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An unexpected new cave-dwelling species of the genus *Leucogeorgia* Verhoeff, 1930 (Diplopoda: Julida: Julidae) from the Chechen Republic, Caucasus, Russia

Неожиданный новый пещерный вид рода *Leucogeorgia* Verhoeff, 1930 (Diplopoda: Julida: Julidae) из Чеченской Республики, Кавказ, Россия

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KEY WORDS: Leucogeorgiini, millipede, new records, taxonomy.

КЛЮЧЕВЫЕ СЛОВА: Leucogeorgiini, двупарноногие многоножки, новые находки, таксономия.

ABSTRACT. This paper is devoted to the description of a presumed troglobiont millipede, *Leucogeorgia umari* sp.n., from a cave formed by sulfuric acid karstification processes in Chechnya, northern Caucasus, Russia. This is the 16th member in the genus and the first record of a cave-dwelling *Leucogeorgia* species on the northeastern macro slope of the Greater Caucasus Ridge, or Caucasus Major. The new species represents an isolate lying rather far northeast of the distribution core area of the genus in the western Caucasus. The new species is diagnosed, described in detail, illustrated using several techniques, and mapped. New records of some previously described or unidentified species of the genus are also presented. The relationship of the new species with congeners and the distribution of the genus *Leucogeorgia* are briefly discussed. A plausible scenario of speciation in *Leucogeorgia* is hypothesized in connection with global Pleistocene climate changes. Some interesting cave-dwelling arthropods with a similar isolated distribution in carbonate massifs on the northern macro slope of the Caucasus are also listed.

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РЕЗЮМЕ. Данная статья посвящена описанию нового предполагаемого троглобионта, многоножки *Leucogeorgia umari* sp.n. из пещеры сернокислотного спелеогенеза в Чечне (Северный Кавказ, Россия). Это 16-й представитель рода и первая находка пещерных видов *Leucogeorgia* на северо-восточном макросклоне Главного Кавказского хребта. Новый вид представляет собой изолят, живущий достаточно далеко на северо-восток от главного ядра распространения рода на Западном Кавказе. Даны диагноз, подробное описание, иллюстрации с использованием нескольких методов и карта с распространением нового вида. Представлены новые находки ряда ранее описанных и не идентифицированных видов рода. Кратко обсуждаются взаимоотношения нового вида с другими видами и распространение рода *Leucogeorgia*. Выдвигается гипотеза о возможном сценарии видообразования у *Leucogeorgia* в связи с глобальными плейстоценовыми изменениями климата. Заодно упоминаются некоторые интересные пещерные членистоногие с аналогичным изолированным распространением в карбонатных массивах на северном макросклоне Кавказа.

Introduction

Recently, Antić and Reip [2020] revised the Caucasian leucogeorgiinine genera *Archileucogeorgia* Lohmander, 1936 and *Leucogeorgia* Verhoeff, 1930, treating the former genus as a junior subjective synonym of the latter. Furthermore, the number of *Leucogeorgia* species was increased from four to 15, with 11 new

species described and all but one presumed troglobionts [Antić, Reip, 2020]. *Leucogeorgia* has thus become a diplopod genus with the greatest number of troglobiotic species in the Caucasus. Until now, species of this genus have only been known to occur in caves and/or a few epigean habitats in the northwestern Caucasus. One more interesting observation related to *Leucogeorgia* is that seven of the 15 known species superficially look slightly different and their mouthparts are modified for a presumed semi-aquatic lifestyle and a filtering diet. Thus, the northwestern Caucasus is globally an area among the richest in hydrophilous millipede species [Antić, Reip, 2020]. Some of these species are deep cave-dwellers, including *L. profunda* Antić et Reip, 2020, the world's deepest terrestrial arthropod recorded so far [Antić, 2021; Antić, Makarov, 2022; see also below].

In this paper, we describe a new, rather unexpected species of the genus *Leucogeorgia* from a cave formed by sulfuric acid karstification processes in Chechnya, northeastern Caucasus Major. Since the record comes from the northeastern macro slope of the Greater Caucasus Ridge, closer to the shore of the Caspian Sea, the distribution area of the genus has considerably expanded.

