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The millipedes (Diplopoda) of the Republic of North Ossetia – Alania, northern Caucasus, Russia, with special reference to the fauna of the North Ossetian Nature Reserve

Двупарноногие многоножки (Diplopoda) Республики Северная Осетия – Алания (Северный Кавказ, Россия), с особым акцентом на фауну Северо-Осетинского государственного природного заповедника

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KEY WORDS: faunistic diversity, faunistic records, distribution.
КЛЮЧЕВЫЕ СЛОВА: фаунистическое разнообразие, фаунистика, распространение.

ABSTRACT. The results of a taxonomic treatment of the Diplopoda collected in the North Ossetian Nature Reserve, Caucasus, Russia are presented. The millipede fauna of the Republic of North Ossetia presently contains 17 species (including three, *Cylindroiulus placidus* (Lignau, 1903), *Nemasoma caucasicum* (Lohmander, 1932) and *Omobrachyiulus caucasicus* (Karsch, 1881), which are new to the fauna of the republic) from 15 genera, ten families and five orders, of which only about half, all supplied with faunistic records and partly illustrated, have been encountered in the nature reserve. The fauna is dominated by Caucasian endemic or subendemic zoogeographic elements, these being mainly confined to montane woodlands. The distribution of millipedes both downwards (to drier plain steppes or xeric woodlands) and upwards (to the subalpine and alpine meadows) tends to grow increasingly sporadic, thus emphasizing the Diplopoda as a generally mesophilous forest-dwelling soil-litter macrofauna group.

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РЕЗЮМЕ. Приведены результаты таксономической обработки Diplopoda, собранных в Северо-Осетинском государственном заповеднике (Северный Кавказ, Россия). Диплоподы фауны Северной Осетии – Алании ныне включают 17 видов (в т.ч. три, новые для фауны республики: *Cylindroiulus placidus* (Lignau, 1903), *Nemasoma caucasicum* (Lohmander, 1932) и *Omobrachyiulus caucasicus* (Karsch, 1881)) из 15 родов, десяти семейств и пяти отрядов. Лишь половина этих видов, для которых указаны фаунистические находки и частично даны иллюстрации, отмечена на территории заповедника. В фауне доминируют кавказские эндемичные или субэндемичные зоогеографические элементы, которые в основном приурочены к горным лесам. Распространение диплопод вниз (в более сухие степные или ксерофильные лесные биотопы) или вверх (в субальпийские и альпийские луга) имеет тенденцию становиться все более спорадическим, и это лишь подчеркивает то, что Diplopoda в целом – это мезофильная лесная группа почвенно-подстилочной мезофауны.

Introduction

The North Ossetian State Nature Reserve is a mostly montane protected area located on the northern macro slope in the central part of the Main Caucasian Mountain Range, or the Caucasus Major, within the Republic of North Ossetia – Alania, Russia. The nature reserve is the only one in the republic and it covers an area of ca 30,000 ha of strictly protected territories, plus another 41,000 ha of adjacent and partly conserved areas. The nature reserve consists of four main parts, Arkhon, Buron, Tsey and Fiagdon, plus the central administration located in the town of Alagir (http://zapovednik15.ru/o-zapovednike).

The present paper has mainly been prompted by the small field mission conducted in 2021 by O.L. Makarova, A.B. Babenko and M.D. Antipova to the Tsey glacier to study periglacial soil fauna communities. However, not only the millipedes they collected that

are being put on record below, but all previous reports, mainly published as based on older collections, and fresh material of Diplopoda from the North Ossetian Nature Reserve. The opportunity is also taken to review the entire diplopod fauna of the Republic of North Ossetia – Alania in order to emphasize the importance of the sole nature reserve in the republic for the conservation of the fauna in the whole of the Caucasus.

Material and methods

The material underlying the present contribution, both old and new, belongs to the collection of the Zoological Museum of the Moscow State University (ZMUM), Russia. Pictures were taken with a Canon EOS 5D digital camera and stacked using Zerene Stacker software.

The material taken in July 2021 is part of a comprehensive study of successional processes on the Tsey glacier foreland in North Ossetia – Alania. Sampling plots included surfaces denudated for 0 to 170 years, with 142–150 pitfall traps per day operating in every habitat, coupled with both intensely sifting the litter and hand collection. Animals were fixed in 96% ethanol.

Only the following habitats sampled were found to contain millipedes:

A shrub field (ice-free since 2007) dominated by young *Salix* spp., *Betula raddeana*, with participation of *Calamogrostis arundinacea*, *Chamerion caucasicum*, *Hedyzarum tauricum*, *Lotus* sp., *Trifolium* spp., *Alchemilla* spp., *Gallium* sp., *Papaver oreophilum*.

