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Stygobiotic species of the genus *Niphargus* Schiödte, 1849 (Amphipoda: Niphargidae) from the Republic of Adygea, with a review and validation of the species from the northern slope of the Great Caucasian Ridge

Стигобионтный вид рода *Niphargus* Schiödte, 1849 (Amphipoda: Niphargidae) из Республики Адыгея, с обзором и подтверждением видов с северного склона Большого Кавказского хребта

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КЛЮЧЕВЫЕ СЛОВА. Разнообразие, филогения, таксономия, ракообразные, стигобионты, COI мтДНК, Кавказ.

ABSTRACT. Two stygobiotic species of the genus *Niphargus* Schiödte, 1849 (Crustacea: Amphipoda: Niphargidae) are discovered in the territory of the Republic of Adygea for the first time. The first species, described herein as *Niphargus circassianus* sp.n., was found in the hyporhean habitats of mountainous forest streams around Gut Mountain, in the valleys of the White (Belaya) and Dah rivers, near the village of Dakhovskaya. The second species, represented by a single tiny specimen and as such remains undescribed, was found during laboratory analysis of samples of the substratum taken from the Mezmaysky Spring (Maykop district, Hadzhoh). The article also provides a review of the records of the amphipod families Niphargidae and Crangonyctidae from Adygea, as well as formally taxonomically validates the previously described species of the genus *Niphargus* from the northern slope of the Great Caucasian Ridge and the Ciscaucasian Plain.

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РЕЗЮМЕ. Впервые на территории Республики Адыгея обнаружены два вида стигобионтных ракообразных рода *Niphargus* Schiödte, 1849 (Crustacea: Amphipoda: Niphargidae). Первый вид, описанный в статье как *Niphargus circassianus* sp.n., был обнаружен в гипогейных местообитаниях горных лесных ручьев вокруг горы Гут, в долинах рек Белая и Дах, недалеко от станицы Даховская. Второй вид, представленный единственным крошечным экземпляром, был обнаружен при лабораторном анализе образцов субстрата, взятых из Мезмайского родника (Майкопский район, Хаджох). В статье также представлен обзор описаний других представителей, в целом стигобиотионтных семейств амфипод (Niphargidae и Crangonyctidae), обитающих в Адыгее, а также официально валидизируются ранее описанные виды рода *Niphargus* с северного склона Большого Кавказского хребта и Предкавказской равнины.

Introduction

During the Pleistocene period (2.6 to 0.01 million years ago (Mya)), global climatic changes significantly changed the diversity and composition of fauna in the Caucasus and the adjacent Ciscaucasian plain [Webb, Bartlein, 1992; Krever *et al*., 2001; Zachos *et al*., 2001; Tarkhnishvili *et al*., 2012; Tarkhnishvili, 2014]. The Last Glacial Maximum (LGM, 23–18 Kya) had a significant impact on the terrestrial and subterranean fauna (e.g., Tarasov *et al*. [2000]; Willis *et al*. [2000]; Hewitt [2000, 2003, 2004]; Keppel *et al*. [2012]; Yanina [2020]). Ice sheets and a cold dry climate made large areas of Southern Europe and the Caucasus almost uninhabitable, especially during the Quaternary period, which is why their modern fauna is now severely impoverished (e.g., Tarasov *et al*. [2000]; Hewitt [2000]; Stewart, Lister [2001]). However, in some areas protected by mountain ranges or influenced by warm sea air masses, a relatively large variety of animals have been preserved in groundwater [Tarasov *et al*., 2000; Stewart, Lister, 2001; Provan, Bennett, 2008; Stewart *et al*., 2010; Schmitt, Varga, 2012; Kyrkjeeide *et al*., 2014]. These areas are usually fragmented, poorly

connected, and still poorly understood. Recent studies have shown that endemic and subendemic stygobiotic/subterranean animals have survived in their modern habitats along the northern lowlands of the Black and Azov Seas during past glacial periods, and it has been suggested that there was an ancient glacial refugium in the Prikubanskaya lowlands [Birštein, 1954; Dedyu, 1963; Topachevskii, 1969; Martynov, Godunko, 2013; Sidorov, Kovtun, 2015; Martynov, 2019; Tomilova *et al*., 2020; Marin, Palatov, 2023; Palatov, Marin, 2023] and the Republic of North Ossetia-Alania [Marin, Palatov, 2021, 2024; Anistratenko *et al*., 2022; Palatov, Sokolova, 2021]. Regions far from the coast and mountain ranges are currently less well-studied in terms of biodiversity and endemism compared to, for example, coastal areas of the Black Sea and South Caucasus. This lack of information or low diversity of cave and stygobiotic species in these regions can be primarily attributed to a lack of research, followed by the influence of past cooling and glacial periods.

The subterranean and stygobiotic fauna of the Republic of Adygea are currently known to be relatively poor. Only a few species have been identified from its territory, including the cave cricket *Dolichopoda euxina* Semenov, 1901 (Insecta: Orthoptera: Rhaphidophoridae) [Shapovalov *et al*., 2015]; stygomorphic turbellarian *Dendrocoelides* sp. (Turbellaria: Dendrocoelidae) [Shumeev, 2008]; and stygomorphic oligochaeta *Allolobophora cavatica* Michaelsen, 1910 (Oligochaeta: Crassiclitellata: Lumbricidae) [Michaelsen, 1910]. At the same time, no subterranean or stygobiotic crustaceans have been reported from Adygea so far, but several epigean representatives of generally stygobiotic families have already been identified. For example, epigean *Niphargus hrabei* S. Karaman, 1932 (Amphipoda: Niphargidae) in ponds and rice checks near the Prikubansky farm and ponds near Psekups [Palatov, Marin, 2021], and epigean *Synurella taurica* Martynov, 1931 (Amphipoda: Crangonyctidae) in the pond near Psekups [Marin, Palatov, 2022]. Undoubtedly, historical climatic events, especially periods of glaciation, have affected the presence and abundance of various groups of animals in the territory of Adygea. However, there are still large karst formations and deep caves in this area that could potentially preserve underground species that survived severe glaciation.

In 2023, we had the opportunity to study stygobiotic crustaceans in various habitats in the Adygea region and fortunately discovered two new species of these animals. The first species was found in the hyporhean habitats of mountainous forest streams around Gut Mountain, in the valleys of the Belaya and Dah rivers, near the village of Dakhovskaya. The second species, represented by a single tiny specimen, was found during laboratory analysis of samples of the substratum taken from the Mezmaysky Spring (44°16′51.3″N 40°10′42.3″E), located in the Hadzhoh, Maykop district. Both are the first stygobiotic species of the genus *Niphargus* discovered in the territory of the Republic of Adygea.

This article aims to describe one of these newly discovered stygobiotic species of the genus *Niphargus* found in the hyporhean habitats of mountainous forest streams in Adygea, as well as to review and formally validate previously described species of the genus *Niphargus* from the northern part of the Caucasus Range and the Ciscaucasian Plain (e.g., Marin, Palatov [2023, 2024]).

Materials and Methods

SAMPLE COLLECTION AND PROCESSING. Stygobiotic crustaceans were collected from various hypogean and subterranean water resources (springs, wells, cave reservoirs, and river hyporhea) in the mountainous area of the Republic of Adygea in July 2023. In our study, we conducted a random sampling from all available locations and water sources, as this was the first biogeographical survey in the area, which could not be conducted according to any scheme. A plastic hand-net with a pore size of about 1 mm was used to collect the crustaceans.

All collected crustaceans were preserved in 90% ethanol for molecular genetic analysis. At least one individual of each collected species from each location was used for genetic analysis in order to understand their genetic diversity and distribution in the region. The type material (holotype and paratypes) was deposited at the collection of the Zoological Museum of Moscow State University, Moscow (ZMMU); additional material was deposited in the authors' personal collection at the A.N. Severtsov Institute of Ecology and Evolution of RAS, Moscow (LEMMI).

MORPHOLOGICAL STUDY. All collected specimens were preliminarily processed, sorted based on specific morphological features, and photographed under an Olympus SX10 light microscope at standard magnifications of ×5, ×7, and ×10. Scanning electron microscopy (SEM) images were taken using a Vega3 Tescan microscope at the Paleontological Museum of the Paleontological Institute of the Russian Academy of Sciences, Moscow. Specimens were cleaned in an ultrasonic cleaner, dehydrated with acetone, and then critical-point dried (CPD). After that, the specimens were fixed on stubs with double-sided Scotch tape and coated with gold by sputtering using a Polaron PS 100.

The body length (bl., mm) was measured as the dorsal length from the distal margin of the head to the posterior margin of the telson, with the exclusion of both antennae and uropod III.

MOLECULAR GENETIC STUDY. To understand the genetic diversity within the studied amphipods a fragment of cytochrome oxidase C subunit I (COI mtDNA) was used [Avise, 1994; Hebert *et al*., 2003]. Total genomic DNA was extracted from muscle tissue using the innuPREP DNA Micro Kit (AnalitikJena, Germany). The gene marker was amplified by using the universal primers LCO1490 (5'–GGTCAACAAATCATAAAGATATTGG–3') and HC02198 (5'–TAAACTTCAGGGTGACCAAAAAATCA–3') under the standard protocol conditions [Folmer *et al*., 1994]. PCR products were then sequenced using a Genetic Analyzer ABI 3500 (Applied Biosystems, USA) and BigDye 3.1 (Applied Biosystems, USA) with forward and reverse primers. A consensus dataset of aligned sequences (~646 base pairs) was obtained with MEGA 7.0. The best evolutionary substitution model was determined using MEGA 7.0 [Kumar *et al*., 2016] and jModeltest2.1.141 (Diego Darriba, Universidade da Coruña as part of the Computer Architecture Group (GAC), Coruña, Spain) on XSEDE via the CIPRES (Cyber Infrastructure for Phylogenetic Research) Science Gateway V. 3.3 (http://www.phylo.org/, accessed on 30 December 2024). A phylogenetic analysis was conducted with PhyML 3.0 [Guindon *et al*., 2010] with several models based on BIC (Bayesian Information Criterion) and AIC (Akaike Information Criterion).

