiz River basin (Photos by S.V. Dragan).

Figs 29–32. Localities of some Diamesinae from Khakassia. 29 — Abakan City, channel of the Abakan River, poplar forest; 30 — unnamed stream of Bolshoi On River basin, altitude 2063 m above sea level; 31 — Askiz River; 32 — "Zimnyi" Stream of Askiz River basin (Photos by S.V. Dragan).

ternite IX with 12–14 setae. Aedeagal lobe 160–180 µm long, in distal part shaped like a golf-club (Fig. 28). Phallapodeme 172 µm long. Gonocoxite 356–360 µm long; superior volsella small, rounded, with microtrichia; median volsella spiniferous. Gonostylus 188–200 µm long widest in about middle and narrowing towards apex with megaseta 20–24 µm long and 2 subapical setae, 36–40 µm long (Figs 21–22, 27). Transverse sternapodeme trapezoidal, 240 µm wide and 24–28 µm high. HR 1.85–1.91.

***Pupa*** and ***larva*** are described by Liu et al. [2016].

***Distribution.*** East Palaearctic species. Was known from China, Korea, Japan and Russian Far East. For East Siberia is recorded for the first time.

## Results of DNA barcoding

A total of 15 specimens belonging to *Diamesa* Meigen, *Sympotthastia* Pagast and *Pseudodiamesa* Goetghebuer were sequenced. The final alignment of the COI barcode region yielded 658 base pairs.

We made a comparison of the obtained sequences with data of BOLD systems. The closest sequence to *D. parancysta* were *Diamesa* sp. XJC (BIN BOLD:ADL0342), the average p-distance between them were 0.38 % which corresponding to species level. Notably that *Diamesa* sp. XJC consist of five specimens in BOLD systems, of which 4 specimens (XJDQD1074-18 - XJDQD1077-18) collected in Xinjiang, China and specimen COLEB087-18 collected in Wrangell—St. Elias National Park and Preserve, Canada. Thus, *D. parancysta* have a large area with minimal intraspecific divergence. Monophyly of *D. parancysta* and 2 specimens of *Diamesa* sp. XJC from China (XJDQD1074-18) and Canada (COLEB087-18) were high supported (Bayesian posterior probability, BPP=1) which confirms their conspecificity (Fig. 33).

*D. hamaticornis* was closed to a wide number of specimens belonging to *D. cinerella, D. hamaticornis*, *D. hyperborea* and *D. tonsa*. The average p-distances between 7 specimens of 4 species were 0.46 %. Close High similarity of *D. cinerella*, *D. hamaticornis* and *D. tonsa* was discussed in Lencioni et al. [2020]. Apparently, *cinerella* group also includes the *D. hyperborea* from continental Norway and Svalbard. Four species were included in the high supported clade (BPP = 1).

