



JAFFUELIOBRYUM • INDUSIELLA

2. *Jaffueliobryum wrightii* (Sullivant) Thériot, Rev. Bryol., n. s. 1: 193. 1928 [F]



Coscinodon wrightii Sullivant, Musc. Hepat. U.S., 132. 1856

Plants in small dense cushions or turfs, yellow-green to dark olivaceous, hoary. **Stems** 5–15 mm, sparsely branched, julaceous. **Leaves** crowded, broadly oval to obovate, appressed-julaceous throughout stem, 0.4–0.9 mm

excluding awn, apex rounded-obtuse, lamina 1-stratose to rarely 2-stratose in bands, awn length highly variable, 0.2–1.3 mm, hyaline; costa in transverse-section flat, not keeled; proximal cells quadrate to short-rectangular, 12–25 × 10–15 µm, often appearing lax; mid leaf cells oval to irregularly rhomboidal, mostly 1.5–2:1 or more, 7–20 µm; distal cells longer, irregularly elongate-rhomboidal, somewhat hyaline. **Sexual condition** autoicous or sometimes cryptoicous; perichaetial leaf lamina to 1.3 mm, awn 1.2–2 mm. **Seta** 0.2–0.4 mm.

Capsule yellow-brown turning red-brown with age, ovoid, 0.7–1 mm; operculum short-rostrate, 0.4–0.5 mm.

Capsules mature spring–summer depending on elevation. Widespread and locally common on dry sandstone or limestone rock, rarely metamorphic rock, open arid to semi-arid shrub, woodland communities, grasslands; moderate to high elevations (typically below 2000 m but ranging from 200–2800 m); Alta.; Ariz., Calif., Colo., Iowa, Kans., Minn., Mont., Nebr., Nev., N.Mex., Okla., S.Dak., Tex., Wis., Wyo.; Mexico; South America (Bolivia); Asia (China, possibly Kazakhstan, Mongolia, Russia).

Jaffueliobryum wrightii is the most widespread species of the genus, extends farther south and west than *J. raii* in the flora area, and is typically found at somewhat lower elevations in drier and hotter regions than the latter. Because of its unusual disjunct distribution and its calciphile ecology, further studies using ecological, morphological, and DNA data would be of considerable interest. Like *J. raii*, this species also occurs in the Driftless Area of Iowa, Minnesota, and Wisconsin.

5. **INDUSIELLA** Brotherus & Müller Hal., Bot. Centralbl. 75: 322. 1898 • [Latin *indusium*, tunic, and *-ella*, diminutive, alluding to inrolled hyaline leaf margins]

Patricia M. Eckel

Plants (6.5–)7–9 mm, succulent, in dense cushions, brownish and translucent proximally, succulent, blackish green and opaque distally. **Leaves** ellipsoid-ligulate, leaf limb ligulate and tubulose-fistulose beyond a flat, flaring and sheathing base, apex cucullate-fistulose; lamina beyond the base spirally inrolled, 2-stratose except for a margin 2- or 1-stratose in several rows, adaxial cells and cells of inrolled margins thin-walled, hyaline, strongly chlorophyllose, mucous or minutely apiculate; basal cells heterogeneous, oblate, quadrate and short-rectangular, with straight, somewhat thinner walls than cells in the leaf limb; mid leaf and distal cells quadrate or rectangular, with straight, somewhat thick walls. **Gemmae** absent. **Sexual condition** autoicous; perichaetial leaves slightly enlarged. [**Seta** short, straight. **Capsule** erect, shortly exerted, symmetric, subglobose; annulus differentiated, of small non-vesciculate, quadrate, thin-walled cells, persistent; operculum long-rostrate, falling detached from the columella. **Calyptra** campanulate-mitrate, not erose, deeply lobed, large, covering the entire capsule, deeply plicate.]

Species 1: Alaska, Asia, Africa.

Affiliation of *Indusiella* with the Grimmiaceae is most evident in the large, campanulate-plicate calyptra and rather short, cribose peristome. The thickened transverse basal cell walls contrasted with the thinner longitudinal walls are typical of many species of *Grimmia*, though also of *Encalypta*. *Indusiella* is the only genus in the Grimmiaceae with specialized photosynthetic modifications in the leaf blade, although the family contains one other monotypic genus, *Aligrimmia* R. S. Williams of arid regions of Peru, with peculiar costal lamellae that apparently enhance photosynthetic capacity. Enhanced laminal photosynthetic tissue within rolled laminal margins is, however, also characteristic of a few species in the pottiaceous genera *Hilpertia*, *Pseudocrossidium*, and *Tortula*. Although the habit and leaf shape of *Indusiella* closely resemble those of *Aloina* and *Crossidium* in the Pottiaceae, it lacks the filaments on the adaxial surface of the costa that are characteristic of those genera. B. M. Murray (1984) discussed xeromorphic specializations of genera in both families as well as phytogeographic considerations relevant to a relict Beringian flora on slopes along the Yukon River basin along the Alaska-Canada border where the North American collection of *Indusiella* was made.