Material and methods

In October 2019 and November 2020, biospeleological studies were carried out on the northeastern slope of the Caucasus Major in sulfuric caves in the lower reaches of Sharo-Agrun River valley, Chechen Republic, Russia. As a result, a unique invertebrate fauna has been revealed, including several new species of Oniscidea, Aranei, Diplopoda, Diplura, Collembola etc. to be described.

Specimens used in this study and preserved in 70% ethanol are deposited in the collections of the Zoological Museum, State University of Moscow, Russia (ZMUM), the Museum of Natural History, Vienna, Austria (NHMW), the Institute of Zoology, University of Belgrade – Faculty of Biology, Belgrade, Serbia (IZB), and the private collections of I. Turbanov (IT). Animals were examined and dissected using a Nikon SMZ 745T binocular stereo microscope and measured using a Zeiss Stemi 2000-C binocular stereo microscope (IZB). Certain dissected structures were mounted in glycerin for temporary microscopic slides and observed with a Carl Zeiss Axioscope 40 microscope (IZB). The penes were photographed with a Canon PowerShot A80 digital camera connected to a Carl Zeiss Axioscope 40 microscope (IZB). Pictures of the gonopods were made with a Canon PowerShot A80 digital camera connected to an Axioscope 40 microscope and stacked with Zerene Stacker (IZB). Drawings of the gonopods were executed using a computer monitor and pictures of these structures (IZB). Pictures of the specimens and relevant habitus structures were made using a Nikon DS-Ri-2 camera mounted on a Nikon SMZ25 stereo microscope using NIS-Elements Microscope Imaging Software with an Extended Depth of Focus (EDF) patch (NHMW). For scanning electron microscopy (SEM), the structures were dehydrated in an ascending alcohol series (70%, 80%, 90%, 96% EtOH) and acetone, and air dried. Structures were mounted on aluminum stubs equipped with a sticky aluminum tape, coated with platinum (Leica EM SCD500) and studied with a JEOL JSM 6610-LV at an accelerating voltage of 15 kV or with a JEOL JSM-6460-LV (NHMW). The picture of a live millipede was taken by I.T. with an Olympus TG-5 digital camera.

The distribution map was created using Google Earth Pro (ver. 7.3.4.8248) and Adobe Photoshop CS6. The final images were processed with Adobe Photoshop CS6.

Gonopod terminology follows that of Antić & Reip [2020]. Abbreviations used to denote gonopod structures are explained directly in the figure captions and in the text.

Results

Class Diplopoda de Blainville in Gervais, 1844
Order Julida Brandt, 1833
Family Julidae Leach, 1814
Tribe Leucogeorgiini Verhoeff, 1930

Genus *Leucogeorgia* Verhoeff, 1930

Leucogeorgia umari **sp.n.**
Figs 1–3.

HOLOTYPE ♂ (ZMUM), Russia, Chechen Republic, Shatoysky District, 7.7 km south of Ulus-Kert, right bank of Sharo-Argun River, Kamila (= Kamila-Hyeh) Cave, 42.92°N, 45.78°E, 18.X.2019, S.A. Kapralov leg.

PARATYPES: 2 ♀♀, 1 juv. (ZMUM), same collection data as for holotype; 1 ♂, 5 ♀♀, 2 juv. (ZMUM), 1 ♀ (NHMW MY10301), same collection data as for holotype but 15.X.2019; 1 ♂ (used for SEM, NHMW MY10274), 3 ♀♀ (ZMUM), 3 ♀♀ (IT), same cave, 1.XI.2020, I.S. Turbanov leg.

NAME. The new species honours Umar T. Masaev, the Chechen speleologist from Urus-Martan, Chechen Republic, Russia, who actively promotes biospeleological research in the North Caucasus.

