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BRYOPHYTE VEGETATION OF BASHKIRIA, SOUTH URALS. V. ON THE BRYOPHYTE COMMUNITIES OF THE SOUTHERN KRAKA RANGE

РАСТИТЕЛЬНОСТЬ МОХООБРАЗНЫХ БАШКИРИИ, ЮЖНЫЙ УРАЛ. V. К БРИОСООБЩЕСТВАМ ХРЕБТА ЮЖНЫЙ КРАКА

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Abstract

In the Southern Kraka Range (the Bashkir State Nature Reserve, South Ural region), the observation and classification of some epiphytic, epixylic, and epilithic bryophyte communities were performed following the Brown-Blanquet approach. The revealed communities are represented by five associations and four rangless communities belonging to 5 classes, 6 orders and 6 alliances. The relevés and localities of the communities of the classes ***Racomitrietea heterostichi*** Neumayr 1971 and ***Ctenidietea mollusci*** von Hübschmann ex Grgić 1980 are reported for the South Urals for the first time.

Резюме

На хребте Южный Крака (Башкирский государственный природный заповедник, Южно-Уральский регион) в соответствии с подходом Браун-Бланке проведены обследование и классификация некоторых эпифитных, эпиксильных и эпилитных сообществ мохообразных. Выявленные брионозы представлены 5 ассоциациями и 4 безранговыми сообществами, относящимися к 5 классам, 6 порядкам и 6 союзам. Описания и местонахождения сообществ классов ***Racomitrietea heterostichi*** Neumayr 1971 и ***Ctenidietea mollusci*** von Hübschmann ex Grgić 1980 приводятся для Южного Урала впервые.

KEYWORDS: bryophytes, bryophyte communities, syntaxonomy, the South Urals

Introduction

In the Republic of Bashkortostan (South Ural region), the floristic classification of bryophyte communities is not sufficiently developed (Baisheva *et al.*, 1994; Baisheva, 1995, 2000, 2023). This article presents the results of a study of some bryophyte communities in the western part of the Bashkir State Nature Reserve. In the territory of this special protected area, bryophyte flora has been thoroughly investigated only in the middle of the past century (Selivanova-Gorodkova & Schljakov, 1956). Later, some data have been published on common bryophytes revealed in the different forest communities of this territory (Martynenko *et al.,* 2003), as well as on rare species (Martynenko, 2021). The purpose of this work is to classify some epiphyte, epixylic and epilithic bryophyte communities described in the Southern Kraka Range.

Material and Methods

The study was conducted in the Southern Kraka Range and some adjacent areas. According to the geobotanical zoning of the Republic of Bashkortostan, the study area is located within the Beloretsko-Subkhangulovsky district of pine, larch and birch forests and tall grass meadows of the Southern Ural mountain province (Zhudova, 1966).

The Southern Kraka Range is composed mainly of various types of mafic (basic) rocks (lherzolites, harzburgites, dunites, serpentinites, etc.), while other types of rocks (sandstones, siltstones, mudstones, limestones, dolomites, etc.) are much less represented (Snachev *et al.*, 2001). The elevation varies from 440 to 850 m above sea level. The climate is continental and moderately cool. The average annual temperature is +1.4°C, the average January temperature is –14.5°C, the average July temperature is +17°C. The average annual precipitation is 540 mm (Yaparov, 2005).

Mountain forests are mainly dominated by *Pinus sylvestris* L.*, Larix sukaczewii* Dylis, *Betula pendula* Roth, and *Populus tremula* L. The broad-leaved trees (*Tilia cordata* Mill., *Acer platanoides* L., and *Ulmus laevis* Pall.) grow mainly as admixture in floodplains, since the eastern border of the range of Eastern European broad-leaved nemoral forests is located approximately 50 km from the study area. Steppes are mainly associated with steep slopes of southern and southeastern exposure (Martynenko *et al.*, 2003).

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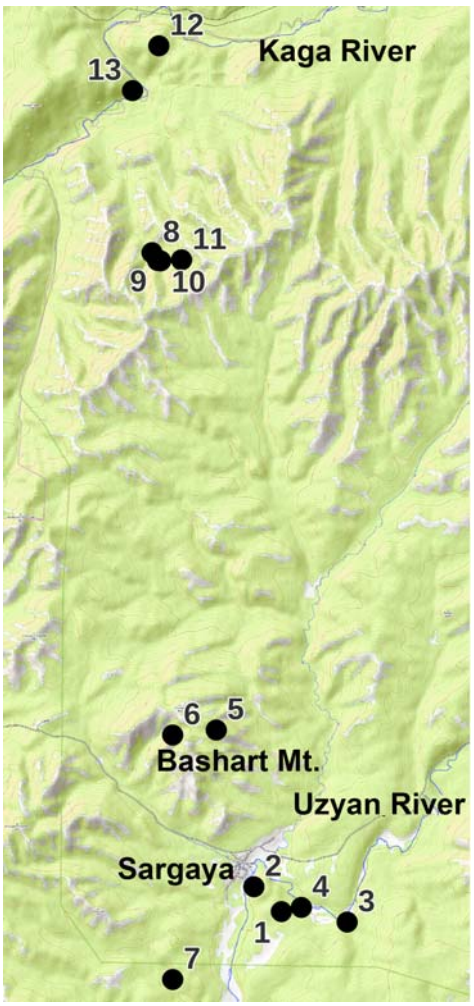

