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Botanica Pacifica
Botanical Garden-Institute FEB RAS
Makovskii Str. 142
Vladivostok 690024 RUSSIA

http://www.geobotanica.ru/bp

botanica.pacifica@icloud.com
krestov@biosoil.ru
vabakalin@gmail.com

MONOGRAPH

The Revision of '*Jungermannia* s.l.' in the North Pacific: the Genera *Endogemma*, *Jungermannia* s. str., *Metasolenostoma*, *Plectocolea* and *Solenostoma* (Hepaticae)

Vadim A. Bakalin

Vadim A. Bakalin
e-mail: vabakalin@gmail.com

Botanical Garden-Institute FEB RAS,
Vladivostok, Russia

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ABSTRACT

The genera *Endogemma*, *Jungermannia* s. str., *Plectocolea*, *Metasolenostoma* and *Solenostoma* are revised for the North Pacific, including the Russian Far East and northwestern North America. The revision is based on critical study of material from author collection as well as from the herbaria KPABG, VBGI, LE, MHA, TNS, HIRO, KYO, NICH, G, F, MO, NY, SAP, UBC, etc. In total over 1400 specimens of the species recognized in this paper were studied by the author. Some taxa were transferred from genus *Plectocolea* to genus *Solenostoma* in accordance with the recent molecular study achievements. Twenty-nine species are recognized, each species is annotated with morphological description, taxonomic or other comments, review of ecology and distribution in treated area, and list of specimens examined. Figures are prepared for the majority of taxa. Two keys for identification of taxa (fertile and sterile plants), *Jungermannia* s.l. is historically reviewed for the treated area and discussion of morphological features valuable for taxa identification is provided.

Keywords

Jungermannia, *Solenostoma*, *Plectocolea*, *Endogemma*, *Metasolenostoma*, North Pacific, Western North America, the Russian Far East, distribution, ecology, Hepaticae, taxonomy

РЕЗЮМЕ

Бакалин В.А. Ревизия '*Jungermannia* s.l.' в Северной Пацифике: роды *Endogemma*, *Jungermannia* s. str., *Metasolenostoma*, *Plectocolea* и *Solenostoma* (Hepaticae)

Роды *Endogemma*, *Jungermannia* s. str., *Plectocolea*, *Metasolenostoma* и *Solenostoma* ревизованы для Северной Пацифики, включая российский Дальний Восток и западную часть Северной Америки (севернее Мексики). ревизия основана на критическом изучении коллекций автора и материала из KPABG, VBGI, LE, MHA, TNS, HIRO, KYO, NICH, G, F, MO, NY, SAP, UBC и др. В общей сложности 1400 образцов признаваемых в статей видов было изучено при пордготовке настоящей ревизии. Некоторые таксоны перенесены из рода *Plectocolea* в род *Solenostoma* в соответствии с новейшими достижениями по систематике этой группы. Всего в пределах исследованного региона выявлено 29 видов. Для каждого вида приводится морфологическое описание, комментарии таксономического характера, обзор экологии и распространения в изученном регионе. Почти для всех таксонов приводятся оригинальные иллюстрации. Работа включает два ключа для определения видов укзанных родов, краткий очерк истории изучения *Jungermannia* s.l. в Северной Пацифике и обзор морфологических признаков, важных для определения признаваемых таксонов.

Ключевые слова

Jungermannia, *Solenostoma*, *Plectocolea*, *Endogemma*, *Metasolenostoma*, Северная Пацифика, запад Северной Америки, российский Дальний Восток, распространение, экология, Hepaticae, таксономия

CONTENT

INTRODUCTION

As currently viewed '*Jungermannia* s.l.' is an artificial conglomerate of *Endogemma*, *Jungermannia* s. str., *Plectocolea*, *Metasolenostoma*, *Protosolenotoma* and *Solenostoma* belonging to three different families: Jungermanniaceae, Endogemmataceae and Solenostomataceae, with latter two distinguished mostly by molecular-genetic evidence. This point of view have been supported in many works and accepted in the most of recent publications (Crandall-Stotler et al. 2009, Vilnet et al. 2011, Bakalin et al. 2014). However, for practical reasons and due to closely related morphology of six aforementioned genera it seems to be better to treat them within single paper. Indeed most recent collections of these genera I have seen, collected by 'floristic bryologists' and being identified just up to genus, were named as '*Jungermannia*' despite the fact that less that 10 % of worldwide recognized taxa of the group belong to *Jungermannia* s. str., but not to *Solenostoma*, etc. I do not contest systematic position of those narrow genera (contrarily the splitting is highly reasonable in my opinion), but in practice species belonging to those genera are commonly misidentified not only to the same genus (if a narrow concept is used), but often to another genera (despite belonging to different families). I attempt to describe this artificial group within one account. The main goal of the paper is to provide identification keys, descriptions and illustrations of the species and some subspecific taxa of *Jungermannia* s.l. and to promote the development of regional floristic research. I avoid phytogeographic consideration in this paper because data on distribution of the species across the area remain imperfect and because of the 'complex' character of the bulk of taxa described here.

AREA TREATED

The main focus of the work is the area from the Arctic to Temperate zones under strong influence of North Pacific Ocean on the both sides of the latter. In 'administrative' view it includes Primorskii and Khabarovsk Territories, Sakhalin and Magadan Provinces and Chukotskii Autonomous Region (Chukotka) in the Russian Far East. On the opposite side of Pacific Ocean it continues with Alaska, Washington, Oregon and California of U.S.A. and British Columbia of Canada. The total area is over 5 million km^2 (Fig. 1). The close floristic relationship between these two 'sides' of Pacific Ocean, especially in its northern part, is the result of common evolution as well as migratory processes across 'Beringia' and 'Hultenia', particularly in the Quaternary period that was described many times (Yurtzev 1974). The treated areas share many taxa common on the both sides of the ocean, although climate may be drastically different, from temperate and wet climate in South Kurils, monsoon Primorskii Territory, to arctic Beringia and in eastern portion of the Pacific, from Beringia to dry temperate mediterranean climate in southern California. In this respect, an attempt to review a majority of groups of plants for the aforementioned area might be not holistic due to strong discrepancies in taxonomic composition of different localities across so large a gradient. Fortunately, these discrepancies are not so strict in '*Jungermannia* s.l.', as well as in many generally 'northern' genera of hepatics, such as *Scapania*, *Lophozia* and *Nardia*. For example, there are no species in the two latter genera known in Western North America that do not occur in the Russian Far East, except *Solenostoma rubrum*. *Vice versa* the situation is more complicated, because the southern flank of the Russian Far East is under strong influence of East Asian diversity center and shares some unique taxa from that land.

Similarly, although much more complex, relationships are observed in '*Jungermannia* s.l.'. Formally it would be reasonable to eliminate from the present work the southern tips of the Russian Far East to make the cumulative flora more homogenous and the approach more generalizable. However, I did not do this for certain practical reasons. The first of them is the fact this paper will be used for identification of material from the Russian Far East (or even for Russia, since no other modern treatments are available) regardless of wheter the specimen was collected without or within of the range's southern tip. Thus the elimination of southern part of the Russian Far East may result in numerous misidentifications in the practice. Pursuant to the latter, and also to enlarge the audience that may use this paper, I added to this account taxa that do not occur in treated area, but which are known in North America north of Mexico (but not including Greenland), although I do not discuss them in detail. Aside from the practical reasons there is the probability that species not known by now within western North America will be found there in the course of future researches. I did not include in consideration the species that may be found in the southern flank of the Russian Far East (mostly East Asian endemics) because those species are alien to the most part of the North Pacific and because I plan to devote a special analysis of those species in the future.

THE BRIEF HISTORY OF STUDY OF '*JUNGERMANNIA* S.L.' AROUND NORTH PACIFIC

The first purposeful hepaticological researches where '*Jungermannia* s.l.' were recorded for the Russian Far East were reports on bryophytes collected in Vega-Expedition (Arnell 1917) and review of the liverwort flora of Kamchatka (Arnell 1927). Later data on distribution of liverworts in Kamchatka were published by H. Persson (1970), mainly based on identification of E. Hultén's Kamchatka expedition collections. The researches in Chukotka Autonomous District (Chukotka) were activated due to efforts of O.M. Afonina, who amassed rather exhaustive collections over more than 30 years. The specimens of the latter collection were identified mostly by Czech bryologist J. Duda and summarized by Afonina & Duda (1992) and Afonina (2000). The southwardly situated Koryak Uplands has been of no special interest to bryologists and only a few papers devoted to hepatics of this area may be found (Afonina & Duda 1989, Konstantinova & Kuzmina 2001). Adjacent Magadan Province was not exhaustively studied and only rather imperfect and preliminary data on hepatics of this very large and diverse land are available (Blagodatskikh &

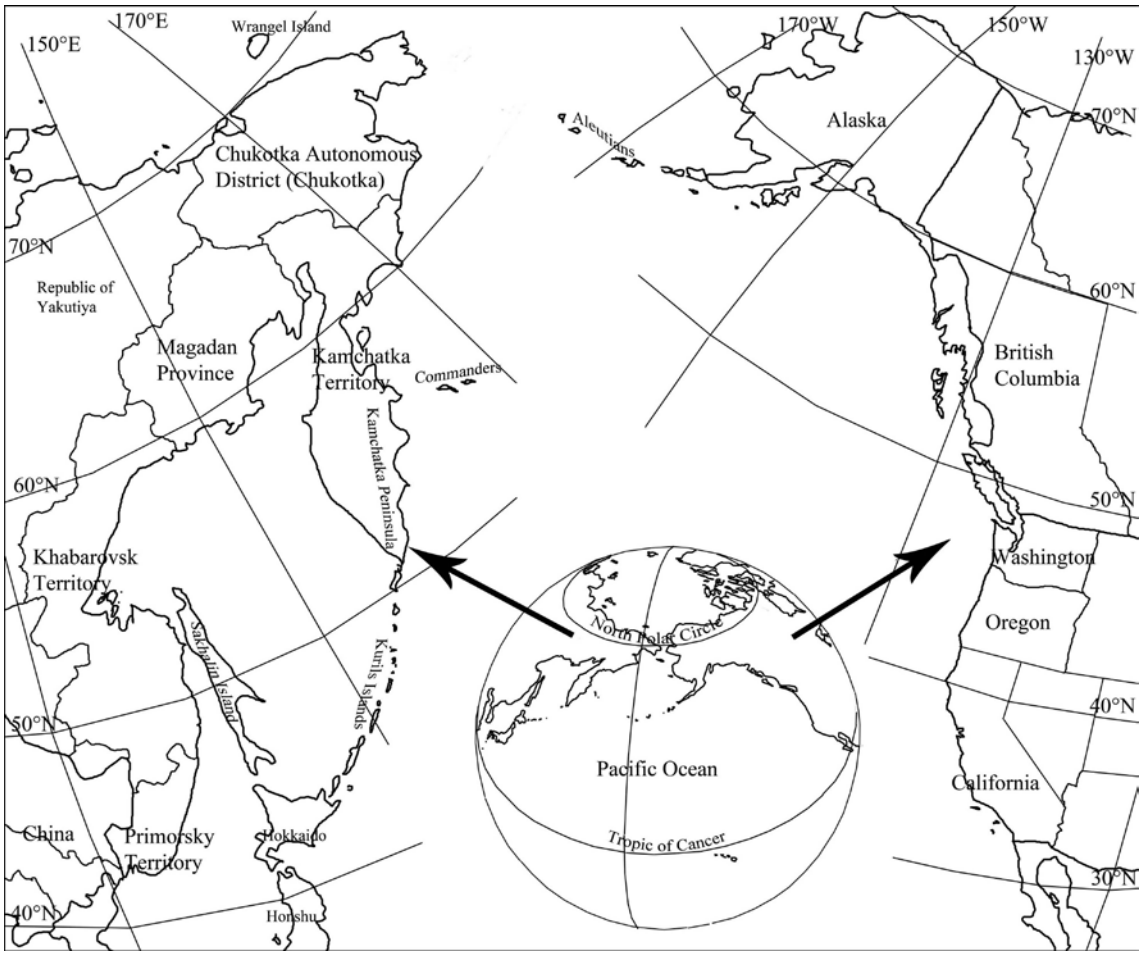

Figure 1 Studied area showing administrative and geographic units mentioned in the paper

Duda 1989). Certain progress in the recognition of Magadan Province flora just started some years ago and only a few data have been published. Within Kamchatka, the active researches were re-activated within the past 15 years, starting from short lists by Blagodatskikh & Duda (2001), Potemkin (2003), etc., to a monograph on the Kamchatka liverwort flora and its phytogeography by Bakalin (2009). The latter book also includes information on occurrence of liverworts in Northern Kurils and Commanders, the areas previously very poorly investigated.

The first records of '*Jungermannia* s.l.' for the southern part of the Russian Far East were published in numerous works by S.K. Gambaryan, who also compiled the checklist of hepatics known in southern half of the Primorskii Territory. She described in her miscellaneous works ecological and geographical patterns of some hepatics (Gambaryan 1992, 2001, Cherdantseva & Gambaryan 1986). Within last ten years research has become very active in the southern flank of the Russian Far East, resulting in publications of a checklist of South Kurils (Bakalin et al. 2009), a book on the bryophyte flora of Sakhalin (Bakalin et al. 2012), and some floristic records from other administrative subunits (Konstantinova et al. 2002). Because of the considerably increased amount of information on the distribution of hepatics in the Russian Far East, a special book, containing dot maps for each recorded species for the land, was published by Bakalin (2010).

All of aforementioned books had special phytogeographical or floristic purpose, but do not deal with '*Jungermannia* s.l.' taxonomy. Only three papers for the latter subject have appeared within last several years. These articles are devoted to description of new species or re-evaluation of some '*Jungermannia* s.l.' taxa at the species level and were published by Bakalin & Vilnet (2009, 2012) and Bakalin et al. (2014). Aside from these recent works, a somewhat out of date five-volume monograph by Schljakov "Hepatics of North USSR" for the northern part of the Russian Far East that includes a more or less detailed treatment of species of '*Jungermannia* s.l.' occurring in the northern part of USSR (Schljakov 1981).

The study of Western North American '*Jungermannia* s.l.' began with the classic work by Underwood (1883). The latter paper describes *Jungermannia rubra* Gottsche ex Underwood (= *Solenostoma rubrum*), the only western American endemic species in '*Jungermannia* s.l.'. Later the great achievement in 'western American hepaticology' was a publication of monograph on hepatics of California by M.A. Howe (1899). The latter includes also report of *Solenostoma obovatum* (as *Nardia obovata*) new for North America, and the discussion on status of *Jungermannia rubra* (= *Solenostoma rubrum*). Then some short reports on additional information, such as by Haynes (1909) appeared. Available data were summarized by Clark and Frye (1928) and Sanborn E.I. (1929). Shortly after, some new records were published by Clark & Frye (1934) and Fulford (1936).

Nicely conducted research was undertaken in British Columbia by J. Godfrey that resulted in a remarkable, but unfortunately never officially published "The Hepaticae and Anthocerotae of Southwestern British Columbia" (1977) as well as the description of peculiar *Jungermannia schusteriana* J. Godfrey & G. Godfrey (= *Plectocolea schusteriana*), the species being closely related to Estern Asian *P. flagellata* (Godfrey & Godfrey 1979). An outstanding role in the study of British Columbia and Alaska was also played by W.B. Schofield (Schofield 1968, 1969, 1984, Schofield et al. 2002).

Northward precise work was conducted on Aleutian hepatics, unfortunately still existing only in manuscript (Davison 1993). It is especially regrettable since the author provided some tentatively new species (not published everywhere) as '*Jungermannia aleutica*' (from Adak and Atka Islands), allied to *Plectocolea schusteriana*, '*Jungermannia* sp. nov.' closely allied or identical to *Solenostoma obscurum*, and such strongly unexpected in the Aleutians '*Jungermannia* cf. *macrocarpa'*. Despite repeated attempts I was unable to receive the specimens for study and thus confirm their status.

The Alaskan hepatics, including data on distribution of '*Jungermannia* s.l.', were reviewed in numerous works by Clark & Frye (1946, 1948), Evans (1914, etc.), W.J. Eyerdam (1952), Persson (1946, 1947, 1952, 1962, 1963, 1968) and summarized by I.A. Worley (1970). Arctic Alaska was exhaustively studied and treated by Steere & Inoue (1978). Recent additions also are given by Potemkin (1995).

The last regional work in Western North America was published by Doyle & Stotler (2006). This considerably enriched the knowledge of taxonomic composition and provided contemporary data on ecology and distribution of hepatics in California. Recent researchis actively being conducted in Oregon, resulting in the distribution of the unpublished "Illustrated Key to Liverwort Genera of Oregon" by Dr. D. Wagner (http://www.fernzenmosses.com).

Only a few of the above works dealt with '*Jungermannia* s.l.' taxonomy. The only recent achievement is the review of '*Jungermannia* s.l.' in western North America by Váňa & Hong (1999). The authors (l.c.) clarified data on the distribution of the species within North America West of hundredth meridian. The some additional data were also published in the review by Bakalin (2012).

THE BRIEF RECENT HISTORY OF GENERIC SUBDIVISION OF '*JUNGERMANNIA* S.L.'

Originally *Jungermannia*, as the genus, was treated very broadly, with the type *Jungermannia lanceolata* L. *n. rej.* (= *J. atrovirens* Dumort., not *Liochlaena lanceolata* Nees), that being the type of almost all recognized leafy hepatics. Thus taxonomical history of *Jungermannia* is the history of splitting, when genus becomes narrower and narrower as the result of elevation of many groups to the generic level. This interesting and complex progress was discussed by T. Amakawa (1959) and J. Váňa (1973a). However, the cited works accepted the broad generic concept and treated *Jungermannia* as a complex genus including *Jungermannia* s. str., *Endogemma*, *Plectocolea*, *Solenostoma*, *Liochlaena*, etc.

The narrow (in comparison with the cited works by Váňa and Amakawa) generic concept in this group was established by Mitten who first treated *Solenostoma* and *Plectocolea* as distinct units (Mitten 1865, 1871). These narrow genera were forgotten shortly after their description. They were used at the beginning of twentieth century only by F. Stephani (1901, 1917), who recognized *Solenostoma* as separate genus from *Jungermannia*. But Stephani's treatment of *Solenostoma* did not clarified the situation because his usage of these units was sometimes chaotic and illogical (many synonyms of the same species may be found in his descriptions both under *Jungermannia* and *Solenostoma*). His treatments did not promote, but rather impeded the acceptance of these units. Aside from Stephani only a few hepaticologists have accepted a narrow generic concept within twentieth century with the most valuable works published by Müller (1956) and Schljakov (1981). Unfortunately these and some other works could not change the general tendency. Mostly due to efforts of Czech bryologist Váňa (1973 a) the majority of European authors (Damsholt 2002, Grolle 1983, Grolle & Long 2000) followed Amakawa (1959, 1960). In North America the most valuable input to understanding of this group was made by R.M. Schuster (1969) who recognized *Solenostoma*, however not as the genus different from *Jungermannia* s. str., but as different from *Liochlaena*, which he erroneously regarded as *Jungermannia* s. str. due to confusion of *Jungermannia lanceolata* L. with *Liochlaena lanceolata* Nees.

Contrary to Váňa (1973 a, 1974 b, Váňa & Hong 1999) who consistently upheld the principle of treatment in the broad sense of *Jungermannia*, the recent molecular phylogenetic studies (Yatsentyuk et al. 2004, Forrest et al. 2006, De Roo et al. 2007, Hentschel et al. 2007), showed *Jungermannia* s.l. is polyphyletic and includes members of four families: *Jungermannia* s. str. (remains in Jungermanniaceae), *Liochlaena* Nees (transferred to Delavayellaceae), *Solenostoma* (including *Plectocolea*) went to the recently described Solenostomataceae Stotler & Crand.-Stotl. (Crandall-Stotler et al. 2009), and *Jungermannia caespiticia* Lindenb (transferred to Endogemmataceae: Vilnet et al. 2011). Amusingly, Váňa, an early notorious apologist of the broad concept in *Jungermannia* started immediately to create innumerable new combinations to transfer most of former *Jungermannia* to *Solenostoma* (Váňa & Long 2009; Váňa et al. 2010). Sometimes Váňa create doubled combinations for the same (in his opinion!) taxon, as it was made for '*Nardia montana'* and '*Jungermannia wattsiana*' regarded by Váňa (Váňa 1975 a, Váňa et al. 2012) as synonyms, but nevertheless firstly proposed as *Solenostoma wattsianum* (Steph.) Váňa et al. (Váňa et al. 2010) and again as *Solenostoma montanum* (Steph.) Váňa et al. (2012). Commonly these transfers are not based on molecular phylogenetic studies, and are not even confirmed by studies of type collections at all. The names appear just some months after the species was described under another genus that *currently* is not being recognized by Váňa (Váňa et al. 2012, 2013).

Nevertheless, the genera *Endogemma* and *Solenostoma* are currently accepted (Borovichev 2014, Konstantinova & Lapshina 2014) in almost all major works. However, the fourth genus, *Plectocolea* is not widely recognized now outside of Russia. Some attempts to consolidate *Plectocolea* as a genus separate from *Solenostoma* were made by Bakalin &

Vilnet (2012) and Bakalin (2013). The most recent advances (Bakalin et al. 2014) demonstrated the necessity to evaluate two more genera in the *Solenostoma* – *Plectocolea* complex: *Protosolenostoma* (not present in the treated area) and *Metasolenostoma*. Given data in hand, some of taxa previously regarded as members of *Plectocolea* (or *Jungermannia* subg. *Plectocolea*) should be transferred to *Solenostoma* s. str. I did not include any taxonomical supra-specific speculations to the present account, to economize space and because they have been discussed before (Bakalin et al. 2014).

THE MAIN MORPHOLOGICAL FEATURES USED IN TAXONOMY OF '*JUNGERMANNIA* S.L' AT SPECIES LEVEL

There is a lot of information concerning variability of morphological parameters within *Jungermannia* s.l., mainly in works by Amakawa (1959), Váňa (1973 a) and Schuster (1969). Information on the taxonomical value of features that may be used in '*Jungermannia* s.l.' on the species level is rather limited. Commonly authors provide limited information as 'differentiations' that sometimes seems highly disputable, such as: 1) "more oval to ovoid perianth and very small androecia (only 1–3 pairs of bracts)" (Váňa 1972 a), "sehr nahe, von denen sie durch kleine Merkmale in Blattform und Blattzellen unterscheidet" (Váňa 1974 a), "beide Arten sind aber durch die Geschlechtsverteilung und das Areal leicht zu unterscheiden" (Váňa 1974 a), etc.

The only recently Váňa et al. (2013) discussed the taxonomic value of some morphological features in the *Solenostoma* – *Plectocolea* conglomerate, mostly focusing on the pair *Solenostoma sanguinolentum* (Griff.) Steph. – *S. marcescens* (Mitt.) Bakalin, but also with reference to other taxa. The authors (l. c.) sequentially showed that such features as inflorescence type, perianth wall structure, size, color and leaf cells features are not valuable in the taxonomy of *Solenostoma* s. l. even if taken together, as the complex. This approach is rather amusing if it be compared with the 'differentiations' given by Váňa and cited above. Moreover, if such a point of view is accepted, no more than one species needs to be recognized within *Solenostoma* s.l., because all of them may be connected one to another, especially if Váňa's et al. (2013) approach is used.

Admittedly, there are not (or nearly so) any single feature that may support the description or re-evaluation of the species by itself. On the other hand, a complex of unlinked features, even if each of them may be regarded as 'not stable' (each evaluated alone) are evidence that a new taxon is at hand. Thus, the following description of various types of features it always needs to take into account that the features are taxonomically functional as a complex only. The features described here are only for practical purposes, not with taxonomical value at the supra-species level (e.g. for separating genera or sections).

1. Plant color. Sometimes this feature was regarded as very unstable due to 'belief' that in shady conditions any species commonly becomes green and loses secondary brown, purple or other pigmentations (Váňa et al. 2013). However this feature may be regarded as an ability to produce different colors, and then it has taxonomical value. The one of the best examples is the pair *Solenostoma sphaerocarpum* – *S. confertissimum*. The former species, even in maximally exposed places develops only brown-olive to sepia brown pigmentation, as opposed to the latter, which easily acquires a purple pigmentation even in not well insolated places.

2. Plant size. There is distinct difference in mean width between different species that may be used in the key. When indicating plant size in the description I provide data on width, with elimination of measurements of ca. 10 % of the weakest plants (commonly depauperate plants).

3. Rhizoids color and texture. The rhizoid color varies within all treated genera, being exclusively pale in *Jungermannia* and *Endogemma*, mostly pale in *Solenostoma* and mostly purple to purplish in *Plectocolea*. It seems there are no species with purple rhizoids that could not lose this pigmentation and become colorless, at least in some isolated part of stem. However, such species as *Plectocolea erecta*, *P. rigidula*, *P. tetragona*, etc. have purple rhizoids almost constantly, with rare exceptions of some isolated parts (mostly near the apex), where rhizoids may be colorless.On the other hand, the majority of species, which commonly have colorless to grayish and brownish rhizoids, cannot develop purple to purplish or pink pigmentation, even in part. By texture the rhizoids may be soft or rigid, when rigid then commonly purple colored. Some species, such as *Solenostoma rotundatum* and *S. otianum*, commonly produce a mixture of soft and colorless rhizoids and rigid and purple colored ones. Both texture and color in the most cases may be regarded as qualitative features and 'work' in identification only alongside a complex of other features.

4. Rhizoids position and origin. In the most cases the rhizoids originate from the ventral stem area, however sometimes leaf lamina may also produce rhizoids and this ability seems to be a taxonomically valuable feature. Most such species are distributed outside the area treated, with the exception of *S. confertissimum* (which may be easily distinguished from the related *S. sphaerocarpum* also by to this feature) which commonly has rhizoids from initial cells in the lamina, and some other taxa in which the presence of laminar rhizoids is rare. In some species (*P. radicellosa* (Mitt.) Mitt., *P. granulata* (Steph.) Bakalin, etc. (not present in the treated flora), rhizoids originate in the contact zone of ventral leaf margin and stem (both from leaf and stem). Rhizoids may be spreading from the stem at different angles, being united into fascicles or separate one from another; rarely they spread upward and cover the ventral leaf surface (*Plectocolea comata*, etc.). Rarely, rhizoids are decurrent down the stem and form distinct fascicles in a clear line going down the stem (Bakalin 2014). Commonly this line becomes ill-defined near stem base, where rhizoids again may be obliquely to erect spreading. Only two species in area treated (*Solenostoma confertissimum*, *S. pseudopyriflorum*) may be regarded as having such fasciculate rhizoids. However, in both mentioned taxa the rhizoid fascicle is far less distinct than in many Himalayan or East Asian species (*Solenostoma lanigerum* (Mitt.) Váňa et D.G. Long, *S. clavellatum* Mitt. ex Steph., *Plectocolea unispiris* Amakawa, etc.).

5. Stem. Two main features of the stem are used in differentiation of species within *Jungermannia* s.l. The first one is the stem cross-section morphology. Most species of *Jungermannia* s.l. have an ill-defined cortex layer or nearly uniform cells inward. However, some taxa (e.g. *Plectocolea schusteriana*, *Solenostoma obscurum*) have well-defined hyaloderm tissue and then a sclerodermis outside the inner tissue. Such species commonly have whitish to nearly glistening stems that may help to differentiate some taxa. Another valuable feature is the ratio of shoot (branch with leaves) width and stem diameter. In some species the stem is comparatively wide. The most noticeable example is *Jungermannia polaris,* which may be differentiated from *J. pumila* by this feature.

6. Leaves:
a) *Position on the stem*. Leaf insertion line varies from nearly horizontal to oblique and transverse (= vertical), although varying when stems branch and measurements may be taken from the majority of shoots, but not from all of them. Then this feature may be a good character for distinction of some taxa. Leaves also vary from nearly imbricate to obliquely and erect spreading. Aside from the nature of spreading, another feature is similar but not the same: that is leaf orientation, when leaves may be obliquely to transversely oriented. Although both features might be regarded as closely related, sometimes subtransversely inserted leaves are obliquely oriented (*Solenostoma pseudopyriflorum*) or obliquely inserted leaves may be subtransversely oriented (*Metasolenostoma orientale*). Leaves may be variously decurrent on both sides of the stem. For the measurements of 'decurrency length' the ratio the length of decurrent portion to stem diameter is used in the description. The state 'leaves decurrent for 1/3 of stem width dorsally' means decurrent portion of the leaf is one third of stem width (in this case equivalent to stem diameter).

b) *Shape*. In the most cases the leaf measurements and shapes are based on the flattened leaf. The shape varies from transversely elliptic and reniform to elliptic and ovate. Commonly leaves represent not a true elliptic or ovate shape but one variously deformed to obliquely reniform, obliquely ovate, etc. In the most cases the leaf apex is entire, but may be also retuse and emarginate (*Solenostoma hyalinum*, etc.) or, as extreme variant, even distinctly bilobed (*S. bilobum*).

The most common variant of leaf shape on the stem (when not flattened) are variations of concave-canaliculate. However, sometimes leaves may be distinctly concave to almost cupped (*Solenostoma pusillum*) and then lacerate when flattened in the slide preparation, or contrarily slightly to distinctly convex (as in *Plectocolea comata* and *P. plagiochilacea* not present in treated area). Aside of general shape, the leaf margin may be narrowly revolute throughout (taxa not present in treated area), or only have a recurved antical margin (*Plectocolea kurilensis*).

7. Leaf cells. The parameters of cell size, structure (pachydermous/leptodermous) and trigone size are features of great variability. However, some species show high stability in this respect. The species of *Jungermannia* and *Endogemma* characterized by small to vestigial trigones. *Endogemma caespiticia*, *Plectocolea granulata*, *Metasolenostoma gracillimum*, *Solenostoma fusiforme* (Steph.) R.M. Schust. (absent in our area, but found in adjacent Japan), etc., are almost uniformly characterized by leptodermous cells and small to vestigial trigones. Contrary many species of *Solenostoma* and *Plectocolea* commonly have trigones that are moderate to large in size to bulging (the most noticeable examples in our area include *Solenostoma pseudopyriflorum*, *Plectocolea infusca*, etc.).

The trigones in leaf cells vary from wanting to small, moderate and large. These descriptive categories are used in keys and morphological diagnoses and may be clarified as following: large – the distance between trigone to the nearest one is less than diameter of trigone, moderate – the distance between one trigone to the next is more than trigone diameter, but less than triple the diameter of the trigone, small – the distance between trigones is more than triple the trigone diameter.

The cell size is remarkably varied, although all *Jungermannia* are characterized by small cells that sometimes may help in differentiation of submerged and lax forms of *Jungermannia eucordifolia* from *Solenostoma fusiforme*.

The anatomy of cells along leaf margin is a category different than the that of midleaf cells. Some species have very distinct traits in marginal cells including absolute and/or relative (to midleaf or to next rows inward) difference in size, character of thickness, trigones and cuticle. For measurements in the descriptions I used features of cell size along margin, i.e. calculation of length of cell along external wall (thus this parameter is not the real length of cell, because sometimes cells elongated in tangential direction, but not along margin).

8. Leaf cell cuticle. When describing leaf cuticle, the terms papillose, verrucose and striolate are commonly used in different papers in different senses. To avoid misunderstanding in the present work I use the following definitions: verruca – the protuberance spherical in projection, papilla – the thickening elliptic in projection with length not more than 3 times more than the width, striola – thickening linear in shape with length:width ratio more than 3:1. In general all these variants of surface ornament vary from nearly absent to noticeable and are distributed throughout the treated complex. This feature commonly does not correlate with leaf cell trigones. For instance, *Plectocolea granulata* commonly has throughout a papillose to verrucose cuticle, but is also characterized by small to vestigial trigones.

9. Inflorescence. This feature is commonly given in keys and may be used for identification and differentiation of morphologically similar taxa. The majority of species have dioicous inflorescences, although there are several species that are paroicous (*Solenostoma confertissimum*, *S. sphaerocarpum*, *S. pseudopyriflorum*, etc.). The only evident example of heteroicous inflorescence (i.e. ability to develop both paroicous and dioicous plants) was confirmed genetically for *Solenostoma rossicum* (Bakalin & Vilnet 2012). I do not refer to true heteroicity or autoicity those cases of some arctic forms of *Jungermannia pumila* that may produce androecial innovations.

10. Perianth features. The perianth shape and cells have been regarded for long as taxonomically valuable in distinguishing of subgenera. It was believed (cf. Schuster 1969): 1) *Jungermannia* commonly have bi-tristratose perianth on the most extent, when *Solenostoma* and *Plectocolea* perianth walls should be unistratose; 2) *Solenostoma* and *Jungermannnia* perianth being composed by isodiametric cells, where *Plectocolea* perianth cells are elongate; and 3) the *Solenostoma* perianth is rostellate with commonly beaked mouth. Unfortunately when these features are applied to the worldwide flora it becomes evident that 1) many *Solenostoma* and some *Plectocolea* have a bistratose perianth wall, 2) many *Solenostoma* species do not have a rostellate or beaked mouth, and 3) some *Solenostoma* species (e.g., as *S. hyalinum*) have elongate perianth cells. Thus, for delimitation of *Solenostoma* and *Plectocolea* at the generic level these features are not applicable. However, for practical reasons when the local flora is treated, the aforementioned features of perianth shape and structure may be successfully used for delimitation of morphologically related taxa.

11. Perigynium is absent in *Jungermannia* and *Endogemma*, commonly absent to vestigial or low in *Solenostoma*, commonly present, but low in *Metasolenostoma* and *Protosolenostoma*, and commonly (in all regional taxa) well developed in *Plectocolea*. The size of perigynium in comparison with the height of perianth is a valuable morphological feature, stable in the most species of the locally recognized *Plectocolea* and *Solenostoma*. Such species as *Solenostoma obscurum* and *Plectocolea schusteriana* are constantly characterized by a high perigynium, exceeding the perianth in the length. Contrarily, *P. ovalifolia*, which is closely related to *Solenostoma obscurum,* has short perigynium.

12. Sporophyte characteristics. The value of these characteristics in 'practical taxonomy' is strongly limited due to rather rare occurrence of sporophytes in specimens examined. The only case when study of sporophyte is needed for delimitation of closely related taxa is the pair *Plectocolea unispiris – P. virgata* (both are not known in our area) due to monospiral elaters of the former and bispiral in the latter. In the most species of the range of the flora elaters are bispiral (rarely trispiral in *S. confertissimum*, cf. Váňa 1973 a).

MATERIAL

The material used for compiling this work are the herbarium specimens collected by the author from the Russian Far East and other part of Russia, as well as in East Asian, as well as those available for study from the herbaria KPABG, VBGI, LE, MHA, TNS, HIRO, KYO, NICH, G, F, MO, NY, SAP, UBC, etc. All specimens collected by the author are housed in VBGI (mostly from the southern part of the Russian Far East and adjacent countries) and KPABG (mostly the northern part). In total over 1400 specimens of the species recognized in this paper were studied by the author. Not all of them are cited in the 'specimens examined' section to economize space, with only a few specimens added from other regions.

TAXONOMICAL TREATMENT

'*Jungermannia* s.l.' is an artificial complex including members of three families and six genera. Therefore no any evolutional or systematic senses were input to the keys. The keys were constructed only for the practical reason to identify taxa. The features used in the keys are sometimes usable only for identification of plants collected within area treated and cannot be applied for identification of species outside of treated area. The descriptions of genera and species are based on the studied material from treated area and not include the features occurring in the species outside of area treated (especially in East Asia and Himalaya).

Preliminary remarks for keys

The most of forms of the species presented in treated area may be identified by the keys provided below. However some species are very closely morphologically similar and in this case only typical forms may be identified. For evaluation whether the identification is correct the special comments of taxonomical and other character are placed below the species description. Some morphologically malleable species are placed into key twice or even thrice. Due to the fact some of genera intergrade one to other morphologically no reliable key to genera is possible to construct. Particularly some species of *Solenostoma* will be housed in *Plectocolea* and *vice versa*. Additionally some species of the complex (such as *Solenostoma fossombronioides* or *S. rubrum*) basing on morphology may be placed both to *Solenostoma*, *Metasolenostoma* and even *Protosolenostoma*. Many species were never sequenced and their clear position is not known. To avoid this problem I provide the general keys for the complex *Jungermannia* s.l. directly to species. Two keys placed below: the first one is based on generative and vegetative features and the second one is based mostly on vegetative characters.

Key for fertile material

1) Perianth fusiform to conical, gradually narrowed to the mouth 2
1) Perianth rostellate, suddenly contracted to the mouth, mostly 3–5-plicate, at least, in upper 1/4 if its length 26

2) Perianth bistratose in its lower 2/3, composed by isodiametric to shortly rectangular cells, never turbinate near mouth; perigynium absent or vestigial; plants without red or purple coloration (as exception, purple coloration present in inflated area of male bracts) ..... 3 (*Jungermannia*)
2) Perianth unistratose in its lower half (with the exception of the lowest 2–3 rows of cells), composed by elongated cells (commonly 2 times longer than wide in the perianth middle), sometimes turbinate at mouth; perigynium well developed; red or purple coloration commonly present at least as traces in ventral side of stem and rhizoids .... 9 (*Plectocolea* and *Solenostoma*)

3) Plants paroicous (rarely, in Arctic, with some antheridial innovations below perianth, but always with admixture of paroicous branches present within larger mats) 4
3) Plants dioicous 6

4) Leaves longer than wide, mostly contiguous to imbricate, canaliculate to almost flat, sheathing the stem near base and erect spreading above; perianthous plants semi-erect; plants of acidic to neutral substrata, mostly near running water, rarely on wet cliffs ..... *Jungermannia pumila* (p. 78)
4) Leaves as long as wide or nearly so, distant to contiguous, concave, rarely canaliculate and flattened, not or loosely sheathing the stem near base; perianthous plants ascending; plants growing in acidic to basic substrates, mostly in mesic conditions, rarely near running water 5

5) Plants with leaves 4–6 times wider than stem; leaves obliquely spreading, obliquely inserted, distant; perianth ellipsoidal to rhomboidal, 4–5-plicate near mouth; restricted to shady limestone outcrops in broadleaved forest zone in southern flank of treated area in the Russian Far East .... *Jungermannia konstantinovae* (p. 75)
5) Plants with leaves 1.2–1.8 times wider than stem; leaves mostly semi-appressed to the stem, subtransversely to (rarer) obliquely inserted, concave; perianth ellipsoidal to ob-pyriform, loosely pluriplicate near mouth; restricted to acidic to neutral substrata in tundra zone or belt (in mountains) ..... *Jungermannia polaris* (p. 75)

6) Plants mostly 0.5–1.2 mm wide with leaves obliquely inserted and oriented, laterally appressed to the stem, mostly rounded triangular; growing in acidic substrata .... *Jungermannia borealis* (p. 70)
6) Plants more than 1.4 mm wide with leaves obliquely to transversely inserted, laterally erect spreading or sheathing the stem (not appressed), widely triangular to ovoid; growing in acidic to basic substrata 7

7) Leaves laterally erect, canaliculate, distant to contiguous; plants yellowish green to brownish green in color; restricted to *Ca*-rich substrata in mesic habitats .... *Jungermannia atrovirens* (p. 68)
7) Leaves concave to concave-canaliculate, mostly contiguous to subimbricate, not or loosely laterally erect; plants deep green to brownish and green-brown; restricted to acidic substrata in wet habitats 8

8) Leaves sheathing the stem and covering lover part of the next leaf above, more or less lax, widely triangular, commonly undulate and crispate at the margin; midleaf cells with colorless to brownish cell walls; plants 1.4–3.0 mm wide; growing submerged or in very wet habitats near sluggishly flowing streams and sometimes in ponds of swampy landscapes ..... *Jungermannia eucordifolia* (p. 72)

8) Leaves spreading, ovate to ovate-triangular in shape, rigid, not undulate nor crispate at the margin; midleaf cells commonly with walls rusty-red to brown in color; plants 0.7–1.5 mm wide; growing in mesic condition on cliffs, sandy soil, etc. ..... *Jungermannia exsertifolia* (p. 74)

9) Leaves bilobed, with acute to obtuse lobes; plants of cephalozioid appearance ..... *Solenostoma bilobum* (p. 98)
9) Leaves entire to, rarely, emarginate (mostly in female bracts); plants of typical 'plectocoleoid' appearance 10

10) Plants paroicous 11
10) Plants dioicous 13

11) Plants pellucid, light green to yellowish green, leaves obliquely oriented, leaf margin (especially in upper part of shoot) commonly undulate, perigynium low, ca. 1/3 of perianth length or less, rhizoids purplish to purple ..... [*Plectocolea fossombronioides* (p. 82)]
11) Plants not pellucid, deep green to brownish green and (when small) yellowish brownish, almost constantly with distinct traces of purple coloration throughout or in part of shoot, leaves not undulate, subtransversely oriented (at least in normally developed shoots), perigynium more than 1/2 of perianth length, rhizoids purple to brownish and nearly colorless 12

12) Plants 2.2–2.8 mm wide; rhizoids deep purple; leaves mostly more than 1 mm wide and long, obliquely inserted; restricted to lower elevations where in stream valleys ..... *Solenostoma obovatum* (p. 103)
12) Plants 0.7–2.0 mm wide; rhizoids brownish to light pink, rarely deep purple; leaves less than 1 mm wide and long, subtransversely to moderately obliquely inserted; mostly in higher elevations where near streams and in wet tundras ..... *Solenostoma subellipticum* (p. 117)

13) Leaves with distinct rim of swollen cells that 1–1.5 larger than midleaf cells in size 14
13) Leaves without distinct rim of swollen cells (at least in sterile shoots), although external walls of marginal cells sometimes thickened 15

14) Perigynium, 1/2 – 3/4 of perianth length; restricted by eastern North America ..... [*Solenostoma crenuliformis* (p. 81)]
14) Perigynium the same length with perianth or slightly shorter; restricted to temperate East Asia ... *Plectocolea rigidula*

15) Plants erect, sometimes with distinct rhizoids fascicle, decurrent down the stem; plants commonly with geotropic stolons 16
15) Plants creeping to ascending, rhizoids spreading from the stem, or decurrent down, but not forming the distinct fascicle, geotropic stolons rare 17

16) Leaves obliquely spreading from the stem, distant to contiguous, concave-canaliculate; plants of Temperate East Asia ..... [*Plectocolea flagellata*, not treated here]
16) Leaves sheathing the base, contiguous, concave-canaliculate to concave, overlapping the lower part of next situated leaf; plants of boreal Western North America ..... *Plectocolea schusteriana* (p. 92)

17) Plants (0.7) 1.0–1.5 mm wide, commonly pellucid, whitish, pale greenish, pale brownish to white-brownish, pale blackish gray to greenish gray, sometimes with blackish violet tint at leaf margin near the apex; rhizoids colorless to brownish; restricted by habitats with high content of sulphur in areal of extinct or extant volcanism, mostly near thermal springs ..... *Plectocolea vulcanicola* (p. 94)
17) Plants similar size or larger, green to deep green, brown, purplish, rarely violet or pale greenish; rhizoids colorless to brownish and purplish to purple; plants of sulphur-free habitats, not present near thermal springs 18

18) Plants green to brownish and pale greenish, leaves commonly loosely appressed laterally; rhizoids colorless to pink and light purplish; leaves obliquely inserted, commonly emarginated in upper part of shoot ..... *Solenostoma hyalinum* (p. 101)
18) Plants deep green to brown and purplish to violet; rhizoids colorless to deep purple; leaves obliquely to subtransversely inserted, not emarginate (rarely emarginate in female bracts) 19

19) Rhizoids deep purple to brown-purple, sometimes with violet tint, rigid 20
19) Rhizoids colorless to light rose and pale purplish 24

20) Leaves orbicular or nearly so, erect spreading; midleaf cells with 2–3 granulate oil-bodies; temperate East Asia species ..... *Solenostoma rotundatum* (p. 113)
20) Leaves ovate to widely triangular, obliquely spreading to cuntiguous; midleaf cells with 3 and more oil-bodies per cell 21

21) Perigynium 2 and more times longer than perianth; leaves widely obliquely ovate to widely ovate and elliptic; leaf cells oil bodies mostly botryoidal; plants 2.1–4.8 mm wide; restricted to Boreal zone in western North America ... *Plectocolea schusteriana* (p. 92)
21) Perigynium less than 2 times longer than perianth; leaves ovate to obliquely ovate; leaf cells oil bocied granulate; plants less than 2 mm wide (if wider – the stem is whitish when dry); not restricted to boreal Western North America 22

22) Perigynium 1.0–1.8 of perianth length; stem whitish when dry ..... *Solenostoma obscurum* (p. 104)
22) Perigynium shorter than perianth; stem brownish, brown to green when dry 23

23) External wall of leaf rim thickened; perigynium the same length with perianth or slightly shorter; plants with common brown to rusty brown pigmentation (especially along leaf rim) ..... *Plectocolea rigidula* (p. 91)
23) External wall of leaf rime not or slightly thickened; perigynium 1/5 – 1/3 of perianth length; plants mostly deep green to dirty green, sometimes with purple tint ..... *Plectocolea ovalifolia* (p. 90)

24) Oil-bodies grayish, not filling cell lumen; rhizoids pink to light purple, rarely brownish; antical leaf margin commonly revolute; leaves distinctly canaliculate, enclosed one to another; ventral leafless stolons commonly present ..... *Plectocolea kurilensis* (p. 88)
24) Oil-bodies brownish ("*infusca*-type": Amakawa 1960), nearly filling cell lumen; rhizoids colorless to light rose and purplish; dorsal leaf margin flattened to slightly involute; leaves concave to loosely concave-canaliculate, distant, rarely enclosed one to another; ventral leafless stolons absent 25

25) Leaves nearly orbicular, more or less distant, rarely contiguous, concave, nearly contiguous ..... *Plectocolea infusca* var. *recondita* (p. 86)
25) Leaves ovate to obliquely ovate, contiguous, concave-canaliculate to canaliculate, contiguous to distant, not undulate at margin ..... *Plectocolea infusca* var. *infusca* (p. 83)

26) Plants whitish to yellowish, without red or purple pigmentation (as exception that pigmentation present in perianth plicae); leaf cells leptodermous, contain 1 (–2) brownish coarsely granulate oil bodies nearly filing cell lumen (or oil bodies not seen); endogenous gemmae sometimes present (commonly localized within unfertilized perianth) ..... 27 (*Endogemma*, *Metasolenostoma*)
26) Plants brownish, sepia brown, bright to deep green, brown and purple brown to blackish, commonly at least

with traces of red or purple pigmentation; leaf cells meso- to pachydermous with moderate in size to bulging trigones, contain 3 and more oil-bodies; endogenous gemmae absent .. .. 28 (*Solenostoma*, *Metasolenostoma*)

27) Plants mostly with subtransversely inserted leaves, 0.5–1.1 mm wide, 2–3 (5) mm long; leaf cells with 1(2) large brownish oil-bodies nearly filling cell lumen; endogenous gemmae commonly present; plants of mesic habitats with disturbed vegetation cover ..... *Endogemma caespiticia* (p. 66)
27) Plants mostly with obliquely inserted leaves, 1.0–2.8 mm wide, 15–40 mm long; leaves with more than 4 colorless oil-bodies per cell; endogenous gemmae absent; plants of sulphur-rich habitats, or at least areas of extant or extinct volcanism ..... *Metasolenostoma orientale* (p. 122)

28) Plants paroicous 29
28) Plants dioicous or heteroicous 35

29) Plants brownish to sepia brown and blackish colored, red, purple and rusty red pigmentation is totally absent, even near perianth beak and keels 30
29) Plants with red, purple and rusty-red pigmentation commonly present 32

30) Plants creeping, closely adhering to substratum, 0.2–0.3 mm wide ..... *Solenostoma sphaerocarpum* var. *nana* (p. 115)
30) Plants ascending to erect, loosely adhering to the substratum, (0.3) 0.5–2.0 mm wide 31

31) Perianth unistratose from near the base to mouth; plants commonly brown to sepia brown; rhizoids colorless to brownish; mostly North noreal to Arctic .... *Solenostoma sphaerocarpum* var. *sphaerocarpum* (p. 115)
31) Perianth bistratose in lower half; plants deep green (commonly with red pigmentation present, see couple 6); rhizoids colorless to brownish and pale purplish; South boreal to temperate, East Asian .... *Solenotoma pseudopyriflorum* (p. 107)

32) Plants commonly lax textured, with leaves loosely undulate along margin and dorsally widely decurrent; rhizoids originated in ventral side of stem and from isolated cells in leaf lamina, in well developed shoots decurrent down the stem in more or less distinct fascicle .... *Solenostoma confertissimum* (p. 98)
32) Plants rigid, leaves not undulate, barely or shortly decurrent dorsally; rhizoids originate from ventral side of stem and (rarely) lower part of the perianth 33

33) Perianth bistratose in lower half, commonly rhizogenous; plants ascending to erect .. *Solenotoma pseudopyriflorum* (p. 107)
33) Perianth unistratose, not rhizogenous; plants creeping to ascending and erect 34

34) Plants creeping to loosely ascending near apex in perianthous shoots, closely adhering to the substratum, 0.15–0.4 mm wide, mostly reddish to red-brown; invariable paroicous ..... *Solenostoma pusillum* (p. 109)
34) Plants ascending, loosely adhering to the substratum, 0.3–1.5 mm wide, commonly pale green to deep green, with characteristically red to purple-red marked leaf margins and area near perianth beak; heteroicous (both paroicous and dioicous plants may be found) ... *Solenostoma rossicum* (p. 110)

35) Leaves bordered with swollen cells 36
35) Leaves not bordered with swollen cells, marginal cells commonly smaller than in the midleaf 38

36) Swollen cells 1.5–2 times wider than midleaf cells in diameter, cell walls along leaf margin equally thickened .... *Metasolnostoma gracillimum* f. *crenulatum* (p. 120)
36) Swollen cells 0.9–1.2 times wider than midleaf cells, cell walls along margin are equally or not equally thickened ... 37

37) Plants lax, mostly erect in dense patches; leaf margin undulate; leaves transversely oriented, sheathing the stem; shoots blackish to reddish blackish in color; stem whitish; midleaf cells leptodermous, along margin subequally thickened, with vestigial trigones .... *Metasolenostoma orientale* (p. 122)
37) Plants not lax, creeping to ascending; leaf margin not undulate, horizontally spreading, not or loosely sheathing the stem, not blackish, commonly with reddish to red brown pigmentation; stem not whitish; midleaf cells commonly pachydermous, along margin with large, sometimes confluent trigones ..... *Solenostoma rubrum* (p. 113)

38) Perigynium developed, 1/4 – 1/3 of perianth length, perianth commonly rhizogenous in lower third .... *Metasolenostoma ochotense* (p. 121)
38) Perigynium vestigial or less than 1/5 of perianth length 39

39) Midleaf cells trigones vestigial to virtually absent 40
39) Midleaf cells trigones moderate in size to large, concave to convex 15

40) Plants less 1 mm wide; perianth cylindrical to clavate, distinctly keeled; avoid habitats with high content of sulphur 41
40) Plants wider than (1.0) 1.7 mm wide; perianth fusiform to clavate, sometimes undistinctly keeled; restricted to area of extinct and extant volcanism to the habitat with high content of sulphur ..... *Metasolenostoma orientale* (p. 122)

41) Plants creeping, yellowish brownish, pale green, greenish; American part of treated area .... *Metasolenostoma gracillimum* var. *gracillimum* (p. 120)
41) Plants ascending to erect, brown to blackish; southern part of boreal East Asia .... [*Solenostoma rishiriense*, not treated here]

42) Plants green to pale green, without deep brown pigmentation, red coloration restricted to area near perianth beak and leaf rim in upper part of shoot; heteroicous (both dioicous and paroicous phases are present) .... *Solenostoma rossicum* (p. 110)
42) Plants deep green to red-brown, redish coloration commonly distributed throughout as traces, or plants green; dioicous ..... *Solenostoma appalachianum* (p. 97)

Key to species, based mostly on vegetative characteristics, ecology and distribution patterns (not applicable for some unusual forms of some taxa)

1) Leaves clearly bilobed; plants of cephalozioid appearance; South Kuril Islands ..... *Solenostoma bilobum* (p. 98)
1) Leaves entire to emarginate; plants of jungermannioid appearance 2

2) Plants whitish to yellowish; leaf cells with 1 (2) large, filling cell lumen, brownish coarsely granulate oil bodies; endogenous gemmae commonly present .... *Endogemma caespiticia* (p. 66)
2) Plants whitish, yellowish or other color; leaf cells with (2) 3 and more oil-bodies, mostly not filling cell lumen; endogenous gemmae absent 3

3) Plants growing on fine soil near stream with high content of sulphur (sometimes even on crystalline sulphur strata), commonly in the areas of extinct or extant volcanism; leaves obliquely inserted, long decurrent, sheathing the stem near base 4
3) Plants avoid substrata or water contain sulphur, not present in thermal habitats in areas of extinct or extant volcanism; leaves obliquely inserted or not, sheathing the stem near base or not 5

4) Leaves commonly undulate at the margin and emarginate in apex (in well developed plants), commonly reniform, leaf rim not distinct; perigynium present ..... *Plectocolea vulcanicola* (p. 94)
4) Leaves not undulate at margin, not emarginate at apex, commonly ovate, leaf rim commonly distinct (composed by swollen cells or not, and/or deeply colored; perigynium absent to vestigial ..... *Metasolenostoma orientale* (p. 122)

5) Leaves bearing rhizoid initial cells; rhizoids colorless to pale pink, commonly forming the fascicle decurrent down the stem ..... *Solenostoma confertissimum* (p. 98)
5) Leaves free of rhizoid initial cells; rhizoids colorless to variously colored, rarely forming fascicle decurrent down the stem 6

6) Leaf margin bordered by swollen cells, rim commonly distinctly deeper colored 7
6) Leaf margin not bordered by swollen cells, rim is not marked by deeper coloration 10

7) Swollen cells not equally thickened, with large, sometimes confluent trigones, cells nearly the same size with those in midleaf or slightly larger ..... *Solenostoma rubrum* (p. 113)
7) Swollen cells are equally thickened, the same size with inner ones or larger 8

8) Rhizoids colorless to brownish; leaf margin cells 1.5–2.0 times larger than those in the midleaf ..... *Metasolenostoma gracillimum* f. *crenulatum* (p. 120)
8) Rhizoids red, purple, brown-purple to violet; leaf margin cells 0.9–1.4 times larger than those in the midleaf 9

9) Plants 0.5–1.2 mm wide, erect to ascending, whitish brownish to brownish rusty, rarer greenish yellow; basal (especially in ventral side) part of leaves sometimes with deep purple to purplish coloration; temperate East Asia ..... *Plectocolea rigidula* (p. 91)
9) Plants 1.1–2.5 mm wide, prostrate to ascending, yellowish brown, brownish to brown reddish, rarely in shady places pale greenish to whitish and very soft and gentle, basal part of leaves is not differs in coloration or paler; Eastern North America ..... [*Plectocolea crenuliformis* (p. 81)]

10) Plants pellucid to whitish, pale greenish to pale brownish; trigones small to nearly absent, concave 11
10) Plants green to deep green, brownish, reddish, purplish and purple-brown 13

11) Rhizoids brown-red to (rarer) purplish and pale brownish, rigid; leaves strongly undulate at margin; plants of 'fossombronioid' appearance; paroicous; restricted to eastern North America ..... *Plectocolea fossombronioides* (p. 82)
11) Rhizoids colorless to brownish, rarely pale purplish, rather soft; leaves not or loosely undulate at margin; plants not similar to *Fossombronia*; dioicous; not restricted to eastern North America 12

12) Leaves commonly emarginate at apex, especially near shoot apex; obliquely inserted, commonly nearly flattened, appressed to the stem laterally, when well-developed – transversely elliptic to reniform in shape; perigynium present; distributed around treated area, but more common in its northern part ..... *Solenostoma hyalinum* (p. 101)
12) Leaves not emarginate; obliquely to subtransversely inserted, concave, laterally erect spreading, orbicular or nearly so; perigynium reduced; restricted to American part of treated area ..... *Metasolenotoma gracillimum* f. *gracillimum* (p. 120)

13) Plants over vertical wall of limestone cliffs 14
13) Plants ovoid limestone cliffs, although sometimes growing in other (not limestone) *Ca*-rich habitats 15

14) Leaves distant, orbicular, flattened to concave; paroicous; plants 1.0–1.2 (–1.5) mm wide; southern flank of the Russian Far East ..... *Jungermannia konstantinovae* (p. 75)
14) Leaves contiguous, ovate, commonly canaliculate, enclosed one to other; dioicous; plants 1.4–2.5 mm wide; not restricted to the South of the Russian Far East ..... *Jungermannia atrovirens* (p. 68)

15) Rhizoids deep purple to purple-brown 16
15) Rhizoids mostly colorless to brownish and pink, rarely purplish, but not purple nor purple-brown 22

16) Leaves mostly widely triangular to widely ovate, sheathing the stem (such as stem is invisible), canaliculate-concave, commonly undulate at margin; oil-bodies botryoidal; perigynium 2 times longer than perianth; Western North America ..... *Plectocolea schusteriana* (p. 92)
16) Leaves not or loosely sheathing the stem, canaliculate to concave and flattened, not undulate at margin; oil-bodies not botryoidal; perigynium less than 2 times as long as perianth; not restricted to Western North America 17

17) Plants erect, 1.2–1.5 mm wide; rhizoids in distinct fascicle decurrent down the stem; leaves erect spreading, ovate to obliquely ovate; temperate East Asia. Not present in the Russian Far East but may be likely found ... [*Plectocolea virgata*
17) Plants ascending, rarely erect (if erect – 1.5–2.3 mm wide); rhizoids not or loosely decurrent down the stem, not forming distinct fascicle; leaves of various shape; restricted or not restricted to temperate East Asia 18

18) Plants ascending to erect; leaves mostly orbicular, nearly flattened in upper half, erect spreading; oil-bodies 2–3 per cell; Temperate East Asia ..... *Solenostoma rotundatum* (p. 113)
18) Plants ascending (erect only in dense patches); leaves orbicular to ovate, canaliculate to canaliculate-concave, erect spreading or not; oil-bodies 4 and more per cell; more northerly distributed taxa 19

19) Stem whitish and glossy when dry, with distinct hyalodermis; rhizoids commonly with distinct violet tint; perigynium longer than perianth; dioicous ..... *Solenostoma obscurum* (p. 104)
19) Stem not whitish nor glossy when dry; rhizoids without violet coloration; perigynium shorter than 1/2 of perianth length (dioicous plant) or as long to longer than perianth (paroicous plants) 20

20) Plants 2.0–2.5 mm wide, ascending to erect; growing near streams, leaves subtransversely to transversely oriented; paroicous ..... *Solenostoma obovatum* (p. 103)
20) Plants less than 2 mm wide, creeping to ascending; growing near streams or in wet hollows in tundras; leaves obliquely oriented; paroicous or dioicous 21

21) Rhizoids colorless to pink and pale purplish; mostly in tundra zone and alpine belt, distributed northward of 50°N; paroicous; perigynium 2/3 – 3/3 of perianth leangth ..... *Solenostoma subellipticum* (p. 117)
21) Rhizoids purple to purple-brown; boreal coniferous forest to subalpine and alpine communities southward of 54°N in Eastern Asia; dioicous; perigynium 1/4 – 1/2 of perianth length ..... *Plectocolea ovalifolia* (p. 90)

22) Plants deep green to brownish deep green and dirty green, large 2.0–3.0 mm width; leaves widely triangular, sheathing the stem; commonly submerged, growing in the bogs or near streams ..... *Jungermannia eucordifolia* (p. 72)
22) Plants bright green, pale green, reddish, brownish, yellowish to brown or blackish, rarely deep green or dirty green, but then smaller than 2.0 mm wide and leaves are erect to obliquely spreading, not sheathing and not overlapping the lower half of next situated leaf upward; rarely submerged 23

23) Plants with imbricate leaves, creeping to loosely ascending, closely attached to the substratum, less than 1 mm

wide; growing on fine soil, commonly in roadsides or pathes or in fine soil spots in tundras, paroicous 24
23) Plants with spreading leaves, ascending to erect, not closely attached to the substratum, mostly wider than 1 mm wide, commonly on stones and cliffs, among mosses in tundras, sometimes in roadsides; paroicous or dioicous .. 26

24) Plants with distinct red-brown to rusty pigmentation, 0.15–0.4 mm wide, only near the perianth up to 1 mm wide, perianth rostellate, plicate ..... *Solenostoma pusillum* (p. 109)
24) Plants without even traces of red or rusty pigmentation, perianth rostellate or not, obovate to fusiform 25

25) Stem 100–150 μm in diameter; shoot with leaves 1.5 times wider than stem; leaves 250–320 μm long; perianth cylindrical to cylindrical-fusiform .... *Jungermannia polaris* (p. 75)
25) Stem 70–90 μm in diameter; shoot with leaves 2.0 and more times wider than stem, leaves 330–350 μm long; perianth rostellate, 4–5-keeled .... *Solenostoma sphaerocarpum* var. *nanum* (p. 115)

26) Rhizoids commonly purplish to pink, sometimes colorless to brownish, but always with pink to purplish tint near rhizoid origin area; in most cases perigynium well developed and upper part of perianth composed by elongated cells (or perianth not seen) 27
26) Rhizoids colorless to brownish and grayish; perigynium vestigial to 1/4 of perianth length, upper part of perianth composed by nearly isodiametric cells (not more than 1.5 times longer than wide) 31

27) Plants of 'solenostomoid' appearance, mostly erect, with erect spreading leaves; rhizoids commonly forming fascicle decurrent down the stem; paroicous; south boreal to temperate East Asia .... *Solenostoma pseudopyriflorum* (p. 107)
27) Plants of 'plectocoleoid' appearance, prostrate to ascending with obliquely spreading leaves; rhizoids not forming fascicle; paroicous or dioicous; not limited in distribution by the southern part of the Russian Far East 28

28) Plants of North Boreal to Arctic zone, not deeply penetrate southward even by mountain ranges, confined to mountain tundra and stream banks in mountainous areas; paroicous; commonly less than 2 mm wide .... *Solenostoma subellipticum* (p. 117)
28) Plants of temperate to south toreal East Asia; dioicous; commonly wider than 2 mm 29

29) Leaves orbicular or nearly so, subimbricate to slightly obliquely spreading, concave .... *Plectocolea infusca* var. *recondita* (p. 86)
29) Leaves ovate, obliquely spreading, concave-canaliculate, commonly enclosed one to another 30

30) Oil-bodies grayish, not filling cell lumen; rhizoids pink to light purple, rarely brownish; antical leaf margin commonly revolute; leaves distinctly canaliculate, enclosed one to another; ventral leafless stolons commonly present .... *Plectocolea kurilensis* (p. 88)
30) Oil-bodies brownish ('*infusca*-type': Amakawa 1960), nearly filling cell lumen; rhizoids colorless to light pink and purplish; antical leaf margin flattened to slightly involute; leaves concave to loosely canaliculate, loosely enclosed one to other; ventral leafless stolons absent .... *Plectocolea infusca* var. *infusca* (p. 83)

31) Plants deep green to dirty green, yellowish green and blackish green without any traces of red or purple pigmentation; plants of mostly very wet substrata (hygric conditions) near streams, rarer on wet rocks or more or less dry *Ca*-rich cliffs (*J. atrovirens*); perianth fusiform to cylindrical-fusiform, gradually narrowed to the mouth 32
31) Plant bright green to deep green, brown, rusty brown with purple and red pigmentation common (at least as traces or located near perianth beak and leaf rim; plants common on fine soil along roadsides or in other similar conditions near streams, but in mesic conditions; avoid *Ca*-rich substrata; perianth tubular to clavate, rostellate, keeled near mouth 35

32) Plants of mesic to nearly xeric conditions, growing on cliffs or other crystalline *Ca*-rich substrata, 1.4–2.5 mm wide; leaves mostly ovate ..... *Jungermannia atrovirens* (p. 68)
32) Plants of hygric to hydric, rarely mesic conditions, avoid *Ca*-rich substrata, mostly narrower than 1.5 mm wide; leaves ovate or not 33

33) Plants creeping to loosely ascending; leaves mostly flattened to slightly canaliculate or concave, laterally appressed to the stem; dioicous ..... *Jungermannia borealis* (p. 70)
33) Plants ascending to erect; leaves concave to concave-canaliculate, obliquely to erect spreading; paroicous or dioicous 34

34) Plants commonly fertile, paroicous, bright to deep green; leaf cell walls colorless to grayish and yellowish; distributed in Boreal zone, rarely penetrating south- and northward .. .. *Jungermannia pumila* (p. 78)
34) Plants commonly sterile, dioicous, brown green to brownish blackish deep green; leaf cell walls rusty to nearly orange; distributed mostly in mountainous areas of Temperate East Asia, rarely penetrating to North-East Asia along Kurils, Kamchatka and Commanders .... *Jungermannia exertifolia* (p. 74)

35) Plant brown to sepia brown, yellowish brown and brownish green, without traces of red or purple pigmentation 36
35) Plants commonly with purple or red pigmentation, sometimes located only near perianth beak, leaf rim and/or ventral leaf base 37

36) Plants brownish to brown; leaves distant; trigones of leaf cells small to indistinct; dioicous; growing on rocks along stream in mountainous areas (subalpine to alpine belt) of Temperate East Asia, not present in our area, but likely to be found ..... [*S. rishiriense*, not treated here]
36) Plant yellowish brown to sepia brown and green brownish; leaves contiguous; trigones in leaf cells small to moderate in size; paroicous; growing on fine soil along stream and roadsides in low to moderate levels of mountains in Boreal zone .... *Solenostoma sphaerocarpum* var. *sphaerocarpum* (p. 115)

37) Plants pale green, yellowish green to brownish, stem whitish; reddish or purple pigmentation located only near perianth beak and (rarer) leaf rims of upper leaves; heteroicous (dioicous and paroicous phases may be found); distributed in Boreal to North-Temperate East Asia; growing in roadsides or other mesic conditions (mostly tundra or tundroid communities) in open places .... *Solenostoma rossicum* (p. 110)
37) Plants deep and bright green to brownish, red-brown, rusty brown and brown purplish, red or purple pigmentation is more intense in upper part of shoots and/or ventral leaf bases, stem brownish; dioicous; growing on cliffs or boulders in mesic conditions or in xero-mesic scoria fields (or other volcanic deposits) 38

38) Plants commonly brownish to brown and purplish brown; growing on scoria fields or tufa and pumice deposits in the areas of extant volcanism; perigynium 1/4 – 1/3 of perianth length; distributed in Boreal Asia eastward of Sea of Okhotsk ..... *Metasolenotoma ochotense* (p. 121)
38) Plants commonly bright green, green yellow, yellowish green brownish, with purple or purplish pigmentation more evident in ventral leaf bases; growing on moist rock crevices or on rocky surfaces, rarely on bare soil in human disturbed

areas; perigynium vestigial; distributed eastward of treated area in North America (Georgia, Michigan, North and South Carolina, Virginia) ..... [*Solenostoma appalachianum* (p. 97)]

DESCRIPTIONS

This section lists families in alphabetical order, genera in the same order within family and then species within genus in alphabetical order too. Russian Pacific includes six administrative subunits of Russia: (from south to north) Primorskii and Khabarovsk Territories, Sakhalin and Magadan Provinces, Kamchatka Territory and Chukotskii Autonomous Region (Chukotka). The American side of North Pacific includes in the present work Canadian British Columbia and four states of U.S.A.: Alaska, Washington, Oregon and California.

