

## Stonefly fauna (Insecta, Plecoptera) of the Putorana Plateau, Russia

### Фауна веснянок (Insecta, Plecoptera) плато Путорана

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**Key words:** stoneflies, fauna, lakes, rivers, streams, mires, distribution, Putorana, Siberia, Arctic.

**Ключевые слова:** веснянки, фауна, озёра, реки, ручьи, болота, распределение, Путорана, Сибирь, Арктика.

**Abstract.** The fauna of stoneflies (Insecta, Plecoptera) of the Putorana Plateau in the north of East Siberia, Russia, has been investigated for the first time. The study is based on the collections of adult and immature stoneflies made by the second author in late June to mid-August 2019, 2021, 2022, and 2024 in 9 areas in the western and central parts of Putorana, using 12 sampling techniques. According to these results, the stonefly fauna of Putorana is poor; in total, only 12 species from 9 genera in 5 families were recorded. Among them, there are 5 species of Capniidae, 3 spp. of Chloroperlidae, 2 spp. of Nemouridae, and one species of each Leuctridae and Perlodidae. Seven species are reported for the north of Eastern Siberia for the first time. The species distribution by the altitudinal landscape zones and habitats is discussed. In Putorana, stoneflies inhabit all types of running and standing waters, occurring in all altitudinal zones, from the boreal forest to the mountain desert. According to the chorological analysis, the species with the East Palaearctic distribution are numerous (7), whereas species with the Transpalaearctic, Amphipacific, Holarctic Circumpolar, and Arctic European-Asian range types are single.

**Резюме.** Впервые изучена фауна веснянок (Insecta, Plecoptera) плато Путорана на севере Восточной Сибири России. Работа основана на сборах имаго и личинок, выполненных вторым автором с конца июня до середины августа 2019, 2021, 2022 и 2024 гг. в 9 районах западной и центральной части плато Путорана, с использованием 12 методов сбора. По нашим данным, фауна веснянок Путорана бедна; всего отмечено 12 видов из 9 родов и 5 семейств, в том числе 5 видов из семейства Capniidae, 3 вида Chloroperlidae, 2 вида Nemouridae и по одному виду Leuctridae и Perlodidae. Семь видов веснянок указываются для севера Восточной Сибири впервые. Приводятся данные о распределении веснянок по высотным ландшафтными поясам и биотопам. В регионе Путорана веснянки заселяют все типы водотоков и стоячих водоёмов, встречаясь от тайги до горных пустынь. Согласно хорологическому анализу, преобладают виды с восточно-палеарктическим ареалом (7), а виды с транспалеарктическим, амфиоцифическим, голарктическим циркумполярным и арктическим европейско-азиатским типом распространения единичны.

## Introduction

The Putorana Plateau is a trappean mountain massif situated in the northwestern part of the Central Siberian Plateau (67–71° N) and characterised by a great diversity of landscapes and habitats. The Putorana Plateau is the largest monolithic mountain range located north of the Arctic Circle and is one of the most significant regions accumulating biodiversity in the Arctic [Vertebrate..., 2004]. The plateau reaches a height of 1.0–1.5 km and is cut by deep valleys (50–600 m a.s.l.) with rivers and large lakes. The Putorana region includes three landscape zones: boreal forests (in valleys, mostly below 600 m), mountain tundra (mostly between 600 and 1000 m), and mountain desert (mostly above 900 m).

The Putoranskii State Nature Reserve belongs to the «Reserves of Taimyr» designed to protect and investigate the unique nature of the Russian Arctic. The Putorana Plateau is recognised by UNESCO as a world cultural and natural heritage site, as a single natural complex of subarctic and arctic ecosystems within an isolated mountainous country, with virgin taiga, forest tundra, tundra and arctic desert, untouched lakes, streams, and waterfalls. The biota of this ancient and difficult-to-access region has always attracted the attention of researchers.

At present, the species composition of vascular plants and vertebrates in Putorana is relatively well studied [Romanov, 1996; Vertebrate..., 2004; Pospelov, Pospelova, 2021]. At the same time, the insect fauna of the Putorana region is still poorly known. In particular, no published data on the stoneflies of Putorana can be found, except for a few records of unidentified plecopteran larvae in benthic samples from some lakes [Vershinin, 1963; Zadelenov et al., 2017].

Stoneflies play an essential role in the functioning of freshwater ecosystems, especially in northern and mountainous regions. Predatory larvae of stoneflies compete with juvenile fish for food, and, on the other hand, they are included in fish feeding spectra. At the

larval stage, stoneflies are most sensitive to any type of pollution and, therefore, are successfully used as biological indicators of the degree of anthropogenic disturbance of watercourses [Lenat, 1993].

In this paper, we provide the first data on the Plecoptera fauna of Putorana and its habitat and landscape distribution, based on the field collections of 2019, 2021, 2022, and 2024.

## Material and methods

The material was collected by the second author in the western and central parts of the Putorana Plateau, mostly in the borders of the Putoranskii State Nature Reserve and in its buffering zone (all mentioned localities are within the borders of Taymyrskii Dolgano-Nenetskii Raion, Krasnoyarskii Krai of Russia), on field trips in late June–July 2019, July–August 2021, July–August 2022, and July 2024. The material was collected from the following nine areas (Fig. 1; areas are listed west to east and north to south; ranges of sample numbers are given as «PP + number» for each area; for the details, see the list of samples in Appen-

dix 1): **1** — SW part of the Kharaelakh (= Talnakh) Mountains N, NE, and E of Talnakh Town (PP427–447, 547–555, 631–645); **2** — SE environs of Lake Lama (area of Bunisyak tourist base) including the Lama Mountains S of the lake (PP559–625); **3** — mountains in environs of Lake Bunisyak, upper reaches of the rivers Bunisyak and Khikikal (PP1014–1098); **4** — NE environs of Lake Sobach'e (area of Lake Sobach'e field base), including the Dynkengda Mountains between the lake and the canyon of the Khikikal River (PP59, 65, 201–273); **5** — W environs of Lake Nakomyaken, including the valley of the Tonel River in its lower reach, the Tonel Mountains S of the lake, and the Nakomyaken Mountains N of the lake (PP288–390); **6** — SE environs of Lake Keta (area of Keta field base) including the Keta Mountains between the lakes Keta and Kutaramakan (PP66–113); **7** — environs of Lake Duluk, including the mountains W and NW of the lake (PP450–536); **8** — N environs of Lake Ayan (area of Northern Ayan field base) (PP6); **9** — S environs of Lake Ayan (area of Northern Ayan field base) including the mountains S of Lake Ayan and the Kapchug River (PP11–49).

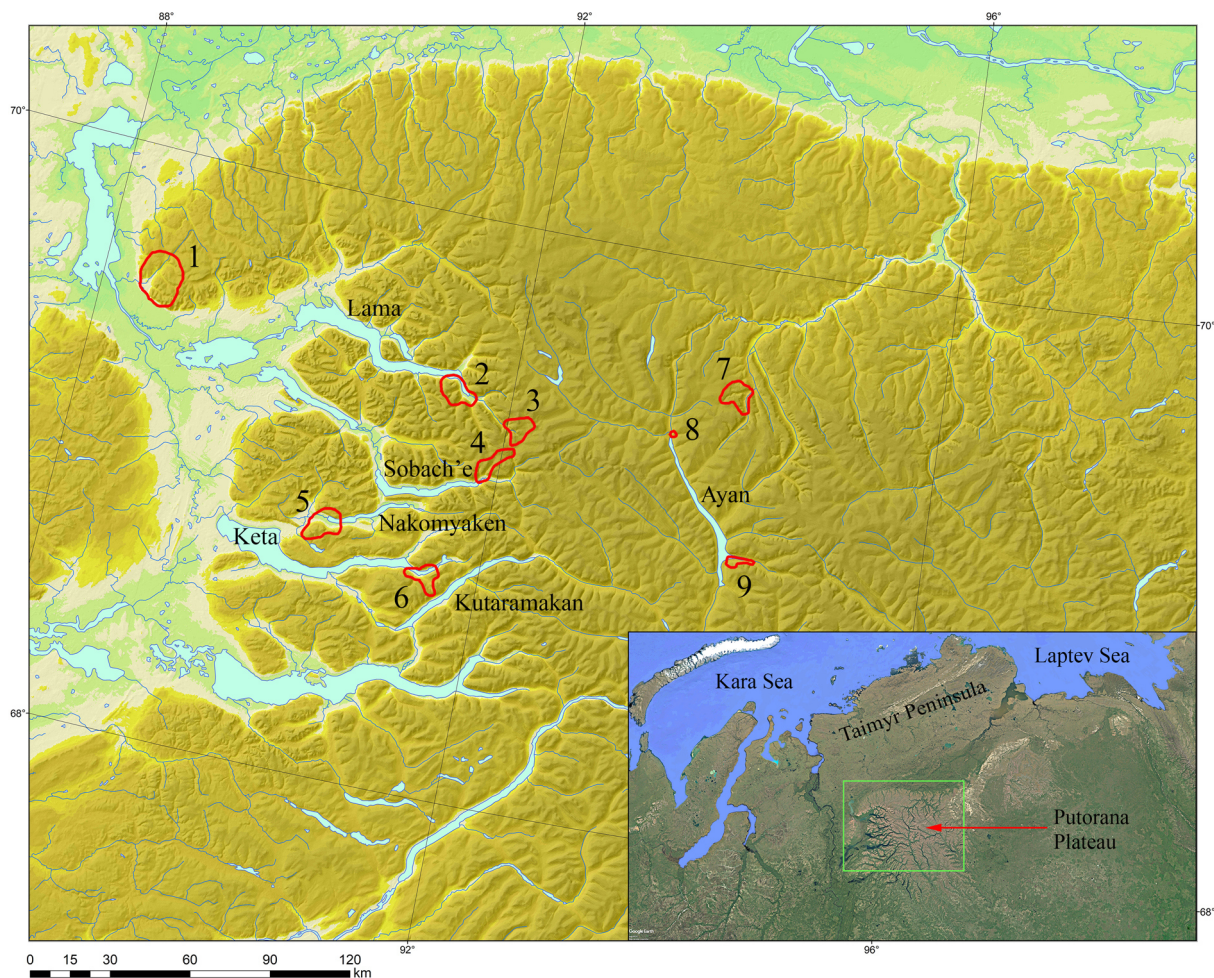


Fig. 1. Locality map of Plecoptera in the Putorana Plateau. For numbers see Material and methods.

