

## Genus *Fossombronia* (Fossombroniaceae, Marchantiophyta) in the Russian Far East

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**Abstract** – The genus *Fossombronia* Raddi in the Russian Far East is reviewed based on herbarium specimens mostly of recent collections. Three species are recognized (*F. alaskana* Steere & Inoue, *F. pusilla* (L.) Nees and *F. japonica* Schiffn.). The descriptions and illustrations based on studied specimens are provided along with the identification key of *Fossombronia* in the Russian Far East. *F. japonica* is recorded for the first time in Russia and *F. pusilla* is the only recent confirmed record of the species in Russia.

***Fossombronia* / Hepaticae / taxonomy / phytogeography / the Russian Far East**

### INTRODUCTION

*Fossombronia* includes 93 species in the world (Söderström *et al.*, 2015), distributed from the Subarctic to the Subantarctic with main diversity centres in Australia (33 species) and South Africa (23 species) (Frey & Stech, 2009). The most taxonomically valuable features of the genus are found in spore morphology, whereas only a few features from vegetative organs may be usable in identification (cf. Schuster, 1992; Kravesky *et al.*, 2005; Milne *et al.*, 2011; etc.). The latter complicates the distributional studies of the genus due to the sporadic production of sporophytes (or limited period of production) in local populations. The spore sculpture features that are most valuable, diverse and of taxonomic value are observed in the distal face of the spore, where several main types may be found (Schuster, 1992). Although the limited number of species within the genus may be identified in a sterile state, the majority of taxa require spore bearing plants for correct identification. The majority of *Fossombronia* are soft, lax and ephemeral plants that may be overlooked in the collection. This genus has never been revised in Russia or specifically in the

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Russian Far East, although many excellent papers were published by Ladyzhenskaya in Russian (Ladyzhenskaya, 1956, 1963; Ladyzhenskaya & Zenkova, 1955).

The actuality of a modern revision of the genus in the Russian Far East is particularly obvious when taking into account the last checklists of the Russian liverworts. The checklist by Konstantinova *et al.* (1992) includes 3 species recorded for the Far East (*F. alaskana*, *F. longiseta* (Austin) Austin and *F. wondraczeckii* (Corda) Dumort.). The next checklist by Konstantinova *et al.* (2009) was uncritically followed to Kravesky *et al.* (2005) and recognized only *F. alaskana* in the Russian Far East. However, the treatment of *Fossombronia* for East Asia and Oceania by Kravesky *et al.* (2005) was based on very limited specimen numbers from the northern Eastern Asia, which resulted in a very questionable conclusion that the Russian Far East appears to house only *F. alaskana*. As we found in the course of our current research, the genus in the Russian Far East includes at least three species, all of them known from several localities across the Russian Far East. Along with the latter, the present work enriches the data on distributional patterns and regional morphological variation of the taxa of the genus. Therefore, the main goal of this account is to present the current data on species distribution and morphology of *Fossombronia* taxa within the Russian Far East.

## MATERIALS AND METHODS

This study is based on a critical revision of specimens that are kept in the Botanical Garden-Institute, Vladivostok (VBGI, with the incorporated collection from VLA) as well as the herbaria of the Polar-Alpine Botanical Garden-Institute (KPABG) and Komarov's Botanical Institute (LE). The amount of material in this work covers no less than 80% of all specimens of *Fossombronia* from the Russian Far East preserved in herbaria. All of the morphological descriptions that are provided, as well as the illustrations, are based on studied material and reflect the regional peculiarity of *Fossombronia* taxa.

## TAXONOMIC TREATMENT

*Fossombronia* Raddi, *Jungermannogr. Etrusca* 29. 1818.

Plants 1-3 mm wide and 2-10 mm long, green to pale green, sometimes with red or purplish to brownish tint at the leaf margins; simply or pseudodichotomously 1-2-furcated. Leaves obliquely inserted, succubous, crispate, often lobed at the margin. Oil-bodies in the mid-leaf cells are small, numerous; homogeneous, segmented or biconcentric. Tubers lacking in regional taxa. Monoicous (regional taxa). Antheridia and archegonia in simple acropetal sequence or situated on different branches. Antheridia naked. Sporophyte protected by caulocalices (pseudoperianth). Spores areolate or with irregular lamellae on distal face.

Type: *Fossombronia angulosa* (Dicks.) Raddi, *Jungermannogr. Etrusca*: 29, 1818. – *Jungermannia angulosa* Dicks., *Fasc. Pl. Crypt. Brit.* 1: 7, 1785.

Three species occur in the Russian Far East: *F. alaskana*, *F. japonica* and *F. pusilla*. All of them prefer moist clayish roadsides and more rarely occur in natural habitats, growing in cliff crevices along sea coast, solifluction spots in tundra, crevices of gravelly barrens and riversides. *Fossombronia* taxa in area treated prefer open sites and rarely occur under shady conditions.

### Keys to the species of *Fossombronia* recorded in the Russian Far East

#### Key to species in the Russian Far East for specimens with ripe spores

1. Spore distal face continuously and regularly reticulate across.....  
the surface ..... *F. japonica* Schiffn.
- 1'. Spore distal face very irregularly reticulate or lamellate .....2
  2. Spore distal face very irregularly reticulate, with 7-9 irregular alveolae across the face, or, more common with radiating lamellae, in large part parallel or irregularly furcated [occurs in Arctic area and 'alpine' belt of the mountains southward].....*F. alaskana* Steere & Inoue
  - 2'. Spore distal face lamellate; 5-7 lamellae, 6-10  $\mu\text{m}$  apart, they project as 12-19 spines around the margin of each spore, lamellae are almost parallel, sometimes anastomosing low ridges [occurs in low elevations in the southern portion of the area treated].....*F. pusilla* (L.) Nees

