

ON THE HEPATIC FLORA OF SAYAN MOUNTAINS (SOUTH SIBERIA)

К ФЛОРЕ ПЕЧЕНОЧНИКОВ САЯН (ЮЖНАЯ СИБИРЬ)

NADEZHDA A. KONSTANTINOVA¹ & ARKADIJ N. VASILJEV²

Н. А. КОНСТАНТИНОВА¹ и А. Н. ВАСИЛЬЕВ²

Abstract

An annotated list of new or interesting species of hepatics of the Sayan Mountains is presented. It includes 43 taxa new for Sayan, 25 of which are new for South Siberia, and *Diplophyllum obtusatum* is new for Eurasia. A number of species are reported as much more common in Sayan than it was known previously. The peculiarities of distribution of phytogeographically interesting species are discussed. The new combinations are suggested for ten species of the genus *Schistochilopsis* (Kitag.) Konst., comb. nov. (= *Lophozia* subgen. *Schistochilopsis* Kitag., *Massularia* Schljak., nom. illeg.) and for *Cephaloziella arctogena* (Schust.) Konst., comb. nov. (*Cephaloziella rubella* subsp. *arctogena* (Schust.) Schust. & Damsh.).

Резюме

Приводится аннотированный список новых для Саян, а также редких видов печеночников. 43 вида - новые для Саян, из них 25 впервые отмечены для Южной Сибири, а *Diplophyllum obtusatum* Schust. - впервые для Евразии. Многие виды, ранее считавшиеся редкими, оказались широко распространенными в Саянах. Обсуждается также распространение ряда видов, интересных в фитогеографическом отношении. Предложены новые комбинации для 10 видов *Schistochilopsis* (Kitag.) Konst., comb. nov. (= *Lophozia* subgen. *Schistochilopsis* Kitag., *Massularia* Schljak., nom. illeg.) и для *Cephaloziella arctogena* (Schust.) Konst. comb. nov. (*Cephaloziella rubella* subsp. *arctogena* (Schust.) Schust. & Damsh.).

PHYSIOGRAPHY

Eastern and Western Sayan Mountains are situated in the central part in South Siberia. Eastern Sayan (ES) is a mountain range of about 1000 km long stretching from NW to SE. The relief of its NW part is of medium elevation, and the mountains have flat tops, while south-east part has an alpine topography. Here the steep slopes are cut with hollows and valleys, the mountain tops are often sharp and the crests are jagged. The Manku-Sardykh Peak (alt. 3491 m) of Eastern Sayan is the highest point of Sayan. Western Sayan (WS) extends from south-west to north-east and is also about 1000 km long. Alpine relief forms are predominating. The elevations reach 1400 - 3000 m.

The climate of the Sayan is determined by its central position on Eurasiatic continent as well as by local conditions created by the moun-

tains with opened out slopes or deep gorges. The mean annual temperature in the area is below zero, the mean temperature of January at the 900-1400 m elevation is from -17 to -26°C, and that of July is +12° - +18°C. Precipitations are extremely uneven. Humid air masses come from the west or northwest causing annual precipitation of 1200 mm on the northern and western slopes of ES. On the other hand, southern and eastern slopes, hollows and valleys are in rain-shade receiving only 200 to 800 mm annually. The essential amount of annual precipitation falls in summer. The duration of snow cover varies from 200 to 240 days, sometimes - 300 days.

HISTORICAL BACKGROUND, MATERIALS & METHODS

Until last decade only few papers including data on several common hepatics were published (Martyanov, 1882; Arnell, 1898; Elenkin, 1902;

¹ - Polar-Alpine Botanical Garden, Kirovsk-6, Murmansk Prov. 184230 Russia. - Россия 184230 Мурманская обл., Кировск-6, Полярно-Альпийский ботанический сад.

² - Biological Faculty of Krasnoyarsk Pedagogical Institute, A. Lebedeva str., 89, Krasnoyarsk 660049 Russia - Россия 660049 Красноярск, А. Лебедева, 89, Красноярский педагогический институт, Биологический факультет

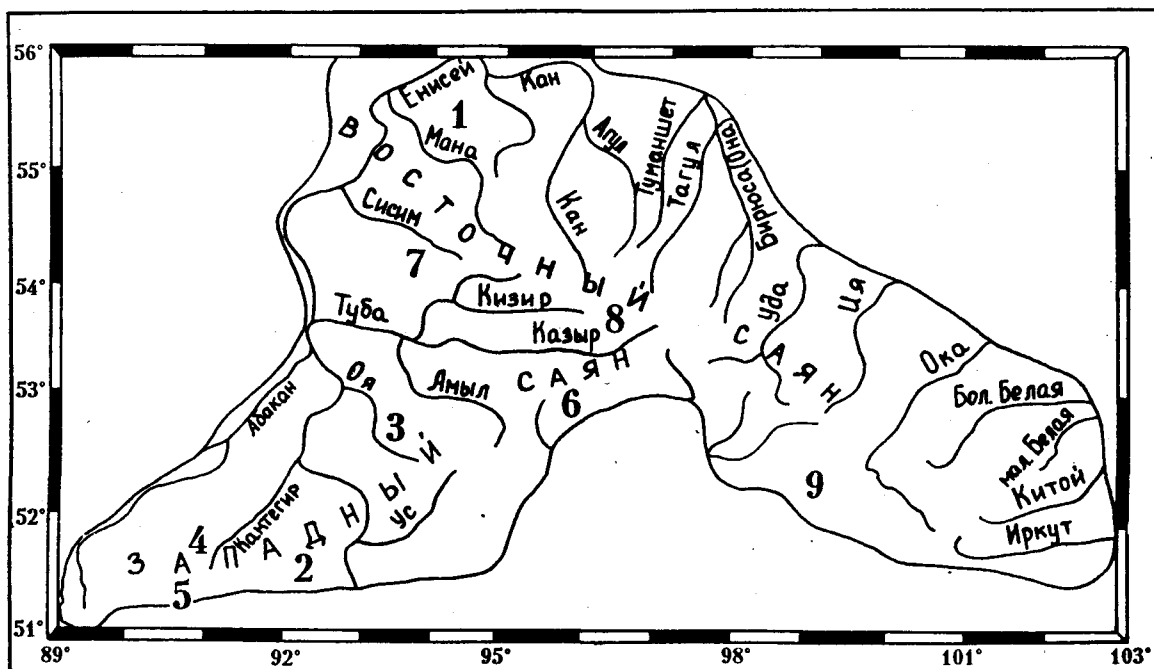


Fig. 1. Map of Western Sayan (Западный Саян) and Eastern Sayan (Восточный Саян) with the collecting localities:

- | | |
|--|---|
| 1 - Nature Reserve State "Stolby" | - Заповедник "Столбы"; |
| 2 - Sayano-Shushenskiy Nature Reserve, Range Khemchikskij | - Саяно-Шушенский заповедник, хр. Хемчикский. |
| 3 - Range Kulumys, Range Oiskij, Malyi Kebezh River, Medvezh'ya and Olenya Rechka | - хр. Кулумыс, хр. Ойский, р. Малый Кебезь, Медвежья и Оленья Речка |
| 4 - Karasibo (Kharasip) River and Karasu River | - рр. Карасибо (Харасип) и Карасу |
| 5 - Ona River, Malyi On River and Bolshoi On River | - рр. Она, Малый Он, Большой Он |
| 6 - Range Ergak-Torgak-Taiga | - хр. Ергак-Торгак-Тайга |
| 7 - Sisim River near railway stations Shchetinkino and Kazyr | - р. Сисим близ ж. д. ст. Щетинкино и Казыр |
| 8 - Vala Range, Kryzhina Range, Grandiozniy Peak, Mezhdurechnoe Lake, Prochnodnaya River | - хр. Вала, хр. Крыжина, пик Грандиозный, оз. Междуреченское, р. Проходная. |
| 9 Topografov Peak, Upper Tissa River | - пик Топографов, верховья р. Тисса |

Brotherus & Savicz, 1932; Kaalas, 1918; Savicz-Ljubitskaya, 1961). Later the knowledge of the hepatics from South Siberia and Sayan particularly was greatly contributed and summarized by Vana (1988). Recently Vasiljev (1992) published the moss and hepatic flora of Nature Reserves "Stolby" and "Sayano-Shushenskij" which are situated in Eastern and Western Sayan respectively.

The present paper is based on the determinations of the specimens collected mainly by A.N. Vasiljev in the course of his extensive field research in Sayan (Fig. 1). Some specimens collected by L. V. Bardunov together with Vasiljev as well as A. E. Sonnicova (indicated in the list of species as L. B. and A. S. respectively) were also studied. Determinations of Vasiljev were revised by the senior author and some taxa published by Vasiljev (1992) were excluded. About 700 herbarium specimens have been de-

termined, and many interesting species were found. In the following list the new taxa for South Siberia and Sayan are presented, as well as some rare species or species previously considered as rare. The species in the list are arranged according Schljakov (1976, 1979-1982), the nomenclature is based on that in Konstantinova & al., (1992), with exception of some changes mentioned below.

As it was found by R. Grolle (pers. corresp.), the name *Massularia* was validated for a genus of vascular plants (Rubiaceae) earlier, than for the genus of hepatics, and therefore is inapplicable to the latter. In some modern studies this genus is regarded as subgenus *Schistochilopsis* Kitag. of the genus *Lophozia* (cf. Schuster, 1988; Bisang, 1991). However, we believe that it is more convenient to work with small genera and follow Schljakov (1972, 1985) that this subgenus to be treated as separate genus.

Schistochilopsis (Kitag.) Konst., comb. nov. - *Lophozia* subg. *Schistochilopsis* Kitag. J. Hattori Bot. Lab. 28: 289. 1965; *Lophozia* subgen. *Massula* K. Muell., Ber. Deutsche Bot. Ges., 57: 341. 1939, *nom. nud.*; *Massula* (K. Muell.) Schljak. - Nov. Syst. Plant. Non Vasc. 9: 314. 1972, *nom. illeg.*; *Massularia* Schljak. - Nov. Syst. Plant. Non Vasc. 22: 232. 1985, *nom. illeg.*, non (K. Schum.) Hoyle in Burtt Davy et Hoyle, Check-Lists For. Trees and Schubs Brit. Emp., No.3, Draft Descr. Check-List Gold Coast: 110. 1937.

Type species: *Lophozia cornuta* (Steph.) Hatt.

As a consequence the names of all species of this genus should be changed as follows:

S. cornuta (Steph.) Konst., comb. nov. - *Schistochila cornuta* Steph., Spec. Hep. 4: 84. 1909.

S. capitata (Hook.) Konst., comb. nov. - *Jungermannia capitata* Hook., Brit. Jungerm.: tab. 80. 1816.

S. laxa (Lindb.) Konst., comb. nov. - *Jungermannia laxa* Lindb., Acta Soc. Sci. Fenn. 10: 529. 1875.

S. grandiretis (Lindb.) Konst., comb. nov. - *Jungermannia grandiretis* Lindb. in Kaal., Nyt. Mag. Naturvid. 33: 322. 1893.

S. nakanishii (Inoue) Konst., comb. nov. - *Lophozia nakanishii* Inoue, Bull. Natl. Sci. Mus. (Tokyo) 9: 37. 1966.

S. incisa (Schrad.) Konst., comb. nov. - *Jungermannia incisa* Schrad., Syst. Samml. Krypt. Gew. 2: 5. 1796.

S. opacifolia (Meyl.) Konst., comb. nov. - *Lophozia opacifolia* Culm ex Meyl., Hep. Suisse: 174. 1924.

S. hyperarctica (Schust.) Konst., comb. nov. - *Lophozia hyperarctica* Schust., Canad. J. Bot. 39: 967. 1961.

S. elegans (Schust.) Konst., comb. nov. - *Lophozia excisa* (Dicks.) Dum. var. *elegans* Schust., Hep. Anthoc. North Amer. 2: 522. 1969; *Massula elegans* (Schust.) Schljak. Pechenochnye mkhi Severa SSSR, 3: 68. 1980, *nom. illeg.*

S. setosa (Mitt.) Konst., comb. nov. - *Jungermannia setosa* Mitt. - J. Proc. Linn. Soc., Bot. 5: 92. "1861" 1860.

ANNOTATED LIST OF HEPATICS RARE OR NEW TO
SAYAN MOUNTAINS

In the following list taxa new for Sayan are marked

by a single asterisk, and those new for South Siberia - by a double asterisk. The main collecting localities are shown on the map (Fig.1) and mentioned in the text under the same number with following detailization of each locality. Voucher specimens are deposited in the Herbarium of Krasnoyarsk State University and in the Herbarium of Polar-Alpine Botanical Garden of Kola Science Center of Russian Academy of Sciences (KPABG).

***Aneura pinguis** (L.) Dum. - ES, 8: Mezhdurechnoe Lake, timberline, brook bank, a few plants among *Saccobasis polita* (5.VIII.1989).

***Riccardia latifrons** (Lindb.) Lindb. - WS, 2: lower course of Golaya River, in *Picea obovata* - *Pinus sibirica* forest (17.VII.1986).