Рис. 1. Карта районов сбора на плато Путорана. Номера см. в разделе «Материал и методы».

The nine areas surveyed include the localities situated at an altitude of 45 to 1250 m a.s.l. Many of them are situated in the bottom parts and on the slopes of the deep valleys of great lakes (Lama, Sobach'e, Nakomyaken, Keta, and Ayan) and relatively large rivers (e.g., rivers Ayan, Duluk, and Tonel). The lakes belong to several river basins: the Norilka and Pyasina Lake-River System, the Khatanga River Basin, and the Yenisei River Basin, and have a water surface area of up to 452 km<sup>2</sup> elongated in the latitudinal or submeridional direction. Large lakes are of glacial-tectonic origin; they are characterised by flowing, cold water, low water mineralization (13–42 mg/l), and high oxygen concentration. Their maximum depth exceeds 200 m. The water temperature in the surface layers ranges from 6.5 to 17 °C, and in the bottom layer, from 3.8 to 9.0 °C in July–August [Ver-shinin, 1963; Bogdanov, 1985]. The surveyed rivers are mostly mountainous, turbulent, and full-flowing, with numerous rapids and waterfalls; some of them flow in narrow, winding canyons with steep slopes. In the valleys of small rivers and streams, gorges are common; the bottom is covered with boulders. In winter, running waters freeze to the bottom, ice forms on many, and in summer, high and prolonged floods are not uncommon. The main food of rivers, like lakes, is obtained by melting snow and summer rains. The thickness of the thawing layer of permafrost ranges from several tens of cm to 3–4 m. The climate is sharply continental; the period of open water is 3.5–4 months in the valleys.

The material of Plecoptera was collected in the scope of a large-scale entomological survey of insects conducted by the second author in different habitats and landscapes of Putorana. Sampling techniques generally accepted in entomology and freshwater hydrobiology were used. Most of the sampling sites were situated in the valleys of lakes, rivers and streams, at the shorelines of various freshwaters, and in other wet and semiaquatic habitats, such as mires, lakelets, and puddles. Most stonefly adults were collected by sweeping with an entomological net along the shorelines and over water, as well as by sweeping vegetation (grass stands, shrubs, etc.) in these and other wet habitats. In addition, adults were collected (manually with entomological tweezers, with an aspirator, or with an aquatic net) from the stones, rocks, and other substrates predominantly near water, from the surface film of water, and from the samples of foam accumulated in quiet areas of watercourses and near lake shores (so-called Thiennemann's samples). Additional sampling techniques used to collect adult stoneflies were yellow pan traps (yellow plates) and pitfall traps. The collection of larvae was carried out mostly with aquatic nets of different sizes. Sweeping with aquatic nets of the bottom layer and water margins, in particular, semiaquatic vegetation, was widely used, as was kick-sampling of stony and gravel bottom substrates in fast-running streams and rivers. To collect the larvae, the sampled material was washed through the sieves and hand-sorted in a tray with water or floated in a strong solution of NaCl. As an additional technique, manual sampling of larvae from stones taken from the water, was used.

In total, 990 specimens of stoneflies at the larval and adult stages were collected in 170 samples taken from over 115 localities. The specimens were kept in 80–85 % ethanol, determined by the first author, and deposited in the collections of the Federal Scientific Center of East Asia Terrestrial Biodiversity (Vladivostok) and Zoological Institute (Saint Petersburg).

The distribution ranges are divided into five types in two groups, Holarctic and Palaearctic [Zhiltzova, Levanidova, 1984; Zhiltzova, 2002, 2004]. Holarctic group: 1 — Holarctic Circumpolar species; 2 — Amphipacific species occurring in both Asia and North America. Palaearctic group: 3 — Eastern Palaearctic species occurring east of the Yenisei River; 4 — Transpalaearctic species distributed throughout the Palaearctic; 5 — Arctic European-Asian species distributed in the Arctic and Subarctic, throughout the European part of Russia, the Polar Urals, and northern Siberia.

An annotated list of Plecoptera species known from the Putorana Plateau together with a list of sampling localities and dates is given in Appendix (p. 6–12). The present work is registered in ZooBank ([www.zoobank.org](http://www.zoobank.org)) under LSID urn:lsid:zoobank.org:pub:0E281636-9F9B-4BFB-9862-E1E680CD7A8A

## Results and discussion

In the surveyed 9 areas of Putorana, 12 species in 9 genera and 5 families were recorded, based on the materials from four field seasons (Table 1; see Appendix for the details). Seven species are reported for the north of Eastern Siberia for the first time. A list of the stonefly species cannot be considered final; this is the first report about the stoneflies in Putorana. So far, we can only give a preliminary assessment of the taxonomic diversity of Plecoptera in the study area.

The fauna of Plecoptera in Putorana is characterised by a low species number, which is correlated with a regular decrease in species richness from south to north, a harsh mountainous subarctic climate and, as a result, a relatively low productivity of aquatic ecosystems [Zadelenov et al., 2017]. The number of discovered taxa does not exceed 15 % of the species number of Plecoptera of the entire Krasnoyarskii Krai [Zapekina-Dulkeit, 1980]. The members of the families Taeniopterygidae, Pteronarcyidae and Perlidae have not yet been found in Putorana. A common feature of the stonefly fauna in the Arctic, including the Putorana Plateau, is the absence or a limited number of species from the families Perlidae and Pteronarcyidae, the latter being leaf litter shredders. The relatively low amount of coarse particulate organic matter (CPOM) in running waters of the forested and tundra zones of the Putorana Plateau and semivoltine or several-years life cycle probably limit the presence of large shredders such as Pteronarcyidae. Most of Arctic species face a greater level of unreliability and unpredictability in their food supply. Survival and development thus depend on their ability to spread risk across a wide range of food resources. The low diversity and abundance of herbivorous forage insects could be limiting to

obligate predators such as Perlidae, which also apparently have a low cold-adaptive capacity in comparison with Perlodidae or Chloroperlidae. Chloroperlids and perlodids are usually facultative predators and have a flexible feeding strategy and trophic relationships; with a lack of animal food, they easily shift to plant food and vice versa, while changing the feeding type and trophic level [Stewart, Ricker, 1997; Stewart, Oswood, 2006; Teslenko, 2006].

The family Chloroperlidae is represented in our samples by three species (*A. mediata*, *A. rostellata* and *S. errata*). They were found mostly in or near stony, often fast-flowing, streams and rivers in the forest zone in the western part of Putorana (see Figs 2, 4 and 6 for examples). The only representative of the Perlodidae, an oligothermic East Palaearctic species *A. polaris*, has colonised cold or fast-flowing streams and rivers, as well as cold lakes, in the forest, tundra, and mountain desert zones of the Putorana Plateau. Stoneflies in the family Capniidae are distinguished by the highest richness: four genera and five species have been recorded, three of which were recorded from or near the waterbodies situated above the forest boundary, i.e. in the zones of mountain tundra and desert. Remarkably, two of these species, *C. zaicevi* and *I. guentheri*, were not recorded in the forest zone (Table 1). Apparently, Capniidae is one of the most advanced families in the conditions of permafrost; it is distinguished by the variability of morphological structures and biological adaptations, which make it possible to be among the most numerous in the number of species and to adapt to various types of water bodies at low and high latitudes. We recorded from Putorana one species of Leuctridae and two species of Nemouridae; *P. zapkinae* (Leuctridae) was found only in a forest stream, whereas *N. arctica* (Nemouridae) was recorded in various aquatic and semiaquatic habitats in all three zones, from forests to mountain deserts. The second species of

Nemouridae, *N. cinerea*, was registered only in running waters of the forest zone.

The number of families and species of Plecoptera decreases from the boreal forest zone to the mountain desert zone (Table 1). In total, only three species of twelve (*M. silvatica*, *N. arctica* and *A. polaris*) were recorded in all three landscape zones, from forest to mountain desert.

Five of twelve stonefly species were abundant at least in some localities (see Table 1 and Appendix for the details). According to our observations, the larvae of *A. polaris* predominated in total biomass of macrobenthos in some of fast-flowing streams and rivers.

The stonefly distribution among nine study areas and the respective lake basins is uneven. The greatest species richness of stoneflies was recorded in the forested valleys of Lake Nakomyaken (8) and Lake Keta (6), which are situated in the western part of the Putorana Plateau.

The geographical distribution of Putorana stoneflies is described by five range types. Seven of the twelve species have East Palaearctic range type, two species are Transpalearctic (for the details, see also Appendix: *N. cinerea*), and species with Amphipacific, Holarctic Circumpolar and Arctic European-Asian distribution are single.

The regional stonefly fauna of the Putorana Plateau bears a significant resemblance to the fauna of the Arctic Reserve «Wrangel Island», situated in the Arctic Ocean between the East Siberian and Chukchi Seas (Chukotskii Autonomous Okrug). Four stonefly species, *A. polaris*, *N. arctica*, *M. silvatica* and *M. variabilis*, have been recorded in the tundra streams of the Arctic desert of Wrangel Island [Makarchenko et al., 1980]; three of them also inhabit the Putorana Plateau. Although the richness of the stonefly fauna of Chukotka (arctic and subarctic region in Northeast Asia) exceeds the richness of the stonefly fauna of Putorana more than twice [Teslenko, Khamenkova, 2023], the family Capniidae contains about 40 % of all species found in each regional fauna.

