

MOSS FLORA OF GUNIB AREA IN DAGESTAN, THE EASTERN CAUCASUS

ФЛОРА МХОВ ГУНИБА, ДАГЕСТАН, ВОСТОЧНЫЙ КАВКАЗ

M.S. IGNATOV¹, V.E. FEDOSOV², E.A. IGNATOVA²,
G.YA. DOROSHINA³ & V.I. ZOLOTOV¹

М.С. ИГНАТОВ¹, В.Э. ФЕДОСОВ², Е.А. ИГНАТОВА²,
Г.Я. ДОРОШИНА³, В.И. ЗОЛОТОВ¹

Abstract

Annotated list of 215 moss species of small local mountain area in Dagestan Republic (East Caucasus) is presented. It includes many rare and interesting xerophytic species, e.g. *Indusiella thianschanica*, *Jaffuelobryum latifolium*, *Crossidium squamiferum*, *Tortula atrovirens*, *Molendoa schliephakei*. Among others, *Anacamptodon splachnoides*, *Seligeria patula* and *Tortella tortuosa* var. *fleischeri* are new to Russia, *Philonotis falcata* and *Bryum sibiricum* are new to Europe. A short discussion on environments and species characteristic for each type of habitat is provided.

Резюме

Описана флора небольшого горного района Дагестана, в составе которой много редких и интересных видов, в частности ксерофиты *Indusiella thianschanica*, *Jaffuelobryum latifolium*, *Crossidium squamiferum*, *Tortula atrovirens*, *Molendoa schliephakei*. Два вида, *Anacamptodon splachnoides* и *Seligeria patula*, а также разновидность *Tortella tortuosa* var. *fleischeri* приводятся как новые для флоры России; находки *Philonotis falcata* и *Bryum sibiricum* являются новыми для Европы. Дан аннотированный список 215 видов и краткая характеристика природных условий.

KEYWORDS: Dagestan, flora, mosses, Russia, xerophytes.

INTRODUCTION

Recent advances in the studies of Caucasian bryophytes have brought a lot of new data, but they concern mostly the western and central Caucasus, while its eastern part, including Dagestan, still remains poorly known. This paper provides a list of species of one local flora in Dagestan that appears quite rich in a number of species, as well as in rare and interesting species.

The studied area is a mountain plateau at the left bank of the Kara-Koisu River in the central part of Dagestan (42°23-25'N – 46°52-57'E). This river flows at the height ca. 900 m

elev., and has tributaries that separate the Gunib Plateau, a mountain block, ca. 3×5 km (1470 hectares in total), with the elevations from ca. 1400 to 2351 m (Fig. 1). Slopes from all sides are very steep, with numerous cliffs. The Gunib settlement is situated at the height 1000-1200 m on a slope down to the Kara-Koisu River, and a road crossing it is the only road to the plateau, whereupon there are a few small villages scattered along a creek valley at the height 1400-1900 m, and the station of the Mountain Botanical Garden (1750 m) with experimental plots (1700-2000 m).

¹ – Main Botanical Garden of Russian Academy of Sciences, Botanicheskaya 4, Moscow 127276 Russia – Россия 127276 Москва, Ботаническая, 4, Главный ботанический сад РАН, e-mails: misha_ignatov@list.ru; bryum@list.ru

² – Moscow State University, Biological Faculty, Vorob'ovu gory 1-12, Moscow 119991 Russia – Россия 119991 Москва, Московский гос. университет, Биологический факультет, e-mails: fedosov_v@mail.ru; arctoa@list.ru

³ – V. L. Komarov Botanical Institute Rus. Acad. Sci., Prof. Popov Str., 2, St. Petersburg, 197376 Russia – Россия 197376 Санкт-Петербург, ул. Проф. Попова, 2, Ботанический институт им. В.Л. Комарова РАН; e-mail: marushka-le@mail.ru

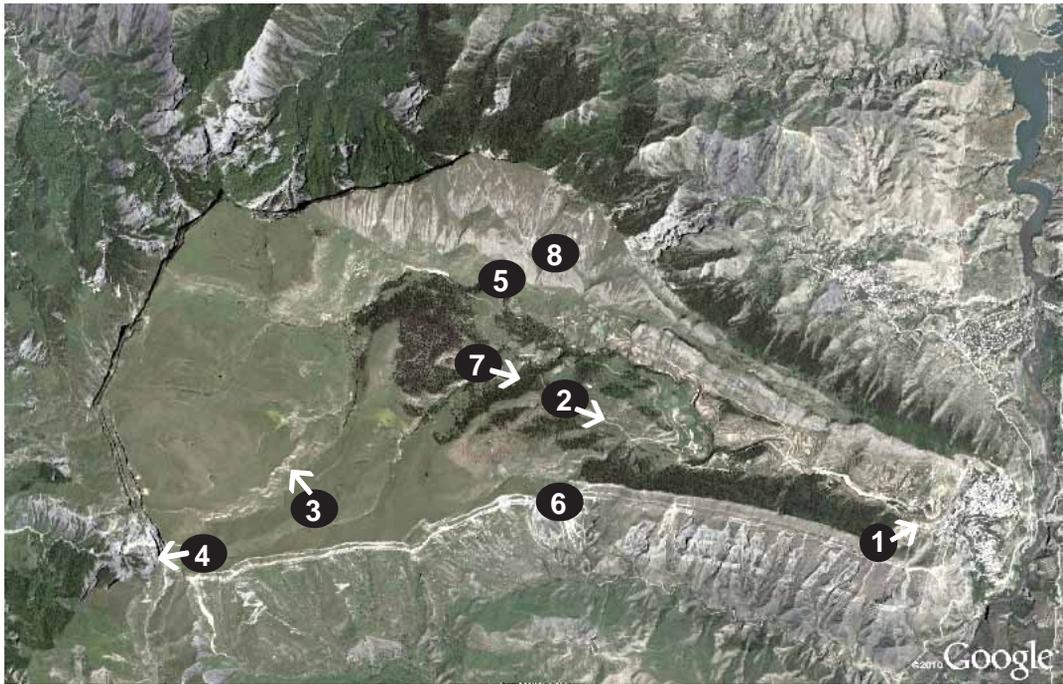


Fig. 1. Space photo of Gunib Plateau (courtesy of Google Inc.: (<http://maps.google.com/maps?hl=en&q=google+earth&ie=UTF8&hq=google+earth&hnear=&ll=42.401784,46.909733&spn=0.072,0.132351&t=h&z=13>)). Places of views in Fig. 2: 1-8 are shown with direction where from pictures were taken, if appropriate. See explanation to Fig. 2 for additional information.

