

## Rare liverworts in Komi Republic (Russia)

Michail Vladimirovich Dulin

Institute for Biology of Komi SC UB RAS, Kommunisticheskaya st. 28, Syktyvkar, 167982, Komi Republic, Russia

E-mail: dulin@ib.komisc.ru

**Abstract:** Data are presented on distribution and ecology of 10 rare liverwort species (*Anastrophyllum sphenoloboides*, *Arnellia fennica*, *Haplomitrium bookeri*, *Cephalozia macounii*, *Cephalozia elachista*, *Lophozia ascendens*, *Nardia japonica*, *Scapania scandica*, *Schistochilopsis laxa*, *Sphenolobus cavifolius*) included in the Red Data Book of the Komi Republic, and 8 species (*Dichiton integerrimum*, *Harpanthus scutatus*, *Kurzia pauciflora*, *Lophozia pellucida*, *Lophozia perssonii*, *Odontoschisma denudatum*, *Scapania nemorea*, *Schistochilopsis hyperarctica*) suggested for inclusion in the new edition of the Red Data Book of the Komi Republic.

**Kokkuvõte:** Haruldased helviksamblad Komi Vabariigis (Venemaa)

Esitatakse andmestik Komi Vabariigi Punasesse Raamatusse kuuluva kümne helviksambaliigi kohta (*Anastrophyllum sphenoloboides*, *Arnellia fennica*, *Haplomitrium bookeri*, *Cephalozia macounii*, *Cephalozia elachista*, *Lophozia ascendens*, *Nardia japonica*, *Scapania scandica*, *Schistochilopsis laxa*, *Sphenolobus cavifolius*) ning kaheksa helviksambaliigi kohta (*Dichiton integerrimum*, *Harpanthus scutatus*, *Kurzia pauciflora*, *Lophozia pellucida*, *Lophozia perssonii*, *Odontoschisma denudatum*, *Scapania nemorea*, *Schistochilopsis hyperarctica*), mida on kavas lisada Komi Vabariigi Punase Raamatu uude versiooni.

### INTRODUCTION

The Komi Republic is situated in the north-east of the European Russia between 59°12' and 68°25' N and 45°25' and 66°15' E. The longest stretch is (from south-west to north-east) ca 1300 km and the total area 416,000 km<sup>2</sup>. Topographically the area is situated within the Russian Plain and the Urals. Considerable diversity of environmental conditions is the consequence of great latitudinal distance and geographical heterogeneity. Extreme northern and north-eastern part of Komi lies in tundra and forest tundra, and the rest of the area belongs to the taiga zone.

There are widespread and rare species among liverworts, as in any group of plants, and rare species often need to be protected. Protection of liverworts (as other bryophytes) is characterized by several peculiar features. These plants are usually small and can be identified only with difficulties in the field. Thus, it is difficult to protect specific species separately. The complexity of protection of rare liverwort species causes the goal of protection of areas of their concentration, such as their ecotopes with the whole specific plant complex by creation (or preservation of the existing) network of protected natural areas of different statuses (nature reserves, national parks, refuges, natural artefacts). The first steps to achieve are field surveys and compilation of checklists or lists of rare species in the areas.

### MATERIALS AND METHODS

The Red Data Book of any subject of the Russian Federation is an official legal document compiled by public authorities. The Book grants them administrative and legal warrants, and thus increases possibilities for their conservation and recovery. Properly compiled plant and animal species checklists serve a legal basis for it. Legal treatment of protection of rare and endangered species, including compiling and maintaining the Red Data Book of any subject of the Russian Federation is determined by Federal Laws «On the Fauna» and «On the Nature Protection». The Red Data Book is regularly reviewed (every ten years) (Taskaev, 1998; Methodical Guidelines..., 2006).

It is necessary to highlight the following principal criteria for inclusion of species into the list of endangered species needing special protection: 1 – habitats scarcity; 2 – location on distribution area margins; 3 – presence of species in the Red Data Book of the International Union for Conservation of Nature (IUCN), in the Red Data Book of European Bryophytes, and in the Red Data Books of the former Soviet Union and Russia; 4 – endemic and relict nature of species. Rarity categories are classified according to IUCN criteria (Taskaev, 1998).

The species names follow Konstantinova et al. (1992) except for *Schistochilopsis*.

Species were attributed to geographic groups according to classification suggested by Konstantinova (2000).

## RESULTS AND DISCUSSION

Investigation of the distribution of liverwort species in Komi Republic by G.V. Zhelezнова and T.P. Shubina provided information to compile a list of 10 rare liverworts species to be included in the Komi Red Data Book (Taskaev, 1998). Investigations performed in 1999–2005 in Komi Republic gave information about new localities of the liverworts included in the Red Date Book. On the basis of all data the complete list of known localities is prepared. It includes the data on identified specimens, the ecological and geographical characteristics of sampling areas with coordinates, accompanying liverworts species, inventory or field number of the specimens, collection date and the name of collector (see Appendix). Reference to the basic sources of information of the species mentioned is provided.

### Liverworts in first edition of the Red Data Book of the Komi Republic

Ten liverworts are included in the Red Data Book of Komi Republic, three of them belong to the second category and seven to the third.

Category 2 – vulnerable species: taxa are likely to be attributed to the Endangered category in the near future provided that the effect of adverse factors continues. The following species fall in this category:

*CEPHALOZIA MACOUNII* (Austin) Austin (Zhelezнова, 1974; 1985; Dulin et al., 2003; Dulin, 2007). – Boreal circumpolar species. Three localities (Fig. 3).

*HAPLOMITRIUM HOOKERI* (Sm.) Nees (Zhelezнова, 1985). – Boreal disjunct species. One locality (Fig. 1).

*NARDIA JAPONICA* Steph. (Schljakov, 1980; Zhelezнова, 1985). – Arctic-montane Eurasian-Western American species. Two localities (Fig. 3).

