

DICHELYMA (FONTINALACEAE, BRYOPHYTA) IN RUSSIA

DICHELYMA (FONTINALACEAE, BRYOPHYTA) В РОССИИ

IRINA V. CZERNYADJEVA¹ & ELENA A. IGNATOVA²

ИРИНА В. ЧЕРНЯДЬЕВА¹, ЕЛЕНА А. ИГНАТОВА²

Abstract

Four species of *Dichelyma* are known at present in Russia: *D. capillaceum* (With.) Myrin, *D. falcatum* (Hedw.) Myrin, *D. japonicum* Card. and *D. uncinatum* Mitt. The latter species is newly reported for the country. It was discovered in herbarium collections from Commander Islands (Kamchatsky Territory), Chukotka and Anabar Plateau (Krasnoyarsk Territory, Taimyr District). All these specimens were previously identified as *D. capillaceum*. Distribution of the latter species in Russia is restricted to central and northern parts of European Russia and Western Siberia (middle course of Ob River). *Dichelyma falcatum* is not rare in northern part of European Russia and in montane areas of southern Siberia, southern Taimyr and Chukotka, known also in central European Russia (south to Tver Province), Urals, Western Siberia, Republic Sakha (Yakutia), and Kamchatka. *Dichelyma japonicum* is known from single locality in Iturup Island (Kuril Islands). Key to identification, descriptions, data on distribution in Russia and ecology are provided for all species, illustrations of *D. capillaceum* and *D. uncinatum* are also included.

Резюме

В настоящее время на территории России известны 4 вида из рода *Dichelyma*: *D. capillaceum* (With.) Myrin, *D. falcatum* (Hedw.) Myrin, *D. japonicum* Card. и *D. uncinatum* Mitt. Последний вид впервые приводится для России. Он был выявлен в коллекциях с Командорских островов (Камчатский край), Чукотки и Анабарского плато (Красноярский край, Таймырский Автономный район), первоначально определенных как *D. capillaceum*. Ареал *D. capillaceum* в России охватывает центр и север европейской части, доходя на восток до Западной Сибири (среднего течения Оби). *Dichelyma falcatum* нередко встречается на севере европейской России, в горах юга Сибири, на юге Таймыра (Анабарское плато) и на Чукотке, вид также известен по спорадическим находкам из центра европейской части (на юг до Тверской области), на Урале, в равнинной части Западной Сибири, в Якутии и на Камчатке. *Dichelyma japonicum* найдена в России в одном местонахождении на о. Итуруп (Курильские острова). Приводятся ключ для определения, описания всех видов, данные по их распространению в России и экологии, для *D. capillaceum* и *D. uncinatum* также даны рисунки.

KEYWORDS: *Dichelyma*, mosses, new records, Russia.

In the first check-list of mosses of the former USSR (Ignatov & Afonina, 1992), the genus *Dichelyma* was represented only by one species, *D. falcatum*, missing a record of *D. capillaceum* for Karelian Isthmus in NW European Russia (Brotherus, 1923). Subsequent floristic exploration brought a number of new localities of the latter species from the different regions in both European and Asian Russia (Czernyadjeva, 2002; Afonina, 2006; Volosnova *et al.*, 2012; Fedosov *et al.*, 2011, 2012). In addition, *Dichelyma japonicum* was collected recently on Iturup, Kuril Islands (Bakalin *et al.*, 2009); this species was considered to be endemic of Japan before this finding. In the course of preparation a treatment of the genus for the Moss Flora of Russia, we revised herbarium collections in LE, MHA, MW, VLA, KPABG, NS,

and SYKO and found that some specimens of *D. capillaceum* from the Asian Russia actually belong to *D. uncinatum*. These two species are widespread in North America; they have clear differences in sporophyte structure whereas their gametophytic characters are more variable and overlapping. All collections from European Russia lack sporophytes, while they were found in some specimens from Bering Island (Commander Islands), Chukotka and Anabar Plateau (Southern Taimyr), supporting identification of the species. *Dichelyma uncinatum* is newly reported for Eurasia. We provide key to identification of species known in Russia, species descriptions, overview of their ecological patterns and distribution in Russia, as well as illustrations for *D. capillaceum* and *D. uncinatum*.

¹ – V.L. Komarov Botanical Institute Rus. Acad. Sci., Prof. Popov Str., 2, St. Petersburg, 197376 Russia – Россия 197376, г. Санкт-Петербург, ул. проф. Попова, 2, Ботанический институт им. В.Л. Комарова РАН; e-mail: irinamosses@gmail.com

² – Moscow State University, Biological Faculty, Geobotany Dept., Moscow 119234 Russia – Россия 119234, Москва, Московский университет, Биологический факультет, каф. геоботаники; e-mail: arctoa@list.ru.

Dichelyma Myrin, Kongl. Vetensk. Acad. Handl. 1832:273. 1933.

Plants slender to robust, growing in loose tufts, rarely mixed with other mosses in moist persistent habitats, occasionally submerged in water; glossy to dull when dry; yellowish, greenish, yellowish-brown distally, dark greyish-brown in proximal parts. Stems prostrate or pendent, sparsely irregularly branched, reddish-brown, brown to blackish, glossy; stem and branch tips erect-ascending to strongly falcate-secund or circinate; paraphyllia absent; proximal branch leaves partly reduced¹; central strand and hyalodermis absent; rhizoids densely clustered in areas of plant attachment to substrate, brown to dark red, not or irregularly branched, finely papillose. Leaves densely or distantly arranged, stem invisible or visible among leaves, leaves strongly to obscurely 3-ranked, erect-spreading to strongly falcate-secund or circinate, keeled, ovate, lanceolate to linear-lanceolate, gradually narrowed to obtuse or acute tip or very long acuminate apex, not or weakly decurrent; margin plane or narrowly recurved, entire or rarely with few denticulations in lower part, weakly serrulate to serrate distally; costa single, in cross-section formed by homogeneous cells, subpercurrent, percurrent to excurrent in a long, aristate, denticulate or smooth subula; median laminal cells linear, slightly flexuose, thin-walled, smooth, eporose, upper laminal cells shorter, basal laminal cells shorter and wider, incrassate and porose, brownish, alar cells not or weakly differentiated.