The treatment of each species includes 5 sections: 1) morphological description, 2) comments (of various, but mostly taxonomical character), 3) distribution (detailed for North Pacific and very schematic general), 4) ecology and 5) specimens examined (collectors Vadim Bakalin and Nadya Konstantinova are abbreviated as VB and NK respectively, other names are given in full). In any descriptions, when complex numerical data are placed, the first is the length and the second is width, if otherwise is not mentioned. The parameters placed in the descriptions are based entirely on specimens examined; only in some exceptional cases I cite morphological data from literature sources (with corresponding references). The section Specimens examined divided into two subsection: specimen examined from Russia, Canada and U.S.A. (not only the parts belonging to studied area within those countries), and then, starting from the new paragraph, other countries listed in alphabetical order. Within the countries I mostly used administrative subunits (arranged alphabetically), but in some cases natural regions were put in the section, instead of commonly numerous and small-sized subunits (e.g. Caucasus, Altai, etc.).

Aside of specimens examined the main sources on the distribution data within treated area and adjacent countries were as following (not cited in distribution section): Konstantinova et al. (2009) for Siberia, Bakalin (2010) for the Russian Far East, Yamada & Choe (1997) for Korean Peninsula, Yamada & Iwatsuki (2006) for Japan, Váňa & Hong (1999) and Doyle & Stotler (2006) for Pacific North America and Schuster (1969) for other part of North America. These sources are certainly not absolutely exhaustive and in some particular cases I use another works that, however, referenced in the text.

ENDOGEMMATACEAE Konstant., Vilnet & A.V. Troitsky, Folia Crypt. Estonica 48: 132, 2011.

This monotypic family was described recently (Vilnet et al. 2011) as having some relations to Solenostomataceae and Gymnomitriaceae. The striking feature of the family is the endogenous gemmae – a rare feature in hepatics, and present, e.g. in thallose *Blasia* L. and *Riccardia* Gray. Endogemmataceae (due to data in hand) is the monotypic family and its description is the same with the species.

ENDOGEMMA Konstant., Vilnet & A.V. Troitsky, Folia Crypt. Estonica 48: 132, 2011.

Type species: *Endogemma caespiticia.*

Endogemma caespiticia (Lindenb.) Konstant., Vilnet & A.V. Troitsky, Folia Crypt. Estonica 48: 132, 2011 (= *Solenostoma caespiticium* (Lindenb.) Steph., Sp. Hep., 2: 57, 1901; *Jungermannia caespiticia* Lindenb., Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur., 14 (Suppl.): 67, 1829).

Description. Plants 0.5–1.1 mm, near perianth up 1.5 mm wide, ca. 2–3 (–5) mm length, creeping to ascending, frequently fertile and with endogenous gemmae concentrated in unfertilized perianths, sometimes with ventral etiolated innovations, pale brownish, white, whitish green and whitish greenish with dirty brownish and brown tint near gemmiparous apices. Stem (150–) 200–300 μm wide, branching lateral, mainly below gemmae tips or perianths, dorsal surface cells thin-walled, with indistinct trigones, (47–) 70–240 × 28–50 μm. Rhizoids dense to scattered, colorless to brownish, in indistinct obliquely spreading fascicles commonly closely attaching plant to the substratum. Leaves distant to contiguous and subimbricate, inserted at angle of 30–70° with axis in lower part of stem to (in upper part, and near perianth) 70–80°, dorsally not decurrent or decurrent up 1/6 of stem width (evident only in large plants), ventrally subtransversely inserted, not decurrent, 300–765 × (315–) 500–1000 μm (1 : 0.6–0.7 (–0.9)), transversely elliptic, flattened to slightly concave and loosely canaliculate, sometimes with undulate margin. Cells in the midleaf thin-walled, from (rarely) 28 × 28 μm to 47–90 × 42–65 μm, trigones wanting to very small and concave; cells near margin (30–) 40–70 (–100) μm, thin-walled, but sometimes with thickened external wall, trigones concave, cuticle smooth throughout. Oil bodies in almost all leaf cells, 1(2) per cell, grayish to brownish, coarsely granulate, nearly filling cell lumen. Gemmae orbicular to shortly elliptic and irregularly tetragonal in projection, 8.4–14.0 (18.0) × 7.0–10.0 (14.0) μm. Dioicous. Perianth terminal, exerted for 3/4 of its length, fusiform to cylindrical, 5-plicate (1-dorsal, 2-lateral and 2-ventral), 1000–1850 × 400–1000 μm (smaller perianth with unfertilized archegonia commonly filled by gemmae), perigynium up 1/4 of perianth's length or indistinct, with 1 pair of leaves, not rhizogenous, ca. 5 archegonia in perichaetium, bracts transversely elliptic to transversely rectangular, with undulate-crispate margin, ca. 900 × 1300 μm, sheathing perianth in base and deflexed or straight erect in upper half. Capsule 280–300 μm length; elaters 140–170 × 8.4 μm, 2-spiral; spores finely papillose, 11.2–15.4 μm in diameter. Figure 2.

Comment. Despite *Endogemma caespiticia* has systematic position strongly isolated from Solenostomataceae, its appearance is typically 'solenostomoid', particularly due to rostellate, 4–5-plicate perianth. In the most cases it is easily distinguished from regional *Solenostoma* by endogenous gemmae, pale yellowish plant color, dioicous inflorescence, 1(2) large oil body per leaf cell that nearly filling cell lumen, commonly very thin-walled leaf cells and wanting to small and concave trigones. Being sterile, without gemmae and in the absence of living cells for study, it may be probably con-

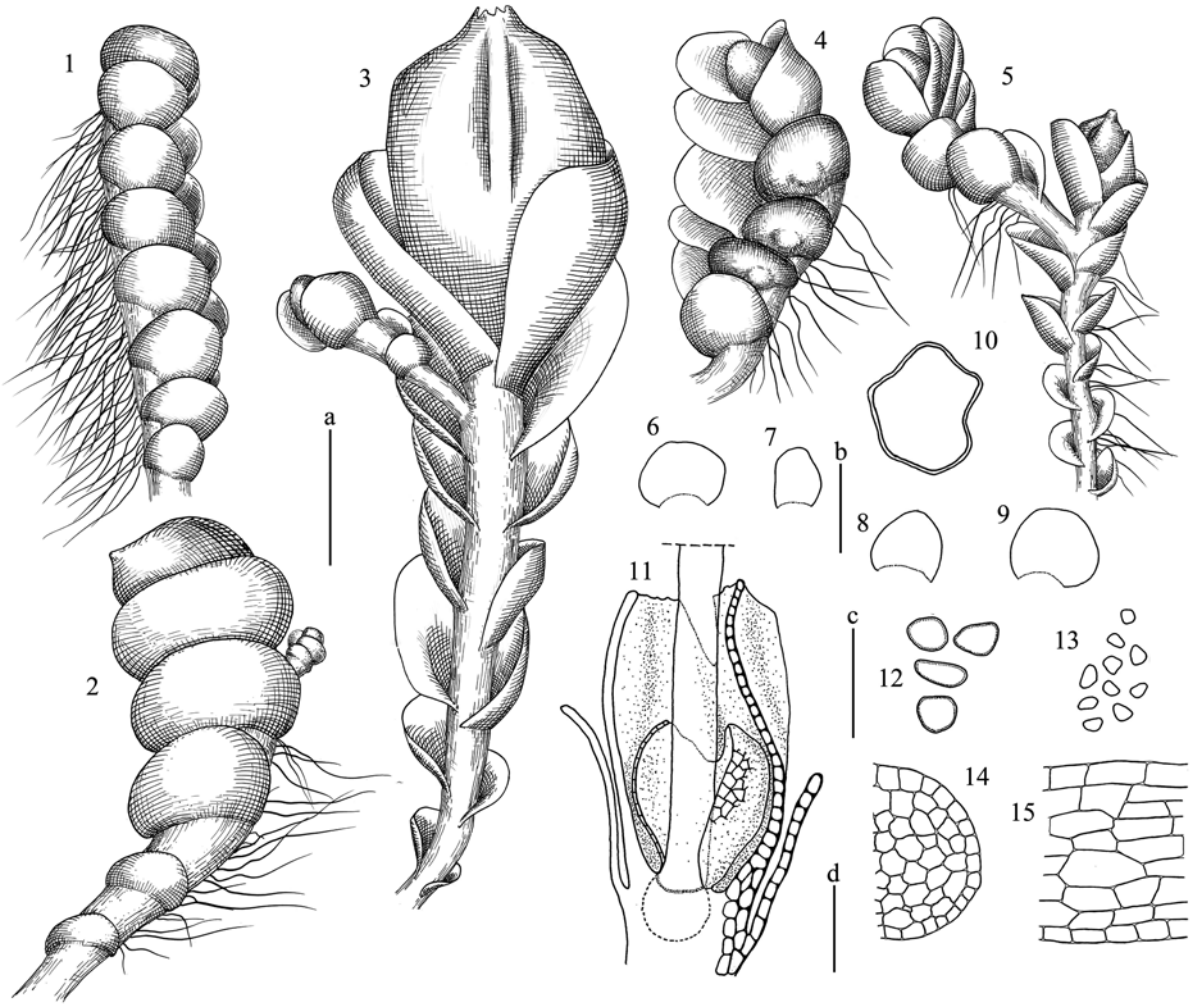

Figure 2 *Endogemma caespiticia* (Lindenb.) Konstant., Vilnet & A.V. Troitsky 1– sterile branch; 2, 3, 5 – branch with perianth; 4 – branch with androecia; 6–9 – leaves; 10 – perianth cross section at the middle part; 11 – perianth longitude section; 12, 13 – gemmae; 14 – stem cross section; 15 – stem longitude section. 1, 3 – from K-13-9a-03 (KPABG); 2, 4 – from KPABG-104221 (KPABG); 6–9, 12–15 – from K-50-28-02 (KPABG); 10, 11 – from KPABG-104425 (KPABG). Scales: a – 500 μm, for 1–5, 11; b – 1 mm, for 6–10; c – 50 μm, for 12; d – 100 μm, for 13–15

fused with *Solenostoma confertissimum* and *S. sphaerocarpum*. In the latter case the attention should be paid to very thin-walled and large (mostly more than 45 μm in length and 42 μm in width in the midleaf) leaf cells, as well as pale yellowish color of plants without red pigmentation.

Distribution. Boreal sub-circumpolar species. Taken into account its ability to produce gemmae and preference to grow in man-made habitats, such as roadsides and waste lands, it is possible to suspect the quick spreading of this species within past decades of years. Within treated area, this species recorded in all administrative subunits of the Russian Far East (although very rare northward of 60°N), in adjacent Siberia distributed disjunctively and known from Western and Southern Siberia and Republic of Yakutiya. In North American side seems to be quite rare and recorded only from British Columbia and Alaska, eastward also known from rather isolate locality in New York.

Ecology. Acido- to neutrophilic mesophyte. The taxon prefers habitats with natively or anthropogenic disturbed vegetation: on clayish soil along roadsides and on stream banks in coniferous forest belt, rarely ascending to crooked alpine forests and mountain tundra or occurring in tundra zone. In the Russian Far East it occurs mostly below 500 m a.s.l., with rare exceptions confined to anthropogenically modified habitats such as in in Iturup Island (1020 m a.s.l.), where it occurs along old roadside and Central Kamchatka, where it grows along stream bank near road.

Specimens examined. RUSSIA, Khabarovsk Territory, North of Sihote-Alin Mt. System (~49°21'N 137°48'E), 270 m alt., VB, Kh-47-1-13, 29.VIII.2013 (VBGI), Sakhalin, Due area (50°49'20"N 142°05'21"E), VB, S-58-9-09 05.IX.2009 (VBGI), Buryatiya, Khamar-Daban Range, VB, 15-1 04.VIII.1999 (KPABG), Caucasus, Adygeya (44°00'51"N 39°57'33"E), NK, K441-4-07 12.X.2007 (KPABG), Chita Province, Udokan Range (57°01'N 119°35'E), VB, 13-5-00 10.VII.2000 (KPABG), Kamchatka, Karaginskij Island (59°01'48"N 164°58'13"E), VB, K-24-5-05 02.VIII.2005 (VBGI), Central Kamchatka (55°40'N 157°40'E), VB, K-50-28-02 14.IX.2002 (KPABG, duplicate in VBGI), East Kamchatka (54°25'50"N 160°08'22"E), Chernyagina O.A., 18.IX.1988 (VBGI), North Kamchatka (59°10'N 159°50'E), VB, K-24-3-03 14.VI.2003 (KPABG, duplicate in VBGI), West Kamchatka (52°50'N 156°15'E), VB, K-10-18-03 04.VI.2003 (KPABG, duplicate in VBGI), Chernyagina O.A., VII.1990 (VBGI), Karelia, Pryazhinskij District (61°33'44"N 33°37'10"E), VB 22.VI.1997 (KPABG, duplicate in VBGI), Khabarovsk Territory, Gobilli River Basin (49°16'00"N 138°21'35"E), VB, Kh-71-12-09 21.IX.2009 (VBGI), Lanzhiskiye Mts. (59°26'32"N 143°30'44"E), VB, Kh-21-7-08 19.VII.2008 (VBGI), (59°23'40"N 143°34'20"E), VB, Kh-29-1-08 21.VII.2008 (VBGI), (59°27'31"N 143°27'49"E), VB, Kh-40-1-08 26.VII.2008 (VBGI), Silinka River area (50°45'50"N

136°25’27”E), VB, Kh-8-6-07 31.V.2007 (VBGI), Solnechnyj District (50°45’50”N 136°25’27”E), VB, Kh-8-5-07 31.V.2007 (VBGI), Komi Republic, Troitsko-Pechyorskii District, Dulin M.V., 25.VI.2001 (KPABG), Kurils Islands, Iturup Island (44°54’40”N 147°28’06”E), VB, K-14-2-07 09.VIII.2007 (VBGI), (45°08’33”N 147°57’26”E), VB, K-51-24a-05 14.IX.2005 (VBGI), Kunashir Island (43°51’52”N 145°30’10”E), VB, K-45-3a-06 04.IX.2006 (VBGI), Magadan Province, Seimchan River Basin (63°13’38”N 152°08’09”E), VB, Mag-15-15-10 13.VI.2010 (VBGI), Murmansk Province, Alakurtti Settl. Area, Schljakov R.N., 81 30.VII.1971 (KPABG), Kandalaksha Bay, NK, 189-1-91 17.VIII.1991 (KPABG), Khibiny Mts., NK, 1в-96 30.VI.1996 (KPABG), Umbozero Lake area, NK, K200-12-04 13.VIII.2004 (KPABG), Primorskii Territory, Khanka District (44°55’N 131°58’E), VB, P-24-4-10 11.VII.2010 (VBGI), Sakhalin Island, Argi-Pagi Settl. (51°17’48”N 142°42’42”E), VB, S-55-1-09 04.IX.2009 (VBGI), Chaivo Bay (52°21’39”N 143°11’33”E), Barkalov V.Yu., 01.VIII.2008 (VBGI), Due area (50°49’21”N 142°05’21”E), VB S-58-17-09 05.IX.2009 (VBGI), Moskalvo Settl. (53°35’39”N 142°31’33”E), VB, S-35-1-09 26.VIII.2009 (VBGI), Pilenga River Basin (51°01’31”N 142°50’50”E), VB, S-29-5-09 22.VIII.2009 (VBGI), Pomr' Bay (53°37’36”N 142°43’10”E), VB, S-34-1-09 25.VIII.2009 (VBGI), Smirnykh Settl. (49°45’N 142°45’E), Barkalov V.Yu., 29.VIII.2008 (VBGI), Yuzhno-Sakhalinsk Area (46°57’N 142°44’E), Ignatov M.S., 09.VIII.2006 (VBGI), Tver Province, Kuvshinovskii District, Notov A.A., 30.VII.1994 (KPABG).

GERMANY (isotype of *Jungermannia caespeticia* Lindenb.: “Ad Bergedorf in silvaticis”) (G00115178); SLOVAKIA, Slovakia orientalis, Váňa J., VI.1980 (KPABG); U.S.A., New York, Ontario Co., Schuster R.M., 3120 28.X.1945 (F).

JUNGERMANNIACEAE Reichenbach, Botanik fur Damen 256, 1828.

JUNGERMANNIA L. emend. Schljakov, Sp. Plant. 1131. 1753. [named in honor of botany teacher L. Jungermann] (= *Solenostoma* Mitt. subg. *Luridae* (Spruce) Müll. Frib., Hedwigia 81: 117, 1942).

Type species: *Jungermannia lanceolata* L. Sp. Pl. 1131 (n. ill., = *J. atrovirens*)

Plants deep green to brown and greenish brown, without traces of red or purple pigmentation (with very rare exception in inflate area of male bracts or near shoot tips). Stem mostly elliptic in cross section, branching terminal or intercalary, dorsal surface cells subisodiametric. Rhizoids colorless to yellowish or brownish, never red or purple. Leaves inserted at angle ca. 20-60º with axis. Cells in the midleaf subisodiametric to slightly oblong, walls thin to slightly or moderately thickened, mostly colorless to brownish in color, trigones mostly small, concave to wanting. Perianth terminal, mostly 2 (–3)-stratose for lower 2/3 of its length, cells in the perianth middle subisodiametric to shortly rectangular, fusiform to clavate, gradually narrowed or suddenly contracted to the mouth, sometimes 4–5-plicatae at upper part. Androecia intercalary, in 2–10 pairs of bracts, with 1 (–2) antheridia per bract, stalk biseriate.

Jungermannia atrovirens Dumort., Syll. Jungerm. Europ., 51, 1831. (= *Solenostoma atrovirens* (Dumort.) Mull. Frib., Hedwigia, 81: 117. 1942; *Jungermannia tristis* Nees, Naturg. Eur. Leberm. 2: 461, 1836.)

Description. Plants (0.7) 1.4–2.5 mm (near perianth up 3 mm) wide, 7–20 mm long, prostrate to ascending, yellowish greenish to brownish green and dark green. Stem 150–300 μm in diameter, orbicular in cross section, rarely elliptic, 175–315 μm in wide and 120–300 μm high, branching lateral or ventral (commonly as subfloral innovation only), dorsal surface cells subquadrate to rectangular and oblong-rectangular, thin- to slightly thick-walled, walls colorless to brownish, with small to medium-sized concave trigones, 35–70 (125) × 20–30 μm, cuticle distinctly striolate; in the stem cross section outer cells larger than inner ones, ca. 20–23 μm in diameter, walls thickened, brownish to brown colored, inner cells ca. 12–15 μm in diameter, mostly pentagonal, with thinner yellowish to colorless walls, trigones small and concave. Rhizoids scattered to nearly absent, colorless to pale-brownish and yellowish, erect to obliquely spreading or decurrent down along the stem, but not forming fascicle. Leaves distant to contiguous, laterally erect, loosely canaliculate to concave-canaliculate and nearly flattened, inserted at angle 15–45° with axis, dorsally subtransversely inserted, not or very barely decurrent, ventrally subtransversely to loosely arcuately inserted not or shortly decurrent, 800–1250 × 750×1250 μm (0.8–1 : 0.9–1), ovate to rounded-ovate and widely triangular. Cells in the midleaf 20–40 (50) × 15–30 μm, thin- to slightly thick-walled, walls brownish to yellowish brownish, commonly flexuous, trigones indistinct; along margin 15–27 μm, thin-walled, walls brownish, cuticle smooth to striolate in lower half or papillose throughout. Dioicous. Perianth terminal, fusiform to long rhomboidal, clavate and ob-pyriform in projection, 1500–2000 × 700–900 μm, smooth to indistinctly pluriplicate in upper part, exerted from bracts for 4/5 – 5/5 of its length, perigynium absent, archegonia ca. 5 in perichaetium, bracts concave-canaliculate, sometimes with deflexed apices, ca. 1500–2000 × 1450 μm. Androecia intercalary in 2–8 (10) pairs of bracts, different generations divided by 5–7 pairs of sterile leaves, 1(2)-androus, stalk biseriate, ca. 40 μm in length, body nearly spherical, ca. 240–270 μm in diameter, male bracts rather canaliculate, distinctly deflexed near apex, ca. 1000 × 1000 μm. Capsule wall bistratose. Elaters ca. 8 μm in width, bispiral. Spores 14–18 μm in diameter, finely papillose, reddish brown. Figure 3.

Comment. The striking characters of the taxon includes dioicous inflorescence, obliquely oriented and erect spreading leaves, more or less large size (in the most cases plants wider than 1.4 mm) and occurrence on limestone. The nearest morphological ally among regional taxa is *Jungermannia borealis* that also characterized by dioicous inflorescence. The latter species may be distinguished from *J. atrovirens* by its smaller size (plants mostly less than 1.4 mm wide), northern boreal to Arctic distribution (it is only disjunctively occurs southward of 55°N in treated area), commonly slightly laterally appressed, not erect spreading leaves (this does not concern of fertile branches of *J. borealis*) and rather occasional, but not virtually universal as in *J. atrovirens* occurrence in *Ca*-rich substrata.

Distribution. Boreo-Temperate Montane circumpolar. In the western part of North America the species recorded from Alaska, and southward to British Columbia, Washington, Oregon and California; eastward known in Alberta, Idaho, Montana, Utah, Colorado and then in Eastern coast in Nova Scotia and Quebec. Within the Russian Far East it is known across eastern fridges of the territory, from Chukotka to Kurils, Sakhalin and Primorskii Territory. Westward in Siberia sparsely occur in its eastern part (at least some of re-

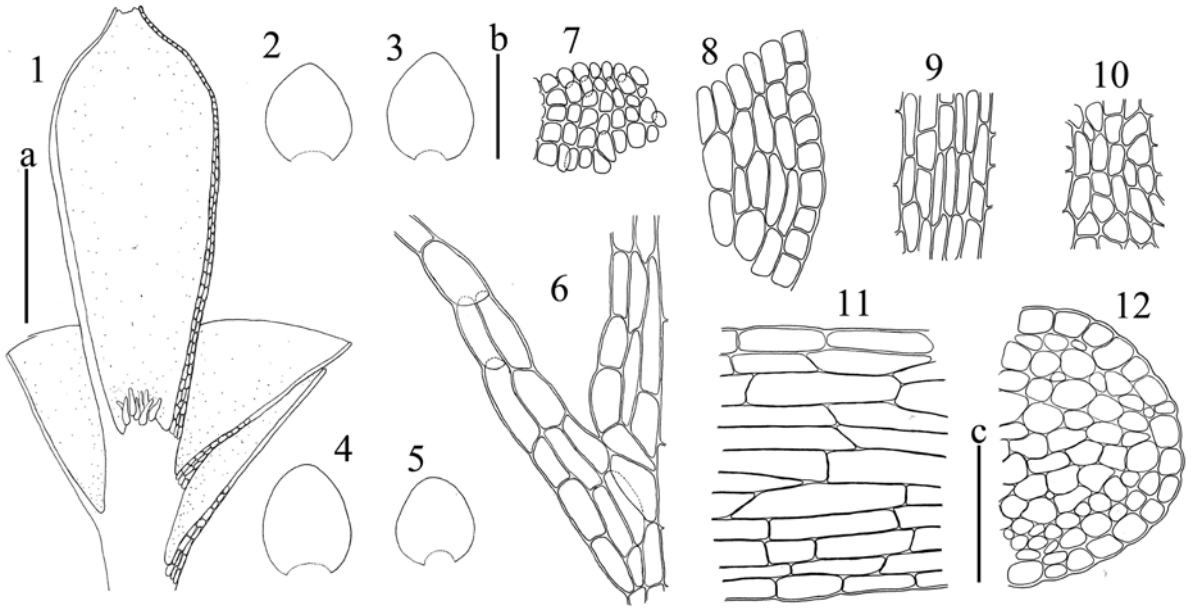

Figure 3 *Jungermannia atrovirens* Dumort. 1 – perianth longitude section; 2–5 – leaves; 6 – leaf base longitude section; 7 – perianth mouth; 8 – cells in ventral leaf base; 9 – cells in perianth lower part; 10 – cells in the perianth middle part; 11 – stem longitude section; 12 – stem cross section. 1–12 – from K-92-13-04 (KPABG). Scales: a – 1 mm, for 1; b – 1 mm, for 2–5; c – 1 mm, for 6–12.

cords may be incorrect). Throughout of its area the species is confined in distribution by occurrence of limestone or (rarely) other basic substrates. In the Russian Far East it occurs mostly in elevations from near sea level to 500 m a.s.l., although in southern parts sometimes reaches considerable higher altitudes (up 1500 m a.s.l. in Primorskii Territory and 1134 m a.s.l. in Sakhalin). Within North America this species sporadically occurs from low elevation to 2438 m a.s.l. in Colorado, where nevertheless occurs within coniferous forest belt (talus, spruce-forested ravine). This altitudinal diapason is rather similar to that in southwardly adjacent to the Russian Far East Korean Peninsula and Japan, where it reaches 1118 and 1700 m a.s.l. correspondingly.

Ecology. Basiphilic hygrophyte. The species is confined to mesic, but occasionally moistened limestone cliffs and boulders, mostly in Boreal zone, where in coniferous forest belt, although occasionally spreading to temperate deciduous forests.

Specimens examined. RUSSIA, Caucasus, Adygeya (44°04'52"N 40°00'01"E), NK, K422-2-07 11.X.2007 (KPABG), (43°59'27"N 40°07'44"E), NK, K464-21-07 17.X.2007 (KPABG), (44°00'14"N 40°08'22"E), NK, K484-5-07 20.X.2007 (KPABG), Aibga Range (43°38'05"N 40°16'33"E), NK, K452-1-08 12.X.2008 (KPABG); Krasnodarskii Territory (43°34'54"N 40°01'01"E), NK, K177-3-09 04.X.2009 (KPABG); Mzymta River (43°34'55"N 40°00'51"E), NK, K188-09 04.X.2009 (KPABG), (43°36'05"N 40°04'39"E), NK, K198-1-09 06.X.2009 (KPABG), Chukotka, Dlinnaya River, Kuzmina Ye.Yu. 08.VII.1988 (KPABG, duplicate in VBGI), Kamchatka Peninsula, Central Kamchatka (55°55'N 159°00'E), VB, K-44-1a-02 08.IX.2002 (KPABG, duplicate in VBGI), South Kamchatka, VB, K-74-13-04 08.VII.2004 (KPABG), Kemerovskaya Province, Kuznetskii Alatau Range (54°42'N 88°27'E), NK, VI.2000 (KPABG); Kurils Islands, Kunashir Island (44°27'41"N 146°06'49"E), VB, K-37-17a-06 28.VIII.2006 (VBGI), Paramushir Island (50°29'05"N 155°46'30"E), VB, K-92-13-04 23.VII.2004 (KPABG, duplicate in VBGI), Murmansk Province, Ontojoki River, Schljakov R.N., 203 04.VII.1972 (KPABG), Ponoj River lower course, Schljakov R.N., 554 04.VIII.1978 (KPABG), Pyukhyakuru canyon, NK, 58/6 11.VIII.1986 (KPABG), NK, 58-3-86 15.VIII.1986 (KPABG), NK, 63/2 11.VIII.1986 (KPABG), Primorskii Territory, Partizansk District (43°20'50"N 133°39'22"), VB, P-65-18-06 03.X.2006 (VBGI), Sakhalin Island, Chamga Mt. (50°46'04"N 143°15'18"), VB, S-26-20-06 14.VIII.2006 (VBGI), (50°45'09"N 143°18'26"), VB S-27-24a-06 15.VIII.2006 (VBGI), (50°45'32"N 143°17'43"E), VB, S-27-32-06 15.VIII.2006 (VBGI), (50°46'47"N 143°16'28"E), VB, S-63-18-09 12.IX.2009 (VBGI), Schmidt Peninsula (54°04'10"N 142°29'26"E), VB, S-48-9-09 01.IX.2009 (VBGI), Vaida Mt. (49°53'16"N 143°27'08"E), VB, S-34-2-06 21.VIII.2006 (VBGI), Sayan Mts., Sayan East, Vasilijev A.N., 10.VIII.1990 (KPABG); CANADA, British Columbia, Bridal Fall (49°12'N 121°44'W), NK, A142/1-95 06.X.1995 (KPABG, duplicate in VBGI); North Vancouver District, NK, A134-95 06.X.1995 (KPABG, duplicate in VBGI); Seymour Mt. (49°23'N 122°57'W), NK, A134-95 06.X.1995 (KPABG, duplicate in VBGI); Vancouver Island, (no data on collector) V.1887 (MO5273069), Macoun J., 13.V.1909 (MO5273070); U.S.A., Alaska, Aleutian, Tanaklak Island (51°57'42"N 176°06'29"W), Schofield W.B., 25.VIII.2006 (MO6093480), Wyoming, Albany County, Rocky Mts. (41°20'N 106°15') Kosovich-Anderson Ye. I., #13655 2.IX.2012 (herb. Kosovich-Anderson, duplicate in VBGI), California, Placer Co. MacFadden F.A., 11.07.1933 (MO5218660), Siskiyou Co. (41°52'N 123°38'W), Ignatov M.S., 13.VIII.1989 (VBGI), Colorado, Boulder Co., Weber W.A. 27.X.1960 (MO4446711), Weber W.A. 27.X.1960 (MO3660699), Oregon, Multnomah Co., Schofield W.B. & G. Godfrey, 68169 24.III.1978 (TNS), Washington, Kingleo Co., Frye T.C., 05.VI.1906 (NY00567432, NY00567431), Ann Lake (48°30'N 120°45'W), NK, A73/2-95 07.IX.1995 (KPABG, duplicate in VBGI), Clallam Co. (48°20'N 124°25'W), Schofield W.B., J. Spence, 77699 08.VII.1982 (TNS).

BELGIUM, Belgian Ardennes, NK, 2-20-10-99 20.X.1999 (KPABG); CHINA, Liaoning, Kuandian Co., Baishilazi, Cao T. 38708 (IFP 00008012), Kuandian, Baishilazi, Cao T. 38714 (IFP 00008010), 38673 (IFP 00008011); Yunnan, Gongshan Co., Zang M. 1197 (IFP 00000426); CZECH REPUBLIC, Moravia, Beskydy, Zemanova H. 28.VIII.1974 (KPABG); A. Vězda 01.IV.1957 (KPABG); GEORGIA, Adjara, Woronow G. 21.VII.1910 (TBI), Mtirala National Park (41°40'30.1"N 41°52'58.1"E), VB 12.V.2013, (s.d.) Dolukhanov 18.IX.1939 (TBI), Utseri, Brotherus V.F. 12.VII.1877 (TBI), Khevi, Kazbegi, Chikovani N. 16.VII.1971. (TBI, duplicate in VBGI); GERMANY (Lectotypus of *Jungermannia riparia* Tayl. var. *major* Gottsche et Rabenh. Hepaticae Europeae, No. 276, designated by Váňa 1973b), Bruggen. U., Geheeb G00114367 (G); JAPAN, Chiba Pref. Kimitu-shi, NakamuraT., 5109 31.V.1990 (CBM), Fukuoka Pref., Koshosan Mt., Kuwahara Y., 3427/2145 25.X.1954 (HIRO), Hokkaido, Hidaka Mts., Petagiri Mt., Inoue H., 20173 28.VII.1970 (TNS),

Inoue H., 20375 28.VII.1970 (TNS), Kushiro-cho, Takita K., 1653 27.V.1984 (SAPT), Tsurugizan Mt., Tokachi, Sakuma E., 4116/2340 25.VII.1965 (HIRO), Hyogo Pref., Kobe-shi, Rokko Mt., Takamiya H., 63 07.VIII.1988 (CBM), Kochi Pref., Kami-gun, Monobe-mura, Mt. Ishidate, Hasegawa J. 6923 26.VIII.1978 (KYO), Mie Pref., Kuki, Owase-shi, Yamada K., 6775 12.VII.1964 (NICH), Nagano Pref., Ikura, Shimizu D. (Hepaticae Japonicae Exsiccatae ser. 5 (1952) n. 221, as *Jungermania tristis*), VIII.1952 (SAP); Mt. Toyoguchi in the S. Japanese Alps, Inoue H., 8951 VIII.1960 (TNS); Todai-Kitazawa Pass, Mt. Senjyo, Amakawa T., 1780 02.VIII.1957 (HIRO), Toyamagawa River, Sakuma E., 13562/1779 14.VIII.1968 (HIRO), Nara Pref., Akadani, Ootomura, Yoshino-gun, Kitagawa N., 9732 08.VIII.1966 (KYO); Ikadaba, Kawakami-mura, Yoshino-gun, Kitagawa N., 14518 26.VII.1973 (KYO), 14698 27.VII.1973 (KYO), Osaka Pref. route from Nameri to Mt. Makino, Kodama T., 12749/1918 04.I.1958 (HIRO), Oshima Pref., Garonosawa, Mizutani M., 379 08.VIII.1970 (NICH), Saitama Pref., Chichibu, Urayama, Hashidate, Iwata T., 1061 27.XII.1971 (TNS); NORWAY, Hadmark, Lindberg H. & Lindberg S.O. 26.VI.1887 (KPABG); SOUTH KOREA, Deogyu Mt., Choi S.S., 18.IX.2008 (VBGI), (38°49'53"N 127°42'41"E), VB, Kor-14-14-08 27.06.2008 (VBGI), Gangwon-do, Samcheok-si (37°19'22"N 129°00'32"E), Choi S.S., 7447 20.VII.2010 (JNU, duplicate in VBGI), Gaya Mt. (35°48'23"N 128°08'27"E), Choi S.S. 08.IX.2009 (VBGI), Gyeongsangnam-do, Hamyang-gun (35°19'49"N 127°41'34"E), Choi S.S., 6029 07.X.2009 (JNU, duplicate in VBGI), Gyeongsangnam-do (35°48'22"N 128°08'27"E), Choi S.S., 4353 09.IX.2009 (VBGI), Jeollabuk-do, Muju-gun (35°56'00"N 127°46'23"E), Choi S.S., 5235 11.X.2009 (JNU, duplicate in VBGI), Jeonnam Prov., VB Kor-17-18-11 (VBGI), Jiri Mt. (35°21'57"N 127°34'45"E), VB, Kor-14-20-09 19.VI.2009 (VBGI), (35°18'50"N 127°44'30"E), VB, Kor-1-7a-09 13.VI.2009 (VBGI), Kwang-Nang, Hong W.S., 1728 05.VI.1960 (HIRO), KyongNam Province (35°21'57" 127°34'45"E), VB, Kor-14-20-09 19.06.2009 (VBGI), (35°18'50"N 127°44'30"E), VB, Kor-1-7a-09 13.06.2009 (VBGI); SWEDEN, Gotland, Lindberg S.O. 27.VI.1875 (KPABG); SWITZERLAND (isotype of *Jungermannia potamophila* Müll.Arg. ex Moug., Nestl. & Schimp. Stirpes Cryptogamae Vogeso-Rhenanae 15: 1418. 1860: Switzerland. 1856. J. Muller. (No. 167) G14571/00115172) (G).

Jungermannia borealis Damsh. & Váňa, Lindbergia, 4: 5, 1977 (= *Jungermannia karl-muelleri* sensu Váňa, Folia Geobot. Phytotax., 8: 276, 1973; non Grolle, Oesterr. Bot. Z. 111: 190, 1964; *Solenostoma oblongifolium* sensu R.M. Schust., Hep. Anthocerot. North Amer. 2: 936, 1969 non *Solenostoma oblongifolium* (Müll. Frib.) Müll. Frib., Hedwigia 81: 117, 1942.)

Description. Plants (0.3–) 0.5–1.0 (–1.5) mm wide, 4–15 mm length, loosely ascending to creeping, brown, greenish brown, blackish green, black-brown, yellowish brown to pale yellowish, rarely with purplish tint near apex, sometimes become greenish near apex. Stem (100) 120–190 (–300) μm wide, nearly orbicular in cross section, branching rarely occur, lateral or ventral; cells in dorsal surface ca. 30–55 × 12–22 μm, walls brownish; in the stem cross section outer cells ca. 22–27 μm in diameter, walls slightly thickened, walls brownish, inner cells ca. 12–18 μm in diameter. Rhizoids colorless to brownish, scattered, to sometimes dense in some areas, in fascicles or separated, erect to obliquely spreading. Leaves distant to contiguous and subimbricate, erect spreading, slightly turned to dorsal side, concave, canaliculate to flattened, rarely with brown rim along margin, inserted at angle (30–) 40–80° with axis, and up 70–80° (90) dorsally where not decurrent or rarely decurrent up 1/7 (–1/3) of stem width, ventrally arcuately to subtransversely inserted, orbicular to rounded-triangle, rounded-lingulate, reniform and ovate, 300–800 (–1200) × 350–850 (–1250) μm ((0.8–) 0.9–1 : 0.9–1). Cells in the midleaf 17–33 × 12–18 (–26) μm, mostly hexagonal, thin-walled, walls yellowish to brown, rarely orange-brown, trigones small and concave to indistinct or rarely triangle to convex, near margin 10–20 μm, thin-walled to sometimes with equally thickened walls, cuticle striolate in lower half of leaf (rarely smooth there), in upper part smooth or striolate. Dioicous. Perianth ob-pyriform, fusiform, clavate to rhomboidal and cylindrical, smoothed to distinctly plicate near mouth, ca. 1000–2000 × 450–750 μm, exerted for 1/2 – 3/2 of its length, gradually narrowed or suddenly contracted to sometimes beaked mouth, perianth mouth crenulate, perianth cells in the upper part of perianth 10–12 μm in diameter, subquadrate to isodiametric, walls brownish, thickened, trigones triangle to convex, cells in the perianth middle 25–30 × 15–20 μm, rectangular to obliquely rectangular, in lower part 30–50 × 15–23 μm, rectangular, walls thin, colorless, cuticle striolate-papillose with the exception of the upper 1/4; perigynium absent; innovation frequent, 1 (–3) per perianth; female bracts slightly bigger than sterile leaves, in 1 pair, ca. 900–1250 (–1800) × 650–980 (–1500) μm, ovate to triangle, contiguous, concave, rarely loosely inflated at the base. Androecia in 2–6 (12) pairs, male bracts inflated in base, sometimes purplish in inflated area, erect, but not deflexed, with 1–2 antheridia per bract. Capsule wall bistratose. Elaters ca. 7–8 μm in width, bispiral. Spores 14–16 μm in diameter, finely papillose, reddish brown. Figure 4.

Comment. The species is most closely related to *Jungermannia atrovirens*, see discussion under latter. When sterile *J. borealis* may be easily mistaken with sterile phases of *J. pumila*. In the latter case the main attention should be paid to the habitat. When *J. pumila* commonly growing in the areas under constant or occasional impact of flowing water and never occurs within or over wet mossy patches in the tundra zone, the last habitat in preferable for *J. borealis*. The latter species also avoids habitats with direct impact of water, although sometimes take part in the forming of patches along sluggishly flowing streams in tundra zone (or corresponding belt in southwardly distributed mountains). Both taxa occur on wet cliffs and in their not strongly shaded crevices, but they are more or less different in general distribution. While main "core" of *J. borealis* are Arctic, Subarctic and, probably, North Boreal zones and the species almost does not occur southward, *J. pumila* is more or less frequent in Boreal and North Temperate zones, although rarely occurs in the North of the Russian Far East and western North America. Additional morphological features helps distinguish two species includes more subtransversely inserted and oriented and erect spreading leaves in *J. pumila*, contrary to obliquely inserted and slightly appressed to the stem leaves of *J. borealis*. Unfortunately the listed features are not universal and some sterile plants may not be satisfactorily identified. Sometimes confusion is possible when plants are perianthous, but no evidences of antheridia presence. This is more or less common situation in *J. pumila*, since it is commonly growing in the habitats under impact of flowing water that flush out antheridia and their remnants (such as stalks). The main distinguishing feature of *J. pumila* in that case in strongly, although gradually increasing size of leaves depending of proximity of perianth, while leaves size only

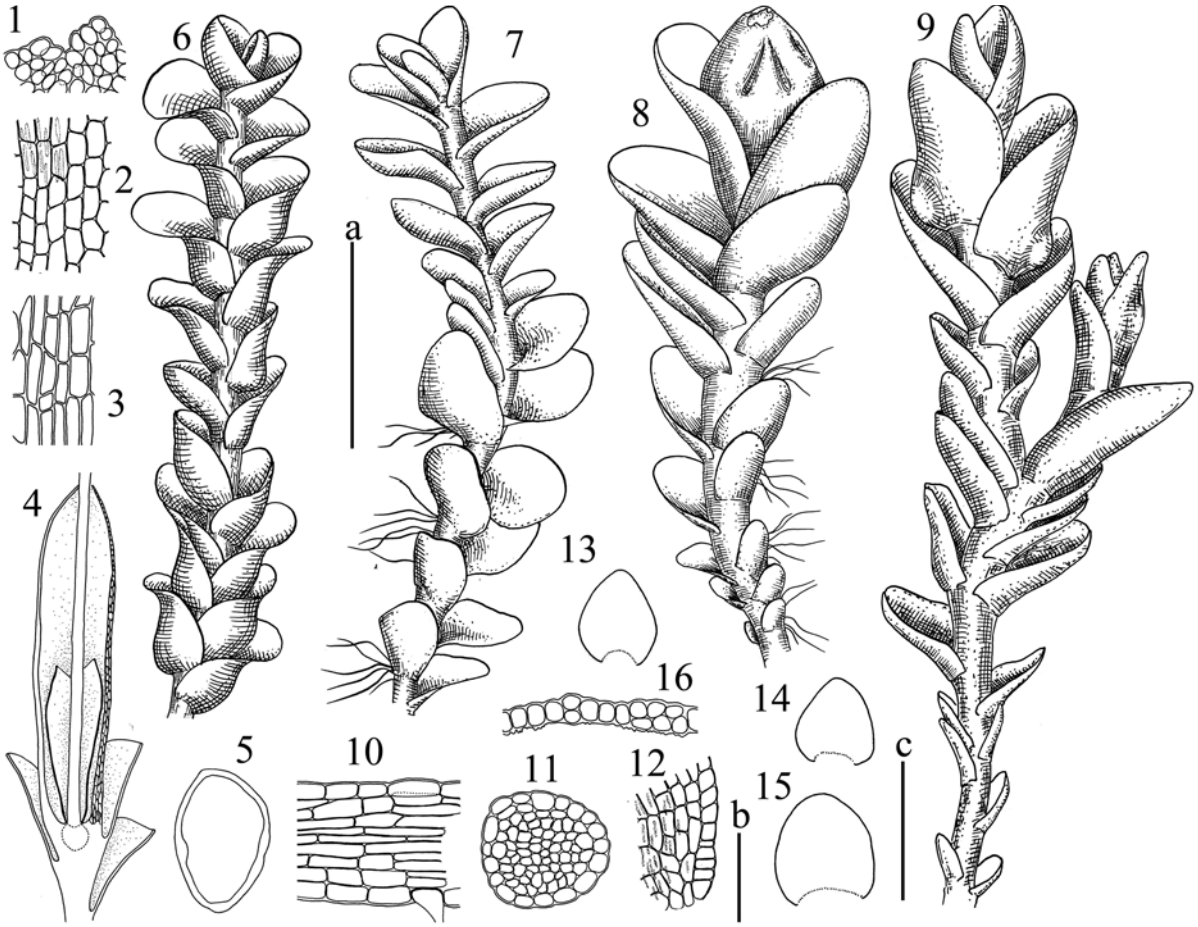

Figure 4 *Jungermannia borealis* Damsh. & Váňa: 1 – perianth mouth; 2 – cells in the perianth middle part, view from inside of perianth; 3 – cells in the perianth lower part; 4 – perianth longitude section; 5 – perianth cross section at the middle part; 6 – branch with androecia; 7 – sterile branch; 8 – branch with perianth; 9 – branch with androecia; 10 – stem longitude section; 11 – stem cross section; 12 – cells in the leaf ventral base; 13–15 – leaves; 16 – perianth cross section in the middle part, fragment showing papillae in inner wall. 1–5, 10–16 – from K-54-7-04 (KPABG); 6 – from K-54-2-04 (KPABG); 7 – from K10-13-02 (KPABG); 8 – from KPABG-103394 (KPABG); 9 – from Kuzmina Ye.Yu. 08.VII.1988 (KPABG). Scales: a – 1 mm, for 4–9; b – 100 μm, for 1–3, 10–12, 16; c – 1 mm, for 13–15

slightly increases to perianth in *J. borealis*. Perianth length sometimes also may help to differ two species. Perianth of *J. pumila* comparatively large and commonly reach 3 mm long (or even more), contrary to perianth in *J. borealis* that is commonly shorter than 2 mm long.

Distribution. Arctic Montane circumpolar. In the Western North America known from Alaska, British Columbia and again re-occurrs in California (doubtful), eastward of treated area it is present in Canadian Nunavut. In the Russian Far East the species occurs in low elevations in subarctic to Arctic zones (Chukotka, Magadan Province, Kamchatka, north extreme of Khabarovsk Territory) and very sparsely re-occurs southward in much higher elevations, as 1300 m a.s.l. in Sakhalin. Westward in Siberia sparsely distributed in its Eastern part and Republic of Yakutiya. In adjacent Japan it is known from very limited number of locals, all of them are over than 2300 m a.s.l.

Ecology. Acido- to neutrophilic meso-hygro- to hygrophyte. The species is common participant of snow bed habitats and mountain or zonal tundras, also occurrs in wet mossy tundras and over moss patches along sluggishly flowing streams. The species is almost restricted to tundra zone and does not penetrate southward nor descend down from mountain tundras.

Specimens examined. RUSSIA, Buryatiya, Khamar-Daban Range, VB, 17-1 05.VIII.1999 (KPABG), (51°31'N 104°03'E), Melick H., 213210 15.IX.2010 (VBGI), Caucasus, Karachayevo-Cherkessiya (43°15'45"N 41°36'41"E), NK, K432-1-05 07.IX.05 (KPABG), Chukotka, Dlinnaya River, Kuzmina Ye.Yu., 08.VII.1988 (KPABG, duplicate in VBGI), Commander Islands, Bering Island (54°40'N 166°15'E), VB, K-10-13-02 09.VIII.2002 (KPABG, duplicate in VBGI), K-18-6-02 11.VIII.2002 (KPABG), VB K-21-1-02 15.VIII.2002 (KPABG), K-4-12-02 07.VIII.2002 (KPABG), Mednyj Island (54°46'45"N 167°35'00"E), VB, K-50-2-04 02.VII.2004 (KPABG, duplicate in VBGI), (54°47'45"N 167°31'50"E), VB, K-54-2-04 03.VII.2004 (KPABG, duplicate in VBGI), Kamchatka, Karaginskij Island (58°57'39"N 164°14'14"E), VB, K-18-1-05 01.VIII.2005 (VBGI), (58°57'58"N 164°13'34"E), VB, K-23a-9-05 02.VIII.2005 (VBGI), (58°57'16"N 164°14'43"E), VB, K-26-5-05 03.VIII.2005 (VBGI), North Kamchatka (58°50'N 161°20'E), VB, K-32-2-03 11.VII.2003 (KPABG, duplicate in VBGI), South Kamchatka, VB, K-74-10a-04 08.VII.2004 (KPABG, duplicate in VBGI), Russkaya Bay, VB, K-74-10-04 08.VII.2004 (KPABG, duplicate in VBGI), Karelia, Kalevala District, VB, 26 16.VII.1998 (KPABG), Khabarovsk Territory, Bureya River Upper course (51°43'N 134°18'E), Ignatov M.S., 27.VIII.1997 (KPABG, duplicate in VBGI), Lanzhiskiye Mts. (59°27'14"N 143°36'22"E), VB, Kh-32-10-08 23.VII.2008 (VBGI), Krasnoyarsk Territory, Putorana Plateau, Otnyukova T.N. 05.VIII.1990 (KPABG), Tulokanda River, Otnyukova T.N., 28.VII.1990 (KPABG), Murmansk Province, Khibiny Mts., NK, 1108/2 11.VIII.1974 (KPABG), NK 12-2-96 09.VIII.1994 (KPABG), Ponoj River lower course, Schljakov R.N., 538a 03.VIII.1972 (KPABG), Por'ya Bay, NK, 131-13-91 11.VIII.1991 (KPABG), Sakhalin Island, Chamga Mt. (50°45'18"N 143°17'55"E), VB, S-61-18-09 11.IX.2009 (VBGI);

U.S.A., Alaska, Aleutian Islands, Kiska I., Darigo N., 22.09.1995 (MO4441798); California, Del Norte Co. (41°49'N 123°51'W), Duell R. 23.IV.1981 (NY00567437), Trinity Co. (40°53'N 123°32'W) Duell R., 26.IV.1981 (NY00567436), Humboldt County (41°02'N 123°38'W), Duell R., 2328 18.IV.1981 (KPABG), Washington, Baker Mt. (47°55'N 122°06'W), NK, A11/6-95 14.VIII.1995 (KPABG, duplicate in VBGI); Wyoming, Park Co., Rocky Mts., Shoshone National Forest (44°57'N 109°29'W), Kosovich-Anderson Ye. I., #2668 14.VIII.2008 (herb. KosovicYe. h-Anderson, duplicate in VBGI), #8255 (herb. KosovicYe. h-Anderson, duplicate in VBGI), (44°55'N 109°31'W), Kosovich-Anderson Ye. I., #6844 26.IV.2010 (herb. KosovicYe. h-Anderson, duplicate in VBGI).

GREENLAND, South Greenland, Kangikitsoq, Schuster R.M. & K. Damsholt, 82-1873 05.VIII.1982 (F); JAPAN, Nagano Pref., Chino-shi, Daidoshin, near the sammit of Mt. Yokodake Mts. (35°59'13"N 138°22'16"E), Furuki T., 22678 08.IX.2011 (CBM), 15126 02.IX.1998 (CBM), Southern Japan Alps, Jizo Mt. (35°43'39"N 138°08'58"E), Furuki T., 23024 09.VIII.2012 (CBM), Suwa-gun, Diadoshin Mt., Furuki T. 11739 05.X.1994 (CBM).

Jungermannia eucordifolia Schljakov, Pechen. Mkhi Severa SSSR. 4: 37, 1981 (= *Jungermannia cordifolia* Hook., Brit. Jungerm., tab. 32, 1812, non *J. cordifolia* Brot. 1804, nec *J. cordifolia* Ehrh. ex F. Weber et Mohr 1807; *Jungermannia exsertifolia* Steph. ssp. *cordifolia* (Dumort.) Váňa, Folia Geobot. Phytotax. 8, 3: 268, 1973; *Solenostoma cordifolium* (Hook.) Steph., Sp. hep. 2: 61, 1901; *Jungermannia exsertifolia* subsp. *cordifolia* var. *pendletonii* (Pears.) Váňa, Folia Geobot. Phytotax. 8: 271, 1973).

Description. Plants 20–100 mm in length and 1.4–3.5 mm width, semi-erect, blackish green, deep green-brown, brownish black, rarely pale brownish greenish, yellowish brown or rusty-brown, sometimes become green near apex. Stem 200–500 μm in width and ca. 170–450 μm in height; dorsal surface cells 125–200 × 20–30 μm, linear to long rectangular; in the stem cross section outer cells not different from inner ones, but walls of external cells are brown colored contrary to almost colorless inner ones, walls thin, sometimes lightly flexuous, trigones small and concave. Rhizoids sparse to solitary, colorless to brownish, decurrent down the stem, but not forming the fascicles or spreading. Leaves sometimes darker colored along margin, subimbricate and then enclosed one to another, contiguous or, rarely, distant, sheathing and commonly overlapping lower half of the leaf situated above, or obliquely spreading, rarely laterally erect, inserted at angle of 30–45° with axis, dorsally up 70°, not decurrent or, rarely, decurrent for 1/5 of stem width, ventrally arcuately inserted, decurrent up 1/3 of stem width, 1150–2230 × 1130–2700 μm (0.8–1.3 : 1), widest in lower 1/3, concave-canaliculate or, rarely, flattened, rounded triangle to widely ovoid, commonly undulate along margin. Cells in the midleaf 28–50 × 20–30 μm, rectangular to oblong hexagonal, walls thin to evidently thickened, brownish to brown, trigones absent or very small and indistinct, rarely triangle to convex, cuticle slightly striolate in lower 1/4 or smooth throughout; along margin 20–33 μm, isodiametrical, trigones distinct and concave or indistinct, rarely cell walls equally thickened. Dioicous. Perianth obovate to clavate, pluriplicate near mouth, commonly with 2–3 ventral or lateral innovations, ventrally sometimes rhizogenous, with brownish to rarely purplish fascicles of rhizoids, ca. 3000 × 1250 μm, exerted for 1/2 of the length, mouth crenulate, perianth unistratose in upper 1/3, down – bistratose and sometimes 3-stratose, cuticle striolate, with the exception of the upper 1/4, cells in the perianth middle 38–45 × 15–22 μm, walls thickened, trigones distinct, concave; perigynium absent; female bracts in 1 pair, slightly inflated in base, subtransversely inserted, suborbicular. Androecia intercalary, spicate, with 3–10 pairs of bracts, different generations divided by 1–2 pairs of sterile leaves; male bracts triangular, inflated in the base, 1–2-androus, stalk biseriate, ca. 30–35 × 23 μm. Capsule ellipsoidal. Elaters 100–140 × 8 μm, bispiral. Spores 19–24 μm, finely papillose. Figure 5.

Comment. In the most cases this is very easily recognizable species due to its large size and sheathing leaves covering lower part of next situated leaf. The confusion is possible with very closely morphologically related *Jungermannia exsertifolia* (sometimes both species are treated as subspecies one to another). The latter may be distinguished by its smaller size, mostly smaller than 1.8 mm wide, although plants in holotype of *J. exsertifolia* from Sendai (leg. 19.V.1907 U. Jishiba G-00112197) reach 2.5 mm wide, obliquely spreading, distinctly canaliculate-concave leaves (versus sheathing and covering the next leaf), less obliquely inserted leaves (although variation in this parameter is widely overlaps), more rigid texture, and especially by rusty brownish pigmentation of cell walls in the midleaf. Also *J. eucordifolia* growing in very wet sometimes submerged habitats, when *J. exsertifolia* mostly occurs in moist substrata not covered with water. The distinctions between two species needs in further consideration.

Distribution. Boreal circumpolar. More or less widely distributed species across North America, known in western side from Alaska, then in British Columbia, Washington, Oregon, California. In the lands adjacent to westernmost areas recorded from Alberta, Yukon, Montana, Idaho, Wyoming, Utah, Nevada, Arizona and New Mexico; eastward known from Ontario, Quebec, Newfoundland, Labrador, Nova Scotia, and southward in Great Lakes area in Michigan and Wisconsin, eastward in Maine, New Hampshire, Vermont, New York, Massachusetts and Connecticut. In the Russian Far East the species is known from suboceanic areas across latitudinal range from Chukotka to Primorskii Territory and Kurils, but being more common in the middle part of the Russian Far East. Westward in Siberia the taxon is known from several localities in its southern part. Most of Russian Far East localitites are confined to elevations from near sea level to 500 m a.s.l., with a few exceptions near 1000 m a.s.l. in wet mossy tundras of smooth-surfaced spoors of Sredinny Range in Kamchatka. Contrary, in North America the species known from Sea level in Alaska and rapidly becoming 'subalpine' southward via 1400–1800 m a.s.l. in Washington to above 2300–3000 m a.s.l. in Colorado and Wyoming.

Ecology. Acidophilic hygro- to hydrophyte. The most typical habitat of the species is the beds of sluggishly flowing streams, although it is also common on wet cliffs near waterfalls, along watercourses of various size and also occurs in Subarctic in swampy ponds (not those of anthropogenic origin) and hollows in oligotrophic bogs with open water pools, much rarer growing submerged up to 10 and more meters depth in the lakes.

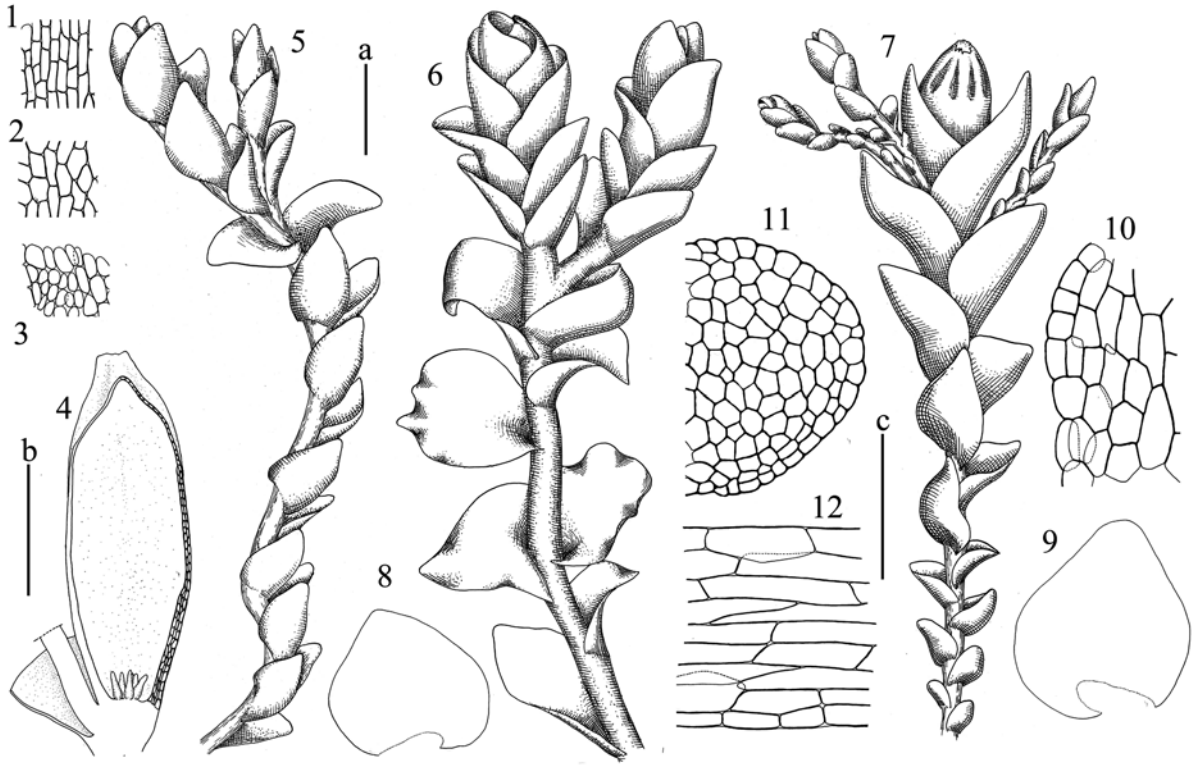

Figure 5 *Jungermannia eucordifolia* Schljakov: 1 – cells in perianth lower part; 2 – cells in the perianth middle part; 3 – perianth mouth; 4 – perianth longitude section; 5 – sterile branch; 6 – branch with androecia; 7 – branch with perianth; 8, 9 – leaves; 10 – cells in ventral leaf base; 11 – stem cross section; 12 – stem longitude section. 1-4, 7 – from K-36-2-04 (KPABG); 5 – from K-50-26-02 (KPABG); 6, 8-10 – from K-24-9-03 (KPABG); 11-12 – from K-23-2-04 (KPABG). Scales: a – 1 mm, for 5–9; b – 1 mm, for 4; c – 200 μm, for 1–3, 10–12

Specimens examined. RUSSIA, Caucasus, Adygeya (43°52’48”N 40°39’21”E), NK, K133-1-09 22.IX.2009 (KPABG), Commander Islands, Bering Island (54°40’N 166°15’E), VB, K-23-4-02 15.VIII.2002 (KPABG, duplicate in VBGI), Mednyj Island (54°43’30”N 167°40’45”E), VB, K-23-2-04 01.VII.2004 (KPABG, duplicate in VBGI), (54°42’30”N 167°46’00”E), VB, K-36-2-04 01.VII.2004 (KPABG, duplicate in VBGI), (54°45’20”N 167°36’15”E), VB, K-45-4-04 02.VII.2004 (KPABG, duplicate in VBGI), Kamchatka, Karaginskij Island (58°57’39” 164°14’14”E), VB, K-18-7-05 01.VIII.2005 (VBGI), (58°57’58”N 164°13’34”E), VB, K-23a-3-05 02.VIII.2005 (VBGI), Central Kamchatka (56°39’20”N 159°29’28”E), VB, K-133-6-04 13.IX.2004 (VBGI), (55°40’00”N 157°40’00”E), VB, K-50-26-02 14.IX.2002 (KPABG, duplicate in VBGI), East Kamchatka (53°45’N 158°50’E), VB, K-60-2-01 08.VIII.2001 (KPABG, duplicate in VBGI), North Kamchatka (58°50’N 161°20’E), VB, K-23-3-03 11.VII.2003 (KPABG), (59°10’N 159°50’E), VB, K-24-9-03 14.VI.2003 (KPABG, duplicate in VBGI), Kemerovskaya Province, Kuznetskii Alatau Range (54°37’N 88°18’E), NK, 90-2-00 06.VII.2000 (KPABG), Komi Republic, Troitsko-Pechyorskii District, Zheleznova G.V., 24-89 18.VI.1989 (KPABG), Kurils Islands, Iturup Island (44°55’56”N 147°32’30”E), VB, K-10-15-07 07.VIII.2007 (VBGI), (45°12’38”N 147°51’12”E), VB, K-47-12-05 12.IX.2005 (VBGI), (45°08’07”N 147°57’45”E), VB, K-52-4-05 14.IX.2005 (VBGI), (45°05’21”N 147°59’00”E), VB, K-54-17-05 15.IX.2005 (VBGI), Kunashir Island, VB, K-43-1b-06 03.IX.2006 (VBGI), Paramushir Island (50°25’30”N 155°50’45”E), VB, K-106-9-04 28.VII.2004 (KPABG, duplicate in VBGI), (50°41’50”N 156°08’00”E), VB, K-78-2-04 13.VII.2004 (KPABG), Shikotan Island (43°46’34”N 146°44’19”E), VB, K-42-42-07 25.VIII.2007 (VBGI), (43°48’08”N 146°38’46”E), VB, K-49-14-07 28.VIII.2007 (VBGI), (43°44’29”N 146°41’20”E), VB, K-58-9-07 02.IX.2007 (VBGI), (43°51’45”N 146°55’58”E), VB, K-65-32-07 06.IX.2007 (VBGI), Murmansk Province, Monchegorsk District, VB, 11-1-02 30.VI.2002 (KPABG), Rybachij Peninsula, NK, 17/7 10.VII.1981 (KPABG), Vyrmes Lake (68°35’49”N 32°30’52”E), NK, 225-4-02 17.IX.2002 (KPABG), Perm’ Province, Visherskii State Reserve (61°15’N 59°12’E), Bezgodov A.G., АБ231-98 07.VII.1998 (KPABG), Primorskij Territory, Lazovskii District, middle course of Sinegornaya Pad' Stream in Krivaya River Basin (43°04'02»N 133°36'37»E), 227 m alt., flood-plain broadleaved (mostly *Juglans*, *Acer*, *Fraxinus*, *Ulmus*) forest, VB, P-73-36-11 22.IX.2011 (VBGI), Sakhalin Island, Chamga Mt. (50°46’04”N 143°15’18”E), VB, S-26-19-06 14.VIII.2006 (VBGI), (50°45’09”N 143°18’26”E), VB, S-27-25-06 15.VIII.2006 (VBGI), (50°44’50”N 143°17’17”E), VB, S-30-2-06 17.VIII.2006 (VBGI), (50°45’18”N 143°17’55”E), VB, S-60-5-09 11.IX.2009 (VBGI), Korsakov District (46°20’08”N 143°22’17”E), VB, S-66-1-09 16.IX.2009 (VBGI), Schmidt Peninsula (54°05’N 142°29’E), VB, S-48-5-09 01.IX.2009 (VBGI); CANADA, Alberta, Jasper Nat. Park, Weber W.A. 21.VII.1959 (MO5624647), British Columbia, Queen Charlotte Islands, Moresby I., Schofield W.B. 26.VII.1964 (MO5371863), West Vancouver (49°20’N 123°10’W), Schofield W.B. 74213 13.IX.79 (F); CHINA, Sichuan, Nanchuan, Jinfo Mt., 1600 m alt., Meizhi Wang, 860603, 08.VII.1986 (PE 00656023); U.S.A., Alaska, Adak Island (51°49’N 176°36’W), Schofield W.B., 101612 07.VIII.1994 (F), Attu I. (52°51’N 173°14’W), Schofield W.B., 12.VIII.2000 (MO715138), Schaack G.B. van, 22.IV.1945 (MO2105756), Colorado, Gilpin Co., Weber W.A. 25.IX.1963 (MO5635355), Larimer Co., Hermann F.J., 20.IX.1975 (MO5929890), New Mexico, Otero Co. (33°33’31”N 105°48’52”W), Worthington R.D. 22.VII.2001 (NY00670849), Utah, Salt Lake, Flowers S., 09.VII.1938 (NY00243952), Washington, Jefferson Co., Spangler P.J., 12.VII.1988 (NY00244530), Baker Mt. (47°35’N 122°17’W), NK, A84/3-95 13.IX.1995 (KPABG, duplicate in VBGI), Yakima Co. (46°36’N 120°30’W), NK, A28/1-95 22.VIII.1995 (KPABG, duplicate in VBGI), Wyoming, Beartooth Mt., Lawton E., 24.VIII.1953 (NY00243958), Teton Pass (43°49’N 110°39’W), NK, A49/3-95 29.VIII.1995 (KPABG, duplicate in VBGI), (44°44’N 109°45’W), NK, A69/5-95 02.IX.1995 (KPABG, duplicate in VBGI), Albany Co., Rocky Mts., Medicine Bow National Forest, wet surface of granite debris, in deep shade under Juniperus communis, 2390 m alt. (42°15.845-850’N W 105°28.170-175’W), Kosovich-Anderson Ye. I., #64(16541) 1.IX.2013 (herb. KosovicYe. h-Anderson, duplicate in VBGI), (42°16.230-235’N 105°27.804-805’W), Kosovich-Anderson Ye. I., #62(16477) 1.IX.2013 (herb. Kosovich-Anderson, duplicate in VBGI), Carbon Co., granite rocks lining the creek, in shade of willows, 2800 m alt. (41°09.710-720’N 107°01.750-755’W), Kosovich-Anderson Ye. I., #38(16031) 17.VIII.2013

(herb. Kosovich-Anderson, duplicate in VBGI), Fremont County, *Picea engelmannii* forest, volcanic rocks lining the creek, in splash zone and submerged, on sandy substrate, in shade of trees, 2800 m alt. (43°46.210-211'N 109°58.750-755'W), Kosovich-Anderson Ye. I., #5(14593) 15.VII.2013 (herb. Kosovich-Anderson, duplicate in VBGI), Park County, stream bank, on wet sandy-clayey soil, in partial shade (44°57.370-380'N 109°28.900'W), 3300 m alt., Kosovich-Anderson Ye. I., #6736 25.VII.2010 (herb. KosovicYe. h-Anderson, duplicate in VBGI).

