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Bucklandiella angustissima sp. nov. (Grimmiaceae), a new austral amphipacific species with the smallest capsules and the shortest setae in the genus

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Abstract — *Bucklandiella angustissima* Bednarek-Ochyra *et* Ochyra is described as a new species. It is known in Australasia from the southern cool-temperate zone of the South Island of New Zealand and its offshore islands including the Auckland and Campbell Islands, as well as subantarctic Macquarie Island, and in South America from the northern Andes of Ecuador. The new species belongs to *Bucklandiella* Roiv. sect. *Emersae* (Bednarek-Ochyra) Bednarek-Ochyra *et* Ochyra and is allied to Australasian *B. emersa* (Müll. Hal.) Bednarek-Ochyra *et* Ochyra. It is a saxicole readily distinguished from all its congeners in having very small, subglobose to ovoid or obloid capsules, 0.5-0.8 mm long, on fairly stout and very short setae, only 0.8-1.2 mm. These are the smallest capsules and the shortest setae in the large genus *Bucklandiella*. Additionally, the species has very short peristome teeth, 200-220 µm long, and a very narrow costa, 40-60 µm wide, with only two enlarged adaxial epidermal cells throughout its entire length. The taxonomic status of *Racomitrium crispipilum* (Taylor) A. Jaeger var. *brevifolium* Thér., which is known only in sterile condition from a single altimontane site in Ecuador, is briefly assessed and this variety is considered to be identical to *Bucklandiella angustissima*. Five new combinations are made: *Bucklandiella* subsect. *Andicola* (Bednarek-Ochyra) Bednarek-Ochyra *et* Ochyra, *B.* subsect. *Depressae* (Bednarek-Ochyra) Bednarek-Ochyra *et* Ochyra, *B. depressa* (Lesq.) Bednarek-Ochyra *et* Ochyra, *B. dichelymoides* (Herzog) Bednarek-Ochyra *et* Ochyra, and *B. subcrispipila* (Müll. Hal.) Bednarek-Ochyra *et* Ochyra. The latter name is neotypified.

Auckland Islands / Australasia / Bryophyta / Campbell Islands / distribution / Ecuador / Macquarie Island / New Zealand / nomenclature / *Racomitrium* / South America / Subantarctica / taxonomy

INTRODUCTION

During ongoing monographic studies of the genus *Bucklandiella* Roiv., the largest segregate of the traditionally conceived genus *Racomitrium* Brid. (Ochyra *et al.*, 2003), our attention was drawn to several plants from the South Island of New Zealand and its offshore islands in the southern cool-temperate zone (Auckland and Campbell Islands) and the Subantarctic (Macquarie Island). They differed from all other known *Bucklandiella* species in having exceptionally small capsules, less than one millimetre long, on exceedingly short setae, to

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1.2 mm long. These unique sporophyte features are coupled with a peculiar anatomy of the costa which, as seen in transverse section, consists of only two large adaxial epidermal cells throughout its whole length from the leaf apex to the leaf base. This combination of both sporophyte and gametophyte traits is unknown in any other species of *Bucklandiella* and warrants recognition of these populations as a new species, *B. angustissima*, whose epithet refers to a narrow costa.

The only known taxon in the Southern Hemisphere which exhibits a similar structure of the costa is *Racomitrium crispipilum* (Taylor) A.Jaeger var. *brevifolium* Thér. It was described from a single collection from the summit area of Mt. Pichincha in the northern Andes of Ecuador (Thériot, 1936). This taxon matches well the Australasian plants of *Bucklandiella angustissima*, except for the smaller size of the leaves, a feature which is unlikely to give rise to any problems of identification. However, the Andean material is entirely sterile and lacks sporophyte characters which are critical for the thorough definition of the new species. Therefore, we prefer to describe this new taxon on the basis of the complete Australasian material which bears both gametophyte and sporophyte characters, rather than elevate *R. crispipilum* var. *brevifolium* to species rank. The latter is based upon sterile material from well outside the area in which the species has optimum occurrence but looks as though it might represent the same species. This solution is not in conflict with the Recommendation 24B.2 of the current Code (McNeill et al., 2006) which addresses the situation in which a varietal epithet has wide currency and should be retained when a variety is raised to species rank.

