

## A new species of bristletails of the genus *Petrobiellus* (Microcoryphia: Machilidae) from Sakhalin

## Новый вид щетинохвосток рода *Petrobiellus* (Archaeognatha: Machilidae) с Сахалина

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**Abstract.** *Petrobiellus sachalinensis* sp. nov. from the northwest of Sakhalin Island (Russia) is described and illustrated. It is compared with the three other known species of the genus, *P. takunagae* Silvestri, 1943 from Honshu Island (Japan), *P. curvistylis* Uchida, 1954 from Hachijo-jima Island (Japan), and *P. kusakini* Kaplin, 1980 from Simushir Island (Russia). The new species can be distinguished from the congeners by the colour of body and scales, by distribution of pigment, by colour and shape of paired ocelli, and by structure of compound eyes, maxillary palps, legs, urites, and ovipositor.

**Резюме.** Описан и проиллюстрирован *Petrobiellus sachalinensis* sp. nov. с северо-запада Сахалина (Россия). Приведено сравнение нового вида с тремя другими известными видами рода, *P. takunagae* Silvestri, 1943 с острова Хонсю (Япония), *P. curvistylis* Uchida, 1954 с острова Хатидзэдзима (Япония) и *P. kusakini* Kaplin, 1980 с острова Симушир (Россия). Новый вид отличается от них цветом тела и чешуек, распределением пигмента, цветом и формой парных глазков, строением сложных глаз, нижнечелюстных щупиков, ног, брюшных сегментов и яйцеклада.

**Key words:** taxonomy, Sakhalin Island, Palaearctic Region, Archaeognatha, Machilidae, *Petrobiellus*, new species

**Ключевые слова:** таксономия, Сахалин, Палеарктика, Archaeognatha, Machilidae, *Petrobiellus*, новый вид

**Zoobank Article LSID:** [urn:lsid:zoobank.org:pub:F21075F1-3741-4670-B69D-EF178CF5D765](https://zoobank.org/pub:F21075F1-3741-4670-B69D-EF178CF5D765)

### Introduction

Until now, the genus *Petrobiellus* Silvestri, 1943 included the three described species: *P. takunagae* Silvestri, 1943 (Japan, Honshu Island, the Kii Peninsula, Wakayama Prefecture) known from one female, *P. kusakini* Kaplin, 1980 (Russia, Simushir Island) known from two females collected in caves of the seashore, and *P. curvistylis* Uchida, 1954 (Japan, Hachijo-jima Island) known from two males and two females (Silvestri, 1943;

Uchida, 1954; Kaplin, 1980). Ryuichiro Machida from the Sugadaira Research Station, Mountain Science Center, University of Tsukuba, Japan collected several females and males of *P. takunagae* on the seashore of the Kii Peninsula (the type locality of *P. curvistylis*). In this respect, as he wrote to me, it is possible that *P. curvistylis* is a junior synonym of *P. takunagae*. To solve this question, a more detailed morphological comparison of these species is necessary. Nevertheless, *P. curvistylis* is considered here as a separate species.

*Petrobiellus bannaensis* from the Xishuangbanna Dai Autonomous Prefecture (21°55'N, 101°14'E) and *P. puerensis* from the Ning'er Hani and Yi Autonomous County (101°2'E, 23°5'N), Yunnan Province, China, were named on the basis of molecular data, without diagnoses and designation of nomenclatural types (Ma Yue et al., 2015), and therefore these names are *nomen nudum*.

The aim of the present work is to describe the forth species of *Petrobiellus*, which was found recently in the north of Sakhalin Island, Russia.



Fig. 1. *Petrobiellus sachalinensis* sp. nov., general view.

## Material and methods

All specimens of the new species were collected on the northwest coast of Sakhalin Island under stones and were preserved in 75% ethanol. The holotype (female) and one paratype (female) are mounted in Faure's solution on permanent microscope slides; the remaining paratypes are preserved in 75% ethanol. The specimens examined are deposited in the collection of the All-Russian Institute of Plant Protection, Russian Academy of Sciences, St Petersburg–Pushkin.

The size ratios of the morphological parts of the body of *P. curvistylis* in Table 4 are given in accordance with the figures of Uchida (1954).