Uncorrected pairwise genetic distances (*p*-distances±SE) were calculated based on available sequences using MEGA

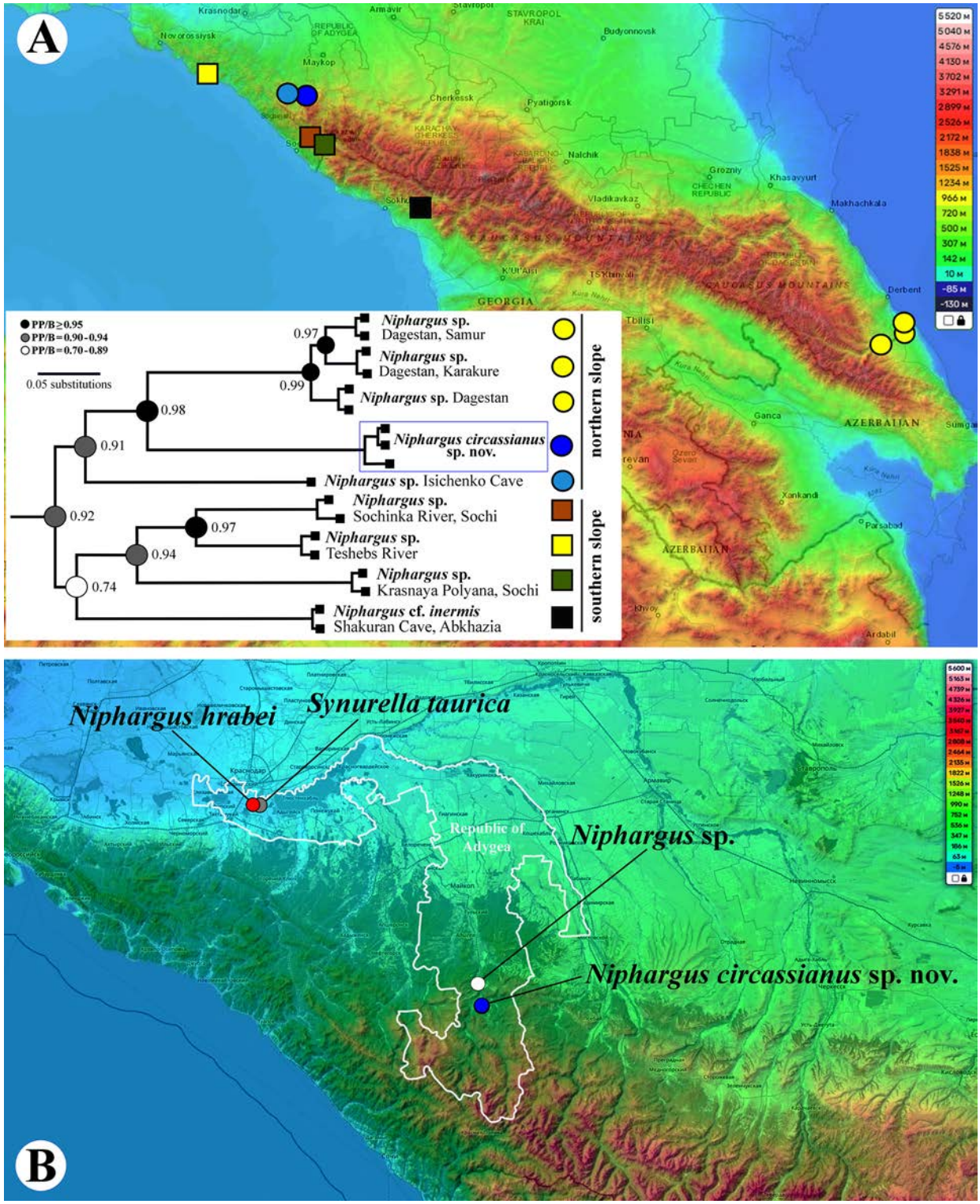

Fig. 1. A — map of distribution and phylogenetic relations of *Niphargus circassianus* sp.n. and mostly related species of the genus *Niphargus* along the Great Caucasian Range based on COI mtDNA gene marker (ML algorithm, GTR+G+I model); B — known distribution of the representatives of the genus *Niphargus* and *Synurella* in the Republic of Adygea (the borders of the republic are marked with a white line). The maps are taken from https://ru-ru.topographic-map.com

Рис. 1. А — карта распространения и филогенетические связи *Niphargus circassianus* sp.n. с наиболее родственными видами рода *Niphargus* вдоль Большого Кавказского хребта, основанная на маркере гена COI мтДНК (алгоритм ML, модель GTR+G+I); В — известное распределение представителей рода *Niphargus* и *Synurella* в Республике Адыгея (границы республики обозначены белой линией). Карты взяты из https://ru-ru.topographic-map.com

7.0 with the Kimura 2-Parameter (K2P) model of evolution [Kimura, 1980].

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Only primary synonyms are given in the article.

Results

Taxonomic account and description of a new species

Order Amphipoda Latreille, 1816
Family Niphargidae Bousfield, 1977
Genus *Niphargus* Schiödte, 1849

Niphargus circassianus Marin et Palatov sp.n.

Figs 2–6.

Material examined. HOLOTYPE, 1 ♂ (bl. 3.2 mm) (ZMMU Mb-1297), Russian Federation, Republic of Adygea, Maykop District, in a small spring (helokrene) located in the Belaya River valley, 4 km upstream from Dakhovskaya village, 44°11′13.06″N 40°09′50.51″E, about 505 m a.s.l., 10 July 2023, coll. I. Marin, D. Palatov.

PARATYPES, 1 ♂, 3 ♀♀ (bl. 2.5–3.5 mm) (ZMMU Mb-1298), same data and locality as holotype.

Additional material: 2 ♀♀ (LEMMI), same data and locality as holotype; 3 ♂♂, 9 ♀♀, Russian Federation, Republic of Adygea, Maykop District, hyporhean zone of the Bolshaya Zlobina River, 1 km upstream from the confluence with the Dakh River, 44°13′04.74″N 40°12′30.28″E, about 500 m a.s.l., 11 July 2023, coll. I. Marin, D. Palatov.

Etymology. The new species was named after the Circassians (Adygs), the people inhabiting the territory of the Republic of Adygea since at least the IVth Millennium BC.

Diagnosis. Small sized species, with the *body length* up to 3.5 mm. *Head* without eyes and pigmented spots on anterior lobe. Posteroventral corners of *epimeral plates I–II* rounded, *epimeral plate III* with triangularly produced posteroventral corner. *Urosomite I* with simple single setae; *urosomite II* with strong spines in posterodorsal angle on each side; *urosomite III* unarmed. Distal article of *mandibular palp* with a group of 4 A-setae, 2–3 B-setae, 11–12 D-setae and 4–5 E-setae. Outer lobe of *maxilla I* with 7 robust comb-like spines, carrying 0–1 thin tooth each. Dactyli of *pereopods III–VII* at inner margin with small additional spine near basis of nail. *Uropod I* rami of nearly equal length; *uropod III* similar in ♂♂ and ♀♀, with distal article about 5.5–6 times shorter than proximal article. *Pleopods* with 4 hooks in retinacules. *Telson* with 3–4 relatively long distal spines, 1–2 long or medium lateral spines, accompanying by 2 plumose setae on each side; dorsal surface without spines.

Description. BODY: depigmented, moderately slender.

HEAD (Fig. 6*d*): approximately 9–10% of body length; without rostrum, eyes and pigmented spots on anterior lobe; with subrounded lateral cephalic lobes and excavated anteroventral sinus (Fig. 6*d*).

PEREON: pereonites I–VII without setae, smooth (Fig. 6*a*).

PLEOSOMA: pleonites I–III with several short marginal setae on each posterodorsal margin (Fig. 6*a*).

EPIMERAL PLATES. Epimeral plates I–II with rounded posteroventral angles, epimeral plate III with triangularly produced posteroventral angle (Fig. 5*a–c*). Epimeral plate I (Fig. 5*a*): ventral margin slightly concave, without spines; posterior margin convex, with 2 setae along posterior margin, subrounded posteroventral angle with 1 strong seta. Epimeral plate II (Fig. 5*b*): ventral margin convex, with ventral 4 spines; posterior margin slightly convex, with 3 setae along posterior margin; subrounded posteroventral angle with 1 strong seta. Epimeral plate III (Fig. 5*c*): ventral margin convex, with 3 ventral spines; posterior margin with triangularly produced posteroventral angle with 1 strong seta, with 3 setae along posterior margin.

UROSOMITES (Fig. 6*b*): Urosomite I with 1 long simple seta on each side dorsolaterally; urosomite II with 1 strong spine on each side dorsolaterally; urosomite III unarmed.

COXAL PLATES: Coxal plate I of quadrate shape, with convex anteroventral corner (Fig. 2*f, g*). Width/depth ratios of coxal plates I–IV about 1/1, 0.9/1, 0.9/1 and 1/1, respectively; anterior margin with 5–6 setae each. Coxal plate IV ventrally concave (Fig. 4*c*). Coxal plates V–VI (Fig. 4*d, f*) anteriorly with large lobe with 1–3 setae; posterior margins with a single seta. Coxal plate VII (Fig. 4*h*) half-rounded shaped with 1 posterior seta. Coxal gills II–VI ovoid, length ratios of gills/bases of pereopods about 0.66/1, 0.75/1, 0.82/1, 0.75/1 and 0.52/1, respectively.

ANTENNA I (Fig. 2*a*): slender, 0.53–0.55X of body length; peduncular articles moderately slender, with ratio 1/0.72/0.44; flagellum consists of 18 articles, most of them with 2 short aesthetascs each; accessory flagellum short, 2-articulated (Fig. 2*b*). Length ratio of antennas I/II close to 1/0.6.

ANTENNA II (Fig. 2*d*): peduncular articles moderately slender, with several long setae along ventral margin, dorsal setae shorter than inner ones; flagellum relatively short, consisting of 8 articles with relatively short setae; lengths of peduncle articles IV/V about 1/0.83; flagellum about 0.80X of length of peduncular articles IV+V.

LABRUM (Fig. 3*a*) typical.

LABIUM (Fig. 3*b*): with entire, subrounded outer lobes and well developed smaller inner lobes.

MANDIBLES (Fig. 3*c–f*). Left mandible (Fig. 3*c, d*): incisor with 4 teeth, lacinia mobilis with 2 large teeth; with a row of 6 serrated setae between lacinia and molar, few spatulate setae and a single long seta at base of molar. Right mandible (Fig. 3*e, f*): incisor process with 4 teeth, lacinia mobilis with 4 blunt teeth, with a row of 6 serrated setae between lacinia and molar; ratio of mandibular palp article II/III (distal) about 1/0.97–1.0; proximal article of palp without setae; article II with 7–8 setae; distal article with a group of 4 A-setae, 2–3 B-setae, 11–12 D-setae and 4–5 E-setae.

MAXILLA I (Fig. 3*g*): inner lobe with 1 long distal seta, outer lobe with 7 robust comb-like spines, carrying 0–1 thin denticles each, innermost tooth with 5 tiny denticles (0–0–0–0–1–5) (Fig. 3*h*)); palp 2-articulated, distal article with 4 simple setae distally.

MAXILLA II (Fig. 3*i*): both plates with numerous long distal simple setae, outer lobe with row of fine setae along outer margin.

MAXILLIPED (Fig. 3*j*): inner plate short, with 3 distal robust setae intermixed with 3 distal simple setae; outer plate reaching half of palpal article II, with a row of 11 distolateral spines and distal setae; palpal article III with 1 median setae at outer margin; palpal article IV with numerous strong setae at outer margin; nail shorter than pedestal, with 1 seta near basis.

GNATHOPOD I (Fig. 2*f, g*): basis width/length about 0.37/1; ischium with a group of 3–4 posterodistal setae; carpus about 0.48X of basis length and 0.64X of propodus length, with a single distal group of setae anteriorly, with transverse rows of setae along posterior margin and a row of setae posterolaterally; propodus trapezoidal, setose, with row of setae at posterior margin; anterior margin with a single group of setae in addition to anterodistal group of long setae; with several groups of short setae on the inner surface; palmar corner armed with 1 long spiniform palmar seta, 3 serrated spiniform setae and a single supporting spiniform seta on inner surface (Fig. 2*h*); nail length about 0.5X of total dactylus length, with a single seta on anterior margin.