Indusiella is found in arctic-alpine, high altitude desert and steppe regions.

SELECTED REFERENCE Murray, B. M. 1984. A revision of the monotypic genera *Indusiella*, *Aligrimmia* and *Coscimodontella* (Musci: Grimmiaceae), with comments on convergent xeromorphological features. *Bryologist* 87: 24–36.

1. **Indusiella thianschanica** Brotherus & Müller Hal., Bot. Centralbl. 75: 322. 1898 [F]



Plants in dense dark brown to black cushions. **Stem** central strand strong, to $\frac{1}{3}$ stem diameter. **Leaves** 0.8–1 mm, apex obtuse to broadly acute, in section abaxial cells with thickened quasi-opaque external walls, basal lamina 1-stratose; largest distal leaves occasionally tipped with a hyaline

apiculus of one or two cells, often eroded; costa in section with adaxial hyaline cells somewhat larger and more

bulging than the semi-opaque thick-walled abaxial cells, costa with stereid cells present, two or more hydroids in the proximal leaf region, fewer to absent toward the apex; leaf cells smooth; basal cells with thicker transverse walls. **Sexual condition** autoicous; perigonia sessile, situated within the perichaetium projecting beyond the group of archegonia (synautoicous or cryptoicous), leaves short, suborbicular, broadly acuminate. **Seta** centrally attached, 0.7–1 mm. **Capsule** smooth (not plicate), composed of irregularly shaped thick-walled cells; peristome teeth erect, irregularly split in distal half into 2–3 filiform segments, irregularly perforate, spiculate, united at the base. **Spores** spherical, yellowish brown, 9–12 μm .

Mineral soil over calcareous sedimentary rock; moderate elevations (300[–5100] m); Alaska; Asia (Caucasus in Dagestan, China, Mongolia, Russia in Siberia); Africa (Chad).

Indusiella thianschanicais is found in arid situations, with the single North American specimen on thin, fine mineral soil over calcareous sedimentary rock.

15b. GRIMMIACEAE subfam. RACOMITRIOIDEAE Bednarek-Ochyra & Ochyra in R. Ochyra et al., Cens. Cat. Polish Mosses, 135. 2003

Ryszard Ochyra

Plants cladocarpous or rarely acrocarpous. **Stem** creeping, ascending, to erect, central strand absent. **Leaves** erect or spreading, straight or curved, sometimes recurved when wet, lanceolate to oblong-lanceolate, less often elliptic, ovate to lingulate, keeled to canaliculate-concave; margins recurved to revolute, entire or erose-dentate, serrate or cristate at the apex, costa rarely spurred or forked distally, sometimes ending in mid leaf, subpercurrent or excurrent, smooth or papillose, in transverse section reniform to elliptical, sometimes semi-terete or strongly flattened, with (2–) 3–15 adaxial cells near base, much larger than abaxial cells, often excurrent as an awn, awn smooth, or toothed or papillose or both; laminal cells smooth, pseudopapillose, or papillose; basal cells rectangular to linear, nodulose-porose, usually thick-walled, always with spiral thickenings forming a colored strip along the insertion; mid leaf cells quadrate to elongate, mostly strongly sinuose-nodulose. **Specialized asexual reproduction** very rare by gemmae arising from the base of the costa on the abaxial side. **Sexual condition** dioicous. **Seta** usually long, straight or rarely slightly arcuate, smooth or papillose, one to several per perichaetium; vaginula with sinuose-nodulose epidermal cells. **Capsule** erect, exserted, symmetric, ovoid, obloid to cylindric, usually smooth or obscurely striate; stomates present; annulus present, deciduous; operculum long-rostrate; peristome mostly with basal membrane and preperistome, equally thickened and weakly trabeculate both adaxially and abaxially, irregularly split into 2–3 branches to the middle or regularly divided into two filaments nearly to the base. **Calyptra** conic-mitrate, not plicate, often papillose at the apex, covering operculum to $\frac{1}{2}$ of capsule.

Genera 4, species ca. 75 (4 genera, 28 species in the flora): worldwide.

