Polish Botanical Journal 57(1): 181–195, 2012

CONTRIBUTION TO THE HEPATIC FLORA OF THE NORDAUSTLANDET (SVALBARD). I. HEPATICS OF THE NORTH COAST OF MURCHISON FJORDEN

NADEZHDA KONSTANTINOVA & ANATOLIY SAVCHENKO

Abstract. An annotated list of hepatics of the northern coast of Murchison Fjorden (Nordaustlandet, Svalbard) was compiled. It includes 31 species, the majority of which are recorded new for Nordaustlandet. *Cephaloziella polystratosa* (R. M. Schust. & Damsh.) Konstant., *Lophoziopsis rubrigemma* (R. M. Schust.) Konstant. & Vilnet and *Leiocolea badensis* var. *apiculata* R. M. Schust. are reported as new for Svalbard. *Scapania ligulifolia* (R. M. Schust.) R. M. Schust. and *Leiocolea collaris* (Nees) Schljakov are confirmed to occur in Svalbard. New localities for six taxa very rare in Svalbard are described: *Leiocolea badensis* (Gottsche) Jørg., *Leiocolea heterocolpos* (Thed. *ex* C. Hartm.) H. Buch var. *harpanthoides* (Bryhn & Kaal.), *Lophoziopsis polaris* (R. M. Schust.) Konstant. & Vilnet, *Oleolophozia personii* (H. Buch & S. W. Arnell) L. Soderstr., *Scapania gymnostomophila* Kaal. and *Solenostoma sphaerocarpum* (Hook.) Steph. var. *nanum* (Nees) R. M. Schust. For the species treated their distribution in Svalbard and some morphological peculiarities are discussed.

Key words: Hepatics, taxonomy, distribution, phytogeography, reproduction, ecology, flora, Nordaustlandet, Svalbard

Nadezhda Konstantinova & Anatoliy Savchenko, Polar-Alpine Botanical Garden-Institute, Kola Scientific Center, Russian Academy of Sciences, Kirovsk, Murmansk Province, 184256, Russia; e-mail: nadya50@list.ru

INTRODUCTION

Nordaustlandet is the second-largest island in the archipelago of Svalbard. Most of its area is covered by glaciers. The former Kinnvika Scientific Station is located in the western part of Nordaustlandet on the northwest coast of Murchison Fjorden (80°03′06″N, 18°13′17″E; Fig. 1). In the environs of this station are the largest ice-free flats in Nordaustlandet. The area is hilly, with elevations from 15 to 150 m a.s.l., and up to 218 m a.s.l. in the easternmost part. The bedrock is formed of early Neuproterozoic (Sturtian) carbonate rock (dolomite and limestone) with stromatolites (Dallmann *et al.* 2002), replaced by clastic sedimentary rocks in the eastern part (Fig. 1). Alexandrova (1977) referred to Nordaustlandet as a zone of polar desert, whereas Elvebakk (1985, 1990) and Möller (2000) maintained that only the easternmost part of the island should be considered polar desert. The vegetation in the vicinity of Kinnvika is very poor. The gentle slopes of the hills are covered by eluvial deposits. At first glance it is a lifeless desert. Plants and lichens are hidden between and under rocks, in small crevices in rocks, in crevices on spots of bare soil in the center of rock polygons, and in narrows between polygons. Fragments of plant communities are restricted generally to banks of shallow streams, especially those on accumulative–abrasion marine terraces, edges of melting snowfields, the bases of huge rocks and borders of polygons. The richest vegetation is under bird colonies in the easternmost part of the area.

The flora and vegetation of Nordaustlandet are very insufficiently studied. Data on the hepatics of Nordaustlandet are confined to several records of species widespread in Svalbard (Berggren 1875) and several findings of ours which are hepatics new for Svalbard or rare on the archipelago (Konstantinova & Savchenko 2008a). These studies deal with northern parts of Nordaustlandet. Almost nothing is known about the hepatics of the western part of the island and Murchison Fjorden in particular. The area we studied lies within the Nordaust-Svalbard Nature Reserve. Firm data on

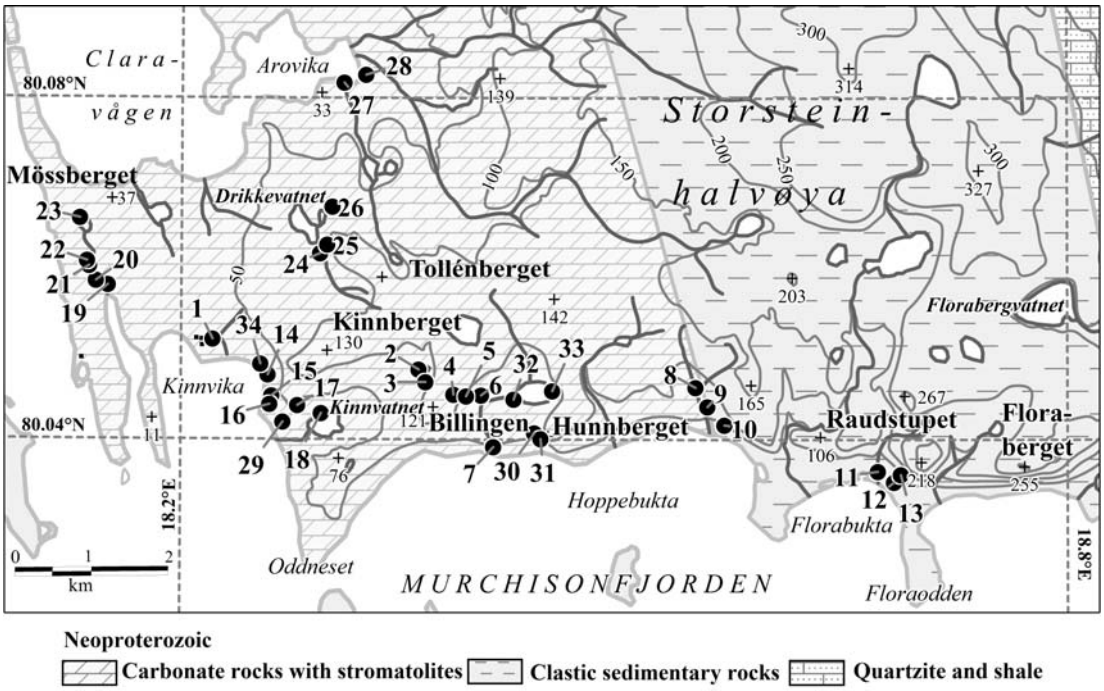

Fig. 1. Collection localities (details in Table 1).

the diversity and distribution of the hepatics of this part of the reserve have been needed.

Material and methods

We gathered hepatics on the north coast of Murchison Fjorden during seven days in 2010, mainly in the surroundings of the former Kinnvika Scientific Station (Fig. 1). We collected *ca* 160 specimens from 76 localities. For all localities the coordinates and elevations were determined with a GPS. Most of the collected specimens were studied fresh in the laboratory of the Russian Academy of Sciences in Barentsburg and then again in the Polar-Alpine Botanical Garden-Institute (Kirovsk, Murmansk Province).

All studied specimens are stored in the Herbarium of the Polar-Alpine Botanical Garden-Institute of the Kola Scientific Center, Russian Academy of Sciences (KPABG).

Abbreviations in the list of species

* – new record for Nordaustlandet; ** – new record for Svalbard

Abbreviations for reproductive structures: and. – androecia; gyn. – gynoecia; per. – perianthia or pseudoperianthia; spor. – sporogonia; gem. – gemmae

Frequency categories for more common species: sporadic (3–7 localities), frequent (8–13 localities) and common (more than 13 localities).

