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Two new species of the genus *Trachelipus* Budde-Lund, 1908 (Isopoda: Oniscidea: Trachelipodidae) from the Chechen Republic, Russia

Два новых вида рода *Trachelipus* Budde-Lund, 1908 (Isopoda: Oniscidea: Trachelipodidae) из Чеченской Республики, Россия

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КЛЮЧЕВЫЕ СЛОВА: ДНК баркодинг, COI мтДНК, мокрица, Кавказ, распространение, таксономия.

ABSTRACT. Two new species of woodlice belonging to the family Trachelipodidae, *Trachelipus sulphuricus* sp.n. and *T. tshetshenicus* sp.n. both from the Chechen Republic (northern Caucasus, Russia) are described. Diagnostic features of these species as well as affinities within the genus *Trachelipus* Budde-Lund, 1908 based on molecular markers COI mtDNA gene are provided (DNA barcoding).

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РЕЗЮМЕ. Описаны два новых вида мокриц, относящихся к семейству Trachelipodidae, *Trachelipus sulphuricus* sp.n. и *T. tshetshenicus* sp.n., из Чеченской Республики (Северный Кавказ, Россия). Приведены диагностические признаки этих видов, а также родственные связи внутри рода *Trachelipus* Budde-Lund, 1908 на основе молекулярных маркеров гена COI мтДНК (ДНК баркодинг).

Introduction

The genus *Trachelipus* Budde-Lund, 1908 (Oniscidea: Crinocheta: Trachelipodidae) includes more than 50 species [Schmidt, 1997; Schmalfuss, 2003; Boyko *et al*., 2008]. The species of this genus are morphologically variable [Tomescu *et al*., 2015], which in turn makes their identification problematic. However, there are a number of studies [Parmakelis *et al*., 2008; Raupach *et al*., 2022] based on molecular data, which show that some species of *Trachelipus* have very high intraspecific differences, which allows considering some of their populations as independent species. Thus, the reliability of the taxonomic features used seems questionable, and to solve this problem, a comprehensive study based on the synthesis of morphological and molecular genetic data (integrative taxonomy) is proposed [Parmakelis *et al*., 2008; Raupach *et al*., 2022].

At the same time, a vast diversity of this genus can be found in regional faunas like the Caucasus [Kuznetsova, Gongalsky, 2012]. The Caucasus is one of the biodiversity hotspots [Myers *et al*., 2000], with a high variety of landscapes and habitats. We consider the Caucasus within

the following boundaries: the Kumo-Manych Depression separating it from the Russian Plain in the north; the Black Sea and the Sea of Azov in the west and the Caspian Sea in the east; the state borders of Georgia, Azerbaijan and Armenia with Iran and Turkey in the south, with the Araks River running along most of them [Coene, 2009]. To date, ten valid species of the genus *Trachelipus* are known within the Caucasus region: *T. caucasius* (Verhoeff, 1918) and *T. lignaui* (Verhoeff, 1918), Gagra, Abkhazia [Verhoeff, 1918]; *T. lutshnikii* (Verhoeff, 1933), Sochi, Krasnodar Prov., Russia [Verhoeff, 1933]; *T. nassonovi* Borutzky, 1976, Gyumri, Armenia; *T. armenicus* Borutzky, 1976, Aragats Mt., Armenia; *T. lencoranicus* Borutzky, 1976, Lankaran, Azerbaijan [Borutzky, 1976]; *T. utrishensis* Gongalsky, 2017 was described from the Utrish Nature Reserve, Krasnodar Prov., Russia [Gongalsky, 2017]; *T. pieperi* Schmalfuss, 1986 recorded for Dagestan and Azerbaijan [Gongalsky *et al*., 2023]; *T. ensiculorum* (Verhoeff, 1949) recorded from the vicinity of Yerevan, Armenia [Vandel, 1980]; *T. razzautii* (Arcangeli, 1913) recorded for Utrish Nature Reserve, Krasnodar Prov., Russia [Gongalsky, Kuznetsova, 2009, 2011].

In the revision of the genus *Trachelipus* of the western part of the Caucasus [Schmalfuss, Khisametdinova, 2015], a redescription was made based on the study of type series and new material for the following species – *T. caucasius*, *T. lignaui* and *T. lutshnikii*; it was shown that the populations of *T. razzautii* from the Black Sea coast of the Caucasus and from northern Italy (type locality of this species) have small differences; and also, the status of *nomen dubium* was assigned to *T. longipennis* (Budde-Lund, 1885), which was described from a series of syntypes from Abkhazia and the southern coast of Crimea [Budde-Lund, 1885], and to *T. gagriensis* (Verhoeff, 1918) described from the vicinity of Gagra, Abkhazia [Verhoeff, 1918]. Later, another paper was published revising the genus *Trachelipus* of the eastern part of the Caucasus [Gongalsky *et al*., 2023], in which a redescription was made and the taxonomic status was discussed based on an integrative taxonomy, as well as the indicated new finds for the following species — *T. lencoranicus* (= *T. azerbaidzhanus* Schmalfuss, 1986), *T. pieperi*, *T. armenicus*, and *T. nassonovi*.

Despite such a long history of studying the genus *Trachelipus* in the Caucasus, its individual regions have not been covered by research. Our pioneering study of *Trachelipus* in the Chechen Republic (northern part of the Caucasus, Russia) is based on an integrative taxonomic approach, which allowed us to describe two new species of this genus.

Material and methods

Sampling. The material for this study was collected in the Chechen Republic, Russia in 2019-2021. A map of the collection sites of the studied material is shown in Fig. 1. The distribution map was created using Google Earth Pro (v.7.3.4.8248) and Adobe Photoshop CS6 (v.13.0.1.3).

The material is deposited in the collection of the Zoological Museum of Moscow University, Russia (ZMMU), and partly retained in the private collection of the first author at the A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Moscow, Russia (abbreviation KG).

Morphological analysis. Processing and dissections were done by using a Leica MZ8 binocular microscope. Micro preparations of diagnostic body appendages were done in euparal (Carl Roth GmbH + Co., Germany). Line drawings were executed with the help of an Olympus BX41 microscope supplied with an Olympus U-DA camera lucida (Olympus Corporation, Japan).

Some individuals were attached to aluminum stubs, coated with gold in a S150A Sputter Coater (Quorum Technologies Ltd., UK), and studied under a Tescan Vega TS5130MM scanning electron microscope (SEM) (s.r.o. TESCAN, Czech Republic). Terminology used in the species description is mainly based on Vandel [1960].

Molecular and phylogenetic study. To isolate total DNA, pereiopods 4 or 5 were used from specimens fixed alive in 96% ethanol. Total cellular DNA was isolated using the Diatom DNA Prep 100 kit (Laboratory Isogen Ltd, Russia). For the analysis of genetic variability (DNA barcoding), fragments of the mitochondrial cytochrome *c* oxidase subunit I (COI mtDNA) locus were used. COI mtDNA was amplified with primers HCO2198/LCO1490 [Folmer *et al*., 1994]. The polymerase chain reaction was carried out on a Bio-Rad T 100 thermocycler (Bio-Rad Laboratories, USA) in a specially selected temperature regime: the initial denudation of 95 °C was 5 min; annealing of 93 °C for 35 sec, 45 °C for 40 sec, 72 °C for 40 sec (40 cycles), the final elongation of 72 °C lasted for 7 min. For the polymerase chain reaction (PCR), a set of reagents for the amplification of "5x Mas Mix-2025″ (Dialat Ltd, Russia) was used. The 10 µl reaction mixture contained 2 µl total DNA, 2 µl mix and 1 µl of each primer. The amplification products were separated by electrophoresis in 1.5% agarose gel in 1x TBE and visualized with ethidium bromide.

Molecular genetic studies were conducted on five samples of new species: *Trachelipus tshetshenicus* sp.n. — two, and *T. sulphuricus* sp.n. — three samples. As comparative phylogenetic material, we obtained 11 COI sequences from several other morphologically similar Caucasian *Trachelipus* species (*T.* cf. *lutshnikii* — eight, and *T.* cf. *caucasius* — three samples), as well as included other sequences (*T. lencoranicus* — one, *T. pieperi* — two, *T. armenicus* — three, and *T. lignau* — one samples) from Gongalsky *et al.* [2023] (these sequences are deposited in the GenBank (NCBI) by this study). All available sequences of *Trachelipus* species from the GenBank with comparable base pair linear were used as comparative material: *T. kytherensis* (Strouhal, 1929) [Parmakelis *et al*., 2008], *T. nodulosus* (C. Koch, 1838), *T. rathkii* (Brandt, 1833), and *T. ratzeburgii* (Brandt, 1833) [Raupach *et al*., 2022]. *Tylos ponticus* Grebnicki, 1874 (Tylida: Tylidae) [Raupach *et al*., 2022] and *Lucasioides altaicus* Gongalsky, Nefediev et Turbanov, 2021 (Crinocheta: Agnaridae) [Gongalsky *et al*., 2021] are used as outgroups. For more detailed information on the samples used in the molecular genetic studies, see Table 1.

DNA chromatograms were checked for errors in FinchTV 1.4.0 [Rothgänger *et al*., 2006], and the DNA sequences were aligned using BioEdit v.5.0.9 [Hall, 1999]. Phylogenetic analysis was performed on COI (630 bp) sequences.

The Bayesian phylogenetic analysis was performed in a Bayesian statistical framework implemented in BEAST v.1.10.4. [Hill, Baele, 2019] with 2×10^7 MCMC generations (10% burn-in) and parameters sampled every 2000 steps. The substitution models by codon position for Bayesian analysis (BA) were selected in PartitionFinder v.2.1.1 [Lanfear *et al*., 2016] with the greedy algorithm [Lanfear *et al*., 2012] (position 1 — GTR+I+X; position 2 — HKY+I+X; position 3 — GTR+I+G+X).

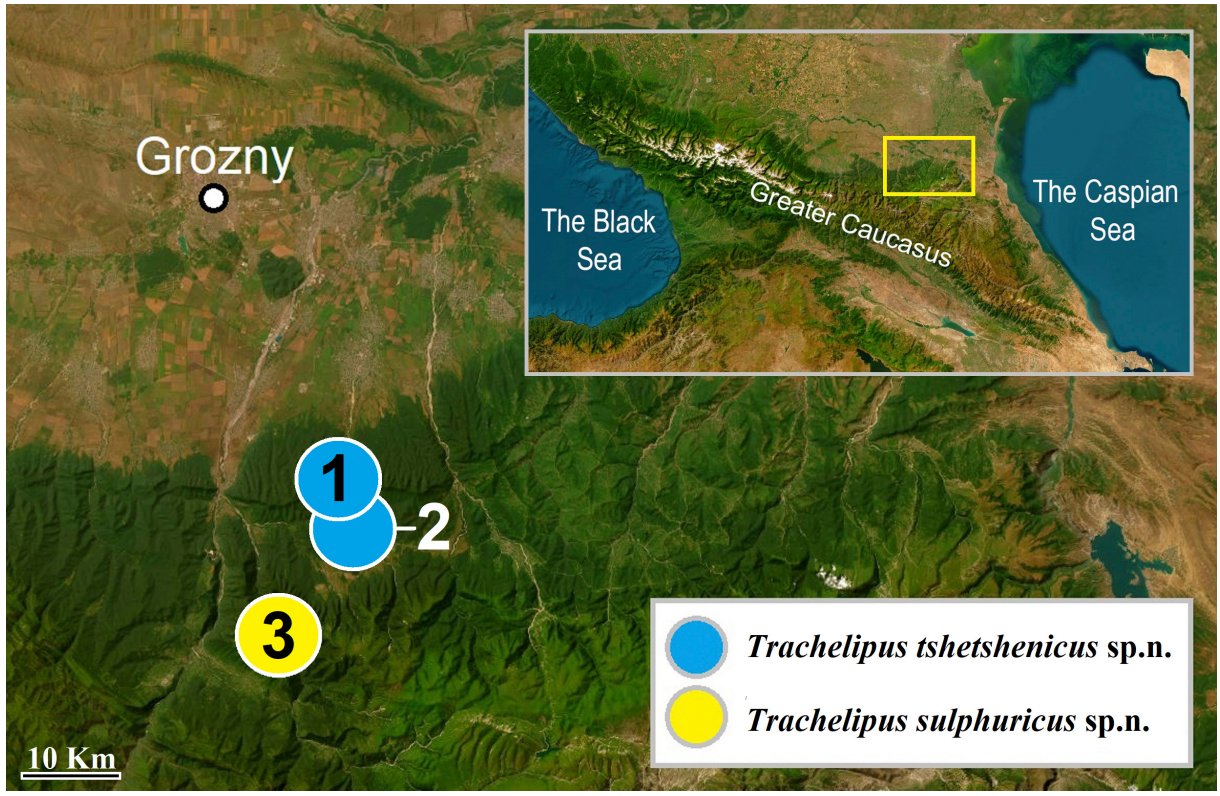

Fig. 1. Relief map of the Chechen Republic (Russia) with collection sites of two new species of *Trachelipus* spp.: 1 — near Agishty Vill.; 2 — near Tevzana Vill.; 3 — Kamila and Magomed caves on the bank of the Sharo-Argun River.