Especially steep is the S-facing slope of the plateau, being 75° and formed by continuous cliffs. At the same time N-facing slope is moderately steep, $30-50^\circ$, with forests alternating with chutes formed by rock-falls combined with strong subsequent erosion. Altogether forests cover some 190 hectares (about 13% of the plateau area), and the rest of the land are mainly meadows, steppes and rocks.

Below 1600-1700 m the forest is formed by *Carpinus caucasica* and *Quercus petraea* (vegetation information is generally quoted from Nakhutsrishvili et al., 2009), and above – mostly by *Pinus kochiana* and *Betula* (mixture of *B. pendula*, *B. litwinowii* and *B. raddeana*). Forests are intermixed in more flattened places with numer-

ous pastures. In the central part of the plateau no trees grow above 1900-1950 m, where extensive pastures cover the summit area (although on steep slopes *Betula* reaches 2100 m). The summit area (between 2000 and 2351 m) is a moderately gentle (mostly less than 10°) slope with meadow vegetation that has a number of subalpine elements (*Primula*, *Fritillaria*, *Muscari*, *Cerastium*, *Draba*, *Gagea*, *Iris*, *Trollius*, *Ranunculus*, *Gentiana*, *Androsace*) and is dominated by *Festuca woronowii* (*Festuca varia* p.p.), *Carex humilis*, etc.

Rocks are limestone and dolomites throughout this area, and cliffs and extensive rock outcrops occur in many places, having almost no vascular plant vegetation. However lichens and bryophytes occur on their faces, and although

Fig. 2. Photographs of different habitats in Gunib Plateau. 1 – slopes with scattered trees, the place where *Lindbergia dagestanica* was collected in 1932 [1400-1550 m]; 2 – pasture with scattered *Pyrus*, where *Lindbergia grandiretis* and *Zygodon rupestris* were found [1700 m]; 3 – summit area, cliffs with the uppermost locality of *Indusiella thinschanica* [2100 m]; 4 – view from the plateau summit [2300 m]; 5 – dolomite cliffs on S-facing slope, locality of *Entosthodon handelii* [1800 m]; 6 – cliffs with complex of xerophytic mosses *Jaffueloibryum latifolium*, *Indusiella thinschanica*, *Crossidium squamiferum*, *Tortula atrovirens*, *Molendoa schliephakei* [1900 m]; 7 – pine and birch forest (right) and scattered tree in pasture (mostly *Pyrus*) [1800 m]; 8 – lonely *Pyrus* tree on xeric S-facing slope, where *Lindbergia grandiretis* and *Syntrichia laevipila* were collected [1700 m].



the number of species here is not great, many species are rare and interesting. Some xerophytes like *Indusiella thianschanica*, *Jaffueliobryum latifolium*, *Tortula atrovirens*, *Molendoa schliephakei* are quite common here, more rare are *Crossidium squamiferum*, *Aloina rigida*, etc.

Steep S-facing slopes have petrophytic steppes with *Salvia canescens*, *Thymis* spp., *Artemisia* spp., *Prunus* spp., etc., and at places with spiny shrubs of *Astragalus denudatus* and *Onobrychis cornuta*. These places have moss composition similar to that on cliffs, although most xeric species (*Indusiella* and *Jaffueliobryum*) are usually absent or rare in such places, while *Grimmia tergestina*, *G. anodon*, *Gymnostomum aeruginosum*, *Didymodon validus*, *Molendoa sendtneriana*, *Syntrichia sinensis* are quite abundant.

Further towards more mesic condition, epilithic moss flora is enriched by *Orthotrichum anomalum*, *O. cupulatum*, *Pseudoleskeella tectorum*, *Trichostomum crispulum*, *Stereodon vaucheri*, etc.

Mesic rocks is the habitat most diverse in moss species, and their characteristics cannot be fully covered in this brief overview. Among most common species *Tortella tortuosa*, *Bryoerythrophyllum recurvirostrum*, *Encalypta procera*, *Ditrichum flexicaule*, *Distichium capillaceum*, *Schistidium elegantulum*, *S. crassipilum*, *Fissidens dubius*, *Mnium lycopodioides* can be mentioned.

On wet cliffs in more or less shaded places the characteristic hygrophilous calciphilous flora occurs, including *Cyrtomnium hymenophylloides*, *Myurella julacea*, *Orthothecium intricatum*, *Brachythecium cirrosum*, etc., with four species of *Seligeria*, *S. pusilla* being most common.

Mosses at ground level differ in various forests. Broad-leaved forests are rather dry and dense, often almost without herbs; interesting bryophytes are *Homomallium incurvatum* and *Serpoleskea confervoides*, both common on low boulders, numerous in these forests. At places *Pseudoleskeella catenulata* is common.

On soil in open, grassy, relatively dry pine and birch forests, *Abietinella abietina*, *Brachythecium albicans*, and *Entodon concinnus* occur, in more mesic places *Hylocomium splendens* and *Rhytidiadelphus triquetrum* grow. *Pleurozium schreberi* was found in a very few places in a pine forest. At places, *Dicranum dispersum* is quite abundant.