Table 1. A list of Plecoptera collected from the Putorana Plateau and their distribution by landscape zones  
Таблица 1. Список веснянок, собранных на плато Путорана, и их распределение по ландшафтными зонам

Family / Species	Boreal forest	Mountain tundra	Mountain desert
<b>Capniidae</b>			
<i>Capnia atra</i> Morton, 1896	+	–	–
<i>Capnia zaicevi</i> Klapálek, 1914	–	+	++
<i>Eucapnopsis brevicauda</i> (Claassen, 1924) *	+	–	–
<i>Isocapnia guentheri</i> (Joost, 1970) *	–	+	–
<i>Mesocapnia silvatica</i> Raušer, 1968 *	+++	++	++
<b>Leuctridae</b>			
<i>Paraleuctra zapkinae</i> Zhiltzova, 1974 *	+	–	–
<b>Nemouridae</b>			
<i>Nemoura arctica</i> Esben-Petersen, 1910	+++	+++	++
<i>Nemoura cinerea</i> (Retzius, 1783)	++	–	–
<b>Chloroperlidae</b>			
<i>Alloperla mediata</i> (Navás, 1925) *	+++	–	–
<i>Alloperla rostellata</i> (Klapálek, 1923) *	++	–	–
<i>Suwalia errata</i> Li et Li, 2021 *	+++	+	–
<b>Perlodidae</b>			
<i>Arcyopteryx polaris</i> Klapálek, 1912	+++	+++	++
<b>Number of taxa</b> (families / species)	5 / 10	4 / 6	3 / 4

Notes. + — recorded only as single specimens, ++ — may be common, +++ — may be abundant. Species recorded from the north of Eastern Siberia for the first time are asterisked (\*).

Примечание. + — отмечен единично, ++ — может быть обычным, +++ — может быть многочисленным. Виды, впервые отмеченные для северной части Восточной Сибири, помечены звездочкой (\*).



Fig. 2–7. Examples of habitats of Plecoptera on the Putorana Plateau. 2 — middle reach of river in NE environs of Lake Sobach'e (ca. 69°09.256' N, 91°53.958' E, h~370–400 m a.s.l.): habitat of *Mesocapnia* sp., *Suwallia errata* and *Arcynopteryx polaris*; 3 — the Bunisyak River near inflow to NE end of Lake Bunisyak (69°17.3039' N, 92°10.9073' E, h~943 m a.s.l.): habitat of abundant larvae of *Mesocapnia* sp., *Nemoura arctica* and *A. polaris*; 4 — lower reach of the Malyy Orokán River in SE environs of Lake Keta (68°45.226' N, 91°29.647' E, h~102 m a.s.l.): habitat of *Eucapnopsis brevicauda*, *Mesocapnia* sp., *Alloperla mediata*, *A. rostellata*, and *A. polaris*; 5 — small lake in stony mountain desert N of Lake Bunisyak (69°18.1010' N, 92°08.3486' E, h~1075 m a.s.l.): habitat of *Capnia zaitzevi*; 6 — upper reach of stream 3 km SW of W end of Lake Nakomyaken 2.5–3 km above mouth (ca. 68°50.653' N, 90°38.132' E, h~280–300 m): habitat of *E. brevicauda*, *Mesocapnia* sp., *Paraleuctra zapekinae*, *Nemoura* sp., *S. errata*, and *A. polaris*; 7 — stream flowing into SE end of Lake Bunisyak (69°17.2070' N, 92°10.7155' E, h~945 m a.s.l.): habitat of *Isocapnia guentheri* and *N. arctica*. Photos by A. Przhiboro.

Рис. 2–7. Примеры биотопов веснянок плато Путорана. 2 — среднее течение реки в северо-восточных окрестностях оз. Собачье (ок. 69°09.256' N, 91°53.958' E, h~370–400 м н.у.м.): биотоп *Mesocapnia* sp., *Suwallia errata* и *Arcynopteryx polaris*; 3 — р. Бунисьяк у впадения в северо-восточную оконечность оз. Бунисьяк (69°17.3039' N, 92°10.9073' E, h~943 м н.у.м.): биотоп массового развития личинок *Mesocapnia* sp., *Nemoura arctica* и *A. polaris*; 4 — нижнее течение р. Малый Орокан в юго-восточных окрестностях оз. Кета (68°45.226' N, 91°29.647' E, h~102 м н.у.м.): биотоп *Eucapnopsis brevicauda*, *Mesocapnia* sp., *Alloperla mediata*, *A. rostellata* и *A. polaris*; 5 — озерко в каменистой горной пустыне к северу от оз. Бунисьяк (69°18.1010' N, 92°08.3486' E, h~1075 м н.у.м.): биотоп *Capnia zaitzevi*; 6 — верхнее течение ручья в 3 км юго-западнее от западной оконечности оз. Накомьякен, в 2,5–3 км выше устья (ок. 68°50.653' N, 90°38.132' E, h~280–300 м н.у.м.): биотоп *E. brevicauda*, *Mesocapnia* sp., *Paraleuctra zapekinae*, *Nemoura* sp., *S. errata* и *A. polaris*; 7 — ручей, впадающий в юго-восточную оконечность оз. Бунисьяк (69°17.2070' N, 92°10.7155' E, h~945 м н.у.м.): биотоп *Isocapnia guentheri* и *N. arctica*. Фото А. Пржиборо.

In the Putorana region, stoneflies virtually inhabit all types of standing and running waters, including running waters of all sizes and different-type standing waters, from large lakes to small pools and puddles, situated both in the lowlands (e.g., in mires) and in the higher altitudes. The stoneflies occur in the standing and running waters in the three altitudinal zones of Putorana, from the boreal forest to the mountain desert, and represent an important part of the ecosystems of this Subarctic region.

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**Appendix to the article:** V.A. Teslenko, A.A. Przhiboro. Stonefly fauna (Insecta, Plecoptera) of the Putorana Plateau, Russia (Euroasian Entomological Journal. 2024. Vol.23. No.6. P.331–336).

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### **The list of sampling localities and dates of stonefly species (Insecta, Plecoptera) from the Putorana Plateau, Russia**

The label data are preceded by the original expedition numberings of samples; samples from the mountain tundra and mountain desert zones, i.e. from the upper part of the plateau situated well above the forest boundary, are asterisked; the others were taken from the slopes and valleys within the forest zone.

**PP6:** Ayan River, «Northern Ayan» field base, 1 km N of Lake Ayan, 69°20.560' N, 93°32.703' E, 468 m a.s.l., 30.VI.2019; **PP11:** SE end of Lake Ayan, 0.5–1 km of River Kapchug near its mouth, 300 m S of point 68°59.992' N 94°26.191' E, 498 m a.s.l., forestless cotton grass and sedge bog near stream (W tributary of Kapchug), sweep-net, 3.VII.2019; **PP12:** SE end of Lake Ayan, stream – W tributary of Kapchug River mouth, larch-Dushekia forest, 300–400 m from PP13, 500–520 m a.s.l., sweep-net, 3.VII.2019; **PP13:** SE end of Lake Ayan, tributary of Kapchug River at mouth, forested mire, 100 m N from stream, 68°59.992' N, 94°26.191' E, 498 m a.s.l., sweep-net, 3.VII.2019; **PP21:** S end of Lake Ayan, stream 600 m SE from «Southern Ayan» field base, stream banks at 300 m section below waterfall, 68°59.971' N, 94°15.863' E 568 m a.s.l., 4.VII.2019; **PP25:** S end of Lake Ayan, mire «Southern Ayan 3» («dry») 500 m E from «Southern Ayan» field base, 69°00.097' N, 94°15.568' E, 484 m a.s.l., sweep-net, 4–5.VII.2019; **PP27:** S end of Lake Ayan, mire «Southern Ayan 3» («dry»), 500 m E from «Southern Ayan» field base, 69°00.097' N, 94°15.568' E, 484 m a.s.l., sweep-net, 5.VII.2019; **PP31:** S end of Lake Ayan, stream SE from «Southern Ayan» field base, section upstream of columnar canyon, tributary of left bank with waterfalls, 68°59.069' N, 94°16.688' E 723 m a.s.l., sweep-net, 6.VII.2019; **PP33:** S end of Lake Ayan, stream SE from «Southern Ayan» field base, 500 m section upstream of columnar canyon, ca. 68°59.069' N, 94°16.688' E, 723 m a.s.l., sweep-net and hand sampling from stones, 6.VII.2019; **PP42:** S end of Lake Ayan, mire «South Ayan 2» («wet») in hollow 300 m E from «Southern Ayan» field base, 69°00.107' N, 94°15.444' E 481 m a.s.l., yellow pan traps, 5–7.VII.2019; **PP43:** S end of Lake Ayan, mire «Southern Ayan 3» («dry»), 500 m E from «Southern Ayan» field base, 69°00.097' N, 94°15.568' E, 484 m a.s.l., yellow pan traps, 5–7.VII.2019; **PP48:** S end of Lake Ayan, «Southern Ayan» field base, stream, 200 m above mouth, 69°0.151' N, 94°15.340' E, 470 m a.s.l., sweep-net, 8.VII.2019; **PP49:** S end of Lake Ayan, «Southern Ayan» field base, grass 'anthropogenic' meadow on lake shore, 69°0.151' N, 94°15.340' E, 470 m a.s.l., sweep-net, 8.VII.2019; **PP59:** NE environs of Lake Sobach' E, moss-sedge bog on terrace above left bank of river, 2 km NW from «Sobach' E» field base, 69°07.758' N, 91°51.043' E, 162 m a.s.l.,