Рис. 1. Физическая карта Чеченской Республики (Россия) с местами сбора двух новых видов *Trachelipus* spp.:1 — окр. с. Агишты; 2 — окр. с. Тевзана; 3 — пещеры Камила и Магомед на берегу реки Шаро-Аргун.

The average intra-group as well as the average pairwise intergroup *p*-distances using concatenated COI sequences data set were calculated using the MEGA7 program [Kumar *et al*., 2016] with 1000 bootstrap replicas.

Results

Phylogenetic relationships and genetic distance

The phylogenetic Bayesian tree of the genus *Trachelipus* shows (Fig. 2) that *T. tshetshenicus* sp.n. (genetic line 10) and *T. sulphuricus* sp.n. (line 8) forms its own lineages and is a sister (with a high support) to *T. armenicus* from Republic of Dagestan, Russia and Armenia (line 7), and *T.* cf. *caucasius* from Krasnaya Polyana Krasnodar Prov., Russia (line 9). The genetic *p*-distance between *T. tshetshenicus* sp.n. and *T. sulphuricus* sp.n. is 0.104 ± 0.012; *T. tshetshenicus* sp.n. differs from *T. armenicus* by 0.093 ± 0,011 and *T.* cf. *caucasius* (line 9) by 0.095 ± 0.012; and *T. sulphuricus* sp.n. by 0.111 ± 0.012 and 0.121 ± 0.013, respectively (Table 2). Being combined together, aforementioned species form a clade that is sister to a clade of the Caucasians species *T.* cf. *lutshnikii* (lines 1 and 6), *T. lencoranicus* (line 2), *T. pieperi* (line 3), *T.* cf. *caucasius* (lines 4 and 5). The obtained results confirm that *T. tshetshenicus* sp.n. and *T. sulphuricus* sp.n. is an independent new species.

The new species are genetically distinct from geographically adjacent species: *T. tshetshenicus* sp.n. from *T. lencoranicus* (line 2) by the genetic p-distance 0.103 ± 0.012 and *T. pieperi* (line 2) by 0.110 ± 0.012; *T. sulphuricus* sp.n. by 0.131 ± 0.013 and 0.123 ± 0.012, respectively (Table 2). Intraspecific divergence of *T. tshetshenicus* sp.n. (0) and *T. sulphuricus* sp.n. (0.01) is comparable to such in other species (Table 2).

Taxonomy

Class Malacostraca Latreille, 1802
Order Isopoda Latreille, 1817
Family Trachelipodidae Strouhal, 1953
Genus *Trachelipus* Budde-Lund, 1908

Trachelipus tshetshenicus Gongalsky, Turbanov et Byzov **sp.n.**
Figs 3–6.

HOLOTYPE ♂ (ZMMU Mc-1467), Russia, Chechen Republic, Vedeno Distr., near Tevzana Vill., 42°58′19″N 45°57′53″E, 18.X.2021, K.B. Gongalsky leg.

PARATYPES: 1 ♂ (KG), together with holotype; 2 ♂♂, 1 ♀ (ZMMU Mc-1468), Russia, Chechen Republic, Shali Distr., near Agishty Vill., 43°00′29″N 45°53′35″E, 18.X.2021, K.B. Gongalsky leg.

ETYMOLOGY. The Latinized adjective *tshetshenicus* indicates that the new species is named after the Chechen Republic, Russia, where it was discovered.

DIAGNOSIS. Frontal lobe triangular, shorter than lateral ones; exopodite of pleopod I uniformly rounded on inner edge;

Table 1. A list of the sampling sites and accession numbers of the COI mtDNA gene sequences for *Trachelipus* spp. included in this study. References are given for the sequences obtained from GenBank (NCBI).
Таблица 1. Список мест отбора проб и номеров доступа последовательностей генов мтДНК COI для *Trachelipus* spp., включенных в это исследование. Ссылки даны на последовательности из GenBank (NCBI).

Species	Localities	GenBank (NCBI) No.	Line No.	Sequence references
Trachelipus tshetshenicus sp.n.	Russia, Chechen Republic, Vedeno Distr., near Tevzana Vill., 42°58′19″N 45°57′53″E	PQ867758 PQ867759 PQ867760	10	This study
Trachelipus sulphuricus sp.n.	Russia, Chechen Republic, Shatoy Distr., 7.7 km south of Ulus-Kert, right bank of Sharo-Argun River, Kamila (= Kamila-Hyeh) Cave, ca. 42°54′05″N 45°47′09″E	PQ867757 PQ867775	8	This study
Trachelipus armenicus	Russia, Republic of Dagestan, Khiv Distr., Trkal Vill., 41°43′00.3″N 47°58′11.1″E	PQ867761 PQ867762	7	This study; Gongalsky *et al.* [2023]
	Armenia, Aragatsotn Prov., near Hovhannavank Monastery, 40°20′19.6″N 44°23′19.2″E	PQ867756	7	
Trachelipus lencoranicus	Russia, Republic of Dagestan, Magaramkent Distr., Samur forest, 41°48′57.0″N 48°34′43.0″E	PQ867755	2	This study; Gongalsky *et al*. [2023]
Trachelipus lignaui	Abkhazia, Gudauta Distr., near Pitsunda, 43°09′54.2″N 40°24′59.3″E	PQ867773	18	This study; Gongalsky *et al*. [2023]
Trachelipus pieperi	Russia, Republic of Dagestan, Magaramkent Distr., Samur forest, 41°48′57.0″N 48°34′43.0″E	PQ867753 PQ867754	3	This study; Gongalsky *et al*. [2023]
Trachelipus cf. *lutshnikii*	Russia, Krasnodar Prov., Adler Distr., near Kazachiy Brod, 43°31′22″N 39°59′33″E	PQ867767	6	This study
	Russia, Krasnodar Prov., Khosta Distr., Akhun Mt., 43°33′7″N 39°50′16″E	PQ867765 PQ867766	6	
	Russia, Krasnodar Prov., Adler Distr., Estosadok, 43°40′53″N 40°16′31″E	PQ867768 PQ867769 PQ867770	1	
	Russia, Krasnodar Prov., Utrish Nature Reserve, 44°46′25″N 37°31′07″E	PQ867764 PQ867774	1	
Trachelipus cf. *caucasius*	Abkhazia, Gudauta Distr., Pitsunda, 43°10′08″N 40°21′04″E	PQ867772	4	This study
	Abkhazia, Gudauta Distr., lake Ritsa, 43°28′20″N 40°31′56″E	PQ867763	5	
	Russia, Krasnodar Prov., Adler Distr., Krasnaya Polyana, 43°40′48″N 40°12′56″E	PQ867771	9	
Trachelipus kytherensis	Greece, Vouraikos — 500 m, Peloponnisos	EF027396	16	Parmakelis *et al.* [2008]
	Greece, Chelmos Mt — 900 m, Peloponnisos	EF027400	16	
	Greece, Proussos — 600 m, Sterea Ellada	EF027449 EF027450,	17	
Trachelipus nodulosus	Germany, Badlands, 50°52′48″N 10°50′24″E	MN810588	11	Raupach *et al*. [2022]
Trachelipus rathkii	Germany, Apfelstaedt bei Ingersleben, 50°55′12″N 10°57′00″E	MN810872	12	Raupach *et al*. [2022]
	Germany, Saxony-Anhalt, Hohe Garbe / Alandniederung, 53°01′12″N 11°37′12″E	MN810814	14	
	Germany, North Rhine-Westphalia, Koeln, 50°58′59.9″N 7°03′35.6″E	MT521239	15	
	Germany, Saxony, Landkreis Bautzen, Bautzen, 51°10′49.4″N 14°26′05.6″E	MT521165	13	

Table 1 (continued).
Таблица 1 (окончание).

Species	Localities	GenBank (NCBI) No.	Line No.	Sequence references
Trachelipus ratzeburgii	Germany, Seeberg Wald, 50°54′36″N 10°43′12″E	MN810717	19	Raupach *et al*. [2022]
	Germany, Bavaria, Wank 3 km NE Garmisch-Partenkirchen, 47°30′21.6″N 11°08′52.8″E	MT521111	19	
	Germany, Bavaria, Landkreis Garmisch-Partenkirchen, 47°29′31.6″N 11°05′44.9″E	MT521128	19	
	Germany, Bavaria, 2 km WNW Gaishofen, 8 km ESE Vilshofen, 48°36′36.0″N 13°18′14.4″E	MT521145	19	
Tylos ponticus	Spain, A Coruna, Ferrol, 43°29′03.8″N 8°13′58.8″W “	MT521213	out-group	Raupach *et al*. [2022]
Lucasioides altaicus	Russia, Altai Prov., Charyshskoye Distr., near Komendantka, Altai State University (ASU) Field Station “Goluboi Utios″, 51°21″38.0″N, 83°38′02.7″E	MT499211	out-group	Gongalsky *et al.* [2021]

apex of carpopodite ridge of pereopod VII located closer to middle of carpopodite; ridge occupies most of carpopodite length; the carpopodite of pereiopod VII with angular ridge, its greatest width almost in middle of carpopodite; dorsal scale-setae shorter than wide.

DESCRIPTION. *Somatic characters.* Body length: males 9.0–11.0 mm, female 12.0 mm. Body colour violet-black with white spots, forming white stripe on proximal part of epimeres (Fig. 3A). Exopods of uropods violet-black (Fig. 3A). Dorsal surface of cephalon with slight tuberosity (Figs 3B, 4A). Pereion tergites slightly tuberculous. Posterior margin of coxal plates on segments 1–2 deeply sinuous (Figs 3, 4B). Dorsal surface covered with Y-shaped scale-setae (Fig. 4C). Glandular pore fields small, circular, more distant from the lateral margin than 2–3 sizes of their diameter (Figs 3B, 4B). Body wide; pleon forms continuous margin with pereon (Fig. 3). Noduli lateralis located close to posterior edge of tergites, on pereonite 1 much more centrally (Figs 3B, 4B). Cephalic lobes small, evenly rounded in front (Figs 3B, 4A). Middle lobe protrudes forward as slightly rounded angle; obtuse angle between it and lateral lobes (Figs 3B, 4A). Telson triangular, deeply sinuous on sides. Telson protrudes beyond propodites of uropods (Fig. 3).

