

ON *SPHAGNUM MIRUM* (SUBGEN. *SQUARROSA*) AND *S. OLAFII* (SUBGEN. *ACUTIFOLIA*)
(SPHAGNACEAE, BRYOPHYTA) IN RUSSIA

О *SPHAGNUM MIRUM* (SUBGEN. *SQUARROSA*) И *S. OLAFII* (SUBGEN. *ACUTIFOLIA*)
(SPHAGNACEAE, BRYOPHYTA) В РОССИИ

KJELL I. FLATBERG¹, OLGA M. AFONINA², YURI S. MAMONTOV³, VLADIMIR E. FEDOSOV⁴
& ELENA A. IGNATOVA⁴

КЪЕЛ И. ФЛАТБЕРГ¹, ОЛЬГА М. АФОНИНА², ЮРИЙ С. МАМОНТОВ³, ВЛАДИМИР Э. ФЕДОСОВ⁴,
ЕЛЕНА А. ИГНАТОВА⁴

Abstract

Two moss species, *Sphagnum mirum* and *S. olafii* are reported from Russia for the first time. *Sphagnum mirum* was found in Ary-Mas Station, Eastern Taimyr, and in Zabaikalsky Territory; *S. olafii* was revealed in collections from Chukotka Peninsula and from Zabaikalsky Territory. Both species were recently described by the first author from the Arctic: Alaska (*S. mirum*) and Svalbard (*S. olafii*), and their ranges remain insufficiently known. Both findings in Russia are new for Asia and continental Eurasia. Localities in Zabaikalsky Territory are the southernmost ones for both species, the only known outside Arctic. Descriptions and illustrations of these species, based on Asian collections, are provided, their ecology and distinctive morphological characters are overviewed.

Резюме

Sphagnum mirum и *S. olafii* впервые выявлены в России. *S. mirum* обнаружен в коллекциях из урочища Ары-Мас (Восточный Таймыр) и из Забайкальского края, *S. olafii* – с Чукотки и Забайкалья. Оба вида были недавно описаны первым автором из Арктики: с Аляски (*S. mirum*) и Шпицбергена (*S. olafii*), и их распространение остается слабо изученным. Оба вида впервые найдены в Азии и в материковой Евразии, и их местонахождения в Забайкалье являются самыми южными и пока единственными за пределами Арктики. В статье представлены описания и иллюстрации видов, основанные на азиатских образцах, рассматривается их экология и отличия от близких видов, известных в Азии.

KEYWORDS: *Sphagnum*, rare species, subgenus *Acutifolia*, subgenus *Squarrosa*, Asian Russia.

Recent exploration of Asian Russia in terms of peat mosses revealed a number of species new for this huge territory and made an addition to their known distribution (Maksimov, 2007; Maksimov & Ignatova, 2008; Maksimov *et al.*, 2016). However, several recently described arctic species have not been recorded there in spite of wide distribution of Arctic landscapes in northern Asia and rather intensely studied local moss floras (Afonina, 2004; Fedosov *et al.*, 2011).

Recent revision of peat moss collections from sect. *Squarrosa* kept in MW revealed a new locality of *Sphagnum mirum* in eastern Taimyr (collected by VF, identified by KF). The first author also identified *S. mirum* in

the course of his study of specimens from Zabaikalsky Territory in LE, as well as *S. olafii*, another poorly known Arctic species. The latter species was also found among specimens from Chukotka Peninsula collected by OA. In the present paper, we provide an overview of these records, the description and illustrations of these species based on Russian specimens and their distinction from similar species.