DESCRIPTION

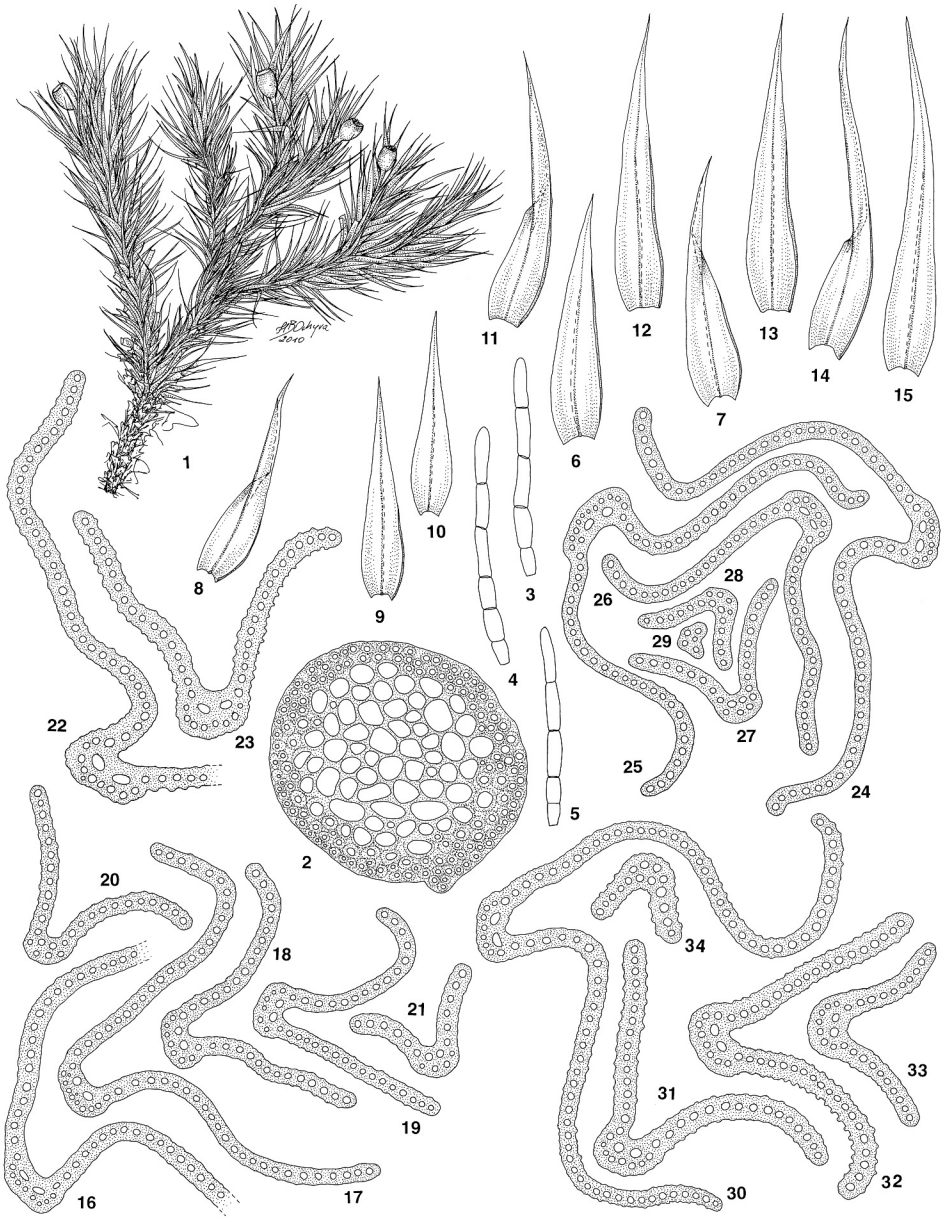
Bucklandiella angustissima* Bednarek-Ochyra *et* Ochyra, *sp. nov. **Figs 1-70**

Diagnosis — *Species haec* Bucklandiellae emerso *proxima, sed ab eo recedit setis perbrevibus, 0.8-1.2 mm longis, capsulis minutissimis, subglobosis vel obloidis, 0.5-0.8 mm longis, dentibus peristomii brevissimis, indivisis vel irregulariter divisis, 200-220 µm longis et costis angustioribus, duobus cellulis magnis ventralibus per totam longitudinem praeditis.*

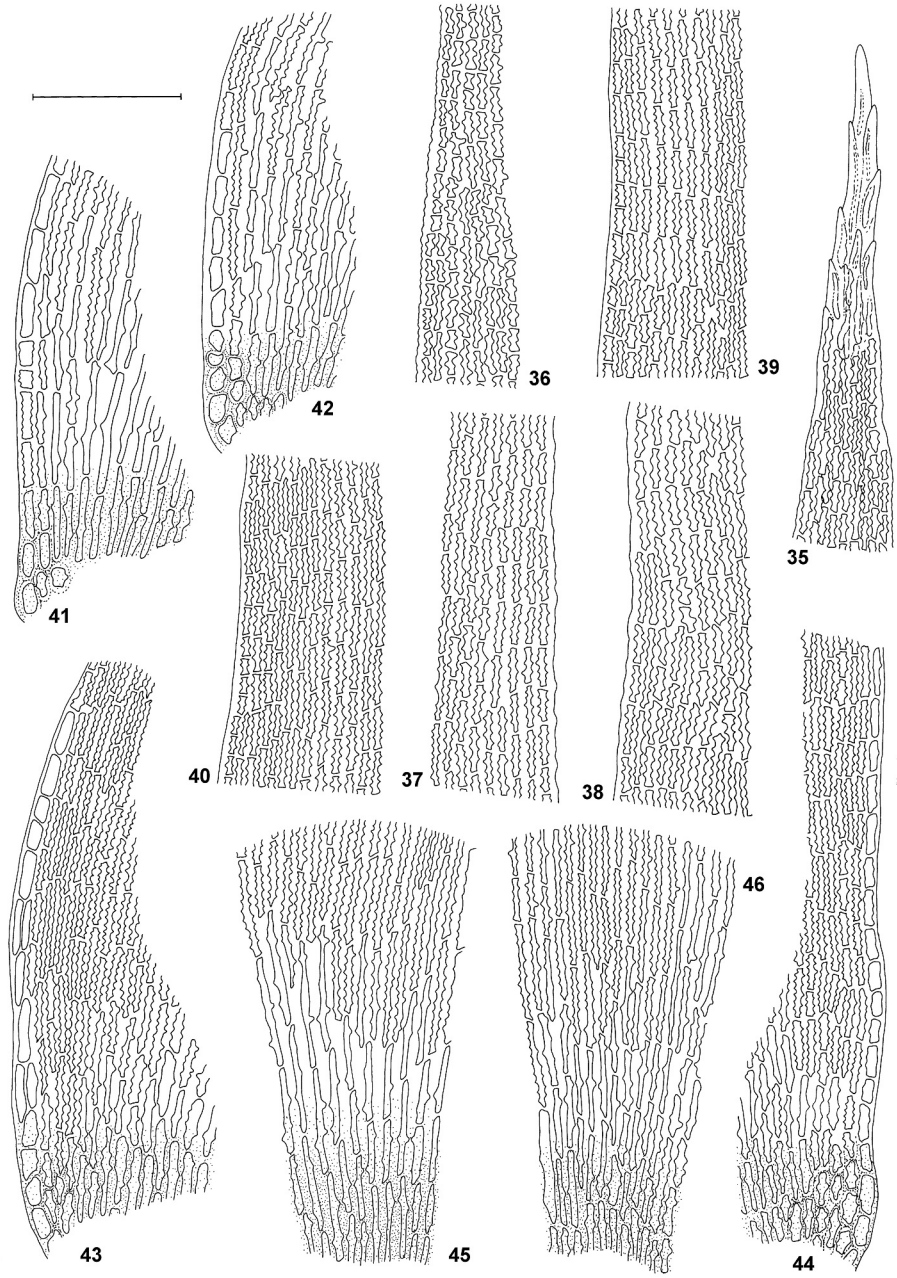
Type — NEW ZEALAND. **AUCKLAND ISLANDS.** ADAMS ISLAND: on summit of S.W. Adams Trig, lat. 50°52' S, long. 165°56' E; elev. 520 m; on rock cliffs and open stones in alpine moor with abundant cushion plants and mosses; 30 December 1972, *Vitt 9668* (Holotype: ALTA).

