

LIVERWORTS OF THE GEOLOGICAL RESERVE “SKALY KAMENKY” (KOMI REPUBLIC)
ПЕЧЕНОЧНИКИ ГЕОЛОГИЧЕСКОГО ЗАКАЗНИКА “СКАЛЫ КАМЕНКИ”
(РЕСПУБЛИКА КОМИ)

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Abstract

An annotated list of liverworts of the geological reserve “Skaly Kamenky” includes 61 species and one subspecies. This territory was not explored for liverwort flora before. Information on habitat, substrates, reproductive system and associated species is provided. Five new sites of rare species red-listed in the Komi Republic (*Arnellia fennica*, *Heterogemma laxa*, *Lophziopsis pellucida*, *Oleolophozia perssonii*, *Schistochilopsis hyperarctica*) is presented. Some taxa (*Jungermannia polaris*, *Moerckia flotoviana* u *Cephaloziella elegans*, *Cephaloziella arctogena*) was recently found in the flora of the Komi Republic, so their distribution and ecology are still little known.

Резюме

Приводится аннотированный список печеночников геологического заказника “Скалы Каменки”, включающий 61 вид и 1 подвид. Флора печеночников заказника исследована впервые. В списке для каждого вида указаны местообитания, субстрат, наличие органов размножения и сопутствующие виды. Выявлены новые местонахождения пяти редких видов, включенных в Красную книгу Республики Коми: *Arnellia fennica*, *Heterogemma laxa*, *Lophziopsis pellucida*, *Oleolophozia perssonii*, *Schistochilopsis hyperarctica*. Некоторые таксоны (*Jungermannia polaris*, *Moerckia flotoviana* u *Cephaloziella elegans*, *Cephaloziella arctogena*) были недавно обнаружены во флоре Республики Коми, и их распространение в республике и особенности экологии до сих пор малоизвестны.

KEYWORDS: flora, liverworts, rare species, geological reserve, the Ydzhyd-Kamenka River, Komi Republic.

INTRODUCTION

Geological reserve “Skaly Kamenky” is located downstream the Ydzhyd-Kamenka River, a right tributary of the Kozhva River (the Pechora River basin) within the limits of Pechora administrative area in 40 km south-west from the town Pechora. The reserve includes 10 km zone along the Ydzhyd-Kamenka River from its mouth to the bridge (the road Izyayu - Berezovka). The width of the protected zone is 200 m on the both banks of the river. In the reserve, the Ydzhyd-Kamenka River forms canyon-like valley with rocky banks up to 30-40 m height.

Orographically, this region is a part of the Pechora ridge, which is situated in Kozhva area of the Pechora north-taiga province (Isachenko, 1964). Flat hilly moraine plains (50-100 m a.s.l.) with certain hills up to 250 m usually appear here.

From the regional geological point of view, the territory is located in south part of the Pechora-Kozhva swell. Paleozoic deposits form the Kamenskaya anticline structure in this place. The core of the fold is formed by lime-

stones of Famennian layer of the Upper Devon, and the legs by the deposits of the Low Carbon and Perm.

According to geobotanical zoning of Nonblack Soil Zone of European Russia (Aleksandrova & Jurkovskaja, 1989), the study area is located in the Izhma-Kozhva-Pechora district of the Vychegda-Pechora subprovince of the North European taiga province. Vegetation cover is dominated by pine forests (lichen, moss-lichen and moss types). Spruce forests (moss and grassy) are often located in river valleys. Larch is also a common in forests of the region. It often participates in shrublet and grass-moss communities dominated by spruce, pine, birch, formed on rocky screes. Birch and aspen forests (tall-herbaceous and herbaceous types) appear on slopes and in river floodplains. Large areas are covered by meadows (grass and tall herb variant). Mires, afforested by pine or birch, are also frequent here (oligotrophic mires with *Sphagnum fuscum*).

The “Skaly Kamenky” reserve is the one in the Komi Republic geological reserves created for protecting and preserving of unique landscapes of the Kozhva River