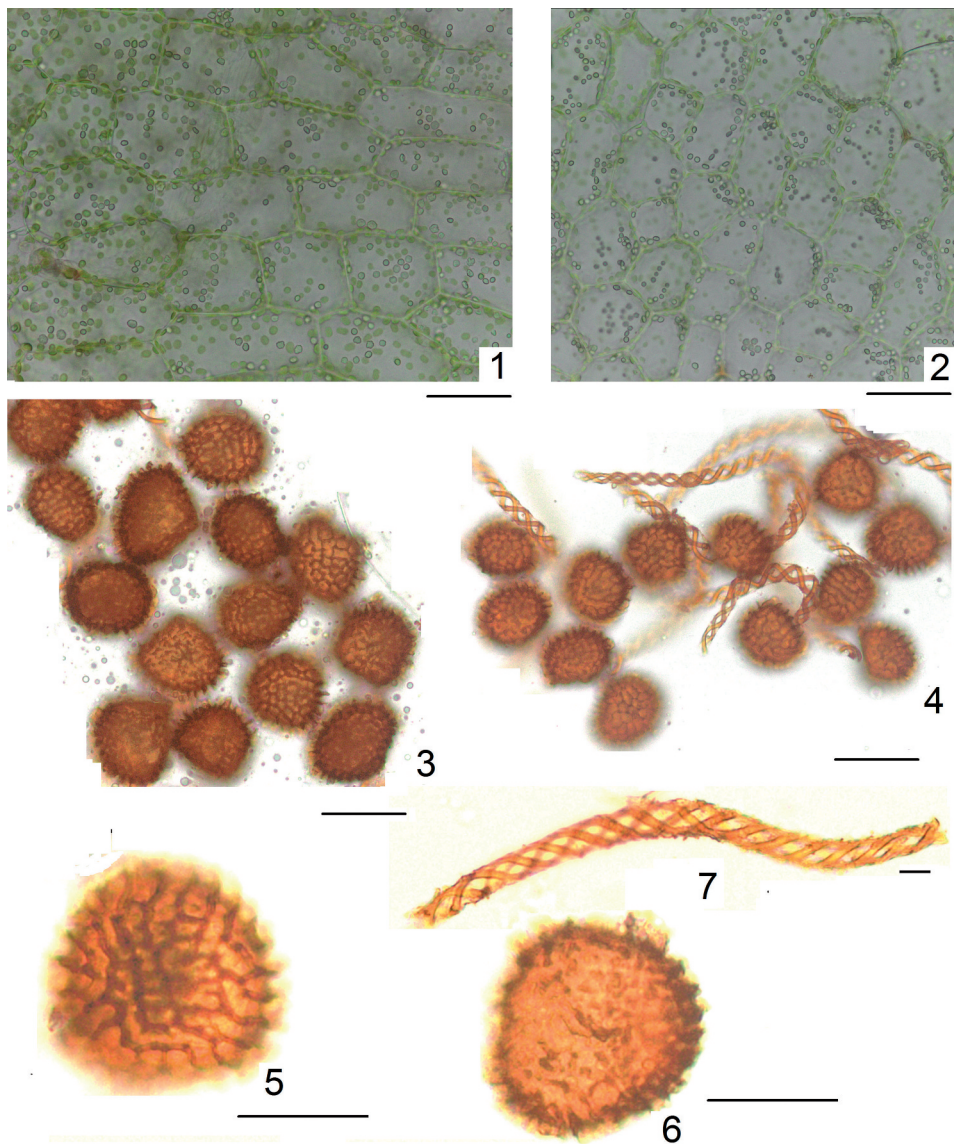
#### Key to species in the Russian Far East for specimens in fertile conditions and ripe spores

1. Caulocalices (pseudoperianth) distally constricted to mouth, which appearing mostly 3-4-angled; sexual condition autoecious; spore distal face very irregularly reticulate, or, more common with radiating lamellae, in large part parallel or irregularly furcated.....*F. alaskana* Steere & Inoue
- 1'. Caulocalices mouth erect or slightly recurved, non angled; sexual condition parocous to synoecious; spore distal face regularly reticulate or lamellate.....2
  2. Spore distal face continuously and regularly reticulate across the surface ....  
..... *F. japonica* Schiffn.
  - 2'. Spore distal face lamellate, consisting of 5-7 lamellae, 6-10  $\mu\text{m}$  apart, they project as 12-19 spines around the margin of each spore.....*F. pusilla* (L.) Nees

*Fossombronia alaskana* Steere & Inoue, *The bryologist* 77: 66-71. 1974.

#### Figs 1-7

Plants small, 0.8-1(-1.4) mm wide and 3-4.8(-5.5) mm long, green, but purplish to brownish with age; stem sporadically 1-2-furcated, creeping, plane dorsally and strongly convex ventrally; in cross section 230-260  $\mu\text{m}$  wide, composed of monomorphic and thin-walled cells. Leaves imbricate, turned dorsally or obliquely oriented; subquadrate to rectangular, 800-1000  $\mu\text{m}$  long and 1000-1200  $\mu\text{m}$  wide; undulate; margins entire to crispate, irregularly dentate or lobed; marginal papillae present at lobe apices. Median leaf cells 21-40  $\times$  32-48  $\mu\text{m}$ , thin-walled. Oil-bodies (13-)20-42 per cell, spherical to ellipsoidal, very small, 2.5-3  $\mu\text{m}$ , almost homogeneous, shining. Tubers lacking. Rhizoids forming dense mats along ventral surface of the stem, purplish. Monoicous (synoicous). Antheridia situated on separate branches; antheridium spherical, short stalked; perigonial scales subtending the antheridia, triangular. Archegonia mainly situated along the dorsal midline of the stem. Caulocalices (pseudoperianth) to 1.2-1.6 mm high; campanulate; surface



Figs 1-7. *Fossombronina alaskana* Steere et Inoue. 1-2. Cells from middle of leaf with oil-bodies; 3-4. Spores and elaters; 5. Spore, distal face; 6. Spore, proximal face; 7. Elater. Scale bars: 3-4 – 40  $\mu$ m; 1-2, 5-6 – 20  $\mu$ m, 7 – 10  $\mu$ m (1, 3, – from Primorsky Territory #P35-5-14 (VBGI); 2, 4, 6 – from Magadan Province, *Bakalin* #Mag30-9-14 (VBGI); 5, 7 – from Magadan Province, *Bakalin* #Mag38-5-11 (VBGI; KPABG)).

usually lamellate or smooth, distally constricted to mouth; mouth appearing mostly 3-4-angled, irregularly lobed; margin undulate. Seta to 5 mm long; capsule spherical; brown at maturity; epidermal cells hyaline; inner layer with both nodular and semi-annular thickenings. Spores (32-)35-43  $\mu\text{m}$ ; yellow-brown, not remaining united in tetrads at maturity; distal face sculpture variable, never coarsely reticulate, with 7-9 irregular areolae, but usually with cross lamellae, in large part parallel or irregularly furcated, with 20-30 lamellar projections around the equatorial margin; proximal face verruculose; triradiate mark poorly developed. Elaters rare, pale yellow, 132-182  $\mu\text{m}$  long, 8-11  $\mu\text{m}$  wide; mostly 2-spiral, rarely 3-spiral.