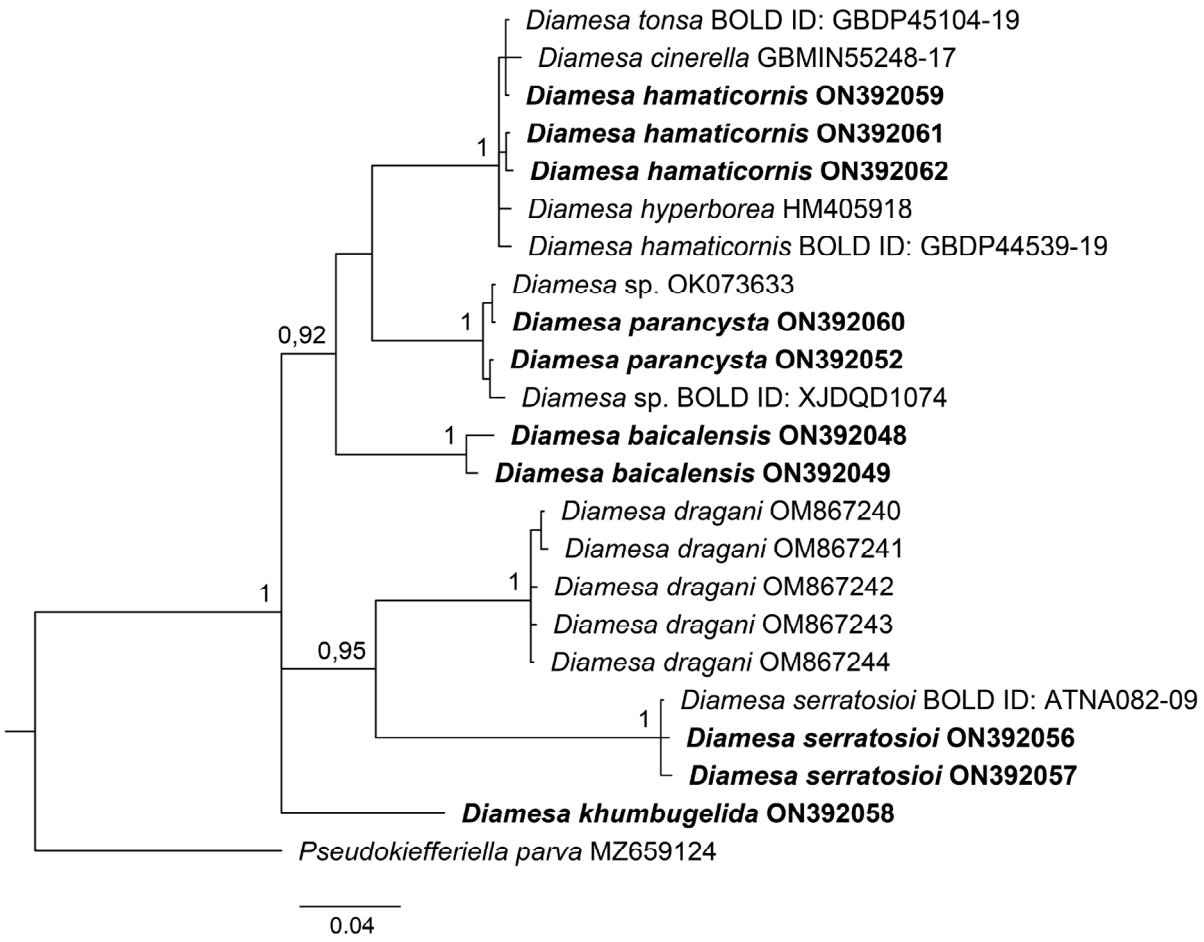



Fig. 33. Bayesian tree on mitochondrion COI gene of genus *Diamesa* using obtained sequences and close sequences from GenBank and BOLD systems. Clade support is indicated by posterior probabilities e ≥ 0.70 above each branch. Specimens obtained in this study are in bold.

Рис. 33. Байесовское дерево, построенное с использованием гена цитохромоксидазы 1 на основании полученных последовательностей рода *Diamesa*, а также сходных сиквенсов из генного банка и системы BOLD. Значения апостериорной вероятности выше 0,70 указаны над узлами ветвления. Секвенированные в настоящей работе особи выделены полужирным шрифтом.

Sequences of *D. baicalensis* and *D. khumbugelida* were unique. The closest available species were *D. zernyi and D. tonsa* which differed from the obtained sequences by 6.80 % and 7.65 % respectively.

Sequences of *D. serratosioi* were conspecific to *D. serratosioi* ATNA082-09 (BIN BOLD: AAD4446). The average sequences divergence between sequences were 0.38 %.

The obtained sequences of *S. takatensis* are most similar to the sequences of *S. takatensis,* which are privately available in BOLD. The closest published sequence belongs to *S. spinifera* with sequence divergence 8.42 %.

We also add to the Bayesian tree sequences of *D. dragani* (OM867240-OM867244) which was related to the *D. steinboecki* group and collected from Khakassia [Makarchenko et al., 2022].