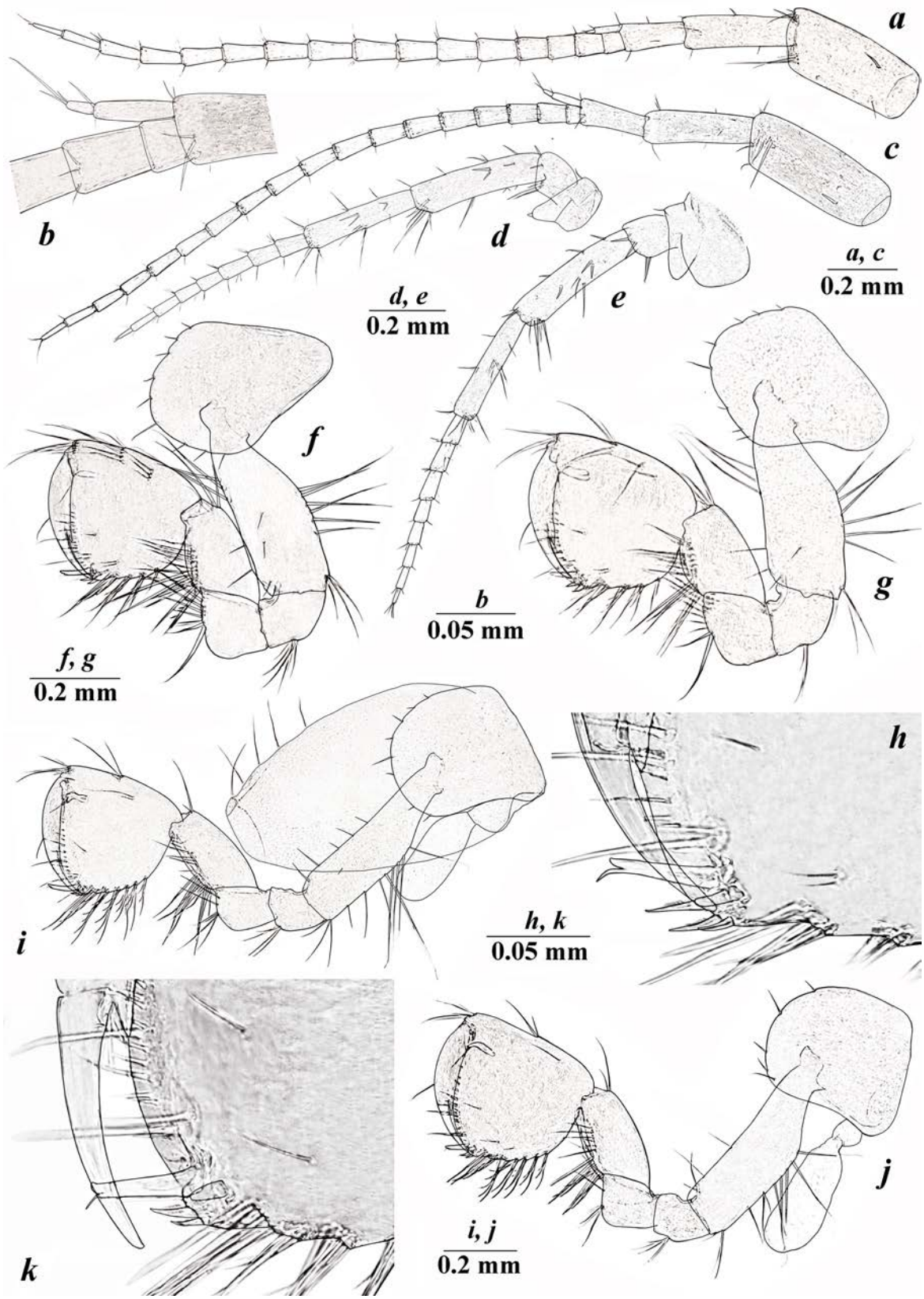

Fig. 2. *Niphargus circassianus* sp.n., ♂: (*b, c, e, g, h, k, j*) and ♀ (*a, d, f, i*): *a, c* — antenna I; *b* — accessory flagellum of antenna I; *d, e* — antenna II; *f, g* — gnathopod I; *h* — palmar margin of chela of GI; *i, j* — gnathopod II; *k* — palmar margin of chela of GII.

Рис. 2. *Niphargus circassianus* sp.n., ♂: (*b, c, e, g, h, k, j*) и ♀ (*a, d, f, i*): *a, c* — антенна I; *b* — дополнительный жгутик антенны I; *d, e* — антенна II; *f, g* — гнатопода I; *h* — пальмарный край GI; *i, j* — гнатопода II; *k* — пальмарный край GII.

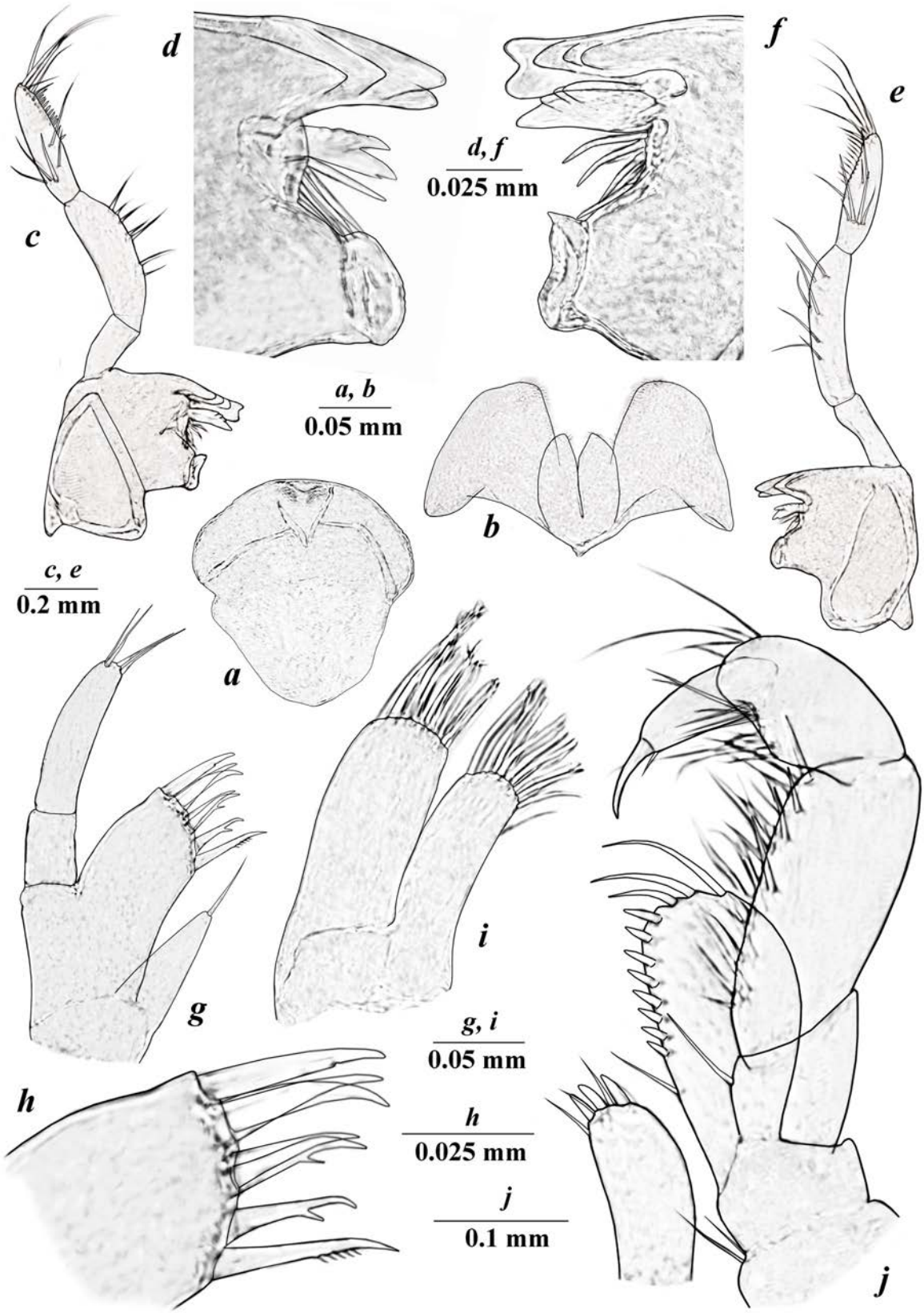

Fig. 3. *Niphargus circassianus* sp.n., ♂: *a* — labrum; *b* — labium; *c, e* — mandibles; *d, f* — incisor process and *pars incisiva*; *g* — maxilla I; *h* — distal margin of upper endite; *i* — maxilla II; *j* — maxilliped.

Рис. 3. *Niphargus circassianus* sp.n., ♂: *a* — верхняя губа; *b* — нижняя губа; *c, e* — мандибулы; *d, f* — резцовый отросток и нижняя часть резца; *g* — максилла I; *h* — дистальный край верхнего эндита; *i* — максилла II; *j* — максиллипеда.