Sphagnum mirum Flatberg & Thingsgaard, Bryologist 106: 504. f. 1, 3–21, 26–29. 2003[2004]. Fig. 1

Plants medium-sized, yellowish-brown, forming low hummocks. Stems yellowish-green, with 2–3 layered

¹ – University Museum, Norwegian University of Science and Technology, NO-7491 Trondheim, Norway; e-mail: kjell.flatberg@vm.ntnu.no

² – V.L. Komarov Botanical Institute Rus. Acad. Sci., Prof. Popov Str., 2, St. Petersburg, 197376 Russia – Россия 197376, г. Санкт-Петербург, ул. проф. Попова, д. 2, Ботанический институт им. В.Л. Комарова РАН; e-mail: stereodon@yandex.ru and yur-mamontov@yandex.ru

³ – Tsitsin Main Botanical Garden, Russian Academy of Sciences, Botanicheskaya 4, Moscow 127276 Russia – Россия 127276 Москва, Ботаническая 4, ГБС РАН; e-mail: yur-mamontov@yandex.ru

⁴ – Moscow State University, Faculty of biology, Vorob'ovu gory 1-12, Moscow 119991 Russia – Россия 119234, Москва, Московский университет, Биологический факультет, каф. геоботаники; e-mails: fedosov_v@mail.ru and arctoa@list.ru