Racomitrium crispipilum (Taylor) A.Jaeger var. *brevifolium* Thér., *Rev. Bryol. Lichénol.* N. Sér. 9: 11. 1936, ***syn. nov.*** – TYPE CITATION: [Ecuador] Loc. I [Rochers du Rucu Pichincha, 4.600-4.650 m] (n° 4359). [Lectotype (*selected here*): "Herb. Crypt. Mus. Paris 3459 Rhacomitrium crispipilum (Tayl.) Jaeg. var. nov. brevifolium Thér. Rochers du Rucu Pichincha vers 4650 m 17-XII-1930 R. Benoist" – PC!].

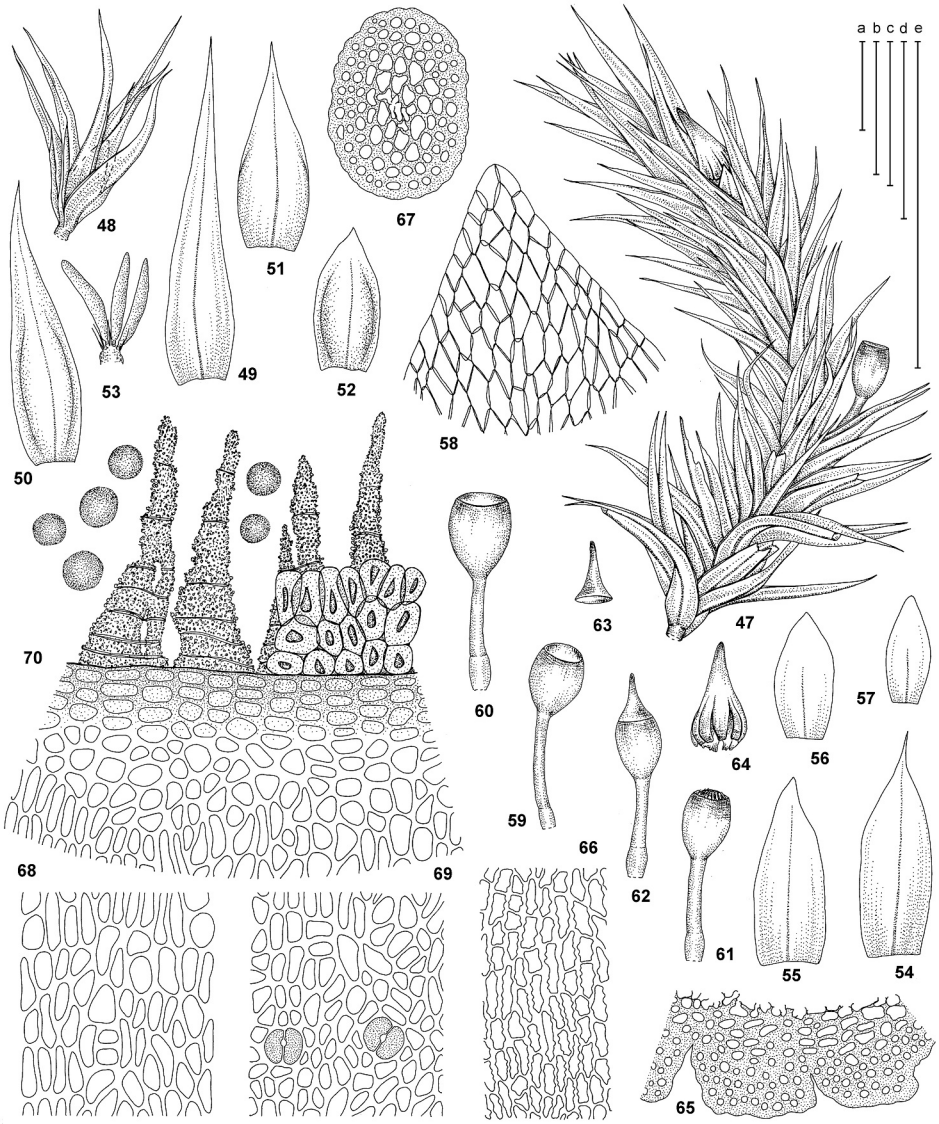
Description — **Plants** small and short to medium-sized, fairly slender to moderately coarse, forming rigid, dense but rather incoherent and easily crumbling tufts or patches, occasionally small compact cushions, slightly lustrous, bright, olive or