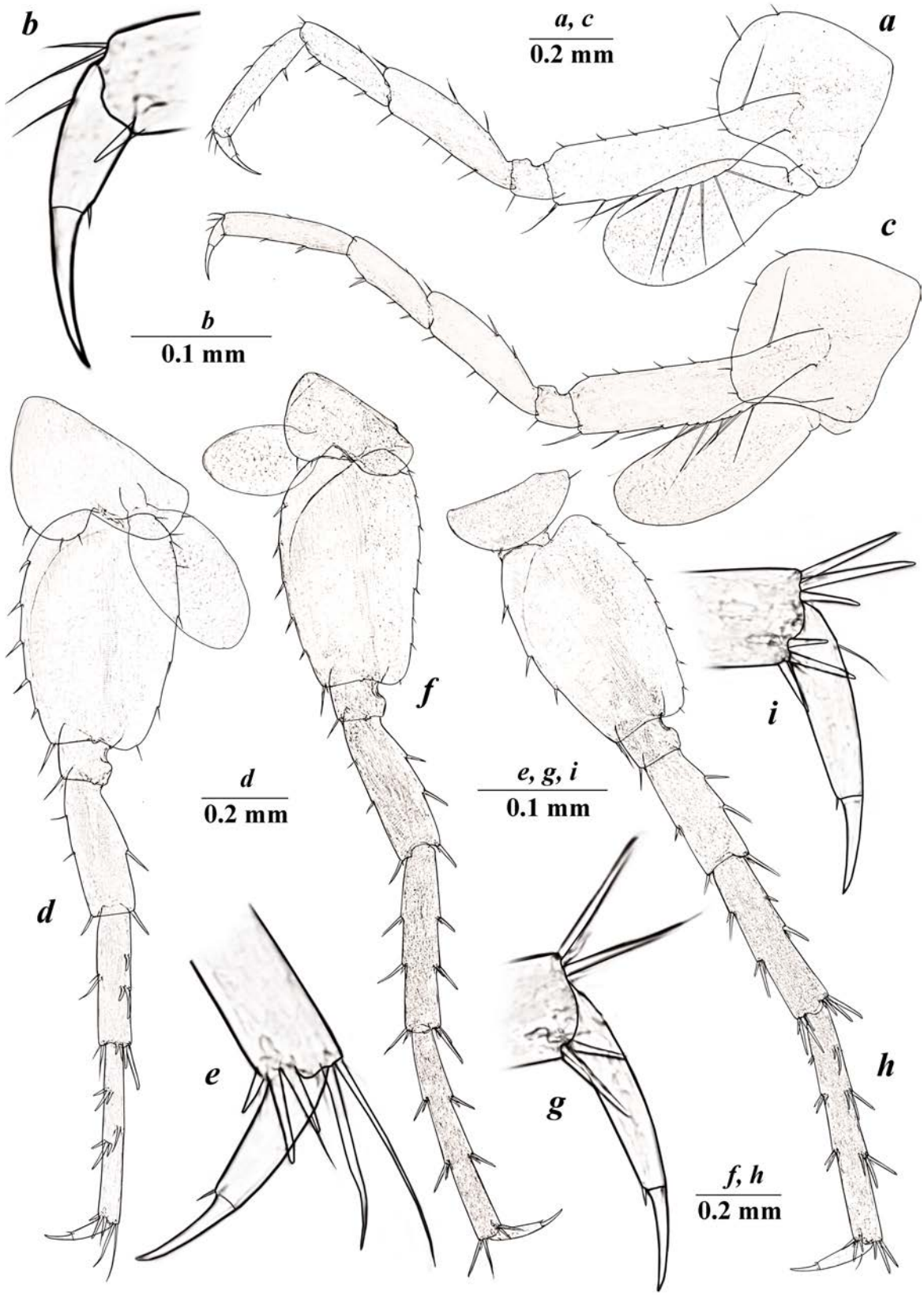

Fig. 4. *Niphargus circassianus* sp.n., ♂: *a* — pereopod III; *b* — dactylus of PIII; *c* — pereopod IV; *d* — dactylus of PIV; *e* — pereopod V; *f* — dactylus of PV; *g* — pereopod VI; *h* — dactylus of PVI; *i* — pereopod VII; *j* — dactylus of PVII.

Рис. 4. *Niphargus circassianus* sp.n. ♂: *a* — переопода III; *b* — дактилус PIII; *c* — переопода IV; *d* — дактилус PIV; *e* — переопода V; *f* — дактилус PV; *g* — переопода VI; *h* — дактилус PVI; *i* — переопода VII; *j* — дактилус PVII.

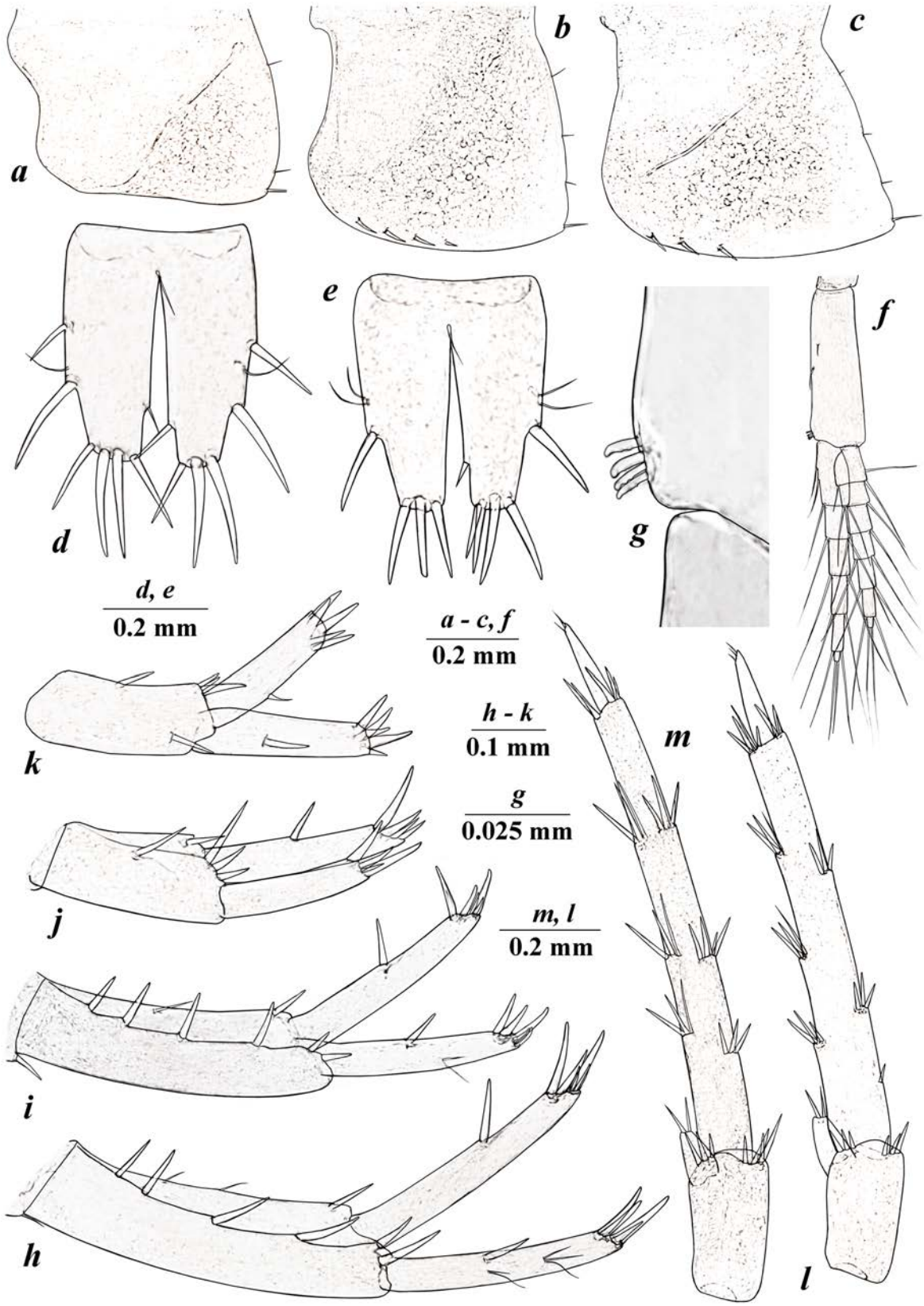

Fig. 5. *Niphargus circassianus* sp.n., ♂: (*a–d, f–i, k, m*) and ♀ (*e, h, j, l*): *a–c* — epimeral plates I–III; *d, e* — telson; *f* — pleopod III; *g* — retinacle of pleopod II; *h, i* — uropod I; *j, k* — uropod II; *l, m* — uropod III.

Рис. 5. *Niphargus circassianus* sp.n., ♂: (*a–d, f–i, k, m*) и ♀ (*e, h, j, l*): *a–c* — эпимеральные пластины I–III; d, *e* — тельсон; *f* — плеопода III; *g* — ретинакула плеопод II; *h, i* — уропода I; *j, k* — уропода II; *l, m* — уропода III.

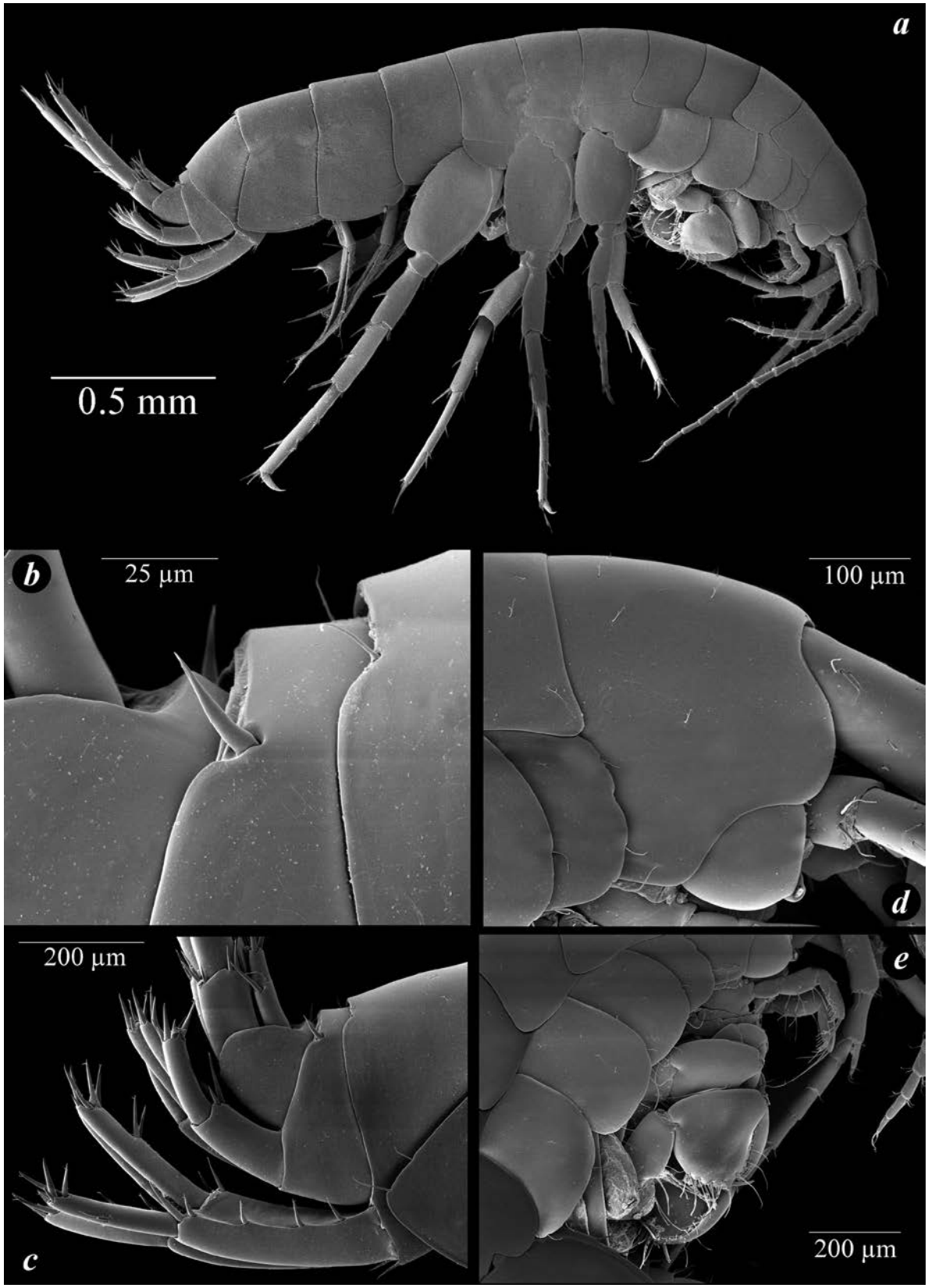

Fig. 6. *Niphargus circassianus* sp.n., SEM, ♂: *a* — general lateral view; *b* — dorsal part of urosomal somites; *c* — urosome and uropods I–II; *d* — head; *e* — gnathopods I–II.

