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RESEARCH PAPER

New species of bristletails of the family Machilidae (Archaeognatha) from Kazakhstan

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Abstract. The fauna of bristletails of the family Machilidae in Kazakhstan currently includes one species of the genus *Silvestrichiloides* Mendes, 1990 and 13 species of the genus *Allopsontus* Silvestri, 1911. The present study describes one new species of the genus *Silvestrichiloides* (*S. berkarensis* Kaplin, sp. nov. from South Kazakhstan) and two new species of the genus *Allopsontus* (*A.* (*Kaplinilis*) *nigrostriatus* Kaplin, sp. nov. and *A.* (*Machilanus*) *perfectus* Kaplin, sp. nov. from Southeastern Kazakhstan). *Silvestrichiloides berkarensis* sp. nov. differs from the other species of this genus in the structure of antennal flagellum, apical palpomere of labial palp and ovipositor. Among species of the subgenus *Kaplinilis* Mendes, 1990, *A. nigrostriatus* sp. nov. belongs to a group of species characterized by numerous short chaetae on the ventral surface of the 5–7th palpomeres of the male maxillary palp and by the absence on the labial palp. This group includes two species: *A. volgensis* Kaplin, 1999 from Samara Region and *A. smelyanskii* Kaplin, 1999 from Orenbourg Region (both Russia). The new species differs from *A. volgensis* and *A. smelyanskii* in the length of the body and antenna, color of scales on the upper surface of the body, shape of the compound eye and paired ocellus, structure of the flagellum and apical palpomere of the male labial palp. The subgenus *Machilanus* Silvestri, 1934 is represented only by *A. bitschi* Wygodzinsky, 1962 from Afghanistan and *A. perfectus* sp. nov., which are characterized by numerous short chaetae on the ventral surface of the 2nd–7th palpomeres of the male maxillary palp. *Allopsontus perfectus* sp. nov. differs from *A. bitschi* in the shape of compound eyes, paired ocellus, structure of male labial palp and genitalia.

Key words. Archaeognatha, Microcoryphia, *Silvestrichiloides*, *Allopsontus*, *Kaplinilis, Machilanus*, taxonomy, Almaty Region, Zhambyl Region, Kazakhstan, Palaearctic Region

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Introduction

The fauna of bristletails of the family Machilidae in Kazakhstan has been poorly studied and currently includes only 13 species from the genus *Allopsontus* Silvestri, 1911 and one species from the genus *Silvestrichiloides* Mendes, 1990 (Silvestri 1911, Paclt 1960, Mendes 1990). Species of the genus *Allopsontus* from Kazakhstan belong to 6 subgenera:

(1) *Allopsontus* s. str.: *A.* (*A.*) *kerzhneri* (Kaplin, 1982), *A.* (*A.*) *linnaeusi* Kaplin, 2007, *A.* (*A.*) *asiaticus* Kaplin, 2014, *A.* (*A.*) *verae* Kaplin, 2015 and *A.* (*A.*) *saryozeki* Kaplin, 2015;
(2) *Allopsontoides* Mendes, 1990: *A.* (*A.*) *simplex* (Kaplin, 1982);
(3) *Kaplinilis* Mendes, 1990: *A.* (*K.*) *dzhungaricus* (Kaplin, 1985) and *A.* (*K.*) *ilyai* Kaplin, 2018;
(4) *Anisopsontus* Mendes, 1990: *A.* (*A.*) *ciliatus* (Wygodzinsky, 1970); *A.* (*A.*) *pulchellus* (Kaplin, 1982) and *A.* (*A.*) *tekelensis* Kaplin, 2015;
(5) *Aridopsontinus* Kaplin, 2012: *A.* (*A.*) *varvarae* Kaplin, 2012;
(6) *Anisoptinus* Kaplin, 2017: *A.* (*A.*) *nigrus* Kaplin, 2017.

Most of them are distributed in Southeastern Kazakhstan (Almaty Region). Only two species of this genus

(*A*. (*A*.) *linnaeusi* and *A*. (*K*.) *ilyai*) are distributed in East Kazakhstan (East Kazakhstan Region) (Kaplin 2018). A key to the subgenera and species of the genus *Allopsontus* from Kazakhstan and localities of *Allopsontus* species in Kazakhstan were given by Kaplin (2018).

Silvestrichiloides beckeri (Paclt, 1960) was described from South Kazakhstan (Turkestan Region).

Bristletail material collected by G. V. Shakula in Southeastern and South Kazakhstan was examined and revealed two new species of the genus *Allopsontus* and one new species of the genus *Silvestrichiloides*. Their descriptions are given below.

Materials and methods

All collected specimens of bristletails were preserved in 70% ethanol. The holotypes and some paratypes were mounted in Faure's solution on permanent microscope slides, the remaining paratypes were preserved in 70% ethanol. The studied specimens were deposited in the collection of the All-Russian Institute of Plant Protection, St. Petersburg-Pushkin (VIZR).

The following abbreviations are used:

d distance between border of sensory field and proximal end of femur;
LF length of femur;
LSF length of sensory field;
WF width of femur;
WSF width of sensory field.

Table 1. Number of spines on legs of *Silvestrichiloides berkarensis* sp. nov.

Segments		Sex and pair of legs					
		Male			Female		
		fore	middle	hind	fore	middle	hind
Tarsomeres	1st	6	6–8	8–9	4	6–8	6
	2nd	14	12–14	16	14	10–14	14
	3rd	6	6	6	6–8	6	6
Tibia		8	12–14	19	8	10	18
Femur		2	0	9–10	2	5–8	10

Taxonomy

Genus *Silvestrichiloides* Mendes, 1990

Silvestrichiloides Mendes, 1990: 91–92. Type species: *Silvestrichilis beckeri* Paclt, 1960.

Silvestrichiloides berkarensis Kaplin, sp. nov.

(Figs 1, 2)

Type material. Holotype: ♂ (slide-mounted, VIZR), **KAZAKHSTAN:** Zhambyl Region, Zhualy District, near Berkara, 42°53′30.5″N, 70°36′44.5″E, *Maly Karatau* Range, Berkarinski Complex Reserve, Gorge Berkara, 955 m a.s.l., under a dry tree on the ground near the stream, July 06, 2019, G. Shakula leg. Paratypes: 5 ♀♀ (1 ♀ on slide), the same locality, G. Shakula leg. (VIZR).

Description. Body length: male 12.6 mm, female 11.6–12.8 mm. Body width: male 3.5 mm, female 3.2–3.6 mm. Cercus length: male broken, female 6.0 mm. Total width of eyes: male 1.20 mm, female 1.13–1.15 mm. Eye length: male 0.54 mm, female 0.50–0.52 mm. Paired ocellus width and length: 0.29–0.30 mm and 0.16–0.17 mm, respectively, in both sexes. Coxal stylus length: male 0.8–0.9 mm, female 0.7–0.8 mm. Ovipositor length: 2.2–2.4 mm. Antennae slightly shorter than body. General body color whitish. Antennal base, frons, gena, occiput with brown pigment of weak intensity. Color of scales on upper and lower surfaces of body brownish or light brownish, respectively. Distal chains of flagellum divided into 12–14 annuli. Cercus of female approximately 0.52 body length.