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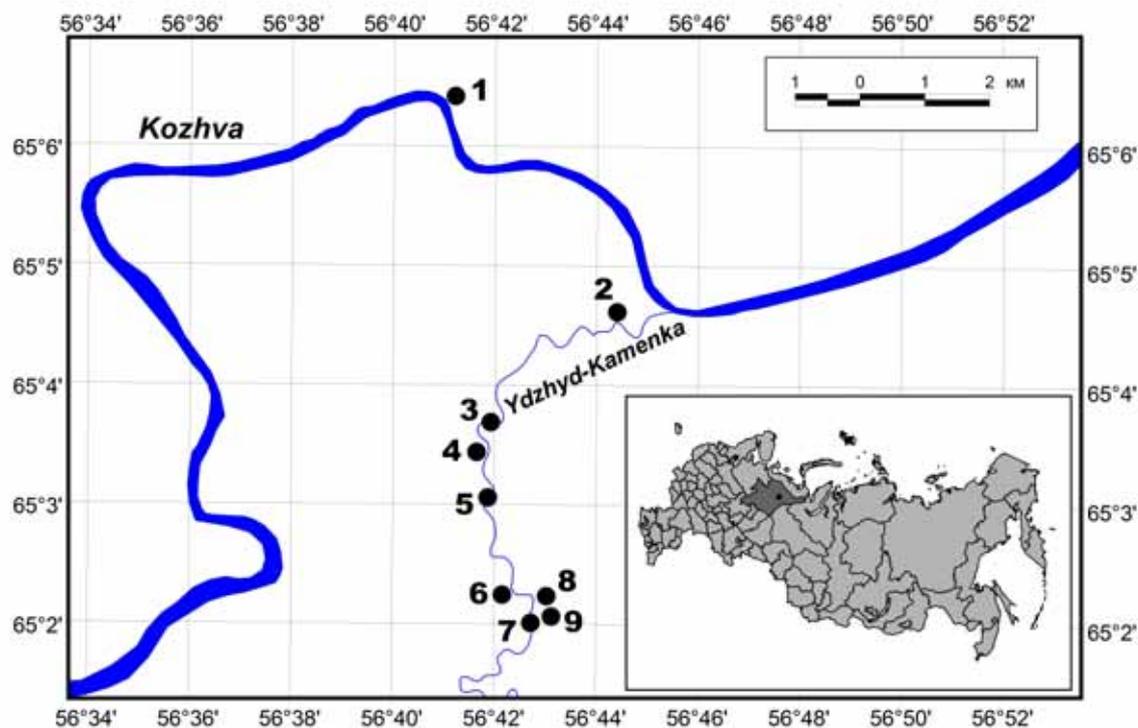


Fig. 1. Main collection sites in the vicinities of the geological reserve “Skaly Kamenky”.

- 1 - 4.5 km northwest of the mouth of Ydzhyd-Kamenka River, left bank of the Kozhva River opposite the beach «Chernye peski», outside the reserve (65°06'20.9"N; 56°41'10.4"E; ca. 45 m alt.) (here and below relevee numbers are provided: 997-999mvd);
- 2 - 0.7 km southwest of the Ydzhyd-Kamenka River mouth, left bank, rock outcrops «Chernyj kamenj» (65°04'35.2"N; 56°44'23.5"E; ca. 50 m alt.) (984-986mvd);
- 3 - 3.0 km southwest of the Ydzhyd-Kamenka River mouth: **3A** - right bank (65°03'45.1"N; 56°42'10.3"E; ca. 60 m alt.) (989-990mvd), **3B** - left bank (65°03'44.4"N; 56°41'57.1"E; ca. 50 m alt.) (991-992mvd), **3C** - left bank (65°03'44.1"N; 56°41'46.7"E; ca. 50 m alt.) (993-995mvd);
- 4 - 4.0 km southwest of the Ydzhyd-Kamenka River mouth, left bank, downstream from the stone quarry and hydrogen-sulphidous spring: **4A** - (65°03'29.6"N; 56°41'54.3"E; ca. 65 m alt.) (1002-1004mvd);
- 5 - 4.0 km southwest of the Ydzhyd-Kamenka River mouth, near stone quarry and hydrogen-sulphidous spring: **5A** - left bank (65°03'08.6"N; 56°41'41.4"E; ca. 60 m alt.) (1001 mvd, 1006-1009mvd), **5B** - right bank (65°03'08.2"N; 56°42'01.4"E; ca. 45 m alt.) (1005mvd);
- 6 - vicinities of the Novaja Berezovka Settlement, 5.0 km south-southwest of the Ydzhyd-Kamenka River mouth, left bank (65°02'18.6"N; 56°42'24.4"E; ca. 65 m alt.) (1011mvd);
- 7 - vicinities of the Novaja Berezovka Settlement, 5.0 km south-southwest of the Ydzhyd-Kamenka River mouth, near the bridge: **7A** - left bank (65°02'10.1"N; 56°42'41.7"E; ca. 75 m alt.) (1010mvd), **7B** - right bank (65°02'07.1"N; 56°42'44.9"E; ca. 70 m alt.) (1000 mvd, 1018-1020mvd);
- 8 - vicinities of the Novaja Berezovka Settlement, 5.0 km south-southwest of the Ydzhyd-Kamenka River mouth, right bank: **8A** - outside the settlement (65°02'19.2"N; 56°42'44.7"E; ca. 85 m alt.) (983mvd, 1012-1017mvd), **8B** - in the settlement near the boiler-house, outside the reserve (65°02'15.0"N; 56°43'04.6"E; ca. 100 m alt.) (987-988mvd);
- 9 - vicinities of the Novaja Berezovka Settlement, 5.0 km south-southwest of the Ydzhyd-Kamenka River mouth, right bank, outside the reserve (65°02'18.8"N; 56°43'18.3"E; ca. 90 m alt.) (996 mvd).

basin, which include rock outcrops of the Upper Devon and Carbon age rich in organic residues with bitumen and oil signs and sulfur springs (Taskaev & Timonin, 1993).