DIAGNOSIS. This blind and unpigmented species (*vs L. oculata* Antić et Reip, 2020, both pigmented and with ommatidia) belongs to the group of *Leucogeorgia* spp. without modified mouthparts (*vs* modified mouthparts in *L. caudata* Antić et Reip, 2020, *L. longipes* Verhoeff, 1930, *L. mystax* Antić et Reip, 2020, *L. profunda* Antić et Reip, 2020, *L. rediviva* Golovatch, 1983, *L. redivivoides* Antić et Reip, 2020 and *L. turbanovi* Antić et Reip, 2020), also characterized by the presence of strongly developed teeth on the mesomeral claw (*vs* either absent from *L. golovatchi* Antić et Reip, 2020, *L. lobata* Antić et Reip, 2020 and *L. prometheus* Antić et Reip, 2020, or poorly developed in *L. gioi* Antić et Reip, 2020). *Leucogeorgia umari* sp.n. differs from the presumably most similar species *L. abchasica* (Lohmander, 1936), *L. borealis* Antić et Reip, 2020 and *L. satunini* (Lohmander, 1936), by the presence of a short promentum of the gnathochilarium that does not exceed half the length of the mesal edges of the lamellae linguales (*vs* promentum much longer, clearly exceeding half the length of the mesal edges of the lamellae linguales in all three latter species). In addition, the new species differs from these three congeners in other habitual and gonopodal characteristics: ventral margin of ring 7 subtrapezoidal (*vs* subtriangular in *L. abchasica* or more or less rounded in *L. borealis* and *L. satunini*), midbody setae short, ca 5% vertical diameter of rings (*vs* longer, ca 10% vertical diameter of rings in *L. satunini*), tibiotarsal part of leg-pair 1 not swollen (*vs* obviously swollen in *L. borealis*), mesomeral claw robust (*vs*

Fig. 1. Habitus of *Leucogeorgia umari* sp.n. A — ♀ *in situ*; B — ♂ holotype (ZMUM), lateral view; C — ♀ paratype (NHMW MY10301), lateral view; D — ♂ holotype (ZMUM), anterior part of the body, lateral view; E — ♀ paratype (NHMW MY10301), anterior part of the body, lateral view; F — ♀ paratype (NHMW MY10301), midbody rings, lateral view, arrows indicate metazonital setae; G — ♂ paratype (ZMUM), telson, ventral view; H — ♀ paratype (NHMW MY10301), posterior part of the body, lateral view. Scale bars: 1 mm (B, C), 0.5 mm (D–H).

Рис. 1. Общий вид *Leucogeorgia umari* sp.n. A — ♀ *in situ*; B — ♂ голотип (ZMUM), сбоку; C — ♀ паратип (NHMW MY10301), сбоку; D — ♂ голотип (ZMUM), передняя часть тела, сбоку; E — ♀ паратип (NHMW MY10301), передняя часть тела, сбоку; F — ♀ паратип (NHMW MY10301), среднетуловищные сегменты, сбоку, стрелками указаны метазонитальные щетинки; G — ♂ паратип (ZMUM), тельсон, снизу; H — ♀ паратип (NHMW MY10301), задняя часть тела, сбоку. Масштаб: 1 мм (B, C), 0,5 мм (D–H).

Fig. 2. *Leucogeorgia umari* sp.n., ♂ paratype (NHMW MY10274). A — head, anterior view; B — head with gnathochilarium, ventral view; C — left antenna, dorsal view; D — ring 7, lateral and ventral views, respectively; E — ventral margin of ring 7, lateral view; F — leg-pair 1, anterior view; G — left leg 1, lateral view; H — right gonopods, mesal and lateral views, respectively; I — penes, posterior view. Abbreviations: am — accessory membrane; f — flagellum; m — mesomere; mc — mesomeral claw; ml — mesomeral lamella; o — opisthomere; p — promere; pl — protective lamella; s — solenomere; v — velum. Scale bars: 0.5 mm (C), 0.2 mm (A, B, D, I), 0.1 mm (E, H), 0.05 mm (F, G).

Fig. 2. *Leucogeorgia umari* sp.n., ♂ паратип (NHMW MY10274). A — голова, спереди; B — голова с гнатохилариумом, снизу; C — левая антенна, сверху; D — сегмент 7, соответственно сбоку и снизу; E — вентральный край сегмента 7, сбоку; F — пара ног 1, спереди; G — левая нога 1, сбоку; H — правые гоноподы, соотвественно изнутри и сбоку; I — пенисы, сзади. Сокращения: am — вспомогательная мембрана; f — жгутик; m — мезомер; mc — мезомерный коготь; ml — мезомеральная ламелла; o — опистомер; p — промер; pl — защитная ламелла; s — соленомер; v — велум. Масштаб: 0,5 мм (C), 0,2 мм (A, B, D, I), 0,1 мм (E, H), 0,05 мм (F, G).

