

An Annotated Checklist of the Millipedes (Myriapoda: Diplopoda) from the Stavropol Territory, Northern Caucasus, Russia

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ABSTRACT

The present review aims at systematizing the data on the fauna of Diplopoda of the Stavropol Territory, as well as their distributions in the study area. This paper is based on the previous studies dating back from 1897 to 2021, as well as on the unpublished records of millipedes from the Stavropol Territory and North Ossetia–Alania. As a result, 27 species of millipedes belonging to 20 genera, eight families, and five orders, and have been identified from the study area. One species is new to the fauna of the Caucasus: *Polydesmus stuxbergi* Attems, 1907. As many as 14 species are endemic to the Caucasus, including two that are presently known from the Stavropol Territory alone: *Vegrandosoma tabacarui* Antić et Makarov, 2016 and *Omobrachiulus zuevi* Vagalinski, 2021. The southwestern parts of the region appear to support most of the diplopod species: the Shpakovskiy District (including the city of Stavropol) is the richest with 24 species it supports, followed by the Kochubeevskiy, Predgorniy, Georgievskiy, and Aleksandrovskiy districts with 12, 11, 10 and 7 species, respectively. This markedly corresponds to the distribution of forest habitats in the region. Since woodlands cover only 1.6% of the region's area, many diplopods are likely to be vulnerable and require protection, especially those few that are endemic to the Stavropol Upland.

Keywords: Fauna, Faunistic records, Distribution, Ciscaucasia.

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INTRODUCTION

The myriapod class Diplopoda is the third largest among terrestrial arthropods following the insects and the arachnids, presently encompassing more than 11,000 described species [1]. Sometimes, their diversity is estimated at 80,000 species [2]. Most millipedes are mesophiles living in the leaf litter of temperate and tropical forests. They play important roles in soil formation, participating in the processing of plant residues, as well as animal droppings [2]. In addition, due to the limited mobility, millipedes can serve as an important model group for zoogeographic studies [3].

The Stavropol Territory covers an area of 66,160 km² and is mainly located within central Ciscaucasia, Russia. The western border runs

along the Azov-Kuban Lowland, while the east is along the Terek-Kuma Lowland. In the north, the territory is limited by the Kumo-Manych Depression, in the south by the foothills of the Greater Caucasus, or Caucasus Major. The region is dominated by open landscapes: steppe and forested steppe in the western part, vs. semi-desert in the eastern part. Most of the territory (over 80%) has long been transformed anthropogenically and used for agricultural needs, forests occupying only about 1.6% of the area. The largest woodlands are located in the southern and western districts of the region that receive most of the precipitations. These are the Beshtaugorskiy forest and the mountain forests in the vicinity of Kislovodsk in the Predgorniy District, forests on the Mount Strizhament, and in the vicinity of Stavropol within the Shpakovskiy District. In addition, there are

forests in the floodplains of the rivers Kuban, Zelenchuk, Terek, and Kuma.

Until recently, the fauna of Diplopoda of the Stavropol Territory was only marginally studied, relevant information being scattered only in a few papers [4-10]. The first and preliminary review was published rather recently [11], altogether with 19 diplopod species recorded. Since then, several review papers have appeared dealing with various groups of the Caucasian millipedes [12-18]. This allows for the list of Diplopoda species of the Stavropol Territory to be considerably supplemented, bringing it both in line with the current nomenclature and to a total of 27 species. Some previously unpublished records of and notes on the distributions of the diplopods in the region are also given.

MATERIALS AND METHODS

The list of species was compiled based on literature data published from 1897 to 2021. In addition, the work puts on record the material collected in 2017–2019 in the Stavropol Territory and the Republic of North Ossetia–Alania. All new samples are kept in the author's collection. For all species, their distributions and known records in the Stavropol Territory are reiterated.

RESULTS AND DISCUSSION

Order Polyxenida

Family Polyxenidae

Genus Propolyxenus Silvestri, 1948

Propolyxenus argentifer (Verhoeff, 1921)

Type Locality. Azerbaijan.

Distribution. Georgia [19], Russia: Caucasus, Azerbaijan, Iran, Turkey (possibly), Southern Europe (possibly) [17].

Occurrence in the Stavropol Territory. Shpakovskiy District, Kirovskiy District, Predgorniy District [17].

Notes. The species was originally described based on material from various geographic regions (Southern Europe and the Caucasus) [20]. According to the latest revision, populations from Southern Europe may be cryptic species, but the molecular analysis is required to verify this [17]. The species

Polyxenus trivittatus Verhoeff, 1941 and *P. Sokolowi* Lignau, 1924, both of which were previously recorded from the Caucasus, are junior synonyms of *Propolyxenus argentifer* [17]. Within the Stavropol Territory, it occurs in wormwood and forb steppes, as well as in pine plantations.