Subfamily Racomitrioideae is characterized by a *Racomitrium*-type peristome, consistently sinuose-nodulose walls of the laminal cells and epidermal cells of the vaginula, absence of stem central strand, non-plicate calyptrae, and cladocarpous arrangement of the perichaetia. Taxa belonging to this subfamily have sometimes been associated with *Ptychomitrium* and *Campylostelium*, and placed in the subfamily Ptychomitrioideae in the Grimmiaceae. Despite their overall morphological similarity, these taxa seem to be only remotely related. In *Ptychomitrium* the laminal cell walls are straight or weakly sinuose, the calyptrae deeply plicate, and the plants acrocarpous. In addition, the preperistome is absent, and the peristome teeth lack trabeculae and have a characteristic air gap at their base. Moreover, *Ptychomitrium* is cryptoicous because the male branches are small and arise from the base of vaginula inside the perichaetial leaf circle. The Racomitrioideae consists of four genera that are segregates from the large and heterogeneous *Racomitrium* in the broad sense.

SELECTED REFERENCES Allen, B. H. 1994b. The Grimmiaceae (Musci) in Maine. III. *Racomitrium*. *Evansia* 11: 41–54. Frye, T. C. 1917–1918. The rhacomitriums of western North America. *Bryologist* 20: 91–98; 21: 1–16. Lawton, E. 1972. The genus *Rhacomitrium* in America and Japan. *J. Hattori Bot. Lab.* 35: 252–262.

1. Laminal cells smooth or pseudopapillose; peristome teeth short, divided to the middle, rarely deeper, into 2–3 irregular prongs 6. *Bucklandiella*, p. 267
1. Laminal cells papillose; peristome teeth long, split at least to the middle into 2(–3) filiform, ± regular filaments.
 2. Laminal cells with tall, conical papillae situated over the lumina; alar cells hyaline or yellowish hyaline, thin-walled, forming prominent, decurrent auricles 7. *Niphotrichum*, p. 285
 2. Laminal cells with large, flat papillae situated over the longitudinal walls; alar cells absent or distinct, brown to yellowish orange, not hyaline, thick-walled.
 3. Hyaline hair-point always present, usually long, strongly papillose eroso-dentate, long decurrent down the leaf margins; seta papillose, sinistrorse when dry; costa percurrent, unbranched; capsule slightly ventricose at base; calyptra smooth or minutely roughened 8. *Racomitrium*, p. 293
 3. Hyaline hair-point absent or present, rarely long, smooth to denticulate, never papillose or decurrent; seta smooth, dextrorse when dry (in *C. fascicularis* and *C. corrugatus* only once twisted to the left immediately below the capsule and proximally twisted to the left); costa ending well before the apex, often branched and spurred distally; capsule never bulging at base; calyptra distinctly verrucose to papillose 9. *Codriophorus*, p. 295

6. BUCKLANDIELLA Roivainen, Ann. Bot. Fenn. 9: 116. 1972 • [From Monte Buckland, mountain of Isla Grande de Tierra del Fuego, name commemorating William Buckland, 1784–1856, geologist, canon of Christ Church, Oxford, dean of Westminster from 1845, and Latin *-ella*, diminutive]

Ryszard Ochyra

Halina Bednarek-Ochyra

Bucklandia Roivainen, Suom. Elain-ja Kasvit. Seuran Van. Tiedon. 9: 98, figs. 1, 2. 1955 not Sternber 1825; *Dryptodon* subg. *Ellipticodryptodon* Vilhelm; *Racomitrium* sect. *Ellipticodryptodon* (Vilhelm) Ochyra, Sérgio & Schumacker; *Racomitrium* subg. *Ellipticodryptodon* (Vilhelm) Bednarek-Ochyra & Ochyra; *Racomitrium* subg. *Microcarpa* Vilhelm

Plants small to large, in loose or compact tufts or forming extensive patches or mats, green, brown, yellowish, olive green, less often blackish brown or occasionally jet-black. **Stems** erect, decumbent or creeping, much dichotomously to irregularly, sometimes (sub-)pinnately branched, rarely almost simple and unbranched. **Leaves** lanceolate, oblong- or ovate-lanceolate, concave proximally, canaliculate to carinate distally; margins 1-stratose to variously multistratose, variously recurved to revolute on one or both sides, entire; apices acute or occasionally narrowly obtuse, entire or very seldom crenulate, long-piliferous to short-hyaline-tipped or sometimes epilose, if present, hyaline to yellowish hyaline, never papillose; costa single, percurrent, semi-terete in the distal and median parts, reniform to strongly flattened in the proximal portion, 2- to multistratose, with 2 to many enlarged, adaxial epidermal cells and small, substereid or stereid central and abaxial cells; laminal cells 1-stratose throughout or variously multistratose in the distal half, with moderately to strongly incrassate, sinuose to nodulose lateral walls, smooth or often pseudopapillose; basal laminal cells elongate, long-rectangular to linear; distal laminal cells

quadrate, rounded-quadrate, oblate to rectangular. **Inner perichaetial leaves** not or strongly modified, often entirely hyaline to yellowish hyaline. **Seta** 1–3 per perichaetium, erect, twisted clockwise distally, smooth. **Capsule** brown, castaneous or blackish brown, straight, symmetric, ovoid, ellipsoid, obloid to narrowly cylindrical, narrowed at the mouth, without or with an indistinct neck; exothecial cells variable in size and shape, subquadrate to oblong, with thin to thick, straight or flexuose walls; annulus compound, abruptly or tardily deciduous, 2–4-seriate; operculum straight or slanted, conic-rostrate or long-rostellate; peristome teeth lanceolate to triangular, reddish brown or brown, cleft into 2–3 filiform, terete prongs in the distal half, occasionally 2-fid nearly to the base. **Calyptra** 4–5-lobed at the base, naked. **Spores** spheric, finely granular to coarsely papillose.