Compound eyes dark with bluish tint (in alcohol). Ratio of length to width of compound eye about 0.90 in both sexes; ratio of contact line length to eye length about 0.40, in both sexes (Fig. 1A). Paired ocellus sublateral, ovoid, light brown with narrow white border, in male about 1.7

Table 2. Morphological features in the species of the genus *Silvestrichiloides* (after Paclt 1960 and Kaplin 1982, 1999).

Morphological characters			***S. berkarensis* sp. nov.**	***S. beckeri*** (Paclt, 1960)	***S. gussakovskii*** (Kaplin, 1982)	***S. asiaticus*** Kaplin, 1999 (♀)
Number of annuli in distal chains of flagellum			12–14	?	16–18	8
Ratio of length to width of compound eye			0.90	?	0.93–1.02	0.86
Ratio of length of contact line to length of eye			0.40	?	0.44–0.48	0.50
Ratio of width to length of paired ocellus			1.70–1.90	?	2.30	2.10
Number of hyaline spines on 5th palpomere of maxillary palp		♂	3	?	5–6	?
		♀	5	?	6–9	2–3
Ratio of length to width of apical palpomere of labial palp		♂	0.82	0.60	0.57	?
		♀	1.20	0.73	0.93	1.07
Ratios of lengths of urostylus (without apical spines) and urocoxites	VIII	♂	1.00	?	1.00	?
		♀	0.90	?		0.86
	IX	♂	1.30	?	1.45	?
		♀	0.84	?	1.00	0.81
Number of inner sublateral spines on urocoxites IX		♂	9–10	?	7–9	?
		♀	6–9	?	12	7–9
Number of ovipositor divisions			27–28	38	32–39	28–30
Number of digging spines on posterior gonapophysis			21	?	16–19	16
Distribution			Kazakhstan: Zhambyl Region, Berkara Gorge	Kazakhstan: Turkestan Region; Uzbekistan: Jizzakh Region; Tajikistan: Sughd Region	Tajikistan: Kondara Gorge, Hissar Range; Kyrgyzstan: Ferghana Range	Uzbekistan: Surkhandarya Region, Babadag Range

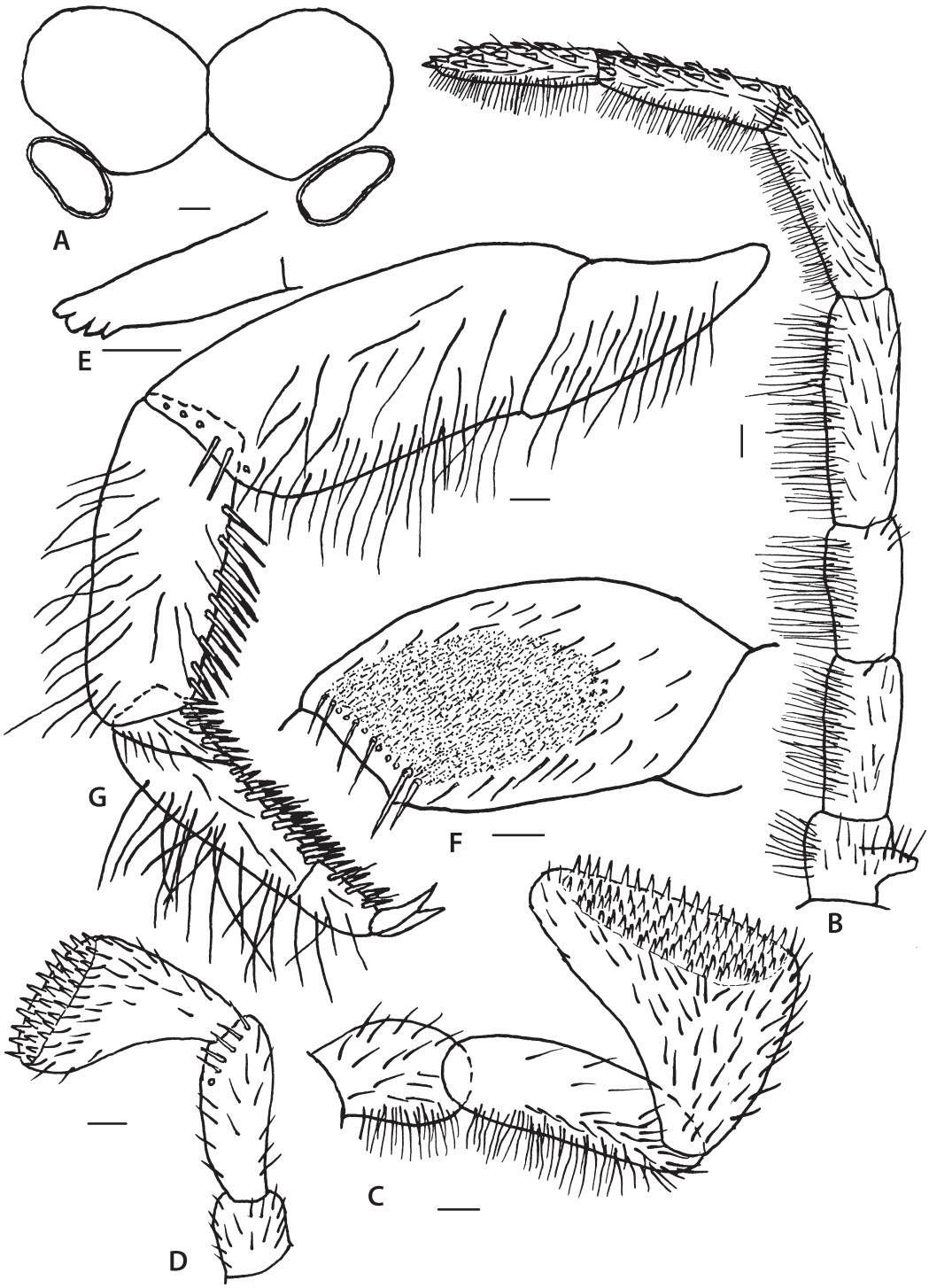

Fig. 1. *Silvestrichiloides berkarensis* sp. nov. (A–C, E–G – male, holotype; D – female, paratype): A – eyes and ocelli, front view; B – maxillary palp; C, D – labial palp; E – apex of mandible; F – fore femur; G – part of middle leg. Scale bar: 0.1 mm.

and in female 1.9 times as wide as long. Distance between inner margins of paired ocelli about 0.55 and between their outer margins 0.96 times total width of compound eyes, in both sexes. Frons between paired ocelli not especially convex.

Apical palpomere of maxillary palp in male about 0.90 and in female 0.82 times as long as preceding one. Their 5th palpomere in male 1.0 and in female 1.2 times as long as 4th palpomere. Dorsal surface of 7th, 6th and 5th palpomeres of maxillary palp, respectively, with 11–12, 10–11 and 3 hyaline spines in male and 12–13, 13 and 5 spines in female (Fig. 1B). Ventral surface of 1st–7th palpomeres of male maxillary palp as well as dorsal surface of 1st and 2nd palpomeres of male labial palp with relatively numerous and long ciliary chaetae. Apical palpomere of labial palp triangularly oval, in male 0.82 and in female 1.20 times as long as wide (Figs 1C, D). Mandibles with four distal teeth in both sexes (Fig. 1E).

