

TO THE LIVERWORT FLORA OF CAUCASUS: THE LIVERWORTS OF THE UPPER
KURDZHIPS RIVER BASIN (KRASNODAR TERRITORY)

К ФЛОРЕ ПЕЧЕНОЧНИКОВ КАВКАЗА: ПЕЧЕНОЧНИКИ БАССЕЙНА ВЕРХНЕГО
ТЕЧЕНИЯ РЕКИ КУРДЖИПС (КРАСНОДАРСКИЙ КРАЙ)

NADEZHDA A. KONSTANTINOVA¹ & ANATOLIY N. SAVCHENKO¹

НАДЕЖДА А. КОНСТАНТИНОВА¹, АНАТОЛИЙ Н. САВЧЕНКО¹

Abstract

The annotated list of liverworts of the middle course of the Kurjips River (Caucasus, Krasnodar Territory) is compiled based on identification of 150 specimens gathered by the authors in 2018. It counts 35 species, among them one species (*Scapania glaucocephala*) is recorded as new for Caucasus and two species (*Scapania calcicola* and *Trichocolea tomentella*) as new for the Krasnodar Territory. Five liverwort species are threatened in Krasnodar Territory including *Frullania parvistipula* (= *F. caucasica*), which is critically endangered in Europe. Two species of *Cololejeunea* (*C. rossettiana* and *C. calcarea*), which in Russia only occur in the Caucasus and were previously considered rare, were collected in most of the studied areas, although always in very small numbers. Annotations to the species include distribution, description of habitats and data on reproduction structures. Distribution of the phytogeographically interesting species is discussed.

Резюме

Приводится аннотированный список печеночников среднего течения бассейна реки Курджипс (Кавказ, Краснодарский край), составленный на основании определения 150 образцов, собранных авторами в 2018 году. Список насчитывает 35 видов и включает один вид (*Scapania glaucocephala*) новый для Кавказа, два вида (*Scapania calcicola* и *Trichocolea tomentella*) новые для Краснодарского края. Выявлены новые местонахождения пяти видов из числа внесенных в Красную книгу Краснодарского края, в том числе один вид, отнесенный к критически угрожаемым в Европе: *Frullania parvistipula* (= *F. caucasica*). Два вида *Cololejeunea* (*C. rossettiana* и *C. calcarea*), встречающиеся в России только на Кавказе и считавшиеся здесь редкими, собраны в подходящих местообитаниях в большинстве обследованных точек. Аннотации к видам включают перечень выявленных точек нахождения, описание местообитаний, перечень сопутствующих видов, наличие генеративных и вегетативных органов размножения, общее распространение и распространение на Кавказе.

KEYWORDS: liverworts, ecology, distribution, phytogeography, Caucasus

INTRODUCTION

Caucasus is a strongly isolated mountain system with some areas that never were glaciated. As a result several centers of the tertial flora are preserved in the Caucasus (Pavlov, 1948). The upper reaches of the river Kurdzhips, in particular the Guam and Kurdzhips Gorges are well known enclaves of Colchis flora of vascular plants with numerous tertial relicts including *Taxus baccata* L., *Staphylea pinnata* L. etc. as well as some Caucasus endemics e.g. *Staphylea colchica* Stev., *Buxus colchica* Pojark., *Silene hoefftiana* Fisch., etc. (<https://anapacity.com/landshaftnye-pamyatniki/guamskoe-ushhele.html>). Since 1988, the Guam Gorge has been a natural monument. There was no information about the liverworts flora in

this area. In general, information about the flora of the liverworts of the Krasnodar Territory concerns mainly the coastal areas of the Black Sea and the adjacent slopes of the Caucasus. This work fills a gap in our knowledge about the distribution of liverworts in the mid-mountain regions of Caucasus within the Krasnodar Territory.

STUDY AREA

The study area is located in the Apsheronskiy District of the Krasnodar Territory. Our main goal was to study the liverworts of the Guam Gorge, which is a sharply narrowing valley of the Kurdzhips River, developed by the river between the Lagonaki and Guam ranges (Caucasus) known for rich relict flora of vascular plants. In addition to the Guam Gorge, we studied the liverworts on the

¹ – Polar-Alpine Botanical Garden, Kola Sci. Centre, Russ. Acad. Sci., Kirovsk-6, Murmansk Province, 184256 Russia; e-mail: nadya50@list.ru; ORCID (NK): 0000-0002-7600-0512; (AS): 0000-0003-2520-8070.