JAPAN, Aomori Pref., Okura Pen., Towada Lake, Higuchi T. 12779/2323 27.VIII.1967 (HIRO), Nagano Pref., Senjo Mt. (Hepaticae Japonicae Exsiccatae ser. 6 (1954) n. 268 *Jungermannia senjoensis* Amakawa isotype), Shimizu D. 10.VIII.1953 (SAP), Senjo Mt., Shimizu D. 10.VIII.1953 (NICH), Nara Pref., Akadani, Ootomura, Yoshino-gun, Kitagawa N., 11369 09.VI.1968 (KYO), Kitamata-gawa, near Shionoha, Kawakawi-mura, Kitagawa N., 14685 27.VII.1973 (KYO); SOUTH KOREA, Montague des Diamants, Faurie U. 23.VI.1906 (KYO).

Jungermannia exsertifolia Steph., Sp. Hepat. 6: 86, 1917 (= *Jungermannia cordifolia* Hook. ssp. *exsertifolia* (Steph.) Amak., J. Hattori Bot. Lab. 22: 44, 1960; *Jungermannia exsertifolia* Steph. s. str.)

Plants (3–) 10–30 (–40) mm long and 0.7–2.5 mm wide, ascending to erect in dense to loose patches, brown, yellowish brown to (rarely) reddish brown (recorded in old specimens only and probably the result of age). Stem 120–300 × 120–250 μm, elliptic to orbicular in cross section, dorsal surface cells slightly thick-walled, rectangular to oblong-hexagonal, with small concave or indistinct trigones, 60–100 × 23–30 μm, cuticle partly indistinctly striolate; in the stem cross section with large-celled outer layer, where cell walls are thickened and brown colored, ca. 20–26 μm in diameter, inner layer composed by smaller , more or less thin-walled, rectangular to oblong-hexagonal cells with small concave to indistinct trigones, ca. 15–25 μm in diameter. Rhizoids rare, colorless to brownish, in indistinct obliquely spreading fascicles or decurrent down the stem. Leaves contiguous, commonly sheathing the stem in the base, inserted at angle of 40–50° with axis, dorsally subtransverse, not decurrent, ventrally subtransversely to loosely arcuately inserted, not decurrent or decurrent up to 1/5 of stem width; widely ovate, triangle to triangle-ovate, concave to canaliculate, widest between 1/2 – 1/3 of the leaf length in lower half of the leaf, 900–1250 × 750–1250 μm (1 : 0.9–1), obliquely spreading. Cells in the midleaf thin-walled, walls brown to rusty brownish and orange colored, subisodiametric with lumen rounded to elliptic, 25–40 × 20–25 μm, trigones small, concave to convex; along margin 12.5–25.0 μm, with thin to thickened (especially external) walls, walls more deeply orange-brown colored (in comparison with cells inward); cuticle distinctly papillose in the lower half of the leaf, in upper part distinctly to very indistinctly striolate-papillose or smooth. Dioicous. Perianth terminal, frequently with 1 innovation, clavate to fusiform, 2250–3000 × 750–1000 μm, smooth to (sometimes) 4-plicate in upper 1/4 – 1/2 of perianth length, cells in the perianth middle shortly to elongate rectangular, moderately thick-walled, walls brownish, 28–60 × 15–25 μm with small concave trigones, archegonia ca. 5 in perichaetium; perigynium absent to indistinct; bracts concave to concave-canaliculate, ca. 1250–2500 × 1000–1250 μm. Androecia intercalary, in 3–5 pairs of bracts, 1–2-androus, stalk 2-seriate, bracts triangle, similar with sterile leaves in size, inflated in lower half and imbricate above, sometimes reddish in inflated area. Seta 12 mm length. Capsule elliptic, ca. 1000 × 600 μm, bistratose, inner layer cells with semi-annular thickenings, 35–45 × 15 × 19 μm, outer layer cells 40–42 × 20–25 μm with nodular thickenings, 2 on each side. Elaters 2-spiral, ca. 150 × 9 μm, without homogenous thickenings at the ends, spores finely papillose, 25–27 μm in diameter. The recent figure may be found in http://www.mobot.org/plantscience/bfna/V3/JungJungermannia.htm.

Comment. The only related species is *Jungermannia eucordifolia*, and distinctions with the latter are poorly understood. For differentiation see comment under *J. eucordifolia*. Sometimes smaller phases of the taxon from mesic habitats may be probably confused with *J. borealis*. The latter differs from *J. exsertifolia* in slightly laterally appressed leaves (versus erect to obliquely spreading), creeping to ascending growth form (versus erect to ascending), smaller size (commonly less that 1.0 mm, versus 1.0–2.5 mm wide). Additionally *J. exsertifolia* not found in Arctic and Subarctic zones, the areas preferable for *J. borealis*.

Distribution. Boreal Montane East Asian. The distribution of species is poorly understood. The majority of records of *J. exsertifolia* from Japan (from where the species was described) belong to the typical phases of *J. eucordifolia*, not to *J. exsertifolia* in its narrow sense. In North America this species recorded from a few isolated locals in British Columbia, Washington, California, Montana and Wyoming. Within the Russian Far East the species known from some locals in subarctic areas under strong influence of ocean, such as Commanders, North Kamchatka, North Kurils, northern coast of Sea of Okhotsk, with isolated record in Tardoki-Yani of southern part of Khabarovsk Territory (probably periglacial refugium). When in New World the species occupies elevation higher 1800–2000 m a.s.l. and probably has relictual character of distribution, in the Russian Far East it starts from near sea level to 1335 m a.s.l. in Iturup Island of South Kurils (although re-occurs southward in Shikotan and Japanese archipelago in much lower elevation).

Ecology. Acido- to neutrophilic hygrophyte. The species growing on mesic, but periodically moistened cliffs and boulders (mostly acidic reaction) along mountain streams in upper level of forest belt in mountains, rarely reaching tundras or crooked subalpine forest belt. In comparison with *J. eucordifolia* the species prefers more xeric conditions that obliges to suspect *J. exertifolia* as just xeromorphous modification of the former, although preliminary genetic studies showed strong distance of typical *J. eucordifolia* from *J. exertifolia* from Korean Peninsula (Vilnet, pers. comm.).

Specimens examined. RUSSIA, Caucasus, Karachayevo-Cherkessiya (43°43'39"N 40°41'13"E), NK, K322-1-08 16.IX.2008 (KPABG), Commander Islands, Bering Island (54°40'N 166°15'E), VB, K-11-27-02 10.VIII.2002 (KPABG), Mednyj Island (54°58'50"N 167°29'15"E), VB, K-57-5-04, 03.VII.2004 (KPABG, duplicate in VBGI), Kamchatka Peninsula, North Kamchatka (58°50'N 161°20'E), VB K-33-1-03 11.VII.2003 (KPABG, duplicate in VBGI), Khabarovsk Territory, Lanzhiskiye Mts. (59°25'08"N 143°29'36"E), VB, Kh-37-1-08 25.VII.2008 (VBGI), (59°25'36"N 143°28'37"E), VB, Kh-43-6-08 27.VII.2008

(VBGI), Solnechnyj District (50°44'28"N 136°23'28"E), VB, Kh-7-17-07 31.V.2007 (VBGI), Tardoki-Yani Mt., VB, Kh-45-5-13 (VBGI), Kuril Islands, Iturup Island (44°53'25"N 147°26'42"E), VB, K-15-28-07 09.VIII.2007 (VBGI), Paramushir Island (50°38'55"N 156°07'32"E), VB, K-77-2-04 13.VII.2004 (KPABG, duplicate in VBGI), (50°25'45"N 155°45'00"E), VB, K-89-16-04 23.VII.2004 (KPABG, duplicate in VBGI), Shikotan Island (43°46'08"N 146°43'29"E), VB, K-45-37-07 26.VIII.2007 (VBGI), Shumshu Island (50°42'05"N 156°15'10"E), VB, K-121-16-04 14.VIII.2004 (KPABG, duplicate in VBGI), Murmansk Province, Khibiny Mts., NK, K201-6-04 13.VIII.2004 (KPABG); CANADA, British Columbia, Vancouver Island, Brooks Peninsula (50°08'N 127°43'W), Schofield W.B., 82642 13.VIII.1984 (F); U.S.A., California, Fresco Co. (37°06'N 119°06'W), Shevock J.R., 21.VII.1996 (MO4436744), Montana, Macdonald Lake, Williams R.S. 09.VIII.1891 (NY00244378), Washington, Yakima Co. (46°36'N 120°30'W), NK, A24/4-95 22.VIII.1995 (KPABG, duplicate in VBGI), Wyoming, Fremont Co., moist clay between rocks, 2650 m alt. (43°34.055-060'N 109°53.025-030'W), Kosovich-Anderson Ye.I., #32(15746), 25.VII.2013 (herb. Kosovich-Anderson Ye.I., duplicate in VBGI), Park Co., *Salix* sp. – *Carex* spp. – Bryidae fen crossed by streams, on granite rocks in fast-flowing water, 3000 m alt. (44°57.089-090'N 109°35.535-545'W), Kosovich-Anderson Ye.I., #5250 22.VIII.2009 (herb. Kosovich-Anderson, duplicate in VBGI).

JAPAN, Hokkaido Pref., Rebun Island, Momiowa, Hasegawa J., 7946 26.VIII.1984 (KYO), Miyagi Pref. (holotype of *J. exsertifolia* 'Japan. Sendai'), Jishiba U., 153, 19.V.1907 (G14574/00112197), Nagano Pref., Azusayama, Ikura, Shimizu D., 2327 VIII.1952 (HIRO), Senjo Mt., Shimizu D., 10.VIII.1953 (F), Shiga Pref., Myoodani, Bomura, Kitada-cho, Kodama T., 22679 24.XI.1963 (KYO), Myo-o-dani, Tatada-cho, Kodama T., 22679/1814 24.XI. 1963 (HIRO), Tochigi Pref., Nikko city, Ooyagawa, Kitagawa N., 15899 07.X.1977 (KYO), Wakayama Pref., Yasu-kawa, Kodama T., 28.III.1971 (F), Yamagata Pref., Chokai Mt., route from Lake Torino-umi to Yuza, Kitagawa N., 4515 19.VIII.1960 (KYO), Minami-arupusu-shi, near Kitazawa Pass, Southern Japan Alps (35°44'20"N 138°12'58"E), Furuki T., 23040b 09.VIII.2012 (CBM); TAIWAN, Taitung Co., Lisong, Lai M.J., 9577 24.XII.1977 (F).

Jungermannia konstantinovae Bakalin et Vilnet, Arctoa 18: 161, 2009 [2010].

Description. Plants deep green to brownish green. Shoots 1.0–1.2 (–1.5) mm wide, 10–20 mm long, prostrate. Stem 150–180 μm wide, orbicular in cross section, branching lateral, rarely ventral, dorsal surface cells with slightly thickened walls with indistinct trigones, 50–120 × 24–28 μm. Rhizoids scattered, colorless to grayish, erect, sometimes in indistinct fascicles. Leaves distant, flattened, rarely slightly concave or canaliculate-concave (especially near androecia), broadly ovate to transversely elliptic, rarely slightly retuse at apex, 300–500 × 350–600 μm (1 : 0.8–0.9), inserted at angle of 15–25° with axis, obliquely inserted dorsally, where not decurrent, ventrally subtransversely to arcuately inserted, not or barely decurrent. Midleaf cells thin-walled, with brownish walls, 15–28 × 13–18 μm, trigones indistinct; cells along margin 15–28 μm, cuticle smooth throughout. Oil bodies 2–4 (–8) per cell, nearly smooth. Paroicous. Perianths terminal, deep green, elliptic to rhomboidal, 5-plicate (2 lateral, 1 dorsal, 2 ventral) in upper half, almost always with 1 ventral innovation, ca. 1.0 × 0.7 mm, unistratose to base, cells in the perianth middle 24–35 × 20–30 μm, subisodiametric, with concave to triangle trigones, archegonia ca. 7 per perichaetium; perigynium indistinct; bracts equal in size to male bracts. Androecia in 2–3 pairs below perichaetium, bracts strongly concave to cupped 0.85 × 1.00–1.05 mm or smaller in lower pairs, 1-androus, stalk biseriate. Figure 6: 7–9.

Comment. This is the recently described species and up today known from type locality only. Although population in type locality is stable and produces androecia and perianths regularly I (and other collectors, as far as I know) was not able to observe sporophytes. Also, despite the careful search in other localities in habitats suitable for the species, the species was not found until present. The species characterized by the number of specific features easily separating it from other regionally recognized species of *Jungermannia*. The most striking ones include unistratose perianth, prostrate growth form, very obliquely inserted leaves that are widely ovate to transversely elliptic and flattened to slightly concave in the shape. By the unistratose perianth that is composed by subisodiametric cells and 5-plicate in upper part, the species gives aspect of *Solenostoma*, but specially conducted molecular research (Bakalin & Vilnet 2009), as well as deep green color of plants, rhizoids with no trace of reddish pigmentation, and calciphilous ecology ascertain position of the species within *Jungermannia*, but not *Solenostoma*. The comparison with possible relatives was also given by Bakalin & Vilnet (2009).

Distribution. Temperate East Asian. Known from the type locality only, in southern flank of the Russian Far East (Primorskii Territory) at the elevation of 300 m a.s.l. Since no relative species were found both in adjacent areas of the Russian Far East as well as in Korean Peninsula and Japan, this species may be treated as relict having highly definite distribution.

Ecology. Calciphilous mesophyte. The species growing on wet calcareous cliffs in deep ravine, surrounded scattered oak and *Rhododendron* shrubs, in Temperate broadleaved forest zone. The locality is under strong impact of oceanic water-rich air-masses, on the slope opened to the sea and commonly shrouded by fog.

Specimens examined. RUSSIA, Primorskij Territory, Nakhodka city area, Sestra Mt. (42°49'40"N 132°59'38"E), 300m alt., limestone cliffs VB, P-69-16-08 17.X.2008 (VBGI, holotype and many specimens from the same locality) VB, P-70-4-11 21.IX.2011 (VBGI), VB P-47-4-08 14.VIII.2008 (VBGI).

Jungermannia polaris Lindb., Öfvers. Förh. Kongl. Svenska Vetensk.-Akad. 23: 560, 1867 (= *Solenostoma polare* (Lindb.) R.M. Schust., Bull. Natl. Mus. Canada 164: 48, 1959).

Description. Plants 0.2–0.4 (0.7) mm wide, near perianth up 0.5 mm wide, up 2–7 mm long, creeping to (perinthous) ascending, yellowish brown to black-brown and blackish green near apex, sometimes become blackish in lower part of shoot, perianth commonly black-green. Stem (80) 100–250 μm wide, evidently to slightly flexuous, orbicular in cross section, dorsal surface cells thin-walled, with indistinct trigones, 28–55 × 15–28 μm. Rhizoids dense to rather scattered, brownish to nearly colorless, erect to obliquely spreading, separated or in indistinct fascicles. Leaves contiguous to subimbricate and imbricate, sheathing to laterally erect spreading, concave to concave-canaliculate and cupped, inserted at angle ca. (30) 45–75° with stem or (rarely) almost transversely inserted, dorsally subtransversely inserted, not decurrent, ventrally subtransversely inserted, not decurrent, 280–300 × 250–320 μm (1 : 0.9–1), widely ovate

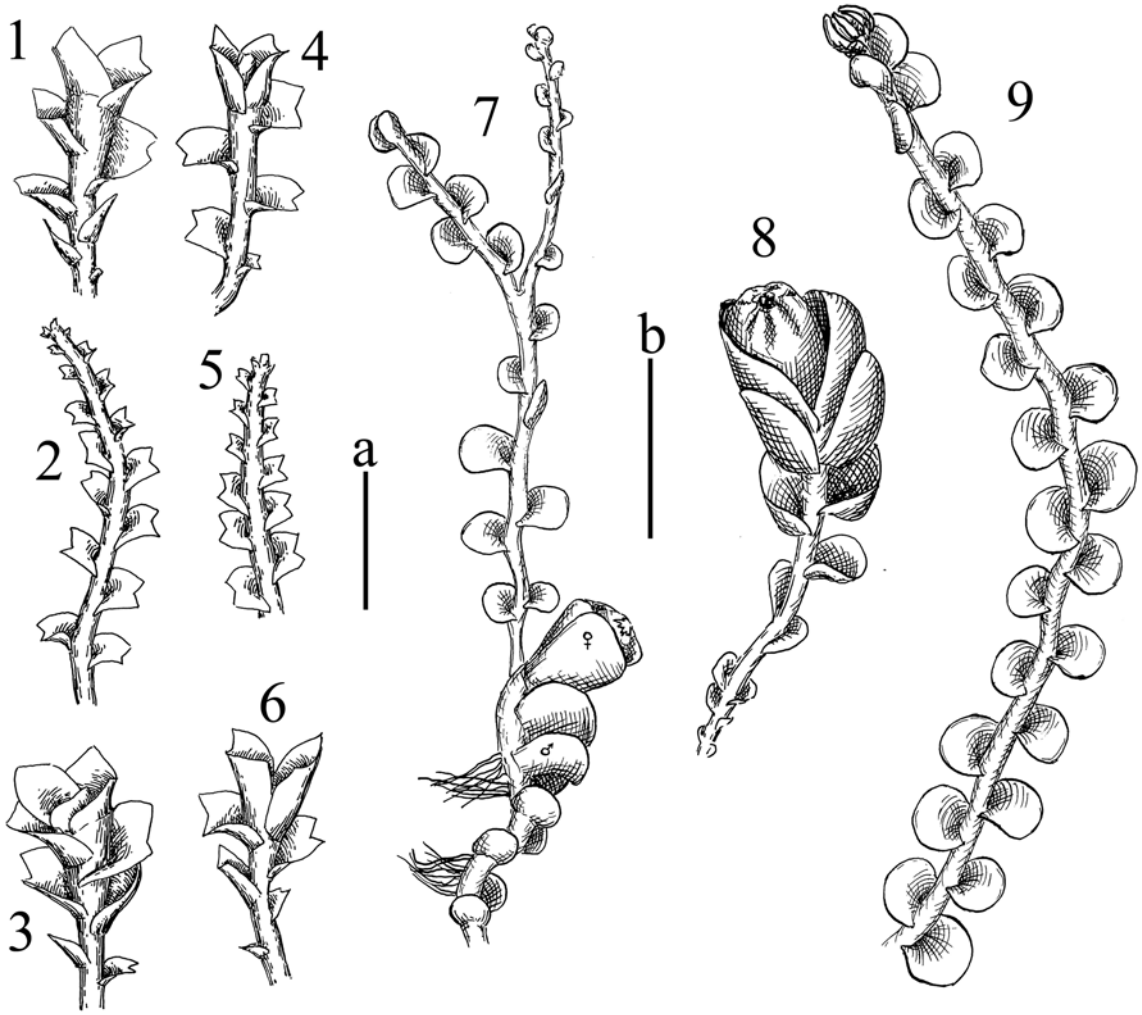

Figure 6 *Solenostoma bilobum* (Amak.) Potemkin et Nyushko: 1–6: 1, 3, 4, 6 – branch with perianth; 2, 5 – sterile branch. 1–6 – from K-50-53-07 (VBGI). *Jungermannia konstantinovae* Bakalin et Vilnet: 7–9: 7, 8 – branch with perianth and androecia, 9 – sterile branch. 7–9 – from P-69-16-08 (VBGI). Scales: a – 1 mm, for 1–6; b – 1 mm, for 7–9

to reniform, suborbicular, lingulate- and triangle-rounded. Cells in the midleaf thin-walled, with brownish to brownish yellow walls, 17–25 × 12–24 μm, trigones small, concave, near margin 12–20 μm, thin-walled, walls brownish, cuticle smooth. Paroicous. Perianth terminal, sometimes with ventral innovations, fusiform, ovate to ob-pyriform in projection to rhomboidal and cylindrical, pluriplicate at mouth, 750–1610 × 350–700 μm, mouth crenulate, perianth in upper 1/3 of its length unistratose, composed by quadrate to rectangular cells, 15–33 × 11–15 μm, walls thickened, brown colored, cuticle smooth, perianth in middle part 1–2-stratose, composed by oblong to obliquely rectangular cells, 25–40 × 12–17 μm, walls thickened in exposed area and thin in other parts, cuticle striolate below middle part, perianth in lower part 2-stratose, cells rectangular to oblong elliptic, 45–53 × 15–18 μm, walls thin, archegonia ca. 5–8 in perichaetium; perigynium absent; bracts the same size with male bract. Androecia in 2–3 pairs below perichaetium, or divided from the latter by 2 pairs of sterile leaves, 1–2-androus, antheridial body nearly spherical, ca. 80 μm in diameter, antheridial stalk biseriate, ca. 65 × 25 μm; bracts concave to cupped, imbricate, sometimes inflated at the base, ca. 420–600 × 450–600 μm. Capsule dark brown, subspherical to shortly ovoid, outer cells subrectangular, 12–14 μm in width, with 2–4 nodular thickenings and 0–2 on horizontal wall; inner layer cells narrowly rectangular, with 4–6 annular bands. Elaters ca. 7–8 μm in width. Spores 15–18 μm in diameter, finely papillose, yellowish brown. Figure 7.

Comment. Readily distinguishing species when typical phases are occurred. The closest relatives are *J. borealis* and *J. pumila*. The main peculiar features are comparatively wide stem that width is 1/2 – 1/3 (1/4) of branch width, monoicous inflorescence (the feature sharing with *J. pumila*), dark color (similar to *J. borealis*), avoiding of strongly rheophilic habitats (similar to *J. borealis*), tendency to occupy habitats on fine soil near snow-beds and to form communities with other cryophilous and basiphilous plants like *Anthelia juratzkana* (Limpr.) Trevis., *Clevea hyalina* (Sommerf.) Lindb. and *Preissia quadrata* (Scop.) Nees (similar to *Jungermannia borealis*). As it possible to expect from above, the confusion may be likely occur with *J. borealis*. Two species growing in the same vegetation zones (Arctic to Subarctic) and have similar ecological preferences. However *J. borealis* commonly avoid basiphilous habitats, contrary to *J. polaris*; as the second, *J. borealis* has rather flattened and laterally appressed leaves (versus strongly concave and sub- to imbricate, and compa-

ratively thin stem). However, some forms of *J. polaris* from very wet habitats and in the absence of generative structures may not be satisfactory differentiated from *J. borealis*. Much rarer confusion is possible with depauperate forms of *J. pumila*, occurring in the northern extremities of its area. Such forms become smaller in size and also characterized by shorter perianth (contrary to Schljakov, 1981, this is not constant feature in the both species). In that cases the main attention should be paid to longer than wide leaves in *J. pumila* (versus wider than long in *J. polaris*) and comparatively wide stem. In any way some forms may be named only tentatively. One of such examples is the specimen of NY00099009, I identified as *J. polaris* due to wide leaves of the plants and despite comparatively thin stem. I suggest practical to provide full description of that specimen below, because to unite it within general *J. polaris* diagnosis might promote the confusion in understanding of the species.

Specimen NY00099009. Plants 1–5 mm in length and 0.7–0.9 mm width, prostrate to (in fertile plants) ascending, deep green brownish to brown-green in deeper colored shoots. Fertile plants are larger than sterile ones. Stem flexuous 175–250 μm in diameter, dorsal surface cells more or less thin-walled, mostly rectangular to oblique rectangular, 25.0–50.0 × 12.5–20.0 μm, cuticle finely striolate; in the stem cross section cells more or less uniform, slightly smaller in inner space, more or less thin-walled or indistinctly thickened, with small concave trigones, outer cells ca. 17–23 μm in diameter, inner ca. 15–20 μm in diameter. Rhizoids dense, brownish, in indistinct fascicles or bundles. Leaves distant to contiguous, inserted at angle of 45° with axis, dorsally not or barely decurrent, ventrally subtransversely inserted, not decurrent; 380–450 × 410–600 μm (1 : 0.7–0.95), reniform to widely triangle, distinctly concave, widest at lower 1/3 of the leaf length. Cells in the midleaf slightly thick-walled, brownish colored, subisodiametric to quadrate 17–25 × 12–23 μm, trigones small, concave; along margin 12–20 μm, with slightly thickened walls, walls brown colored; cuticle smooth throughout. Paroicous. Perianth brown colored at narrowed part, exerted for 2/3 – 4/5 of its length, smooth, fusiform, gradually narrowed to the mouth, lightly pluriplicate near mouth, ca. 1610 × 700 μm, mouth crenulate, perianth in upper part unistratose, cells quadrate to rectangular, 15–33 × 11–15 μm, walls thickened, brown colored, cuticle smooth, perianth in middle part 1–2-stratose, cells oblong to oblique rectangular, 25–40 × 12–17 μm, walls thickened in colored area and thin in other parts, cuticle striolate on lower half of the perianth, perianth in lower part 2-stratose, cells rectangular to oblong elliptic, 45–53 × 15–18 μm, walls thin, ca. 8–10 archegonia in perichaetium; perigynium indistinct or very low; bracts just below perianth, in one pair, similar with sterile leaves, but frequently undulate at margin, elliptic to orbicular, widest in the middle, 600–770 × 700–735 μm. Androecia below female bracts, divided from the female bracts by the one pair of sterile leaves, with 1 (–2) pair of bracts, 1 (2)-androus, stalk biseriate, ca. 65 × 25 μm; bracts strongly inflate in base, partly violet in inflated area, apex deflexed, ca. 420 × 480–600 μm.

Distribution. Arctic Montane circumpolar. The rather rare species in western North America, known in Alaska, and British Columbia, Washington and then southward in California. Eastward occurs in Nunavut and Montana, then Minnesota, Michigan and Wisconsin near Great Lakes. In the Russian Far East the species occurs in northern half of the land: Chukotka, Kamchatka, Commanders, Magadan Province and after long gap re-occurs in Central Sakhalin in Chamga Mt. – an area hosed many periglacial relicts in the Russian Far East (Bakalin et al. 2012). Westward the species is known from a few locals in Siberia. In the Russian

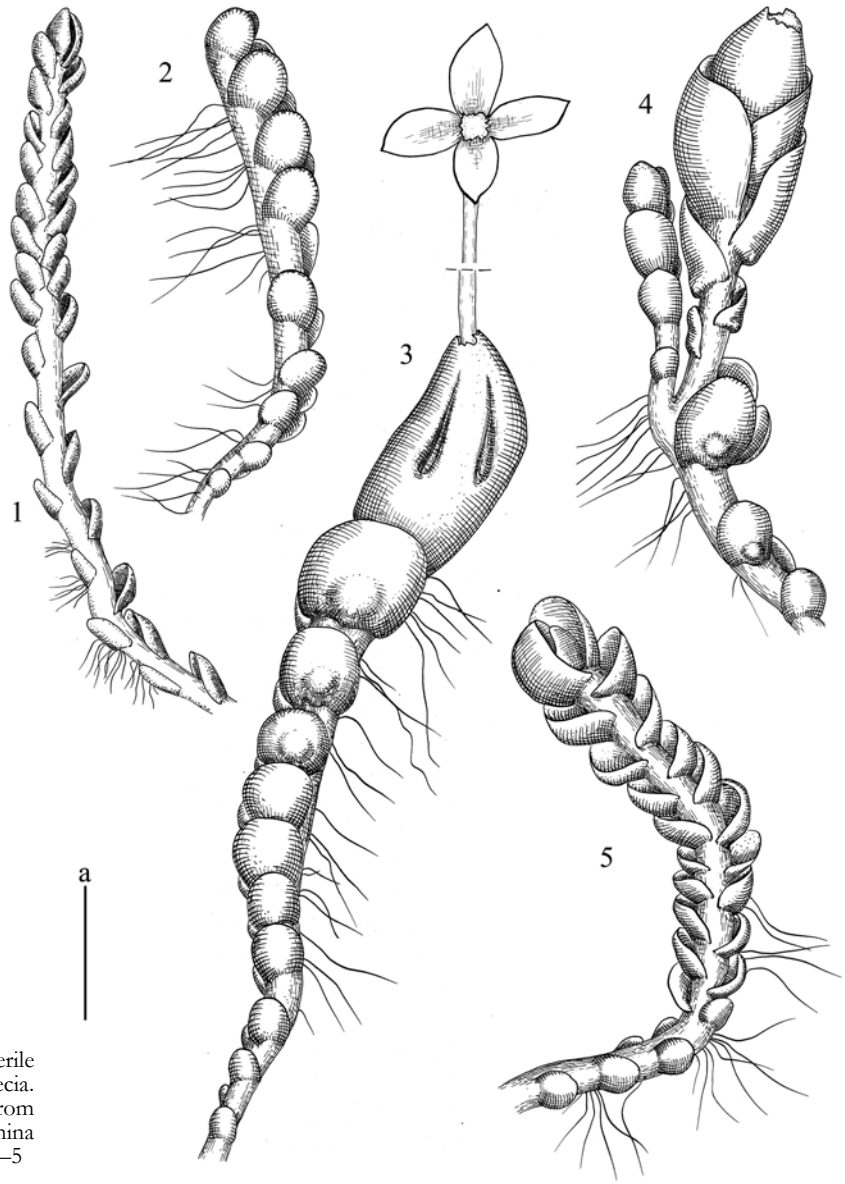

Figure 7 *Jungermannia polaris* Lindb.: 1, 2, 5 – sterile branch; 3, 4 – branch with perianth and androecia. 1, 4 – from K-50-11-03 (KPABG); 2, 3 – from K-10-5-02 (KPABG); 5 – from Ye.Yu. Kuzmina 08.VII.1988 (KPABG). Scale: a – 300 μm, for 1–5

Far East the species mostly distributed in the area below 600 m a.s.l. (reaches 1300 m a.s.l. in Sakhalin Island only); in North America its elevation varies from near the sea level in Alaska and North Canada to 3500 m a.s.l. in California.

Ecology. Basi- to neutrophilic meso-hygrophyte. The most preferable habitat of this species is snow-bed communities of cryo-mesophytic basiphilous mosses and bare soil at the same conditions. The species is also occurs near alpine and subalpine streams, rocks near waterfall (both in the spray zone or aside of it). Sometimes (East Kamchatka) the species growing on wet volcanic ashes of basic reaction. The species occurs in tundra zone or corresponding belt in the mountains and throughout the area confined (or nearly so) by basic conditions in the areas under influence of oceanic air masses.

Specimens examined. RUSSIA, Chukotka, Dlinnaya River, Kuzmina Ye.Yu., 08.VII.1988 (KPABG, duplicate in VBGI), Pekulnejskoye Lake, Kuzmina Ye.Yu., 28.VII.1987 (KPABG, duplicate in VBGI), Commander Islands, Bering Island)54°40'N 166°15'E), VB, K-10-5-02 09.VIII.2002 (KPABG, duplicate in VBGI), Mednyj Island, Mamayev E., K-49-03-EM 20.VII.2003 (KPABG, duplicate in VBGI), Kamchatka, Karaginskij Island (58°57'44"N 164°14'44"E), VB, K-19-7-05 01.VIII.2005 (VBGI), (58°57'15"N 164°14'29"E), VB, K-23-2-05 01.VIII.2005 (VBGI), East Kamchatka (56°11'N 160°21'E), VB, K-50-11-03 22.VII.2003 (KPABG, duplicate in VBGI), VB K-64-6-03 25.VII.2003 (KPABG, duplicate in VBGI), Magadan Province, Olskoye Plateau (60°37'35"N 151°33'09"E), VB, Mag-7-4-10 09.VI.2010 (VBGI), (60°38'45"N 151°29'13"E), VB, Mag-8-38-10 10.VI.2010 (VBGI), Seimchan River Basin (63°12'57"N 152°07'35"E), VB, Mag-14-2-10 13.VI.2010 (VBGI), Omsukchan District, VB, Mag-23-9-12 (VBGI), Murmansk Province, Kola Peninsula eastern flank, no data on collector, 432 31.VII.1972 (KPABG), Nentskii Autonomous Okrug, Bolshezemel'skaya Tundra, Lavrinenko O.V., M12П1.1 21.VII.2000 (KPABG), Timan Range (67°19'33"N 49°20'39"E), Dulin M.V., 23.VIII.2006 (KPABG), Sakhalin Island, Chamga Mt. (50°44'57"N 143°18'26"E), VB, S-27-10b-06 15.VIII.2006 (VBGI), (50°44'49"N 143°17'51"E), VB, S-30-15a-06 17.VIII.2006 (VBGI), (50°45'18"N 143°17'55"E), VB, S-61-5-09 11.IX.2009 (VBGI); U.S.A., Alaska, Meade River Post Office (70°29'N 157°25'W), Steere W.C. (NY00099009).

GREENLAND, West Greenland, Disko I. (66°14'N 53°32'W), Steere W.C., 29.VI.1962 (NY00099014); NORWAY, Sor-Trondelag (62°20'N 09°40'E), Lindberg S.O., 11.VII.1882 (KPABG); SLOVAKIA, Belianske Tatry, Váňa J. 05.IX.1967 (TNS).

Jungermannia pumila With., Arr. Brit. Pl. (ed. 3) 3: 883, 1796. (= *Solenostoma pumilum* (With.) Müll.Frib., Hedwigia 81: 117, 1942; *Jungermannia karl-muelleri* Grolle, Oesterr. Bot. Z. 111: 190, 1964; *Jungermannia karl-mulleri* Grolle ssp. *heteroicum* (R.M. Schust.) Stotler & Crandall-Stotler, Bryologist 80: 413, 1977; *Solenostoma oblongifolium* Müll.Frib. subsp. *heteroicum* R.M. Schust. & Damsh., Meddel. Grønland 199: 167, 1974; *Solenostoma pumilum* (With.) Grolle subsp. *anomalum* R.M. Schust. & Damsh., Meddel. Grønland 199: 165, 1974).

Description. Plants 3–6 (–10) mm long and 0.8–1.4 (2.0) mm wide (up 1.5 mm wide near the perianth), ascending to erect, dirty green, yellowish green, yellowish brownish to deep and bright green, sometimes with blackish leaf margins. Stem 100–280 μm in width and 90–270 μm in height, elliptic to orbicular in cross section; dorsal surface cells 20–33 × 25–30 μm, subquadrate to shortly rectangular, cuticle striolate-papillose; in the stem cross section cells near dorsal side larger, ca. 22–30 μm in diameter, thick-walled, walls yellowish, near the ventral side smaller (both external and inner), slightly thickened, walls brownish. Rhizoids sparse, in indistinct fascicles, erect to obliquely spreading, colorless to grayish and brownish. Leaves laterally erect, sheathing the stem in the base, inserted at angle 30–70° with axis (nearly the top of perianthous plant subtransversely inserted), dorsally obliquely to subtransversely inserted, not or barely decurrent, ventrally subtransversely to arcuately inserted, not to shortly decurrent; 550–1050 × 380–820 μm (0.7–0.9 : 1), ovate to (rarely) nearly lingulate, ovate-triangle, rounded-elliptic and rounded-ovate, distinctly concave-canaliculate to flattened. Midleaf cells thin- to moderately thick-walled, 22–45 × 12–24 μm, walls colorless to yellowish, trigones small, distinct or wanting, concave, to (rarely) moderate in size and convex; along margin 10–22 μm, with thin- to slightly thickened walls, walls yellowish to brownish, cuticle smooth throughout. Oil-bodies 2–6 per cell, 4–8 (10) × (17) 20–25 μm, finely granulate. Paroicous (some Arctic phases are heteroicous, but very rare). Perianth sometimes with 1 ventral innovation, fusiform to rhomboidal in projection, gradually narrowed to the pluriplicate mouth, 910–3000 × 450–750 μm, with 8–10 archegonia per perichaetium, exerted from bracts for 1/2 – 3/4 of the perianth length, cells in upper part ca. 17–20 μm in diameter, isodiametric, penta- to hexagonal, trigones distinct, concave, cuticle smooth, perianth in its middle part unistratose, composed by oblong cells, ca. 17–25 × 12–15 μm, thin-walled, trigones triangle to concave, cuticle striolate, perianth lower part bi- to tristratose, cells 33–50 × 15–22 μm, rectangular to oblique rectangular and linear, walls thin to thickened, trigones concave, cuticle distinctly papillose; perigynium indistinct; female bracts just below perianth, in 1 pair, ca. 1190 × 930 μm, similar to sterile leaves. Androecia below perianths, with (1–) 2 (–3) pairs of bracts, ca. 1050 × 930 μm, ovate-triangle, slightly larger than sterile leaves, strongly inflated near the base, uni-androus. Seta ca. 4.5 mm long. Capsule ellipsoidal 650–700 × 250–300 μm, bistratose, inner layer cells 50–70 × 9–12 μm with annular thickenings, outer layer cells 60–70 × 28–30 μm with 6–8 nodular thickenings in vertical wall. Elaters bispiral ca. 140–160 × 7–11 μm, with or without homogenous tapering ends. Figure 8.

Comment. Mostly easily recognizable species due to paroicous inflorescence, erect spreading leaves gradually becoming strongly larger near the perianth and occurrence in the areas with at least occasional flowing water impact. Some untypical forms may be confused with *Jungermannia borealis* and *J. polaris* that discussed under the latter taxa. The confusion with *J. atrovirens* seems to be also possible. The latter differs from *J. pumila* in comparatively larger size, obligate distribution in limestone or at least *Ca*-rich substrata (versus preferring of acidic habitats), tendency to occupy drier habitats (versus hydro- to hygrophilic ones), dioicous inflorescence (versus almost constant bisexuality, with rare exception of heteroicity of Arctic phases of *J. pumila*) and branches not or slightly dilated to the perianth.

Similar to *J. polaris* this species has morphologically transitional forms to the latter. Below I describe the specimen from the southern flank of the Russian Far East (Shikotan Island in the Kurils Chain) characterized by small size, but

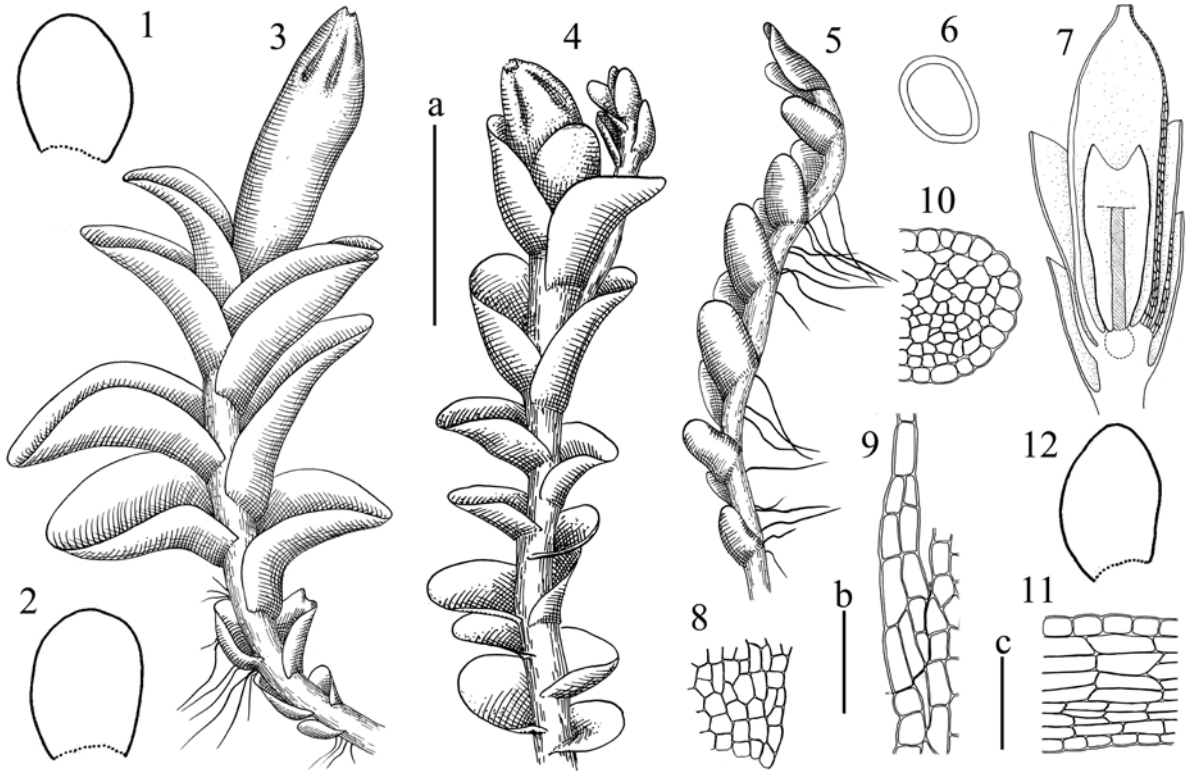

Figure 8 *Jungermannia pumila* With.: 1, 2, 12 – leaves; 3, 4 – branch with perianth and androecia; 5 – sterile branch, 6 – perianth cross section at the middle part; 7 – perianth longitude section, 8 – cells in ventral leaf base; 9 – leaf base longitude section; 10 – stem cross section; 11 – stem longitude section. 1, 2, 6–16 – from K-65-6-01 (KPABG); 3 – from KPABG-106772 (KPABG); 4 – from KPABG-100244 (KPABG); 5 – from K-59-6-01 (KPABG). Scales: a – 1 mm, for 1–7, 12; b – 50 μm, for 9; c – 100 μm, for 8, 10, 11

having longer than wide leaves. I suggest it should be *J. pumila* also due to southern position of collecting locality and untypical for *J. polaris* habitat.

Specimen K-65-17-07. Plants 0.3–0.5 (0.7) mm wide, near perichaetium up 1.2 mm width, ca. 2–5 mm in length, creeping to ascending, fertile plants erect, deep to dirty green, sometimes with brownish tint. Stem 120–190 μm wide, orbicular in cross section, dorsal surface cells thin-walled, walls brownish, with concave trigones, 30–45 × 18–25 μm, cuticle loosely striolate. Rhizoids scattered, grayish to brownish, erect to obliquely spreading, separated or united in indistinct fascicles, more dense near apex. Leaves distant to contiguous, concave, rarely on sterile shoots flattened, inserted at angle 40–50° with axis, dorsally barely (not more 1/5 of stem width) decurrent, ventrally arcuately inserted, not decurrent, 250–375 × 235–300 μm (0.9 : 1), ovate to widely oval. Cells in the midleaf thin-walled, lumen rounded, 27–35 (40) × 22–28 μm, trigones small, concave, near margin 17–22 μm, thin-walled, walls colorless to slightly brownish, cuticle smooth or striolate at leaf base. Paroicous. Perianth terminal, fusiform to cylindrical, 1100–1250 × 450–500 μm, cells in the perianth middle subquadrate to shortly rectangular and hexagonal, thin-walled, sometimes with flexuous walls, 24–35 × 22–27 μm, archegonia ca. 3 in perichaetium; perigynium indistinct; female bracts widely ovoid, concave to canaliculate, sheathing perianth at base and erect spreading above, ca. 625x780 μm. Androecia in 2 pairs below perichaetium, or divided from female bract by 1–2 pairs of sterile leaves.

Distribution. Boreal Montane circumpolar. Widely distributed and most common species in the area treated. In western North America known from Alaska, then in British Columbia, Washington, Oregon and California. Known in almost all administrative subunits within Canada and U.S.A. with the exception of southern part of the latter, but probably will be found there. Recorded in Canada outside of treated area (from west to east) in Northwest Territories, Alberta, Nunavut, Ontario, Quebec, Newfoundland and Nova Scotia. Southward, in U.S.A., known from Idaho, Utah, Montana, Wyoming, Colorado and New Mexico, then have a gap and re-occurs near Great Lakes in Minnesota, Wisconsin, Illinois, Michigan and southward in Iowa, Kentucky, West Virginia Tennessee, and again near Atlantic Coast in Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rode Island, New York, Pennsylvania, New Jersey, Maryland, District of Columbia, Virginia and North Carolina. Within the Russian Far East it is known from all administrative subunits. Westward in Siberia sparsely distributed in northern half and more or less common in its southern one. The altitudinal diapason of the species stretches from near sea level to 1300 m a.s.l. in Kamchatka Territory and to 1200 m a.s.l. in Primorskii Territory, being most common between 200 and 500 m a.s.l. In North America the species distributed from sea level in Alaska, British Columbia and Washington to over 2500 m a.s.l. in California and Wyoming.

Ecology. Acidophilic to *Ca*-tolerate hygrophyte. The species prefers rocky habitats of acidic to neutral environments, which are temporarily (but regularly) or permanently moistened: rheophilous stream banks, cliffs near waterfalls, etc. Much rarer it occurs on wet cliffs far from watercourses, sandy soil along streams, wet mossy tundras (also along margin of spots of bare ground of cryogenic origin, where become to forms transitional in morphology to *J. polaris*)

and lake banks. The species mostly growing in boreal coniferous and temperate broadleaved forest zones and corresponding belts, although sometimes penetrates to Subarctic and even Arctic (as in Wrangel Island at 72°N).

Specimens examined. RUSSIA, Buryatiya, Khamar-Daban Range, NK, 25-1-02 30.VII.2002 (KPABG), Chita Province, Kura District (49°53'N 112°03'E), Afonina O.M., OAf11606a 16.VIII.2006 (KPABG), Chukotka, Dlinnaya River, Kuzmina Ye.Yu., 08.VII.1988 (KPABG, duplicate in VBGI), Pekulnejskoye Lake, Kuzmina Ye.Yu., 28.VII.1986 (KPABG, duplicate in VBGI), Kamchatka, Central Kamchatka (56°08'18"N 158°55'47"E), VB, K-130-24-04 08.IX.2004 (VBGI), (55°55'N 158°40'E), VB, K-90-7-01 04.IX.2001 (KPABG, duplicate in VBGI), East Kamchatka (53°08'N 158°32'E), VB, K-1-3-03 30.V.2003 (KPABG, duplicate in VBGI), (56°11'N 160°21'E), VB, K-52-2a-03 23.VII.2003 (KPABG, duplicate in VBGI), (53°45'N 158°50'E), VB, K-59-6-01 08.VIII.2001 (KPABG, duplicate in VBGI), North Kamchatka (58°50'N 161°20'E), VB, K-34-1-03 11.VII.2003 (KPABG, duplicate in VBGI), Kemerovskaya Province, Kuznetskii Alatau Range (54°37'N 88°18'E), NK, 96-4-00 06.VII.2000 (KPABG), Khabarovsk Territory, Lanzhiskiye Mts. (59°25'08"N 143°29'36"E), VB, Kh-36-8-08 25.VII.2008 (VBGI), Tardoki-Yani Mt., VB Kh-40-15-13 (VBGI), Kurils Islands, Iturup Island (45°12'28"N 147°50'18"E), VB, K-46-3a-05 11.IX.2005 (VBGI), (45°12'38"N 147°51'12"E), VB, K-47-10-05 12.IX.2005 (VBGI), Kunashir Island (44°27'41"N 146°06'49"E), VB, K-37-17b-06 28.VIII.2007 (VBGI), (44°21'38"N 146°16'17"E), VB, K-58-3c-06 14.IX.2007 (VBGI), Paramushir Island (50°26'55"N 155°52'05"E), VB, K-104-10-04 28.VII.2004 (KPABG), (50°38'55"N 156°07'32"E), VB, K-75-16-04 13.VII.2004 (KPABG, duplicate in VBGI), Shikotan Island (43°46'34"N 146°44'19"E), VB, K-42-50-07 25.VIII.2007 (VBGI), (43°48'08"N 146°38'46"E), VB, K-49-25-07 28.VIII.2007 (VBGI), (43°51'45"N146°45'58"E), VB K-65-17-07 06.IX.2007 (VBGI), Shumshu Island (50°43'25"N 156°13'00"E), VB, K-120-13-04 14.VIII.2004 (KPABG, duplicate in VBGI), Magadan Province, Kamennyj Range (59°47'23"N 149°20'21"E), VB, Mag-23-16-10 17.VI.2010 (VBGI), Olskii District, Mochalova O.A., 18.IX.2003 (KPABG), Murmansk Province, Kandalaksha Bay, NK, 15/2 01.VIII.1986 (KPABG), Khibiny Mts., NK, 35-5-98 09.VIII.1998 (KPABG), Sal'nyye tundry massif, Borovichev E., 01.VIII.2004 (KPABG), Primorskii Territory, Lazovskii District, VB, P-73-42-11 (VBGI), Shkotovskii District (43°06'07"N 132°41'31"E), VB, P-72-9-05 09.X.2005 (VBGI), (43°04'15"N 132°41'37"E), VB, P-74-74-05 10.X.2005 (VBGI), Sakhalin Island, Chamga Mt. (50°45'09"N 143°18'26"E), VB, S-27-27-06 15.VIII.2006 (VBGI), (50°44'50"N 143°17'17"E), VB, S-30-1a-06 17.VIII.2006 (VBGI), Nevelsk District (46°44'25"N 142°08'03"E), VB, S-67-12-09 17.IX.2009 (VBGI), Schmidt Peninsula (54°01'01"N 142°56'34"E), VB, S-41-8-09 29.VIII.2009 (VBGI), (54°04'10"N 142°49'26"E), VB, S-48-2-09 01.IX.2009 (VBGI), Vaida Mt. (49°52'21"N 143°28'38"E), VB, S-32-7-06 20.VIII.2006 (VBGI), Ignatov M.S. 20.VIII.2006 (VBGI), Zhdanko Mt. (48°03'00"N 142°31'44"E), VB, S-25-54-09 20.VIII.2009 (VBGI), Tuva Republic, Todzha Basin, VB, 99-11-1 17.VII.1999 (KPABG), Yakutiya, Kodar Range (57°31'N 119°35'E), VB, 22-4-00 27.VII.2000 (KPABG); CANADA, British Columbia, Simpson Pass, Brinkman A.H., 23.VIII.1913 (NY00099059); U.S.A., Wyoming Fremont County, wet sandy soil of bank, in shade beneath tall forbs (43°28.830-840'N 109°52.320-330'W), 2800 m alt., Kosovich-Anderson Ye. I., #24(15212) 20.VII.2013 (herb. Kosovich-Anderson, duplicate in VBGI), California, Fresco Co. (37°09'00"N 119°06'10"W), Shevock J.R., 19.VIII.1996 (MO4436770), Washington, Baker Mt. (47°55'N 122°06'W), NK, A12/1-95 14.VIII.1995 (KPABG, duplicate in VBGI), Wyoming, Teton Pass (44°44'N 109°45'W), NK, A69/7-95 02.IX.1995 (KPABG, duplicate in VBGI).

CHINA, Sichuan, Nanchuan, Jinfoshan Mt., on stone, 1980 m alt., Meizhi Wang, 860668, 09.VIII.1986 (PE 00656021), Liaoning, Huanren Co., Laotudingzi, on rock, 700 m alt., Cao T., 467 (IFP 00003252), Kuandian Co., Baishilazi, on soil above rock, Cao T., 38500 (IFP 00008009); FINLAND, Ostrobottnia kajanensis (64°15'N 27°40'E), Lackstrom E.F., 16.IV.1872 (KPABG); Japan, Hokkaido Pref., Hakodate Mt., Kuwahara Y., 5759/2118 27.VII.1956 (HIRO), Rishiri Island, Shimizu D., 2119 23.VII.1954 (HIRO), Sapporo-shi, Teine Mt., Uchida A., 1040/1256 11.XI.1999 (SAPT), 1042/1125 11.XI.1999 (SAPT), 460/1257 11.IX.1999 (SAPT), Nagano Pref., Yatsugatake Mts., Furuki T., 4120 01.IX.1982 (CBM), Togakushi Mt., Sakuma E., 14197/2336 06.X.1968 (HIRO), Tokyo, Makino T., 15.IV.1895 (SAP), Wakayama Pref., Takeyama Mt., Kodama T., 27150/2333 17.I.1965 (HIRO), Yamagata Pref., Zao Mt., Dokko pond, Furuki T., 13247b 05.IX.1996 (CBM); SLOVAKIA, Nizke Tatry, Hubackova J. no data (KPABG); TAIWAN, Nantou Co., Taroko National Park, Chengkung, Furuki T., 22060 30.IX.2009 (CBM), Furuki T., 22097 01.X.2009 (CBM).

SOLENOSTOMATACEAE Stotler & Crand.-Stot., Edinburgh Journ. Bot. 66: 190, 2009.

PLECTOCOLEA (Mitt.) Mitt., Flora Vitiensis 405, 1873. [from Greek "pleko" – turbinate and "koleos" – vagina (here it means perianth) due to turbinate upper part of perianth] (=*Solenostoma* subgen. *Plectocolea* Mitt., Journ. Proc. Linnean Soc. 8: 156, 1865; *Jungermannia* L. subg. *Plectocolea* (Mitt.) Amak. J. Hattori Bot. Lab., 21: 270, 1960.

Type species: *Solenostoma radicellosum* Mitt. J. Linn. Soc., Bot. 8: 156, 1865. (= *Plectocolea radicellosa* (Mitt.) Mitt. In: Seeman Fl. Vitiensis, 2: 405, 1971)

Description. Plants prostrate to ascending and erect, yellowish brown, brownish to brown reddish, deep green brown-purple (the bright coloration predominate). Stem transversely elliptic to rounded in cross section, branching lateral intercalary or ventral, rarely occurring in the most of species, but in some species is very frequent, especially as postical innovations and scale-like leaved to leafless strongly rhizogenous stolons; dorsal surface cells rectangular to linear, thin- to thick-walled with distinct or indistinct trigones and mostly striolate cuticle. Rhizoids colorless to red-brown and purple, blackish brown and brown with purple (or at least purplish) pigmentation (purplish pigmentation is one of characteristic features of the genus and may be commonly found, at least as the traces). Leaves distant to contiguous and subimbricate, obliquely inserted, mostly distinctly decurrent dorsally and (sometimes) ventrally. Cells in the midleaf subisodiametric, mostly penta- to hexagonal, walls colorless to yellowish and brownish, slightly to evidently thickened or thin, trigones distinct, concave to convex. Perianth conical to cylindrical and pyriform, unistratose throughout or bistratose in lower third, composed in the perianth middle by long-rectangular to semi-linear or (rarely) shortly oblong cells; perigynium (in our taxa) always present, 1/4 – 2/1 of perianth length.

Comment. *Solenostoma* subg. *Plectocolea* was described by Mitten (1865 a) as "Perianthium terminale, tubulosum, plicatum, ore denticulatum. Caulis ascendens. Folia explanata, disticha, pagina inferior, radicellis villosa. Amphigastria parva obsolete". The only species attributed to that subgenus was *Solenostoma radicellosum* Mitt. (=*Plectocolea radicellosa* (Mitt.) Mitt.), described in the same paper. This taxon is the type of subg. *Plectocolea* and the latter genus *Plectocolea* (Mitt.) Mitt. In the comments to the newly described subgenus Mitten (1865 a: 155) wrote "This species agrees very nearly with *Jungermannia polyrhiza* Hook., and forms with it and a few other Indian species a small group, remarkable for their plicate perianths and for the presence of the root-like filaments on the underside of the leaves". Eight years later Mitten (1871) elevated subgeneric rank of *Plectocolea* to

generic and proposed genus *Plectocolea* (Mitt.) Mitt. due to general characteristics of new genus as (Mitten 1871: 405) "the perianth, which is plicated throughout its length and not contracted at its apex into a tubular mouth". Current morphological concept of *Plectocolea* is somewhat different from that suggested by Mitten (1865 a) and includes other characters.

Plectocolea crenuliformis (Aust.) Mitt., Trans. Linn. Soc. Ser. 2, 3: 198, 1891. (= *Jungermannia crenuliformis* Aust., Bull. Torrey Bot. Club, 3: 10, 1872; *Solenostoma crenuliforme* (Aust.) Steph. Sp. Hep., 2: 56, 1901).

Description. Plants 3–15 (–20) mm long and 1.1–2.5 mm wide, prostrate to ascending, yellowish brown, brownish to brown reddish, with characteristically more deeply colored leaf margin, rarely in shady places pale greenish to whitish and very soft and gentle; female plants bigger than sterile ones. Stem 105–360 (–385) μm in width and 80–250 (305) μm in height, branching lateral intercalary or ventral, rarely occur; dorsal surface cells 63–175 × (12–) 15–25 μm, linear, rectangular to obliquely rectangular, walls thin to very thick and brownish (up to 2.5–3.5 μm in thickness), trigones indistinct, cuticle loosely striolate; in the stem cross section there are at least four variants of structure: 1) three-layered with outer cells (hyaloderm) ca. 17–30 μm in diameter, thin-walled, walls colorless, middle stratum (scleroderm) ca. 12–15 μm in diameter, thick-walled, walls yellowish, and inner cells ca. 12–23 μm in diameter, slightly thick-walled to thin-walled; 2) (in weakly developed phases) in the stem cross section there are 2 strata: outer with slightly thick-walled cells, ca. 25–27 μm in diameter, inner with cell wall thin to slightly thickened, cells mostly hexagonal, ca. 25–37 μm in diameter, cell walls colorless; 3) no distinct differentiation in the stem cross section, although walls become thicker to dorsal side, outer cells larger, ca. 25–33 μm in diameter, inner smaller, ca. 20–25 μm in diameter, become smaller near ventral side; 4) two-layered stem, with outer cells smaller than inner, ca. 17–23 μm in diameter, thick-walled, walls brownish, but in ventral side outer cells rather thin-walled, walls purplish, inner cells slightly thick-walled, walls flexuous, ca. 25–35 μm in diameter, trigones indistinct to small concave. Rhizoids purple-brown to purple, blackish brown and brown, sparse to numerous and dense in indistinct fascicles, decurrent down the stem or erect. Leaves distant, inserted at angle 15–45° with axis, dorsally decurrent for 1/4 of stem width, ventrally subtransversely inserted, insertion line loosely arcuate to straight, 775–1185 × 775–1400 μm (0.95–1.3 : 1), widest at the middle or slightly below, flattened to loosely concave and concave-channeled, obliquely lingulate to obliquely ovate, elliptic, transversely elliptic, reniform and suborbicular. Cells in the midleaf 30–45 (50) × 20–38 (–45) μm, subisodiametric, mostly 5–6-gonal, lumen mostly rounded, walls colorless to yellowish, slightly thickened, trigones distinct, mostly concave, more rarely triangular and large, convex; along margin (15–) 28–45 (50) μm, very thick-walled to thin-walled (in shady phases), but external wall almost invariantly thickened, walls colorless, yellowish to brownish and yellowish brownish with more deeply colored external wall, cuticle smooth to verrucose near ventral leaf base or rarely throughout. Oil-bodies (1–) 2–3 (–5) per cell, ellipsoidal to shortly fusiform, 6–9 × 3–6 μm. Dioicous. Perianth terminal on main axis, conical, in upper part pluriplicate, but with 3–5 main plicae, gradually narrowed to the mouth, ca. 700–1050 × 700 μm, hidden within bracts or exerted up to 1/4 of its length, mouth crenulate, composed by more or less short (ca. 1.5 as long as wide) cells, cells in the perianth middle part 25–43 × 15–20 μm in diameter, rectangular to oblong rectangular, strongly thick-walled, walls pink-rose to purplish, cuticle smooth; perigynium 1/2 – 3/4 of perianth length, with 1–2 pairs of bracts; female bracts just below perianth, in 1–2 pair, similar to sterile leaves, but longer, ca. 1050–1225 × 1070–1190 μm, elliptic to oblong lingulate, sometimes (pairs developed on the perigynium) shortly retuse at apex, widest at middle or in the lower 1/3 of the bract, sheathing perianth and perigynium at the base and canaliculate and deflexed away the perianth un upper half. Androecia intercalary, with 3–4 pairs of bracts (frequently androecial branch die out upper androecia), with 2 antheridia per bract, stalk biseriate, ca. 50 × 22 μm; bracts with slightly, but distinctly developed rim of swollen cells. Figure 9: 1–9.

Comment. The distinctive Eastern North American species very closely morphologically related and vicarious to East Asian *Plectocolea rigidula*. Both species share the following characters: nearly prostrate growth form, purple to purple-brown rigid rhizoids not forming distinct fascicle decurrent down the stem, large-celled leaf margin rim, with commonly strongly and almost equally thickened walls (in shady forms not thickened, similar in size with midleaf cells, and only slightly larger than cells in the next rows inward of leaf margin), typical 'plectocoleoid' perianth and large perigynium. Aside strongly detached distribution, the differences between two species are scarce and may be found in the width of cells in dorsal side of the stem (15–25 μm in *P. crenuiliformi*s versus 28–45 μm in *P. rigidula*), leaves decurrent in their dorsal base up to 1/4 of stem width in *P. crenuliformis* versus up to 1/2 in *P. rigidula* and commonly longer midleaf cells where length is about 1.5–2.0 of width. However these features may not be constant and the relationships of two species need in future considerations. Taking into account the fact the status of species based on geographic principles commonly confirm by recent molecular studies, the pair *rigidula-crenuliformis* may represent two 'good' species as well. Some depauperate weak plants of the species may be probably mistaken with *P. fossombronioides*, for distinctions see discussion under latter.