Results and discussion

Based on identification of the collected specimens this annotated list of hepatics was compiled. It includes 30 species. Nomenclature follows Konstantinova *et al.* (2009), with some changes according to Söderström *et al.* (2010) and Rubasinghe *et al.* (2011). Collection sites are followed by information on the presence of reproductive structures (in square brackets); for some names synonyms generally accepted in Europe are given. Then the collection localities (acc. Fig. 1, Table 1) are given, followed by habitat characteristics. For rare species collected from 1–3 localities the labels are cited in full; for more common species the specimens

Table 1. Description of localities studied.

Number of locality	Description of localities	Coordinates	Elevation (m a.s.l.)
1	First marine terrace near Kinnvika scientific station.	80°3′6″ N, 18°13′17″ E	10–15
2	West macro slope of Billingen Mt., gentle south-west facing slope to small lake.	80°2′53″ N, 18°21′39″ E	80
3	West macro slope of Billingen Mt., gentle north-west facing slope to small lake.	80°2′48″ N, 18°21′56″ E	89
4	East macro slope of Billingen Mt., rock fields on gentle east facing slope.	80°2′43″ N, 18°23′5″ E	106
5	East macro slope of Billingen Mt., gentle east facing slope.	80°2′42″ N, 18°23′35″ E	97
6	East macro slope of Billingen Mt, sources of mossy rivulet.	80°2′43″ N, 18°24′12″ E	75
7	Hoppebukta to the south-east from Billingen, first marine terrace.	80°2′21″ N, 18°24′42″ E	43
8	Valley of stream flowing into the Hoppebukta, south facing slope with numerous rivulets.	80°2′46″ N, 18°32′54″ E	92
9	Numerous rivulets on east facing slope Hoppebukta.	80°2′38″ N, 18°33′23″ E	81
10	Rock fields near snowfield on southeast coast of Hoppebukta.	80°2′30″ N, 18°34′5″ E	51
11	Florabukta, at the bottom of cliffs with bird colonies.	80°2′11″ N, 18°40′18″ E	11
12	Florabukta, steep slope under bird colonies.	80°2′6″ N, 18°40′58″ E	8
13	Florabukta, quartzite outcrops with herb-bryophyte communities between huge boulders on slope under cliffs with bird colonies.	80°2′9″ N, 18°41′14″ E	36
14	East coast of Kinnvika bay, first marine terrace.	80°2′51″ N, 18°15′32″ E	6
15	East coast of Kinnvika bay, first marine terrace, bank of rivulet.	80°2′42″ N, 18°15′41″ E	12
16	East coast of Kinnvika bay, first marine terrace, bank of pool.	80°2′39″ N, 18°15′36″ E	7
17	West bank of Kinnvatnet Lake, seepages on gentle slope to the lake.	80°2′38″ N, 18°16′44″ E	39
18	South-east facing slope to Kinnvatnet Lake.	80°2′35″ N, 18°17′42″ E	17
19	Gentle slope to the stream at the north end of Austre Tvillingneset.	80°3′29″ N, 18°9′1″ E	1
20	Gentle slope to the stream at the north end of Austre Tvillingneset.	80°3′31″ N, 18°8′31″ E	3
21	Detritus plateau at the north end of Tvillingneset.	80°3′37″ N, 18°8′14″ E	7
22	End of Tvillingneset Seepage at the bottom of hill.	80°3′39″ N, 18°8′10″ E	5
23	Bank of unnamed lake at the bottom of Mossberget.	80°3′57″ N, 18°7′51″ E	14
24	Seepage on north facing slope of Western spur of Tollenberget.	80°3′42″ N, 18°17′38″ E	42
25	South-west facing slope of Western spur of Tollenberget.	80°3′46″ N, 18°17′55″ E	60
26	North bank of Drikkevatnet.	80°4′2″ N, 18°18′7″ E	42
27	North facing slope on the east coast of Arovika bay.	80°4′54″ N, 18°18′35″ E	1
28	Bank of river flows into the Arovika bay.	80°4′58″ N, 18°19′28″ E	3
29	Rock outcrops on hill in east coast of Kinnvika bay.	80°2′31″ N, 18°16′8″ E	18
30	Hoppebukta, slope with rivulets under rock outcrops with bird colony on Hunnberget.	80°2′27″ N, 18°26′21″ E	57
31	Hoppebukta, first marine terrace near rock outcrops with bird colony on Hunnberget.	80°2′24″ N, 18°26′37″ E	43
32	West bank of unnamed lake at the bottom of Hunnberget.	80°2′41″ N, 18°25′31″ E	60
33	East bank of unnamed lake at the bottom of Hunnberget.	80°2′45″ N, 18°27′5″ E	79
34	First marine terrace on east coast of Kinnvika bay.	80°2′56″ N, 18°15′14″ E	20

are not cited but their frequency is characterized. The distribution as well as some morphological peculiarities of the species are briefly discussed. Distribution patterns in general are given according to Konstantinova (2000).

ANNOTATED LIST OF SPECIES

**Aneura pinguis* (L.) Dumort.

Collection sites: 1, 9, 14, 15, 32. Sporadic. On clay soil, dead mosses, plant detritus, in moss cushions along streams and in beds of temporary streams; on soil among rocks on first sea terrace, as well as on decaying mosses and vascular plants on polygons. Often occurring as stems among mosses or mixed with *Blepharostoma trichophyllum* var. *brevirete*, *Cephaloziella varians*, *Jungermannia polaris*, *Leiocolea* spp. and *Schljakovianthus quadrilobus*.

Nearly cosmopolitan (Schuster & Damsholt, 1974), one of the commonest hepatics in Svalbard.

Anthelia juratzkana (Limpr.) Trevis.

Collection site 11 [per., and., spor.]; in extensive mats on soil along stream (K14-3a-10), mixed with *Cephaloziella varians*.

Arctomontane species and one of the commonest hepatics in Svalbard. The rarity of the species in the studied area can be explained by the prevalence of carbonate rocks which this species avoids.

Barbilophozia hatcheri (A. Evans) Loeske

Collection site 13 [gem.]; on thin layer of wet soil under and between quartzite rocks (K19-10), mats without admixture of other hepatics.

Arctoboreomontane circumpolar (bipolar) species. Widespread in Svalbard according to Frisvoll and Elvebakk (1996). In Svalbard the species is restricted mostly to boulder fields, which are nearly absent in the studied area.

**Blepharostoma trichophyllum* (L.) Dumort. var. *brevirete* Bryhn & Kaal.

Collection sites: 1, 5–9, 12–14, 16, 17, 20–23, 25, 26, 28, 30–32, 34 [per., gem.]. Common. It is the most widespread hepatic in the area studied. It occurs as admixture in most collected specimens. On fine earth, soil, loam, plant detritus, among mosses along streams, in beds of temporary streams, between protuberances and rock detritus in micro-depressions on polygons and spots of bare soil, on detritus in lichen and moss-lichen communities, on clay soil near rocks, on soil in moss-*Salix polaris* communities under bird colonies, on flat ledges of cliffs. Sometimes the species dominates with *Schljakovianthus quadrilobus* in bryophyte communities along springs on sea terraces. Of 23 admixed hepatics the commonest are *Cephaloziella varians*, *Schljakovianthus quadrilobus*, *Leiocolea heterocolpos* var. *harpanthoides*, *Aneura pinguis* and *Jungermannia polaris*.

Arctoboreomontane circumpolar species. It is the most common hepatic in Svalbard, but we agree with Frisvoll and Elvebakk (1996) that the distribution and ecology of var. *brevirete* vs. var. *trichophyllum* need to be characterized more precisely. In the area treated the type variety was not found.

**Cephalozia ambigua* C. Massal.

Collection site 11; along stream on sea terrace under bird colony (K15-1-10). The species forms a band of cushions covering several square decimeters with minor admixture of *Cephaloziella varians.* Collection site 12: moss-*Salix polaris*-herb community along streams under bird colony on sea terrace, on side of hillock (K16-2-10), mixed with *Blepharostoma trichophyllum* var. *brevirete*, *Lophoziopsis polaris*, *Lophozia wenzelii*, *Sphenolobus minutus* and *Tritomaria quinquedentata.*

Arctomontane circumpolar species. Widespread and often abundant in Svalbard, but absent or very rare in areas with carbonate rocks.