A mature mixed forest (ice-free since 1911–1913) with moss pads and dead fallen wood, dominated by *Betula* sp., *Salix* spp., *Pinus kochiana*, *Solidago virgaurea*, *Trifolium* spp., *Geranium* spp., *Lapsana intermedia*, *Silene* sp., *Pyrola media*.

An older *Acer* forest dominated by *Acer trautvetteri*, *Prunus racimosa*, *Ribes biebersteinii*, *Aconitum nasutum*, *Padus avium*, *Senecio platyphyllus*, *Urtica dioica*, *Euphorbia glaberrima*, *Rumex alpinum*.

An older *Fagus orientalis* forest with moss-clad rocks.

Taxonomy and faunistics

Order Glomerida

Family **Glomeridellidae**

Typhloglomeris lohmanderi (Golovatch, 1989)

REMARKS. This species is endemic to the central Caucasus within both Caucasus Major and Caucasus Minor, recorded from North Ossetia – Alania only south of Vladikavkaz [Golovatch, 1989].

Family **Glomeridae**

Trachysphaera costata (Waga, 1857)

REMARK. This common, Eastern European to Eastern Mediterranean and partly parthenogenetic species is also very widely distributed in the Near East and the Caucasus region, but recorded from North Ossetia – Alania only south of Alagir, beyond the nature reserve [Golovatch, 1990; Antić *et al*., 2021].

Order Polyzoniida

Family **Hirudisomatidae**

Hirudisoma roseum (Victor, 1839)

REMARKS. This Caucasian subendemic species has so far been recorded from several places in North Ossetia, both lowland plain and foothill ones [Golovatch *et al*., 2015]. It has not been formally encountered yet within the North Ossetian Nature Reserve.

Order Chordeumatida

Family **Anthroleucosomatidae**

Acanthophorella irystoni Antić et Makarov, 2016

REMARKS. Only two species of Chordeumatida, both representing the family Anthroleucosomatidae, have so far been recorded from North Ossetia – Alania: *Caucaseuma variabile* Antić et Makarov, 2016 (see below), and *Acanthophorella irystoni* Antić et Makarov, 2016, from the foothills south of Vladikavkaz [Antić, Makarov, 2016]. This species is likely to be endemic to North Ossetia – Alania.

Caucaseuma variabile Antić et Makarov, 2016

MATERIAL. 2 ♀♀ (ZMUM), Caucasus, Russia, North Ossetian Nature Reserve, Tsey, 1800 m a.s.l., *Pinus* forest, pitfall traps, 30.VIII.1984, O. Gvozdeva leg.; 1 juv. ♂ (ZMUM), Tsey, 42.786890°N 43.889351°E, ca 1985 m a.s.l., *Acer* forest with dominating *Aconitum nasutum*, litter, 25.VII.2021, A. Babenko et al. leg.

REMARKS. The type series of this species has been described from 700–1900 m a.s.l. near Alagir, North Ossetian Nature Reserve, whereas non-types have been encountered at Sochi, Krasnodar Province, at Stavropol, both Russia, and at Stepantsminda, Mtskheta-Tianeti, Georgia [Antić, Makarov, 2016]. This rather widespread and morphologically somewhat variable species seems to be endemic to the western and central parts of the Caucasus Major.

Order Polydesmida

Family **Polydesmidae**

Brachydesmus assimilis Lohmander, 1936

REMARKS. Only two species of Polydesmidae have so far been recorded from North Ossetia – Alania: *B. assimilis* Lohmander, 1936 and *B. kalischewskyi* Lignau, 1915, morph B [Golovatch *et al*., 2016], both from the northern, mostly plain to foothill parts of North Ossetia – Alania. This species is very common and widespread across much of the Caucasus, yet being strictly endemic to both Caucasus Major and Caucasus Minor [Golovatch *et al*., 2016].

Brachydesmus kalischewskyi Lignau, 1915

Fig. 1.

MATERIAL. 3 ♂♂, 1 ♀ (ZMUM), Caucasus, Russia, North Ossetian Nature Reserve, Alagir, 650 m, *Fagus* forest, soil samples, 4.IX.1983; 1 ♂, 1 ♀ (ZMUM), same place and date, all O. Gvozdeva leg.

REMARKS. Only *B. kalischewskyi*, morph B, has been recorded from the North Ossetian Nature Reserve [Golovatch *et al*., 2016]. Generally, this polymorphous species of Polydesmidae is the most common across and subendemic to the Caucasus region, also being encountered in the adjacent parts of Turkey and Iran [Golovatch *et al*., 2016].