Species ca. 50 (12 in the flora): North America, Central America, South America, Eurasia, Africa, Atlantic Islands, Pacific Islands, Australia, Antarctica.

Bucklandiella is the largest and taxonomically most difficult segregate of a broadly conceived *Racomitrium*. It is a clearly defined and easily recognized taxon that, in contrast to the other three segregates of *Racomitrium*, comprises taxa with smooth laminal cells. There may be pseudopapillae, due to numerous longitudinal cuticular ridges that make the leaf surface rugged and appear papillose in transverse-section. The smooth laminal cells are coupled with relatively short, lanceolate or triangular peristome teeth, which are irregularly divided in the distal half into 2–3 or occasionally 4 branches, which however, are sometimes only irregularly perforated along the median line. In some cases the teeth remain undivided. Additionally, the following combination of characters is typical of this genus: narrowly lanceolate to ovate-triangular leaves; unbranched, percurrent costa; awns, if present, smooth, denticulate, or spinulose but never papillose; leaf margins 1–2(–4)-stratose in one to several cell rows; and seta always smooth, twisted to the right when dry.

SELECTED REFERENCE Frisvoll, A. A. 1988. A taxonomic revision of the *Racomitrium heterostichum* group (Bryophyta, Grimmiaceae) in N. and C. America, N. Africa, Europe and Asia. *Gunneria* 59.

1. Leaves noticeably spiral-ranked around the stem when dry; perichaetia and sporophyte unknown 6a. *Bucklandiella* sect. *Marginatae* (in part), p. 270
1. Leaves never spiral-ranked when dry; perichaetia and sporophyte known.
 2. Innermost perichaetial leaves similar to the vegetative leaves, moderately sheathing proximally, chlorophyllose, acuminate and piliferous distally; leaf awn erect-recurved to squarrose, not flexuose when dry.
 3. Large, yellow-olivaceous plants usually with a long awn, awn long-decurrent 6c. *Bucklandiella* sect. *Lawtonia*, p. 278
 3. Smaller, greenish or brownish plants with a short awn, awn not or only slightly decurrent 6d. *Bucklandiella* sect. *Sudeticae*, p. 280
 2. Innermost perichaetial leaves not similar to the vegetative leaves, sheathing, obtuse, not or shortly apiculate, occasionally with a short awn but then the basal leaf cells with incrassate, porose and nodulose lateral walls; leaf awn erect, usually strongly flexuose when dry.
 4. Innermost perichaetial leaves hyaline proximally, fairly large, chlorophyllose distally with an areolation of cells with strongly incrassate walls; basal leaf cells not sinuose, with nodulose, porose and strongly incrassate walls 6a. *Bucklandiella* sect. *Marginatae* (in part), p. 270
 4. Innermost perichaetial leaves hyaline or yellowish hyaline throughout, often fairly small; basal leaf cells sinuose 6b. *Bucklandiella* sect. *Laevifoliae*, p. 273