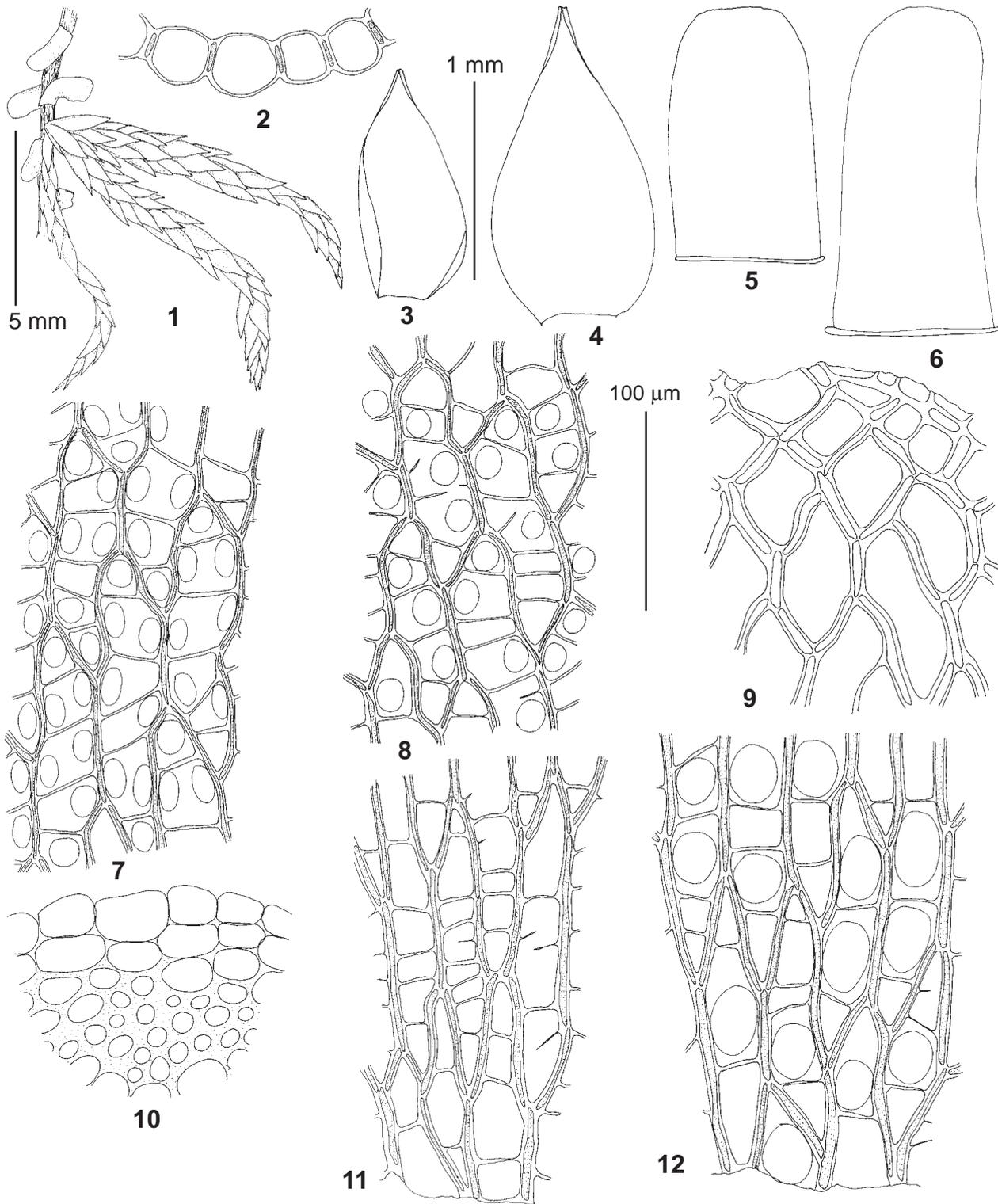


Fig. 1. *Sphagnum mirum* Flatberg & Thingsgaard (1–2, 4, 6–12 from: Russia, Taimyr, Fedosov 07A-1-10, MW; 3, 5 – from: Russia, Zabaikalsky Territory, Afonina 7712, LE). 1 – part of stem and branch fascicle, dry; 2 – branch leaf transverse section; 3–4 – branch leaves; 5–6 – stem leaves; 7 – cells on convex surface of branch leaf in its middle part; 8 – cells on concave surface of branch leaf in its middle part; 9 – cells on convex surface of stem leaf in its distal part; 10 – stem transverse section; 11 – cells on convex surface of branch leaf at its base; 12 – cells on convex surface of branch leaf at its base. Scale bars: 5 mm for 1; 1 mm for 3–6; 100 µm for 2, 7–12.

hyalodermis. Stem leaves 1.45–1.7×0.8 mm, lingulate, with narrow, poorly defined border, broad fimbriate apex and non-septate hyaline cells without pores and fibrils.

Branch fascicles of 2 spreading and 1–2 hanging branches. Branch leaves 1.4–1.75 mm long, ovate, with a narrow involute tips; hyaline cells in proximal half of leaf apor-

ose on convex surface and with large elliptic pores on concave surface; hyaline cells on convex surface in distal half of leaf with numerous rather large pores at cell ends and along commissures, on concave surface with large round pores; chlorophyllous cells in transverse section of branch leaf narrow elliptical, enclosed on both surfaces, with the widest part in the leaf middle. Gametangia and sporophytes not seen in Russian collections. [Sexual condition dioicous. Spores ca. 31 μm].

Differentiation. *S. mirum* is closely related to *S. teres* (Schimp.) Lngstr. and *S. tundrae* Flatberg. According to Flatberg & Thinggaard (2003), the most prominent morphological characters of *S. mirum* are chlorophyllous cells in transverse section elliptical to elliptical-rectangular, broadest in middle part, broadly enclosed on both surfaces vs. triangular to ovate-triangular, broadest near convex surface (*S. teres*) and elliptic to elliptic-ovate, broadest at some distance apart from the convex surface (*S. tundrae*); distinctly papillose inner surface of hyaline cells where facing chlorophyllous cells vs. less distinctly papillose in both *S. teres* and *S. tundrae*; pendent branch leaves markedly shorter than divergent branch leaves vs. not markedly shorter ones in both *S. teres* and *S. tundrae*. The main difference between *S. mirum* and *S. teres* includes opposite position of pores in hyaline cells in proximal part of branch leaves: *S. mirum* has aporose hyaline cells on convex surface and large faint pores on concave side, while in *S. teres* pores are present on convex side and absent on concave one. In *S. tundrae*, pores are present in hyaline cells on both surfaces of basal part of branch leaves. In addition, *S. mirum* can be separated from *S. tundrae* by narrow involute tips of branch leaves, which are broadly truncate in the latter species.