sweep-net, 14.VIII.2019; **PP65:** NE environs of Lake Sobach' E, river 3 km NW from «Sobach' E» field base, 69°08.689' N, 91°49.269' E, 404 m a.s.l., kick-netting from stones at high current velocity, 14.VIII.2019; **PP66:** SE environs of Lake Keta, larch woodlands, 500 m S from «Keta» field base, 500 m E from mouth of Malyi Orokan River, 68°45.517' N, 91°29.707' E, ca. 100 m, sweep-net, 15–24.VII.2019; **PP68:** SE environs of Lake Keta, drying stream in channel at mouth of Malyi Orokan River, 68°45.226' N, 91°29.647' E, 102 m a.s.l., sweep-net, 15–16.VII.2019; **PP73, PP80, PP81:** SE environs of Lake Keta, «Keta» field base, «Keta-lower» mire, less than 1 km S of lake shore, under first rock ledge, 68°45.271' N, 91°29.868' E–68°45.303' N, 91°30.003' E, 99–100 m a.s.l., aquatic net from puddles (PP73), sweep-net (PP80), yellow pan traps (PP81), 16–20.VII.2019; **PP74, PP84, PP85, PP87:** SE environs of Lake Keta, «Keta-upper» mire, about 1 km from S from «Keta» field base, on terrace above the first rock ledge, 68°45.179' N, 91°30.080' E, 157 m a.s.l., aquatic net from puddles (PP74), sweep-net (PP84), yellow pan traps (PP85, PP87), 16–22.VII.2019; **PP76:** SE environs of Lake Keta, lower reach of Malyi Orokan River, 68°45.226' N, 91°29.647' E, 102 m a.s.l., from moist stones, 20.VII.2019; **PP77:** SE environs of Lake Keta, lower reach of Malyi Orokan River, floodplain deciduous forest with grass stands, 68°45.226' N, 91°29.647' E, 102 m a.s.l., sweep-net, 20.VII.2019; **PP78, PP95, PP105:** SE environs of Lake Keta, lower reach of Malyi Orokan River, 68°45.226' N, 91°29.647' E, 102 m a.s.l., sweep-net above water and at banks (PP78), kick-netting from stony bottom and hand-sampling from stones at bottom (PP95, PP105), 20 and 23.VII.2019; **PP91:** SE environs of Lake Keta, lower reach of Malyi Orokan River, 68°45.226' N, 91°29.647' E, 102 m a.s.l., yellow pan traps, 20–23.VII.2019; **PP96:** SE environs of Lake Keta, drying stream opposite to (NNE of) «Keta» field base, 300 m above mouth, near lower part of waterfall with hygropteris zone, 68°46.540' N, 91°30.773' E, 95 m a.s.l., sweep-net, 21.VII.2019; **PP97:** SE environs of Lake Keta, Malyi Orokan River, lower reach from lower cliffs to lower waterfall, 68°45.226' N, 91°29.647' E, 102 m a.s.l., 68°44.965' N, 91°30.096' E, 130 m a.s.l., sweep-net, 21/22.VII.2019; **PP98:** SE environs of Lake Keta, Malyi Orokan River, from lower waterfall, 68°44.965' N, 91°30.096' E, 130 m to 250 m a.s.l., sweep-net, 21.VII.2019; **PP101\*:** Keta Mts, pass to Kutaramakan Lake, above Malyi Orokan River source, spring bog with streams, 68°42.253' N, 91°36.926' E, 688 m a.s.l., sweep-net, 21, 22.VII.2019; **PP106:** SE environs of Lake Keta, stream canyon 3 km W of Chopko River, mouth to first waterfall, 68°45.983' N, 91°22.655' E–68°45.723' N, 91°22.535' E, 107–170 m a.s.l., sweep-net, 23.VII.2019; **PP107:** SE environs of Lake Keta, stream canyon 3 km W of Chopko River, from 7th to 13th waterfall, 68°45.121' N, 91°21.583' E, 200–350 m a.s.l., sweep-net, 23.VII.2019;

**PP108:** SE environs of Lake Keta, stream canyon 3 km W from Chopko River, birch forest on gentle slopes above 13th waterfall, 68°45.121' N, 91°21.583' E, 412 m a.s.l., sweep-net, 23, 24.VII.2019; **PP109:** SE environs of Lake Keta, stream canyon 3 km W of Chopko River above 13th waterfall, 68°45.121' N, 91°21.583' E, 412 m a.s.l., stones from stream bottom and at water margin, 23/24.VII.2019; **PP110:** SE environs of Lake Keta, stream 3 km W of Chopko River, helocrene above 16th waterfall, at upper border of shrubs, 68°44.552' N, 91°21.434' E, 567 m a.s.l., sweep-net, 23, 24.VII.2019; **PP113:** SE environs of Lake Keta, temporary stream in forest, 2 km W of Chopko River, 68°45.364' N, 91°23.800' E, 200 m a.s.l., stones from stream bottom, 24.VII.2019; **PP201:** NE environs of Lake Sobach' E, river 1 km N of «Sobach' E» field base, 69°08.012' N, 91°53.303' E, 91 m a.s.l., stones at high current, 13.VII.2021; **PP207, PP231:** NE environs of Lake Sobach' E, 1 km NW of «Sobach' E» field base, moss-sedge bog on terrace at left bank of river, 69°07.758' N, 91°51.043' E, 162 m a.s.l., sweep-net, 14.VII. and 18.VII.2021; **PP210:** NE environs of Lake Sobach' E, river 1 km NW of «Sobach' E» field base, 69°07.759' N, 91°50.838' E, 140 m a.s.l., stones at high current, 14.VII.2021; **PP214:** NE environs of Lake Sobach' E, river 1.5 km NW of «Sobach' E» field base, 69°07.920' N, 91°50.375' E, 205 m a.s.l., stones at high current, 15.VII.2021; **PP240:** NE environs of Lake Sobach' E, river bank 3 km NNE of «Sobach' E» field base, 69°09.256' N, 91°53.958' E, 368 m a.s.l., stones at high current, kick-netting and hand sampling, 20.VII.2021; **PP242:** NE environs of Lake Sobach' E, river 3–4.5 km NNE of «Sobach' E» field base, between 69°09.256' N, 91°53.958' E and 69°09.253' N, 91°53.959' E, 370–500 m a.s.l., sweep-net, 21.VII.2021; **PP246\*:** NE environs of Lake Sobach' E, 5 km NNE of «Sobach' E» field base, wet flat areas near stream with forbs, willow, moss, 69°10.351' N, 91°55.055' E, 730–750 m a.s.l., sweep-net, 21.VII.2021; **PP251\*:** NE environs of Lake Sobach' E, 10 km NNE of «Sobach' E» field base, gently sloping valley with lakes 5.5 km W of right bank of Khikikal River canyon, streamlet in stony desert, 69°12.880' N, 91°58.239' E, 921 m a.s.l., net and hand-sampling between stones, 22.VII.2021; **PP252\*:** NE environs of Lake Sobach' E, 11 km NE of «Sobach' E» field base, gentle valley with lakes about 3.5 km W of right bank of Khikikal River canyon, dry and wet grassy gentle slopes with streams, 69°12.914' N, 92°00.119' E, about 900 m a.s.l., sweep-net, 22.VII.2021; **PP255\*:** NE environs of Lake Sobach' E, 5 km NNE of «Sobach' E» field base, stream, 69°10.351' N, 91°55.055' E, 740 m a.s.l., from stones at bottom, 23.VII.2021; **PP256\*:** **PP258\*:** NE environs of Lake Sobach' E, 5 km NNE of «Sobach' E» field base, wet sites at stream with forbs, willow and moss, 69°10.351' N, 91°55.055' E, 730–750 m a.s.l., yellow pan traps (PP256), sweep-net (PP258), 21–23.VII.2021; **PP266:** NE environs of Lake Sobach' E, river 2 km NNE of «Sobach' E» field base, hygropetric zone at cascade of three waterfalls, with puddles and

moss, 69°08.766' N, 91°53.176' E, 271 m a.s.l., sweep-net, 24.VII.2021; **PP270:** NE environs of Lake Sobach' E, mire with stream near lake shore, about 400 m NW of «Sobach' E» field base, 69°07.716' N, 91°52.149' E, 63 m a.s.l., yellow pan traps, 19–25.VII.2021; **PP271:** NE environs of Lake Sobach' E, river 1 km W of «Sobach' E» field base, mouth (alluvial fan), 69°07.462' N, 91°52.203' E, 65 m a.s.l., yellow pan traps, 19–25.VII.2021; **PP272, PP273:** NE environs of Lake Sobach' E, 1 km NW of «Sobach' E» field base, moss-sedge mire on terrace above left bank of river, 69°07.758' N, 91°51.043' E, 162 m a.s.l., yellow pan traps (PP272), pitfall traps (PP273), 18–26.VII.2021; **PP288:** Tonel River about 2 km above mouth, W of Lake Nakomyaken, dead channel, 68°52.585' N, 90°30.366' E, 95 m a.s.l., *Carex* stands, sweep-net, 29.VII.2021; **PP301:** stream 3 km SW of W end of Lake Nakomyaken, lower reach and dry stony streambed near mouth, between 68°51.867' N, 90°36.950' E, 90 m a.s.l., and 68°51.377' N, 90°37.221' E, 134 m a.s.l., sweep-net, 31.VII.2021; **PP302:** stream 3 km SW of W end of Lake Nakomyaken, lower reach, about 1 km above mouth, 68°51.377' N, 90°37.221' E, 130–140 m a.s.l., sweep-net, 31.VII.2021; **PP303, PP304:** stream 3 km SW of W end of Lake Nakomyaken, lower reach, about 1 km above mouth, stony streambed, 68°51.377' N, 90°37.221' E, 130–140 m a.s.l., hand sampling from stones at bottom (PP303) and kick-netting (PP304), 31.VII.2021; **PP306:** SW end of Lake Nakomyaken, lake shore and mouths of small streams, with willow and sedges, 68°51.899' N, 90°32.660' E, 93 m a.s.l., sweep-net, 1.VIII.2021; **PP316:** Tonel River about 3 km above mouth, W of Lake Nakomyaken, forested «grassy» hummocky mire with streams, 300 m S of river, 68°52.310' N, 90°28.908' E, 94 m a.s.l., sweep-net, 3.VIII.2021; **PP318:** Tonel River valley, right bank 3 km above mouth, W of Lake Nakomyaken, rheo-limnocene at edge of mire at foot of gently sloping hill, about 500 m S of Tonel River, 68°52.252' N, 90°28.853' E, 95 m a.s.l., kick-netting, sampling from stones and algal mats, 3.VIII.2021; **PP323:** Tonel River valley 3 km above mouth, W of Lake Nakomyaken, stream flowing into lake 1 in depression on first terrace, 700 m S of river, about 68°52.126' N, 90°28.793' E, 130 m a.s.l., kick-netting, sampling from stones at bottom, 3.VIII.2021; **PP342, PP345:** stream 3 km SW of W end of Lake Nakomyaken, lower reach, 1–2 km above mouth, between 68°51.377' N, 90°37.221' E and 68°51.046' N, 90°37.764' E, 120–190 m a.s.l., sweep-net (PP342), from water surface and foam (PP345), 6.VIII.2021; **PP346:** stream 3 km SW of W end of Lake Nakomyaken, middle reach, 2–2.5 km above mouth, between 68°51.046' N, 90°37.764' E and 68°50.766' N, 90°38.010' E, 190–230 m a.s.l., sweep-net, 6.VIII.2021; **PP348:** stream 3 km SW of W end of Lake Nakomyaken, 3 km SW from lake, middle reach, 2 km above mouth, 100 m downstream entrance to rocky canyon, 68°50.766' N, 90°38.010' E, 230 m a.s.l., sweep-net, 6.VIII.2021; **PP349:** stream 3 km SW of W end of Lake Nakomyaken, stony middle reach, 2–2.3 km above