MATERIAL AND METHODS

Our field work in the vicinities of the geological reserve “Skaly Kamenky” was conducted in 2012. Liverwort collections were made in 38 localities, they include

338 samples. All collections are deposited in the herbarium of the Institute of Biology, Syktyvkar (SYKO).

Species in the list are annotated by the presence of structures associated with reproduction (gem. - gemmae; per. - perianthia or pseudoperianthia; andr. - androecia; gyn. - gynoecia; spor. - sporophytes; fem. re. - female receptacle; m. re. - male receptacle), collection points (numbers follow Fig. 1), habitat, substrate, and accom-

panying species. Taxa included in the Red Data Book of the Komi Republic (2009) are marked by ^R. The nomenclature of liverworts follows Konstantinova, Bakalin et al. (2009).

SPECIES LIST

- Aneura pinguis* (L.) Dumort. (andr., per., spor.) – 7B, 8A, 8B: on slightly matted loamy soil and concrete slabs in the settlement near the boiler-house; on slightly matted loamy soil of vertical surface of ground wall bordering with road ditch at base of steep slope afforested by schrublet-grass-moss birch-spruce forest; on vertical surface of ground wall of stream channel in the schrublet-moss mixed pine-birch-spruce forest. In pure patches.
- ^R *Arnellia fennica* (Gottsche) Lindb. – 3A: on ledges and cavities in the middle part of rock outcrops afforested by grass-moss spruce-birch community (NWW-faced slope). In pure patches and with *Leiocolea badensis* and *Lophoziaopsis pelucida*.
- Athalamia hyalina* (Sommerf.) S.Hatt. (andr.) – 7A, 8A: on ledges and cavities of rock outcrops (E-faced slope); on ledges of rock outcrops in ravine birch-spruce grass-moss community. In pure patches.
- Barbilophozia barbata* (Schmidel ex Schreb.) Loeske (gem., per.) – 3B, 5A, 7B: on decaying wood and on butts of trees (*Betula* L.) in the inundated schrublet-moss spruce forest; on decaying wood in grassy aspen forest; on decaying wood in the upper part of steep river slope afforested by grassy birch forest (W-faced slope). In pure patches and with *Barbilophozia hatcheri*, *Lophocolea minor*, *Lophoziaopsis longidens*.
- B. hatcheri* (A.Evans) Loeske (gem., andr., per.) – 3B, 5A, 7B, 8A: on decaying wood in an inundated schrublet-moss spruce forest, in schrublet-*Polytrichum-Sphagnum* mixed birch-spruce forest, in grassy aspen forest, in ravine grass-moss birch-spruce forest; on slightly matted loamy and sandy-loamy soil along roadside of dirt forest roads. In pure patches and with *Barbilophozia barbata*, *Isopaches bicrenatus*, *Lophoziaopsis excisa*, *Ptilidium ciliare*, *P. pulcherrimum*, *Schljakovia kunzeana*.
- Blasia pusilla* L. (gem.) – 1, 3B, 4: on slightly matted loamy soil at slope ledge between inundated schrublet-moss spruce forest and pebbly bar; on slightly matted soil of roadside wall of the forest road in schrublet-lichen-moss pine forest; on slightly matted loamy soil of vertical surface of ground wall between inundated meadow and pebbly bar along the river bank. In pure patches and with *Cephalozia pleniceps*, *Nardia geoscyphus*, *Plectocolea hyalina*, *Scapania curta*.
- Calyptopogon integrastipula* Steph. (gem.) – 3B, 4, 8A: on slightly matted loamy soil at slope ledge between inundated schrublet-moss spruce forest and pebbly bar; on decaying wood and on stones on rock scree (SEE-faced slope) afforested by spruce-birch-larch schrublet-moss community; on decaying wood in inundated schrublet-moss spruce forest; on vertical surface of ground wall of stream channel in the schrublet-moss mixed pine-birch-spruce forest. In pure patches and with *Cephalozia bicuspidata*, *C. lunulifolia*, *C. pleniceps*, *Lepidozia reptans*, *Lophozia ventricosa*, *Nardia geoscyphus* and other.