***Cephaloziella polystratosa* (R. M. Schust. & Damsh.) Konstant.

Cephaloziella divaricata var. *polystratosa* (R. M. Schust. & Damsh.) Potemkin

Collection site 13 [per., and., spor.]; quartzite outcrops, *Ranunculus*-grass-moss community

between huge boulders, in small narrow wall of boulder covered by peat soil without admixture of other hepatics (mats of several square centimeters) or mixed with *Lophoziopsis rubrigemma* (K17-4-10).

Poorly known arctic species. It was described from southern Greenland (Schuster & Damsholt 1987) as *Cephaloziella byssacea* (Roth.) Warnst. var. *polystratosa* R. M. Schust. & Damsh.) and apart from the *locus clasicus* it is known from several localities in Russia (Konstantinova 2000, Konstantinova *et al.* 2009).

Cephaloziella varians (Gottsche) Steph.

Cephaloziella arctica Bryhn & Douin

Collection sites: 1, 9–12, 14, 20, 21–24, 27, 30, 32, 33 [per., and., spor.]. Common. On moist loamy soil near snowfields, on soil between rocks along lakes and streams, on sides of hillocks along streams under bird colonies, in micro-depressions in rocky lichen communities, on protuberances in moss-liverwort communities along springs, in lichen-cotton grass-moss communities at the base of carbonate rocks, on dead plants and mosses on polygons, and on solifluction spots on gentle slopes to lakes and rivers. Usually mixed with other hepatics; 18 species were recorded as admixture to it. The commonest admixed hepatics are *Blepharostoma trichophyllum* var. *brevirete* and *Schljakovianthus quadrilobus.* Sporophytes were found only once (K31-1a-10).

Arctoboreomontane bipolar species very common in the Arctic and particularly in Svalbard. In the area treated it is one of the commonest species.

* ***Clevea hyalina*** (Sommerf.) Lindb. [*Athalamia hyalina* (Sommerf.) S. Hatt.] var. ***rufescens*** (S. W. Arnell) Konstant. ***stat. et comb. nov***.

Basionym: *Clevea hyalina* (Sommerf.) Lindb. forma *rufescens* S. W. Arnell, *in* Arnell S. & O. Mårtensson *Ark. Bot. Ser. 2* **4**(6): 123. 1959.

Collection sites: 1, 8, 14, 18, 31, 34 [gyn., and.]. Sporadic. On moist clay soil at the base of limestone outcrops, along dried beds of temporary streams on the first marine terrace, on clay soil among lichens and dead mosses on the edge of the sea terrace. Single thalli on and among mosses or with *Sauteria alpina*, *Scapania ligulifolia*, *Jungermannia polaris* and *Blepharostoma trichophyllum* var. *brevirete.*

Arctomontane circumpolar species. According to Frisvoll and Elvebakk (1996) it is sporadic in Svalbard. All studied specimens were referred to var. *rufescens*. It differs from the type variety in having pale to deep purple and red-brown scales, the red-brown colored dorsal surface of the thalli, and numerous very high oscioles sometimes mixed with numerous scales in male plants.

We believe that variety is the more appropriate status for this taxon because of its high arctic distribution and quite characteristic appearance.

* ***Jungermannia*** cf. ***borealis*** Damsh. & Váňa

Collection site 23 [and.]; detritus bank of lake, spots of bryophytes 2 m from the water. Many plants among the specimens are with androecia, but no traces of gynoecia were found. Plants are very small, 0.2–0.35 mm wide with cells in the middle of leaves 12–14(16) μm, with many enlarged cells up to 14 × 25 and 12 × 28 μm in the basal part of leaves. According to Damsholt and Váňa (1977), enlarged cells of leaf bases are characteristic for *J. pumila* With., but the dioicous inflorescence as well as brownish to reddish tinged walls of cells and the presence of small but distinct trigones convinced us to refer the cited specimen to *J. borealis* rather than *J. pumila* or *J. polaris*.

Arctomontane circumpolar species. It was reported for Svalbard by Arnell and Mårtensson (1959) but then excluded from the Svalbard flora by Frisvoll and Elvebakk (1996).

* ***Jungermannia polaris*** Lindb.

Collection sites: 4–6, 8, 9, 13, 20, 27, 30, 32, 33 [per., and., spor.]. Frequent but usually sparse. On loamy soil along mossy banks of streams from snowfields, among boulders on banks of streams, on protuberances in rocky lichen tundra, on moist loamy soil at the base of boulders, at the base of rock outcrops and on spots in patchy tundra,

between frost boils and detritus in the center of polygons. Sometimes forms loose mats without any admixture of other bryophytes on bare loamy soil near water, but more often grows as admixture with such calciphilous species as *Leiocolea badensis*, *Scapania gymnostomophila*, *S. ligulifolia*, *Lophoziopsis pellucida*, *Oleolophozia personii* and *Sauteria alpina*, or widespread in hepatics of the studied area (*Blepharostoma trichophyllum* var. *brevirete*, *Cephaloziella varians*, *Aneura pinguis*).

Arctomontane circumpolar species. The species was characterized by Frisvoll and Elvebakk (1996) as sporadic in Svalbard. In the area treated it is one of the most common hepatics.

**Leiocolea badensis* (Gottsche) Jørg.

Collection sites: 2, 5, 9, 10, 25, 30, 34. Sporadic. On sides and under thalli of lichens, near and partly under rocks and detritus in small (up to 0.5–1 cm deep) depressions, under stems of *Saxifraga oppositifolia* L. on spots of feebly overgrown soil on gentle slopes to lakes and streams, among (and under) lichens on rock polygons, on moist loamy soil along streams among rocks on sea terraces. The commonest admixed hepatics are calciphilous *Schljakovianthus quadrilobus* and *Lophoziopsis pellucida* as well as hepatics common in Svalbard such as *Aneura pinguis*, *Blepharostoma trichophyllum* var. *brevirete*, *Cephaloziella varians* and *Jungermannia polaris*.

Leiocolea badensis differs from *L. collaris*, presumably rarer in Svalbard, by its smaller size contrasting with large cells (up to 35–40 μm wide), very small trigones, the nonpapillose cuticle of leaf cells and the absence of underleaves.

Arctoboreomontane circumpolar species. It was characterized as very rare in Svalbard by Frisvoll and Elvebakk (1996). Earlier it was recorded from Rechercherchefjorden (Karczmarz & Święs 1990; Święs & Karczmarz 1991) and Kongsfjorden (Arnell & Mårtensson 1959). Probably the species is not rare in Svalbard (Fig. 2) but is overlooked because of its very small size, occurrence as scattered shoots, and difficulties in identification.

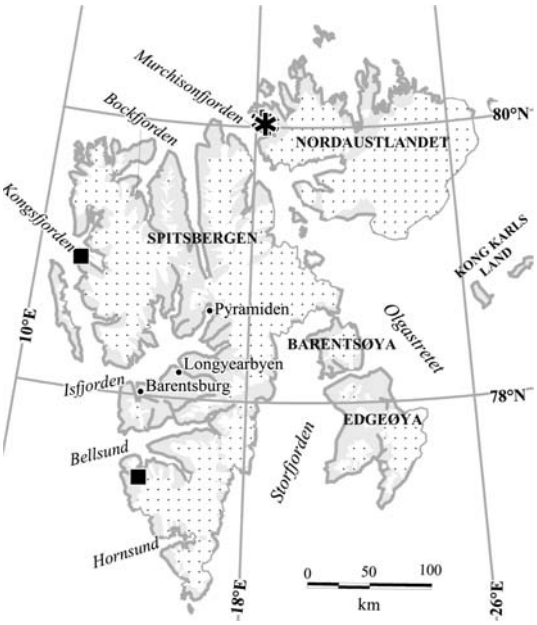

Fig. 2. Distribution of *Leiocolea badensis* (Gottsche) Jørg. in Svalbard. ■ – previously known localities; ✱ – localities discovered during our study.