Appendages. Antennula with three articles (Fig. 5B); first article long; second article two times shorter as first; third almost as long as first and narrow, bearing tuft of aesthetascs at apex. Antenna (Fig. 5A) reaching middle of pereonite 3 (Fig. 3B); flagellum with two articles, of equal length. Flagellum as long as fifth segment of antenna (Fig. 5A).

Left mandible (Fig. 5C) with pars incisiva with three teeth; basal to lacinia is hairy lobe with 2 penicils; molar penicil consisting of tuft of plumose setae. Right mandible (Fig. 5D) with pars incisiva with four teeth; hairy lobe with three penicils; molar penicil as in left. Maxillula (Fig. 5G): medial corner of inner endite with two strong penicils. Apical edge of outer endite bearing ten teeth. Six medial teeth slenderer, some with cleft tips. Maxilla with bilobate edge, medial half of apical edge of inner lobe with dense brush of short hairs (Fig. 5F). Maxilliped with outer corner of endite with two acute tips and large spine near inner corner (Fig. 5E). Basal article of palp with two large spines. Tip of distal article of palp consisting of brush of spines. Pleopods with all exopods bearing uncovered lungs (Fig. 6D, H, J–K). Uropods (Fig. 3) with exopods flattened and oval shaped.

Male: Pereopods (Fig. 6A–C). Ischium of pereopod 7 with ventral margin slightly concave. Carpus has prominent dorsal crest, widest in middle of carpus (Fig. 6C).

Genital papilla of shape typical of genus (Fig. 6G). Exopod of pleopod 1 with long distal process parallel to base of segment directed outwards (Fig. 6D). Edge of pseudotrachea smooth. Endopod of pleopod 1 with dorsal furrow and with row of spines which become longer the closer to tip they are (Fig. 6E, F). Exopod pleopod 2: exopod triangular with concave outer margin (Fig. 6H); endopod 2 much longer than exopod, narrow, with parallel sides (Fig. 6I). Exopods of pleopods 3–5 (Fig. 6J–L) triangular, slightly decreasing in size from third to fifth.

ECOLOGY. Inhabiting in the litter of broadleaf forest.

DISTRIBUTION. Currently known only from the type localities.

COMPARATIVE REMARKS. The new species differs from the other species of *Trachelipus* from the Caucasus as following.

From *Trachelipus lutshnikii* [Verhoeff, 1933; Schmalfuss, Khisametdinova, 2015], to which the new species is morphologically the closest, is distinguished by the males exopodite of pleopod I uniformly rounded on the inner edge, its process departs at a smaller angle to the base (*vs*. the inner edge has two more or less straight sections and an angle between them, the process departs at a greater angle to the base in *T. lutshnikii*); in males, the apex of the carpopodite ridge of pereopod VII is located closer to the middle of the carpopodite, the ridge occupies most of the length of the carpopodite, the setae on the lower edge of the carpopodite are longer (*vs*. the apex of the ridge is located closer to the base, the ridge occupies a smaller part, the large setae on the lower edge are shorter in *T. lutshnikii*); in males, the distal edge of the ischiopodite of pereiopod VII is concave (*vs*. almost straight in *T. lutshnikii*).

From *Trachelipus caucasius* [Verhoeff, 1918; Schmalfuss, Khisametdinova, 2015], the new species is distinguished by the developed frontal lobe (*vs.* not developed in *T. caucasius*); in males, the exopodite of pleopod I has a notch in front of the process on the outer edge (*vs.* without a notch in front of the process on the outer edge in *T. caucasius*); in males, the ischiopodite of pereiopod VII is widest distally, the distal edge is concave (*vs.* greatest width at a distance from the end of the ischiopodite, the distal edge is very weakly concave, almost straight in *T. caucasius*); in males, the carpopodite of pereiopod VII has an

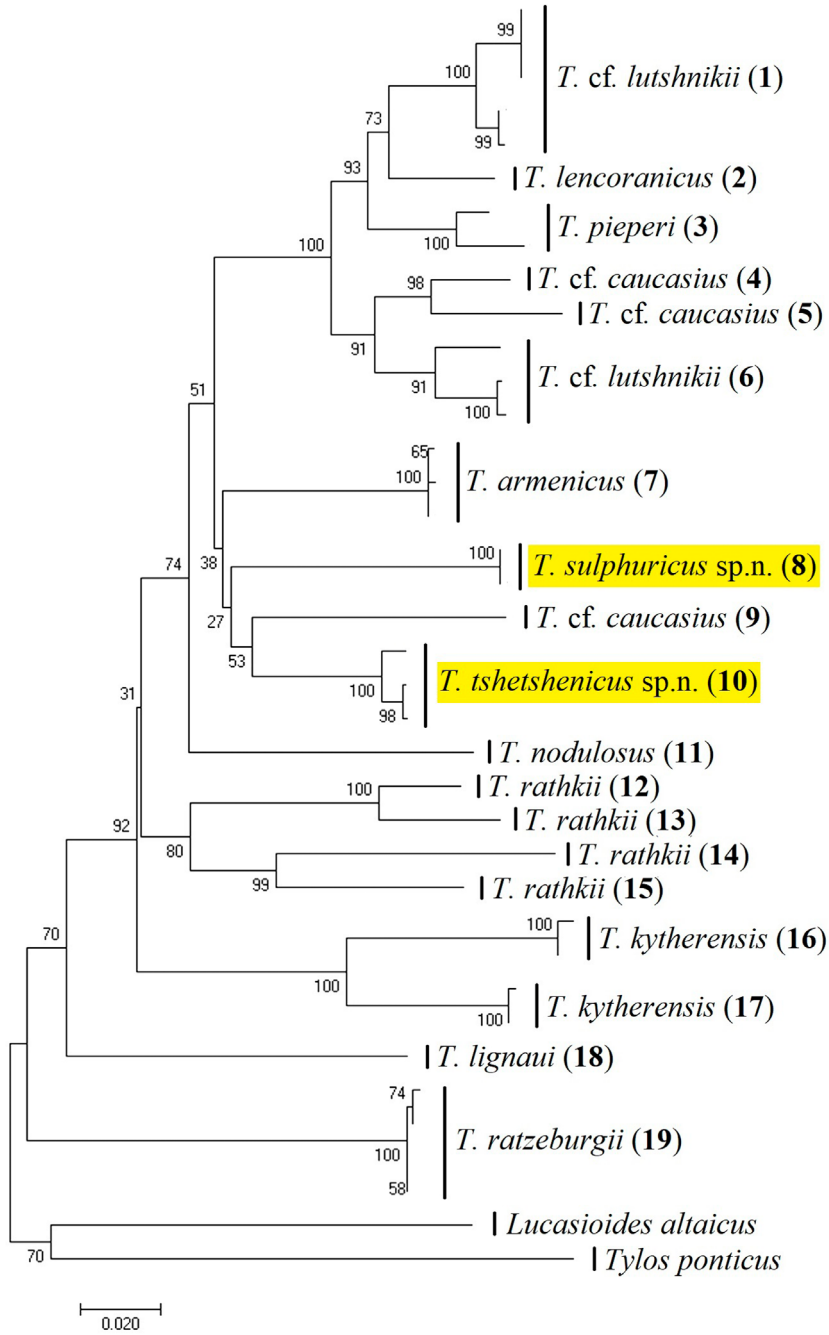

Fig. 2. Phylogeny of *Trachelipus* species based on Bayesian analysis (BA) of COI mtDNA gene sequences. New species are highlighted. Lineage numbers are given in bold from 1 to 19 (for line numbering, see Table 1).

Fig. 2. Филогения видов рода *Trachelipus*, основанная на анализе последовательностей генов мтДНК COI методом байесовского анализа (BA). Новые виды выделены. Номера линий указаны жирным шрифтом от 1 до 19 (нумерацию линий см. в табл. 1).

angular ridge, its greatest width is almost in the middle of the carpopodite (*vs.* the carpopodite ridge is rounded, its greatest width is closer to the base in *T. caucasius*).

From *Trachelipus lignaui* [Verhoeff, 1918; Schmalfuss, Khisametdinova, 2015], the new species is distinguished by males with the process of the exopodite of pleopod I bent at a small angle to the base (*vs.* almost not bent and has a very large angle to the base in *T. lignaui*); in males the ridge of the carpopodite of pereiopod VII is without a tooth (*vs.* with a large tooth in *T. lignaui*); the pore fields on the first pereionite are located at a distance from the edge greater than its diameter (*vs.* the pore fields are located almost at the very edge in *T. lignaui*); larger, up to 12.0 mm (*vs.* smaller, up to 8.5 mm in *T. lignaui*); body color violet-black with white spots, forming white stripe on proximal part of epimeres, exopods of uropods violet-black (*vs.* light brown with usual light muscle spots, two rows of light streaks on bases of pereon-epimera, posterior parts of pereon-epimera, antennae and uropods yellowish in *T. lignaui*).

Table 2. Genetic p-distances between species Trachelipus spp. for COI mtDNA sequences. The averages of interspecies distances are given below diagonal, the standard errors are given above diagonal; the intraspecies divergence is given in a diagonal in bold. Lineage numbers (from 1 to 19) are given in parentheses after the species name (for line numbering, see Table 1).

Таблица 2. Генетические *p*-дистанции между видами *Trachelipus* spp. для последовательностей мтДНК COI. Средние значения межвидовых расстояний приведены под диагональю, стандартные ошибки — над диагональю; внутривидовая дивергенция указана по диагонали жирным шрифтом. Номера линий (от 1 до 19) приведены в скобках после названия вида (нумерацию линий см. в табл. 1).