Figs 1-34. *Bucklandiella angustissima* Bednarek-Ochyra *et* Ochyra. – **1.** Habit, wet. **2.** Cross-section of stem. **3-5.** Axillary hairs. **6-15.** Leaves. **16-34.** Cross-section of leaves, sequentially from base to apex. [1, 3-5, 11-13, 16-21 from *Vitt 9668*, holotype, ALTA; 2 from *Vitt 9666*, ALTA; 6-7 from *Seppelt 6006*, KRAM; 8-10, 30-34 from *Benoist 3459*, PC, lectotype of *Racomitrium crispipilum* var. *brevifolium*; 22-23 from *Vitt 9868*, ALTA; 14-15, 24-29 from *Fife 5441*, CHR]. Scale bars: a – 1 mm (6-15); b – 100 µm (2, 16-34); c – 0.5 cm (1); d – 100 µm (3-5).



Figs 35-46. *Bucklandiella angustissima* Bednarek-Ochyra *et* Ochyra. **35.** Leaf apex. **36-37.** Upper laminal cells. **38-40.** Mid-leaf cells. **41-44.** Basal marginal cells. **45-46.** Basal juxtacostal cells. [35, 37, 39, 41, 45 from *Vitt 9668*, holotype, ALTA; 36, 40, 42, 46 from *Benoist 3459*, PC, lectotype of *Racomitrium crispipilum* var. *brevifolium*; 38 from *Fife 5441*, CHR; 43 from *Vitt 8993*, ALTA; 44 from *Vitt 9649*, ALTA]. Scale bar: 100 µm.



Figs 47-70. *Bucklandiella angustissima* Bednarek-Ochyra *et* Ochyra. **47.** Branch with capsules, wet. **48.** Perigonium. **49.** Outer perigonial bract. **50-51.** Median perigonial bracts. **52.** Innermost perigonial bract. **53.** Antheridia. **54-55.** Median perichaetial leaves. **56-57.** Innermost perichaetial leaves. **58.** Apex of innermost perichaetial leaf. **59-60.** Mature deoperculate capsules with destroyed peristomes, wet. **61.** Mature deoperculate capsule with peristome, wet. **62.** Operculate capsule, wet. **63.** Operculum. **64.** Calyptra. **65.** Cross-section of calyptra. **66.** Epidermal cells of vaginula. **67.** Cross-section of seta. **68.** Mid-urn exothecial cells. **69.** Exothecial cells at base of urn and stomata. **70.** Portion of peristome, with exothecial cells at orifice, annulus and spores. [All from *Vitt 9668*, holotype, ALTA]. Scale bars: a – 1 mm (48, 59-64); b – 100 µm (58, 65-70); c – 1 mm (49-53); d – 1 mm (54-57); e – (47).

yellow- to olive-brown above, dull, brown to blackish brown below. **Stems** erect, straight, usually 2.0-3.5 cm tall, seldom as short as 1.0-1.5 cm or, occasionally, 7.5-8.5 cm high, rather thin but rigid, yellow to yellow-brown, sparsely irregularly branched to simple, often with more numerous short, lateral, cuspidate branchlets in the distal portion, densely foliated, not radiculose or with sparse, long, sparingly branched, smooth, reddish brown rhizoids, mostly scattered near the base, in cross-section rounded, without a central strand and with a weak, (1-)2(-3)-stratose cortex of yellow to yellow-brown or yellow-orange stereid cells with markedly thickened walls and small lumina, rather abruptly grading into 3-5-stratose medulla of fairly large, hyaline or yellowish hyaline, thick-walled cells; **axillary hairs** uniseriate, filiform, 105-130 µm long, hyaline throughout, 6-7-celled, composed of elongate cells in the distal part and short, barrel-shaped basal cells. **Leaves** crowded, closely imbricate, stiff, straight or sometimes somewhat curved, not or slightly altered, erect and appressed to erect-spreading, sometimes recurved at the tips when dry, erecto-patent when wet, narrowly lanceolate to ovate-lanceolate, gradually long-acuminate, sharply acute, with a yellowish or yellowish-brownish thorn-like, not or only shortly hyaline tipped or rarely mostly hyaline hair-point, (2.0-)2.5-3.0 (-3.5) mm long (incl. hair-point), concave, narrowly canaliculate throughout, with a single fold near the costa towards the base, not or shortly decurrent, without or with small auricles; **hair-point** thorn-like or capillaceous, straight, sharply acute, plane, smooth or remotely bluntly or sharply serrulate, yellowish to yellowish-brownish throughout or only in the lower part and with a hyaline tip, occasionally almost entirely hyaline, 0.1-0.35 mm long, decurrent down the margins of the lamina and gradually merging into the chlorophyllose apical leaf cells, with distinct cell areolation; **margins** entire or somewhat lumpy at sides near the apex, plane on one side throughout, recurved on the other side to 1/2-2/3 the leaf length, unistratose throughout; **costa** single, percurrent to short-excurrent, yellow to yellow-brownish, rather poorly defined and almost concolorous with the laminal cells, but well defined on one side in the proximal part because of the fold of the lamina, 40-60 µm wide near the base, not or slightly tapering upwards, in transverse section distinctly convex dorsally, bistratose throughout or with an incomplete third row of substereid cells in the proximal portion, semi-terete to reniform in outline in the distal part, rectangular in the median part, strongly flattened and markedly asymmetrically reniform and situated at the bottom of a fairly deep furrow in the proximal part, narrowly canaliculate on the ventral side, consisting of 2 enlarged ventral epidermal cells throughout and 6-8 small substereid cells above and 9-11 below; **laminal cells** smooth to weakly or strongly pseudopapillose owing to the longitudinal cuticular thickenings giving the leaves a papillose appearance in transverse section, unistratose and rectangular, with strongly thickened, sinuose longitudinal walls throughout the lamina, short-rectangular in the upper part, 15-30 µm long, 4-6 µm wide, occasionally mixed with irregular, short-rectangular to subquadrate cells, 8-12 µm long, becoming longly rectangular, 30-60 µm long, in the median part and long-rectangular to linear-rectangular, 40-85 µm long, with strongly nodulose walls in the suprabasal part; **basal cells** long rectangular, with strongly incrassate and nodose walls, 20-35 µm long, 6-10 µm wide, concolorous with the adjacent basal cells or pale yellowish, yellowish-brownish to orange-yellow, forming a distinct strip of 2 rows along the insertion; **basal marginal cells** short- to long-rectangular, pellucid, hyaline to yellowish hyaline, with straight and thin to moderately thickened and slightly sinuose walls, 15-35(-50) µm long, 5-8 (-10) µm wide, forming a distinct, translucent, uniseriate border composed of (5-)13-20 cells, occasionally on some leaves the marginal cells poorly differentiated or undifferentiated; **alar cells**

