Arthropoda Selecta 34(4): 461–472

Millipedes (Diplopoda) of the Samur Forest National Park, Dagestan, Caucasus, Russia

Двупарноногие многоножки (Diplopoda) национального парка «Самурский лес» (Дагестан, Кавказ, Россия)

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KEY WORDS: fauna, ecology, zoogeography.
КЛЮЧЕВЫЕ СЛОВА: фауна, экология, зоогеография.

ABSTRACT. The millipede fauna of the Samur Forest National Park, southeastern Dagestan, Caucasus, presently contains some 10 species and genera, altogether representing seven families and six orders. Pitfall trapping performed in various habitats from early April to late June demonstrates that two julid species are the most widespread and abundant there: the dominant *Omobrachyiulus caucasicus* (Karsch, 1881) and the subdominant *Rossiulus kessleri* (Lohmander, 1927). The relative poverty of the diplopod fauna of the Samur Forest in comparison with the lists of the western and central Caucasus could be accounted for by the low precipitation rate typical of the semi-desert belt, periodically resulting in litter drought. This humidity deficit fails to be compensated for even by the intense sub-surface ground water drain characteristic of the Samur Forest. Zoogeographically, its fauna is totally devoid of narrowly endemic diplopod species, being generally characterized instead as an impoverished variant of the Caucasian realm fauna and barely tied to the geographically nearest Hyrcanian biogeographic province with its rich and highly endemic diplopod fauna.

How to cite this paper: Golovatch S.I., Makarova O.L., Osipov D.V. 2025. Millipedes (Diplopoda) of the Samur Forest National Park, Dagestan, Caucasus, Russia // Arthropoda Selecta. Vol.34. No.4. P.461–472. doi: 10.15298/arthsel.34.4.01

РЕЗЮМЕ. Диплоподы фауны Самурского леса (Юго-Восточный Дагестан, Кавказ) ныне насчитывают всего лишь 10 видов и родов, в целом представляющие семь семейств и шесть отрядов. Материал, собранный почвенными ловушками, установленными в разных биотопах с апреля по июнь 2021 г., демонстрирует наибольшее обилие и распространенность двух видов: доминанта *Omobrachyiulus caucasicus* (Karsch, 1881) и субдоминанта *Rossiulus kessleri* (Lohmander, 1927). Относительная бедность фауны диплопод Самурского леса по сравнению с фаунами Западного и Центрального Кавказа можно объяснить малым количеством осадков, типичными для полупустынной зоны и эпизодически приводящими к иссушению подстилки. Этот дефицит влаги, по-видимому, не может быть компенсирован даже интенсивным подповерхностным стоком, характерным для Самурского леса. С точки зрения зоогеографии его фауна совершенно лишена узкоэндемичных видов диплопод и в целом может характеризоваться, как обедненный вариант фауны кавказского региона, едва связанный с географически самой близкой Гирканской биогеографической провинцией с ее богатой и высоко эндемичной фауной диплопод.

Introduction

The lower reaches of Samur (= Samoor) River are known to serve as a frontier between Dagestan, Russia and the Republic of Azerbaijan at the coast of the Caspian Sea (Fig. 1). Both north and south of its vast and strongly ramified delta, the area is protected and supports highly peculiar liana woodlands which, on the Dagestan side, received since 1991 the status of a national park. Both the State Samur Forest National Park (ca 11,200 ha in area) and its southern counterpart, the Samur-Yalama National Park in Azerbaijan (ca 11,772 ha in area), represent a relict of the mild Hyrcanian broadleaved forest formerly widely distributed along the western and southern coasts of the Caspian Sea, and still support deciduous liana forests with their characteristic flora and fauna (https://ru.wikipedia.org/wiki/Самурский лес). The ancient, meso- to hygrophilous Hyrcanian biogeographic province at the Caspian Sea is generally considered as a counterpart to and contemporary with the similarly mild and initial

Colchidan biogeographic province at the Black Sea, both provinces composing the main mesic biogeographic regions of the Caucasus and dating back to the Miocene [Abdurakhmanov, 2017].

No special research on the millipede fauna, population surface activities and phenology has ever been conducted in Dagestan, eastern Caucasus Major. From west to east, the millipede diversity in the entire Caucasus Major is known to steadily and rather gradually drop [Golovatch *et al.*, 2024]. Whereas even the local millipede faunas, or faunules, of low-montane areas in the relatively humid woodlands of the western Caucasus can comprise 16–32 species [Chumachenko, 2016; Korobushkin *et al.*, 2016], the regional lists of the generally more arid and montane Central Caucasus usually contain already 17−19 diplopod species [Golovatch, Antipova, 2022; Golovatch *et al.*, 2024]. The near-Caspian Hyrcanian wood- and shrublands of Iran are thereby known to be populated by at least 33 millipede species [Golovatch, 2025].

The objectives of the present contribution are to estimate the millipede diversity of the relict Samur Forest, a nature reserve in southeastern Dagestan, as well as to evaluate the structure of diplopod assemblages in various habitats, and to elucidate the surface activity of the species starting with the vegetation season (early April) to the onset of the hot period (late June).

Material and methods

Study area

Collection was carried out in the southernmost part of the Dagestan State Nature Reserve, in the territory of the Samur Forest, near the Russia-Azerbaijan border (42°N, 48°E; Fig. 1). The area is located in the Maritime Lowland, with four ancient marine terraces being traceable up to 140–170 m a.s.l. [Cis-Samuria…, 2003]. The region belongs to the semi-desert climatic and biotic zone, annual precipitations being low (usually up to 350 mm). Yet the near-surface lie of the ground waters that form numerous springs and creeks ensure Cis-Samuria's high soil humidity levels [Lvov, 1961]. This is the good water supply that allows a large number of mesophilous hardwood species to grow there, mainly such broadleaved deciduous trees as oak (*Quercus*), hornbeam (*Carpinus*), alder (*Alnus*) or poplar (*Populus*). The relict Samur Forest supports the sole liana woodland in Russia, the local liana complex alone comprising 14 species [Lwov, 1961].

The region's climate is moderate, the annual temperatures average 12.5 °C, the mid-July temperature is 24.6 °C, *vs* 1.4 °C in mid-January [Akaev *et al.*, 1996]. The annual precipitation rate is 290–410 mm [Akaev *et al.*, 1996; Cis-Samuria…, 2003; Pogoda i klimat, 2025]. The snow cover is unstable, while breeze winds blow from the sea almost all the year round. Most other climatic data used in our paper were taken from the archives available at the site Pogoda i klimat, 2025.

The following habitats have been covered by pitfall trapping (Figs 1 and 2, Table 1):

(1) Hornbeam (*Carpinus*) forest (Fig. 2a), 41.8520° N, 48.5440° E.

This is the most widespread and extensive woodland in the Samur Forest. The vegetation cover is poor and uniform, usually with bare-ground patches, typically containing wood spurge (*Euphorbia amygdaloides*) and abundant ivy (*Hedera pastuchovii*). Shading prominent from May to October, leaf litter annual and thick, especially so in wood spurge beds (maximum 25–30 cm thick). The soil is loamy, hard, lumpy, with a well-expressed humus stratum; the humidification level variable depending on both relief and season; no abundant dew in the evening. The microclimate is generally leveled and stable. The pitfall traps were set in a line gradually declining towards, but not reaching a forest creek.

(2) Poplar (*Populus*) forest (Fig. 2c), 41.87879° N, 48.5245° E.

A maritime forest type, probably secondary, is characteristic of relatively humidified places. The herb cover is well-developed, grasses (Poaceae, e.g. dog grass, *Elymus*) and motley grasses taking up large proportions; the woodland is sparse, mainly black poplar (*Populus nigra*) with admixtures of oak, hornbeam and a developed shrub storey (hawthorn, medlar etc.).

(3) Oak (*Quercus*) forest (Fig. 2b), 41.8535° N, 48.5506° E.

A mixed shrubby oak woodland characteristic of dry places such as forest and glade edges, and noticeable altitudinal gradients on slopes. Oak is admixed with other hardwood species like hornbeam and maple. The woodland is sparse, with gaps occupied by xerophytic shrubs (abundant hawthorn, *Crataegus*) and lawns; the herb vegetation is diverse, with a considerable participation of grasses, the plants being hard and not very tall. Generally, the vegetation is mixed and ecotone in character. The soil is gravelly-loamy, very hard, completely solidified towards summer. Dew of low intensity sets in the evening.