Diocious. Perigonia budlike, lateral, small, 1.1-1.4 mm long, perigonal leaves elliptical to ovate, acute to cuspidate, ecostate, margin entire. Perichaetial leaves strongly elongating after fertilization, forming cylindrical perichaetium, sheathing the setae, spirally twisted around seta, covering or not covering the capsule, inner perichaetial leaves linear-lanceolate, to 9 mm long, ecostate, margin entire. Seta short or long. Capsule ovoid, oblong, oblong-cylindrical to cylindrical, immersed, laterally emergent, emergent or exserted, stomata absent, exothecial cells short, irregular, collenchymatous; annulus lacking; operculum conic to obliquely long-rostrate; exostome teeth inserted somewhat below mouth, linear, trabeculae widely spaced, yellow, brown or orange, spiculose-papillose or papillose, perforated along median line; endostome segments longer than exostome teeth, brown, red to brownish-orange, spiculose to finely papillose, keeled and joined by lateral appendages, forming trellis-like cone, joined by lateral bars only distally (trellis imperfect) or throughout (trellis perfect). Calyptra large, long-cucullate, covering the capsule, finally split along one side. Spores spheric, smooth or finely papillose.

Type – *Dichelyma capillaceum* (With.) Myrin. The genus includes 5 species distributed mainly in arctic and

boreal regions of the Northern Hemisphere; 4 species are known in Russia. Worldwide revision of the genus was provided by Welch (1960).

KEY TO IDENTIFICATION OF *DICHELYMA* SPECIES
IN RUSSIA

1. Leaves filiform-acuminate, costa excurrent in a long aristate subula 2
— Leaves lanceolate to ovate, acuminate to obtuse, costa subpercurrent to shortly excurrent 3
2. Leaves erect-spreading to weakly falcate, 3.5-5.5×0.3-0.5 mm, with length/width ratio 8-14:1; [seta 2-4 mm, capsule immersed or emergent; endostome segments joined only at their tips and often look free, not joined laterally with each other]
..... *Dichelyma capillaceum*
— Leaves strongly falcate-secund to circinate, 3.0-5.0×0.4-0.6 mm, with length/width ratio 6-10:1; seta 7-15 mm, capsule exserted; endostome segments joined laterally throughout and form strongly perforated cone *Dichelyma uncinatum*
3. Leaves 3.5-6.0×0.8-1.3 mm, with length/width ratio 4-6:1, acute to acuminate, costa shortly excurrent .
..... *Dichelyma falcatum*
— Leaves 2.5-3.5×0.7-1.0 mm, with length/width ratio 3-5:1, obtuse, costa subpercurrent
..... *Dichelyma japonicum*

Dichelyma capillaceum (With.) Myrin, Kongl. Vetensk. Acad. Handl. 1832: 274. 1833. — *Fontinalis capillacea* With., Syst. Arr. Brit. Pl (ed. 4) 3: 773. 1801. Figs. 1, 2 (B, C), 3.

Plants moderate in size to slender, irregularly and sparsely branched, yellowish, greenish-brown to dark greyish-brown at base, dull or weakly glossy when dry. Stems 5-9 cm, yellowish-brown, brown to blackish, stem and branch tips erect-ascending, flexuose-spreading to weakly falcate-secund. Leaves ±distant, stem often seen among leaves, leaves obscurely 3-ranked, erect-spreading to weakly falcate-secund, twisted when dry, weakly keeled, linear-lanceolate, gradually narrowed to very long narrowly acuminate apex, not or weakly decurrent, (3.5-) 4.0-5.0(-5.5)×0.3-0.5 mm, with length/width ratio 8-14: 1; margin plane, entire or rarely with few denticulations in proximal part, weakly serrulate distally; costa, 40-75 µm wide at base, excurrent in a long, aristate, denticulate or smooth subula of about 30-50 % the leaf length; median laminal cells (65-)80-100(-140)×5-10 µm, linear, slightly flexuose, thin-walled, smooth, eporose, upper laminal cells shorter, basal laminal cells shorter and wider, incrassate and porose, alar cells not differentiated. All specimens from Russia lack sporophytes. [Perichaetial leaves to 7 mm, covering the capsule. Seta 2-4 mm. Capsule 1-2 mm long, oblong-cylindrical, immersed or emergent; operculum obliquely longly rostrate; exostome teeth spiculose-papillose; endostome segments longer than exos-

¹ – For partial reduction of proximal branch leaves in Fontinalaceae see Spirina & Ignatov, 2011.