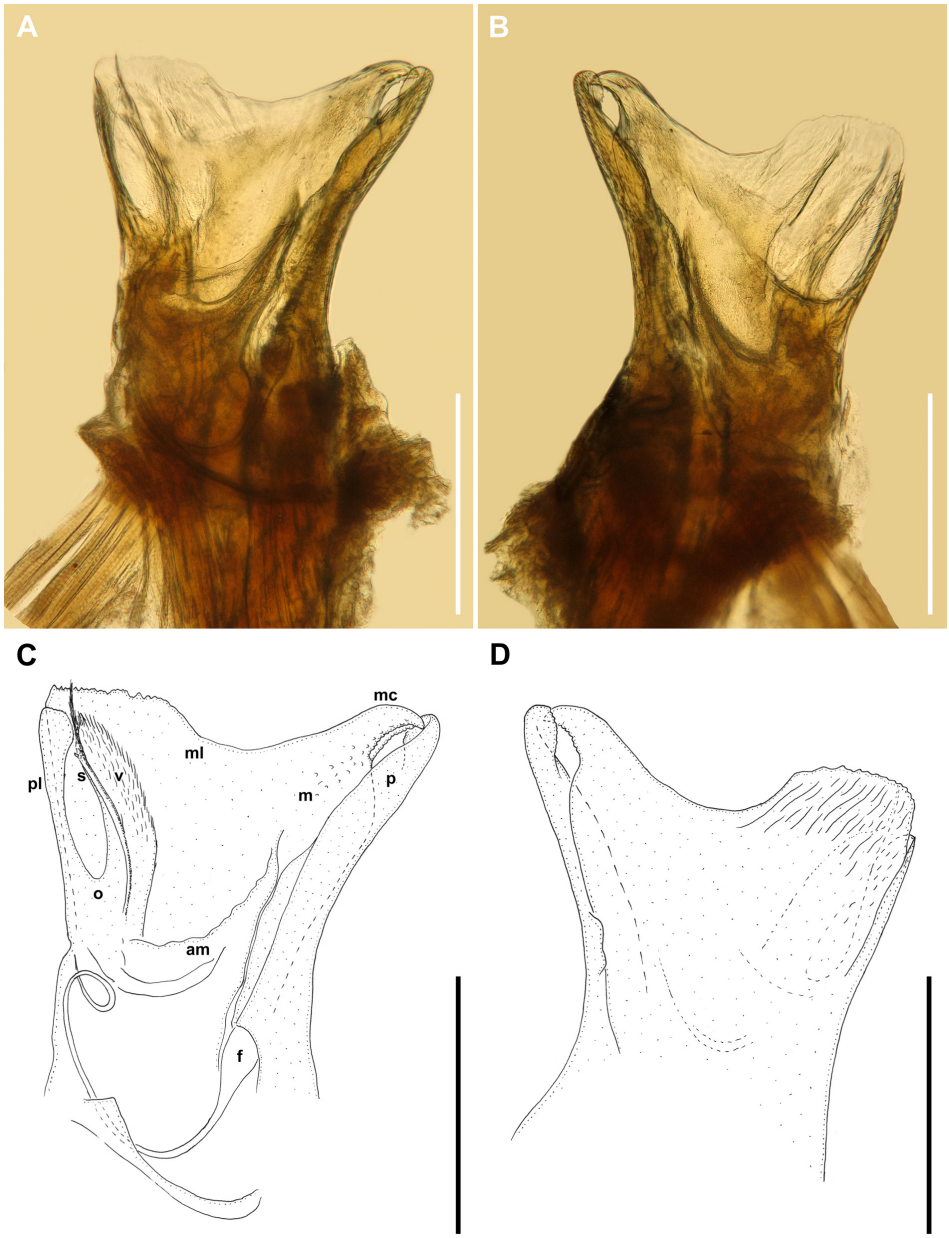

Fig. 3. Right gonopods of *Leucogeorgia umari* sp.n., ♂ holotype (ZMUM). A, C — mesal views; B, D — lateral views. Abbreviations: am — accessory membrane; f — flagellum; m — mesomere; mc — mesomeral claw; ml — mesomeral lamella; o — opisthomere; p — promere; pl — protective lamella; s — solenomere; v — velum. Scale bar: 0.3 mm.