Bazzania bidentula (Steph.) Steph. - WS, 2: mouth of Malaya Golaya River, ca. 1100 m, *Picea obovata* - *Pinus sibirica* forest, on decaying wood (26.VII.1986). The distribution of this species was discussed by Vana & Soldan (1985) who cited the ES as the western and northern limit of this species. The locality in WS extends further its western limit.

***Calyptogeia suecica** (H. Arnell et J. Perss.) K. Muell. - ES, 7: dark coniferous forest, on logs, associated with *Crossocalyx hellerianus*, *Cephalozia connivens*, *Scapania apiculata*, *Ptilidium pulcherrimum* (13.VII.1989). There are many gemmiparous shoots as well as some plants with marsupium without any trace of anteridium in specimens. Plants pellucid to pale yellowish and pale brownish, small, about 1 mm wide and 4-7 mm long, middle leaf cells averaging 25-27 (30) μm . The locality in Sayan is the second in Siberia. The first and easternmost Asiatic locality of this "by no means a rarity of mountains in central and north Europe and north America" is in the surroundings of Baikal Lake (Vana & Soldan, 1985).

***Iwatsukia jishibae** (Steph.) Kitag. - WS, 2: Al-Jan River, on decaying wood, associated with *Anastrophyllum michauxii* and *Lepidozia reptans* (27.VII.1987). Many plants with perianths, male plants and a few sporophytes are presented in the specimen. Plants have numerous flagellae, relatively remote leaves, characteristic shape of leaves and female bracts, pellucid cells with walls markedly thick, and with many distinct "Tangl's canals". However, our plants differ from previous descriptions of the species in larger underleaves which are often deeply bilobed with each lobe up to 10 cells in length and 1-2 cells in width (cf. Schuster, 1968). Androecia on short, ventral-intercalary branches and intercalary on leading axis, spicate, of 3 (4) pairs of closely imbricate bracts larger than leaves in size (300-420 x 350-490 μm), bracts bilobed like leaves, but usually with a discrete antical third lobe or tooth, 1-androus (Fig.2). Anteridial body subglobular, stalk 2-seriate. Capsule oblong-ovoid (most of capsules were open),

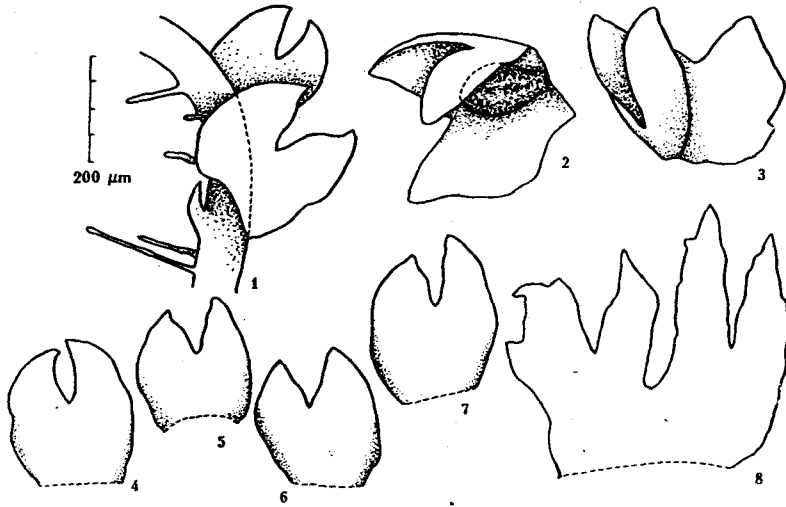


Fig. 2. *Iwatsukia jishibae* (Steph.) Kitag. 1- Part of sterile shoot; 2,3- Male bracts; 4-7 - Leaves; 8 - Female bract

4-valved to base, valves 2-stratose. Elaters 2-spiral, 6-7 μm in diam.; spores small (8-11 μm), 1-celled, finely verruculose. This very rare species was previously known only from Japan, Himalaya, Costa Rica, Mauritius, Reunion and Seychelles, and Papua New Guinea (Vana & Piippo, 1989), but recently J. Vana has found it in Altai Mts. (Konstantinova & al., 1992). Our locality is the second in Russia.

***Pleurocladula albescens** (Hook.) Grolle - WS, 5: Upper Malyi On River, rock-field, on brook bank, dominated in mats (5.VII.1968, L.B.).

****Cephalozia connivens** (Dicks.) Lindb. - ES, 7: dark coniferous forest, on log, associated with *Crossocalix hellerianus*, *Calypogeia suecica*, *Scapania apiculata*, *Ptilidium pulcherrimum* (13.VII.1989).

****Cephaloziella arctogena** (Schust.) Konst., comb. nov. (*Cephaloziella rubella* var. *arctogena* Schust., in Schuster & Damsholt, Meddel. om Gronland 199(1): 314, 1974) - WS, 2: Upper Bolshaya Ura River, alt. 1100 m, in *Larix* + *Betula* shrubby and herbaceous forest, among *Dicranum fragilifolium* Lindb., *Crossogyna autumnalis*. In the specimen studied were many paroicous and some heteroicous plants, as well as some plants with mature sporophytes. Paroicous inflorescence, small cells (at lobe bases mostly 9-11 μm), spores of 7-9 μm , distinct underleaves and red or brown secondary pigmentation place our specimen in *C. arctogena*. But the cells of perianth mouth are a little longer than those described previously; averaging 9-11 x 34-43 (49) μm (Fig.3), not 7-8 x 25-38 (40) μm (Schuster, 1980, 1988; Damsholt and Long, 1983).

In the size of perianth mouth cells (as well as in paroicous inflorescence) the plants from Sayan approach to "very poorly understood" *C. stellulifera* (Schuster, 1980). They differ however from the latter in much smaller cells, presence of secondary pigmentation, and non-squarrose bract lobes. Furthermore, the cells of perianth mouth of studied plants

are thin-walled and not free at their apices. This is not characteristic for *C. stellulifera*. *C. arctogena* was considered previously as an arctic subspecies of *C. rubella* (Schuster, 1980; Potemkin, 1993). The finding in Sayans changes completely distributional pattern of this taxa and provides an additional argument to distinguish it as a separate species.

****C. divaricata** (Sm.) Schiffn. var. *divaricata* - ES, 8: Wala Range, *Pinus sibirica* forest, in ground vegetation, some plants among *Orthocaulis kunzeanus* (7.VIII.1989). Earlier from Sayans var. *scabra* (M.A. Howe) S. Arnell was known only (Vana & Soldan, 1985).