Alternative key emphasizing gametophyte traits

1. Leaves epilose, with chlorophyllose apex and without any trace of a hyaline or subhyaline awn.
 2. Leaves spirally arranged around the stem 2. *Bucklandiella afoninae*
 2. Leaves never spirally arranged.
 3. Leaves crisped when dry; margin 2-stratose to the base for 2–4 cell rows; plants often reddish brown 10. *Bucklandiella macounii* (in part)
 3. Leaves erect-appressed when dry; margins often 1-stratose or at most 2-stratose for 1–3 cell rows in the distal portion; plants not reddish brown.
 4. Leaf apex broadly rounded and crenulate; margin shortly recurved and often plane or nearly so on one side, 1-stratose 6. *Bucklandiella pacifica*
 4. Leaf apex narrowly rounded and never crenulate; margins recurved on both sides towards the apex, or less recurved but then leaf apex narrow, often 2-stratose.
 5. Leaf narrow with a strongly convex costa on the abaxial side towards the apex; margin recurved to $\frac{1}{2}$ (– $\frac{3}{4}$) the leaf length on one side and more shortly recurved to plane on the other; innermost perichaetial leaves slightly differentiated 12. *Bucklandiella sudetica* (in part)
 5. Leaf broader with a less convex costa on the abaxial side towards the apex; margin recurved towards the apex; innermost perichaetial leaves hyaline.
 6. Leaf margin smooth, 1-stratose or in part 2-stratose distally, costa medium broad, 80–100 μm , and (3–)4-stratose basally 3. *Bucklandiella affinis* (in part)
 6. Leaf margin lumpy, usually 2-stratose for 1–3 cell rows distally; costa narrow, 50–80 μm , and usually 3-stratose basally . . . 7. *Bucklandiella venusta* (in part)
 1. At least some leaves with a short or long, hyaline to subhyaline awn.
 7. Costa grooved and winged on the abaxial side, asymmetric in outline; awns terete, sharply spinulose 11. *Bucklandiella occidentalis*
 7. Costa symmetric in outline, not furrowed and winged abaxially; awns not terete, less strongly spinulose.
 8. Leaf margins regularly 2(–3)-stratose for 2–4(–6) cell rows; costa predominantly 4-stratose basally; awns short, to 0.2 mm, yellowish or reddish hyaline; plants mostly reddish brown 10. *Bucklandiella macounii* (in part)
 8. Leaf margins 1–2-stratose for 1 cell row or occasionally 2(–3)-stratose for 2(–3) cell rows; costa predominantly (2–)3(–4)-stratose basally; awns longer, hyaline; plants never reddish brown.
 9. Basal leaf cells with nodulose, porose and strongly incrassate lateral walls; costa with 3–4 enlarged adaxial cells in the basal portion 1. *Bucklandiella microcarpa*
 9. Basal leaf cells with nodulose-sinuose, less thick-walled and porose lateral walls; costa with 5 or more adaxial cells near the base.
 10. Costa broadly canaliculate with 4–9 adaxial cells and moderately convex abaxially in mid leaf.
 11. Costa very broad, 70–90 μm , with 5–8 adaxial cells in the distal part; awns coarsely and sharply spinulose and denticulate; laminal cells prominently pseudopapillose; innermost perichaetial leaves weakly differentiated, piliferous 9. *Bucklandiella brevipes*
 11. Costa narrower, less than 75 μm , with 2–4 adaxial cells in the distal part; awns not or less denticulate and spinulose; laminal cells smooth or moderately pseudopapillose; innermost perichaetial leaves strongly

- differentiated.
12. Leaf margin 1-stratose with some 2-stratose patches in the distal part, smooth; awns soft and usually flexuose; plants less robust, usually much branched 4. *Bucklandiella heterosticha* (in part)
12. Leaf margin 2-stratose for 1–3 cell rows, lumpy distally; awns stiff, not flexuose; plants coarse and robust, sparsely branched 5. *Bucklandiella obesa* (in part)
- [10. Shifted to left margin.—Ed.]
10. Costa not or less obviously canaliculate with 3–4 adaxial cells and strongly convex abaxially in mid leaf.
13. Leaf margin recurved to about $\frac{1}{2}$ (– $\frac{3}{4}$) the leaf length on one side and shorter to nearly plane on the other side; awns erect-recurved to squarrose when dry.
14. Awns broad and long, 0.5–1.5 mm, decurrent down the leaf margins; leaves long, (3.5–)4–5.5(–6) mm; robust plants 8. *Bucklandiella lawtoniae*
14. Awns narrow and short, to 0.4 mm but usually shorter, not decurrent; leaves short, less than 3 mm; small to medium-sized, seldom moderately robust plants 12. *Bucklandiella sudetica* (in part)
13. Leaf margin recurved to the apex or occasionally shorter on one side; awns frequently straight when dry.
15. Leaf margin lumpy, mostly 2-stratose for 1–2(–3) cell rows distally; awns stout, not or weakly flexuose and strongly spinulose.
16. Plant robust; costa broad, 85–120 μ m, with 4–9 adaxial cells in the base; leaves 3–4 \times 0.7–1 mm 5. *Bucklandiella obesa* (in part)
16. Plant small to medium-sized; costa narrow, 50–80 μ m with 3–5 adaxial cells in the base; leaves 1.7–2.4 \times 0.5–0.7 mm 7. *Bucklandiella venusta* (in part)
15. Leaf margin smooth or nearly so, usually 1-stratose, occasionally 1(–2)-stratose for 1(–2) cell rows distally; awns soft, flexuose and weakly spinulose.
17. Costa carinate and predominantly 3-stratose in the distal and medial parts 3. *Bucklandiella affinis* (in part)
17. Costa canaliculate and predominantly 2-stratose in the distal and medial parts 4. *Bucklandiella heterosticha* (in part)

6a. BUCKLANDIELLA Roivainen sect. MARGINATAE (Bednarek-Ochyra) Bednarek-Ochyra & Ochyra in R. Ochyra et al., Cens. Cat. Polish Mosses, 143. 2003