Distribution. *Sphagnum mirum* was recently described from Alaska (Flatberg & Thinggaard 2003) based on material collected from one locality in the Bethel area. In 2007 it was collected by the first author from one locality in the Nunavik area, arctic Canada (62°22'57"N – 77°52'15.9"W; TRH B-727552-54). Specimens from Russia were referred to *S. mirum* by Flatberg in 2011, but remained unpublished. The species was also reported from Yakutia (Ignatova *et al.*, 2011; Ignatov *et al.*, 2014), but these specimens were reidentified later as *S. tundrae*.

Ecology. In Taimyr the species occurs in boggy cotton-grass (*Eriophorum vaginatum*, *E. polystachion*) dominated tundra, with *Betula exilis*, *Salix hastata*, *S. reptans*, *Carex concolor*, *Pedicularis* spp., *Tomentypnum nitens*, *Dicranum elongatum*, *Aulacomnium palustre*, *Scorpidium revolvens*, *Hamatocaulis vernicosus*, *Calliergon giganteum*, *Sphagnum beringiense*, *S. tundrae*, etc. It was collected on hummock near a small lake. For more details about the area and its bryophyte flora see Norin (1978) and Fedosov & Afonina (2009). In Zabaikalsky Territory *S. mirum* grew in dwarf birch dominated community with peat mosses and swampy willow stand, at 1140 m a.s.l.

Specimens examined: Krasnoyarsk Territory: Taimyr Municipal District, Khatanga Settlement outskirts, Ary-Mas key area, on the left bank of Novaja River near Ary-Mas Station of Taimyrsky State Reserve (72°28'N – 110°52'E), 1.IX.2007, Fedosov 07A-1-3, 07A-1-10, det. Flatberg (MW). **Zabaikalsky Territory:** Kalar District, Baikal-Amur Mainline, Nalednaya crossing point (56°30'22"N – 117°07'29"E), 1140 m alt., 6.VIII.2012, Afonina 7712 & 7612 (LE).

Sphagnum olafii Flatberg, Journal of Bryology 17: 613. f. 1–4. 1993. Fig. 2

Plants medium-sized, in soft and compact tufts, brownish or lightly pinkish, capitulum fattened. Stem green-brownish; hyalodermis 2–3-layered, cells of outer layer aporose or with one (rarely two) semicircular pores in cell ends, without fibrils. Stem leaves lingulate-triangular, often with somewhat involute margins above; apex subacute, obtuse, often narrowly truncate; 1.4–1.7×0.75–0.8 mm; hyaline cells on convex surface faintly fibrillose, septate, without pores. Branch fascicles with 2 spreading and 1 (rarely 2) pendent branches. Branch leaves ovate-lanceolate, 1.6–2.0 mm long; hyaline cells on convex surface in middle part of leaf with elliptic commissural pores, on concave surface with large circular pores; chlorophyllous cells in transverse section triangular to sometimes triangular-trapezoidal, exposed to both surfaces or sometimes distinctly enclosed on convex surface. Sexual condition autoicous. Spores 24–30 μm .

Flatberg (2007) reported *S. olafii* with sporophytes from western Greenland, and in 2009 sporophyte-bearing plants of the species were collected in northeast Greenland in the Zackenberg Area, the photo of this species made by K Hassel is provided in his publication (Hassel *et al.*, 2014). Sporophytes also present in one of collections from Chukotka (Egvekinot Settlement surroundings). The capsule is mature, but with intact operculum and with short pseudopodium (Fig. 2: 1). It could remain not open due to unfavorable weather condition.