Category 3 – rare species: taxa with small populations size that are at risk to become vulnerable or endangered. The following species fall in this category:

*ANASTROPHYLLUM SPHENOLOBOIDES* R.M. Schust. (Zhelezнова & Schljakov, 1976; Zhelezнова, 1985). – Arctic, almost circumpolar species. One locality (Fig. 2).

*ARNELLIA FENNICA* (Gottsche) Lindb. (Zickendrath, 1900; Pole, 1915; Zinovjeva, 1973; Kildjush-

evsky & Zhelezнова, 1974; Zhelezнова, 1978, 1982; 1985; Bezzgodov et al., 2003; Dulin, 2007). – Arctic-montane, almost circumpolar species. Eighteen localities (including literature data) (Fig. 1).

*CEPHALOZIELLA ELACHISTA* (J.B.Jack ex Gottsche et Rabenh.) Schiffn. (Zhelezнова, 1974; 1985). – Boreal Atlantic species. Two localities (Fig. 2).

*LOPHOZIA ASCENDENS* (Warnst.) R.M. Schust. (Zhelezнова, 1974; 1985; Dulin, 2001, 2007). – Boreal circumpolar species. Fourteen localities (Fig. 1).

*SCAPANIA SCANDICA* (Arnell et H. Buch) Macvicar (Zhelezнова, 1982; Bakalin et al., 2001; Dulin, 2007). – Arctic-montane, almost circumpolar species. Nine localities (Fig. 2).

*SCHISTOCHILOPSIS LAXA* (Lindb.) Konstantinova (Zhelezнова, 1985; Dulin, 2001, 2007). – Boreal Atlantic species. Five localities (Fig. 2).

*SPHENOLOBUS CAVIFOLIUS* (H. Buch et S.W. Arnell) Müll.Frib. (Zinovjeva, 1973; Zhelezнова & Shubina, 1997; 1998). – Arctic almost circumpolar species. Three localities (including literature data) (Fig. 1).

The recent investigations resulted in new localities for seven rare liverworts protected in Komi Republic: *Arnellia fennica*, *Cephalozia macounii*, *Cephaloziella elachista*, *Lophozia ascendens*, *Nardia japonica*, *Scapania scandica* and *Schistochilopsis laxa*. Eight protected species were found in 10 areas of various level of protection: flora refuges “Nomburgsky” (*Anastrophyllum sphenoloboides*, *Lophozia ascendens*), “Syktyvkarsky” (*Arnellia fennica*), “Mylsky” (*Nardia japonica*), “Soivinsky” (*Arnellia fennica*, *Lophozia ascendens*), complex refuges “Udorsky” (*Cephalozia macounii*, *Cephaloziella elachista*, *Lophozia ascendens*), “Belaya Kedva” (*Arnellia fennica*), complex refuges “Sindorsky” (*Cephalozia macounii*, *Cephaloziella elachista*, *Lophozia ascendens*, *Schistochilopsis laxa*, *Scapania scandica*), forest refuge “Porubsky” (*Lophozia ascendens*), “Pecho-ro-Ilychsky” conservation area (*Arnellia fennica*, *Cephalozia macounii*, *Lophozia ascendens*, *Scapania scandica*), and geological conservation area “Skala Lek-Iz” (*Arnellia fennica*). Preservation of liverworts’ habitats in the protected areas is efficient to fulfil the conservation goals for the rare liverworts, and effective to protect bryophytes as a whole.

### Liverworts proposed for inclusion in the second edition of the Red Data Book of the Komi Republic

Discovery of two rare calciphilous species (*Lophozia pellucida* and *Schistochilopsis hyperarctica*) was an important result of our investigation. These species need protection at the regional level and were recommended for inclusion in the new issue of "The Red Data Book of Komi Republic". *Lophozia pellucida* is a little-known Arctic liverwort which is considered rare in Europe (ECCB, 1995). Only few localities are known in Europe, in Sweden and Norway (Söderström, 1995), as well as in Nenetsky Autonomous Region (Konstantinova & Lavrinenko, 2002) and Murmansk Region (Konstantinova, 1990; 1996; 2001). *Schistochilopsis hyperarctica* is a poorly known Arctic calciphilous species with obscure distribution. It was found only in Pinezhsky conservation area in Europe (Vána & Ignatov, 1993).

Beside the species mentioned above, the new edition of the "Red Data Book of the Komi Republic" will include further six rare liverworts. Four of these are species at their easternmost and north-easternmost margin of their distribution range (*Harpanthus scutatus*, *Kurzia pauciflora*, *Odontoschisma denudatum*, *Scapania nemorea*), and two (*Dichiton integerrimum* and *Lophozia perssonii*) are confined to rare substrates (limestone and sandstone).

*Scapania scandica* will be excluded from the list since it is rather widely spread in the region.

The new species included in the second edition of the "Red Data Book of the Komi Republic" fall in the following threat categories.

#### Category 2 – vulnerable species:

*DICHITON INTEGERRIMUM* (Lindb.) H.Buch. (Zheleznova, 1985). – Montane European-Greenlandic species. One locality (Fig. 3).

#### Category 3 – rare species:

*HARPANTHUS SCUTATUS* (F.Weber et D.Mohr) Spruce (Dulin et al., 2003; Dulin, 2007). – Nemoral amphi-oceanic species. Three localities (Fig. 4).

*KURZIA PAUCIFLORA* (Dicks.) Grolle (Dulin, 2007). – Boreal, almost circumpolar species. One locality (Fig. 4).

*LOPHOZIA PELLUCIDA* R.M. Schust. (Dulin et al., 2003; Bezgodov et al., 2003; Dulin, 2007). – Arctic, almost circumpolar species. Five localities (Fig. 2).

*LOPHOZIA PERSSONII* H.Buch et S.W.Arnell (Zheleznova, 1985; Dulin et al., 2003; Dulin, 2007). – Arctic-montane European-Siberian species. Four localities (Fig. 4).

*ODONTOSCHISMA DENUDATUM* (Mart.) Dumort. (Dulin, 2007). – Nemoral amphi-oceanic species. Four localities (Fig. 4).