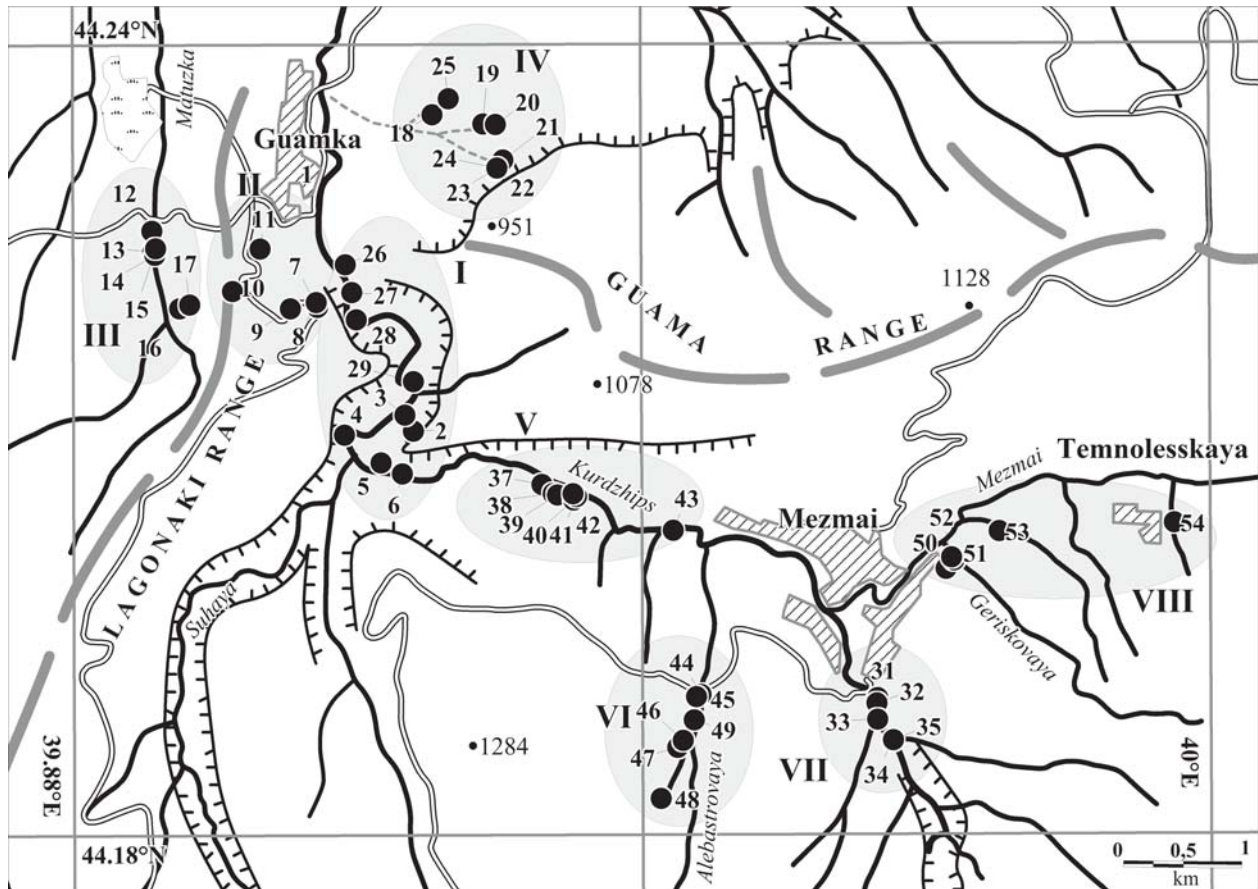


Fig. 1. Collecting localities (explanations in the text).

adjacent slopes of ranges Lagonaki and Guama, and in the valleys of the tributaries of Kurdzhips River, particularly Mezmai and Armovka rivers and in narrow Kurdzhips Gorge upstream Mezmai village (Fig. 1). The Guam Gorge is developed in a thick layer of Jurassic and Cretaceous limestone and dolomites (Fig. 2A) and reaches a length of three kilometers with a width along the bed of the Kurdzhips river up to 400 m. The almost sheer cliffs are composed of dolomitized limestones (https://ru.wikipedia.org/wiki/Гуамское_ущелье). In the central part of the gorge, steep cliffs often break off to the stream (Fig. 2:B), which makes it impossible to collect on them, but in some places there are small rocky beaches on the banks. Collecting in the gorge was carried out only from the lower parts of the almost vertical cliffs along the railway (Fig. 2: C) and on separate accessible sections of the river bank (Fig. 2:D). It was not possible to collect liverworts along the left tributary of the Sukhaya Balka River due to the fact that the passage there was closed due to the danger of rockfalls. Near the village Mezmai the gorge sharply widens. Here in the river valley there are secondary broadleaf forests (Fig. 2:E) dominated by *Fagus orientalis* Lipsky, *Carpinus caucasica* Grossh., *Abies nordmanniana* (Steven) Spach and elements of Colchian undergrowth (*Buxus colchica* Pojark., *Hedera helix* Lowe etc.). Liverworts here