Differentiation. *Sphagnum olafii* is similar to *S. arcticum* Flatberg, and the specimens from Chukotka Peninsula were initially identified by R. Gauthier as *S. arcticum* (Afonina, 2004). Flatberg (1993, 2007) mentioned that both stem and branch leaves of *S. olafii* are longer and narrower than leaves of *S. arcticum*; however, in some Russian specimens of the former species leaves are slightly shorter than they are originally described, and are comparable in length to leaves of *S. arcticum* (see Fig. 3: 1–12, specimens also from Russia). At the same type, shape of stem leaves is different in these species: in *S. olafii* they are more acute, considerably narrowed to the apex, but broadly truncate and lacerate above, whereas in *S. arcticum* they are broadly lingulate or even lingulate-spathulate, not narrowed distally, with broadly obtuse and more or less fimbriate-lacerate apex. Narrowed, but truncate apex of stem leaves is a distinctive character of *S. olafii*, separating it from some other species of sect. *Acutifolia* with similarly acute stem leaves, like *S. capillifolia*

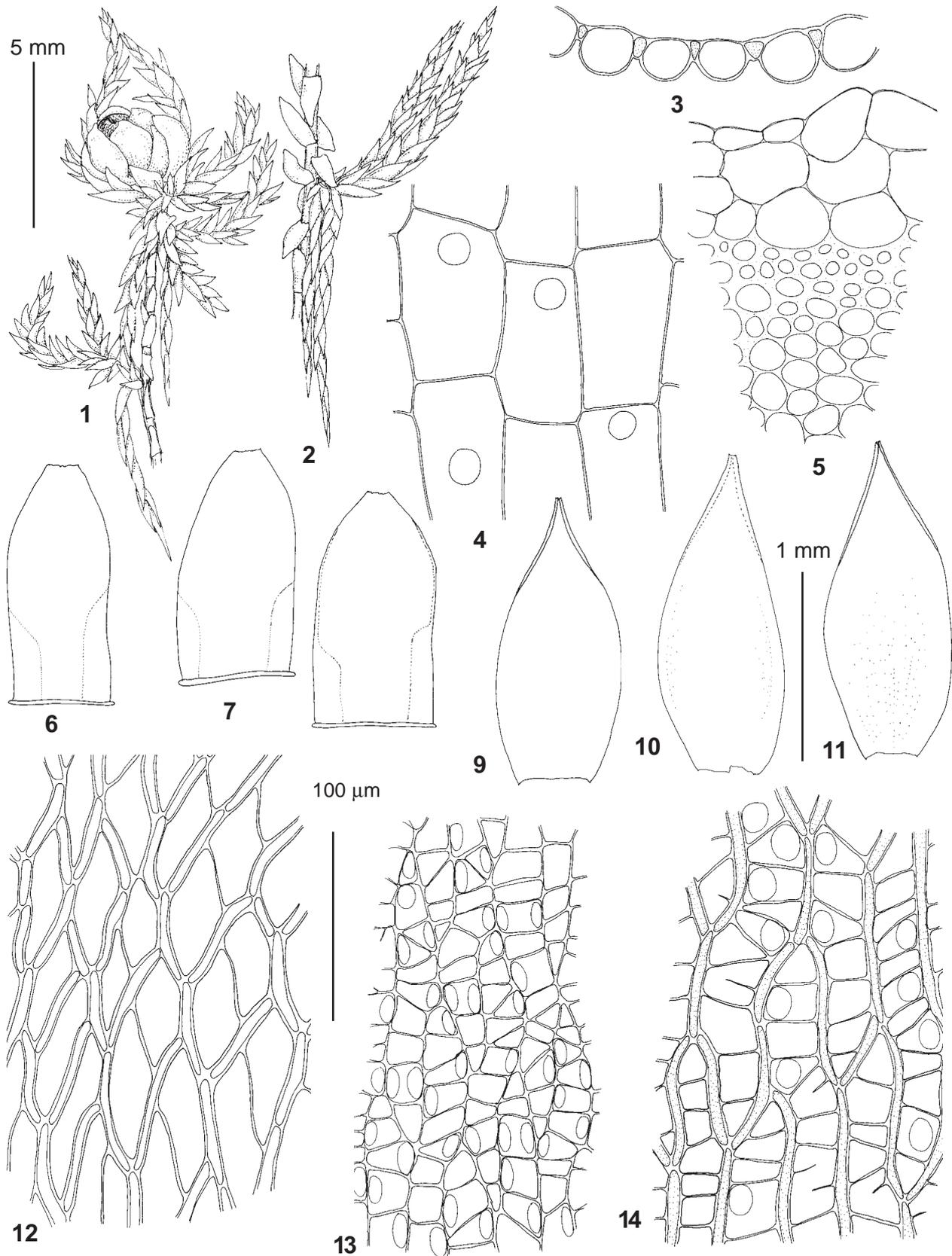


Fig. 2. *Sphagnum olafii* Flatberg (from: Russia, Chukotka, 17.VIII.1977 *Afonina s.n.*, LE). 1 – part of plant with capitula and sporophyte, dry; 2 – part of stem and branch fascicle, dry; 3 – branch leaf transverse section; 4 – hyalodermis; 5 – stem transverse section; 6–8 – stem leaves; 9–11 – branch leaves; 12 – cells on convex surface of stem leaf in its distal part; 13 – cells on convex surface of branch leaf in its middle part; 14 – cells on concave surface of branch leaf in its middle part. Scale bars: 5 mm for 1–2; 1 mm for 6–11; 100 μm for 3–5, 12–14.