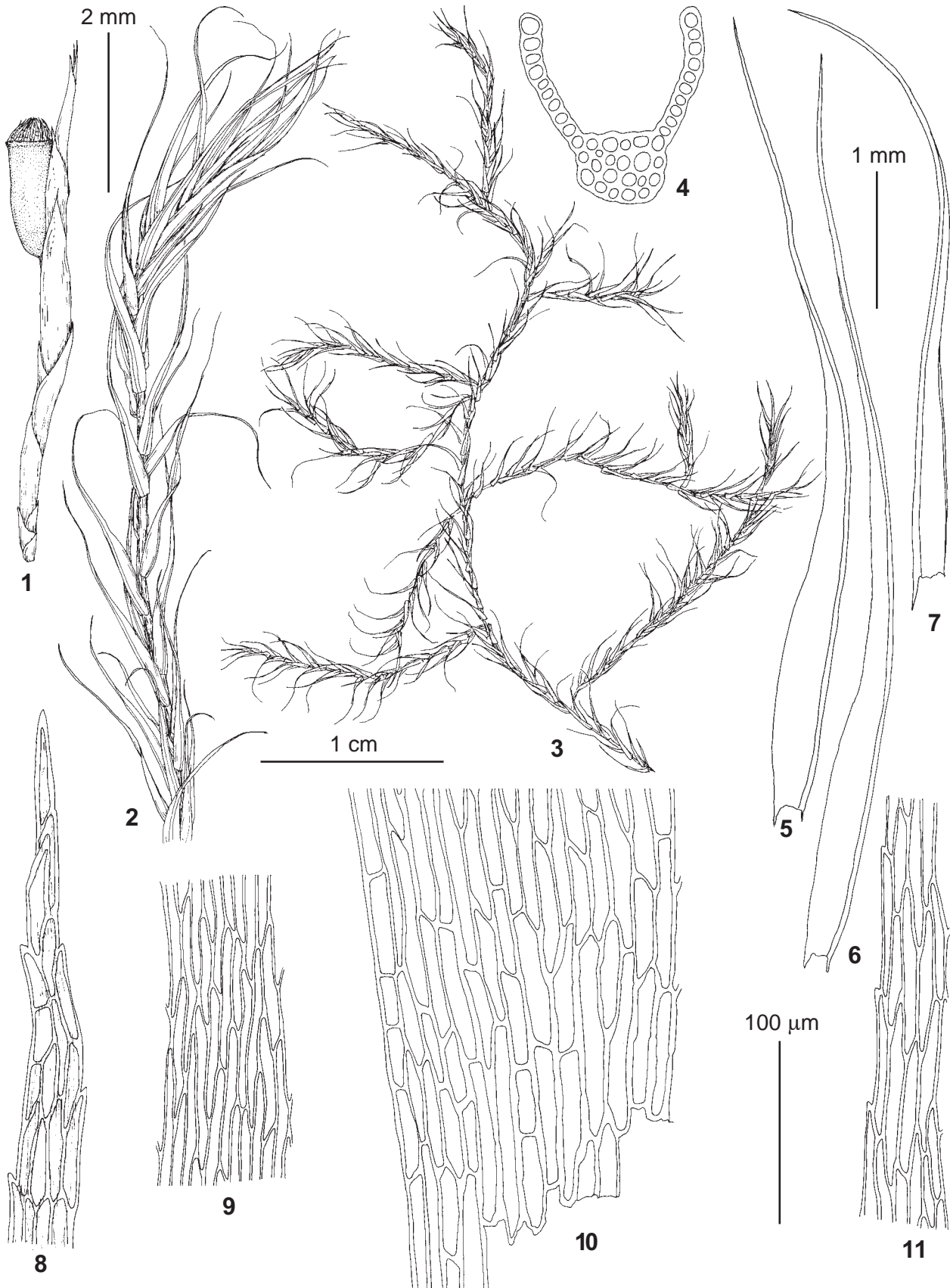


Fig. 1. *Dichelyma capillaceum* (With.) Myrin (1 – from Sweden, Stockholm, 14.IX.1864, *S.O. Lindberg s.n.*, LE; 2-11 – from: Russia, [Leningrad Province], Karel'sky Isthmus, 20.VI.1914, *H. Lindberg s.n.*, LE): 1 – perichaetium & capsule, dry; 2-3 – habit, dry; 4 – leaf transverse section; 5-7 – leaves; 8 – upper laminal cells; 9, 11 – median laminal cells; 10 – basal laminal cells. Scale bars: 1 cm for 3; 2 mm for 1-2; 1 mm for 5-7; 100 μm for 4, 8-11.



Fig. 2. Peristomes of *Dichelyma*. A: *D. uncinatum* Mitt. (from: Russia, Kamchatsky Territory, Aleutsky District, Bering Island, Fedosov #10-3-599, MW); B-C: *D. capillaceum* (With.) Myrin (from: Sweden, Stockholm, 14.IX.1864, S.O. Lindberg s.n., LE). A – dry; B-C – wet; B comprises the broken off upper parts of exostome and endostome, adherent to each other by their tips. Scale bar: 0.5 mm for all.

tome teeth spiculose-papillose; endostome segments longer than exostome teeth, joined only at apices, forming imperfect trellis, reddish or brownish-orange, spiculose-papillose. Spores 10-15 μm]

Differentiation. The species is characterized by very longly excurrent costa, with excurrent part up to 30-50% of leaf length, and distantly foliated shoots. It shares these characters with *D. uncinatum*, which possesses a considerable difficulties in identification of sterile plants. Stem and branch tips and leaves of *D. capillaceum* are typically erect, contrary to strongly falcate ones of *D. uncinatum*; however, this character is rather variable in the former species, and some collections from European Russia and West Siberia exhibit more or less falcate shoots. There are some small differences in leaf width and length and their ratios (see the keys and Table 1) between two species. In *D. capillaceum*, shoots are slightly more distantly foliated, while in *D. uncinatum* leaves are denser, though stem is also visible among them. At the same time, specimens with sporophytes are easily separated due to the difference in seta length, 2-4 mm in *D. capillaceum* vs. 7-15 mm in *D. uncinatum*, and capsules im-

mersed vs. exserted. There is also a difference in peristome structure: endostome segments are joined only by their tips and form incomplete trellis in *D. capillaceum*, while they are joined by lateral appendages at the whole length and form a complete trellis in *D. uncinatum*. Unfortunately all specimens of *D. capillaceum* from Russia lack capsules (in spite of both archegonia and anteridia are present), and we refer them to the species on the basis of gametophyte characters and distribution pattern. At the same time, capsules were found at least in some collections of *D. uncinatum* in every region where it was revealed.

In spite of a considerable difference in size of plants and leaf shape between *D. capillaceum* and *D. falcatum*, in some cases it is difficult to separate them. In the latter species, leaves from lower and middle parts of shoots may have longly excurrent costa; in such cases leaves from distal parts of shoots should be checked, as they have percurrent or only shortly excurrent costa, contrary to always very longly excurrent one in *D. capillaceum*. In addition, leaves of *D. capillaceum* are narrower (0.3-0.5 mm wide) and only weakly keeled vs. wider (0.8-1.3 mm wide) and strongly keeled leaves in *D. falcatum*. It

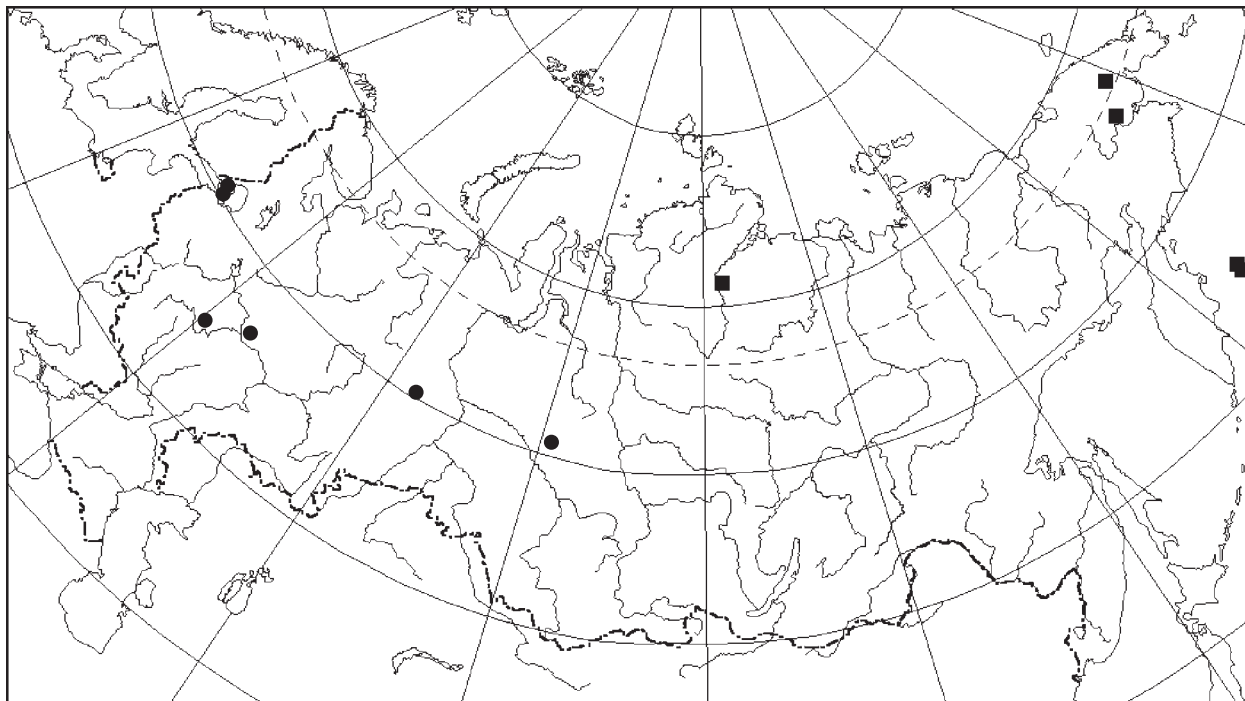


Fig. 3. Distribution of *Dichelyma capillaceum* (With.) Myrin (circles) and *D. uncinatum* Mitt. (squares) in Russia.