occur on decaying wood and on trunks and branches of trees, rare on the fall. Upstream of the river there is another rather narrow gorge, the so-called Kurdzhips Canyon. It was possible to collect only the lower part of the canyon as a significant part of it is very difficult to pass and requires climbing equipment. Unlike the Guam Gorge, where the vegetation is quite severely disturbed as a result of the construction and operation of the railway, the Kurdzhips Canyon has preserved its natural phytocenoses (Fig. 2: F). The most rare and phytogeographically interesting species (e.g. *Trichocolea tomentella*, *Scapania gymnostomphila*) were collected in this canyon (Fig. 2: G, H, I, J). In addition to two gorges, we explored the valleys of three large tributaries of the Kurdzhips River – Mezmai, Matuska and Alebasrovaya (Fig. 2: K). During the one-day collecting trip to each of the valleys, we collected liverworts on rotting wood and tree trunks in beech-hornbeam-fir forests with Colchian undergrowth, as well as on rock outcrops in these forests and along the banks of rivers and their tributaries. In addition, one site was surveyed in the foothills of the Guam Ridge (Fig. 1: IV) and one in the foothills of Lagonaki Range (Fig. 1: II). The vegetation in both sites is mainly represented by secondary beech-hornbeam forests with elements of Colchian undergrowth and rock outcrops.

MATERIAL AND METHODS

We gathered liverworts in the Kurdzhips River Basin from 18 to 28 September 2018. In total 150 specimens were collected from 88 sites at altitudes from ca. 450 to 1000 m. For all collecting sites the coordinates and elevations were measured using GPS. Collecting localities are grouped into 54 locations and are shown on the map as eight groups I–VIII (Fig. 1):

I (1-6, 26-29). Western part of Guam Gorge, the left bank of Kurdzhips River: 1 – on east facing cliff, 44°13'49"N – 39°54'8"E, 457 m alt.; 2 – east facing cliff, 44°12'38"N – 39°54'52"E, 483 m alt.; 3 – east facing cliff, 44°12'42"N – 39°54'49"E, 503 m alt.; 4 – east vertical mossy cliff 44°12'37"N – 39°54'26"E, 572 m alt.; 5 – rock outcrops, in crevices, on rock, 44°12'29"N – 39°54'40"E, 594 m alt.; 6 – on *Fagus orientalis*, 44°13'12"N – 39°54'16"E, 683 m alt.; 26 – near the entrance, on ledge of cliff, 44°13'23"N – 39°54'27"E, 581 m alt.; 27 – cliffs near entrance, 44°13'16"N – 39°54'29"E, 555 m alt.; 28 – mossy rocks on bank of river, 44°13'8"N – 39°54'31"E, 556 m alt.; 29 – cliffs on bank of river, 44°12'51"N – 39°54'52"E, 558 m alt.

II (7-11). Northern slopes of Lagonaki Ridge, near Guam town: 7 – on edge of deciduous forest along the road, on *Fagus orientalis*, ca. 25-30 cm in diameter, mixed with lichens, 44°13'12"N – 39°54'16"E, 683 m alt.; 8 – on loamy soil and decaying wood in roadside ditch, 44°13'13"N – 39°54'16"E, 698 m alt.; 9 – deciduous forest along the road, on decaying mossy wood, 44°13'11"N – 39°54'6"E, 682 m alt.; 10 – dry north faced mossy cliffs in deciduous forest, 44°13'16"N – 39°53'44"E, 647 m alt.; 11 – beech forest on gentle slope, on *Fagus orientalis* ca. 30 cm in diameter at ca. 1.5 m height, 44°13'28"N – 39°53'54"E, 543 m alt.

III (12-17). Valley of Matuzka River the right tributary of Kurdzhips River: 12 – bank of the river, on boulder, 44°13'33"N – 39°53'13"E, 479 m alt.; 13 – young hornbeam-beech forest with single beech up to 1.5 m in diameter, but mostly beeches are 10-20 cm in diameter, 44°13'27"N – 39°53'13"E, 498 m alt.; 14 – beech forest on high bank of river, on relatively dry decaying log, 44°13'26"N – 39°53'14"E, 500 m alt.; 15 – beech forest with herbs and *Hedera helix* in ground floor, on bark of huge (ca. 60 cm in diameter) beech, 44°13'28"N – 39°53'15"E, 494 m alt.; 16 – on vertical cliff on edge of crevices, just on rock, 44°13'12"N – 39°53'24"E, 547 m alt.; 17 – on trunk of dead *Buxus colchica* ca. 8 cm in diameter, 44°13'13"N – 39°53'27"E, 564 m alt.