- C. muelleriana* (Schiffn.) Müll.Frib. (gem.) – 3B, 8A: on slightly matted loamy soil at slope ledge between inundated schrublet-moss spruce forest and pebbly bar; on decaying wood in the inundated schrublet-moss spruce forest; on decaying wood in schrublet-*Polytrichum-Sphagnum* mixed birch-spruce forest; on vertical surface of ground wall of stream channel in the schrublet-moss mixed pine-birch-spruce forest. With *Cephalozia bicuspidata* and *Lepidozia reptans*.
- C. neesiana* (C.Massal. & Carestia) Müll.Frib. (gem.) – 9: on decaying wood on mesooligotrophic schrublet-*Eriophorum-Sphagnum* mire afforested by low pine. In pure patches.
- C. sphagnicola* (Arnell & J.Perss.) Warnst. & Loeske (gem.) – 9: on *Sphagnum* hummocks and in *Sphagnum* hollows on mesooligotrophic schrublet-*Eriophorum-Sphagnum* mire afforested by low pine. In pure patches and with *Cephalozia loitlesbergeri*, *Cephalozia rubella*, *Gymnocolea inflata*, *Heterogemma laxa*, *Lophozia ventricosa*, *Mylia anomala*.
- Cephalozia bicuspidata* (L.) Dumort. (per., spor.) – 3B, 3C, 5A, 8A: on decaying wood in an inundated schrublet-moss spruce forest; on decaying pine wood on rock scree at base of cliff (SE-faced slope); on decaying wood in closed grass birch coppice; on slightly matted loamy soil of ruts of forest road in the schrublet-*Polytrichum-Sphagnum* mixed birch-spruce forest; on vertical surface of ground wall of stream channel in the schrublet-moss mixed pine-birch-spruce forest. In pure patches and with *Calyptopogon integrastipula*, *C. muelleriana*, *Lepidozia reptans*, *Lophozia silvicola*, *L. ventricosa*, *Nardia geoscyphus*, *Ptilidium pulcherrimum*, *Scapania curta*, *Tritomaria exsectiformis*.
- C. leucantha* Spruce – 8A: on vertical surface of ground wall of stream channel in the schrublet-moss mixed pine-birch-spruce forest. With *Cephalozia bicuspidata*, *Lophozia ventricosa*.
- C. loitlesbergeri* Schiffn. (per.) – 9: on *Sphagnum* hummocks and in *Sphagnum* hollows on mesooligotrophic schrublet-*Eriophorum-Sphagnum* mire with pine. In pure patches and with *Calyptopogon sphagnicola*, *Cephalozia spinigera*, *Mylia anomala*.
- Cephalozia lunulifolia* (Dumort.) Dumort. (per., spor.) – 3B, 4, 5A, 8A, 9: on decaying wood and on butts of trees (*Picea*) in the inundated schrublet-moss spruce forest, in grassy aspen forest, in inundated schrublet-moss spruce forest, in schrublet-*Polytrichum-Sphagnum* mixed birch-spruce forest, in ravine grass-moss birch-spruce forest; on decaying wood on mesooligotrophic schrublet-*Eriophorum-Sphagnum* mire afforested by low pine; on peaty soil in *Carex-Sphagnum*-moss mire afforested by low pine and birch; on vertical surface of ground wall of stream channel in the schrublet-moss mixed pine-birch-spruce forest. In pure patches and with *Calyptopogon integrastipula*, *Crossocalyx hellerianus*, *Lepidozia reptans*, *Lophozia silvicola*, *L. ventricosa*, *Schljakovia kunzeana*, *Ptilidium pulcherrimum*.
- C. pleniceps* (Austin) Lindb. (andr., per., spor.) – 3B, 4, 5A, 9: on decaying wood in the inundated schrublet-moss spruce forest and on soil in closed grass birch coppice; on slightly matted loamy soil at slope ledge between inundated schrublet-moss spruce forest and pebbly bar; on *Sphagnum* hummocks on mesooligotrophic schrublet-*Eriophorum-Sphagnum* mire afforested by low pine; on stones on rock scree (SEE-faced slope) afforested by spruce-birch-larch schrublet-moss community. In pure patches and with *Blasia pusilla*, *Calyptopogon integrastipula*, *Leiocolea heterocolpos*, *Lophocolea heterophylla*, *Mylia anomala*.
- Cephalozia arctogena* (R.M.Schust.) Konstant. (andr., per., spor.) – 3C: on decaying pine wood on rock scree at base of cliff (SE-faced slope). With *Lophoziaopsis excisa*, *Ptilidium pulcherrimum*, *Tritomaria exsectiformis*.
- C. elegans* (Heeg) Schiffn. (gem., per.) – 8A: on decaying wood