Fig. 1. Collecting localities in Republic of Bashkortostan, Burzyanskiy District:
1 – 1 km south-east of Sargaya village, mesophytic birch-pine forest on the western mountain slope (53.33645°N, 57.79473°E), 510 m alt., 6.VI.1997.
2 – the eastern mountain slope to the left bank of the Uzyan River near the Sargaya village, boreal mossy pine forest (53.34063°N, 57.78721°E), 250 alt., 6.VI.1997.
3 – 2.5 km south-east of Sargaya village, the northern mountain slope to the left bank of the Uzyan River, boreal mossy pine forest (53.33458°N, 57.81287°E), 510m alt., 7.VI.1997.
4 – 1.4 km east of Sargaya village, the valley of the Uzyan River, open cliffs (53.33711°N, 57.80025°E), 550 alt., 7.VI.1997.
5 – the eastern slope of the Bashart Mt., pine-birch forest (53.36680°N, 57.77727°E), 770 m alt., 8.VI.1997.
6 – the western slope of the Bashart Mt., birch-larch forest (53.36604°N, 57.76522°E), 750 alt., 8.VI.1997.
7 – 2.5 km south-west of Sargaya village, the valley of Bala-Yelga stream, open cliffs (53.3253433°N, 57.76449°E), 520 m alt., 9.VI.1997.
8 – 3 km south of Yangi-Yul cordon, the valley of the Yevlankun Kluch stream, open cliffs (53.44630°N, 57.76092°E), 580 m alt., 10.VI.1997.
9 – 3.5 km south of Yangi-Yul cordon, the middle part of the mountain slope to the left bank of the Yevlankun Kluch stream, open cliffs (53.44498°N, 57.76247°E), 610 m alt., 10.VI.1997.
10 – 3.3 km south of Yangi-Yul cordon, the mountain slope to the right bank of the Yevlankun Kluch stream, grassy larch forest (53.44542°N, 57.76399°E), 630 m alt., 10.VI.1997.
11 – 3.5 km south-south-east of Yangi-Yul cordon, the western slope of the mountain, grassy pine forest (53.445049°N, 57.769094°E), 670 m alt., 10.VI.1997.
12 – 1 km north of Yangi-Yul cordon, the south-eastern mountain slope, lime-pine forest (53.48073391°N, 57.76344899°E), 540 m alt., 11.VI.1997.
13 – valley of the Kaga River opposite the Yangi-Yul cordon, the floodplain alder-bird cherry forest (53.47332°N, 57.756009°E), 440 m alt., 11.VI.1997.

75 geobotanical relevés of the bryophyte cover on the tree trunks, decaying wood and stony substrates (rock outcrops, cliffs and boulders) were carried out in 1997. Particular attention was paid to the ecological homogeneity of the sample plots, i.e. moisture, illumination, exposition, *etc.* The area of sample plots ranges from 1 to 100 dm^2. The abundance of species was evaluated according to the Braun-Blanquet abundance scale: r – extremely rare, cover is negligible; + – cover is not more than 1 %; 1 – 1–5 %; 2 – 5–25 %; 3 – 25–50 %; 4 – 50–75 %; 5 – 75–100 %. Since some vegetation units are represented by a small number of relevés, the constancy values are indicated by the percentage proportion of relevés in which the species is present. It does allow the merging of different synoptic tables without loss of accuracy (Dengler *et al*., 2008). The abundance of species within each vegetation unite is indicated in the form of the degree of the constancy values (Table 1).

During the fieldwork, only the preliminary abundance of species was evaluated, and the real abundance was defined in the laboratory after the identification of species with a microscope. The names of syntaxa follow the International Code of Phytosociological Nomenclature (Theurillat *et al.,* 2021). The system of high vegetation units is mainly after Mucina *et al.* (2016). The nomenclature of bryophytes and lichens is after Hodgetts *et al.* (2020) and Urbanavichus (2010).The specimens are deposited at the Herbarium of the Institute of Biology of the Ufa Federal Research Centre of the Russian Academy of Sciences (UFA).

In the text the following abbreviations are used: T – trunk of tree, B – base of tree, R – rotten wood, SL – soil, ST – rocky substrate, BP – *Betula pendula*, PS – *Pinus sylvestris*, TC – *Tilia cordata*, ass. – association, subass. – subassociation, d.s. – diagnostic species.