IV (18-25). North-western part of Guam Ridge, near Guam town: 18 – beech-pear forest with *Hedera helix*, 44°14'4"N – 39°55'0"E, 557 m alt.; 19 – beech forest with *Rosa* and *Abies* undergrowth, 44°14'2"N – 39°55'19"E, 592 m alt.; 20 – *Fagus-Carpinus* forest with pear, 44°14'2"N – 39°55'24"E, 605 m alt.; 21 – mossy rock field on steep slope, on side of rock, on dead mosses, 44°13'52"N – 39°55'27"E, 678 m alt.; 24 – north

faced cliffs, on rock, 44°13'50"N – 39°55'24"E, 719 m alt.; 25 – *Carpinus-Fagus* forest with single *Acer*, 44°14'9"N – 39°55'6"E, 571 m alt.

V (37-43). Eastern part of Guam Gorge, the left bank of Kurdzhips River: 37 – young beech forest, 44°12'23"N – 39°55'41"E, 598 m alt.; 38 – *Abies-Fagus* forest with *Ilex* and *Hedera helix*, 44°12'21"N – 39°55'45"E, 615 m alt.; 39 – *Abies-Fagus* forest with *Hedera helix* and ferns, 44°12'20"N – 39°55'47"E, 620 m alt.; 40 – *Fagus* dominated forest with fern and grasses near the road, 44°12'19"N – 39°55'53"E, 610 m alt.; 41 – *Fagus* forest with mossy rocks and sparse ferns, grasses and undergrowth of *Taxus baccata*; 44°12'20"N – 39°55'54"E, 608 m alt.; 42 – the first river terrace, rock outcrop in forest, 44°12'21"N – 39°55'53"E, 614 m alt.; 43 – the first river terrace, high bank of Kurdzhips River, hazel growth, 44°12'11"N – 39°56'31"E, 629 m alt.

VI (44-49). Valley of Alebastrovaya River (tributary of Kurdzhips River): 45 – *Abies-Fagus* forest with grasses and *Hedera helix*, 44°11'25"N – 39°56'40"E, 795 m alt.; 46 – cliffs in *Abies-Fagus* forest on terrace on the left bank of Alebastrovaya River, 44°11'13"N – 39°56'34"E, 855 m alt.; 47 – rotten moist log of *Fagus* on steep slope, 44°11'11"N – 39°56'32"E, 865 m alt.; 48 – *Carpinus-Fagus* forest with colchis undergrowth and ground floor, 44°10'57"N – 39°56'26"E, 989 m alt.; 49 – *Abies-Fagus* forest with dominance of *Hedera helix* in ground floor on high bank of river, 44°11'19"N – 39°56'39"E, 813 m alt.

VII (31-35). Right bank of Kurdzhips River, near Mezmai Village, Kurdzhips Gorge: 31 – bank of river near small waterfall, 44°11'25"N – 39°57'48"E, 668 m alt.; 32 – bank of river, 44°11'23"N – 39°57'48"E, 685 m alt.; 33 – in dead *Buxus colchica* stands with single trees of *Fagus* on steep slope to the river, 44°11'19"N – 39°57'48"E, 691 m alt.; 34 – mossy rock fields forested with dead *Taxus baccata* in deep depression on the high bank of river, 44°11'13"N – 39°57'54"E, 683 m alt.; 35 – deep moist grotto, 44°11'13"N – 39°57'54"E, 688 m alt.

VIII (50-54). Near Mezmai Village, valley of Mezmai River: 50 – young beech forest, 44°12'0"N – 39°58'15"E, 709 m alt.; 51 – Geriskovaya (Kamenka) River, left tributary of Mezmai River, beech forest with mossy rocks on bank of river, 44°12'2"N – 39°58'18"E, 718 m alt.; 52 – Geriskovaya (Kamenka) River, left tributary of Mezmai River, north-west cliffs in beech forest on bank of river, 44°12'3"N – 39°58'17"E, 724 m alt.; 53 – Geriskovaya (Kamenka) River, left tributary of Mezmai River, *Abies-Fagus* forest with grasses, 44°12'10"N – 39°58'35"E, 741 m alt.; 54 – left tributary of Mezmai River near Temnolesskay village, *Abies-Fagus* with grasses forest, cliffs near small waterfall, 44°12'12"N – 39°59'41"E, 800 m alt.

The collected specimens were studied in the laboratory of the Polar-Alpine Botanical Garden-Institute



Fig. 2. Main habitats of liverworts in Kurdzhips River Basin. A: Guamka Gorge view from the town; B: vertical cliffs to the water; steep cliffs break off to the stream; C: vertical cliffs along railway in the Guam Gorge; D: separate accessible sections of the river bank in the Guam Gorge; E: secondary broadleaf forests in the valley of Kurdzhips River; F: broadleaf forests on steep slopes of Kurdzhips Canyon; G: mats of *Trichocolea tomentella* between the boots of bryologists; H: mats of *Trichocolea tomentella*; I: *Scapania glaucocephala* on bark of huge *Tilia cordata*; K: gemmae shoots of *Scapania glaucocephala*; L: waterfall and bryophyte mats on rocks (Alebastrovaya River).