- in schrublet-*Polytrichum-Sphagnum* mixed birch-spruce forest. In pure patches.
- C. rubella* (Nees) Warnst. (gem., andr., per., spor.) – 4, 5B, 8A, 9: on decaying wood in schrublet-*Polytrichum-Sphagnum* mixed birch-spruce and in ravine birch-spruce grass-moss forests; on decaying wood and on stones in basal part of rock scree often afforested by spruce and birch (SEE- and W-faced slopes); on *Sphagnum* hummocks and in *Sphagnum* hollows on mesooligotrophic schrublet-*Eriophorum-Sphagnum* mire afforested by low pine; on slightly matted sandy-loam soil of high roadside slope along forest road in the schrublet-moss mixed birch-spruce-pine forest. In pure patches and with *Calypogeia sphagnicola*, *Isopaches bicrenatus*, *Lophozia ventricosa*, *Lophozopsis excisa*.
- C. spinigera* (Lindb.) Warnst. (andr., per., spor.) – 9: in *Sphagnum* hollows on mesooligotrophic schrublet-*Eriophorum-Sphagnum* mire afforested by low pine. With *Calypogeia sphagnicola*, *Cephalozia loitlesbergeri*, *Cladopodiella fluitans*, *Gymnocolea inflata*, *Mylia anomala*.
- Chiloscyphus pallescens* (Ehrh. ex Hoffm.) Dumort. – 2, 3C, 4, 7B: on stones shaded by bushes in basal part of rocky scree (S-faced slope); on wet humus soil in inundated tall herb-moss spruce forest; on slightly matted loamy soil of vertical surface of ground wall bordering with road ditch at base of steep slope afforested by schrublet-grass-moss birch-spruce forest; on slightly matted loamy soil of vertical surface of ground wall between inundated meadow and pebbly bar along the river bank. In pure patches and with *Lophocolea minor*.
- Cladopodiella fluitans* (Nees) H.Buch (per.) – 9: in *Sphagnum* hollows on mesooligotrophic schrublet-*Eriophorum-Sphagnum* mire afforested by low pine. In pure patches and with *Cephalozia spinigera*.
- Conocephalum conicum* (L.) Dumort. – 3C: on wet humus soil in inundated large-herb-moss spruce forest. In pure patches.
- Crossocalyx hellerianus* (Nees ex Lindenb.) Meyl. (gem., per., spor.) – 3B, 3C, 8A: on decaying wood in the inundated schrublet-moss spruce, in ravine grass-moss birch-spruce forests; on decaying pine wood on rock scree at base of cliff (SE-faced slope). In pure patches and with *Cephalozia lunulifolia*, *Lophozia silvicola*, *Lophozopsis excisa*, *Ptilidium pulcherrimum*, *Tritomaria exsectiformis*.
- Gymnocolea inflata* (Huds.) Dumort. (per., spor.) – 8A, 9: in *Sphagnum* hollows on mesooligotrophic schrublet-*Eriophorum-Sphagnum* mire afforested by low pine; on slightly matted loamy soil of ruts of forest road in the schrublet-*Polytrichum-Sphagnum* mixed birch-spruce forest; in hollows in schrublet-*Polytrichum-Sphagnum* mixed birch-spruce forest. In pure patches and with *Lophozia silvicola*, *L. ventricosa*, *Scapania curta*, *S. irrigua*.
- ^R *Heterogemma laxa* (Jürg.) Konstant. & Vilnet – 9: in *Sphagnum* hollows on mesooligotrophic schrublet-*Eriophorum-Sphagnum* mire afforested by low pine. With *Calypogeia sphagnicola*.
- Isopaches bicrenatus* (Schmidel ex Hoffm.) H.Buch (gem., per., spor.) – 1, 3B, 8A: on slightly matted loamy soil at slope ledge between inundated schrublet-moss spruce forest and pebbly bar; on slightly matted soil along roadside of the dirt forest roads. In pure patches and with *Cephalozia rubella*, *Barbilophozia hatcheri*, *Lophozopsis excisa*, *Nardia geoscyphus*, *Plectocolea hyalina*, *Scapania curta*.
- Jungermannia polaris* Lindb. (per.) – 6: on fine grained soil of ledges and cavities of rocky outcrops bending in the site of water drain (NE-faced slope). In pure patches and with *Leiocolea badensis*, *Scapania gymnostomophila*.
- Leiocolea badensis* (Gottsche) Jürg. (andr., per., spor.) – 1, 3A, 5B, 6, 7A, 7B, 8A: on ledges and cavities in basal and middle part of rocky outcrops often afforested by spruce and birch preferably in the site of groundwater outputs (SW-, SWW-, NWW-, NE- and E-faced slopes); on slightly matted loamy soil of vertical surface of ground wall bordering with road ditch at base of steep slope afforested by schrublet-grass-moss birch-spruce forest; on stones in basal part of rock scree (in the site of groundwater outputs) afforested by low spruce or with dryas-lichen-moss cover (W-faced slope). In pure patches or with *Arnellia fennica*, *Jungermannia polaris*, *Preissia quadrata*, *Schistochilopsis hyperarctica*.
- L. gillmanii* (Austin) A.Evans (per.) – 6: on fine grained soil of ledges and cavities of rocky outcrops bending in the site of water drain (NE-faced slope). In pure patches.
- L. heterocolpos* (Thed. ex C.Hartm.) H.Buch (gem., per.) – 4, 5B, 7B, 8A: on ledges and cavities in basal part of rocky outcrops afforested by spruce and birch (SWW-faced slope); on decaying wood and on stones in basal part of rock scree (in the site of groundwater outputs) afforested by low spruce, birch, larch (SEE- and W-faced slopes); on slightly matted loamy soil of vertical surface of ground wall bordering with road ditch at base of steep slope afforested by schrublet-grass-moss birch-spruce forest. In pure patches and with *Calypogeia integristipula*, *Cephalozia pleniceps*, *Lophozopsis excisa*, *Ptilidium ciliare*.
- Lepidozia reptans* (L.) Dumort. (per., spor.) – 3B, 3C, 4, 8A: on decaying wood in the inundated schrublet-moss spruce, in schrublet-*Polytrichum-Sphagnum* mixed birch-spruce, in ravine grass-moss birch-spruce forests; on decaying pine wood on rock scree at base of cliff (SE-faced slope). In pure patches and with *Calypogeia integristipula*, *C. muelleriana*, *Cephalozia lunulifolia*, *Lophozia silvicola*, *L. ventricosa*.
- Lophocolea heterophylla* (Schrud.) Dumort. (per.) – 5A: on decaying wood and on soil in closed coppice grass birch forest. With *Cephalozia pleniceps*, *Lophozia silvicola*, *Lophozopsis excisa*, *Schljakovia kunzeana*.
- L. minor* Nees (gem.) – 2, 3B, 6, 7B: on fine grained soil of ledges and cavities and on stones of rocky outcrops and in basal part of rocky scree (NE and S-faced slopes); on decaying wood in the inundated schrublet-moss spruce and grass birch forests; on slightly matted loamy soil of vertical surface of ground wall bordering with road ditch at base of steep slope afforested by schrublet-grass-moss birch-spruce forest. In pure patches and with *Barbilophozia barbata*, *Chiloscyphus pallescens*, *Ptilidium pulcherrimum*.
- Lophozia silvicola* H.Buch (gem., andr., per., spor.) – 3B, 5A, 8A: on decaying wood, on soil in hollows and on butts of trees (*Picea*) in the inundated schrublet-moss spruce, in ravine grass-moss birch-spruce, in schrublet-*Polytrichum-Sphagnum* mixed birch-spruce, in closed coppice grass birch forests; on peaty soil in *Carex-Sphagnum*-moss mire afforested by low pine and birch. With *Cephalozia bicuspidata*, *C. lunulifolia*, *Crossocalyx hellerianus*, *Gymnocolea inflata*, *Lepidozia reptans*, *Lophocolea heterophylla*, *Ptilidium pulcherrimum*, *Schljakovia kunzeana*, *Tritomaria exsectiformis*.
- L. ventricosa* (Dicks.) Dumort. (gem., andr., per., spor.) – 3B, 4, 8A, 9: on decaying wood and on butts of trees (*Picea*, *Larix* Hill) in schrublet-*Polytrichum-Sphagnum* mixed birch-spruce, in inundated schrublet-moss spruce forests; on verti-