Tree bases in a mesic forest are covered by *Plagiomnium cuspidatum*, *Thuidium delicatulum*, *Entodon schleicheri*, *Platygyrium repens*. On trunks in more open places (and in the forest on higher parts of trunks) *Leucodon immersus* and *Pylaisia polyantha* are the most abundant, while *Homalothecium* and *Anomodon* species are surprisingly not so common comparatively with other regions of Caucasus.

Among *Orthotrichum*, in mesic places *O. vladikavkanum* and *O. striatum* are especially common, while in more open places the commonest is *O. pumium*.

Tree trunks in open places are very interesting. On many trees, especially on *Pyrus*, we found *Lindbergia grandiretis*, *Fabronia* spp., and occasionally also *Tortula laevipila*, *Orthotrichum diaphanum*, *Zygodon rupestris*.

Soil banks have interesting species composition, ranging from xerophytic *Tortula protobryoides*, *T. acaulon*, *Weissia* spp. to numerous *Bryum* species on damp soil. Especially interesting, although very rare appear to be species of *Entosthodon*: 5 species were found; two of them were identified, but for other three we failed to find a name, and they are described as new species in a separate paper in this volume (Fedosov et al., 2010).

Subalpine meadows in summit area are poor in mosses as grasses are usually dense; among them *Entodon concinnus*, *Rhytidium rugosum*, *Abietinella abietina* and *Climacium dendroides* were recorded as most common.

CLIMATE

Meteorological station at 1583 m elev. provides the following data: annual precipitation 680 mm, mean annual temperature +6.7°C, mean temperature of August (warmest month) +16.5°C, of January (coldest month) – 5.2°C; frostless period is 167 days (Physiography..., 1996).

EXPLORATION

No special publications on Gunib mosses exist, although there is a number of specimens in LE from this area. The largest number of specimens was gathered in 1925 by Ivonna Bogdanovskaya [better known by her subsequent name, Bogdanovskaya-Gienef], but solitary collections were done also in 1861 by Ruprecht (det. S.O. Lindberg), in 1916 by V.Babet, W. Lipsky (det. Brotherus), in 1916 and 1924 by M. Mirzoeva

(det. Schljakov), in 1929 by A. Poretsky, in 1961 by G. Nepli, in 1961 by A. Bobrov, in 1964 by Mikhailova (det. by A.L. Abramova & I.I. Abramov). Collections include mostly widespread species, likely gathered for general description of vegetation. Rare species and especially those not collected later were checked and partly reidentified by Doroshina. There is also a small collection in MW made in 1932 by N.V. Samsel (identified later by Ignatova), in which one very interesting species of *Lindbergia* was found (see Ignatova et al., 2010).

Collections in the area were carried out on May 18-22, 2009 by Ignatov, Ignatova, Doroshina and D. Shilnikov, and by Fedosov on May 25-26, 2010. Ca. 1000 specimens were collected, and their identification, together with previous data, resulted in a list of 215 species, which is rather rich for this relatively limited and quite xeric area. Due to a lot of novelties, we are publishing here these materials, assuming that they are hardly complete and further study would certainly bring additional interesting findings in this area.

LIST OF SPECIES

Species names are given according to the check-list (Ignatov, Afonina, Ignatova et al., 2006), with the addition of new species described in Fedosov et al. (2010) and Ignatova et al. (2010). Altitudes in meters are given after species names, and they are followed by brief overview of habitat and notes on frequency for most common and most rare species. Main set of specimens is in MHA, with numerous duplicates in MW and LE. Specimens that are kept only in LE and MW have this mark in the end of annotation.

Abietinella abietina – 1370-1750 – soil, rocks and occasionally *Betula* and *Carpinus* tree bases, in open places and in *Pinus-Betula* forests, locally abundant.
Aloina rigida – 1440-2000 – xeric calcareous rocks, open faces and crevices, rather rare.
Amblyodon dealbatus – [?] – on rocks in dry stream bed, Bogdanovskaya, 21.VI.1925 (LE), with admixture of *Palustriella commutata*, *Mnium marginatum*.
Amblystegium serpens – 1550-1850 – soil, rocks, trunks, in mesic to quite dry places, rather common.
Anacamptodon splachnoides – 1500-1770 – in cracks of trunks in crooked forest and on rather open slope.
Anoetangium handelii – 1760 – dry rocks in shady canyon.
Anomodon attenuatus – 1600-1770 – on base of *Carpi-*

nus tree, on rocks, rather rare.

A. longifolius – 1750 – calcareous rocks, in one place.
A. rugelii – 1820 – soil near rock outcrop (LE).
A. viticulosus – 1700-1810 – rocks in forests and in shady canyons, occasionally on *Betula* trunks.
Barbula convoluta – 1600 – roadside, on clayish and gravelly soil.
B. unguiculata – 1750 – once found on roadside.
Bartramia pomiformis – [?] – in pine forest, coll. Mikhailova 24.VIII.1964 (LE).
Brachythecium campestre – 1600-1900 – on soil in pine and birch forests, along roadsides, on rocks, occasionally on stumps and *Salix* trunks.
B. cirrosus – 1770-2000 – on rock outcrops and in crooked *Betula* forest on steep slope in niches under rocks and roots.
B. glareosum – 1750-1850 – rocks in pasture, in openings in forest, mesic rock outcrops.
B. rivulare – 2000 – rocks along dry stream bed.
B. rotaeantum De Not.(=*B. capillaceum*) – 1500-1760 – trunks and rocks in mesic habitats, not common.
B. rutabulum – 1550-1820 – rocks near creek and rocky sides of road in *Betula* forest.
Bryoerythrophyllum recurvirostrum – 1550-2000 – common on rocks and soil on eroded slopes in mesic habitats.
Bryum algovicum – 1700-1800 – rocky hedge, gravelly soil and rocks along roads.
B. amblyodon – 2300 – meadow in summit area.
B. arcticum – 1730 – on soil on slopes to roadside in *Betula* forest.
B. argenteum – 1330-1915 – on rocks, concrete blocks and soil in open places; moderately common; in xeric habitats plants have more expanded hyaline part of leaves, corresponding to var. *lanatum*.
B. bicolor – 1860-2000 – on rocks in dry stream bed and on xeric S-facing slope, rare.
B. capillare – 1550-2000 – on rocks at creek bank and in meadow in summit area, rare.
B. elegans – 2030 – on soil near rocks, in one place.
B. funckii – 1770-1790 – on soil at base of N-facing cliff.
B. lonchocaulon – 1300 – wet cliffs near road on steep slope, in waterfall area.
B. mildeanum – 1740-1850 – on humus on ledges of dolomite cliff and on pasture near upper tree line.
B. moravicum – 1500-1870 – most common on trunks of *Betula*, also on stumps, rocks at creek banks and in forest, occasionally on soil.
B. pseudotriquetrum – 2000-2070 – springs on open N-facing slope and springy mire in summit area. Collection of Bogdanovskaya on rock near waterfall, ca. 1300 m, 19.VI.1925 (LE).
B. rutilans – 1730 – soil in open forest.
B. schleicheri – 2050 – lake banks in overtrampled