The geobotanical relevés were made in 13 localities in the Southern Kraka Range (Fig. 1).

Also, additional data (two relevés from the Abzelilovskiy District) were used to characterize the association ***Grimmietum longirostris*** Nörr1969, which is reported for the first time for the Republic of Bashkortostan: Locality 14 – the Kurkak Range, the Manbatchura Mt., open rock outcrops at the top of the mountain (53.80925°N, 58.72492°E), 780 m alt., 18.VI.1997.

The precise of localities is approximately 0.5 km.

RESULTS

Totally, five associations and four rangless communities belonging to 5 classes, 6 orders and 6 alliances

were recorded in the study area (Table 1). The syntaxomical position of the revealed communities is mentioned below. Relevé tables of vegetation units are provided in the supplementary materials, SM: (https://kmkjournals.com/upload/PDF/Arctoa/33/Arctoa_33_Baisheva_SM.docx).

LIST OF SYNTAXA

Class ***Schistidietea apocarpi*** Ježek & Vondráček 1962 (syn. ***Grimmietea anodontis*** Hadač & Vondráček in Ježek & Vondráček 1962)

Order ***Schistidietalia apocarpi*** Ježek & Vondráček 1962

Alliance ***Grimmion tergestinae*** Šmarda 1947 (Syn. ***Schistidion apocarpi*** Ježek & Vondráček 1962)

Ass. ***Pseudoleskeelletum catenulatae*** Ježek & Vondráček 1962

Class ***Ctenidietea mollusci*** von Hübschmann ex Grgić 1980

Order ***Ctenidietalia mollusci*** Hadač et Šmarda in Klika et Hadač 1944

Alliance ***Ctenidion mollusci*** Ştefureac 1941 (Syn. ***Tortellion tortuosae*** Ştefureac 1941)

Tortella tortuosa – community

Campylium chrysophyllum – community

Class ***Racomitrietea heterostichi*** Neumayr 1971

Order ***Grimmietalia commutatae*** Šmarda et Vaněk in Šmarda 1947

Alliance ***Grimmion commutatae*** von Krusenstjerna 1945

Ass. ***Grimmietum longirostris*** Nörr1969

Hedwigia mollis – community

Class ***Cladonio digitatae-Lepidozietea reptantis*** Ježek & Vondráček 1962

Order ***Diplophylletalia albicantis*** Philippi 1963

Alliance ***Pohlion crudae*** Privitera & Puglisi 1997

Pohlia cruda – community

Order ***Brachythecietalia rutabulo-salebrosi*** Marstaller 1987

Alliance ***Bryo capillaris-Brachythecion rutabuli*** Lecointe 1975

Ass. ***Brachythecietum salebroso–reflexi*** Pisarenko 1999

Class ***Frullanio dilatatae-Leucodontetea sciuroidis*** Mohan 1978

Order ***Dicranetalia scoparii*** Barkman 1958

Alliance ***Dicrano scoparii-Hypnion filiformis*** Barkman 1958

Ass. ***Platygyrietum repentis*** Le Blanc ex Marstaller 1986

Ass. ***Ptilidio pulcherrimi-Hypnetum pallescentis*** Barkman ex Willmanns 1962

subass. ***P.p.-H.p.*** *typicum*

subass. ***P.p.-H.p.*** *callicladietosum haldaniani* Baisheva 1995

In the study area, the aquatic bryophyte communities belonging to the association ***Cratoneuretum filicini*** Poelt 1954 (the class ***Platyhypnidio–Fontinalietea antipyreticae*** Philippi 1956) were also described. This association has been characterized in another publication (Baisheva *et al.*, 2004).

DESCRIPTION OF SYNTAXA

Association ***Pseudoleskeelletum catenulatae*** Ježek & Vondráček 1962 (Table 1, column 1)

Diagnostic species: *Pseudoleskeella catenulata.*

Only two xero-mesophytic communities of this association were described in the locality No.11 (Fig.1): Relevé No. 85. On rock outcrops in a sparse dry grassy pine forest. Size of the sample plot 3000 cm^2 (15×20 cm), moss cover 70 %. *Pseudoleskeella catenulata* 4, *Schistidium submuticum* 2.

Relevé No. 87. On open rock outcrops. Size of the sample plot 2025 cm^2 (45×45 cm), moss cover 65 %. *Pseudoleskeella catenulata* 3, *Tortella tortuosa* 2, *Syntrichia ruralis* 2.

This association belongs to the alliance ***Grimmion tergestinae*** Šmarda 1947, which unites light-demanding epilithic bryophyte communities growing on carbonate rock outcrops in Europe (Mucina *et al.*, 2016). In the study area, *Pseudoleskeella catenulata* has scattered distribution (Selivanova-Gorodkova & Shlyakov, 1956), probably due to the rarity of limestone outcrops. These communities are quite common in the Belaya River valley, located approximately 15-50 km west of the study area (Baisheva, 2023).