(4) Tall-grass and liana forest (Fig. 2c), 41.88030° N, 48.5218° E.

Sparse woodlands (thin probably because of soil erosion and tree diseases caused by high humidity) located like strips along the banks of a forest river, very damp, consisting of poplar, alder and hornbeam. Tall (*ca* 1.5 m high) broadleaved motley grasses on open grounds with considerable shares of umbillifers (Umbilliferae), but small proportions of grasses (Poaceae), bramble (*Rubus sanctus*), smilax vines (*Smilax excels*) and ferns. Leaf litter is likely to get quickly decomposed, leaving the ground under the herb cover bare; the humus stratum is well-expressed, plant debris being moldy. Vegetation is very active.

(5) Alder (*Alnus*) forest (Fig. 2g), 41.8910° N, 48.4870° E.

A coastal, often inundated, young alder woodland (mainly grey alder, *Alnus incana*, but also with individual shrubs of black alder, *Alnus glutinosa*) located on a small island separated by a periodically dried arm of Bolshoy Samur River. Leaf litter is abundant, the soil is sandy with pebbles, with a weak humus horizon. The herb cover is weak, shade well-developed, with abundant bramble (*Rubus caesius*).

(6) *Elaeagnus-Juncus* plot (Fig. 2e), 41.8711° N, 48.5526° E.

A humid, waterlogged, regularly inundated hollow below a dyke, the soil is sandy silt, overgrown with rush and other hydrophilous vegetation, shrubs being represented by silverberry, bramble and tamarisk. Dew is very abundant in the evening.

(7) *Rubus* thicket on slope, 41.8708° N, 48.5527° E.

Dense bramble (*R. sanctus*) thickets on a dyke slope. The ground is gravelly, with a thin layer of bramble litter, well shaded and bare-ground under bramble shrubs. Dew is abundant in the evening. The pitfall traps were set along a ground path and well under bramble branches, yet with an expressed herb cover, mainly small sedge (*Carex*), chickweed (*Stellaria*) etc.

(8) *Rubus* thicket on dyke (Fig. 2f), 41.8761° N, 48.5438° E.

About the same as (7), but the pitfall traps were set in groups deep under bramble shrubs, three of the traps being placed in the lower, swampy part of the dyke inside *Phragmites* reed thickets.

(9) Reed (*Phragmites*)-shrubs thicket near the sea (Fig. 2g), 41.8809° N, 48.5375° E.

A coastal lowland, moderately humidified and with sandy soils, abundantly and densely overgrown with shrubs like pear,

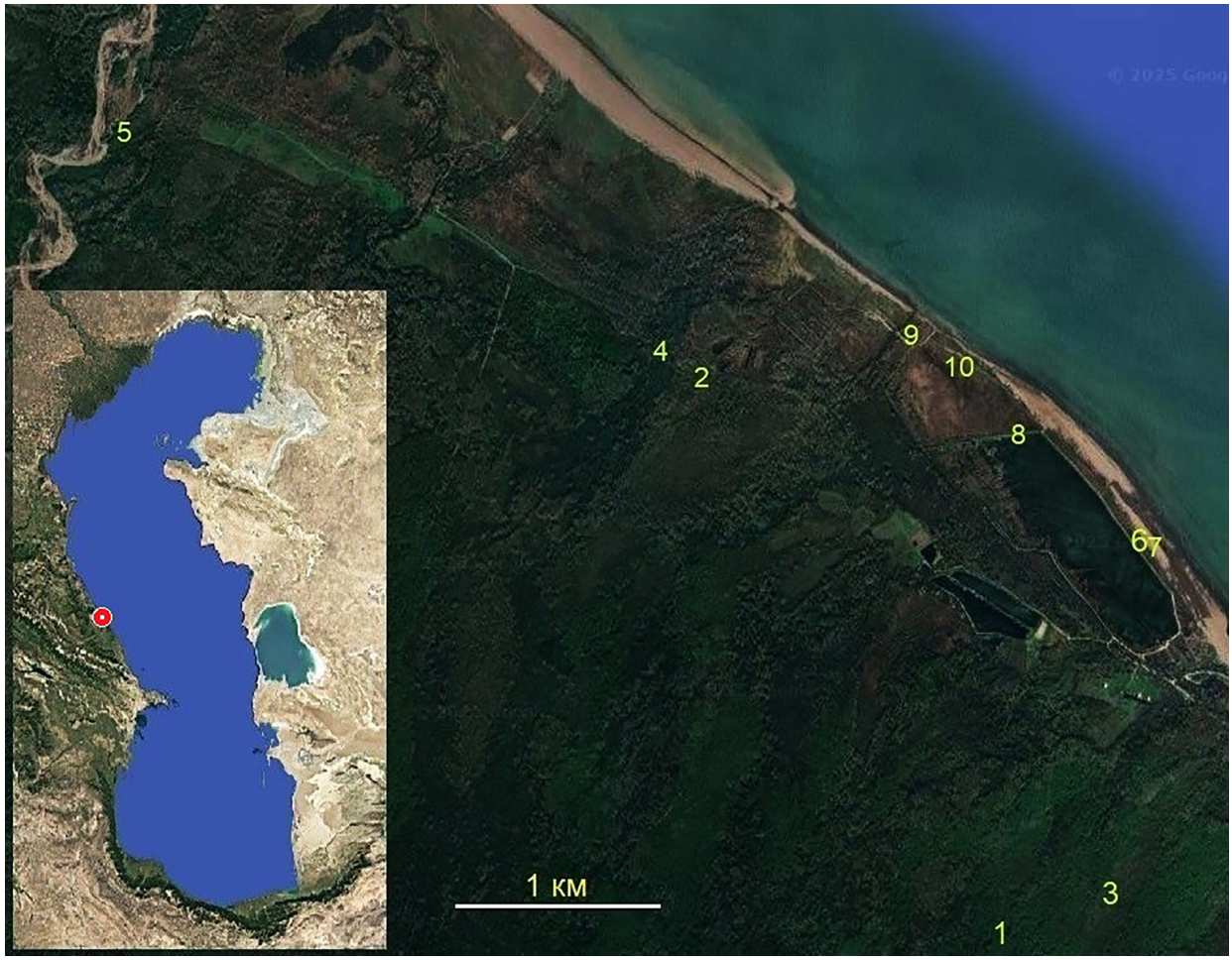

Fig. 1. Schematic map of the Caspian Sea and the study area (Samur Forest, Dagestan). Numbers 1 to 10 correspond to habitats in Table 1.

Рис. 1. Схематическая карта Каспийского моря и изучаемой территории (Самурский лес, Дагестан). Номера с 1 до 10 соответствуют биотопам в Таблице 1.

medlar, loch, tamarisk and bramble (*Rubus sanctus*). The herb cover is rather tall, with considerable shares of grasses and reed. Dew is abundant.

(10) Forb-shrubs heath (coastal lowland) (Fig. 2h), 41.8801° N, 48.5402° E.

A humid coastal lowland with brackish soils, a low and hard herb cover with the participation of sedges (*Carex*), grasses (Poaceae), wormwood (*Artemisia*), rush (*Juncus*) and loch (*Elaeagnus*) beds, individual bushes of apple (*Malus*), pear (*Pyrus*) and tamarisk (*Tamarix*). The ground is sandy, well humidified, leaf and grass litter being well-developed only under shrubs and trees. Evening dew is abundant, although absent on windy days.

Sampling

The large material serving as the basis for the present contribution was mostly taken by two of us (OLM and DVO, both Moscow), coupled with a few other collectors. Nearly all of the collection is presently housed in the Zoological Museum, Moscow State University (ZMUM), supplemented by a sample taken by Roman V. Zuev (Stavropol) which he retained in his personal collection (RZ).

Moreover, because D.V. Osipov's material, unlike all other samples, was amassed using pitfall trapping from early April to late June, 2021, with regular intervals simultaneously in various habitats, this has allowed for the habitat distribution, dynamics and phenology of the surface-active millipedes in Samur Forest to be traced. The early spring to early summer time of the year chosen, and the collecting techniques applied, are especially instructive for tracking the emergence, abundance dynamics and sex ratios of the surface-dwelling diplopod populations during their high season. The habitats for pitfall trapping are all mapped (Fig. 1), and their main characteristics are also described in Table 1.