- pasture, in one place.
- B. sibiricum* – 1730 – rocks along road in *Betula* forest.
- Calliergonella cuspidata* – 1750-2070 – spring mires on grassy slopes, hollows beside stream; rare.
- C. lindbergii* – 1870-2000 – rocks in stream valley.
- Campyliadelphus chrysophyllus* – 1550-1850 – on rock outcrops and soil in *Carpinus*, *Betula* and *Pinus* forests, on rocks in deep creek and stream canyons, on *Juniperus*.
- Campylidium calcareum* – 1550-1770 – rocks in forests and in cliff niches.
- Campylium protensum* – 1550-2000 – rocks at creek bank and N-facing cliffs in summit area.
- Campylophyllum halleri* – 2200 – karst caves with late snow bed, in a series of caves and cracks in abundance.
- Cirriphyllum piliferum* – 1500-1700 – on soil in broad-leaved forest.
- Climacium dendroides* – 1790-1800 {2200} – on soil in pine-birch forest.
- Cratoneuron filicinum* – 1550-2070 – rocks along creek and stream banks, including dry stream beds, near springs, occasionally floating in stagnant pools.
- Crossidium squamiferum* – 1530-2100 – on xeric slopes on rocks and soil upon them, occasionally on rocks in meadows.
- C. squamiferum* var. *pottioides* – 1820 – xeric rocks, only one collection (LE).
- Ctenidium molluscum* – 1770 – on big rocks and *Juniperus* trunks in crooked forest.
- Cynodontium fallax* – 1850-1870 – pine-birch forest, base of pine trunk.
- Cyrtomnium hymenophylloides* – 1550-2000 – more or less wet rock outcrops in canyons and forest.
- Dicranella varia* – 1530-2000 – on soil near rock outcrops in stream valley and near road.
- Dicranodontium denudatum* – [1700-1900?] – rotten log in *Betula* forest, 30.VI.1925, coll. Bogdanovskaya (LE).
- Dicranum bonjeanii* – 2000 – wet N-facing cliffs on open slope, near caves with late snow patches.
- D. dispersum* – 1370-2000 – rocks in broad-leaves forest and on open slopes and along roads, on N-facing outcrops above tree line, on soil in *Betula* forest; relatively common.
- D. polysetum* – [1700-1900?] – rotten log in *Betula* forest, 30.VI.1925, coll. Bogdanovskaya (LE).
- D. scoparium* – 1700-1870 – on soil in forest and on *Betula* and *Pinus* trunk bases.
- D. spadiceum* – 1550-2250 – N-facing cliffs and rock falls at their foot.
- Didymodon cordatus* – 1330-1800 – in cliff crack on fine soil and on dry rocks in meadow.
- D. fallax* – 1730-1750 – on rocks of hedge and rocky slides along road.
- D. ferrugineus* – 1600-2000 – rock outcrops in rather mesic habitats in forest and canyons; rather widespread in the area.
- D. icmadophilus* – 1730-1850 – rocks in N-facing, usually mesic to humid places, in forests; on S-facing slopes in caves.
- D. perobtusus* – 1760 – on rocks in deep but dry creek canyon on generally xeric S-facing slope.
- D. rigidulus* – 1330-2000 – roadsides, dry slopes, rock outcrops near streams, in forests, as well as in open places, on rocks of hedges; very common in the area.
- D. spadiceus* – 1760 – rock outcrops near stream (LE).
- D. validus* – 1440-2100 – soil and rocks in more xeric habitats, comparatively with *D. rigidulus*.
- D. vinealis* – 1730 – along road in *Betula* forest, on gravelly soil.
- Distichium capillaceum* – 1550-1730 – rather wet calcareous rocks and soil nearby, rock hedges, on soil in meadows above tree line; common.
- D. inclinatum* – 1940 – on soil in niche of rocks (LE).
- Ditrichum flexicaule* – 1850 – on rocks at base of S-facing cliff, much rarer than the next species.
- D. gracile* – 1500-2000 – rock outcrops, mostly N-facing, rock hedges and cliff ledges.
- Drepanocladus aduncus* – 1300 – wet cliffs near road (LE).
- D. polygamus* – 1750 – moderately wet meadow.
- Ecalypta alpina* – 2000 – in one place, but in big amount on N-facing rocks surrounded by mesic grassland vegetation.
- E. procera* – 1550-2100 – rocks in mesic to quite xeric, usually open places; among rocks of hedges.
- E. rhamnoides* – 1730-2000 – on soil in meadows, rocks along road in *Betula* forest and N-facing outcrops, niches among big rocks, etc.
- E. trachymitria* – 1730-1800 – on rocks along road in *Betula* forest and on soil in grazing meadow, two collections.
- E. vulgaris* – 1770 – rocks in crooked *Betula* forest.
- Entodon concinnus* – 1500-1790 – abundant on soil in *Betula* and *Pinus-Betula* forests, occasionally on rock outcrops and rock-fields at cliff bases.
- E. schleicheri* – 1470-1820 – on *Betula* and *Carpinus* trunks, occasionally on soil (in forest, near trunks) and on rocks.
- Entosthodon abramovae* – 1440 – wet and shaded cliff base in narrow creek canyon (MW).
- E. dagestanicus* – 1440 – wet and shaded cliff base in narrow creek canyon, not far from previous species (MW).
- E. handelii* – 1860 – steep rocky S-facing slope with scattered xeric shrubs.
- E. muhlenbergii* – 1850-1940 – S-facing slope, in cliff crevices.
- E. stenophyllum* – 1330 – clayish-gravelly roadside in