C. divaricata var. *scabra* (M. A. Howe) S. Arnell - ES, 1: mouth of Indei Stream, Mana River Valley, on cliffs, mixed with *Radula complanata* (26.VI.1984). Second record in ES.

****C. subdentata** Warnst. - WS, 2: Khemchikskij Range, northern slope, right bank of Aldy-Uzyk River, near trail, ca. 1590 m., among *Dicranum elongatum* (1.VII.1983, A.S.).

***Orthocaulis floerkei** (F. Web. et Mohr) Buch - in ground vegetation of forests, open woodlands, alpine meadows, sometimes on humus among rocks on rock-fields. Common both in WS and ES.

***Barbilophozia hatcheri** (Evans) Loeske - not rare in the ground vegetation of forest, in high mountains, on rock outcrops, among rocks on rock-field, etc. Both in WS and ES.

****Leiocolea gillmanii** (Aust.) Evans - WS, 3: Olenya Rechka, ca. 1400 m, on rocks in river bed, not submerged (18.VI.1968, L.B.); ES, 8: Kryzhina Range, alpine meadow, on boulders, associated with *Leiocolea heterocolpos*, *Scistocheilopsis incisa*, *Blepharostoma trichophyllum* (6.VIII.1989), and in high mountains in cliff crevices, associated with *Scapania cuspiduligera*, *Blepharostoma trichophyllum*, *Preissia quadrata* (6.VIII.1989); Wala Range, brook bank, associated with *Scapania cuspiduligera*, *Blepharostoma*

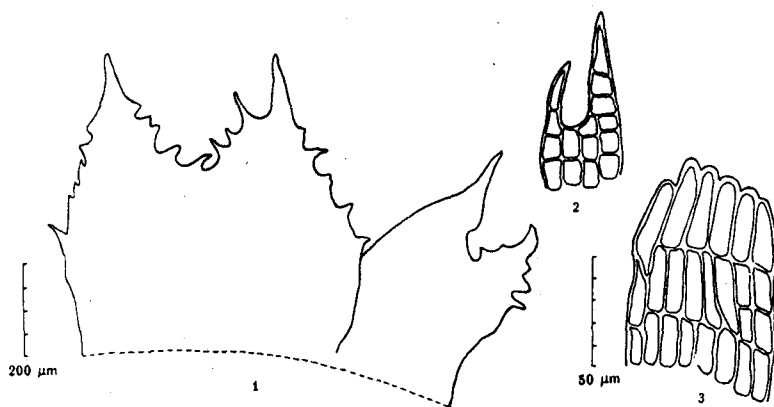


Fig. 3. *Cephaloziella arctogena* (Schust.) Konst. - 1- Female bract and bracteole; 2-Underleaf; 3- Sector of perianth mouth

trichophyllum, *Pellia neesiana* (10.VIII.1991).

***L. bantriensis* (Hook.) Joerg. - ES, 8: Kryzhina Range, high mountains, in crevices, associated with *Preissia quadrata*, *Scapania cuspiduligera*, *Jungermannia pumila*, *Blepharostoma trichophyllum* (6.VIII.1991).

***L. alpestris* (F.Web.) Isov. - ES, 1: near Inzhul Cordon, spruce forest with *Pinus sibirica*, on humus and rock (20.VI.1986).

***Schistochilopsis grandiretis* (Lindb.) Konst. - ES, 8: Kryzhina Range, Upper Prokhodnaya River, on rocks at stream bank, associated with *Schistochilopsis opacifolia*, *Leiocolea heterocolpos*, *Tritomaria scitula*, *Solenostoma confertissimum*, *Lophozia major*, *Blepharostoma trichophyllum*, *Marchantia alpestris* (2.VIII.1991).

***S. opacifolia* (Culm.) Konst. - ES, 8: Kryzhina Range, high mountains, on rocks, associated with *Gymnomitrium concinatum*, *Lophozia sudetica*, *Marsupella boeckii* (6.VIII.1989) and Upper Prokhodnaya River, on rocks at stream bank, mixed with *Blepharostoma trichophyllum*, *Leiocolea heterocolpos*, *Tritomaria scitula*, *Solenostoma sphaerocarpaceum*, *Lophozia major* (2.VIII.1989).

***Lophozia major* (C. Jens.) Schljak. - WS, 5: Upper Malyi On River, mountain tundra, on brook bank, associated with *Solenostoma confertissimum*, *Orthocaulis quadrilobus*, *Cephalozia pleniceps*, *Blepharostoma trichophyllum*, *Lophozia confertifolia*, *Scapania cf. irrigua* (4.VII.1968, L.B.); ES, 8: Kryzhina Range, Upper Prokhodnaya River, on deposit substrate on rocks at stream bank, associated with *Tritomaria scitula*, *Schistochilopsis grandiretis*, *Leiocolea heterocolpos*, *Solenostoma confertissimum*, *Blepharostoma trichophyllum*, *Marchantia alpestris* (2.VIII.1991); on rocks at stream bank, associated with *Blepharostoma trichophyllum*, *Leiocolea heterocolpos*, *Tritomaria scitula*, *Schistochilopsis opacifolia*, *Solenostoma sphaerocarpaceum*, *Scapania sp.* (2.VIII.1989); 9: Upper Tissa River, on brook bank, some stems among *Scapania subalpina*, *Tritomaria quinqueidentata*, *Blepharostoma trichophyllum*, *Leiocolea heterocolpos* (14.VIII.1990).

**L. sudetica* (Nees ex Hueb.) Grolle - WS, 2:

Upper Malaya Ura River, ca. 1750 m, at lake shore, with *Gymnocolea inflata*, *Nardia geoscyphus* (26.VII.1987); ES, 9: Upper Tissa River, high mountains, on rock-field, in depressions (10.VIII.1990).

***Gymnocolea inflata* (Huds.) Dum. - WS, 2: Upper Malaya Ura River, ca.1750 m, at lake shore, in pure patches or associated with *Lophozia sudetica*, *Nardia geoscyphus* (26.VII.1987).

***Tritomaria scitula* (Tayl.) Joerg. - ES, 8: Upper Prokhodnaya River, on rocks, on stream bank, on deposit substrate, associated with *Schistochilopsis grandiretis*, *Leiocolea heterocolpos*, *Solenostoma confertissimum*, *Lophozia major*, *Blepharostoma trichophyllum*, *Marchantia alpestris* (2.VIII.1991); Wala Range, on brook bank, mixed with *Blepharostoma trichophyllum*, *Leiocolea heterocolpos* (7.VIII.1989).

Anastrophyllum michauxii (F. Web.) Buch - on decaying wood in dark coniferous forests, often with perianths, sometimes with sporophytes. Evidently not rare both in WS (1,5) and ES (8).