Racomitrium sect. *Marginata* Bednarek-Ochyra, Fragm. Florist. Geobot., Ser. Polon. 2: 175. 1995

Plants small, medium-sized to large, fairly slender to coarse, sometimes hoary. **Stems** prostrate, curved-ascending to erect, 1–15 cm, often copiously pinnately or intricately branched. **Leaves** lanceolate, straight to falcate, piliferous or muticous; hair-point often long, strongly flexuose; margins usually recurved on both sides to $\frac{1}{2}$ – $\frac{3}{4}$ of the leaf length, rarely to the apex, 1–2-stratose; costa 2–3-stratose in the proximal part; laminal cells long-rectangular in the distal half, esinuose, porose and with strongly incrassate walls near the base; basal marginal border present, composed of transparent cells. **Innermost perichaetial leaves** strongly differentiated, hyaline proximally, chlorophyllose distally with areolation of cells with strongly incrassate walls, epilose or rarely piliferous.

Species ca. 10 (2 in the flora): North America, Central America, South America, Eurasia, Africa, Atlantic Islands, Indian Ocean Islands, Pacific Islands, Australia, Antarctica.

Section *Marginatae* is a sharply delimited taxon characterized primarily by strongly modified innermost perichaetial leaves that have the areolation in the distal half composed of cells with strongly incrassate walls. Additionally, the basal cells of vegetative leaves are esinuose with markedly incrassate lateral walls, the distal cells tend to be elongate, and the basal marginal border is present and is composed of pellucid, esinuose cells.

1. Leaves often secund, not spirally arranged; basal marginal border composed of quadrate to short-rectangular cells, esinuose or very seldom sinuose; hair-point mostly present, 0.3–1.1 mm, capillaceous, flexuose, sharply denticulate 1. *Bucklandiella microcarpa*
1. Leaves straight, spirally twisted around the stem; basal marginal border composed of long-rectangular to linear cells; hair-point absent or short, to 0.4 mm, stout, straight, nodulose-denticulate 2. *Bucklandiella afoninae*

1. ***Bucklandiella microcarpa*** (Hedwig) Bednarek-Ochyra & Ochyra in R. Ochyra et al., Cens. Cat. Polish Mosses, 146. 2003



Trichostomum microcarpon
Hedwig, Sp. Musc. Frond., 112,
plate 23, figs. 8–12. 1801;
Racomitrium canadense (Michaux)
Bridel; *R. heterostichum* var.
microcarpon (Hedwig) Boulay;
R. heterostichum var. *ramulosum*;
(Lindberg) G. N. Jones;
R. microcarpon (Hedwig) Bridel;

Trichostomum canadense Michaux

Plants small to medium-sized, rarely fairly large, forming loose or dense tufts or mats, green, yellowish or olive green to light yellowish or sometimes grayish in the upper part, brown to blackish proximally, not or hoary. **Stems** prostrate to erect-ascending, (1–)2–4(–7) cm, copiously branched, mostly with short lateral, tuft-like subpinnate branchlets giving the plants a nodose appearance. **Leaves** loosely imbricate and often secund on drying, erect-spreading to recurved when moist, (1.5–)2–3.4(–3.8) × (0.4–)0.5–0.7(–0.8) mm, keeled in the distal part, narrowly canaliculate basally, piliferous or seldom epilose; hair-point erect, hyaline, capillaceous, flexuose, 0.3–0.7(–1.1) mm, not or slightly decurrent down the leaf margins; margins broadly recurved to revolute on one or both sides for $\frac{1}{2}$ – $\frac{3}{4}$ the leaf length, rarely to the apex, 1-stratose throughout, sometimes with 2-stratose patches; costa percurrent, convex abaxially, (50–)60–80 (–100) μ m wide near the base, (35–)40–55 μ m wide distally, 2–3-stratose basally with (2–)3–4(–5) markedly enlarged adaxial cells, 2–3-stratose in the middle with 2–3(–4) large adaxial cells and 2-stratose distally with (1–)2(–3) adaxial cells; laminal cells 1-stratose, smooth or often strongly pseudopapillose; distal and median cells strongly sinuose, rectangular, 20–30 × 9–10 μ m, becoming shorter or oblate towards the margins; basal

cells elongate to linear, 25–95 × 8–12 μ m, with strongly incrassate and porose walls; alar cells not or weakly differentiated; basal marginal cells quadrate to short-rectangular, rarely long-rectangular, esinuose or very seldom sinuose, hyaline or very rarely chlorophyllose, forming pellucid, 1(–2)-seriate border of (5–)10–20(–25) cells, very occasionally not transparent. **Innermost perichaetial leaves** (4–6), markedly modified, ovate, acuminate, epilose or very seldom piliferous, hyaline to yellowish hyaline in the proximal half, chlorophyllose in the distal half with strongly incrassate cell walls. **Seta** dark red to reddish brown, (2.5–)4.5–8 mm. **Capsule** obloid-cylindric to elongate-ovoid, (1.2–)1.5–2 × 0.3–0.6 mm, brown, dull to weakly lustrous; peristome teeth yellow-reddish, 310–350 μ m, papillose, irregularly divided nearly to the base into 2 prongs, sometimes only with elongate perforations, without or with a low basal membrane, 10–15 μ m high. **Operculum** conical-rostrate, to 1 mm, with a straight or slanted beak. **Spores** (10–)12–14(–16) μ m.