Family **Paradoxosomatidae**

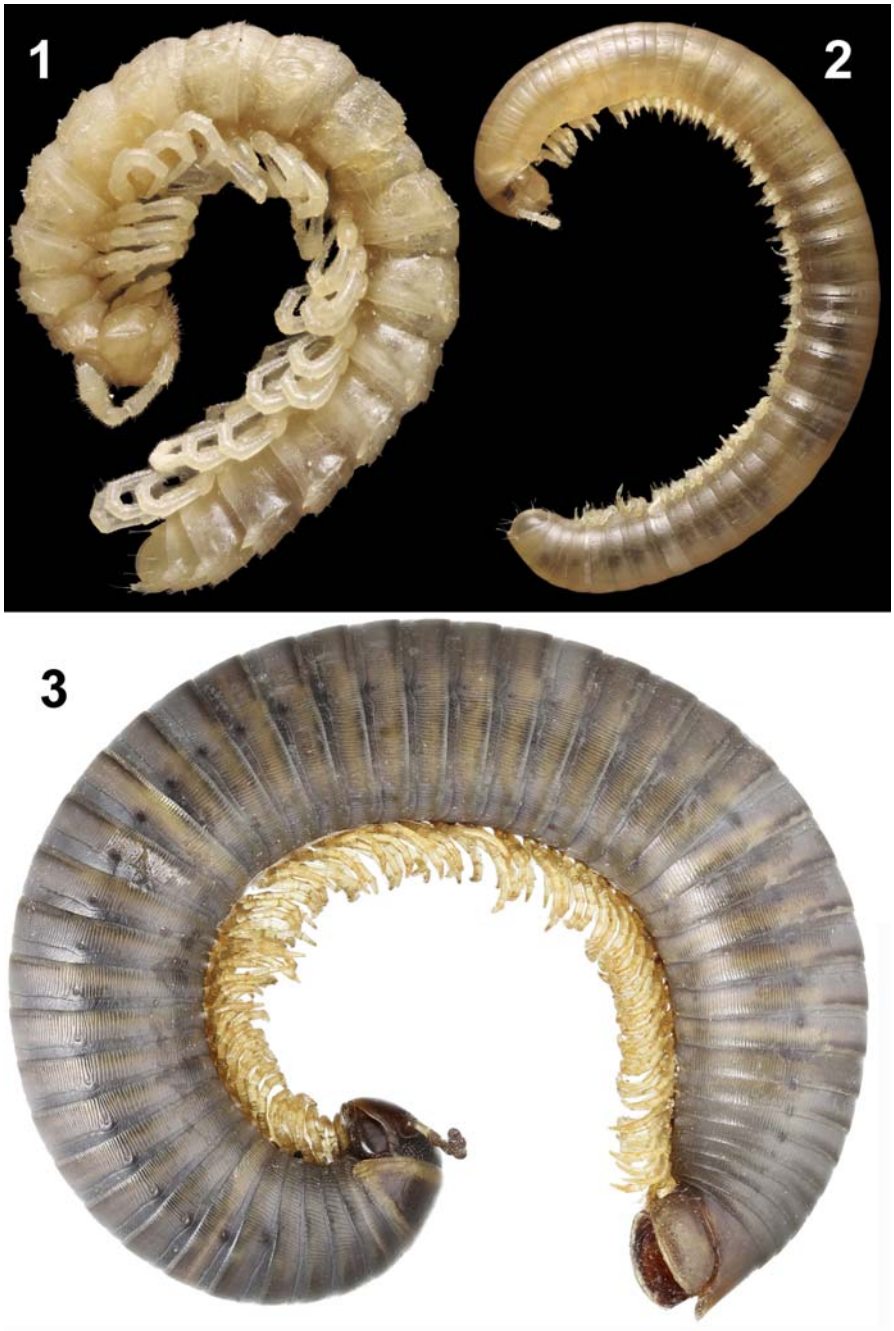
Strongylosoma kordylamythrum Attems, 1898

REMARK. A very common and widespread Caucasian subendemic species, a forest-dweller occurring in North Ossetia – Alania up to 2000 m a.s.l., but yet not recorded from the nature reserve [Evsyukov *et al*., 2016].

Family **Trichopolydesmidae**

Caucasodesmus inexpectatus Golovatch, 1985

REMARK. This species is an apparent troglobiont that has been described and remains known only from the Nyvjin-



Figs 1–3. Habitus of *Brachydesmus kalischewskyi* Lignau, 1915, ♂ of morph B, *Cylindroiulus placidus* (Lignau, 1903), ♂, and *Rossiulus kessleri* (Lohmander, 1927), ♀, from the North Ossetian Nature Reserve, lateral views. Photographs by K.V. Makarov, taken not to scale.