	T. pieperi (3)	*T. sulphuricus* sp.n. (8)	*T. lencoranicus* (2)	*T.* cf. *lutshnikii* (1)	*T. lignaui* (18)	*T. armenicus* (7)	*T. tshetshenicus* sp.n. (10)	*T.* cf. *lutshnikii* (6)	*T.* cf. *caucasius* (4)	*T.* cf. *caucasius* (9)	*T.* cf. *caucasius* (5)	*T. kytherensis* (16)	*T. kytherensis* (17)	*T. nodulosus* (11)	*T. rathkii* (12)	*T. rathkii* (14)	*T. rathkii* (15)	*T. rathkii* (13)	*T. ratzeburgii* (19)
T. pieperi (3)	**0.02**	0.012	0.01	0.009	0.014	0.012	0.011	0.010	0.010	0.013	0.011	0.015	0.014	0.014	0.013	0.013	0.012	0.013	0.014
T. sulphuricus sp.n. (8)	0.123	**0**	0.013	0.013	0.015	0.012	0.012	0.013	0.013	0.013	0.014	0.015	0.015	0.013	0.014	0.014	0.014	0.014	0.015
T. lencoranicus (2)	0.061	0.131	—	0.008	0.013	0.012	0.012	0.010	0.011	0.013	0.012	0.015	0.015	0.014	0.014	0.014	0.013	0.014	0.014
T. cf. *lutshnikii* (1)	0.068	0.140	0.056	**0.01**	0.013	0.013	0.012	0.010	0.010	0.014	0.012	0.015	0.014	0.013	0.013	0.014	0.013	0.013	0.014
T. lignaui (18)	0.163	0.171	0.150	0.154	—	0.014	0.013	0.013	0.014	0.015	0.015	0.015	0.015	0.014	0.015	0.015	0.015	0.015	0.014
T. armenicus (7)	0.111	0.111	0.113	0.121	0.151	**0**	0.011	0.012	0.012	0.012	0.013	0.015	0.015	0.013	0.014	0.015	0.013	0.014	0.015
T. tshetshenicus sp.n. (10)	0.110	0.104	0.103	0.107	0.142	0.093	**0.01**	0.011	0.012	0.012	0.013	0.015	0.014	0.013	0.012	0.014	0.012	0.013	0.014
T. cf. *lutshnikii* (6)	0.082	0.135	0.079	0.078	0.161	0.113	0.105	**0.02**	0.008	0.013	0.010	0.015	0.014	0.013	0.013	0.014	0.013	0.013	0.014
T. cf. *caucasius* (4)	0.078	0.126	0.087	0.082	0.173	0.106	0.107	0.057	—	0.013	0.009	0.015	0.014	0.014	0.013	0.014	0.013	0.014	0.014
T. cf. *caucasius* (9)	0.135	0.121	0.128	0.131	0.176	0.111	0.095	0.129	0.123	—	0.014	0.014	0.014	0.014	0.014	0.015	0.014	0.014	0.015
T. cf. *caucasius* (5)	0.096	0.145	0.095	0.104	0.174	0.119	0.127	0.073	0.050	0.144	—	0.016	0.014	0.014	0.014	0.015	0.014	0.014	0.014
T. kytherensis (16)	0.174	0.174	0.159	0.177	0.182	0.167	0.158	0.171	0.185	0.164	0.182	**0**	0.011	0.015	0.014	0.015	0.015	0.015	0.015
T. kytherensis (17)	0.170	0.161	0.161	0.165	0.177	0.160	0.141	0.160	0.162	0.153	0.161	0.089	**0**	0.014	0.014	0.015	0.014	0.014	0.015
T. nodulosus (11)	0.145	0.132	0.145	0.134	0.171	0.122	0.116	0.141	0.145	0.132	0.150	0.168	0.143	—	0.014	0.015	0.013	0.014	0.015
T. rathkii (12)	0.141	0.155	0.150	0.149	0.166	0.134	0.133	0.143	0.141	0.149	0.152	0.158	0.149	0.150	—	0.013	0.013	0.008	0.015
T. rathkii (14)	0.153	0.155	0.160	0.165	0.178	0.158	0.154	0.159	0.165	0.162	0.168	0.169	0.174	0.170	0.141	—	0.012	0.014	0.016
T. rathkii (15)	0.138	0.152	0.149	0.142	0.158	0.134	0.129	0.144	0.142	0.153	0.166	0.169	0.170	0.142	0.124	0.105	—	0.013	0.015
T. rathkii (13)	0.154	0.157	0.152	0.156	0.166	0.146	0.138	0.150	0.149	0.163	0.157	0.161	0.148	0.157	0.048	0.145	0.126	—	0.015
T. ratzeburgii (19)	0.175	0.184	0.172	0.170	0.166	0.184	0.167	0.165	0.172	0.195	0.169	0.190	0.181	0.185	0.181	0.197	0.185	0.193	**0**

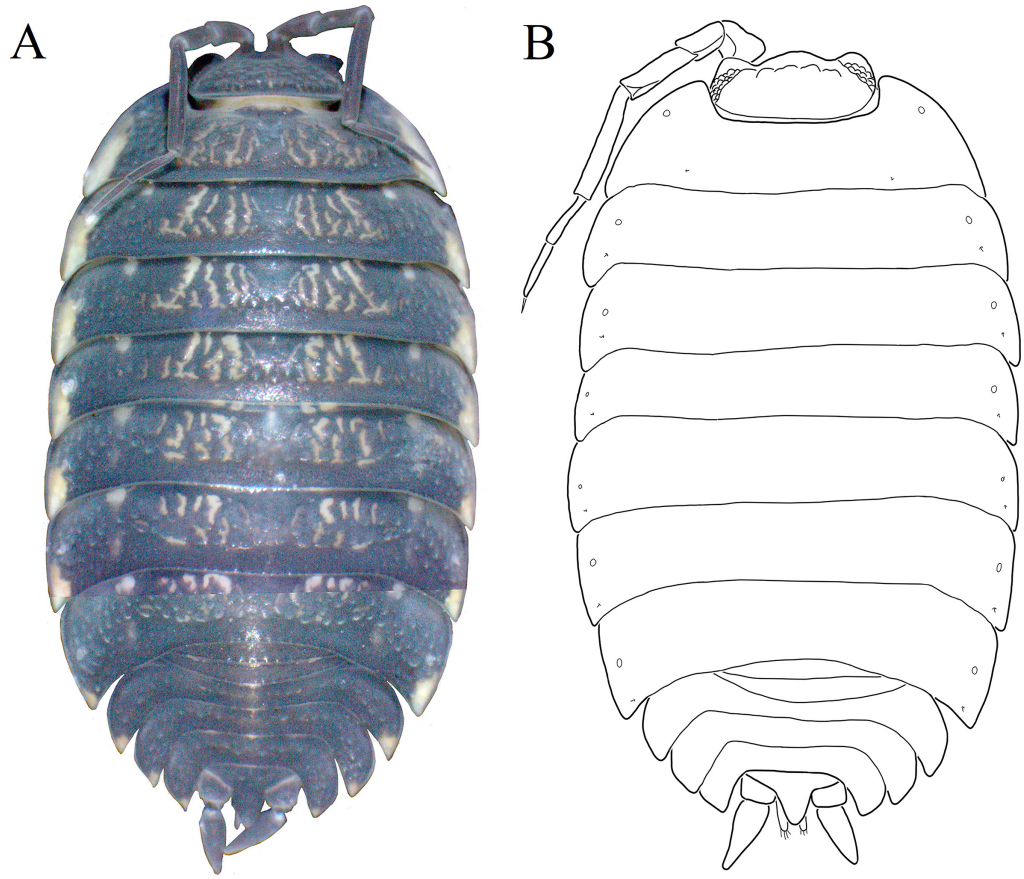

Fig. 3. *Trachelipus tshetshenicus* sp.n. from near Tevzana (Chechen Republic, Russia), male: A — general view (photo); B — body outline with pereon epimera, noduli laterales and glandular pore fields. No scale bars.

Рис. 3. *Trachelipus tshetshenicus* sp.n. из окр. Тевзаны (Чеченская Республика, Россия), самец: A — общий вид (фото); B — абрис тела с эпимерами перейона с обозначенным положением noduli laterales и поровыми полями. Без масштаба.

From *Trachelipus nassonovi* [Borutzky, 1976; Gongalsky *et al*., 2023], the new species is distinguished by the following characters: in males, the carpopodite of pereiopod VII has one ridge (*vs.* with two ridges in *T. nassonovi*); in males, the exopodite of pleopod I is rounded (*vs.* angular in *T. nassonovi*); in males, the ischiopodite of pereiopod VII has a strongly concave caudal margin (*vs.* with a weakly concave caudal margin in *T. nassonovi*).

From *Trachelipus armenicus* [Borutzky, 1976; Gongalsky *et al*., 2023], the new species is distinguished by the following characters: in males the carpopodite ridge of pereiopod VII clearly ends before the end of the carpopodite, angular (*vs.* the ridge occupies almost the entire carpopodite, rounded in *T. armenicus*); the frontal lobe of the head is shorter than the lateral ones, triangular in shape (*vs.* the frontal lobe is rounded, protruding forward, the lateral lobes are small in *T. armenicus*); in males the exopodite of pleopod I is rounded (*vs.* angular in *T. armenicus*).

From *Trachelipus lencoranicus* [Borutzky, 1976; Schmalfuss, 1986; Gongalsky *et al*., 2023], the new species is distinguished by the following characters: dorsal scale-setae shorter than wide (*vs.* longer than wide in *T. lencoranicus*); pore fields and noduli laterales located at approximately the same level (*vs.* noduli laterales closer to the middle of the body than pore fields in *T. lencoranicus*); lateral lobes of the head longer than the frontal (*vs.* lateral lobes shorter than the frontal in *T. lencoranicus*).

From *Trachelipus utrishensis* [Gongalsky, 2017], the new species is distinguished by the following characters: the frontal lobes of the head are shorter (*vs.* longer in *T. utrishensis*); in males, the carpopodite of pereiopod VII has a small ridge (*vs.* with a large ridge in *T. utrishensis*); in males, the endopodite of pleopod I has a straight tip (*vs.* with a curved tip in *T. utrishensis*); in males, the process of the exopodite of pleopod I extends at a small angle to the base (*vs.* slightly curved, has a very large angle to the base in *T. utrishensis*).

From *Trachelipus pieperi* [Schmalfuss, 1986; Gongalsky *et al*., 2023], the new species is distinguished by the following characters: in males, the process of the exopodite of pleopod I is not bent toward the base (*vs.* the process of the exopodite is bent toward the base in *T. pieperi*); in males, the setae on the carpopodite of pereiopod VII are longer (*vs.* the setae are shorter in *T. pieperi*).

From *Trachelipus ensiculorum* [Verhoeff, 1949], the new species is distinguished by the following characters: in males, the process of the exopodite of pleopod I is wide and straight (*vs.* thin and curved in *T. ensiculorum*); in males, the ridge of the carpopodite of pereiopod VII occupies most of the length of the carpopodite, with the greatest width close to the middle of the carpopodite (*vs.* the ridge is short, occupies slightly more than half the length, with the greatest width between the middle and the base in *T. ensiculorum*).