**Differentiation.** *Fossombronia alaskana* is similar morphologically to *F. foveolata* Lindb. and *F. japonica*, but differs from each in: 1. erect leaves vs. patent to suberect in *F. foveolata* and *F. japonica*; 2. rhizoids forming dense mats along the ventral surface of the stem vs. rhizoids loosely scattered along the ventral surface of the stem in *F. foveolata* and *F. japonica*; and 3. spore distal face very irregularly reticulate, with 7-9 irregular areolae, but usually with cross lamellae, in large part parallel or irregularly furcated vs. distal face reticulate, forming 5-8 penta- or hexagonal alveoli as in *F. foveolata* and *F. japonica*.

**Ecology.** Acidophilic meso- to hygrophyte. The species is mostly confined to the northern part of the area, with a few localities known in the southern part, where the taxon grows in alpine heathland. The species occurs on fine soil along streams although away from direct and constant impact of running water. In alpine tundra (as well as alpine heathland of the southern flank of the area) the species occurs on fine (clayey) soil in solifluction spots. Throughout its area the species is confined to the areas of distribution of permafrost grounds (and seems to be a phytogeographical relict in Olkhovaya Mt., where it is growing on relict permafrost).

**Distribution.** *Fossombronia alaskana* has nearly arctomontane Asian-North American distribution and is known to be from Alaska (Steere & Inoue, 1974), Western Greenland (Schuster, 1992), Japan and Northern Korea (Krayesky *et al.*, 2005) and Asiatic Russia. In Russia the species was reported from Yamal-Nenets Autonomous District (Potemkin, 1993), Krasnoyarsk Territory (Andrejeva, 2009), Republic of Yakutiya (Sofronova, 2010, 2011), Transbaikal Territory (Mamontov & Afonina, 2012) and some localities in the Russian Far East - Chukotka Autonomous District: Anadyr River Basin (Afonina & Duda, 1993), Kamchatka Territory (Andrejeva, 2009), Kuril Islands: Kunashir Island (Bakalin, 2007; Bakalin *et al.*, 2009), Primorsky Territory (Bakalin, 2008). However, the specimens cited by Bakalin (2009) for the aforementioned Kunashir Island belong to *F. pusilla* (see below). In the course of the present study, *F. alaskana* was additionally found in the Magadan Province.

*Fossombronia alaskana* is included in the Red Data Book of Russia as a rare species (Potemkin, 2008). Indeed, before it was known from very limited localities in the Yamal-Nenets Autonomous District and the Chukotka Autonomous District. Currently many additional localities for this species were found (see above) and we have no reason to regard this species as rare in Russia.

**Specimens examined** (newly reported areas marked by an asterisk): RUSSIA. **Chukotka Autonomous District**, Anadyr River Basin, on the bank of the Enmyynvaam River, 3 July 1980, Afonina s.n. (LE); \***Magadan Province**, Ol'skoe Basalt Plateau in the upper course of the Olya River, 60°38'47"N, 151°13'56"E, 1262 m alt., flat mountainous plateau, covered by wet tundra, solifluction spots, fine-grained soil, with *Riccia sorocarpa* Bisch., 10 August 2011, Bakalin Mag56-5-11, Mag56-6-11, Mag56-7-11 (VBGI; KPABG); ibidem,