Order Glomerida

Family Doderiidae

Genus Trachysphaera Heller, 1858

Trachysphaera costata (Waga, 1857)

Type Locality. Poland.

Distribution. Albania, Bosnia-Herzegovina, Bulgaria, Czech Republic, Germany, Greece, Croatia, Hungary, Montenegro, Poland. Romania, Serbia, Slovenia, Slovakia, Ukraine [21], Crimea, Russia: Caucasus, Georgia, Abkhazia, Azerbaijan, Armenia, Turkey, Iran [22-24].

Occurrence in the Stavropol Territory. Shpakovskiy District, Predgorniy District, Kochubeevskiy District [11]. **New record:** 3 females, Alexandrovskiy Distr., near Alexandrovskoe, Tomuzlovskiy Forest, 19.III.2017, R.V. Zuev leg.

Notes. The species usually occurs in forest habitats. It can be found in the soil, sometimes under the bark, and in rotting wood. Within the Stavropol Territory, this species seems to be fully represented by parthenogenetic populations.

Order Polydesmida

Family Paradoxosomatidae

Genus Strongylosoma Brandt, 1833

Strongylosoma kordylamythrum Attems, 1898

Type Localities. Abkhazia, Azerbaijan.

Distribution. Russia: Caucasus, Azerbaijan, Georgia, Iran [7, 9, 10, 13, 25].

Occurrence in the Stavropol Territory. Shpakovskiy District, Predgorniy District, Kochubeevskiy District, Alexandrovskiy District [7, 9, 11, 13].

Notes. A species were common in the forests in the Stavropol Territory. The northern range limit runs along with the mouth of the Don River, Rostov-on-Don Region, and the Kumomanych Depression, Kalmykia; a further

northward dispersal of the species cannot be excluded, since ornithochory has already been shown for *S. kordylamythrum* in Ciscaucasia [9].

Genus *Oxidus* Cook, 1911

Oxidus gracilis (C.L. Koch, 1847)

Type Locality. Austria.

Distribution. Cosmopolitan [21].

Occurrence in the Stavropol Territory. Stavropol City [11].

Notes. This anthropochoric species of Oriental origins is known naturalized in Georgia and the Krasnodar Territory [7, 26], but in the Stavropol Territory, it has only been found in the greenhouse of the Botanical Garden of Stavropol. Only one specimen has been encountered in open terrain next to the greenhouse [11].

Family Polydesmidae

Genus *Polydesmus* Latreille, 1802/03

Polydesmus muralewiczi Lohmander, 1936

Type Locality. Psebai, North Caucasus.

Distribution. Russia: Caucasus [14], Georgia [27].

Occurrence in the Stavropol Territory. Shpakovskiy District [11]; Georgievskiy District, Andropovskiy District [14].

Notes. Occurring in forb steppes and forest habitats.

Polydesmus stuxbergi Attems, 1907

Type Locality. Crimea.

Distribution. Crimea [28], southern Ukraine [29], South European Russia [10].

Occurrence in the Stavropol Territory. **New record:** 1 male, 11 females, Predgorniy Distr., Pyatigorsk City, Mount Mashuk, broadleaved forest, 22.V.2019, D.S. Stanovov leg.

Notes. This is the first record of the species from the Stavropol Territory and the Caucasus. According to Evsyukov and Golovach [10], *P. stuxbergi* from the Rostov-on-Don Region somewhat differs from specimens from Crimea in the structure of the gonopods, but the gonopods of the male from Pyatigorsk fully agrees with the original description [28].

Genus *Brachydesmus* Heller, 1858

Brachydesmus assimilis Lohmander, 1936

Type Locality. Georgia.

Distribution. Georgia, Azerbaijan, Armenia, Russia: Caucasus [7, 14].

Occurrence in the Stavropol Territory. Kochubeevskiy District [11]; Kirovskiy District [14].

Note. A species rare in the Stavropol Territory hitherto found only in floodplain forests.

Brachydesmus kalischewskyi Lignau, 1915

Type Locality. Abkhazia.

Distribution. Russia: Caucasus, Abkhazia, Georgia, Azerbaijan, Armenia, Iran [14, 24].

Occurrence in the Stavropol Territory. Shpakovskiy District, Georgievskiy District, Predgorniy District [11].

Notes. A polymorphic and common Caucasian species distributed all over the Caucasus. Only morph B, corresponding to *B. karawajewi* Lohmander, 1928 [11], a junior synonym of *B. kalischewskyi* [14], has been recorded from the Stavropol Territory.