The communities of the class ***Ctenidietea mollusci*** von Hübschmann ex Grgič 1980:

Tortella tortuosa – community (Table 1, column 2; table 1 in SM, columns 1–5)

Diagnostic species: *Tortella tortuosa.*

Campylium chrysophyllum – community (Table 1, column 3; table 1 in SM, columns 6–10)

Diagnostic species: *Campylium chrysophyllum.*

The class ***Ctenidietea mollusci*** von Hübschmann ex Grgič 1980 comprises bryophyte vegetation on shaded, moist to temporarily dry base rocks and occasionally on calcareous soil surfaces (Hübschmann, 1986; Mucina *et al*., 2016). In the bryophyte flora of the Republic of Bashkortostan, the diagnostic block of this class and its higher syntaxa is represented by a significant number of species (*Flexitrichum flexicaule, Encalypta streptocarpa, Gymnostomum aeruginosum, Jungermannia borealis, Mesoptychia heterocolpos, Orthothecium intricatum, Marchantia quadrata, Tortella tortuosa, T. fragilis, Campylium chrysophyllum, Campylophyllum halleri, Plagiopus oederianus, Platydictya jungermannioides, Timmia bavarica, Tortula mucronifolia, Aneura pinguis, Clevea hyalina, etc.*). However, *Ctenidium molluscum*, the main diagnostic species of this class, has not yet been found in the Southern Urals.

In the study area, the communities ordered to this class were described on basic rock outcrops in the dry pine and larch mountain forests. The communities are distinguished by the predominance of *Tortella tortuosa* and *Campylium*

chrysophyllum, which have large ecological amplitude and colonize almost all basic substrates in the Central Europe (Hübschmann, 1986). Available data are insufficient to establish ecological differences between these vegetation units, and further investigations are needed to clarify their syntaxonomical position.

Association ***Grimmietum longirostris*** Nörr1969 (Table 1, column 4; table 2 in SM)

Diagnostic species: *Grimmia longirostris.*

This association is reported for the first time for the Republic of Bashkortostan. It belongs to the class ***Racomitrietea heterostichi*** Neumayr 1971, which unites bryophyte communities on sunny, exposed, siliceous rocks, boulders and screes (Mucina *et al*., 2016). These communities with high abundance of *Grimmia longirostris* were described on well illuminated serpentinites and sandstones in the scarce pine forests, steppes and near the top of the mountains above the forest belt. The cover of the communities is not high and varies from 15 to 80%, accounting for on average 48%. The species number in relevé is 5–7, accounting for on average 6.

This association was first described as ***Grimmietum ovatae*** Nörr 1969 and united the species-poor moss-lichen communities with high abundancy of *Grimmia longirostris* and *Cladonia chlorophaea,* growing on open and well-illuminated mineral-rich silicate rocks in the Harz. Later, this boreal-temperate association was reported from Germany, where it is widespread at the low and middle elevations of the Hessen and the central part of the country, as well as from Turkei, Italy and some other regions (Hübschmann, 1986; Puglisi & Privitera, 2012, Marstaller, 2005, 2010).

The Ural's communities of this association are characterized by the absence of *Bucklandiella heterosticha*, as well as some other species, i.e. *Grimmia trichophylla, Hypnum cupressiforme*, *etc.* Among the lichens, some xerophytic species, which grow on dry steppe soil (*Cladonia pocillum, Phaeophyscia constipata*) are present in these communities.

In the Table 2 in SM, the data from the study area are supplemented by two relevés described on the Kurkak Range, located approximately 50 km east from the Southern Kraka Range.

Hedwigia mollis – community (Table 1, column 5; table 3 in SM)

Diagnostic species: *Hedwigia mollis.*

These communities with high abundancy of *Hedwigia mollis* were found on sunny or semi-shaded quartz sandstones, chloritized siltstones, harzburgites and serpentinites within birch-pine and pine forests, as well as on the open cliffs. The mean cover is 60%, the species number in relevé varies from 3 to 10, accounting for on average 6.3. The related species are *Paraleucobryum longifolium, Abietinella abietina, Leucodon sciuroides, Cynodontium strumiferum, etc.*

The distribution of *Hedwigia mollis* is not yet well-studied because this species was recently described (Ignatova *et al.,* 2016; Ignatov *et al*., 2018). Currently, it is known from European Russia (the southern part of the Kola Peninsula, the Republic of Karelia, several provinces in the East European Plain and the Southern Urals), Finland (Boychuk & Várkonyi, 2022), the Caucasus, and the Altai Mountains (Ignatov *et al*., 2018).