Рис. 6. *Niphargus circassianus* sp.n., SEM, ♂: *a* — общий вид сбоку; *b* — дорсальная часть сомитов уросомы; *c* — уросома и уроподы I–II; *d* — голова; *e* — гнатоподы I–II.

GNATHOPOD II (Fig. 2*i, j*): basis width/length about 0.27/1; ischium with 4 posterodistal setae; carpus about 0.61X of basis length and 0.86X of propodus length, with distal group of setae anteriorly, few transverse rows of setae along posterior margin and a row of setae posterolaterally; propodus trapezoidal, setose, larger than propodus of GI (I/II as 0.86/1), posterior margin with rows of long simple setae, anterior margin with a single group of 2 setae in addition to 4–5 anterodistal setae, with 3 setae on inner surface; palmar corner armed with 1 long spiniform palmar seta, 2 serrated spiniform seta and a single supporting spiniform seta on inner surface (Fig. 2*k*); dactylus with a single seta on anterior margin, nail length is about 0.37X of total length of dactylus.

PEREOPODS III–IV (Fig. 4*a–c*) almost similar in size and shape; basis about 4.3X as long as wide, with posterior margin bearing long marginal setae, with distoventral group of setae; ischium short, almost quadrate, with ventrodistal single seta; merus slender, about 3.8–4.0X as long as wide, with simple setae along dorsal and ventral margins; carpus about 3.3–3.5X as long as wide, with simple setae along dorsal and ventral margins; carpus/propodus ratio about 0.85/1; propodus about 5.3X as long as wide, with 2 groups of spines along ventral margin, and distoventral strong spine-like setae; dactylus (Fig. 4*b*) relatively stout, curved, sharp distally, with 1 small ventral seta at base of nail and 1 small plumose seta at outer margin; ratio of dactyli of propodus of PIII/IV about 0.9/1, nail length 0.50–0.55X of the total length of dactylus.

PEREOPODS V–VII (Fig. 4*d, f, h*); length ratio of PpV/VI/VII close to 1/1.35/1.40; length of PVII is about 0.6X of total body length.

PEREOPOD V (Fig. 4*d*): basis relatively stout, about 1.4X as long as wide, close to rectangular, with feebly marked posteroventral lobe, posterior and anterior margins slightly convex, posterior margin with 7 small marginal setae, without facial setae, anterior margin convex, with 5 slender marginal setae, which are distinctly longer and stouter than posterior ones; ischium short, almost quadrate; merus stout, about 2.7X as long as wide, with simple setae and spines along dorsal and ventral margins; carpus about 4.5X as long as wide, with simple setae along dorsal and ventral margins; carpus/propodus ratio about 0.8/1; propodus slender, about 7.8X as long as wide, with several bunches of short spines, with 3 distoventral and 2 long distodorsal spines; dactylus (Fig. 4*e*) with 1 small ventral seta at base of nail and 1 short plumose seta at outer margin.

PEREOPOD VI (Fig. 4*f*): basis about 1.6X as long as wide, with feebly marked posteroventral lobe, posterior and anterior margins slightly convex, posterior margin with 9 small marginal setae, without facial setae, anterior margin convex, with 5 slender marginal setae, which are distinctly longer and stouter than posterior ones; ischium short, almost quadrate; merus stout, about 3.0X as long as wide, with simple setae and spines along dorsal and ventral margins; carpus about 4.8X as long as wide, with simple setae along dorsal and ventral margins; carpus/propodus ratio about 0.8/1; propodus slender, about 7.2X as long as wide, with several bunches of short spines, with 3 distoventral and 2 long distodorsal spines; dactylus (Fig. 4*g*) with 1 small ventral seta at base of nail and 1 short plumose seta at outer margin.

PEREOPOD VII (Fig. 5*h*): mostly similar to PVI; basis relatively stout, about 1.5X as long as wide, posterior and anterior margins convex, with feebly marked posteroventral lobe, posterior margin with 10 tiny marginal setae, without facial setae, anterior margin convex, with 3 slender marginal setae, which are distinctly longer and stouter than posterior ones; ischium wider than long; merus stout, about 2.5X as long as wide, with simple setae and spines along dorsal and ventral margins; carpus about 4.6X as long as wide, with simple setae along dorsal and ventral margins; carpus/propodus ratio about 0.7/1; propodus slender, about 8.0X as long as wide, with several bunches of short spines, and 3 distoventral and 4 distodorsal spines; dactylus (Fig. 4*i*) with 1 small ventral seta at base of nail and 1 short plumose seta at outer margin.

PLEOPODS (Fig. 5*f*): pleopods I–II with basal segments smooth, with 4 hooks in retinacules (Fig. 5*g*).

UROPOD I (Fig. 5*h, i*): protopodite about 3.6X as long as wide, with 4 dorso-external spines and 1–2 dorso-internal setae; rami straight and subequal in length both in ♂♂ and ♀♀; length ratio of protopodite/endopodite/exopodite about 1.0/0.7/0.7; endopodite almost straight, about 5.5–6.0X as long as wide, with 1 strong spine and 1–2 groups spiniform setae laterally and 5 strong spines apically; exopodite not paddle-like, straight, about 6.0–6.4X as long as wide, with 1 strong spine laterally and 5 spines apically; ratio of exopodite/endopodite lengths is 0.97/1.

UROPOD II (Fig. 5*j, k*): protopodite about 2.6X as long as wide, with 4 dorso-external spines and 1 dorso-internal setae; rami straight and subequal in length both in ♂♂ and ♀♀; length ratio of protopodite/endopodite/exopodite about 1.0/0.9/0.8; endopodite almost straight, about 3.8X as long as wide, with 0–1 strong spine laterally and 5 strong spines apically; exopodite straight, about 3.7X as long as wide, with 1 strong spine laterally and 5 spines apically.

UROPOD III (Fig. 5*l, m*): about 0.27–0.30X of body length both in ♂♂ and ♀♀; protopodite about 1.7X as long as wide, with numerous apical spines; rami unequal, endopodite short, about 8.8–9.0X shorter than exopodite, without setae laterally and 2 setae apically; distal article is 4.5X shorter than proximal article, with 2–3 simple setae apically; proximal article about 7.5X as long as wide, with 3 groups of thin-flexible, spiniform and plumose setae along inner margin and 2–3 groups of spiniform setae along outer margin.

TELSON (Fig. 5*d, e*): about 1.2X as long as wide; cleft about 0.8X of telson length; margins weakly rounded or rounded and narrowing apically; with variable setal pattern, including 3–4 apical spiniform setae, 2 lateral spiniform setae, accompanying by 2 plumose setae on each side; apical spiniform setae are 0.46–0.50X of length of telson.

Coloration. Body coloration is translucent white.

Body size. The largest collected ♀ has bl. 3.5 mm.

GenBank Accession Number. PV158270, PV158271.

ZooBank registration. The LSID for this species is: urn:lsid:zoobank.org:act:D3D5FC22-7EDC-4D07-AAA7-0DBCA1ACD812.

Molecular phylogenetic approach. The molecular genetic analysis revealed the monophyly (ML–BS=95%) of the studied phylogenetic lineage, including *Niphargus circassianus* Marin et Palatov sp.n. and several undescribed species from the northern and the southern slopes of the Great Caucasian Ridge (see Fig. 1). The phylogenetic analysis also supports the relationship of this lineage with some representatives of the "*carpathicus*" species group (after Straškraba [1972]), being phylogenetically related to *Niphargus amirani* Marin, 2020 and other species within the "*Niphargus borutzkyi*" ingroup (see Marin *et al*, [2023]), *Niphargus alanicus* Marin et Palatov, 2021 and *Niphargus* cf. *inermis* Birštein, 1940.

The intraspecific genetic differences (*p*-distances±SE) within *Niphargus circassianus* Marin et Palatov sp.n. is about 3.4% (0.034±0.008 substitutions per 100 nucleotides), with the difference between populations close to 5% (0.050±0.010 substitutions per 100 nucleotides). These genetic distances are close to interspecific ones, but at this time, no significant morphological differences have been observed between the populations, and we consider them to be a single biological species.

Table 1. Uncorrected pairwise genetic (COI mtDNA) distances (*p*-distance±SE) (substitutions per 100 nucleotides) between *Niphargus circassianus* Marin et Palatov sp.n. (n=3) and other phylogenetically relative congeners.
Таблица 1. Нескорректированные парные генетические дистанции (COI мтДНК) (*p*-дистанция±SE) (замены на 100 нуклеотидов) между *Niphargus circassianus* Marin et Palatov sp.n. (n=3) и другими филогенетически родственными представителями рода.

Species (or locality for undescribed species)	***p*-distances±S.E.**
Niphargus sp. — Samur Karakure (n=2)	0.178±0.024
Niphargus sp. — Teshebs River (n=2)	0.182±0.025
Niphargus sp. — Dagestan (n=2)	0.189±0.025
Niphargus sp. — Krasnaya Polyana, Sochi (n=2)	0.191±0.024
Niphargus sp. — Dagestan Samur (n=2)	0.197±0.026
Niphargus alanicus (n=6)	0.197±0.027
Niphargus sp. — Isichenko Cave (n=1)	0.198±0.024
Niphargus "borutzkyi" species ingroup (n=8)	0.200±0.027
Niphargus sp. — Sochinka River, Sochi (n=3)	0.213±0.027
N. cf. *inermis* — Nizhne Shakuran Cave, Abkhazia (n=2)	0.233±0.031
Niphargus sp. — Mezmaysky Spring, Adygea (n=1)	0.245±0.031

The interspecific genetic distances (*p*-distance±SE) between the species with the studied group mostly exceed 17% (see Table 1), which justifies the long isolation of these species over a period of more than 4–6 Mya (sensu Lefébure *et al*. [2006, 2007]; Copilaş-Ciocianu, Petrusek [2018]; Guy-Haim *et al*. [2018]; Copilaş-Ciocianu *et al*. [2019]). The genetic divergence between *Niphargus circassianus* Marin et Palatov sp.n. and the species (*Niphargus* sp.) found in the Mezmaysky Spring (Adygea) (see below) is close to 24% (0.245±0/031 substitutions per 100 nucleotides) showing that these species are not phylogenetically related.

Taxonomic remarks. The new species can be easily separated from the phylogenetically related and already described *Niphargus alanicus* Marin et Palatov, 2021 (after Marin, Palatov [2021]) by 1) by the relatively feebly distally produced and subrounded lateral cephalic lobe; 2) the presence of a simple seta on dorsolateral margin of urosomal somite I (vs. a strong spine); 3) the presence of a small spine-like setae on the inner margin of dactyli of pereopods III–VII (vs. a tiny seta); 4) the presence of 4 ventral short spine-like setae along ventral margin of epimeral plate II (vs. only 2 long setae); 5) the presence of 1 spiniform seta laterally on rami of uropod I (vs. 3 spiniform setae); and 6) the presence of 1–2 lateral strong spines on telson lobes (vs. 2–3 long lateral spines).