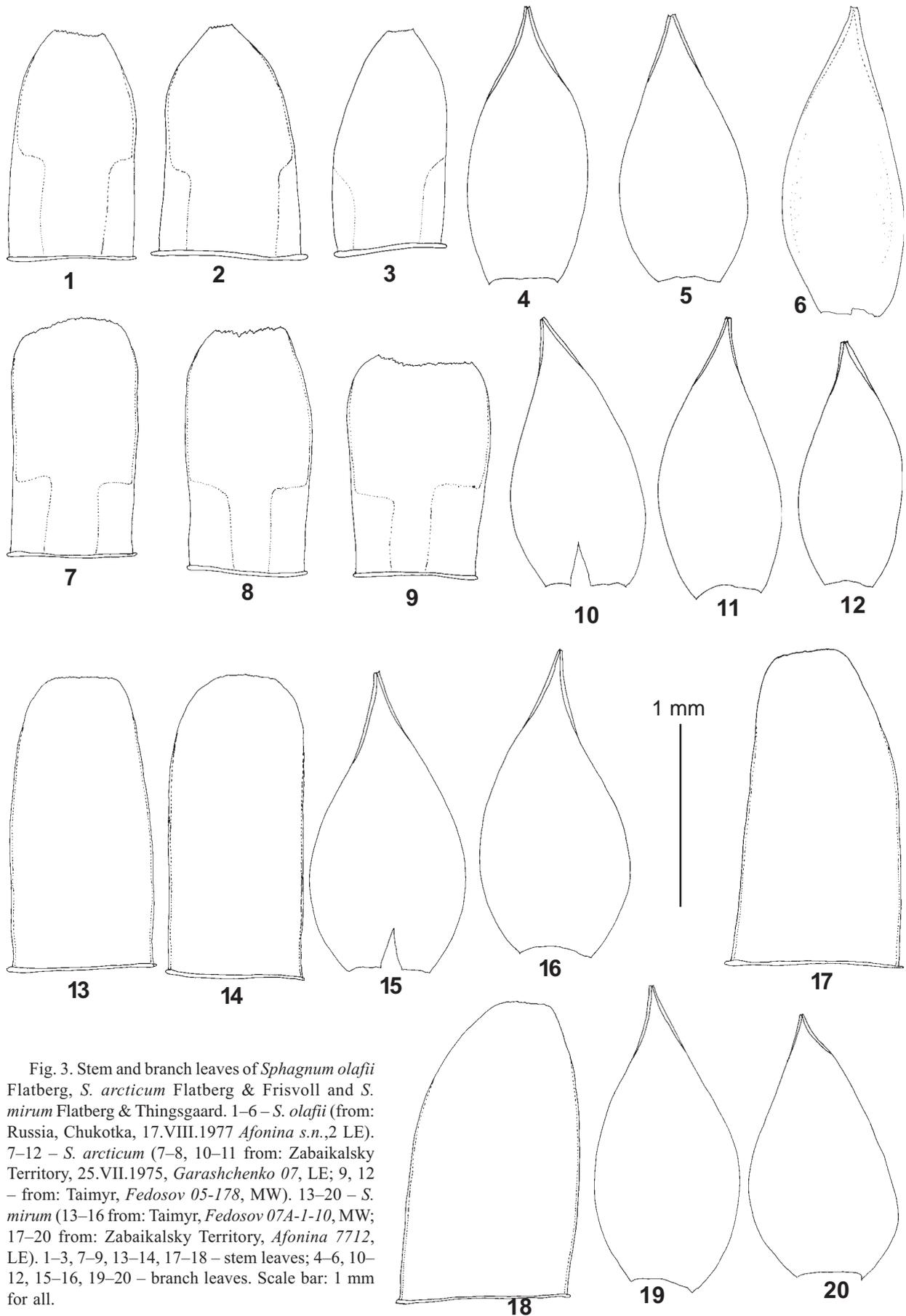


Fig. 3. Stem and branch leaves of *Sphagnum olafii* Flatberg, *S. arcticum* Flatberg & Frisvoll and *S. mirum* Flatberg & Thingsgaard. 1–6 – *S. olafii* (from: Russia, Chukotka, 17.VIII.1977 Afonina s.n., 2 LE). 7–12 – *S. arcticum* (7–8, 10–11 from: Zabaikalsky Territory, 25.VII.1975, Garashchenko 07, LE; 9, 12 – from: Taimyr, Fedosov 05-178, MW). 13–20 – *S. mirum* (13–16 from: Taimyr, Fedosov 07A-1-10, MW; 17–20 from: Zabaikalsky Territory, Afonina 7712, LE). 1–3, 7–9, 13–14, 17–18 – stem leaves; 4–6, 10–12, 15–16, 19–20 – branch leaves. Scale bar: 1 mm for all.

um and *S. subnitens*, which are not truncate or lacerate at apex. Absence of metallic lustre is helpful for distinguishing *S. olafii* from *S. subfulvum*.

Distribution. The species was described by K.I. Flatberg (1993) from Svalbard and consequently was found in Greenland and North America (Canada, Quebec) (Flatberg, 2007; Hassel *et al.*, 2014). The finding in Zabaikalsky Territory is the first southernmost locality and first time record for Russia.