***Leiocolea badensis* var. *apiculata* R. M. Schust.

Collection site 32 [and.]; spot of bare soil on slope to lake, under snowfield, crust on dead mosses (K67-10), mixed with *Jungermannia polaris*.

The studied plants have, characteristic for the variety, apiculate or mucronate lobe apices often ending in 2-celled apices with an elongated uppermost cell, large subapical cells of lobes that vary from 30×30 μm to 33×38 μm and 36×47 μm, leaf margins sometimes having solitary teeth, very large cortical cells of the stem (28–)32–40 μm wide and 40–60 μm long, and a faintly striolate cuticle of the stem. However, the leaf cells are not as large as described for the type by Schuster (1969). Width varies in the middle of leaves from 28 μm to 36 μm and in a few leaves to 40 μm. This variety was described by Schuster (1969) from western Greenland and has not been reported from other localities.

**Leiocolea collaris* (Nees) Schljakov

Collection site 23; bank of lake, fragment of moss community (K35-1-10); 32: on dead vascular

plants and mosses on polygons (K63-3-10) mixed with *Aneura pinguis*, *Blepharostoma trichophyllum* var. *brevirete*, *Cephaloziella varians* and *Schljakovianthus quadrilobus* var. *glareosa*, and in crevices among mosses and soil protuberances on spots of bare soil on a gentle slope to the river (K64-10) mixed with *Blepharostoma trichophyllum* var. *brevirete* and *Lophoziopsis perssonii*.

Arctoboreomontane circumpolar species. The species was recorded from Svalbard by Lindberg (1867) and Hagen (1952) but was excluded from the list of hepatics of Svalbard by Frisvoll and Elvebakk (1996). Later it was found by the first author in specimens collected by N. E. Koroleva from the vicinity of the Calypso Scientific Station and in the valley of the Reshersher River [Konstantinova & Koroleva 2003 as *Leiocolea alpestris* (F. Web.) Isov.]. In the studied specimens the plants were referred to *L. collaris* based on the relatively large underleaves (about half of leaf length), apiculate leaf lobes often ending in 1–2 superposed cells, relatively small but enlarged cells of leaves, and papillose-striolate cuticle of leaf cells.

* ***Leiocolea gillmanii*** (Austin) A. Evans

Collection sites: 6, 9, 18, 23 [and., gyn., spor.]. Sporadic. On moist loamy soil and moist hillocks on banks of rivulets, near rocks on mossy banks of small streams from snowfields, sometimes on edge of soil spots on detritus slopes. In mats without other bryophytes or mixed with *Blepharostoma trichophyllum* var. *brevirete* and *Jungermannia polaris*. Plants are often very small, 0.7–1.0 mm wide and 4–6 mm long. When dry the plants are almost black, sometimes with green basal parts of upper leaves; on some plants most leaves have a partly damaged hyaline margin. The perichaetial bracts include antheridia at the base, and many juvenile perianths are hidden in large perichaetial leaves.

Arctoboreomontane circumpolar species. The species was characterized as rare in Svalbard by Frisvoll and Elvebakk (1996). During our study of the hepatics of Svalbard we found that *L. gillmanii* is not rare in areas with carbonate rocks; on the east coast of Billefjorden it is quite common and sometimes abundant (Konstantinova & Savchenko 2008b).

* ***Leiocolea heterocolpos*** (Thed. *ex* C. Hartm.) H. Buch var. ***harpanthoides*** (Bryhn & Kaal.) S. W. Arnell

Collection sites: 8, 9, 14, 20, 25, 34 [per.]. Sporadic. In cracks between polygons on the first marine terrace and in rocky lichen tundra, on soil among rocks on banks of streams, on clay soil among lichens and dead mosses along and in beds of temporary streams, and on flat ledges on steep carbonate outcrops. Usually mixed with hepatics widespread in the studied area (*Blepharostoma trichophyllum* var. *brevirete*, *Cephaloziella varians*, *Schljakovianthus quadrilobus*, *Scapania ligulifolia*, *Tritomaria scitula*).

Arctoboreomontane circumpolar species. According to Frisvoll and Elvebakk (1996), *Leiocolea heterocolpos* is one of the commonest hepatics in Svalbard. In the area considered it occurs only as var. *harpanthoides*. The variety is restricted to relatively dry habitats and differs from the type variety in the absence of gemmae, concave and less deeply bilobed leaves, more rounded to blunt lobes, smaller leaf cells (14–)15–20 μm, and deep brown to red-brown pigmentation. Earlier this high arctic variety was recorded on Svalbard from Kongsfjorden [Arnell & Mårtensson 1959 as var. *arctica* (S. W. Arnell) Mårtensson *ex*. S. W. Arnell].

* ***Lophozia wenzelii*** (Nees) Steph. var. ***groenlandica*** (Nees) Bakalin

Lophozia groenlandica (Nees) Macoun

Collection site 12 [gem.]: moss-*Salix polaris*-grass community on steep slope with numerous rivulets under bird colony, in upper part of hillock (K16-3a-10), mixed with *Blepharostoma trichophyllum* var. *brevirete*, *Cephaloziella varians* and *Tritomaria quinquedentata*, and on large hillock (K16-2-10) mixed with *Blepharostoma trichophyllum* var. *brevirete*, *Cephalozia ambigua*, *Lophoziopsis polaris*, *Sphenolobus minutus* and *Tritomaria quinquedentata*.

Arctomontane circumpolar species. The species

possibly is not rare in Svalbard (Frisvoll & Elvebakk 1996). This species is often confused with another taxon of *Lophozia* with green gemmae, so its distribution in Svalbard is poorly known.

* ***Lophoziopsis pellucida*** (R. M. Schust.) Konstant. & Vilnet

Lophozia pellucida R. M. Schust.

Collection sites: 1, 7, 9, 24, 25, 30, 34 [gem.]. Sporadic. Among mosses on detritus in seepages, on hillocks on flat marine terraces, on soil between rocks at the edge of *Saxifraga*-moss communities on steep slopes of carbonate outcrops, on soil under boulders and among rocks on banks of rivulets under bird colony, on clay soil among lichens and dead mosses in depressions of temporary watercourses. In small monospecific patches or mixed with such calciphiles as *Leiocolea badensis*, *Oleolophozia perssonii*, *Lophoziopsis polaris*, *Schljakovianthus quadrilobus*, *Scapania gymnostomophila*, *Scapania ligulifolia* and *Tritomaria scitula*.

Poorly known arctic circumpolar species. Earlier it was recorded in Svalbard from Bockfjorden (Frisvoll & Blom 1993) and from the east coast of Billefjorden, the environs of Pyramiden settlement (Bakalin 2005, based on one specimen collected by N. E. Koroleva).

* ***Lophoziopsis pellucida*** (R. M. Schust.) Konstant. & Vilnet var. ***minor*** (R. M. Schust.) Konstant. & Vilnet

Collection site 7 [gem.]; on protuberances on spots of bare soil on marine terraces (K7-1a-10), mixed with *Blepharostoma trichophyllum* var. *brevirete* and *Scapania ligulifolia*.

* ***Lophoziopsis polaris*** (R. M. Schust.) Konstant. & Vilnet

Lophozia polaris (R. M. Schust.) R. M. Schust. & Damsh.

Collection sites: 12, 23, 27, 29, 30, 34 [gem.]. Sporadic but sometimes abundant. On peaty soil and on rocks covered by soil along rivulets with mossy banks, on soil between huge boulders in places with melting snow, at the edge of fragments of lichen-cotton grass-moss communities at the base of weathered limestone outcrops, in crevices of limestone outcrops, on dead mosses near snowfields, among mosses on flat ledges of limestone outcrops. Sometimes in pure extensive mats or mixed with bryophytes. The commonest admixed hepatics are *Blepharostoma trichophyllum* var. *brevirete* and *Cephaloziella varians*; less common are *Lophoziopsis pellucida* and *Tritomaria scitula*.