Рис. 3. Правые гоноподы *Leucogeorgia umari* sp.n., ♂ голотип (ZMUM). A, C — вид изнутри; B, D — вид сбоку. Сокращения: am — вспомогательная мембрана; f — жгутик; m — мезомер; mc — мезомерный коготь; ml — мезомеральная ламелла; o — опистомер; p — промер; pl — защитная ламелла; s — соленомер; v — велум. Маштаб: 0,3 мм.

more slender in *L. abchasica* and *L. satunini* or even more robust and stout in *L. borealis*), mesomeral lamella anteriorly with a clearly concave distal margin (*vs* distal margin of mesomeral lamella flattened or poorly concave in the other three species).

DESCRIPTION.

Size and number of body rings. Holotype male 26.5 mm long, vertical diameter of largest body ring 1.6 mm, body with 49 podous rings + 1 apodous ring + telson. Paratype males 24.5 or 27 mm long, vertical diameter of largest body ring 1.5 or 1.7 mm, body with 45 podous rings + 1 apodous ring + telson or 51 podous rings + 0 apodous rings + telson, respectively. Paratype females 24.5–30 mm long, vertical diameter of largest body ring 1.6–2 mm, body with 47–52 podous rings + 0–1 apodous ring + telson.

Colour. Live animals unpigmented, whitish, with orange ozadenes (Fig. 1A). Specimens from ethanol yellowish brown (Fig. 1B-H).

Head (Figs 1D, E, 2A–C). Without ommatidia (Fig. 1D, E). Frontal setae absent (Fig. 2A). Labrum with three labral

teeth, (6)7+7–9+9 labral and 4(5) supralabral setae (Fig. 2A). Gnathochilarium (Fig. 2B) with a short and deltoid prementum. Lamellae linguales with 4+4 or 5+5 setae, stipites with 3+3 long distolateral setae and 2+4 or 4+6 short medial setae in paratype males. Antennae 2.6 mm long (in paratype male NHMW MY10274 2.7 mm in length), their length 150% vertical diameter of the largest body ring. Lengths of antennomeres I–VIII (in mm): 0.18 (I), 0.49 (II), 0.48 (III), 0.45 (IV), 0.57 (V), 0.25 (VI), 0.15 (VII) and 0.03 (VIII). Length/width ratio of antennomeres I–VII: 1 (I), 2.8 (II), 2.8 (III), 2.5 (IV), 2.6 (V), 1.1 (VI) and 1 (VII). Antennomeres V and VI each with a terminal corolla of large sensilla basiconica bacilliformia; antennomere VII with a terminal corolla of small sensilla basiconica bacilliformia (Fig. 2C).

Body rings (Fig. 1A–F). Entire metazonal area with longitudinal striations. Metazonal setae short, length of midbody setae ca 5% vertical diameter of rings (Fig. 1F).

Telson (Fig. 1G, H). Epiproct with an almost missing preanal process. Paraprocts rounded, setose, mesal edges bulging, resembling lips. Hypoproct without any modifications, rhomboid, with ca 10 setae.

Legs in males. First pair of legs modified, hook-shaped (Figs 1D, 2F, G), with three complete podomeres; coxa with one seta; prefemur with 6–7 setae; femur, postfemur and tibiotarsus coalesced; femur with three setae and a mesal tuberculate bulge; postfemur with one seta; tibiotarsus with a small distal lobe (tarsal remnant), ventral surface of tibiotarsal termination tuberculate. Postfemoral and tibial ventral pads well developed on anterior legs, then gradually disappearing towards posterior legs.

Ventral margin of male body ring 7 (Fig. 2D, E). Low, subtrapezoidal.

Penes (Fig. 2I). Short, trapezoid, distally with two small subtriangular lobes.