Distribution. Boreo-Temperate Eastern North American endemic, known both from boreal zone in Canada (Ontario, Quebec) through New York, Pennsilvania, New Jersey southward to South Temperate Zone in Georgia and spreading westward to Arkansas and Wisconsin. The data on altitudinal distribution are highly imperfect, presumable the species prefers lowland conditions and not exceed 500 m a.s.l.

Ecology. Acido- to neutrophilic mesophyte. The species prefers occupy circum-neutral to acidic rocks and sandstone, growing along shaded rocky streams, or in areas with disturbed vegetation cover in lowlands. In zonal aspect the species most common in Temperate zone, although also

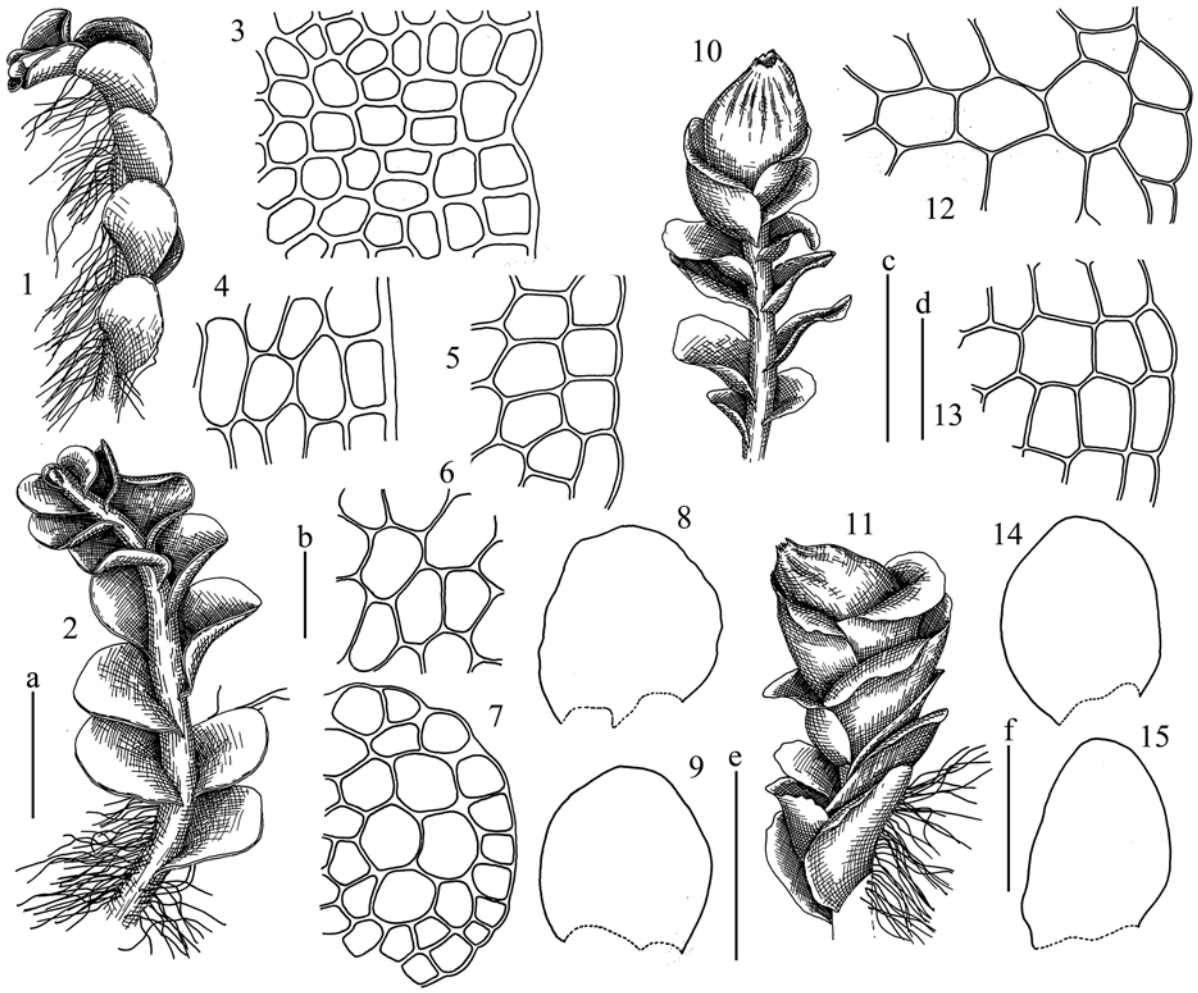

Figure 9 *Plectocolea crenuliformis* (Aust.) Mitt.: 1–9: 1, 2 – sterile branch; 3–5 – leaf margin cells; 6 – midleaf cells; 7 – stem cross section; 8, 9 – leaves. 1, 2, 7 – from MO1952291 (MO); 3, 4 – from NY00244437 (NY); 5 – from NY00243898 (NY); 6 – from NY00243903 (NY). *Plectocolea fossombronioides* (Aust.) Mitt.: 10–15: 10, 11 – branch with perianth and androecia; 12, 13 – cells along leaf margin; 14, 15 – leaves. 10, 11 – from NY00244042 (NY); 12, 13 – from NY00244023 (NY); 14, 15 – from MO5215490 (MO). Scales: a – 1 mm, for 1, 2; b – 50 μm, for 3–7; c – 1 mm, for 10, 11; d – 50 μm, for 12, 13; e – 1 mm, for 8, 9; f – 500 μm, for 14, 15

occurs in southern part of Boreal zone (eastern Canada) or reaches transitional to Subtropics zone in Georgia. Throughout of its area the species grows in lowlands and not penetrate to mountains and that is similar in ecological preferences to *Endogemma caespiticia*, but more southern in distribution.

Specimens examined. U.S.A., Alabama, Winston Co., Bryson C.T., 08.III.1979 (MO3985251), Arkansas, Madison Co., Redfearn P.L., 04.III.1965 (MO3670274), Polk Co., Anderson L.E., 11.V.1953 (MO3952291), Indiana, Crawford Co., Wagner K.A., 28.IX.1950 (NY00243898), Kansas, Woodson Co., MacGregor R., 27.IX.1952 (NY00243903), New Jersey, Closter (F), Oregon Coos Co., Doty M. 01.I.1941 (NY00244437).

Plectocolea fossombronioides (Aust.) Mitt., Trans. Linn. Soc. Bot., ser 2, 3: 198, 1891. (= *Jungermannia fossombronioides* Aust., Proc. Acad. Nat. Sci. Philadelphia, 21: 220, 1869 [1870]; *Solenostoma fossombronioides* (Aust.) R.M. Schust., Hepat. Anth. N. Amer., 2: 1027, 1969).

Plants of 'fossombronioid' appearance, very soft and, 3–6 mm long and 0.7–1.0 mm wide, prostrate to ascending (near apex of fertile shoot), pale brownish, whitish, yellowish brown; fertile plants slightly larger than sterile. Stem 105–175 μm in width and 100–165 μm in height, dorsal surface cells ca. 70–87 × 25–30 μm, thin-walled or slightly thickened, trigones indistinct; in the stem cross section composed by more or less uniform mostly thin-walled, penta- to hexagonal cells, ca. 20–38 μm in diameter, smaller near ventral side, walls colorless to brownish, trigones absent or very small. Rhizoids dense, brown-purple to (rarer) purplish and pale brownish, rigid, separated one from other, or sometimes united into indistinct fascicles, erect spreading from the stem. Leaves distant to contiguous, inserted at angle 15–20° with stem, dorsally shortly decurrent (not more than 1/5 of stem width), ventrally inserted at angle 50–60° with axis, not decurrent; 600–700 × 490–600 μm (0.8–0.9 : 1), lingulate to ovate, widest between 1/2 and 1/3 of leaf length, flattened to obscurely concave, the biggest leaves commonly undulated at margin. Cells in the midleaf thin-walled, 38–60 × 35–43 μm, walls brownish to colorless, trigones small, concave; along margin 25–35 μm, slightly elongate along margin, walls thin, colorless; cuticle smooth throughout. Oil-bodies 2–5 (–8) per cell, 6–8 × 8–22 μm. Paroicous, but occasionally with some androecious innovations. Perianth without subfloral innovations, exerted for 1/3 – 2/3 of its length, cylindrical, 5-plicate when mature (1 – dorsal, 2 – lateral, 2 – ventral) or pluriplicate, obscurely

contracted to the mouth, perianth composed by uniformly elongated cells, ca. 70–85 × 25–33 μm, walls thin, trigones small to indistinct, cuticle smooth; perigynium 3/4 – 4/4 of perianth length, with 2 pairs of bracts; bracts just below perianth, the same shape as male bracts. Androecia just below female bracts (or, occasionally in separate branches), with 2–3 (–4) pairs of bracts (if in separate branches – with 3–4 pairs of bracts), with 1–2 antheridia per bract, antheridial body shortly elliptical to spherical, ca. 120–170 × 120–170 μm, stalk biseriate, ca. 38 × 25 μm; bracts strongly inflated near the base with margin (especially the nearest pair to the perichaetium) deflexed away of the perianth. Seta ca. 150 μm in diameter. Capsule shortly ellipsoidal, ca. 700 × 630 μm, bistratose, inner cells, long rectangular 50–100 × 7.5–13 μm, with 5–8 annular thickenings, outer cells subquadrate to rectangular, ca. 33–55 × 40–43 μm with 2–3 nodular thickenings in vertical wall, and 0–2 on the horizontal one. Elaters bispiral, ca. 165 × 7.5 μm, with homogenous ends ca. 30 μm long, spores brown to brown reddish, spherical, finely papillose, 15–16 μm in diameter. Figure 9: 10–15.

Comment. The species is characterized by soft and tiny plants, almost entirely paroicous inflorescence, mostly brownish purple to purplish rigid rhizoids. The species is giving aspect of *Fossombronia* that reflected in the epithet. When sterile it may be mistaken with depauperate plants from shady places of *Plectocolea crenuliformis*, *Solenostoma hyalinum* and with *Metasolenostoma gracillimum* f. *gracillimum*. Sterile plants of *Plectocolea fossombronioides* differs from *P. crenuliformis* in the absence of thick-walled swollen cell rim along leaf margin, or, when it is not present (in shady forms), by cells along margin that are equal or larger than midleaf cells in the latter, versus evidently smaller in *P. fossombronioides*. The cell size is also distinctive, when cells in the midleaf of *P. crenuliformis* mostly fit to 30–45 × 20–38 μm, the midleaf cells in *P. fossombronioides* are larger, 38–60 × 35–43 μm. *P. fossombronioides* differs from sterile plants of *Metasolenostoma gracillimum* f. *gracillimum* and *Solenotoma hyalinum* in more lax texture, considerable larger midleaf cells and mostly brown-purple to brown rigid rhizoids (versus colorless to slightly purplish and soft in the latter).

Distribution. Temperate Eastern North American endemic species stretches from Connecticut and New Jersey to South Carolina, Georgia and Mississippi, westward to Illinois and even Kansas, and also known from Indiana, North Carolina, Ohio and West Virginia. The species occurs in low to middle elevations (registered from 200 to 900 m a.s.l.).

Ecology. Acido- to neutrophilic mesophyte. The species prefers soil-covered rocks along streams, sometimes it is occasional pioneer on sedimentary or slightly metamorphosed rocks or growing on clayey soil along roadside. This is temperate taxon distributed in broadleaved forest zone.

Specimens examined. U.S.A., Illinois, Pope Co., 27.IX.1981 (MO3686676), Kansas, Lesvenworth Co., MacGregor R., 15.V.1948 (NY00244023), Missouri, Johnson Co., Castaner D., 14.IV.1978 (MO5215490), New Jersey, Closter Co. (F), Vireginia, Bedford Co., Patterson P.M., 19.IX.1943 (NY00244042), Chesterfield Co., Patterson P.M. 16.VIII.1948 (NY00244040).

Plectocolea infusca Mitt., Trans. Linn. Soc. London, Botany 3: 196, 1981. (=*Jungermannia infusca* (Mitt.) Steph., Bull. Herbier Boissier, sér. 2, 1: 512 [Sp. Hepat. 2: 74]. 1901; *Solenostoma infuscum* (Mitt.) Hentschel, Plant Syst. Evol. 268: 152. 2007.; *Solenostoma ovicalyx* Steph., Sp. Hepat. 6: 82 1917 *syn. nov.*)

Description. Plants (1.0) 1.5–2.5 (2.7) mm wide (male shoots 1.2–1.5 mm wide, narrowed in androecial part), 5–15 mm in long, ascending to prostrate, light green, yellowish green, yellowish brown to brownish green, more deeply colored at shoots tips (where sometimes with purplish tint). Stem 200–380 μm in diameter, orbicular in cross section, dorsal surface cells thin- to thick-walled, walls yellowish brown, with concave to indistinct trigones, mostly rectangular, 70–100 × 22–32 μm. Rhizoids colorless to purplish, light rose and brownish, mostly dense, erect to obliquely spreading, separated or united into unclear fascicles and forming mat under stem. Leaves contiguous to (rarer) distant, concave, concave-canaliculate to flattened, commonly enclosed one to another, inserted at angle of 30–50° (–55) with axis, dorsally not decurrent or decurrent up to 1/5 – 2/3 of stem width, ventrally subtransversely to arcuately inserted, barely decurrent, 820–1670 × 820–1720 μm (0.9–1.1 : 1), widely ovoid to orbicular-lingulate, lingulate and elliptic. Cells in the midleaf thin-walled, 25–53 × 20–40 μm, walls colorless to slightly brownish, trigones large, convex; cells along leaf margin 12–30 (–37) μm, thin-walled, commonly with thickened external wall, trigones moderate in size, convex; cuticle smooth throughout to loosely papillose in lower half, rarely papilose in the midleaf and become smooth to the margins. Oil bodies (2) 3–6 (8) per cell granulate, brownish to deep brownish, nearly filling cell lumen. Dioicous. Perianth terminal, shortly fusiform to conical, sometimes with 1–2 ventral or lateral innovations, 3- to pluriplicate, exerted for 1/4 – 2/3 of its length, ca. 900–1250 × 500–750 μm, mouth crenulate due to protrudent, elongate thin-walled cells; perianth upper part cells 50.0–73.5 × 17.0–31.5 μm, thin-walled, trigones small, concave, cells elongate; perianth middle part cells similar to upper, in lower part oblong, thin-walled, trigones small, concave, 63–126 × 27–46 μm, unistratose to the base, archegonia 5–10 in perichaetium; perigynium (1/4–) 1/3 – 3/3 of perianth length, rhizogenous ventrally; female bracts slightly wider than sterile leaves, sheathing near their base, ovoid to ovoid-triangular. Androecia with 4–6 (10) pairs of bracts, spicate or nearly so, intercalary, 1(2)-androus, antheridial body nearly spherical, ca. 150 μm in diameter, antheridial stalk biseriate; male bracts smaller than sterile leaves (and androecial part of the shoot narrower than sterile), 770–925 × 880–990 μm, obliquely ovate to obliquely widely triangular, moderately to strongly inflated in the base, obliquely spreading in upper half, commonly recurved along dorsal margin. Elaters bispiral, ca. 168 × 8–9 μm, with long (31.5–42.5 μm) homogenous ends. Spores papillose, brown, 16.8–18.9 μm in diameter. Figures 10 and 11.

Comment. The easily recognizable species of mostly East Asian distribution. The main diagnostic traits includes comparatively large size, bright coloration of shoots, leaves

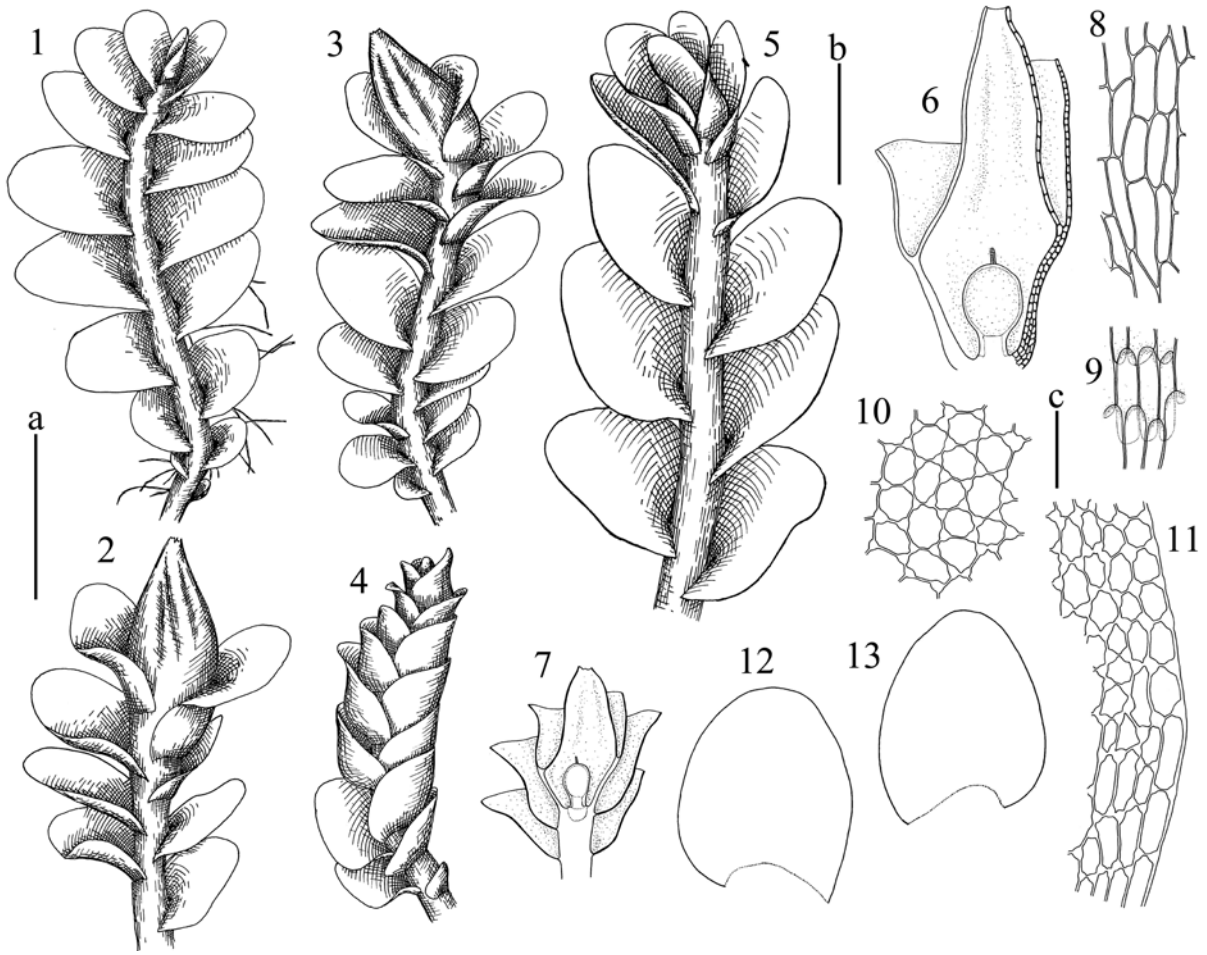

Figure 10 *Plectocolea infusca* Mitt.: 1, 5 – sterile branch; 2, 3 – branch with perianth; 4 – branch with androecia; 6, 7 – perianth longitude section; 8 – cells in the perianth lower part; 9 – cells in the perianth upper part; 10 – midleaf cells; 11 – cells in the ventral leaf base, 12, 13 – leaves. 1-3 – from S-25-22-06 (VBGI); 4, 5 – from S-25-2a-06 (VBGI); 6–13 – from P-2-15-07 (VBGI). Scales: a – 1 mm, for 1–5, 7, 12, 13; b – 500 μm, for 6; c – 50 μm, for 8–11.

enclosed one to another, convex trigones in leaf cells and particularly deep brownish large oil bodies nearly filling cell lumen. The confusion is possible with *Solenostoma hyalinum* and *Plectocolea kurilensis*, for differentiations see comments under those species. Some deviate forms are occurred southward of treated area and may be expected to occur in the southern flank of the Russian Far East, therefore seems to be practical to discuss them here.

Specimen IFP00003375. Rhizoids not fasciculate, colorless to purple. Leaf cells thin-walled, with distinct triangle to convex trigones. Plants yellowish-brownish. Leaves in older part of shoots subtransversely inserted (by insertion type similar to *Plectocolea virgata* or *P. erecta*), near perianth erect spreading.

Specimen IFP00003210. Leaves similar in shape to *P. comata*, but leaf cuticle is smooth.

Specimen IFP00023951. In some plants rhizoids forming fascicle decurrent down the stem (distinct in upper part, but indistinct in lower one). In other characteristics this is typical *P. infusca*.

Specimen PE01093386. A form with very large, bulging, sometimes confluent trigones in the leaf cells.

Distribution (var. *infusca*). Temperate East Asian. Distinctive East Asian taxon fairly common in Japan, Korea and Eastern China. In area treated it is abundant in southern flank in the Russian Far East and recorded from Primorskii Territory, Sakhalin Island and Kurils. Throughout of its Far Eastern area the species occurs in low elevations not exceeding 300 m a.s.l., although its occurs in much higher altitudes in Japan and Korean Peninsula.

Ecology. (var. *infusca*) Acidophilic to *Ca*-tolerate meso- to hygrophyte. This is epilithic taxon occurring on wet to moist stones and cliffs both along streams and other watercourses to aside of direct impact of the water. Sometimes it plays a role of pioneer and occurs on crumbling slopes to lakes and sea in *Quercus* to *Alnus* forests. It prefers semi-shaded to shaded habitats in temperate broad-leaved to (rarer) south boreal coniferous communities and is one of the most common taxa of the genus in the southern flank of the area.

Specimens examined (var. *infusca*). RUSSIA, Kurils Islands, Iturup Island (44°52'14"N 147°20'42"), VB, K-23-6-07 13.VIII.2007 (VBGI), (44°45'51"N 147°11'11"E), VB, K-27-44-07 16.VIII.2007 (VBGI), (44°46'27"N 147°26'38"E), VB, K-34-1-07 19.VIII.2007 (VBGI), Kunashir Island (44°28'59"N 146°05'38"E), VB, K-42-10a-06 01.IX.2006 (VBGI), (43°53'04"N 145°27'43"E), VB, K-46-19-06 06.IX.2006 (VBGI), (44°17'N 146°17'E), VB, K-60-3a-06 15.IX.2006 (VBGI), Shikotan Island (43°47'56"N 146°43'56"E), VB, K-40-47-07 24.VIII.2007 (VBGI), (43°47'47"N 146°35'50"E), Barkalov V.Yu., K-52-7-07 30.VIII.2007 (VBGI), (43°44'40"N 146°35'10"E), VB, K-54-5-07 31.VIII.2007 (VBGI), (43°50'54"N 146°47'25"E), VB, K-64-11-

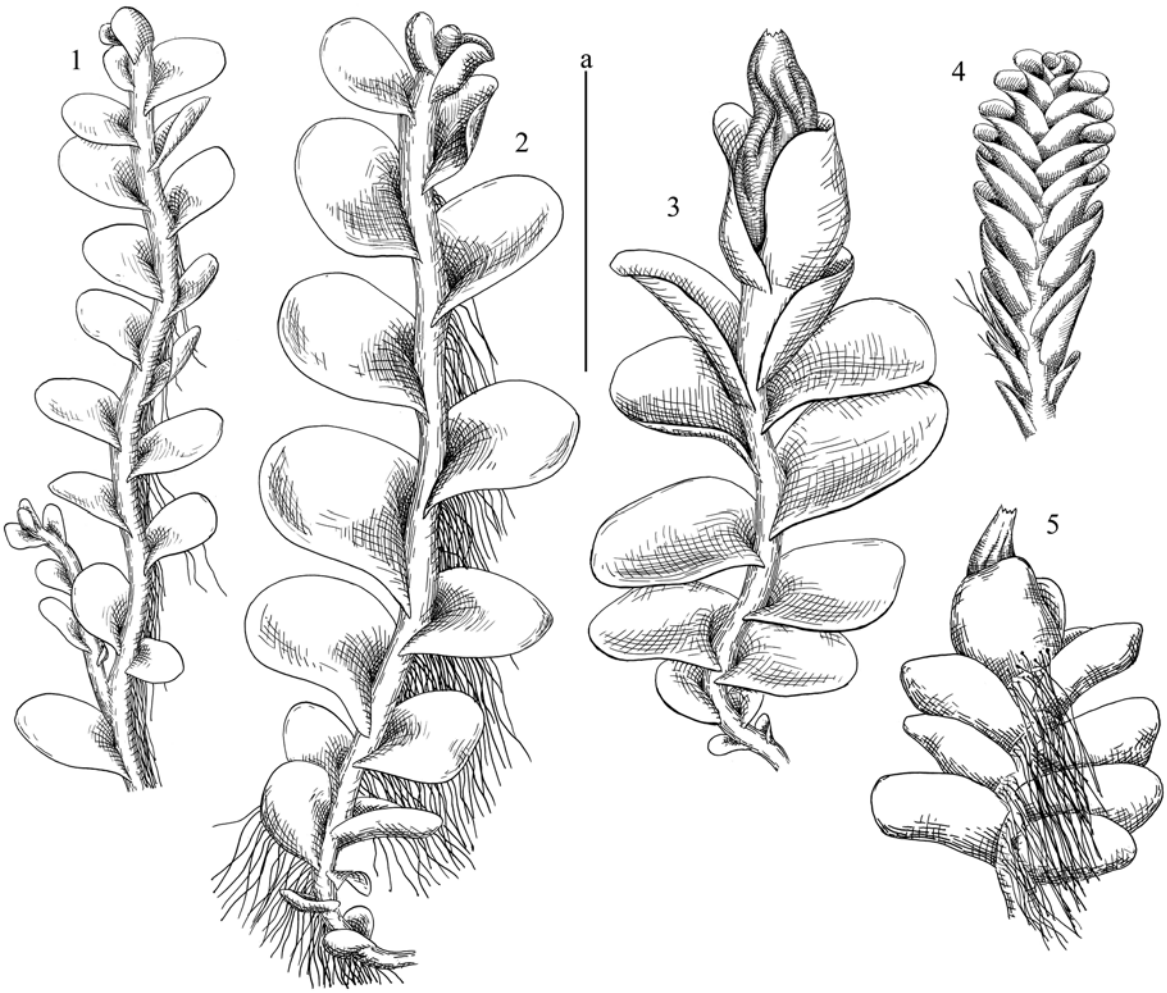

Figure 11 *Plectocolea infusca* Mitt.: 2: 1, 2 – sterile branch; 3 – branch with perianth; 4 – branch with androecia; 5 – branch with perianth, ventral view. 1–3, 5 – from P-2-15-07 (VBGI); 4 – from K-40-47-07 (VBGI). Scale: a – 2 mm, for 1–5

07 06.IX.2007 (VBGI), Primorskij Territory, Dal'negorsk town area, sea shore area (44°25'54"N 135°57'06"E), 92 m alt., *Quercus mongolica* forest on steep slope to sea, VB, 16.IX.2011 (VBGI), Khasanskii District (43°05'34"N 131°31'18"E), VB, P-2-15-07 17.V.2007 (VBGI), Olginskij District (43°17'10"N 134°40'49"E), Gambaryan S.K., 26.VII.1980 (VBGI), Partizansk District (42°58'08"N 133°02'41"E), VB, P-76-15-05 19.X.2005 (VBGI), Popov Island (42°57N 131°43"E), Gambaryan S.K., 09.X.1979 (VBGI), Lazovskii District, VB, P-45-11-12 (VBGI), Sakhalin Island, Belaya River (45°15'17"N 142°48'43"E), VB, S-25-22-06 12.VIII.2006 (VBGI), Zhdanko Mt. (48°03'00"N 142°31'44"E), VB, S-27-3-09 20.VIII.2009 (VBGI).

CHINA, Anhui, Huoshan Co., Dabieshan Mt., Baimajian, Cai K.H., 2197 (IFP 00023986), Fujiang, Wuyi Mt., 800 m alt., Li D.K., 11450 (IFP 00024557), Guizhou, Guiyang, Shunhai Forest Farm, Gao C., 40235 (IFP 00023628), Jiangkou Co., Mt. Fanjing, on soil, Gao C., 32125 (IFP 00023951), Hunan, Jiangyong Co. (24°57"N 111°01'E), Piippo S., 61014 21.IX.1999 (F), Hubei, Yichang, Dalaoling Reserve (31°04,3'N 110°55,1'E), on shade soil slope, Fen Xia Li, 2091 10.XI.2007 (PE), Jiangsu, Nanjing, Zang M. 1967 (IFP 00023775), Jiangxi, Huanglong temple, on soil, Mu Zang 28, 27.VI.1957 (PE 01093385), Jiaolu Bridge, on soil, Mu Zang 83, 29.VI.1957 (PE 01093386), Lushan Mt., on stone, Bangjie, Chen et al., 72 10.VII.1956 (PE 01093383), Jilin, Antu, Changbai Mt., Xiaotianchi, 1700 m alt., Sun J., 679 (IFP 00024644), Changbai Co., along Yalujiang River, on rock, 1240 m alt., Gao C., 7299 (IFP 00024465), Hengshan Forest Farm, on cliff, Gao C. 7313 (IFP 00023982), Changbai Mt., on rock, 1490 m alt., Sun J., 807 (IFP 00026550), Liaoning, Benxi Co., Lianshanguan, on soil, Gao C., 13412 (IFP 00023803), Fengcheng Co., Fenghuang Mt., on cliff near river, on soil, Gao C. 6012 (IFP 00000506), on soil Cao T.39050 (IFP 00023846), Fenghuangshan Mt., Miaogou, Jia X.Y., 880578 (IFP 00023812), on soil, Cao T., 39046 (IFP 00024541), Zhuanghe Co., Xianrendong, on soil, Jia X.Y. 880578 (IFP 00023799), Sichuan, Nanchuan, Jinfo Mt., roadside, on soil, 1000 m alt., Meizhi Wang, 59759, 14.VIII.2003 (PE 01072895), Xizang, Motuo, Ani Bridge, 1400 m alt., Meizhi Wang 800186-3,30.VI.1980 (PE 01740470), Yunnan, Gongshan Co., 1650 m alt., Zang M., 3286 (IFP 00003210), Luxi Co., Taitai, on slope near forest, 1370 m alt., Li X.J., 61 (IFP 00003375), Xishuangbanna, Menglun, Li X.J., 2730 (IFP 00023814), Mangang, on soil, Li X.J. 2818 (IFP 00023984), Zhejiang, Yandang Mt., 850 m alt., Li D.K. (IFP 00023645), Suichang Co., Jiulong Mt., on rock, 1170 m alt., Hong R.L. 1869 (IFP 00023963); JAPAN, Aomori Pref. Mutsu Faurie U. 186 09 1886 (KYO), Towada-shi, Oirase Gorge, Kaede Bridge (40°31'N 140°58'E), Ota M. & T. Furuki, 23320 28.IX.2013 (CBM), (40°32'N 140°58'E), Ota M. & T. Furuki, 23434 30.IX.2013 (CBM), Chiba Pref., Ichihara-shi, Yuki, Yoro-keikoku, Nakamura T., 4 29.IV.1974 (CBM), Ehime Pref., Nakahagi, Tokui M., 917 VIII.1949 (NICH), Fukuoka Pref. Tagama-gun, VB VB J-7-4-14 (VBGI), Hokkaido Pref., Hakodate, Faurie U., 222 01.V.1886 (KYO), Kamikawa, Daisetsu Mt., Sasaki T., 748 23.VIII.1951 (NICH), Shunko-dai, Sasaki T. (Hepaticae Japonicae Exsiccatae ser. 15 (1967) n. 716 Jungermannia infusca var. ovalifolia 16.VI.63 (SAP)), Shunko-dai, Sasaki T. 16.VI.1963 (F), Iwate Pref., Hayachine Mt., Inoue H., 25.VII.1974 (TNS), Kagoshima Pref., Amami-oshima Isl., Sumiyou River, Furuki T., 11980 04.II.1995 (CBM), Yakushima Island, near Senpiro Falls (30°15'30"N 130°34'55"E), Furuki T., 23481 03.III.2014 (CBM), Kochi Pref., Tosa, Makino T., 11 1895 (SAP), Mie Pref., Akame-kyo, Kitagawa N., 3100 06.VII.1959 (KYO), Miyazaki Pref., Nichinan, VB, J-2-35-14 (VBGI), Miyagi Pref., Sendai (holotype of *Jungermannia vaginans* Steph. Sp. Hepat. 6: 95. 1917.: Japan. Sendai. 27.X.1907. E. Uematsu G16634/00067145) (G), Gunma Pref. (holotype of *Solenostoma ovicalyx* Steph. Sp. Hepat. 6: 82. 1917.: Japan. Mt. Komagadake. VIII.1903. K. Tamura (37)),

G16636/00067157 (G), Miyazaki Pref., Obi, Hattori S. (Hepaticae Japonicae Exsiccatae ser. 1 (1946) n. 8 Plectocolea ovicalyx III.1945) (SAP), Nara Pref., Akadani, Ootomura, Yoshino-gun, Kitagawa N., 11334 08.VI.1968 (KYO), Niigata Pref., Myoko Mt., Sakuma E., 5355/2244 26.IX.1965 (HIRO), Saitama Pref., Chichibu Mts., Ohchi-gawa-nishi valley, Furuki T., 12130 27.IV.1995 (CBM), Shiga Pref., Kiryu-tsuji, Seta-cho, Kirita-gun, Kitagawa N., 11096 14.I.1968 (KYO), Shizuoka Pref., Fuji Mt., Inoue H., 25180 15.X.1980 (TNS), Tokyo, Makino T., VI.1896 (SAP), Tosa Prov., Imano Mt., Okamura, 147 31.XII.1904 (NICH), Yamaguchi Pref., Futashika, Furuki T., 15.IV.1985 (F), Nasuzan, Faurie U., 72 VII.1897 (KYO), "Unzen in Kyushu", Faurie U., 15363 III.1895 (KYO); SOUTH KOREA, ChonNam Province (34°37'35"N 127°25'54"E), VB Kor-21-13-09 20.VI.2009 (VBGI), Deogyu Mt. (35°50'14"N 127°42'17"E), VB, Kor-13-7-08 27.VI.2008 (VBGI), (35°46'57"N 129°42'46"E), VB, Kor-16-14-08 30.VI.2008 (VBGI), (35°51'36"N 127°45'58"E), VB, Kor-8-6-08 24.VI.2008 (VBGI), Jeju Island (Quelpart), Faurie U., 84 X.1906 (KYO), Jiri Mt. (35°19'45"N127°43'10"E), VB, Kor-13-2a-09 16.VI.2009 (VBGI), (35°21'57"N 127°34'45"E), VB, Kor-14-4-09 19.VI.2009 (VBGI), (35°21'10"N 127°34'13"E), VB, Kor-17-3-09 19.VI.2009 (VBGI), Jeonnam Prov., VB, Kor-17-06-11 (VBGI), Kangwon Province, Seorak Mt., VB, Kor-11-20-11 (VBGI).

Variation. Additionally to the type variety described and discussed above two other varieties may be recognized. One of them is known far away from treated area: *Plectocolea infusca* var. *memiadzei* Bakalin, described from Georgia in area adjacent to Black sea in southern Caucasus (Colchis forests). For distinctions and illustrations see Bakalin et al. (2013). Other variety is needed to be described here to replace mistakenly treated *Plectocolea infusca* var. *ovicalyx* (Steph.) Bakalin (= *Solenostoma ovicalyx* Steph., *Jungermannia infusca* var. *ovicalyx* (Steph.) Amak.) in Russia (Konstantinova et al. 2009). As I found during the study of the type of *Solenostoma ovicalyx* Steph. in herbarium G (Holotypus: Japan. Mt. Komagadake. VIII.1903. K. Tamura (37) G16636/00067157), it is fully identical to *Plectocolea infusca* Mitt. Thus the new name should be originated for the taxon occurred in Russia that is placed below.

Plectocolea infusca* var. *recondita Bakalin *var. nov.* (= *Plectocolea infusca* var. *ovicalyx* (Steph.) Bakalin Arctoa 17: 207 2007 sensu Bakalin, non *Solenostoma ovicalyx* sensu Steph. Sp. Hepat. 6: 82, 1917).

Description. Plants 0.6–1.2 (1.7) mm wide (in androecial part of shoots – commonly narrower, than in sterile and female), 3–10 mm long, ascending to prostrate, yellowish green, brownish green, yellowish-brownish to brownish red and brown-purple, rarer pale green, male plants more deeply colored. Stem 150–200 μm, orbicular to slightly transversely elliptic in cross section, dorsal surface cells with thickened to thin walls, with indistinct to concave trigones, (60) 80–160 × 15–30 μm. Rhizoids rather dense, colorless, pale purplish to purplish brownish and pink, rarely purple(?), in indistinct erect spreading fascicles. Leaves distant to contiguous, concave to flattened, sometimes loosely canaliculate, inserted at angle of 35–50° with axis (in shady forms subhorizontally), dorsally decurrent up 1/4 – 1/3 of stem width, ventrally subtransversely to arcuately inserted, not or barely decurrent, 375–900 × 500–1000 μm (1 : 0.8–0.9), reniform, lingulate, transversely elliptic to widely ovate. Cells in the midleaf thin-walled, with rounded lumen, walls colorless, 24–35 (–40) × 24–35 μm, trigones large to moderate in size, convex to concave; along margin (20–) 25–34 μm, thin-walled, with thickened external wall, walls brownish, trigones large and convex, sometimes confluent in tangential wall, rarely concave; cuticle smooth, but frequently slightly striolate near leaf margin. Dioicous. Perianth terminal, hidden within or exerted from bracts for 1/3 – 1/4 of its length, conical, shortly fusiform to rhomboidal, pluriplicate in upper half, sometimes barely turbinate at the mouth, ca. 800–1500 × 650–800 μm, cells in the perianth middle thin- to slightly thick-walled, trigones distinct, triangle to convex, 50–80 × 20–32 μm, ca. 5–8 archegonia per perichaetium; perigynium 1/4 – 2/3 of perianth length, strongly rhizogenous ventrally and (sometimes) loosely rhizogenous dorsally (rhizoids colorless to slightly brownish); female bracts sheathing the perigynium at the base, undulate at margin, sometimes slightly retuse, transversely elliptic, 800–1250 × 1000 × 1150 μm. Androecia intercalary, in 4–5 or more pairs of bracts, 2–3-androus, antheridial stalk composed (1)2 rows of cells, 45–90 μm in length, male bracts concave, inflated at base or not, with deflexed to erect spreading apex, 450–600 × 450–900 μm. Figure 12.

Holotypus: RUSSIA, Kurils Islands, Shikotan Island (43°46'08"N 146°43'29"E), 300 m alt., cliff crevices, in mixture with *Nardia scalaris* (Schrad.) Gray and *Cephalozia bicuspidata* (L.) Dumort., VB, K-45-11-07 26.VIII.2007 (VBGI).

Comment. The taxon is very closely related to var. *infusca*, but differs in typical cases by transversely elliptic to reniform and widely lingulate leaves, and smaller size of shoots. Due to wider leaves var. *recondita* probably may be confused with *Solenostoma hyalinum*, from which differs in '*infusca*'-type oil bodies (brownish, filling cell), commonly present brown coloration with tint of purple or red pigmentation and more southern distribution. Also this new variety probably possesses to develop purple pigmentation of rhizoids. Some forms are related to *P. ovalifolia* due to its smaller size and purplish rhizoids and some ones trends. These and other modifications(?) are described below.

Specimen S-25-1-06. The large form, similar to *P. infusca* var. *infusca*. I put it to var. *recondita* due to commonly wider than long lingulate leaves. The short description is as following: Plants 1.5–2.0 mm wide, ca. 5–10 mm long, prostrate, light green to yellowish and brownish green. Stem 200–280 μm in diameter, orbicular in cross section, not branched, dorsal surface cells thin-walled, trigones indistinct, 80–120 × 16–26 μm. Rhizoids rather numerous, colorless to pale brownish or locally purplish, erect. Leaves distant, flattened to slightly concave (mostly in lower half of leaf), inserted at angle of 15–30° with axis, dorsally decurrent up 1/3 of stem width, ventrally subtransversely inserted, barely decurrent, 900–1000 × 850–1000 μm (0.9–1.1 : 1), lingulate to ovoid. Cells in the midleaf with mostly hexagonal lumen, walls thin to slightly thickened, colorless, 30–40 × 26–35 μm, trigones distinct, concave; along margin 28–32 μm, thin-walled, but with thickened external wall, cuticle smooth. Dioicous. Androecia intercalary, with 7 pairs of bracts, 2-androus, antheridial stalk composed 2 rows of cells, ca. 50 μm in length, body nearly spherical ca. 200 μm in diameter, bracts inflated at base and deflexed at margin, 650–750 × 900–1100 μm.

Specimen K-64-15-07. The opposite variant to the described above, that characterized smaller than commonly shoots that

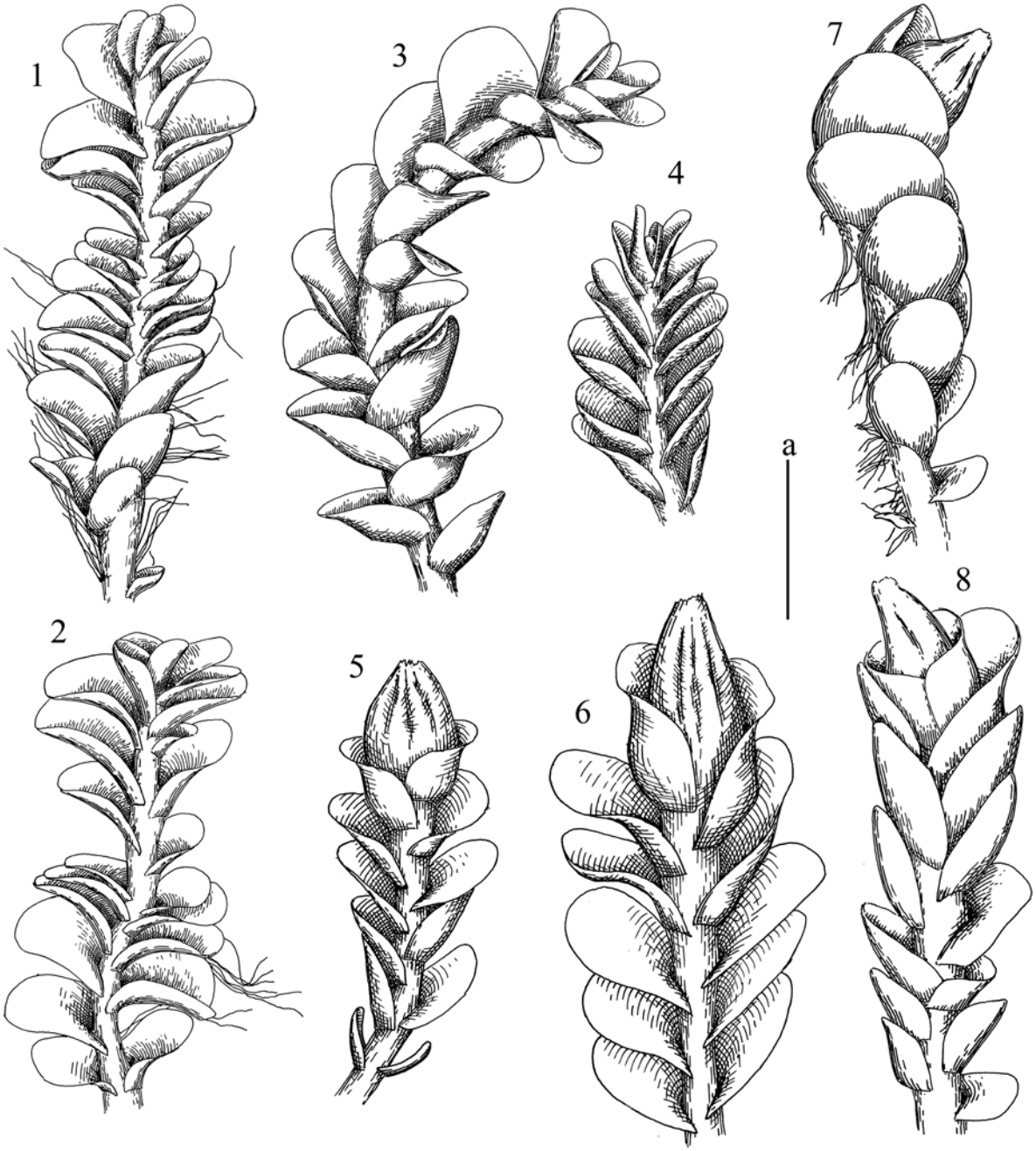

Figure 12 *Plectocolea infusca* var. *recondita* Bakalin: 1–4 – sterile branch; 5–8 – branch with perianth. 1, 2 – from K-46-6a-06 (VBGI); 3 – from K-49-20-07 (VBGI); 4–6 – from P-76-12-05 (VBGI); 7, 8 – from K-45-11-07 (VBGI). Scale: a – 1 mm, for 1–8

suggest *Plectocolea ovalifolia*. It was put into var. *recondita* due to very wide leaves and comparatively high perigynium not present in *P. ovalifolia*. The description is as following: Plants 0.7–1.0 mm (perianthous up 1.2 mm) wide, ca. 5–10 mm in length, creping to (fertile shoots) ascending, yellowish brown to brownish purplish with characteristic purple coloration in leaf base, stem and (sometimes) apices of the shoots. Stem 200–250 μm in diameter, orbicular in cross section, dorsal surface cells thick- to thin-walled, walls brownish purplish, trigones small, concave, cells mostly rectangular 80–100 × 25–35 μm. Rhizoids rather dense, purple to nearly brownish colorless, erect, occasionally in indistinct fascicles (in small-leaved stoloniform branches). Leaves contiguous to subimbricate, concave to flattened, inserted at angle of 40–50° with axis, dorsally not or barely decurrent, ventrally subtransversely inserted, not decurrent, 225–250 × 480–750 μm (1 : 0.3–0.6), transversely elliptic to widely lingulate. Cells in the midleaf with nearly rounded lumen, thin-walled, walls rose to purplish, 35–40 × 28–35 μm, trigones large and convex, near margin 32–45 μm, thin-walled, but with thickened external wall, walls brownish, trigones large and convex, cuticle smooth. Oil-bodies granulate, nearly filling cell lumen, 3–5 per cell, 15–19 × 7–9 μm. Dioicous. Perianth terminal, shortly fusiform to conical, 3-plicate to loosely pluriplicate in upper part, exerted from bracts for 1/4 – 1/2 of its length, ca. 7 archegonia per perichaetium; perigynium ca. 2/3 – 3/3 of perianth length, rhizogenous ventrally and (sometimes) laterally, with (1–) 2 pairs of leaves, bracts sheathing perigynium near their bases, upward canaliculate and erect spreading, ca. 800 × 900 μm. Androecia intercalary, with 2 pairs of bracts, with 1 antheridium per bract, antheridial stalk biseriate, ca. 50 μm long, male bracts concave, loosely inflated at base, transversely elliptic, ca. 225–250 × 600–650 μm.

Distribution. Boreo-Temperate East Asian. Due to data in hand it is known from the southern flank of the Russian Far East (Sakhalin, Kurils, Primorskii Territory), Japan, Korean Peninsula and Eastern China. It commonly occurs at the similar altitude with var. *infusca*.

Ecology. Acido- to neutrophilic mesophyte. In comparison with var. *infusca*, var. *recondita* prefers more dry and open habitats, it commonly occurs along sandy banks of stream, crumpling slopes to watercourses, lakes and sea, and rarely may be found on decaying wood. Contrary to var. *infusca*, the present variety mainly occurs in south boreal coniferous, but not in broadleaved forests.

Specimens examined. RUSSIA, Kurils Islands, Iturup Island (44°52'14"N 147°20'42"E), VB, K-24-10-07 13.VIII.2007 (VBGI), Iturup Island (45°20'51"N 147°52'46"E), VB, K-71-7a-05 26.IX.2005 (VBGI), Kunashir Island (44°27'40"N 146°06'49"E), VB, K-40-8d-06 30.VIII.2006 (VBGI), (43°53'04"N 145°27'43"E), VB, K-46-6-06 06.IX.2006 (VBGI), Shikotan Island (43°46'34"N 146°44'19"E), VB, K-42-26-07 25.VIII.2007 (VBGI), (43°48'08"N 146°38'46"E), VB, K-49-20-07 28.VIII.2007 (VBGI), (43°44'40"N 146°35'10"E), Oleynikov A.Yu., K-53-8-07 30.VIII.2007 (VBGI), (43°50'54"N 146°47'25"E), VB, K-64-15-07 06.IX.2007 (VBGI), (43°51'45"N 146°45'58"E), VB, K-65-18-07 06.IX.2007 (VBGI), Primorskii Territory, Khasanskii District (43°06'18"N 131°30'45"E), Gambaryan S.K., 11.IX.1978 (VBGI), Partizansk District (42°58'08"N 133°02'41"E), VB, P-76-12-05 19.X.2005 (VBGI), Sakhalin Island, Korsakov District (46°20'08"N 143°22'17"E), VB, S-66-4-09 16.IX.2009 (VBGI), Nevelsk District (46°28'28"N 141°49'42"E), VB, S-70-2-09 17.IX.2009 (VBGI).

CHINA, Anhui, Xiaohuangshan Mt., Sugu Temple, on soil, 1300 m alt., Hu R.L., 116 (IFP 00003185), Chongquin, Xue Bao Shan, Mayunlinchang, (31°38646'N 108°44,644'E), on soil in roadside, Yu Jia 25.VII.2008 (PE), Hubei, Shennongjia (31°30'N 110°30'E), Bartholomew B. et al., 1668B 21.IX.1980 (F), Jiangxi, Lushan Mt., Central China Normal University 3019, 1953 (PE 01093389), Liaoning, Fenghuangshan Mt., on soil, Gao C., 6990 (IFP 00003213), Yunnan, Kunming, Sigong, on soil, 250 m alt., Gao C., 34288 (IFP 00024587); JAPAN, Aomori Pref., Osorezan, Faurie U., 1193 11.X.1902 (KYO); (s. loc.), Kodama T., 6709 07.VIII.1954 (TNS).

Plectocolea kurilensis (Bakalin) Bakalin et Vilnet, Bryologist 115(4): 577, 2012. (= *Plectocolea flagellata* var. *kurilensis* Bakalin in Bakalin et al., Arctoa 18: 90, 2009).

Description. Plants (1.5) 2–3 mm wide, 5–20 mm long, erect to ascending, sometimes loosely laterally compressed, bright green to brownish and yellowish green (in herbarium frequently brownish yellow), purplish pigmentation very rarely present on leaf margins near shoot apex, but in ventral side (both stem and leaves base) frequently with purplish tint. Stem (150) 200–450 μm in diameter, straight to flexuous, orbicular in cross section, branching ventral and lateral, dorsal surface cells thin-walled with indistinct trigones to slightly thick-walled with concave trigones, 70–180 × 15–38 μm, cuticle commonly striolate. Peculiar geotropic stolons commonly present, ca. 2000–5000 μm length and 75–100 μm in diameter, fragile, strongly rhizogenous, rhizoids colorless to brownish and distinctly purple (the latter coloration not present in rhizoids originated in stem!) Rhizoids scattered to rather numerous and dense in indistinct fascicles, erect to obliquely spreading to loosely or somewhat clearly decurrent down the stem and forming loose fascicle, grayish brownish, brownish, purplish to purplish brown. Leaves erect, contiguous to somewhat distant, concave-canaliculate to canaliculate, with erect spreading "canals", enclosed one to other, median line of channel incurved down stem, or rarely leaves flattened, leaf margin in dorsal side frequently slightly incurved to apex or, contrary deflexed, inserted at angle of 30–85° with axis, dorsally subtransversely inserted decurrent up 1/4 – 4/4 of stem width), ventrally subtransversely to arcuately inserted, decurrent for 1/6 – 1/3 of stem width, 800–1250 × 800–1350 μm (0.9–1 : 0.9–1), elliptic, widely elliptic to suborbicular, transversely elliptic, ovate and widely ovate. Cells in the midleaf thin-walled, walls colorless, 30–65 × 24–45 μm, lumen mostly elliptic, trigones large, convex; cells along margin 20–35 μm, thin-walled to somewhat thickened, with thickened external wall, trigones large, convex, cuticle smooth, only near ventral leaf base sometimes indistinctly striolate; oil-bodies 2–6 per cell, grayish, granulate, spherical, 6–10 μm in diameter to oblong up 14 μm long. Dioicous. Perianth terminal, conical, narrow conical to fusiform, pluriplicate, sometimes turbinate at the mouth, with 3–4 main plicae (if 4-plicate: 1 dorsal, 2 lateral, 1 ventral), without subfloral innovations, emergent from bracts for 1/5 – 1/2 of its length, ca. 1000–1400 × 500–750 μm; mouth crenulate due to protrudent elliptical thin-walled cells; in the middle 70–98 × 22–28 μm, thin-walled, trigones moderate in size, convex; near the base 140–170 × 34–48 μm, thin–walled, with small to indistinct, triangle to concave trigones, 5–15 archegonia in perichaetium; perigynium 1/4 – 4/4 of perianth length, with 1–2 pairs of leaves, frequently strongly rhizogenous laterally and ventrally (rhizoids mainly brownish to colorless); female bracts smaller than sterile leaves situated below, sheathing perianth basally, in upper part erect to concave with deflexed margin (especially in dorsal side), ca. 800–1600 × 1100–1850 μm, widely trapezoid to widely ovate. Androecia intercalary, with 2–4 pairs of bracts, different generations divided by 5–7 pairs of sterile leaves, 1–3-androus, antheridial stalk biseriate, ca. 42–48 × 25 μm, body nearly spherical, ca. 180 μm in diameter, to elliptical ca. 170 × 150 μm, bracts strongly inflated at base and canaliculate above, not colored in inflated area, same size with the biggest sterile leaves. Capsule ellipsoidal 600–900 × 350–500 μm, wall bistratose, outer layer cells subquadrate ca. 30 × 30–32 μm with 2–3 nodulose thickenings in each vertical wall, inner cells flexuous-linear ca. 60–90 × 9–17 μm with distinct 4–6 annular to semiannular thickenings. Figure 13.

Comment. This species was originally described as variety within *Plectocolea flagellata* (*P. flagellata* var. *kurilensis*: Bakalin et al. 2009), due to the presence of leafless ventral stolons. Later Bakalin & Vilnet (2012) found this is separate species distant from *P. flagellata* and related to *P. infusca*. It was also found the species distribution is not limited by South Kurils but covers southern flank of the Russian Far East and also known from several localities in Japan. *Plectocolea kurilensis* is most superficially similar to both *P. infusca* s. str. and *P. rosulans*. From the latter it differs in non-fasciculate rhizoids that are commonly erect to obliquely spreading away from the stem, ascending growth form, slightly smaller size (mostly 2–3 versus 3–4 mm), and also distribution, whereas *P. kurilensis* is mostly found in *Abies-Picea*

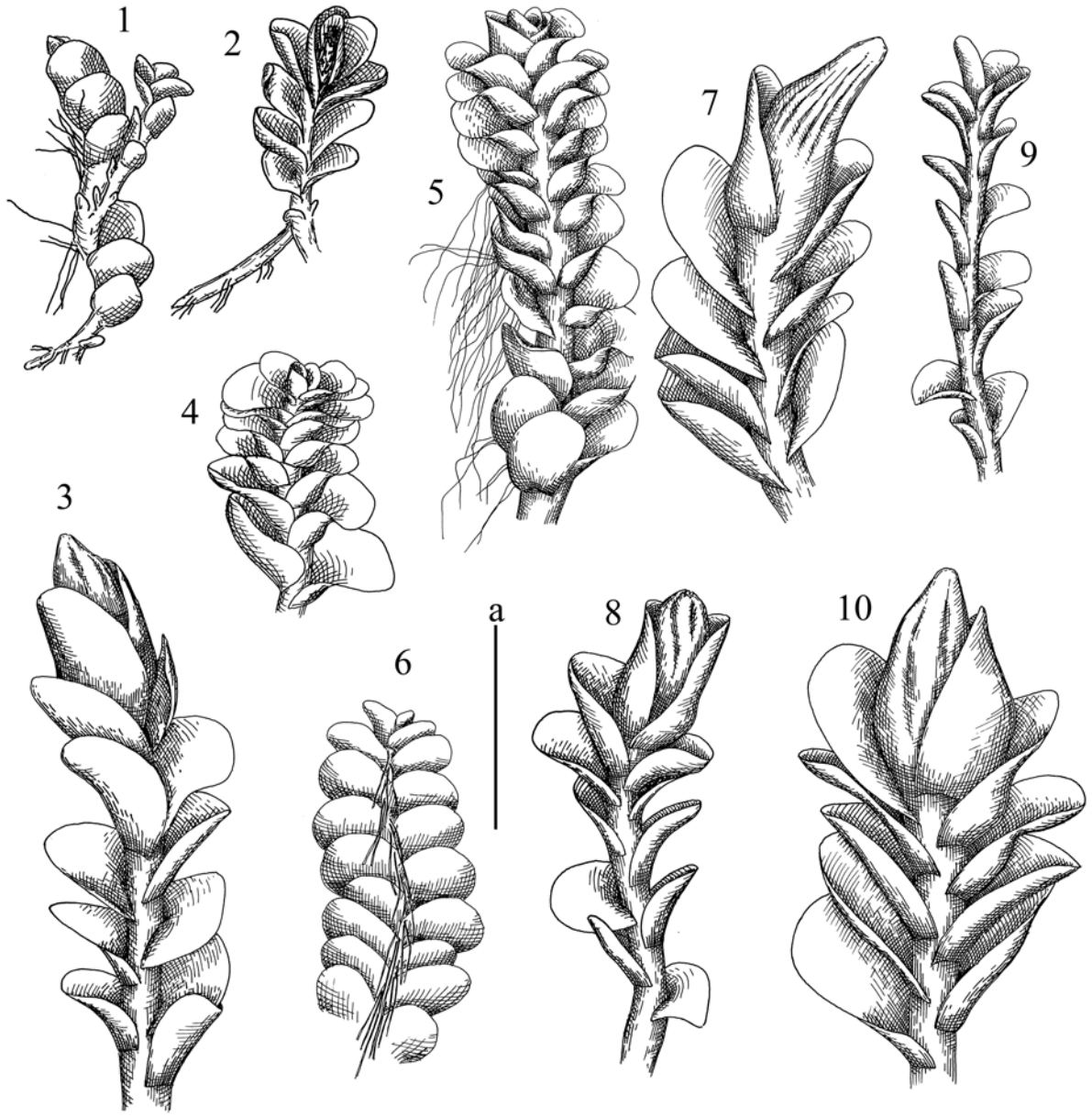

Figure 13 *Plectocolea kurilensis* (Bakalin) Bakalin et Vilnet: 1, 3, 7, 8, 10 – branch with perianth; 2 – branch with archegonia; 4, 5 – branch with androecia; 6 – sterile branch, ventral view; 9 – sterile branch. 1, 2 – from K-10-1-07 (VBGI); 5, 7, 9, 10 – from K-52-9-08 (VBGI); 3, 4, 6, 8 – from P-72-1-05 (VBGI). Scale: a – 2 mm, for 1–10

temperate communities, the range of *P. rosulans* is mostly subtropical. Much close relation occurs to the *P. infusca* var. *infusca*. *P. kurilensis* different from the latter in: 1) smaller, grayish oil-bodies versus oil-bodies of the "*infusca*"-type; 2) commonly deflexed antical leaf margins and undulate leaves versus leaves with non deflexed margin; 3) mostly purplish to almost purple rhizoids versus mostly colorless, rose and rarely purplish rhizoids; 4) sporadic presence of leafless stolons.

Distribution. Temperate East Asian. Probably south boreal to temperate East Asian taxon. Currently it is known from the South of the Russian Far East in southern part of Primorskii Territory and South Kurils, surprisingly absent in Sakhalin. Southward it was also found in few locals in Japan, but likely distributed wider and at least should be found in many additional localities in Korean Peninsula and Japan. The altitudinal diapason in the Russian Far East stretches from near sea level to near 500 m a.s.l.

Ecology. Acido- to Neutrophilic meso-hygrophyte. The species commonly occurs in *Picea-Abies* forests enriched by broadleaved trees such as *Fraxinus*, *Acer*, *Phellodendron*, *Kalopanax*, etc., common understory includes *Eleutherococcus*, *Euonymus*, etc. The community preferred type in Primorskii Territory commonly called as 'Ussuri taiga' that means peculiar mixture of Boreal and Temperate elements. In insular part of the Russian Far East it prefers communities with aforementioned trees and *Sasa* understory. Preferable habitats of the species are part shaded, moist (but not wet) cliffs and rocks along stream, but aside of constant impact of the flowing water. In general character, the ecology of the species is similar to *P. infusca* var. *infusca* from which the species was only recently segregated.

Specimens examined. RUSSIA, Kurils Islands, Iturup Island (44°55'55"N 147°34'30"E), VB, K-10-1-07 (holotype of *Plectocolea flagellata* var. *kurilensis*) 07.VIII.2007 (VBGI), (44°52'14"N 147°20'42"E), VB, K-23-5-07 13.VIII.2007 (VBGI), (45°20'48

147 52 20 VB K-70-2-05 26.IX.05 (VBGI), Kunashir Island (43°53'04"N 145°27'43"E), VB, K-46-5-06 06.IX.2007 (VBGI), (44°17'N 146°17'E), VB, K-60-5-06, 15.IX.2006 (VBGI), Primorskij Territory, Lazovskii District, middle course of Sinegornaya Pad' Stream (43°04'02"N 133°36'37"E), 227 m alt., floodplain broadleaved (mostly *Juglans*, *Acer*, *Fraxinus*, *Ulmus*) forest, VB, P-73-40-11 22.IX.2011. (VBGI), Shkotovskii District (43°06'05"N 132°41'29"E), VB, P-52-9-08, 06.IX.2008 (VBGI), VB, P-72-1-05 (VBGI).

JAPAN, Aomori Pref., Mutsu, Faurie U., 186 IX.1886 (KYO), Fukuoka Pref., Tagama-gun, VB, J-6-51-14 (VBGI), Hokkaido Pref., Daisetsu Mt., Sasaki T., 1295 12.VIII.1952 (NICH), Kanagawa Pref., Hakone, Kitagawa N., 16768 02.VIII.1980 (KYO), Miyazaki Pref., Iwato, Amakawa T. (Hepaticae Japonicae Exsiccatae ser. 7 (1956) n. 336 as *Plectocolea infusca* 27.VIII.1952) (SAP), Kitakata, Amakawa T. (Hepaticae Japonicae Exsiccatae ser. 8 (1956) n. 384, as Plectocolea infusca 02.IV.1953) (SAP), Oita Pref., Fuka-yabakei, Noguchi A. (Hepaticae Japonicae Exsiccatae ser. 4 (1951) n. 185 as *Plectocolea ovicalyx* VII.1950) (SAP), Shiga Pref., Shakuhage-dani, Kaigahe, Kodama T., 27937, 27.VII.1965 (KYO), Tochigi Pref., Nikko-shi, Arsawa, Daiya River, Hasegawa J., 7882 15.IX.1992 (KYO), Tokyo, Nishitama-gun, Inoue H., 21.X.1984 (KPABG).

Plectocolea ovalifolia (Amak.) Bakalin & Vilnet, Bryologist 115(4): 579, 2012. (=*Plectocolea infusca* var. *ovalifolia* Amak., Journ. Jap. Bot. 34: 115, 1959; *Jungermannia infusca* var. *ovalifolia* (Amak.) Amak., Journ. Hatt. Bot. Lab. 22: 33, 1960)

Description. Plants 0.7–1.7 mm wide (near perianth up 1.7–2.0 mm wide), ca. 3–15 mm long, creeping to ascending, deep green to dirty-, brownish and yellowish green. Stem (150) 170–220 μm in diameter, orbicular in cross section, dorsal surface cells thin-walled to slightly thickened, trigones very small, concave, 45–70 × 22–28 μm. Rhizoids scattered to isolated or dense, purple to red-purple or (rarely) brownish purple, erect spreading, sometimes in light tufts. Leaves erect spreading, distant, rarely contiguous, concave to concave-canaliculate, rarely flattened, inserted at angle of 40–50° with axis, dorsally not or shortly decurrent (for 1/5 of stem width), ventrally subtransversely inserted, insertion line straight to loosely arcuate; 600–1250 × 400–1200 μm (0.75–1 : 1), orbicular to ovate or lingulate. Cells in the midleaf mainly hexagonal, thin-walled, walls colorless, (26) 28–42 × 24–32 μm, trigones small and concave to large triangle to convex or concave; cells along margin 24–31 μm, thin-walled, with small concave trigones, external wall slightly or strongly thickened; cuticle smooth to rarely very loosely striolate near leaf base. Dioicous. Perianth smooth to loosely 3-pluriplicate, fusiform, exerted from bracts for 2/3 – 4/5 of its length, ca. 1500 × 750 μm, cells along perianth mouth clavate and protrudent to form crenulate armature; in the perianth middle 34–53 × 18–35 μm with slightly thickened to thin walls and small to medium concave trigones, bistratose in lower third, ca. 5 archegonia in perichaetium; perigynium 1/5 – 1/2 of perianth length, with one pair of leaves, not or loosely rhizogenous; female bracts similar to leaves, but wider, sheathing perianth at the base and erect spreading in upper 2/3 of its length, loosely canaliculate, ca. 750 × 700 μm. Androecia intercalary, with 2–4 pairs of bracts, different generation divided by at least 6–7 pairs of sterile leaves, with 1–3 antheridia per bract, antheridial body spherical, 110–120 μm in diameter, stalk biseriate, ca. 34–40 × 28 μm, bracts purplish or not differs in color from sterile leaves, strongly inflated at the base, deflexed along margin, widely ovate to transversely elliptic, ca. 500–600 × 650–750 μm. Figure 14.