## Taxonomy

Order **Microcoryphia** Verhoeff, 1904

Family **Machilidae** Grassi, 1888

Subfamily **Petrobiellinae** Kaplin, 1985

Genus ***Petrobiellus*** Silvestri, 1943

***Petrobiellus sachalinensis* sp. nov.**

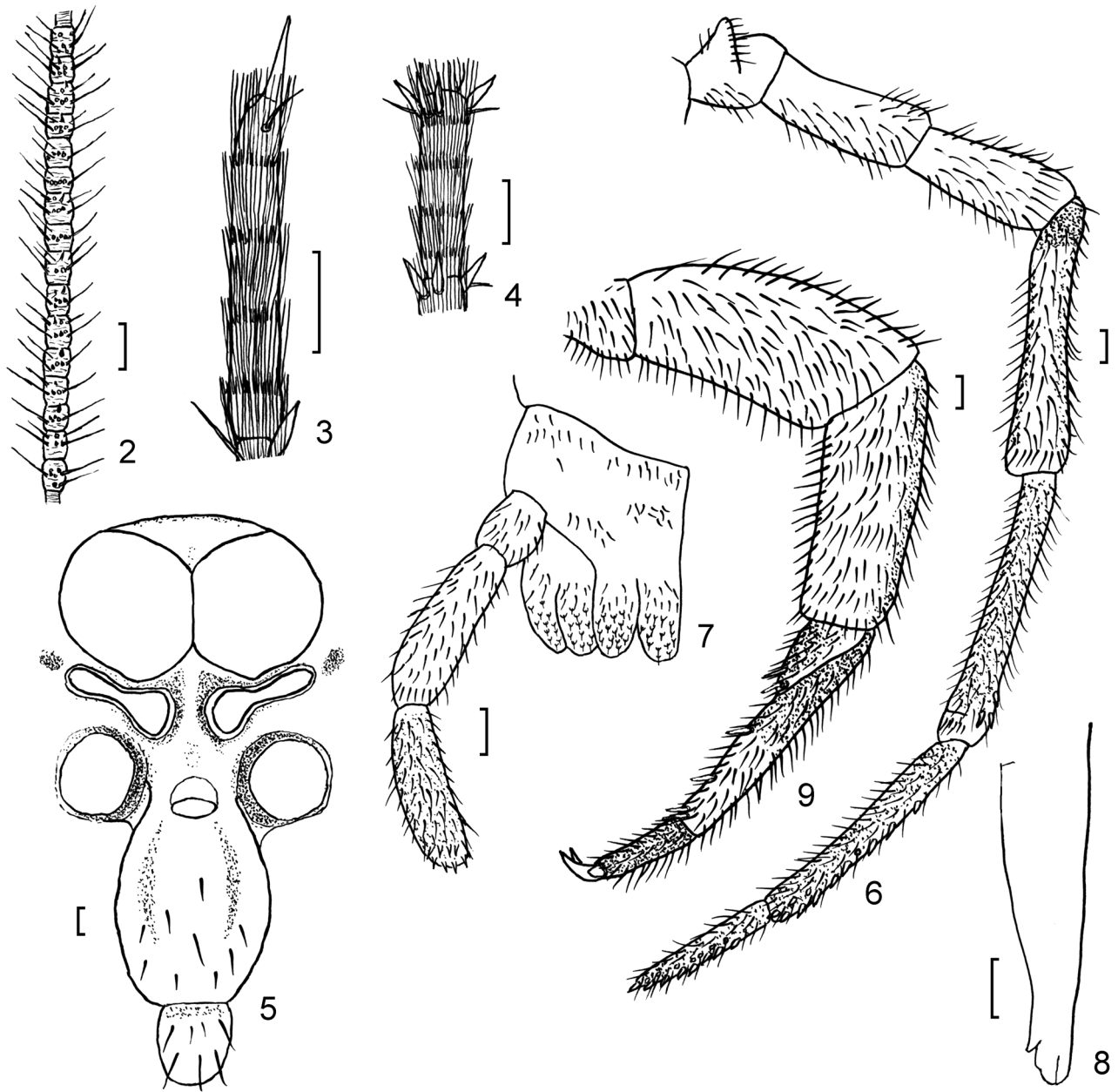
(Figs 1–13)

*Holotype*. Female (slide-mounted), **Russia, Sakhalin Prov.**, western shore of northern Sakhalin I., near Aleksandrovsk-Sakhalinsky, 50°54'N 142°09'E, shoreline, under stones, 8.VIII.2019, V. Kaplin leg.

*Paratypes*. 11 females (1 female on slide), same data as for holotype.