For convenience reasons, the main period of pitfall trapping was divided into five stages (S1–5 in Fig. 3), the boundaries between which do not strictly coincide. In particular, **S1** lasted from 4−8.04 to 19−20.04, **S2** from 19−20.05 to 8−10.05, **S3** from 8−10.05 to 26−28.05, **S4** from 26−28.05 to 14−15.06, and **S5** from 14−15.06 to 29−30.06.2021.

Each pitfall trap represented a standard, industrially manufactured, plastic cup 7 cm in top diameter and 9.5 cm in height, filled to 1/2 with 4% formalin as fixative. The traps were set at distances about 1 m between each other. After the removal from traps, the material was rinsed with water and cleaned from dirt and litter (leaves and other plant debris, non-target animals, soil particles etc.). Then all arthropods were placed in 75% ethanol for further storage. Further sorting the arthropods into higher taxonomic groups was performed later in the laboratory.

Because the number of pitfall traps varied from 6 to 40 between habitats and collecting dates, the yields were always recalculated per 100 traps per day so as to become properly comparable for further analyses. The material sections per species

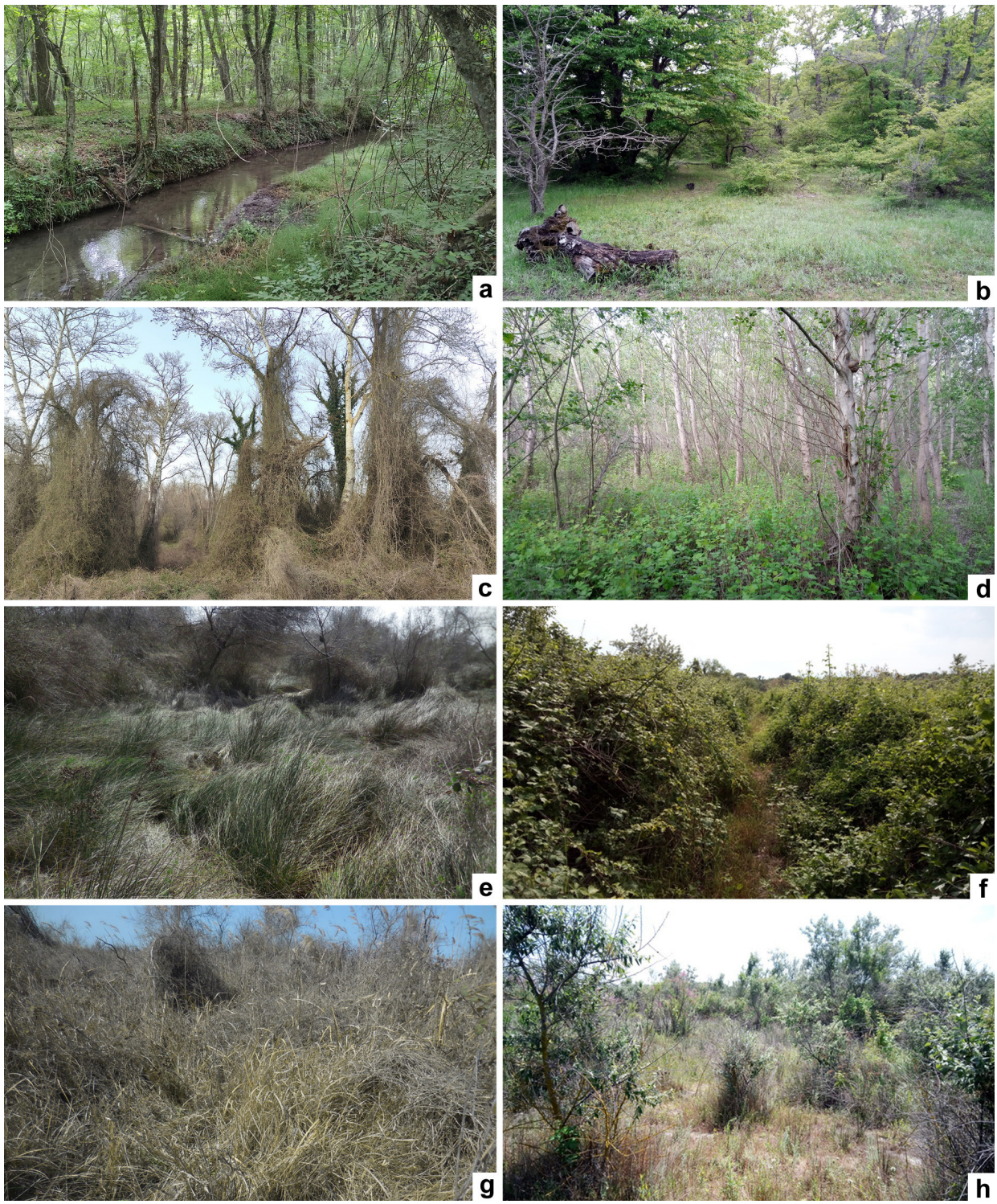

Fig. 2. Sampling sites: **(a)** *Carpinus* forest, **(b)** sparse *Quercus* woodland, **(c)** tall-grass and liana forest, **(d)** *Alnus* forest, **(e)** *Elaeagnus*-*Juncus* plot, **(f)** *Rubus* thicket, dyke, **(g)** seaside *Phragmites*-shrubs thicket, **(h)** seaside forb-shrubs heath (April–June 2021, Samur Forest, Dagestan). Photographs **(a)** and **(c)** courtesy D.M. Palatov.

Рис. 2. Места взятия проб: **(a)** грабовый (*Carpinus*) лес, **(b)** разреженная дубрава (*Quercus*), **(c)** высокотравный лиановый лес, **(d)** ольховый (*Alnus*) лес, **(e)** участок с лохом (*Elaeagnus*) и ситником (*Juncus*), **(f)** заросли ежевики (*Rubus*) на плотине, **(g)** приморские заросли тростника (*Phragmites*) и кустарников, **(h)** приморская разнотравно-кустарниковая пустошь (апрель–июнь 2021 г., Самурский лес, Дагестан). Фотографии **(a)** и **(c)** любезно предоставлены Д.М. Палатовым.

Table 1. Characteristics of the studied habitats (Samur Forest, Dagestan, April to June 2021).
Таблица 1. Характеристики изученный биотопов (Самурский лес, Дагестан, апрель–июнь 2021 г.).

No. on map (Fig. 1)	Habitat	Landscape position	Location of pitfall traps, coordinates	Dominant plants	Litter thickness, cm	Ground features	Total number of trap days
Forests							
1	*Carpinus* forest	The most widespread and extensive woodland type on plains, riddled with streams.	41.8520° N, 48.5440° E	*Carpinus betulus, Euphorbia amygdaloides, Hedera pastuchovii.*	5–15	Loamy, lumpy, with a well-expressed humus stratum, of moderate humidity.	2514
2	*Populus* forest	A riverine forest type, probably secondary, characteristic of relatively humidified maritime areas.	41.8788° N, 48.5245° E	*Populus nigra*, *Quercus pedunculiflora*, *Carpinus betulus*, *Craetegus* sp., *Mespilus germanica*, *Elytrigia repens*, forbs.	3–10	Loamy, of moderate humidity.	1320
3	Sparse *Quercus* woodland	Forest edges, drained slopes.	41.8535° N, 48.5506° E	*Quercus pedunculiflora*, *Carpinus betulus*, *Acer campestre*, *Craetegus* sp., hard grasses.	0–10	Gravelly-loamy, very hard, completely solidified towards summer.	1963
4	Tall-grass and liana forest	Located mainly along forest river banks.	41.8803° N, 48.5218° E	*Populus* sp., *Alnus* sp., *Carpinus betulus*, *Rubus sanctus*, *Smilax excelsa*, tall (*ca* 1.5 m high) broadleaved motley grasses with considerable shares of Umbilliferae and ferns.	0–15	Very humid, with a well-expressed humus stratum.	1005
5	*Alnus* forest	Riparian young forest, located in an area separated by a periodically dried arm of Bolshoy Samur River.	41.8910° N, 48.4870° E	*Alnus incana*, *Alnus glutinosa barbata*, *Rubus caesius.*	5–10	Sandy-shingly, often inundated, with a weak humus horizon.	2723
6	*Elaeagnus-Juncus* plot	Silverberry and rushes thicket in an elongate swamp depression below a dyke.	41.8711° N, 48.5526° E	*Elaeagnus caspica*, *Juncus* sp., *Rubus sanctus.*	0–5	Sandy-silt, waterlogged, regularly inundated soil.	1117
Bushes							
7	*Rubus* thicket, slope	Bramble thicket on a dyke slope, along the earth road.	41.8708° N, 48.5527° E	*Rubus sanctus*, *Carex* sp., *Stellaria* sp.	1–3	Gravelly, with a thin layer of bramble litter.	916
8	*Rubus* thicket, dyke	Bramble thicket on a low dyke including waterlogged sites.	41.8761° N, 48.5438° E	*Rubus sanctus*, *Phragmites australis.*	1–3	Gravelly, with a thin layer of bramble litter.	522
Seaside lowland plots							
9	*Phragmites*-shrubs thicket	A coastal lowland densely overgrown with reeds and shrubs.	41.8809° N, 48.5375° E	*Phragmites australis*, *Elaeagnus caspica*, *Prunus* sp., *Tamarix* sp., *Mespilus germanica*, *Rubus sanctus*, grasses.	2–5	Loamy, moderately humidified, saline soil with a weak humus horizon.	823
10	Forb-shrubs heath	Maritime plain with sparce grass-shrub vegetation.	41.8801° N, 48.5402° E	*Carex* sp., *Juncus acutus*, *Artemisia* sp., *Tamarix* sp., *Pyrus* sp., *Malus* sp., *Elaeagnus caspica*.	0–3	Sandy, well humidified, saline soil; leaf and grass litter being well-developed only under shrubs and trees.	1047