Рис. 1–3. Общий вид *Brachydesmus kalischewskyi* Lignau, 1915 (♂ морфы B), *Cylindroiulus placidus* (Lignau, 1903), ♂, и *Rossiulus kessleri* (Lohmander, 1927), ♀, из Северо-Осетинского государственного заповедника, сбоку. Фотографии К.В. Макарова, снято без масштаба.

lagat (= Tagardonskaya) cave in the Alagir District of North Ossetia – Alania, slightly outside the nature reserve [Golovatch, 1984/85].

Order Julida
Family **Blaniulidae**
Nopoiulus kochii (Gervais, 1847)

REMARKS. This subcosmopolitan species is extremely common and widespread in the Caucasus, being encountered in various environments, both synanthropic and natural [Golovatch, Enghoff, 1990]. It has been recorded from several habitats and places from North Ossetia – Alania [Golovatch, Enghoff, 1990], including the North Ossetian Nature Reserve (Alagir).

Figs 4–8. *Byzantorhopalum rossicum* (Timotheew, 1897), ♂ from the North Ossetian Nature Reserve: 4 — habitus, lateral view; 5–8 — posterior gonopod with a detached flagellum of anterior gonopod, anterior, lateral, posterior and mesal views, respectively. Photographs by K.V. Makarov, taken not to scale.

Рис. 4–8. *Byzantorhopalum rossicum* (Timotheew, 1897), ♂ из Северо-Осетинского государственного заповедника: 4 — общий вид, сбоку; 5–8 — задний гонопод с оторвавшимся жгутиком переднего гонопода, соответственно спереди, сбоку, сзади и изнутри. Фотографии К.В. Макарова, снято без масштаба.

Family **Julidae**

Byzantorhopalum rossicum (Timotheew, 1897)

Figs 4–8.

MATERIAL. 3 ♂♂, 3 ♀♀ (ZMUM), Caucasus, Russia, North Ossetian Nature Reserve, Tsey, 1800 m a.s.l., *Fagus* forest, 1700 m a.s.l., pitfall traps, 23.VIII.1984, S. Alekseev leg.; 1 ♀ (ZMUM), same place, 1700 m a.s.l., *Fagus* forest, soil samples, 1.IX.1983, O. Gvozdeva leg.; 2 ♀♀ (ZMUM), North Ossetian Nature Reserve, Tsey, 42.7830°N, 43.8701°E, ca 2190 m a.s.l., mixed *Pinus, Betula & Salix* forest, pitfall traps, 19.VII.–23.VII.2021; 1 ♂ (ZMUM), Tsey, 42.7830°N, 43.8701°E, ca 2190 m a.s.l., mixed *Pinus Betula & Salix* forest, litter, 26.VII.2021; 1 ♂ (ZMUM), North Ossetian Nature Reserve, Tsey, 42.7766°N, 43.8613°E, 2295 m a.s.l., 26.VII. 2021, all A. Babenko et al. leg.

REMARKS. This common Eastern European to Eastern Mediterranean species is considered as being especially characteristic of the forested steppe belt [Golovatch, 1984], also being widespread across the northern Caucasus, including North Ossetia – Alania and the North Ossetian Nature Reserve. It has been encountered from lowland steppe areas up to 3000 m a.s.l. [Vagalinski, Golovatch, 2021].

Cylindroiulus placidus (Lignau, 1903)

Fig. 2.

MATERIAL. 7 ♂♂, 6 ♀♀, 9 juv. (ZMUM), Caucasus, Russia, North Ossetian Nature Reserve, Tsey, 1700 m, *Fagus* forest, soil samples, 13.VIII.1984; 2 juv. (ZMUM), same place, 1.IX.1983; 3 ♂♂. 8 ♀♀, 6 juv. (ZMUM), same place, 21.VIII.1984, all O. Gvozdeva leg.; 2 ♂♂, 1 ♀ (ZMUM), North Ossetia – Alania, near Alagir, 43.061236°N, 44.293155°E, Khetaga Forest, rotten wood, 6.I.2022, O. Makarova leg.

REMARK. This widespread, Caucasian, endemic, forest-dwelling species [Read, 1992] has not been formally recorded yet from North Ossetia – Alania, where it appears to be quite common in the North Ossetian Nature Reserve and beyond it.

Omobrachyiulus caucasicus (Karsch, 1881)

Figs 9–14.