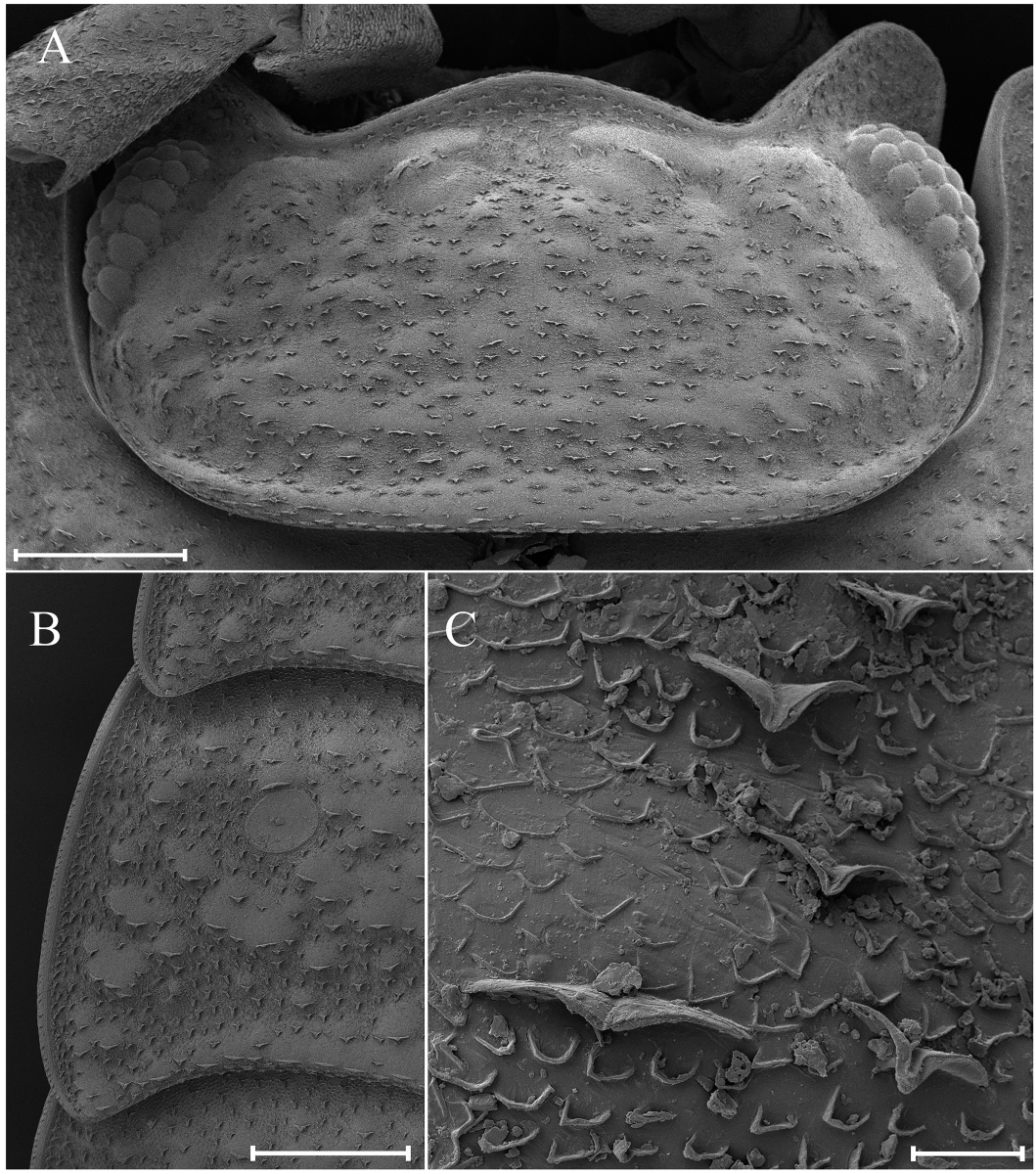

Fig. 4. *Trachelipus tshetshenicus* sp.n. (SEM photo) from near Tevzana (Chechen Republic, Russia), male: A — head; B — 2nd pereon epimera, nodulus lateralis and glandular pore field; C — dorsal scale-setae. Scale bars: 0.5 mm (A, B), 0.02 mm (C).

Рис. 4. *Trachelipus tshetshenicus* sp.n. (СЭМ фото) из окр. Тевзаны (Чеченская Республика, Россия), самец: A — голова; B — эпимера 2-го сегмента перейона с nodulus lateralis и поровым полем; C — дорзальные сеты. Масштаб: 0,5 мм (A, B), 0,02 мм (C).

From *Trachelipus razzautii* [Schmalfuss, Khisametdinova, 2015], the new species is distinguished by the following characters: the frontal lobe is shorter than the lateral ones (*vs.* the frontal lobe is larger than the lateral ones in *T. razzautii*); in males the exopodite process of pleopod I is located at a small angle to the base (*vs.* the process is almost not curved, has a very large angle to the base in *T. razzautii*); in males the carpopodite of pereiopod VII has a small ridge (*vs.* with a large high ridge in *T. razzautii*); in males the endopodite of pleopod I has a straight tip (*vs.* with a curved tip in *T. razzautii*); body colour violet-black with white spots, forming white stripe on proximal part of epimeres, exopods of uropods violet-black (*vs*. light brown with pronounced yellowish muscle spots, two rows of light streaks on bases of pereonepimera and one median row, posterior corners of pereonepimera and uropods yellowish in *T. razzautii*).

Trachelipus sulphuricus Gongalsky, Turbanov et Byzov **sp.n.**

Figs 7–10.

HOLOTYPE ♂ (ZMMU Mc-1469), Russia, Chechen Republic, Shatoy Distr., 7.7 km south of Ulus-Kert, right bank of Sharo-Argun River, Kamila (= Kamila-Hyeh) Cave, ca. 42°54′05″N 45°47′09″E, 1.XI.2020, I.S. Turbanov leg.

PARATYPES: 1 ♂, 2 ♀♀ (ZMMU Mc-1470); 1 ♂, 2 ♀♀ (KG), all together with holotype.

OTHER MATERIAL: 2 ♀♀ (KG), same cave, 15.X.2019, S.A. Kapralov leg.; 3 ♂♂, 2 ♀♀ (KG), same place, Magomed (= Magomed-Hyeh) Cave, ca. 42°54′05″N 45°47′08″E, 1.XI.2020, I.S. Turbanov leg.

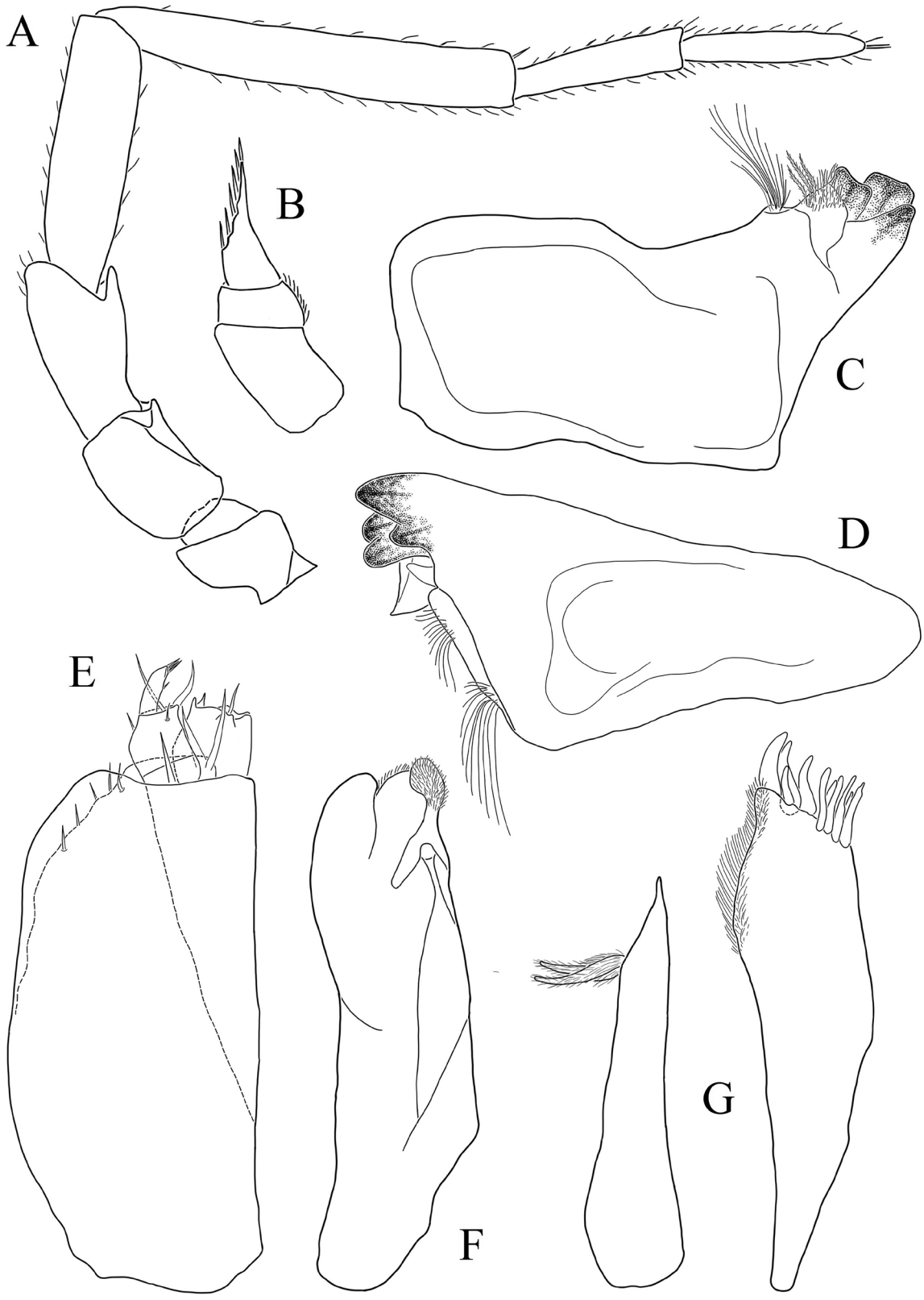

Fig. 5. *Trachelipus tshetshenicus* sp.n. from near Tevzana (Chechen Republic, Russia), male: A — antenna; B — antennula; C — left mandible; D — right mandible; E — maxilliped; F — maxilla; G — maxillula. No scale bars.

Рис. 5. *Trachelipus tshetshenicus* sp.n. из окр. Тевзаны (Чеченская Республика, Россия), самец: A — антенна; B — антеннула; C — левая мандибула; D — правая мандибула; E — максиллипед; F — максилла; G — максиллула. Без масштаба.

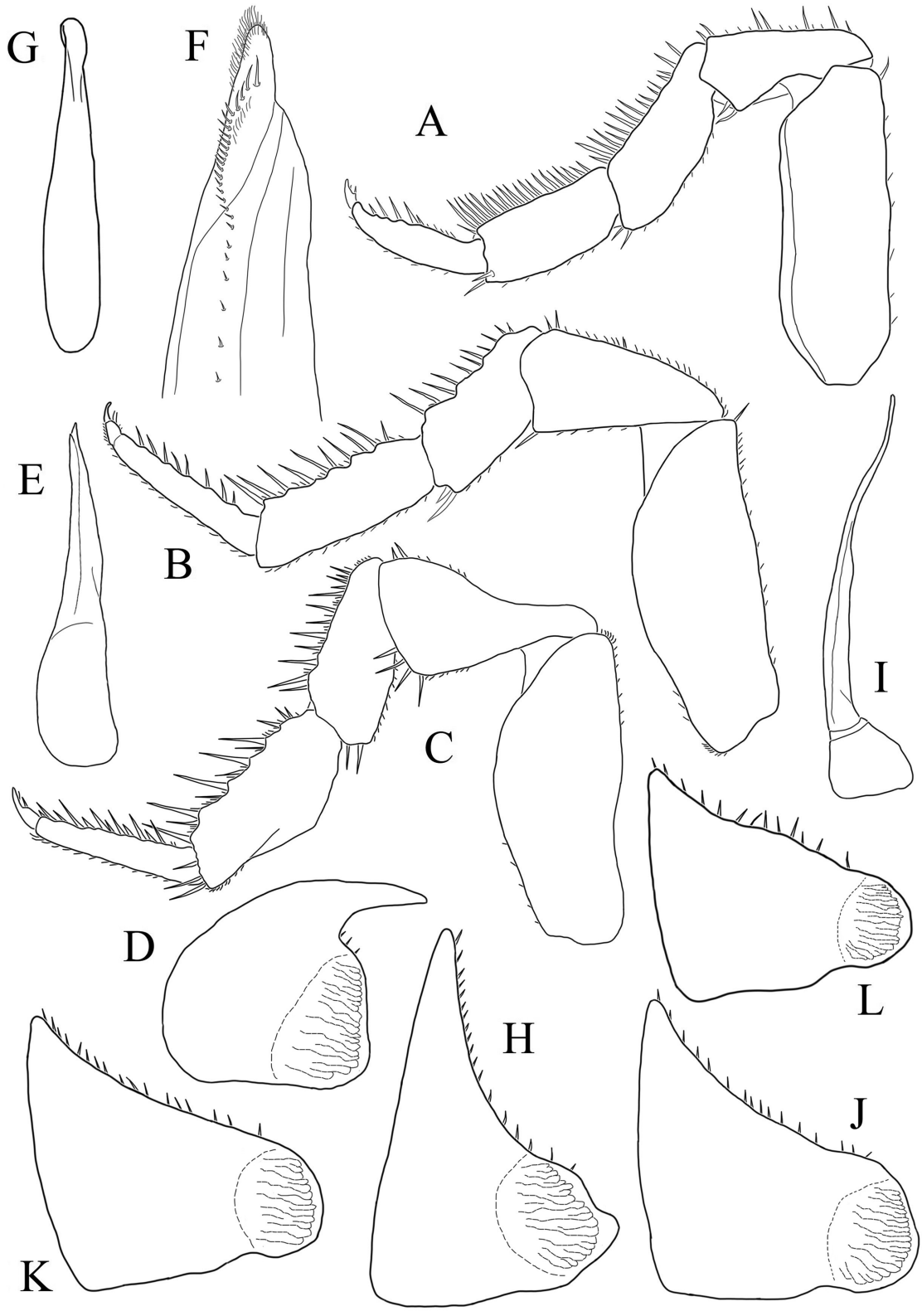

Fig. 6. *Trachelipus tshetshenicus* sp.n. from near Tevzana (Chechen Republic, Russia), male: A — pereopod 1; B — pereopod 6; C — pereopod 7; D — exopod of pleopod 1; E — endopod of pleopod 1; F — tip of endopod of pleopod 1; G — genital papilla; H — exopod of pleopod 2; I — endopod of pleopod 2; J — exopod of pleopod 3; K — exopod of pleopod 4; L — exopod of pleopod 5. No scale bars.