The p-distances between *Ps.* aff. *nivosa* and specimen of *Ps. nivosa* collected from Perm Krai (Russia) and deposed in BOLD systems under number GBMNB14891-20 (BIN BOLD: ADB8603) were 2.51 % which indicates their conspecificity. Another species of *Ps. nivosa*

Table 7. Lengths (in μm) and proportions of leg segments of *Sympotthastia takatensis* (Tokunaga), male (n = 2)
Таблица 7. Длина члеников ног (мкм) и их индексы самца *Sympotthastia takatensis* (Tokunaga) (n = 2)

| P | f | t | $ta_1$ | $ta_2$ | $ta_3$ | $ta_4$ | $ta_5$ | LR | BV | SV |
|---|---|---|---|---|---|---|---|---|---|---|
| $P_1$ | 1443–1640 | 1738–1920 | 1263–1300 | 656–705 | 443–508 | 279–410 | 180–213 | 0.68–0.73 | 2.63–2.85 | 2.51–2.74 |
| $P_2$ | 1525–1760 | 1804–1860 | 900–986 | 556–558 | 385–402 | 213 | 164–197 | 0.48–0.49 | 3.19–3.30 | 3.76–4.02 |
| $P_3$ | 1840–2120 | 2080–2240 | 1320–1360 | 672–722 | 443–476 | 246–262 | 197 | 0.61–0.63 | 3.36–3.45 | 2.97–3.21 |

(BIN BOLD: AAF6936) uniting specimens from Norway, Finland and Leningrad Oblast of Russia. The average sequence divergence between *Ps.* aff. *nivosa* and *Ps. nivosa* (BIN BOLD: AAF6936) were 6.39 %. These results indicate the need for a taxonomical revision of this species.

## Acknowledgements

The authors are deeply grateful to the head of the Zoological Museum of the N. F. Katanova Khakass State University (Abakan) Dr. A.A. Asochakov as well as A.P. Pavlov (Chernogorsk) and A.G. Karmanova (Abakan) for assistance in organizing of joint expeditions and collecting material.

The research was carried out within the state assignment of Ministry of Science and Higher Education of the Russian Federation (theme No. 121031000147-6).

## References

Andrianova A.V., Aponasenko A.D., Makarskaia G.V., Postnikova P.V., Ponomareva Iu.A., Tarskikh S.V. 2015. Structural characteristics of the biological communities of ecosystems of the lakes with different degrees of mineralization (Republic of Khakassia) // Voda: khimiya i ecologiya [Water: chemistry and ecology]. No.12. P.41–47. [In Russian].

Andrianova A.V. 2017. Modern data of the zoobenthos of the Chulym river // International journal of applied and fundamental research. No.6–2. P.257–261. [In Russian].

Andrianova A.V. 2018. Structural organization of bottom fauna in the Yenisey basin (upstream and midstream) // International journal of applied and fundamental research. No.7. P.140–145. [In Russian].

Ashe P., O'Connor J.P. 2009. A World Catalogue of Chironomidae (Diptera). Part 1. Buchonomyiinae, Chilenomyiinae, Podonominae, Aphroteniinae, Tanypodinae, Usambaromyiinae, Diamesinae, Prodiamesinae and Telmatogetoninae. Irish Biogeographical Society & National Museum of Ireland, Dublin. 445 pp.

Borisova E.V., Tolomeev A.P., Drobotov A.V., Sushchik N.N. 2019. Emergence of midges (Chironomidae, Diptera) from a saline lake as a source of organic matter and essential biochemical compounds for arid ecosystems in South Siberia // Journal of Siberian Federal University. Biology.Vol.12. No.2. P.196–215.

Burnev S.L., Zadelenov V.A. 1989. [Changes in the feeding pattern of grayling during the period of filling the Sayano-Shushenskoye Reservoir] // Rybokhozyaistvennye issledovaniya na vodoyomakh Krasnoyarskogo kraya. Vyp.296. L.: GosNIORKH. P.88–92. [In Russian].

Dubovskaya O.P., Gol'd Z.G. 1981. [Hydrobiological regime and water quality of the Sayano-Shushenskoye Reservoir] // IV s'ezd Vsesoyuznogo gidrologicheskogo obshchestva (Kiev, 1–4 dekabrya 1981 g.). Tezisy dokladov. Ch.3. Kiev: Naukova dumka. P.20–21. [In Russian].

Felsenstein J. 1981 Evolutionary trees from DNA sequences: A maximum likelihood approach // Journal of Molecular Evolution. Vol.17. P.368–376.