Acidic rocks, boulders and cliffs, as well as on soil or gravel, often in late snow areas, on stony mossy tundra, stony slopes and granite rock underhangs on talus slopes, mostly in exposed, dry or moist sites; low to high elevations (0–1700 m); Greenland; B.C., N.B., Nfld. and Labr., N.S., Ont., Que., Yukon; Alaska, Maine, Minn., Mont., N.H., N.J., N.Y., Vt., Wash.; Europe; arctic, temperate Asia.

Bucklandiella microcarpa is a temperate moss, occasionally penetrating into the Arctic. It has a bicentric distribution in North America, being most common and widespread in the eastern part of the continent and less frequent in the west, where it occurs mostly in the Rocky Mountains from the Yukon to Montana. It is principally a Euro-American species, with some scattered records in Siberia. In Europe it shows distinct continental tendencies and is absent from the oceanic western part, including the British Isles.

Bucklandiella microcarpa is an unmistakable species that is at once distinct from other North American congeners by its long, pellucid basal marginal border of esinuose cells and markedly modified innermost perichaetial leaves, with chlorophyllose distal cells having strongly incrassate walls and basal laminal cells that are esinuose and have porose and prominently thickened lateral walls. Also, it is worth noting that the laminal cells are usually pseudopapillose in *B. microcarpa* and the pseudopapillosity is especially pronounced in the western North American populations.

Bucklandiella microcarpa resembles *B. affinis*, *B. heterosticha*, *B. sudetica*, and *B. venusta* in leaf shape and in having pilose leaves. The first two species are also similar in having typically 1-stratose leaf margins. In addition to their less well developed or absent basal marginal border, these species differ from *B. microcarpa* in having broader costae: 80–100 μm versus 60–80 μm in the proximal portion. *Bucklandiella sudetica* and *B. venusta* also differ from *B. microcarpa* in having regularly 2-stratose leaf margins. In Alaska, *B. microcarpa* is likely to be mistaken with *Dryptodon jacuticus* (= *Grimmia leibergii*), which has long-pilose leaves and similar costal anatomy, with 3–4 much enlarged adaxial cells. However, *D. jacuticus* has 2-stratose leaf margins and subquadrate to short-rectangular laminal cells in the distal part, straight or only slightly flexuose hair-points, and undifferentiated basal marginal cells.

2. *Bucklandiella afoninae* (Frisvoll) Bednarek-Ochyra & Ochyra in R. Ochyra et al., Cens. Cat. Polish Mosses, 144. 2003 ☐



Racomitrium afoninae Frisvoll, J. Bryol. 15: 275, figs. 1, 2. 1988

Plants fairly large, rather coarse, densely caespitose, olive green distally, brownish or blackish proximally. **Stems** erect-ascending, 2–5 cm, moderately, irregularly branched. **Leaves** loosely appressed, spirally twisted

around the stem or somewhat contorted when dry, erect-spreading when moist, lanceolate, (2–)2.3–2.7(–2.9) \times 0.5–0.6 mm, muticous or with a short, to 0.4 mm, hyaline, bluntly denticulate to crenulate hair-point; margins broadly recurved to mid-leaf or $\frac{3}{4}$ way up the leaf on one side, plane or narrowly recurved in the broadest part on the other side, variously 1–2-stratose in 1 cell row distally; costa percurrent, 80–90 μm wide basally, 55–75 μm wide distally, strongly convex on the abaxial side, 3-stratose in the base with 4(–5) enlarged adaxial cells, 3–4-stratose in the middle with 3–4 large adaxial cells and 2–3-stratose distally with 2 adaxial cells; laminal cells 1-stratose with occasional 2-stratose patched near the apex, smooth or slightly pseudopapillose; distal and median cells rectangular, 25–50 \times 10–12 μm , strongly sinuose-nodulose and thick-walled; basal cells long-rectangular to linear, 50–90 \times 10–12 μm , with strongly porose and incrassate lateral walls, to 7 μm thick; alar cells undifferentiated; basal marginal cells esinuose, moderately thick-walled, long-rectangular to linear, 50–100 \times 5–8 μm , hyaline, forming a transparent border extending to the broadest part of the leaf. Sterile.