From the species of the "*Niphargus borutzkyi*" species ingroup, currently including *Niphargus borutzkyi* Birštein, 1933, *N. amirani* Marin, 2020, *N. rachalechkhumensis* Marin, Barjadze, Maghradze et Palatov, 2023 and *N. tvishiensis* Marin, Barjadze, Maghradze et Palatov, 2023 (see Marin [2020]; Marin *et al*. [2023]), by 1) relatively feebly distally produced and subrounded lateral cephalic lobe; 2) the presence of a simple seta on dorsolateral margin of urosomal somite I (vs. 2 simple setae) and single strong spine on dorsolateral margin of urosomal somite II (vs. several spines accompanying with several simple setae); 3) 4 hooks in retinacules of pleopods (vs. 6–8 hooks); 4) the presence of 1 spiniform seta laterally on rami of uropod I (vs. 2 spiniform setae); 5) the presence of 1 spiniform seta laterally on rami of uropod II (vs. 2 spiniform setae); 6) significantly shorter distal article of uropod III in ♂♂; and 7) the presence of 1–2 lateral strong spines on telson lobes (vs. usually 2–3 long lateral spines).

From *Niphargus inermis* Birštein, 1940 (see Birštein [1940]; Marin, Palatov [2021]), by 1) relatively feebly distally produced and subrounded lateral cephalic lobe; 2) the presence of a single spine on dorsolateral margin of urosomal somite II (vs. a strong spine and a simple seta); 3) the presence of 4 ventral short spine-like setae along ventral margin of epimeral plate II (vs. only 2 long setae) and 3 ventral short spine-like setae along ventral margin of epimeral plate III (vs. only 2 long setae); and 4) the presence of 1 spiniform seta laterally on rami of uropod I (vs. 3 spiniform setae).

Morphological differences from undescribed species within this group will be presented at a later date, once these species have been fully described.

Distribution and Ecology. Currently, this species is found only in the small mountainous streams and springs located in the forest zone of the foothills of around Gut Mountain (44°11′45.3″N 40°12′20.2″E), in the valleys of the White (Belaya) and Dah rivers, near the village of Dakhovskaya, the Republic of Adygea.

Niphargus sp.

Material. 1 damaged specimen (bl. 3.0 mm), Russian Federation, North Caucasus, the Republic of Adygea, Maykop District, Hadzhoh, Kamennomostskij, in the Mezmaysky Spring, 44°16′51.3″N 40°10′42.3″E, about 450 meters above the sea level, 12 July 2023, coll. D. Palatov, I. Marin.

Remarks. This species is obviously stygobiotic. According to the molecular-genetic analysis of the single available specimen, the species belongs to the "*carpathicus*" species group, being closely related to the Georgian "*Niphargus alasonius*" species complex, most of the North Ossetian species (see below; [Marin, Palatov, 2024]) and southwestern Caucasian species group, including *Niphargus smirnovi* Birštein, 1952, *Niphargus caelestis* G. Karaman, 1982, *N. latimanus* Birštein, 1952 and several other undescribed species [Marin, Palatov, in prep.]. This species is not phylogenetically closely related to the *Niphargus circassianus* sp.n. described above, with the genetic divergence between the species close to 24% (0.245±0/031 substitutions per 100 nucleotides) (see Table 1).

Distribution. The species known only from the Mezmaysky Spring, 44°16′51.3″N 40°10′42.3″E, in the Republic of Adygea.

A review and formal validation of the previously described species of the genus *Niphargus* from the northern part of the Caucasus Range and the Ciscaucasian Plain

Seven extant species of the genus *Niphargus* were recently described by Marin and Palatov, [2023a, 2024] from the Ciscaucasian Plain (Rostov-on-Don) and the Republic of North Ossetia-Alania. Unfortunately, Diversity (ISSN 1424-2818) and Waters (ISSN 2073-4441), in which the descriptions were published, were online-only journals and did not include a correct ZooBank registration number (LSID), which is required for validation of new names in electronic-only publications (ICZN, 2012). Consequently, the following names, *Niphargus rostovi* Marin et Palatov, 2023 (see Marin, Palatov [2023a]), *N. zeyensis* Marin et Palatov, 2024, *N. ardonicus* Marin et Palatov, 2024, *N. fiagdonicus* Marin et Palatov, 2024, *N. osseticus* Marin et Palatov, 2024, *N. sadonicus* Marin et Palatov, 2024 and *N. tschertschesovae* Marin et Palatov, 2024 (see Marin, Palatov [2024]) were not available (nomina nuda), according to ICZN standards [ICZN 1999, 2012]. Therefore, the present note serves to validate these names by fulfilling the ICZN conditions for nomenclatural availability. The holotypes of all species are deposited in the collection of the Zoological Museum of Moscow State University (ZMMU), Moscow, Russia. The present journal Arthropoda Selecta (ISSN 0136-006X) has published paper copies and the publication of new species names are valid upon publication of this article. Accordingly, the date and authorship of the new species names are those of this note and not those of Marin, Palatov [2023a, 2024].

Order Amphipoda Latreille, 1816
Family Niphargidae Bousfield, 1977
Genus *Niphargus* Schiödte, 1849

Niphargus rostovi Marin et Palatov sp.n.

Niphargus rostovi Marin et Palatov, 2023a, 6, figs 2–7, n.nud.

Type series. HOLOTYPE, ♂ (bl. 3.0 mm), ZMMU Mb-1259, Russian Federation, the Northern Black/Azov Sea Lowland, Rostov Oblast', Rostov-on-Don, Proletarskiy district, 47°13′59.9″N 39°47′00.1″E, about 40 m a.s.l., a small spring on a shore of the Kiziterinka River, hand net sampling, coll. D. Palatov et I. Marin, 18 May 2022.

PARATYPES, 1♂, 1♀ (bl. 3.0 and 2.5 mm), ZMMU Mb-1260, same locality and data as for holotype.

Diagnosis. *Head* without eyes or pigmented spots on anterior lobe. Posteroventral corners of *epimeral plates I–II* rounded and bluntly, produced in *epimeral plate III*. *Urosomite I* unarmed, *urosomite II* with 1 strong spine in a posterodorsal angle, one on each side; *urosomite III* unarmed. Accessory flagellum of *antenna I* short, 2-articulated. Article III of *mandibular palp* equal to article II, with 1 A-seta; 1 C-seta; 8–10 D-setae and 4 E-setae. Outer plate of *maxilliped III* with strong spines. Dactyli of *pereopods III–VII* simple, with small simple seta at the inner margin near basis of nail, dactyli of *pereopods III–VII* elongated, about 4–5 times as long as it is wide. Rami of *uropod I* of nearly equal length, equal in length to basal segment. *Pleopods* with 2 hooks in retinacules, without setae. *Telson* elongated, with 3 relatively long distal spines, accompanied by 1–2 simple setae on each side; dorsal surface with a tuft of 2–3 long simple setae in the medial part.

Description. For the complete description see Marin & Palatov [2023a].

Taxonomic remarks. *Niphargus rostovi* Marin et Palatov sp.n. can be easily separated from most closely related *Niphargus karkabounasi* Ntakis, Anastasiadou, Zakšek et Fišer, 2015 by the presence of un-armed (smooth) spines on outer lobe of maxilla I (vs. usually with 1–2 lateral teeth; trapezoidal form of palm (propodus) of both gnathopods I–II (vs. distinctly triangular); unarmed protopodite of uropod II (vs. 1–2 dorsointernal spines); rounded and non-produced posteroventral angle of epimeral plate I (vs. sharply posteriorly produced), and stouter and shorter distal spines of lobes of telson.

For the comparison with other congeners see Marin & Palatov [2023a].

GenBank accession numbers. OQ918541, OQ918542.

ZooBank registration. The LSID for this species is: urn:lsid:zoobank.org:act:E6AABADF-145B-4C0F-B72D-AE9D6ECB9771.

Distribution. The species is known only from a single spring (47°13′59.9″N 39°47′00.1″E) located on the slope of the Kiziterinka River in the Proletarskiy district (Nakhichevan-on-Don) within the borders of the city of Rostov-on-Don.

Niphargus ardonicus Marin et Palatov sp.n.

Niphargus ardonicus Marin et Palatov, 2024: 9, figs S1–S4, S11a, b, n.nud.

Type series. HOLOTYPE: ♀ (bl. 10 mm) (ZMMU Mb-1282), Russian Federation, North Caucasus, the Republic of North Ossetia–Alania, Alagirsky District, a spring in the Ardon River Valley, about 8 km south of Alagir, 42°55′31.79″N 44°11′26.14″E, about 823 m a.s.l., coll. D. Palatov, 3 October 2020.

PARATYPES: 2♀♀ (ZMMU Mb-1283), same data as for holotype.

Diagnosis. *Head* without pigmented spots on anterior lobe. Posteroventral corners of *epimeral plates I–III* rounded. *Uropod II* with 2 strong spines at posterodorsal angles on each side. Distal article of *mandibular palp* with a group of 4–6 A-setae, 2–3 B-setae, 14–15 D-setae, and 4–5 E-setae. Outer lobe of *maxilliped I* with 7 robust comb-like spines, carrying 5–6 thin teeth each. Dactyli of *pereopods III–IV* at the inner margin without strong spines near the bases of nails. Dactyli of *pereopods V–VII* with a small additional spine. Rami of *uropod I* of equal length. Retinacules of *pleopods II–III* with 5 hooks. *Telson* with 3–4 relatively long distal spines, 1–2 long or medium lateral spines, and 2 plumose setae on each side.

Description. For the complete description and differences from congeners see Marin & Palatov [2024, Supplementary Materials (Figs S1–S4 and S11*a*, *b*)].

Taxonomic remarks. The species can be easily separated from already described *N. alanicus* Marin et Palatov, 2021 by: 1) the presence of numerous smaller spine-like setae along outer margin of robust spines of maxilla I (vs. absent); 2) the presence of simple seta on dorsolateral margin of urosomal somite I (vs. strong spine); 3) a strong additional spine-like setae on dactyli of ambulatory pereiopods (vs. simple seta); 4) 5 hooks in retinacules of pleopods (vs. 4 hooks); 5) smaller coxal gill on gnathopods II; and 6) the presence of 1 lateral and 3 distal strong spines on each lobe of telson (vs. 2–3 lateral and 6 distal spines).

For the comparison with other congeners see Marin & Palatov [2024].

GenBank accession numbers. PP715911–PP715916.

ZooBank registration. The LSID for this species is: urn:lsid:zoobank.org:act:3D13E027-C2E5-47D6-9783-9DC3EC705996

Distribution. This species is found in the forest zone of the foothills of Ossetia, at the base of all river valleys (gorges) facing the plain, in the foothills of the Urukh, Ardon, Gizeldon, and Mayramadag river valleys.

Niphargus fiagdonicus Marin et Palatov sp.n.

Niphargus fiagdonicus Marin et Palatov, 2024: 10, figs S5, S6, S11c, d, n.nud.

Type series. HOLOTYPE: ♀ (bl. 12 mm) (ZMMU Mb-1284), Russian Federation, Republic of North Ossetia–Alania, Alagirsky District, a spring (42°49′18.5″N 44°16′17.8″E) in the Fiagdon River Valley, near the Alan Holy Dormition Monastery in Hidikus, 1295 m a.s.l., coll. D. Palatov, 16 May 2023.