Рис. 6. *Trachelipus tshetshenicus* sp.n. из окр. Тевзаны (Чеченская Республика, Россия), самец: A — переопод 1; B — переопод 6; C — переопод 7; D — экзопод плеопода 1; E — эндопод плеопода 1; F — вершина эндопода плеопода 1; G — генитальная папилла; H — экзопод плеопода 2; I — эндопод плеопода 2; J — экзопод плеопода 3; K — экзопод плеопода 4; L — экзопод плеопода 5. Без масштаба.

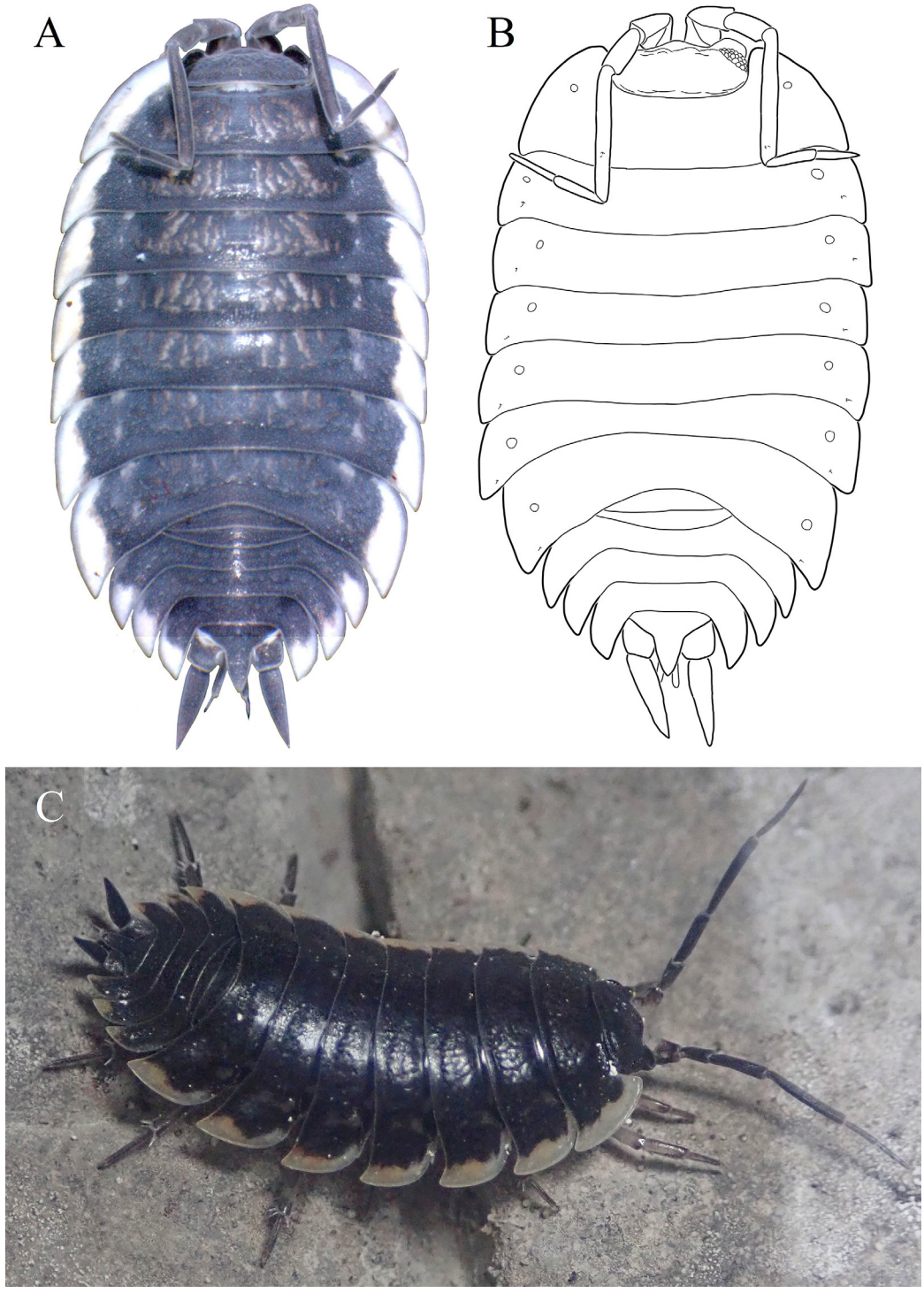

Fig. 7. *Trachelipus sulphuricus* sp.n. from Kamila Cave (Chechen Republic, Russia), male: A — general view (photo); b — body outline with pereon epimera, noduli laterales and glandular pore fields; C — alive specimen (photo *in situ*). No scale bars.

Рис. 7. *Trachelipus sulphuricus* sp.n. из пещеры Камила (Чеченская Республика, Россия), самец: A — общий вид (фото); B — абрис тела с эпимерами перейона с обозначенным положением noduli laterales и поровыми полями; C — живая особь (фото *in situ*). Без масштаба.

ETYMOLOGY. The Latin adjective *sulphuricus* indicates that the new species is described from a caves of sulfuric acid speleogenesis (SAS caves).

DIAGNOSIS. Frontal line slightly shorter than lateral; dorsal scale-setae shorter than wide; pore fields on pereonite I far from edge; in males exopodite of pleopod I with notch in front of the process on outer edge; greatest width of ischiopodite of pereiopod VII at distal part; caudal edge of ischiopodite concave; inner edge of exopodite of pleopod I uniformly rounded, its process extends almost parallel to base.

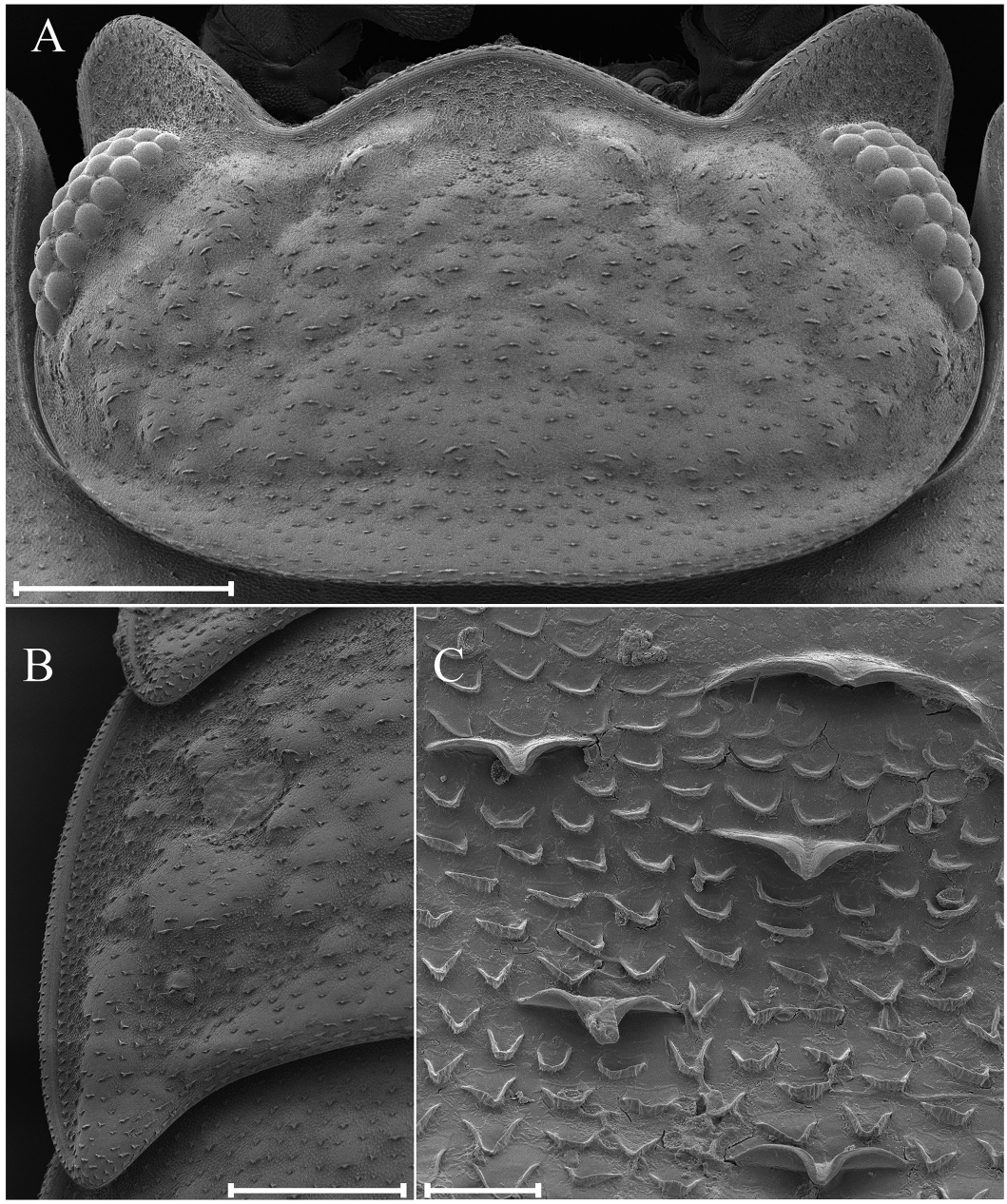

Fig. 8. *Trachelipus sulphuricus* sp.n. (SEM photo) from Kamila Cave (Chechen Republic, Russia), male: A — head; B — 2nd pereon epimera, nodulus lateralis and glandular pore field; C — dorsal scale-setae. Scale bars: 0.5 mm (A, B), 0.02 mm (C).

Рис. 8. *Trachelipus sulphuricus* sp.n. (СЭМ фото) из пещеры Камила (Чеченская Республика, Россия), самец: A — голова; B — эпимера 2-го сегмента перейона с nodulus lateralis и поровым полем; C — дорзальные сеты. Масштаб: 0,5 мм (A, B), 0,02 мм (C).