The habitats and floristic composition of ***Hedwigia mollis*** – communities are close to those of the association ***Hedwigietum albicantis*** Allorge ex Vanden Berghen 1953, which unites the bryophytic communities with a predominance of *Hedwigia ciliata* (in the broad sense of this species). In Northern, Central and Southern Europe, association ***Hedwigietum albicantis*** was reported from hilly and submontane areas on mineral-rich silicate rock outcrops (decarbonated diabases, basalts, granites, gneisses, sandstones), rarely – on Devonian limestones in sunny and semi-shaded habitats (Hübschmann, 1986). It has a wide distribution and is represented by some subassociations with co-domination of *Paraleucobryum longifolium, Schistidium papillosum, Polytrichum piliferum, Cynodontium bruntonii* and *Racomitrium lanuginosum* (Marstaller, 2006). *Hedwigia ciliata* was earlier considered as a sub-cosmopolitan species, but now its distribution seems to be restricted to Europe (including some northern and central regions of European Russia) and Africa (Ignatov *et al*., 2018). In the Bashkir State Nature Reserve, *Hedwigia ciliata* s.l. was noted as a common species, growing in dry habitats on both basic and acidic rock outcrops (Selivanova-Gorodkova & Shlyakov, 1996). To clarify the syntaxonomical position of the Ural's communities with *Hedwigia mollis*, the additional data should be collected.

Pohlia cruda – community (Table 1, column 6; table 4 in SM)

Diagnostic species: *Pohlia cruda*.

These bryophyte communities dominated by *Pohlia cruda* were described on the soil layer, covering the polymictic sandstones and foliated mudstones in small niches in the rocks, between tree roots, near the cliffs and boulders in the forest dominated by *Pinus sylvestris,* boreal mosses (*Pleurozium schreberi, Hylocomium splendens, Dicranum scoparium*) and *Vaccinium myrtillus.* The moss cover is 85–90 %, and the species number in relevé varies from 4 to 11, accounting for on average 6.

The dominance of *Pohlia cruda* and the presence of the diagnostic species of the class ***Cladonio digitatae-Lepidozietea reptantis*** and the order ***Diplophylletalia albicantis*** (*Plagiothecium denticulatum, P. rossicum*) and the alliance ***Pohlion crudae*** (*Isopterygiopsis pulchella*), allow us to order our communities into the alliance ***Pohlion crudae*** Privitera & Puglisi 1997. This alliance and the association ***Pohlietum crudae*** Privitera & Puglisi 1997 were first described in high montane areas of Mt. Etna (Italy) at an elevation of 1500–1950 m above sea level. This alliance unites mountain terri-humicolous,

mesophytic, sciophytic bryophyte communities that grow on acid and more or less humified soils in niches, crevices, small caves, and ravines in rocks where a thick layer of soil accumulates (Privitera & Puglisi, 1996). The diagnostic species of the alliance ***Pohlion crudae*** are *Pohlia cruda, Pohlia elongata, Bartramia ithyphylla, Brachytheciastrum velutinum, B. collinum, Amphidium mougeottii, Isopterygiopsis pulchella* (Puglisi & Privitera, 2012).

Floristically, our communities are close to the association ***Pohlietum crudae*** due to the dominance of *Pohlia cruda* and the presence of *Distichium capillaceum.* However, the absence of *Amphidium mougeotii, Bartramia ithyphylla, Brachytheciastrum collinum,* as well as the presence of some basophilous species (*Neckera pennata, Mnium marginatum*, *Oxystegus tenuirostris*), indicating less acidic substrates, do not allow us to order the communities of the study area into this association. Additional data needs to be collected to clarify the syntaxonomical position of these communities.

Association ***Brachythecietum salebroso–reflexi*** Pisarenko 1999 (Table 1, column 7; table 5 in SM)

Diagnostic species: *Sciuro-hypnum reflexum, Brachythecium salebrosum.*

This association belongs to the order ***Brachythecietalia rutabulo–salebrosi*** and the alliance ***Bryo capillaris–Brachythecion rutabili***, which united the bryophyte communities of hemerophilous weft- and mat-forming pleurocarpous mosses on nutrient-rich rotting wood at any stage of decay and on root flares in habitats with base-rich soil (Mucina *et al*., 2016). The diagnostic species of this association are simultaneously diagnostic for this high syntaxa.

In the study area, the communities with a predominance of *Sciuro-hypnum reflexum* and the presence of *Brachythecium salebrosum* were described in pine, larch, birch-pine and pine-birch-lime forests, mainly on rotten wood, rarely – on the bases of *Tilia cordata* trees and on the boulders covered with litter. The related species are *Amblystegium serpens*, *Sanionia uncinata*, *etc*. The cover of the communities is 90–100 %, and the species number in relevé varies from 4 to 11, accounting for on average 7.4.

The association ***Brachythecietum salebroso–reflexi*** was first described in chernevaia taiga of Western Siberia (Pisarenko, 1999). Later, it was also found in the Nizhny Novgorod Province, where these communities occur in coniferous-broad-leaved and broad-leaved forests, as well as in forested mires (Shestakova & Biryukova, 2023). The floristic composition of the communities in the study area is similar to that described in other regions.