undifferentiated or quadrate, rounded to shortly oblong, often with incrassate and porose walls, forming flat to slightly convex, dark brown, orange-brown or reddish orange, decurrent auricles.

Dioicous. Perigonia bud-like, about 2 mm long, with outer perigonial bracts similar to the vegetative leaves, ovate-lanceolate, 1.9-2.1 mm long, broadly ovate and short-acuminate inner bracts and ovate, broadly acute to obtuse, brown, concave innermost bracts, 1.0-1.2 mm long, with a poorly defined costa, enclosing 6-8 claviform, short-stalked, brownish antheridia, intermixed with short, brown paraphyses. **Outer perichaetial leaves** similar in shape and areolation to the vegetative leaves, lanceolate to ovate-lanceolate, 2.2-3.0 mm long, 0.45-0.55 mm wide, straight or slightly curved, shortly piliferous, with a brownish or yellowish hyaline to hyaline hair-point to 0.4 mm long; **inner perichaetial leaves** progressively smaller inward, oblong to oblong-ovate, shortly acuminate to broadly acute, 0.9-1.3 mm long, ca 0.4 mm wide, with a weak, subpercurrent costa and areolation of elongate cells with strongly incrassate and nodose walls, becoming progressively thinner and straight-walled and hyaline at the margins; **innermost perichaetial leaves** (2-3) ovate to oblong-ovate, broadly obtuse, convolute, hyaline throughout, 0.6-0.8 mm long, 0.25-0.3 mm wide, with a faint costa ceasing in the middle of the bract, a lax areolation of thin-walled, hexagonal cells and bluntly crenulate margins. **Seta** rather stout, singly per perichaetium, 0.8-1.2 mm long (without a vaginula), erect, straight, not or twisted once clockwise when dry, yellowish brown to pale brown, in transverse section with 1-2(-3)-stratose cortex of small cells with strongly incrassate walls, abruptly passing into 3-4-stratose medula of large, hyaline, thin- to thick-walled cells; **vaginula** obloid to ovoid, 0.3-0.5 mm long, brown, with epidermal cells variable in shape, short-rectangular to elongate, with thick- and sinuose walls. **Capsules** erect, mostly immersed in leaves to shortly exserted, straight, symmetric, subglobose, ovoid to obloid, gradually or abruptly tapering to the seta, 0.5-0.8 mm long, 0.45-0.6 mm wide, drab, dull to slightly glossy, becoming dark brown with age; **annulus** compound, deciduous, to 85-90 µm broad and reaching nearly half the height of the peristome teeth, composed of 3 rows of cells, with the upper row of large, thick-walled, transparent, vesiculose cells; **operculum** distinctly convex, conical, with a straight, acute rostrum, 0.5-0.7 mm long; **exothecial cells** variable in shape but predominantly oblong to long-rectangular, 30-50 µm long, 6-10 µm wide, mixed with some elliptical or irregular cells, 15-30 µm long, 10-15 µm wide, with strongly incrassate walls, becoming smaller, rounded and oblate at the urn mouth, and forming a bright, orange to orange-brown strip of 4-7 rows of cells at the orifice; **stomata** at the extreme base of the urn, 5-7 per urn, superficial, bicellular, round-pored, small, 25-30 µm in diameter; **peristome** single, consisting of 16 lanceolate, yellow brownish to yellow teeth, 200-220 µm long, 50-55 µm wide at the base, straight, erect-spreading to widely spreading when dry, entire or irregularly split into 2 unequal, terete branches to the middle or below, densely covered with spiculose papillae throughout on both surfaces. **Spores** globose, pale brownish, finely papillose, (20-)24-28(-30) µm in diameter. **Calyptra** conical, mitrate to cucullate, brown, naked, smooth to delicately ridged, 4-5-lobed at the base.