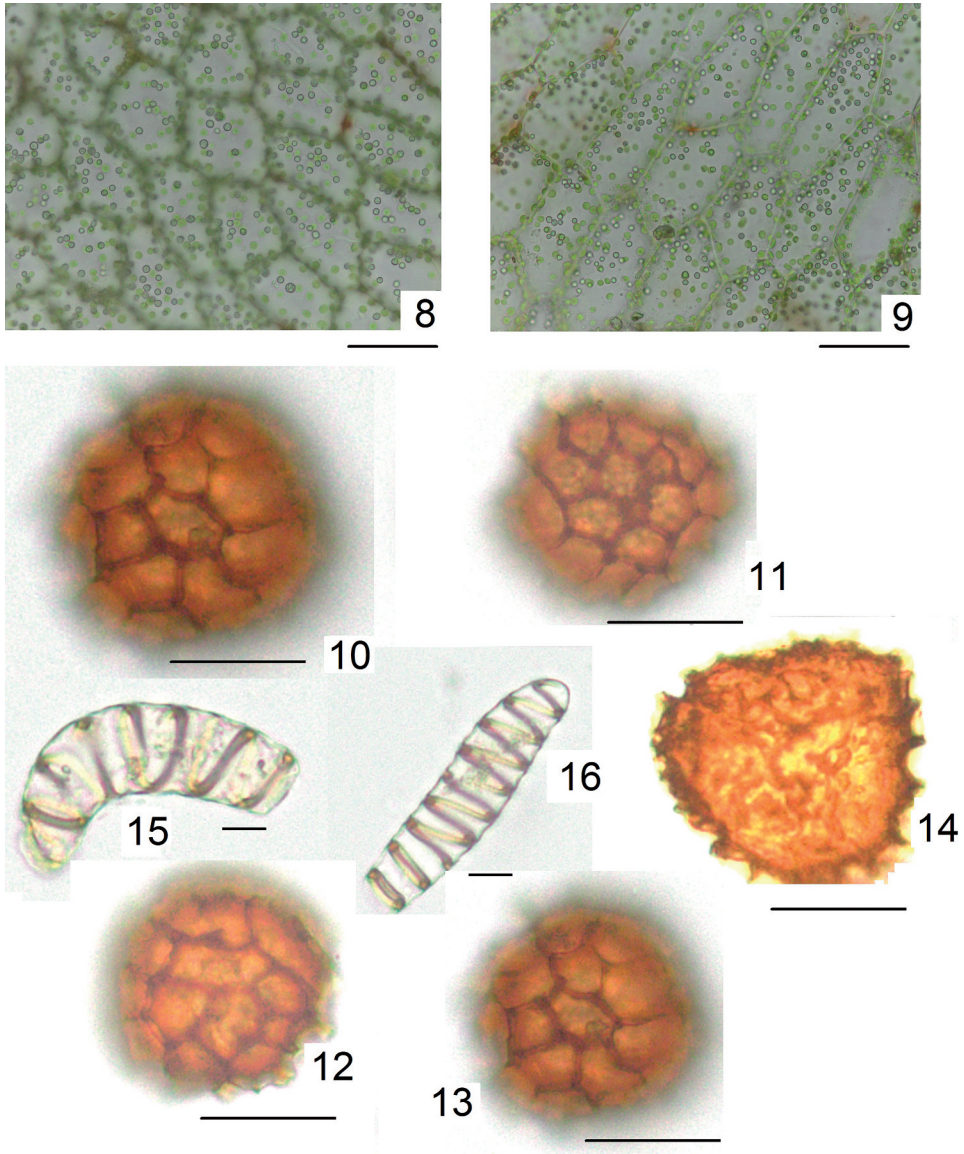
60°38'10"N, 151°31'45"E, 1078 m alt., wet dwarf shrub-moss tundra on slope, bare ground on the solifluction spot, 14 August 2012, *Bakalin* Mag38-5-11 (VBGI; KPABG); ibidem, ca. 7 km to the east from the top of Skif Mt. in the upper course of Maltan River, 60°39'11"N, 151°28'12"E, 1056 m alt., solifluction spot in the tundra, 5 August 2014, *Bakalin* Mag29-3-14 (VBGI; KPABG); ibidem, ca. 5 km to the east from the top of Skif Mt. in the upper course of Maltan River, south-facing slope of the Mt. with top of 1350 m alt., 60°38'38"N, 151°26'22"E, 1150 m alt., solifluction spot in mossy tundra, 6 August 2014, *Bakalin* Mag30-9-14 (VBGI; KPABG); **Primorsky Territory**, Partizansk District, area near the top of Olkhovaya Mt., 43°26'48"N, 133°39'21"E, 1660 m alt., gravelly barrens intermingled with crooked *Picea ajanensis*-*Betula lanata* forest, clay in gravelly barrens crevices, 12 September 2014, *Bakalin* P35-4-14, 35-5-14 (VBGI; KPABG); ibidem, 43°20'50"N, 133°39'22"E, 1600 m alt., crevices among stones in gravelly barrens field, 10 September 2010, *Bakalin* P44-8-10 (VBGI; KPABG); USA. **Alaska**, Cape Thompson, Chukchi Sea, tundra and snow-filled valley south of camp, shale and granite area, *Steere & Inoue* 21058 (TNS 064250).

***Fossombronia japonica* Schiffn., Österr. Bot. Z. 49 (11): 389. 1899**      **Figs 9-16**

*Fossombronia akiensis* Horik., *Bot. Mag. (Tokyo)* 48: 453. 1834. – *Fossombronia cristula* var. *verdoornii* Chalaud, *Annales Bryologici* 4: 143. 1931. – *Fossombronia australinipponica* Horik., *J. Sci. Hiroshima Univ., Ser. B, Div. 2, Bot.* 2: 138. f. 8. 1934. – *Fossombronia foreaui* Udar & S. C. Srivast., *Beihefte zur Nova Hedwigia* 47: 463. 1973.

Plants medium-sized, 2-3 mm wide and 2-10(–12) mm long, yellowish green, sometimes with red tint at the leaf margins; pseudodichotomously sparingly 1-2-furcated; stem prostrate or ascending when growing among other bryophytes, slightly concave dorsally and convex ventrally; in cross section 220-265 µm wide, internal cells parenchymatous, thin-walled, larger towards periphery, smaller in the middle where they are usually infected by fungal hyphae. Leaves imbricate, patent to suberect; subquadrate to broadly oblong-lingulate, 800-1200 µm long and 1200 µm wide; towards apex rounded to truncate; margins slightly undulate, irregularly dentate. Apical marginal cells 20-85 × 18-55 µm; median leaf cells isodiametric, 21-88 × 20-58(–65) µm, thin-walled. Oil-bodies 9-21 per cell, spherical to ellipsoidal, very small, 1.5-3 µm, segmented, shining. Tubers lacking. Rhizoids scattered along the ventral surface of the stem, deep purplish. Monoicous (paroicous to synoicous). Antheridia situated along the dorsal midline of the stem; antheridium spherical, yellowish; perigonial scales absent. Archegonia mainly situated along the dorsal midline of the stem. Caulocalices (pseudoperianth) to 1.5 mm high; campanulate; surface smooth; mouth erect or slightly recurved; margin undulate. Seta 1-3 mm long; capsule shortly exerted, spherical; brown at maturity; epidermal cells hyaline; inner layer with both nodular and semi-annular thickenings. Spores (32-) 35-55 µm in diameter; reddish brown, not remaining united in tetrads at maturity; distal face reticulate; forming 5-8 penta- or hexagonal and heptagonal alveoli, with 10-18 lamellar projections around the equatorial margin; proximal face verruculose; triradiate mark absent. Elaters very rare, yellow, (25-)35-80 (–98) µm long, 5-12 µm wide; mostly unispiral, or, rarely, bispiral.

**Differentiation.** *Fossombronia japonica* differs from other Russian Far East species (*F. alaskana*, *F. pusilla* and *F. wondraczeckii*) in the regularly reticulate distal face of spores. According to Kravesky *et al.* (2005) the species is similar to *F. cristula* Austin, from which it differs in: 1. leaves obovate to quadrate with marginal teeth vs. oblong leaves that are always entire in *F. cristula*; 2. oil-bodies



Figs 8-16. *Fossombronia japonica* Schiffn. **8-9.** Cells from middle of leaf with oil-bodies; **10-13.** Spore, distal face; **14.** Spore, proximal face; **15-16.** Elaters. Scale bars: 8-9, 11-14 – 30  $\mu\text{m}$ ; 10 – 20  $\mu\text{m}$ , 15-16 – 5  $\mu\text{m}$  (8-11, 16 – from Sakhalin Province, *Bakalin* #S35-4-09 (VBGI); 12-15 – from Primorsky Territory, 28 September 2012, *Barkalov* (VBGI)).

segmented vs. homogenous in *F. cristula*; and 3. *F. japonica* is mostly tropical to subtropical East Asian - Oceania taxon vs. *F. cristula* is a temperate taxon, endemic to the Eastern USA. Lectotype of *F. japonica* was designated by Stotler *et al.* (2003).