MATERIAL. 5 ♀♀ (ZMUM), Caucasus, Russia, North Ossetian Nature Reserve, 1800 m a.s.l., *Fagus* forest, pitfall traps, 23.VIII.1984, S. Alekseev leg.; 3 ♀♀ (ZMUM), same place, pitfall traps, 11–18.VIII.1982, leg. N. Matveyeva; 1 ♀, 3 juv. (ZMUM), same place, Alagir, *Fagus* forest, 1700 m a.s.l., pitfall traps, 13.VIII.1984, 2 ♀♀, 11 juv. (ZMUM), North Ossetian Nature Reserve, Tsey, 1700 m a.s.l., *Fagus* forest, soil samples, 13.VIII.1984; 1 ♂, 1 ♀ (ZMUM), same place, 1700 m a.s.l., *Pinus* forest, pitfall traps, 27.VIII.1983; 1 ♂ (ZMUM), same place, pitfall traps, 3.IX.1983; 1 ♀ (ZMUM), same place, *Fagus* forest, soil samples, 21.VIII.1983; 1 ♂, 1 ♀ (ZMUM), Tsey, 1800 m a.s.l., *Fagus* forest, pitfall traps, 20.VIII.1984, all O. Gvozdeva leg.; 2 ♂♂ (ZMUM), North Ossetian Nature Reserve, Tsey, 42.7766°N, 43.8613°E, 2295 m a.s.l., 26.VII.2021; 3 ♂♂ (ZMUM), Tsey, 42.786890N, 43.889351E, ca 1985 m a.s.l., *Acer* forest with dominant *Aconitum nasutum*, pitfall traps, 19.VII.–23.VII.2021; 1 juv. (ZMUM), Tsey, 42.788990°N, 43.906460°E, 1890 m a.s.l., *Fagus* forest, dead wood, 29.VII.2021; 1 ♂ (ZMUM), same place, 1890 m a.s.l., *Fagus* forest, moss on stones, 30.VII.2021; 5 juv. (ZMUM), same place, ca 1985 m a.s.l., *Acer* forest with dominating *Aconitum nasutum*, 19.VII.2021, all A. Babenko et al. leg.

REMARKS. This common Caucasian subendemic species is widespread across the entire Caucasus region [Vagalinski, Golovatch, 2021], although it has not been formally recorded yet from North Ossetia – Alania. In the North Ossetian Nature Reserve, it occurs from lowlands up to 2000 m a.s.l.

Julus jedryczkowskii Golovatch, 1981

Figs 15–22.

MATERIAL. 3 juv. (ZMUM), Caucasus, Russia, North Ossetian Nature Reserve, Alagir, 1800 m a.s.l., *Fagus* forest, soil samples, 13.VIII.1984; 2 ♀♀ (ZMUM), North Ossetian Nature Reserve, Tsey, 1700 m a.s.l., *Fagus* forest, soil samples, 13.VIII.1984; 1 ♂, 2 ♀♀ (ZMUM), same place, 21.VIII.1983, all O. Gvozdeva leg.; 3 ♂♂ (ZMUM), North Ossetian Nature Reserve, Tsey, 42.7830°N, 43.8701°E, ca 2190 m a.s.l., mixed *Pinus, Betula & Salix* forest, pitfall traps, 19.VII.–23.VII.2021; 1 juv. (ZMUM), same place, ca 2190 m a.s.l., litter, 19.VII.2021; 8 ♂♂, 4 ♀♀ (ZMUM), Tsey, 42.786890°N 43.889351°E, ca 1985 m a.s.l., *Acer* forest with dominant *Aconitum nasutum*, pitfall traps, 19.VII.–23.VII.2021; 1 ♀, 1 juv. (ZMUM), same place, ca 1985 m a.s.l., *Acer* forest, litter, 25.VII.2021; 1 ♀, 2 juv. (ZMUM), same place, 1984 m, *Acer* forest with dominating *Aconitum nasutum*, 19.VII.2021, all A. Babenko et.al. leg.

REMARK. This montane species seems to be endemic to North Ossetia – Alania, encountered at 650–3200 m a.s.l., while the above samples from the Tsey Canyon may be regarded as strict topotypes [Evsyukov *et al*., 2018].

Rossiulus kessleri (Lohmander, 1927)

Fig. 3.

MATERIAL. 1 ♂, 1 ♀ (ZMUM), Caucasus, Russia, North Ossetian Nature Reserve, Tsey, S slope of Tsey Mt. Range, 2000 m a.s.l., subalpine meadow, 13.VIII.1982; 2 ♀♀, 2 juv. (ZMUM), 2000 m a.s.l., subalpine meadow, VIII.1984, all S. Alekseev leg.