*SCAPANIA NEMOREA* (L.) Grolle (Bakalin et al., 2001; Dulin, 2007). – Nemoral amphi-oceanic species. Two localities (Fig. 1).

*SCHISTOCHILOPSIS HYPERARCTICA* (R.M. Schust.) Konstantinova (Dulin et al., 2003; Dulin, 2007). – Arctic species with uncertain distribution. Two localities (Fig. 3).

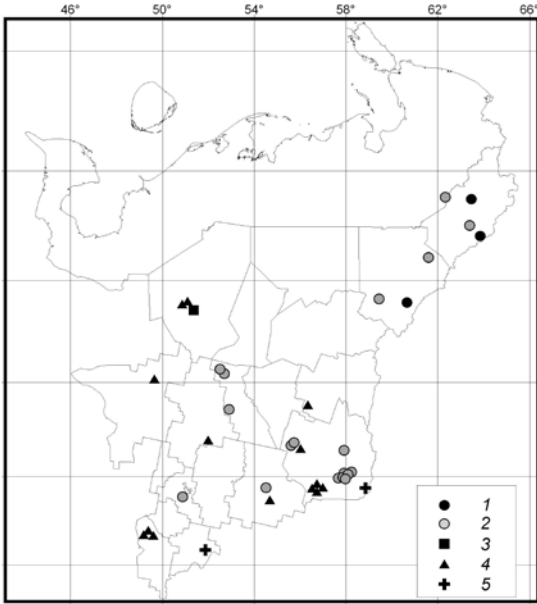
Like the liverworts in the first edition of the Red Data Book of the Komi Republic, species suggested for conservation grow in protected natural territories of various status which enhances the opportunities for their conservation and recovery. Thus, the liverworts suggested for the new edition are registered in the following protected areas: nature reservations "Sindorsky" (*Harpanthus scutatus*), "Soivinsky" (*Lophozia pellucida*, *Schistochilopsis hyperarctica*), "Boloto Don-ty" (*Kurzia pauciflora*), "Pechoro-Ilychsky" conservation area (*Odontoschisma denudatum*).

The new edition of the Red Data Book of the Komi Republic includes thus 17 liverwort species belonging to 14 genera from 9 families. Rare protected species make 10.4% of total liverwort flora of the Republic which nowadays numbers 164 species (Dulin, 2008). The majority of the protected species are characterized by a boreal and arctic distribution type (Table 1).

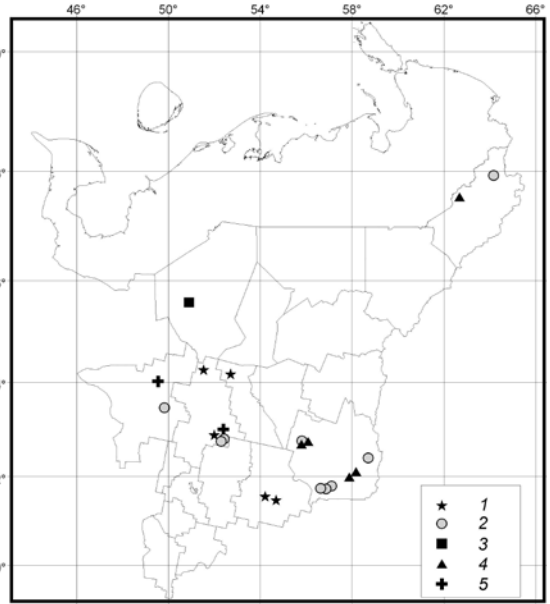
Analysis of distribution of rare liverworts in main types of habitat and substrates showed that forest communities include the majority of rare species, and most species grow on soil (Table 2).

### ACKNOWLEDGEMENTS

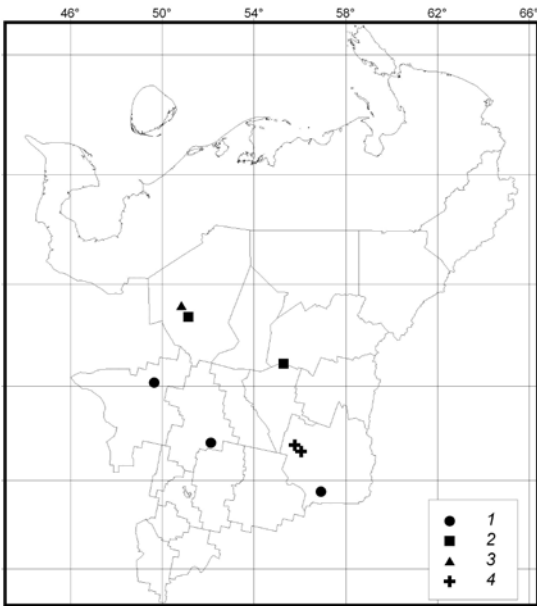
The author expresses sincere gratitude to S.V. Balina for assistance in translation of the article and V.M. Schanov for help in creating of the maps. The work is done with a financial support of Russian Fund of Fundamental Researches (projects 06-04-48002 and 06-04-48225).



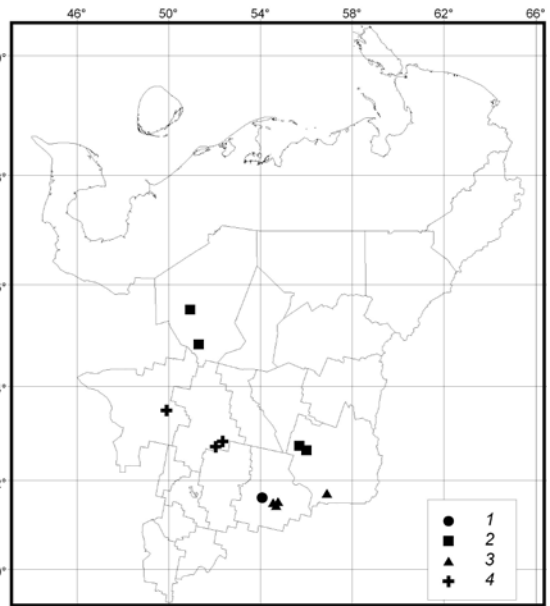
**Fig. 1.** Distribution of five rare liverworts in Komi Republic. 1 – *Sphenobolus cavifolius*, 2 – *Arnellia fennica*, 3 – *Haplomitrium hookeri*, 4 – *Lophozia ascendens*, 5 – *Scapania nemorea*.