*Description*. Female. Body length (not including antennae): 8.4–11.6 mm; body width: 2.9–3.1 mm; cercal length: 5.5–5.7 mm; total width of compound eyes: 0.94–1.00 mm; eye length: 0.54–0.57 mm; paired ocelli width: 0.49–0.51 mm, length: 0.17–0.18 mm. Middle and hind coxal styli length: 0.60–0.65 mm. Ovipositor length: 3.35–3.50 mm. General body colour whitish or slightly yellowish, almost without pigment. Antennal base, frons, lateral parts of clypeus, basal part of first and third articles of maxillary palps, mandibulae, hypopharynx, and first, third and basal half of second tarsomeres with brown or brown-violet pigment of weak or medium intensity. Maxillary and labial palps, flagellum and pedicellus of antennae, legs, coxal and abdominal styli without scales. Scapus with very sparse scales. Colour of scales whitish or light gray. Metanotum also with one pair, urotergites with three pairs of large spots of brown scales (Fig. 1). Antennae very long, 1.5–1.9 times as long as body. Distal chains of flagellum divided into 14–23 annuli (Fig. 2). Clypeus without long thin bristles. Cercus approximately 0.48–0.55 times as long as body, with about 21–24 divisions. Apex of cercus with one apical spike (Fig. 3). All divisions of cerci, except for apical one or two, with 1–3 colorless spines on inner side supporting cerci above substrate. Divisions in middle part of cerci also with one outer lateral spine (Fig. 4).

Compound eyes dark, with bluish tinge (in ethanol). Ratio of length to width of compound eye



**Figs 2–9.** *Petrobiellus sachalinensis* sp. nov., holotype (female). **2**, distal chain of flagellum; **3**, apex of cercus; **4**, divisions in middle part of cercus; **5**, anterior part of head (vertex, compound eyes, paired ocelli, frons, antennae bases, median ocellus, clypeus, and labrum); **6**, maxillary palpus; **7**, labial palpus and labium (part); **8**, apex of mandible; **9**, fore leg (part). Scale bar: 0.1 mm.

about 1.13–1.15; ratio of contact line to length of eyes about 0.45. Paired ocelli sole-shaped, brown, with narrow white bordering, 2.8–3.0 times as wide as long. Distance between inner margins of paired ocelli 0.13–0.15 and between their outer margins 0.96–0.98 times total width of compound eyes (Fig. 5). Frons clearly convex between paired ocelli.

**Table 1.** Ratios of the length to width of the leg parts in females of *Petrobiellus sachalinensis* sp. nov.

Segments	Pair of legs		
	fore	middle	hind
Femur	2.64–2.83	2.68–2.74	2.83–2.91
Tibia	3.00–3.22	2.82–3.12	3.68–3.74
Tarsus	6.50–6.67	6.40–6.65	9.12–9.36

**Table 2.** Number of spines at the legs in females of *Petrobiellus sachalinensis* sp. nov.

Segments		Pair of legs		
		fore	middle	hind
Tarsomeres	1st	2	2	4–5
	2nd	4	6	7
	3rd	0	0	0
Tibia		0	0	1–2
Femur		0	0	0