Comment. The taxon was treated as variety within *Plectocolea infusca* for more than 60 years, until recently it was shown it is rather distinct species (Bakalin & Vilnet 2012). It differs from *P. infusca* in: 1) purple rhizoids in *P. ovalifolia* versus colorless to rose and rarely purplish rhizoids in *P. infusca* s. str.; 2) oil bodies colorless to grayish, small, distributed at the margins of the cell lumen versus brownish and filling the cell lumen (of '*infusca*'-type); 3) smaller plant size (1–1.7 mm versus 2–3 mm wide); 4) more or less distant to rarely contiguous leaves versus contiguous to subimbricate and enclosed one to another leaves; 5) ovate leaves versus lingulate to broadly or transversely elliptic leaves. Additionally, both taxa never occur within the same community because *P. ovalifolia* prefers subalpine to alpine habitats, rarely descending to the coniferous forest belt, while *P. infusca* is a common species in the temperate belt and even penetrates deeply into the subtropics. The most morphologically related species is *Solenostoma obscurum* and the distinctions between them are discussed under the latter. When sterile, *Plectocolea ovalifolia* may be mistaken with paroicous *Solenostoma subellipticum*, they differ in following: 1) *Plectocolea ovalifolia* is distributed mostly in North Boreal forest zone, Subarctic and Arctic, where (despite similar preferences in habitat) *P. ovalifolia* hardly occurs northward of 50°N, the area where two taxa may meet together are North Kurils, Commanders and Kamchatka Peninsula; 2) rhizoids are purple in *P. ovalifolia* but colorless to grayish, brownish and purplish in *Solenostoma subellipticum*.

Distribution. Boreal Montane East Asian. The species occurs in Japan, Korea, insular to peninsular areas of the Russian Far East (South Kamchatka, Kurils and Sakhalin), throughout in the areas under strong influence of oceanic air masses. Within Russian Pacific the species mostly occurs from near sea level to 500 m a.s.l.

Ecology. Acidophilic to neutro-tolerate meso- to hygrophyte. The species occurs on various types of rocky substrates (granites, andesites, tufa conglomerates, etc.) in semi-shaded to shaded places on rocks and cliffs along or aside of streams and other watercourses. Rarely it also grows in open places on steep slopes to sea or lakes, moist roadsides, pumice deposits. It prefers boreal taiga to subalpine belts in the mountains or sometimes growing in lowered tundroid communities formed under severe wind conditions along sea coast.

Specimens examined. RUSSIA, Kurils Islands, Iturup Island (45°20'49"N 147°52'20"E), VB, K-70-2a-05 26.IX.2005 (VBGI), Shikotan Island (43°47'08"N 146°41'10"E), VB, K-41-26-07 25.VIII.2007 (VBGI), (43°48'08"N 146°38'46"E), VB, K-49-10-07 28.VIII.2007 (VBGI), (43°47'47"N 146°35'50"E), VB, K-50-52-07 30.VIII.2007 (VBGI), (43°44'40"N 146°35'10"E), Oleynikov A.Y., K-53-3-07 30.VIII.2007 (VBGI), (43°45'13"N 146°43'00"E), VB, K-61-20-07, 03.IX.2007 (VBGI), Sakhalin, Kimonai, Faurie U., 155 21.IX.1908 (KYO), Korsakov District (46°20'08"N 143°22'17"E), VB, S-66-11-09 16.IX.2009 (VBGI), Zhdanko Mt. (48°05'07"N 142°31'24"E), Harpel J.A., 27442 02.VIII.2001 (VBGI), (48°03'00"N 142°31'44"E, VB, S-25-5-09 20.VIII.2009 (VBGI).

JAPAN, Aomori Pref., Towada-shi, Oirase Gorge, Ishikedo (40°32'N 140°58'E), Ota M. & T. Furuki, 23317 27.IX.2013 (CBM), (40°31'N 140°58'E), Ota M. & T. Furuki, 23346 29.IX.2013 (CBM), Jowala, Utarube, Noguchi A., 29.VII.1954 (NICH), Gunma Pref.,

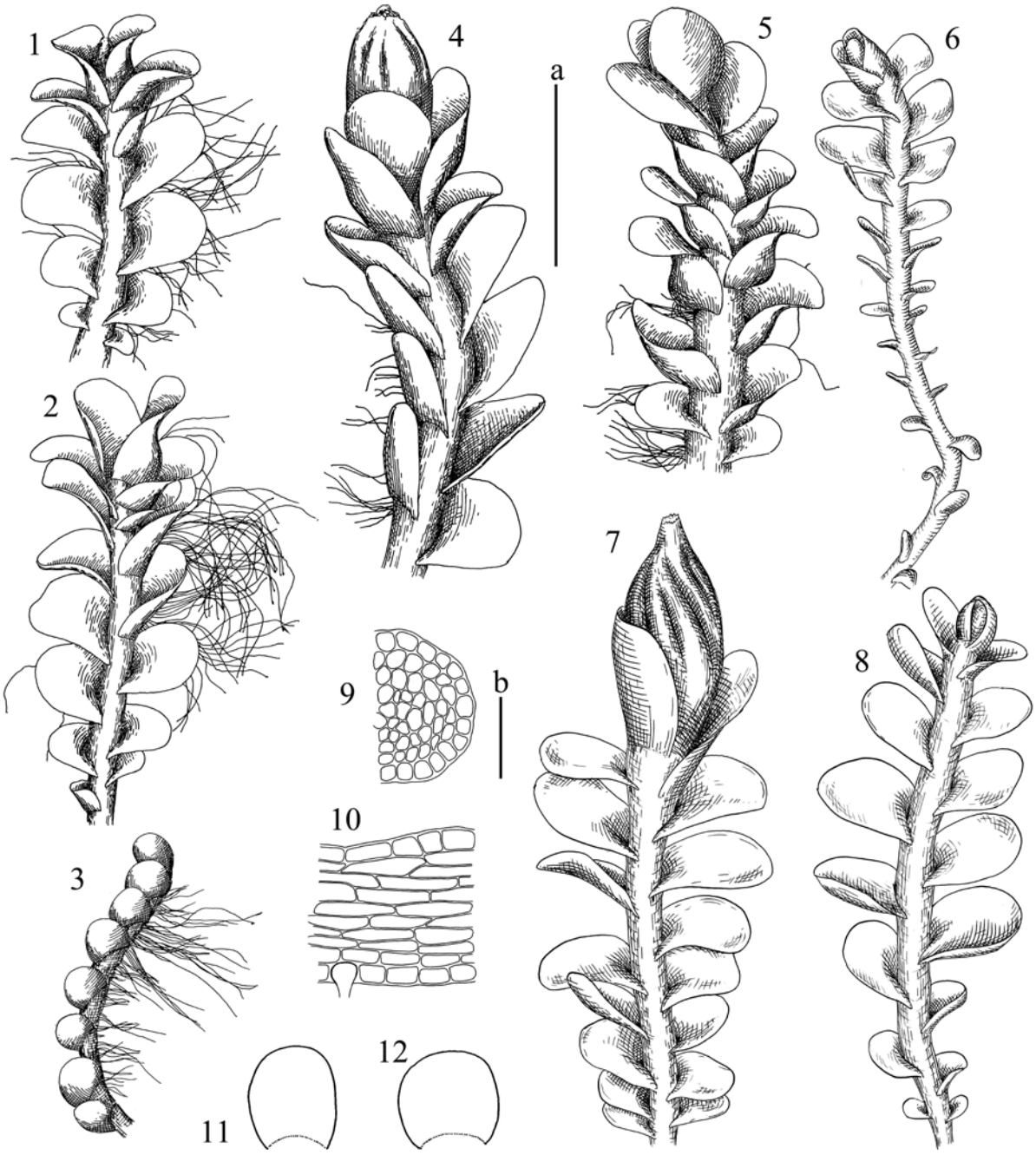

Figure 14 *Plectocolea ovalifolia* (Amak.) Bakalin et Vilnet: 1, 2 – branch with archegonia; 3, 6, 8 – sterile branch; 4, 7 – branch with perianth; 9 – stem cross section; 10 – stem longitude section; 11, 12 – leaves. 1, 2 – from K-53-3-07 (VBGI); 4, 5 – from K-61-20-07 (VBGI); 3 – from S-66-11-09 (VBGI); 6–12 – from Harpel J.A., 27442 (VBGI). Scales: a – 1 mm, for 1–8, 11, 12; b – 100 μm, for 9, 10

Tanigawa Mt., Inoue H., 5960 VII.1956 (NICH), Hokkaido Pref., Akan Lake - Mt. Meakan, Ono M., 4176 20.VIII.1957 (HIRO), Daisetsu Mt., Kitagawa N., 6021 20.VIII.1961 (KYO), Kurodake Mt., Kuwahara Y., 5782 21.VII.1956 (NICH), Nosappu-misaki, east of Nemuro-shi, Kitagawa N., 6289 28.VIII.1961 (KYO), Rishiri Isl., Yamnai valley, Shimizu D., 25.VII.1954 (NICH), Shirikishinai-mura, Esan (holotype of *Plectocolea infusca* var. *ovalifolia* Amak.), Kuwahara Y., 5758 27.VII.1956 (NICH), Yukomanbetsu, Takita K., 1129 30.VII.1983 (SAPT), Nagano Pref., Sugadaira, Daimyojin-zawa River, Saito K., 2164, 29.VIII.1968 (HIRO), Yatsugatake Mt., Furuki T., 4032 01.IX.1982 (CBM), Niigata Pref., Myoko Mt., Sakuma E., 13927 22.IX.1968 (HIRO), Tokushima Pref., Tsurugi-san, Kitagawa N., 5097 30.V.1961 (KYO), Tottori Pref., Tottori-shi, Ue-machi, Ouchi-dani Park (35°30'05"N 134°15'00"E), 60 m alt., broadleaved (deciduous and evergreen)–coniferous (*Cryptomeria* and *Chamaecyparis*) shrubby forest, VB, J-1-56-13 10.III.2013 (VBGI), Yamagata Pref., Zao Mt., Dokko pond, Furuki T., 13249, 05.IX.1996 (CBM), Yamanashi Pref., Yatsugatake Mt., Furuki T., 4204 29.IX.1982 (CBM); SOUTH KOREA, Seorak Mt., Hong W.S., 5586 11.VII.1961 (HIRO).

Plectocolea rigidula S. Hatt., Journ. Jap. Bot. 27: 53, 1952. (= *Jungermannia kyushuensis* Amak., Journ. Hattori Bot. Lab. 22: 23, 1960)

Description. Plants 0.7–2.5 (3.0) mm wide (male shoots 0.5–1.2 mm wide, narrowed in androecial part, female shoots near perianth up 2.0–3.0 mm), up 5–15 mm long, erect to ascending, whitish brownish to brownish rusty, rarer greenish yellow, frequently with purple tint and characteristically brown to purple-brown leaf margins, sometimes with deep purple to purplish coloration of basal (especially in ventral side) part of leaves. Stem 200–300 μm wide, orbicu-

lar in cross section, dorsal surface cells thin-walled to thick-walled (depending on exposure), with indistinct trigones to small and concave trigones, 110–180 × 28–45 μm. Rhizoids dense, deep purple, on some shoots brownish with purplish tint, scattered, rigid, erect spreading, sometimes in indistinct fascicles. Leaves contiguous to distant, concave to flattened, with undulate and/or sometimes deflexed margin, inserted at angle of 15–55° with axis, dorsally decurrent up 1/2 of stem width, ventrally subtransversely to arcuately inserted, decurrent for 1/3 – 1/2 of stem width, or only barely decurrent, size varies from 350–500 × 420–750 μm (1–1 : 0.6–0.8) to 1050–1400 × 1050–1100 μm (0.8–1 : 0.9–1), ovoid (bigger) to transversely elliptic (small). Cells in the midleaf thin-walled, 45–90 × 26–45 μm, trigones triangle to convex, near margin 30–42 μm, thin- to thick-walled, with strongly thickened external wall, with convex trigones, cuticle smooth throughout, sometimes with exception of lower 1/3 of leaf length where loosely striolate. Dioicous. Perianth exerted from bracts for 1/4 – 1/5 of its length, fusiform to long conical, 3- to pluriplicate, sometimes turbinate in upper part, plicae and area near the mouth commonly purplish, ca. 1000–1200 × 625–1000 μm, without innovations, archegonia 5–7 in perichaetium; perigynium 1/3 – 3/3 of perianth length, not rhizogenous. Androecia intercalary, with 2–5 or more pairs of bracts, somewhat spicate, different generations divided by 4–7 pairs of sterile leaves, with 1-4 antheridia per bract, antheridial stalk biseriate, ca. 45 μm in length, body nearly spherical, ca. 150–160 μm in diameter, bracts strongly inflated at base, purplish to purple in inflated part, and with characteristically deflexed upper half, ca. 450–550 × 750 μm. Figure 15: 5–7.

Comment. Commonly readily recognizable species due to the combination of purple rigid rhizoids, dioicous inflorescence, rusty to brown or purplish brown coloration and particularly to leaf rim composed by larger than in inward rows of cells, with mostly thickened cell walls. The closest relative is *P. crenuliformis* replaces *P. rigidula* in Eastern North America, the distinctions between them are discussed under the former. Among regional genera the confusion is probably possible with *Solenostoma rotundatum* occurring in the same area with *Plectocolea rigidula*. Both species also merge purple coloration of rhizoids, but being different in: 1) presence of large celled, with commonly thickened cell walls leaf rim in *Plectocolea rigidula* versus absence of such kind of rim in *Solenostoma rotundatum*; 2) coloration that is commonly rusty to brown and purplish brown (with the exception of forms from shady places) in *Plectocolea rigidula* versus deep green to brownish green in *Solenostoma rotundatum*; 3) midleaf cell size, that are 45–90 × 26–45 μm in *Plectocolea rigidula* versus 25–38 × 17–24 in *Solenostoma rotundatum*. Due to presence of the leaf rim of large cells the confusion seems to be possible with '*Solenostoma koreanum*' phase of *S. fusiformis* and *S. ochotense*. Two latter species although sometimes have large-celled rim, but belong to *Solenostoma* and characterized by another type of perianth, as well as low to vestigial perigynium and colorless to (rarely) purplish and soft rhizoids.

Distribution. Temperate East Asian. The nearly Japanese endemic, spreading northward to the very closely adjacent South Kurils (Kunashir and Shikotan Islands). The altitudinal range within the Russian Far East stretches from near sea level to 200 m a.s.l., southward in Japan it occupies higher latitudes, reaching 1900 m a.s.l. in Gifu Prefecture.

Ecology. Acidophilic hygrophyte. The species prefers rocky substrates along streams and waterfalls, although aside of direct constant impact of water, mostly in open places. All localities are within broadleaved deciduous forest zone or corresponding belt in the mountains.

Specimens examined. RUSSIA, Kurils Islands, Kunashir Island (44°27'41"N 146°06'49"E), VB, K-37-11-06 28.VIII.2006 (VBGI), (44°23'50"N 146°01'40"E), VB, K-43-5-06 03.IX.2006 (VBGI), (43°48'08"N 146°38'46"E), Shikotan Island, VB, K-49-11-07 28.VIII.2007 (VBGI).

JAPAN, Gifu Pref., Ontake Volcano Hattori S. (Hepaticae Japonicae Exsiccatae ser. 14 (1965) n. 669 as *Jungermannia kyushuensis*) 13.VIII.1964 (SAP), Kagoshima Pref., Kosugidani, Yakushima Isl., Amakawa T., 2137/2446 26.VII.1956 (HIRO), Kumamoto Pref., Mizukami, Mayebara K., 2681 XI.1950 (NICH), 988 02.XI.1947 (NICH), 990 02.XI.1947 (NICH), Mie Pref. Hirakura, Misugi-mura, Magofuku T., 113/3236/2445 04.V.1965 (HIRO), Miyazaki Pref., Hiei-Shishigawa Mt., Higashiusukigun, Amakawa T., 1075/2444 30.XI.1952 (HIRO), Tokushima Pref., Meiseigun, Kimiyamamachi, Akawa, Hiroshi Inobu T., 702/2443 17.X.1945 (HIRO).

Plectocolea schusteriana (J.D. Godfrey & G. Godfrey) Bakalin *comb. nov*. Basionym: *Jungermannia schusterana* J.D. Godfrey et G. Godfrey, J. Hattori Bot. Lab., 46: 109, 1979 (= *Solenostoma schusterianum* (J.D. Godfrey et G. Godfrey) Váňa, Hentschel & J. Heinrichs, Cryptog. Bryol., 31(2): 137, 2010, *Jungermannia aleutica* Davison, Floristic Phytogeographic Studies Hepatic Flora Aleutian, 66 1993, nom. inval., Art. 29.1, 39.1. *syn. nov. prov.*).

Description. Plants 20–60 mm in length and 2.1–4.8 mm width, ascending to erect, deep green, brownish deep green and green brown and green-purple (due to purple colored ventral bases of leaves); female plants slightly bigger than male and sterile and have mainly retuse leaves (even far down of perianth). Stem 280–525 μm in width and 220–400 μm in height, dorsal surface cells thin-walled, mostly elongate rectangular to oblique rectangular and linear, 70–125 × 15–20 μm, trigones small and concave, cuticle distinctly striolate; in the stem cross section mostly 3-strated: outer (hyaloderm) moderately thick-walled to almost thin-walled, ca. 12–25 μm in diameter, walls brown (external wall more deeply) to purplish and purple colored, medium (scleroderm) very thick-walled with commonly visible median lamina of cell wall, ca. 17–25 μm in diameter, inner thin-walled to moderately thick-walled, ca. 17–38 μm in diameter, with indistinct trigones and walls mostly colorless. Rhizoids uncommon in male and sterile shoots, but more or dense on female, purple to brown-purple, in the bundle or separated one from other or in indistinct fascicles. Leaves distant to contiguous, inserted at angle of 50° with axis, dorsally decurrent for 1/2 – 2/2 of the stem width, ventrally subtransversely inserted, line insertion arcuate, decurrent for 1/2 – 2/2 of stem width; (875) 1100–2400 × (830) 1000–2000 μm (0.6–0.9 (1.05) : 1), oval to ovate-oval, obliquely ovate, widest slightly between 1–2/1/3 of lower part of leaf, with rounded to acuminate or retuse apex, clinging the stem in the base,

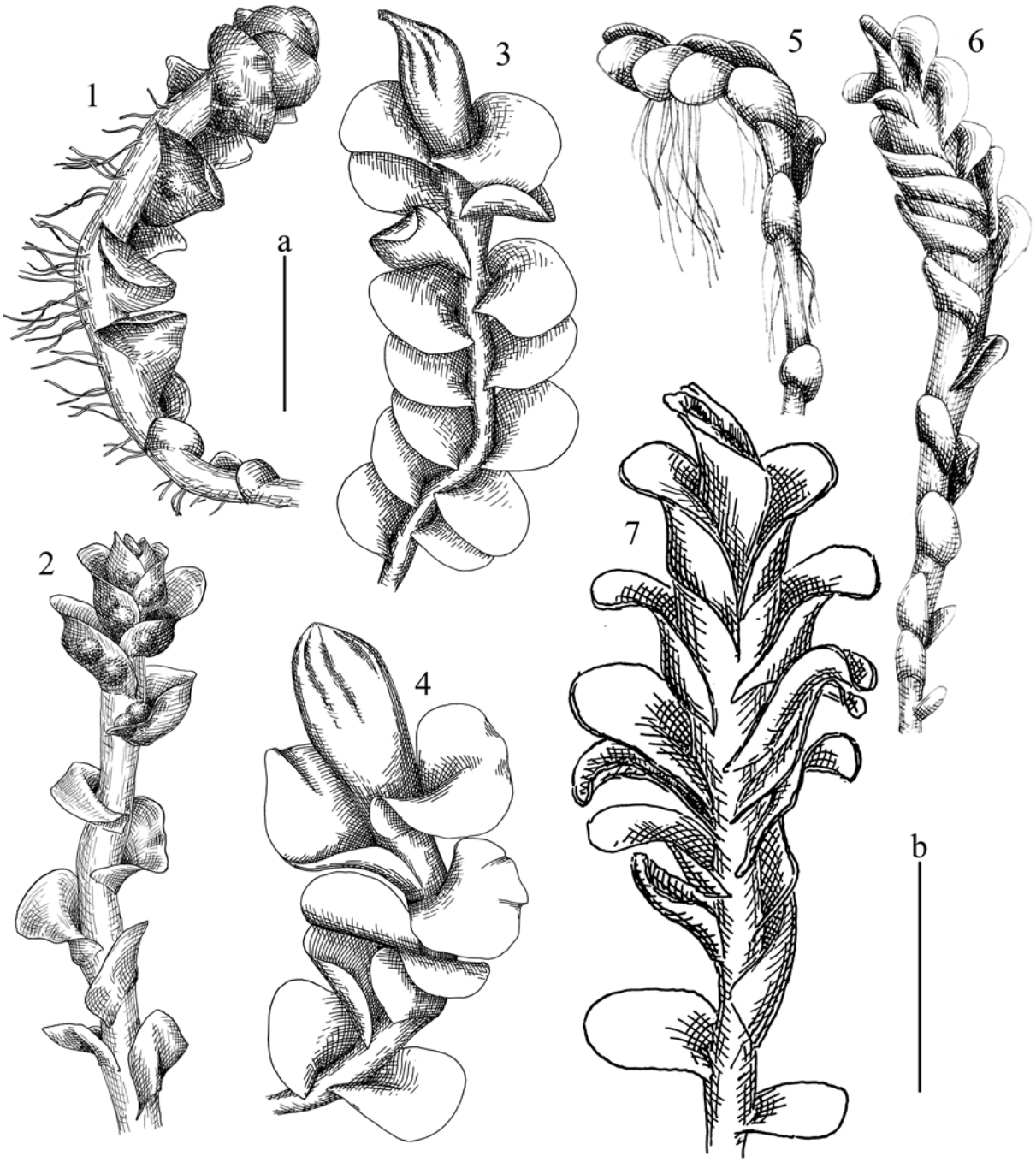

Figure 15 *Metasolenostoma ochotense* Vilnet et Bakalin: 1–4: 1, 2 – branch with androecia; 3, 4 – branch with perianth. 1, 2 – from K-111-2-04 (VBGI); 3, 4 – from S-67-2-09 (VBGI). *Plectocolea rigidula* S. Hatt.: 5–7: 5 – sterile branch; 6, 7 – branch with archegonia. 5–7 – from K-43-5-06 (VBGI). Scales: a – 1 mm, for 1–6; b – 1 mm, for 7

but channeled and deflexed or erect in upper 2/3 of leaf. Cells in the midleaf thin-walled, subisodiametric to oblong 35–50 (–58) × 33–43 μm, trigones large and bulging; along margin 20–38 μm, with slightly to obviously thickened external wall; cuticle finely striolate everywhere but more markedly in lower part or sometimes loosely developed. Oil-bodies grape-cluster type, consisting of distinctly glistening, homogenous globules, (1–) 2–6 (–8) per cell., spherical (5–) 6–15 μm in diameter to ovoid 6–14 × 7–19 μm. Dioicous. Perianth terminal on main axis, immersed to emergent for 1/3 of its length, conical pluriplicate and turbinate to the mouth, ca. 490 × 490 μm, perianth in upper part unistratose, cells rectangular to obliquely rectangular, 38–75 × 10–13 μm, walls thickened, yellowish colored, perianth in lower part 2-stratose, cells linear to oblong rectangular, 125–200 × 20–25 μm, walls moderately thickened; perigynium rhizogenous ventrally, 2 and more times longer than perianth; bracts just below perianth, in 2 pairs (due to high and robust perigynium), ovate, shortly bilobed, 1250–1400 × 1250–1300 (0.95–1.1 : 1). Androecia intercalary in 8–13 pairs of bracts, 1–2-androus, stalk biseriate, ca. 63 × 18 μm; bracts slightly inflated in base, but flattened and deflexed away the stem above, purplish to deep-green purple in inflated area, more or less similar in shape to sterile leaves, but complicated in micro-slide due to inflation in the base. Capsule with outer cells 30–58 ×

22–34 μm, each cell with 2–4 nodular thickenings on each vertical wall and with 0–2 on horizontal wall; inner cells 40–110 × 10–22 μm; elaters 8–12 μm in width, 2-spiral; spores reddish to golden-brown, 14–18 μm in diameter. Figure 16: 1–7.

Comment. The large and beautiful species that easily to recognize due to its large size, exceeding 2.1 mm and reaches 4.8 mm wide, deep green to green-purple pigmentation, dorsally secund (due to orientation, but not real leaf shape) leaves, peculiarly high perigynium exceeding 2 perianth lengths, distinct differentiation of the stem tissue in the crossection into hyaloderm and scleroderma, and (at least sometimes) botryoidal oil-bodies. Sometimes at the first look large phases of the species may be recognized as *Anastrepta*, but not *Plectocolea* at all. The confusion of depauperate phases is possible only with *Solenostoma obscurum*, the distinctions are discussed under the latter. Váňa & Hong (1999: 143) noted as characteristic features of the species also "abundant flagelliferous branches and by having stoloniferous shoot apices". In my experience these structures present in a few plants and are not constant. One of the forms of the species is *Jungermannia aleutica*, the name not effectively and not validly published. Despite several attempts I was not able to receive the specimen for studies, but by the description given by Davison (1993) this is the synonym of *Plectocolea schusteriana*. The differences cited by Davison (l.c., shape of leaf, degree of cell differentiation in stem cross section, abundance of stoloniferous branches and rhizoid production and slight differences in cell size) seems to be environmentally induced.

Distribution. Boreo-Temperate Montane Western American. This endemic taxon stretching area from southern Alaska and Aleutians, via British Columbia to northern Washington. It occupies middle elevations in the mountains, although stretches from near sea level (in Vancouver Island) to 1330 m a.s.l. in Washington.

Ecology. Acidophilic hygro-hydrophyte. The species prefers wet rocks and cliffs in open places or in part shade, submerged to in short distance aside of streams, mostly in coniferous and crooked forest belts in the areas under strong influence of oceanic air masses.

Specimens examined. CANADA, British Columbia, Queen Charlotte Islands, Moresby I. (52°45'N 132°03'W), Schofield W.B., 14.VIII.1985 (MO3662829), Chatl I., Schofield W.B., 9.VII.1962 (UBC-b8967), Raza I. (50°18'N 125°01'W), Godfrey J.D., 25.V.1977 (UBC-b24704), North Vancouver, Schofield W.B. 26.II.1978 (NY00099007), Vancouver I., Strathcona park (49°39'N 125°12'E), Halbert R.L., 10.VIII.1969 (UBC-b84162, UBC-b84171, UBC-b84172, UBC-b84168), 3.IX.1972 (UBC-b25831), (50°11'N 127°46'W), Godfrey J.D., 15.VIII.1975 (UBC-b25686), (49°27'N 123°17'W), NK, A96/3-95 24.IX.1995 (KPABG, duplicate in VBGI), (50°28'N 125°34"W), Schofield W.B., 85576 28.VII.1986 (F); U.S.A., Alaska, Ketchikan (55°21'N 131°29'E), Worley I.A., 15.V.1968 (UBC-b25840), Washington, Baker Mt. (47°55'N 122°06'W), NK, A20/5-95 16.VIII.1995 (KPABG, duplicate in VBGI), Shonomish Co. (47°55'N 122°06'W), NK, A15/1-95 14.VIII.1995 (KPABG, duplicate in VBGI).

Plectocolea vulcanicola (Schiffn.) Bakalin Arctoa, 23: 117, 2014 (=*Nardia vulcanicola* Schiffn., Denkschr. Akad. Wiss. Wien, KI. Math.-Naturw., 67: 191,1899; *Jungermannia thermarum* Steph., Bull. Herb. Boissier 2: 77, 1901; *Plectocolea magna* Amak., Journ. Jap. Bot. 32: 310, 1957; *Jungermannia magna* (Amak.) Amak., Journ. Hattori Bot. Lab., 22: 29, 1960)

Description. Plants (0.7) 1.0–2.0 mm wide, 5–15 mm in length, erect to ascending, whitish, pale greenish, pale brownish to white-brownish, pale blackish gray to greenish gray, sometimes with blackish light violet tint at leaf margin near apex. Stem 150–350 μm wide, orbicular in cross section, dorsal surface cells thin-walled with indistinct trigones to moderately thick-walled, with small concave trigones, 50–170 × 20–38 μm. Rhizoids isolated, scattered to somewhat dense, colorless, erect, rarely in lax indistinct fascicles. Leaves distant to contiguous and imbricate (coverine lower half of the next situated leaf), flattened, to concave and cupped, inserted at angle of 15–50° with axis, dorsally ca. 15–25°, decurrent up 1/2 of stem width, on ventral side up 70–80° line insertion loosely arcuate, not or barely decurrent, 300–750 × 500–1250 μm (1 : 0.7–0.9), widely ovoid to orbicular and transverse elliptic, commonly truncate, the biggest leaves frequently emarginate. Cells in the midleaf thin-walled, 35–88 × 26–48 μm, trigones indistinct or distinct concave, near margin 30–75 μm with concave trigones, cuticle smooth or very indistinctly striolate in lower 1/5 of leaf length. Dioicous. Perianth terminal, fusiform, pluriplicate, sometimes with 5 main plicae, in upper part sometimes turbinate, no innovation, ca. 1200 × 550, exerted for 1/5 – 1/3 of its length or nearly hidden in bracts, cells in perianth middle elongated-linear, 90–180 × 28–45 μm, thin- to thick-walled with small concave trigones, perigynium 1/2 – 2/2 of perianth length, not rhizogenous, with 2 pairs leaves, archegonia 10–15 in perichaetium, bracts 1000–1750 × 1500–2000 μm, concave, undulate to undulate-crispate at margin. Androecia intercalary, with 3–4 pairs of bracts, different generations divided by 4–5 pairs of sterile leaves, with 1 antheridium per bract, antheridial stalk ca. 35 μm in length, bracts inflated at base or not inflated, concave, transversely oval, sometimes with retuse apex, ca. 400 × 500 μm. Figure 17.

Comment. The species may be easily recognized due to: 1) occurrence in sulphur-rich areas; 2) soft texture of plants; 3) pale color to peculiarly whitish blackish color with common blackish violet to violet-black colored upper part of shoots; 4) large leaf cell with small concave trigones. The only species similar to *Plectocolea vulcanicola* is *Metasolenostoma orientale*, also sharing with *Plectocolea vulcanicola* sulphur-rich habitats. *Plectocolea vulcanicola* differs from *Metasolenostoma orientale* in presence of well developed perigynium and commonly truncate and emarginate (at least larger ones) leaves those commonly oriented to dorsal side of shoot. Contrary, *M. orientale* has vestigial to very low (less than 1/4 of perianth length) perigynium and widely ovoid to rounded-triangular leaves with well defines apex that is neither truncate nor emarginate. The perianth shape is not constantly help to differs two taxa, although commonly perianth of *M. orientale* has typical 'solenostomoid' appearance with rostellate and loosely beaked mouth, some forms has fusiform perianth without well defined plicae; also both species have perianth composed by elongate cells, that are longer in *Plectocolea vulcanicola*, but diapasons of variability are largely overlapped. Despite the differentiation written

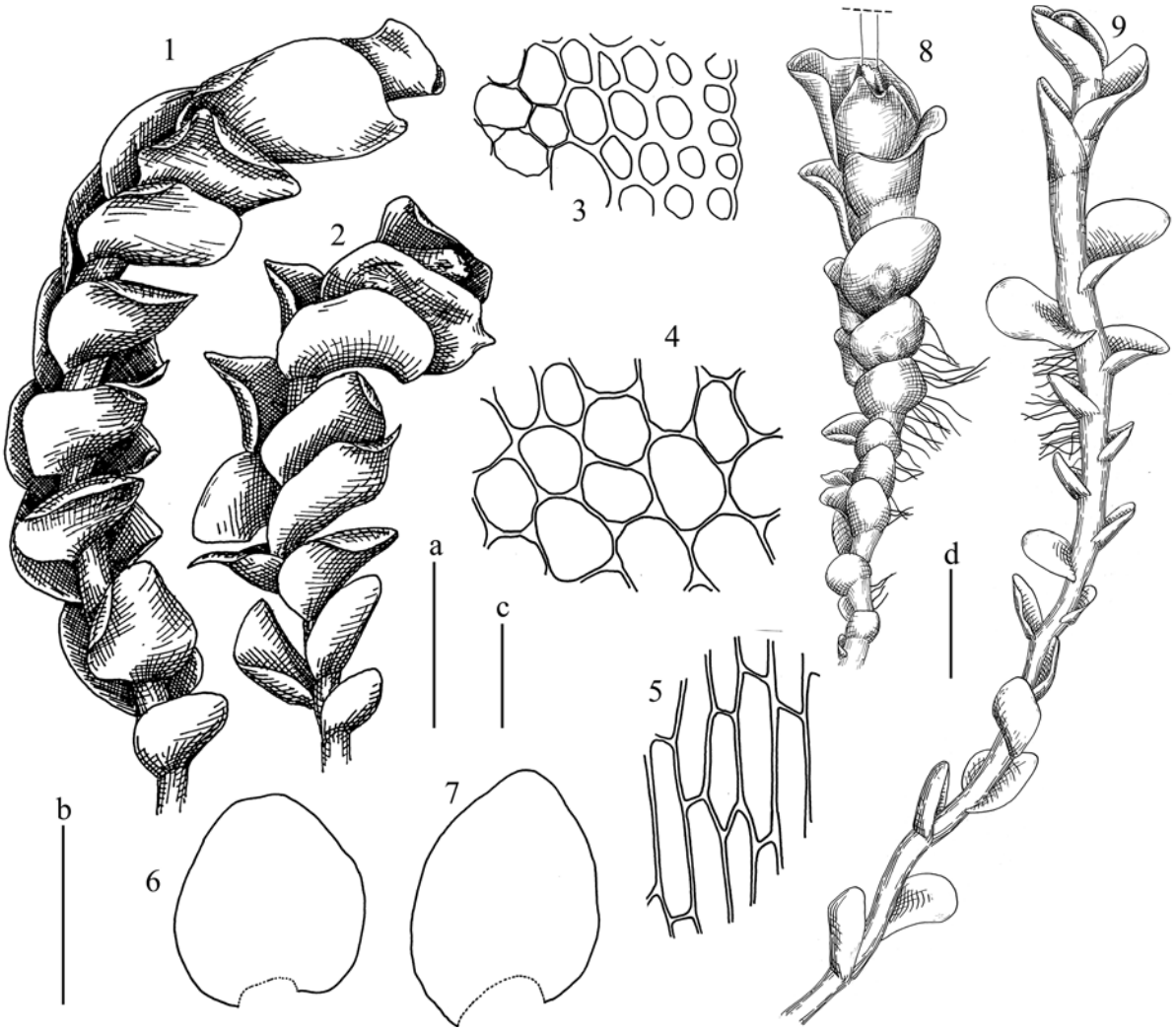

Figure 16. *Plectocolea schusteriana* (J.D. Godfrey et G. Godfrey) Bakalin: 1–5: 1 – sterile branch; 2 – branch with perianth; 3 – part of stem cross section; 4 – cells in the perianth middle; 5 – cells in the perianth lower part; 6, 7 – leaves. 1, 2 – from A96`3-95 (KPABG); 3–7 – from NY00099007 (NY). *Solenostoma subellipticum* (Lindb. ex Heeg) R.M. Schust.: 8, 9: 8 – branch with perianth and androecia; 9 – sterile branch. 8, 9 – from K-42-7-04 (KPABG). Scales: a – 2 mm, for 1, 2; b – 2 mm, for 6, 7; c – 500 μm, for 3–5; d – 1 mm, for 8, 9

above some small sterile and depauperate branches may not be differentiated satisfactory.

Another taxon with which *Plectocolea vulcanicola* may be confused is *Solenostoma hyalinum*. The latter has similarly pallid color in the area treated and wider than long leaves those commonly emarginate at apex. However *Plectocolea vulcanicola* strikingly differs in habitat and distribution. When *Solenostoma hyalinum* has Arctic to North Boreal distribution rarely penetrating southward along mountainous system, where nevertheless almost uniformly confined by alpine to subalpine vegetation belt and avoid sulphur-rich substrata, for *Plectocolea vulcanicola* prefers high sulphur content of substrata or water flowing nearby. It occurs in Kamchatka subarctic, although is more common southward, when occurring in cool area it is uniformly attached to the banks of thermal springs that at least not frozen at winters. Another difference between two species is the midleaf cell size. Although cell size in the both species noticeably varies, they are commonly larger in *P. vulcanicola* (35–88 × 26–48 μm) versus 25–40 × 25–40 μm in *Solenostoma hyalinum*. The conducted by A. Vilnet special molecular research of this group (Bakalin & Vilnet 2012) showed two latter species have only distant relations and belong to two different clades.

Distribution. Azonal East Asian. Its distribution is determined by the distribution of thermal pools and springs of volcanic origin and mostly attached to Asian part of so-called 'Pacific Ring of Fire'. Within area treated it is recorded in Kamchatka and Kurils, southward its area stretches across Japan to Java, where it is also attached to volcanogenic modified areas. Most of records from the Russian Far East are below than 500 m a.s.l., with one exception from South Kamchatka, where the species was collected from altitudes above 1000 m a.s.l.

Ecology. Mainly acidophilic sulphur-tolerate hygro- to hydrophite. Throughout of the area the species occurs in the sulphur-rich substrata, or near or within watercourses with water rich with sulphur. This is only species sometimes growing on crystalloid sulphur near hot stream of solution sulphuric and sulphurous acids. The highest substrata temperature I observed where this species was able to survive was above 50°C in the South Kurils. Everywhere this species is attached to the places of recently (in geological sense of

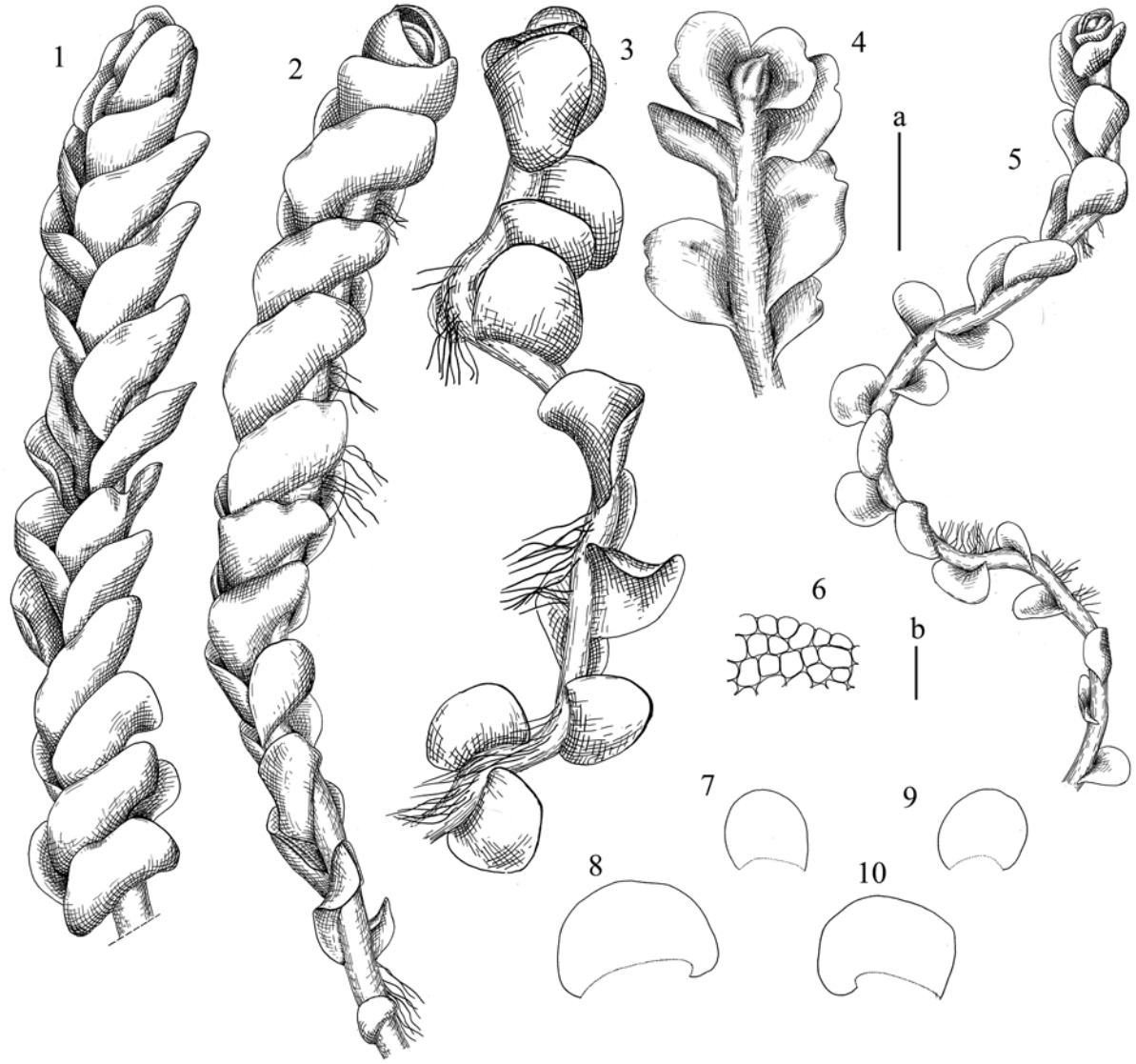

Figure 17 *Plectocolea vulcanicola* (Schiffn.) Bakalin: 1, 2 – sterile branches; 3, 5 – depauperate sterile branch; 4 – branch with juvenile perianth; 6 – perianth mouth; 7–10 – leaves. 1, 2 – from K-53-1-05 (VBGI); 3, 5 – from K-16-13-03 (KPABG); 4 – from KPABG-105726 (KPABG); 6–10 – from KPABG-106415 (KPABG). Scales: a – 1 mm, for 1–5, 7–10; b – 100 μm, for 6

this word) extinct or extant volcanism that is the main determinative factor of its distribution as far as I see. The habitats of this species are never frozen at winter and most probably not covered with snow at all. The surrounded vegetation commonly does not have direct impact to the habitat of the species (with the exception of possible light shading) and attempt to find the relationships between vegetation type and distribution of the species were failed. Within the Russian Far East this species occurs in tundra (or tundra-like) communities in Kamchatka, via subarctic crooked *Betula ermanii* Cham. forests to broadleaved forests in South Kurils.

Specimens examined. RUSSIA, Kamchatka, East Kamchatka (54°30'N 159°55'E), Neshatayeva V.Yu., 18.III.2004 (KPABG, duplicate in VBGI), South Kamchatka (52°50'N 157°40'E), VB, K-16-13-03, 07.VI.2003 (KPABG), (52°32'N 158°12'E), Chernyagina O.A., 13.VIII.2001 (LE, duplicate in VBGI), Kuril Islands, Iturup Island (45°06'13"N 147°59'16"E), VB, K-53-1-05 15.IX.2005 (VBGI), (45°05'21"N 147°59'00"E), VB, K-54-12-05 15.IX.2005 (VBGI), (45°04'40"N 147°59'13"E), VB, K-60-8-05 17.IX.2005 (VBGI), (45°15'32"N 148°10'23"E), VB, K-66-14-05 22.IX.2005 (VBGI), (45°15'48"N 148°13'03"E), VB, K-67-7a-05 23.IX.2005 (VBGI), (45°06'12"N 148°00'56"E), Bardunov L.V., 17.IX.1980 (VBGI), Kunashir Island (44°27'41"N 146°06'49"E), VB, K-37-14-06 28.VIII.2006 (VBGI), (43°51'52"N 145°30'10"E), VB, K-45-2-06 04.IX.2006 (VBGI), (44°00'20"N 145°46'23"E), VB, K-52-4a-06 10.IX.2007 (VBGI), Shikotan Island (43°57'56"N 146°43'56"E), VB, K-40-39-07 24.VIII.2007 (VBGI).

CHINA, Sichuan, E Mai Shan, 1050 m alt., J.S. Lou, 74a, 1973 (PE), Baixi, on stone, Bangjie Chen, 10.XI.1945 (PE 01076195); INODONESIA, Java (holotype of *Nardia vulcanicola* Schiffn.: Java. Prov. Praenger, ad lacum vulcanum "Telega Bodas". Regio Nubium. 1660 m a.s.l. 15.II.1894, #482) (G00121010); JAPAN, Aomori Pref., Osorezan, Faurie U., 1218 11.X.1902 (KYO), Sukayu, Arakawa, Aomori-city, Hakkoda-san, Kitagawa N., 4146 07.IX.1959 (KYO); (neotype of *Jungermannia thermarum*: Japan. Hakkoda. Eaux thermals. Faurie U., 12791) (G00067147), Ehime Pref., Tonaru, Suminomachi, Ochi K., 315 25.I.1943 (HIRO), Hokkaido Pref., Chitose, Miyabe K., 05.IX.1896 (SAP), Hakodate, Shirikishinai-mura, Esan, Kuwahara Y., 5770 26.VII.1956 (NICH), Iwate Pref., route from Iwate-yama Mt. to lake Onawashiro-ko, Kitagawa N., 3873 30.VIII.1959 (KYO), Kagoshima Pref., Hananoego - Kosugidani in Yakushima Island, Amakawa T., 2157 27.VII.1956 (HIRO, NICH), Nagano Pref., Kiso-ontake Hattori S. (Hepaticae Japonicae Exsiccatae ser. 7 (1956) n. 337 as *Plectocolea pallida* 27.VIII.1953) (SAP, NICH), Ontake Mt., Yukawa Hot Spring, Nakajima T., 1079 27.VIII.1953 (NICH), Yatsu Mts., Inoue H., 7597 VIII.1957 (NICH), Shimane Pref., Iishi-gun,

Tonbara-cho, Maruyama, Deguchi H., 36811, 02.XI.2003 (CBM), Dake, Faurie U., 1557 X.1904 (KYO), Sendai, Tsurugi Mt., Faurie U., 14490 IX.1894 (KYO), Sobosan, Faurie U., 330 1899 (KYO).

SOLENOSTOMA Mitt. emend. Zerov J. Linn. Soc. Bot., 8: 51 1865 [From Greek "solen" – canal and "stoma" – mouth, due to suddenly contracted perianth to the mouth] (*Jungermannia* subg. *Solenostoma* (Mitt.) Amak., J. Hattori Bot. Lab., 22: 53, 1960; Solenostoma subg. Solenostoma R.M. Schust., Hep. Anth. North Amer., 2: 942. 1969).

Type species: *Jungermannia tersa* C. G. D. Nees Naturg. Europäischen Lebermoose. 1: 279, 1833 (= *Solenostoma sphaerocarpum*)

Plants ascending to erect, rarely creeping, greenish, pale green yellowish, yellowish brownish to dirty green, in the most species with characteristically red or purple coloration (at least as the tint at the tips of perianthia and leaf rim). Branching lateral-intercalary or ventral (as subfloral innovations), no geotropic stolons. Rhizoids mostly dense, in bundles, colorless to brownish, rarely reddish to purple. Leaves contiguous to imbricate, subtransversely to (more rarely) obliquely inserted, dorsally decurrent or not. Cells in the midleaf mostly thin-walled, walls colorless to yellowish, never deep brownish or orange-brown, trigones mostly distinct, concave to convex. Perianth tubular obtrapezoidal to clavate and conical, unistratose up to base or sometimes bistratose in lower 1/5 – 2/3 of the length, suddenly contracted to the beaked mouth and distinctly 3–5-keeled (1–2 dorsal, 0–2 lateral, 1–2 ventral), or gradually narrowed to not or obscurely beaked mouth; perigynium indistinct or up to 2/3 of perianth length.

Solenostoma appalachianum Bakalin, Arctoa 23: 127, 2014 (= *Jungermannia pyriflora* sensu Schust., Hep. Anth. North Amer. 2: 9631969, auct non Steph., Sp. Hepat. 6: 83, 1817; *Solenostoma appalachianum* R.M. Schust., *in sched.*)

Description. Plants 3–5 mm in length and 0.7–1.4 mm width, erect to ascending, bright green, green yellow, yellowish green brownish; female plants the same size with sterile ones, but male are narrower. Stem 175–245 μm in width and 160–220 μm in height; dorsal surface cells 30–38 × 15–25 μm with thickened walls, walls brownish and, sometimes, with reddish tint; in the stem cross section outer cells ca. 22–30 μm in diameter, walls thickened, yellowish, trigones large, convex, inner cells 20–30 μm in diameter, lesser thickened, walls colorless, trigones small. Rhizoids very dense, nearly colorless to brownish and rarely purplish, obliquely or at right angle with stem spreading, in dense fascicles, or decurrent down the stem. Leaves contiguous to imbricate, inserted at angle 45–50° with axis, dorsally shortly decurrent (not more than 1/3 of the stem width), ventrally subtransversely inserted, insertion line arcuate, decurrent for 1/5 of stem width; 500–700 × 650–1050 μm (1 : 0.7–0.9), orbicular, widest near the middle, concave to concave-canaliculate. Cells in the midleaf thin-walled or with loosely thickened walls, subisodiametric, mostly tetra- to hexagonal, 22–30 × 20–25 μm, walls colorless, trigones distinct, triangle to slightly convex, lumen nearly rounded; along margin 12–18 μm, thin-walled to slightly thickened, walls colorless, cuticle smooth everywhere. Dioicous. Perianth terminal on main axis, innovations rare, exerted for 1/3 – 1/2 of its length, 1120–1190 × 560–630 μm, oblong to shortly fusiform, with 4–5 distinct plicae (1–2 dorsal, 2 lateral, 1 ventral), suddenly con tracted to the beaked mouth, perianth mouth crenulate to denticulate, perianth in upper part unistratose, cells isodiametric, 15–20 μm in diameter, trigones convex, cuticle smooth, in the middle part bistratose, composed by oblong to isodiametric cells, ca. 30–40 × 17–23 μm, walls thin, rarely with intermediate thickenings, cuticle smooth, in lower 1/4 bistratose, composed by rectangular to oblong rectangular cells, 33–45 × 15–20 μm, thin-walled, trigones concave, cuticle papillose; perigynium indistinct; bracts just below perianth, in 1 pair, ca. 750 × 1000–1050 μm, orbicular to transversely elliptic, canaliculate. Androecia intercalary, but sometimes the branch above androecium become depauperate and die out, spicate, in 5–8 pairs of bracts, ca. 630–700 × 840–930 μm, orbicular to transversely elliptic, cupped, but with incurved margin, with 2 (–3) antheridia per bract, stalk biseriate, ca. 63–68 × 17–23 μm.

Comment. Commonly easily identifiable species due to dioicous inflorescence, erect to ascending growth form, more or less rigid structure, colorless to light purplish rhizoids and moderate size. Formally this taxon is not present in treated area, but likely to be found. The species may be confused with *Solenostoma rossicum*, some phases of that are dioicous. *S. appalachianum* differs from the latter in following: 1) constantly dioicous inflorescence, versus heteroicous, when both paroicous and dioicous phases may be found in *S. rossicum*; 2) purplish pigmentation, when present, distributed more or less evenly, versus purplish pigmentation limited to leaf margins of upper part of shoots and especially purple colored perianth beak (that is colorless to greenish in *S. appalachianum*, even if purplish pigmentation generally present; 3) commonly larger size, that in well developed plants 1.0 mm wide, versus well developed plants smaller than 1.0 mm wide; 4) temperate versus subarctic to boreal distribution. The relationships of this species with *S. pyriflorum* are not clear and discussed by Bakalin (2014).

Distribution. Temperate Eastern American endemic with unclear status. The area is imperfectly known and due to data in hand it covers Great Lakes area (Michigan) and southward in temperate vegetation belt in Appalachia (Virginia, North Carolina, South Carolina and Georgia), with isolate locality in Wyoming. The altitudinal range mostly covers middle to high belts in the mountains and due to data in hand stretches from 660 m a.s.l. (Georgia) to 2500 m a.s.l. (Wyoming).

Ecology. Acidophilic meso- to hygrophyte. The species is restricted to moist rock crevices or other moist rocky surfaces and (rarely) bare soil in human disturbed areas in the temperate (also coniferous temperate) forests. The species mostly prefers shaded habitats, although sometimes growing in open sites along streams. Once it was collected on decaying log that is highly uncharacteristic for species and for the genus as the whole.

Specimens examined. U.S.A., Georgia, Rabun Co., Schuster R.M., 40031 VIII.1957 (F), High Falls, Schuster R.M., 40709 03.VIII.1958

(NICH), North Carolina,Graham Co., Davison P.G., 03.X.1997 (MO5635736), Haywood Co., Schuster R.M., 17.VII.1957 (MO6001431, F), 39371e 17.VII.1957 (F), 39379 17.VII.1957 (F), Jackson Co., Schuster R.M., 39468 22.VII.1957 (F), 29387 01.IX.1953 (NICH), 29379 (holotype of *Solenostoma appalachianum*) (G25914/00067159), Macon Co., Schuster R.M., 39441 22.VII.1957 (F), Yancey Co., Schuster R.M., 9551 08.VIII.1958 (F), South Carolina, Oconee Co., Thomson R., Schuster R.M., 41009 23.VIII.1958 (NICH), Wyoming, Teton Pass (44°44'N 109°45'W), NK, A69/6-95 02.IX.1995 (KPABG, duplicate in VBGI).

Solenostoma bilobum (Amak.) Potemkin & Nyushko, Pechen. Antotser. Ross. T. 1: 286, 2009. (= *Plectocolea biloba* Amak., Journ. Jap. Bot., 32: 216. f. 7., 1957; *Plectocolea biloba* S. Hatt., Journ. Hattori Bot. Lab., 15: 64, 1955 *nom. nud.*; *Jungermannia cephalozioides* Amak., Journ. Hattori Bot. Lab., 22: 41, 1960)

Description. Plants 0.3–0.7 mm wide (male shoots 0.7–0.8 mm wide in androecial part, female near perianth up 0.8–1.0 mm wide), up to 3–7 mm long, creeping, light green to yellowish green. Stem 100–150 (200) μm wide, orbicular in cross section, braches ventral, originated as leafless stolons and then become to normally leaved branch, dorsal surface cells thin-walled, with indistinct trigones, 35–65 × 15–20 μm. Rhizoids purple to purplish pink, scattered, with pseudopodia-like ends. Leaves distant, flattened, inserted at angle of 15–25° with axis, dorsally up 40°, not decurrent, ventrally subtransversely inserted, not decurrent, 200–225 × 250–300 (1 : 0.8–0.9) or scale-like, <100 μm in length, transversely elliptic, divided to 1/3 – 1/4 of length by widely angular sinus, lobes angular with apiculate apices, frequently end by 2 superposed cells. Cells in the midleaf thin-walled, 20–35 × 18–25 μm, trigones indistinct, near margin 18–21 μm, thin-walled, cuticle smooth. Dioicous. Perianth terminal, hidden within bracts, arched to conical, smooth, contracted to the mouth, ca. 375 × 450 μm, without subfloral innovations, archegonia ca. 5 in perichaetium; perigynium 3/2 of perianth length; female bracts similar to large leaves. Androecia in 2 pairs of bracts, intercalary, with 1 antheridium per bract, antheridial body nearly spherical, ca. 130–140 μm in diameter, antheridial stalk uniseriate, bracts cupped, with purple tint, ca. 450 × 450 μm or smaller. [Spores 14–15 μm in diameter. Elaters 7.5 μm wide (Amakawa 1960)]. Figure 6: 1–6.

Comment. The very distinctive species due to its bilobed and obliquely inserted leaves and rigid texture that giving aspect of large sized *Cylindrocolea*. The only relative that might be found in the World's flora is the Korean-Japanese *Plectocolea emarginata* Amak., differs from the former in only emarginate leaves with rounded, but not acute lobes and slightly larger size.

Distribution. Arctic-Boreal Montane East Aisan. This is an evident Japanese-Korean endemic taxon spreading southward to Kyoto Prefecture, with a few records in the southern flank of the Russian Far East (Shikotan Island of the South Kurils), closely adjacent to Japanese Hokkaido. Throughout its area it occurs in the low elevations (less than 300 m a.s.l.), although in Japan it sometimes penetrates to subalpine belt as up to 1380 m a.s.l. in Yamagata Pref.

Ecology. Acidophilic meso- to hygrophyte. The species prefers semi-shaded moist to, rarely, wet rocks aside of direct impact of running water in subalpine belt (low grass tundroid communities, crooked forest belt).

Specimens examined. RUSSIA, Kurils Islands, Shikotan Island (43°46'34"N 146°44'19"E), VB, K-43-4-07 25.VIII.2007 (VBGI), (43°48'08"N 146°38'46"E), VB, K-48-4-07 27.VIII.007 (VBGI), (43°47'47"N 146°35'50"E), VB, K-50-53-07 30.VIII.2007 (VBGI).

JAPAN, Hokkaido Pref., Abashiri-gun, Bihoro-cho, Furuki T., 6173 IX.1985 (KYO), Apoi Mt., Shimizu D., 11.VIII.1954 (NICH), Hidaka, near Samani, along Poorosan-shibetsu River, Shimizu D., 54772 11.VIII.1954 (HIRO), Rishiri Isl., Shimizu D., 04.IX.1954 (NICH), Kyoto Pref., Kitakuwata, Shimodani valley, Hasegawa J., 1884 10.VI.1974 (KYO), Yamagata Pref., Zao Mt., Dokko pond, Furuki T., 13246 05.IX.1996 (CBM), Norikura, Faurie U., 1794 VIII.1905 (KYO).

Solenostoma confertissimum (Nees) Schljakov, Pechen. Mkhi Severa SSSR, 4: 51 1981 (= *Jungermannia confertissima* Nees, Naturgesch. Eur. Leberm., 1: 277, 291, 1836; *Solenostoma pyriflorum* subsp. *purpureum* R.M. Schust. & Damsholt, Meddel. Grønland, 199: 176 1974; *Jungermannia pyriflora* subsp. *purpurea* (R.M. Schust. & Damsholt) Stotler & Crandall-Stotler, Bryologist, 80: 413 ,1977; *Solenostoma pyriflorum* var. *innovatum* R.M. Schust. & Damsholt, Meddel. Grønland, 199: 179, 1974; *Jungermannia pyriflora* subsp. *purpurea* var. *innovata* (R.M. Schust. & Damsholt) Stotler & Crandal-Stotler, Bryologist, 80: 413, 1977)

Description. Plants (0.3) 0.7–2.5 mm wide, up 3–10 mm long, ascending to erect, greenish, pale green yellowish, yellowish brown to brownish-yellow-green and dirty green with distinct red pigmentation, especially near apex and perianth where reddish and purplish brownish. Stem 180–400 μm diameter, rounded in cross-section, to elliptic and 245–520 μm wide and 240–500 μm high, dorsal surface cells thin- moderately thick-walled, trigones small and concave or indistinct, ca. (30) 50–150 × (19) 25–45 (48) μm, cuticle smooth. Rhizoids rather dense to scattered, in indistinct fascicles that commonly erect to obliquely spreading, or recurrent down the stem and forming distinct fascicle, colorless to brownish and light purplish, originated both ventral side of stem and some cells of lower half of leaf lamina. Leaves distant to contiguous and subimbricate, concave to flattened and concave-canaliculate, rarely undulate at margin, sometimes laterally appressed to the stem, inserted at angle of (40) 50–80° with axis, dorsally subtransversely inserted, not or decurrent up (1/7) 1/5 – 1/3 of stem width, ventrally subtransversely inserted, decurrent up 1/3 of stem width, 375–735 × 550–1050 μm (1.0 : 0.6–0.9), transversely oval to suborbicular and reniform, bearing initial rhizoid cells in lower third. Cells in the midleaf thin- to moderately thick-walled, walls brownish to brownish reddish or colorless, subquadrate to hexagonal, subisodiametric, 26–42 × 22–32 μm, trigones small concave to distinct and convex, along margin 12–28 μm, commonly with thickened external wall, walls brown to brownish reddish in color, rarely with decolorate external wall, cuticle smooth. Oil-bodies 3–5 per cell, papillose, nearly oval, 7–9 × 3.4–5 μm. Paroicous. Perianth terminal, sometimes with 1–2 ventral innovations, ob-pyriform to subclavate and ob-trapezoidal, with (3) 4–5 distinct, rarely indistinct plicae, exerted for 1/3 – 3/4 of its length, ca. 1450–1700 × 665–1000 μm, suddenly contracted to

beaked, crenulate along margin mouth, perianth in upper part unistratose, cells isodiametrical, mostly hexagonal, 20–30 μm in diameter, trigones distinct, convex, perianth in lower part 2-stratose (for 1/3 of perianth length), cells obliquely rectangular to hexagonal, 25–45 × 17–21 μm, walls thin, trigones small and concave to indistinct; perigynium 1/6 – 1/3 of perianth's length or indistinct, with 1 pair of leaves, strongly rhizogenous ventrally and laterally, ca. 5 archegonia in perichaetium, bracts ca. 600–750 × 1000–1050 μm, appressed to the perianth. Androecia in 2–4 pairs just below female bracts or divided from the latter by 1–2 (3) pairs of sterile leaves, with 2 (–4) antheridia per bract, stalk biseriate, ca. 80 μm in length, bracts concave to cupped, ca. 650 × 1050 μm, frequently with red to rusty-red rim along margin. Seta 200–250 μm in diameter. Capsule spherical to shortly ellipsoidal, ca. 700 × 700 μm, bistratose, inner cells, obliquely rectangular to irregular in shape 38–63 × 12–18 μm, with 5–8 annular thickenings, outer cells quadrate to shortly rectangular, ca. 30–43 × 22–35 μm with 2–3 nodular thickenings in vertical wall, and 0–2 on the horizontal one. Elaters 2-spiral, 100–200 × 7.5–11.5 μm, clearly tapered to ends, commonly with homogenous ending. Spores finely papillose, 23.8–26.6 μm in diameter, brown to brown-reddish. Figure 18.

Comment. The characteristic features of the species include paroicous inflorescence, commonly (but not constantly) rhizoids united into indistinct, rarer distinct fascicle decurrent down the stem, presence of purplish to reddish coloration of plants and rhizoids sporadically originated in the leaf lamina. The species may be readily mistaken with couple of species, including *S. sphaerocarpum*, *S. pusillum*, *S. pseudopyriflorum* and *S. rossicum*. It differs strikingly from *S. sphaerocarpum* in: 1) presence of red to purplish pigmentation especially obvious near shoot apex, versus mostly sepia-brown colored, without traces of red or purple in the plants of *S. sphaerocarpum*; 2) rhizoids that commonly united into fascicle decurrent down the stem; 3) rhizogenous leaves never occurring in *S. sphaerocarpum* (in *S. confertissimum* mostly present, although rarely absent). The distinction of the species from *S. pusillum* is more troublesome, especially in small depauperate phases of *S. confertissimum*. The general differences includes smaller plants in *S. pusillum* (0.15–0.4 mm wide versus 0.7–2.5 mm in *S. confertissimum*), gradually, but strongly dilated shoots to the perianth in *S. pusillum* (the shoots 2–3 times wider near perianth in *S. pusillum*, versus only slightly, not more than 1.5 times wider in *S. confertissimum*. The commonly stated distinction between *S. pusillum* and *S. confertissimum* in rhizoids orientation and origin is not the constant feature. Indeed, commonly *S. confertissimum* has slightly rhizogenous leaf lamina, but rarely rhizoids from the leaf may occur in *S. pusillum* too; also characteristic for common phase presence of rhizoid fascicle decurrent down the stem in *S. confertissimum* is not obvious in creeping shoots (those also smaller that common) and therefore closely like to *S. pusillum*.