is also a problem to identify *D. falcatum* when it grows in rapidly running streams and has many leaves with strongly destroyed laminae, and therefore resembling narrow leaves of *D. capillaceum*; checking of some entire leaves is helpful in such cases. Difficulties in separation of these two species in Europe were discussed by K. Hylander (1999).

Distribution. *Dichelyma capillaceum* is widespread in boreal zone of eastern North America, with few localities in inner parts of continent in Oklahoma, U.S.A. and Manitoba Province, Canada (Crum & Anderson, 1981; Ireland et al., 1987). In Europe, *D. capillaceum* is a rare species; it is included into Red Data Book of European Bryophytes (1995) and Red Data Book of East Fennoscandia (1998). It is distributed in southern Sweden and central Finland, and also some scattered records are known from Denmark, France, Germany, Poland, Italy, and Romania (Red Data Book..., 1995). The range of *D. capillaceum* was overviewed by Toivonen (1972) and Hedenäs et al. (1996) who referred it to the group of species with boreal amphiatlantic distribution. Ingerpuu & Vellak (1998) recorded *D. capillaceum* for Estonia. In Russia, it was known for a long time from single locality in the Leningrad Province (NW Russia), where it was collected by H. Lindberg in 1914 (Brotherus, 1923). In 2000, it was discovered in Western Siberia, Khanty-Mansijsk Autonomous District (Vah River, middle Ob River) by the senior author (Czernyadjeva, 2002); additional collections from this area ("Kondinskie Lakes" Nature Park) were provided in 2006 by E.D. Lapshina (Herbarium of Yugorsky State University). It was also reported later from Oksky State Reserve, Ryazan Province (Volosnova et al., 2012), collected in Kerzhensky State Re-

serve (S.Yu. Popov, MHA) and in St.-Petersburg City (E.N. Andreeva, LE). All records from Chukotka (Afonina, 2006), Taimyrsky Autonomous District (Fedosov et al., 2011) and Kamchatsky Territory (Fedosov, 2010) are erroneous, they are based on specimens which were re-identified as *D. uncinatum*.

Ecology. In Russia, the species grows in flood valley habitats represented by willow, oak and birch woods; it occupies rotten wood, roots and branches of trees near water courses, usually above water and rarely submerged. It forms pure mats, and only a specimen from Vah River (Western Siberia) contains an admixture of *Leskea polycarpa* Hedw.

Specimens examined: RUSSIA. EUROPEAN RUSSIA: **Leningrad Province:** Karel'sky Isthmus, par. Muola, ad ostia omnis Saaretojoki, 20.VI.1914, H. Lindberg s.n. (LE); Sankt-Petersburg, Kurortny District, Glukhoe lake, 11.IX.2009, Andreeva s.n. (LE); **Ryazan Province:** Oksky Nature Reserve, 16.X.2009, Volosnova s.n. (MW); **Nizhegorodsky Province:** Kerzhensky Reserve, 16.IX.2001, Popov s.n. (MHA); ASIAN RUSSIA: **Khanty-Mansijsk Autonomous District:** Middle Ob River, Lower Sabun River, 4.VIII.2000, Czernyadjeva & E.Yu. Kuzmina #57 (LE); "Kondinskie Lakes" Nature Park, 9.VII.2006, Lapshina, rel. #356 (Herbarium of Yugorsky State University, duplicate in MHA).

SWEDEN: Stockholm, 30.VI.1864, S.O. Lindberg s.n. (LE); Dalsland, 2.X.1913, Larsson s.n. (LE); Småland, 10.VI.1956, Christoffersson s.n. (LE); Stockholm, 30.VI.1864, S.O. Lindberg s.n. (LE); Scania, Osby, Skansen, X.1935, Hovgard # 315 (LE); **GERMANY:** Köln, Andres #2989 (LE); **CANADA:** Quebec, Rouville, 15.X.1956, Fabius # 7790 (LE); Ontario, Brant Co., 24.XII.1943, Cain #1609 (LE); Nova Scotia, Lunenburg County, 20.VII.1974, Ireland s.n. (LE); **U.S.A.:** Missouri, Ripley County, 9.VI.1973, Redfearn #28638 (LE);