(Kirovsk, Murmansk Province). The specimens are deposited in the Herbarium of Polar-Alpine Botanical Garden-Institute of the Kola Scientific Center, Russian Academy of Sciences (KPABG). Specimen voucher information is incorporated in the L, former CRIS – Cryptogamic Russian Information System (<https://isling.org>)

ANNOTATED LIST OF SPECIES

The annotated list of liverworts includes 35 species. The species in the list are arranged in alphabetical order. The nomenclature of liverworts generally follows Hodgetts *et al.* (2020). Some synonyms used in the literature on Caucasus are given in square brackets. After the species name the presence of reproductive structures is given in parentheses (and. – androecia; gyn. – gynoecia; per. – perianths or pseudoperianths; spor. – sporophytes; gem. – gemmae). The collecting sites are listed according Fig. 1. Habitat characteristics and some accompanying species are given for sporadic and widespread species, and at least one reference to a herbarium number in L (<https://isling.org>) is cited. For species collected from 1–2 (3) localities, labels are given in full and the herbarium numbers of specimens in the Herbarium of Polar-Alpine Botanical Garden-Institute (KPABG) are specified. The sites of easily recognized species that are marked but not confirmed by herbarium samples are indicated in parentheses.

New records for the Krasnodar Territory are marked as one asterisk (*), new records for the Caucasus – as two asterisks (**).

Aneura pinguis (L.) Dumort. (and., gyn.) – II: 8, 9; V: 39, 42 – on logs and different types of decaying wood and on bark mostly of *Fagus orientalis* in broadleaf or mixed forests, mostly in pure mats [122317].

Apopellia endiviifolia (Dicks.) Nebel & D. Quandt [*Pellia endiviifolia* (Dicks.) Dumort.] (per., and.) – I: 3, (4), 5, (6, 27), 28; II: 9; VI: (47); VII:35; VIII: 52 – on moist loamy soil covering rocks along streams, at base and in crevices on cliffs and rock outcrops in moist forests, on moist cliffs and on side of roads. One of the commonest and often abundant species in the area. In pure mats [122304] or with *Mesoptychia collaris*, *Conocephalum conicum*, *Jungermannia atrovirens*.

Blepharostoma trichophyllum (L.) Dumort. – VI: 47 – on side of mossy log of *Fagus orientalis* ca. 1.5 m in diameter [122384]. In mats dominated by *Lioclaena subulata* with an admixture of *Riccardia palmata* and *Nowellia curvifolia*.

Cephalozia bicuspidata (L.) Dumort. – VII: 33 – on side of huge (1 m in diameter) decaying logs of *Fagus orientalis* [122422], single shoots in mats dominated by *Riccardia palmata* with admixture of *Syzygiella autumnalis* and *Lophocolea heterophylla*.

Cephaloziella divaricata (Sm.) Schiffn. (per., and., gem., dioicous) – III: 14 – scattered on wood on edge of mats dominated by *Lophocolea heterophylla*; V: 40 – on rotten log [122429], dominating in thin mats, with single shoots of *Lophocolea heterophylla*.

Cololejeunea calcarea (Lib.) Steph. (per., and.) – I: 2, 27, 29, 41, 42; VII: 31, 32, 33; VIII: 51, 54 – in deep ravines or near waterfalls, on cliffs, creeping on rocks, more often on vertical north faced cliffs or at base of cliffs, usually in pure mats

[122301], rarely with *Radula complanata*, *Lejeunea cavifolia*, *Mesoptychia collaris*, *Pedinophyllum interruptum*, once on destroyed bark of large tree [122352], mixed with *Scapania glaucocephala* and *Lejeunea cavifolia*.

C. rosettiana (C. Massal.) Schiffn. (per., and.) – II: 10; III: 16; IV: 21, 24; VI: 46 – in crevices on vertical rocks, usually as thin net just on rock (Fig. 2) without other bryophytes [122381], or on living or dead mosses, or mixed with *Metzgeria conjugata* [122414].

Conocephalum conicum (L.) Dumort. – I: 2, (3), (4), 5, (6), 28; III: (12); IV: (25); VI: (47); VII: 31, 34; VIII: 52 – on moist rocks and loamy soil, more rarely on sandy soil at base of cliffs, on cliffs and rocks in humid gorges, on banks of small creeks and rivers, especially near waterfalls or on sides of moist grotto, in crevices, on rocks, abundant in Guam Gorge. Often in pure huge mats or mixed with *Apopellia endiviifolia*, more rarely with *Marchantia quadrata*, *Mesoptychia collaris*, *Pedinophyllum interruptum*.