The confusion with *S. pseudopyriflorum* seems to be less possible due to the fact these species distribution is not sympatric. *S. pseudopyriflorum* does not occur (or at least not known) in North America and northward of 55°N in the Russian Far East, where *S. confertissimum* distributed northward of this parallel (with the exception of one locality in Central Sakhalin and also Kamchatka where *S. pseudopyriflorum* does not occur). In other ways two species share obscurely fasciculate rhizoids and presence of red to purplish pigmentation. Although they are rather distant genetically (Bakalin & Vilnet 2012) their distinction in the practice sometimes troublesome. Aside distribution patterns in treated area *S. pseudopyriflorum* commonly more rigid that *S. confertissimum* and has bistratose perianth in lower 1/2 – 2/3 of its length, versus unistratose nearly to base or 2–3-stratose in lower 1/3 perianth in *S. confertissimum*. Also rhizogenous cells of leaf lamina are more or less constant feature in *S. confertissimum*, but occurring in *S. pseudopyriflorum* only in isolated leaves and known in a few populations. The third feature is the shape of male bracts that are strongly inflated in *S. confertissimum* contrary to loosely or virtually not inflated in *S. pseudopyriflorum*. As additional feature the shape of sterile leaves may be used. Sterile leaves in *S. confertissimum* commonly covers lower half of the next situated leaf, concave and, in a manner, laterally appressed to the stem. Contrary, leaves in *S. pseudopyriflorum* are concave-canaliculate and erect to obliquely spreading. At last, *S. confertissimum* differs from *S. rossica* in common presence of rhizogenous cells in leaf lamina (versus total absence), rhizoids commonly decurrent down the stem and then forming distinct to obscure fascicle (versus obliquely spreading rhizoids), and purplish to reddish pigmentation, that is more obvious near apex, but not restricted to perianth mouth (versus strikingly restricted red or purple coloration of perianth mouth in *S. rossica*). Additionally *S. rossica* is heteroicous species, where both paroicous and dioicous phases are present, but *S. confertissimum* is apparently uniformly paroicous.

Distribution. Boreal Montane Circumpolar. In general, *S. confertissimum* is one of the most common species of the genus in the northern part of Europe, but it is much rarer in Siberia and the Russian Far East, as well as North America. The distribution in North America confined to Alaska, British Columbia, California and adjacent Nevada and Wyoming, eastward known in rater limited number of localities in Great Lakes area in Quebec, Michigan and Wisconsin. Previously, this species was recorded in the northern edge of California by Doyle and Stotler (2006), who indicated that the elevation for the species was lower than 1100 m a.s.l. The latter report is rather surprising, because those elevations contain temperate vegetation. Even in much colder Kamchatka the area of the species is above 1000 m a.s.l. Within the Russian Far East the species locally abundant in Kamchatka and, probably, Chukotka, with a few isolated records in Central Sakhalin, Khabarovsk Territory and Magadan Province.

Ecology. Acidophilic meso- to hygrophyte. The species prefers alpine to subalpine habitats, although it commonly descends into the boreal forest belt and also occurs in lowland tundras.

Specimens examined. RUSSIA, Buryatiya, Khamar-Daban Range (51°30'20"N 105°24'45"E), NK, 130-2a-01 16.VIII.2001 (KPABG), VB, 24-10 09.VIII.1999 (KPABG), NK, 26-1-02 30.VII.2002 (KPABG), (51°31'N 104°03'E), Melick H., 213211 15.IX.2010 (VBGI), Caucasus, Karachayevo-Cherkessiya

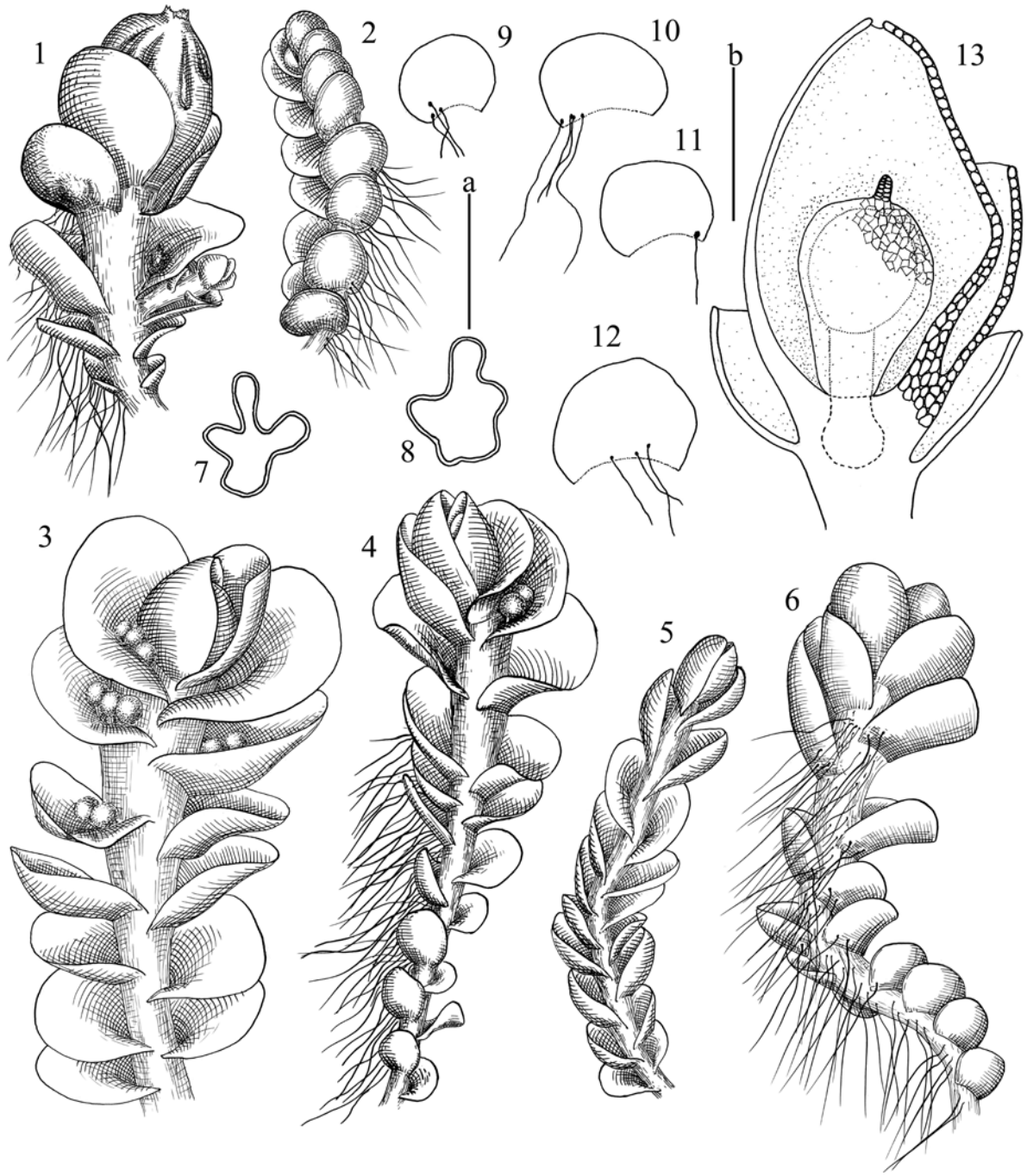

Figure 18 *Solenostoma confertissimum* (Nees) Schljakov: 1 – branch with perianth and androecia; 2, 5 – sterile branch; 3, 4 – branch with androecia and archegonia; 6 – branch with androecia and archegonia, ventral view; 7, 8 – perianth cross section at the middle part; 9–12 – leaves; 13 – perianth longitude section. 1, 3 – from KPABG-105424 (KPABG); 2, 5 – from K-57-17-02 (KPABG); 4, 6 – from KPABG-105177 (KPABG); 7–13 – from K-111-15-03 (KPABG). Scales: a – 1 mm, for 3–12; b – 500 μm, for 13

(43°43'14"N 40°41'30"E), NK, K336-1-08 17.IX.2008 (KPABG), (43°21'13"N 41°45'53"E), NK, K504-2-05 15.IX.2005 (KPABG), (43°15'16"N 41°48'52"E), NK, K520-4-05 17.IX.2005 (KPABG), (43°15'15"N 41°49'29"E), NK, K541-6-05 20.IX.2005 (KPABG), Chita Province, Udokan Range (57°08'N 119°30'E), VB, 11-3-00 07.VII.2000 (KPABG), Kamchatka, Central Kamchatka (55°55'N 158°40'E), VB, K-111-15-03 09.IX.2003 (KPABG, duplicate in VBGI), (55°45'N 157°52'E), VB, K-57-17-02 21.IX.2002 (KPABG, duplicate in VBGI), (55°40'N 157°55'E), VB, K-57-6-02 21.IX.2002 (KPABG), East Kamchatka (56°11'03"N 160°21'14"E), VB, K-40-5-03 21.VII.2003 (KPABG, duplicate in VBGI), Klyuchevskoj Dol, Czernyadjeva I.V., 22.VIII.2004 (VBGI), West Kamchatka (52°50'N 156°15'E), VB, K-10-18-03 04.VI.2003 (KPABG, duplicate in VBGI), Karelia, Loukhi District, VB, 19.VII.1998 (KPABG), Pryazhinskij District, VB, 22.VI.1997 (VBGI), Kemerovskaya Province, Kuznetskii Alatau Range (54°37'N 88°18'E), NK, 95-2-00 06.VII.2000 (KPABG), Khabarovsk Territory, Tardoki-Yani Mt., VB, Kh-40-19-23 (VBGI), Komi Republic, Troitsko-Pechyorskii District, Zheleznova G.V., 42-89 20.VI.1989 (KPABG), Magadan Province, Omsukchan District, VB, Mag-26-2-12 (VBGI), Murmansk Province, Chunatundra massif, VB, 5-9-02 27.VI.2002 (KPABG), Khibiny Mts., Schljakov R.N., 203 20.VIII.1966 (KPABG), Perm' Province, Basegi State Reserve (58°55'41"N 58°27'31"E), NK, K371-1-04 04.IX.2004 (KPABG), Yakutiya, Kodar Range, VB, 20-12-00 24.VII.2000 (KPABG); U.S.A., California, Humboldt Co. (41°09'N 123°41'W), Norris D.H., 17.02.1981 (NY00244362), Sierra Co., Theirs B.M., 06.VI.1988 (NY00243851), Wyoming, Shoshone

Natl. forest (43°58'N 109°31'W), NK, A32/3-95 27.VIII.1995 (KPABG, duplicate in VBGI).

CZECH REPUBLIC, Krkonose Mts., Váňa J. (KPABG); JAPAN, Nagano Pref., Yatsugatake Mt., Furuki T., 4058 01.IX.1982 (CBM); SLOVAKIA, Nizke Tatry, Váňa J., 17.VIII.1968 (TNS).

Solenostoma hyalinum (Lyell) Mitt., Nat. Hist. Azores, 319, 1870. (= *Plectocolea hyalina* (Lyell) Mitt., Trans. Linn. Soc. Bot. Ser., 2, 3: 198, 1891; *Jungermannia hyalina* Lyell, Brit. Jungermann. Pl., 63, 1814).

Description. Plants 0.8–2.5 (–3.0) mm wide, ca. 3–15 mm in length, creeping to loosely ascending (in perianthous plants only), hyaline, pale green to yellowish and brownish green. Stem 120–250 μm in diameter, orbicular in cross section, branching ventral (as innovations), become to normally developed shoots, dorsal surface cells slightly thick-walled, linear to long rectangular 60–150 × 15–22 μm, trigones indistinct. Rhizoids brownish, brownish-reddish, pinkish to nearly colorless, but almost always with distinct purplish tint, scattered to nearly numerous, in loose fascicles, commonly forming mat under stem. Leaves distant, flattened to slightly concave, inserted at angle of 15–25° with axis, dorsally clearly or barely decurrent up to 1/4 of stem width, ventrally subtransversely to arcuately inserted, not or barely decurrent, 400–1300 × 400–1200 μm (0.9–1.2 : 1), suborbicular, transversely elliptic to widely ovate, lingulate and reniform, sometimes loosely crispate at the margin. Cells in the midleaf subisodiametric hexagonal, thin- to (rarely) slightly thick-walled, walls colorless, 25–40 (–50) × 25–40 (50) μm, trigones small and concave to moderate in size and convex; along margin 25–38 μm, thin-walled, commonly with thickened external wall, trigones convex, cuticle smooth, with the exception of the lower third or area around margin, where sometimes obscurely striolate. Oil-bodies colorless to grayish, spherical, finely granulate, ca. 3.5–4.5 μm in diameter to oblong 8–15 (–22) × (4–) 6–8 μm, 2–8 (10) per cell. Dioicous. Perianth terminal, commonly with 1 innovation, mostly conical, rarely fusiform to spherical, loosely to distinctly pluriplicate, sometimes turbinate at the mouth, hidden within bracts or exerted up to 2/3 of its length, ca. 1000–1225 × 500–1000 μm, ca. 5 archegonia per perichaetium; perigynium ca. 1/2 – 2/3 of perianth length, with 1 pair of leaves; female bracts erect, transversely elliptic, undulate at margin and commonly retuse, ca. 1400 × 1750 μm. Androecia intercalary, different generations divided by 1–3 pairs of sterile leaves, with 3–4 pairs of bracts, 1–2-androus, body ellipsoidal 170–200 × 140–180 μm, brown, stalk biseriate, ca. 100–140 × 15–20 μm; male bracts ca. 900–1000 × 600–1080 μm, trapezoidal to ovate, shortly bilobed to retuse. Figures 19: 1, 2 and 20: 4–8.

Comment. Easily recognizable species when typical forms are in hand. Its characteristic features include prostrate growth form, pale color (that reflected the name), wider than long leaves that commonly truncate to emarginate near apex, more or less large size (shoots wider than 1.5 mm), dioicous inflorescence, pale brownish to pinkish rhizoids forming mat under the stem and leaf cells with moderate in size and mostly convex trigones. This typical and frequent in Europe form occurs in the Russian Far East as rarity and most of specimens from the area belong to leptodermous modifications characterized by smaller size and moderate in size to small concave trigones. The latter modifications may be mistaken with *Metasolenostoma ochotense* and *M. gracillimum* f. *gracillimum*. The possibility sometimes aggravates due to the occasional presence of weakly developed rim of slightly swollen cells along leaf margin in *Solenostoma hyalinum*. In that cases the main differentiation features of the latter from the formers are: 1) the presence of well developed perigynium in *S. hyalinum* (1/2 or more of perianth length versus less than 1/4 (1/3) in *Metasolenostoma ochotense* and very low perigynium in *M. gracillimum*); 2) comparatively short and conical perianth, as long as wide or slightly longer than wide, versus evidently 'solenostomoid' perianth nearly tubular in shape and with rostellate mouth; 3) no red or purple pigmentation, versus common (to uniform) presence of the latter in *M. gracillimum* and *M. ochotense*. Currently *M. gracillimum* f. *gracillimum* is not known in the Russian Far East and only a few isolated records are in western North America that also prevents misidentification in a manner.

On the other hand, confusion of well developed plants is likely possible with *Plectocolea infusca*, almost consistently replacing *Solenostoma hyalinum* southward of 50–45°N in the Russian Far East. The main differentiating features of *S. hyalinum* are: 1) colorless to grayish oil bodies that not filling cell lumen versus distinctly brownish and filling cell lumen in *P. infusca*; 2) larger leaves are always wider than long and commonly retuse to emarginate at apex, versus as long as wide leaves not emarginate in apex; 3) pale colored and in a manner hyaline plants versus always brightly colored *P. infusca*.

Despite the notes placed above it seems to be practical to review some deviating forms that is likely to find in treated area.

Specimen KPABG105726. The leptodermous form characterized by small size, dioicous inflorescence, characteristic coloration and well developed perigynium that suggests *Solenostoma hyalinum*. The short description is as following: Plants 0.6–1.0 mm wide (near perianth and in the largest plants up 1.5 mm wide), up 3–8 mm long, creeping, pale green. Stem 100–150 (in upper part of perianthous shoots slightly wider) μm, dorsal surface cells very thin-walled, with indistinct trigones, 35–60 × 15–18 μm. Rhizoids scattered, colorless. Leaves distant, flattened, inserted at angle of 15–25° with axis, dorsally shortly decurrent (up 1/6 of stem width), ventrally subtransversely inserted, line insertion arcuate, not decurrent, 300–450 × 300–625 μm (1 : 0.7–1), reniform, transversely elliptic to lingulate. Cells in the midleaf thin-walled, walls colorless, 20–28 × 18–26 μm, trigones small concave, near margin 20–23 μm, thin-walled, cuticle smooth. Dioicous. Perianth terminal, exerted from bracts for 1/2 of its length, conical, smoothed, ca. 750 × 500 μm, perigynium 2/3 of perianth length, with 1 pair of leaves, bracts erect from perigynium, ca. 550 × 800 μm, undulate at margin sometimes loosely retuse at apex.

Specimen PE00644681. This specimen collected as far from the treated area as in Sichuan (China) and characterized by 1) midleaf cells 42–67 × 37–47 μm, thin-walled, trigones small, concave, cells along margin 37–57 μm, thin-walled, trigones small, concave; cuticle smooth, rarely indistinctly papillose along margin; 2) rhizoids colorless to (rarely) light purplish. For the first view it resembles *Endogemma caespitici-*

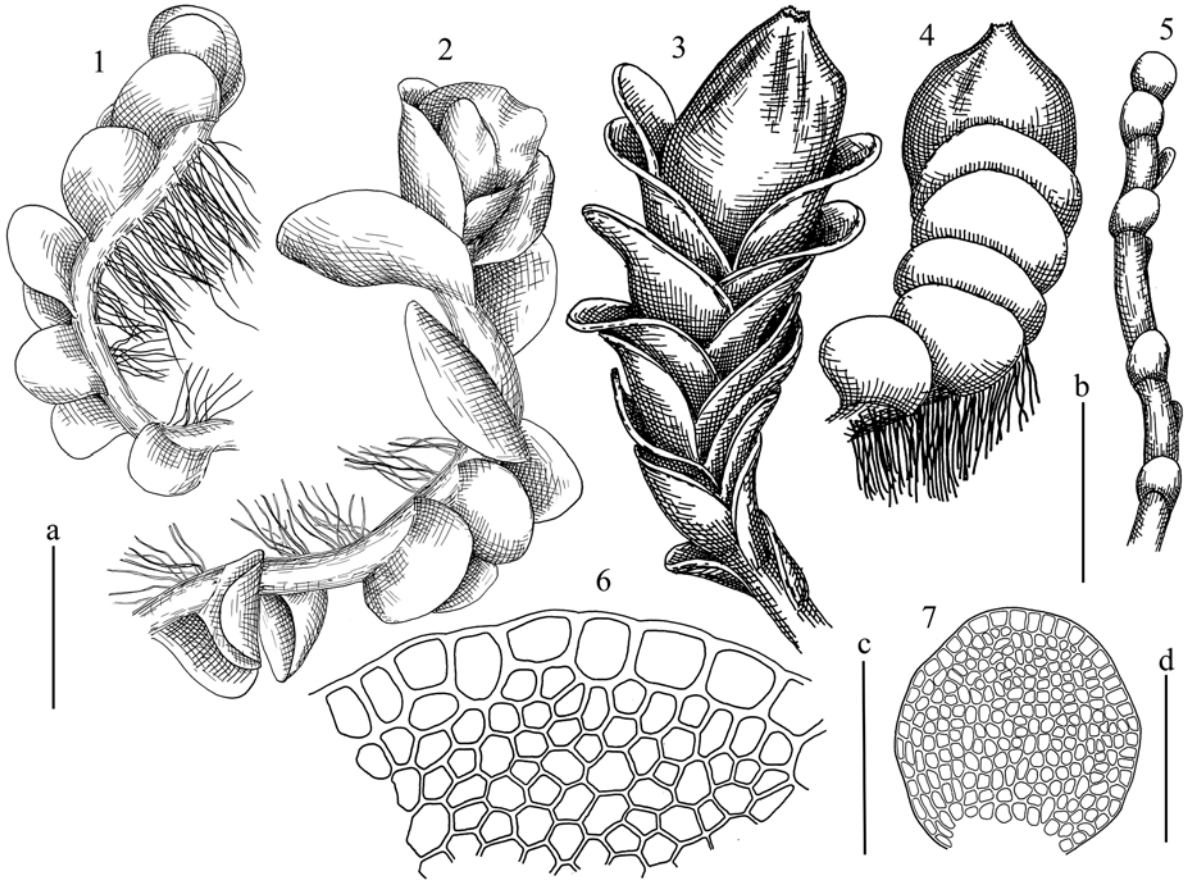

Figure 19 *Solenostoma hyalinum* (Lyell) Mitt.: 1, 2: 1 – sterile branch; 2 – branch with archegonia. 1, 2 – from KPABG-103773 (KPABG). *Metasolenostoma gracillimum* (Sm.) Vilnet et Bakalin f. *crenulatum* (J.E. Smith) Vilnet et Bakalin: 3–7: 3, 4 – branch with perianth; 5 – sterile depauperate branch; 6 – cells along leaf margin; 7 – leaf. 3–5 – from MO1091740 (MO); 6, 7 – from NY00243858 (NY). Scales: a – 1 mm, for 1, 2; b – 500 μm, for 3–5; c – 100 μm, for 6; d – 200 μm, for 7

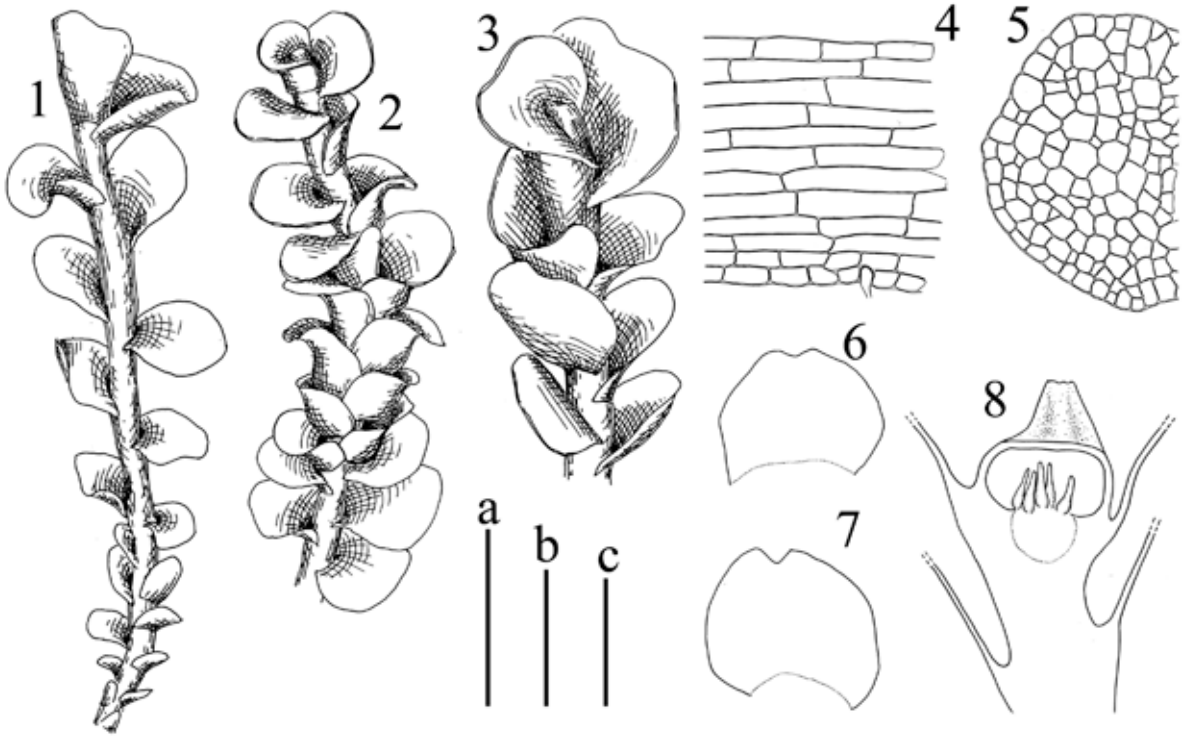

Figure 20 *Solenostoma rotundatum* Amak.: 1–3: 1 – sterile branch; 2 – male branch; 3 – branch with perianth. 1-3 – from K-12-5-07 (VBGI). *Solenostoma hyalinum* (Lyell) Mitt.: 4–8: 4 – stem longitude section; 5 – stem cross section; 6, 7 – leaves; 8 – perianth longitude section. 4–8 – from KPABG-105726. Scales: a – 1 mm, for 1–3; b – 100 μm, for 4, 5; c – 1 mm, for 6–8. Scale: a – 1 mm, for 1–6

um, but differs from the latter in leaf cell trigones presence, number of oil-bodies (just residues were found, ca. 4–5 per cell). Although it differs from typical *Solenostoma hyalinum* in subtransversely inserted, concave leaves and larger leaf cells.

Specimen NY00244209. The specimen is sterile and difficult to separate it from *Solenostoma obovatum*. Like *S. obovatum* it has more or less deep color, but trigones are distinctly convex (rarely occur in *S. obovatum*) and cuticle is uniformly smooth that is not characteristic especially for deeply colored phases of *S. obovatum*.

Distribution. Boreo-Temperate Montane(?) circumpolar. In Western North America the species is distributed throughout from Alaska to British Columbia and Alberta and southward in Washington, Oregon and California. When in Alaska and Canada the distribution of the species starts nearly from sea level, southward minimal altitude gradually increases. Total altitudinal diapason in North America stretches from near sea level to 2500 m alt. At the rest part of North America the species presents in the majority of administrative subunits, with expectable absence in southern dry or warm states such as Texas and Florida. Due to data in hand, in addition to the mentioned western administrative subunits it also grows in Canadian Ontario and Quebec, and U.S.A.'s Arizona, Colorado, Connecticut, District of Columbia, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Massachusetts, Michigan, Minnesota, Mississippi, New Hampshire, New Mexico, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Virginia, Wisconsin, Wyoming. In the Russian Far East the species distributed from Chukotka to Kurils and Sakhalin and does not occurs in Primorskii Territory, being more or less common in northern half of the area. Westward in Siberia this species sparsely distributed, although locally abundant in some areas of the northern half. The altitudinal diapason in the Russian Far East stretches from near sea level to 900–1400 m a.s.l. (upper elevation in southern part of the Far East). In general outline this species is much rarer in the Pacific Russia than in northern Europe, because a lot of taxa (*Plectocolea ovalifolia*, *P. kurilensis*, etc) vicariously replacing it in the former and prevent the realization of potential distribution.

Ecology. Acidophilic meso-hygrophyte. The species prefers mountain tundras and boreal coniferous forests, where growing on wet soil (both sandy and humic) along streams, rarer in wet mossy tundras, among mosses or along margin of solifluction spots, also sometimes it occurs at wet clayish roadsides. Throughout its area within North Pacific the species inclined to occupy semi-shaded moist to wet habitats.

Specimens examined. RUSSIA, Buryatiya, Khamar-Daban Range, NK, 66-3-02 04.VIII.2002 (KPABG), Caucasus, Karachayevo-Cherkessiya (43°43'45"N 40°41'47"E), NK, K311-2-08 15.IX.2008 (KPABG), Kamchatka, East Kamchatka (53°20'N 158°30'E), VB, K-56-10-01 07.VIII.2001 (KPABG, duplicate in VBGI), (53°10'N 158°70'E), VB, K-68-7-01 14.VIII.2001 (KPABG, duplicate in VBGI), (54°25'50"N 160°08'22"E), Chernyagina O.A., 10.IX.1988 (VBGI), West Kamchatka (52°50'N 156°15'E), VB, K-9-12-03 04.VI.2003 (KPABG, duplicate in VBGI), Karelia, Kalevala District (64°37'N 30°41'E), Kuznetsova S.Ya., 29.VII.1972 (KPABG, duplicate in VBGI), Kojtajoki (63°02'26"N 31°25'04"E), Maksimov A.I., 10.VIII.1997 (VBGI), Loukhi District, VB, 82 19.VII.1998 (KPABG), VB, 08.VIII.1997 (KPABG), Pryazhinskij District, VB, 22.VI.1997 (KPABG), Pudozhskii Disrict, Lapshin P.N., 09.VIII.1999 (KPABG), Suoyarvi District (63°02'26"N 31°25'04"E), Maksimov A.I., 10.VIII.1997 (VBGI), Kemerovskaya Province, Kuznetskii Alatau Range (54°37'N 88°18'E), NK, 95-2-00 06.VII.2000 (KPABG), Khabarovsk Territory, Solnechnyj District (50°41'12"N 136°27'02"E), VB, Kh-6-22-07 30.V.2007 (VBGI), Verkhnebureinskij District (52°05'N 135°00'E), Ignatov M.S., 27.VIII.1997 (KPABG, duplicate in VBGI), (51°58'N 134°52'E), Ignatov M.S., 21.VIII.1997 (KPABG, duplicate in VBGI), Komi Republic, Troitsko-Pechyorskii District (64°46'N 55°51'E), Dulin M.V. 25.VI.2001 (KPABG), Kurils Islands, Iturup Island (44°54'43"N 147°28'38"E), VB, K-13-13-07 08.VIII.2007 (VBGI), (45°15'32"N 148°10'23"E), VB, K-66-7a-05 22.IX.2005 (VBGI), (45°15'48"N 148°13'03"E), VB, K-67-3a-05 23.IX.2005 (VBGI); Kunashir Island (44°15'21"N 146°05'57"E), VB, K-63-22-06 17.IX.2006 (VBGI), Murmansk Province, Iokanga River Basin, NK, 58-1-97 17.IX.1997 (KPABG), Kandalaksha Bay, NK, 414-2-92 19.VIII.1992 (KPABG), Khibiny Mts., NK, 309c-00 19.VIII.2000 (KPABG), Kovdozero Lake area, NK, K82-1-05 11.VIII.2005 (KPABG), Ponoj River upper course, Schljakov R.N., 112 13.VII.1975 (KPABG), Sal'nyye tundry massif, VB, 15-1-01 01.VII.2001 (KPABG), Umbozero Lake area, NK, K200-12-04 13.VIII.2004 (KPABG), Perm' Province, Basegi State Reserve (58°59'02"N 58°34'12"E), NK, K351-2-04 02.IX.2004 (KPABG), Sakhalin Island, Belaya River (47°15'00"N 142°47'46"E), Harpel J. & Cherdantseva V.Ya., 16.VII.2001 (KPABG, duplicate in VBGI), Schmidt Peninsula (54°01'01"N 142°56'34"E), VB, S-41-9-09 29.VIII.2009 (VBGI), Yakutiya, Udokan Range, VB, 1-44-00 03.VII.2000 (KPABG); CANADA, British Columbia, Marble Mt., Schofield W.B., 58716 05.VII.1975 (KPABG); U.S.A., Alabama, Dekalb, Smith T.E., 29.VIII.1985 (MO5635347), Illinois, La Salle, Redfearn P.L., 11.VII.1973 (MO5635732), Voth P.D., 11.XI.1938 (MO5213238), Kansas, Douglas Co., Ungar I.A., 27.IX.1959 (NY00244258), New Jersey, Palisades, Austin C., 1873 (NY00244413), North Carolina, Jackson Co., Schuster R.M., 39468 22.VII.1957 (F), Ohio, Leanga Co., Hacker O., 01.X.1893 (NY00244209), Urbana Co., Hainitz M.P., 1885 (NY00244208).

CHINA, Jiangsu, Wuzhifeng Mt., Mu Zang, 102, 30.VI.1957 (PE 01093388), Jilin, Changbaishan Mt., on rock, 1660 m alt., Sun J., 704 (IFP 00026718), Sun J., 696 (IFP 00026284), Sun J., 701 (IFP 00026557), Liaoning, Dandong, Jinjiang Mt., Gao C., 8530 (IFP 00023633), Sichuan, Miyi Co., Wang L.S., 83-685 (IFP 00024555), Wang L.S. 83-685 (IFP 00024579), Muli Co., Yazui Forest Farm, on soil, Gao C., 21194 (IFP 00023842), Wenchuan, Wolong, on stone, 2500 m alt., Jianxin Luo, 03397, 23.VII.1981 (PE 00660767), (29°00'N 99°25'E), Yu Jia J07252 14.VII.2004 (PE 00644681), Yunnan, Kunming, 1620 m alt., Xu W.X., 865 (IFP 00003373), Lijiang, Xiangshan Mt., 2600 m alt., Li X.J., 86167 (IFP 00024466), Gongshan County, Gaoligong Mt., west slope, on stone near river, 2000 m alt., Mei Zhi Wang, 9678a 28.VII.1982 (PE); CZECH REPUBLIC, Krkoše, J. Váňa (KPABG); FINLAND, Regio aboensis, Lindberg H. & Lindberg S.O., 05.VII.1878 (KPABG); FRANCE, Haute Savoie, Voirons, Bernet H., 05.VI.1881 (F); GEORGIA, Adjara, Chulo, Woronow G., 14.VIII.1910 (TBI), Woronow G., 05.VIII.1910 (TBI), 2200 m alt., subalpine belt, on soil. 20.VIII.1971. N. Chikovani (VBGI), VB, G-11-23-13 (VBGI); JAPAN, Aichi Pref., Sarunage Mt. Nishikamogun, Ogasawara, 2646 09.III.1969 (HIRO), Aomori Pref., Towada-shi, Oirase Gorge, near junction with Sobe River (40°32'N 140°58'E), Ota M. & T. Furuki, 23428 30.IX.2013 (CBM), Fukushima Pref., Fujiwara, Watanabe R., 3160 30.III.1959 (NICH), Hokkaido Pref., Akancho, Takida K., 223 05.VIII.1978 (NICH), Kushiro-cho, Takita K., 343 12.VIII.1980 (SAPT), Rebun Island, Kafukai, Hasegawa J., 7967 27.VIII.1984 (KYO), Sounkyo-Mt. Kurodake in Daisetsu Mts., Kuwahara Y., 5732/1904 21.VII.1956 (HIRO), Tanninkyo, Daisetsu Mt. Shimizu D. (ex NICH54964/1903) 19.VIII.1954 (HIRO), Yubetsu, Takita K., 223 05.VIII.1978 (SAPT), Ishikawa Pref., Hakusan Mt., Akiyama H., 3201 23.VII.1982 (KYO), Shimane Pref., Kaminogimachi, Matsue, Shimose S., 1067/2622 27.II.1966 (HIRO), Tochigi Pref., Nikko city, Ooyagawa, Kitagawa N., 15939 07.X.1977 (KYO); SOUTH KOREA, Jeonnam Prov., Namhae Island (34°42'46"N 127°58'43"E), 65 m alt., VB Kor-23-01-11 21.V.2011 (VBGI).

Solenostoma obovatum (Nees) R.M. Schust., Hep. Anth. N. Amer., 2: 1007, 1969. (= *Plectocolea obovata* (Nees) Mitt. Fl.

Vit., 405, 1873; *Jungermannia obovata* Nees Naturgesch. Eur. Leberm., 1: 332, 1833)

Description. Plants 4–15 mm long and 2.2–2.5 mm wide, ascending, dirty yellowish green, yellowish greenish, dirty-yellowish brown. Stem 240–290 μm wide and 120–180 μm high, branching rarely occur, lateral or ventral; dorsal surface cells 63–125 × 20–23 μm, long rectangular, obliquely rectangular to linear, walls slightly thickened, trigones indistinct to concave and small; in the stem cross section outer cells slightly larger than inner ones, ca. 20–25 μm in diameter, walls slightly thickened, inner ca. 12–23 μm in diameter, mostly penta- to hexagonal, trigones indistinct. Rhizoids deep purple, sparse, decurrent down the stem. Leaves distant to contiguous, inserted at angle 15–20° with axis, dorsally clearly decurrent up 1/3 of the stem width, ventrally subtransversely to arcuately inserted, not decurrent; 1050–1225 × 1050–1120 μm (1 : 0.9–1.15), lingulate to trapezoidal, sometimes emarginate or retuse at apex, flattened to concave. Cells in the midleaf 20–25 × 15–22 μm, mostly tetra- to pentagonal, walls colorless, slightly thickened, trigones distinct, mostly concave, rarely triangular; along margin 15–18 μm, thin-walled, walls yellowish to yellowish-brownish, trigones triangle to slightly convex, cuticle smooth. Oil-bodies 2–5 (–6) per cell, spherical, 4–8 (–10) μm in diameter to ellipsoidal 6–15 (–20) × 4–8 (–10) μm. Paroicous. Perianth terminal, exerted from bracts for 1/4 of its length, conical, pluriplicate, sometimes turbinate, ca. 750 × 750 μm; perigynium 3/2 – 4/2 of perianth length; female bracts the same size with male bracts, sheathing perigynium in the base, with apex deflexed. Androecia below perianths, commonly divided from the latter by 1–3 pairs of sterile leaves, with 3–4 pairs of bracts, ca. 900–1000 × 600–1080 μm, trapezoidal to ovate, shortly bilobate to retuse, with 1–2 antheridia per bract, antheridial body ellipsoidal 170–200 × 140–180 μm, brown, stalk biseriate, ca. 100–140 × 15–20 μm. Seta ca. 150 μm in diameter and 9000 μm long. Capsule 700–1000 μm in length, ellipsoidal, capsule wall bistratose, outer layer cells subquadrate to rectangular, 20–40 × 28–35 μm, with 2 nodular thickenings in each vertical wall, inner cells irregularly linear, 30–90 × 8–20 μm with 6–11 annular thickenings. Elaters ca. 150 × 12, bispiral, with narrowed homogenous ends. Spores finely papillose, spherical, 20–22 μm in diameter.

Comment. This species characterized by paroicous inflorescence, high perigynium that exceeding the perianth in length, wider than long leaves, more or less large size (commonly wider than 2.2 mm) and deep purple rhizoids. When fertile, the only related species is *Solenostoma subellipticum*. The latter differs from the former in smaller size (less than 2.0 mm wide in *S. subellipticum*), commonly brownish to grayish and purplish, but very rare purple rhizoids, and commonly longer than wide leaves. The latter feature is not constant and some phases, which were referred to *S. obovatum* from the Russian Far East, basing on this feature, really belong to *S. subellipticum* (the re-identification was also confirmed by DNA analysis, cf. Bakalin & Vilnet 2012). The sterile plants may be confused with *S. obscurum* and *Plectocolea ovalifolia*. Both do not occur northward of 55°N in the Russian Far East. However, in the Western North America *Solenostoma obscurum* meets *S. obovatum* in Alaska, British Columbia, Washington and Oregon. Sterile plants of *S. obovatum* may be distinguished from both *Plectocolea ovalifolia* and *Solenostoma obscurum* by larger size, exceeding 2.2 mm wide. Also *S. obscurum* commonly has whitish and glistening stem (especially obvious in dry plants), due to hyaloderm layer presence – a trait not present in *S. obovatum*. Nevertheless some forms of *S. obovatum* may be not differentiable in sterile conditions from the former.

Distribution. Arctic to Arcto-Boreal Montane sub-circumpolar. It unexpectedly does not occur in the northern part of the Russian Far East, all previous records (Bakalin 2010) are the misidentification for *Solenostoma subellipticum*. Contrary, this species is not rare in Western North America and known from Alaska, Alberta, British Columbia, Washington, Oregon and California. Eastward, after rather disjunctive locality in Montana it re-appears in Newfoundland, Quebec, Maine, New Hampshire and Vermont.

Ecology. Acidophilic meso- to hygrophyte. The species prefers shaded or open wet rocks and soil along streams, or rarely growing submerged. Generally it occurs in tundras and north boreal types of coniferous forests or corresponding belts of mountains situated southward.

Specimens examined. RUSSIA, Buryatiya, Khamar-Daban Range (51°30'07"N 105°24'08"E), NK, 136-6-01 16.VIII.2001 (KPABG), NK 45-1-01 07.VIII.2001 (KPABG), Caucasus, Karachayevo-Cherkessiya (43°43'39"N 40°41'13"E), NK, K322-2-08 16.IX.2008 (KPABG), (43°43'37"N 40°41'09"E), NK, K324-1-08 16.IX.2008 (KPABG), (43°16'54"N 41°37'05"E), NK, K415-1-05 07.IX.2005 (KPABG), Chita Province, Udokan Range, VB, 5-11-00 05.VII.2000 (KPABG), Kamchatka, Central Kamchatka (55°40'N 157°40'E), VB, K-50-24-02 14.IX.2002 (KPABG, duplicate in VBGI), Karelia, Loukhi District, VB, 08.VIII.1997 (KPABG), Kemerovskaya Province, Kuznetskii Alatau Range (54°39'N 88°25'E), NK, 60-1-00 28.VI.2000 (KPABG), (54°42'N 88°27'E), NK, VI.2000 (KPABG), Pisarenko O.Yu. 18.VII.1998 (KPABG), Khabarovsk Territory, Ulchinskii District (51°28'15"N 139°52'53"E), Roenko E., 48/5 08.VIII.2011 (VBGI), Komi Republic, Troitsko-Pechyorskii District, Zheleznova G.V., 13-85 18.VI.1985 (KPABG), Murmansk Province, Khibiny Mts., NK, 315-2-00 20.VIII.2000 (KPABG), (67°39'56"N 33°51'33"E), Schljakov R.N., 21.VII.1974 (KPABG, duplicate in VBGI), NK 27.VIII.1987 (KPABG), Lavna-Tundra Mts., NK, 152/4 01.VIII.1988 (KPABG), Lovozerskii District (67°33'21"N 35°16'24"E), NK, K208-11-07 09.IX.2007 (KPABG), Ponoj River lower course, Schljakov R.N., 474 02.VIII.1972 (KPABG), Rybachij Peninsula, NK, 17/7 10.VII.1981 (KPABG), Perm' Province, Basegi State Reserve (58°54'53"N 58°29'34"E), NK, K318-4-04 31.VIII.2004 (KPABG), (58°56'09"N 58°34'19"E), NK, K345-5-04 01.IX.2004 (KPABG), (58°48'46"N 58°22'40"E), NK, K382-3b-04 06.IX.2004 (KPABG); CANADA, British Columbia, Vancouver (49°27'N 123°17'E), NK, A96/2-95 24.IX.1995 (KPABG, duplicate in VBGI); U.S.A., Alaska, Kodiak I., Trelease W., 03.VII.1899 (MO5374479), Wyoming, Park Co., moss-lined peaty banks of stream, in shade of willows, 3100 m alt. (44°55.015-020'N 109°29.884-886'W), Kosovich-Anderson Ye. I., #5655 25.VIII.2009 (herb. Kosovic h-Anderson, duplicate in VBGI).

SLOVAKIA, Nizke Tatry, Franklová H., 30.VIII.1987 (KPABG).

Solenostoma obscurum (A. Evans) R.M. Schust., Rhodora, 59: 252, 1957. (= *Plectocolea obscura* (A. Evans) A. Evans in H. Buch, A. Evans & Verdoorn, Ann. Bryol., 10: 4, 1938; *Nardia obscura* A. Evans, Rhodora, 21: 159, 1919; *Jungermannia evansii* Váňa, Folia Geobot. Phytotax., 10: 69, 1975).

Plants 0.7–2.2 mm wide, up 3–10 mm long, ascending to creeping, dark green, dirty green to brownish green, brow-

nish, brown and yellowish brown, commonly with purple coloration in leaf base (especially near androecia), commonly with very peculiar purple-light violet tint, especially near perianths and shoot apex. Stem 150–400 μm in diameter, mostly whitish and glistening, especially when dry, orbicular to transversely elliptic in cross section, branching lateral and ventral (mostly as subfloral innovations), dorsal surface cells thin- to thick-walled, with indistinct trigones, 60–150 (–180) × 15–30 μm, cuticle striolate; stem cross section sometimes 3-stratose, with outer (hyaloderm) with thin external wall and moderately thickened other walls, ca. 12–25 μm in diameter, medium (scleroderm) composed by thick-walled cells, walls yellowish in color, ca. 12–20 μm in diameter, inner cells with walls thin to moderately thickened, cells mostly polygonal, ca. 12–22 μm in diameter, cell walls colorless; in poorly developed plants the aforementioned strata are not well defined. Rhizoids more or less rigid, purple, purple-violet, purple-brown, blackish violet, to pink-rose, scattered to numerous, spreading separately or in unclear fascicles and forming loose mat under stem, rarely decurrent down stem in the not well-defined fascicles. Leaves distant to contiguous, sheathing in the base and erect spreading above, flattened to concave and concave-canaliculate, inserted at angle of (15–) 50–80° with axis, dorsally subtransversely inserted not- or decurrent up 1/4 of stem width, ventrally subtransversely to arcuately inserted, not- or decurrent for 1/4 of stem width, 280–1225 × 300–1200 μm ((0.8–) 0.9–1 : 0.9–1), ovate to reniform and elliptic to transversely elliptic with rounded to retuse apex. Cells in the midleaf thin-walled, rarely thick-walled, with rounded lumen, walls sometimes flexuous, purplish to brownish and colorless, 27–35 (–42) × 26–34 μm, trigones large to moderate in size, triangular to convex, along margin 15–28 (33) μm, cell walls thin, but with thickened external wall, walls brownish, purplish to colorless, trigones large, convex to triangle, locally confluent, leaf margin sometimes discolored; cuticle distinctly papillose (at least in the midleaf), rarely almost smooth; oil bodies finely papillose, (1) 2–3 per cell, 8–16 × 6–8 μm. Dioicous. Perianth hidden within bracts, or exerted less than for 1/4 of its length, frequently with 1 ventral innovation, conical, mostly 3-plicate (1 dorsal and 2 lateral) or pluriplicate, with plicae commonly undulate near the mouth, sometimes loosely turbinate at the mouth, 330–1000 × 470–750 μm, with ca. 5–6 archegonia per perichaetium; mouth crenulate due to protrudent conical thick-walled cells, walls yellowish to brownish; cells in the perianth middle 25–62 × 10–25 μm, thin- to thick-walled; cells near perianth base similar to middle, perianth unistratose throughout or, rarely bistratose in lower third, cuticle commonly distinctly striolate; perigynium 1/1 – 2/1 of perianth length, in large part bare (not covered by leaves), rhizogenous ventrally, with 1–2 pairs of leaves; female bracts sheathing perigynium in the base and erect to deflexed above, ca. 600–1750 × 750–1470 μm, sometimes undulate at margin and clearly emarginate at apex. Androecia intercalary, spicate or not, with 2–4 pairs of bracts, different generations divided by at least 6–7 pairs of sterile leaves, 1 (2)-androus, antheridial stalk 2-seriate, 40–120 × 15–30 μm, bracts transversely elliptic, sometimes purple to purplish-violet, concave, inflated at the base and erect spreading to deflexed in upper part, ca. 500–700 × 700–800 μm. Figure 21.

Comment. Mostly easily recognizable species due to whitish and glistening stem (that may be explained by hyaloderm tissue presence), high perigynium (1–2 of perianth length), purple rhizoids and dioicous inflorescence. When fertile may be confused with *Plectocolea ovalifolia* and weakly developed forms of *P. schusteriana*. *Solenostoma obscurum* differs from *Plectocolea ovalifolia* in high perigynium, more that 1 of perianth length (versus not more than 1/2), glistening stem, and also distribution. Due to data in hand, *Solenostoma obscurum* is distributed in Western North America (where *Plectocolea ovalifolia* is not known) and middle to southern continental Russian Far East (only one record in Kamchatka existing, but the latter is from the central part of the peninsula – an area with rather subcontinental climate). Contrary *P. ovalifolia* distributed mostly in insular part on eastern border of the Russian Far East (the north-easternmost point is in Commanders). The confusion with *P. schusteriana* seems to be less probable, although both species commonly have differentiation of the stem tissue into hyaloderm and scleroderm (uncommon feature in *Plectocolea* and *Solenostoma*). *Plectocolea schusteriana* in the most cases is much larger in size (both leaves and plants) than *Solenostoma obscurum*. Two species also differs in oil body structure that supposedly is botrioidal in *Plectocolea schusteriana*. Howev, the latter feature may be not stable in the *P. schusteriana*. I did not see oil-bodies of *P. schusteriana*, but W.S. Hong, in notice in the herbarium sheet (UBC-b84162), noted that no grape-cluster bodies were observed. Additionally two species may be distinguished by leaf shape that is longer than wide in *Solenostoma obscurum* contrary to wider than long in *Plectocolea schusteriana*. Despite the listed differentiations some forms merge two species (e.g. UBC-b25831) and may be named only tentatively. When sterile, aside aforementioned taxa *Solenostoma obscurum* may be mistaken with *S. subellipticum*. In that case main attention should be paid to stem coloration (whitish and glistening in *S. obscurum*, versus brownish and dull in *S. subellipticum* and *Plectocolea ovalifolia*), common presence of hyaloderm tissue in the stem of *Solenostoma obscurum* (absent in *S. subellipticum* and *Plectocolea ovalifolia*) and purple rhizoids (colorless to brownish and slightly purplish in *Solenostoma subellipticum*, but also purple in *Plectocolea ovalifolia*).

Distribution. Amphi-North Pacific Montane Boreal. This species until recently was treated as North American endemic, but recently (Potemkin 2003) it was recorded for Russia from Kamchatka and shortly was found in many other localities in the Russian Far East, as well as from Republic of Korea (Bakalin 2010). In Western North America it is currently known from Alaska, British Columbia, Oregon and Washington, eastward occurs in the land of eastern side of USA, stretching from Maine, Vermont, New Hampshire, Massachusetts and New York to North Carolina, Tennessee and even Georgia. Within the Russian Far East the species known from South Kamchatka, southern part of Primorskii Territory and isolate locality in Tardoki-Yani Mt. in southern part of Khabarovsk Territory. This is the taxon of

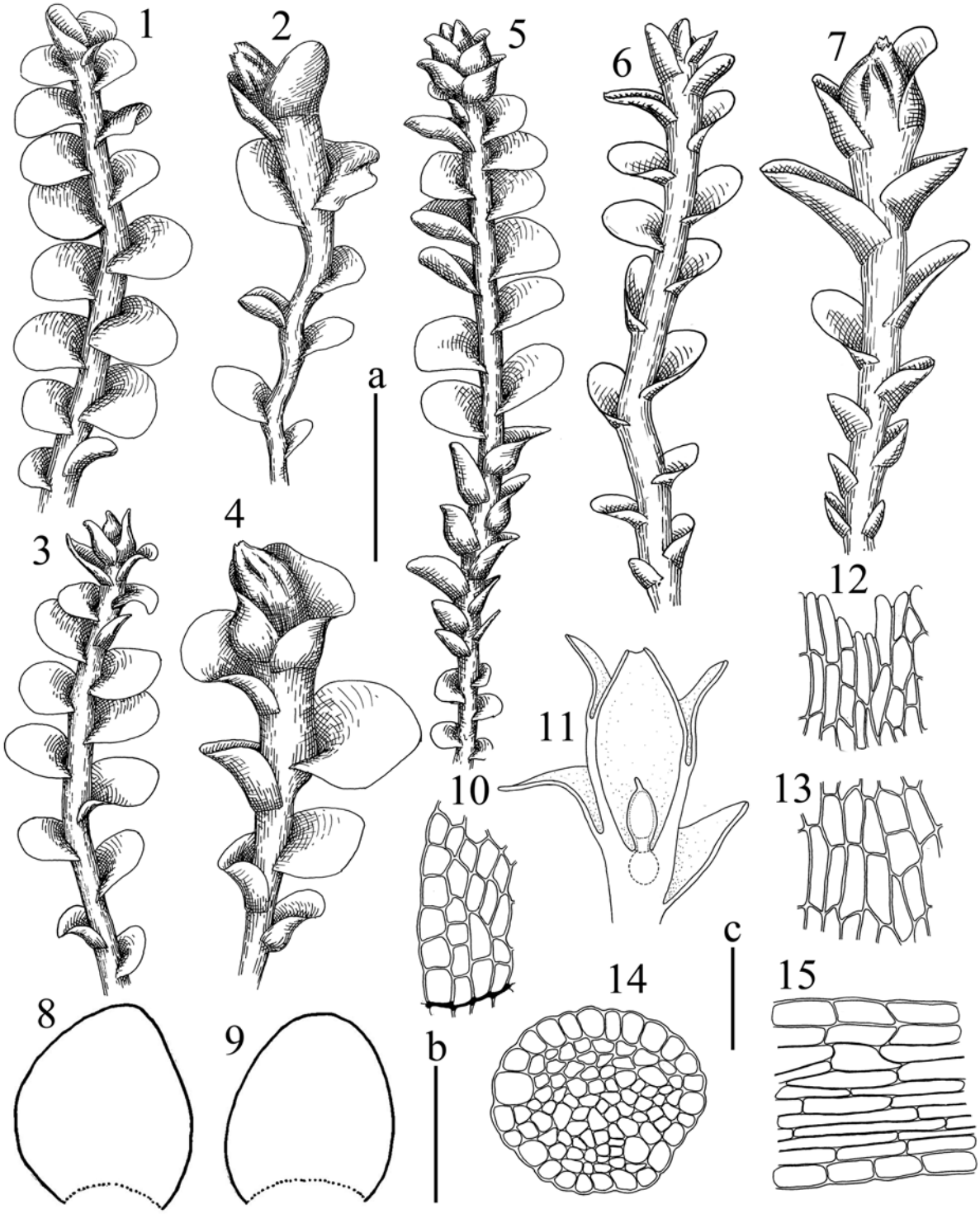

Figure 21 *Solenostoma obscurum* (A. Evans) R.M. Schust.: 1, 3, 6 – sterile branch; 2, 4, 7 – branch with perianth; 5 – branch with androecia; 8, 9 – leaves; 10 – leaf cells in ventral base; 11 – perianth longitude section; 12 – perianth mouth; 13 – cells in the perianth lower part; 14 – stem cross section; 15 – stem longitude section. 1–5 – from P-65-3-06 (VBGI); 6–15 – from Czernyadjeva I.V., 12.VIII.2002 (LE, duplicate in VBGI). Scales: a – 1 mm, for 1-7, 11; b – 500 μm, for 8, 9; c – 100 μm, for 10, 12–15

middle to high mountain elevation and found in Russian Pacific from 400 to 1500 m a.s.l. and occurs even higher (presumable up 3000 m a.s.l.) in southern part of its area in North America. The material discussed under "*Jungermannia* sp. nov." by Davison (1993) most probably belong to this species. The only difference announced by Davison (l.c.) is shortly bilobed leaves. However, in my experience *P. obscura* frequently has such shortly bilobed leaves and I agree with J. Váňa (cited from Davison 1993: 71) this taxon "may be no more than an environmentally induced form of *J. evansii*" (= *Solenostoma obscurum*).

Ecology. Acidophilic hygro-mesophite. The species prefers moist to mesic semi-shaded cliffs of acidic reaction, near temporary streams. It grows in crooked forests belt and mountainous boreal coniferous forests, rarely penetrating to temperate broadleaved forests and not known in tundra.

In East Asia, aside of the Russian Far East there is one isolated locality of *P. obscura* in Seorak Mts. in northern part of South Korea, – the place relatively rich in relict records of some other bryophytes and vascular plants, such as *Scapania sphaerifera* Buch et Tuomik. and *Pinus pumila* (Pall.) Regel.

Specimens examined. RUSSIA, Chita Province, Udokan Range, VB, 5-5-00 05.VII.2000 (KPABG), Kamchatka, South Kamchatka (52°54'N 157°30'E), Czernyadjeva I.V., 12.VIII.2002 (LE, duplicate in VBGI), Primorskii Territory, Partizansk District (43°05'05"N 132°41'40"E), VB, P-56-1-08 07.X.2008 (VBGI), Partizansk District (43°20'50"N 133°39'22"E), VB, P-65-38-06 03.X.2006 (VBGI), Shkotovskii District, Pidan Mt. (43°06'07"N 132°41'31"E), VB, P-38-6-10 06.IX.2010 (VBGI), P-72-32a-05 09.X.2005 (VBGI), (43°20'50"N 133°39'22"E), VB, P-66-6-06 04.X.2006 (VBGI), Khabarovsk Territory, Tardoki-Yani Mt., VB, Kh-40-4-13 (VBGI), VB, Kh-32-27-13 (VBGI); U.S.A., Maine, Jordan Mt., Lorenz A., 22.VII.1920 (NY00243934), North Carolina, Cherockee, Schuster R.M., 01.VI.1952 (NY00243936).

JAPAN, Hokkaido Pref., Hidaka Mts., Petagiri Mt., Inoue H., 70133 26.VII.1970 (TNS); SOUTH KOREA, Kangwon Province, Seorak Mt. (38°07'33"N 128°27'22"E), VB, Kor-10-42-11 12.V.2011 (VBGI).

Solenostoma pseudopyriflorum Bakalin & Vilnet, Arctoa 18: 159, 2009[2010]

Description. Plants rigid, erect to ascending, light-green to yellow-green, yellowish brown and purplish brown, characteristically with purplish to purple-red color in leaf base and stem, and sometimes perianth (particularly in its lower half). Shoots (3) 5–15 mm long, 1.0–2.7 mm wide. Stem (0.15) 0.2–0.3 (0.4) mm wide, orbicular in cross section, branching rarely occurs, ventral or lateral, originated as innovations, but gives rise to normally developed shoots, dorsal surface cell walls slightly to moderately thickened, walls brown, brownish to purplish, with small concave trigones, (28) 60–90 (120) × (15) 20–26 (32) μm. Rhizoids scattered to numerous, erect or decurrent down stem in indistinct fascicles, purple to purplish brown, light rose, rarely colorless (in some part of shoots). Leaves distant to contiguous and subimbricate, erect spreading, subtransversely to obliquely oriented, inserted at angle of (45) 60–85° with stem, dorsally decurrent for 1/6 – 1/3 (2/3) of stem width, on ventral side subtransversely to arcuately inserted, not or barely decurrent or decurrent up to 1/2 of stem width, widely ovoid to widely triangular, suborbicular and transversely oval, flattened to concave-canaliculate, sometimes with deflexed apex, rarely undulate at margin, wider than long, 0.72–1.20 × 0.72–1.50 mm (1 : 0.8–0.9 (–1)), to longer than wide, 0.68–0.90 × 0.66–0.83 mm (0.9–1 : 1). Cells in midleaf thin-walled, lumen subquadrate to rounded, (17) 25–40 (45) × (14) 15–28 (32) μm, walls colorless to rose and purplish, trigones small to large in size, concave to convex, near margin (14) 17–26 (30) μm, thin-walled, trigones distinct, triangle to convex, external walls frequently thickened, cuticle smooth throughout. Paroicous. Perianth terminal, deep green to purple-green, obpyriform or widely clavate to cylindrical, emergent up to 2/3 of its length from bracts, smooth or weakly 3–4-plicate in upper part, sometimes with 1 ventral innovation (once dorsal innovation was found in K-12-8-07), weakly rhizogenous in basal part (both dorsal, lateral and ventral sides), ca. 1.8–2.2 × 1.0 mm; perigynium indistinct or up to 1/5 of perianth length, archegonia 5–15 per perichaetium, female bracts equal in size with male bracts, undulate at margin, loosely clinging perianth in lower part, bracteole absent. Androecia with (1) 2 (3) pairs of bracts below female bracts, or separated from the latter by 1 pair of sterile leaves; antheridia 1–2 per bract, easily disintegrate; antheridial body nearly spherical, ca. 120 μm in diameter, stalk with 2 (rarely, near stalk base with 1) cell rows, ca. 70 μm long, bracts concave, widely oval to nearly orbicular, ca. (0.75) 0.95–1.10 × (1.00) 1.10–1.30 μm, loosely inflated at base and purplish in inflated area, with deflexed apices. Capsule ellipsoidal, ca. 500 × 300 μm, bistratose, inner cells flexuous-linear, ca. 60–80 × 9 μm with 6–11 annular thickenings, outer cells ca. 32 × 28 μm, subquadrate, with 2 nodular thickenings on each vertical wall. Seta ca. 70 mm in diameter and ca. 5 mm long. Spores ca. 18 μm, finely papillose, reddish brown, elaters ca. 150–180 × 5–9 μm, bispiral, with elongated (up 25 μm long) gradually narrowed ends. Figure 22.

Comment. Within area treated this is easily recognizable species die to combination of the following characteristics: 1) paroicous inflorescence, 2) almost uniform presence of purple to purplish coloration, 3) concave-canaliculate, erect spreading leaves, 4) occurrence in the Russian Far East southward of 55°N (in South Kurils southward of 45°N). The species was recorded for Russia under several names that overviewed by Bakalin & Vilnet (2009). *Solenostoma pseudopyriflorum* may be probably mistaken with *S. confertissimum* due to similarly paroicous inflorescence and common presence of red to purplish pigmentation. Although the areas of the both species are evidently separated, the description of differentiation features seems to be practical and they are given under *S. confertissimum*. The confusion with *S. sphaerocarpum* seems to be less probable due to differences in coloration (the most common in *S. sphaerocarpum* sepia-brown coloration is absent in *S. pseudopyriflorum*), leaf shape and position (concave and overlapping lower half of the next leaf, versus erect spreading concave-canaliculate) and differences in distribution (North Boreal to Arctic versus South Boreal to Temperate). Despite the listed features *Solenostoma pseudopyriflorum* was confused with *S. sphaerocarpum* by Váňa. Váňa et al. (2013: 37) incorrectly wrote: "It should be mentioned that the identification of two specimens by the senior author [Váňa means the specimens identified by him as '*J. pyriflora*' for Altai collection made by M.S. Ignatov – VB] (attributed to *Solenostoma pseudopyriflorum* by Bakalin & Vilnet 2010: 160) was based only on the fact that one specimen has only terminal androecia and the second one is fully sterile (at least the parts of specimens available for examination)". Firstly, the parts of specimens preserved in MHA have mature sporophytes and it is difficult to believe that in the part of the same specimens only terminal androecia were preserved. Secondly, if even the last allegation is correct, I have sent to him copious material (in total 6 envelopes, and I have indicated that they are paroicous) at the middle of 2006 with well developed perianth and androecia and then he answered me (Váňa, pers. comm., 10 Nov. 2006) "In my opinion this *Jungermannia* (*Solenostoma*) is only *J. sphaerocarpa*.

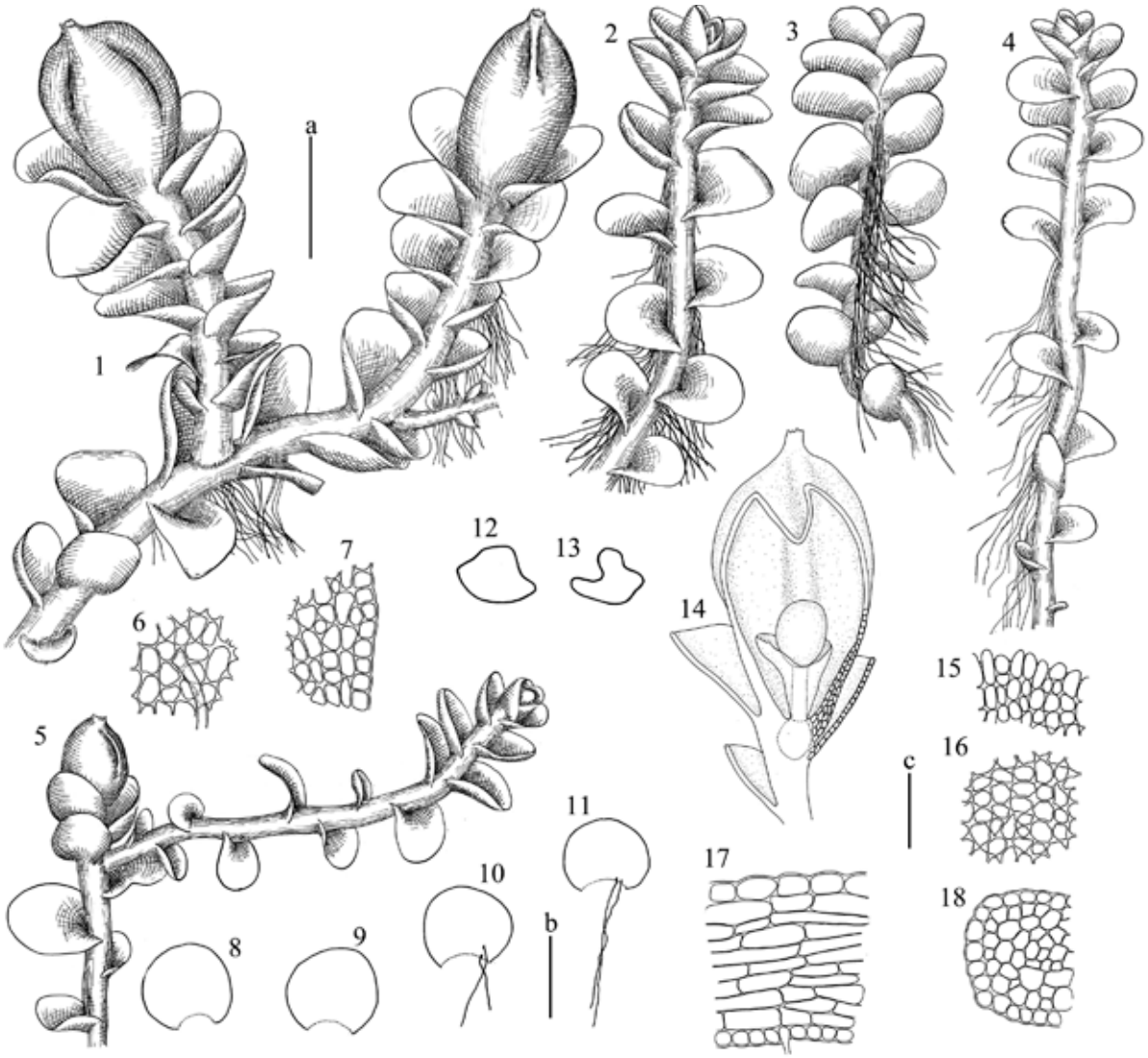

Figure 22 *Solenostoma pseudopyriflorum* Bakalin & Vilnet: 1, 5 – branch with perianth and androecia; 2, 4 – sterile branch; 4 – sterile branch, ventral view; 6 – rhizogenous cells in the lower part of leaf; 7 – ventral leaf base; 8-11 – leaves; 12 – perianth cross section in the middle; 13 – perianth cross section in upper third; 14 – perianth longitude section; 15 – perianth mouth; 16 – cells in the perianth middle; 17 – stem longitude section; 18 – stem cross section. 1–18 from P-65-12-06 (VBGI). Scales: a – 1 mm, for 1–5, 14; b – 1 mm, for 8–13; c – 100 mcm, for 15–18

This species is very variable and occurs in different conditions over the world".