***Saccobasis polita* (Nees) Buch - ES, 8: Mezhdurechnoe Lake, timberline, on brook bank, female plants in pure tuft, plants with antheridia - mixed with mosses and *Aneura pinguis* (5.VIII.1989).

***Nardia geoscyphus* (De Not.) Lindb. - WS, 2: Upper Malaya Ura River, ca. 1750 m, at lake shore, associated with *Lophozia sudetica*, *Gymnocolea inflata* (26.VII.1987); ES, 8: Kryzhina Range, high mountains, on cliff, associated with *Cephalozia pleniceps*, *Tritomaria quinqueidentata*, *Blepharostoma trichophyllum*, *Leiocolea heterocolpos* (6.VIII.1989).

***Jungermannia pumila* With. - ES, 8: Kryzhina Range, high mountains, in crevices, associated with *Preissia quadrata*, *Scapania cuspiduligera*, *Leiocolea bantriensis*, *Blepharostoma trichophyllum* (6.VIII.1991), and on cliff, associated with *Blepharostoma trichophyllum*, *Solenostoma confertissimum* (6.VIII.1989).

***Solenostoma confertissimum* (Nees) Schljak. - WS, 5: Upper Malyi On River, on brook bank, associated with *Lophozia major*, *Orthocaulis quadrilobus*, *Cephalozia pleniceps*, *Blepharostoma trichophyllum* var. *brevirete*, *Lophozia confertifolia*,

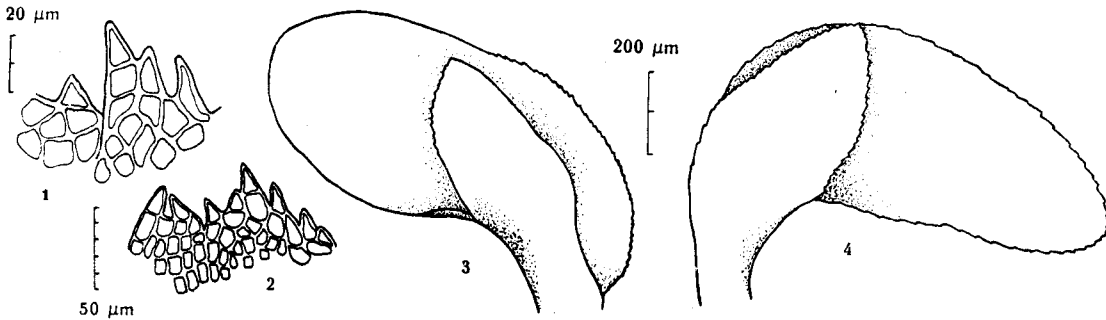


Fig. 4. *Diplophyllum obtusatum* Schust. 1-2 - Sectors of perianth mouth; 3-4 Leaves.

Scapania cf. *irrigua* (4.VII.1968, L.B.); 3: near Olenya Rechka, ca. 1400 m, on rocks in stream, some stems among *Plectocolea obovata*, *Leiocolea gillmanii* (18.VI.1968, L.B.); ES, 8: Upper Prokhodnaya River, on stream bank, on deposit substrate, on rocks, among *Schistochilopsis opacifolia*, *S. grandiretis*, *Leiocolea gillmanii*, *Tritomaria scitula*, *Lophozia major*, *Blepharostoma trichophyllum*, *Marchantia alpestris* (2.VIII.1991).

****S. sphaerocarpum** (Hook.) Steph. var. **nana** (Nees) Schust. - ES, 9: Upper Tissa River, high mountains, on stream bank, associated with *Scapania obcordata* and *Anthelia juratzkana* (8.VIII.1990); 8: Upper Prokhodnaya River, on stream bank, on rocks, associated with *Blepharostoma trichophyllum*, *Leiocolea heterocolpos*, *Tritomaria scitula*, *Schistochilopsis opacifolia*, *Lophozia major*, *Scapania* sp. (2.VIII.1989). Status of this taxon is problematic (cf. Schuster, 1988; Koponen et al., 1977; Potemkin, 1993) but we believe that it will be better to distinguish it. Sayanan plants differ from typical *S. sphaerocarpum* in smaller size of shoots (to 10 mm long x 0.6 mm wide), leaves (ca. 550-600 x 400-450 µm) and cells (marginal ca. 18-20 µm and median ca. 20-23 µm) as well as more broad leaves (width:length ratio 1.1 - 1.3!). They differ from *S. confertissimum* in not fasciculate rhizoids, arising from stem only, and the absence of any trace of vinaceous pigmentation.

Plectocolea obovata (Nees) Lindb. - WS, 3: near Olenya Rechka, ca. 1400, on rocks in stream, associated with *Scapania subalpina*, *Leiocolea gillmanii*, *Solenostoma confertissimum*, (18.VI.1968, L.B.); ES, 3: near Olenya Rechka, Oiskoe Lake, submerged (31.VII.1966). Previously this species was known from the mountain Altaen in WS only (Kaalas, 1918).

Gymnomitrium concinnatum (Lightf.) Corda - on rock outcrops, evidently not rare in upper belts of both ES and WS. Previously was reported from ES only (Vana, 1988).

****Marsupella sphacelata** (Gierske ex Lindenb.) Dum. - WS, 3: Olenya Rechka, ca. 1400 m, on rocks in brook, submerged, associated with *Scapania undulata* (20.VI.1968, L.B.).

****M. boeckii** (Aust.) Lindb. ex Kaal. - ES, 8:

Kryzhina Range, high mountains, on rock outcrops, associated with *Gymnomitrium concinnatum*, *Lophozia sudetica*, *Schistochilopsis opacifolia* (6.VIII.1989).

Macrodiplophyllum microdontum (Mitt.) H. Perss. - WS, 2: Upper Golaya River, high mountains, rock-field, in depressions, pure mats (29.VII.1986). Previously it was recorded for ES (Vana & Soldan, 1985). Our locality is the westernmost.