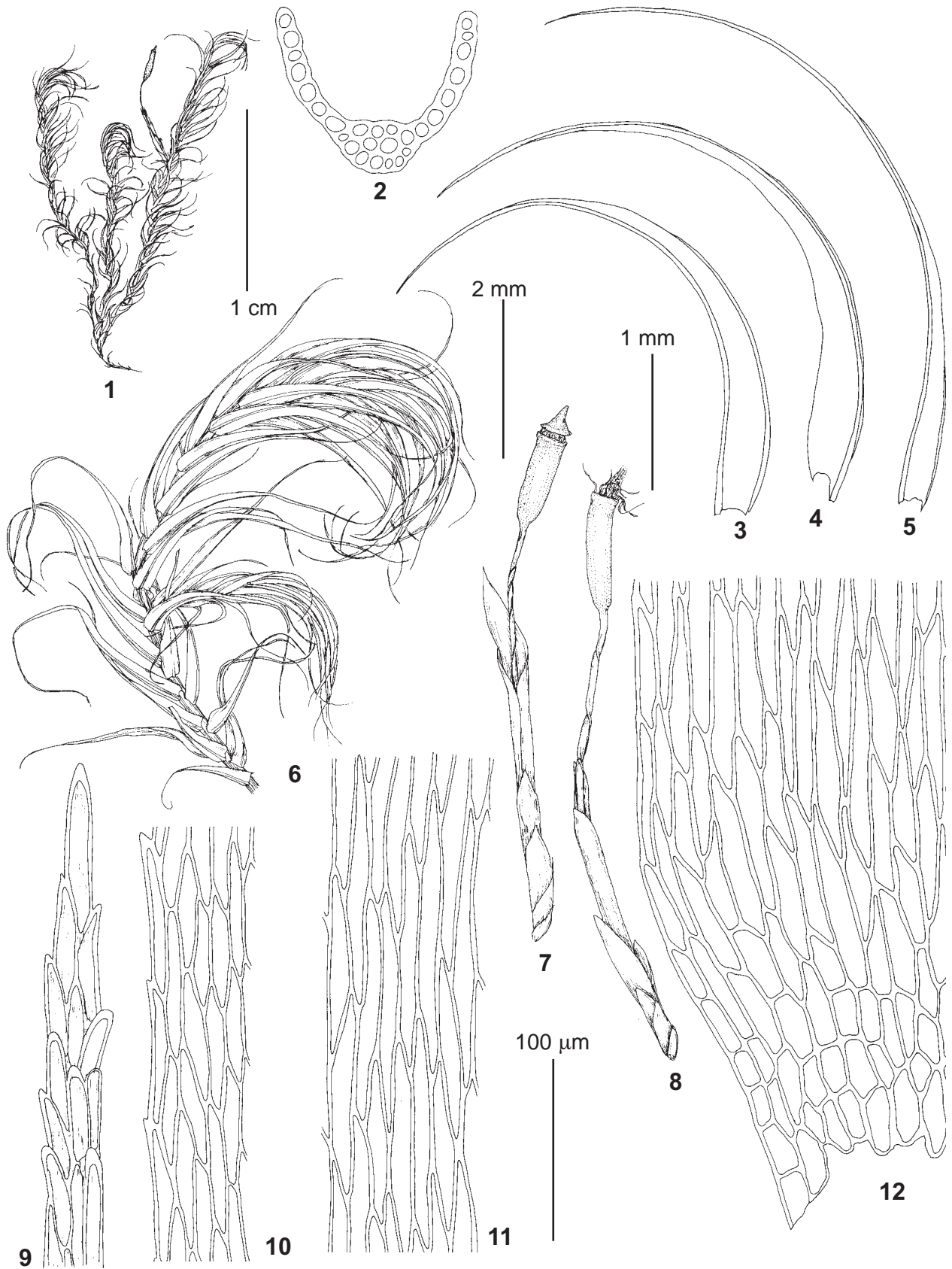


Fig. 4. *Dichelyma uncinatum* Mitt. (from: Russia, Kamchatsky Territory, Aleutsky District, Bering Island, Fedosov #10-3-599, MW): 1, 6 – habit, dry; 2 – leaf transverse section; 3-5 – leaves; 7 – perichaetium and capsule with operculum; 8 – perichaetium and open capsule; 9 – upper laminal cells; 10-11 – median laminal cells; 12 – basal laminal cells. Scale bars: 1 cm for 1; 2 mm for 6-8; 1 mm for 3-5; 100 μm for 2, 9-12.

Main, Waldo Co., 26.X.1951, *Johnson* #37 (LE); North Carolina, Greene Co., 20.X.1949, *Conard s.n.* (LE); Florida, Wakulla Co., 13.V.1950, *Wagner* #2464 (LE); Indiana, Porter Co., 27.VII.1935, *Welch* #9695 (LE).

Dichelyma uncinatum Mitt., J. Linn. Soc., Bot. 8: 44. 1864. — *Dichelyma cylindricarpum* Austin, Bot. Gaz. 2: 111. 1877; *Dichelyma uncinatum* var. *cylindricarpum* (Austin) Cardot, Mém. Soc. Sci. Nat. Math. Cherbourg 28: 139. 1892; *Dichelyma falcatum* var. *uncinatum* (Mitten) E. Lawton, Moss Fl. Pacif. N.W., 231. 1971. Figs. 3-4.

Plants of moderate size, irregularly and sparsely branched, yellowish, greenish brown to dark greyish-brown at base, silky glossy when dry. Stems to 5-11 cm, reddish brown, brown to blackish, stem and branch tips strongly falcate-secund to circinate. Leaves \pm distant, making stem hardly visible, obscurely 3-ranked, strongly falcate-secund to circinate, weakly keeled, linear-lanceolate, gradually narrowed to very long, narrowly acuminate apex, not or weakly decurrent, (3.0-)3.5-4.5 (-5.0) \times 0.5-0.7 mm, length/width ratio 6-10: 1; margin plane, entire or with few denticulations in proximal part, weakly serrulate to serrulate distally; costa 50-75 μ m wide at base, excurrent in a long, aristate, denticulate or smooth subula of about 25-45 % the leaf length; median laminal cells (65-)80-100(-140) \times 5-8(-10) μ m, linear, slightly flexuose, thin-walled, smooth, eporose, upper laminal cells shorter, basal laminal cells shorter and wider, incrassate and porose, alar cells not differentiated. Perichaetial leaves to 8 mm long, sheathing the setae, not covering the capsule. Seta 7-15 mm. Capsule 1.5-2.5 mm long, oblong-cylindrical to cylindrical, exserted; operculum conic; exostome teeth spiculate-papillose; endostome yellowish or brownish orange, longer than exostome teeth, spiculate-papillose, trellis perfect. Spores 12-15 μ m, smooth.

Differentiation. Main diagnostic characters of the species include longly excurrent costa, with excurrent part 25-45% of the leaf length, \pm distantly foliate shoots and strongly falcate-secund leaves and branch tips. Differences from *D. capillaceum* are discussed under this species. Sometimes *D. uncinatum* can be also confused with *D. falcatum*; it differs from the latter species in the same way as *D. capillaceum*.

Distribution. The species is common in the western North America and rare in its eastern part, with few records in Quebec and Ontario, Canada (Crum & Anderson, 1981). Its revealing in herbarium collections from Asian Russia greatly extends its area westward. It is a first record of *D. uncinatum* from Eurasia. It was found in Commander Islands, Chukotka and westward to Southern Taimyr (Anabar Plateau).

Ecology. Similarly to *D. capillaceum*, *D. uncinatum* grows in flood-valley willow stands, at trunk bases and on rotten wood near water courses; it also occupies rocks at stream and river banks. It forms pure mats or can be

mixed with *Dichelyma falcatum*, *Leptodictium riparium* (Hedw.) Warnst. or *Sanionia uncinata* (Hedw.) Loeske.

Specimens examined: RUSSIA: Kamchatsky Territory: Aleutsky District, Bering Island, Poludennaya bay, 16.VIII.2010, *Fedosov* #10-3-599, #10-3-599a (MW); Aleutsky District, Bering Island, Kommander bay, 9.VIII.2010, *Fedosov* #10-3-432 (MW); Taimyrsky Autonomous District: Khatanga, Medvezh'ya River, 19.VIII.2011, *Fedosov* #11-543 (MW); Chukotsky Autonomous District: Anadyrsko-Koryaksky District, Belaya River, 1.VII.1980, *Afonina s.n.* (LE); Anadyrsky District, Anadyr' River basin, Baran'e Lake, 4.VIII.1980, *Afonina s.n.* (LE).