Folmer O., Black M., Hoeh W., Lutz R., Vrijenhoek R. 1994 DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates // Molecular Marine Biology and Biotechnology. Vol.3. P.294–299.

Gol'd Z.G. 1976. [Biological assessment of the water quality of small rivers Sora, Byurya (Yenisei Basin)] // Nauchnye doklady vysshei shkoly. Biologicheskie nauki. 1976. No.3(147). M.:Vysshaya shkola. P.40–45. [In Russian].

Gol'd Z.G., Dubovskaya O.P., Luzhbin O.V. 1985. [Formation of the hydrobiological regime of the Sayano-Shushenskoye Reservoir in the first years of its filling (1979–1982)] // Kompleksnye issledovaniya ekosistem basseina reki Enisei. Krasnoyarsk: Izdatel'stvo Krasnoyarskogo universiteta. P.102–125. [In Russian]

Gol'd Z.G., Shulepina S.P. 2008. [On the assessment of water quality in deep-water reservoirs by the structure of benthic communities (on the example of the Krasnoyarsk Reservoir)] // Vodoochistka. Vodopodgotovka. Vodosnabzheniye. No.12. P.62–69. [In Russian].

Gol'd Z.G., Skoptsova G.N., Shulepina S.P., Ageev A.V. 2008. [Macrozoobenthos of the Krasnoyarsk Reservoir] // Alimov A.F. et al. (Ed.): Krasnoyarsk Water Reservoir: monitoring, biota, water quality. Krasnoyarsk: Sibirskii federal'nyi un-t. P.189–230. [In Russian].

Gosudarstvennyi doklad «O sostoyanii okruzhayushchei sredy Respubliki Khakasiya v 2020 godu». 2020. Lushnikova O.S. et al. (Eds). Abakan. 190 p. [In Russian].

Greze I.I. 1957a. [Tendipedid larvae from the Yenisei] // Trudy Vsesoyuznogo gidrobiologicheskogo obshchestva. T.VIII. P.231–245. [In Russian].

Grese V.N. 1957b. Fish forage resources of the Yenisei river and their utilization // Izvestiya Vsesoyuznogo Nauchno-issledovatel'skogo instituta ozernogo i rechnogo rybnogo chozyaistva. T. XLI [Proceedings of the All-Union Scientific Research Institute of Lake and River Fisheries. Vol. XLI]. M.: Pishchepromizdat. 234 p. [In Russian].

Greze V.N., Sychyova A.V. 1964. [Hydrobiological characteristics of the Yenisei before its regulation by the dam of the Krasnoyarsk hydroelectric power station] // Rybnoe khozyaistvo Vostochnoi Sibiri. Krasnoyarsk. P.79–91. [In Russian].

Hansen D.C., Cook E.F. 1976. The systematics and morphology of the Nearctic species of *Diamesa* Meigen, 1835 (Diptera: Chironomidae) // Memoirs of the American Entomological Society. Vol.30. P.1–203.

Hasegawa M., Kishino H., Yano Ta. 1985. Dating of the human-ape splitting by a molecular clock of mitochondrial DNA // Journal of Molecular Evolution. Vol.22. P.160–174.

Kieffer J.-J. 1924. Chironomides nouveaux ou rares de l'Europe central // Bull. Soc. Hist. Nat. Moselle. Vol.30. P.11–110.

Kobayashi T., Endo K. 2008. Synonymic notes on some species of Chironomidae (Diptera) described by Dr. M. Sasa (†) // Zootaxa. Vol.1712. P.49–64.

Kovalyova G.A. 2019. [Preliminary data on the composition of zoobenthos and zooperiphyton of Bolshoe Dikoe Lake (Republic of Khakassia)] // Ekologiay Yuzhnoi Sibiri i sopredel'nykh territorii. Vyp.23. T.I. Abakan: Izdatel'stvo FGBOU VO «Khakasskii gosudarstvennyi universitet im. N.F. Katanova». P.47–48. [In Russian].