****Diplophyllum obtusatum** (Schust.) Schust. - ES, 9: upper part of Tissa River basin, light *Larix* forest, on boulder, on edge of mat of *Scapania scandica*, *Tritomaria quinquedentata*, *Sphenobolus minutus* (3.VIII.1990). First locality in Eurasia. This taxon has been described by Schuster (1974) from Minnesota, and occurred just in few localities in North America. In Sayan only some stems of this species were collected, but they were distinctly autoicous with antheridia disposed on branches with small leaves beneath perianth. This species can be distinguished from closely allied *D. obtusifolium* as follows:

- Autoicous, with numerous subfloral, often male innovations; antheridia disposed on abbreviated (shorter than adjacent leaves of the main shoots) branches with small reduced bracts, perianth bordered by 1-2-celled teeth with apical cell usually elongated but its length:width ratio do not exceed 1:2 and more often is 1:1.5 (in plants from Sayan the more elongated apical cells are 9-12 x 17-22 µm), cells of teeth up to 18-20 µm wide (in Sayan plants about 14-15 µm); gemmae usually present (in Sayan specimens gemmae not found may be because of very sparse material with perianth and male innovations on each stem, cf. Schuster, 1974: 219, footnote); dorsal lobe with subacute or weakly apiculate apex (Fig. 4), cells coarsely papillose *D. obtusatum*

- Paroicous, male bracts large, situated below perianth near apex of leading stems; subfloral innovations only exceptionally developed; perianth mouth with some or many teeth formed of 2-3 elongated cells, the wide-length ratio of apical cells often more than 1:2 and can exceed 1:3 (4); gemmae usually absent; dorsal lobe broadly rounded at the apex, cells usually more or less faintly papillose *D. obtusifolium*

***D. obtusifolium** (Hook.) Dum. - WS, 2: Lower Golaya River, on rock outcrops in shade, several stems among *Sphenolobus minutus* (17.VII.1986).

***Scapania apiculata** Spruce - ES, 7: dark coniferous forest, on log, associated with *Crossocalix hellerianus*, *Cephalozia connivens*, *Calypogeia suecica*, *Ptilidium pulcherrimum* (13.VII.1989). The second locality in Asia, the first one is in surroundings of Baikal Lake (Vana, 1988). Some plants with anteridia; the only one shoot with very small (9-11 µm) one-celled red gemmae was found in our collections. Leaf cells with characteristic very coarse bulging trigones.

***S. crassiretis** Bryhn - WS, 2: Malaya Golaya River mouth, ca. 1100 m, at river bank, on rocks, associated with *S. rufidula* and *Tritomaria exsecta* (26.VII.1990); Lower Golaya River, on cliff, associated with *Sphenolobus minutus* and *Diplophyllum obtusifolium* (17.VII.1986); ES, 9: Upper Tissa River, high mountains, rock-field, on rocks covered with humus, associated with *S. spitsbergensis*, *Tritomaria quinque-dentata* (10.VIII.1990).

S. cuspiduligera (Nees) K. Muell. - ES, 8: Kryzhina Range, high mountains, in cliff crevices, mixed with *Blepharostoma trichophyllum*, *Leiocolea gillmanii*, *Preissia quadrata* (6.VIII.1989); WS, 5: Bolshoi On River, ca. 1050 m, on rocks at river bank (14.VII.1968, L.B.). Previously was recorded from ES (Vana, 1988).

****S. gymnostomophila** Kaal. - ES, 1: Mana River, near Cordon Berdy, dark coniferous forest, on rocks, several shoots scattered among *Amphidium lapponicum* (4.VIII.1985).

** **S. kaurinii** Ryan - ES, 9: Upper Tissa River, high mountains, rock-field, on rocks covered with humus, associated with *S. spitsbergensis* and *Tetralophozia setiformis* (10.VIII.90). The record of this rather rare and poorly known taxon in Sayan is of great interest. According Schuster (1974), many records of *S. kaurinii* from America are doubtful. In our specimens some clearly parvicous plants were found. They are characterized also by lobulate-ciliate perianth mouth, typical "kaurinii" shape of leaves, small trigones of cells, mostly two-celled, greenish mixed with purple gemmae averaging 17-20 x 20-29 µm.

****S. obcordata** (Berggr.) S. Arnell - ES, 9: Upper Tissa River, high mountains, on stream bank, associated with *Solenostoma sphaerocarpum* var. *nana* and *Anthelia juratzkana* (8.VIII.1990).

****S. paludicola** Loeske et K. Muell. - WS, 4: Upper Karasu River, ca. 1850 m, swampy meadow, near pool (6.VII.1968, L.B.).

***S. rufidula** Warnst. - WS, 2: Malaya Golaya River mouth, ca. 1100 m, on rocks at stream bank, associated with *Scapania crassiretis* (26.VII.1986); Lower Malaya Golaya River, on deposit substrate on rocks at river bank (17.VII.1986); 3: Olenya Rechka,

rock-field, on rocks covered with humus, mixed with *Tritomaria quinque-dentata* (20.VI.1968, L.B.).

***S. scandica** (H. Arnell et Buch) Macv. f. **parvifolia** (Warnst.) Schljak. - ES, 9: Upper Tissa River, *Larix sibirica* + *Pinus sibirica* light forest, on humus on boulder, associated with *Schistochilopsis opacifolia*, *Blepharostoma trichophyllum*, *Sphenolobus minutus* (14.VIII.1990); *Pinus sibirica* light forest, on fine soil layer on boulder, mixed with *Cephalozia bicuspidata* (4.VIII.1990); light *Larix* forest, on rocks, associated with *Diplophyllum obtusatum*, *Tritomaria quinque-dentata*, *Sphenolobus minutus* (3.VIII.1990); ES, Saryg-Sen, ca. 750 m, in spruce forest (*Picea obovata*), on decaying stump, mixed with *Lophocolea heterophylla* (24.VII.1968, L.B.).

***S. sphaerifera** Buch et Tuomik. - WS, 2: Malaya Golaya River mouth, ca. 1100 m, *Pinus sibirica* forest, on boulder, in one specimen mixed with *Andreaea rupestris* and *Sphenolobus minutus*, in another - several stems with perianths, mixed with *Andreaea rupestris*, *Tritomaria exsectiformis*, *Sphenolobus saxicola* (26.VII.1986).

***S. spitsbergensis** (Lindb.) K. Muell. - WS, 2: Malaya Golaya River mouth, ca. 1100 m, on rocks at river bank, associated with *Tritomaria exsecta* (26.VII.1986); 3: Olenya Rechka, ca. 1400 m, rock-field, on rocks covered with humus, associated with *Gymnomitrium concinatum*, *Marsupella emarginata*, *Blepharostoma trichophyllum*, *Tritomaria quinque-dentata*, *Barbilophozia hatcheri* (20.VI.1968, L.B.); ES, 9: Upper Tissa River Basin, high mountains, rock-field, on rocks covered with humus, mixed with *Cephalozia bicuspidata*, *Leiocolea heterocolpos* or *Barbilophozia hatcheri*, *Marsupella emarginata*, *Tetralophozia setiformis*, *Gymnomitrium concinatum*, *Tritomaria quinque-dentata* (10.VIII.1990).