Gonopods (Figs 2H, 3). Promere (**p**) long and slender, with a flagellum (**f**); apical part spatulate, with denticulate margins; basal half with two poorly developed ridges. Mesomere (**m**) with a well-developed and denticulate mesomeral claw (**mc**); mesomeral lamella (**ml**), slightly serrate distally, posterior part finely fimbriate, distal edge concave anteriorly and convex posteriorly. Opisthomere (**o**) bipartite. Anterior branch of opisthomere with a solenomere (**s**) showing a medium-sized tip reaching or slightly exceeding the distalmost edge of mesomeral lamella, and a well-developed and fimbriate velum (**v**). Posterior branch of opisthomere in the form of a shield-like, spatulate, protective lamella (**pl**), straight, with its distal part slightly curved anteriad. Mesomere and opisthomere connected basally with an accessory membrane (**am**).

New records of some previously described species

Leucogerogia abchasica (Lohmander, 1936)

MATERIAL. 7 ♂♂, 8 ♀♀ (NHMW MY10302), Abkhazia, Gulripsh Distr., near Tsebelda, Tsebeldinskaya Cave, pitfall traps, 8–28.VIII.1990; 1 ♂, 1 ♀ (ZMUM), same collection data as previous but ca 150 m from entrance, 20.VIII.1990–26.VI.1991; 2 ♀♀ (ZMUM), same collection data as previous but ca 200 m from entrance, 27.VIII.1991, all A.G. Koval leg.

Leucogeorgia lobata Antić et Reip, 2020

MATERIAL. 2 ♀♀, 4 juv. (topotypes, NHMW MY10303), Georgia, Samegrelo-Zemo Svaneti, Chkhorotsku Distr., near Chkhorotsku, Odishi Plateau, Kalitshona (= Konglomeratnaya) Cave, 42.53°N, 42.16°E, 19.X.2021, J. Grego leg.; 1 ♀, 1 juv. (NHMW MY10304), same region but Garakha, Garakha Cave, 42.53°N, 42.17°E, 17.IX.2021, J. Grego & M. Szekeres leg.

Leucogeorgia profunda Antić et Reip, 2020

MATERIAL. 1 ♂ (IZB), 1 ♂ (NHMW MY10256), Abkhazia, Gagra Distr., Gagra Mt Ridge, Arabika karst Massif, Veryovkina Cave, –2190 m deep, 43.41°N, 40.35°E, 18.VIII.2019, 1 ♀ (IZB), same collection data as previous but –2204 m deep, 22.VIII.2019, all P.E. Demidov leg.

REMARK. The female found at a depth of –2204 m represents the world's deepest record of a terrestrial arthropod. This information was already mentioned elsewhere [Antić, 2021; Antić, Makarov, 2022].

Leucogeorgia prometheus Antić et Reip, 2020

MATERIAL. 1 ♂, 2 ♀♀ (NHMW MY10305), Georgia, Tsqaltubo Distr., Sataplia-Tskaltubo karst Massif, Kumistavi, Datvi Cave, 42.37°N, 42.60°E, 16.X.2021, J. Grego & M. Szekeres leg.

Unidentified *Leucogeorgia* specimens

MATERIAL. 1 ♀ (ZMUM), Abkhazia, Gudauta Distr., Duripsh klastokarst massif, Duripsh, Duripshskaya Vodyanaya Cave, 29.VIII.2017; 1 juv. (ZMUM), same collection data as previous, but Lakerbaya Cave, 27.VIII.2017, all I. Turbanov leg.; 1 ♀ (ZMUM), Abkhazia, Tkvarchel Distr., 4.3 km on the northwest of Tkvarchel, in an abandoned railway tunnel from Tkvarchel to Akarmara, 42.86°N, 41.74°E, 24.III.2021, D.M. Palatov leg.; 1 ♀ (NHMW MY10306), Georgia, Samegrelo-Zemo Svaneti, Utra Mts., cave 1 under the ruins of Jegeta Church, northwest of Khobi, 42.39°N, 41.84°E, 21.X.2021, J. Grego & M. Szekeres leg.