**Fig. 2.** Distribution of five rare liverworts in Komi Republic. 1 – *Schistochilopsis laxa*, 2 – *Scapania scandica*, 3 – *Anastrophyllum sphenoloboides*, 4 – *Lophozia pellucida*, 5 – *Cephaloziella elachista*.



**Fig. 3.** Distribution of four rare liverworts in Komi Republic. 1 – *Cephalozia macounii*, 2 – *Nardia japonica*, 3 – *Dichiton integerrimum*, 4 – *Schistochilopsis hyperarctica*.



**Fig. 4.** Distribution of four rare liverworts in Komi Republic. 1 – *Kurzia pauciflora*, 2 – *Lophozia perssonii*, 3 – *Odontoschisma denudatum*, 4 – *Harpanthus scutatus*.

**Table 1.** Distribution of rare liverworts of Komi Republic according to biogeographic groups

Group	Montane	Arctic- montane	Nemoral	Arctic	Boreal	Total
Disjunct					1	1
European-Greenlandic	1					1
Eurasian-Western American		1				1
European-Siberian		1				1
Uncertain distribution				1		1
Atlantic					2	2
Circumpolar					2	2
Amphi-oceanic			3			3
Almost circumpolar		1		3	1	5
Total	1	3	3	4	6	17

**Table 2.** Distribution of rare liverworts according to main types of habitats and substrates. Abbreviations: A – anthropogenic; T – tundra; W – wetland; O - outcrops; B – bog; F – forest; TB – tree boles; R – rotten timber; S – stones; E – soil.

Species	Habitats						Substrates			
	A	T	W	O	B	F	TB	R	S	E
<i>Anastrophyllum sphenoloboides</i>					+					+
<i>Arnellia fennica</i>		+		+		+	+	+	+	+
<i>Cephalozia macounii</i>						+		+		
<i>Cephaloziella elachista</i>					+	+				+
<i>Dichiton integerrimum</i>				+					+	
<i>Haplomitrium bookeri</i>				+					+	
<i>Harpanthus scutatus</i>						+		+		
<i>Kurzia pauciflora</i>					+			+		
<i>Lophozia ascendens</i>						+	+	+	+	
<i>Lophozia pellucida</i>			+	+					+	+
<i>Lophozia perssonii</i>				+					+	+
<i>Nardia japonica</i>	+									+
<i>Odontoschisma denudatum</i>					+	+				+
<i>Scapania nemorea</i>			+		+					+
<i>Schistochilopsis hyperarctica</i>				+					+	
<i>Schistochilopsis laxa</i>					+	+		+		+
<i>Sphenolobus cavifolius</i>		+								+
Total	1	2	2	6	6	7	2	6	7	10

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## APPENDIX

Known localities for rare liverworts in Komi Republic.

Abbreviations: Dist. = District; N = north; S = south; E = east; W = west. The specimens missing in herbarium SYKO are marked with field numbers.

**Anastrophyllum sphenoloboides:** 1) Ust-Tsilemsky Dist., 3 km N from Nonburg village (65°35' N; 50°37' E); pines, bushes and sphagnum, among hummocks; *Cephalozia leucantha*; No. 14448; 09.VIII.1973, G.V. Zheleznova.

**Arnellia fennica:** 1) Vorkutinsky Dist., Harbeisiye Lakes, hydrobiologists' camp (67°32' N; 62°52' E); bush and moss tundra, on sides of hummocks; No. 3781; 17.VII.1969, I.D. Kildushevsky & G.V. Zheleznova. 2) Vorkutinsky Dist., "Gornyyak" sovhoz, Un-Yaga farm (66°26' N; 62°05' E); fir and birch forest, on a path; No. 3179; 10.VII.1968, N.S. Kotelina. 3) Intinsky Dist., Kozhim River, 15 km upstream from railway bridge (65°39' N; 59°47' E); wet rocks; *Leiocolea heterocolpos*, *Scapania gymnostomophila*, *Tritomaria quinquedentata*; No. 8085; 14.VIII.1971, I.D. Kildushevsky & G.V. Zheleznova. 4) Uhtinsky Dist., Belaya Kedva River, 123 km upstream from the river mouth (64°10' N; 52°34' E); limestone outcrop at the stream influx, spruces, bushes and grass; *Preissia quadrata*; No. 17304, 17296, 17295; 12.VII.1975, G.V. Zheleznova & L.S. Fedorova. 5) Uhtinsky Dist., 71 km upstream from Belaya Kedva river mouth, at Merkushyel stream influx (64°13' N; 52°30' E); above water in the cavity of limestone outcrop; No. 17297; 21.VII.1975, G.V. Zheleznova & L.S. Fedorova. 6) Troitsko-Pechersky Dist., Pechoro-Ilychsky nature reserve, left bank of Bolshaya Shaitanovka River, 3 km WNW from its influx into Pechora River (62°01' N; 58°07' E); slope to N; No. 26061; 06.VII.1994, A.A. Kustysheva. 7) Troitsko-Pechersky Dist., Chalna mountain (62°02' N; 58°09' E); limestone outcrop, at the base of scree, on large stones and at their basis; No. 36904, 36962; 09.VII.2000, A.G. Bezgodov & I.B. Kucherov. 8) Troitsko-Pechersky Dist., Pihovka River mouth (61°59' N; 58°06' E); limestone outcrop, on the wet shaded wall; No. 36880, 36873; 15.VII.2000, A.G. Bezgodov & I.B. Kucherov. 9) Troitsko-Pechersky Dist., left side of Pechora River valley downstream to Shezhym River mouth (62°06' N; 58°24' E); limestone outcrop, on humus at the bottom of walls and on terraces; No. 36889, 36899, 36872; 04.VII.2000, A.G. Bezgodov & I.B. Kucherov. 10) Troitsko-Pechersky Dist., left side of Pechora River valley at Bolshaya Shaitanovka River mouth (62°02' N; 58°12' E); limestone outcrop along billabong bank, large rock scree, on the sides of rocks covered with moss; No. 36940; 13.VII.2000, A.G. Bezgodov & I.B. Kucherov. 11) Troitsko-Pechersky Dist., right bank of Ilych River, 5.5 km E from Ispredyu River mouth, Lek-Iz Rock (62°34' N; 58°09' E); rock scree, between rocks; field number 322mvd; 02.VI.2003, M.V. Dulin. 12) Troitsko-Pechersky Dist., Grishestav village suburbs, right bank of Soiva River (62°40' N; 55°41' E); limestone outcrop of N exposition; *Leiocolea badensis*; No. 36049; 06.VII.2002, B.Y. Teterjuk. 13) Troitsko-Pechersky Dist., Nizhnyaya Omra town (62°44'–62°45' N; 55°46'–55°52' E), limestone outcrops in Soiva and Nizhnyaya Omra valleys, on humus at