Table 2. Catching efficiency (ind. per 100 pitfall traps per day) of diplopod species in the study habitats (Samur Forest, Dagestan, April–June 2021).
Таблица 2. Уловистость ловушками (экз. на 100 ловушко-суток) видов диплопод в изученных биотопах (Самурский лес, Дагестан, апрель–июнь 2021 г.).

вид	Forests						Bushes		Seaside lowland plots		Total	No. of ind.
	Carpinus forest	*Populus* forest	Sparse *Quercus* woodland	Tall-grass and liana forest	*Alnus* forest	*Elaeagnus*–*Juncus* plot	*Rubus* thicket, slope	*Rubus* thicket, dyke	*Fragmites*-shrubs thicket	Forb-shrubs heath		
Amblyiulus hirtus			0.21								0.21	1
Brachydesmus kalischewskyi		0.53	0.25		1.20			0.88			2.86	9
Brachyiulus lusitanus						0.48		3.13	0.56		4.16	5
Craspedosoma raulinsii	2.55										2.55	11
Nopoiulus kochii				0.33							0.33	1
Omobrachyiulus caucasicus	0.18		0.25	36.19	251.58	40.51	120.89	7.61			457.20	1531
Propolyxenus argentifer					0.52						0.52	1
Rossiulus kessleri				11.04	2.04			32.56	13.69	3.98	63.31	107
Strongylosoma lenkoranum	1.09			0.33	6.46	0.48	0.56	1.97			10.88	22
Trachysphaera costata				1.96							1.96	6
Number of species	**3**	**1**	**3**	**5**	**5**	**3**	**2**	**5**	**2**	**1**		
Total catching efficiency	3.81	0.53	0.71	49.85	261.81	41.47	121.44	46.14	14.25	3.98		**1696**

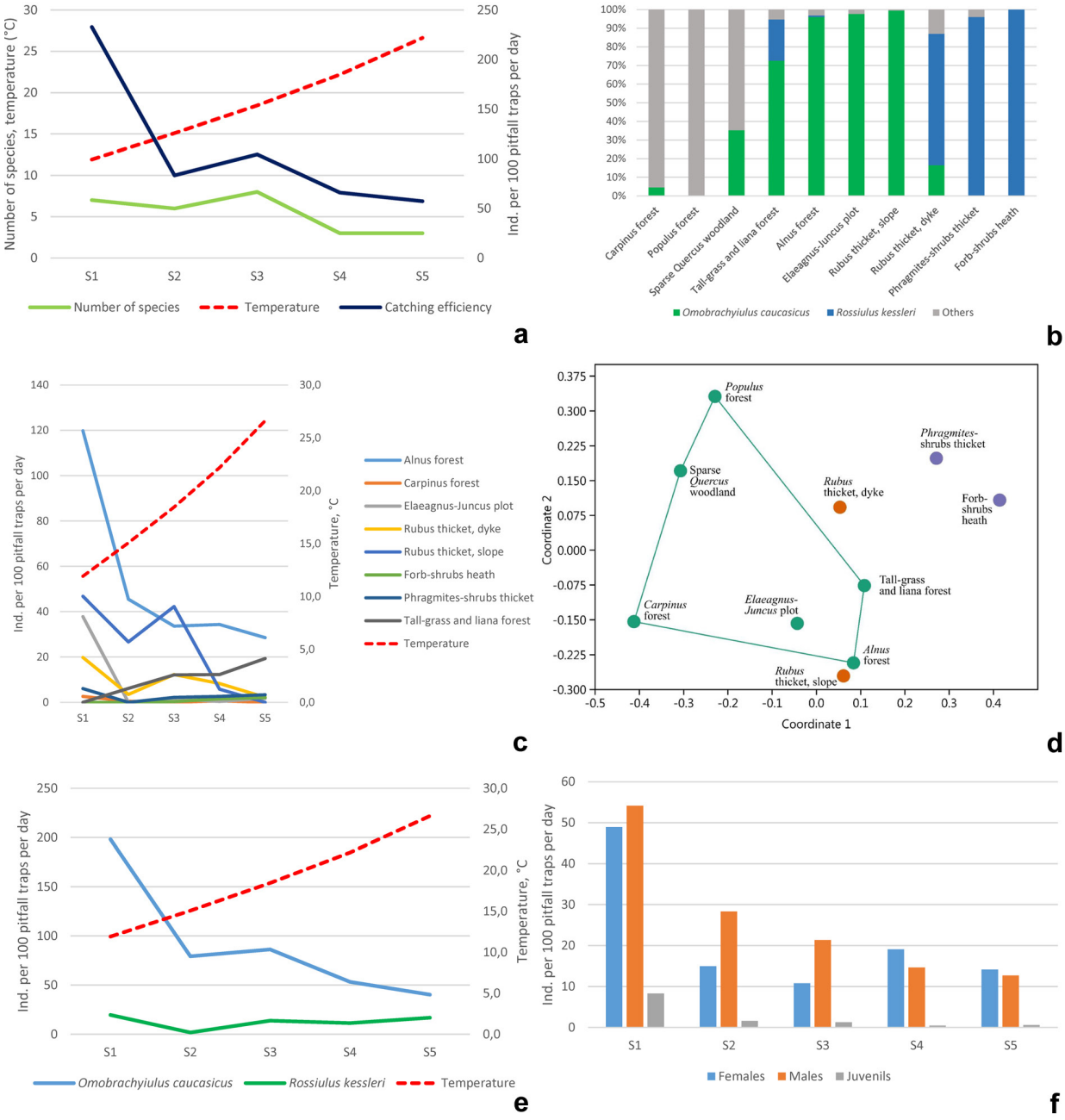

Fig. 3. Structure and dynamics of diplopod assemblages (April–June 2021, Samur Forest, Dagestan): **(a)** dynamics of the total diplopod species diversity and catching efficiency along with a growing average daily temperature; **(b)** species structure (%) of diplopod communities in different habitats (all data); **(c)** dynamics of the diplopod catching efficiency in different habitats along with a growing average daily temperature; **(d)** classification of the study diplopod communities based on the Bray-Curtis similarity index (all data, non-metric ordination, stress factor 0.2005); **(e)** dynamics of the total catching efficiency of two mass diplopod species along with a growing average daily temperature; **(f)** demography of *Omobrachyiulus caucasicus* in the *Alnus* forest (S1–5, see Methods).