Additional specimens seen (Paratypes) — NEW ZEALAND. **SOUTH ISLAND.** ***Nelson***: Scarlett Range, Shelter Rock Basin [Grid Ref. M27 513812], alt. 1370 m, lat. 41°22.5' S, long. 172°17.9' E; *Chinochloa pallens* dominated slope at head of cirque, mesic outcrop, exposed ledge, weak seepage; associates: *Andreaea mutabilis, Blindia martinii* and *Jamesoniella tasmanica*; 10 February 1987, *Fife 8127* (CHR). ***West Coast***: Grey District, Paparoa Mountains, cirque on east flank of Mt. Priestley [Grid Ref. S38 053344], alt. 900-1050 m;

upper subalpine snow-tussock grassland with areas of carpet grass (*Chinochloa australis*) and scrub of *Dracophyllum longifolium*, *D. uniflorum* & *Olearia colensoi*; south and west facing slopes with numerous granite outcrops and boggy depressions, S-facing granite ledge, on humus; 11 April 1983, *Fife 5441* (CHR). **AUCKLAND ISLANDS**. ***Adams Island***: on large cliffs to west of S.W. Adams Trig, lat. 50°52' S, long. 165°56' E; elev. 470 m; in cushion plant-herb-moss tundra; 30 December 1972, *Vitt 9674* (ALTA); same locality, on rock cliffs and open stones in alpine moor with abundant cushion plants and mosses; 30 December 1972, *Vitt 9666* (ALTA); just east of Logan Point and WSW of S.W. Adams Trig, lat. 50°52' S, long. 165°56' E; elev. 320 m; on sea cliffs and surrounding area in cushion plant-herb-moss tundra and tussock-grassland; 30 December 1972, *Vitt 9649* (ALTA). ***Auckland Island***: summit southwest of Mt. Easton, lat. 50°38' S, long. 166°09' E; elev. 490 m; on granitic rock outcrops with abundant seepages in cushion plant dominated tundra; 17 December 1972, *Vitt 8993* (ALTA); on summit cliffs of Mt. Raynal, lat. 50°44' S, long. 166°04' E; elev. 645 m; moist cushion plant moss tundra with numerous seepages; 2 January 1973, *Vitt 9868* (ALTA).

SUBANTARCTICA. AUSTRALIA. **MACQUARIE ISLAND.** Summit of Mt. Hamilton, lat. 54°42'40.0'' S, long. 158°49'39.0'' E, alt. 410 m; in fellfield on summit ridge; 11 January 1980, *Seppelt 9621* (HO, KRAM); peak on north side of Square Lake, lat. 54°33'54.04'' S, long. 158°54'00.0'' E, alt. 170 m; forming tufts on gravelly soil in fellfield; 6 February 1978, *Seppelt 6006* (HO, KRAM).

SOUTH AMERICA. ECUADOR. **PICHINCHA.** Rucu Pichincha, lat. 0°09' S, long. 78°34' W, alt. 4650 m, on rocks, 17 December 1930, *Benoist 3459* (PC, type of *Racomitrium crispipilum* var. *brevifolium*).

TAXONOMIC DISCUSSION

Bucklandiella angustissima is a remarkable species which is diagnosed by the following set of characters: (*1*) very small, subglobose, ovoid to obloid capsules, 0.5-0.8 mm long and 0.45-0.6 mm wide; (*2*) very short and relatively stout setae, 0.8-1.2 mm (without a vaginula); (*3*) very short, 200-220 µm, simple or irregularly cleft, to various distances, peristome teeth; (*4*) very large and wide annulus, 85-90 µm, covering nearly half the lower part of the peristome; (*5*) large, finely papillose spores, 20-30 µm in diameter; (*6*) strongly modified, hyaline and epilose innermost perichaetial bracts; (*7*) unistratose leaf margins; (*8*) usually well developed basal marginal border in leaves of pellucid, hyaline to yellowish hyaline cells; (*9*) narrow, bistratose costa, with an imperfect third row of substereid cells in the extreme base and with two large ventral epidermal cells throughout its whole length.

Of these, the most noticeable are exceptionally small measurements of the capsules and setae which are apparently the smallest and the shortest ones in the entire genus. In all the species of *Bucklandiella* the capsules are more than one millimetre long and only occasionally they are as short as 0.7 mm in some populations of *B. sudetica* (Funck) Bednarek-Ochyra *et* Ochyra. Likewise, in the majority of species the seta length ranges from 2.5 to 14.5 mm and only in the narrowly interpreted *B. crispula* (Hook.f. *et* Wilson) Bednarek-Ochyra *et* Ochyra from the Auckland and Campbell Islands the setae are 1.5 mm long. Thus, *B. angustissima* can be designated as a species having the smallest capsules and the shortest setae in the large genus *Bucklandiella*.

Bucklandiella angustissima is doubtless most closely related to *B. emersa* (Müll. Hal.) Bednarek-Ochyra *et* Ochyra, an Australasian species known from Tasmania and south-eastern Australia and extending to Papua New Guinea, Sumatra and Borneo in Malesia (Frisvoll, 1988). This species is a representative

of the separate section of the genus, *Bucklandiella* sect. *Emersae* (Bednarek-Ochyra) Bednarek-Ochyra *et* Ochyra, which is diagnosed by having strongly modified, hyaline and epilose innermost perichaetial bracts, the presence of a basal marginal leaf border, unistratose leaf margins and principally a bistratose costa. *Bucklandiella angustissima* shares all these traits and fits well the concept of this section. However, *B. emersa*, the type of the section, is at once distinct from *B. angustissima* by its long setae, (3.5-)5.5-9.5 mm, obloid-cylindrical to cylindrical capsules, (1.5-)1.8-2.2 mm long, broader costa, 60-75 µm wide near the base, with three enlarged ventral epidermal cells in the lower half.