the basis of rocks, on silt and among mosses on the rock sides; *Blepharostoma trichophyllum*, *Leiocolea collaris*, *L. heterocolpos*, *L. gillmanii*, *Scapania gymnostomophila* etc.; field numbers 252mvd, 258mvd, 262mvd, 269mvd etc.; collections of 2001, 2003, M.V. Dulin. 14) Ust-Kulomsky Dist., Jejim-Parma hill, bank of Bidz-Yel River (Vapol-Yu River affluent) (61°45' N; 54°30' E); limestone outcrop; No. 230; 06.IX.1940, B.P. Kolesnikov. 15) Syktvydinsky Dist., Syktvykar suburbs, 18 km of Syktvykar – Kirov Highway, Syktvykarsky refuge (61°33' N; 50°37' E); mixed sedge and grass forest, on rotten timber and near trunks; *Blepharostoma trichophyllum*, *Leiocolea heterocolpos*; No. 39494, 39493; 19.VIII.2004, G.V. Zheleznova.

**Cephalozia macounii:** 1) Udorsky Dist., 1 km E from Elva-Mezenskaya River mouth (64°04' N; 49°18' E); stream valley, grass-moss forest, on rotten timber; No. 14181; 25.VI.1972, I.D. Kildushevsky & G.V. Zheleznova. 2) Knjazhpogostsky Dist., Sindor town suburbs, Sindorskoye Lake, 3 km SE from Ugum River mouth, near bridge across right affluent, beside railway (62°41' N; 52°01' E); sphagnum pinery, on rotten timber; *Calypogeia muelleriana*, *Cephalozia lunulifolia*, *Mylia anomala*; No. 38436; 08.VIII.2000, M.V. Dulin. 3) Troitsko-Pechersky Dist., Yaksha town, right bank of Pechora River 2 km NW from Starikovaya River mouth to Perevalka, (61°45' N; 57°05' E); spruce forest near stream, on rotten log; *Cephalozia bicuspidata*, *C. lunulifolia*, *Lophozia silvicola*, *Ptilidium pulcherrimum*; No. 37894; 08.VIII.1999, M.V. Dulin.

**Cephalozia elachista:** 1) Udorsky Dist., 3.5 km along the road from Verhnemezensk town to Politovo village (64°01' N; 49°11' E); edge of sphagnum swamp; No. 15922; *Cephalozia loitlesbergeri*; 28.VI.1972, I.D. Kildushevsky & G.V. Zheleznova. 2) Knjazhpogostsky Dist., suburb of Sindor town, Sindorskoye Lake, 3 km SE from Ugum River mouth, near bridge across the right affluent, beside railway (62°41' N; 52°01' E); sphagnum pinery, on open soil; *Calypogeia muelleriana*, *Cephalozia lunulifolia*, *Gymnocolea inflata*, *Mylia anomala*; No. 38045, 38047, 38048; 08.VIII.2000, M.V. Dulin.

**Dichiton integerrimum:** 1) Ust-Tsilemsky Dist., suburbs of Nonburg village, right bank of the Nonburg river, 5 km upstream from River mouth (65°32' N; 50°34' E); limestone outcrops, on rocks; No. 14423; 10.VII.1973, G.V. Zheleznova.

**Haplomitrium hookeri:** 1) Ust-Tsilemsky Dist., right bank of Tsilma River (across Philippovo village) (65°26' N; 51°08' E); sand outcrop, on the bank among rocks; No. 15638; 26.VII.1973, G.V. Zheleznova.

**Harpanthus scutatus:** 1) Udorsky Dist., vicinity of Glotovo village, 1.5 km SW from Borovskaya (Borovo) village, (63°30' N; 49°34' E); terrace, birch-spruce forest, on rotten wood; field number No.16B, 8.VII.1972, I.D. Kildushevsky & G.V. Zheleznova. 2) Knjazhpogostsky Dist., vicinity of Sindor village, SE part of Sindor Lake; 2.5 km SE from the Ugum river mouth, right bank of the river (62°41' N; 52°01' E); mixed forest; on rotten log and stub; *Blepharostoma trichophyllum*, *Plagiochila porelloides*; field number 239mvd, 6.VIII.2000, Dulin M.V. 3) Knjazhpogostsky Dist., 3 km SE from the Ugum river mouth, right bank of the river (62°41' N; 52°01' E); birch-pine littoral forest, on the roots of an uprooted pine; field number 242mvd, 6.VIII.2000, M.V. Dulin.

**Kurzia pauciflora:** 1) Ust-Kulomsky Dist., vicinities of Don village, N bank of the Donskoje Lake, 9.5 km from

boat station, 300 m N from lake bank (61° 37' N; 54° 02' E); oligotrophic bog "Donskoje"; a rotten stub; field number No. 47mvd, 14.VII.1999, M.V.Dulin.