- upper part of E-facing slope (MW).
- Eucladium verticillatum* – 1300-1860 – dripping cliffs and otherwise wet calcareous rocks in moderately shaded habitats.
- Fabronia ciliaris* – 1550-1600 – on *Betula* and *Pyrus* in scattered tree stands.
- F. pusilla* – 1500-1500 – crack of bark of old *Carpinus* and on *Pyrus* in scattered tree stand.
- Fissidens adianthoides* – 1300-1820 – on wet soil on N-facing slopes, rare (LE).
- F. bryoides* – 1530-1800 – sporadic and in rather diverse habitats: at base of cliff in forest, on soil in pasture, on eroded limestone, on rather xeric cliffs.
- F. dubius* – 1500-2000 – on mesic rock faces, ledges and niches, *Betula* trunks, stumps.
- F. taxifolius* – 1550-2000 – rock outcrops, rocky soil in forest, soil banks in pastured meadow in summit area; sporadic.
- F. viridulus* – 1760 – shaded rocks in deep dry canyon on S-facing macroslope.
- Funaria hygrometrica* – 1700-1750 – wet disturbed places and lawns in Botanical Garden.
- Grimmia anodon* – 1400 – 2250 – dry rocks on xeric slopes.
- G. elatior* – 1770 – one huge rock in crooked *Betula* forest on steep slope.
- G. tergestina* – 1440 -1820 – on rocks in xero-mesic and especially in xeric habitats, where it is one of the most common species; on rock hedges.
- Gymnostomum aeruginosum* – 1600-2000 – very common on limestone cliffs and rock outcrops, from very xeric S-facing slopes to mesic rock outcrops in forests and on rather wet N-facing rocks in summit area.
- G. calcareum* – 1740 – rare on shaded limestones.
- Gyrowesia tenuis* – 1860 – in big crevice of cliff, one collection.
- Hedwigia ciliata* – [?] – On rocks, coll. Nepli, 15.VII.1961 (LE).
- Homalothecium philippeanum* – 1770-2000 – on rocks at base of N-facing cliffs and in crooked *Betula* forest (abundant in one limited area), and only once found in another place on cliff.
- H. sericeum* – 1740 – only one collection on *Betula* trunk in *Betula* forest.
- Homomallium incurvatum* – 1450-1770 – on rocks in dark *Carpinus* forests and in *Betula* forests, bases of *Carpinus* trunks, on rocks in meadows and in canyons.
- Hygroamblystegium varium* – 1750-1940 – on soil in more or less wet meadows, on rock hedges.
- Hygrohypnum luridum* – 1550-2000 – wet rocks along creek and stream banks, etc.
- Hylocomium splendens* – 1700-1740 – on soil in *Betula* and *Pinus* forest, sporadic, but locally abundant.
- Hymenostylium recurvirostrum* – 1300-2000 – rock outcrops in shady, relatively dry to wet places, in forests, canyons and summit area.
- Hypnum cupressiforme* – 1500-1770 – on rocks and occasionally soil in forest and near creek bank, and on *Betula* trunks.
- Indusiella thianschanica* – 1440-2250 – rocks on more or less open xeric slopes.
- Jaffuelobryum latifolium* – 1370-1860 – rocks on xeric slopes.
- Leucodon immersus* – 1550-850 – on *Salix*, *Malus* and *Betula* in open places, on rocks.
- L. sciuroides* – 1700-1900 – on *Salix* and *Betula* in open places.
- Lindbergia grandiretis* – 1550-1900 – on *Pyrus*, more rarely on *Salix* in more or less open places.
- L. dagestanica* – ca. 1500-1600 – on trunks (collection of Samsel, 1932, MW).
- Mniobryum starkeanum* – 1700-2250 – sporadic on S-facing cliffs.
- Mnium lycopodioides* – 1550-2000 – mesic to wet rock outcrops, occasionally on exerted *Betula* roots.
- M. marginatum* – 1530-2250 – rock outcrops and rock hedges.
- M. spinosum* – 1500-1860 – on soil bank in forest and on rocks.
- M. stellare* – 1700 – on soil at roots of *Betula* on steep slope in forest.
- M. thomsonii* – 1550-2250 – mossy boulder, cliffs along small creek.
- Molendoa schliephackei* – 1440-2000 – common on cliffs and rocks outcrops, occasionally on separate boulders in mesic to very xeric places.
- M. sendtneriana* – 1440-2220 – rock outcrops, both in mesic habitats in forests and on xeric S-facing slopes.
- Myurella julacea* – 1770-2000 – among big rocks in mesic places in crooked forest and in a creek canyon in summit meadow area.
- M. sibirica* – 1940 – on soil in cliff crevices, one collection (LE), and twice collected by Bogdanovskaya at [2100-2300 m], 20 and 23.VI.1925 (LE, as *M. apiculata*).
- Neckera besseri* – 1700-1800 – on rock outcrop in forest and in cave at cliff base.
- N. complanata* – 1750-1810 – on rocks in pine and birch forest, occasionally on *Betula* base; rare.
- Orthothecium intricatum* – 1770-2110 – among big rocks in mesic places in crooked forest and in a creek canyon in summit meadow area.
- Orthotrichum anomalum* – 1370-1760 – on rocks (cliffs and separate boulders in meadow), rock hedges, exerted roots of *Carpinus*; rather common.
- O. cupulatum* – 1770 – abundant on one big rock at base of N-facing cliff.
- O. diaphanum* – 1550 – on *Pyrus* near road in *Betula*