Kumar S., Stecher G., Tamura K. 2016. MEGA7: Molecular Evolutionary Genetics Analysis version 7.0 for bigger datasets // Molecular Biology and Evolution. Vol.33. N. 7. P.1870–1874.

Krutikov A.I. 2008. [The Republic of Khakassia] // Entsiklopediya Respubliki Khakasiya: V 2-kh t. Krasnoyarsk: Polikor. T.2: O-YA. P.93–94. [In Russian].

Kuskovskii V.S., Krivosheev A.S. 1989. Mineral'nye ozyora Sibiri (yug Krasnoyarskogo kraya). Novosibirsk: Nauka. 200 p. [In Russian].

Kuznetsova O.A. 2011. Bottom community succession changes in deep-water Krasnoyarsk Reservoir // Vestnik Krasnoyarskogo gosudarstvennogo agrarnogo universiteta. No.9. P.99–103. [In Russian].

Kuznetsova O.A. 2012. [Chorology of the bottom biocenoses of the deep-water reservoir] // Vestnik Khakasskogo gosudarstvennogo universiteta im. N.F. Katanova. No.2. P.131–134. [In Russian].

Kuznetsova O.A. 2017. [Ecological and biological characteristics of structure-forming species of bottom biocenoses of the Krasnoyarsk Reservoir] // EurasiaScience. Sbornik statei IX mezhdunarodnoi nauchno-prakticheskoi konferentsii. Ch.1. M.: Nauchno-izdatel'skii tsentr «Aktual'nost.RF». P.27–30. [In Russian].

Lanfear R., Calcott B., Ho S.Y., Guindon S. 2012. Partitionfinder: combined selection of partitioning schemes and substitution models for phylogenetic analyses // Molecular Biology and Evolution. Vol.29, No.6. P.1695–1701.

Lencioni V., Rodriguez-Prieto A., Allegrucci G. 2021. Congruence between molecular and morphological systematics of Alpine non-biting midges (Chironomidae, Diamesinae) // *Zoologica Scripta*. 00:1–18.https://doi.org/10.1111/zsc.12480.

Linevich A.A. 1953. Tendipedidae of upper part of Angara River // Trudy Irkutskogo Gosudarstvennogo Universiteta im. A.A. Zhdanova. Irkutsk. Vol.7, No.1–2. P.153–175. [In Russian].

Linevich A.A. 1963. On biology of midges of the family Tendipedidae // Biology of Baikal invertebrates. Moscow-Leningrad: AN SSSR. P.3–48. [In Russian].

Linevich A.A., Makarchenko E.A. 1989. New or little known species of subfamily Diamesinae (Diptera, Chironomidae) from Baikal Territory // Systematics and ecology of river organisms. Vladivostok: DVNC AN SSSR. P.20–37. [In Russian].

Linevich A.A., Makarchenko E.A., Aleksandrov V.N. 2002. Chironomids of Baikal and Pribaikalye. Podonominae, Tanypodinae, Diamesinae, Prodiamesinae, Orthocladiinae: Index of species and forms. Novosibirsk: Nauka. 136 p. [In Russian].

Lipina N.N. 1949. [Tendipedid larvae of Teletskoye Lake, its tributaries and the Biya River] // Trudy Zoologicheskogo instituta Akademii nauk SSSR. T. VII. M.-L.: Izdatel'stvo Akademii nauk SSSR. P.193–212. [In Russian].

Liu W., Ferrington L.C. Jr, Wang X. 2016. *Sympotthastia wuyiensis* sp.n. from China, with description of the immature stages of *S. takatensis* (Tokunaga) (Diptera, Chironomidae) // Zootaxa. Vol.4126, No.3. P.427–434.

Makarchenko E.A. 1984. Two new species of *Sympotthastia* Pagast (Diptera, Chironomidae) from south of the Soviet Far East // Biology of freshwater of the Far East. Vladivostok: DVNC AN SSSR. P.87–91. [In Russian].

Makarchenko E.A. 1985. Chironomids of the Soviet Far East. Subfamilies Podonominae, Diamesinae and Prodiamesinae. Vladivostok: DVNC AN SSSR. P. 1–208. [In Russian].