**Ecology.** In the area treated, this is an acidophilic mesophyte that is found growing on sandy or clayish soil along roadsides, thus suspecting that it is an adventive species in the Russian Far East whereby it may have been introduced within the last century. The ecological preferences of the species in Russia are in contrast with those from adjacent lands, where the species prefers swampy communities where it grows on moist, bare soil.

**Distribution.** The species is widespread in Japan and Taiwan spreading eastward as far as Papua New Guinea and Java (Krayesky *et al.*, 2005; Huang *et al.*, 2009; Katagiri & Furuki, 2012). The occurrence of this taxon in the Russian Far East was expected, and it was found in Sakhalin Province and Primorsky Territory. The species is recorded here for the first time for Russia and the Republic of Korea.

**Specimens examined** (newly reported areas marked by an asterisk): RUSSIA. \***Sakhalin Province**, Sakhalin Island, spit near Moskalvo Settlement, 53°35'39.4"N, 142°31'32.9"E, 3 m alt., mire on sandy soil with cover of dwarf shrub-moss community intermingled by *Pinus pumila* thickets, wet sand along roadside, 26 August 2009, *Bakalin* S35-4-09, S35-7-09 (VBGI; KPABG); \***Primorsky Territory**, Khasan District, Gamov Peninsula, Telyakovskogo Bay, ~43°13'N, 132°19'E, wet roadside on slope, 28 September 2012, *Barkalov* s.n. (VBGI; KPABG); JAPAN. **Hiroshima-ken**, Yamagata-gun, Geihokucho, Nishiyawatabara, Yawata Highlands, Ozaki Moor, ca. 1.5 km SW of Mt. Takanosu, on moist soil beside point, 13 November 1996, *Yamaguchi & Matsumoto* s.n. (KPABG; Bryophytes Asia, Fasc. 4 (1997), as *Fossombronia foveolata* var. *cristula* (Austin) R.M. Schust.); \*REPUBLIC OF KOREA. Ulsan-si, Ulju-gun, Ungchon-myeon, Eunhyeon-ri, Moojechi wetland, on wet soil near the wetland, 30 September 2010, *Choi*, Choi 8309 (KPABG; Hepaticae Korea Exsiccatae, Fasc. 1, #77, *Fossombronia foveolata* var. *cristula*).

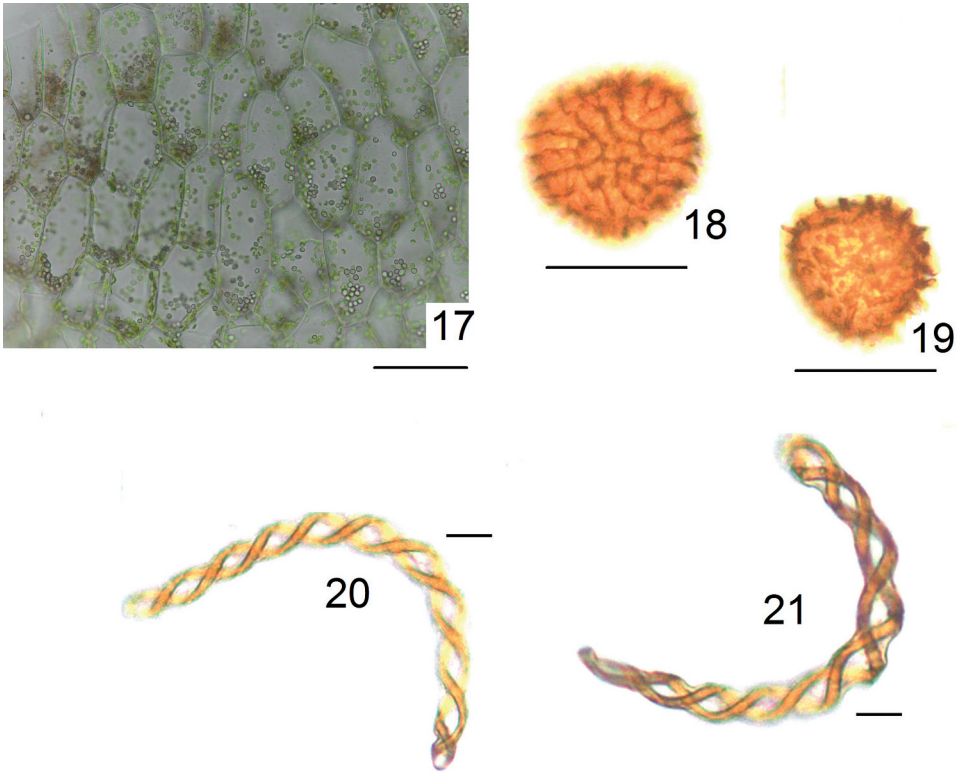
*Fossombronia pusilla* (L.) Nees, *Naturgesch. Eur. Leberm.* 3: 319, 1838.

**Figs 17-21**

*Jungermannia pusilla* L., *Sp. Pl.* 1: 1136, 1753.