Frullania caucasica Steph. (= *F. parvistipula* Steph. in Europe) – II: 11; III: 13, 17; IV: 18, 20, 25; V: 37, 38, 43; VIII: 51, 53 – on bark of *Fagus orientalis*, *Carpinus*, *Buxus colchica*, *Corylus avellana* L., *Pyrus communis* L. subsp. *caucasica* (Fed.) Browicz, often on dead or young trees at a height of 1.5–2.5 m. Occurs both in pure mats [122409] or mixed with *Frullania dilatata*, *Porella platyphylla*, *Radula complanata*, *Metzgeria furcata*.

F. dilatata (L.) Dumort. – I: 6; II: 7, 8, 9, 11; III: 13, 17; IV: 19, 20, 25; V: 37, 38, 39; VI:45; VIII: 50, 51, 53, 54 – on trunks of broadleaf trees, sometimes on dry slim twigs, more often on *Fagus orientalis* or *Carpinus* at a height 1–3 meters, collected as well on trunk of dead *Buxus colchica*, very rarely on cliffs. In pure mats [122412] or mixed with *Frullania caucasica* [122413], *Porella platyphylla*, *Radula complanata*, *R. lindenberiana*, *Metzgeria furcata*. One of the commonest species.

F. tamarisci (L.) Dumort. (and.) – VI: 49 – on trunk of *Fagus orientalis* up to two meters high [KPABG(H)-122388], in pure mats.

Fuscocephaloziopsis catenulata (Huebener) Váňa et L. Söderstr. subsp. *catenulata*. (per., and.) – VI: 45 – on side of log of *Abies* ca. 25 cm in diameter, with *Nowellia curvifolia*, *Lophocolea heterophylla* [122432]; 46 – on side of rotten stump, with *Lepidozia reptans* [122435].

F. lunulifolia (Dumort.) Váňa et L. Söderstr. (per.) – V: 41 – on side of rotten log ca. 1.5 in diameter, in pure mats [122369].

Jungermannia atrovirens Dumort. (per., and.) – I: 2, 4, 26, 27, 28; II: 9; VI: 47, 48; VII: 31, 32, 33, 35; VIII: 52 – creeps on rocks at bases of shaded moist limestone cliffs in Guam Gorge where it is common, as well on side or in crevices of rocks on banks of river near small waterfall, in thin pure mats or net just on rock or on soil covered rocks, usually in pure mats [122305] or with admixture of *Apopellia endiviifolia*, *Mesoptychia collaris*, *Scapania cuspiduligera*, *Preissia quadrata*.

Lejeunea cavifolia (Ehrh.) Lindb. (per.) – VII: 32 – on huge rock on bank of river, mixed with *Cololejeunea calcarea*, *Mesoptychia collaris*, *Scapania cuspiduligera* [122354] or on bark of huge tree with *Cololejeunea calcarea* and *Scapania glaucocephala* [122351].

Lepidozia reptans (L.) Dumort. (per.) – VI: 46 – on side of rotten stump in *Abies-Fagus* forest, in pure mats or with admixture of *Fuscocephaloziopsis catenulata* [122435].