The confusion of *S. pseudopyriflorum* and *S. pyriflorum* seems to be more likely (that was made a lot of time, e.g. Váňa & Ignatov 1995). Two species strikingly differs in inflorescence that is invariably paroicous in the former and dioicous in the latter. Additional features are not uniformly constant and includes: 1) purple pigmentation present in *S. pseudopyriflorum* near leaf base, and, sometimes in the stem and base of perianth, contrary to *S. pyriflorum*, where apical part of leaves (mostly near shoot apices) and perianth, but not leaf base and stem are purple colored, 2) rhizoids in *S. pseudopuriflorum* vary from colorless to purple and brownish purplish, but in *S. pyriflorum* uniformly colorless to brownish; 3) although rare *S. pseudopyriflorum* able to produce rhizoids from leaf lamina – a feature completely unknown in *S. pyriflorum*.

Distribution. East-Asian Boreo-Temperate Montane, with disjunctive records from Baikal Lake and Altai Mts. Within the Russian Far East the species covers area southward of 55°N and the most common taxon of the genus in Primorskii Territory, Sakhalin and South Kurils. Southward of this area the species sporadically occurs up to middle Japan. Altitudinal range of the species in the Russian Far East covers middle to high mountain elevations (400–1500 m a.s.l.), although in Sakhalin the species sometimes occurs in lowlands at the altitude near 60–100 m a.s.l.

Ecology. Acidophilic mesophyte. The species occurs on wet and usually shaded rocks and cliffs uniformly in the forest with spruce and/or fir dominating, with common understory of some East Asian shrubs such as *Aralia*, *Eleutherococcus*, *Oplopanax* or gramineous *Sasa* in the areas of distribution mountain ranges. It commonly growing along streams, but aside of strong impact of running water or found in moist cliffs on shady slopes in coniferous forests. The distribution and ecology of species is rather similar to that of *Lophozia lantratoviae* Bakalin, except the latter is not yet recorded in South Kurils and contrary *Solenostoma pseudopyriflorum* that is not known in the Caucasus.

Specimens examined. RUSSIA, Altai Mts., Uedinennoye Lake (51°49'N 87°48'E), Ignatov M.S., #0/1982 06.VI.1989 (MHA), Buryatiya, Khamar-Daban Range, NK, 13-17-01 04.VIII.2001 (KPABG), NK, 14-01 05.VIII.2001 (KPABG), NK, 15-1-01 05.VIII.2001 (KPABG), NK, 27-5-01 05.VIII.2001 (KPABG), NK, 79-01 10.VIII.2001 (KPABG), Khabarovsk Territory, Solnechnyj District (50°42'53"N 136°23'49"E), VB, Kh-5-36-07 29.V.2007 (VBGI), (50°44'52"N 136°23'28"E), VB, Kh-7-8-07 31.V.2007 (VBGI), Verkhnebureinskij District (52°04'N 134°56'E), Borisov B.I., 25.VII.1992 (MW, duplicate in VBGI), Tardoki-Yani Mt., VB, Kh-45-20-13 (VBGI), VB, Kh-32-4-13 (VBGI), Kurils Islands, Iturup Island, (44°54'57"N 147°30'20"E), VB, K-12-8-07 (holotype of *S. pseudopyriflorum*) 08.VIII.2007 (VBGI, duplicate in KPABG), (45°05'26"N 147°59'32"E), VB, K-56-3-05 15.IX.2005 (VBGI), Shikotan Island (43°52'17"N 146°51'18"E), VB, K-38-22-07 23.VIII.2007 (VBGI), Primorskii Territory, Chuguevskij District, Bardunov L.V., 01.IX.1977 (VBGI), Partizansk District (43°05'05"N 132°41'40"E), VB, P-56-19-08 07.VIII.2008 (VBGI), (43°20'50"N 133°39'22"E), VB, P-65-12-06 03.X.2006 (VBGI), Lazovskii District, VB, P-45-13-12 (VBGI), Shkotovskii District (43°04'15"N 132°41'37"E), VB, P-74-79a-05 10.X.2005 (VBGI), VB, P-18-2-12 (VBGI), VB, P-15-26-12 (VBGI), Sakhalin, Kimonai, Faurie U., 154 21.IX.1908 (KYO), Belaya River (47°15'17"N 142°48'47"E), VB, S-25-27a-06 12.VIII.2006 (VBGI), Chamga Mt. (50°46'47"N 143°16'28"E), VB, S-63-3-09 12.IX.2009 (VBGI), Schmidt Peninsula (54°01'01"N 142°56'34"E), VB, S-41-19-09 29.VIII.2009 (VBGI), (54°04'02"N 142°49'11"E), VB, S-49-1-09 01.IX.2009 (VBGI), Vaida Mt. (49°53'16"N 143°27'08"E), VB, S-34-3-06 21.VIII.2006 (VBGI), Yuzhno-Sakhalinsk Area (46°54'11"N 142°56'08"E), VB, S-37-6-05 03.IX.2005 (VBGI).

JAPAN, Nagano Pref., Diadoshin Mt. summit, Furuki T., 11734, 05.X.1994 (CBM), Kai-koma Mt., Amakawa T., 2326/2147 04.VIII.1957 (HIRO), 2369/2123 04.VIII.1957 (HIRO), Kimbu Mt. (no data on collector) 5153/2243 14.VII.55 (HIRO) Yatsu Mt., Natsuzawa Pass, Inoue H., 97/2143 IX.1957 (HIRO), Nara Pref., Omine Mt., Kodama T., 14832 06.VIII.1959 (NICH, KYO), route from Wakinoshuku to Daifugen Mt., Kodama T., 14881/2130 06.VIII.1959 (HIRO), Sanyo-kozasa Mt., Kodama T., 1432 VIII.1959 (HIRO), Niigata Pref., Myoko-kogoncho, Sakuma E., 7156/2125 26.VII.1966 (HIRO), Yamanashi Pref., Hirogawara-Shirane-oike, Kitadate Mt., Amakawa T., 5408/2246 12.VIII.1967 (HIRO); SOUTH KOREA, Pomasa, Faurie U., 4 20.V.1906 (KYO).

Solenostoma pusillum (C.E.O. Jensen) Steph., Sp. Hepat., 6: 83, 1917. (= *Aplozia pusilla* C.E.O. Jensen, Rev. Bryol., 39: 92, 1912; *Jungermannia jenseniana* Grolle, Oesterreich. Bot. Zeit., 111: 190, 1964; *Solenostoma jenseniana* (Grolle) Bakalin, Arctoa 12: 89, 2003).

Description. Plants 0.15–0.4 mm, near perianth up 1.05 mm wide, creeping, fertile ascending, yellowish brown, become reddish near apex and perianth. Stem 80–120 μm wide (in fertile shoots up 230 μm), orbicular in cross section, dorsal surface cells 28–70 × 14–25 μm. Rhizoids colorless to brownish and grayish, obliquely to erect spreading, commonly forming mat under stem. Leaves inserted at angle of 40–70° with axis, 180–270 × 270–360 μm (1 : 0.6–0.75), transversely elliptic to loosely reniform, concave, imbricate to rarely contiguous or distant. Cells in the midleaf 20–32 × 18–27 μm, thin-walled, with triangle to (in colored part of shoot) convex trigones, near margin thin-walled with strongly convex trigones, especially in external wall, 15–27 μm. Paroicous. Perianth 4–5-keeled (sometimes indistinctly or not keeled), exerted for 1/3 – 1/2 of its length or hidden within bracts, perigynium up 1/3 of perianth length. Androecia in 2–3 pairs below female bracts, 1-androus; male bracts convex in lower half and erect spreading or recurved above. [Spores 115–18 μm in diameter. Elaters 8–9 μm wide (Jensen 1912)]. Figure 23.

Comment. The striking features of this species include presence low perigynium (up 1/3 of perianth length), presence of red to purplish pigmentation, at least as tint, paroicous inflorescence, small size, prostrate growth form and shoot width noticeable increasing to the area near perianth. This small and commonly overlooked species may be misidentified for depauperate or xeric forms of *Solenostoma confertissimum* or *S. rubrum*. *Solenostoma confertissimum* differs from *S. pusillum* in much larger size (0.7–2.5 mm wide, versus 0.15–0.4 mm wide in sterile branches), shoots not or slightly dilated to the perianth (versus dilated for 2–3 timed wider than sterile branch), larger cell size in dorsal epidermis and ability to produce rhizoids from leaf lamina. The confusion with *S. rubrum* seems to be less probable also due to fact *S. pusillum* does not occur in North America and also the complex feature, including: 1) sterile branch width (0.7–1.8 mm in *S. rubrum*, versus 0.15–0.4 mm in *S. pusillum*), 2) cells in the midleaf (30–45 × 30–60 μm versus 20–32 × 18–27 μm), 3) cells in the leaf margin (20–45 μm versus 15–27 μm, and inflorescence type (dioicous versus paroicous). Although it should be noted that both species are very similar in habitat preferences.

The confusion of *S. pusillum* is also probable with *S. rossicum*. Two species differs in size (0.15–0.4 mm wide in sterile shorts of *S. pusillum*, versus 0.3–1.0 mm wide in *S. rossicum*), sometimes in inflorescence (uniformly paroicous versus heteroicous with both paroicous and dioicous phases present), coloration (especially obvious in basal part of shoot where yellowish brown versus whitish, and also in perianth where it is brownish to purplish at whole extent versus pale greenish to whitish, but almost always with markedly purple colored perianth beak), comparatively wider leaves (length : width ratio 1 : 0.6–0.75 versus 1 : 0.8–1.1).

Distribution. Arctic Montane(?) sub-circumpolar. Distribution in Asia is imperfectly known, probably this species overlooked when collecting due to its small size or misidentified. Only a few localities in Western and Eastern Kamchatka are known in the Russian Far East (records from South Kurils in Bakalin, 2010, are misidentification for other taxa), where it grows in low to middle mountain elevations. It seems to be this species may be found in Western North America.

Ecology. Acidophilic mesophyte. Within area treated invariable growing in fine soil of the solifluction spots of cryogenic origin in open places in mountain tundras. In Eastern Kamchatka it occurs in the area with disturbed vegetation cover due to volcanic eruptions (growing on fresh ashes).

Specimens examined. RUSSIA, Buryatiya, Khamar-Daban Range (51°30'36"N 105°25'12"E), NK, 129-5b-01 16.VIII.2001 (KPABG), (51°17'17"N 105°16'16"E), NK, 75-2-02 05.VIII.2002 (KPABG), Kamchatka, East Kamchatka (52°50'N 156°15'E), VB, K-9-23-03 04.VI.2003 (KPABG, duplicate in VBGI), North Kamchatka (59°10'N 159°50'E), VB, K-26-1-03 14.VI.2003 (KPABG, duplicate in VBGI), Yamalo-Nenetskii Autonomous Okrug, Polar Ural, Czernyadjeva I.V., Ч22-88 1988 (KPABG).

NORWAY, Svalbard Archipelago, Dresselhuys (78°06'06"N 14°19'52"E), NK, K147-5a-04 30.VII.2004 (KPABG); SWEDEN, Jamtland, Undersaker bei Edsasen, Henavagen, Jensen C. & H.W. Arnell, 17.VII.1912 (HIRO).

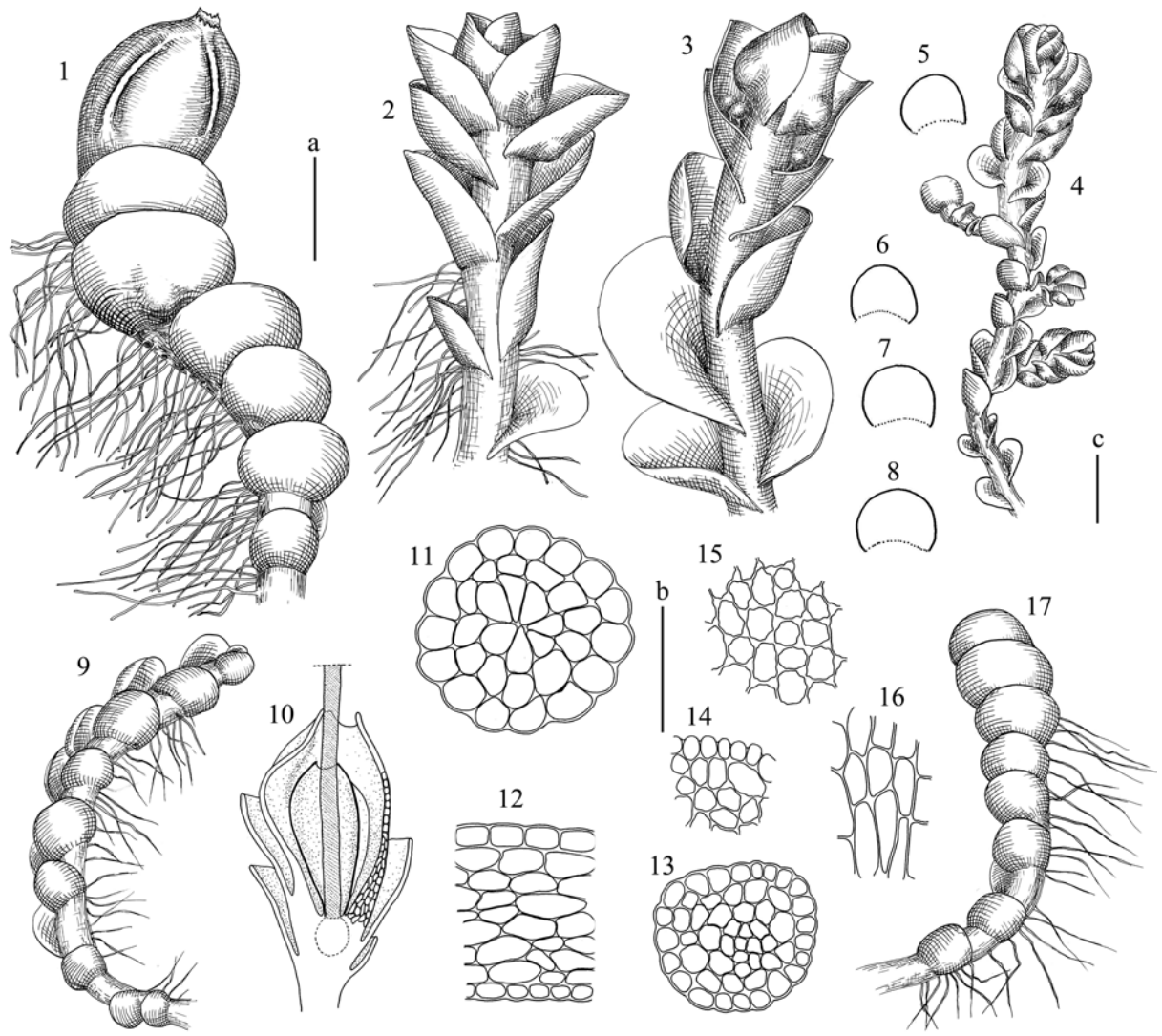

Figure 23 *Solenostoma pusillum* (C.E.O. Jensen) Steph.: 1 – branch with perianth and androecia; 2, 4 – branch with androecia and archegonia; 3 – branch with androecia and archegonia (leaves partly detached); 5–8 – leaves; 9, 17 – sterile branch; 10 – perianth longitude section; 11 – seta cross section; 12 – stem longitude section; 13 – stem cross section; 14 – perianth mouth; 15 – cells in the perianth middle part; 16 – cells in the perianth lower part. 1–3 – from K-9-23-03 (KPABG); 4, 9, 17 – from K-26-1-03 (KPABG); 5–8, 10–16 – from KPABG-105332 (KPABG). Scales: a – 200 μm, for 1–3, 9, 10, 17; b – 100 μm, for 11–16; c – 200 μm, for 4–8

Solenostoma rossicum Bakalin et Vilnet '*rossica*', Bryologist, 115(4): 571, 2012

Description. Plants 0.3–1.0 (near perianth up 1.5) mm wide, up 3–8 mm long, erect and ascending to creeping (sterile plants), brown, blackish brown to yellowish brown, yellowish green and light green, commonly whitish in basal portion of shoots, and especially in stem, with purplish red colored leaf margins and perianth tips. Stem (80) 100–300 μm wide, whitish, ventral side the same color, branching rarely occurs, mostly as innovations below perianth, dorsal surface cells slightly thickened to thin, trigones indistinct, shortly rectangular 30–40 × 20–30 μm. Rhizoids scattered to numerous, in indistinct fascicles, colorless to brownish. Leaves contiguous to imbricate, erect spreading, inserted at angle of 60–85° with axis, dorsally barely or for 1/2 of stem width decurrent, on ventral side subtransversely inserted, line insertion arcuate, not or barely decurrent, 250–1000 × 220–1100 μm (1 : 0.8–1.1), transversely elliptic to orbicular, broadly ovate and reniform, concave to concave-canaliculate and (rarely) flattened. Cells in the midleaf thin-walled, 25–34 × 22–30 μm, walls thin, brownish to colorless, trigones moderate in size, convex to small and concave, near margin 22–28 μm, trigones convex, walls reddish to brownish and colorless, external wall commonly discolored and thickened; near the base 30–56 × 22–28 μm, thin-walled, trigones small, concave to triangle; cuticle smooth throughout. Heteroicous. Paroicous phase: perianth shortly fusiform to cylindrical, 3–4-plicate, exerted for 1/5 – 1/4 of its length or hidden within bracts, 0.6–0.7 × 0.5–0.6 mm; mouth crenulate due to protrudent clavate to subclavate deeply colored (mostly purplish, rarely brownish) cells; middle part 22–34 × 19–28 μm, mostly subquadrate to rectangular, thin-walled with moderate in size, convex trigones; near the base cells isodiametric, ca. 22–25 μm in diameter, mostly hexagonal, thin-walled, with small triangle to concave trigones, unistratose throughout. Perigynium small (less 1/5 of perianth length). Bracts similar to leaves, but shorter, ca. 0.5 × 1.0 mm, imbricate or slightly deflexed, mostly concave. Androecia in 1–2 pairs of bracts below perichaetium, or divided from the latter by 1–2 pairs of sterile

leaves, (1) 2-androus, antheridial body nearly spherical ca. 120 μm in diameter, stalk biseriate, bracts ca. 650 × 750 μm, nearly orbicular. Dioicous phase: perianth terminal, nearly hidden in bracts (exerted not more than 1/4 – 1/5 of its length, 3 (4)-plicate, shortly ellipsoidal to shortly fusiform and cylindrical, ca. 600–1200 × 500–750 μm, markedly purple near the beak; mouth crenulate due to protrudent shortly subclavate elongated, deeply colored (mostly purplish, rarely brownish) cells; in the middle part with cells mostly isodiametric 22–24 (34) × 19–34 μm, trigones rather small to moderate in size, concave to triangle and convex; near the base 34–53 × 17–28 μm, thin-walled, with small concave trigones; 2 (3)-stratose in lower 1/3 – 1/4 of its length, archegonia ca. 10–12 per perichaetium; perigynium indistinct or up 1/5 of perianth length, bracts the same size and shape with the biggest sterile leaves, ca. 5 archegonia in perichaetium. Androecia in 2–4 pairs of strongly concave, inflated in the base and purplish colored there bracts, intercalary, 1–3 (4)-androus, antheridial body nearly spherical, to shortly elliptic, ca. 130 μm in diameter to ellipsoidal ca. 154 × 140 μm, stalk with 1 cells row, ca. 35 μm in length, bracts reniform to transversely elliptic, ca. 300–500 × 500–700 μm. Seta ca. 1500–2000 μm long, 120 μm in diameter, capsule ellipsoidal ca. 700 × 400 μm, inner cells 50–70 × 12–15 μm, frequently with flexuous walls, with 6–8 annular thickenings, outer cells nearly subquadrate, ca. 30 × 28 μm with 2 nodular thickenings in vertical walls, elaters bispiral ca. 100–150 × 8 μm, commonly with homogenous endings ca. 17–18 μm long. Spores finely papillose, ca. 17 μm in diameter. Figure 24.

Comment. The species was described relatively recently (Bakalin & Vilnet 2012) and this is the first species in *Solenostoma* for which identity of dioicous and paroicous plants was confirmed genetically. Thus the most striking feature of *S. rossicum* is the heteroicous inflorescence, other diagnostic features includes whitish stem and markedly red purple colored perianth tip. Before it was regarded (dioicous phases of the latter) by Bakalin & Vilnet (2009) as *S. rubrum*, the species closely morphologically related to the former. *S. rossicum* differs from *S. rubrum* in its heteroicous inflorescence, the absence of well-developed, large-celled (when cells along the margin are 1.2–1.5 times larger than the inner cells) rim along the leaf margin with unequally thickened walls. Additionally, the red pigmentation that is highly uniform in *S. rubrum* is only rarely developed in *S. rossicum*. In most cases, the red pigmentation occurs only in the perianth tips.

Due to subtransversely inserted suborbicular and commonly subimbricate leaves, the species may be mistaken for *S. sphaerocarpum* (which is genetically most closely related to *S. rossicum*, cf. Bakalin & Vilnet 2012), but it differs in the red pigmentation (at least in perianth tips), the heteroicous inflorescence, a noticeable whitish to pale brownish colored stem especially in its lower part, and a peculiar absence of sepia or sepia-brown pigmentation, which is very characteristic for *S. sphaerocarpum*.

One year after description *Solenostoma rossicum* was synonymized with *S. sphaerocarpum* by Váňa et al. (2013). Unfortunately authors (l.c.) did not study (or even request) the type material to compare it with *S. sphaerocarpum*, and based their statement on original description published by Bakalin & Vilnet (2012). The main arguments of Váňa et al. (2013) are following:

1) Color is not valuable feature. Váňa et al. (2013: 38) wrote that "Reddish colour was not reported until now in *Solenostoma sphaerocarpum* except for the information in the description of *Jungermannia pusilla* (Jensen 1912: 92) Buch (1936: 71) in Amakawa (1960: 59 "tinged with purple"). Japanese specimens of *Jungermannia pusilla* were erroneously identified and belong to *Solenostoma sphaerocarpum* (Vaňa 1974 b: 396)". Thus this statement based on probably studied specimens identified as *Jungermannia pusilla* (in the sense of *Solenostoma pusillum*) by Amakawa, and published by the latter in 1960 (Amakawa 1960). Indeed Váňa (1974 b: 396) wrote "die Angabe aus Japan (Amakawa 1960 u.a.) its durch die Verwechslung mit *J. sphaerocarpa* Hook. gegeben". However this indication contradicts to the latter one by Damsholt & Váňa (1977: 22): "it is characteristic that [*'Jungermannia confertissima'* – VB] plants exposed to the sun often develop reddish to purplish pigmentation in the both leaves and the distal part of the perianth; whereas corresponding forms of *J. sphaerocarpa* develop brown to fuscous pigmen-

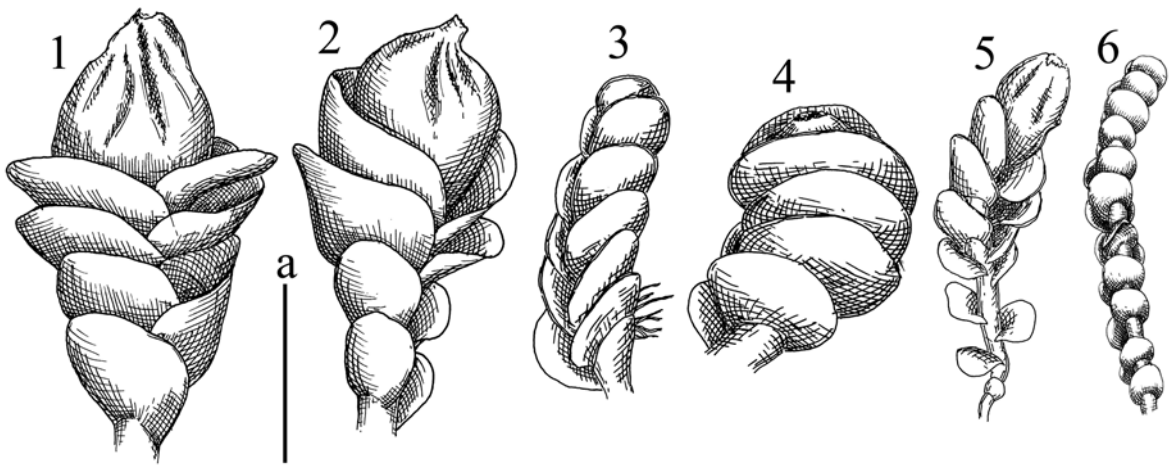

Figure 24 *Solenostoma rossicum* Bakalin et Vilnet: 1, 2, 5 – branch with perianth; 3, 6 – sterile branch; 4 – branch with perianth and androecia. 1, 2 – from K-67-6-05 (VBGI); 3, 4 – from Kh-40-5-08 (VBGI); 5, 6 – from K-33-3-08 (VBGI). Scale: a – 1 mm, for 1–6

tation". In my opinion the latter statement is more correct. Why plants of *S. sphaerocarpum* may develop red pigmentation in Japan, and why these plants should be conspecific to *S. sphaerocarpum*? Our study (Bakalin & Vilnet 2012) just showed that 'reddish colored' *Solenostoma*, superficially similar to *S. sphaerocarpum* from the Russian Far East (from North to South) belong to another species, we named *Solenostoma rossicum*. This rather suggest that 'red phase' of *S. sphaerocarpum* from Japan (sensu Váňa 1974 b) should belong to *S. rossicum* or another species. Nevertheless, Bakalin & Vilnet (2012) did not provide any suggestions to what species mentioned Japanese plants may belong. I can suggest that if one study, based on genetic analysis as well, from the Eastern Asia showed 'red' and 'not red' populations in Eastern Asia are different, the opposite opinion should be also confirmed by genetic studies as well. Váňa et al. (2013: 39) seems to be formally agree with the latter statement, because (e.g.) they regret that "no samples of *Solenostoma hokkaidense* were included in their phylogeny" despite the fact the last known collection of '*Solenostoma hokkaidense*' was made over than 60 years ago, and even despite the fact their '*Solenostoma hokkaidense*" belong rather to another genus (*Plectocolea*, but not *Solenostoma*).

2) Heteroecy is not valuable feature. Váňa et al. (2013: 38) wrote: "The occurrence of "paroicous phase" and "heteroicous phase", as the they wrote (l.c.: 573) is not surprising. This situation is not unknown in the genus *Solenostoma* and similar genera. Our opinion on *Solenostoma rossicum* is influenced by the above discussion about proterandry and heteroicity of *Solenostoma sanguinolentum*, *Jungermannia pumila* and other species." Firstly it should be noted, that *Jungermannia pumila* belong to another family (that Váňa et al. 2013 have accepted!) and similarity between *Jungermannia* and *Solenostoma* is just superficial and cannot be used here as confirmation of presence of heteroicy in *Solenostoma*. Secondly I do not agree *S. sanguinolentum* is heteroicous species. Váňa et al (2013: 37) believe that *S. sanguinolentum* is heteroicous because type of *Jungermannia marcescens* Mitt. is paroicous. That discussion results from my previous paper (Bakalin 2013) where I showed '*J. marcescens*' differs in the complex features (also paroicous inflorescence) from *S. sanguinolentum* and should be treated as distinct species, *S. marcescens* (Mitt.) Bakalin. The specific status of '*Jungermannia marcescens* was also showed by Amakawa (1966). The latter point of view is contradicting to Váňa, who regarded two names (*Jungermannia sanguinolenta* and *J. marcescens*) as synonymous (Váňa 1972 b). By the way in the citet paper (Bakalin 2013) I showed that two taxa different in sexuality, perianth size (including its exertion) and structure (larger plants of *S. sanguinolentum* has unistratose perianth on the most of its extent, but smaller perianths of *S. marcescens* – bistratose on the most extent), coloration (no red coloration in *S. marcescens*, but it is uniformly present in exposed plants of *S. sanguinolentum*), leaf cell size, etc. Váňa et al. (2013) stated that the listed features are not stable and thus *S. marcescens* is the synonym of *S. sanguinolentum* and this *species collectiva* therefore should be heteroicous. I suggest that if this point of view might be accepted, no species in *Solenostoma* may be recognized, because most valuable features in the systematic of *Solenostoma* are supposedly (due to Váňa et al. 2013) not valuable. Noticeable that Váňa (1974 b, etc.) used the same features to evaluate new taxa, which he (Váňa et al. 2013) considered unstable later. I cannot follow to Váňa et al. (2013) proposals in this way, as well as I cannot accept that different sexuality of plants in the types of *S. sanguinolentum* and *S. marcescens* is inscrutable evidence of heteroecy of *S. sanguinolentum*. I also suggest that if even *S. sanguinolentum* by incredible way is heteroicous this does not means heteroecy is not 'good' taxonomic character. Thus synonymyzation of *S. rossicum* and *S. sphaerocarpum* cannot be accepted.

Another question is the possible identity of *Solenostoma pyriflorum* subsp. *purpureum* R.M. Schust. & Damsh. (Schuster & Damsholt 1974: 176. f. 12: 1–9.) to *Solenostoma sphaerocarpum*. Damsholt & Váňa (1977) put it into synonymy of '*Jungermannia confertissima* Nees', but recently Damsholt (2011) has transferred it to *Solenostoma sphaerocarpum* as '*Jungermannia sphaerocarpa* subsp. *purpurea* (R.M. Schust. & Damsh.) Damsh.'. Two years later it was synonymized by Váňa et al. (2013) with *Solenostoma sphaerocarpum*. I did not studied type of *Jungermannia pyriflora* subsp. *purpureum* and have no opinion on the status of the latter, but in any way the presence of red pigmentation does not mean neither this is *Solenostoma sphaerocarpum* s. str. nor *S. rossicum* is the synonym of *S. sphaerocarpum*.

Distribution. Boreal East Asian (circum-Okhotian endemic). Due to data in hand this species distributed around Sea of Othotsk in the northernmost edge of Khabarovsk Territory, and southward to Kurils and Sakhalin Island. In North-East Asia this species almost everywhere vicariously replaces *S. sphaerocarpum*, with the exceptions of Commanders, Kamchatka (where *S. rosicum* is not known) and disjunctive locality in northern Sakhalin. Altitudinal range stretches from sea coast and lowland tundras (where they are present), then, after noticeable gap (occupied by temperate to boreal communities), continues in subalpine to alpine belts over 1100 m a.s.l. in South Kurils and 1680 m a.s.l. in northern Sikhote-Alin.

Ecology. Acidophilic mesophyte. The species prefers moist clayish to sandy soil in the places with disturbed vegetation cover. In anthropogenic transformed habitats this is roadsides of old roads. In nature conditions preferable habitat is crumbling fine soil in cliff crevices along sea coast (including such special habitat as white pumice deposits). By vegetation type preference this is subarctic species, known in *Pinus pumila* belt in northern part of Khabarovsk Territory (but do not descending to *Larix* lighted forests) to tundroid communities of South Kurils in coastal areas under strong impact of aeolation.

Specimens examined. RUSSIA, Khabarovsk Territory, Okhotsk District (59°26'11"N 143°30'24"E), VB, Kh-18-6-08 19.VII.2008 (VBGI), (59°25'25"N 143°25'05"E), VB, Kh-25-1-08 20.VII.2008 (VBGI), (59°26'39"N 143°28'13"E), VB, Kh-33-2-08 24.VII.2008 (VBGI), (59°27'31"N 143°27'49"E), VB, Kh-40-3-08 26.VII.2008 (VBGI), VB, Kh-40-4-08 (holotyope of *S. rossicum*) 26.VII.2008 (VBGI, duplicate in KPABG), Tardoki-Yani, VB, Kh-35-10-13 (VBGI), VB, Kh-38-11-13 (VBGI), Kurils Islands, Iturup Island (45°06'08"N 148°01'09"E), VB, K-58-16b-05 16.IX.2005 (VBGI), (45°15'32"N 148°10'23"E), VB, K-66-20-05 22.IX.2005 (VBGI), (45°15'48'N 148°13'03"E), VB, K-67-6-05 23.IX.2005 (VBGI), Kunashir Island (43°53'04"N 145°27'43"E), VB, K-46-13a-06 06.IX.2006 (VBGI), (44°15'58"N 146°06'23"E), VB, K-62-3-06

17.IX.2006 (VBGI), Shikotan Island (43°47'56"N 146°43'56"E), VB, K-40-44-07 24.VIII.2007 (VBGI), Sakhalin Island, Due area (50°49'21"N 142°05'21"E), VB, S-58-11-09 05.IX.2009 (VBGI).

JAPAN, Tottori Pref., Daisen Mt., Kitagawa N., 5230 27.VII.1961 (KYO).

Solenostoma rotundatum Amak., Journ. Jap. Bot., 31: 50, 1956. (= *Jungermannia rotundata* (Amak.) Amak., Journ. Hatt. Bot. Lab., 22: 73, 1960; *Plectocolea harana* Amak., Misc. Bryol. Lichenol., 2(3): 33, 1960; *Plectocolea riparia* H. Hara, Research Reports Kôchi Univ. 7(22): 14, 1958 *nom. illeg.*, non *Plectocolea riparia* (Taylor) Mitt., Trans. Linn. Soc. London, Bot. 3: 198, 1891)

Description. Plants 1.0–2.6 mm wide (male shoots ca. 1.2–1.5 mm wide, narrowed in androecial part), up 5–10 mm long, erect to ascending, deep green to brownish green. Stem (150) 200–300 μm wide, orbicular in cross section, braches not seen, dorsal surface cells thin-walled with indistinct trigones, 80–120 × 20–35 μm. Rhizoids deep purple, rigid, dense, in indistinct fascicles obliquely spreading or decurrent down the stem, but not forming distinct fascicle. Leaves distant, concave to flattened, commonly undulate at margin, inserted at angle of 60–80° with axis, dorsally decurrent up 1/3 – 1/1 of stem width, ventrally subtransversely inserted, barely decurrent, 1000–1300 × 800–1250 μm (0.8–1 : 1), widely ovoid to orbicular. Cells in the midleaf thin-walled, 25–38 × 17–24 μm, walls brownish, trigones concave to triangle, near margin 20–28 μm, thin-walled, cuticle smooth everywhere, with exception of lower 1/6 of leaf length where loosely striolate. Oil bodies in midleaf cells (1) 2 (3) per cell, spherical to oblong. Dioicous. Perianth terminal, hidden in bracts or exerted, fusiform to obovate, pluriplicate, turbinate at mouth or not, ca. 800–2000 × 700–1000 μm, sometimes with lateral and ventral innovations in 2–4 pairs of leaves below perichaetium. archegonia 1–5 in perichaetium; perigynium 1/2 – 1/1 of perianth length, strongly rhizogenous; female bracts with undulate margin, slightly wider than sterile leaves. Androecia in 3 (4) pairs, intercalary, 1-androus, antheridial body shortly ellipsoidal, ca. 280 × 250 μm, bracts inflated at the base and deflexed at apex. [Elaters ca. 10 × 9 μm. Spores ca. 18 μm. (Amakawa 1960)]. Figure 20: 1–3.

Comment. More or less distinct species due to its ascending to erect stem, dense and purple colored rigid rhizoids that sometimes decurrent down the stem, but not forming distinct fascicle, subtransversely inserted and nearly orbicular leaves. Among regionally recognized species the confusion does not seems easy. *Plectocolea ovalifolia* and *Solenostoma obscurum* distributed in the Russian Far East also have purple rhizoids not united into the distinct fascicle, but they mostly differs from *S. rotundatum* in prostrate to ascending growth form, high perigynium (in *S. obscurum*), more numerous oil bodies (in *Plectocolea ovalifolia*), mostly ovate to elliptic leaves (versus mostly orbicular), occurrence in warm-temperate communities, such as broadleaves forests and southern Boreal coniferous forests enriched with many temperate trees (*Acer*, *Fraxinus*, etc.), shrubs (*Toxicodendron*, *Eubotryoides*, etc.) and *Sasa*. The distinctions from *Plectocolea rigidula*, the species with similarly rigid and purple rhizoids and occurred in the similar habitats with *Solenostoma rotundatum,* are discussed under the former. The confusion is readily possible with some taxa distributed southward of treated area, such as East Asian *Plectocolea torticalyx* (Steph.) S. Hatt. Two taxa differ in size (commonly more than 3 mm wide in *P. torticalyx*, versus less than 2.6 in *Solenostoma rotundatum*), leaves and cell size and type of oil bodies ('grape-cluster type' in *Plectocolea torticalyx* versus granulate in *Solenostoma rotundatum*).

Distribution. Temperate Montane East Asian. This species occurs in North-East China, Korean Peninsula and Japan with the only record in Iturup Island in the South Kurils of Russia. Within species area it may be locally abundant, being one of the most common species in middle of Korean Peninsula. This is mostly low to middle elevation taxon, found in Iturup at the elevation of 395 m a.s.l., and distributed in Japan within 0 to 900 m a.s.l., regardless of latitude.

Ecology. Acidophilic hygro- to hydrophyte. It occupies open to part shaded places in broadleaved forest zone or belt or spreading to subtropical zone in Ryukyu Archipelago, northward it sporadically occurs in boreal coniferous forests, although always preferring those enriched by many southern elements (see above). It prefers rocky substrates and sometimes growing in running water, being one of the most rheophilic resistant species in treated area.

Specimens examined. RUSSIA, Kurils Islands, Iturup Island (44°54'57"N 147°30'20"E), VB, K-12-5-07 08.VIII.2007 (VBGI).

CHINA, Liaoning, Fengcheng Co., Fenghuangshan Mt., Gao C., 42318 (IFP 00023570), Gao C., 6142 (IFP 00023905), Cao T. 39042 (IFP 00003188); JAPAN, Chiba Pref., Kiyosumi Mt., Furuki T., 17029 16.XI.2001 (CBM), Konishi, Sanbu-gun, Furuki T., 9027 10.XI.1990 (CBM), Fukuoka Pref., Hikosan Mt., Amakawa T., 12.VIII.1958 (HIRO), Hokkaido Pref., Hidaka, Horoizumi-mura, Sakubaisawa, Shimizu D., 14.VIII.1954 (NICH), Tsurugizan Mt., Tokachi, Sakuma E., 4111 25.VII.1965 (HIRO), Hyogo Pref., Myokosan, Kodama T. (Hepaticae Japonicae Exsiccatae ser. 16 (1969) n. 777 as *Jungermannia harana* 20.X.1963) (SAP), Kodama T., 20.X.1963 (F), Iwate Pref., Hayachina Mt., foot of the mountain, Hiratsuto, Shimizu D., 06.IX.1954 (NICH), Nagasaki Pref., Nagasaki city, Amakawa T., 2250, 23.III.1957 (NICH), Niigata Pref., Gochi, Naoezu, Sakuma E., 2624 01.XII.1968 (HIRO), Okinawa Pref., Iriomote Island, Yamaguchi T., 1196 05.XI.1981 (HIRO), Yamaguchi T., 3561 24.VII.1982 (HIRO), Yamaguchi T., 903 30.X.1981 (HIRO), Osaka Pref., Higashi-tottori, Kodama T. (Hepaticae Japonicae Exsiccatae ser. 14 (1965) n. 668 as *Jungermannia harana* 23.XI.1962) (SAP), Tottori-ike to Izeki Pass, Kodama T. 23.XI.1962 (TNS), Shinano Pref., Sanbe Mt., Amakawa T., 13.VIII.1954 (HIRO), Tochigi Pref., Nikko city, Ooyagawa, Kitagawa N., 15925 07.X.1977 (KYO), Kitagawa N., 17027 22.X.1981 (KYO), Tokyo, Makino T., 15.IV.1895 (SAP), Wakayama Pref., Tanabe, Ohta K., 24.XI.1971 (TNS), Miyazaki Pref., Nichinan, VB, J-1-12a-14 (VBGI); SOUTH KOREA, Pukham Mt., Hong W.S., 7254 15.X.1961 (HIRO), Jeonnam Prov., Oinarodo Island (34°26'09"N 127°30'21"E), VB, Kor-18-38-11 20.V.2011 (VBGI), Kang Nung, Hong W.S., 50 10.V.1959 (HIRO), Kwang-Nang, Hong W.S., 1802 05.VI.1960 (HIRO), Chonbuk Prov., VB, Kor-13-22-11 (VBGI).

Solenostoma rubrum (Gottsche ex Underw.) R.M. Schust., Hepat. Anth. North Amer., 2: 1007, 1969 (= *Jungermannia rubra* Gottsche ex Underw., Bot. Gaz., 13: 113, 1888)

Description. Plants 3–8 mm long and 0.7–1.8 mm wide, prostrate to (mainly) ascending and erect, green, green purplish (due to purple colored ventral base of leaves) to yellowish pale green, yellowish brown, brownish, brownish reddish, with markedly purple colored perianth

beak and tops of ascending erect shoots; female plants the same size with sterile ones or slightly larger, male branches looks wider due to incurved apices of the bracts. Stem 210–370 μm in wide and 160–300 μm high, transversely elliptic in cross section; dorsal surface cells rectangular, ca. 74–100 × 25–38 μm thin-walled, trigones indistinct, cuticle striolate-papillose; in the stem cross section outer cells smaller than inner ones, ca. 17–25 μm in diameter, walls slightly thickened (external wall evidently thickened), yellowish, trigones distinct, concave, inner cells penta- to polygonal, ca. 33–50 μm in diameter, thin-walled, walls colorless, trigones small to indistinct. Rhizoids sparse to common, originated mostly in area near ventral base of leaves and commonly absent in upper 3–4 pairs of leaves, colorless to pale grayish and brownish, in indistinct fascicles decurrent down the stem or obliquely to erect spreading and forming mat under stem. Leaves distant to contiguous and subimbricate, inserted at angle ca. 45–65° with axis, dorsally decurrent for 1/4 of the stem width, ventrally subtransversely to arcuately inserted, barely decurrent (in some shoots are inserted at angle ca. 80–85° with the axis and not decurrent both dorsally and ventrally); 630–1050 × 700–1225 μm (1 : 0.6–1), suborbicular, transversely elliptic to orbicular-lingulate and orbicular-ovate, widest near the middle, concave to canaliculate, sometimes deflexed away the stem. Cells in the midleaf thin-walled, subisodiametric, mostly penta- to hexagonal, 30–45 × 30–60 μm, walls colorless to purplish, trigones distinct, concave to triangle; along margin 20–45 μm, with external wall clearly thickened (rarely walls subequally thickened), sometimes, with visible median lamina in marginal cell walls, trigones distinct, triangle, cuticle smooth. Dioicous. Perianth terminal on main axis, no innovations, exerted for 2/3 of its length, 1470–1750 × 985–1050 μm, clavate to shortly fusiform, with 4 distinct plicae (1 dorsal, 2 lateral, 1 ventral), suddenly contracted to the beaked mouth, perianth mouth crenulate, perianth in upper part unistratose, composed by subisodiametric to oblong cells, 25–33 × 38–50 μm, trigones moderate in size, convex, cells in the middle part of perianth subisodiametric, ca. 33–50 × 30–38 μm, walls thin, trigones moderate in size, triangle to convex, cuticle smooth, lower part bistratose, composed by rectangular to oblique rectangular cells, 100–150 × 28–38 μm, trigones small and concave, cuticle striolate papillose; perigynium small, lesser than 1/6 of the perianth length; female bracts in one pair, ca. 720–900 × 95–100 μm, lingulate to obtrapezoidal, frequently shortly bilobate, sheathing perianth in its lower part, but deflexed above. Androecia intercalary, spicate, with deflexed apices of male bracts, in 3–5 pairs of bracts, ca. 630 × 875 μm, orbicular to transversely elliptic, strongly inflated at the base and cupped above, but with recurved margin, 2-androus, antheridial body shortly elliptical to spherical, ca. 110–140 × 95–140 μm or smaller (probably immature ones), stalk biseriate. Seta ca. 3000 μm in length, 200 μm in width. Capsule brown, shortly ellipsoidal, ca. 500–625 × 490–500 μm; inner cells 45–60 × 10–15 μm, oblong-rectangular to irregular in shape, with 7–8 annular thickenings; outer cells rectangular, 25–50 × 15–23 μm, with 3–4 nodular thickenings in each vertical wall and with 0–1 on horizontal wall. Elaters reddish-brown, bispiral ca. 112 × 7.5 μm, homogenous narrowed endings from each side ca. 13–15 μm long. Spores brown to reddish brown, papillose, ca. 15–16 μm in diameter.

Comment. More or less distinct species due to dioicous inflorescence, border of slightly larger cells along leaf margin, red to purplish pigmentation. On the one hand it may be confused with *Metasolenostoma gracillimum* due to presence of leaf rim. Exhaustive study by A. Evans (1919) showed *Solenostoma rubrum* is different from the latter and should be recognized as distinct species. On the other hand, confusion is possible with heteroicous *S. rossicum*. For distinctions from the latter species see comments under those. Within the species one variety, in addition to var. *rubrum*, may be recognized (see below).

Distribution. The Boreo-Temperate western North American endemic. The taxon stretches area from Alaska via Alberta and British Columbia to Washington, Idaho, Montana, Oregon, Wyoming and California. All previous records of the species for the Russian Far East (Konstantinova et al. 2009; etc) were referred to *Solenostoma rossicum* (Bakalin & Vilnet 2012). The only record from the Russian Far East is from Commanders that closely adjacent to Aleutians. The record from Chukotka, provided by Afonina (2000) could not be revised in the present study.

Ecology. Acidophilic hygro-meso- to meso-xerophyte. The species is restricted to habitats with native or anthropogenically disturbed vegetation cover, where it most frequently occurs on moist soil along streams and clayey roadsides in low to middle elevations (maximal 2160 m a.s.l., cf. Váňa & Hong 1999) within boreal to temperate forest zone, although sometimes reaches subarctic (Commanders) or descend to temperate-subtropical communities (California).

Specimens examined (var. *rubrum*). RUSSIA, Commander Islands, Bering Island (54°40'N 166°15'E), VB, K-30-5-02 19.VIII.2002 (KPABG, duplicate in VBGI); CANADA, British Columbia, Haney Research Forest, Schofield W.B., 06.04.1978 (NY00099057), Vancouver Island, Frye T.C., 3165 30.VII.1943 (F), Boas F.M., 07.III.1964 (F); U.S.A., California, Lake Co., Toren E., 28.06.1998 (MO5128546), Mendocino Co. (39°21'N 123°49'W), Whittemore A.T., 14.12.1978 (MO4446926), Doyle W.T., 12.04.1994 (NY00244440), San Mateo Co. (37°15'N 122°13'W) Whittemore A.T., 10.10.1992 (MO3967021), Howe M.A., 20.04.1895 (NY00244424), Santa Cruz Co., Farlow W.G., V.1885 (NY00244444), Contra Costa Co., Howell J.T., 07.II.1943 (F), Sonoma Co., Howe M.A., 14.III.1896 (F), Oregon, Lane Co. (43°56'48"N 123°32'00"W), Wagner D.H., 05.04.1996 (MO4462328), Henderson L.F., 15.03.1935 (NY00244454), Tillamook Co., Wagner D.H., 16.10.1977 (NY00244453), Benton Co., Doty M., 22.II.1940 (F), Reedsport Co., Frye T.C., 26.III.1935 (F), Washington, Monroe Co., Taylor E.C., 16.IX.1960 (NY00244436), Palmer Co. (47°16'N 121°47'E), Frye T.C., 4.XII.1932 (NY00244423), Seattle, Roberts C.M., 2556 06.III.1925 (F).

Solenostoma rubrum var. ***underwoodii*** Bakalin, Polish Bot. Journ., 58(1): 131, 2013. (= *Nardia macounii* Underw., *in sched.*)

Comment. The variety differs from *Solenostoma rubrum* var. *rubrum* in 1) purplish pale violet coloration (versus commonly red coloration in var. *rubrum*); 2) very small trigones to virtually absent inward of the leaf margin border cells (versus well developed); 3) mostly subequally thickened leaf rim cells (versus strongly unequally thickened, commonly

with large trigones); 4) long exerted perianth (up to 4/5 or even more versus shortly to 1/2 – 3/5 of its length exerted). The variety is based on the specimens identified as *Nardia macounii* by L.M. Underwood, the taxon being never validly described although it was published in the *Exsiccatae Hepaticae Americanae* N. 169. The name was only mentioned by Váňa (1974: 400, translation from German by VB): "no intraspecific taxa were described [within *S. rubrum*]; plants as *Nardia macounii* Underw. *in sched.* were selected, but put into ordinary modification (red colored)". This conclusion was based on study of material in FI (Váňa 1974 b: 398). My study did not support this concept. Var. *underwoodii* has intermediate morphology between *Metasolenostoma gracillimum* and *Solenostoma rubrum*. Váňa et al. (2013) regarded this taxon as the common form *Solenostoma rubrum* and thus not deserving the recognition in variety level. Váňa et al. (2013) statements based on study of the specimen in FI that supposedly should be identical with the holotype in NY. However, at least coloration of plants is different (if description by Váňa et al. (2013) is correct) from plants in the type. Other Váňa's et al. (2013: 42) arguments are following: 1) "in the FI specimen the trigones are small, but not absent", yes I indicated "very small to virtually absent trigones" (Bakalin 2013: 131), contrary to moderate in size and convex in var. *rubrum*; 2) "nearly all specimens of *Solenostoma rubrum* examined have sub-equally thickened marginal leaf cells", I disagree with this, indeed, marginal cell walls are commonly thickened in *S. rubrum*, but they have large convex trigones, so walls cannot be called as 'sub-equally thickened'; 3) concerning of perianth exertion Váňa et al. (2013: 42) wrote "this character is depending on the maturity of perianth", this is not so, some species (e.g. *Solenostoma pusillum*) have shortly exerted perianth, whereas other (e.g. *S. pseudopyriflorum*) have long exerted perianth. Váňa's et al. (2013) statements also contradict to previous work by Váňa, when he used exertion as taxonomic feature on the species (not variety!) level, e.g. Váňa (1975b): "4a… Perianth die Hüllblätter überragend …" versus "4b … Perianth die Hüllblätter nicht überragend …". Thus I suggest this var. *underwoodii* may be recognized at least on the variety level.

Distribution. Boreo-Temperate Western North American. Not well defined endemic of southern half of western North America, known from Washington and Oregon known from near the sea level to 700 m a.s.l..

Ecology. Acidophilic mesophyte. The ecology of the species is poorly understood, most probably it is similar to var. *rubrum*, but with tendency to occupy wetter and more shaded places.

Specimen examined. (var. *underwoodii*) U.S.A., California, Caspar Creek (39°21'N 123°49'W), Whittemore A.T., 531 14.XII.1978 (F), Contra Costa Co., Howell J.T., 605 IX.1942 (F), Marin Co., Howell J.T., 272 03.VI.1945 (F), 682 19.VIII.1945 (F), 26.III.1950 (F), Sierra Co. (39°29'57"N 121°00'35"W), 1000 m alt., Shevock J.R., 42913 30.VIII.2013 (CAS, duplicate in VBGI) Washington, Kalaloch Co., Frye T.C., 21.VIII.1931 (F), Scenic Co. (47°44'N 121°09'W), Frye T.C., 14.IX.1932 (F), Shohomish Co., Eyerdam W.J., 30.III.1948 (F), King Co., Seattle, C. V. Piper (holotype of var. *underwoodii*), 12.IV.1891 (NY 564814), (isotypes of var. *underwoodii*) (NY 564815, 564817), Thurston Co., Olympia, L. F. Henderson, 2596 (paratype of var. *underwoodii*) 19.IV.1981 (NY 564816).

Solenostoma sphaerocarpum (Hook.) Steph. Sp. Hepat., 2: 61, 1901. (= *Jungermannia sphaerocarpa* Hook., Brit. Jungermann., pl. 74, 1815)

Description. Plants 0.27–2.0 mm wide and 3–7 mm long, erect to ascending, sepia to brownish yellow, yellowish brown and grayish brown, sometimes becomes greenish or blackish near apex, without traces of red pigmentation, but rarely with rusty tint. Stem ca. 150–300 μm in diameter, orbicular in cross section; dorsal surface cells 30–76 × 22–34 μm, thin- to obscurely thick-walled, subrectangular to hexagonal, nearly isodiametric to oblong, cuticle obscurely striolate; in the stem cross section cells ca. 20–25 μm in diameter, walls brownish, mostly thickened, trigones small but distinct, concave. Rhizoids numerous, dirty grayish to almost colorless, in indistinct fascicles, mostly erect to obliquely spreading, more rarely decurrent down the stem, but not forming distinct fascicle. Leaves contiguous to distant and subimbricate, inserted at angle of 50–80° with axis, on dorsal side not or shortly decurrent, 390–700 × 420–900 μm (0.8–1.4 : 1), widest in middle or just below, concave to (rarer) almost flat. Cells in the midleaf 20–32 × 19–27 μm, lumen rounded to hexagonal, walls thin to obscurely thickened, brownish, trigones small concave to large convex; along margin 16–25 μm commonly with thickened external wall or with thickened walls throughout; cuticle striolate in lower 1/3 or smooth throughout. Oil-bodies 5–6 per cell, finely granulate, brownish-grayish, oval in projection, 5–11 × 4–7 μm. Paroicous. Perianth terminal on main axis, innovations lateral, 1–2 per gynoecium, rarely present, emergent for 1/4 – 2/3 of its length, 1540–1750 × 1540–1540 μm, tubular with the suddenly tightened beaked mouth, with 3–4 (5) distinct plicae (1–2- dorsal, 2 ventral, or 1 ventral and 2 lateral), perianth mouth crenulate, perianth mainly unistratose, but bistratose in lower portion, in the middle part composed by subisodiametric to oblong, mostly hexagonal cells 28–35 (40) × 17–23 μm; perigynium up 1/5 (1/3) of the perianth length; bracts almost not differentiable from sterile leaves, slightly larger, in 1 pair, ca. 750–800 × 1000–1250 μm, concave to flattened, rarely obscurely undulate at margin or slightly retuse. Androecia below perichaetium, in 1–2 pair of bracts, bracts similar with sterile leaves, but slightly inflated near the base, 2–3-androus, stalk biseriate, ca. 43 × 17 μm. Seta ca. 1500–2000 μm in length, 120 μm in width. Capsule oval ca. 600–700 × 400 μm, inner cells 50–70 × 12–15 μm, frequently with flexuous walls, with 6–8 annular thickenings, outer cells nearly subquadrate, ca. 30 × 28 μm with 2 nodular thickenings in vertical wall. Elaters 2-spiral ca. 150 × 8 μm. Spores finely papillose, ca. 17 μm in diameter. Figure 25.

Comment. The distinctive characters of this species are paroicous inflorescence, commonly contiguous to subimbricate leaves, covering lower half of upward situated leaves and peculiar sepia-brown color, without traces of red or purple pigmentation. The species may be mistaken with *Solenostoma confertissimum* and *S. rossicum* that discussed under the latter species. The one variety may be recognized within *S. sphaerocarpum* that is discussed below.

Distribution (var. *sphaerocarpum*). Generally Boreal Montane circumpolar species. Within North America

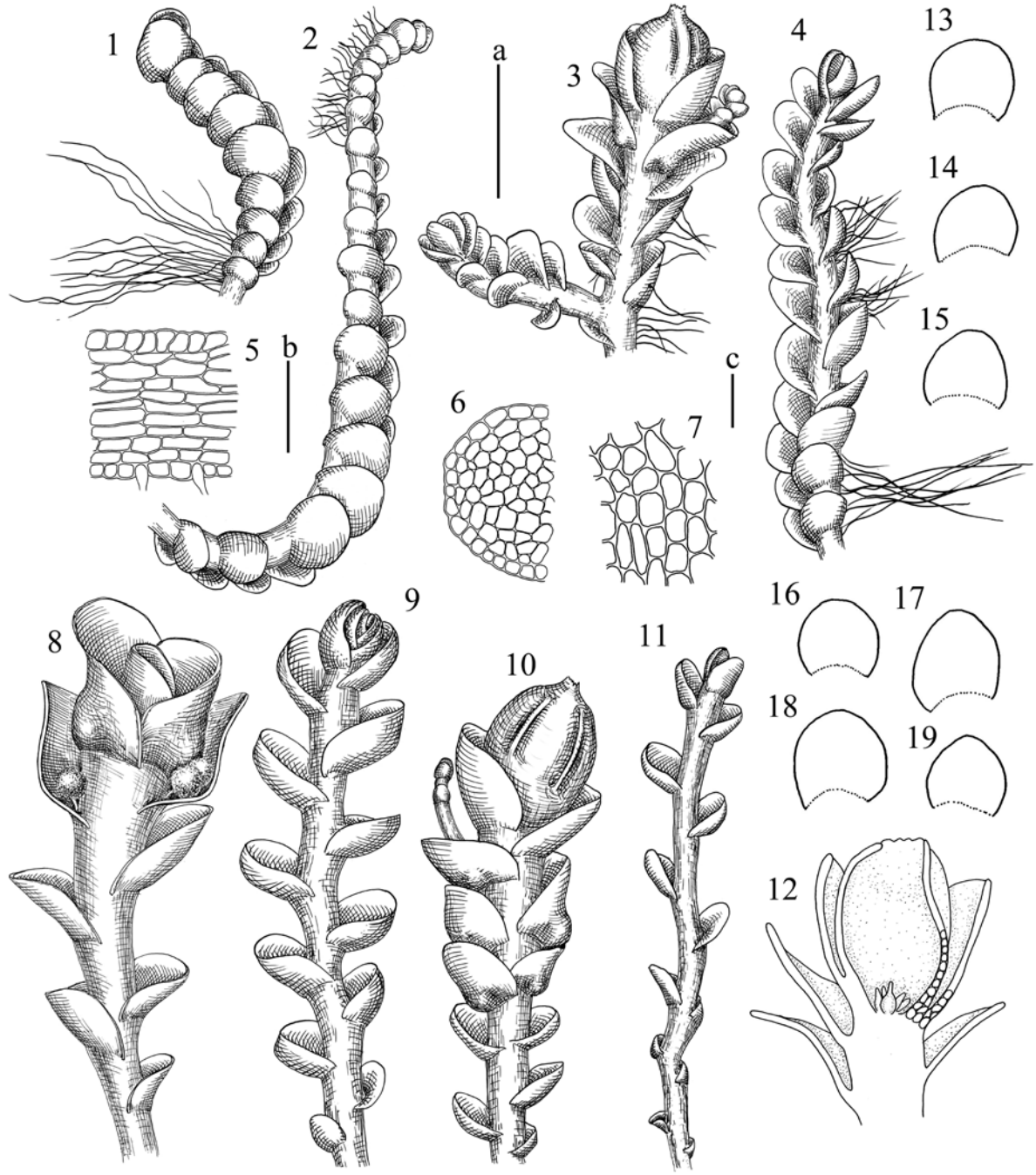

Figure 25 *Solenostoma sphaerocarpum* (Hook.) Steph.: 1, 4, 9 – sterile branch; 2 – sterile branch with attenuate tip; 3, 10 – branch with perianth and androecia; 5 – stem longitude section; 6 – stem cross section; 7 – cells in the perianth middle part; 8 – branch with androecia and archegonia (leaves partly detached); 11 – sterile depauperate branch; 12 – perianth longitude section; 13–19 – leaves. 1–7, 12–19 – from K-23-12-03 (KPABG); 8 – from Ye.Yu. Kuz'mina E1(2), KPABG-100246 (KPABG); 9–11 – from K-111-6-03 (KPABG). Scales: a – 1 mm, for 1–4, 8–12; b – 200 μm, for 5, 6; c – 50 μm, for 7

S. sphaerocarpum distributed across the continent, but more common in the northern part. In the southern half of the continent, the species occurs in highly mountainous areas, reaching 3100 m alt. in California and 3500 m alt. in Colorado. At the western side known from Alaska, Alberta, British Columbia, Washington, Idaho, Oregon, Nevada, California; in central part confirmed for Yukon, Northwest Territories, Montana, Wyoming, Utah, Colorado; and in eastern side from Newfoundland, Nunavut, Quebec, Maine, Michigan, Minnesota, New Hampshire, New York and Wisconsin. The distribution in the Russian Far East is confined to Kamchatka and Commanders and isolated local from Sakhalin. Westward in Siberia, the species is much widely distributed and locally abundant in all administrative subunits of the latter. The species occurs from near sea level (in Sakhalin in tundroid community along sea coast under strong wind impact) and, after gap, in mountain tundras above 1000 m a.s.l.

Ecology. Acidophilic to neutro-tolerant mesophyte. Commonly occurrs in man-made habitats such as moist sandy to clayish roadsides, wasteland and pits. In native communities growing on moist soil and rocks near streams,

spots of bare ground in tundras (including solifluction spots). The taxon is mostly found in tundra communities, but it is not rare in the North Boreal forest area (in North America) or corresponding belt in the mountains, especially in humid regions, although there it is mostly attached to anthropogenic disturbed lands too.

Specimens examined. RUSSIA, Caucasus, Aibga Range (43°37'49"N 40°17'39"E), NK, K207-3a-09, 09.X.2009 (KPABG), Karachayevo-Cherkessiya (43°43'45"N 40°41'47"E), NK, K311-2-08 15.IX.2008 (KPABG), (43°28'21"N 41°41'14"E), NK, K547-4-05 21.IX.2005 (KPABG), Chukotka, Koryak Upland, Kuzmina Ye.Yu., E1(2) 17.VII.1987 (KPABG, duplicate in VBGI), Commander Islands, Mednyj Island (54°46'45"N 167°35'00"E), VB, K-50-5-04 02.VII.2004 (KPABG, duplicate in VBGI), Kamchatka, Central Kamchatka (56°06'13"N 160°02'11"E), VB, K-102-1-03 19.VIII.2003 (KPABG, duplicate in VBGI), (55°55'N 158°40'E), VB, K-111-6-03 09.IX.2003 (KPABG, duplicate in VBGI), (56°39'20"N 159°29'28"E), VB, K-133-26-04 13.IX.2004 (VBGI), East Kamchatka (56°10'52"N 160°21'37"E), VB, K-42-4-03 21.VII.2003 (KPABG), Karelia, Kalevala District, Ramenskaya M.L., 21.VIII.1956 (KPABG), Kostomuksha area (64°35'N 30°36'E), VB, 15.VII.1998 (KPABG), Loukhi District, VB, 08.VIII.1997 (KPABG), 13.VIII.1997 (KPABG, duplicate in VBGI), Pryazhinskij District (61°33'44"N 33°37'10"E), VB, 22.VI.1997 (KPABG), Kemerovskaya Province, Kuznetskii Alatau Range (54°42'N 88°25'E), NK, 54-6-00 27.VI.2000 (KPABG), (54°49'N 88°21'E), NK, 9-00 20.VI.2000 (KPABG), Komi Republic, Troitsko-Pechyorskii District, Zheleznova G.V., 145-89 09.VII.1989 (KPABG), Magadan Province, Magadan city area (59°30'27"N 150°56'11"E), VB, Mag-22-29-10 16.VI.2010 (VBGI), Olskoye Plateau (60°38'45"N 151°29'13"E), VB, Mag-8-1-10 10.VI.2010 (VBGI), Murmansk Province, Khibiny Mts., NK, 14-1-96 10.VIII.1996 (KPABG), NK, 17-2-91 1991 (KPABG), NK, 20-96 10.VIII.1996 (KPABG), Sal'nyye tundry massif, VB, 7-3-01 30.VI.2001 (KPABG), Sakhalin Island, Due area (50°49'21"N 142°05'21"E), VB, S-58-10-09 05.IX.2009 (VBGI); U.S.A., Alaska, Port Clarence, Trelease W., 12.07.1899 (MO5273060), California, Mono Co. (37°58'N 119°16'W), Ignatov M.S., 03.IX.1989 (MHA, duplicate in VBGI); Dana Mt. (isotype of *Jungermannia danicola* Gottsche ex Underw.) Bolander (No. 24) (G14436/00115337), Colorado, Larimer Co., Weber W.A., 14.07.1956 (NY00244503), Nevada, Washoe Co. (39°19'N 119°56'W), Whittemore A.T., 19.10.1992 (MO3966883).