mouth, between 68°51.046' N, 90°37.764' E and 68°50.766' N, 90°38.010' E, 190–230 m a.s.l., from water surface and foam near bank, 6.VIII.2021; **PP350**: stream 3 km SW of W end of Lake Nakomyaken, middle reach, 2.3 km above mouth, in lower half of rocky canyon, 100–200 m above 68°50.766' N, 90°38.010' E, 240–250 m a.s.l., sweep-net, 6.VIII.2021; **PP351**, **PP352**: stream 3 km SW of W end of Lake Nakomyaken, upper reach, 2.5 km above mouth, above rocky canyon, in subalpine zone, stony bed, 68°50.653' N, 90°38.132' E, ca. 260 m a.s.l., kick-netting and hand sampling from stones at bottom (PP351), from water surface and foam near bank (PP352), 6.VIII.2021; **PP353**: stream 3 km SW of W end of Lake Nakomyaken, upper reach, 2.5–3 km above mouth, rocky channel, in shrub zone above rocky canyon, 260–320 m a.s.l., above 68°50.653' N, 90°38.132' E, sweep-net, 6.VIII.2021; **PP354**: W end of Lake Nakomyaken, S slope, 1.5 km SW of lake shore, drying stream in canyon, 68°51.310' N, 90°32.063' E, 220 m a.s.l., sweep-net, 7.VIII.2021; **PP360\***: Tonel Mts, SW of Lake Nakomyaken, small lake on terrace under summit, 68°50.543' N, 90°30.169' E, 634 m a.s.l., sweep-net, 7.VIII.2021; **PP364\***: Tonel Mts, SW of Lake Nakomyaken, near pass, small streams from under dry slopes, between 68°50.253' N, 90°29.683' E and 68°50.065' N, 90°29.606' E, 670–690 m a.s.l., sweep-net, 8.VIII.2021; **PP366\***: Tonel Mts, SW of Lake Nakomyaken, S gentle slopes of peak «898 m", 68°49.576' N, 90°27.957' E, between pass 68°49.734' N, 90°29.827' E and E foot of Mungurdakh Mt, 68°49.227' N, 90°26.911' E, 700–800 m a.s.l., dry stony tundra and dry meadows, sweep-net, 8.VIII.2021; **PP376**: SW environs of Lake Nakomyaken, ca. 100 m a.s.l., about 200 m SW of lake shore at 68°51.899' N, 90°32.660' E, dry larch-birch forest with grasses and horsetails, sweep-net, 9.VIII.2021; **PP378**, **PP389**, **PP390**: SW environs of Lake Nakomyaken, small stream 100–150 m E of field base (2nd from it), 100–300 m above mouth, 68°51.813' N, 90°32.635' E, 95 m a.s.l., kick-sampling by aquatic net and collecting from stones at bottom (PP378), sweep-net above riffles (PP389), from water surface and foam (PP390), 9 and 11.VIII.2021; **PP427**: S foothills of Kharaelakh Mts, stream near Krasnyi Kamen' valley, 69°28.694' N, 88°31.650' E, 163 m a.s.l., sweep-net, 10.VII.2022; **PP442\***: Kharaelakh Mts, small lakes in tundra, ca. 10 km N of Talnakh City, lake 2 under slope, 69°36.904' N, 88°26.351' E, 375 m a.s.l., sweep-net, 13.VI.2022; **PP443\***: Kharaelakh Mts, small lakes in tundra, ca. 10 km N of Talnakh City, lake 3 on hill, 69°36.758' N, 88°26.694' E, 409 m a.s.l., sweep-net, 13.VI.2022; **PP445\***: Kharaelakh Mts, small lakes in tundra ca. 10 km N of Talnakh City, lake 4 (ribbon-shaped under slope), 69°36.488' N, 88°25.793' E, 396 m a.s.l., sweep-net, 13.VI.2022; **PP446\***, **PP447\***: Kharaelakh Mts, tundra ca. 10 km N of Talnakh City, stream across road, 69°36.246' N, 88°25.268' E, 368 m

a.s.l., sweep-net at banks (PP446), sampling by aquatic net from shallow water and water margin (PP447), 13.VI.2022; **PP450**, **PP452**: Lake Duluk, near Duluk field base, stony-sandy lake shore, 69°33.388' N, 94°08.675' E, 391 m a.s.l., sweep-net and hand sampling, 15–24.VII.2022; **PP453**: Lake Duluk, near Duluk field base, wet meadow stripe along W shore of lake, 5–20 m above waterline, and Duschekia and willow thickets above it, 69°33.388' N, 94°08.675' E, 391 m a.s.l., sweep-net, 15–18.VII.2022; **PP454**: Lake Duluk, W shore near Duluk field base, 150–200 m from lake, un-forested grassy mire between field base and lake, 69°33.388' N, 94°08.675' E, 391 m a.s.l., sweep-net, 15–18.VII.2022; **PP460**: Lake Duluk, near W shore at Duluk field base, larch woodland, 69°33.464' N, 94°08.421' E, 414 m a.s.l., sweep-net, 15–18.VII.2022; **PP461**: Duluk River, downstream Lake Duluk, right bank with grass and pebbles, from first riffles from 69°33.841' N, 94°09.486' E, 396 m to 69°34.122' N, 94°09.990' E, 389 m a.s.l., sweep-net, 16.VII.2022; **PP472**: left tributary of Duluk River, 1.5 km NW of Lake Duluk, right bank, 69°34.051' N, 94°06.895' E, 477 m a.s.l., from ice 1–2 m high, 17.VII.2022; **PP474**: left tributary of Duluk River, 1.5 km NW of Lake Duluk, 69°34.051' N, 94°06.895' E, 477 m a.s.l., from stones at bottom, 17.VII.2022; **PP475**: left tributary of Duluk River, 1.5 km NW of Lake Duluk, 69°34.051' N, 94°06.895' E, 477 m a.s.l., kick-netting, 17.VII.2022; **PP476**: Lake Duluk, W shore near Duluk field base, 69°33.388' N, 94°08.675' E, 395 m a.s.l., sweep-net, 18.VII.2022; **PP478**: Lake Duluk, W shore, rocky stream flowing into lake (lower 30 m), 69°32.500' N, 94°08.264' E, 394 m a.s.l., from stones, 18.VII.2022; **PP479**: Lake Duluk, S end, dry shore meadows with streamlets, 300–400 m S of point 69°32.500' N, 94°08.264' E, 394 m a.s.l., sweep-net, 18.VII.2022; **PP480**: Duluk River downstream Lake Duluk, right river bank with grass, between 69°33.841' N, 94°09.486' E, 396 m a.s.l., and 69°34.122' N, 94°09.990' E, 389 m a.s.l., sweep-net, 18.VII.2022; **PP481**: Duluk River downstream Lake Duluk, right bank, small floodplain lake with sedges at shores, 69°34.608' N, 94°10.904' E, 398 m a.s.l., sweep-net, 18.VII.2022; **PP488\***: W of Lake Duluk, border between tundra and stony desert, 69°33.086' N, 94°06.262' E, 938 m a.s.l., small puddles among moss and stones, from water and water surface, 19.VII.2022; **PP489\***: NW of Lake Duluk, between 69°32.909' N, 94°06.508' E and 69°33.035' N, 94°05.862' E, 900–1000 m a.s.l., sweep-net, 19.VII.2022; **PP490**: left tributary of Duluk River, 1.5 km NW of Lake Duluk, between 69°34.051' N, 94°06.895' E, 477 m a.s.l., and 69°33.988' N, 94°06.169' E, 497 m a.s.l., sweep-net, 21.VII.2022; **PP495\***, **PP509\***, **PP510\***, **PP517\***: NW of Lake Duluk, rocky mountain desert, small lake, 69°34.788' N, 94°04.304' E, 976 m a.s.l., sampling by aquatic net near shore (PP495), sweep-net at shores (PP509), yellow pan traps (PP510), sampling by aquat-