- forest.
- O. obtusifolium* – 1550-1760 – on *Pyrus*, *Salix*, *Populus*, in rather open places.
- O. pallens* – 1470-1750 – on trunks of *Carpinus* and *Betula* in forests.
- O. pumilum* – 1370 – on *Betula*, *Carpinus*, *Fraxinus*, *Juniperus*, *Populus*, *Pyrus* trunks, often in open places.
- O. sordidum* – 1550 – on *Betula* in *Carpinus* forest.
- O. speciosum* – 1560 – on *Pyrus*, *Malus*, in rather open places (LE).
- O. striatum* – 1550-1850 – quite common on trunks of *Betula*, including basal parts, occasionally on stumps.
- O. vladikavkanum* – 1500-1870 – common, on *Betula* in forest and in open places, occasionally on *Juniperus*.
- Oxystegus tenuirostris* – 1730 – on rocks and soil on slides to road in *Betula* forest, in wet to mesic places; plants have unusually long and stiff leaves comparatively with specimens of this species from the other parts of Russia.
- Palustriella commutata* – 1750-2000 – in springy mire on slope, and in rather slowly flowing water of stream in summit area.
- Paraleucobryum longifolium* – [1700-1900?] – rotten log in *Betula* forest. 30.VI.1925, coll. Bogdanovskaya (LE).
- Philonotis fontana* – 1300 – dripping calcareous cliff.
- P. falcata* – 1740 – on soil near stream. This is a first record of the widespread Asiatic species in Europe.
- Plagiobryum zieri* – 2000 – wet rock outcrops on slope to small stream canyon in summit area.
- Plagiomnium affine* – 1530-2100 – rock outcrop in depression on slope in summit area.
- P. cuspidatum* – 1700-1790 – on soil, rocks, *Betula* trunks in forest.
- P. elatum* – 1700-1970 – on soil in *Betula* forest and near stream.
- P. medium* – On soil 30.VI.1925, coll. Bogdanovskaya (LE).
- P. rostratum* – 1550-2000 – on wet to mesic rock outcrops, and on soil banks in meadows in summit area.
- P. undulatum* – 1650 – on soil in open forest.
- Plagiopus oederianus* – 1530-2000 – wet to mesic rock outcrops.
- Plagiothecium nemorale* – 1700 – on *Betula* roots.
- Platydictya jungermannioides* – 2010 – niche of rock outcrop in summit area.
- Platygyrium repens* – 1500-1800 – on *Betula* and *Pinus* trunks, mostly at bases.
- Pleurozium schreberi* – 1700-1730 – on soil in *Betula* forest, rare.
- Pogonatum urnigerum* – [1700-1900?] – In *Pinus* forest, 28.VI.1925, coll. Bogdanovskaya (LE).
- Pohlia cruda* – 1530-1730 – on soil on slide to road in *Betula* forest.
- P. nutans* – 1820 – N-facing slope; in forest under rock overhang (LE).
- P. walenbergii* – 2050 – springs at base on N-facing slope, among a pasture.
- Polytrichastrum alpinum* – 2000 – rock outcrops on N-facing slope.
- Polytrichum juniperinum* – 1750 – on soil in pine forest on slope.
- Pseudoleskeella catenulata* – 1330-2050 – on rocks in forest and in deep dry canyons, rocky soil at cliff base, in rather xero-mesic habitats.
- P. nervosa* – 1370-2000 – on rocks, *Carpinus*, *Pyrus* and *Betula* trunks.
- P. rupestris* – 1500-2050 – on rocks and on stump in xero-mesic habitats, rare.
- P. tectorum* – 1370-1850 – relatively common on *Betula*, occasionally on *Pyrus*, *Juniperus* and on rocks.
- Pterigynandrum filiforme* – 1370-2220 – on *Pinus*, *Betula* and on rocks, rare.
- Pterygoneurum ovatum* – 1330 – on rocky soil at cliff base.
- Pylaisia polyantha* – 1370-1900 – common on *Betula*, *Carpinus*, *Pinus*, *Pyrus*, *Salix* trunks, more rarely on rocks, in open places and in forests.
- Rhizomnium punctatum* – 1550 – rocks along river, rare.
- Rhodobryum ontariense* – 1720-1750 – in rather mesic *Betula* and *Betula-Pinus* forests.
- Rhynchostegium murale* – 1650-1770 – calcareous rocks mostly in shady and humid places (in forest, near creek, under better developed herbaceous vegetation).
- Rhytidadelphus triquetrus* – 1700-1800 – soil and rocks in forest, occasionally in meadows on N-facing slopes.
- Rhytidium rugosum* – 1500-1790 – rocks and rocky soil in broad-leaved, as well as in *Betula* forests.
- Saelania glaucescens* – 1500-1740 – on soil and in crevices of rock outcrops, among mosses (LE).
- Sanionia uncinata* – 1700-2000 – on *Betula* trunks and on rocks.
- Schistidium crassipilum* – 1440-1860 – dry open limestones, both cliffs and separate boulders in meadows, occasionally sides of creeks and open forests in relatively mesic habitats.
- S. elegantulum* – 1370-2000 – on rocks, mostly in forests, occasionally in open meso-xeric places.
- S. robustum* – 1760-1850 – rocks at cliff base and boulders in crooked *Betula* forest.
- Sciuro-hypnum populeum* – 1550-2000 – rocks along creek and N-facing rock outcrops in summit area.
- Scorpidium cossonii* – 1800 – along brook bank, among grasses, coll. D. Shilnikov (LE).
- Seligeria calcarea* – 1130-1440 – shaded cliff in canyon.