Рис. 3. Структура и динамика сообществ диплопод (апрель–июнь 2021 г., Самурский лес, Дагестан): **(a)** динамика общего разнообразия видов диплопод и уловистости ловушек с ростом среднесуточной температуры; **(b)** видовая структура (%) сообществ диплопод в разных биотопах (все данные); **(c)** динамика уловистости диплопод ловушками в разных биотопах с ростом среднесуточной температуры; **(d)** классификация изученных сообществ диплопод на основе коэффициента сходства Брея–Кертиса (все данные, неметрическая ординация, стресс-фактор 0.2005); **(e)** динамика общей уловистости ловушками двух массовых видов диплопод с ростом среднесуточной температуры; **(f)** демография вида *Omobrachyiulus caucasicus* в ольшанике (*Alnus*) (S1–5, см. Методы).

present the whole yield per sample, whereas the comparisons in abundance between the habitats and collection dates were construed as cumulative curves per 100 traps per day. Naturally, the total yield (Table 2) and the resulting graphs (Fig. 3) concern only the few mass species and sufficiently abundant samples. The values of the mean temperatures are derived from the closest meteorological station located at the town of Derbent, 60 km N of Primorsky (http://www.pogodaiklimat.ru).

Some material was collected in January 2021 through sieving the litter in several forest habitats. These records are only qualitative, being referred to in the appropriate species accounts.

The following abbreviations are used herein: p.t. — pitfall trapping; s.p. — same place; s.p.d. — same place and date; s.p.h. — same place and habitat.

Faunistic part

Class Diplopoda
Order Polyxenida
Family Polyxenidae

Propolyxenus argentifer (Verhoeff, 1921)

MATERIAL. 7 ex. (ZMUM), Russia, Dagestan, near Primorsky, 41.86º N, 48.56º E, *Populus* forest, 3–9.IV.2021; 5 ex. (ZMUM), s.p.d., bank of a pond, reed thickets; 1 ex. (ZMUM), s.p.d., *Quercus* forest near sea shore; 4 juv. (ZMUM), s.p.d., *Phragmites* reed thickets on dyke, all O.L. Makarova leg.; 1 ex. (RZ), s.p., N 41º50′37″, E 48º34′30″, *Alnus* forest, bank of a stream, leaf litter, 4.VI.2021, R.V. Zuev leg.; 1 ex. (ZMUM), s.p., *Alnus* forest, p.t., 4–20.IV.2021; 1 ex. (ZMUM), s.p., *Pinus* forest, p.t., 20.IV–9.V.2021, all D.V. Osipov leg.

REMARKS. This species is the most common and widespread polyxenid in the Caucasus [Short *et al*., 2020], including Hyrcania within both the Republic of Azerbaijan and Iran. The records geographically closest to Dagestan are those from near Nabran, Caspian Sea coast of Azerbaijan [Short *et al*., 2020], not too far away from the Samur River delta. Above are the first formal records of *P. argentifer* from Dagestan, to be supplemented by the following fresh sample: 1 juv. (ZMUM), Dagestan, near Kochubey. 44º23′ N, 48º56′ E, *Tamarix* grove, 7–10.VI.2021, O.L. Makarova leg.

Order Glomerida
Family Glomeridae

Trachysphaera costata (Wagaб 1857)

MATERIAL. 1 ♀ (ZMUM), Russia, Dagestan, near Primorsky, 41.84401º N, 48.57133º E, mixed *Quercus* & *Carpinus* forest, 2.II.2023, D.I. Korobushkin leg.; 6 ex. (ZMUM), s.p., tall-grass and liana forest, 41.86º N, 48.56º E, p.t., 15–30.VI.2021, D.V. Osipov leg.

REMARK. This common and widespread Eastern European to eastern Mediterranean species occurs throughout the Caucasus, including entire Hyrcania (Golovatch *et al.*, 2022). It has already been recorded from Dagestan [Esyukov *et al.*, 2022], but is new to the Samur Forest fauna.

Order Chordeumatida
Family Craspedosomatidae

Craspedosoma raulinsii Leach, 1814

MATERIAL. 11 ♂♂, 10 ♀♀, 10 juv. (ZMUM), Russia, Dagestan, near Primorsky, 41,86º N, 48,56º E, *Quercus* forest, 13.I.2021, O.L. Makarova; 4 ♂♂, 6 ♀♀ (ZMUM), s.p., *Carpinus* forest, p.t., 5–15.IV.2021; 1 ♀ (ZMUM), s.p.d., p.t., 19.IV–10.V.2021, all D.V. Osipov leg.

REMARKS. This basically Western to Central European species, albeit slightly misspelled as *C. rawlinsi*, seems to have only recently become introduced to and established in central European Russia: city parks of Moscow and Nizhny Novgorod [Golovatch, 2021]. The above record from near the Caspian Sea coast of Dagestan is quite surprising, certainly representing another anthropochoric introduction. It is also known to have recently been introduced to Canada, North America [McAlpine, Shear, 2018].

The species identity of the above Dagestan sample has been confirmed by D. Antić, the best specialist in Caucasian (and not only) Chordeumatida [Antić, Makarov, 2016; Antić *et al*., 2018]. Above are also the first formal records of the genus *Craspedosoma* Leach, 1814 and the family Craspedosomatidae from the entire Caucasus, and of the order Chordeumatida from Dagestan, so far a *terra incognita*, as only numerous genera and species of the family Anthroleucosomatidae have hitherto been known to populate the Caucasus region.

Order Polydesmida
Family Polydesmidae

Brachydesmus kalischewskyi Lignau, 1915

MATERIAL. 2 ♂♂ (ZMUM), Russia, Dagestan, near Primorsky, 41.86º N, 48.56º E, *Quercus* forest near cordon, 3–9.IV.2021; 1 ♂, 1 ♀ (ZMUM), s.p.d., *Quercus* forest, 13.I.2021; 3 juv. (ZMUM), s.p., forest litter, 13.I.2021, all O.L. Makarova leg.; 3 ♀ (RZ), s.p., 41º53′11″ N, 48º30′24″ E, meadow, under logs, 1–2.V.2021, Yu.V. Dyachkov leg.; 2 ♂♂ (ZMUM), s.p., 41.86º N, 48.56º E, *Alnus* forest, p.t., 20.IV–9.V.2021; 1 ♂ (ZMUM), s.p.h., p.t., 9–27.V.2021; 1 ♀ (ZMUM), s.p., *Carpinus* forest, p.t., 5–15.IV.2021; 2 ♀♀ (ZMUM), s.p.h., p.t., 19.IV–10.V.2021; 1 ♀ (ZMUM), s.p., *Rubus* thicket on dyke, p.t., 8–28.V.2021; 1 juv. (ZMUM), s.p., upper *Populus* forest, 20.IV–9.V.2021; 1 ♀ (ZMUM), s.p., sparse *Quercus* woodland, p.t., 19.IV–9.V.2021, all D.V. Osipov leg.

REMARKS. This polymorphous species is very common and widespread in the entire Caucasus region, being its subendemic [Golovatch *et al.*, 2016]. The areas of the Samur forest or its surroundings, both in Dagestan and Azerbaijan, have hitherto been known to support only morph B of this species. Since the above new samples also reveal the presence of morph D, the State Samur Forest National Park appears to harbour two syntopically coexisting morphs of *B. kalischewskyi*, both of which clearly differ in size even superficially (morph B considerably smaller than D) [Golovatch *et al.*, 2016].

Family Paradoxosomatidae

Strongylosoma lenkoranum Attems, 1898

MATERIAL.1 ♀ (ZMUM), Russia, Dagestan, near Primorsky, 41.86º N, 48.56º E, *Carpinus* forest, p.t., 5–15.IV.2021; 2 ♀♀ (ZMUM), s.p., p.t., 19.IV–10.V.2021; 2 ♂♂ (ZMUM), s.p., p.t., 26.V–14.VI.2021; 7 ♂♂, 5 ♀♀ (ZMUM), s.p., *Alnus* forest, p.t., 4–20.IV.2021; 1 ♀ (ZMUM), s.p.h., 14–29.VI.2021; 1 juv. (ZMUM), s.p., *Rubus* thicket on dyke, p.t., 8–20.IV.2021; 1 ♂ (ZMUM), s.p.h., p.t., 28.V–15.VI.2021; 1 juv. (ZMUM), s.p., *Carpinus* forest, p.t., 26.V–14.VI.2021; 1 ♂ (ZMUM), s.p., tall-grass and liana forest, p.t., 9–27.V.2021, all D.V. Osipov leg.; 1 ♂, 1 subad. ♀ (ZMUM), same locality, *Carpinus* & *Quercus* forest, litter, 16.X.2021, D.I. Korobushkin & K.B. Gongalsky leg.