DESCRIPTION. *Somatic characters.* Body length: males 8.0–12.0 mm, females 9.0–15.0 mm. Body colour violet-black with tiny yellow spots, forming wide white stripe on proximal part of epimeres (Fig. 7A, C). Distal parts of epimeres white (Fig. 7A, C). Exopods of uropods violet-black (Fig. 7A, C). Dorsal surface of cephalon with slight tuberosity (Figs 7B, 8A). Pereion tergites slightly tuberculous. Posterior margin of coxal plates on segments 1–2 deeply sinuous (Figs 7B, 8B). Dorsal surface covered with Y-shaped scale-setae (Fig. 8C). Glandular pore fields large, circular, more distant from the lateral margin than 2–4 sizes of their diameter (Figs 7B, 8B). Body relatively wide; pleon forms continuous margin with pereon (Fig. 7). Noduli lateralis located close to posterior edge of tergites, on pereonite 1 much more centrally (Figs 7B, 8B). Cephalic lobes small, square-shaped in front (Figs 7B, 8A). Middle lobe protrudes forward as slightly rounded angle; obtuse angle between it and lateral lobes (Fig. 8A). Telson triangular, sinuous on sides. Telson protrudes beyond propodites of uropods (Fig. 7).

Appendages. Antennula with three articles (Fig. 9B); first article long; second article two times shorter as first; third almost as long as first and narrow, bearing tuft of aesthetascs at apex. Antenna (Fig. 9A) reaching rear edge of pereonite 3 (Fig. 7B); flagellum with two articles, of equal length. Flagellum as long as fifth segment of antenna (Fig. 9A).

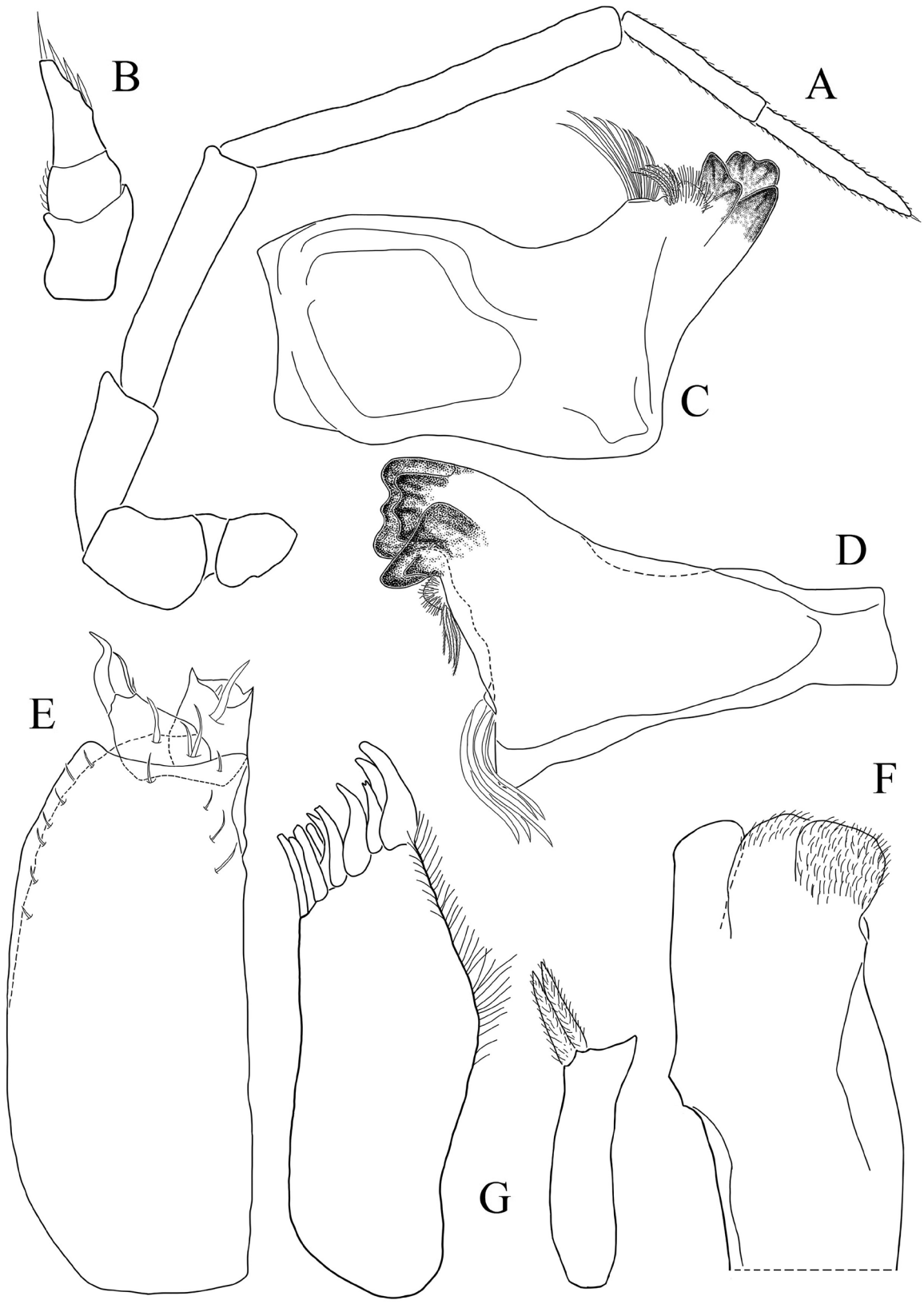

Fig. 9. *Trachelipus sulphuricus* sp.n. from Kamila Cave (Chechen Republic, Russia), male: A — antenna; B — antennula; C — left mandible; D — right mandible; E — maxilliped; F — maxilla; G — maxillula. No scale bars.

Рис. 9. *Trachelipus sulphuricus* sp.n. из пещеры Камила (Чеченская Республика, Россия), самец: A — антенна; B — антеннула; C — левая мандибула; D — правая мандибула; E — максиллипед; F — максилла; G — максиллула. Без масштаба.

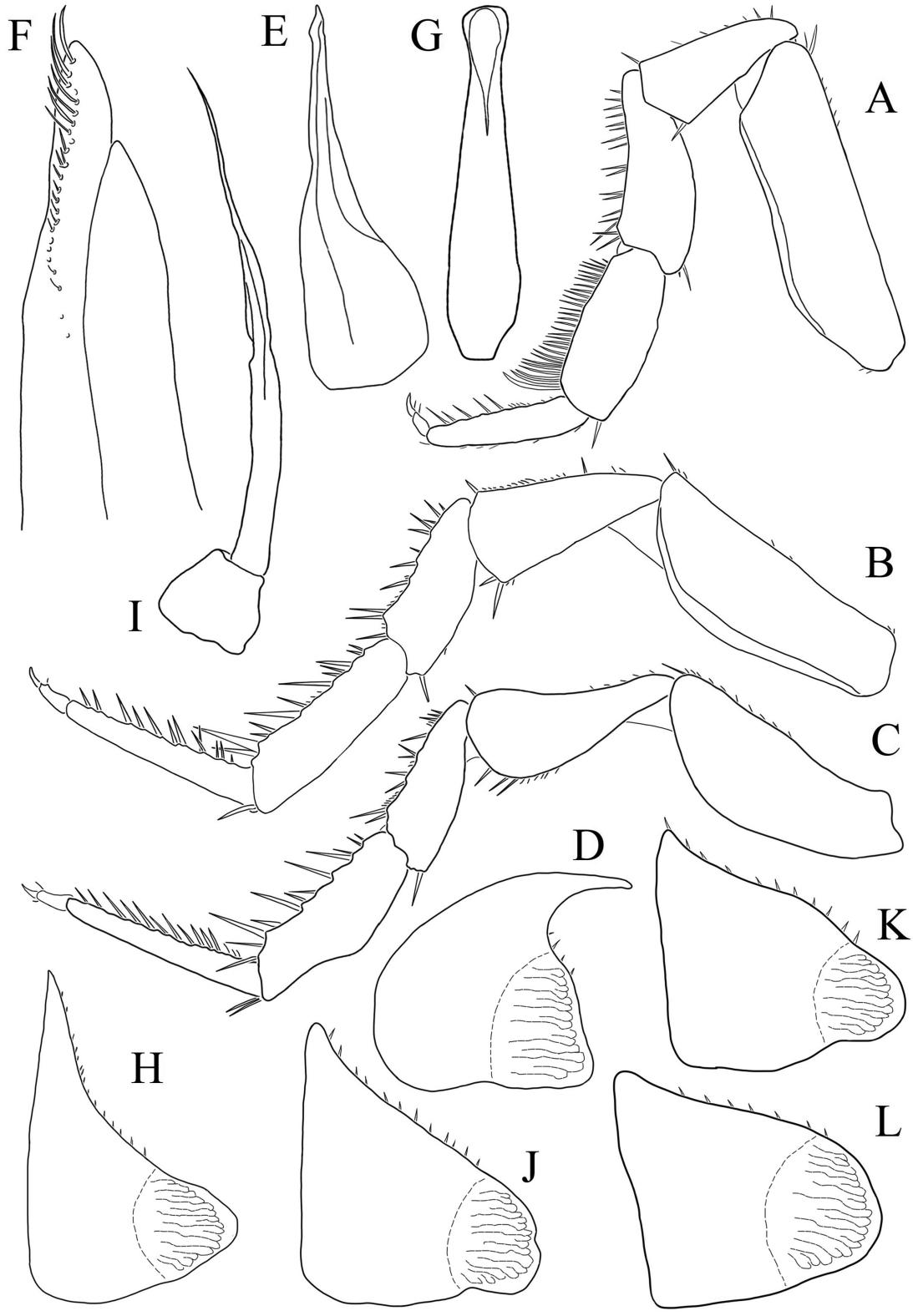

Fig. 10. *Trachelipus sulphuricus* sp.n. from Kamila Cave (Chechen Republic, Russia), male: A — pereopod 1; B — pereopod 6; C — pereopod 7; D — exopod of pleopod 1; E — endopod of pleopod 1; F — tip of endopod of pleopod 1; G — genital papilla; H — exopod of pleopod 2; I — endopod of pleopod 2; J — exopod of pleopod 3; K — exopod of pleopod 4; L — exopod of pleopod 5. No scale bars.

Рис. 10. *Trachelipus sulphuricus* sp.n. из пещеры Камила (Чеченская Республика, Россия), самец: A — переопод 1; B — переопод 6; C — переопод 7; D — экзопод плеопода 1; E — эндопод плеопода 1; F — вершина эндопода плеопода 1; G — генитальная папилла; H — экзопод плеопода 2; I — эндопод плеопода 2; J — экзопод плеопода 3; K — экзопод плеопода 4; L — экзопод плеопода 5. Без масштаба.

Left mandible (Fig. 9C) with pars incisiva with three teeth; basal to the lacinia is hairy lobe with four penicils; molar penicil consisting of tuft of plumose setae. Right mandible (Fig. 9D) with pars incisiva with four teeth; hairy lobe with four penicils; molar penicil as in left. Maxillula (Fig. 9G): medial corner of inner endite with two strong penicils. Apical edge of outer endite bearing ten teeth. Six medial teeth slenderer. Maxilla with bilobate edge, medial half of apical edge of inner lobe with dense brush of short hairs (Fig. 9F). Maxilliped with outer corner of endite with two acute tips and large spine near inner corner (Fig. 9E). Basal article of palp with two large spines. Tip of distal article of palp consisting of brush of spines. Pleopods with all exopods bearing uncovered lungs (Fig. 10D, H, J–K). Uropods (Fig. 7) with exopods flattened and cone shaped.