Fore femur of male and fore and middle femora of female widened. Ratio of length of 3rd tarsomere to total

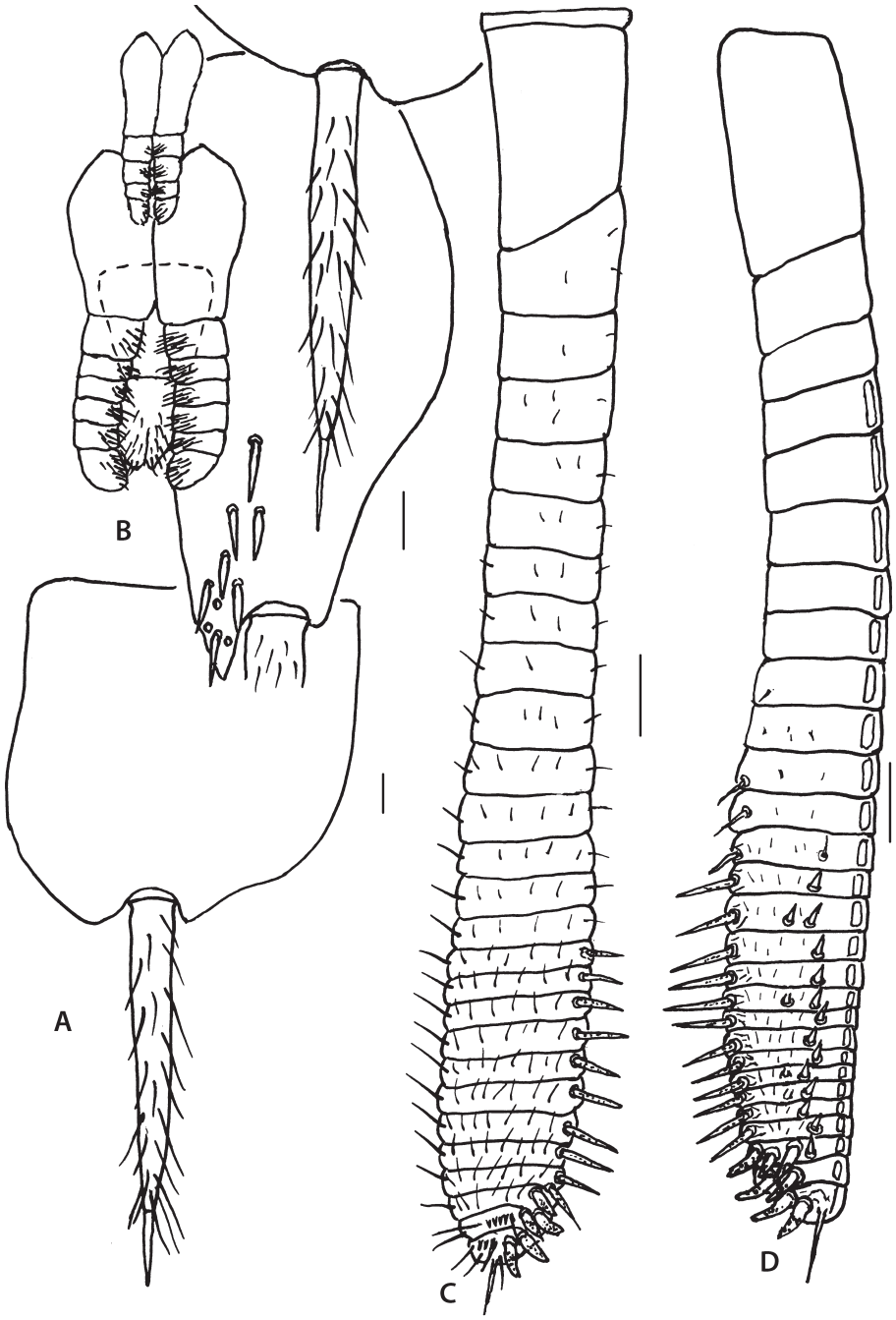

Fig. 2. *Silvestrichiloides berkarensis* sp. nov. (B – male, holotype; A, C, D – female, paratype): A – urocoxite VIII; B – urocoxite VIII (part) with parameres and urocoxite IX, with parameres and penis; C – anterior gonapophysis; D – posterior gonapophysis. Scale bar: 0.1 mm.

length of hind tarsus 0.27–0.28 in male and 0.31–0.32 in female. Fore femur of male with opened, well developed sensory field, which includes numerous simple, relatively short sensilla connected to distal row of strong chaetae (Fig. 1F). Metric ratios concerning sensory field and femur as follows: LSF/WSF: 1.65, LSF/LF: 0.57, WSF/WF: 0.65, d/LF: 0.26, d/LSF: 0.45, d/WSF: 0.74. Under surface of tarsus, tibia and femur of male and female with two rows of pigmented spines, lacking in middle femur of male (Fig. 1G, Table 1). Middle leg of male with numerous long chaetae. Ratios of length of styli to width of middle and hind coxae about 1.6 in male and 1.5 in female.

In both sexes, urocoxites I–VII with 1 + 1 eversible vesicles. Ratios of lengths of urostyli (without apical spines) and urocoxites II–VII 0.50–0.58, in both sexes; VIII 1.00 in male and 0.92 in female, IX 1.30 in male and 0.84 in female. Ratios of lengths of apical spines and urostyli II–VII 0.30–0.32, VIII about 0.25, IX 0.15–0.16, in both sexes. Posterior angle of urosternites II–VI 103°–106°, in both sexes. Urocoxites VII of female with protruding lobes between eversible vesicles. Ratio of length to width of one lobe about 0.90. Thoracic tergites, urotergites I–III, urosternites and urocoxites I–VIII without sublateral spines, in both sexes (Fig. 2A). Urocoxites IX with 9–10 + 9–10 inner sublateral hyaline spines in male and 6–9 + 6–9 ones in female. Number of sublateral hyaline spines on urotergites IV 3 + 3 in male and 4 + 4 in female; V 5 + 5 in male and 4–6 + 4–6 in female; VI 5 + 5, in both sexes;

VII 6–8 + 6–8 in male and 5 + 5 in female; VIII 7–9 + 7–9 in male and 7 + 7 in female; IX 8–9 + 8–9 in male and 6–7 + 6–7 in female; X 3 + 3, in both sexes.

Male genitalia with parameres on urites VIII and IX. Parameres VIII with 1 + 3–4, IX with 1 + 6 divisions (Fig. 2B). Ratios of lengths of parameres VIII and IX 1.8. Parameres IX slightly surpassing apex of penis, clearly not attaining level of apex of urocoxites IX. Ratio of distance between apices of parameres of urocoxites IX to width of distal division of penis about 3.3. Basal division of penis about 1.2 times as long as its distal division.