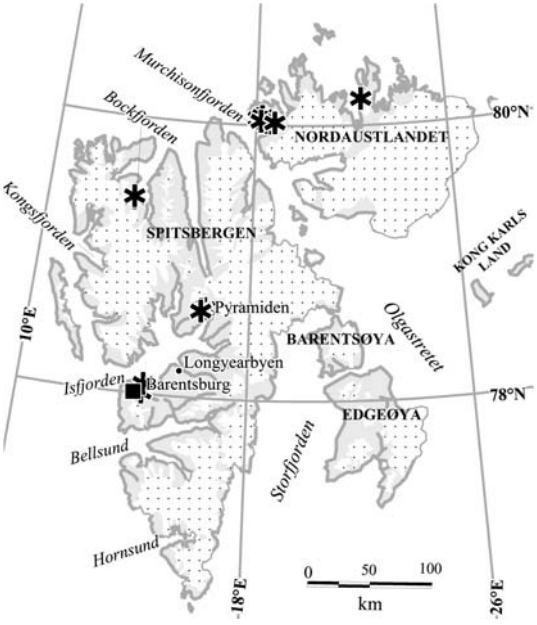

Fig. 3. Distribution of *Lophoziopsis polaris* (R. M. Schust.) Konstant. & Vilnet in Svalbard. ■ – previously known localities; ✱ – localities discovered during our study.

Arctomontane circumpolar species. The first noteworthy record of this species for Svalbard was by Hadač (1989) from Kongressdallen. We collected it in Bockfjorden (Konstantinova & Savchenko 2006), as well as Linnedalen, Prins Oscars Land (Nordaustlandet, Rijpfjoren), and on the east coast of Billefjorden in the environs of Pyramiden settlement. In Grønndalen, *L. polaris* var. *sphagnorum* (R. M. Schust.) R. M. Schust. & Damsh. was gathered (Konstantinova & Savchenko 2008c). Apparently *Lophoziopsis polaris* is not rare in Svalbard (Fig. 3) and locally is even abundant.

*[*]**Lophoziopsis propagulifera*** (Gottsche) Konstant. & Vilnet

Lophozia propagulifera (Gottsche) Steph. – *Lophozia latifolia* R. M. Schust. – *Lophozia jurensis* Meyl. *ex* Müll.Frib.

Collection sites: 1, 10, 13, 28, 29 [gem.]. Sporadic. On moist clay soil and fine earth between rocks at the base of outcrops, on gentle slopes. Occurs mostly as single stems among mosses.

Arctoboreomontane bipolar species. It was reported from Svalbard several times (as *Lophozia latifolia* R. M. Schust.) but Frisvoll and Elvebakk (1996) questioned most previous records. We collected species in different regions of Svalbard, where it is not rare but usually is scattered among bryophytes.

*[**]**Lophoziopsis rubrigemma*** (R. M. Schust.) Konstant. & Vilnet

Lophozia rubrigemma R. M. Schust.

Collection site 13 [gem.]; quartzite outcrops, moss-herb community between huge boulders, on peat soil in small cracks on boulder, without admixture of other hepatics (K17-3-10) or mixed with *Cephaloziella polystratosa* (K17-4-10).

Poorly known arctic species. Apart of northwestern Greenland from where the species was described (Schuster 1969), it is known from western Greenland, the Canadian Arctic Archipelago, Alaska (Bakalin 2005), Kamchatka, mountains of southern Siberia, Franz Josef Land, the Jamal Peninsula and Murmansk Province (Konstantinova 2000; Konstantinova *et al*. 2009).

Marchantia polymorpha L. subsp. ***montivagans*** Bischl. & Boissel.-Dub.

Marchantia alpestris (Nees) Burgeff

Collection site 12 [gem.]; moss-*Salix polaris*-herb community on steep slope with numerous rivulets under bird colony, on soil on bank of rivulet (K16-1-10); 30: on flat rocks and between rocks among mosses in depression at the base of slope under bird colony, extensive mats (K58-10).

Arctomontane circumpolar species. The species is not rare in Svalbard but is restricted almost exclusively to localities under bird colonies (Frisvoll & Elvebakk 1996).

*[*]**Oleolophozia personii*** (H. Buch & S. W. Arnell) L. Söderstr.

Lophoziopsis perssonii (H. Buch & S. W. Arnell) Konstant. & Vilnet – *Lophozia perssonii* H. Buch & S. W. Arnell

Collection sites: 2, 3, 25, 32 [gem.]. Sporadic. In micro-crevices on bare soil, among mosses, at edge of cushion of lichens, in small clefts and between protuberances, on fine earth on clay spots in centers of rocky polygons, on clay bare soil on gentle slopes to river beds and lakes, on ledges of cliffs. Plants are characteristically bright green with a 'cap' of orange gemmae and grow in mats or low turfs without other hepatics or mixed with calciphiles (*Leiocolea collaris*, *Lophoziopsis pellucida*, *Scapania gymnostomophila*, *S. ligulifolia*) or widespread Ca-tolerant hepatics (*Blepharostoma trichophyllum* var. *brevirete*, *Jungermannia polaris*).

Fig. 4. Distribution of *Oleolophozia personii* (H. Buch. & S. W. Arnell) L. Soderstr. in Svalbard. ■ – previously known localities; ✱ – localities discovered during our study.

Rare arctomontane species (Konstantinova 2000). It was recorded in Svalbard from two localities in Kongsfjorden (Arnell & Mårtensson 1959) and from two localities on the east coast of Billifjorden (Konstantinova & Savchenko 2008b). The species probably is not rare in areas with carbonate rocks but probably is overlooked because of its small size and possibly short-term occurrence in temporary habitats (Fig. 4).

Preissia quadrata (Scop.) Nees

Collection sites: 1, 9, 10, 31, 34 [male and female receptacles]. Sporadic. On clay soil between rocks on banks of rivulets on marine terraces, where the species occurs sporadically, usually as single thalli among dead mosses and lichens. The commonest admixed species are *Blepharostoma trichophyllum* var. *brevirete*, *Cephaloziella varians*, *Leiocolea heterocolpos* var. *harpanthoides*, *L. collaris*, *Schljakovianthus quadrilobus* and *Scapania ligulifolia.* The collected plants are small and sometimes have 2 appendages on ventral scales, thalli with 2 or even 3 layers of aerenchyma and a sharp keel in the middle. Probably a high arctic form or variety.

Arctoboreomontane circumpolar species. It is characterized as common in Svalbard by Frisvoll and Elvebakk (1996).

Sauteria alpina (Nees) Nees

Collection sites: 18, 20, 31, 34 [and., gyn., spor.]. Sporadic. On clay soil among lichens and dead mosses at the base of limestone rocks and along temporary rivulets on marine terraces, where the species is not rare. The commonest admixed species are *Clevea hyalina* var. *rufescens*, *Scapania ligulifolia*, *Jungermannia polaris* and *Blepharostoma trichophyllum* var. *brevirete.*

Arctomontane circumpolar species. It is characterized as common in Svalbard by Frisvoll and Elvebakk (1996).

The studied specimens are light green and have decolorate and swollen margins of thalli, inflated air chambers, and oil bodies in ventral scales characteristic for the species, but many specimens have very large ventral scales and appear dioicous. Such forms at first glance resemble *Clevea hyalina*. The male and female thalli are usually very close and possibly are branches of one thallus base which was destroyed, so the plants are autoicous. Similar forms from Greenland were discussed in detail by Schuster (1992).

Scapania gymnostomophila Kaal.