***S. subalpina** (Nees ex Lindenb.) Dum. - WS, 3: Olenya Rechka, ca. 1400 m, on rocks in river bed, plants with perianths and sporophytes, mixed with *Plectocolea obovata*, *Leiocolea gillmanii*, *Solenostoma confertissimum* (18.VI.1968, L.B.); ES, 8: Wala Range, timberline, brook bank, with *Marchantia alpestris* (7.VIII.1990); 9: Upper Tissa River basin, *Larix* forest, brook bank, on fine soil layer on rocks (9.VIII.1990); Upper Tissa River, brook bank, with *Tritomaria quinque-dentata*, *Blepharostoma trichophyllum*, *Leiocolea heterocolpos*, *Lophozia major* (14.VIII.1990).

***S. uliginosa** (Lindenb.) Dum. - ES, 9: Upper Tissa River, stream bank in light *Larix* forest, with *S. subalpina*, *Blepharostoma trichophyllum* var. *brevirete*, *Lophozia major*, *Tritomaria quinque-dentata*, *Leiocolea heterocolpos* (14.VIII.1990).

S. undulata (L.) Dum. - WS, 3: Olenya Rechka, ca. 1400 m, on rocks in brook, submerged, mixed with *Marsupella sphacelata* (20.VI.1968, L.B.). Pre-

viously was recorded for ES (Vana, 1988).

***Mannia fragrans** (Balb.) Frye et Clark - ES, 1: Mana River, Khaidynka, on cliff (3.VIII.1985).

Pressia quadrata (Scop.) Nees ES, 8: Kryzhina Range, high mountains, in cliff crevices, with *Scapania cuspiduligera*, *Blepharostoma trichophyllum*, *Leiocolea gillmanii* (6.VIII.1989). Previously was known from WS (Vasiljev, 1992).

****Marchantia alpestris** (Nees) Burgeff: ES, 8: Upper Prokhdnaya River, river bank, on deposit substrate on rocks, associated with *Schistochilopsis opacifolia*, *S. grandiretis*, *Leiocolea heterocolpos*, *Tritomaria scitula*, *Solenostoma confertissimum*, *Lophozia major*, *Blepharostoma trichophyllum* (2.VIII.1991), and Wala Range, timberline, brook bank, mixed with *Scapania subalpina* (7.VIII.1989).

DISCUSSION

Most of the species listed above are more or less common hepatics. Many of them have hypoarcto-montane distribution (*Leiocolea gillmanii*, *L. bantriensis*, *L. alpestris*, *Lophozia sudetica*, *Tritomaria scitula*, *Scapania scandica*, *S. paludicola*, *S. subalpina*). Boreal species are fewer (*Riccardia latifrons*, *Cephalozia divaricata*, *Gymnocolea inflata*) as well as arcto-alpine species (*Pleurocladula albescens*, *Schistochilopsis opacifolia*) and montane hepaticae (*Jungermannia pumila*). One of the new for Sayan records is believed to be a cosmopolitan species (*Aneura pinguis*). Predominance of hypoarcto-montane species among listed above hepatics may be explained by comparatively poorly explored upper belt of the Sayans.

However, besides these common species there were found several hepatics having sporadic distribution in the world (*Schistochilopsis grandiretis*, *Diplophyllum obtusifolium*, *Scapania spitsbergensis*, *S. kaurinii*, *Lophozia major*, *Calypogeia suecica*).

The recent discovery in Sayans of some hepatics change considerably their phytogeographical patters. So, some species (*Nardia geoscyphus*, *Marsupella sphacelata*, *M. boeckii*, *Scapania undulata*) previously were reported as oceanic species (Schljakov, 1981). *Orthocaulis floerkei* was known as "species with a rather disjunct, suboceanic distribution in the Northern Hemisphere: Europe, western and eastern North America and two locations in the Far East..." (Gradstein & Vana, 1987). However it appears to be widespread in Sayan and evidently in the whole South Siberia. *Saccobasis polita* and *Plectocolea obovata* were known earlier as European-American species (Schljakov, 1980, 1981).

Of the special interest is the repeated collection of *Scapania sphaerifera* in the Western Sayan; earlier it was reported for Eastern Sayan (Vana & Soldan, 1987). Collections of *Macrolophyllum microdontum* and *Scapania rufidula*, rather rare eastern asiatic spe-

cies in Western Sayan are the most western localities for both of them.

The remarkable record is the little known species *Diplophyllum obtusatum*, previously known from North America only.

A number of hepatics were found to be much more widespread in Sayans than it was previously known: *Lophozia longiflora*, *L. confertifolia*, *Cephalozia pleniceps*, *C. lunulifolia*, *C. leucantha*, *Obtusifolium obtusum*, *Schistochilopsis incisa*, *Orthocaulis kunzeanus*, *Marsupella emarginata*, *Mylia taylorii*. They were recorded from one or two localities, but in fact appears to be not rare in both Western and Eastern Sayan.

Combining all available data, the flora of Hepaticae of Sayan Mts. includes 127 species. Certainly, it is not a limit, and further investigations will reveal many rare and interesting hepatics.

THE LIST OF HEPATICS OF SAYAN MTS.

(! - species revised by the senior author)

- Anastrophyllum michauxii* (F.Web.) Buch !
Aneura pinguis (L.) Dum. !
Anthelia juratzkana (Limpr.) Trev. !
Apometzgeria pubescens (Schrank) Kuwah. (Vasiljev, 1992)
Arnellia fennica (Gott.) Lindb. !
Asterella saccata (Wahlenb.) Evans (Vasiljev, 1992)
Barbilophozia barbata (Schmid. ex Schreb.) Loeske !
B. hatcheri (Evans) Loeske !
B. lycopodioides (Wallr.) Loeske !
Bazzania bidentula (Steph.) Steph. !
B. tricrenata (Wahlenb.) Lindb. (Vasiljev, 1992)
Blasia pusilla L. (Vana, 1988)
Blepharostoma trichophyllum (L.) Dum. !
 var. *brevirete* Bryhn et Kaal. !
Calypogeia integristipula Steph. !
C. muelleriana (Schiffn.) K.Muell. (Vasiljev, 1992)
C. neesiana (C.Mass. et Carest.) K.Muell. (Vasiljev, 1992)
C. suecica (H.Arnell et J.Perss.) K.Muell. !
Cephalozia bicuspidata (L.) Dum. !
C. connivens (Dicks.) Lindb. !
C. leucantha Spruce !
C. lunulifolia (Dum.) Dum. !
C. pleniceps (Aust.) Lindb. !
Cephalozia arctogena (Schust.) Konst. !
C. divaricata (Sm.) Schiffn. !
 var. *scabra* (M.A.Howe) S.Arnell !
C. subdentata Warnst. !
Chiloscyphus polyanthos (L.) Corda (Vasiljev, 1992)
C. pallescens (Ehrh. ex Hoffm.) Dum. (Vasiljev, 1992)
Conocephalum conicum (L.) Und. (Savicz-Ljubitskaya, 1961; Vasiljev, 1992)
Crossocalyx hellerianus (Nees ex Lindenb.) Meyl. !
Crossogymna autumnalis (DC.) Schljak. !
Diplophyllum obtusatum (Schust.) Schust. !
D. obtusifolium (Hook.) Dum. !
D. taxifolium (Wahlenb.) Dum. !
Frullania bolanderi Aust. (Vana & Soldan, 1985; Vasiljev, 1992)
F. davurica Hampe (Vana, 1988; Vasiljev, 1992)
F. dilatata (L.) Dum. (Vana, 1988; Vasiljev, 1992)
F. kaponenii Hatt. (Vana & Soldan, 1985)