Ovipositor sclerotized in distal part, thickened, almost completely covered by urocoxites IX, stout, typical of the genus *Silvestrichiloides*. Gonapophyses VIII and IX with 27 and 28 divisions, respectively (Figs 2C, D). Apical spines of gonapophyses as long as three distal divisions combined. Two or three distal divisions of anterior gonapophysis and three divisions of posterior gonapophysis with 4–5 and 7–8 large inner lateral fossorial teeth, respectively. The following 11–12 divisions of posterior gonapophysis with one inner and one outer lateral rows of large pigmented macrochaetae and fossorial spines, respectively. One basal division of anterior gonapophysis and 8–9 basal divisions of posterior gonapophysis glabrous. Distribution of chaetae on gonapophyses as shown in Figs 2C, D.

Differential diagnosis. *Silvestrichiloides berkarensis* sp. nov. differs from the other species of this genus in the number of annuli in the distal chains of the antennal flagellum, the structure of the apical palpomere of the labial palp, the number of ovipositor divisions, and the number of digging teeth on the posterior gonapophysis (Table 2).

Etymology. The new species takes its name from the type locality, Berkara; adjective.

Habitat. Mountain shrub steppe.

Distribution. Kazakhstan (Zhambyl Region, Maly Karatau Range).

Genus *Allopsontus* Silvestri, 1911

Subgenus *Kaplinilis* Mendes, 1990

Kaplinilis Mendes, 1990: 28–29. Type species: *Machilanus bifarius* Wygodzinsky, 1970.

Allopsontus nigrostriatus Kaplin, sp. nov.

(Figs 3, 4)

Type material. Holotype: ♂ (slide-mounted, VIZR): **KAZAKHSTAN:** Almaty Region, Raiymbek District, 43°02′2.5″N, 78°48′51.4″E, *upper Charyn River,* ≈ 1817 m, petrophytic steppe, under stone, June 07, 2019, G. Shakula leg.

Description. Body length: 7.3 mm. Body width: 2.0 mm. Cercus length: 3.1 mm. Total width of eyes: 0.84 mm. Eye length: 0.50 mm. Paired ocellus width and length: 0.24 mm and 0.11 mm, respectively. Coxal stylus length: 0.50–0.55 mm. Antennae slightly longer than body. General body color whitish. Antennal base, frons, gena, occiput, hypopharynx, mandible, maxilla, postabdomen with violet pigment of weak intensity. Upper surface of body with scale pattern composed of two almost black and three light brownish-gray longitudinal stripes of approximately equal width. Lower surface of body covered with light brownish-gray and white scales. Distal chains of flagellum divided into 9–11 annuli. Cercus approximately 0.43 body length.

Table 3. Ratios of length to width of tarsi, tibiae and femora of male *Allopsontus nigrostriatus* sp. nov.

Segments	Pair of legs		
	fore	middle	hind
Tarsus	4.43	4.08	6.21
Tibia	1.81	1.69	2.14
Femur	1.58	1.86	1.99

Table 4. Number of spines on legs of male *Allopsontus nigrostriatus* sp. nov.

Segments		Pair of legs		
		fore	middle	hind
Tarsomeres	1st	5	6	5
	2nd	14	12	14–16
	3rd	8–10	8	8
Tibia		8–10	16–18	25
Femur		35–40	0	0

Table 5. Ratios of lengths of urosternites, urocoxites and urostyli (without apical spines) in male *Allopsontus nigrostriatus* sp. nov.

Urites	Urosternite / urocoxite	Stylus / urocoxite	Apical spine / stylus
II	0.62	0.86	0.21
III	0.60	0.80	0.22
IV	0.61	0.73	0.23
V	0.59	0.72	0.22
VI	0.56	0.71	0.23
VII	0.40	0.74	0.22
VIII	0.21	0.80	0.20
IX	–	1.00	0.15

Compound eyes dark with bluish tint (in alcohol). Ratio of length to width of compound eye about 1.19; ratio of contact line length to eye length about 0.50 (Fig. 3A). Paired ocellus sublateral, ovoid, light brown with narrow white border, 1.9 times as wide as long. Distance between inner margins of paired ocelli about 0.54 and between their outer margins 0.93 total width of compound eyes. Frons between paired ocelli not convex.

Apical palpomere of maxillary palp about 1.03 times as long as preceding one. 5th palpomere about 1.4 times as long as 4th palpomere. Dorsal surface of 7th, 6th and 5th palpomeres of maxillary palp with 14, 13 and 3 hyaline spines, respectively (Fig. 3B). Ventral surface of 5–7th palpomeres of maxillary palp with numerous short, adpressed and pigmented chaetae, absent on labial palp. Apical palpomere of labial palp triangularly oval, 2.1 times as long as wide; with about 35 sensorial cones (Fig. 3C). Mandibles with four distal teeth (Fig. 3D).

Fore and middle tibiae and femora widened (Table 3). Fore femur with opened sensory field, which includes about 65–70 relatively large rosette-shaped sensilla. Sensory field is in contact with distal row of strong chaetae (Fig. 3E). Metric rations concerning sensory field and femur as follows: LSF/WSF: 1.88, LSF/LF: 0.52, WSF/WF: 0.38, d/LF: 0.32, d/LSF: 0.61, d/WSF: 1.15. Ratio of length of 3rd tarsomere to total length of hind tarsus about 0.41–0.42. Undersurface of tarsus and tibia with two rows