Ecology. In Zabaikalsky Territory the species was collected in tundra belt (1780 m alt.). In Chukotka the habitats of *S. olafii* are confined to the wet dwarf-willow and dwarf-birch-sedge-mossy tundras on upland terrace and on gentle slope. The moss cover in these tundras is formed by such species as *Aulacomnium palustre*, *Hylacomium splendens*, *Oncophorus wahlenbergii*, *Racomitrium lanuginosum*, *Tomentypnum nitens*, *Scorpidium revolvens*, *Warnstorfia sarmentosa*, *etc.*

Specimens examined: **Russia: Southern Siberia, Zabaikalsky Territory:** Kalar District, Kodar Range, upper of Sredny Sakukan River, Medvezhy Brook (56°54'35.4"N – 117°36'44.7"E), 1780 m alt., tundra belt, on stones in dry brook bed, 1.VII.2013, *Mamontov 338/1* (LE, TRH). **Chukotka Autonomous Okrug:** Middle course Getlyanen River (65°10'N – 173°00'W), sedge-sphagnous bog, 5.VIII.1976, *Afonina s.n.* (LE, TRH); Bay Cross, vicinity of Egvekinot Settlement (66°20'N – 179°07'W), hummocky dwarf-willow-sedge-mossy tundra in lower part of slope, 17.VIII.1977, *Afonina s.n.* (LE, TRH); vicinity of Ioni Lake, Ioni Mt in middle course of Ioniveem Creek (65°53'N – 173°44'W), in hummocky dwarf birch-blueberry-sedge-mossy tundra with wet depressions, 5.VII.1977, *Afonina s.n.* (LE, TRH).