Additionally, *Bucklandiella emersa* has smooth or only faintly pseudopapillose laminal cells. In contrast, in some populations of *B. angustissima* the laminal cells are prominently pseudopapillose due to distinct longitudinal cuticular ridges on both leaf surfaces which give the leaf a papillose aspect in transverse section. The pseudopapillose leaves occur also in the type material of *Racomitrium crispipilum* var. *brevifolium* from Ecuador, here considered to be identical to *B. angustissima*. Moreover, this taxon has none or a poorly developed, short basal marginal border, consisting of to 5-8 translucent cells with somewhat thickened and straight or weakly sinuose walls. However, this state of the basal marginal border in the South American plant is not exceptional in *B. angustissima* and a similar situation is observed in some plants from Australasia in which the marginal border may be absent on some leaves on the same plant or even in the same leaf it is absent on one side and present on the other. In general, a similarly variable basal marginal border is observed in other species of *Bucklandiella* in the austral region, for instance in the amphiatlantic *B. pachydictyon* (Cardot) Bednarek-Ochyra *et* Ochyra (Ochyra *et al.*, 2008a; Bednarek-Ochyra & Ochyra, 2008a).

Another species of sect. *Emersae* which may be mistaken for *Bucklandiella angustissima* is *B. elegans* (Müll.Hal.) Bednarek-Ochyra *et* Ochyra, an endemic to New Zealand (Bednarek-Ochyra & Ochyra, 2010a). This is a pretty and unmistakable species which is at once distinguished from *B. angustissima* in having elongate-cylindrical capsules with very long peristome teeth, 450-600 µm, a bistratose costa with four enlarged ventral epidermal cells in the proximal portion and small spores, 15-17 µm in diameter.

In its very narrow costa, *Bucklandiella angustissima* is similar to *B. rupestris* (Hook.f. *et* Wilson) Bednarek-Ochyra *et* Ochyra, a pan-south-temperate species. The costa is asymmetric in the proximal part and has only two larger adaxial epidermal cells. Moreover, this species has very short and undivided peristome teeth, 190-220 µm long, large spores, 22-30 µm wide, and entirely unistratose laminal cells. However, *B. rupestris* entirely lacks a basal marginal border of pellucid and esinuose cells and has subquadrate to short-rectangular distal laminal cells with characteristic transverse striae over the cell lumina. The leaves are muticous or end with a short, brownish awn which may become hyaline with age, and they are imbricate and spirally arranged on the stem, giving it a characteristic catenulate appearance. This species differs essentially from *B. angustissima* in its innermost perichaetial leaves which are chlorophyllose, with the areolation of sturdy and thick-walled cells.

Although the genus *Bucklandiella* is still not fully studied in the Southern Hemisphere, including Australasia, South America and the Subantarctic islands, *B. angustissima* is rather unlikely to be mistaken for other species which represent different sections of this morphologically diverse genus. The unistratose laminal cells distinguish it at once from *B. crispula* and *B. didyma* (Mont.) Bednarek-Ochyra *et* Ochyra, the latter being a pan-south-temperate species known from South America, subantarctic islands and Australasia (Bednarek-Ochyra &

Ochyra, 2008b, 2010b), which have a distinct basal marginal border but the laminal cells are bistratose distally, at least at the margins. Likewise, *B. lamprocarpa* (Müll.Hal.) Bednarek-Ochyra & Ochyra, a species known from subantarctic Macquarie Island (Bednarek-Ochyra & Ochyra, 2007a), Heard Island (Bednarek-Ochyra & Ochyra, 2010c) and Îles Kerguelen (Bednarek-Ochyra & Ochyra, 1998), as well as from South America (Bednarek-Ochyra *et al.*, 1996, 2002; Bednarek-Ochyra & Ochyra, 1994, 2009a), is immediately distinct in its polystratose leaf margins and the complete lack of the basal marginal border.

Bucklandiella angustissima is readily distinguished from species of *Bucklandiella* sect. *Marginatae* (Bednarek-Ochyra) Bednarek-Ochyra *et* Ochyra to which belong *B. pycnotricha* (Müll.Hal.) Bednarek-Ochyra, Ochyra *et* Seppelt from Tasmania, *B. allanfifei* Bednarek-Ochyra *et* Ochyra from New Zealand and *B. striatipila* (Cardot) Bednarek-Ochyra *et* Ochyra from South America (Bednarek-Ochyra & Ochyra, 2010b) and subantarctic Îes Crozet (Bednarek-Ochyra & Ochyra 2009b) and Îles Kerguelen (Bednarek-Ochyra & Ochyra, 2010d), as well as the pantropical oreophyte *B. crispipila* (Bednarek-Ochyra *et al.*, 1999; Bednarek-Ochyra & Ochyra, 2007b). These species share the presence of the basal marginal border with *B. angustissima* but have the innermost perichaetial leaves strongly modified, with sturdy chlorophyllose areolation in the distal part and the cells with strongly porose and incrassate walls. Moreover, the costa is broader and has 3-11 enlarged adaxial epidermal cells in the promixal part.

The other Australasian species of *Bucklandiella* are also definitely distinct from *B. angustissima*. *Bucklandiella ptychophylla* (Mitt.) Bednarek-Ochyra *et* Ochyra and *B. curiosissima* (Bednarek-Ochyra *et* Ochyra) Bednarek-Ochyra *et* Ochyra have strongly plicate leaf laminae and the latter has additionally very long and strongly spinose hyaline hair-points, while *B. crumiana* (Fife) Bednarek-Ochyra *et* Ochyra is characterised by having caducous leaf apices, a unique feature in the genus *Bucklandiella*. Finally, *B. sudetica* which is known from south-eastern Australia (Frisvoll, 1986) differs from *B. angustissima* in its strong, tristratose costa, bistratose leaf margins in the upper part, short distal laminal cells, small spores, 10-14 µm wide, and setae 3.0-3.5 mm long.