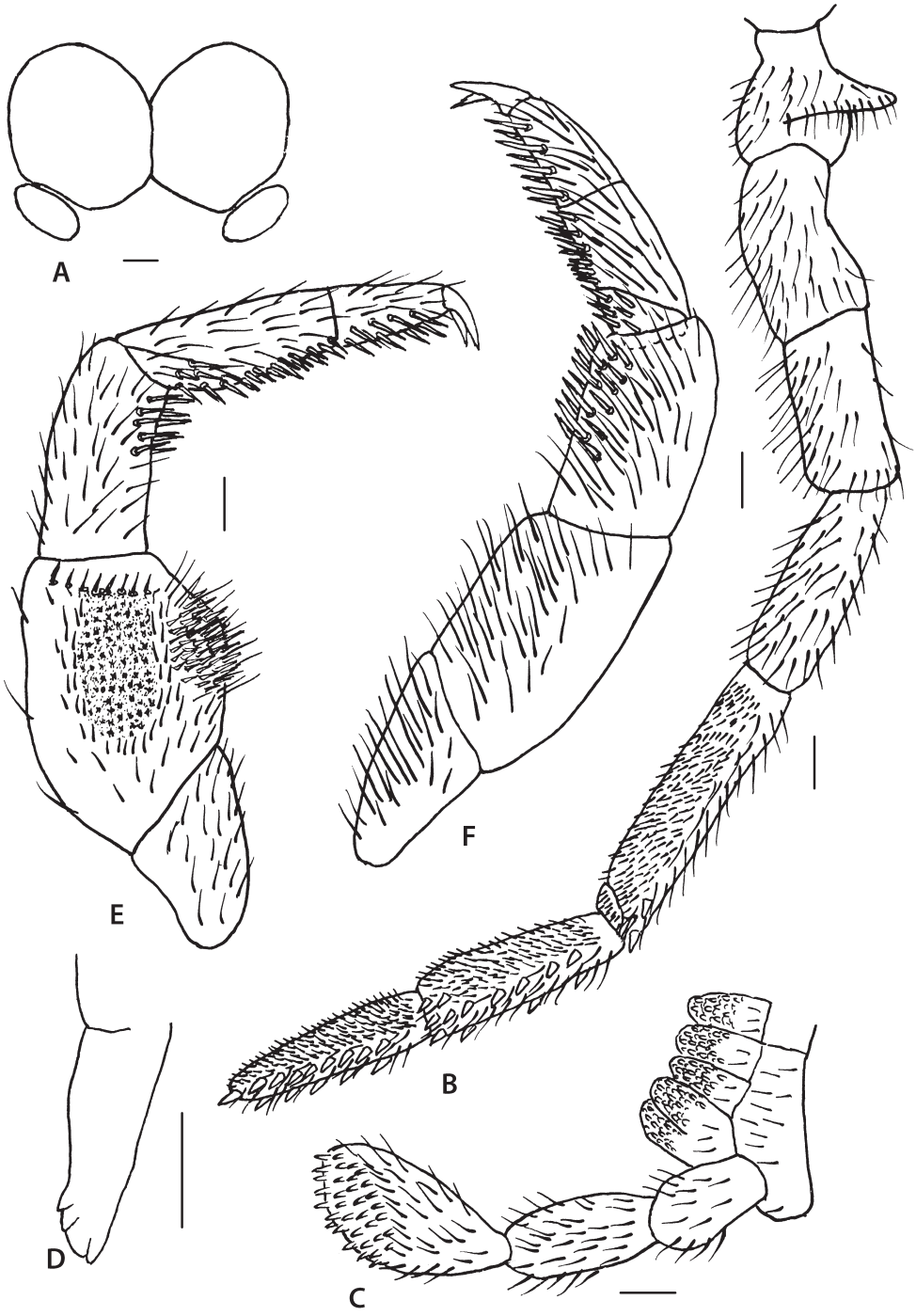

Fig. 3. *Allopsontus nigrostriatus* sp. nov. male, holotype: A – eyes and ocelli, front view; B – maxillary palp; C – labial palp; D – apex of mandible; E – part of fore leg; F – part of middle leg. Scale bar: 0.1 mm.

of pigmented spines, absent on middle and hind femur (Fig. 3F, Table 4). Fore femur with 35–40 such spines. Ratio of length of styli to width of middle and hind coxae about 1.2 and 1.4, respectively.

Urocoxites I–VII with 1 + 1 eversible vesicles (Fig. 4A). Thoracic tergites, urotergites I–III and X, urosternites and urocoxites without sublateral hyaline spines (Fig. 4B). Number of sublateral hyaline spines on urotergites IV–VIII 2 + 2, IX 3 + 3. Ratios of lengths of urostyli (without apical spine), urosternites and urocoxites II–IX as shown in Table 5. Posterior angle of urosternites II–VI 96°–103°, VII about 130°.

Male genitalia with parameres on urite IX. Parameres with 1 + 5 divisions slightly not surpassing apex of penis, almost attaining level of apex of urocoxites IX (Fig. 4C). Penis thick, ratio of width to length of its apical division about 0.67. Lengths of basal and apical divisions of penis almost the same.

Differential diagnosis. *Allopsontus nigrostriatus* sp. nov. with 1 + 1 eversible vesicles on urites II–VII belongs to the subgenus *Kaplinilis*, to the group of species with numerous short, adpressed and pigmented chaetae on the ventral surface of the 5–7th palpomeres of male maxillary palp and absent on their labial palp. This group includes

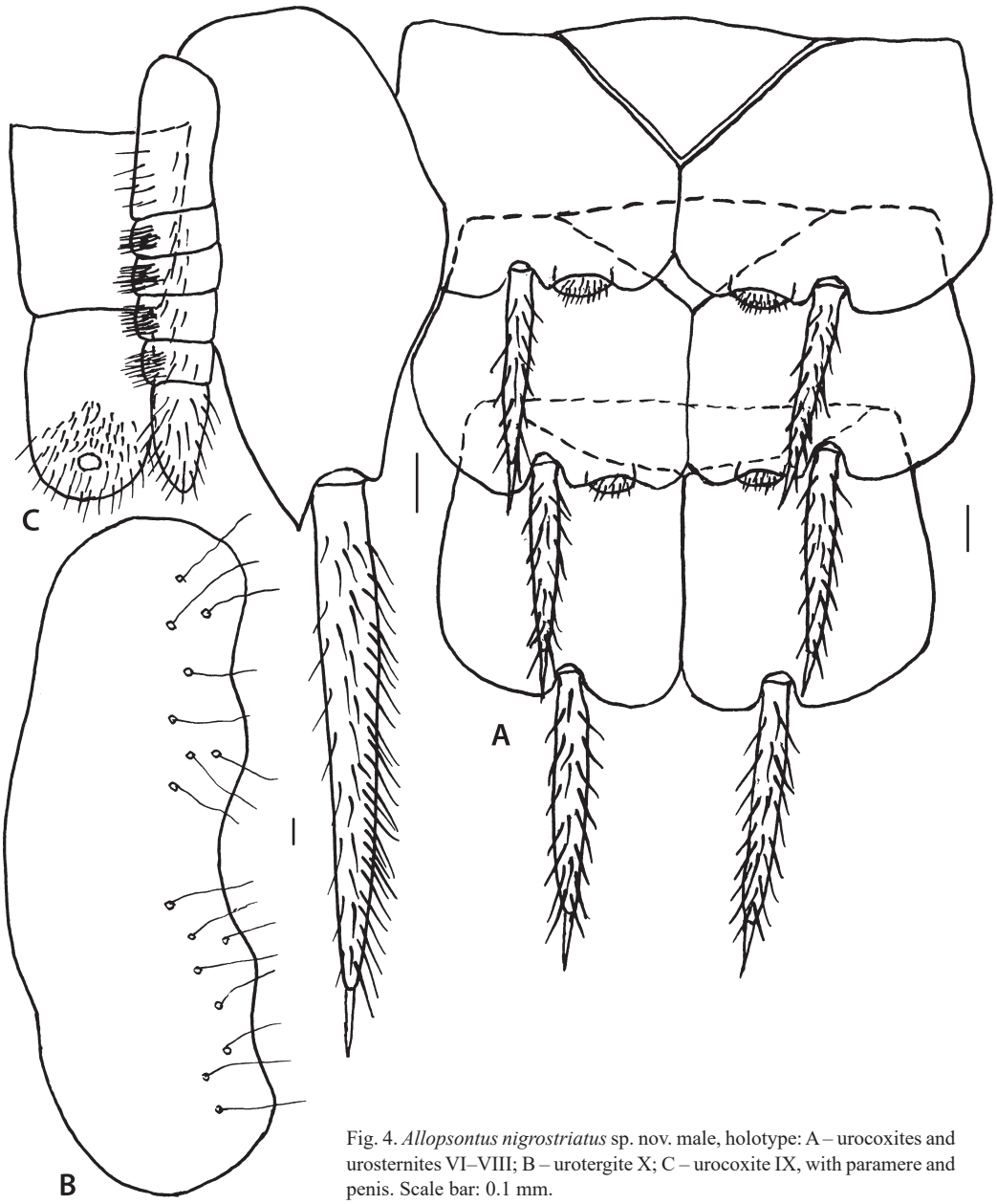

Fig. 4. *Allopsontus nigrostriatus* sp. nov. male, holotype: A – urocoxites and urosternites VI–VIII; B – urotergite X; C – urocoxite IX, with paramere and penis. Scale bar: 0.1 mm.