Association ***Platygyrietum repentis*** Le Blanc ex Marstaller 1986 (Table 1, column 8; table 6 in SM, columns 1–5)

Diagnostic species: *Platygyrium repens.*

The communities dominated by *Platygyrium repens* were found in the lime-pine forest, which complex herb layer formed by both nemoral and boreal species (*Aegopodium podagraria, Stellaria holostea, Oxalis acetosella, Viola mirabilis, etc.*). All bryophyte communities were described on the bark of *Tilia cordata* from the base up to the height 100–130 m above the ground (once – on the upper side of the tilted trunk, along which the rainwater flowed). The cover is 70–95 %, the species number in relevé varies from 4 to 7, accounting for on average 5.4.

The floristic composition of the communities includes the epiphytic species *Pylaisia polyantha* and *Lewinskya speciosa,* the species typical for the tree bases and rotten wood (*Dicranum scoparium, D. montanum, Sanionia uncinata*), as well as the lichens *Hypogymnia physodes* and *Parmelia sulcata*. The floristic composition of the communities in the study area is similar to those previously described within the more mesophytic broad-leaved and dark coniferous-broadleaf forests (Baisheva, 1995, 2023), but differs by the absence of *Pseudoleskeella nervosa.*

Association ***Ptilidio pulcherrimi-Hypnetum pallescentis*** Barkman ex Willmanns 1962:

subass. ***P.p.-H.p.*** typicum (Table 1, column 9; table 6 in SM, columns 6–10)

Diagnostic species: *Ptilidium pulcherrimim, Jochenia pallescens.*

subass. ***P.p.-H.p.*** *callicladietosum haldaniani* Baisheva 1995 (Table 1, column 10; table 6 in SM, columns 11–15)

Diagnostic species: *Ptilidium pulcherrimim, Jochenia pallescens, Callicladium haldaneanum.*

In the study area, the communities of the association ***Ptilidio pulcherrimi-Hypnetum pallescentis*** are common and grow in the birch-pine, lime-pine and boreal mossy pine forests on rotten wood in the early stages of decay, as well as on the tree bases of *Betula pendula* and *Pinus sylvestris.* The cover is 95–100 %, the species number in relevé varies from 3 to 9, accounting for on average 5.7.

This association seems to be common in the boreal and hemiboreal zones and mountain regions of European Russia and Western Siberia (Baisheva *et al*., 1994; Baisheva, 1995, 2000, 2023; Pisarenko, 1999; Shestakova & Biryukova, 2023). The floristic composition of the communities in the study area is similar to that described in the forests of other regions of the Republic Bashkortostan and Russia.

Discussion

The bryophyte vegetation of the Southern Kraka Range differs from those of the areas with numerous limestone outcrops, i.e. the Bashkir Cis-Urals and the valley of the Belaya River (Baisheva *et al*., 1994; Baisheva, 2023) by the rarity of mesophytic epiphytic and epilithic communities typical for broad-leaved forests and limestones, as well as the presence of the light-demanding epilithic communities growing on igneous rocks.

The species *Hedwigia mollis, Mesoptychia heterocolpos, Plagiothecium rossicum, Schistidium submuticum, S.* cf. *flexipile, S. pulchrum* are reported for the first time for the Bashkir State Nature Reserve.

Table 1. Syntaxa of bryophyte communities revealed in the Southern Kraka mountain range: 1 – Ass. ***Pseudoleskeelletum catenulatae*** Ježek & Vondráček 1962; 2 – ***Tortella tortuosa*** – community; 3 – ***Campyliadelphus chrysophyllus*** – community; 4 – Ass. ***Grimmietum longirostris*** Nörr 1969; 5 – ***Hedwigia mollis*** – community; 6 **–** ***Pohlia cruda*** – community; 7 – Ass. ***Brachythecietum salebroso–reflexi*** Pisarenko **1999**; 8 **–** Ass.***Platygyrietum repentis*** Le Blanc ex Marstaller 1986; 9 – Ass. ***Ptilidio pulcherrimi-Hypnetum pallescentis*** Barkman ex Willmanns 1962: subass. ***P.p.-H.p. typicum***; 10 – Ass. ***Ptilidio pulcherrimi-Hypnetum pallescentis*** Barkman ex Willmanns 1962: subass. ***P.p.-H.p. callicladietosum haldaniani*** Baisheva 1995