REMARKS. Adults captured in pitfall traps only in April to June. This seems to be the northernmost occurrence of this widespread, mostly Caucasian species in the Caucasus [Evsyukov *et al.*, 2016]. The recent record in the Samara Region, eastern European Russia is certainly because of an unintentional introduction [Golovatch *et al.*, 2025].

Order Julida
Family Blaniulidae

Nopoiulus kochii (Gervais, 1847)

MATERIAL. 1 juv. ♂ (ZMUM), Russia, Dagestan, near Primorsky, 41.86º N, 48.56º E, *Alnus* forest, 3–9.IV.2021, O.L. Makarova leg.; 1 juv. ♀ (ZMUM), s.p., tall-grass and liana forest, p.t., 9–27.V.2021, D.V. Osipov leg.

REMARKS. This ubiquitous and anthropochoric species is very common and widespread in the Caucasus, likely its origin centre [Golovatch, Enghoff, 1990]. It has already been recorded from areas adjacent to the Samur Forest, both in Dagestan and Azerbaijan, still being formally new to the fauna of the State Samur Forest National Park.

Family Julidae

Amblyiulus hirtus Evsyukov, Golovatch et Antić, 2021

MATERIAL. 3 ♀♀ (ZMUM), Russia, Dagestan, near Primorsky, 41.86º N, 48.56º E, *Alnus* forest, 3–9.IV.2021, O.L. Makarova leg.; 1

♂ (ZMUM), s.p., sparse *Quercus* woodland, p.t., 10–26.V.2021, D.V. Osipov leg.

REMARKS. This species has recently been described from the eastern Caucasus Major within both Dagestan and Azerbaijan [Evsyukov *et al.*, 2021] and it has since been recorded from the State Samur Forest National Park [Evsyukov *et al.*, 2022].

Brachyiulus lusitanus Verhoeff, 1898

MATERIAL. 1 ♂ (ZMUM), Russia, Dagestan, near Primorsky, 41.86º N, 48.56º E, pebble beach, 6.IV.2021, O.L. Makarova leg. 1 ♂, 2 ♀♀ (ZMUM), s.p., *Rubus* thicket on dyke, p.t., 8–20.IV.2021; 1 ♀ (ZMUM), s.p., seaside *Phragmites* reed thickets, p.t., 9–27.V.2021, all D.V. Osipov leg.

REMARKS. This basically Mediterranean species which has attained a subcosmopolitan distribution through anthropochory is long known from several places throughout the Caucasus [Vagalinski, Golovatch, 2021], yet being formally new to the fauna of Dagestan.

Omobrachyiulus caucasicus (Karsch, 1881)

MATERIAL. 5 ♂♂, 14 ♀♀, 5 juv. (ZMUM), Russia, Dagestan, near Primorsky, 41.86º N, 48.56º E, *Alnus* forest, litter, 3–9.IV.2021; 1 ♂, 4 ♀♀, 1 juv. (ZMUM), s.p.d., bank of a pond, *Phragmites* reeds; 12 ♂♂, 5 ♀♀ (ZMUM), s.p.d., sand dunes, under *Elaeagnus* trees; 3 ♂♂, 12 juv. (ZMUM), s.p.d., *Quercus* forest near cordon; 2 juv. (ZMUM), s.p.d., under an *Alnus* tree, sifted litter; 2 juv. (ZMUM), s.p.d., cordon, reeds; 4 ♂♂, 3 ♀♀, 1 juv. (ZMUM), s.p.d., sand dunes, under logs; 1 ♀, 1 juv. (ZMUM), s.p., *Fagus* forest, litter, 11–13.I.2021, all O.L. Makarova leg.; 1 ♀ (ZMUM), same locality, *Carpinus* & *Quercus* forest, litter, 16.X.2021, D.I. Korobushkin & K.B. Gongalsky leg.; 7 ♂♂, 1 ♀, 1 juv. (RZ), s.p., 41º51′48,2″ N, 48º32′47″ E, forest, in leaf litter and under rock, 29.IV–1.V.2021, Yu.V. Dyachkov and A.A. Fomichev leg.; 2 ♂♂, 3 ♀♀ (RZ), s.p., 41º53′11″ N, 48º30′24″ E, meadow, under logs, 1–2.V.2021; 6 ♂♂, 7 ♀♀ (RZ), s.p.d., forest, under logs, all Yu.V. Dyachkov leg.; 2 ♂♂, 7 ♀♀ (ZMUM), s.p., 41.844334º N, 48.570391º E, mixed *Carpinus* & *Quercus* forest, litter, 24.II.2021; 1 ♀ (ZMUM), Russia, Dagestan, near Primorsky, 41.84401º N, 48.57133º E, mixed *Quercus* & *Carpinus* forest, 2.II.2023, all D.I. Korobushkin leg.; 82 ♂♂, 76 ♀♀, 15 juv. (ZMUM), s.p., 41.86º N, 48.56º E, *Alnus* forest, p.t., 4–20.IV.2021; 170 ♂♂, 93 ♀♀, 11 juv. (ZMUM), s.p.h., p.t., 20.IV–9.V.2021; 109 ♂♂, 60 ♀♀, 7 juv. (ZMUM), s.p.h., p.t., 9–27.V.2021; 56 ♂♂, 108 ♀♀, 1 juv. (ZMUM), s.p.h., p.t., 27.V–15.VI.2021; 40 ♂♂, 52 ♀♀, 1 juv. (ZMUM), s.p.h., p.t., 15–30.VI.2021; 22 ♂♂, 18 ♀♀, 1 juv. (ZMUM), s.p.h., p.t., 5–15.IV.2021; 40 ♂♂, 18 ♀♀, 1 juv. (ZMUM), s.p.h., p.t., 19.IV–10.V.2021; 41 ♂♂, 16 ♀♀, 2 juv. (ZMUM), s.p.h., p.t., 10–26.V.2021; 33 ♂♂, 8 ♀♀, 2 juv. (ZMUM), s.p.h., 26.V–14.VI.2021; 21 ♂♂, 16 ♀♀, 2 juv. (ZMUM), s.p.h., p.t., 14–29.VI.2021; 3 ♂♂ (ZMUM), s.p., *Rubus* thicket on dyke, p.t., 8–20.IV.2021; 1 ♂ (ZMUM), s.p.h., p.t., 8–28.V.2021; 1 ♂ (ZMUM), s.p.h., p.t., 28.V–15.VI.2021; 50 ♂♂, 20 ♀♀, 10 juv. (ZMUM), s.p., *Rubus* thicket, p.t., 6–19.IV.2021; 7 ♂♂, 8 ♀♀ (ZMUM), s.p.h., p.t., 28.V–14.VI.2021; 27 ♂♂, 47 ♀♀, 2 juv. (ZMUM), s.p.h., p.t., 8–28.V.2021; 25 ♂♂, 17 ♀♀, 3 juv. (ZMUM), s.p.h., p.t., 19.IV–8.V.2021; 7 ♀♀ (ZMUM), s.p.h., p.t., 14–29.VI.2021; 1 ♀ (ZMUM), s.p., sparse *Quercus* woodland, p.t., 19.IV–9.V.2021; 38 ♂♂ 30 ♀♀, 8 juv. (ZMUM), s.p., *Juncus* plot 1, p.t., 8–19.IV.2021; 3 ♂♂ (ZMUM), s.p.h., p.t., 8–28.V.2021; 1 ♂ (ZMUM), s.p.h., *Juncus* plot 2, p.t., 28.V–14.VI.2021; 2 ♂♂, 2 ♀♀ (ZMUM), s.p.h., p.t., *Juncus* plot 2, 14–29.VI.2021; 1 ♂ (ZMUM), s.p., *Carpinus* forest, p.t., 26.V–14.VI.2021; 14 ♂♂, 19 ♀♀ (ZMUM), s.p., tall-grass and liana forest, p.t.,15–30.VI.2021; 14 ♂♂, 11 ♀♀ (ZMUM), s.p.h., p.t., 9–27.V.2021; 2 ♂♂, 5 ♀♀ (ZMUM), s.p.h., p.t., 20.IV–4.V.2021, 2 ♀♀ (ZMUM), Dagestan, Sarykum dune, 43.104º N, 47.2513º E, forest, 10.VI.2021, all D.V. Osipov leg.;

REMARKS. This species is subendemic to the Caucasus, being very common and widespread all over the region [Vagalinski, Golovatch, 2021]. It has been recorded from many places not too far away from the Samur Forest area, both in Dagestan and Azerbaijan, but still it is formally new to the fauna of the State Samur Forest National Park.