Table 6. Morphological features in males of *Allopsontus nigrostriatus* sp. nov. and its closest congeners (after Kaplin 1999).

Morphological character		***A. nigrostriatus* sp. nov.**	***A. volgensis*** Kaplin, 1999	***A. smelyanskii*** Kaplin, 1999
Body length (mm)		7.30	9.50–11.70	8.40–10.00
Length of antenna		slightly longer than body	shorter then body	shorter then body
Color of scales on upper surface of body		with two almost black and three light brownish-gray longitudinal stripes	brown	brown
Number of annuli in distal chains of flagellum		9–11	5	5
Ratio of length to width of compound eye		1.19	0.95–1.10	1.09–1.19
Ratio of length of contact line to length of eye		0.43	0.37–0.44	0.29–0.35
Ratio of width to length of paired ocellus		1.90	2.00–2.20	2.30–2.70
Ratio of length to width of apical palpomere of labial palp		2.1	3.0–3.2	2.0–2.6
Ratios of lengths of urostylus (without apical spines) and urocoxite	II–VII	0.71–0.86	0.55–0.60	0.64–0.72
	VIII	0.80	0.68–0.71	0.90–0.95
	IX	1.00	0.88	1.00–1.10
Number of divisions in parameres		1 + 5	1 + 7	1 + 6
Distribution		Southeastern Kazakhstan	Samara Region (Russia)	Orenburg Region (Russia)

two described species: *A. volgensis* Kaplin, 1999 from Samara Region and *A. smelyanskii* Kaplin, 1999 from Orenburg Region (both Russia). *Allopsontus nigrostriatus* sp. nov. differs from *A. volgensis* and *A. smelyanskii* in the length of the body and antenna, color of scales on the upper surface of the body, number of annuli in the distal chains of flagellum, shape of compound eye and paired ocellus, structure of the apical palpomere of the labial palp, number of divisions in parameres. The significant differences between these species are summarized in Table 6.

Etymology. Name of the species is a compound Latin adjective *nigrostriatus* (*-a*, *-um*), meaning 'having black stripes', referring to the color of scales on the upper surface of the body.

Habitat. Petrophytic steppe.

Distribution. Kazakhstan (Almaty Region, Raiymbek District, upper Charyn River).

Subgenus *Machilanus* Silvestri, 1934

Machilanus Silvestri, 1934: 4–5. Type species: *Machilanus hummeli* Silvestri, 1934

Allopsontus perfectus Kaplin, sp. nov.

(Figs 5, 6)

Type material. Holotype: ♂ (slide-mounted, VIZR): **KAZAKHSTAN:** Almaty Region, Raiymbek District, 43°02′2.5″N, 78°48′51.4″E, *upper Charyn River,* ≈ 1817 m, petrophytic steppe, under stones, June 07, 2019, G. Shakula leg. Paratype: 1 ♀ (on slide), the same locality, G. Shakula leg. (VIZR).

Description. Body length: male 10.5 mm, female 8.8 mm. Body width: male 2.4 mm, female 2.2 mm. Cercus length: male 3.5 mm, female 2.7 mm. Total width of eyes: male 0.83 mm, female 0.80 mm. Eye length: in both sexes 0.44 mm. Paired ocellus width: male 0.30 mm, female 0.23 mm. Ocellus length: male 0.15 mm, female 0.13 mm. Coxal styli length: male 0.75–0.80 mm, female 0.46–0.50 mm. Antennae slightly shorter than body. General body color whitish or light yellowish. Antennal base, frons, gena, occiput, hypopharynx, mandible, maxilla, 1st–3rd palpomeres of maxillary palp, labium with violet pigment of weak intensity. Flagellum of male brown. Scales on upper surface of body brown and light brown. Color of scales on lower surface of body light brownish. Distal chains of flagellum divided into 5 annuli in male and 8–9 annuli in female (Fig. 5A). Cercus in male approximately 0.33, female 0.31 times as long as body length, including about 16 divisions in both sexes.

Compound eyes dark with bluish tint (in alcohol). Ratio of length to width of compound eye about 1.07–1.11; ratio of contact line length to eye length about 0.39, in both sexes (Fig. 5B). Paired ocellus sublateral, ovoid, light brown with narrow white border, in male 2.0 and in female 1.8 times as wide as long. Distance between inner margins of paired ocelli in male about 0.46 and in female 0.40 of total width of compound eyes. Frons between paired ocelli not convex.

Apical palpomere of maxillary palp in male about 0.80 and in female 0.86 times as long as preceding one. Their 5th palpomere about 1.5 times as long as 4th palpomere, in both sexes. Dorsal surface of 7th, 6th and 5th palpomeres of maxillary palp respectively with 10–11, 9–11 and 2 hyaline spines in male and 13, 14 and 3–4 spines in female. Ventral surface of 2nd–7th palpomeres of male maxillary palp as well as dorsal surface of 1st palpomere and almost full surface of 2nd and 3rd palpomeres of male labial palp with numerous short, adpressed chaetae (Figs 5C, D). Apical palpomere of labial palp triangularly oval, in male 2.0 and in female 2.2 times as long as wide; with about 100 sensorial cones in male and 20 in female. Mandibles with four distal teeth in both sexes (Fig. 5E).

Fore and middle femur widened, in both sexes (Table 7). Fore femur of male with opened sensory field, which includes about 40–45 relatively large rosette-shaped sen-

Table 7. Ratios of length to width of tarsi, tibiae and femora of *Allopsontus perfectus* sp. nov.

Segments	Sex, pair of legs					
	Male			Female		
	fore	middle	hind	fore	middle	hind
Tarsus	5.48	5.77	7.26	4.38	3.74	4.58
Tibia	2.36	2.59	3.52	2.02	1.74	2.67
Femur	1.78	2.32	2.46	1.92	1.77	2.15

Table 8. Number of spines on legs of *Allopsontus perfectus* sp. nov.

Segments		Sex, pair of legs					
		Male			Female		
		fore	middle	hind	fore	middle	hind
Tarsomeres	1st	4–5	6–8	6–7	3	5	4–6
	2nd	18–20	9–10	14	8–10	10	10–12
	3rd	9–10	8	8–10	8	7	8
Tibia		12–14	9–12	12–14	2–3	8–9	14
Femur		20	2–3	2	2	2–3	4–5

Table 9. Ratios of lengths of urosternites, urocoxites and urostyli (without apical spines) in *Allopsontus perfectus* sp. nov.