Diagnosis. *Head* without pigmented spots on anterior lobe. Posteroventral corners of *epimeral plates I–III* rounded. *Uropod II* with 2 strong spines at posterodorsal angles on each side. Distal article of *mandibular palp* with a group of 4–5 A-setae, 2 B-setae, 17–19 D-setae, and 4–5 E-setae. Outer lobe of *maxilliped I* with 7 robust comb-like spines, carrying 3–10 teeth each. Dactyli of *pereopods III–IV* at the inner margin without strong spines near the bases of nails. Dactyli of *pereopods V–VII* with a small additional spine. Rami of *uropod I* of nearly equal length. Retinacula of *pleopods I–III* with 5 hooks. *Telson* with 4 with long distal spines, 2–3 long or medium lateral spines, and 2 plumose setae on each side; dorsal surface without spines.

Description. For the complete description and differences from congeners see Marin and Palatov, 2024 [Supplementary Materials (Figures S5, S6, and S11*c, d*)].

Taxonomic remarks. The species can be easily separated closely related *Niphargus ardonicus* Marin et Palatov sp.n., this species can be separated by 1) smaller coxal gill, which is smaller than basis of pereiopod IV (vs. larger or similar in size to basis of pereiopod IV); 2) less beveled posterior margin of the epimeral plate III; and 3) the presence of 2–3 lateral spines on each lobe of telson (vs. 1 lateral spine).

The differences from *N. alanicus* are similar to *Niphargus ardonicus* Marin et Palatov sp.n. (see above). For the comparison with other congeners see Marin & Palatov [2024].

GenBank accession numbers. PP715920.

ZooBank registration. The LSID for this species is: urn:lsid:zoobank.org:act:00AA8460-BD17-44E2-BFE9-83B168AAB245

Distribution. This species is found only in the type habitat, a small hyporhean spring (42°49′18.5″N 44°16′17.8″E) in the middle course of the Fiagdon River (Kurtatinsky Gorge).

Niphargus osseticus Marin et Palatov sp.n.

Niphargus osseticus Marin et Palatov, 2024: 11, figs S7–S10, S11e, f, n.nud.

Type series. HOLOTYPE: ♂ (bl. 11.5 mm) (ZMMU Mb-1285), Russian Federation, Republic of North Ossetia–Alania, Alagirsky District, a spring inside the Agomskaya Cave, Ardon River Basin, bank of Akhshkadon Gorge, 2.9 km northwest from Oldukhankhokh mt., about 1209 m a.s.l., coll. S. Kapralov, 17 September 2020.

PARATYPES: 2 ♀♀ (ZMMU Mb-1286), same data as for holotype.

Diagnosis. *Head* without pigmented spots on anterior lobe. Posteroventral corners of *epimeral plates I–III* rounded. *Uropod II* with 2 strong spines at posterodorsal angles on each side. Distal article of *mandibular palp* with a group of 6–7 A-setae, 3–4 B-setae, 16–18 D-setae, and 4–5 E-setae. Outer lobe of *maxilla I* with 7 robust spines, carrying 2–4 teeth each. Dactyli of *pereopods III–IV* at the inner mar-gin without strong spines near the bases of nails. Dactyli of *pereopods V–VII* with a small additional spine. Rami of *Uropod I* of nearly equal length. Retinacula of *pleopods I–III* with 5 hooks. *Telson* with 3 relatively long distal spines, 2–3 long or medium lateral spines, and 2 plumose setae on each side; dorsal surface without spines.

Description. For the complete description and differences from congeners see Marin & Palatov, [2024, Supplementary Materials (Figs S7–S10 and S11*e, f*)].

Taxonomic remarks. The species could be separated from *N. alanicus* by 1) 5 hooks in retinacules of pleopods (vs. 4 hooks); 2) the presence of a simple seta on dorsolateral margin of urosomal somite I (vs. strong spine); 3) large coxal gills on gnathopods II and pereiopod IV, exceeding the length of basis (vs. significantly smaller); 4) a strong additional spine-like seta on dactyli of ambulatory pereiopods (vs. simple seta); and 5) the presence of 3 lateral and 3 apical strong spines on each lobe of telson (vs. 2–3 lateral and 5–6 apical spines).

From closely related *Niphargus ardonicus* Marin et Palatov sp.n. and *N. fiagdonicus* Marin et Palatov sp.n., this species can be separated by 1) the presence of only several spine-like setae along outer margin of robust spines of maxilla 1 (vs. numerous smaller spines along outer margin); 2) larger coxal gill, which is similar to the length of basis of pereiopod IV (vs. smaller in size than basis of pereiopod IV); 3) the presence of 2 tuft of 5–6 setae on dorsal margin of palm of gnathopod I (vs. only 1 simple setae); and 4) the presence of 3 lateral spines on each lobe of telson (vs. 1 lateral spine in *N. ardonicus* Marin et Palatov sp.n. and 2 lateral spines in *N. fiagdonicus* Marin et Palatov sp.n.).

GenBank accession numbers. PP715917–PP715919.

ZooBank registration. The LSID for this species is: urn:lsid:zoobank.org:act:FCA983E7-F07F-4FDE-AA71-852E211D6AA2

Distribution. Currently, this species is in two nearby locations – the Agomskaya Cave in the basin of the Ardon River (Akshakadon Gorge) and a spring in the valley of the Fiagdon River (Kurtatinsky Gorge).

Niphargus sadonicus Marin et Palatov sp.n.

Niphargus sadonicus Marin et Palatov, 2024: 12, figs S12–S15, S22a, b, n.nud.

Type series. HOLOTYPE: ♀ (bl. 10 mm) (ZMMU Mb-1287), Russian Federation, Republic of North Ossetia–Alania, Alagirsky District, a stream in an abandoned mine near the village of Sadon, 42°50′40.28″N 44°01′ 16.77″E, about 1155 m a.s.l., coll. D. Palatov, 8 October 2020.

PARATYPES: 2 ♀♀ (ZMMU Mb-1288), same data as for holotype.

Diagnosis. *Head* without pigmented spots on anterior lobe. Posteroventral corners of *epimeral plates I–III* rounded. *Uropod II* with 1 strong spine at a posterodorsal angle on each side. Distal article of *mandibular palp* with a group of 4–5 A-setae, 1–2 B-setae, 12–14 D-setae, and 4–5 E-setae. Outer lobe of *maxilliped I* with seven robust spines, carrying 1–4 teeth each. Dactyli of *pereopods III–IV* at inner margins without strong spines near the bases of nails. Dactyli of *pereopods V–VII* with small additional spiniform setae. Rami of *uropod I* different in length: exopodite shorter than endopodite. *Pleopods I–III* with 3–5 hooks in retinacules. *Telson* with three relatively long distal spines, one long lateral spine, and two plumose setae on each side; dorsal surface without spines.

Description. For the complete description and differences from congeners see Marin & Palatov [2024, Supplementary Materials (Figs S12–S15 and S22*a, b*)].

Taxonomic remarks. The species could be separated from *N. alanicus* by 1) the presence of a strong spine-like seta accompanied by a simple seta on dorsolateral margin of urosomal somite I (vs. a strong spine only); 2) larger coxal gill on gnathopod II, which is equal to basis (vs. significant smaller than basis); and 3) the presence of 3 apical strong spines on each lobe of telson (vs. 5–6 apical spines).

From closely related *Niphargus ardonicus* Marin et Palatov sp.n. and *N. fiagdonicus* Marin et Palatov sp.n., this species can be separated by 1) the presence of only several spine-like setae along outer margin of robust spines of maxilla 1 (vs. numerous smaller spines along outer margin); 2) the presence of 2 tufts of 5–6 setae on dorsal margin of palm of gnathopod I (vs. only

1 simple setae); 3) the presence of a strong spine-like seta accompanied by a simple seta on dorsolateral margin of urosomal somite I (vs. a simple setae only); and 4) the presence of 2 lateral spine on each lobe of telson (vs. 1 lateral spines in *N. ardonicus* Marin et Palatov sp.n.).

From closely related *N. osseticus* Marin et Palatov sp.n. and *N. tschertschesovae* Marin et Palatov sp.n., the new species can be separated by 1) smaller gills on gnathopod II and pereiopod IV, which are smaller than basis (vs. equal to basis in *N. osseticus* Marin et Palatov sp.n.); 2) the presence of 1 lateral spines on each lobe of telson (vs. 2 lateral spines in *N. tschertschesovae* Marin et Palatov sp.n. and 3 lateral spines in *N. osseticus* Marin et Palatov sp.n.); and 3) coxal plate on pereiopod IV is high and narrow (vs. almost subquadrate). For the differences from other congeners see Marin & Palatov [2024].

GenBank accession numbers. PP715903.

ZooBank registration. The LSID for this species is: urn:lsid:zoobank.org:act:8BEA60C8-6E24-4772-96F4-8A017D607C5F

Distribution. The species is known only from the type locality, from an abandoned mine near the village of Sadon.

Niphargus tschertschesovae Marin et Palatov sp.n.

Niphargus tschertschesovae Marin et Palatov, 2024: 12, figs S16, S17, S22c, d, n.nud.

Type series. HOLOTYPE: ♀ (bl. 10 mm) (ZMMU Mb-1289), Russian Federation, Republic of North Ossetia–Alania, Prigorodny District, groundwater of the Gizeldon River near the village of Dargavz, 42°51′08.76″N 44°26′55.55″E, 1395 m a.s.l., coll. D. Palatov, M. Antipova, 22 May 2023.

PARATYPES: 2 ♀♀ (ZMMU Mb-1290), same data as for holotype.

Diagnosis. *Head* without pigmented spots on anterior lobe. Posteroventral corners of *epimeral plates I–III* rounded. *Uropod II* with 1 strong spine at a posterodorsal angle on each side. Distal article of mandibular palps with a group of 4–5 A-setae, 1–2 B-setae, 12–14 D-setae, and 4–5 E-setae. Outer lobe of *maxilliped I* with seven robust spines, carrying 2–10 teeth each. Dactyli of *pereiopods III–IV* at inner margins without strong spines near the bases of nails. Dactyli of *pereopods V–VII* with small additional spiniform setae. Rami of *uropod I* different in length: exopodite shorter than endopodite. Retinacula of *Pleopods I–III* with 3–4 hooks. *Telson* with 3 relatively long distal spines, 2–3 long lateral spines, and 2 plumose setae on each side.

Description. For the complete description and differences from congeners see Marin & Palatov [2024: Supplementary Materials (Figs S16, S17, and S22*c*, *d*)].

Taxonomic remarks. The species could be separated from *N. alanicus* by 1) the presence of a strong spine-like seta accompanied by a simple seta on dorsolateral margin of urosomal somite I (vs. a strong spine only); 2) larger coxal gill on gnathopod II, which is equal to basis (vs. significant smaller than basis); and 3) the presence of 3 apical strong spines on each lobe of telson (vs. 5–6 apical spines).