Rossiulus kessleri (Lohmander, 1927)

MATERIAL. 3 ♀♀ (ZMUM), Russia, Dagestan, near Primorsky, 41.86º N, 48.56º E, bank of a pond, reeds, 3–9.IV.2021; 1 ♀ (ZMUM), s.p.d., lower reaches of Karasu River, *Phragmites* reed thickets; 1 ♀ (ZMUM), s.p.d., *Quercus* forest near cordon, all O.L. Makarova leg.; 4 ♀♀, 7 juv. (RZ), s.p., 41º51′48,2″ N, 48º32′47″ E, forest, in leaf litter and under rock, 29.IV–1.V.2021, Yu.V. Dyachkov and A.A. Fomichev leg.; 1 ♂, 1 ♀ (ZMUM), s.p., *Alnus* forest, p.t., 4–20.IV.2021; 1 ♂ (ZMUM), s.p.h., p.t., 27.V–15.VI.2021; 1 ♂, 3 ♀♀ (ZMUM), s.p.h., p.t., 15–30.VI.2021; 2 ♂♂, 2 ♀♀, 2 juv. (ZMUM), s.p., seaside hollow, p.t., 15–30.VI.2021; 2 ♂♂, 3 ♀♀ (ZMUM), s.p.h., p.t., 27.V–15.VI.2021; 1 juv. (ZMUM), s.p.h., p.t., 9–27.V.2021; 1 ♂, 3 ♀♀. 1 juv. (ZMUM), s.p., seaside *Phragmites* reed thickets, p.t., 27.V–15.VI.2021; 2 ♂♂, 6 ♀♀ (ZMUM), s.p.h., p.t., 8–20.IV.2021; 3 ♀♀ (ZMUM), s.p.h., 9–27.V.2021; 3 ♂♂, 2 ♀♀ (ZMUM), s.p.h., p.t., 15–30.VI.2021; 2 ♀♀ (ZMUM), s.p., tall-grass and liana forest, p.t., 15–30.VI.2021; 3 ♀♀, 1 juv. (ZMUM), s.p.h., p.t., 9–27.V.2021; 3 ♀♀, 1 juv. (ZMUM), s.p.h., p.t., 9–27.V.2021; 3 ♂♂, 8 ♀♀, 1 juv. (ZMUM), s.p., *Rubus* thicket on dyke, p.t., 8–20.IV.2021; 4 ♂♂, 8 ♀♀ (ZMUM), s.p.h., p.t., 8–28.V.2021; 6 ♀♀ (ZMUM), s.p.h., p.t., 28.V–15.VI.2021; 2 juv. (ZMUM), s.p.h., p.t., 20.IV–9.V.2021; 1 ♂, 1 juv. (ZMUM), s.p.h., p.t., 15–30.V.2021, all D.V. Osipov leg.

REMARKS. This calciphilous species is endemic to the Eastern European (= Russian) Plain, ranging from near Arkhangelsk, Vologda and Vyatka in the north to North Ossetia – Alania, Kalmykia and Dagestan, northern Caucasus in the south, and from near Minsk, central Belarus in the west to Bashkortostan and the Orenburg Region in the east [Kime, Enghoff, 2017]. *Rossiulus kessleri* is especially common and abundant in various habitats, both natural and anthropogenic, in the nemoral forest belt (mixed forest, forested steppe and northern steppe) east of the Dnieper River within Ukraine and Russia, showing increased body miniaturisation and tegument sclerotisation, as well as gonopodal structural variations, towards the hotter and drier southeast [Prisnyi, 2001]. The species is formally new to the fauna of the State Samur Forest National Park, this locality presently being the southeastern in its distribution range, but the occurrence in the neighbouring parts of the forest in Azerbaijan is also very likely.

Ecological results

Regular pitfall trapping during all three months of the high season revealed all ten diplopod species that occur in the Samur Forest (Table 2). By far the most common, widespread and abundant species was the pan-Caucasian julid, *Omobrachyiulus caucasicus*, followed by another julid, *Rossiulus kessleri,* a species endemic to the Eastern European Plain and northern Caucasus (Fig, 3b, e). All other diplopods were clearly subordinate and more sporadic in terms of abundance and distribution (Fig. 3b). Perhaps only the introduced *Craspedosoma raulinsii* (the only member of the order Chordeumatida) showed a clear-cut spring activity peak.

Among the Samur habitats surveyed, only the poplar (*Populus*) stand was almost devoid of millipedes (Table 2), the other forest sites, especially the alder (*Alnus*) one, being the richest in terms of both diplopod species diversity and abundance, and both rather steadily dropping along with rising mean daily air-temperatures (Table 2, Fig. 3c). The total catching efficiency showed the same trend (Fig. 3a). Adults always prevailed in the yield, apparently representing the most surface-active stadia (Fig. 3f). In general, all forest stands showed more similarities in the structure of diplopod assemblages compared to

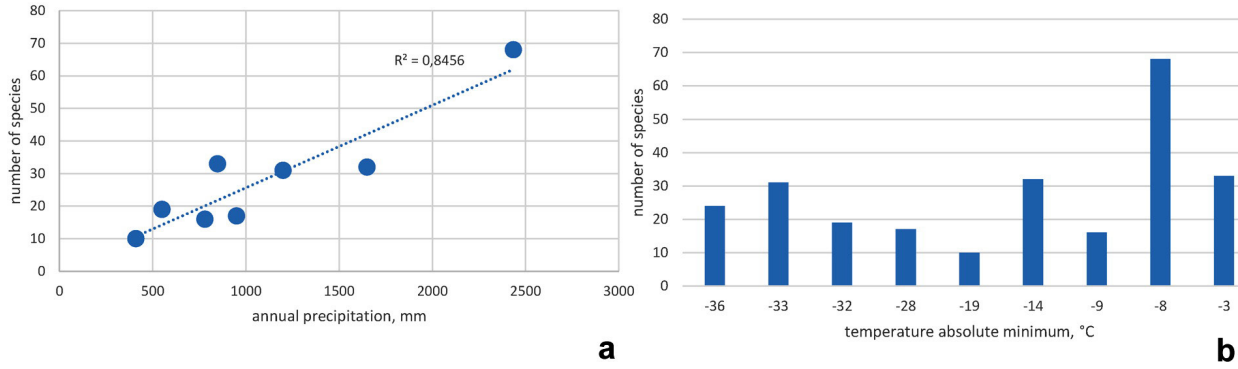

Fig. 4. Number of millipede species in regional faunas of the Caucasus in relation to annual precipitation rate **(a)** and absolute temperature minimum **(b)**. Data derived from the site http://www.pogodaiklimat.ru and literature: Akaev *et al.*, 1996; Chumachenko, 2016; Korobushkin *et al*., 2016; Zuev, 2021; Golovatch, Antipova, 2022; Kokhia, Golovatch, 2018; Zuev *et al*., 2923; Golovatch *et al*., 2024; Golovatch, 2025; our own new data for Samur, Dagestan.

Рис. 4. Связь числа видов диплопод в региональных фаунах Кавказа с годовым количеством осадков **(a)** и абсолютным температурным минимумом **(b)**. Использованы материалы сайта http://www.pogodaiklimat.ru, сведения из: Akaev *et al.*, 1996; Chumachenko, 2016; Korobushkin *et al*., 2016; Zuev, 2021; Golovatch, Antipova, 2022; Kokhia, Golovatch, 2018; Zuev *et al*., 2923; Golovatch *et al*., 2024; Golovatch, 2025; а также наши новые данные по Самуру (Дагестан).

both shrub and grassland sites (Fig. 3d). This fully agrees with the general wisdom that Diplopoda are basically a forest floor-dwelling group of land arthropods [Kime, Golovatch, 2000; Golovatch, Kime, 2009].