- cal surface of ground wall of stream channel in the shrublet-moss mixed pine-birch-spruce forest; on decaying wood, on *Sphagnum* hummocks and hollows on mesooligotrophic shrublet-*Eriophorum-Sphagnum* mire afforested by low pine; slightly matted loamy soil of ruts of forest road in the shrublet-*Polytrichum-Sphagnum* mixed birch-spruce forest. In pure patches and with *Calypogeia sphagnicola*, *Cephalozia bicuspidata*, *C. lunulifolia*, *Cephaloziella rubella*, *Gymnocolea inflata*, *Lepidozia reptans*, *Ptilidium pulcherrimum*, *Tritomaria exsectiformis*.
- L. wenzelii* (Nees) Steph. (gem.) – 9: in *Sphagnum* hollows on mesooligotrophic shrublet-*Eriophorum-Sphagnum* mire afforested by low pine. With *Calypogeia sphagnicola*, *Cephaloziella spinigera*, *Gymnocolea inflata*.
- Lophozia excisa* (Dicks.) Konstant. & Vilnet (gem., andr., per., spor.) – 2, 3C, 4, 5A, 8A: on decaying wood and among bryophytes on stones on rock screes often afforested by spruce-birch-larch shrublet-moss communities (SE and SEE-faced slopes); on decaying wood in closed coppice grass birch and in shrublet-*Polytrichum-Sphagnum* mixed birch-spruce forests; on slightly matted sandy-loam soil of high roadside slope along forest road in the shrublet-moss mixed birch-spruce-pine forest. In pure patches and with *Barbilophozia hatcheri*, *Cephaloziella rubella*, *Crossocalyx hellerianus*, *Isopaches bicrenatus*, *Lophocolea heterophylla*, *Ptilidium pulcherrimum*, *Tritomaria exsectiformis*.
- L. longidens* (Lindb.) Konstant. & Vilnet (gem., andr., per., spor.) – 3B, 4, 5A, 8A: on decaying wood and on butts of trees (*Picea*) in the inundated shrublet-moss spruce, in grass aspen, in shrublet-*Polytrichum-Sphagnum* mixed birch-spruce, in ravine grass-moss birch-spruce forests. In pure patches and with *Barbilophozia hatcheri*, *Ptilidium pulcherrimum*.
- ^R *L. pellucida* (R.M.Schust.) Konstant. & Vilnet (gem.) – 3A: on ledges and cavities in the middle part of rocky outcrops afforested by grass-moss spruce-birch community (NWW-faced slope). In pure patches and with *Arnellia fennica*, *Scapania gymnostomophila*.
- Mannia pilosa* (Hornem.) Frye & L.Clark (fem. re.) – 3C, 8A: on ledges and cavities in basal part of rocky outcrops afforested by spruce and birch (SWW-faced slope); on fine grained soil in the rock niche at base of cliff (SE-faced slope); on ledges of rocky outcrops in birch-spruce grass-moss ravine. In pure patches.
- Marchantia polymorpha* L. subsp. *montivagans* Bischl. & Boissel.-Dub. – 4: on stones in pebbly bar with *Nardosmia* sp.; on slightly matted loamy soil of vertical surface of ground wall between inundated meadow and pebbly bar along the river bank. In pure patches.
- M. polymorpha* L. subsp. *ruderalis* Bischl. & Boissel.-Dub. (gem., fem. re., m. re.) – 1, 2, 3A, 3C, 4, 5A, 5B, 7B, 8B: on wet soil on stones in pebbly bar along bank of river often in the site of groundwater outputs; on fine grained soil, on stones, on ledges and cavities in basal part of rocky outcrops and screes often in the site of groundwater outputs (S-, W- and NWW-faced slopes); on wet humus soil in inundated large-herb-moss spruce willow and large-herb willow forests; on slightly matted loamy soil and concrete slabs in the settlement near the boiler-house; on soil along shore of lake with hydrogen-sulphidous water. In pure patches.
- Moerckia flotoviana* (Nees) Schiffn. (andr., gyn.) – 7B: on slightly matted loamy soil of vertical surface of ground wall bordering with road ditch at base of steep slope afforested by shrublet-grass-moss birch-spruce forest. In pure patches.
- Mylia anomala* (Hook.) Gray (gem.) – 9: on *Sphagnum* hummocks and in *Sphagnum* hollows on mesooligotrophic shrublet-*Eriophorum-Sphagnum* mire afforested by low pine. In pure patches and with *Calypogeia sphagnicola*, *Cephalozia loitlesbergeri*, *C. pleniceps*, *Cephaloziella spinigera*.
- Nardia geoscyphus* (De Not.) Lindb. (andr., per., spor.) – 1, 3B, 8A: on slightly matted loamy soil at slope ledge between inundated shrublet-moss spruce forest and pebbly bar; on slightly matted soil of roadside wall of the forest road in shrublet-lichen-moss pine forest; on slightly matted loamy soil of ruts of forest road in the shrublet-*Polytrichum-Sphagnum* mixed birch-spruce forest. In pure patches and with *Blasia pusilla*, *Cephalozia bicuspidata*, *Plectocolea hyalina*, *Scapania curta*.
- ^R *Oleolophozia perssonii* (H.Buch & S.W.Arnell) L.Söderstr., De Roo & Hedd. (gem.) – 3A: on ledges and cavities in basal impounded part of rocky outcrops (NWW-faced slope). In pure patches.
- Orthocaulis atlanticus* (Kaal.) H.Buch (gem.) – 9: in *Sphagnum* hollows on mesooligotrophic shrublet-*Eriophorum-Sphagnum* mire afforested by low pine. In pure patches.
- Pellia endiviifolia* (Dicks.) Dumort. (andr., per.) – 4, 5A, 8B: on wet soil at grass-moss hollow with low *Salix* sp.; on slightly matted loamy soil of vertical surface of ground wall between inundated meadow and pebbly bar along the river bank; on stony soil of forest road to the river. In pure patches.
- P. neesiana* (Gottsche) Limpr. (per.) – 7B: on humus soil in the inundated large-herb willow forest; on humus soil on inundated large-herb meadow. In pure patches.
- Plagiochila porelloides* (Torr. ex Nees) Lindenb. – 3C: on wet humus soil in inundated large-herb-moss spruce forest. In pure patches.
- Plectocolea hyalina* (Lyell) Mitt. (andr., per., spor.) – 3B, 8B: on wet soil at grass-moss hollow with low *Salix* sp.; on slightly matted loamy soil at slope ledge between inundated shrublet-moss spruce forest and pebbly bar. In pure patches and with *Blasia pusilla*, *Isopaches bicrenatus*, *Nardia geoscyphus*.
- Preissia quadrata* (Scop.) Nees (fem. re., m. re.) – 2, 3A, 5A, 6, 7B, 8A: on fine grained soil on ledges and cavities in basal part of rocky outcrops and screes often in afforested by spruce and birch (in the site of groundwater outputs) (S-, SWW-, NWW- and NE-faced slopes); on slightly matted loamy soil of vertical surface of ground wall bordering with road ditch at base of steep slope afforested by shrublet-grass-moss birch-spruce forest; on stony soil of forest road to the river. In pure patches and with *Leiocolea badensis*, *Schistochilopsis hyperarctica*.
- Ptilidium ciliare* (L.) Hampe – 4, 5B, 8A: on decaying wood and on stones on rock scree (SEE-faced slope) afforested by spruce-birch-larch shrublet-moss community; on decaying wood and on stones in basal part of rock scree (in the site of groundwater outputs) afforested by low spruce with dryas-lichen-moss cover (W-faced slope); on decaying wood in shrublet-*Polytrichum-Sphagnum* mixed birch-spruce forest. In pure patches and with *Barbilophozia hatcheri*, *Leiocolea heterocolpos*, *Lophozia excisa*, *Schljakovia kunzeana*.
- P. pulcherrimum* (Weber) Vain. (per., spor.) – 3B, 3C, 4, 5A, 5B, 7B, 8A: on decaying wood and on butts of trees (*Betula*, *Picea*, *Larix*) in the inundated shrublet-moss spruce in shrublet-*Polytrichum-Sphagnum* mixed birch-spruce, in grass-moss birch-spruce, in grass birch, in grass aspen for-