Male: Pereopods (Fig. 10A–C). Ischium of pereopod 7 with ventral margin slightly concave. Carpus has moderate dorsal crest, widest in middle of carpus (Fig. 10C).

Genital papilla of shape typical of genus (Fig. 10G). Exopod of pleopod 1 with long distal process parallel to base of segment directed outwards (Fig. 10D). Edge of pseudotrachea smooth. Endopod of pleopod 1 with dorsal furrow and with row of spines which become longer the closer to tip they are (Fig. 10E, F). Pleopod 2: exopod triangular with concave outer margin (Fig. 10H); endopod much longer than exopod, narrow, with parallel sides (Fig. 10I). Exopods of pleopods 3–5 (Fig. 10J–L) triangular, slightly decreasing in size from third to fifth.

ECOLOGY. The new species was discovered in a cave with active sulfuric acid speleogenesis (SAS) [Dzhabrailov *et al*., 2019; Chervyatsova *et al*., 2020], and this is the second invertebrate species described from SAS caves in the Caucasus. The SAS cave cluster of the lower reaches of Sharo-Agrun River valley is characterized by a wide range of sulfur-gypsum aggregates [Dzhabrailov *et al*., 2019; Chervyatsova *et al*., 2020], as well as the development of microbial mats of acidophilic bacteria and fungi [Kuzmina *et al*., 2019, 2022]. We consider *T. sulphuricus* sp.n. as a troglophile, since it is not a permanent inhabitant of caves and does not have troglomorphic features. The following invertebrate species are currently known for SAS caves cluster of the lower reaches of Sharo-Agrun River valley: trogloxene *Hyleoglomeris specialis* Golovatch, 1989, troglophile *Trachysphaera minuta* Golovatch, 1976 (Diplopoda: Glomeridae), trogloxene *Omobrachyiulus caucasicus* (Karsch, 1881), and troglobiont *Leucogeorgia umari* Antić et Turbanov, 2022 (Diplopoda: Julidae) [Golovatch *et al*., 2021, 2024; Antić, Turbanov, 2022].

DISTRIBUTION. Currently known from the type localities only.

COMPARATIVE REMARKS. The new species differs from other species of *Trachelipus* from the Caucasus as following.

From *Trachelipus tshetshenicus* sp.n., the new species is distinguished by the following characters: in males, the process of the exopodite of pleopod I is narrow (*vs.* wide in *T. tshetshenicus* sp.n.); in males, the carpopodite of pereiopod VII is narrow (*vs.* wide in *T. tshetshenicus* sp.n.); in males, the ischiopodite of pereiopod VII has a less concave caudal edge of the ischiopodite, the cranial edge and the end of the ischiopodite do not form a noticeable angle, the end of the ischiopodite is rounded (*vs.* more concave along the caudal edge of the ischiopodite, the cranial edge and the end of the ischiopodite form a right angle in *T. tshetshenicus* sp.n.).

From *Trachelipus lencoranicus* [Borutzky, 1976; Schmalfuss, 1986; Gongalsky *et al.*, 2023], to which the new species is most morphologically close and is distinguished by the following characters: dorsal scale-setae shorter than wide (*vs.* longer than wide in *T. lencoranicus*); pore fields closer to the middle of the body, noduli laterles closer to the edge (*vs.* closer to the middle of the body than pore fields in *T. lencoranicus*); lateral lobes of the head slightly longer than the frontal (*vs.* lateral lobes shorter than the frontal in *T. lencoranicus*).

From *Trachelipus caucasius* [Verhoeff, 1918; Schmalfuss, Khisametdinova, 2015], the new species is distinguished by the following characters: the frontal lobe of the head is developed (*vs.* not developed in *T. caucasius*); in males the exopodite of pleopod I has a notch in front of the process on the outer edge (*vs.* without a notch in front of the process on the outer edge in *T. caucasius*); in males the greatest width of the ischiopodite of pereiopod VII of the male is at distal part, the distal edge of the ischiopodite is concave (*vs.* the greatest width of the ischiopodite is at a distance from its end, the distal edge is very slightly concave, almost straight in *T. caucasius*); in males the ridge of the carpopodite of pereiopod VII is angular, its greatest width is almost in the middle of the carpopodite (*vs.* the crest is rounded, its greatest width is closer to the base of the carpopodite in *T. caucasius*).

From *Trachelipus lutshnikii* [Verhoeff, 1933; Schmalfuss, Khisametdinova, 2015], the new species is distinguished by the following characters: in males, the inner edge of the exopodite of pleopod I is uniformly rounded, its process extends almost parallel to the base (*vs.* the inner edge of the exopodite has two more or less straight sections with an angle between them, the process of the exopodite extends at a large angle to the base in *T. lutshnikii*); in males, the caudal edge of the ischiopodite of pereiopod VII is concave (*vs.* the caudal edge is almost straight in *T. lutshnikii*).

From *Trachelipus lignaui* [Verhoeff, 1918; Schmalfuss, Khisametdinova, 2015], the new species is distinguished by the following characters: in males the process of exopodite of pleopod I is almost parallel to the base (*vs.* the process is almost not curved, has a very large angle to the base in *T. lignaui*); in males the ridge of carpopodite of pereiopod VII is without a tooth (*vs.* with a large tooth in *T. lignaui*); the pore fields on the first pereonite are located at a distance from the edge (*vs.* the pore fields on the first pereonite are located almost at the very edge of the pereonite in *T. lignaui*); larger, up to 15.0 mm (*vs.* smaller, up to 8.5 mm in *T. lignaui*); body color violet-black with tiny yellow spots, forming wide white stripe on proximal part of epimeres, exopods of uropods violet-black (*vs.* light brown with usual light muscle spots, two rows of light streaks on bases of pereon-epimera, posterior parts of pereon-epimera, antennae and uropods yellowish in *T. lignaui*).

From *Trachelipus nassonovi* [Borutzky, 1976; Gongalsky *et al*., 2023], the new species is distinguished by the following characters: in males, the carpopodite of pereiopod VII has one ridge (*vs.* with two ridges in *T. nassonovi*); in males, the exopodite of pleopod I is rounded (*vs.* angular in *T. nassonovi*); the frontal lobe of the head is well developed (*vs.* less developed in *T. nassonovi*).

From *Trachelipus armenicus* [Borutzky, 1976; Gongalsky *et al*., 2023], the new species is distinguished by the following characters: in males, the carpopodite ridge of pereiopod VII clearly ends before the distal part of the carpopodite, the ridge is angular (*vs.* the comb occupies almost the entire carpopodite, rounded in *T. armenicus*); the frontal lobe of the head is slightly shorter than the lateral ones, triangular in shape (*vs.* the frontal lobe is rounded, protruding forward, the lateral lobes are small in *T. armenicus*); in males, the exopodite of pleopod I is rounded (*vs.* angular in *T. armenicus*); noduli laterales II–VI are closer to the lateral margin of the segments than the pore fields (*vs.* noduli laterales II–VI are further from the margin of the segments than the pore fields in *T. armenicus*).

From *Trachelipus utrishensis* [Gongalsky, 2017], the new species is distinguished by the following characters: the head

lobes are shorter (*vs.* the head lobes are longer in *T. utrishensis*); in males the carpopodite of pereiopod VII has a small ridge (*vs.* a large ridge in *T. utrishensis*); in males the endopodite of pleopod I has a straight tip (*vs.* with a curved tip in *T. utrishensis*); in males the process of the exopodite of pleopod I extends almost parallel to the base (*vs.* the process of the exopodite is slightly curved, has a very large angle to the base in *T. utrishensis*).

From *Trachelipus pieperi* [Schmalfuss, 1986; Gongalsky *et al*., 2023], the new species is distinguished by the following characters: in males, the process of the exopodite of pleopod I is not curved toward the base (*vs.* curved toward the base in *T. pieperi*); noduli laterales near the lateral margin, pore fields far from the margin (*vs.* noduli laterales and pore fields near the lateral margin in *T. pieperi*).

From *Trachelipus ensiculorum* [Verhoeff, 1949], the new species is distinguished by the following characters: in males, the process of the exopodite of pleopod I is wide, straight (*vs.* very thin, curved in *T. ensiculorum*); in males, the ridge of the carpopodite of pereiopod VII occupies most of the length of the carpopodite, the greatest width is close to the middle of the carpopodite (*vs.* the ridge on the carpopodite is short, occupies slightly more than half the length of the carpopodite, the greatest width is between the middle and the base of the carpopodite in *T. ensiculorum*).

From *Trachelipus razzautii* [Schmalfuss, Khisametdinova, 2015], the new species is distinguished by the following characters: the frontal and lateral lobes are approximately in line, the frontal is slightly shorter (*vs.* the frontal lobe is larger than the lateral ones in *T. razzautii*); in males the process of the exopodite of pleopod I is almost parallel to the base (*vs.* the process of the exopodite is almost not curved, has a very large angle to the base in *T. razzautii*); in males the carpopodite of pereiopod VII has a small ridge (*vs.* with a large ridge in *T. razzautii*); in males the endopodite of pleopod I has a straight tip (*vs.* with a curved tip in *T. razzautii*); body color violet-black with tiny yellow spots, forming wide white stripe on proximal part of epimeres, exopods of uropods violet-black (*vs.* light brown with pronounced yellowish muscle spots, two rows of light streaks on bases of pereonepimera and one median row, posterior corners of pereonepimera and uropods yellowish in *T. razzautii*).

Discussion

Although *Trachelipus tshetshenicus* sp.n. is morphologically closest to *T. lutshnikii*, it belongs to a different genetic lineage and its position on the phylogenetic tree belongs to a different clade (see Fig. 2). At the same time, *T. lutshnikii* is represented by two lineages on the tree (1 and 6) (Fig. 2); in our opinion, each of them represents a distinct species. *Trachelipus sulphuricus* sp.n. is morphologically closest to *T. lencoranicus*, but it has a different phylogenetic position (see Fig. 2). In terms of coloration patterns, *T. sulphuricus* sp.n. is most similar to *T. caucasius*; however, *T. caucasius* is represented on the tree by three lineages (4, 5 and 9), which are most probably separate species, and only lineage 9 belongs to the same species clade as *T. sulphuricus* sp.n.

A similar discrepancy between morphological and genetic data in the Caucasian species (*T. lutshnikii* and *T. caucasius*) is noted in a number of European species of *Trachelipus* [Parmakelis *et al.*, 2008; Raupach *et al.*, 2022], which are partially (*T. rathkii* — lineages 12–15, and *T. kytherensis* — lineages 16, 17) shown in Fig. 2. Moreover, such lineages can occur syntopically. Thus, in a number of cases, the reliability of the taxonomic characters still used in the genus seems questionable [Parmakelis *et al.*, 2008; Raupach *et al.*, 2022]. A detailed study of the type material and its comparison with the topotypical material is necessary, including affiliation of topotypes with genetic data. The obtained data will be compared with other morphologically similar populations, which will allow us to accurately determine their taxonomic status.

In a similar way, it is necessary to re-examine the Caucasian species *T. longipennis* and *T. gagriensis*, which are currently assigned the status of *nomen dubium* without any particular reason [Schmalfuss, Khisametdinova, 2015]. Also, to compare the Caucasian populations of *T. razzautii* with the topotypes from Italy, for which small interpopulation differences have been noted (e.g. the median frontal lobe is shorter and more rounded in the Italian specimens) [Schmalfuss, Khisametdinova, 2015].

Compliance with ethical standards

CONFLICT OF INTEREST: The authors declare that they have no conflict of interest.

Ethical approval: No ethical issues were raised during our research.

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