ic net from mud and sand at 10–50 cm depth (PP517), 21–23.VII.2022; **PP501\***: NW of Lake Duluk, stony streamlet, 69°33.131' N, 93°58.467' E, 1009 m a.s.l., sweep-net, 22.VII.2022; **PP504\***: NW of Lake Duluk, left tributary of Duluk River, above upper waterfall, 69°31.759' N, 93°56.825' E, 1004 m a.s.l., sweep-net, 22.VII.2022; **PP505\***: NW of Lake Duluk, flat marshy meadows with streams between 69°31.759' N, 93°56.825' E, 1004 m a.s.l., and 69°33.131' N, 93°58.467' E, 1009 m a.s.l., sweep-net, 22.VII.2022; **PP512\***: NW of Lake Duluk, stony mountain desert, semi-dry puddles with green algal mats, 69°34.767' N, 94°02.829' E, 996 m a.s.l., aquatic net, 23.VII.2022; **PP513\***, **PP514\***: NW of Lake Duluk, stony mountain desert, small lake 1.5–2 m deep, 69°34.790' N, 94°02.200' E, 981 m a.s.l., sweep-net at shores (PP513), sampling by aquatic net from bottom and stands in shallow water (PP514), 23.VII.2022; **PP523**: Lake Duluk, W shore near Duluk field base, 69°33.388' N, 94°08.675' E, 391 m a.s.l., sweep-net, 24.VII.2022; **PP524**: Duluk River downstream Lake Duluk, right river bank with sedge stands from 1st to 2nd riffle, ca. 69°33.841' N, 94°09.486' E, 396 m a.s.l., sweep-net, 24.VII.2022; **PP528**: Duluk River, 1st riffle downstream Lake Duluk, ca. 69°33.841' N, 94°09.486' E, 396 m a.s.l., kick-netting, 24.VII.2022; **PP529**: Duluk River, downstream Lake Duluk, right bank with sedge stands near first riffle, ca. 69°33.841' N, 94°09.486' E, 396 m a.s.l., aquatic net, 24.VII.2022; **PP530**: Duluk River downstream Lake Duluk, between 1st and 2nd riffles, 69°33.841' N, 94°09.486' E, 396 m, 1.2–1.6 m a.s.l., mud, aquatic net from bottom, 24.VII.2022; **PP532**: N end of Lake Duluk, sedge mire in hollow at W lake shore, behind shore rampart, 69°33.699' N, 94°08.737' E, 419 m a.s.l., sweep-net, 25.VII.2022; **PP536**: NW environs of Lake Duluk, drying stream on slope in larch forest, 69°33.931' N, 94°08.532' E, 439 m a.s.l., sweep-net, 25.VII.2022; **PP547\***: Kharaelakh Mts, Talnakh River valley, two floodplain lakes in middle reach of river, 69°30.543' N, 88°33.919' E, 287 m a.s.l., aquatic net, 28.VII.2022; **PP554\***: Kharaelakh Mts, Talnakh River, upper reach, 69°29.899' N, 88°35.679' E, 314 m a.s.l., from water surface near bank, 28.VII.2022; **PP555\***: Kharaelakh Mts, Talnakh River, upper reach, 69°29.899' N, 88°35.679' E, 314 m a.s.l., from stones at bottom, 28.VII.2022; **PP559**: SE end of Lake Lama, Bunisyak tourists base, 69°23.376' N, 91°33.539' E, 54 m a.s.l., 30.VII–3.VIII.2022; **PP561**: SE end of Lake Lama, partially marshy shore meadow, 1 km E of Bunisyak tourists base, towards mouth of Khoisi River, 69°22.928' N, 91°35.238' E, 47 m a.s.l., sweep-net, 31.VII.2022; **PP563**: SE end of Lake Lama, Khoisi River mouth, left bank with grass and bushes, between 69°22.798' N, 91°35.868' E and 69°22.655' N, 91°36.428' E, 47 m a.s.l., sweep-net, 31.VII.2022; **PP565**: SE end of Lake Lama, near mouth of Khoisi River, larch forest on slope with marshy streamlets, between 69°22.493' N, 91°36.092' E, 114 m a.s.l.,

and 69°22.655' N, 91°36.428' E, 64 m a.s.l., sweep-net, 31.VII.2022; **PP569**: SE end of Lake Lama, 2.5 km W of Bunisyak tourists base, stream in rocky canyon, between two lower waterfalls, 69°23.589' N, 91°30.255' E, 240–250 m a.s.l., from stones in water, 1.VIII.2022; **PP581**: SE end of Lake Lama, mouth of Vekhikay River, dry bed with temporary streams and puddles, 69°23.295' N, 91°33.077' E, 67 m a.s.l., sweep-net and from water surface, 2.VIII.2022; **PP582**: SE end of Lake Lama, Vekhikay River, right bank 1 km above mouth, at point of right dry riverbed origin, pebble and pebble-gravel banks, 69°23.214' N, 91°32.615' E, 82 m a.s.l., sweep-net, 2.VIII.2022; **PP586**: SE end of Lake Lama, partially marshy shore meadow, 1 km E of Bunisyak tourists base towards Khoisi River mouth, 69°22.928' N, 91°35.238' E, 47 m a.s.l., sweep-net, 2.VIII.2022; **PP601\***: SW from E edge of Lake Lama, terrace at S edge of plateau at isthmus between two valleys, wet meadow tundra with streams, 69°23.641' N, 91°22.267' E, 992 m a.s.l., sweep-net, 5.VIII.2022; **PP602\***: SW of E edge of Lake Lama, small rocky lake on isthmus between two valleys, 69°23.592' N, 91°22.308' E, 968 m a.s.l., from water surface, 5.VIII.2022; **PP612**: SE end of Lake Lama, Bunisyak River mouth, riffle, 50 m N of 69°23.237' N, 91°36.207' E, 46 m a.s.l., kick-netting, 7.VIII.2022; **PP615**: SE end of Lake Lama, Bunisyak River mouth, small marshy floodplain flowing lake, 69°23.495' N, 91°36.095' E, 46 m a.s.l., aquatic net, 7.VIII.2022; **PP620**: SE end of Lake Lama, Vekhikay River, right bank 1 km above mouth, at point of right dry riverbed origin, pebble and pebble-gravel banks, 69°23.214' N, 91°32.615' E, 82 m a.s.l., yellow pan traps, 2–8.VIII.2022; **PP621**: SE end of Lake Lama, Khoisi River mouth, left bank with grass and bushes, between 69°22.798' N, 91°35.868' E and 69°22.655' N, 91°36.428' E, 47 m a.s.l., yellow pan traps, 2–8.VIII.2022; **PP622**: SE end of Lake Lama, Vekhikay River, 1 km above mouth, 69°23.214' N, 91°32.615' E, 82 m a.s.l., sweep-net, 8.VIII.2022; **PP623**: SE end of Lake Lama, Vekhikay River, 1 km above mouth, water surface near bank, 69°23.214' N, 91°32.615' E, 82 m a.s.l., 8.VIII.2022; **PP625**: SE end of Lake Lama, Khoisi River mouth, channel, riffle, 200 m NW of 69°22.655' N, 91°36.428' E, 47 m a.s.l., sweep-net, 8.VIII.2022; **PP631\***: Kharaelakh Mts, Olor River valley, «Olor 1» small lake in tundra with stony shores, 69°37.811' N, 88°38.222' E, 403 m a.s.l., aquatic net, 13.VIII.2022; **PP641\***, **PP643\***: Kharaelakh Mts, Olor River valley, row of small lakes «Olor 6» in tundra on stream in hollow, 69°36.901' N, 88°38.181' E, 365 m a.s.l., aquatic net from shallow water and water margin (PP641), kick-netting from stony stream bottom (PP643), 13.VIII.2022; **PP644\***, **PP645\***: Kharaelakh Mts, Olor River, lower reach, near old drilling rig, 69°36.075' N, 88°38.360' E, 290 m a.s.l., sweep-net at dry stony banks (PP644), kick-netting from stony bottom (PP645), 13.VIII.2022; **PP1014\***: S flat shore of Lake

Bunisyak, 69°17.3536' N, 92°10.1435' E, 943 m a.s.l., sweep-net, 16.VII.2024; **PP1017\***: environs of Lake Bunisyak, between 69°17.3039' N, 92°10.9073' E and 69°17.2070' N 92°10.7155' E, 946–956 m a.s.l., tundra, gentle slopes with streamlets below snowfields near E end of lake, sweep-net, 16.VII.2024; **PP1023\***: Lake Bunisyak, shallow water at S shore, ca. 69°17.3536' N, 92°10.1435' E, 942 m a.s.l., 17.VII.2024; **PP1032\***: N environs of Lake Bunisyak, stony mountain desert, small lake in hollow with large snowfield, 69°18.3900' N, 92°08.7275' E, 1052 m a.s.l., from water surface near shore, 18.VII.2024; **PP1035\***: N environs of Lake Bunisyak, stony mountain desert, small lake, 69°18.1010' N, 92°08.3486' E, 1075 m a.s.l., from bottom near shore, 18.VII.2024; **PP1037\***: N environs of Lake Bunisyak, stony mountain desert, small lake, 69°18.1010' N, 92°08.3486' E, 1075 m a.s.l., from water surface near shore, 18.VII.2024; **PP1039\***: N environs of Lake Bunisyak, stony mountain desert, small lake in hollow with snowfield, 69°18.0203' N, 92°08.3348' E, 1063 m a.s.l., from bottom near shore, 18.VII.2024; **PP1045\***: S (left) bank of Bunisyak River downstream of Lake Bunisyak, between 69°17.2688' N, 92°07.5494' E, 949 m a.s.l., and 69°17.4320' N, 92°06.8855' E, 905 m a.s.l., snowfield on slop above large waterfalls and canyon, 19.VII.2024; **PP1047\***: terrace above S bank of Bunisyak River canyon, 69°17.6152' N, 92°05.9594' E, 840 m a.s.l., wet glades with streams and puddles including Sphagnum-sedge-cottongrass bog, sweep-net, 19.VII.2024; **PP1048\***: terrace above S bank of Bunisyak River canyon, 69°17.6152' N, 92°05.9594' E, 840 m a.s.l., Sphagnum-sedge-cottongrass bog, sweep-net, 19.VII.2024; **PP1053\***: S flat shore of Lake Bunisyak, puddles and streamlets between stones under snowfield, 100 m from lake margin, ca. 69°17.3536' N, 92°10.1435' E, ca. 943 m a.s.l., sweep-net, 20.VII.2024; **PP1054\***: SE end of Lake Bunisyak, 69°17.2070' N, 92°10.7155' E, ca. 945 m a.s.l., stony banks of stream, sweep-net, 20.VII.2024; **PP1056\***: Bunisyak River near inflow to NE end of Lake Bunisyak, 69°17.3039' N, 92°10.9073' E, ca. 943 m a.s.l., snowfield at left bank, 20.VII.2024; **PP1057\***: Bunisyak River near inflow to NE end of Lake Bunisyak, 69°17.3039' N, 92°10.9073' E, ca. 943 m a.s.l., stony riffle, kick-netting at 5–30 cm depth, 20.VII.2024; **PP1058\***: Bunisyak River upstream (NE) of Lake Bunisyak, above confluence with right tributary, 69°17.8555' N, 92°11.5540' E, ca. 985 m a.s.l., hand-sampling from stones at bank, 21.VII.2024; **PP1074\***: Khikikal River upstream of its canyon, 69°14.8970' N, 92°08.2897' E, 932 m a.s.l., banks above upper waterfall, sweep-net, 22.VII.2024; **PP1090\***: terrace above N (right) bank of Bunisyak River canyon, between 69°19.6298' N, 92°03.4145' E, 1086 m a.s.l., and 69°19.6745' N, 92°01.5481' E, 1056 m a.s.l., mostly dry tundra on gentle slopes, sweep-net, 23.VII.2024; **PP1094\***: environs of Lake Bunisyak, slope at E end of lake, ca. 69°17.2487' N, 92°11.3186' E, 978 m