Plants medium sized, 1.5-3 mm wide and 4-8 (-10) mm long; green to pale green; simply or pseudodichotomously 1-2-furcated; stem prostrate, fleshy, flat or slightly convex dorsally and convex ventrally; in cross section 230-250 µm wide, internal cells of the stem parenchymatous, thin-walled. Leaves contiguous to imbricate, obliquely inserted; oblong-quadrate or quadrate to reniform, 850-1000 µm wide and 900-1200 µm long; margin entire or crispate, strongly undulate and irregularly lobed to angulate; lobes obtuse to acute. Apical marginal cells 29-80 × 18-76 µm; median leaf cells 35-50 × 42-80 (-96) µm, thin-walled. Oil-bodies 18-32 (-35) per cell, spherical to ellipsoidal, very small 0.5-1.0 µm long, homogeneous or biconcentric. Tubers lacking. Rhizoids scattered along the ventral surface of the stem, purplish. Monoicous (paroicous to synoicous). Antheridia situated at shoot apex becoming intercalary with time; antheridia spherical; perigonial scales absent. Archegonia situated along the dorsal midline of the stem. Caulocalices (pseudoperianth) to 1.5-1.7 mm high; campanulate, shortly stipitate; mouth margin erect to recurved, sinuately lobed; lobes obtuse to acute. Seta 1-5 mm long; capsule spherical; dark brown at maturity; epidermal cells of the wall lacking thickenings; inner layer with complete or incomplete semi-annular thickenings. Spores (35-) 42-58 µm; reddish- to dark brown, not remaining united in tetrads at maturity; distal





Figs 17-21. *Fossombronia pusilla* (L.) Nees. **17.** Cells from middle of leaf with oil-bodies; **18.** Spore, distal face; **19.** Spore, proximal face; **20-21.** Elaters. Scale bars: 17 – 40  $\mu\text{m}$ ; 18-19 – 20  $\mu\text{m}$ , 20-21 – 10  $\mu\text{m}$  (All from Sakhalin Province, Bakalin & Borovichev #K69-3-15 (VBGI)).

face lamellate; 5-7 lamellae, 6-10  $\mu\text{m}$  apart, they project as 12-19 spines around the margin of each spore attaining margin forming lamellae are almost parallel, sometimes anastomosing low ridges; proximal face verruculose; triradiate mark present, but not prominent or absent. Elaters yellowish brown, 105-198  $\mu\text{m}$  long, 6-12  $\mu\text{m}$  wide; mostly bispiral, rarely 3-4-spiral.

**Differentiation.** *Fossombronia pusilla* is morphologically similar to *F. wondraczeckii* in ridged sculpture of spores and similar in size; however, the spores of *F. pusilla* differ from *F. wondraczeckii* in the distal face, 1. 5-7 lamellae 6-10  $\mu\text{m}$  apart vs. 10-13 lamellae 3-5  $\mu\text{m}$  apart in *F. wondraczeckii* and 2. forming 12-19 spines vs. 28-36 in *F. wondraczeckii*.

**Distribution.** The species has suboceanic-submediterranean distribution (Damscholt, 2002). *F. pusilla* is known in many European countries, such as Macaronesia and Azores, as well as in North and South Africa and disjunctively in South America (Chile) (Schuster, 1992; Paton, 1999; Damscholt, 2002; Söderström *et al.*, 2002). In Asia, it was recorded in Turkey in the Near East (Kürschner & Erdağ, 2005) and was found as widespread in China, Taiwan, Japan, the Malay Archipelago and Australia (Scott, 1985; Kraysky *et al.*, 2005; Katagiri & Furuki,

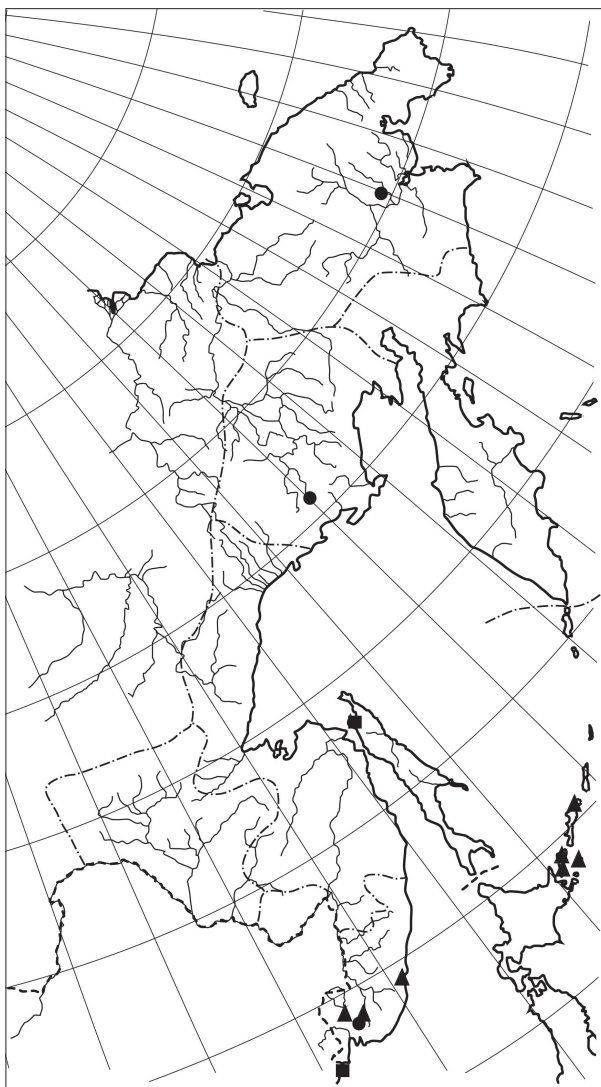


Fig. 22. The distribution of *Fossombronia* in the Russian Far East: *F. japonica* Schiffn. – squares, *F. pusilla* (L.) Nees – triangles, *F. alaskana* Steere et H. Inoue – circles. The solid figures are based on specimens examined, open – figures are based on literature records.

2012). In the course of the present study, this species was found in the Primorsky Territory as well as in Shikotan Island of the Kurils (previously cited as *Fossombronia* sp. by Bakalin *et al.* (2009).