CANADA: British Columbia: Aleza Lake, 2.IX.1957, *Boas* #133 (LE); Moresby Island, 25.VIII.1961, *Schofield* #15554 (LE); Squamish River, 17.VIII.1962, *Schofield* #19542 (LE); U.S.A.: Alaska, 18.VII.1998, *Schofield* #110438 (LE); Oregon, 24.VI.1947, *Mackness s.n.* (LE); Washington, XI.1905, *Leiberg* #1147 (LE); Idaho, Vootenai County, 1888, *Leiberg* #81 (LE); California, 29.IV.1981, *R. & I. Duell* #AZ8687 (LE).

Dichelyma falcatum (Hedw.) Myrin, Kongl. Vetensk. Acad. Handl. 1832: 274. 1833. — *Fontinalis falcata* Hedw., Sp. Musc. Frond. 299. 1801. Fig. 5. Illustrations: Ignatov & Ignatova, 2004; <http://arctoa.ru/Flora/taxonomy-ru/Dichelyma-ill.pdf>.

Plants moderate in size to robust, irregularly and sparsely branched, yellowish, greenish, yellowish-brown to dark greyish-brown at base, silky glossy when dry. Stems to 5-7(-15) cm, reddish brown, brown to blackish, stem and branch tips falcate-secund to erect-ascending. Leaves rather dense, making stem invisible (rare hardly visible), strongly 3-ranked, strongly keeled, falcate-secund to erect-spreading, lanceolate, acute or acuminate, not or weakly decurrent, 3.5-6.0 \times 0.8-1.3 mm, length/width ratio 4-6: 1; margin plane or rarely very narrowly recurved, entire or rarely with few denticulations proximally, serrate at distal part; costa 50-80 μ m wide at base, percurrent to excurrent in a short denticulate point of about 3-10 % the leaf length, rarely subpercurrent; median laminal cells (70-)100-160(-200) \times 5-8(-12) μ m, linear, slightly flexuose, thin-walled, smooth, eporose, upper laminal cells shorter, basal laminal cells shorter and wider, incrassate and porose, alar cells not or weakly differentiated. Perichaetial leaves to 9 mm long, sheathing the setae, not covering the capsule. Seta to 14 mm. Capsule 1-2.5 mm long, oblong to oblong-cylindrical, exserted; operculum high conic or obliquely long-rostrate; exostome teeth yellowish-brown, papillose; endostome segments longer than exostome teeth, finely papillose, trellis perfect. Spores 10-13 μ m, smooth.

Differentiation. The species is characterized by the plant size largest for the genus, densely foliated shoots and clearly 3-ranked leaves with acute apices. Its differences from *D. japonicum*, *D. capillaceum* and *D. uncinatum* are discussed under these species. Presence of costa separates it from species of *Fontinalis*, and strongly keeled leaves and absence of differentiated alar group differentiate it from aquatic and subaquatic species of Amblystegiaceae and Calliergonaceae.

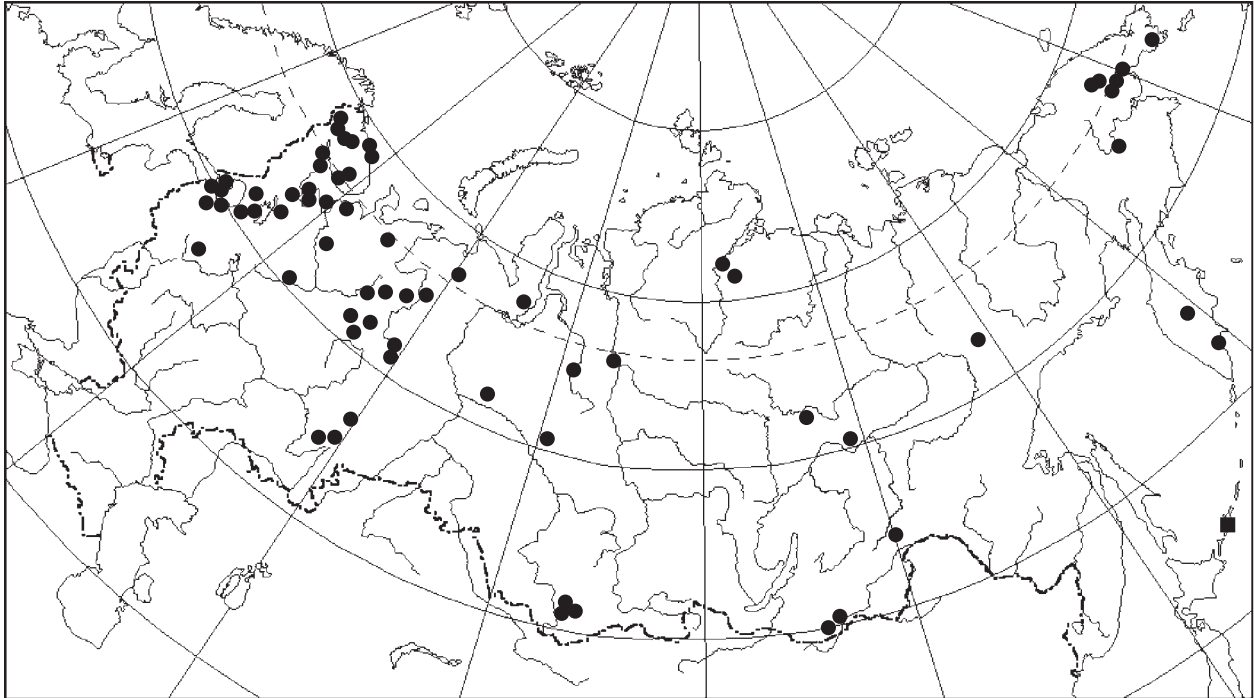


Fig. 5. Distribution of *Dichelyma falcatum* (Hedw.) Myrin (circles) and *D. japonicum* Card. (square) in Russia.

Distribution. *Dichelyma falcatum* has mainly montane distribution throughout Holarctic, with scattered localities in lowlands where it does not exceed boreal and southern arctic zone. It is the most widespread species of the genus, growing in North and Central America, in Eurasia penetrating to Mongolia and NW China and found also in Morocco in Africa. In Russia, it is not rare in Murmansk Province, Karelia, Leningrad and Arkhangelsk Provinces, Komi Republic, in mountains of southern Siberia and Chukotka; it was also collected sporadically in central part of European Russia (south to the Tver Province, while one record from Moscow Province by Ignatov & Ignatova (1990) was found to be erroneous), Urals, Western Siberia, Republic Sakha/Yakutia and Kamchatka.