**Table 3.** Ratios of the lengths of some abdominal structures in females of *Petrobiellus sachalinensis* sp. nov.

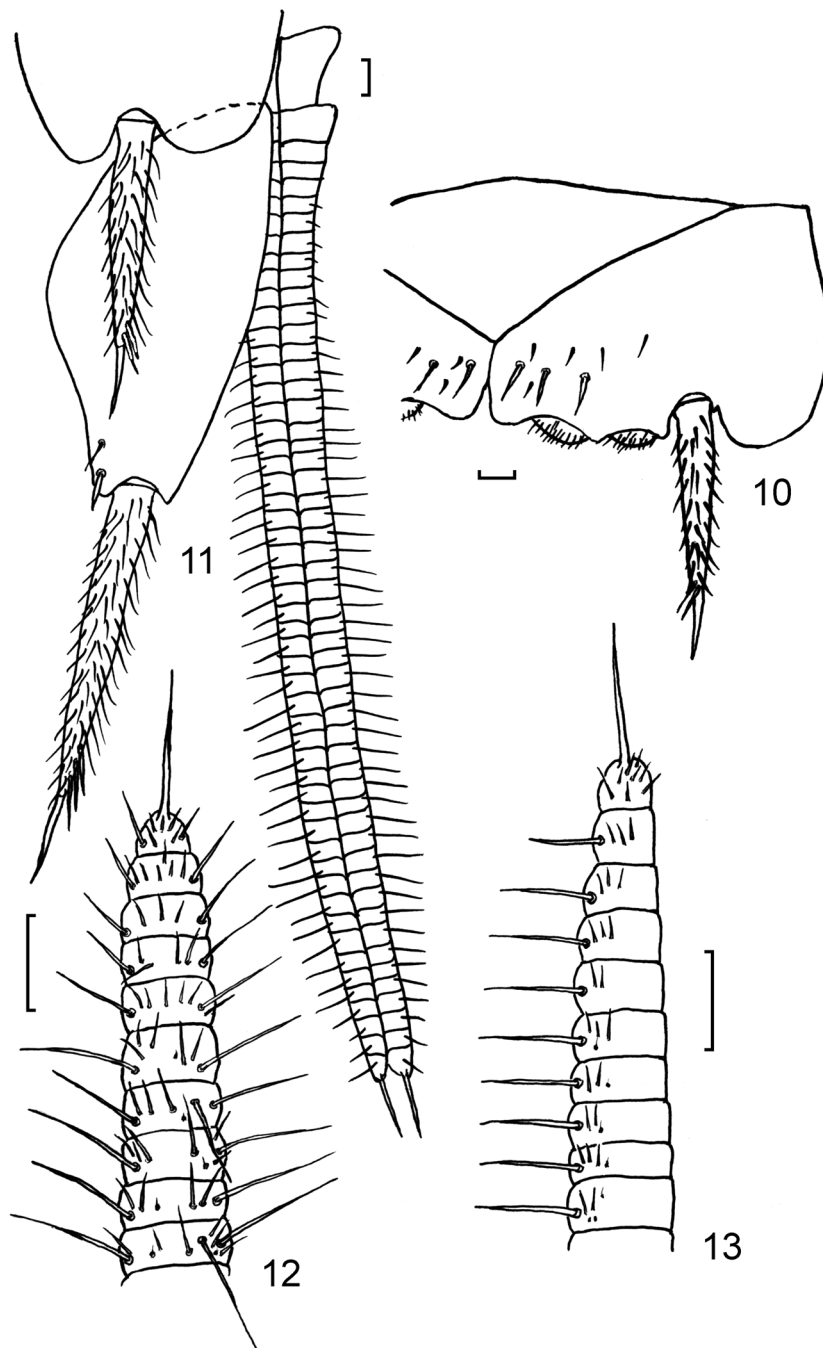
Urites	Urosternite / urocoxite	Stylus / urocoxite	Apical spine / stylus
II	0.69	0.85	0.34
III	0.71	0.84	0.34
IV	0.70	0.81	0.34
V–VII	0.67–0.68	0.74–0.76	0.36–0.37
VIII	–	0.86	0.31
IX	–	0.78	0.28

Note. Length of the stylus does not include apical spines.

**Table 4.** Main morphological differences between females of the species of *Petrobiellus*.

Morphological characters	<i>P. kusakini</i> Kaplin, 1980	<i>P. curvistylis</i> Uchida, 1954	<i>P. sachalinensis</i> sp. nov.
General body colour	yellowish	rufous	whitish or slightly yellowish
Colour of scales on body surface	dark brownish	brownish	whitish or light gray, with several relatively large spots of brown scales
Distribution of hypodermal pigment	head, maxillary palps, mandibles, maxillae, thorax and legs highly pigmented	scapus and pedicellus of antenna, trochanter, femur and tibia of all legs with blackish purple pigment	head and tarsi with brown or brown-violet hypodermal pigment of weak or medium intensity
Colour of paired ocelli	dark, without white bordering	dark	brown, with white bordering
Shape of paired ocelli	pistiliform, strongly narrowed in the middle parts	pistiliform, either of them almost separated in middle into two parts	almost sole-shaped
Ratio of length to width of compound eye	1.09	1.00–1.02	1.13–1.15
Ratios of lengths of apical and preceding articles of maxillary palps	0.83	0.57	0.60–0.62
Ratios of lengths of 5th and 4th articles of maxillary palps	1.20	1.10	1.04–1.06
Number of spines on 2nd tarsomere	16–26	?	4–7
Ratio of length of styli to width of coxae	1.61	1.14	1.05–1.09
Ratios of lengths of urosternite and urocoxite	I	0.32	0.29
	II	0.39	0.52
	VII	0.53	0.40
Ratios of lengths of stylus (without spine) and urocoxite	II	0.91	0.77
	VII	0.77	0.61
Posterior angle of urosternite II	128°	108°	118°
Number of ovipositor divisions	55	?	52–53

Note. *Petrobiellus takunagae* Silvestri, 1943 is not included in the table due to insufficient data in its original description; the characters distinguishing this species from *P. sachalinensis* sp. nov. are given in the *Comparison* section after the description of the new species.



**Figs 10–13.** *Petrobiellus sachalinensis* sp. nov., holotype (female). **10**, urosternite and urocoxites (part) V; **11**, urocoxites VIII (part) and IX, with posterior gonapophyses; **12**, distal part of anterior gonapophyses; **13**, distal part of posterior gonapophyses. Scale bar: 0.1 mm.