**Lophozia ascendens:** 1) Ust-Tsilensky Dist., left bank of Tsilma River, 2 km upstream from Nonburg village (65°33' N; 50°36' E); limestone outcrops in fir and birch forest, on rocks; *Blepharostoma trichophyllum*; No. 14444; 07.VIII.1973, G.V. Zheleznova. 2) Ust-Tsilensky Dist., 1.7 km upstream from Nonburg village (65°33' N; 50°36' E); sphagnum spruce forest; *Blepharostoma trichophyllum*, *Lophocolea minor*, *Orthocaulis kunzeanus*; No. 14465; 07.VIII.1973, G.V. Zheleznova. 3) Udorsky Dist., 1 km E from Elva-Mezenskaya River mouth (64°04' N; 49°18' E); stream valley forest, on rotten timber; *Lepidozia reptans*; No. 14181; 25.VI.1972, I.D. Kildjushevsky & G.V. Zheleznova. 4) Vuktylsky Dist., 0.6 km S from Savinobor village (63°32' N; 56°27' E); hillside, fir forest, on rotten timber; *Cephalozia bicuspidata*, *Lophozia ventricosa*; No. 5545; 22.VI.1970, I.D. Kildjushevsky, G.V. Zheleznova & V.A. Frolova. 5) Knjazhpogostsky Dist., suburb of Sindor town, Sindorskoye Lake, 3 km SE from Ugum River mouth, right bank of the river (62°41' N; 52°01' E); birch-pine forest, on rotten timber; *Blepharostoma trichophyllum*; No. 38298; 07.VIII.2000, M.V. Dulin. 6) Troitsko-Pechersky Dist., suburb of Yaksha town, right bank of Starikovaya River, 150 m upstream from the river mouth (61°45' N; 57°06' E); spruce forest, on the lower part of birch trunk and on rotten timber; *Crossocalyx hellerianus*, *Blepharostoma trichophyllum*, *Lophozia silvicola*, *Orthocaulis kunzeanus*, *Ptilidium pulcherrimum*, *Scapania mucronata*; No. 37673, 37542; 01.VIII.1999, M.V. Dulin. 7) Troitsko-Pechersky Dist., suburb of Yaksha town, right bank of Starikovaya River, spruce forest, on rotten timber; *Crossocalyx hellerianus*, *Lophozia longidens*, *Ptilidium pulcherrimum*, *Tritomaria exsecta*; No. 37080; 30.VII.1999 M.V. Dulin. 8) Troitsko-Pechersky Dist., right bank of Pechora River, Gasnikov backwater, 300 m S from a house along the left bank of the stream (61°44' N; 56°59' E); spruce forest, on rotten timber; *Blepharostoma trichophyllum*, *Calyptogeia suecica*, *Cephalozia lunulifolia*, *Scapania apiculata* etc.; No. 37694; 07.VIII.1999, M.V. Dulin. 9) Troitsko-Pechersky Dist., right bank of Pechora River, Volosnitskaya billabong, 800 m N from the house near mouth of the billabong (61°43' N; 57°03' E); spruce-fir forest, on rotten timber; *Blepharostoma trichophyllum*, *Crossocalyx hellerianus*, *Lophocolea heterophylla*, *Ptilidium pulcherrimum*; No. 37307; 03.VIII.1999, M.V. Dulin. 10) Troitsko-Pechersky Dist., 3 km SSE from Nizhnyaya Omra town, right bank of Nizhnyaya Omra River (62°45' N; 55°52' E); forest, on rotten timber; *Crossocalyx hellerianus*; field number 290mvd; 29.VI.2001, M.V. Dulin. 11) Ust-Kulomsky Dist., suburbs of Don town, right bank of Vychevga River, SE bank of Kadamskoye Lake, along western bank of Podkadamje Lake (61°29' N; 54°41' E); quaking birch-aspens-pine forest, on rotten timber; *Blepharostoma trichophyllum*, *Crossocalyx hellerianus*, *Lophocolea heterophylla*, *Ptilidium pulcherrimum*, *Scapania apiculata* etc.; No. 37003, 37019, 36998, 36997, 36992, 36990, 36995, 36986, 37058; 21.VII.2000, M.V. Dulin. 12) Priluzsky Dist., suburbs of Porub-Kepovskaya village, 6 km NNE, source of Yakim stream (60°48' N; 49°01' E); spruce forest, on rotten timber; *Blepharostoma trichophyllum*, *Calyptogeia muelleriana*, *Cephalozia lunulifolia*, *Riccardia latifrons*, *Ptilidium pulcherrimum*; field

number 298mvd; 25.VII.2001, M.V. Dulin. 13) Priluzsky Dist., 8 km of the road from Spasporub town to Porub-Kepovskaya village, 500 m SSE from Ust-Choy village (60°42' N; 48°59' E); pinery, on rotten timber; *Cephalozia lunulifolia*, *Crossocalyx hellerianus*, *Lophozia ventricosa*, etc.; field number 311mvd; 28.VII.2001, M.V. Dulin. 14) Priluzsky Dist., suburbs of Spasporub town, 18 km of the road Zanutje town – Spasporub town, left bank of Deb River (60°40' N; 49°11' E); quaking aspen forest, on rotten timber; *Blepharostoma trichophyllum*, *Calyptogeia muelleriana*, *Cephalozia lunulifolia*, *Crossocalyx hellerianus*, *Lophozia ventricosa* etc.; field number 312mvd; 28.VII.2001, M.V. Dulin.