REMARKS. This extremely widespread Eastern European species ranging from the Arkhangelsk Region in the north to the northern Caucasus in the south, and from central Belarus in the west to the southern Urals in the east [Golovatch, 1984], seems to show significant variations over its vast distribution area. Thus, the single congener, *R. vilnennis* (Jawłowski, 1925), occurs more westerly (eastern Germany, Kaliningrad Region of Russia, Poland and the Baltic states). Prisnyi [2001] gave ecological details and showed a map suggesting a disjunct distribution based on the large river valley systems in the nemoral belt (Dnieper, Don, Volga) of the Eastern European, or Russian, Plain. He described new varieties of *R. kessleri* and stated that these showed increasing body miniaturisation and tegument sclerotization towards the hotter and dryer southeast. The variety *stepposa* approaches *R. vilnensis* in the shape of the opisthomere and, as the two species occur together in Belarus, Prisnyi [2001] suggests that the status of the latter taxon remains to be confirmed.

Family **Nemasomatidae**

Nemasoma caucasicum (Lohmander, 1932)

MATERIAL. 1 ♀ (ZMUM), Caucasus, Russia, North Ossetian Nature Reserve, Tsey, 42.788990°N, 43.906460°E, 1890 m, *Fagus* forest, dead wood, 29.VII.2021, A. Babenko et al. leg.

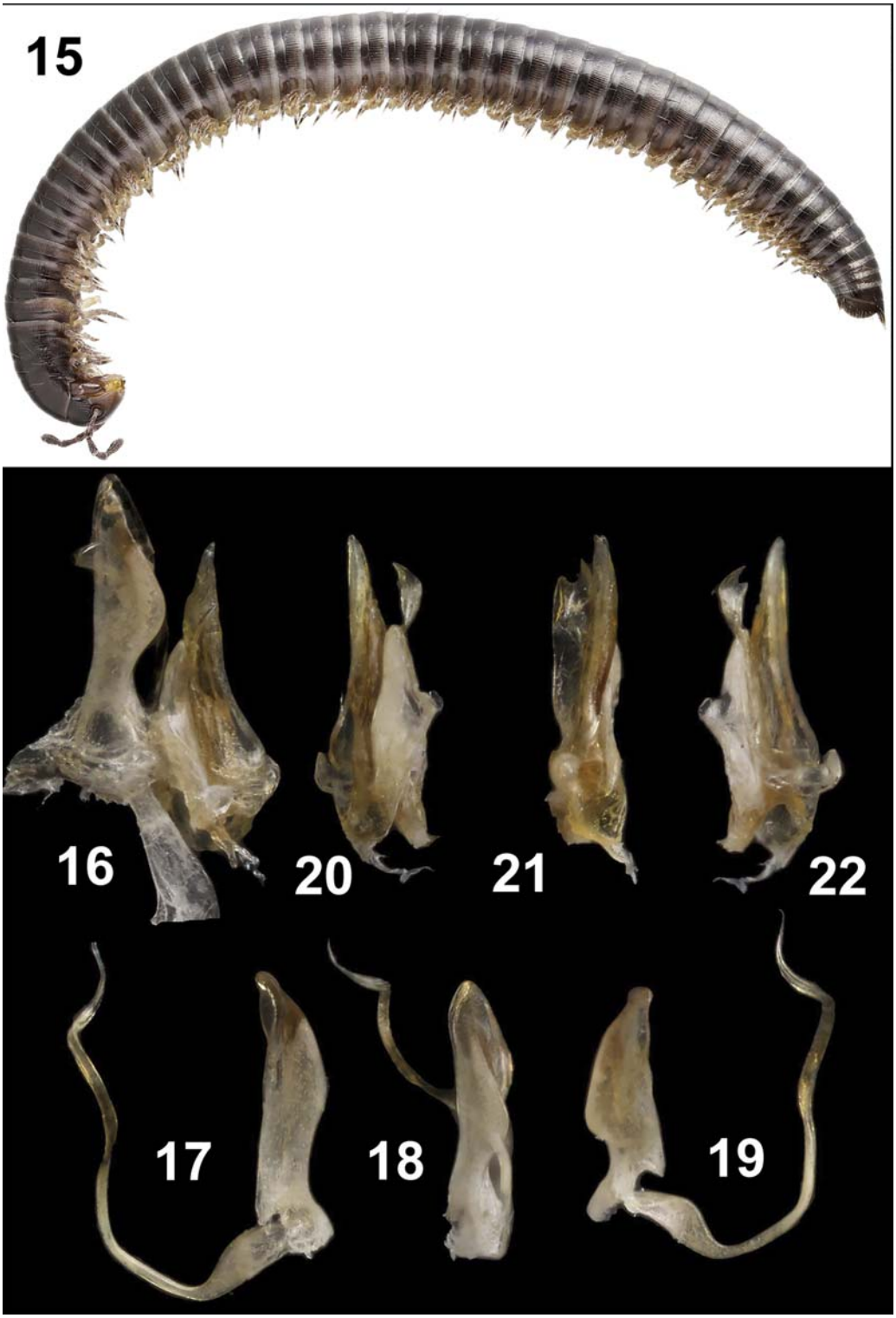
REMARK. This subendemic Caucasian, common and mostly forest-dwelling species is widespread across the Caucasus and northern Turkey, being formally new to the fauna of North Ossetia – Alania [Enghoff, 1985; Golovatch, Matyukhin, 2011; Korobushkin *et al*., 2016].