Brachydesmus superus Latzel, 1884

Type Locality. Prater, near Wien, Austria.

Distribution. Subcosmopolitan [21], Russia: European part [21], Caucasus [14], southwestern Siberia [30]; Abkhazia [14].

Occurrence in the Stavropol Territory. Shpakovskiy District [11], Predgorniy District [14].

Note. A ubiquitous anthropochoric species, apparently introduced to the region concerned [11].

Order Julida

Family Blaniulidae

Genus *Archiboreoiulus* Brolemann, 1921

Archiboreoiulus pallidus (Brade-Birks, 1920)

Type Locality. England.

Distribution. A subcosmopolitan species [31], in Russia: European part [24, 31] and the Caucasus [11].

Occurrence in the Stavropol Territory. Stavropol City [11].

Note. A synanthropic species.

Genus Nopoiulus Menge, 1851

Nopoiulus kochii (Gervais, 1847)

Type Locality. England.

Distribution. Cosmopolitan [8, 31].

Occurrence in the Stavropol Territory. Shpakovskiy District, Georgievskiy District, Kochubeevskiy District, Kirovskiy District, Alexandrovskiy District, Grachevskiy District, Krasnogvardeyskiy District [8, 11]. **New records:** 2 males, 4 females, Predgorniy Distr., Pyatigorsk City, Mount Mashuk, forest, 5–9.IX.2019, R.V. Zuev leg, 2 males, 7 females, same place, 22.V.2019, D.S. Stanovov leg.

Notes. Ubiquitous, over most of its distribution area it is represented by parthenogenetic populations. In the Caucasus, including the Stavropol Territory, bisexual populations are widespread, this being evidence of the natural distribution of this species [8].

Family Nemasomatidae

Genus Nemasoma C.L. Koch, 1847

Nemasoma caucasicum (Lohmander, 1932)

Type Locality. Georgia.

Distribution. Russia: Caucasus, Abkhazia, Georgia, Azerbaijan, Armenia, Turkey [7, 32, 33].

Occurrence in the Stavropol Territory. Shpakovskiy District, Georgievskiy District, Kochubeevskiy District, Predgorniy District [9, 11].

Notes. This species is common in the region, occurring under the bark, often together with *Nopoiulus kochii* [11]. Ornithochory seems likely for this species [9].

Family Julidae

Genus Julus Linnaeus, 1758

Julus colchicus Lohmander, 1936

Type Locality. Abkhazia, Georgia.

Distribution. Abkhazia, Georgia, Turkey, Russia: Caucasus [7, 15, 27, 34-36].

Occurrence in the Stavropol Territory. Shpakovskiy District, Georgievskiy District, Kochubeevskiy District, Alexandrovskiy District [11, 15]. **New record:** 1 male, Predgorniy Distr.,

6 km SW of Bekeshevskaya, forest, 18.IV.2017, R.V. Zuev leg.

Notes. The most common representative of the genus *Julus* in the Caucasus, living in deciduous and mixed forests, alpine and subalpine meadows [15]. Within the Stavropol Territory, it occurs in floodplain forests, forb steppes, and forest belts.

Julus lindholmi Lohmander, 1936

Type Locality. Abkhazia.

Distribution. Abkhazia, Georgia, Russia: Caucasus [7, 15, 27, 34, 37-39].

Occurrence in the Stavropol Territory. Shpakovskiy District [15].

Note. A Caucasian species rare all over the distribution area: Stavropol Territory, Karachaevo-Cherkessia (both Russia), Abkhazia, Svanetia, and central Georgia [15, 39].

Genus Cyldroiulus Verhoeff, 1894

Cyldroiulus pterophylacum Read, 1992

Type Locality. Russia: Guseripl, Adygea.

Distribution. Abkhazia, Georgia, Russia: Caucasus [11, 24, 40, 41].

Occurrence in the Stavropol Territory. Shpakovskiy District, Kochubeevskiy District [11].

Note. In the region concerned, this western and central Caucasian species occurs in forests, sometimes reaching fairly high abundance levels [11].

Cyldroiulus arborum Verhoeff, 1928

Type Locality. Hungary.

Distribution. A European species [31, 42]. **New record:** 3 males, 3 females, Russia, Caucasus, Republic of North Ossetia–Alania, Mozdokskiy District, near Komarovo, Alborovskiy Forest, Terek River floodplain, broadleaved forest, 29.IV.2017, R.V. Zuev leg.

Occurrence in the Stavropol Territory. Shpakovskiy District [11].

Notes. In the region concerned, it is known only from the vicinity of Stavropol City. Additional records are likely in the floodplain forests of Terek River (Kurskiy District).