- S. patula* – 2000 – wet rocks along small stream canyon in summit area.
- S. pusilla* – 1550-2000 – rock outcrops and cliffs in wet shaded places in canyons and forests, in several places.
- S. recurvata* – 1770 – rocks in *Betula* crooked forest, in one place.
- Serpoleskea confervoides* – 1550-1600 – small low rocks in *Carpinus* forest (on many of them) and on rock outcrops.
- S. subtilis* – 1560-1700 – on soil and rotten log (LE).
- Stereodon vaucheri* – 1500-2000 – on rocks, rocky soil, trunks of *Juniperus* and *Carpinus*, in mesic and xero-mesic habitats on open slopes and in forests.
- Syntrichia laevipila* – 1760 – on lonely *Pyrus* near cliffs on open S-facing xeric slope.
- S. ruralis* – 1740-1850 – rock outcrop, rock hedge and one collection on rock-field at base of cliff in forest; only three collections.
- S. sinensis* – 1370-2100 – on rocks, including hedges, soil, *Carpinus*, *Pyrus*, *Salix* trunks; very common in the area.
- S. virescens* – 1550-1760 – on *Pyrus* and *Betula* trunks in rather open places.
- Taxiphyllum wissgrillii* – 1500-1770 – on soil near rock outcrops, in cliff crevices and niches, occasionally on *Betula* trunk base, usually in quite mesic places.
- Thuidium assimile* – 1750-1790 – on soil and rocks in forest and deep canyons.
- T. delicatum* – 1550-2000 – on rocks and soil in forest, on slopes to canyons, occasionally on *Juniperus* trunks.
- Timmia bavarica* – 1600-2200 – damp rock outcrops, occasionally on rocky soil in forests.
- Tortella alpicola* – 1730 – rocks of hedge, one collection.
- T. fragilis* – 1700-2000 – on soil in meadow above tree line.
- T. bambergeri* – 1630 – S-facing slope, on soil in grassland, one collection.
- T. inclinata* – 1500-1760 – dry rocks and soil at cliff base on open S-facing slopes.
- T. tortuosa* – 1500-2030 – rocks, including hedges, soil, pine roots; rather common.
- T. tortuosa* var. *fleischeri* (E. Bauer) Latzel – 1370-1730 – dry rocks and gravelly soil, two collections.
- Tortula acaulon* – 1750 – on soil on lawn in Botanical Garden.
- T. atrovirens* – 1440-2100 – S-facing cliffs; occurs in all studied places in most xeric sites (often associated with *Indusiella*, etc.).
- T. inermis* – 1330 – on rocky soil at cliff base.
- T. lanceola* – 1330 – clayish-gravelly roadside.
- T. mucronifolia* – 1550-2000 – gravelly soil, in forest, among rocks of hedges, on soil in meadows above tree line, one collection on *Betula* trunk.
- T. muralis* – 1330-1760 – on concrete block and rocks in dry canyon bottom (some collections in one of two places could be referred to var. *aestiva*).
- T. obtusifolia* – 1800 – on soil in rock fissures, coll. D. Shilnikov.
- T. protobryoides* – 1330 – clayish-gravelly roadside.
- T. subulata* – 1530-1740 – once found on eroded slope in forest.
- T. systilia* – 1990 – on soil near rock outcrops, one collection.
- Trachycystis ussuriensis* – 1750-1760 – mesic habitats in canyons and in forests, rare.
- Trichostomum crispulum* – 1500-2000 – on soil, especially at cliff bases, on rocks near creek, in cliff crevices, caves, mostly in mesic and xero-mesic habitats; common.
- Ulota coarctata* – 1700 – on *Betula* in forest, one collection (LE).
- Weissia brachycarpa* – 1440-1915 – on soil in pasture and at cliff base and on cliff ledges.
- W. controversa* – 1860 – S-facing slope near road, rocky soil at cliff base.
- W. levieri* – 1850 – on soil in grassland, one collection (LE).
- W. rostellata* – 1850 – on pasture near upper limit of forest vegetation.
- Zygodon rupestris* – 1550-1600 – on *Pyrus* and *Salix* trunk in open *Carpinus* and *Betula* stands and openings along road (3 collections).

NOTES ON INTERESTING FINDINGS AND NON-FINDINGS

There are a few interesting groups of mosses in Gunib area. First of all, this is a complex of xerophytic species distributed mainly in Central Asia and poorly represented in Europe. It includes *Indusiella thianschanica* and *Jaffuelobryum latifolium*, plants common in Mongolian Gobi and NW China. Dagestan is the only place in Europe for *Indusiella*, though in Gunib area we found this species in almost all the suitable habitats: on most xeric, S-facing rocks and cliffs. *Jaffuelobryum* was only recently found in the Caucasus in Kabardino-Balkaria as new to Europe (Kharzinov et al., 2006). Being rare in other parts of the Caucasus, *Jaffuelobryum* does not seem to be rare in Dagestan. Other xerophytes rare in Russia include *Crossidium squamiferum*, *Tortula atrovirens*, *Molendoa schliephakei*, and two latter species are quite common in Gunib area.

Among epiphytes, one interesting fact is the abundance of *Orthotrichum vladikavkanum*, a

rather rare and little known species (cf. Akatova et al., 2004), but in Gunib it is the most common species of the genus. After the first finding of *Lindbergia grandiretis* on *Pyrus* tree in an open place, we undertook intensive search in similar places and in most cases we succeeded to find the species, although often just in amount of a single or very few plants.