The record of *Fossombronia longiseta* for the Amur Province of the Russian Far East (Ladyzhenskaya, 1963), which is the first record of the taxon for the former USSR (and Russia, consequently), should be referred to as the present species. The cited record was overlooked by Krayesky *et al.* (2005). However, Krayesky *et al.* (2005) cited another supposed record of *F. longiseta* for the Primorsky Territory of the Russian Far East by “Gambaryan (1984)” and, in the same paper, rejected it from the Russian flora based on “N. Konstantinova, pers. comm.” (Krayesky *et al.*,

2005: 39). The latter sentence is confusing because the cited work (Gambaryan, 1984) does not contain any indication of this species. Therefore, the only record of *F. longiseta* for the Russian Far East is that by (Ladyzhenskaya, 1963). The specimen on which that record was based seems to be lost (it should be in LE, but it was not found there) and therefore we were unable to confirm it. However, the description and figures of spores in Ladyzhenskaya (1963) and the micrograph of spores in Scott and Pike (1988) made from syntype in H (later designated as lectotype by Schuster, 1992 and then lectotypification clarified by Stotler *et al.* (2003)) are identical with *F. pusilla* (the latter was also commented on by Scott & Pike, 1988: 197). Even this fact shows that there are no robust arguments for the exclusion of *F. pusilla* (with *F. longiseta* a provisional synonym, *cf.* Scott & Pike, 1988) from the flora of the Amur Province. The additional argument in favour of the reliability of the record of the species by Ladyzhenskaya (1963) is the fact we were able to find *F. pusilla* in the Primorsky Territory, which is not far from the locality in the Amur Province.

**Ecology.** Acidophilic meso- to hygrophyte growing along moist clayish to clayey soil in meadows and swampy communities. Along man-made roadside habitats, the species grows over fine soil in the crevices of coastal cliffs and sandy coastal dunes in the areas under strong influence of wet air masses coming from the Pacific. The species seems to be the only taxon occurring in the South Kurils.

**Specimens examined from the area treated** (newly reported areas marked by an asterisk): \***Primorsky Territory**, Vatovskogo Peninsula, northern edge of Vladimir Bay near Ol'ga Settlement, 43°53'00.4"N, 135°30'36.6"E, 25 m alt., sea coast, fine-grained soil on path among shrubs, 21 September 2007, *Bakalin* P83-1-07, P83-4-07 (VBGI; KPABG); Lazo District, Lazovsky Pass, 43°29'36"N, 133°34'48"E, 850 m alt., wet clayish soil in roadside, 7 September 2010, *Bakalin* P41-2-10 (VBGI; KPABG); *ibidem*, 43°29'23.9"N, 133°34'52.5"E, 881 m alt., mixed mostly conifer forest, forest dirt road, on clayish soil banks, 17 October 2008, *Bakalin* P72-1-08 (VBGI); Partizansk District, Lazovsky Pass, 43°29'38"N, 133°34'45"E, 915 m alt., coniferous-deciduous forest with mostly fern cover, clayish roadside of old dirt road, 22 September 2011, *Bakalin* P72-1-11 (VBGI); Khanka District, Melgunovka Creek valley, 44°34'14"N, 132°04'32.9"E, 64 m alt., along dirt road in wet meadow, on clayish wet roadside, 18 October 2008, *Bakalin* P73-2-08 (VBGI; KPABG); \***Sakhalin Province**, Kuril Islands, southern part of Kunashir Island, Otradnoe settlement area, 44°03'24"N, 145°51'44"E, 10 m alt., sea-coastal sandy dunes, on wet sand, 11 September 2007, *Bakalin* K54-1-07; K54-2-07 (VBGI; as *Fossombronia cf. alaskana*); Saratovka River mouth area, 44°15'58"N, 146°06'23"E, 21 m alt., wet grass-sedge meadow with admixture of *Sasa* spp., on road-side, on peaty spots, 17 September 2007, *Bakalin* K62-2-07 (VBGI; as *Fossombronia cf. alaskana*); Shikotan Island, area of Tomari Mt., 43°46'08.3"N, 146°43'29"E, 26 August 2007, *Bakalin* K45-40-07 (VBGI; as *Fossombronia cf. alaskana*); Ostrovnoy Cape Area, 43°44'40"N, 146°35'10"E, 25 m alt., slope near road, 31 August 2007, *Bakalin* K54-35-07, K54-37-07 (VBGI; as *Fossombronia cf. alaskana*); northern part of Iturup Island, Tsirk Bay, Tsirk River downstream, 45°20'02"N, 148°37'04"E, 13 m alt., nearly subarctic vegetation with *Sasa*, moist clay at roadside, 9 September 2015, *Bakalin & Borovichev* K69-3-15 (VBGI; KPABG).

## Excluded taxon

*Fossombronia wondraczeckii* (Corda) Dumort., *Recueil Observ. Jungerm.* 11. 1835.

*Fossombronia wondraczeckii* was reported for the Russian Far East from the Bureya State Nature Reserve (Konstantinova *et al.*, 2002); however, the authors of the paper never observed the actual specimens collected by Dr. M. Ignatov. *F. wondraczeckii* was included in the list based on the report of one of Ignatov's

collaborators on the Bureya expeditions (Dr. Z. Iwatsuki wrote that he supposedly collected this taxon on the trip). After the revision of the NICH herbarium, where that collection should be housed, we did not find any *Fossombronina*. Also, Krayesky *et al.* (2005) provided the robust phytogeographical arguments that this species cannot occur in the treated area (as well as in East Asia as a whole), and we are in agreement with it.

**Acknowledgements.** We are deeply indebted to the authors of TNS (M. Higuchi) and HIRO (Dr. T. Yamaguchi) for specimen loans. We thank Dr. N. Koroleva for comments and English improvement as well as two reviewers for comments that improved the manuscript. The work was partially supported by the Russian Foundation of Basic Researches (grants no. 15-29-02662, 15-04-03479, 15-34-20101).