Collection sites: 7, 9, 13, 17, 21, 23, 30, 32 [gem.]. Frequent but usually as single plants. On and among mosses and lichens, on soil under and among stems of *Saxifraga* spp., *Salix polaris* Wahlenb. and other vascular plants, on dead mosses in micro-depressions on solifluction spots and rocky polygons, in moist crevices on rocks. The commonest admixed hepatics are *Blepharostoma trichophyllum* var. *brevirete*, *Cephaloziella varians*, *Jungermannia polaris*, *Lophoziopsis pellucida* and *Scapania ligulifolia*.

Arctomontane circumpolar species. Previously the species was known from Ekmanfjorden, Nordfjorden (Frisvoll & Blom 1993) and Kongsfjorden (Arnell & Mårtensson 1959). We collected this species several times in Billefjorden in the surroundings of Pyramiden (Konstantinova & Savchenko 2008b). Because of its very small size and occurrence as single plants the species evidently is overlooked and in fact much more widespread in Svalbard than known previously.

In spite of its very small size (3–5 mm long) the species is easily recognized in the field by its very small dorsal lobes and blackish, dark green plants. Under the microscope it is easy to recognize by the very large, long, persistent oil body occurring one per cell.

Scapania ligulifolia (R. M. Schust.) R. M. Schust.

Scapania calcicola (Arnell & J. Perss.) Ingham. subsp. *ligulifolia* (R. M. Schust.) R. M. Schust.

Collection sites: 7, 8, 20, 24, 25, 27, 32, 33 [gem.]. Frequent. On clay near rocks, at the edge of moss cushions on seepages, in micro-depressions in rocky lichen communities, on dead mosses in snowbed communities, on plant detritus on polygons, on moist soil between rocks and in small

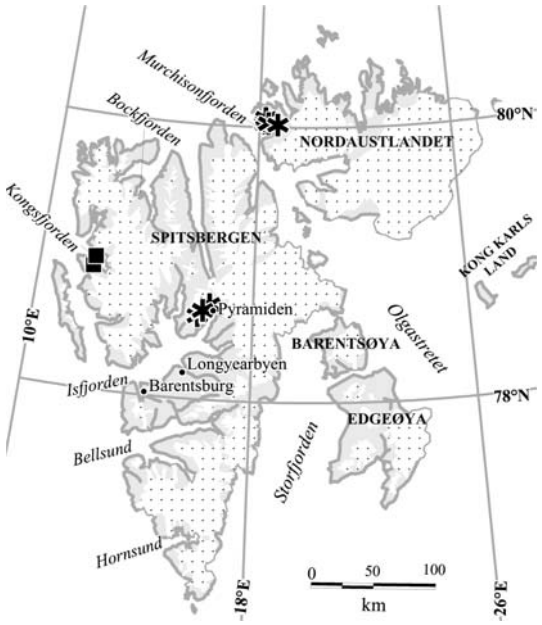

Fig. 5. Distribution of *Scapania ligulifolia* (R. M. Schust.) R. M. Schust. in Svalbard. ■ – previously known localities; ✱ – localities discovered during our study.

cracks under rocks. The commonest admixed species are *Blepharostoma trichophyllum* var. *brevirete*, *Cephaloziella varians* and *Scapania gymnostomophila*.

Predominantly high arctic circumpolar species. Arnell (Arnell & Mårtensson 1959) recorded *Scapania calcicola* from two localities in Kongsfjorden. More likely these records should be attributed to *Scapania ligulifolia*, which was described later (Schuster 1992) and is treated by some authors (Damsholt & Long 1979; Damsholt 2002) as a subspecies of European *Scapania calcicola*. Earlier we recorded *Scapania calcicola* on the east coast of Billifjorden (Konstantinova & Savchenko 2008b). All these records should be referred to *Scapania ligulifolia*. It seems that the species is not rare in Svalbard (Fig. 5) but is overlooked because of its small size and scattered occurrence.

Scapania obcordata (Berggr.) S. W. Arnell

Collection site 13 [gem.]; first marine terrace under bird colony, quartzite outcrops, *Ranunculus*-grass-moss community, on peat soil (K17-1d-10), in mats without admixture of other hepatics.

Arctomontane circumpolar species. The species was characterized by Frisvoll and Elvebakk (1996) as a rare and locally sparse hepatic. According to our data this species is quite common on the archipelago and is locally abundant and dominant in some communities (Konstantinova & Savchenko 2008c, and unpublished data). The rarity of *S. obcordata* in the area treated can be explained by the prevalence of carbonate rocks, which are not a characteristic habitat for this species.

****Schljakovianthus quadrilobus*** (Lindb.) Konstant. & Vilnet

Orthocaulis quadrilobus (Lindb.) H. Buch

Collection sites: 9, 10, 14, 20, 30, 31, 34. Frequent. On soil and in turfs of mosses along rivulets, in depressions between rocky polygons and in detritus lichen communities, on clay soil near snowfields. In dense turfs without other bryophytes or mixed with mosses and hepatics. The commonest admixed species are *Blepharostoma trichophyllum* var. *brevirete*, *Tritomaria scitula*, *Cephaloziella varians* and *Leiocolea heterocolpos* var. *harpanthoides*.

Arctoboreomontane circumpolar species. Common and often abundant in Svalbard (Frisvoll & Elvebakk 1996), including its variety described below.

****Schljakovianthus quadrilobus*** var. ***glareosa*** (Jørg.) Konstant. & Vilnet

Collection sites: 17, 25, 36, 37. Sporadic. In localities drier than those of the type variety. In crevices and hillocks of clay soil, among moss and moss-lichens mats in beds of temporary streams. The commonest admixed hepatics are *Blepharostoma trichophyllum* var. *brevirete* and *Cephaloziella varians*.

****Solenostoma*** cf. ***sphaerocarpum*** (Hook.) Steph. var. ***nanum*** (Nees) R. M. Schust.

Collection site 9; among boulders on bank of mossy stream (K9-1-10); several plants among

Aneura pinguis, *Blepharostoma trichophyllum* var. *brevirete*, *Jungermannia polaris* and *Leiocolea badensis*.

Arctoboreomontane circumpolar species. According to Frisvoll and Elvebakk (1996) all reports of *Solenostoma sphaerocarpum* (as *Jungermannia sphaerocarpa* Hook.) from Svalbard are of var. *nanum.* This taxon is rare in Svalbard but probably overlooked because of its minute size and difficulties in identifying it, especially without the perianth.

Sphenolobus minutus (Schreb.) Berggr.

Collection site 12; moss–*Salix polaris*–herb community along streams under bird colony on marine terrace, on side of hillock (K16-2,4-10), in dense turfs without other bryophytes or with admixture of *Blepharostoma trichophyllum* var. *brevirete*, *Cephalozia ambigua*, *Lophoziopsis polaris*, *Lophozia wenzelii* and *Tritomaria quinquedentata*.

Arctoboreomontane circumpolar species. One of the commonest hepatics in Svalbard but in the studied area it was found at a single locality.

Tritomaria quinquedentata (Huds.) H. Buch

Collection site 11; marine terrace under bird colony, between rocks on moist clay soil on bank of rivulet, in dense turfs without other bryophytes (K14-2-10) or mixed with *Cephaloziella varians* (K14-3b-10); 12: marine terrace under bird colony, steep slope with numerous rivulets, on side of hillock in moss-*Salix polaris*-herb community (K16-2,3-10) mixed with *Blepharostoma trichophyllum* var. *brevirete*, *Cephalozia ambigua*, *Lophoziopsis polaris*, *Lophozia wenzelii* var. *groenlandica* and *Sphenolobus minutus*.

Arctoboreomontane circumpolar species. One of the commonest hepatics in Svalbard.

****Tritomaria scitula*** (Taylor) Jørg.

Collection sites: 20, 21, 28, 29, 30, 34 [gem.]. Sporadic. On clayey soil among lichens and dead mosses along dry stream beds, in depressions in rocky lichen communities, in mossy crevices on soil and on rocks covered by soil between boulders, near rocks on banks of pools. It grows in dense turfs without admixture of hepatics or mixed with hepatics, the commonest of which are *Schljakovianthus quadrilobus* and *Blepharostoma trichophyllum* var. *brevirete*.