Number of syntaxa	1	2	3	4	5	6	7	8	9	10
Number of relevés	2	5	5	5	12	5	5	5	5	5
D.s. of associations, subassociations and communities										
Pseudoleskeella catenulata	**100**$^{3-4}$	.	.	.	.	.	.	.	.	.
Tortella tortuosa	50^{2}	**100**$^{2-4}$	40^{r-1}	20^{1}	25^{r-2}	.	.	.	.	.
Campylium chrysophyllum	.	60^{r-2}	**100**$^{2-3}$	.	.	.	.	.	.	.
Grimmia longirostris	.	.	.	**100**$^{2-4}$	25^{r-1}	.	.	.	.	.
Hedwigia mollis	.	.	.	80^{+-2}	**100**$^{1-3}$	.	.	.	.	.
Pohlia cruda	.	20^{1}	20^{1}	.	.	**100**$^{2-4}$	.	.	.	.
Sciuro-hypnum reflexum	.	.	.	.	8^{r}	.	**100**$^{2-5}$	.	40^{+-2}	.
Brachythecium salebrosum	.	.	.	.	.	.	**100**$^{+-2}$	20^{+}	20^{r}	.
Platygyrium repens.	.	.	40^{r-1}	.	.	.	**100**$^{3-4}$	.	.	
Jochenia pallescens	.	.	.	.	.	.	40^{+-1}	40^{+-2}	**100**$^{2-3}$	**100**$^{1-5}$
Ptilidium pulcherrimum	.	.	.	.	.	.	.	20^{r}	**80**$^{r-3}$	**80**$^{+-4}$
Callicladium haldaneanum	.	.	.	.	.	.	20^{r}	.	.	**100**$^{1-4}$
D.s. of the class ***Ctenidietea mollusci*** and the order ***Ctenidietalia mollusci***										
Mesoptychia heterocolpos	.	40$^{2-3}$	20^{1}	.	.	.	.	.	.	.
D.s. of the class ***Racomitrietea heterostichi***										
Lewinskya rupestris	.	.	.	20^{+}	.	.	.	.	.	.
D.s. of the class ***Frullanio dilatatae-Leucodontetea sciuroidis*** and the order ***Orthotrichetalia***										
Radula complanata	.	60^{r-2}	.	20^{r}	17^{r-2}	20^{1}	.	20^{+}	.	.
Leucodon sciuroides	.	.	.	.	25$^{1-2}$	.	.	.	.	.
Pylaisia polyantha .		.	.	.	.	.	20^{1}	60^{r-+}	.	.
Lewinskya speciosa	.	.	.	.	.	.	.	20^{+}	.	.
D.s. of the order ***Dicranetalia scoparii*** and the alliance ***Dicrano-Hypnion***										
Dicranum montanum	.	.	.	.	.	.	20^{1}	40^{1}	40$^{1-3}$	100^{+-2}
Dicranum scoparium		.	.	.	.	.	60^{+-2}	20^{2}	40^{r-+}	40^{r-1}
D.s. of the class ***Cladonio digitatae-Lepidozietea reptantis***										
Plagiothecium denticulatum	.	.	.	.	.	60^{r-3}	.	.	.	.
Plagiothecium rossicum	.	.	.	.	.	20^{1}	.	.	.	20^{+}
Lophocolea heterophylla	.	.	.	.	.	.	20^{2}	.	60^{r-1}	60^{r-1}
Cladonia coniocraea	.	.	.	.	.	.	.	20^{2}	20^{2}	.
D.s. of the alliance ***Pohlion crudae***										
Isopterygiopsis pulchella	.	.	.	.	.	20^{2}	.	.	.	.
D.s. of the order ***Brachythecietalia rutabulo–salebrosi*** and the alliance ***Bryo–Brachythecion***										
Bryum moravicum	.	.	.	.	25^{r-2}	.	.	.	.	.
Brachytecium capillaceum	.	.	.	.	17^{+-2}	.	.	.	.	.
Amblystegium serpens	.	.	.	.	.	.	40^{r-2}	.	.	20^{r}
Campylium sommerfeltii	.	.	.	.	.	.	20^{r}	.	.	.
Sciuro-hypnum starkei	.	.	.	.	.	.	20^{r}	.	.	.
D.s. of the class ***Hylocomietea splendentis***, the order ***Hylocomietalia splendentis*** and the alliance ***Pleurozion schreberi***										
Hylocomium splendens	.	.	20^{r}	.	.	40^{r-2}	20^{+}	.	.	.
Pleurozium schreberi	.	.	.	.	.	20^{1}	20^{+}	20^{r}	.	40^{r-+}
D.s. of the class ***Neckeretea complanatae*** and the order ***Neckeretalia complanatae***										
Plagiomnium cuspidatum	.	.	.	.	.	40^{r-1}	20^{2}	.	.	.
Mnium marginatum	.	.	.	.	.	40^{r-2}	.	.	.	.
Oxystegus tenuirostris	.	.	.	.	.	40^{r-1}	.	.	.	.
Neckera pennata	.	.	.	.	.	20^{2}	.	.	.	.
Homalia trichomanoides	.	.	.	.	.	20^{1}	.	.	.	.
Pseudoamblystegium subtile	.	.	.	.	.	20^{r}	.	.	.	.