- Liochlaena subulata* (A. Evans) Schljakov (per.) – V: 41; VI: 47; VII: 33 – sporadic on sides of mossy logs of *Fagus orientalis* in forests with elements of the Colchian undergrowth, in pure mats [122423] or dominating in mats with admixture of *Blepharostoma trichophyllum*, *Riccardia palmata*, *Nowellia curvifolia* [122384].
- Lophocolea heterophylla* (Schrad.) Dumort. (per., and., gem.) – II: 8, 10; IV: 21; V: 40; VII: 45, 47, 48; VII: 33 – mostly on logs of *Fagus orientalis*, both on decaying wood and bark, more rarely on soil covered rocks and dead mosses in fresh broadleaf and mixed forest, on loamy soil in ditches along roadsides, sometimes on rocks near waterfalls. In pure mats [122311] or mixed with *Radula complanata*, *Riccardia palmata*, *Syzygiella autumnalis*, *Cephalozia bicuspidata*, *Cephalozia divaricata*, *Nowellia curvifolia*, *Fuscocephaloziopsis catenulata*.
- L. minor* Nees (per., and., gem.) – II: 8 – on loamy soil on roadside ditch, mixed with *Lophocolea heterophylla* [122314].
- Marchantia quadrata* Scop. [*Preissia quadrata* (Scop.) Nees] (arch., and., spor.) – I: 2, 4, 5, 26, 27, 28 – in crevices and on ledges at the base of vertical cliffs, on rocks covered with sandy soil on banks of river in Guam Gorge, were it is sporadic. In pure mats [122334] or with *Conocephalum conicum* and *Mesoptychia collaris*.
- Mesoptychia collaris* (Nees) L. Söderstr. et Váňa (per., and.) – I: 5, 28; VI: 48; VII: 31, 32; VIII: 52, 54 – on sandy and loamy soil in crevices and on ledges of rocks on banks of river, on walls of moist grotto and at base of cliffs and mossy walls of rocks, usually in shaded areas or near running water. In pure mats [122394] or with admixture of *Apopellia endiviifolia*, *Conocephalum conicum*, *Preissia quadrata*, *Jungermannia atrovirens*, more rarely with *Lejeunea cavifolia*, *Scapania cuspiduligera*, *Pedinophyllum interruptum*.
- Metzgeria conjugata* Lindb. (gyn., and.) – VI: 21; V: 41, 42; VI: 47; VII: 31, 32; VIII: 51 – on rocks on banks of river, especially near waterfalls, at the base of rock outcrops and on side of rocks, sometimes on dead mosses in forest, on roots and mossy trunks of *Fagus orientalis* in forests and dead *Buxus colchica* stands, in pure mats [122353] or mixed with *Pedinophyllum interruptum*, *Plagiochila asplenioides*, *Cololejeunea rossettiana*.
- M. furcata* (L.) Dumort. (gyn., and.) – I: 2; VI: 18, 21; V: 39. – on trunks of trees, on sides of rocks in rock fields, on logs in moist beech, pear or *Abies-Fagus* forests with *Hedera helix*. In pure mats [122332] or mixed with *Frullania dilatata*, *F. caucasica*, *Radula complanata*, *R. lindenbergiana*, *Porella platyphylla*.
- Nowellia curvifolia* (Dicks.) Mitt. (per., and.) – III: 13; V: 41; VI: 45, 47; VII: 32 – on sides of logs of different stages of decomposition, on roots in hornbeam-beach forest, in dead *Buxus colchica* stands, in *Abies-Fagus* forests with grasses and *Hedera helix*. In pure mats [122321] or mixed with *Syzygiella autumnalis*, *Liochlaena subulata*, *Blepharostoma trichophyllum*, *Riccardia palmata*, *Fuscocephaloziopsis catenulata*, *Lophocolea heterophylla*.
- Pedinophyllum interruptum* (Nees) Kaal. (per., and.) – I: 28; V: 41; VII: 31, 33; VIII: 51, 52, 54 – sporadic on rocks, mossy rock walls, limestone plates on banks of streams, near waterfalls and running water, at the base of rock outcrop in deep shade in forests in valleys of rivers. In pure mats [122374] or mixed with *Mesoptychia collaris*, *Conocephalum conicum*, *Metzgeria conjugata*.
- Plagiochila asplenioides* (L.) Dumort. (per., and.) – I: (27), 28; II: 8; V: 41; VIII: (51, 52, 53), 54 – sporadic, on banks of streams, at base of rock outcrops in forest, on loamy soil in roadside ditch, in pure mats [122312] or as some shoots in mats with dominance of *Metzgeria conjugata*.
- Porella platyphylla* (L.) Pfeiff. (per., and.) – II: 7, 9; III: 15, 17; V: 40; IV: 19, 20; VIII (50-54) – on trunks of *Fagus orientalis*, *Carpinus*, *Buxus colchica*, and pear in fresh broadleaf or mixed forests with dominance of *Fagus orientalis* and herbs and *Hedera helix* in ground floor, rare on bark of logs. In pure mats [122318] or mixed with *Frullania dilatata*, *F. caucasica*, *Radula complanata*, *R. lindenbergiana*.
- Radula complanata* (L.) Dumort. (per., and., spor.) – I: 6, 29; II: 9; III: 17; V: 37, 38, 39; VI: 45; VIII: 51 – on trunks and branches in different types of broadleaf and mixed forests, on rocks on banks of rivers, on bark of logs, one of the commonest species. In pure mats [122392] or mixed with *Frullania dilatata*, *Frullania caucasica*, *Porella platyphylla*, *Metzgeria furcata*, more rarely with *Lophocolea heterophylla* and *Cololejeunea calcarea*.
- R. lindenbergiana* Gottsche ex C. Hartm. (per., and., spor., dioicous) – I: 5; IV: 18; V: 38, 39; VIII: 51, 54 – on bark of trunks and branches of *Fagus orientalis*, *Carpinus*, pear, mostly in *Abies-Fagus* forests with *Ilex* and *Hedera helix*, rarely on cliffs. In pure mats [122363] or mixed with *Frullania dilatata*, *F. caucasica*, *Porella platyphylla*, *Metzgeria furcata*.
- Riccardia palmata* (Hedw.) Carruth. – VI: 47; VII: 33 – on rotten moist logs of *Fagus orientalis* (ca. 0.8-1 m in diameter) in moist forests on steep slopes in valleys of streams with high humidity. In almost pure mats [122383] or mixed with other species of decaying wood: *Liochlaena subulata*, *Blepharostoma trichophyllum*, *Nowellia curvifolia*, *Syzygiella autumnalis*, *Cephalozia bicuspidata*, *Lophocolea heterophylla*.
- **Scapania calcicola* (Arnell & J. Perss.) Ingham (gem.) – VIII: 51 – limestone slabs with vertical walls, on loamy soil in crevices [K286-1-18]. The species has earlier been recorded in Caucasus for Dagestan (Potemkin *et al.*, 2010; Konstantinova, 2011) and Adygeya Republic (Otte, 2001).
- S. cuspiduligera* (Nees) Müll. Frib. (and.) – VII: 31, 32 – on side of huge rock on bank of river, mixed with *Mesoptychia collaris* and *Jungermannia atrovirens* [122420].
- ***S. glaucocephala* (Taylor) Austin (gem.) – VII: 32 – on destroyed bark of large (ca. 1 m in diameter) tree at 2-3 m height [122351]. Single shoots in specimen with dominance of *Cololejeunea calcarea* [122352] and *Lejeunea cavifolia* [122351]. The species is considered endangered in Europe (Hodgetts *et al.*, 2020).
- Syzygiella autumnalis* (DC.) K. Feldberg, Váňa, Hentschel & Heinrichs (per., and., spor., gem.) – III: 13; V: 41; VI: 45, 46, 48; VII: 33 – on decaying logs in broadleaf or mixed forests. In pure mats [122370] or mixed with *Riccardia palmata*, *Lophocolea heterophylla*, *Nowellia curvifolia*, *Cephalozia bicuspidata*.
- **Trichocolea tomentella* (Ehrh.) Dumort. – VII: 34 (Fig. 2: G) – on rock in deep hole in pure mats with single thalli of *Conocephalum conicum* [122359]. The first record for Russian part of Caucasus. In Caucasus the species has been recorded for Abkhazia and Adjara [Chikovani, 1986; Chikovani & Svanidze, 2004].