Genus Kubaniulus Lohmander, 1936

Kubaniulus gracilis Lohmander, 1936

Type Locality. Russia: Adygea?

Distribution. Russia: Caucasus [16].

Occurrence in Stavropol Territory: Shpakovskiy District, Georgievskiy District [11].

Notes. Found in Adygea and the Krasnodar Territory [7, 16]. In our previous work concerning the fauna of the Stavropol Territory, this species was misidentified as *Chaetoleptophyllum flexum* Golovatch, 1979 [11], since both of these species are similar in size and habitus. The occurrence of *C. flexum* in the study area is doubtful since the distribution area of this species lies within Transcaucasia alone (Georgia, Abkhazia, South Ossetia) [16].

Genus Brachyiulus Berlese, 1884

Brachyiulus jawlowskii Lohmander, 1928

Type Locality. Ukraine.

Distribution. Republic of Moldova, Romania, Poland, Ukraine, Russia: Central European, Southern European [10, 31, 43, 44], southwestern Siberia; Kazakhstan [30], Abkhazia [45].

Occurrence in the Stavropol Territory. Shpakovskiy District [11].

Note. A synanthropic species in the region concerned [11].

Genus Byzantorhopalum Verhoeff, 1930

Byzantorhopalum rossicum (Timotheew, 1897)

Type Localities. Ukraine, Crimea, Russia: Caucasus [4].

Distribution. Ukraine, Crimea, Bulgaria, Greece, Georgia, Azerbaijan, Russia: central European, south European, Caucasus [4, 7, 31, 43, 45, 46].

Occurrence in the Stavropol Territory. Shpakovskiy District, Georgievskiy District, Kochubeevskiy District, Alexandrovskiy District, Grachevskiy District, Andropovskiy District, Predgorniy District, Novoalexandrovskiy District, Novoselitskiy District, Blagodarnenskiy District, Apanasenkovskiy District [4, 11, 45].

Notes. A common species occurring over most of the region concerned in the forest, steppe, and anthropogenic habitats.

Genus Omobrachiulus Lohmander, 1936

Omobrachiulus caucasicus (Karsch, 1881)

Type Locality. Borjom in Georgia.

Distribution. Russia: Caucasus, Georgia, Azerbaijan, Armenia, Turkey, Iran, Greece [7, 35, 45, 47].

Occurrence in the Stavropol Territory. Shpakovskiy District, Georgievskiy District, Kochubeevskiy District, Alexandrovskiy District, Andropovskiy District, Predgorniy District, Kirovskiy District [9, 11, 45]. **New record:** 1 female, Kurskiy Distr., near Galyugaevskaya, broad-leaved forest, leaf litter, 29.IV.2017, R.V. Zuev leg.

Notes. This species is confined to forests and forest belts. Previously, it was referred to in the region as *Megaphyllum brachyurum* (Attems, 1899) [11], actually a junior synonym of *O. caucasicus* [45].

Omobrachiulus faxifer Vagalinski, in Vagalinski et Golovatch, 2021

Type Locality. Adygea, Russia.

Distribution. Russia: Caucasus [45].

Occurrence in the Stavropol Territory. Shpakovskiy District [45].

Notes. Endemic to the northwestern and western Ciscaucasia [45]. A common species in the forests in the vicinities of Stavropol City. Further research may show a wider distribution of the species in the region concerned.

Omobrachiulus zuevi Vagalinski, in Vagalinski et Golovatch, 2021

Type Locality. Russia: Stavropol.

Distribution. Only known from the type locality.

Occurrence in the Stavropol Territory. Shpakovskiy District [45].

Note. Endemic to the Stavropol Upland, but further research may show a wider range of this species.

Genus Unciger Brandt, 1841

Unciger transsilvanicus (Verhoeff, 1899)

Type Locality. Romania.

Distribution. Austria, Bulgaria, Czech Republic, Hungary, Republic of Moldova, Poland, Romania, Serbia, Slovakia, Ukraine, Russia: South Europe [10, 31, 48].

Occurrence in the Stavropol Territory. Shpakovskiy District, Georgievskiy District [10, 11].

Notes. Lohmander described the species *U. kubanus* Lohmander, 1936 [7], the validity of which is still questionable. If further studies show that this is a separate species, then the *Unciger* populations of the Stavropol Territory should be attributed to *U. kubanus*.

Genus Rossiulus Attems, 1927

Rossiulus kessleri (Lohmander, 1927)

Type Locality. Ukraine.

Distribution. Belarus, Ukraine, Russia: European part, Caucasus [7, 31, 44].