- ests; on decaying pine wood on rock scree afforested by spruce-birch-larch shrublet-moss communities often in the sites of groundwater outputs (SE-, SEE- and W-faced slopes). In pure patches and with *Barbilophozia hatcheri*, *Cephalozia lunulifolia*, *Crossocalyx hellerianus*, *Lophocolea minor*, *Lophozia silvicola*, *L. ventricosa*, *Lophozia longidens*, *Tritomaria exsectiformis*.
- Scapania curta* (Mart.) Dumort. (gem., andr.) – 1, 8A: on slightly matted soil of roadside wall of the forest road in shrublet-lichen-moss pine forest; on slightly matted loamy soil of ruts of forest road in the shrublet-*Polytrichum-Sphagnum* mixed birch-spruce forest. In pure patches and with *Blasia pusilla*, *Cephalozia bicuspidata*, *Gymnocolea inflata*, *Isopachys bicrenatus*, *Nardia geoscyphus*.
- S. gymnostomophila* Kaal. (gem.) – 3A, 5B, 6, 7A, 7B, 8A: on ledges and cavities some times on decaying wood in basal and middle part of rocky outcrops afforested by spruce and birch often in the site of groundwater outputs (SWW-, NWW-, W, E and NE-faced slopes); on slightly matted loamy soil of vertical surface of ground wall bordering with road ditch at base of steep slope afforested by shrublet-grass-moss birch-spruce forest. In pure patches and with *Jungermannia polaris*, *Leiocolea badensis*, *Lophoziaopsis pellucida*.
- S. irrigua* (Nees) Nees (gem., andr., per.) – 5A, 8A, 8B: on wet soil at grass-moss hollow with low *Salix* sp.; on soil in closed coppice grass birch forest; on slightly matted loamy soil of ruts of forest road in the shrublet-*Polytrichum-Sphagnum* mixed birch-spruce forest. In pure patches and with *Gymnocolea inflata*.
- S. paludicola* Loeske & Müll.Frib. – 5A: on peaty soil in *Carex-Sphagnum*-moss mire afforested by low pine and birch. In pure patches.
- ^R *Schistochilopsis hyperarctica* (R.M.Schust.) Konstant. (gem.) – 6: on fine grained soil of ledges and cavities of rocky outcrops bending in the site of water drain (NE-faced slope). In pure patches and with *Leiocolea badensis*, *Preissia quadrata*.
- Schljakovia kunzeana* (Huebener) Konstant. & Vilnet – 5A, 8A: on peaty soil in *Carex-Sphagnum*-moss mire afforested by low pine and birch; on soil in closed coppice grass birch forest; on decaying wood in shrublet-*Polytrichum-Sphagnum* mixed birch-spruce forest. With *Barbilophozia hatcheri*, *Cephalozia lunulifolia*, *Lophocolea heterophylla*, *Lophozia silvicola*, *Lophoziaopsis excisa*, *Ptilidium ciliare*.
- Tritomaria exsectiformis* (Breidl.) Loeske (gem.) – 3B, 3C, 8A: on decaying wood in the inundated shrublet-moss spruce and in ravine grass-moss birch-spruce forests; on decaying pine wood on rock scree at base of cliff (SE-faced slope). In pure patches and with *Cephalozia bicuspidata*, *Lepidozia reptans*, *Lophozia silvicola*, *L. ventricosa*, *Lophoziaopsis excisa*, *Ptilidium pulcherrimum*.
- T. scitula* (Taylor) Jurg. (gem.) – 6: on fine grained soil of ledges and cavities of rocky outcrops bending in the site of water drain (NE-faced slope). In pure patches.