ACKNOWLEDGEMENTS

The study of V.E. Fedosov and E.A. Ignatova was partially supported by RFBR grants 14-04-01424, 15-29-02647 and 16-04-01156.

LITERATURE CITED

- [AFONINA, O.M.] АФОНИНА О.М. 2004. Конспект флоры мхов Чукотки. – [Moss flora of Chukotka] *СПб, БИИ РАН [Sankt-Petersburg, Bot. Inst. RAS]*, 260 pp.
- [FEDOSOV, V.E. & O.M. AFONINA] ФЕДОСОВ В.Э., О.М. АФОНИНА. 2009. Дополнения к флоре мхов урочища «Ары-Мас» (Восточный Таймыр). – [Additions to the bryoflora of forestland "Ary-Mas" (Eastern Taimyr)] *Ботанический журнал [Botanichesky Zhurnal]* **94**(9): 11–23.
- FEDOSOV, V.E., E.A. IGNATOVA, M.S. IGNATOV & A.I. MAKSIMOV. 2011. Rare species and preliminary list of mosses of Anabar Plateau (Subarctic Siberia). – *Arctoa* **20**: 153–174.
- FLATBERG, K.I. 1993. *Sphagnum olafii* (sect. *Acutifolia*), a new peat-moss from Svalbard. – *Journal of Bryology* **17** (4): 613–620.
- FLATBERG, K.I. 2007. Contributions to the *Sphagnum* Flora of West Greenland, with *Sphagnum concinnum* stat. et sp. nov. – *Lindbergia* **32** (3): 88–98.
- FLATBERG, K.I. & K. THINGSGAARD. 2003. Taxonomy and geography of *Sphagnum tundrae* with a description of *S. mirum*, sp. nov. (Sphagnaceae, sect. *Squarrosa*). *The Bryologist* **106** (4): 501–515.
- HASSEL, K., H. ZECHMEISTER & T. PRESTØ. 2014. Mosses (Bryophyta) and liverworts (Marchantiophyta) of the Zackenberg valley, north-east Greenland. – *Lindbergia* **37**: 66–84.
- IGNATOV, M.S., V.G. ISAKOVA & E.A. IGNATOVA. 2014. A contribution to the moss flora of Orulgan Range (Yakutia). – *Arctoa* **23**: 194–206.
- IGNATOVA, E.A., E.I. IVANOVA, O.V. IVANOV & M.S. IGNATOV. 2011. Mosses of the Mus-Khaya Mountain (Yakutia, Asiatic Russia). – *Arctoa* **20**: 211–226.
- MAKSIMOV, A.I. 2007. *Sphagnum imbricatum* complex (Sphagnaceae, Bryophyta) in Russia. – *Arctoa* **16**: 25–34.
- MAKSIMOV, A.I., V.E. FEDOSOV & E.A. IGNATOVA. 2016. *Sphagnum beringiense* (Sphagnaceae, Bryophyta) in Russia. – *Arctoa* **25**: 101–105.
- MAKSIMOV, A.I. & E.A. IGNATOVA. 2008. *Sphagnum alaskense* (Sphagnaceae, Bryophyta), a new species for Russia. – *Arctoa* **17**: 109–112.
- [NORIN, V.N. (ed.)] НОРИН В.Н. (ред.). 1978. Ары-Мас: природные условия, флора и растительность самого северного в мире лесного массива. – [Ary-Mas: environments, flora and vegetation of the northernmost forest massif in the world]. *Л., Наука [Leningrad, Nauka]*, 190 pp.