Apical article of maxillary palp 0.60–0.62 times as long as preceding one. Fifth article 1.04–1.06 times as long as 4th article (Fig. 6). Dorsal surface of 7th, 6th and 5th articles of maxillary palp with 13–16, 10–13 and 3 hyaline spines, re-

spectively. Apical article of labial palp fingerlike, 3.3–3.4 times as long as wide (Fig. 7). Mandibles with 2–3 distal teeth (Fig 8).

Femora slightly widened. Ratios of length to width of femur, tibia and tarsus as shown in Table 1. Fore and middle legs shorter than hind legs. Fore and middle tarsus and tibia 0.77 and 0.83 times as long as those of hind legs, respectively. Ratio of length of apical hind tarsomere to total length of hind tarsus about 0.32. Ventral surface of legs without long thin bristles. Fore, middle and hind tarsi and hind tibia with slightly pigmented spines (Fig. 9). Number of spines as shown in Table 2.

Middle and hind legs with coxal styli. Ratio of length of styli to width of middle and hind coxae 1.03–1.06 and 1.09, respectively.

Urites I, VI and VII with 1 + 1, urites II–V with 2 + 2 eversible vesicles (Fig. 10). Posterior angle of urosternites II, III–V, VI, and VII approximately 118°, 110–112°, 107°, and 120°, respectively. Inner posterior lobes of urocoxites VII protruding. Ratio width to length of protruding lobe about 1.0. Ratios of lengths of stylus (without apical spine), urosternites and urocoxites II–IX as shown in Table 3. Ratio of lengths of urosternite and urocoxites I about 0.35. Urocoxites IX with 1 + 1 outer sublateral spines.

Ovipositor slender, elongate, significantly protruding beyond apices of styli IX. Anterior and posterior gonapophyses with 52 or 53 divisions (Fig. 11). Four basal divisions of anterior gonapophyses and about 11 basal divisions of posterior gonapophyses glabrous. Apical spines of gonapophyses as long as three apical divisions combined. Distal divisions of anterior and posterior gonapophyses with

seven or eight setae (not counting sensory setae and apical spines) (Figs 12, 13).

Males are unknown; probably the species is parthenogenetic.

**Comparison.** *Petrobiellus sachalinensis* **sp. nov.** can be distinguished from its congeners by the following characters: the general body colour whitish or slightly yellowish (*vs* yellowish or rufous); colour of scales whitish or light gray (*vs* brownish or dark brownish); body (excluding head and tarsi) almost without pigment (*vs* significantly pigmented); and paired ocelli almost sole-shaped (*vs* pistiliform, strongly narrowed in middle parts). The new species also differs from all other species of the genus in the most elongated compound eyes; relatively short coxal styli; long 4th article of maxillary palp; small number of short supporting spines in ventral part of tarsi; ratios of lengths of urosternite and urocoxite, stylus and urocoxite; posterior angle of urosternite; and number of divisions of ovipositor. The main morphological differences of females of *P. sachalinensis* **sp. nov.** from those of the other species of *Petrobiellus* are given in Table 4. According to the brief description of *P. takunagae* by Silvestri (1943), the distance between the paired ocelli in this species is about half the length of ocellus, and in *P. sachalinensis* **sp. nov.**, this distance is almost equal to the length of ocellus. The new species differs from *P. takunagae* also in femora without pigment and tibiae poorly pigmented (*vs* femora and tibiae with intensive blackish-violet pigment); and four basal divisions of anterior gonapophyses glabrous (*vs* about 12 basal divisions of anterior gonapophyses glabrous).

**Etymology.** The species name is derived from the toponym of Sakhalin.

**Habitats.** Western shores of the northern part of Sakhalin Island. Under stones near the line of seashore (Fig. 14; see Addenda section).

## Addenda

**Electronic supplementary material. Fig. 14.** Habitat of *Petrobiellus sachalinensis* **sp. nov.**

Files format: JPEG. Available from: <https://doi.org/10.31610/zsr/2020.29.1.17>

## Aknowledgements

The author is grateful to Prof Dr Ryuichiro Machida from the Sugadaira Research Station, Mountain Science Center, University of Tsukuba (Tsukuba, Japan) for valuable information on the distribution and taxonomy of *Petrobiellus* species, as well as for a copy of the article with description of *P. curvistylis*, and to Dr. Graeme B. Smith from Australian Museum Research Institute (Sydney, Australia) and Dr Miquel Gaju Ricart from University of Cordoba (Cordoba, Spain) for their valuable comments and suggestions that improved the early version of the manuscript.

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Received 2 January 2020 / Accepted 6 April 2020. Editorial responsibility: A.V. Frolov & D.A. Gapon