Makarchenko E.A. 1987. New or little known chironomids of Podonominae and Diamesinae (Diptera, Chironomidae) from the USSR // Ent. scand. Suppl. 29. P.205–209.

Makarchenko E.A. 1988. Two new species of *Diamesa* Mg. (Diptera, Chironomidae) from the Eastern Palaearctic // Inform. Bull. Biol. Inner Water. Leningrad: Nauka. Vol.79. P.52–56. [In Russian].

Makarchenko E.A. 1989. A new and a little-known species of the genus *Diamesa* (Diptera, Chironomidae) from Tadjikistan // Vestn. Zool. Vol.2. P.82–85. [In Russian].

Makarchenko E.A. 1994. Chironomids of the subfamily Diamesinae (Diptera, Chironomidae) from Japan. II. *33 Sympotthastia* Pagast, 1947 // Bull.Natn.Sci.Mus., Tokyo. Ser.A. Vol.20. No.1. P.51–58.

Makarchenko E.A. 2006. 3.Subfamily Diamesinae // Key to insect of Russian Far East. Vladivostok: Dal'nauka. Diptera and Siphonaptera. Vol.6. Pt.4. P.253–276, 468–480, 607–621. [In Russian].

Makarchenko E.A. 2009. A new finding of *Diamesa khumbugelida* Sæther et Willassen (Diptera, Chironomidae, Diamesinae) from Khamar-Daban Range (Baikal Nature Reserve) // Euroasian Entomological Journal. Vol.8. No.4. P.429–430.

Makarchenko E.A., Semenchenko A.A., Palatov D.M. 2022. Taxonomy of *Diamesa steinboecki* group (Diptera: Chironomidae: Diamesinae), with description and DNA barcoding of new species. I. Subgroups *steinboecki* and *longipes* // Zootaxa. Vol.4951. No.3. P.559–570.

Malyshev A.A. 2007. [Askiz] // Entsiklopediya Respubliki Khakasiya: V 2-kh t. Krasnoyarsk: Polikor. T.1: A-N. P.52. [In Russian].

Maslennikova L.I., Sycheva A.V. 1964. [Feed resources (plankton and benthos) of carp ponds of «Yuzhny» fish farm] // Rybnoe khozyaistvo Vostochnoi Sibiri. Trudy Sibirskogo otdeleniya nauchno-issledovatel'skogo instituta ozernogo i rechnogo rybnogo khozyaistva. Krasnoyarsk. P.201–217. [In Russian].

Mazhugina M.L. 1998. [Geomorphological features of the valley of the Askis and Tes rivers in the semiarid regions of the South Minusinsk Depression] // Vestnik Buryatskogo universiteta. Seriya 3: geografiya, geologiya. Vyp.2. P.100–104. [In Russian].

Montagna M., Mereghetti V., Lencioni V., Rossaro B. 2016. Integrated Taxonomy and DNA Barcoding of Alpine Midges (Diptera: Chironomidae) // PLoS ONE. Vol.11. No.3. e0149673.

Oliver D.R. 1989. The adult males of Diamesinae (Diptera: Chironomidae) of the Holarctic region–Keys and diagnoses // Entomologica Scandinavica. Supplement 34. P.129–154.

Ozyora Khakasii i ikh rybokhozyaistvennoe znachenie. 1976. Siginevich G.P. (Eds). Krasnoyarsk: Krasnoyarskoe knizhnoe izdatel'stvo. 206 p. [In Russian].

Pankratova V.Ya. 1970. Larvae and pupae of the midges of the subfamily Orthocladiinae (Diptera, Chironomidae = Tendipedidae) of the USSR fauna. Key to the USSR fauna, published by Zoological Institute of the USSR Academy of Sciences. L.: Nauka. Vol.102. P.1–344. [In Russian].

Platonova L.V. 1956. [Fauna and productivity of Shira Lake] // Trudy Tomskogo gosudarstvennogo universiteta im. V.V. Kuibysheva. T.142. Seriya biologicheskaya. Pyataya nauchnaya konferentsiya Tomskogo gosudarstvennogo universiteta im. V.V. Kuibysheva, posvyashchonnaya 350-letiyu goroda Tomska. Sektsiya zoologii i gidrobiologii. Tomsk: Izd-vo Tomskogo universiteta. P.65–72. [In Russian].