**Lophozia pellucida:** 1) Vorkutinsky Dist., N part of Bolshoy Harbey Lake, on the island, located 1 km S from the hydrobiologists' camp (67°38' N; 63°14' E); on the landslide, on soil; No. 3749; 18.VII.1969, I.D. Kildjushevsky & G.V. Zheleznova. 2) Troitsko-Pechersky Dist., 2.5 km SSE from Nizhnyaya Omra settlement, right bank of Nizhnyaya Omra River (62°46' N; 55°51' E); rock outcrop along the river bank, on soil among stones and among moss, on wet terraces of limestone outcrops; *Arnellia fennica*, *Leiocolea collaris*, *L. gillmanii*, *Orthocaulis quadrilobus*, *Preissia quadrata*, *Pellia endiviifolia*, *Scapania gymnostomophila*, *Tritomaria scitula*; field number 262mvd; 25.VI.2001, M.V. Dulin. 3) Troitsko-Pechersky Dist., 2 km SSE from Nizhnyaya Omra settlement, right bank of Soiva River, "Soivinsky" refuge (62°44' N; 55°50' E); small rock outcrops of N exposition, on soil and on terraces; *Arnellia fennica*, *Athalamia hyalina*, *Preissia quadrata*, *Pellia endiviifolia*, *Solenostoma confertissimum*; field number 258mvd; 24.VI.2001, M.V. Dulin. 4) Troitsko-Pechersky Dist., left side of Pechora River valley across the Shezhym River mouth (62°06' N; 58°25' E); limestone outcrops; in a wet cavity, on humus; *Preissia quadrata*; No. 36918; 25.VI.2000, A.G. Bezzgodov & I.B. Kucherov. 5) Troitsko-Pechersky Dist., left side of Pechora River valley, Pihovka River mouth (61°59' N; 58°06' E); limestone outcrops, on wet shaded wall; *Arnellia fennica*, *Blepharostoma trichophyllum*, *Leiocolea gillmanii*, *Sphenolobus minutus*, *Tritomaria quinquentata*; No. 36880, 15.VII.2000, A.G. Bezzgodov & I.B. Kucherov.

**Lophozia perssonii:** 1) Ust-Tsilensky Dist., 7 km upwards the Pechorskaya Pizhma from Levkinskaya, right riverbank, limestone outcrops (64° 44' N; 50° 58' E); on humid rocks; No. 15408, 15409; 12.VII.1973, Zheleznova G.V. 2) Ust-Tsilensky Dist., 5 km downwards from Nonburg village, right bank of the Tsilma river (65° 31' N; 50° 40' E); rocky riverbank slope; No. 14439a; 6.VIII.1973, Zheleznova G.V. 3) Troitsko-Pechersky Dist., vicinity of the Nizhnaya Omra, 2.5 km SW, the left bank of the Soiva river (62°45' N; 55°46' E); limestone outcrops, rocky talus overgrown with pine, birch and aspen; on-soil; field number 269mvd, 26.VI.2001, M.V. Dulin. 4) Troitsko-Pechersky Dist., 1 km SE from Nizhnaya Omra village, left bank of Soiva river (62°45' N; 55°49' E); rocky outcrops of carbonate bedrocks; among the mosses on rock ledges; *Preissia quadrata* and *Leiocolea collaris*; field number 252mvd, 23.VI.2001, M.V. Dulin.

**Nardia japonica:** 1) Ust-Tsilensky Dist., 1.2 km along the road from Myla village to Philippovo village (65°26' N; 50°43' E); roadside ditch, on soil; *Nardia insecta*; No. 15367; 01.VII.1973, G.V. Zheleznova. 2) Pechorsky Dist., 1.5 km SE from Zelenoborsk town (64°27' N; 55°20'



E); old sward road, on soil; *Scapania curta*; No. 33071, 33070; 29.VII.2000, G.V. Zheleznova.

***Odontoschisma denudatum***: 1) Troitsko-Pechersky Dist., 15 km SE from Yaksha village, right bank of the Volosnitskaya oxbow (61°43' N; 57°03' E); edge of a sphagnum bog; on soil in a pit left by an uprooted tree; *Gymnocolea inflata*; field number 126mvd, 3.VIII.1999, M.V. Dulin. 2) Ust-Kulomsky Dist., vicinity of Don lake, SE bank of the Kadam lake (61°29' N; 54°41' E); at the edge of a sandy road in a pine forest, and on the road at the edge of a bog; field number 227mvd, 225mvd, 21.VII.2000, M.V. Dulin. 3) Ust-Kulomsky Dist., S part of the Donskoe bog, between the Large Kadam lake and the Middle Kadam lake (61°31' N; 54°43' E); a raised bog; on sandy soil of a road; *Mylia anomala* and other liverworts; field number 229mvd, 21.VII.2000, M.V. Dulin. 4) Ust-Kulomsky Dist., W bank of the Podkadamje lake (61°28' N; 54°41' E); water discharge valley, in a birch-pine forest; on peaty soil, around a burnt stub; *Cephalozia lunulifolia* and *Lepidozia reptans*; field number 230mvd, 22.VII.2000, M.V. Dulin.

***Scapania nemorea***: 1) Kojgorodsky Dist., 10 km SE from Kazhim village, basin of the Nul river, forest brook Tarasovka, forest quarter No. 103 (60° 21' N; 51° 41' E); on soil on the brook bank; field number No. 177mvd, 22.VI.2000, M.V. Dulin. 2) Troitsko-Pechersky Dist., right bank of the Bolshaja Khozja river, 5 km from its confluence with the Unja river (61° 45' N; 59° 09' E); in a zone between a bog and a birch-spruce forest; *Harpanthus flotovianus*, *Obtusifolium obtusum*; No. 33703, 33674, 13.VII.1985, G.V. Zheleznova.