Lindbergia dagestanica, which actually was the main target of our trip to Gunib area, was not found despite we undertook an expanded search in the place where it had been collected in 1932. Tree by tree exploration on this slope revealed *Anacamptodon splachnoides*, a species new to Russia (known from Georgia), and two species of *Fabronia*, *F. ciliaris* and *F. pusilla*, both occurring in the area, although never collected in mixture.

Among epilithic species, *Seligeria patula* is new to Russia (the closest localities are known in Estonia, and Tatry and Balkan Mts.), *Myurella sibirica*, a widespread Asiatic species only recently revealed in the Caucasus. Another Asiatic species, *Philonotis falcata* (Koponen, 1996, 2010) was found at a brook side in meadow in summit area, in a rather 'average' place.

The slides to road in *Betula* forest are at places quite moist, and consequently have diverse moss flora, including numerous *Bryum* species, and *B. sibiricum*, previously considered to be an endemic of Siberia (Zolotov, 2006), was found here.

Five species of *Entosthodon* in the Gunib area is the a quite outstanding number for Russian flora, as the genus is absent in the most territory of the country, or no more than two species have been found in any certain area.

To outline the peculiarity of the place it would be interesting to note that we failed to collect such common species as *Ceratodon purpureus*, and surprisingly *Syntrichia ruralis*, a common xerophyte in southern Russia, was found only in three places, as its habitats in most cases are occupied by *S. sinensis*. The rarity of *Homalothecium* and *Anomodon* spp. which are common in other parts of the Caucasus at similar elevations is also an unusual characteristics of the area.

ACKNOWLEDGEMENTS

We are grateful to Ramazan Murtazaliev for field work providing, Violetta Kotseruba for photoes, Anna Ivanova for improving English. The

work was partly supported by the Biodiversity Program of Russian Academy of Sciences and by Federal program «Scientific and Educational personalities of innovative Russia 2009-2013 years» (government contracts №14.740.11.0165 & №16.740.111.0177).

LITERATURE CITED

- AKATOVA, T.V., Z.Kh. KHARZINOV, E.A. IGNATOVA & M.S. IGNATOV 2004. On three rare species of Orthotrichum (Orthotrichaceae, Musci) in Caucasus. – *Arctoa* **13**: 41-49.
- [DOROSHINA, G.Ya.] ДОРОШИНА Г.Я. 2008. Мхи района Кавказских Минеральных Вод (Ставропольский край). – [Mosses of the Caucasian Mineral Waters area (Stavropol territory)] *Новостям сис. низш. раст.* [Novosti Sist. Nizsh. Rast.] **42**: 241-251.
- FEDOSOV, V.E., E.A. IGNATOVA, M.S. IGNATOV & G.Ya. DOROSHINA 2010. On the genus Entosthodon Schwägr. (Funariaceae, Musci) in the Caucasus. – *Arctoa* **19**: 75-86.
- IGNATOV M.S., O.M. AFONINA, E.A. IGNATOVA, A. ABO-LINA, T.V. AKATOVA, E. Z. BAISHEVA, L.V. BARDUNOV, E.A. BARYAKINA, O.A. BELKINA, A.G. BEZGODOV, M.A. BOYCHUK, V.YA. CHERDANTSEVA, I.V. CZERNYADJEVA, G.YA. DOROSHINA, A.P. DYACHENKO, V.E. FEDOSOV, I.L. GOLDBERG, E.I. IVANOVA, I. JUKONIENE, L. KANNUKENE, S.G. KAZANOVSKY, Z.KH. KHARZINOV, L.E. KURBATOVA, A.I. MAKSIMOV, U.K. MAMATKULOV, V. A. MANAKYAN, O.M. MASLOVSKY, M.G. NAPREENKO, T. N. OTNYUKOVA, L.YA. PARTYKA, O.YU. PISARENKO, N.N. POPOVA, G.F. RYKOVSKY, D.YA. TUBANOVA, G.V. ZHELEZNOVA & V.I. ZOLOTOV 2006. Check-list of mosses of East Europe and North Asia. – *Arctoa* **15**: 1-130.
- IGNATOVA, E.A., M.S. IGNATOV & I.A. MILYUTINA 2010. A revision of the genus Lindbergia (Leskeaceae, Bryophyta) in Russia. – *Arctoa* **19**: 97-116.
- [KHARZINOV, Z. Kh., M.S. IGNATOV, E.A. IGNATOVA & N.N. PORTENIER] ХАРЗИНОВ З.Х., Е.А. ИГНАТОВА, М.С. ИГНАТОВ, Н.Н. ПОРТЕНИЕР 2006. Новые находки мхов в Кабардино-Балкарской Республике. 1. – [New moss records from Kabardino-Balkarian Republic. 1] *Arctoa* **15**: 256-258.
- KOPONEN, T. 1996. Notes on Philonotis (Bartramiaceae, Musci). 1. Status and distribution of Philonotis falcata (Hook.) Mitt. – *Arctoa* **6**: 113-117.
- KOPONEN, T. 2010. Notes on Philonotis (Bartramiaceae, Musci). 7. Key to Chinese Philonotis and Fleishcerobryum. – *Tropical Bryology* **31**: 126-130.
- NAKHUTSRISHVILI, G., SH. SIKHARULIDZE & R. MURTAZALIEV 2009. Concerning two alpine botanical gardens of the Caucasus. – *Second international congress of alpine and arctic botanical gardens*. Munchen: 51-55.
- [PHYSIOGRAPHY OF DAGESTAN] 1996. Физическая география Дагестана. – *Махачкала* [Makhachkala], 383 pp.
- ZOLOTOV, V.I. 2006. On systematics and distribution of some species of Bryum (Bryaceae, Bryophyta) in Russia. – *Arctoa* **15**: 155-162.