Discussion

Until now, the Caucasian Leucogeorgiini (*Leucogeorgia* and *Martvilia* Antić et Reip, 2020) have only been known from caves and/or a few epi/endogean habitats in the western Caucasus. Antić & Reip [2020] showed two biogeographic groups within the genus *Leucogeorgia*. The first, "northwestern" group, is more numerous, with 10 species characterized by relatively robust mesomeral claws with developed teeth. The second, less numerous, "southeastern" group consists of five species with a slender and anteriorly curved mesomeral claw lacking teeth (the exception is *L. gioi* with only a few, poorly developed teeth). According to Antić & Reip [2020], the border between these two groups could be the Enguri River Basin. Based on the structure of the gonopods, particularly mesomeral claws, it is clear that the new species belongs to the "northwestern" biogeographic group.

The discovery of *Leucogeorgia umari* sp.n. on the northeastern macro slope of the Caucasus (Fig. 4, cyan triangle) is of significant interest, since its habitat and locality are quite isolated from the main diversity core of the genus *Leucogeorgia* living in the western Caucasus (Fig. 4, yellow circles). The new species was discovered in a cave with active sulfuric acid speleogenesis (SAS) [Dzhabrailov *et al*., 2019; Chervyatsova *et*

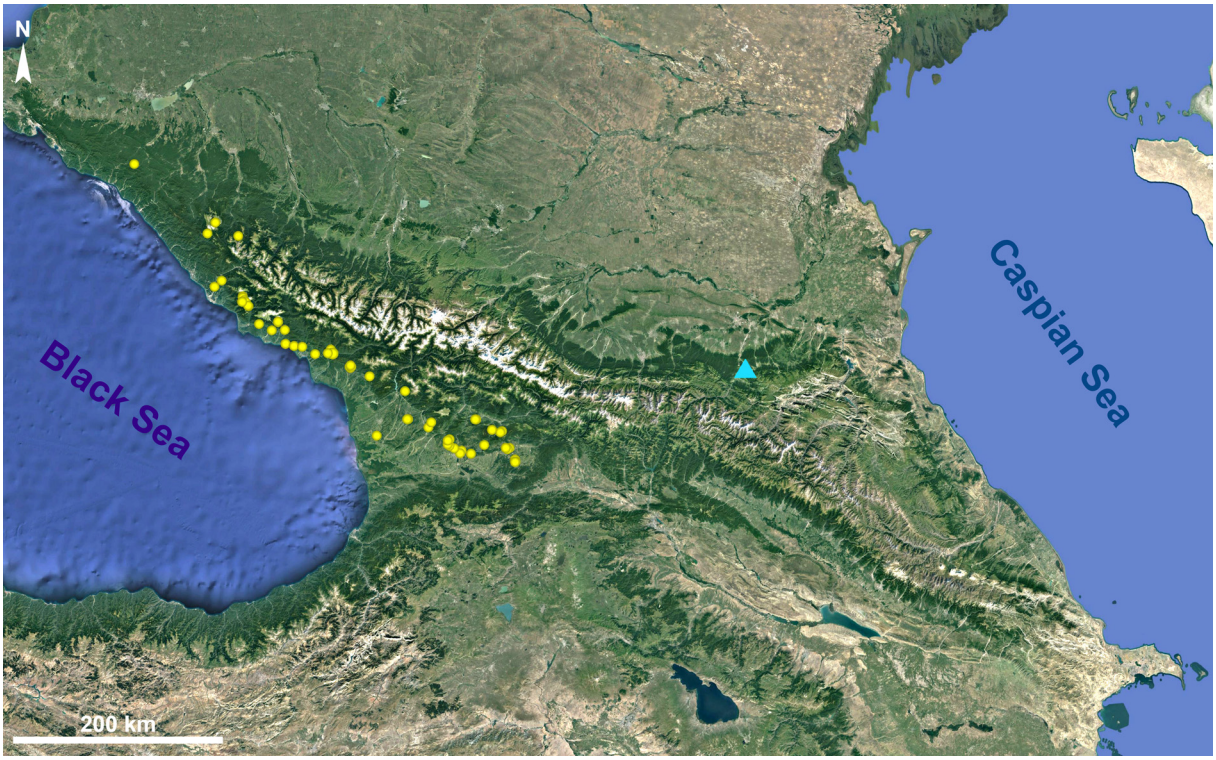

Fig. 4. Distribution of *Leucogeorgia* spp.: yellow circles — all previously described and unidentified species; cyan triangle — *Leucogeorgia umari* sp.n.