Discussion and conclusion

The millipede fauna of the Republic of North Ossetia – Alania, summarized in a tabular form (Table), is presently known to contain 17 species from 15 genera, ten families and five orders, among which only ten species and genera from five families and three orders,

Figs 9–14. *Omobrachyiulus caucasicus* (Karsch, 1881), ♂ from the North Ossetian Nature Reserve: 9 — habitus, lateral view; 10–14 — both gonopods, mesal, submesal, anteromesal, caudal and lateral views, respectively. Photographs by K.V. Makarov, taken not to scale.

Рис. 9–14. *Omobrachyiulus caucasicus* (Karsch, 1881), ♂ из Северо-Осетинского государственного заповедника: 9 — общий вид, сбоку; 10–14 — оба гонопода, соответственно изнутри, почти изнутри, одновременно спереди и изнутри, сзади и сбоку. Фотографии К.В. Макарова, снято без масштаба.



Figs 15–22. *Julus jedryczkowskii* Golovatch, 1981, ♂ from the North Ossetian Nature Reserve: 15 — habitus, lateral view; 16 — both gonopods, anterior view; 17–19 — anterior gonopod, subcaudal, lateral and submesal views, respectively; 20–22 — posterior gonopod with a detached flagellum of anterior gonopod, lateral, submesal and mesal views, respectively. Photographs by K.V. Makarov, taken not to scale.

Рис. 15–22. *Julus jedryczkowskii* Golovatch, 1981, ♂ из Северо-Осетинского государственного заповедника: 15 — общий вид, сбоку; 16 — оба гонопода, спереди; 17–19 — передний гонопод, соответственно почти сзади, сбоку и почти изнутри, 20–22 — задний гонопод с оторванным жгутиком переднего гонопода, соответственно сбоку, почти изнутри и изнутри. Фотографии К.В. Макарова, снято без масштаба.

Table. Fauna and chorology of Diplopoda of North Ossetia – Alania.
Таблица. Фауна и хорология Diplopoda Северной Осетии – Алании.

Species	Chorotypes	Northern plains and foothills	Southern montane forests	Subalpine and alpine meadows	North Ossetian Nature Reserve
Typhloglomeris lohmanderi	CE	+			
Trachysphaera costata	EM	+	+		
Hirudisoma roseum	CSe	+			
Acanthophorella irystoni	NOE	+			+
Caucaseuma variabile	NOE		+		+
Brachydesmus assimilis	CE	+			
Brachydesmus kalischewskyi	Pc		+		+
Strongylosoma kordylamythrum	Pc	+	+		
Caucasodesmus inexpectatus	T		+		
Nopoiulus kochii	A	+	+		+
Byzantorhopalum rossicum	EM	+	+	+	+
Cylindroiulus placidus	Cse		+		+
Omobrachyiulus caucasicus	CE	+	+		+
Julus jedryczkowskii	NORE		+	+	+
Rossiulus kessleri	EE			+	+
Nemasoma caucasicum	Cse		+		+
Total: 17		9	11	3	10

Chorotypes, from wider to increasingly narrower distributions: A — subcosmopolitan anthropochore; EE — Eastern European; EM — Euro-Mediterranean; Pc — pan-Caucasian; CSe — subendemic to the Caucasus; CE — endemic to the Caucasus; NOE — endemic or subendemic to North Ossetia – Alania; NORE — endemic or subendemic to North Ossetian Nature Reserve; T — troglobiont.

i.e. just about half of the fauna, have been recorded from the North Ossetian Nature Reserve. As many as three species are being reported here both from the republic and nature reserve for the first time: *Cylindroiulus placidus*, *Nemasoma caucasicum* and *Omobrachyiulus caucasicus*. This alone seems to be enough to claim the fauna as being far from completely surveyed yet. For example, North Ossetia – Alania still remains a full lacuna for the order Polyxenida which is very common, albeit far from diverse, in the entire Caucasus region [Short *et al*., 2020].