Urites	Urosternite / urocoxite		Stylus / urocoxite		Apical spine / stylus	
	male	female	male	female	male	female
II	0.50	0.58	0.70	0.70	0.22	0.21
III	0.59	0.64	0.70	0.71	0.23	0.22
IV	0.59	0.62	0.70	0.66	0.22	0.22
V	0.59	0.61	0.70	0.64	0.22	0.22
VI	0.56	0.56	0.69	0.62	0.24	0.23
VII	0.48	0.31	0.69	0.66	0.22	0.22
VIII	0.29	–	0.88	0.74	0.19	0.19
IX	–	–	1.24	0.68	0.12	0.15

Table 10. Distribution of sublateral spines on urotergites and urocoxites of *Allopsontus perfectus* sp. nov.

Urites	Urotergite		Urocoxite	
	male	female	male	female
I	0	0	0	0
II	0	0	0	0
III	2 + 2	0	0	1 + 1
IV	6 + 7	0	1 + 1	1 + 1
V	8 + 7	0	1 + 3	1 + 1
VI	8 + 8	1 + 1	4 + 4	2 + 0
VII	8 + 9	2 + 2	3 + 4	1 + 1
VIII	10 + 11	3 + 3	4 + 5	0
IX	11 + 11	3 + 3	2 + 2	0
X	4 + 4	1 + 1	–	–

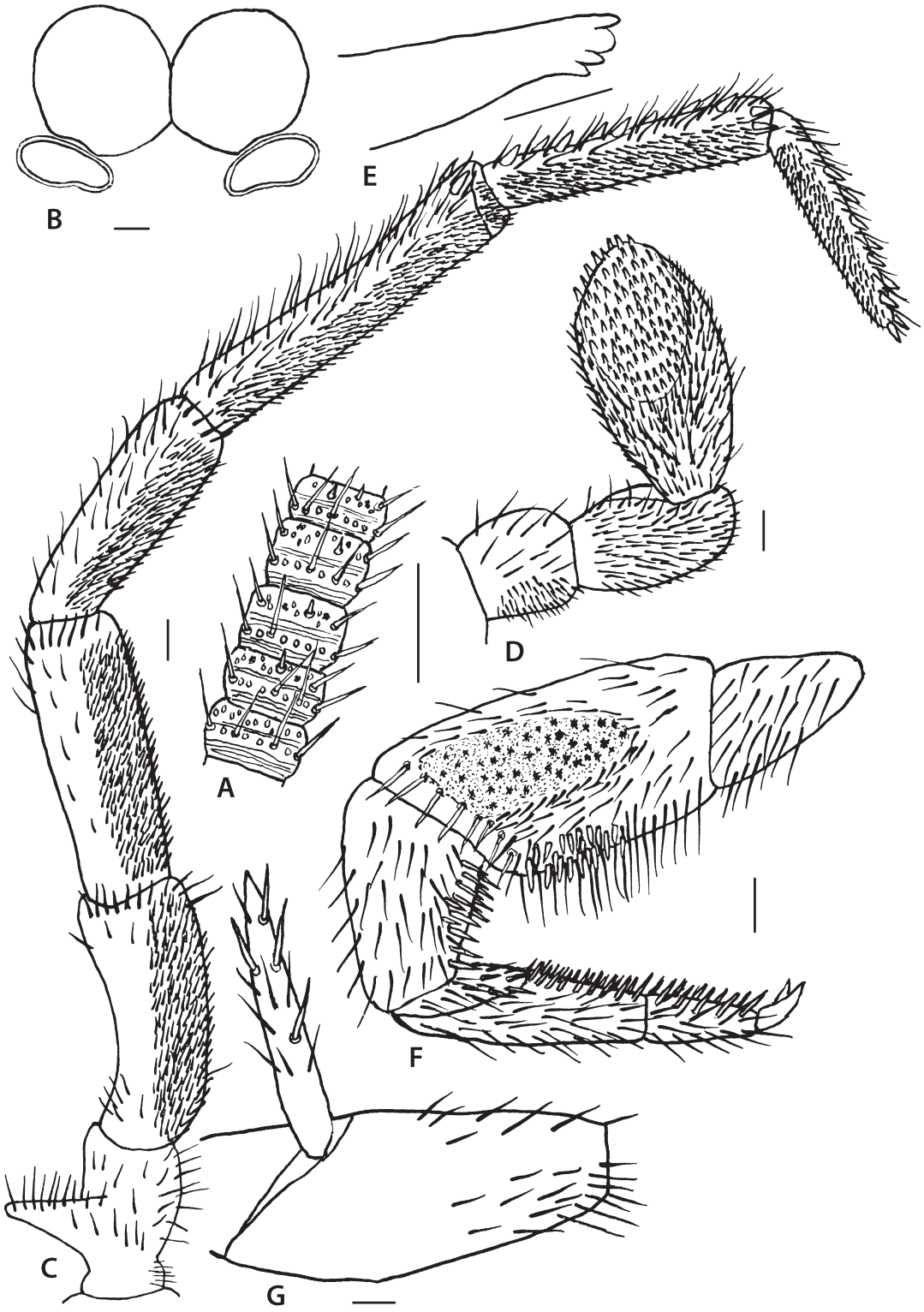

Fig. 5. *Allopsontus perfectus* sp. nov. male, holotype: A – distal chain of flagellum; B – eyes and ocelli, front view; C – maxillary palp; D – labial palp; E – apex of mandible; F – part of fore leg; G – hind coxa with stylus. Scale bar: 0.1 mm.

silla. Sensory field connects to distal row of strong chaetae (Fig. 5F). Metric rations concerning sensory field and femur as follows: LSF/WSF: 2.28, LSF/LF: 0.61, WSF/WF: 0.47, d/LF: 0.25, d/LSF: 0.41, d/WSF: 0.94. Ratio of length of 3rd tarsomere to total length of hind tarsus about 0.34–0.36 in male and 0.41– 0.43 in female. Undersurface of tarsus and tibia with two rows of pigmented spines (Table 8). Fore femur of male with about 20 such spines. Middle and hind femora of male and all femora of female with 2–4 spines. Ratio of length of styli to width of middle and hind coxae about 1.6–1.8 in male and 1.2–1.4 in female (Fig. 5G).