***Scapania scandica***: 1) Vorkutinsky Dist., 1.5 km SEE from Halmer-Yu settlement (67°55' N; 64°50' E); dwarf birch-moss tundra, on soil; *Cephalozia bicuspidata*, *Gymnomitrium concinnatum*, *Solenostoma pusillum*; No. 4252; 30.VII.1969, I.D. Kildjushevsky & G.V. Zheleznova. 2) Udorsky Dist., 3 km NNE from Glotovo village (63°28' N; 49°29' E); birch-spruce forest, on rotten timber; *Blepharostoma trichophyllum*, *Geocalyx graveolens*, *Lophozia ventricosa*, *Tritomaria exsectiformis*; No. 40217, 40218; 09.VII.1972, I.D. Kildjushevsky & G.V. Zheleznova. 3) Troitsko-Pechersky Dist., suburb of Yaksha town, right bank of Pechora River, right bank of Starikovaya River, 4 km NEE from the house in the Starikovaya River mouth (61°45' N; 57°07' E); deep ditch with water, on rotten timber; *Cephalozia bicuspidata*, *C. lunulifolia*, *Lophozia ventricosa*; No. 37106; 31.VII.1999, M.V. Dulin. 4) Troitsko-Pechersky Dist., 150 m upstream from Starikovaya River mouth (61°45' N; 57°06' E); spruce forest, on the lower part of birch trunk and on soil; *Blepharostoma trichophyllum*, *Barbilophozia lycopodioides*, *Crossogyna autumnalis*, *Lophozia longidens*, *L. ventricosa*; No. 37871, 37864; 01.VIII.1999, M.V. Dulin. 5) Troitsko-Pechersky Dist., Gasnikov backwater, 300 m S from the house on the left bank of the stream (61°44' N; 56°59' E); spruce forest, on rotten timber; *Blepharostoma trichophyllum*, *Cephalozia lunulifolia*, *Calypogeia muelleriana*, *Geocalyx graveolens*, etc.; No. 37625; 07.VIII.1999, M.V. Dulin. 6) Troitsko-Pechersky Dist., left bank of Ilych River, 7 km SSE from Ydzhid-Ljaga River mouth (62°24' N; 58°59' E); birch forest, on rotten timber in a hollow filled with water; herbarium PABG, field number 62; 23.VI.1986, G.V. Zheleznova. 7) Troitsko-Pechersky Dist., 2.5 km E from Nizhnyaya Omra settlement, left bank of Nizh-

nyaya Omra River near the bridge, 262 km of the road from Uhta town to Troitsko-Pechorsk settlement (62 46' N; 55°51' E); on soil; *Cephalozia bicuspidata*, *Lophozia ventricosa*, *Orthocaulis kunzeanus*, *Plectocolea hyalina*; field number 265mvd; 25.VI.2001, M.V. Dulin. 8) Knjazhpogostsky Dist., Sindor town suburbs, Sindorskoye Lake, 2.5 km SE from Ugum River mouth, right bank of the river (62°41' N; 52° 01' E); mixed forest, on rotten timber; *Blepharostoma trichophyllum*, *Geocalyx graveolens*, *Orthocaulis kunzeanus*, *Scapania praetervisa*, *Tritomaria exsectiformis*; No. 38175; 06.VIII.2000, M.V. Dulin. 9) Knjazhpogostsky Dist., Sindor town suburbs, Sindorskoye Lake, circumlittoral at the embranchment of railway (62°41' N; 52° 01' E); birch forest, on soil; *Cephalozia bicuspidata*, *Nardia geoscyphus*, *Scapania curta*, *S. irrigua*; No. 38072; 04.VIII.2000, M.V. Dulin.

***Schistochilopsis hyperarctica***: 1) Troitsko-Pechersky Dist., 1 km SE from Nizhnyaya Omra town, left bank of Soiva River, "Soivinsky" refuge (62°45' N; 55°49' E); rock outcrop of carbonate minerals, on soil in wet shaded cavities; field number 252mvd; 23.VI.2001, M.V. Dulin. 2) Troitsko-Pechersky Dist., 2.5 km SEE from the Nizhnyaya Omra town, right bank of Nizhnyaya Omra River (62°46' N; 55°51' E); rock outcrops of limestone along the river bank, on wet rock terraces; *Leiocolea collaris*; field number 262mvd; 25.VI.2001, M.V. Dulin.

***Schistochilopsis laxa***: 1) Uhtinsky Dist., 135.2 km upstream from Belaya Kedva River mouth (64°10' N; 52°34' E); sphagnum swamp, on soil; *Calypogeia sphagnicola*; No. 17184; 05.VII.1975, G.V. Zheleznova & L.S. Fedorova. 2) Knjazhpogostsky Dist., Sindor town suburbs, Sindorskoye Lake, 3 km SE from Ugum River mouth, near the bridge across the right affluent of the river, beside railway (62°41' N; 52°01' E); sphagnum pinery, on soil; No. 38435; 08.VIII.2000, M.V. Dulin. 3) Knjazhpogostsky Dist., 160 km NW from Chinjavoryk settlement, Sredne-Timansky bauxite mine, right bank of Vorykva River, road to the basalt quarry (64°19' N; 51°08' E); spruce forest, on soil; field number 463mvd; 24.VI.2005, M.V. Dulin. 4) Ust-Kulomsky Dist., suburbs of Don village, right bank of Vycheгда River, SE bank of Kadamskoye Lake, along the W bank of Podkadamje Lake (61°29' N; 54°41' E); swamp with rare small pines, on sphagnum moss; *Calypogeia sphagnicola*, *Cephalozia loitlesbergeri*, *Mylia anomala*; No. 37016, 37011; 21.VII.2000, M.V. Dulin. 5) Ust-Kulomsky Dist., 19-20 km of the road Ust-Kulom village-Ust-Nem village (61°37' N; 54°04' E); meso-oligotrophic swamp with birches, on rotten stub; *Calypogeia sphagnicola*, *Cephalozia pleniceps*; field number 219mvd; 19.VII.2000, M.V. Dulin.

***Sphenolobus cavifolius***: 1) Vorkutinsky Dist., suburbs of Vorkuta town, 2 district, sovhoz "Tsentralny", behind the cemetery on a hill (67°30' N; 64°05' E); No. 2677; 08.VII.1960, I.S. Hantimer & G.Y. Eliseeva. 2) Intinsky Dist., Lemva River drainage-basin, left bank of Parnoka-Yu River, 10 km upstream from the mouth, piedmont of Tisva-Iz mountain (65°35' N; 61°05' E); dwarf birch-sphagnum tundra, in wet lowering on soil; No. 12936; 16.VIII.1973, N.I. Nepomilueva.