Rocky ground in tundra; of conservation concern; Alaska; n Asia (Chukotka).

Bucklandiella afoninae is the rarest species of the genus, known in the flora area only from a single site from western Alaska (Seaward Peninsula), which corresponds to several localities of the species in Chukotka in arctic Russia. Although it is known only in the barren state, it fits well into the concept of sect. *Marginatae* on account of its linear basal cells with strongly incrassate and porose longitudinal walls, and the presence of a distinct basal marginal border that is composed of exceptionally long, mostly linear cells. Such leaf border is unknown in any other species of the genus in the flora area. The other exceptional character of this species is spirally twisted leaves, and such leaf arrangement is known only in two austral species of *Bucklandiella*, *B. emersa* and *B. rupestris*.

6b. BUCKLANDIELLA sect. LAEVIFOLIAE (Kindberg) Bednarek-Ochyra & Ochyra in R. Ochyra et al., Cens. Cat. Polish Mosses, 142. 2003

Racomitrium [unranked] *Laevifolia* Kindberg, Eur. N. Amer. Bryin., 235. 1898; *Racomitrium* sect. *Laevifolia* (Kindberg) Noguchi

Plants moderately sized to large, fairly slender to coarse and rigid, often hoary. **Stems** 1–12 cm long, creeping, curved-ascending to erect, sparingly or profusely branched. **Leaves** lanceolate, straight to strongly curved; margins recurved to revolute on both sides to the apex, or less often to $2/3$ – $3/4$ of the leaf length, 1-stratose or less often 2-stratose; mucous or piliferous, awns often long, erect, flexuose, flattened, distantly denticulate at the margins and sometimes spinulose on the abaxial side; costa 3–4-stratose and strongly convex abaxially in the proximal portion; alar cells undifferentiated; basal marginal border absent. **Inner perichaetial leaves** strongly modified, hyaline and epilose, or very seldom shortly piliferous and then chlorophyllose close to the apex. **Peristome teeth** with a basal membrane.

Species 7 (5 in the flora): North America, Europe, Atlantic Islands (Azores, Canary Islands, Iceland, Madeira).

The strongly differentiated innermost perichaetial bracts that are ovate, epilose, and hyaline to yellowish hyaline throughout are diagnostic of section *Laevifoliae*. This is a Euro-American taxon consisting of two species that are endemic to Europe, three endemic to North America, and two that are Euro-American disjuncts.

1. Leaves epilose, with a chlorophyllose apex, awns absent.
 2. Leaf margins recurved to $2/3$ – $3/4$ of the leaf length; alar cells differentiated, short, thick-walled and porose, forming a well-defined, sometimes auriculate group 6. *Bucklandiella pacifica*
 2. Leaf margins recurved to revolute to the apex; alar cells not or weakly differentiated.
 3. Leaf margins 1-stratose, occasionally with 2-stratose patches and smooth in the distal part; costa broader, 80–100 μm , and mostly (3–)4-stratose basally (epilose plants) 3. *Bucklandiella affinis* (in part)
 3. Leaf margins usually 2-stratose for 1–3 cell rows, wavy and lumpy in the distal part; costa narrow, 50–80 μm , and usually 3-stratose basally (epilose plants) 7. *Bucklandiella venusta* (in part)
1. At least some leaves with a short or long, hyaline to subhyaline awn.
 4. Costa broadly canaliculate in mid leaf, moderately convex on the abaxial side and with 4–9 cells on the adaxial side.
 5. Plants moderately robust and less coarse; leaf margins 1-stratose with infrequent 2-stratose patches and smooth distally; awns weakly flexuose 4. *Bucklandiella heterosticha* (in part)
 5. Plants coarse and robust; leaf margins 2-stratose for 1–3 cell rows and lumpy distally, broadly recurved to revolute throughout; awns stiff, not flexuose 5. *Bucklandiella obesa* (in part)
 4. Costa narrowly canaliculate or carinate in mid leaf, strongly convex on the abaxial side and with 3–4 adaxial cells.
 6. Leaf margins usually 2-stratose for 1–2(–3) cell rows and lumpy in the distal portion; awns stout, not or weakly flexuose, strongly spinulose.
 7. Plants robust, almost unbranched; costa broad, 80–120 μm with 4–9 adaxial cells in the basal portion; leaves long, 3–4 mm 5. *Bucklandiella obesa* (in part)
 7. Plants small to medium-sized, copiously branched; costa narrow, 50–80 μm with 3–5 adaxial cells in the basal portion; leaves short, 1.7–2.4 mm 7. *Bucklandiella venusta* (in part)
 6. Leaf margins usually 1-stratose with occasional 2-stratose spots and not lumpy distally; awns soft, usually flexuose and faintly spinulose.