Occurrence in the Stavropol Territory. Shpakovskiy District, Georgievskiy District, Kochubeevskiy District, Alexandrovskiy District, Grachevskiy District, Predgorniy District, Blagodarnenskiy District [7, 9, 11]. **New record:** 1 female, Stavropol Territory, Trunovsky Distr., near Klyuchevskoe, steppe, 23.V.2018, R.V. Zuev leg.

Note. This is one of the most common species of millipedes in the region, occurring in the forest, steppe, and anthropogenic habitats.

Tribe Pachyiulini

Gen. sp. undetermined

Occurrence in the Stavropol Territory. Kochubeevskiy District [18].

Note. As only one female has been captured, more accurate identification of this still enigmatic species of Pachyiulini remains impossible [18].

Order Chordeumatida

Family Anthroleucosomatidae

Genus Caucaseuma Strasser, 1970

Caucaseuma variabile Antić et Makarov, 2016

Type Locality. Russia: North Ossetia.

Distribution. Russia, Georgia [12].

Occurrence in the Stavropol Territory. Stavropol City.

Notes. Within the region concerned, the species has been found only in the Stavropol Botanical Garden. We have also collected females with a similar habitus in the vicinity of Nevinnomyssk, Kochubeevskiy District, but it is possible to reliably identify the species and genus only using male material.

Genus Vegrandosoma

Vegrandosoma tabacarui Antić et Makarov, 2016

Type Locality. Russia: Stavropol City.

Distribution. Only known from type locality [12].

Occurrence in the Stavropol Territory. Stavropol City [12].

Note. This smallest member of the family Anthroleucosomatidae [12] is presently known only from forests of the Stavropol Upland., but records from other places in the region are very likely.

The present review, both updated and extended by new collections, reveals already 27 species of diplopods occurring in the Stavropol Territory. They belong to 20 genera, eight families, and five orders, with 14 species being endemic or subendemic to the Caucasus sensu lato, including two species likely endemic to the Stavropol Upland.

In terms of species diversity, the richest in the region concerned (as well as the Caucasus in general) are the orders Julida and Polydesmida: 16 and 7 species, respectively. The order Chordeumatida is represented by two species, while the order Polyxenida and Glomerida by one species each.

Table 1. Species diversity of Diplopoda of the Stavropol Territory per administrative district.

№	District	No. of species	№	District	No. of species
1.	Alexandrovskiy	7	14.	Kurskiy	1
2.	Andropovskiy	3	15.	Levokumskiy	0

3.	Apanasenkovskiy	1	16.	Mineralovodskiy	0
4.	Arzgirskiy	0	17.	Neftekumskiy	0
5.	Blagodarnenskiy	2	18.	Novoalexandrovskiy	1
6.	Budennovskiy	0	19.	Novoselitskiy	1
7.	Georgievskiy	10	20.	Petrovskiy	0
8.	Grachevskiy	3	21.	Predgornyi	11
9.	Izobilnenskiy	0	22.	Sovetskiy	0
10.	Ipatovskiy	0	23.	Stepnovskiy	0
11.	Kirovskiy	4	24.	Trunovskiy	1
12.	Kochubeevskiy	12	25.	Turkmenskiy	0
13.	Krasnogvardeyskiy	1	26.	Shpakovskiy (including Stavropol City)	24

According to **Table 1**, the richest species compositions of diplopods are confined to the southern and western parts of the region: the Shpakovskiy District (including Stavropol City) with 24 species, followed by the Kochubeevski (12), the Predgornyi (11), the Georgievskiy (10), and the Aleksandrovskiy (7) one. It is noteworthy that information concerning several districts is incomplete to missing. However, a certain trend seems to be clear: most species of diplopods prefer forest habitats in the places where woodlands are quite large even using the standards of the region [2]. Considering that forests occupy only 1.6% of the region's area, many species of diplopods seem to be vulnerable and require protection, especially the few that are presumably endemic to the Stavropol Upland.

CONCLUSION

As a result of our studies, the millipede fauna of the Stavropol Territory is presently known to comprise at least 27 species, including *Polydesmus stuxbergi* which is being reported from the Caucasus for the first time. All records of *Chaetoleptophyllum flexum* from the Stavropol Territory were previously misidentified, actually belonging instead to *Kubaniulus gracilis*.

More than half of the identified species are endemic to the Caucasus. In addition, there are two species presently endemic to the Stavropol Upland: *Omobrachiulus zuevi* and *Vegrandosoma tabacarui*. However, further research may show wider distributions of these species, as well as further interesting records. Most of the species of millipedes are confined in the western and southern parts of the region, thus agreeing well with the distribution of forest habitats.

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