RESULTS AND DISCUSSION

The liverwort flora of the vicinities of the geological reserve “Skaly Kamenky” includes 61 species and one subspecies of liverworts belonging to 37 genera, 22 families, 7 orders, and 2 classes. The majority of species is relatively widespread in the region and throughout the North Holarctic Region (Dulin, 2007). Among others,

there are several species only recently discovered in the Komi Republic, *i.e.*, *Jungermannia polaris* and *Moerckia flotoviana*, found near the Vorkuta City (Dulin, 2013a), as well as *Cephaloziella elegans* and *Cephaloziella arcotoga* reported from the Ilych River basin (Dulin, 2013b). *Orthocaulis atlanticus* is relatively rarely rare in the region, it was previously found only in the Bolshezemelskaya Tundra near Yun-Yaga research station (Zheleznova, 1982). Five species are officially protected and included in the Red Data Book of the Komi Republic (Taskaev, 2009; Dulin, 2008): *Arnellia fennica*, *Heterogemma laxa*, *Lophoziaopsis pellucida*, *Oleolophozia perssonii*, and *Schistochilopsis hyperarctica*. Three former species and *Cephaloziella elegans* are red-listed in Europe (Schumacker & Matriny, 1995). One species, *Oleolophozia perssonii*, is included in the Red Data Book of the Russian Federation (Trutnev, 2008).

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