Ecology. The species grows in running water and on temporary flooded banks of streams, rivers and lakes. It settles on rocks, roots of trees, pending branches of bushes, rotten trunks, rarely on soil. In North America, it is reported mainly from rocks, while in Russia it occupies more diverse habitats. It grows in pure mats or, rarely, mixed with other mosses, e.g. *Calliergon cordifolium* (Hedw.) Kindb., *Fontinalis antipyretica* Hedw., *Leptodictyum riparium*, *Scorpidium cossonii* (Schimp.) Hedenäs, *S. revolvens* (Sw. ex anon.) Rubers, *Sanionia uncinata*, *Sciuro-hypnum reflexum* (Starke) Ignatov & Huttunen, and *Scouleria aquatica* Hook.

Selected specimens examined: RUSSIA. EUROPEAN RUSSIA: Murmansk Province: Ponoj River, Kanevka, 16.VIII.1928, *Zinserling s.n.* (LE); Khibiny Mts, Ajkuajvenchjok River (KPABG); Kharlov Island, 5.VII.1965, *Breslina s.n.* (LE); Varzuga River, Vishennyj Island, 21.VIII.1999, *Belkina s.n.* (KPABG); Laplandsky Reserve, Sal'nye tundry, 20.VIII.2001,

Belkina s.n. (KPABG); Lovozersky Mts, 20.VIII.2001, *Belkina s.n.* (KPABG); Voron'ya River, 26.VIII.2004, *Belkina s.n.* (KPABG); Lavnatundra Mts, 2.VIII.1987, *Belkina s.n.* (KPABG); Kandalakshsky gulf, Por'ya bay, 19.VIII.1991, *Lichachev s.n.* (KPABG); **Karelia:** Belomorsk District, Nyuhcha River, 8.VII.1975, *Volkova s.n.* (LE); Muezersk District, Tiksha, 11.VIII.1970, *Volkova #99* (LE); Muezersk District, Sandal Lake, 24.VIII.1920, *Savicz #1208* (LE); Pudozh District, Vodlozero Lake, 18.VII.1977, *Volkova s.n.* (LE); Loukhi District, Kuonsu-Yarvi Lake, 13.VII.1978, *Volkova s.n.* (LE); Prionezhsky District, Petrozavodsk, 11.VI.1997, *Bakalin & Bakalina # 27* (LE); **Leningrad Province:** Karel'sky Isthmus, Roshchno, 9.IX.1954, *Abramov & Abramova s.n.* (LE); Vyborg District, Severnyj Berezovyy Island, 19.VII.2005, *Kurbatova s.n.* (LE); Tikhvin District, Kanzhaya River, 18.VIII.1997, *Kurbatova s.n.* (LE); Kingisepp District, Kopansky Peninsula, 13.IV.2007, *Kushnevskaya s.n.* (LE); Podporozhsky District, Yaroslavichi, 15.VI.2007, *Kurbatova s.n.* (LE); Luga District, Zhelezo, 24.VII.1972, *V'yunova #379* (LE); **Arkhangelsk Province:** Solovetskie Islands, 21.VII.1890, *Birulya s.n.* (LE); Kelda (Telda) River, Kuloj River basin, 23.VII.1932, *Korchagin s.n.* (LE); Nenetsky District, Pechora River, 12.VIII.1998, *Lavrinenko s.n.* (LE); Onezhsky District, Nizhmozero, 9.VII.2000, *Churakova #910* (MW); Primorsky District, Izhma River, 12.VI.2001, *Churakova #975* (MW); Onezhsky District, Ukhhta River, 9.VII.2000, *Churakova #125* (MW); Verkhnetoemsky District, Palen'ga River, 15.VIII.2000, *Churakova #1458* (MW); **Komi Republic:** Ust'-Tsilemsky District, Tsilma River, 6.VIII.1973, *Zheleznova #150* (SYKO); Izhma District, Sebys' River, 7.VII.2001, *Shubina #15* (SYKO); Uhtinsky District, Czuz'yu River, Chut'insky Reserve, 31.VII.2005, *Dulin #483* (SYKO); Ust'-Vymsky District, Vychegda River, 29.VII.1997, *Kustysheva #310* (SYKO); Ukhtinsky District, Vol' River, 13.VII.1982, *Zheleznova #833* (SYKO); Syktyvdinsky District, Vazh'el'yu River, 26.VI.2005, *Tetryuk #05-012* (SYKO); Syktyvdinsky District, Vychegda River, 26.VII.1998, *Dulin #25* (SYKO); Ust'-Kulomsky District, Nema

Table 1. Diagnostic characters of *Dichelyma* species known in Russia.

| species | <i>D. capillaceum</i> | <i>D. uncinatum</i> | <i>D. falcatum</i> | <i>D. japonicum</i> |
|-------------------------|------------------------------------------------------|---------------------------------------|-------------------------------------------|-------------------------------------------|
| leaves | linear-lanceolate, filiform-acuminate | linear-lanceolate, filiform-acuminate | lanceolate, acute to acuminate | ovate to lanceolate, obtuse to acute |
| leaf length, mm | 3.5-5.5 | 3.0-5.0 | 3.5-6.0 | 2.5-3.5 |
| leaf width, mm | 0.3-0.5 | 0.4-0.6 | 0.8-1.3 | 0.7-1.0 |
| ratio leaf length/width | 8-14: 1 | 6-10:1 | 4-6: 1 | 3-5:1 |
| nerve | excurrent 30-50% | excurrent 25-45% | percurrent to excurrent 3-10% | subpercurrent to percurrent |
| leaf arrangement | weakly 3-ranked | weakly 3-ranked | strongly 3-ranked | 3-ranked |
| leaf density | loose, stem often seen among leaves | loose, stem often seen among leaves | rather dense, stem invisible among leaves | rather dense, stem invisible among leaves |
| stem and branch tips | erect-spreading to | strongly falcato- | falcato-secund | erect-ascending |
| capsule | weakly falcato-secund immersed or laterally emergent | secund to circinate exerted | to erect-spreading exerted | to weakly falcato-secund exerted |