Рис. 4. Распространение *Leucogeorgia* spp.: желтый круг — все ранее описанные и неидентифицированные виды; голубой треугольник — *Leucogeorgia umari* sp.n.

al., 2020], and this is the first 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]. These caves are laid out on the northern macro slope of the Caucasus in the Upper Cretaceous thick-layered limestones of the Turonian and Danish stages (K_2t-d) [Golubova, 2013]. In fact, the carbonate karst massifs of the southern and northern macro slopes of the Caucasus are separated from each other by the Greater Caucasus Ridge which is composed of various intrusive rocks [Shelkhovsky, Zemchenko, 1960]. Thus, the penetration of *Leucogeorgia* into the caves of the northeastern slope of the Caucasus Major from the caves of the western Caucasus may well be ruled out completely. The only logical explanation seems to be that the ancestral form of a troglomorphic *Leucogeorgia* could have been epigean with a larger distribution in the Caucasus. However, the periods of Pleistocene glaciations, the formation and expansion of the ice sheet in the Caucasus [Gobejishvili *et al*., 2011] might have caused the subsequent departure of the epigean ancestral form to karst cavities, where the temperature regime is more stable [Vandel, 1964], thereby fragmenting the area and provoking allopatric speciation (vicariance) in some isolated populations. It is noteworthy that, among the *Leucogeorgia*, only one species, *L. oculata*, is distinguished by a pigmented body, the presence of ommatidia, and the absence of metazonal setae [Antić, Reip, 2020]. This taxon is most likely to still represent the closest to the ancestral form, being in fact an endogean species that has survived the Pleistocene glaciations in one of the biotic glacial refugia of the northwestern Caucasus [Kolakovsky, 1956].

Besides *Leucogeorgia umari* sp.n., several other troglo- or stygobiont arthropod species show similar isolates in carbonate massifs on the northern macro slope of the Caucasus (all from Russia's part). Some of them are worthy of mention: *Typhloligidium kovali* Gongalsky et Taiti 2014 (Isopoda: Ligiidae), described from the Omega-15 Cave, Kabardino-Balkaria [Gongalsky, Taiti, 2014]; *Proasellus uallagirus* Palatov et Sokolova, 2021 and *Proasellus irystonicus* Palatov et Sokolova, 2021 (Isopoda: Asellidae), both described from ground waters of the Alagyr Gorge, North Ossetia–Alania [Palatov, Sokolova, 2021]; *Niphargus alanicus* Marin et Palatov, 2021 (Amphipoda: Niphargidae), described from abandoned mines in the valleys of Sardidon and Dargonkom rivers, North Ossetia–Alania [Marin, Palatov, 2021]; *Nemaspela kovali* Chemeris, 2009 (Opiliones: Nemastomatidae), described from the Fontanka, Omega-12, Omega-15 and Otte-Shik caves,

Kabardino-Balkaria [Chemeris, 2009]; *Caucasodesmus inexpectatus* Golovatch 1985 (Diplopoda: Trichopolydesmidae), described from the Nyvdjinlagat (= Tagardonskaya) Cave, North Ossetia–Alania [Golovatch, 1985]; *Typhlogastrura preobrazhenskyi* Babenko, 1987 (Collembola: Hypogastruridae), described from the Shuby-Nykhasskaya Cave, North Ossetia–Alania [Babenko, 1987], *Plutomurus jeleznovodskii* Kniss et Thibaud, 1999 (Collembola: Tomoceridae), described from a unnamed cave near Zheleznovodsk, Stavropol Province [Kniss, Thibaud, 1999]; and *Meganophthalmus kravetzi* Komarov, 1993 (Coleoptera: Carabidae), described from the Fontanka Cave, Kabardino-Balkaria [Komarov, 1993].

Given the caves of the North Caucasus have not been studied as thoroughly as the caves of the western Caucasus [Turbanov *et al*., 2016a, b, c; Golovatch *et al*., 2018], it is reasonable to expect discoveries of new troglomorphic invertebrates in that area. This will shed additional light on the zoogeographic links of the North Caucasus to the other regions of the eastern Mediterranean.

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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