- F. cf. nisquallensis* Sull. !
F. parvistipula Steph. (Vana & Soldan, 1985)
Gymnocolea inflata (Huds.) Dum. !
Gymnomitrium concinnatum (Lightf.) Corda !
G. coralloides Nees !
Herbertus aduncus (Dicks.) S. Gray (Vana, 1988; Vasiljev, 1992)
Isopaches bicrenatus (Schmid. ex Hoffm.) Buch !
Iwatsukia jishibae (Steph.) Kitag. !
Jungermannia pumila With. !
Leiocolea alpestris (F. Web.) Isov. !
L. bantriensis (Hook.) Joerg. !
L. gillmanii (Aust.) Evans. !
L. heterocolpos (Thed. ex Hartm.) Buch !
Lepidozia reptans (L.) Dum. !
Liochlaena subulata (Evans.) Schljak. (Vasiljev, 1992)
Lophocolea heterophylla (Schrad.) Dum. !
L. minor Nees !
Lophozia confertifolia Schiffn. !
L. excisa (Dicks.) Dum. !
L. longidens (Lindb.) Macoun !
L. longiflora (Nees) Schiffn. !
L. major (C. Jens.) Schljak. !
L. sudetica (Nees ex Hueb.) Grolle !
L. ventricosa (Dicks.) Dum. !
L. wenzelii (Nees) Steph. (Vana, 1988; Vasiljev, 1992)
Macrodiplphyllum microdotum (Mitt.) H. Perss. !
Mannia fragrans (Balb.) Frey et Clark !
M. pilosa (Horn.) Frey et Clark (Vana, 1988)
M. sibirica (K. Muell) Frey et Clark (Vasiljev, 1992)
Marchantia alpestris (Nees) Burgeff !
M. polymorpha L. !
Marsupella boeckii (Aust.) Lindb. ex Kaal. !
M. emarginata (Ehrh.) Dum. !
M. revoluta (Nees) Dum. (Vana, 1988)
M. sphacelata (Giesek. ex Lindenb.) Dum. !
Metzgeria furcata (L.) Dum. (Vasiljev, 1992)
Mylia anomala (Hook.) S. Gray (Vasiljev, 1992)
M. taylori (Hook.) S. Gray !
Nardia geoscyphus (De Not.) Lindb. !
Obtusifolium obtusum (Lindb.) S. Arnell !
Odontoschisma denudatum (Mart.) Dum. (Vana, 1988)
O. elongatum (Lindb.) Evans (Vasiljev, 1992, doubtful record)
Orthocaulis attenuatus (Mart.) Evans !
O. floerkei (F. Web. et Mohr) Buch !
O. kunzeanus (Hueb.) Buch !
O. quadrilobus (Lindb.) Buch !
Pellia neesiana (Gott.) Limpr. !
Plagiochila porelloides (Torrey ex Nees) Lindenb. !
Plectocolea obovata (Nees) Lindb. !
P. hyalina (Lyell) Mitt. (Krasnoborov, Vasiljev, 1986)
Pleurocladula albescens (Hook.) Grolle !
Porella gracillima Mitt. (Vana, 1988)
P. platyphylla (L.) Pfeiff. !
Preissia quadrata (Scop.) Nees !
Ptilidium ciliare (L.) Hampe !
P. pulcherrimum (G. Web.) Vain. !
Radula complanata (L.) Dum. !
Reboulia hemisphaerica (L.) Raddi (Savicz-Ljubitskaya, 1961; Vasiljev, 1992)
Riccardia latifrons (Lindb.) Lindb. !
Ricciocarpos natans (L.) Corda (Savicz-Ljubitskaya, 1961)
Riccia bifurca Hoffm. (Vasiljev, 1992)
Saccobasis polita (Nees) Buch !
Scapania apiculata Spruce !
S. crassiretis Bryhn. !
S. cuspiduligera (Nees) K. Muell. !
S. gymnostomophila Kaal. !
S. hirosakiensis Steph. ex K. Muell. (Vana & Soldan, 1985)
S. irrigua (Nees) Nees !
S. kaurinii Ryan !
S. obcordata (Berggr.) S. Arnell !
S. paludicola Loeske et K. Muell. !
S. rufidula Warnst. !
S. scandica (H. Arnell et Buch) Macv. !
S. sphaerifera Buch et Tuomik. !
S. spitsbergensis (Lindb.) K. Muell. !
S. subalpina (Nees ex Lindenb.) Dum. !
S. uliginosa (Lindenb.) Dum. !
S. undulata (L.) Dum. !
Schistochilopsis grandiretis (Lindb.) Konst. !
S. incisa (Schrad.) Konst. !
S. opacifolia (Meyl.) Konst. !
Solenostoma confertissimum (Nees) Schljak. !
S. gracillimum (Sm.) Schust. f. *crenulatum* (Mitt.) Schust. (Krasnoborov & Vasiljev, 1986)
S. sphaerocarpum (Hook.) Steph. !
Sphenobolus minutus (Schreb.) Berggr. !
S. saxicola (Schrad.) Steph. !
Tetralophozia setiformis (Ehrh.) Schljak. !
Tritomaria execta (Schmid. ex Schrad.) Loeske !
T. exectiformis (Breidl.) Schiffn. ex Loeske !
T. quinquentata (Huds.) Dum. !
T. scitula (Tayl.) Joerg. !

Excluded taxa

Erroneous identification

Pellia epiphylla
Leiocolea badensis
Lophozia ascendens
Sphenobolus cavifolius
Scapania praeteroisa Meyl.
S. verrucosa Heeg.
Marsupella brevissima

Corrected identification

Pellia neesiana
Lophocolea minor
Lophozia ventricosa
Different taxa
S. gymnostomophyla
Macrodiplphyllum microdontium
Lophozia sudetica

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