## REFERENCES

- AFONINA O.M. & DUDA J., 1993 — Liverworts of Chukotka. *Botaniceskii Zhurnal* 78(3): 77-93.
- ANDREJEVA E.N., 2009 — New rare liverwort records from Russian Federation Regions. *Arctoa* 18: 281-286.
- BAKALIN V.A., 2007 — New liverwort records from Sakhalin Province. 2. Southern Kuril Islands. *Arctoa* 16: 202-209.
- BAKALIN V.A., 2008 — On taxonomy of some hepatics from Primorskiy Territory (Russian Far East), with the list of taxa of the territory. *Arctoa* 17: 101-108.
- BAKALIN V.A., CHERDANTSEVA V.YA., IGNATOV M.S., IGNATOVA E.A. & NYUSHKO T.I., 2009 — Bryophyte flora of southern Kurils Islands. *Arctoa* 18: 69-114.
- DAMSHOLT K., 2002 — Illustrated Flora of Nordic Liverworts and Hornworts. Lund, Nordic bryological society, 840 p.
- FREY W. & STECH M., 2009 — Marchantiophyta, Bryophyta, Anthocerotophyta. In: Frey W. (ed.), *Syllabus of Plant Families*. Stuttgart, Borntraeger, 1-257.
- GAMBARYAN S.K., 1984 — The hepatic flora of the high mountains and spurs of Southern Sikhotealin. In: Cherdantseva V.Ya. *et al.* (eds.), *Systematiko-floristicheskie issledovaniya sporovykh rastenij Dalnego Vostoka*. Vladivostok, pp. 54-69.
- HUANG S.-F., YU-CHIH WU YU.-C. & LIN S.-H., 2009 — Materials to the Bryophyte Flora of Taiwan (II) – *Fossombronina caledonica* Steph. (Fossombroniaceae), a New Record. *Taiwania* 54(2): 187-189.
- KATAGIRI, T. & FURUKI T., 2012 — Checklist of Japanese liverworts and hornworts. *Bryological research* 10(7): 193-210.
- KONSTANTINOVA N.A., POTEMKIN A.D. & SCHLJAKOV R.N., 1992 — Check-list of the Hepaticae and Anthocerotae of the former USSR. *Arctoa* 1: 87-127.
- KONSTANTINOVA N.A., BAKALIN V.A., POTEMKIN A.V. & IGNATOV M.S., 2002 — Hepatic flora of the Upper Burea River (Russian Far East). *Arctoa* 11: 393-398.
- KONSTANTINOVA N.A., BAKALIN V.A., ANDREJEVA E.N., BEZGODOV A.G., BOROVICHEV E.A., DULIN M.V. & MAMONTOV YU.S., 2009 — Check-list of liverworts (Marchantiophyta) of Russia. *Arctoa* 18: 1-63.
- KRAYESKY D. M., CRANDALL-STOTLER B. & STOTLER R.E., 2005 — A revision of the genus *Fossombronina* Raddi in East Asia and Oceania. *Journal of the Hattori botanical laboratory* 98: 1-45.
- KÜRSCHNER H. & ERDAĞ A., 2005 — Bryophytes of Turkey: An Annotated Reference List of the Species with Synonyms from the Recent Literature and an Annotated List of Turkish Bryological Literature. *Turkish journal of botany* 29: 95-154.
- LADYZHENSKAYA K.I. & ZENKOVA E.YA., 1955 — Liverworts spore as taxonomic features, for example genus *Fossombronina* Raddi. *Botanical Journal* XL: 853-857.
- LADYZHENSKAYA K.I., 1956 — The first finding of *Fossombronina angulosa* (Dicks.) Raddi in USSR. *Bot. Mat. Otd. Spor. Rast.* 11: 167-176.
- LADYZHENSKAYA K.I., 1963 — *Fossombronina longiseta* Aust. – a new record for USSR. *Bot. Mat. Otd. Spor. Rast.* 16: 165-167.

- MAMONTOV Y.U.S. & AFONINA O.M., 2012 — New liverwort records from Zabaikalsky Territory. 6. *Arctoa* 21: 290-294.
- MILNE M., SHARMA I., FREIRE A.V. & CARGILL D.C., 2011. — Spore ornamentation patterns and species delimitations within Australian *Fossombronina* Raddi (Fossombroniaceae) populations. *The bryologist* 114(1): 128-141.
- PATON J.A., 1999. — The liverwort flora of the British Isles. Colchester, 626 p.
- POTEMKIN A.D., 1993 — The Hepaticae of the Yamal Peninsula, West Siberian Arctic. *Arctoa* 2: 57-101.
- POTEMKIN A.D., 2008 — *Fossombronina alaskana* Steere et Inoue. In: Bardunov L.V. & Novikov V.S. (eds), *Red-list of Russian Federation (plants and fungi)*. Moscow, pp. 644-645.
- SCHUSTER R.M., 1992 — *The Hepaticae and Anthocerotae of North America east of the hundredth meridian. Vol. 5*. Chicago, 854 p.
- SCOTT G.A.M., 1985 — *Southern Australian Liverworts*. Canberra, 216 p.
- SCOTT G. A. M. & PIKE D.C., 1988 — Revisionary notes on *Fossombronina*. *The bryologist* 91: 193-201.
- SÖDERSTRÖM L., HAGBORG A., VON KONRAT M., BARTHOLOMEW-BEGAN S., BELL D., BRISCOE L., BROWN E., CARGILL D.C., COSTA D.P., CRANDALL-STOTLER B.J., COOPER E.D., DAUPHIN G., ENGEL J.J., FELDBERG K., GLENNY D., GRADSTEIN S.R., HE X., HEINRICHS J., HENTSCHEL J., ILKIU-BORGES A.L., KATAGIRI T., KONSTANTINOVA N.A., LARRAÍN J., LONG D.G., NEBEL M., PÓCS T., FELISA PUCHE F., REINER-DREHWALD E., RENNER M.A.M., SASS-GYARMATI A., SCHÄFER-VERWIMP A., MORAGUES J.G.S., STOTLER R.E., SUKKHARAK P., THIERS B.M., URIBE J., VÁÑA J., VILLARREAL J.C., WIGGINTON M., ZHANG L., ZHU R.-L., 2015 — World checklist of hornworts and liverworts. *PhytoKeys* 59: 1-828. doi: 10.3897/phytokeys.59.6261
- SÖDERSTRÖM L., URMI E. & VÁÑA J., 2002 — Distribution of Hepaticae and Anthocerotae in Europe and Macaronesia. *Lindbergia*, 27: 3-47.
- SOFRONOVA E.V., 2010 — New and rare liverworts for Republic of Sakha (Yakutia). (In Russian, English summary). *Novitates systematicae plantarum non vascularum* 44: 355-356.
- SOFRONOVA E.V., 2011 — New liverwort records from Republic of Sakha (Yakutia). 6. *Arctoa* 20: 260.
- STEERE W.C. & INOUE H., 1974 — *Fossombronina alaskana*, a new hepatic from arctic Alaska. *The bryologist* 77: 63-71.
- STOTLER R.E., BRAY J.R., CARGILL D.C., KRAYESKY D. & CRANDALL-STOTLER B.J., 2003 — Typifications in the genus *Fossombronina* (Marchantiophyta). *The bryologist* 106(1): 130-142.