From closely related *Niphargus ardonicus* Marin et Palatov sp.n. and *N. fiagdonicus* Marin et Palatov sp.n., this species can be separated by 1) the presence of only several spine-like setae along outer margin of robust spines of maxilla I (vs. numerous smaller spines along outer margin); 2) the presence of 2 tufts of 5–6 setae on dorsal margin of palm of gnathopod I (vs. only 1 simple setae); 3) the presence of a strong spine-like seta accompanied by a simple seta on dorsolateral margin of urosomal somite I (vs. a simple setae only); and 4) the presence of 2 lateral spine on each lobe of telson (vs. 1 lateral spines in *N. ardonicus* Marin et Palatov sp.n.).

From closely related *N. osseticus* Marin et Palatov sp.n. and *N. sadonicus* Marin et Palatov sp.n., the new species can be separated by 1) smaller gills on gnathopod II and pereiopod IV, which are smaller than basis (vs. equal to basis in *N. osseticus* Marin et Palatov sp.n.); 2) the presence of 2 lateral spines on each lobe of telson (vs. 1 lateral spines in *N. sadonicus* Marin et Palatov sp.n. and 3 lateral spines in *N. osseticus* Marin et Palatov sp.n.); and 3) coxal plate on pereiopod IV is high and narrow (vs. almost subquadrate). For the differences from other congeners see Marin & Palatov [2024].

GenBank accession numbers. PP715908, PP715909.

ZooBank registration. The LSID for this species is: urn:lsid:zoobank.org:act:CC4DD058-25E6-4C11-92BB-27CC3FBEE368

Distribution. This species is known only from hypogean habitats of the Gizeldon River Valley (Ko-banskoe Gorge) near the village of Dargavz.

Niphargus zeyensis Marin et Palatov sp.n.

Niphargus zeyensis Marin et Palatov, 2024: 13, figs S18–S21, S22e, f, n.nud.

Type series. HOLOTYPE: ♂ (bl. 12.5 mm) (ZMMU Mb-1291), Russian Federation, Republic of North Ossetia–Alania, Alagirsky District, Tsey (Zey) Gorge, a stream on the western outskirts of the village of Abaytikau, 42°48′31.7″N 43°57′18.2″E, about 1985 m a.s.l., coll. D. Palatov, 28 July 2021.

PARATYPES: 2 ♀♀ (ZMMU Mb-1292), same data as holotype.

Diagnosis. *Head* without pigmented spots on anterior lobe. Posteroventral corners of *epimeral plates I–III* rounded. *Uropod II* with one strong spine accompanied by a simple seta at posterodorsal angles on each side. Distal article of *mandibular palp* with a group of 5–6 A-setae, 2–3 B-setae, 14–16 D-setae, and 4–5 E-setae. Outer lobe of *maxilliped I* with seven robust spines, carrying 1–4 teeth each. Dactyli of *pereopods I–II* (*gnathopods*) with 5–6 long setae on the outer margins, 3 of which are grouped together. Dactyli of *pereopods III–IV* at inner margins without strong spines near the bases of nails. Dactyli of *pereopods V–VII* with small additional spine-like setae. Rami of uropod I of nearly equal length. *Pleopods I–III* with 5–6 hooks in retinacules. *Telson* with 4–5 relatively long distal spines, 2–3 long lateral spines accompanied by 2 thin plumose setae on each outer side, 0–1 short spine on inner margins of lobes and 0–1 short seta on the dorsal surface of each lobe.

Description. For the complete description and differences from congeners see Marin & Palatov [2024, Supplementary Materials (Figs S18–S21 and S22*e*, *f*)].

Taxonomic remarks. The species can be separated from other species from North Ossetia–Alania by: 1) similar length of distal and proximal articles of uropod III in males (vs. distal article is about 1/3 of the proximal one); 2) epimeral plates II and II armed with paired spines along ventral margin (vs. single spines in a row); 3) dactyli of gnathopods I and II with several tufts of setae along outer margin of dactylus (vs. only one seta); 4) telson with small and thin setae on dorsal surface and inner margins of lobe of telson (vs. absent); 5) 6 apical spins on each lobes of telson) (vs. 3–5 spines, except *N. alanicus* with 6 spines also); and 5, but usually 6 hooks in retinacules of pleopods (vs. maximum 5 hooks, usually less). For the differences from other congeners see Marin & Palatov [2024].

GenBank accession numbers. PP715905–PP715907.

ZooBank registration. The LSID for this species is: urn:lsid:zoobank.org:act:B675E914-511B-472E-811C-20E9832612E1

Distribution. Currently, this species is known only from two neighboring springs on the slope of the valley of the Tseydon River (Tsey (Zey) Gorge).

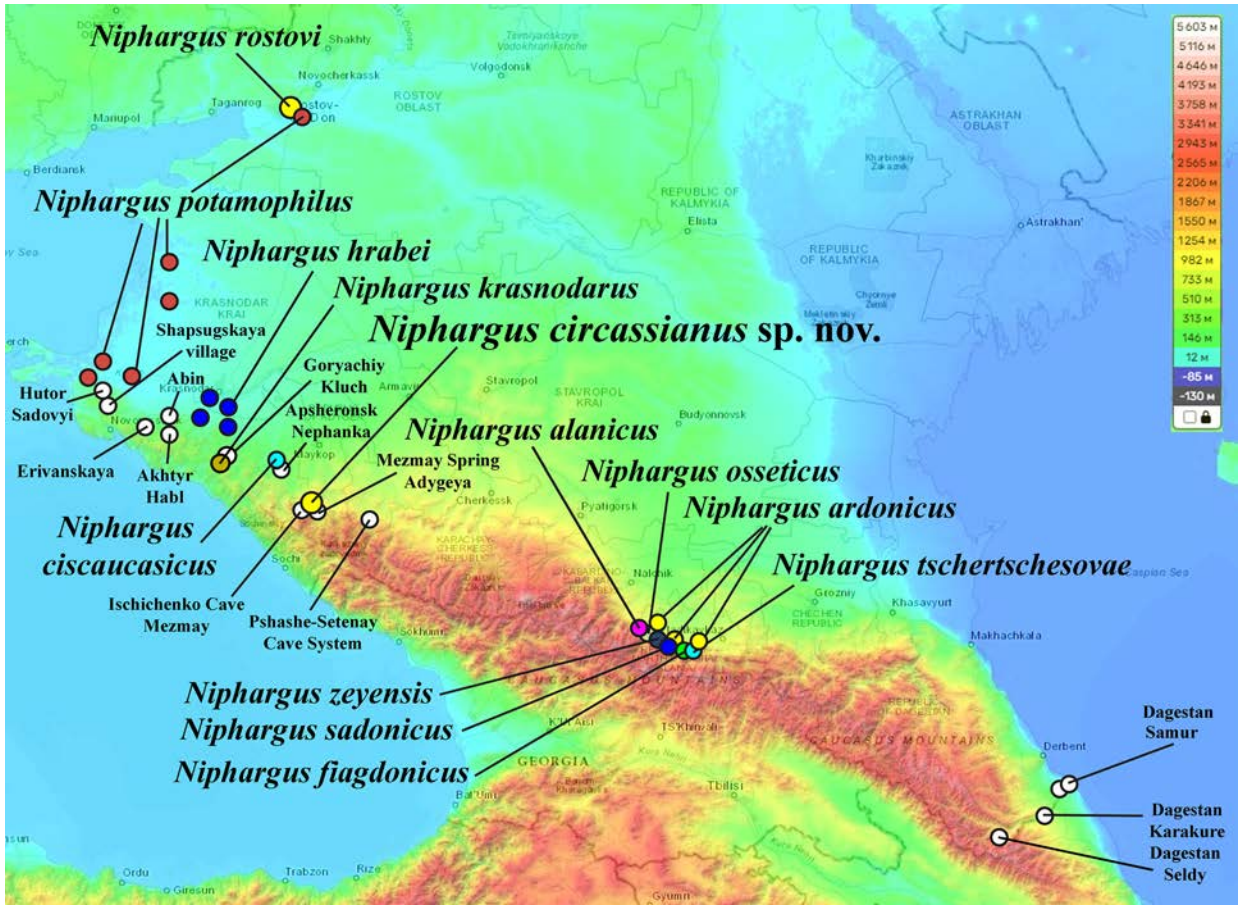

Fig. 7. The known distribution of the representatives of the genus *Niphargus* along the northern slope of the Great Caucasian Ridge. Color circles indicate the locations, where species have already been described, while white circles represent locations where undescribed species have also been recorded. The map is taken from https://ru-ru.topographic-map.com

Рис. 7. Известное распределение представителей рода *Niphargus* вдоль северного склона Большого Кавказского хребта. Цветными кружками обозначены места, где виды уже были описаны, а белыми — места, где обнаружены неописанные виды. Карта взята из https://ru-ru.topographic-map.com

Discussion

It is known that most hyporheic and stygobiotic animals are endemic to narrow localities and live in underground habitats, making their search and study difficult. Currently, hyporheic/stygobiotic crustaceans, including niphargid and crangonyctid amphipods, and representatives of stygobiotic isopods have been found only in the territories of Krasnodar Kray [Marin, Palatov, 2019; Palatov, Marin, 2021], the Republic of Adygea [Palatov, Marin, 2021; present data], the Republic of North Ossetia-Alania [Marin, Palatov, 2021, 2024; Palatov, Sokolova, 2021], the Karachay-Cherkess Republic [Marin, Sinelnikov, 2024] and Dagestan [Palatov *et al*., 2023]. No such crustaceans still have been found in other nearby mountainous regions, such as the Stavropol region, the Republic of Ingushetia, Kabardino-Balkaria, or Chechen Republic (Chechnya). It is likely that a more extensive search for these animals is needed in these regions as well. The distribution of representatives of the genus *Niphargus* along the northern slope of the Caucasus based on our personal data is shown in Figure 7. However, most of the territories where these crustaceans have not been observed have still been very poorly studied on the subject of hyporheic/stygobiotic animals, and most of these studies are based on sporadic data. Currently, it can be clearly stated that these crustaceans are distributed more widely along the northern side of the Greater Caucasus than previously believed.

The majority of the region situated along the northern slope of the Greater Caucasus Range, primarily during the Pleistocene era, experienced significant exposure to low temperatures, both from the surrounding plains and valleys and from the higher elevations, due to the expansion of glaciers (e.g., Tarkhnishvili *et al*. [2012]; Tarkhnishvili [2014]; Shatberashvili *et al*. [2016]). However, in certain areas, the stable conditions of the subterranean environment provided a refuge for hyporheic/stygobiotic invertebrates. It is evident that the mountainous valleys in this region served as a secure habitat for hyporheic/stygobiotic fauna throughout the climatic fluctuations of the Pleistocene (Quaternary) glacial episodes (2.6 Mya–present), and especially during the last glacial maximum (LGM) (23–18 Kya), which allowed them to persist until

the present day. Therefore, the search for new habitats and species of these animals should be focused on the upper regions of the valleys, where the terrain is more pronounced. In contrast, the lowlands and highlands are less likely to be the current habitats of these animals

It is also important to emphasize once again that subterranean species have a limited distribution and require careful conservation and monitoring of their habitats. The loss of a population can result in the extinction of unique ancient genetic lines that cannot be restored.

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