CHINA, Jilin, Changbai Mt., 2480 m alt., Sun J., 123 (IFP 00008883, IFP 00026701); CZECH REPUBLIC, Bohemian Switzerland National Park, NK, 30.VI.2001 (KPABG), Decin District, Váňa J. 31.V.1972 (KPABG), Krkonose Mts., Zemanova H., 22.VIII.1973 (KPABG); FINLAND, *Ostrobottnia kajanensis* (64°15'N 27°40'E), Lackstrom E.F., 12.VI.1872 (KPABG); GEORGIA, Khevi, Kazbegi, Devdoraki Canyon, 1900 m alt., cliffs., Chikovani N., 14.VII.1976 (VBGI); NORWAY, Sor-Trondelag (62°20'N 09°40'E), Lindberg H., Lindberg S.O., 30.VI.1882 (KPABG); TANZANIA, Kilimanjaro Mt., Ist Bivouac, Pocs T., 6788/BO 23.IX.1972 (NICH), Pocs T. et al., 08.VI.1990 (F).

Solenostoma sphaerocarpum var. ***nanum*** (Nees) Mull. Frib. in Rabenh., Krypt. Fl. Deutschl. Oesterr. Schweiz., Ed. 3. 6: 829, 1956. (=*Jungermannia nana* Nees ex Flot., Allgemeine botanische Zeitung., 25: 396, 1833)

Description. Plants 0.2–0.3 mm wide and 1–1.5 mm long, brown to sepia brown and blackish brown, creeping to loosely ascending near apex. Stem 70–90 μm wide, orbicular in cross section, dorsal surface cells thick-walled, walls brown, with indistinct trigones, mostly rectangular, 28–40 × 15–21 μm. Rhizoids colorless, rather numerous, in indistinct fascicles. Leaves mostly concave to canaliculate-concave, distant in basal portion of shoots to imbricate above, inserted at angle of 50–60° with axis, dorsally clearly but shortly decurrent, on ventral side subtransversely inserted, not decurrent, suborbicular to transversely oval 280–300 × 330–350 (1 : 0.8–0.9). Leaf cells in the midleaf mostly hexagonal 18–28 × 15–18 μm, walls slightly thickened, brown, frequently flexuous, trigones acute, triangular, cells along margin with walls slightly thickened, brown, but external wall frequently discolored, 15–21 μm, cuticle smooth.

Comment. The only character differing of this variety from var. *sphaerocarpum* is small size of shoot, reaching 0.2–0.3 mm wide. Some confusion of this variety is possible with *Solenostoma pusillum* that differs from the former in constant presence of red to purple pigmentation, at least as the traces, versus characteristic sepia-brown color in var. *nana*. Váňa (1974 b) treated this variety as mod. *parvifolia-densifolia* of *S. sphaerocarpum* that does not merit variety rank. I prefer to follow Schuster (1969) and to recognize it as variety, until the distribution and variability of it will be well known.

Distribution. Arctic Montane subcircumpolar. The distribution of the variety is poorly known, since this taxon is not commonly recognized and also probably overlooked during collecting. Only isolated locals in the Russian Far East (North and Central Kamchatka) are known where it occurs in lowered tundras near sea coast and re-appears after gap in mountains tundras above 1000 m a.s.l. Not known in North America, although found in adjacent Greenland and Ellesmere Island.

Ecology. The habitats preference of this variety is poorly understood, probably acidophilic xero-mesophyte. Due to data in hand the ecology is similar to that of var. *sphaerocarpum*, but the former inclined to occupy drier places and higher altitude. In Kamchatka it was collected in scoria field developed over or nearby early Holocene buried glacier, the area characterized by considerable instability and high drainage ability. It was also found in lowered (inversive?) tundras along Sea of Okhotsk and mountain tundra on the fine soil of solifluction spot of cryogenic origin. It also was once collected in snowbed habitat.

Specimens examined. RUSSIA, Kamchatka, Central Kamchatka (56°39'20"N 159°29'28"E), VB, K-134-34-04 14.IX.2004 (VBGI), North Kamchatka (59°10'N 159°50'E), VB, K-30-1-03 17.VI.2003 (KPABG, duplicate in VBGI), Murmansk Province, Kil'din Island (69°21'N 34°04'E), NK, 50/9 23.VII.1977 (KPABG), Lovozerskii District (67°07'59"N 39°40'00"E), Dombrovskaya A.V., 186ж 21.VIII.1967 (KPABG).

FINLAND, Enontekio Lapland, Lataseno River, Laine T., s.n. 21.VII.1965 (HIRO).

Solenostoma subellipticum (Lindb. ex Heeg) R.M. Schust., Hepat. Anth. North Amer., 2: 1021, 1969. (= *Plectocolea subelliptica* (Lindberg ex Heeg) A. Evans in H. Buch, A. Evans & F. Verdoorn, Ann. Bryol., 10: 4, 1938; *Nardia subelliptica* Lindb. ex Heeg, Verh. K.K. Zool.-Bot. Ges. Wien, 43: 69, 1893; *Plectocolea obovata* var. *minor* (Carrington) Schljakov, Pechen. Mkhi Severa SSSR, 4: 68, 1981; *Jungermannia subelliptica* (Lindb. ex Heeg) Levier, Bull. Soc. Bot. Ital., 1905: 211, 1905)

Description. Plants (0.6) 0.7–2.0 mm wide, up (3–) 5–20 mm in length, ascending to creeping, rarely erect, deep brownish green, yellowish brownish, sepia-brown, purplish brown to purplish brownish greenish, commonly with purplish and

purplish brownish coloration in bracts and near apex. Stem 140–400 μm (in upper part of fertile shoots up 450 μm) in diameter, orbicular to slightly transversely elliptic in cross section, branching ventral, dorsal surface cells thin- to slightly thick-walled, with indistinct trigones, 40–170 × 10–35 μm, cuticle commonly distinctly striolate. Rhizoids brownish to purplish and light rose to nearly colorless, scattered to dense, in indistinct fascicles. Leaves distant, concave, concave-canaliculate to flattened, inserted at angle of 40–80° with axis, dorsally subtransversely inserted, not decurrent or decurrent up 1/5 – 1/3 of stem width, ventrally subtransversely inserted, line insertion often arcuate, not or barely decurrent (rarely up 1/4 of stem width), 350–1000 × 450–920 ((0.8–) 0.9 : (0.8) 0.9–1), elliptic to ovoid to orbicular and (rarely) reniform, rarely (in brightly colored forms from well exposed sites) with discolored leaf margin. Cells in the midleaf thin-walled, walls brown, brownish to colorless and pink rose, 22–35(60) × 22–40 μm, trigones concave, distinct, to large and convex, along margin 14–38 μm, with brownish thin- to slightly thickened (especially external) walls and triangle to convex trigones; cuticle striolately verrucose, that more distinct in leaf base, sometimes smooth in upper half. Paroicous, rarely heteroicous (some subfloral innovations from paroicous branch with 2 male generations divided by some pairs of sterile leaves). Perianth terminal, hidden in or exerted for 1/3 from bracts, conical to fusiform, pluriplicate, sometimes turbinate in upper portion, ca. 550–1000 × 400–600 μm, sometimes with one ventral innovation, perigynium 2/3 – 6/3 of perianth length, commonly rhizogenous, archegonia ca. 8–17 in perichaetium, bracts the same size with antheridial bracts, sheathing perigynium in the base, canaliculate above, with apex deflexed. Androecia in 2–3 pairs of bracts below perichaetium, sometimes divided from perichaetium by 1–3 pairs of sterile leaves, or sometimes started from perianth (such as female bracts are male bracts at the same moment, intercalary, with (1–) 2 (–3) antheridia per bract, antheridial body nearly spherical, 100–180 μm in diameter, antheridial stalk biseriate, ca. 80–100 × 15–20 μm in length, bracts cupped to concave and inflated (purplish in inflated area) in base, with erect or sometimes deflexed apex, transversely oval to widely ovoid, 630–1350 × 810–1600 μm. Capsule 500–1000 μm in length, ellipsoidal, capsule wall 2-stratose, outer cell subquadrate to rectangular, 20–45 × 26–35 μm with 2–3 nodular thickenings in each vertical wall; inner cells irregularly linear, 30–90 × 8–20 μm with 6–18 annular thickenings. Seta 100–150 μm in diameter and 1500–9000 μm length. Spores finely papillose, spherical, 18–24 μm in diameter. Elaters, 120–150 × 9–12, 2-spiral, with narrowed homogenous ends. Figure 16: 8–9; 26).

Comment. The characteristic features of the species include paroicous inflorescence, pale colored and soft rhizoids, comparatively high perigynium and ovate, commonly longer that wide leaves. Schljakov (1980) treated this species as variety within *Solenostoma obovatum* (*Plectocolea obovata* var. *minor*) that resulted the most of material from Russia both *Solenostoma obovatum* and *S. subellipticum* was fallen into *S. obovatum* without distinguishing of variety level. This created a lot of confusion in understanding of distribution of the both taxa. Indeed some phases merge two species and the Schljakov's point of view looks reasonable supported. Although in the pattern case it is difficult to explain why *S. obovatum* in its narrow sense does not occur in the Russian Far East, although distributed in adjacent western North America and also rather locally abundant in North Europe (the distribution of both taxa in Russian Asia need to be clarified). The recent molecular research (e.g. Bakalin & Vilnet 2012) implicitly showed that two taxa are closely related, but may be treated as different species. I am accepting this point of view also from the practical reason since for the future researches, when self-dependent status of the taxon will be probably accepted, it is better to keep it now as different species than the variety that will be recognized by only a few 'florist' bryologists. The distinctions between two taxa are given under *S. obovatum*. *S. subellipticum* may be also confused with *Plectocolea ovalifolia* and *Solenostoma obscurum*, the differentiations are under latter species.

Distribution. Arctic Montane circumpolar. The distribution of *Solenostoma subellipticum* in North America is imperfectly known, due to data in hand it is rather sporadically ("rare and scattered": Váňa & Hong 1999: 143) distributed and known from Alaska, British Columbia and Washington, re-appearing eastward, after noticeable gap, in Atlantic Canadian Nova Scotia and Quebec. I was able to see only one specimen from Washington that was collected at the elevation of 514 m a.s.l. Contrary within the Russian Far East this is one of the most common species in northern half of the land, stretching southward as up to North Kurils, middle Sakhalin Island and Amur River Lower Course in Khabarovsk Territory. It occurs from near sea level (and spreading by such wind-impacted communities as southward as up to Due Bay in northern Sakhalin) to middle elevation of mountains, exceeding 1300 m a.s.l. in Chamga Mt. in Central Sakhalin.

Ecology. Acidophilic meso- to hygrophyte. The species prefers moist soil and rocks along sluggishly flowing streams (also thermal), rarely submerged, or occurring in wet moss patches in mossy tundras. Almost restricted by mountain tundra or shortly descends to crooked or boreal coniferous forest belts along streams; also occurring in azonal tundroid communities in wet cliffs along sea coast, formed under strong impact of severe winds. The species mostly prefers open sites and rarely occurring in semi-shaded places.

Specimens examined. RUSSIA, Chita Province, Udokan Range (57°08'N 119°30'E), VB, 5-10-11 05.VII.2000 (KPABG), Chukotka, Sireniki Settl. (64°24'30"N 173°56'38"W), Katenin A.E., 04.VIII.1986 (KPABG, duplicate in VBGI), Katenin A.E., 10.VIII.1986 (KPABG), Commander Islands, Bering Island (54°40'N 166°15'E), VB, K-10-16-02 09.VIII.2002 (KPABG, duplicate in VBGI), Mednyj Island (55°44'00"N 167°38'50"E), VB, K-42-7-04 02.VII.2004 (KPABG, duplicate in VBGI), (54°46'45"N 167°35'00"E), VB, K-48-3-04 02.VII.2004 (KPABG), Mamayev E., K-49-03-EM 20.VII.2003 (KPABG, duplicate in VBGI), (54°48'30"N 167°31'00"E), VB, K-55-9-04 03.VII.2004 (KPABG), Kamchatka, Central Kamchatka (56°39'20"N 159°29'28"E), VB, K-133-4-04 13.IX.2004 (VBGI), (56°25'06"N 159°12'54"E), VB, K-137-18-04 17.IX.2004 (VBGI), (55°40'N 157°40'E), VB, K-50-23-02 14.IX.2002 (KPABG, duplicate in VBGI), East Kamchatka (53°45'N 158°50'E), VB, 65-21-01 11.VIII.2001 (KPABG), VB, K-19-1-04 19.VI.2004 (KPABG), (56°11'N 160°21'E), VB, K-48-12-03 22.VII.2003 (KPABG, duplicate in VBGI), (53°45'N 158°50'E), VB, K-59-11-01 08.VIII.2001 (KPABG, duplicate in VBGI), (54°25'50"N 160°08'22"E), Chernyagina O.A., 06.IX.1988 (VBGI), North Kamchatka (59°10'N 159°50'E), VB,

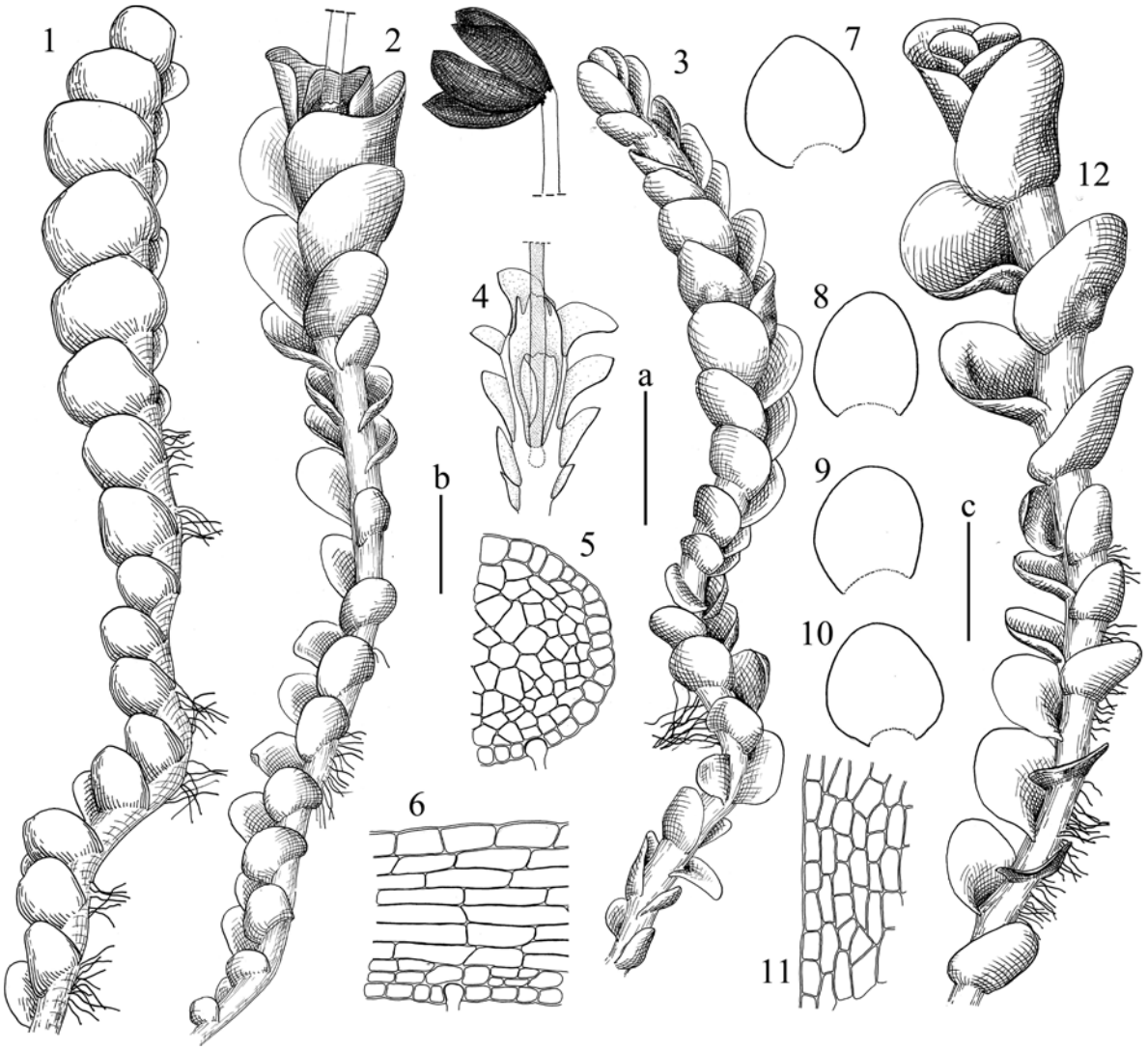

Figure 26 *Solenostoma subellipticum* (Lindb. ex Heeg) R.M. Schust. 1 – sterile branch; 2 – branch with androecia, perianth and sporophyte; 3 – occasional male innovation (probable result of protheoandry); 4 – perianth longitude section; 5 – stem cross section; 6 – stem longitude section; 7–10 – leaves; 11 – ventral leaf base cells; 12 – plant with androecia and archegonia. 1–3 – from K-42-7-04 (KPABG); 4 – from K-59-11-01 (KPABG); 5–12 – from K-60-1-01 (KPABG). Scales: a – 1 mm, for 1–4; b – 100 μm, for 5, 6, 11; c – 500 μm, for 7–10, 12

K-24-2-03 14.VI.2003 (KPABG), South Kamchatka (53°00'N 158°25'E), VB, 76-1-01 22.VIII.2001 (KPABG), Khabarovsk Territory, Ulchinskii District (51°28'15"N 139°52'53"E), Roenko E., 48/1 08.VIII.2011 (VBGI), Kurils Islands, Paramushir Island (50°25'30"N 155°50'45"E), VB, K-106-5-04 28.VII.2004 (KPABG, duplicate in VBGI), (50°38'55"N 156°07'32"E), VB, K-75-17-04 13.VII.2004 (KPABG, duplicate in VBGI), (50°29'05"N 155°46'30"E), VB, K-91-3-04 23.VII.2004 (KPABG), Shumshu Island (50°42'05"N 156°15'10"E), VB K-121-24-04 14.VIII.2004 (KPABG, duplicate in VBGI), Magadan Province, Kamennyj Range (59°47'23"N 149°20'21"E), VB, Mag-23-3-10 17.VI.2010 (VBGI), Magadan city area (59°34'13"N 150°38'32"E), VB, Mag-20-35-10 16.VI.2010 (VBGI), Omsukchan District (61°10'32"N 153°53'33" E), 886 m alt., VB, Mag-34-41-1211.VIII.2012. (VBGI);Murmansk Province, Kandalaksha Bay, NK, 145-2-91 13.VIII.1991 (KPABG), Khibiny Mts., NK, 1127/3 16.VIII.1974 (KPABG), NK, 12-2-96 09.VIII.1994 (KPABG), NK, 309-6b-00 19.VIII.2000 (KPABG), Kil'din Island, Schljakov R.N., 236 24.VII.1977 (KPABG), Lovozerskii District, Belkina O.A., 34/3 18.VII.1983 (KPABG), Belkina O.A., 46-13-846 14.VIII.1984 (KPABG), Nivajarvi Lake, NK, 75/11 13.VIII.1986 (KPABG), Por'ya Bay, NK, 131-10-91 11.VIII.1991 (KPABG), Sakhalin Island, Chamga Mt. (50°44'57"N 143°18'26"E), VB, S-27-8c-06 15.VIII.2006 (VBGI), (50°45'18"N 143°17'55"E), VB, S-60-2-09 11.IX.2009 (VBGI), Due area (50°49'21"N 142°05'21"E), VB, S-58-5-09 05.IX.09 (VBGI), Yakutiya, Udokan Range (57°15'N 119°45'E), VB, 27-7-00 02.VIII.2000 (KPABG); U.S.A., Washington, Whatcom Co., Hong W.S., 01.08.1984 (MO5242410).

CHINA, Xizang, Ridong Co., Qimala, 4700 m alt., Zang M., 5582 (IFP 00003256); GREENLAND, West Greenland, Disko Island (66°14'N 53°32'W), Steere W.C., 09.VII.1962 (NY00099013); NORWAY, Svalbard Archipelago, Dresselhuys (78°06'06"N 14°19'52"E), NK, K-147-2b-04 30.VII.2004 (KPABG).

METASOLENOSTOMA Bakalin et Vilnet Bot. Pacif. 3(2): 10, 2014

Plants delicate, pellucid, mostly flaccid, soft. Epidermal stem cells elongate (2–5 times longer than wide), branching lateral intercalary or ventral, as subfloral innovations, no geotropic stolons. Rhizoids colorless or only slightly (reddish or purplish) colored. Leaves very obliquely inserted. Leaf cells with small to wanting trigones, along margin mostly larger than in the midleaf and commonly with thickened cell walls.

Type species: *Metasolenostoma gracillimum* (Sm.) Vilnet et Bakalin

Comment. This newly recognizing taxonomic unit within the *Solenostoma-Plectocolea* complex has unclear perimeter and some other taxa, now nested in *Plectocolea* (e.g.

P. fossombronioides, *P. crenuliformis*) and *Solenostoma* (e.g. *S. rubrum*) probably need to be transferred to the genus. Currently I avoid making the transfers, because the robust genetic support, based on study of recent materials is need to reveal the objectivity of such changes.

Metasolenostoma gracillimum (Sm.) Vilnet et Bakalin 2014 2014 Bot. Pacif. 3(2): 10, 2014 = *Solenostoma gracillimum* (J.E. Smith) R.M. Schust. Hep. Anth. North Amer. 2: 972 1969; *Jungermannia gracillima* J.E. Smith in Sowerby Engl. Bot., 32: tab. 2238 1811; *Jungermannia crenulata* J.E. Smith in Sowerby Engl. Bot., 21: 1463 1805 non *J. crenulata* Schmidel in Paver Dissert. Jungerm. Charact., 20 1760; *Solenostoma crenulatum* (J.E. Smith) Mitt. J. Linn. Soc. Bot.. 8: 61 1865).

Description. Plants 3–10 mm long and 0.4–0.9 mm wide, fertile up 1.3 mm, prostrate to (fertile) ascending, yellowish brownish to pale green and pale yellowish to brown; female plants yellow red to brownish purplish. Stem (100) 175–245 μm in width and (90) 150–220 μm in height, branching not seen; dorsal surface cells 35–75 × 17–25 μm, rectangular to oblong hexagonal and obliquely rectangular, walls thin; in the stem cross section nearly the same size in outer and inner layers, but outer with cell walls thickened and yellow to brownish colored, inner cells more or less thin-walled, with walls colorless, ca. 15–20 μm in diameter. Rhizoids sparse, colorless, in indistinct fascicles, forming mat under stem or decurrent down the stem, but not forming distinct fascicle. Leaves distant to subimbricate (especially in area 5–7 pairs below the perianth), inserted at angle (10) 15–25° with axis, sometimes to subtransverse (leaves below female bracts); (190) 470–900 × (200) 500–940 μm (1 : (0.7) 0.95), orbicular to rounded triangular, lingulate and reniform, widest at lower 1/3 of the leaf length, more rarely near the middle. Cells in the midleaf (22) 30–45 × (17) 25–35 μm, thin-walled, subisodiametric to shortly oblong, mostly penta- to hexagonal, trigones indistinct; along margin (25) 30–45 μm, very thick-walled or not differs from midleaf cells (then leptodermous, virtually without trigones and with slightly equally thickened walls), walls brownish, cuticle striolate at lower 1/2 of the leaf or smooth everywhere. Dioicous. Perianth terminal on main axis, no innovations, exerted for 1/3 – 1/2 of its length, conical, tubular-conical, ellipsoidal to short clavate, suddenly contracted to mouth 4–5-plicate (1–2 dorsal, 2 lateral, 1 ventral), perianth mouth crenulate, composed elongate thick-walled cells, slightly dilated on the external end, perianth in the middle part composed by rectangular to isodiametric cells, ca. 30–45 × 18–25 μm, cuticle distinctly striolate in lower half; perigynium ca. 1/4 of the perianth length or smaller; bracts not differentiable from sterile leaves, slightly larger only, in 1 pair, ca. 950 × 950–1070 μm. Androecia intercalary, spicate, in 2–3 pairs of bracts, male bracts strongly inflated in the base, with incurved margin of bracts, with 1 antheridium per bract, antheridial body brownish, shortly ellipsoidal ca. 125 × 112 μm, stalk biseriate, ca. 33 × 17 μm. Seta ca. 3000–5000 × 125 μm. Capsule shortly ellipsoidal, bistratose, inner cells, long rectangular 38–63 × 7–13 μm, with 8–10 annular thickenings, outer cells subquadrate, ca. 2530 × 17–35 μm with 1–2 nodular thickenings in both vertical and horizontal walls. Elaters 2-spiral, ca. 100 × 7.5 μm, with homogenous endings ca. 10 μm length. Spores red-brown, spherical, finely papillose, 10–11 μm in diameter. Figure 19: 3–7.

Comment. Aside degree of border development, that vary in the species, but potential ability to develop it is one of the striking trait of the species, this taxon characterized by prostrate growth form, very leptodermous midleaf cells structure, very obliquely inserted leaves and presence of purplish coloration. The species counts two forms that merge by transitional modifications in the area treated. The differentiations from morphologically related species are given under corresponding forms. These forms may be distinguished by the following key:

1. Leaves with the rim of swollen thick-walled cells, 1.5–2.0 times larger than cells of the next 1–2 rows inward ....f. *crenulatum*
1. Leaves without the rim of swollen thick-walled cells, marginal cells nearly the same size with cells of the next rows inward ..... f. *gracillimum*

Metasolenostoma gracillimum f. *gracillimum*

Comment. This form characterized by the leaves without border of large swollen cells, although sometimes marginal cells are moderately equally thickened, but nearly the same size with cells inward. The form may be mistaken with leptodermous phase of *Solenostoma hyalinum* and distinctions are discussed under the latter.

Distribution. Temperate Amphi-Atlantic. Not known in treated area, westward this form recorded in Arkansas, Georgia, Kentucky, New Jersey Texas, but as correctly noted by Schuster (1969: 980), it "actually occurs sporadically through the range of the species". Altitudinal range is imperfectly known, most probably lowland in broadleaved forest zone.

Ecology. Neutrophilic to acidophilic mesophyte. The ecological preference of the taxon appears to be similar to that of f. *crenulatum* (see under the latter), but with a more noticeable inclination to occupy wetter and shady habitats. Based on studied specimens, the form occurs in steep muddy banks of creeks and at the edges of gullies in broadleaved forest zone.

Specimens examined. U.S.A., Arkansas, Redfearn P.L., 27.VI. 1973 (MO5129594), Kentucky, Boyle Co., Studlar S.M., 31630 (MO3673846), Texas, Leon Co., MacGregor R., 07.IV.1953 (NY00244290).

FINLAND, Regio aboensis (60°15'N 24°00'E), Lindberg S.O., 18.VIII.1879 (KPABG); GEORGIA, Adjara, 1900 m alt., on soil. 24.VIII.1971. Chikovani N., (no field number) (TBI, duplicate in VBGI); NETHERLAND, N-Brabant, NK, 1e-3-99 14.X.1999 (KPABG); RUSSIA, Caucasus, Aibga Range (43°37'49"N 40°17'39"E), NK, K205-1-09 09.X.2009 (KPABG), Shakhe River Basin (43°54'01"N 39°49'56"E), NK, K373-1-08 25.IX.2008 (KPABG), (43°54'02"N 39°45'51"E), NK, K378-1-08 25.IX.2008 (KPABG).

Metasolenostoma gracillimum f. ***crenulatum*** (J.E. Smith) Vilnet et Bakalin Bot. Pacif. 3(2): 10, 2014 (*Solenostoma gracillimum* f. *crenulatum* (J.E. Smith) Bakalin, Polish Bot. Journ., 57(1): 141, 2012; *Jungermannia crenulata* J.E. Smith in Sowerby,

Eng. Bot., pl. 1463, 1805; *Solenostoma gracillimum* f. *crenulatum* (J.E. Smith) R.M. Schust. Hep. Anth. North Amer. 2: 980, 1969 *n. illeg.* (no reference to basionym))

Comment. Commonly easily recognized taxon due to leaves with conspicuous border of large swollen cells and leptodermous midleaf cells with vestigial to small concave trigones. Among regional species it may be possible mistaken with *Solenostoma rubrum* that was treated as conspecific with the former for a long time. However Evans (1919) exhaustively studies both taxa and convincingly showed they are different species, although closely related. The main distinctions between *Metasolenostoma gracillimum* f. *crenulatum* and *S. rubrum* are in the leaf border. When leaf border in f. *crenulatum* composed by much larger and equally or nearly so thickened walls, in *S. rubrum* s. str. it is similar in size with cells of next inward rows and thickened noticeable unequally, with large convex trigones that sometimes confluent in tangential walls. Much troublesome distinction of f. *crenulatum* from recently described *Solenostoma rubrum* var. *underwoodii*, characterized by: 1) purplish pale violet coloration, 2) very small trigones to virtually absent inward of the leaf margin; 3) mostly sub-equally thickened leaf rim cells; 4) long exerted perianth. This variety differs from *Metasolenostoma gracillimum* f. *crenulatum* in: 1) presence (although small) trigones in the leaf (vs. almost uniformly absent), 2) smaller difference in size of rim and inner leaf cells, 3) sub-equally thickened leaf margin (vs. equally thickened).

Distribution. Temperate, generally Amphi-Atlantic. Due to data in hand this form (as the species as well) does not occur in Asia at all. The North American distribution is mostly confined to the eastern half of the continent, where the frequency of f. *crenulatum* vastly prevails over f. *gracillimum*. F. *crenulatum* was recorded in the eastern half of the continent in Canada (New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Quebec) and in the USA (Alabama, Connecticut, District of Columbia, Florida, Georgia, Illinois, Iowa, Kentucky, Maine, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia). Recently it was also found in Indiana and California. The latter record is rather surprising, because it is the only known locality of the taxon in western North America. The taxon prefers lowland in broadleaved forest zone.

Ecology. Neutrophilic to acidophilic meso-xerophyte. Apparently this taxon is confined to fine-grained soil along streams and (more frequently) in human-disturbed areas (roadsides, etc.) in temperate and (much rarer) boreal zones.

Specimens examined. CANADA, New Brunswick, York (45°51'N 67°02'E), Ireland R.R., 13.07.1970 (NY00094311), Ontario, Algonquin Park, Cain R.F., 02.06.1943 (NY00163828), Cameron Twp. (46°06'N 78°25'W), Ley L.M., 18.VIII.1987 (NY00094310); FRANCE, Vosges, Frahm, 27.XII.1987 (F); U.S.A., Florida, Gudsden Co., Jackson C., 22.II.1952 (NY00243858), Georgia, Grady Co., Breil D.A., 24.I.1968 (MO1091740), Indiana, Putman Co., Underwood L.M. IX.1893 (MO5374287), Mississippi, Pennebaker F., 28.02.1938 (MO2105739), New York, Tompkins Co., Schuster R.M., 07.11.1943 (MO5380727), Green Co., Smith S.J., 20.VII.1973 (KPABG), Vermont, Brookline Co., Howe M.A. 19.07.1899 (NY00244086), California, Jackson Co., Theirs B.M., I.1987 (NY00244446), Humboldt Co. (40°55'N 124°06'W), Ignatov M.S., 06.VIII.1989 (MHA, duplicate in VBGI). GEORGIA, Adjara, Lazistania Rossica, Woronow G., 07.IX.1910 (TBI), Woronow G., 20.08.1910 (TBI), 1100 m alt., on soil. 17.VIII.1971. N. Chikovani (TBI, duplicate in VBGI); SWEDEN, Skane (56°10'N 13°45'E), Persson J., 15.V.1879 (KPABG); UKRAINE, Kiev Province, Ivanovskii District, Zonyartova O., 20.IX.1968 (KPABG).

Metasolenostoma ochotense Vilnet et Bakalin Bot. Pacif. 3(2): 10, 2014 (= *Solenostoma ochotense* Bakalin et Vilnet Bryologist 115(4): 575 2012).

Description. Plants prostrate to ascending, closely attached to the substratum, brownish to brown and purplish brown, sterile 0.3–1.3 mm in width, up to 1.5–1.8 mm in width in perianthous plants; perianthous plants ascending, commonly with purple marked beak and folds; larger plants commonly with more deeply colored leaf rim. Stem not or rarely branched, 0.15–0.30 mm in d. Rhizoids isolated in small shoots to common and dense, fasciculate in erect spreading indistinct fascicles in larger ones; colorless to brownish. Leaves distant to very distant in smaller shoots to contiguous and subimbricate in larger ones, flattened to concave and loosely canaliculate–concave, the largest with undulate and crispate margin, commonly with retuse apex, spreading, obliquely inserted (ca. 30–45 (–60)° with axis); in larger leaves subtransverse ventrally to subhorizontal in dorsal side, decurrent for 0.5–1.0 of stem width; suborbicolar, widely cordate, reniform, transversely elliptic and trapezoidal, 0.3–0.7 × 0.4–1.2 mm (1 : 0.6–1.0). Midleaf cells thin-walled to obscurely thickened, with small, but distinct concave trigones, to with large triangular to convex trigones, walls brownish, cells mostly 5–6-gonal, 22–36 × 22–34 μm; along margin 19–45 μm, commonly more deeply colored than midleaf cell walls, thin–walled, commonly with convex trigones and thickened external wall; near the base 28–62 × 25–56 μm, thin–walled with very small to medium in size concave trigones; cuticle smooth. Dioicous. Perianth terminal, rarely with subfloral innovations, conical to fusiform and subclavate, with 3 (4) keels, those are sometimes indistinct or distinct and purple colored; 1.0–1.5 × 0.7–1.0 mm; exerted for 1/3 – 2/3 of its length; sometimes rhizogenous in lower third; mouth coarsely crenulate due to protrudent subclavate cells, cells thin-walled; in the middle cells subquadrate to shortly rectangular, with distinct concave trigones, 28–70 × 22–34 μm, thin-walled; near the base 44–90 × 25–28 μm and longer (up 190 μm long); in lower third 2–3-stratose. Perigynium 1/4 – 1/2 of perianth's length, with 1 (2) pairs of bracts. Bracts similar to larger leaves, ca. 1.5–1.7 × 0.7–0.9 mm, undulate and crispate at margin, retuse at apex, erect spreading or appressed to the perianth. Androecia intercalary, although commonly branch becomes depauperate above androecia, with 4–6 pairs of bracts, bracts 2–4-androus, strongly inflated in lower half and commonly recurved along margin. Figure 15:1–4.

Comment. The characteristic for the species are purplish to purple color, prostrate growth form, obliquely inserted leaves, presence of short perigynium, commonly plicate perianth with rostellate mouth and occurrence in the area of extant volcanism. *Metasolenostoma ochotense* was described as the taxon occupying intermediate position between *Plectocolea* and *Solenostoma* (Bakalin & Vilnet 2012). Before that

this species was identified as *S. fusiforme* or *S. koreanum* (Bakalin 2010). *Metasolenostoma ochotense* differs from both in following: 1) the smaller size of the plants ((0.3) 0.4 – 0.8 (1.0) mm wide versus 1.0 – 2.5 mm), and 2) the presence of a well-developed perigynium. *M. ochotense* may be confused with *Solenostoma hyalinum* a rather rare species in the regional flora. It differs from *S. hyalinum* in: 1) its keeled perianth with rather solenostomoid beak; 2) common red-purple coloration (that is not characteristic of *S. hyalinum*).

One year later description this species was synonymized by Váňa et al. (2013) with '*Solenostoma hokkaidense* (Vaňa) Vaňa, Hentschel et J. Heinrichs' (= *Jungermannia subelliptica* var. *nana* Amakawa, J. Hattori Bot. Lab. 22: 21, 1960). They note (Váňa et al. 2013: 39) "However, no samples of *Solenostoma hokkaidense* were included in their phylogeny and they do not mention that taxon at all although it is described from the region. Type plants of *Solenostoma hokkaidense* are poorly developed, whereas Bakalin's plants are mostly optimally developed. Based on this fact, the leaf cells in Russian plants (especially the basal ones) are larger than in the type plants, but falls within the range of variation. This is probably an endemic taxon known only from Kamchatka Peninsula and Kuril Is. in Russia and Rishiri I. (Japan), the area of extant or extinct volcanic activity". If to put aside the question how we could include '*Solenostoma hokkaidense*' to phylogenetic analysis when only one specimen is known for this taxon and why Váňa or his co-authors did not studied the type of *S. ochotensis* (even did not request it) before the synonymization the intricate question will remain: why *Metasolenostoma ochotense* should be compared with '*S. hokkaidense*'? Nevertheless, as that attempt to synonymy two names on the rather puzzling reasons is existing it is need to describe the differentiation features between '*S. hokkaidense*' and *Metasolenostoma ochotense*. The differences between two species are following: '*Solenostoma hokkaidense*' has high perigynium ca. 1 perianth length, while *Metasolenostoma ochotense* has perigynium 1/4 – 1/2 of perianth length. Perianth in '*Solenostoma hokkaidense*' is slightly exerted (mostly covered by the leaves), versus perianth exerted for 1/3 – 2/3 in *Metasolenostoma ochotense*. Cells along leaf margin in the former are 15–18 μm, versus (19) 25–35 (45) μm in the latter. Cells near the leaf base in '*Solenostoma hokkaidense*' are 22–30 × 20 μm, versus 28–62 × 25–56 μm in *Metasolenostoma ochotense*. Rhizoids in *M. ochotense* colorless to brownish, but in '*S. hokkaidense*' pale red. Very preliminary I may suggest '*S. hokkaidense*' is depauperate phase of *Solenostoma obscurum*, but certainly not *Metasolenostoma ochotense*. The type of *Solenostoma hokkaidense* is from moist alpine meadow (Amakawa 1960) that also confirms the latter point of view.

Distribution. Boreal East-Asian. Within area treated the species occurs in western Kamchatka, Kurils, South Sakhalin and North Japan, being most common in northern Kurils. Within the Russian Far East it mostly occurs in lowlands along sea coast, although in South Kurils may be found in the middle mountain elevations up to 400 m a.s.l. Southward in Japan it mostly grows starting from middle to high mountain elevation (500–1900 m a.s.l.).

Ecology. Acidophilic mesophyte. Throughout of its area the species found in volcanically modified habitats, most commonly in the area covered by volcanic ash and scoria field overwetted in flood times. This species is the pioneer of overgrowth processes in Northern Kurils and covers there wet land on young scoria fields being dominant with coverage up to 80 %. This is the common associate with *Juncus* spp., also widely spreading in such wet and bare grounds. Contrary to other species attracted by area of active volcanism (e.g. *Metasolenostoma orientale*, *Plectocolea vulcanicola*), *Metasolenostoma ochotense* does not occur in the sulphur-rich substrata.

Specimens examined. RUSSIA, Kamchatka, West Kamchatka, Sobolevo area, Chenyagina O.A., VII.1990 (VBGI), Kurils Islands, Iturup Island (45°08'33"N 147°57'26"E), VB, K-51-24b-05 14.IX.2005 (VBGI), (45°15'32"N 148°10'23"E), VB, K-66-10a-05 22.IX.2005 (VBGI), Kunashir Island (43°50'13"N 145°32'43"E), VB, K-48-3a-06 07.IX.2006 (VBGI), (44°03'24"N 145°51'44"E) VB, K-54-3-06 11.IX.2006 (VBGI), (44°15'58"N 146°06'23"E), VB, K-62-1-06 17.IX.2006 (VBGI), Paramushir Island (50°19'35"N 155°32'55"E), VB, K-111-1-04 29.VII.2004 (KPABG, duplicate in VBGI), (50°13'50"N 155°34'20"E), VB, K-115-4-04 (holotype of *Solenostoma ochotense*) 02.VIII.2004 (VBGI), Shikotan Island (43°51'45"N 146°45'58"E), VB, K-65-5-07 06.IX.2007 (VBGI), Shumshu Island (50°42'55"N 156°11'45"E), VB, K-127-3-04 15.VIII.2004 (KPABG, duplicate in VBGI), Sakhalin Island, Kamyshovyy Range (50°52'56"N 142°21'44"E), VB, S-57-36-09, 05.IX.2009 (VBGI), Nevelsk District (46°44'25"N 142°08'03"E), VB, S-67-2-09 17.IX.2009 (VBGI).

JAPAN, Aomori Pref., Hakkoda Mt., Kitagawa N., 6386, 02.IX.1961 (KYO), Towada-shi, Oirase Gorge, near junction with Sobe River (40°32'N 140°58'E), Ota M. & T. Furuki, 23444 30.IX.2013 (CBM), Hokkaido Pref., Akadake Mt., Takita K., 1056 29.VII.1983 (SAPT), Daisetsu Mt., Sasaki T., 4220 06.IX.1953 (NICH), Konoishi Mt., Kan S. 23.IX.1969 (HIRO), Kurodake Mt., Kuwahara Y., 5772 21.VII.1956 (HIRO), Kuwahara Y., 5780 11.VII.1956 (HIRO), Kushiro-cho, Takita K., 341 12.VIII.1980 (SAPT), Rishiri Island, Shimizu D., 24.VII.1954 (NICH), Sapporo-shi, Teine Mt., Uchida A., 1049/1251 11.XI.1999 (SAPT), Nagano Pref., Yatsugatake Mt., Furuki T., 4065 01.IX.1982 (CBM).

Metasolenostoma orientale Bakalin et Vilnet Bot. Pacif. 3(2): 12, 2014

Plants ascending to erect, in loose patches 1.0–2.8 mm wide, up 15–40 mm in length, pale green to whitish, sometimes with brownish tint become brownish to black and violet in leaf margin, especially near apex and perianth. Stem 170–300 μm in diameter, orbicular in cross section, rarer elliptic 315–420 × 280–390 μm, branching ventral, rarely occur, dorsal surface cells thin-walled to slightly thick-walled, trigones indistinct or small concave, 78–200 × 17–42 μm. Rhizoids isolated to dense or virtually absent, erect to obliquely spreading, separated or united into indistinct fascicles, rarely forming mat under ventral side of stem, colorless to brownish. Leaves distant to contiguous and subimbricate, on big shoots with undulate leaf margin, rarely retuse in apex, commonly with blackish to brownish border on leaf margin, inserted at angle of (10) 40–70 (80)° with axis, dorsally decurrent for 1/3 – 3/3 of stem width, on ventral side line insertion arcuate or straight, transverse, not or barely decurrent, (615) 1000–1750 × (665) 1200–2135 μm ((0.7–0.9) 1–1.3 : 1), widely obliquely elliptic-triangular to orbicular and widely ovoid, at the base sheathing the stem, loosely canaliculate to concave or flattened above, obliquely spreading laterally. Cells in the midleaf thin, rarely slightly

thickened, mostly oblong to hexagonal, 30–75 × 25–54 μm, with small concave trigones, along margin 28–52 μm, mostly with thickened and colored external wall, cuticle papillose to smooth in lower half of leaf and smooth above, rarely finely striolate throughout. Dioicous. Perianth colorless to blackish commonly becoming brownish, black and violet in the keels, terminal, rhomboidal, 4–5-keeled with distinct 2 lateral and 1 dorsal keels and smoothed or indistinct 2 ventral keels, ca. 2200 × 1100 μm; perigynium virtually absent; female bracts the same size with sterile leaves, bracteole absent. Androecia intercalary, with 5–10 and more pairs of bracts, sometimes spicate, bracts strongly inflate in lower half and obliquely spreading above, with commonly recurved margin. Figures 27 and 28.

Comment. This is easily recognizable species due to generally pallid (whitish to yellowish and greenish) color, lax and soft texture of plants with commonly blackish to black apices with violet tint, large midleaf cells, and occurrence in the area of extinct or extant volcanism on sulphur-rich substrata or under direct impact of water rich with sulphur ions (substrate preferences of the species in North America are poorly understood). The only morphologically related species in treated area is *Plectocolea vulcanicola*, the differentiations are given under the latter. Before (Bakalin 2010, 2012) this taxon was regarded as identical with *Protosolenostoma fusiforme* (= *Solenostoma fusiforme*) known southward in Japan and Korea (Halla-san). After study of the type specimens of the both *Jungermannia fusiformis* and *Solenostoma koreanum* (G –`112194 and G16635`112199 correspondingly) I found two latter are identical (small observed variations have not taxonomical value, that confirm Inoue's (1975) point of view), but different from plants named as '*S. fusiforme*' in Russian Far East and North America (Bakalin 2010, 2012). The newly recognized species differs from *Protosolenostoma fusiforme* in the following: 1) common presence of blackish to black pigmentation with violet tint in shoot apices, 2) ascending to erect growth form versus prostrate to ascending (evident in perianthous plants only) in *P. fusiforme*, 3) although general shoot width measurements are largely overlap but *Metasolenostoma orientale* looks larger, because leaves commonly

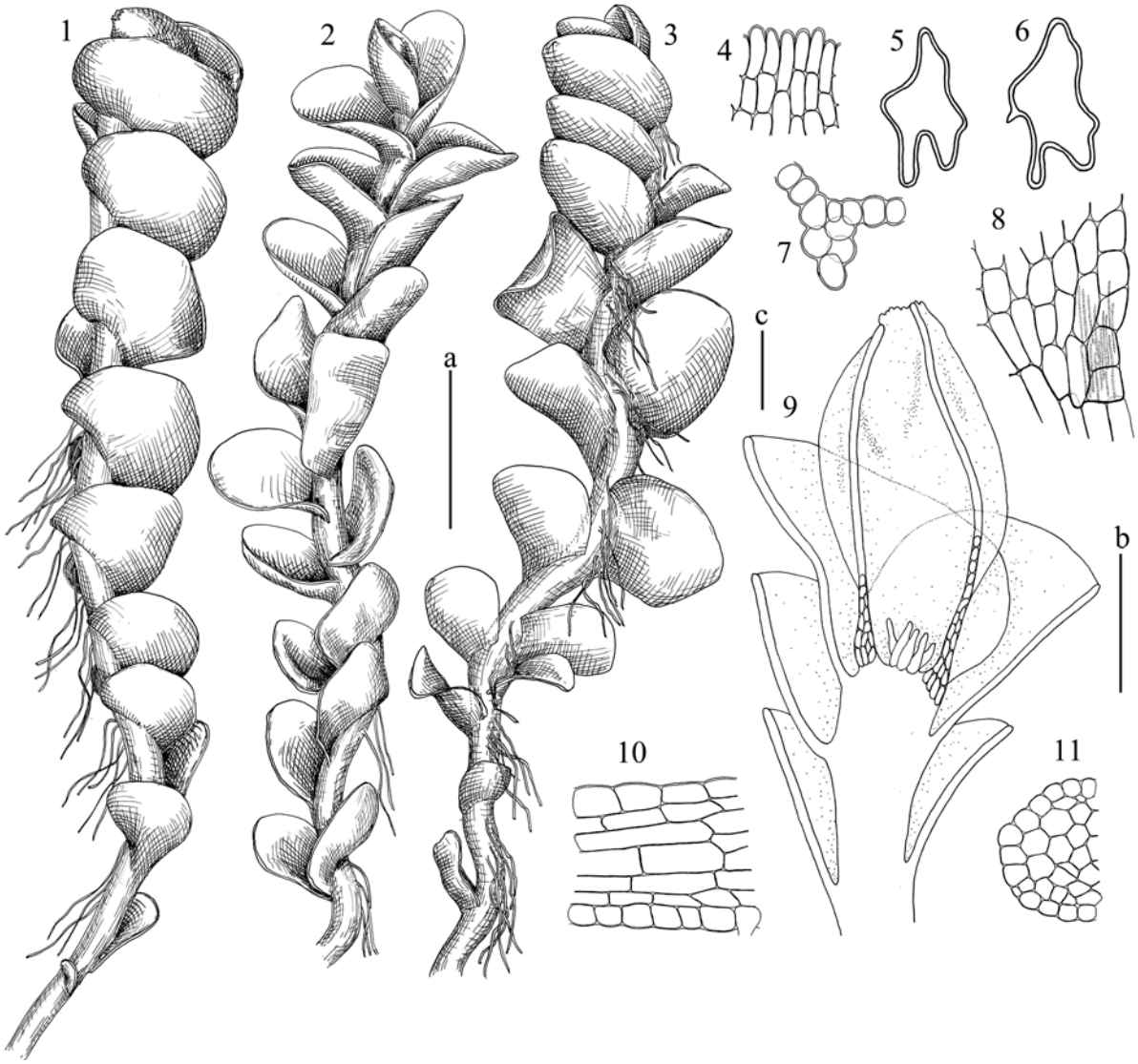

Figure 27 *Metasolenostoma orientale* Bakalin et Vilnet: 1 – branch with perianth; 2 – sterile branch; 3 – sterile branch, ventral view; 4 – perianth mouth; 5, 6 – perianth cross section in the middle part; 7 – perianth keel cross section in the perianth middle part; 8 – leaf cells in ventral base; 9 – perianth longitude section; 10 – stem longitude section; 11 – stem cross section. 1–11 – from K-88-13-01 (VBGI). Scales: a – 2 mm, for 1–3, 5, 6; b – 1 mm, for 9; c – 100 μm, for 4, 7, 8, 10, 11

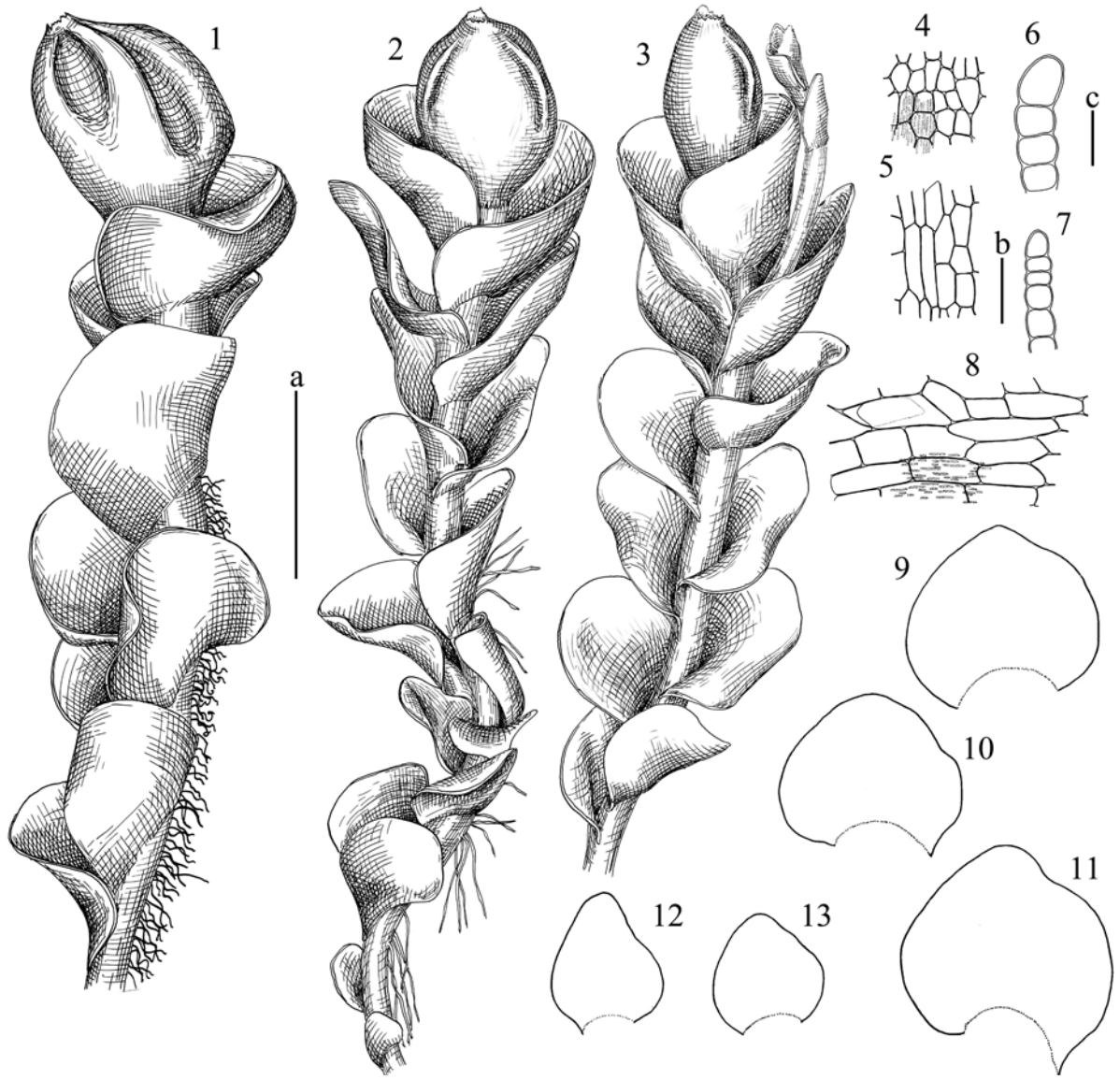

Figure 28 *Metasolenostoma orientale* Bakalin et Vilnet: 1, 2 – branch with perianth; 3 – branch with juvenile perianth; 4 – cells in the perianth middle; 5 – cells in the perianth lower part; 6, 7 – leaf margin cross section; 8 – stem epidermis cells in dorsal side; 9–13 – leaves. 1–13 from K-88-13-01 (VBGI). Scales: a – 2 mm, for 1–3, 9–13; b – 100 μm, for 4, 5, 7, 8; c – 50 μm, for 6

sheathing the stem, while in *Protosolenostoma fusiforme* they are subhorizontally oriented and laterally spreading, this corresponds to 4) strong difference in leaves size that mostly fits 1000–1750 × 1200–2135 μm, when in *P. fusiforme* they are mostly 550–725 × 575–875 μm, and 5) *P. fusiforme* has evidently developed perigynium, that reach 1/4 of perianth length, but virtually absent in *Metasolenostoma orientale*.

Distribution. Azonal Amphi-Pacific. Within treated area the taxon is very common in volcanically modified habitats along North Asian part of 'Pacific Ring of Fire'. Within the Russian Far East it is locally abundant in Eastern Kamchatka and South Kurils (surprisingly absent in North Kurils). In North America, the distribution is confined to its western half and bears relict character. The species occurs in some isolated localities in Aleutians, Washington, Oregon and, surprisingly, Colorado in the USA and British Columbia in Canada. At least half of the localities are in the areas of extinct volcanism.

Ecology. Nearly neutrophilic to acid tolerate hygrophyte. The preferable habitat of the species in the Russian Far East are wet travertine cones, where water is enriched not only by sulphur, but also compound of arsenic and a lot of rare earth elements, including uranium (Dulchenko, pers. comm.). Other habitats are thermal pools and streams (acidic to neutral reaction), where species survive in diapason of pH from 1.8 to 6.8 (Bakalin et al. 2011). The habitats of *Metasolenostoma orientale* do not freeze in winter. Distributed only along these peculiar and certainly azonal habitats, the species occurs from Subarctic zone in Kamchatka (starting from mountain tundra belt, at the elevation over than 1300 m alt.) to broadleaved deciduous forests in South Kurils and Japan.

The data on the ecology of the American material are very scant. Due to data on labels, the material grew in mineral fine-grained soil along the banks of sluggishly flowing streams. Perhaps specimens from Graham Island (British Columbia) and Lincoln County (Oregon) were collected in the similar conditions with Russian ones (cf. Lefebure 1997, Lund 1974).

Specimens examined. RUSSIA, Kamchatka Peninsula, Central Kamchatka (55°45'N 157°53'E), 900 m alt., wet travertine cone (holotype of *Metasolenostoma orientalis*), VB, K-88-13-01 29.VIII.2001 (KPABG103946, duplicate in VBGI), Kurils Islands, Kunashir Island (44°00'20"N 145°46'23"E), 100 m alt., hollows in thermal mire, VB, K-52-18-06 10.IX.2006 (VBGI), (44°29'20"N 146°06'16"E), 50 m alt., hot (40°C) strata of travertine, VB, K-41-4-06 30.VIII.2006 (VBGI), (43°51'52"N 145°30'10"E), 150 m alt., along hot thermal spring, VB, K-45-10-06 04.IX.2006 (VBGI), (43°53'04"N 145°27'43"E), 30 m alt., cliffs near waterfall, VB, K-46-19a-06 06.IX.2006 (VBGI), Iturup Island (45°02'21"N 147°59'00"E), 301 m alt., stream with traces of sulphur, VB, K-54-1-05 15.IX.2005 (VBGI), (45°06'13"N 147°59'16"E), 416 m alt., along sulphur stream, VB, K-53-2-05 15.IX.2005 (VBGI); CANADA, British Columbia, Queen Charlotte Islands, Graham I., Schofield W.B., 19.V.1961 (NY00099055); U.S.A., Colorado, Mineral Co., Cooper D.J. 09VIII.1999 (NY00580773), California, Plumas Co., Brinda J.C.,2836, 26.III.2011 (MO); Oregon, Douglas Co., Wagner D.H., 03.IV.1977 (NY00244529), Lincoln Co., on rock at back end of beach where it meets the bluff, wet seepy area, Halse R.R., 22.VI.2000 (NY00693682), Washington, Rainier Co., Jilett J.G., VII.1919 (NY00243847), Baker Mt. (47°35'N 122°17'W), 1400 m alt., path in the forest, NK, A79/8-95 13.IX.1995 (KPABG, duplicate in VBGI).

JAPAN, Akita Pref., Kurikoma Mt., Saito K. 15.VIII.1965 (NICH 78293), Hokkaido Pref., Hidaka Mt., valley of small river with cliffy shores in orohemiboral (*Abies-Picea-Cercidiphyllum-Acer-Ulmus-Alnus*) woodland, Koponen T., 14307 28.VII.1970 (NICH 116770), Kyoto Pref., Otodaninotaki, 400 m alt., moist rocks, Kodama T., 39491 22.IX.1969 (NICH 104338).

EXCLUDED TAXA, indicated for area treated in literature in or after Stotler & Crandall-Stotler (1977) for Western North America and in or after Konstantinova et al. (2009) for the Russian Far East.

Plectocolea hattoriana Amakawa (Konstantinova et al. 2009; Bakalin et al. 2009; Bakalin 2010) – misidentification for *P. infusca*.

Plectocolea magna Amakawa (Bakalin 2010) – misidentification for *Metasolenostoma ochotense*.

Plectocolea obovata (Nees) Lindb. (Bakalin 2010) – misidentifications for *Solenostoma subellipticum*.

Plectocolea otiana S. Hatt. (Bakalin 2010) – misidentification for *Solenostoma subellipticum*.

Plectocolea rupicola (Amakawa) Bakalin (Konstantinova et al. 2009; Bakalin et al. 2009; Bakalin 2010) – misidentifications for *P. kurilensis*.

Plectocolea virgata Mitt. (Konstantinova et al. 2009; Bakalin et al. 2009; Bakalin 2010) – misidentification for *Plectocolea sp.*

Solenostoma fusiforme (Steph.) R.M. Schust. (Konstantinova et al. 2009; Bakalin et al. 2009; Bakalin 2010, 2012) – misidentifications for *Metasolenostoma orientale*.

Solenostoma gracillimum (Sm.) R.M. Schust. (Konstantinova et al. 2009; Bakalin et al. 2009; Bakalin 2010) – misidentifications for *Metasolenostoma ochotense* and *Solenostoma rubrum* (Commanders).

Solenostoma koreanum Steph. (Konstantinova et al. 2009; Bakalin et al. 2009; Bakalin 2010) – misidentifications for *Metasolenostoma orientale*.

Solenostoma pyriflorum var. *major* Amakawa (Bakalin 2010) – misidentification for *Solenostoma pseudopyriflorum*.

Solenostoma rishiriense Amakawa (Konstantinova et al. 2009; Bakalin et al. 2009; Bakalin & Vilnet 2009) – misidentifications for *Metasolenostoma ochotense* and *Solenotoma rossicum*.

CONCLUSIONS

Until recently the material collected in North Pacific area was identified using mostly Eastern North American, European and Japanese papers. Only a few works were devoted specially to the "*Jungermannia*" of the area treated (Evans 1911; Godfrey & Godfrey 1979; Váňa & Hong 1999). This was resulted in poor understanding of distribution patterns and taxonomic composition of groups in North Pacific. It might be believed, the Russian Far East flora is a simple mixture of "Japanese" and boreal circumpolar species. Lack of consistent patterns with vascular plant floras might be explained by broader distributions and lower levels of endemism of bryophytes, based on Herzog's (1926) work. The recent studies of bryophytes in this region have revealed a lot of previously undescribed species and two genera (Bakalin et al., 2014) that might have origin in the contact zone of circumboreal and strongly specific East Asian floras (Bakalin & Vilnet 2012). The complex evolution processes have resulted in: 1) convergent evolution in different genera and origin of genetically distant, but morphologically similar taxa (e.g. *Solenostoma subellipticum* and *Plectocolea ovalifolia*, *Solenostoma hyalinum* and *Metasolenostoma ochotense*, *Metasolenostoma orientale* and *Plectocolea vulcanicola*, etc.), 2) origin of some clusters of young species in the areas free of total ice shield at the end of Pleistocene or under impact of volcanic activity (*Solenostoma obscurum-S. subellipticum-S. obovatum*, *S. rossicum-S. spherocarpum*). Nevertheless still time the understanding of species distribution patterns and taxonomy in treated area is far from the ideal – the circumstance explained why in the present paper I tried to avoid phytogeographic and 'evolutionary' speculations. These are very valuable tasks for future researches that will be possible after robust progress in the integrative taxonomical researches not only around North Pacific, but also in Japan – one of the key points for understanding of processes of evolution and dispersal of *Solenostoma-Plectocolea* complex.

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Index of species names (the names accepted and described here are in bold, accepted, but only mentioned names are in regular and synonyms are in italics; numbers of pages with morphological descriptions are in bold)

News, Books, Events

MEETINGS RELATED TO BOTANY AND VEGETATION SCIENCE FOR 2015

July 19–24, 2015 – Brno, Czech Republic

58th Annual Symposium of the International Association for Vegetation Science "Understanding Broad-Scale Vegetation Patterns"

Scientific topics: Patterns and drivers of alpha and beta diversity in plant communities: an old, but still insufficiently understood topic; Plant community assembly: niche-based vs. neutral processes and the role of species pools; Plant traits: towards an understanding of the functional diversity of plant communities; Phylogenetic community structure: merging vegetation ecology with phylogenetic research; Vegetation survey: towards the broad-scale synthesis of local vegetation classifications; Large time scales: past vegetation change, effects of historical processes on current vegetation and modern analogues of past ecosystems; Patterns of vegetation change across landscapes: which drivers are important in which contexts?; Community invasibility: plant invasions as broad-scale biogeographical experiments Data sources for broad-scale vegetation studies: can we use composite sets of data originally sampled for other purposes on fine scales?; Vegetation in macroecological modelling: what insights can be obtained from models if broad-scale experiments are not feasible?; Vegetation science serving nature conservationr.

Contact information:

Organizing Committee is leaded by Prof. Milan Chytrý (Chair)
Official Website: http://iavs2015.cz

BOOK

Probatova, N.S. 2014 Chromosome numbers in vascular plants of the Primorskii Krai (the Russian Far East). Dal'nauka, Vladivostok, 343 pp. (in Russian, with English summary)

This book presents the first generalization of the chromosome number data on vascular flora of the Primorskii Krai, for the period of time of chromosome studies (from 1966 up to now). Since 1966, chromosome numbers in 1318 vascular plant species from 604 genera and 128 families were revealed in Primorskii Krai. The chromosome number were the most extensively studied in families Asteraceae – 207 species of 91 genera and in Poaceae – 166 species of 60 genera. Adventive (alien) species in the flora of the Primorskii Krai were marked. References and brief information on the origin of specimens studied were given. The analysis of chromosome number data as a source of information on the flora was given on examples of caryotaxonomic situation in some families and genera. Caryological studies on vascular plants permit to consider these data in the context of special features of the forming of the flora in the south of the Russian Far East, including human impact.

The book is available from the author:

Nina S. Probatova, Institute of Biology and Soil Science FEB RAS Vladivostok 690022 Russia; e-mail: probatova@ibss.dvo.ru

BOOK SERIES

Kozhevnikov A.E. (ed.) 2014 V.L. Komarov Memorial Lectures: Issue 62. Dalnauka, Vladivostok, 316 pp. ISSN 1997-1869 (in Russian, with English summary)

The issue 62 contains reports presented at the 67th annual V.L. Komarov Memorial Lectures held by the Institute of Biology and Soil Science FEB RAS in cooperation with the Primorskii Branch of the Russian Botanical Society. The series cover a wide range of problems of the structure , diversity, distribution, ecology, functioning, evolution and use of plants and publishes experimental, theoretical and review articles in the following areas: Contemporary problems of theoretical botany; Vegetation and its organization; Structure and functioning of plant ecosystems; Problems of taxonomy and systematics of plants; Morphology and anatomy of plants; History of botany and botanical education; Protection and use of vegetation. The issue includes the following papers: Kozhevnikov, A.E. & Z.V. Kozhevnikova Taxonomic composition and special features of the natural flora in the Primorskii Krai; Antonova, L.A. Adventive component in the coastal flora jf the Khabarovskii Krai; Prokopenko, S.V. Vascular flora of the Trudnyi Peninsula (Nakhodka City and its vicinity); Yakubov, V.V. The genera *Pentactina* and *Geum* (Rosaceae) in the Russian Far East; Kholod, S.S. Vegetation and permafrost terrain in Wlangel Island

The book is available from the Institute of Biology and Soil Science FEB RAS

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