Most diplopods of the region in questions appear to be forest-dwellers, this fully agreeing with common wisdom (e.g., Golovatch [1984]). Surprisingly, only three species have been revealed in such high-montane, treeless habitats as subalpine or alpine meadows in North Ossetia – Alania, thereby all three simultaneously being the most widespread and encountered in the North Ossetian Nature Reserve above 2000 m a.s.l. These are the julids *Byzantorhopalum rossicum*, *Rossiulus kessleri* and *Julus jedryczkowskii* (Table). The latter species, like some other *Julus* endemic to the Caucasus, seems to be not only narrowly localized in the Tsey, Kalpersky and Alagir Mountain Ranges in the republic, but it is also confined to the upper forest to alpine belts at altitudes 1800–3200 m a.s.l. [Evsyukov *et al*., 2018]. The particularly widespread Euro-Mediterranean *Byzantorhopalum rossicum* ranges from the steppes in lowland North Ossetia – Alania to the high altitude alpine meadows of the nature reserve [Vagalinski, Golovatch, 2021]. In contrast, the only available records of *Rossiulus kessleri* in North Ossetia – Alania are high-montane and restricted to the Tsey part of the nature reserve. That species has been en-

countered yet in none of the various and well-prospected forests lying below the nival belt at Tsey, whereas north of the Caucasus, in Russia, Ukraine and Belarus, the species is extremely widely distributed and shows polymorphism (e.g., Prisnyi [2001]; Kime, Enghoff [2017]).

Endemism of the Diplopoda of North Ossetia – Alania at the species and, to a lesser degree, generic levels is profound. Thus, among the 17 species and 15 genera of millipedes presently recorded from the republic, 15 species (nearly 90%) and three genera (20%) show a Caucasian distribution pattern, being endemic or subendemic to the Caucasus region (e.g., Kokhia, Golovatch [2020]). Among the very few species strictly endemic to North Ossetia – Alania, *Acanthophorella irystoni*, *Julus jedryczkowskii* and *Caucasodesmus inexpectatus*, only one, *Julus jedryczkowskii*, seems to be endemic to the North Ossetian Nature Reserve.

Even though the Caucasian millipede fauna is known to be very rich in cave-dwellers, presumed troglobionts being especially numerous and conspicuous among Chordeumatida, Julida and Polydesmida (e.g., Antić, Makarov [2016]; Turbanov *et al*. [2016]; Antić, Reip [2020]), the only, and unquestioned, troglobiont millipede so far known in North Ossetia – Alania is *Caucasodesmus inexpectatus* (see above).

Biogeographically, the Caucasus has long been demonstrated to support a very rich and largely endemic or subendemic biota (e.g., Abdurakhmanov [2017]). Land mollusks [Walther *et al*., 2018] or numerous insect groups [Kornoukhova, 1986; Belousov, 1998; Abdurakhmanov, 2017] can serve as some fresh examples to this rule. More specifically, click beetles [Penev, Alekseev, 1996] and stone flies [Cherchesova, Zhiltsova, 2003; Cherchesova *et al*., 2009] of North Ossetia – Alania, however disparate ecologically, and both winged and thus mostly capable dispersers, also appear to show distribution patterns quite similar to those outlined above for Diplopoda. Not only is the whole Caucasus region, but also North Ossetia – Alania as its part dominated by presumably autochthonous elements (endemics and subendemics at the species and, to a lesser degree, generic levels). Their various zoogeographic connections can be traced with the adjacent Eastern Europe, Crimea, Transcaucasia (including Colchis and Hyrcania), and Central Asia. As noted above, the millipede fauna is dominated by Caucasian endemic or subendemic elements, these being mainly confined to montane woodlands, emphasizing that the bulk of the Diplopoda in North Ossetia – Alania are forest-dwellers. Their distribution along the profile, both downwards (to drier plain steppes or xeric woodlands) and upwards (to the subalpine and alpine meadows), tends to grow increasingly sporadic, thus emphasizing the Diplopoda as generally representing a mesophilous forest-dwelling soil-litter macrofauna group.

Expectedly, the level of endemism in the diplopods of North Ossetia – Alania is about as prominent and high as in other poorly vagile soil animals (like snails, woodlice, non-flying arachnids and insects etc.) and much higher than in winged insect groups (most beetles, stone flies, trichopterans etc.) (e.g., Abdurakhmanov [2017]).

According to the 2021 sampling results, over the history of Tsey glaciers' gradual retreat, first diplopods seem to have appeared only 14 years since surface denudation (shrub stage), simultaneously with litter formation on the ground. Most records of millipedes in the Tsey valley are associated with broadleaved forest dominated by *Acer* or *Fagus*, whereas conifer and mixed forests remain mainly neglected.

There is little doubt that further interesting millipede novelties are still ahead along with future explorations of various habitats, natural and anthropogenic, epigean and endogean, across North Ossetia – Alania and its remarkable North Ossetian Nature Reserve.

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