a.s.l., partially wet tundra, sweep-net, 24.VII.2024; **PP1097\***: SE end of Lake Bunisyak, 69°17.2070' N, 92°10.7155' E, ca. 945 m a.s.l., snowfield at E bank of stream flowing into lake, 25.VII.2024; **PP1098\***: E end of Lake Bunisyak between 69°17.2070' N, 92°10.7155' E and 69°17.3039' N, 92°10.9073' E, ca. 943 m a.s.l., hand-sampling under stones at shore of lake and inflow of River Bunisyak, 25.VII.2024.

## An annotated list of stonefly species (Insecta, Plecoptera) of the Putorana Plateau, Russia

In the list, the sample numbers and numbers of specimens are given after the species name. Larva is abbreviated as L.

### Capniidae

#### *Capnia atra* Morton, 1896

**Material.** 1♀ — PP306.

**Distribution.** Transpalaeartic species; known from the British Isles, Central Europe, Fennoscandia, the European part of Russia, except west and south, the Polar Urals, north of the western and eastern Siberia (up to Magadanskaya Oblast), and Krasnoyarskii Krai.

**Notes.** A single female was collected at the shore of Lake Nakomyaken (93 m a.s.l.) with mouths of small streams.

#### *Capnia zaicevi* Klapálek, 1914

Fig. 5.

**Material.** 1♀ — PP445; 1♀ — PP1014; 7♀♀ — PP1032; 6♀♀ — PP1037.

**Distribution.** This insufficiently studied species inhabits the Arctic and Subarctic and seems to have an Arctic European-Asian distribution [Zhiltzova, 2002]. It is known from the northeastern European part of Russia in Bol'shezemel'skaya Tundra, Republic of Komi, the Novaya Zemlya Archipelago, the Polar Urals, and northern Siberia (Gydan Peninsula, Taimyr Peninsula, and the New Siberian Islands).

**Notes.** In Putorana, the species was recorded only above the forest boundary. Single adults were collected in the Kharaelakh Mountains near small lakes in tundra (396 m a.s.l.) and at the shore of Lake Bunisyak in the western part of Putorana (943 m a.s.l.). The species was common at the shorelines of two small lakes (1052–1075 m a.s.l.) in stony mountain desert in the environs of Lake Bunisyak (Fig. 5). In all cases, only females were collected.

#### *Eucapnopsis brevicauda* (Claassen, 1924)

Fig. 4, 6.

**Material.** 1♂ — PP68; 1♀ — PP352.

**Distribution.** Amphipacific species with Siberian - North American distribution [Zhiltzova, 2002]. In Russia, it is known from the Altai, Eastern Siberia including Krasnoyarskii Krai, and the Russian Far East, in particular, Chukotskii Autonomous Okrug, Magadanskaya Oblast, Khabarovskii Krai, Primorskii Krai, and Sakhalinskaya Oblast. Outside Russia, it was recorded from Mongolia, Kazakhstan, and North America, from Alaska to California and Colorado. The species is recorded from the north of Eastern Siberia for the first time.

**Notes.** The species was found in the forest belt at an altitude of 102 m in the lower reach of the Malyi Orokan River

## Stonefly fauna (Insecta, Plecoptera) of the Putorana Plateau, Russia

near Lake Keta (Fig. 4) and at a stream in Lake Nakomyaken valley, in the bush zone, at about 260 m (Fig. 6).

### *Isocapnia guentheri* (Joost, 1970)

Fig. 7.

**Material.** 2♀♀ — PP1045; 1♀(?) — PP1097.

**Distribution.** East Palaearctic species described from Mongolia. Outside Mongolia, it is known only in Russia: it was recorded from Eastern Siberia (Altai, southern parts of Krasnoyarskii Krai, and Yakutia) and is widely distributed across the Russian Far East (from Chukotskii Autonomous Okrug and Kamchatka to Primorskii Krai and southern Sakhalin). The species is recorded from the north of Siberia for the first time.

**Notes.** A few females of this species were collected from snowfields at 900–950 m a.s.l. in tundra in the environs of Lake Bunisyak (Fig. 7).

### *Mesocapnia silvatica* Raušer, 1968

**Material.** 1♂ — PP106; 1♂, 1♀ — PP108; 1♂ — PP270; 1♀ — PP301; 1♂, 10♀♀ — PP302; 1♂, 1♀ — PP306; 1♀ — PP472; 1♀ — PP476; 1♂, 3♀♀ — PP479; 2♀♀ — PP501; 1♀ — PP536; 1♂, 1♀ — PP554; 1♀ — PP565; 2♀♀ — PP581; 1♂, 2♀♀ — PP601; 1♀ — PP602; 1♀ — PP631; 1♀ — PP644; 1♀, 5L — PP645.

**Distribution.** East Palaearctic species, widely distributed in the Far East. In Russia, it is known from Wrangel Island, Chukotskii Autonomous Okrug, Magadanskaya Oblast, Khabarovskii Krai, Primorskii Krai, and Sakhalinskaya Oblast. Outside Russia, it is known from China and Mongolia. The species is recorded from the north of Eastern Siberia for the first time.

**Notes.** The species was found in no less than six of the nine surveyed areas of Putorana, but was usually not abundant and was mostly recorded as single or few specimens. It was recorded along the entire altitudinal profile, but most records were made in the forest zone, at or in running waters of various types, from small streamlets in the forests (both larch and mixed) to larger, fast-flowing streams and rivers with stony beds in deep or open valleys. In the tundra and mountain desert zones, the species was collected from small to large streams and rivers, and also from the shores of small lakes situated far from running water.

### *Mesocapnia* sp.

**Material.** 7L — PP65; 1♀ — PP97; 2♀♀ — PP101; 1L exuviae — PP107; 2♀♀ — PP109; 6L — PP214; 1L — PP240; 1♀ — PP271; 1♀ — PP303; 2L — PP304; 1♀ — PP342; 31♀♀ — PP345; 2♀♀ — PP346; 2♀♀ — PP348; 4♀♀ — PP350; 5♀♀ — PP352; 1♀ — PP354; 1♀ — PP360; 1♀ — PP376; 2♀♀ — PP389; 4♀♀ — PP390; 1L — PP517; 1L — PP555; 1L — PP612; 23L — PP1057; 2♀ (sub-brachypterous) — PP1090.

**Notes.** The females and larvae are probably conspecific to *M. silvatica*.

## Leuctridae

### *Paraleuctra zapekinae* Zhiltzova, 1974

Fig. 6.

**Material.** 2♀♀ — PP345; 1♀ — PP349; 1♀ — PP352.

**Distribution.** East Palaearctic species known from Eastern Siberia and the Russian Far East: Krasnoyarskii Krai, Zabaikalskii Krai, Irkutskaya Oblast, Amurskaya Oblast, Jewish Autonomous Oblast, Khabarovskii Krai, Primorskii Krai, and Sakhalinskaya Oblast; it was also recorded from Mongolia. The species is reported for the north of Eastern Siberia for the first time.

**Notes.** The species was recorded at a stony stream in the valley of Lake Nakomyaken, at 120–260 m a.s.l. in the forest zone up to the bush belt (Fig. 6).

## Nemouridae

### *Nemoura arctica* Esben-Petersen, 1910

**Material.** 1♂, 1♀ — PP12; 2♂♂ — PP27; 1♂ — PP25; 1♂ — PP31; 1♂ — PP43; 2♂♂, 2♀♀ — PP48; 1♂, 1♀ — PP49; 1♂, 2♀♀ — PP59; 1♂, 2♀♀ — PP74; 1♂ — PP84; 1♂, 1♀ — PP85; 1♂, 1♀, 1L — PP109; 1♂ — PP207; 2♂♂ — PP231; 2♂♂, 2♀♀ — PP251; 1♂ — PP252; 1♂, 1♀ — PP256; 1♂ — PP258; 1♂ — PP364; 1♀ — PP442; 2♀♀ — PP443; 1♂, 2♀♀ — PP446; 12♀♀ — PP450; 1♂, 10♀♀ — PP452; 1♀ — PP453; 1♀ — PP454; 1♀ — PP460; 2♂♂, 25♀♀ — PP461; 1♀ — PP472; 1L — PP474; 3♂♂, 3♀♀ — PP480; 1♀ — PP481; 4♂♂, 5♀♀ — PP488; 1♂, 1♀ — PP489; 3♀♀ — PP490; 1♀, 1L — PP495; 2♀♀, 2L — PP 504; 1♀ — PP505; 1♀ — PP509; 1♀ — PP510; 1♀ — PP512; 1♀ — PP513; 1♂, 4L — PP514; 1♀ — PP523; 6♂♂, 54♀♀ — PP524; 10L — PP528; 23♂♂, 49♀♀ — PP529; 2♀♀ — PP530; 1♀ — PP532; 1♀ — PP561; 1♀ — PP601; 1♂, 1♀ — PP1017; 20♂♂, 12♀♀ — PP1047; 15♂♂, 6♀♀ — PP1048; 1♂ — PP1053; 1♂ — PP1054; 4♂♂, 3♀♀ — PP1056; 2♂♂, 3♀♀ — PP1058; 1♂ — PP1094; 1♂ — PP1097; 1♂ — PP1098.