Arctomontane circumpolar species, common in Svalbard.

Discussion

A total of 31 species and 5 varieties are recorded in the area treated. Of these, *Cephaloziella polystratosa*, *Lophoziopsis rubrigemma*, *Leiocolea badensis* var. *apiculata* R. M. Schust. were not reported from Svalbard previously. The first two species prefer neutral soil. They were collected from a single locality in Florabukta where sedimentary rocks are distributed. The last hepatic is a calciphile gathered in an area with carbonate bedrock. All these taxa are poorly known arctic hepatics and their finding was quite predictable in the area treated (see Konstantinova 2003).

Very few hepatics have been reported from Nordaustlandet. The previous records are by Berggren (1875) from Parry's Insel, Nordkap, Castrens Insel and Brandewijne Bai, and include *Barbilophozia hatcheri* (as *Jungermannia flörkii* W. M. and *J. lycopodioides* Wallr.; cf. Frisvoll and Elvebakk 1996), *Cephaloziella varians* (as *Jungermannia divaricata* Sm. var. *incurva* Lindb.), *Gymnomitrion concinnatum*, *G. corallioides*, *Marchantia polymorpha*, *Pseudolophozia sudetica* (as *Jungermannia alpestris* Schleich.), *Ptilidium ciliare*, *Saccobasis polita* (as *Jungermannia* polita N. v. Es.), *Scapania obcordata* (as *Sarcoscyphus obcordatus* Berggr.), *Scapania spitsbergensis* (as *Scapania nemorosa* N. v. Es. *β purpurascens*), *Sphenolobus minutus* (as *Jungermannia minuta* Crantz.) and *Tetralophozia setiformis* (as *Jungermannia setiformis* Ehrh.). Two hepatics widespread in Spitsbergen – *Blepharostoma trichophyllum* (as *Jungermannia trichophylla* L.), and *Cephalozia bicuspidata* (as *Jungermannia bicuspidata* L.) – were reported by him without exact localities ('von südlichen bis zu den nördlichsten Theil Spitzbergens' or 'durch das ganze Gebiet verbreitet'). Five more species were recorded by us from Prins Oskars

Land (Konstantinova & Savchenko 2008a-c) as new and/or rare for Svalbard: *Marsupella boeckii*, *Marsupella sprucei*, *Diplophyllum albicans*, *Gymnomitrion apiculatum* and *Lophoziopsis polaris* (as *Lophozia polaris*). Six hepatics not reported earlier for Nordaustlandet (*Anthelia juratzkana*, *Cephaloziella uncinata*, *Marsupella arctica*, *Prasanthus suecicus*, *Scapania hyperborea*, *Tritomaria quinquedentata*) were mentioned in the last paper without any discussion. Twenty-five hepatics were known for Nordauslandet before this study, the majority of them species of acidic or neutral sites.

Only 9 of 25 hepatics reported from Nordaustlandet before were found in the area studied here. Of these, *Cephaloziella varians* and *Blepharostoma trichophyllum* are widespread both in the area treated and in Svalbard. *Lophoziopsis polaris* probably is not rare in Svalbard (Fig. 3) and the area studied. The other six species (*Anthelia juratzkana*, *Barbilophozia hatcheri*, *Marchantia polymorpha* L. subsp. *montivagans*, *Scapania obcordata*, *Sphenolobus minutus*, *Tritomaria quinquedentata*) are quite common hepatics in Svalbard but in the area considered they are known from few or single localities in its easternmost part, particularly in Florabukta. All these hepatics are species with a wide ecological range but they avoid the carbonate rocks prevailing in the treated area.

The exposed bedrock in the vicinity of the Kinnvika Scientific Station is carbonate except in the easternmost part where only a few localities were studied (Fig. 1). The absence in the studied area of the majority of species relatively widespread in Svalbard, collected in Nordauslandet before, illustrate the great influence of bedrock on the distribution of plants and particularly hepatics. The hepatic flora of this area is formed almost exclusively of calciphilous or widespread Ca-tolerant species. The majority of the hepatics new for Nordauslandet collected in the vicinity of Kinnvika are calciphilous. Several of them are common hepatics both in the area treated and in Svalbard: *Jungermannia polaris*, *Schljakovianthus quadrilobus*, *Preissia quadrata*, *Sauteria alpina*, *Tritomaria scitula*. In addition, a number of very rare (*Leiocolea badensis*, *L. heterocolpos* var. *harpanthoides*, *Lophoziopsis pellucida*, *Oleolophozia personii*, *Scapania gymnostomophila*, *S. ligulifolia*) or rare (*Clevea hyalina*) calciphilous hepatics in Svalbard are frequent or sporadic in the environs of the Kinnvika Scientific Station. Some hepatics (e.g., *Leiocolea collaris*, *L. gillmanii*) are rare both in Svalbard and in the studied area.

A few species of predominantly acidic or neutral sites which are common (*Cephalozia ambigua*) or rare (*Lophozia wenzelii*, *Solenostoma sphaerocarpum* var. *nanum*) in Svalbard and not reported before from Nordauslandet were gathered in the easternmost part of the studied area (localities 10–12, Fig. 1). Cosmopolitan Ca-tolerant *Aneura pinguis* is quite common both in Svalbard and in the area treated.

Generally the hepatic flora of the Kinnvika vicinity is clearly arctic. Nearly half (14) of the known species have an arctomontane distribution. Ten species are arctoboreomontane but five of them are represented only (*Blepharostoma trichophyllum*, *Leiocolea heterocolpos*, *Solenostoma sphaerocarpum*) or partly (*Leiocolea badensis*, *Schljakovianthus quadrilobus*) by their high arctic varieties. Four species are poorly known arctic hepatics. Of the remaining three, two are known from the Arctic and alpine belt of mountains and also from islands of Antarctica (*Cephaloziella varians*, *Lophoziopsis propagulifera*) and one is cosmopolitan (*Aneura pinguis*).

In the course of our study of Bockfjord (Konstantinova & Savchenko 2006), the Gronfjord area and Prins Oscars Land (Konstantinova & Savchenko 2008a, c) eight species were added to the list of hepatics of Svalbard published by Frisvoll and Elvebakk (1996): *Anastrophyllum sphenoloboides* R. M. Schust., *Dichiton integerrimum* (Lindb.) H. Buch, *Lophozia silvicoloides* N. Kitagawa, *Lophoziopsis excisa* (Dicks.) Konstant. & Vilnet [*Lophozia excisa* (Dicks.) Dumort.], *Marsupella sprucei* (Limpr.) H. Bern. and *Marsupella boeckii* (Austin) Lindb., *Odontoschisma elongatum* (Lindb.) Evans, and *Saccobasis polymorpha* (R. M. Schust.) Schljakov. Two species new for Svalbard [*Mannia triandra* (Scop.) Grolle, *Metzgeria furcata* (L.) Dumort.] were reported recently by Borovichev (2010). With the hepatics that are new or confirmed for the archipelago and

discussed here, the list of hepatics of Svalbard numbers 99 species, but we are far from comprehensive knowledge of the diversity and especially the distribution of hepatics in the archipelago. We can expect many new findings in Svalbard in the future.

ACKNOWLEDGMENTS. We thank Dr. Vadim Bakalin for review of the manuscript and valuable comments. This research has been financially supported by the Ministry of Economical Development and Trade of Russian Federation; part of this work was supported by the Russian Foundation for Basic Researches (grants No. 09-04-00281a and 12-04-01476a).

REFERENCES

ALEXANDROVA V. D. 1977. Geobotanicheskoye rayonirovaniye Arktiki i Antarktiki. Nauka, Leningrad.