River, 6.VIII.1983, *Zheleznova* #909 (SYKO); North Ural, Daseyu River, 26.VII.1932, *Govorukhin* s.n. (MW); **Vologda Province**: Tot'ma District, Kamchuga River, 29.VII.1926, *Korchagin* s.n. (LE); **Tver Province**: Ostashkov District, Kamennoe Lake, 5.VI.1909, *Ramensky* s.n. (LE); **Perm Province**: Vishersky Nature Reserve, Lyp'ya River, 21.VI.1995, *Bezgodov* #234 (MW); Vishersky Nature Reserve, Vishera River, 30.VII.2009, *Bezgodov* #812 (MHA); **Bashkortostan Republic**: Beloretzk District, Malyi Iremel' Peak, 1.IX.1990, *Ignatova* s.n. (MW); Beloretzk District, Tyulyuchka River, 7.IX.1990, *Ignatova* #7/45 (MW); **Sverdlovsk Province**: Visimsky Nature Reserve, 20.VIII.1979, *Dyachenko* s.n. (MW); ASIAN RUSSIA: **Yamalo-Nenetsky Autonomous District**: Yamal Peninsula, Syunyaj-Sale, 29.VII.1996, *Czernyadjeva* & E.Yu. Kuzmina #34 (LE); Verkhnetazovsky Reserve, Kochepecha River, 10.VIII.1997, *Czernyadjeva* #21 (LE); **Khanty-Mansijsk Autonomous District**: Middle Ob River, Lower Sabun River, 20.VII.2000, *Czernyadjeva* & E.Yu. Kuzmina #118 (LE); Surgut District, Tro'egan River, 8.VII.2010, *Pisarenko* #op04241 (NS); eastern slope of Subpolar Ural Mts., Neroika, upper course of Kabyla-Yu Stream, 8.VIII.2013, *Lapshina* #55 (Herbarium of Yugorsky State University, duplicate in MHA). **Kemerovo Province**: Kuznetsky Alatau, Tserkovnoe Lake, 27.VIII.2003, *Pisarenko* #op00525 (NS); **Altai Republic**: Altajsky State Reserve, Karakem River, 16.VII.1989, *Ignatov* #0/1757 (MHA); Altajsky State Reserve, Shapshal Range, 26.VI.1990, *Zolotuhin* s.n. (MHA); Altajsky State Reserve, Kurkure Range, 7.VII.1991, *Ignatov* s.n. (MHA); Altajsky State Reserve, Kolbakaya Creek, 31.VII.1993, *Ignatov* #8/117 (MHA); **Taimyrsky Autonomous District**: Khatanga, 21.VII. 2011, *Fedosov* #11-653, 11-619, 11-715 (MW); Anabar-skoje Plateau, Kotujkan River, 22.VII.2007, *Fedosov* #07-197 (MW); **Krasnoyarsk Territory**: Kharutta River, 13.VII.1913, *Pole* s.n. (LE); **Yakutia**: Tomponsky District, Khatuma River, 19.V.1934, *Rabotnov* s.n. (LE); Olekminsky District, Kebekte River basin, 14.VII.1994, *Ivanova* #0033 (LE); Mirninsky District, Ulakhan-Botuobuja River, 16.VII.2006, *Ivanova* #17 (MW); **Zabaikal'sky Territory**: Durdul'ginsky District, "Alkhanaj" Nature Reserve, 21.VII.2005, *Afonina* #3905 (LE); Sokhondinsky Biosphere Reserve, Bukukun River, 21.VII.2008, *Afonina* #06508 (LE); Tungir River, 17.VII.1996, *Golyakov* s.n. (LE); **Kamchatsky Territory**: Middle Range, Esso, 4.VIII.2003, *Czer-*

nyadjeva #81 (LE); Petropavlovsk-Kamchatsky, Savoiko, 1.IX.1928, *Malaise* s.n. (LE); **Chukotsky Autonomous District**: Beringijsky District, Getlyanen River, 31.VII.1976, *Afonina* s.n. (LE); Anadyrsko-Koryaksky District, Onemen bay, 1.IX.1977, *Afonina* s.n. (LE); Anadyrsko-Koryaksky District, Belaya River, 1.VIII.1980, *Afonina* s.n. (LE); Anadyrsky District, Anadyr' River basin, Baran'e Lake, 4.VIII.1980, *Afonina* s.n. (LE); Anadyrsky District, Anadyr' River basin, Nanyuner River, 29.VII.1981, *Afonina* s.n. (LE); Anadyrsky District, Markovo, 8.VII.1933, *Vasil'ev* #1125 (LE).

Dichelyma japonicum Card., Soc. Bot. Genève sér. 2, 1: 132. 1909. — *Dichelyma hatakeyamae* Okam., Bot. Mag. Tokyo 25:137. 1911.

Fig. 5. Illustrations: Cherdantseva, 2010; <http://arctoa.ru/Flo- ra/taxonomy-ru/Dichelyma-ill.pdf>.

Plants moderate in size, irregularly and sparsely branched, yellowish, greenish, yellowish-brown to dark greyish-brown at base, glossy when dry. Stems to 5-10 cm, yellowish brown, brown to blackish, stem and branch tips erect-ascending to weakly falcate-secund. Leaves rather dense, making stem stem invisible, 3-ranked, erect-spreading, keeled, ovate to lanceolate, gradually narrowed, obtuse or acute, not or weakly decurrent, 2.5-3.5×0.7-1.0 mm, length/width ratio 3-5: 1; margin plane or narrowly recurved, entire in proximal part, serrulate to serrate distally; costa 40-60 µm wide at base, subpercurrent, percurrent or, rarely, ending well below leaf apex; median laminal cells 80-150×7-10 µm, linear, slightly flexuose, thin-walled, smooth, eporose, upper laminal cells shorter, basal laminal cells shorter and wider, incrassate and porose, alar cells not differentiated. Perichaetial leaves to 8 mm long, sheathing the setae, not covering the capsule. Seta to 8 mm. Capsule 2-3.5 mm long, oblong-cylindrical, exerted; operculum high conic; exostome teeth spiculose-papillose; endostome segments longer than exostome teeth, spiculose-papillose, trellis perfect. Spores 13-18 µm, minutely papillose.

Differentiation. Densely foliate shoots, 3-ranked, strongly keeled leaves with blunt apices and percurrent or ending below apex costa are diagnostic characters of *D. japonicum*. Two latter characters, as well as shorter leaves (see Table 1) separate the species from *D. falcatum*.

Distribution. Higuchi (2011) referred the species to endemics of Japan, where it grows on Hokkaido and Honshu, on tree trunk bases near water courses and lakes. It was recently found on Middle Kuril Islands, Iturup Island (Bakalin *et al.*, 2009; Cherdantseva, 2010).

Ecology. *D. japonicum* was collected on *Salix* trunk at lake bank, submerged in water.

Specimens examined: RUSSIA: Sakhalinskaya Province, Kuril'sky District, Iturup Island, 21.IX.2005, *Bakalin #64-5-05* (VLA).

JAPAN: Honshu Island, Gifu Prefecture, 19.VII.1973, *Ando s.n.* (LE); Honshu Island, Shiga Prefecture, 28.VIII.1972, *Nakajima #1216* (LE); Honshu Island, Niifata Prefecture, VIII.1949, *Ikegami #172* (LE).

ACKNOWLEDGMENTS

We wish to thank E.N. Andreeva and E.D. Lapshina for providing their specimens from Sankt-Petersburg and Khanty-Mansijsk Region respectively. The work was supported by the Russian Foundation for Basic Research, grant N 13-04-01427 and RAS Program "World Life: Current State and Development".

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