(to be continuied)

Table 1. Syntaxa of bryophyte communities (continuied)

Number of syntaxa	1	2	3	4	5	6	7	8	9	10
Number of relevés	2	5	5	5	12	5	5	5	5	5
					Other species:					
Syntrichia ruralis	50^{2}	.	.	.	.	.	.	.		..
Schistidium submuticum	50^{2}	.	20^{2}	.	.	.	.	.	.	.
Cladonia pyxidata	.	40^{r-+}	40^{+}	.	33^{+}	.	.	.	.	.
Sanionia uncinata	.	80	.	.	8^{r}	.	60^{1-2}	40^{1}	40^{+-2}	.
Bryum capillare	.	40^{r}	40^{+-2}	.	.	.	20^{r}	.	.	.
Ceratodon purpureus	.	20^{+}	.	.	8^{+}	.	20^{1}	.	.	.
Cladonia fimbriata	.	20^{+}	.	.	.	.	20^{+}	.	.	.
Eurhynchium pulchellum	.	40^{1-2}		.	8^{r}	.	.	.	.	.
Brachythecium albicans	.	40^{+-2}	.	.	.	.	.	.	.	.
Dicranum brevifolium	.	20^{+}	.	.	.	.	.	.	.	.
Schistidium cf. flexipile	.	20^{2}	.	.	.	.	.	.	.	.
Abietinella abietina	.	20^{1}	20^{+}	.	42^{+-2}	.	.	.	.	.
Distichium capillaceum	.	.	80^{+-2}	.	.	40^{2}	.	.	.	.
Lepraria finkii	.	.	20^{+}	.	.	.	.	.	.	.
Mycobilimbia tetramera	.	.	20^{+}	.	.	.	.	.	.	.
Bryum sp.	.	.	.	40^{+}	.	.	.	.	.	.
Lophocolea minor	.	.	20^{1}	.	.	.	40^{2-3}	.	20^{r}	20^{r}
Parmelia sulcata	.	.	.	40^{r-+}	8^{+}	.	.	40^{r-1}	.	.
Paraleucobryum longifolium	.	.	.	40^{+2}	50^{+-4}	.	.	.	.	.
Cynodontium strumiferum	.	.	.	40^{+-1}	25^{r-3}	.	.	.	.	.
Cladonia pocillum	.	.	.	20^{+}	8^{+}	.	.	.	.	.
Hypogymnia physodes	.	.	.	20^{+}	33^{+}	.	.	60^{r-2}	.	20^{+}
Cladonia rangiformis	.	.	.	20^{+}	25^{+}	.	.	.	.	.
Cladonia chlorophaea	.	.	.	20^{+}	17^{+}	.	.	.	.	.
Xanthoparmelia stenophylla	.	.	.	40^{r-1}	8^{+}	.	.	.	.	.
Bryum argenteum	.	.	.	20^{1}	.	.	.	.	.	.
Phaeophyscia constipata	.	.	.	20^{+}	.	.	.	.	.	.
Physcia caesia	.	.	.	20^{+}	.	.	.	.	.	.
Physconia muscigena	.	.	.	20^{r}	.	.	.	.	.	.
Pseudoleskeella nervosa	.	.	.	.	8^{+}	.	20^{r}	.	.	.
Pseudoleskeella rupestris	.	.	.	.	25^{2-3}	.	.	.	.	.
Schistidium pulchrum	.	.	.	.	17^{r}	.	.	.	.	.
Sedum hybridum	.	.	.	.	17^{r}	.	.	.	.	.
Hypnum cupressiforme	.	.	.	.	8^{2}	.	.	.	.	.
Parmelia omphalodes	.	.	.	.	8^{+}	.	.	.	.	.
Cladonia coccifera	.	.	.	.	8^{+}	.	.	.	.	.
Evernia mesomorpha	.	.	.	.	8^{+}	.	.	.	.	.
Plagiochila porelloides	.	.	.	.	.	40^{r-3}	.	.	.	.
Dicranella heteromalla	.	.	.	.	.	20^{1}	.	.	.	.
Polytrichum juniperinum	.	.	.	.	.	20^{r}	.	.	.	.
Rhodobryum roseum	.	.	.	.	.	20^{r}	.	.	.	.
Saelania glaucescens	.	.	.	.	.	20^{r}	.	.	.	.
Oxyrrhynchium hians	.	.	.	.	.	40^{2-3}	.		.	.
Pohlia nutans	.	.	.	.	.	.	20^{+}	.	40^{2}	.
Dicranum bonjeanii	.	.	.	.	.	.	20^{1}	.	20^{r}	.
Haplocladium microphyllum	.	.	.	.	.	.	.	20^{+}	.	.
Tetraphis pellucida	.	.	.	.	.	.	.	.	.	20^{r}
Oxalis acetosella	.	.	.	.	.	.	.	.	.	20^{r}

As in other regions of the Republic of Bashkortostan, the bryophyte vegetation in the study area is characterized by a poor floristic composition and representation of diagnostic species of high syntaxa. The list of bryophyte communities in the study area is not yet complete, and further research is needed in this area.

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