**Distribution.** Holarctic, circumpolar species. In Russia, it is known from Kola Peninsula, Republic of Komi, the Polar Urals, Krasnoyarskii Krai, the Eastern Sayan, the Altai, Chukotskii Autonomous Okrug, Magadanskaya Oblast, Kamchatskii Krai, Khabarovskii Krai, Primorskii Krai, and Sakhalinskaya Oblast. Outside Russia, it is known from Northern Europe, Mongolia, and the north of North America.

**Notes.** The species is found in all surveyed areas of Putorana. It is common and sometimes abundant in all landscape zones, reaching an altitude of slightly less than 1000 m. *Nemoura arctica* is eurytopic and occurs in various aquatic and semiaquatic habitats. In running waters of Putorana, the habitats of this species range from large rivers to small streams, both fast and slow, with various bottom substrates, waterfall habitats etc. Among standing waterbodies of the forest zone, the species is common on different-type mires, both wet and dry, and at shores of different-type small lakes. In the tundra and mountain desert zones, the species was commonly found on the shores of small lakes and puddles.

### *Nemoura* sp.

**Material.** 1♀ — PP6; 1♀ — PP11; 1♀ — PP13; 1♀ — PP21; 6♀♀ — PP33; 1♀ — PP42; 2L, 1L exuviae — PP73; 1L exuviae — PP87; 1♀ — PP96; 2♀♀ — PP101; 1♀ — PP110; 1L — PP113; 1♀ — PP246; 7L — PP255; 1♀ — PP266; 1♀ — PP270; 1♀ — PP272; 3♀♀, 1L — PP273; 1♀ — PP288; 3L — PP303; 3L — PP304; 1♀ — PP306; 2♀♀ — PP316; 1L — PP323; 2♀♀ — PP345; 1♀ — PP349; 2♀♀ — PP352; 1♀ — PP354; 7L — PP378; 1L — PP390; 1L — PP447; 27L — PP475; 2L — PP478; 8L — PP517; 1L — PP569; 5L — PP612; 17L — PP615; 3L — PP625; 1L — PP641; 16L — PP643; 9L — PP645; 23L — PP1057; 1♀ — PP1074.

**Notes.** The females and larvae are probably conspecific to *N. arctica*.

### *Nemoura cinerea* (Retzius, 1783)

**Material.** 3L — PP318; 4L — PP625.

**Distribution.** Transpalaearctic species according to Zhiltzova [2004]. At the same time, the species was not recorded in the Far East, hence its range can be classified as West-and-Central Palaearctic according to Gorodkov [1984]. In Russia, *N. cinerea* is widely distributed from the European part through Siberia, including Krasnoyarskii Krai, to the western Transbaikalia. Outside Russia, it is distributed in Europe, including Ukraine, the Baltic countries and Georgia, also known from Turkey, Kazakhstan and Middle Asia.

**Notes.** The most polytopic stonefly species, which inhabits ponds, marshes, and streams. In the mountains, it occurs at altitudes up to 2500 m a.s.l. [Zhiltzova, 2003]. It inhabits all stream types, also found in acid peat bogs, and may be very common in marginal habitats that other Plecoptera fail to colonise [Zwick, 2004]. In Putorana, the species was collected

in a branch near the mouth of the Khoisi River (Lake Lama valley) and in the rheo-limnocene at the edge of mire in the Tonel River valley (near Lake Nakomyaken), at 47–95 m a.s.l.

### Chloroperlidae

#### *Alloperla mediata* (Navás, 1925)

Fig. 4.

**Material.** 1♀ — PP66; 2♂♂ — PP68; 1♀ — PP76; 28♂♂, 15♀♀ — PP77; 3♂♂, 5♀♀ — PP78; 1♀ — PP80; 5♂♂ — PP81; 1♀ — PP84; 10♂♂, 2♀♀ — PP91; 4L — PP95; 4♀♀ — PP98; 18L — PP105; 6L exuviae — PP623; 1L — PP625.

**Distribution.** East Palaearctic species. In Russia, it is known from Krasnoyarskii Krai, the Altai Mountains, Amurskaya Oblast, Khabarovskii Krai, Primorskii Krai, Sakhalinskaya Oblast, Magadanskaya Oblast, and Kamchatskii Krai. Outside Russia, it is known from Mongolia, China, Korea, and Japan. The species is reported for north of Eastern Siberia for the first time.

**Notes.** In Putorana, the species was found only in two localities both situated in the forest zone in (or near) the lower reaches of fast-flowing rivers not far from their inflow to lakes: the Malyi Orokan River (Lake Keta valley, 99–157 m a.s.l.) and the Vekhikai and the Khoisi rivers (Lake Lama valley, 47–82 m a.s.l.). At the Malyi Orokan (Fig. 4), the species was rather abundant. The larvae were collected in the above-mentioned rivers. All records were made in late July to early August.

#### *Alloperla rostellata* (Klapálek, 1923)

Fig. 4.

**Material.** 9L — PP105.

**Distribution.** East Palaearctic species. In Russia, it is known from Krasnoyarskii Krai, the Sayan and Altai Mountains, Irkutskaya Oblast, Zabaikalskii Krai, southern Yakutia, Jewish Autonomous Oblast, Magadanskaya Oblast, Sakhalinskaya Oblast, Khabarovskii Krai, and Primorskii Krai. Outside Russia, it is known from Mongolia and Korea. The species is reported for north of Eastern Siberia for the first time.

**Notes.** The only find in Putorana is made in the lower reach of the Malyi Orokan River near Lake Keta at 102 m a.s.l. (Fig. 4).

#### *Suwallia errata* Li et Li, 2021

Figs 2, 6.

**Material.** 4L — PP201; 1L — PP210; 25L — PP214; 19L — PP240; 1L — PP304; 2♀♀ — PP306; 2♂♂, 2♀♀ — PP346; 2♂♂, 2♀♀ — PP348; 1♂ — PP349; 1♂, 3♀♀ — PP350; 4L — PP351; 1♂, 2♀♀ — PP352; 2♀♀ — PP353; 1♂ — PP366; 1♂ — PP559; 2♂♂ — PP561; 1♂ — PP563; 1♂ — PP582; 4♂♂, 1♀ — PP586; 3♂♂, 5♀♀ — PP620; 1♂ — PP621; 2♀♀ — PP622; 1L — PP625; 1♀ — PP645.

**Distribution.** East Palaearctic species. In Russia, it is known from Krasnoyarskii Krai, the Altai Mountains, the Eastern Sayan Mountains, Magadanskaya Oblast, Amurskaya Oblast, Sakhalinskaya Oblast, Khabarovskii Krai, Primorskii Krai, and Kamchatskii Krai. Outside Russia, the species is known from Mongolia, China, and Japan. The species is recorded for the north of Eastern Siberia for the first time.

**Notes.** The species was recorded in four areas in the western part of Putorana (lakes Lama, Sobach' E, and Nakomyaken, and Kharaelakh Mountains). It was not abundant and found mostly in or near stony, often fast-flowing, streams and rivers in the forest zone (43–368 m a.s.l.) (Figs 2, 6). The two finds above the forest belt are single specimens from the Olor River (Kharaelakh, 280 m a.s.l.) and in dry locality of Tonel Mountains above Lake Nakomyaken (700–800 m a.s.l.).

### Perlodidae

#### *Arcynopteryx polaris* Klapálek, 1912

Figs 2, 3, 4, 6.

**Material.** 2♂♂, 2♀♀, 4L — PP65; 14L — PP105; 1L — PP210; 1L♂ — PP214; 1L♂ exuviae — PP242; 1L — PP304; 1♀ — PP349; 1♂ — PP352; 1♀ — PP366; 1L♂ — PP427; 1♀ — PP460; 4L — PP528; 1♀ — PP547; 1L — PP625; 1L♀ — PP641; 53L — PP643; 8L — PP645; 1L♀ — PP1023; 1L exuviae — PP1032; 2L — PP1035; 2L — PP1039; 5L♂, 9L♀ — PP1057; 1♂ — PP1074; 4♂♂ — PP1098.

**Distribution.** East Palaearctic species. In Russia, it is known from the Sayan and Altai Mountains and the Russian Far East from Chukotskii Autonomous Okrug and Yakutia to Primorskii Krai and Jewish Autonomous Oblast. Outside Russia, it is known from Mongolia, China, and Korea.

**Notes.** The larvae of *A. polaris* are known to occur in different habitats, from oligotrophic lakes and limnocoenes to the mountain streams, where the water summer temperature does not exceed 15–16 °C. In Putorana, the species was recorded along the entire altitudinal profile. In the forest zone, the larvae of *A. polaris* were collected mainly from fast-flowing streams and rivers with stony bottoms (e.g. Figs 2, 4, 6), but they probably develop also in large lakes. In the tundra and mountain desert zones, the larvae colonise a wider spectrum of standing and running waters, in particular, they may be common in small shallow lakes with stony bottoms and may predominate among macrobenthos in fast-flowing streams (e.g. in the Bunisyak River above the same-named lake; Fig. 3). In contrast to other parts of Putorana, the adults observed and collected in Bunisyak area were strongly brachypterous, flightless, mostly running under stones at shorelines.