RESULTS AND DISCUSSION

The studied area is quite small and includes eight main territories with a total area of about 13 square kilometers. The liverwort flora of the studied territory is rather poor, that is characteristic for the zone of broadleaf forests of the Caucasus, especially in areas with calcareous bedrocks. In total, we recorded 35 species. At the same time, flora of this territory is highly specific and includes a number of species found in Russia exclusively or almost exclusively in the Caucasus, as well as some species rare in the world and Europe. One of the most interesting findings is *Scapania glaucocephala*. It is a worldwide rare and poorly known epixylic species restricted to mature coniferous forests of the Northern hemisphere. It was described from western North America and occurs sporadically in both west and east North America (Schuster, 1974), is known from few localities in Europe and is assessed here as endangered (Hallingbäck, 2019), and distributed scattered in Asia (Konstantinova *et al.*, 2009). Morphologically the collected specimen fits well the description of the species. It is the first record of the species from Caucasus. The species was collected in the lower part of a mossy trunk of a living tree in a damp canyon on the river bank (Fig. 2: I, K), i.e. in conditions of high humidity and deep shade. This is quite consistent with the typical habitats for the species, except that until now it was recorded only for decaying wood (Schuster, 1974; Hallingbäck, 2019). One of the new liverworts for the Krasnodar Territory is *Scapania calcicola* s. str. It is not rare montane suboceanic European species restricted to moist shaded areas with limestone bedrocks. In Russia the species has previously been recorded for Dagestan (Potemkin *et al.*, 2010; Konstantinova, 2011) and Adygeia Republic (Otte, 2001). The records of the species for the northern and Arctic Russia should be referred to *S. ligulifolia* R.M. Schust., which previously was synonymized with *S. calcicola* by many authors (Schuster, 1974; Damsholt, 2002; Paton, 1999). Another species new for the Krasnodar Territory is *Trichocolea tomentella*. This species occurs sporadically in temperate regions in Europe, Asia and North America. It is restricted to moist areas with high humidity, therefore, finding it on the swampy bank of river in a deep gorge is quite natural. The species has previously been recorded for Caucasus from Georgia (Chikovani, 1986; Chikovani & Svanidze 2004).

A characteristic feature of the studied region is the fairly wide distribution of two species of the genus *Cololejeunea* (*C. rossettiana* and *C. calcarea*) that occur in Russia in Caucasus only. Both species have European range and in Caucasus they are at the eastern limit of their distribution. For a long time, both species were known in the Caucasus from single localities. In the course of our study of liverworts of Caucasus, we found these species in the most of the studied areas with suitable conditions. It should be emphasized, however, that

these are very small plants that do not form any large clusters, often occurring in very small quantities and it is very difficult to found them. Another species that we would like to focus on is *Frullania caucasica*. The species (as *Frullania parvistipula*) is known in Europe from few localities and evaluated as Critically Endangered in Europe (Campisi *et al.*, 2019; Hodgetts *et al.*, 2019). The taxonomy of *F. parvistipula* and *F. caucasica* needs to be clarified, which will be done in a special article (Mamontov *et al.*, in prep.). Here we refer all the specimens identified in Europe and the Caucasus to *F. caucasica*.

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