Rambaut A, Drummond A.J., Xie D., Baele G., Suchard M.A. 2018. Posterior summarisation in Bayesian phylogenetics using Tracer 1.7 // Systematic Biology. Vol.67, N.5. P.901–904.

Resursy poverkhnostnykh vod SSSR. Tom 16. Angaro-Eniseiskii raion. Vypusk 1. Enisei. 1973. Muranov A.P. (Eds). L.: Gidrometeoizdat. 723 p. [In Russian].

Rogozin D.Yu., Pulyayevskaya M.V., Zuev I.V., Makhutova O.N., Degermendzhi A.G. 2011. Growth, diet and fatty acid composition of Gibel carp *Carassius gibelio* in Lake Shira, a brackish water body in Southern Siberia // Journal of Siberian Federal University. Biology.Vol.4. No.1. P.86–103.

Romanova I.M. 1975. [Feeding and nutritional relationships of fish of the Krasnoyarsk Reservoir during the filling period] // Biologicheskie issledovaniya Krasnoyarskogo vodokhranilishcha. Novosibirsk: Nauka. P.156–165. [In Russian].

Romanova I.M. 1989. [Biology of amphipod in Bele Lake] // Sbornik nauchnykh trudov Gosudarstvennogo nauchno-issledovatel'skogo instituta ozernogo i rechnogo rybnogo khozyaistva Rosrybkhoza. Vyp. 296. P.63–73. [In Russian].

Ronquist F., Teslenko M., Mark P.V.D., Ayres D.L., Darling A., Höhna S., Larget B., Liu L., Suchard M.A., Huelsenbeck J.P. 2012. MrBayes 3.2: Efficient Bayesian Phylogenetic Inference and Model Choice Across a Large Model Space // Systematic Biology. Vol.61. P.539–542.

Sæther O.A. 1980. Glossary of chironomid morphology terminology (Diptera, Chironomidae) // Entomologica scandinavica. Supplement 14. P.1–51.

Sæther O.A., Willassen E. 1987. Four new species of *Diamesa* Meigen, 1835 (Diptera: Chironomidae) from the glaciers of Nepal // Entomologica scandinavica. Supplement 29. P.189–203.

Sasa M. 1996. A Studies on the chironomids collected at the side of Kuroyon Lake and on the highlands of Mount Tate area, Toyama // Some characteristics of water quality and aquatic organism in the chief lakes in Toyama Prefecture (Lake Kurobe). Toyama Prefecture. P.16–47.

Schmid P.E. 1993. A key to the larval Chironomidae and their instars from Austrian Danube region streams and rivers with particular reference to a numerical taxonomic approach. Part I. Diamesinae, Prodiamesinae and Orthocladiinae // Wasser und Abwasser. Supplementband, 3/93. 514 pp.

Serra-Tosio B. 1971. Contribution à l'étude taxonomique, phylogénétique, biogéographique et écologique des Diamesini (Diptera, Chironomidae) d'Europe // Doct. thesis, A l'Université Scientifique et Médicale de Grenoble. Vol.I. P.2A-2E, 1–303. Vol.II: P. 304–462 + [1], pls 1–184.

Serra-Tosio B. 1983. Nouveaux Diamesinae de la Paléarctide méridionale et orientale (Diptera, Chironomidae) // Spixiana. Vol.6, No.1. P.1–26.

Sharypov R.S. 2011. [Structural characteristics of the macrozoobenthos of Marankul' Lake] // Molodyozh' i nauka: Sbornik materialov VI Vserossiiskoi nauchno-tekhnicheskoi konferentsii studentov, aspirantov i molodykh uchenykh. Krasnoyarsk: Sibirskii federal'nyi universitet. Available at http://conf.sfu-kras.ru/sites/mn2010/section9.html (accessed 11 June 2022). [In Russian].