Almost regardless of habitat, Diplopoda demonstrate clear inclinations to dwelling in certain habitats and habitat types (Fig. 3b), as well as drastic to more gradual declines in species richness and abundance along with rising mean daily air-temperatures (Fig, 3a, c). In April, the number of species and their abundance were the highest, whereas both dropped towards June, the end of the high, spring season. In general, such a pattern of phenology is typical of most millipedes in extra-tropical environments, including the Caucasus [Chumachenko, 2016].

Discussion and conclusions

There has been no summarizing information so far on myriapods of the study region. During the Pliocene, ca 5 Mya, woodlands in the Samur area are known to have been similar in composition to the Hyrcanian flora [Abramova, 1977]. The present-day Samur Forest has been termed as "a relict of the past ecosystems alien to the modern geographic situation" [Abdurakhmanov, 2017]. Its hardwood tree flora has been treated as derivative of the subtropical flora of the Talysh Mountains (Hyrcania), yet being ca 0.67 times as rich [Bagomaev, 2005].

The species diversity of the Samur delta's ground-beetles (Coleoptera, Carabidae) likewise appears to be ca 0.67 times as high as in the deltaic near-Caspian ecosystems of the Talysh Mountains. The proportions of Caucasian or Mediterranean elements in the Cis-Samurian carabid fauna are thereby twice as low, this corresponding to the climatic differences between the territories concerned [Bagomaev, 2005]. In contrast to the humid subtropical Talysh, the Samur Forest area which lies in the semi-desert climatic belt is subjected to the annual precipitation rates 2.5–3 times lower (290–410 mm), and the winter temperatures that can drop down to –19…–21 °C against the background of the mean January minimum being –8.5 °C [Akaev *et al.*, 1999; Cis-Samuria…, 2003; Pogoda i klimat, 2025]. However, given the greater number of diplopod species in the North and Central Caucasus [Golovatch *et al*., 2024] where winters are much colder, this seems the water/humidity deficit that is responsible for the relatively low diversity of Diplopoda in the Samur Forest (Fig. 4a, b).

Viewing the millipede fauna of the Greater Caucasus (= Caucasus Major) broadly, their species and, to a lesser degree, generic diversity is known to rather gradually decline from west to east. Thus, the faunas of the Republic of Karachay-Cherkessia, the Stavropol Province, the Republic of North Ossetia – Alania, and the Chechen Republic, all these regions rather comparable in area and also lying on the northern macro slope of the Caucasus Major, but situated increasingly west of Dagestan, amount to 31, 27, 17 and 19 species, respectively [Golovatch *et al*., 2024], *vs* only 10 species in the Samur Forest National Park of Dagestan (Table 2; Fig. 4). In all of the above regions of the Caucasus Major, the mountains are mostly much higher and the winter conditions much more severe compared to the Samur Forest, the mean January temperatures being –5…–7° *vs* 1.4 °C, but the annual precipitations much higher: 550–1200 *vs* 290–410 mm [Akaev *et al.*, 1996; Cis-Samuria…, 2003; Pogoda i klimat, 2025]. The effect observed is especially strong when comparing the largely subtropical faunas of the rather small western Georgia (68 diplopod species, regardless of troglobionts) and the vast and ecologically varied, but mostly much more arid and hot areas of Iran (54 species) [Kokhia, Golovatch, 2018; Golovatch, 2025]. The remarkably high diplopod diversity in western Georgia (Fig. 4a) is well correlated with the unusually high annual precipitation rates that amount there to nearly 2,500 mm [Pogoda i klimat, 2025].

The relative poverty of the diplopod fauna of the Samur Forest in comparison with the lists of the western and central Caucasus could be accounted for by the low precipitation rate typical of the semi-desert belt and

periodically resulting in litter drought. This humidity deficit fails to be compensated for even by the intense sub-surface ground water drain characteristic of the Samur Forest.

As noted above, the millipede fauna of the Samur Forest, however depauperated, is basically Caucasian in composition. This clearly contrasts the fauna of Carabidae beetles, about half of which contains elements with very vast, Euro-Siberian or Palaearctic distributions [Bagomaev, 2005]. The butterfly fauna (Rhopalocera) of the Samur Forest is nearly completely (96%) represented by widespread species "characteristic of Europe" [Tikhonov, 2010].

The only long-term research project similar to ours, but fully based on pitfall trapping, was conducted in three main habitats (different forest types) in March to October 2013 in a *Taxus* and *Buxus* grove of 300 ha in area (*vs* 11,200 ha in the Samur Forest) near Khosta, Caucasian Biosphere Nature Reserve, Greater Sochi, Krasnodar Province [Chumachenko, 2016], i.e. at the opposite end of the Caucasus Major, near the Black Sea coast. The diplopod fauna of the grove amounted to 32 species, mostly endemic or subendemic to Colchis or the Caucasus region in general. Altogether, >9,000 pitfall trap days were employed. The yield totaled 1,208 individuals, with an average of >14 ind. per 100 traps per day.

In this Khosta grove, the catching efficiency of the traps varied considerably between millipede orders. The highest for Glomerida was observed in June and July, 3.04 ind. per 100 traps per day. In contrast, the maximum activity of Polydesmida was noted in August, 6.21 ind. per 100 traps per day, being ca 3.89 ind. per 100 traps per day in the spring and 0.85 ind. per 100 traps per day towards June. Expectedly, the highest activity of Julida at Khosta was recorded in March and April and its sharp fall was observed in mid-summer, much like in the Samur Forest (Fig. 3a). As regards the Chordeumatida, their activities peaked in autumn, 3.30 ind. per 100 traps per day, this contrasting the spring maximum in the Samur Forest.

Against the above background, the Samur faunule amounting to only 10 diplopod species can be postulated as generally being depauperate, although the diplopod populations are rather abundant, averaging >54 ind. per 100 traps per day. The highest species diversity was always observed in habitats well supplied with fresh water, located near constant water bodies and with well-developed closed canopies that protect the floor from direct sunlight. Within a season, the catching efficiency steadily dropped all along and correlated with rising mean daily air and ground temperatures. Apparently, habitat humidity is one of the most significant factors to affect millipede distributions. This fully agrees with the general wisdom that Diplopoda are mostly meso- to hygrophilous animals [Kime, Golovatch, 2000; Golovatch, Kime, 2009].

Both climate and area of the Samur Forest, like most of Dagestan, lie within the semi-desert belt (e.g., Abdurakhmanov [2017]). This alone implies quite dry and hot environmental conditions that affect the biota. To compensate for the zonal deficit of fresh water received through direct precipitations, the Samur Forest, like its counterpart area lying in the Republic of Azerbaijan, enjoys a ramified drain network from the adjacent mountains. It is this network that allows for rather restricted, but numerically mostly abundant millipede population to thrive. The Samur forested deltaic area is an island as it were, framed by xeric territories that strongly hamper exchanges by meso- to hygrophilous biotic elements, Diplopoda being among such. The summer heat and drought in the Samur Forest, the absolute air temperature maximum being +39 °C, occasionally very severe and drying up the forest floor with its litter and topsoil, is another important factor to limit Diplopoda survival and distribution. The largely highly restricted dispersal abilities and the typically poor compensatory ecological capacities, when even one limiting factor cannot be compensated for by others, however favourable, result in millipede species distributions mostly being narrow, and local endemism profound [Golovatch, 1994; Kokhia, Golovatch, 2018]. That the Samur Forest fauna contains no narrowly endemic Diplopoda seems to be another piece of evidence of its likely being residual and impoverished.

Another noteworthy conclusion is, that sufficiently large-scale pitfall trapping alone, when performed during the right season(s), is capable of revealing complete diplopod faunules. This seems to concern at least the Samur Forest millipede faunule that presently encompasses ten species, including even some, like *Trachysphaera costata*, that are very small-sized and apparently slow-moving animals (Table 2).

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.

Acknowledgements. Special thanks are due to the few collectors who have kindly provided their additional material treated above. Dragan Antić (Belgrade, Serbia) very helpfully confirmed the identity of *Craspedosoma raulinsii*. The authors are grateful for the multifarious support in the field to G.S. Dzhamirzoev, deputy director for research, and the rangers of the Dagestan State Nature Reserve. We are also deeply indebted to K.V. Makarov (Moscow) who kindly prepared most figures for publication. In addition, D.M. Palatov (Moscow) generously shared some of his pictures.

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Responsible editor K.G. Mikhailov