In both sexes, urocoxites I, VI and VII with 1 + 1 eversible vesicles, urocoxites II–V with 2 + 2 eversible

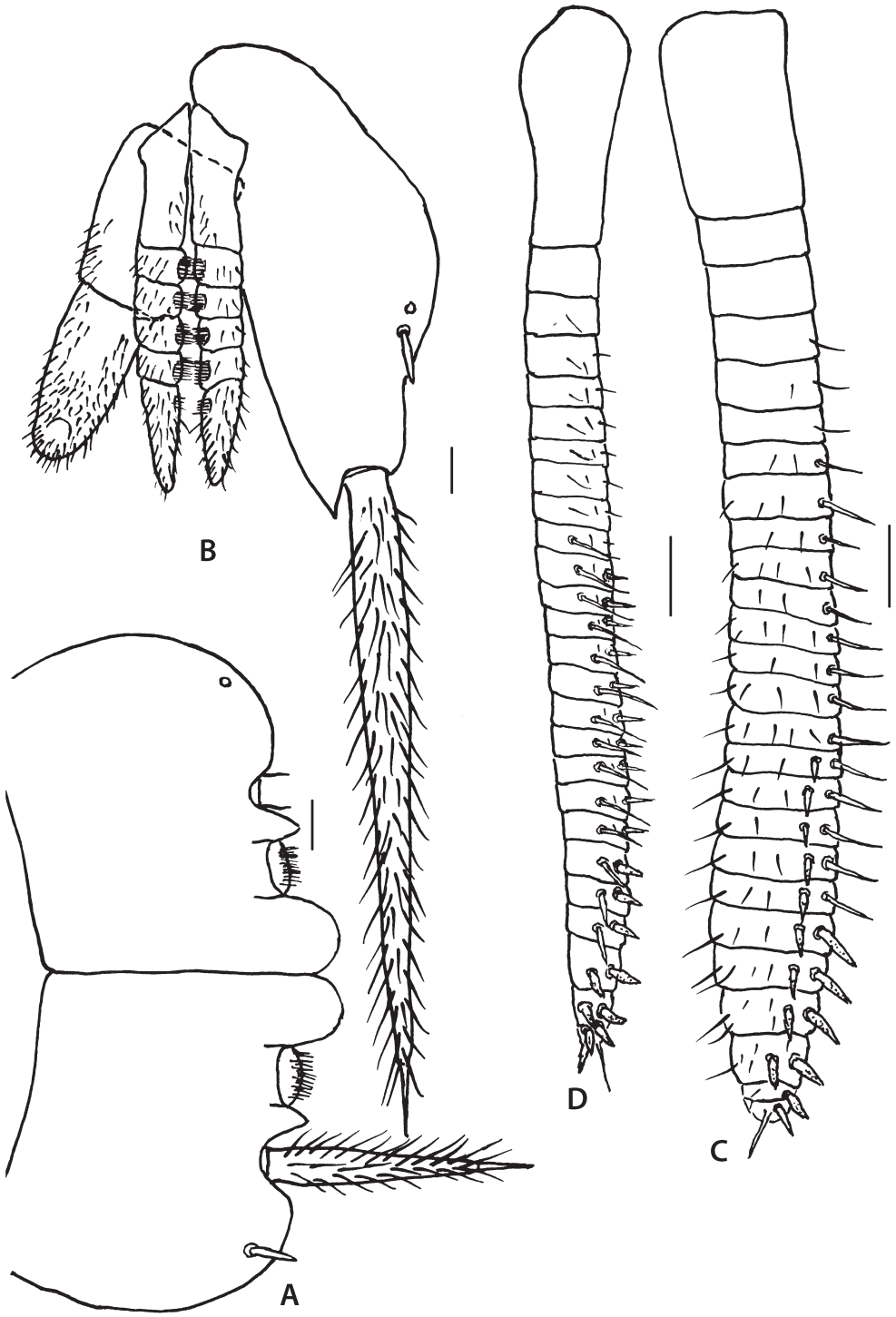

Fig. 6. *Allopsontus perfectus* sp. nov. (B – male, holotype; A, C, D – female, paratype): A – urocoxites VII; B – urocoxite IX, with parameres and penis; C – anterior gonopophysis; D – posterior gonopophysis. Scale bar: 0.1 mm.

vesicles. Ratios of lengths of urosternites, urostyli (without apical spines) and urocoxites II–IX as shown in Table 9. Posterior angle of urosternites II–VI 103°–110° in male and 110°–114° in female, urosternites VII 106° in male and 150° in female and VIII about 158° in male. Urocoxites VII of female with protruding lobes between eversible vesicles. Ratio of length to width of one lobe about 0.67 (Fig. 6A). Thoracic tergites, urotergites I, II, urosternites, urocoxites I, II in both sexes and IX in female without sublateral spines. Urocoxites IX in male with 2 + 2 outer sublateral spines (Fig. 6B). Distribution of sublateral spines on urocoxites and urotergites as shown in Table 10.

Male genitalia with parameres on urite IX. Parameres with 1 + 5 divisions surpassing apex of penis. Penis and parameres almost attaining level of apex of urocoxites IX (Fig. 6B). Penis typical for the genus *Allopsontus*. Ratio of width to length of its apical division about 0.48. Distal division of penis about 1.1 times as long as its basal division.

Ovipositor sclerotized in distal part, thickened, almost completely covered by urocoxites IX, stout. Gonapo-

physes VIII and IX with 26 divisions. Apical spines of anterior and posterior gonapophyses relatively short, as long as 1.5 distal divisions combined. Eleven distal divisions of anterior gonapophysis and 6 distal divisions of posterior gonapophyses with fossorial spines. About three basal divisions of anterior gonapophysis and two basal divisions of posterior gonapophysis glabrous. Distribution of chaetae on divisions of gonapophyses as shown in Figs 6C, D.

Differential diagnosis. *Allopsontus perfectus* sp. nov. with 2 + 2 eversible vesicles on urocoxites II–V in both sexes and relatively short, sclerotized in distal part and thickened ovipositor with fossorial teeth, belongs to the subgenus *Machilanus*. Only one species with numerous short chaetae on the ventral surface of the 2nd–7th palpomeres of the male maxillary palp has been described in the subgenus *Machilanus*, *A. bitschi* (Wygodzinsky, 1962) from Afghanistan. However, the male labial palp of *A. bitschi* lacks numerous short chaetae (Wygodzinsky 1962). Ratio of length to width of compound eye: *A. perfectus* sp. nov. 1.1, *A. bitschi* 1.2; ratio of length of contact line to length of eye about 0.4 and 0.6, respectively. Paired ocellus of *A. perfectus* sp. nov. ovoid, in *A. bitschi* more rounded. Ratio of width to length of paired ocellus in *A. perfectus* sp. nov. 1.8–2.0, in *A. bitschi* 1.4–1.5. Apical division of penis in *A. bitschi* thicker. Ratio of width to length of apical division of penis in *A. perfectus* sp. nov. about 0.48, in *A. bitschi* 0.60.

The new species has several highly specialized adaptations in the structure of the male maxillary and labial palps (numerous short, adpressed chaetae on the ventral surface of the 2nd–7th palpomeres of maxillary palps as well as on the dorsal surface of the 1st palpomere and on almost all the surface of the 2nd and 3rd palpomeres of labial palps), legs (large sensory field on fore femora in male, tarsi and tibiae with spines in both sexes) and ovipositor (gonapophyses with fossorial teeth).

Etymology. The species epithet is a Latin adjective *perfectus* (*-a*, *-um*), meaning perfect, referring to the numerous short adpressed chaetae on the male maxillary and labial palps, the apical palpomere of the male labial palp also with numerous sensorial cones, fore femur of male with well developed sensory field, fore and middle femur widened, undersurface of tarsus and tibia with pigmented spines, in both sexes; ovipositor sclerotized, thickened, relatively short, with fossorial spines in the distal part.

Habitat. Petrophytic steppe.

Distribution. Kazakhstan (Almaty Region, Raiymbek District, upper Charyn River).

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