Shulepina S.P. 2008. [Estimation of water quality of the deep-water Krasnoyarsk Reservoir by benthic invertebrates] // Sovremennoe sostoyanie vodnykh bioresursov: Materialy mezhdunarodnoi konferentsii. Novosibirsk: Agros. P.363–365. [In Russian].

Skoptsov V.G. 1976. [Zoobenthos of Chalpan Lake and its products] // Rybokhozyaistvennoe izuchenie vnutrennikh vodoyomov. Vyp.17. L. P.88–91. [In Russian].

Skoptsova G.N. 1987. [Structural and functional characteristics of the chironomids of the Krasnoyarsk Reservoir] // Donnye bespozvonochnye rek Dal'nego Vostoka i Vostochnoi Sibiri. Voprosy produktivnosti i bioindikatsii zagryaznenii. Vladivostok: DVO AN SSSR. P.37–39. [In Russian].

Sochava V.B., Timofeev D.A. 1968. [Physical-geographical regions of North Asia] // Doklady Instituta geografii Sibiri i Dal'nego Vostoka. T.19. P.3–19. [In Russian].

Tokunaga M. 1936. Chironomidae from Japan (Diptera), VI. Diamesinae // Philippine Journal of Science. Vol.59. P.525–552.

Tokunaga M. 1937. Chironomidae from Japan (Diptera), IX. Tanypodinae and Diamesinae // Philippine Journal of Science. Vol.62. P.21–65.

Tolomeev A.P., Shulepina S.P., Makhutova O.N., Ageev A.V., Drobotov A.V., Sushchik N.N. 2018. Taxonomic composition and biomass of zoobenthos in saline Lake Shira: shifts that happened in 65 years // Journal of Siberian Federal University. Biology.Vol.11. No.4. P.367–383.

Tshernovskij A.A. 1949. Key to larvae of the midges of the family Tendipedidae. Key to the USSR fauna, published by Zoological Institute of the USSR Academy of Sciences. Key to the USSR fauna, published by Zoological Institute of the USSR Academy of Sciences. L.–M.: Nauka. Vol.31. P.1–185. [In Russian].

Ugdyzhekova E.A. 2019. [Taxonomic diversity of macrozoobenthos of the Irikkharasug spring (Askiz River basin)] // Ekologiay Yuzhnoi Sibiri i sopredel'nykh territorii. Vyp. 23. T. I. Abakan: Izdatel'stvo FGBOU VO «Khakasskii gosudarstvennyi universitet im. N.F. Katanova». P.59. [In Russian].

Vershinin N.V. 1975. [Zoobenthos of the Krasnoyarsk Reservoir and its productivity] // Biologicheskie issledovaniya Krasnoyarskogo vodokhranilishcha. Novosibirsk: Nauka. P.138–147. [In Russian].

Wang X. 2000. A revised checklist of Chironomidae from China (Diptera) // Hoffrichter O. (Ed.): Late 20th Century Research on Chironomidae: an Anthology from the 13th International Symposium on Chironomidae. P.653–658. Shaker Verl., Aachen.

Willassen E. 1986. A review of *Diamesa davisi* Edwards and the *davisi* group // Spixiana. Supplement 11. P.109–137.

Willassen E., Hanssen, O., Koksvik, J.I. 2005. *Diamesa parancysta* Serra-Tosio: an East-Palearctic midge new to Europe (Diptera: Chironomidae: Diamesinae) // Norw. J. Entomol. Vol.52. P.69–73.

Wülker W. 1959. Diamesarien-Studien (Diptera, Chironomidae) im Hochschwarzwald //Arch. Hydrobiol. Bd 24. S.338–360.

Zharkikh A. 1994 Estimation of evolutionary distances between nucleotide sequences // Journal of Molecular Evolution. Vol.39. P.315–329.

Zvereva O.S. 1930. [To the study of the productivity of the bottom of the Yenisei River] // Proceedings of the Second Hydrological Congress of U.S.S.R. held in Leningrad 20–27 April 1928. Part III. Sections: of Mathematical Problems in Hydrology, Hydrophysical, Hydrobiological and Hydrotechnical. L.: Gosudarstvennyi gidrologicheskii institut. P.226–228. [In Russian].

*Поступила в редакцию 28.6.2022*