ARNELL S. & MÅRTENSSON O. 1959. A contribution to the knowledge of the bryophyte flora of W. Spitsbergen and Kongsfjorden (King's Bay, 79°N.) in particular. *Ark. Bot.* **4**(6): 105–164

BAKALIN V. A. 2005. Monographicheskaja obrabotka roda *Lophozia* (Dum.) Dum. s.str. Nauka, Moscow.

BERGGREN S. 1875. Musci et Hepaticae Spetsbergenses. Bericht über die Untersuchung der Moosflora Spitsbergensis und Beeren-Eilands während der Schwedischen Expeditionen 1864 und 1868, und Verzeichniss der dort gessammelten Arten. *Kongl. Svenska Vetensk. Akad. Handl.* **13**(7): 1–103.

BOROVICHEV E. A. 2010. New liverwort records from Svalbard. 1. *Arctoa* **19**: 280–281.

DALLMANN W. K., OHTA Y., ELVEVOLD S. & BLOMELER D. (eds) 2002. Bedrock map of Svalbard and Jan Mayen. Temakart No. 33. Norsk Polarinstitutt, Tromsø.

DAMSHOLT K. 2002. Illustrated Flora of Nordic liverworts and hornworts. Nordic. Bryological. Society, Lund.

DAMSHOLT K. & LONG D. 1979. The perianth of *Scapania calcicola* (Arn. et Perss.) Ingham (Hepaticae) and the relationship to *Scapania ligulifolia* (Schust.). *Lindbergia* **5**(2): 73–76.

DAMSHOLT K. & VÁŇA J. 1977. The genus *Jungermannia* L. emend. Dumort. (Hepaticae) in Greenland. *Lindbergia* **4**: 1–26.

ELVEBAKK A. 1985. Higher phytosociological syntaxa on Svalbard and their use in the subdivision of the Arctic. *Nordic J. Bot.* **5**: 273–284.

ELVEBAKK A. 1990. A new method for defining biogeographical zones in the Arctic. In: V. M. KOTLYAKOV & V. E. SOKOLOV (eds), *Arctic research*: *Advances and Prospects*. **2**: 175–186. Academy of Sciences of the USSR, Commission of the Arctic Research, Moscow.

FRISVOLL A. A. & BLOM H. H. 1993. Trua moser i Norge med Svalbard; raud liste. *NINA Utredning* **42**: 1–55.

FRISVOLL A.A. & ELVEBAKK A. 1996. Bryophytes. In: A. ELVEBAKK & P. PRESTRUND (eds), *A catalogue of Svalbard plants*, *fungi*, *algae and cyanobacteria. Part 2*. *Norsk Polarinst. Skr*. **198**: 57–172.

HADAČ E. 1989. Notes on plant communities of Spitsbergen. *Folia Geobot. Phytotax*. **24**: 131–169.

HAGEN A. 1952. Plants collected in Vestspitsbergen in the summer of 1933. *Norsk Polarinstitutt*, *Meddelelser* **70**: 1–14.

KARCZMARZ K. & ŚWIĘS F. 1990. Bryophytes collected in arctic tundra of the eastern slopes of Activekammen (Western Spitsbergen) in 1987–1988. In: J. REPELEWSKA-PEKALOWA & K. PEKALA (eds), *Polar session*, *Periglacial phenomena of western Spitsbergen. Lublin*, *Poland – April 1990. Wyprawy Geograficzne na Spitsbergen*, pp. 175–183. Maria Curie-Sklodowska University, Lublin.

KONSTANTINOVA N. A. 2000. Distribution patterns of the North Holarctic hepatics. *Arctoa* **9**: 29–94. (in Russian with English summary).

KONSTANTINOVA N. A. 2003. On phytogeography of hepatics of Spitzbergen archipelago. In: G. G. MATISHOV & G. A. TARASOV (eds), *Complex investigations of Spitzbergen nature*. **3**: 163–165 & 256 Kola Science Centre, Apatity (in Russian with English summary).

KONSTANTINOVA N. A., BAKALIN V. A. ANDREJEVA E. N., BEZGODOV A. G., BOROVICHEV E. A., DULIN M. V. & MAMONTOV Y. S. 2009. Checklist of liverworts (Marchantiophyta) of Russia. *Arctoa* **18**: 1–64.

KONSTANTINOVA N. A. & KOROLEVA N. E. 2003. On some dwarf forms of hepatics new for Spitzbergen archipelago. In: G. G. MATISHOV & G. A. TARASOV (eds), *Complex investigations of Spitzbergen nature*. **3**: 156–161 & 255–256. Kola Science Centre, Apatity (in Russian with English summary).

KONSTANTINOVA N. A. & SAVCHENKO A. N. 2006. Findings of some rare hepatics in Spitzbergen in western coast of Bockfjorden. In: G. G. MATISHOV & G. A. TARASOV (eds), *Complex investigations of Spitzbergen nature*. **6**: 330–336 & 435. Kola Science Centre, Apatity (in Russian with English summary).

KONSTANTINOVA N. A. & SAVCHENKO A. N. 2008a. Contribution to the hepatic flora of Svalbard. *Lindbergia* **33**: 13–22.

KONSTANTINOVA N. A. & SAVCHENKO A. N. 2008b. Distribution of liverworts, rare for the Svalbard Archipelago, around Piramida (Pyramiden) Settelment. In: G. G. MATISHOV & G. A. TARASOV (eds), *Nature of the shelf and archipelagos of the European Arctic*. *Proceedings of the*

International Scientific Conference (*Murmansk*, *November 9–11*, *2008*). **8**: 177–181. GEOS, Moscow (in Russian with English summary).

KONSTANTINOVA N. A. & SAVCHENKO A. N. 2008c. Hepatics. In: N. E. KOROLEVA, N. A. KONSTANTINOVA, O. A.BELKINA, D. A. DAVYDOV, A. Y. LIKHACHEV, A. N. SAVCHENKO & I. N. Urbabavichene, *Flora and vegetation of Grønfjord area* (*Spitsbergen archipelago*), pp. 54–80. K & M, Apatity (in Russian with English summary).

LINDBERG S. O. 1867. Förteckning öfver mossor: insamlade under de svenska expeditionerna till på Spitsbergen 1858 och 1861. *Kongl. Svenska Vetensk. Acad.*, *Förhandl.* **23**: 535–561.

MÖLLER I. 2000. Pflanzensociologische und vegetationsokologische Studien in Nordwestspitsbergen. *Mitteilungen der Geographishen Gesellschaft in Hamburg* **90**: 1–202.

RUBASINGHE S. C. K., LONG D. G. & MILNE R. 2011. A new combination and three new synonyms in the genus *Clevea* Lindb. (Marchantiopsida, Cleveaceae). *J. Bryol*. **33**(2): 168–169.

SCHUSTER R. M. 1969. The Hepaticae and Anthocerotae of North America east of the hundredth meredian. **2**. Columbia University Press, New York.

SCHUSTER R. M. 1988. The Hepaticae of South Greenland. *Nova Hedwigia* **92**: 1–255.

SCHUSTER R. M. 1992. The Hepaticae and Anthocerotae of North America east of the hundredth meridian. **6**. Columbia University Press, New York.

SCHUSTER R. M. & DAMSHOLT K. 1974. The Hepaticae of West Greenland from ca. 66°N to 72°N. *Meddel. Grønland* **199**(1): 1–373.

SCHUSTER R. M. & DAMSHOLT K. 1987. Some new taxa of Jungermanniales. *Phytologia* **63**(5): 325–328.

SÖDERSTRÖM L., DE ROO R. & HEDDERSON T. 2010. Taxonomic novelties resulting from recent reclassification of the Lophoziaceae/Scapaniaceae clade. *Phytotaxa* **3**: 47–53.

ŚWIĘS F. & KARCZMARZ K. 1991. Bryophytes collected in arctic tundra of the Chamberlin region (Western Spitsbergen) in 1987 and 1988. *Ann. Univ. Mariae Curie-Sklodowska*, *Sect. C*, *Biol*. **46**: 29–43.

Received 25 February 2012