With the description of *Bucklandiella angustissima* the moss flora of New Zealand increased by one distinct species and the genus *Bucklandiella* itself consists at present of eight species in this insular country. Likewise, one more species was added to the moss flora of subantarctic Macquarie Island which has recently gained a modern handbook of mosses (Seppelt, 2004). Since then, several species have been added to the island's flora (Bednarek-Ochyra & Ochyra, 2007a; Ochyra & Seppelt, 2008a, b; Ochyra *et al.*, 2008b) and currently it consists of 87 species, with a further four taxa which have not yet been definitely named to species.

Until the global monographic study of the genus *Bucklandiella* is completed, the real number of species in this genus cannot be precisely given. At the moment about 60 species are definitively placed in *Bucklandiella* (Ochyra *et al.*, 2003; Bednarek-Ochyra & Ochyra 2007c, 2010a) but this does not seem to be the final number. After careful taxonomic studies new data has emerged which indicates that for two species which had initially been placed in *Codriophorus* P.Beauv., namely *C. depressus* (Lesq.) Bednarek-Ochyra *et* Ochyra from western North America and *C. dichelymoides* (Herzog) Bednarek-Ochyra *et* Ochyra from the northern Andes of Colombia (Bednarek-Ochyra, 2006), the correct placement is in *Bucklandiella*. These are isolated taxonomically species which are classified in separate subsections, subsect. *Depressae* (Bednarek-Ochyra) Bednarek-Ochyra *et* Ochyra and subsect. *Andicola* (Bednarek-Ochyra) Bednarek-Ochyra *et* Ochyra.

In addition, one neglected species described from Chile as *Grimmia subcrispipila* (Müller, 1862), has never been given a name in *Bucklandiella*. The name of the species is neotypified herein. Accordingly, the following nomenclatural changes are proposed.

Bucklandiella Roiv. subsect. ***Andicola*** (Bednarek-Ochyra) Bednarek-Ochyra *et* Ochyra, ***comb. nov.***

Basionym: *Racomitrium* Brid. subsect. *Andicola* Bednarek-Ochyra, *Fragm. Florist. Geobot. Ser. Polonica* 2: 64. 1995. TYPE: *Bucklandiella dichelymoides* (Herzog) Bednarek-Ochyra *et* Ochyra (*Racomitrium dichelymoides* Herzog).

Bucklandiella Roiv. subsect. ***Depressae*** (Bednarek-Ochyra) Bednarek-Ochyra *et* Ochyra, ***comb. nov.***

Basionym: *Codriophorus* P.Beauv. subsect. *Depressi* Bednarek-Ochyra, *Taxon. Monogr. Codriophorus*: 151. 2006. TYPE: *Bucklandiella depressa* (Lesq.) Bednarek-Ochyra *et* Ochyra (*Racomitrium depressum* Lesq.).

Bucklandiella depressa (Lesq.) Bednarek-Ochyra *et* Ochyra, ***comb. nov.***

Basionym: *Racomitrium depressum* Lesq., *Mem. Calif. Acad. Sci.* 1: 14. 1868.

Bucklandiella dichelymoides (Herzog) Bednarek-Ochyra *et* Ochyra, ***comb. nov.***

Basionym: *Racomitrium dichelymoides* Herzog, *Hedwigia* 74: 103, *f. 9.* 1934.

Bucklandiella subcrispipila (Müll.Hal.) Bednarek-Ochyra *et* Ochyra, ***comb. nov.***

Basionym: *Grimmia subcrispipila* Müll.Hal., *Bot. Zeit. (Berlin)* 20: 374. 1862. TYPE CITATION: In montibus chilensibus [Holotype: B†; neotype (*selected here*): "Chile: Lago Chapo, about 40 km SE of Pt. Montt, Llanquihue. On boulders (volcanic rocks); elevation about 250 m. Coll. H. Deguchi, November 19, 1981 (H. Inoue, *Bryophyta Selecta Exsiccata* No. 794 as *Racomitrium crispipilum*)" - KRAM!].

HABITAT AND DISTRIBUTION

Bucklandiella angustissima is a saxicolous moss growing on dry or moist, exposed granite rock ledges and outcrops on cliffs and in fellfields. It is typically a cool-adapted moss, occurring in the austral polar and subpolar region of Australasia on subantarctic Macquarie Island, as well as on the Auckland Islands in the New Zealand southern cool-temperate zone. Generally, it has been collected on these islands at higher elevations, at 320-645 m on the Auckland Islands and at 170-410 m on Macquarie Island. At these higher elevations climatic conditions are more severe on these islands than at sea level with an adiabatic air temperature decrease of around 1°C per 100 m increase in altitude (Schultze, 1971). For example, on the subantarctic Prince Edward Islands Zinderen Bakker (1978) estimates that at 250 m above sea level the temperature just above the soil surface falls below 0°C on about 50% of the nights, compared to about 30% at sea level. Additionally, strong winds contribute much to the severity of the climate in these regions because they cause drought stress and wind abrasion of the plants and therefore the fellfields on these islands are often designated as "wind-desert"

(Schenck, 1905; Werth, 1906). As a typical cool-adapted species, *B. angustissima* at lower latitudes in New Zealand occurs at higher altitudes, 900-1370 m, where it grows at similar sites on exposed granitic outcrops on slopes with weak seepages and boggy depressions in the upper snow-tussock grassland dominated with *Chionochloa pallens* Zotov and *Ch. australis* (Buchanan) Zotov. Likewise, in South America the species was recorded at high altitude sites on the summit of Pichincha Volcano, Ecuador, at 4650 m where the climatic conditions resemble very much those of the high latitudes in the Subantarctic.

At present, *Bucklandiella angustissima* is known to occur in two very disjunct areas (Fig. 71). Its main centre of occurrence is in Australasia where it was most frequently collected on the Auckland Islands and on subantarctic Macquarie Island, and it has so far been recorded only twice on the South Island in New Zealand. There is a dramatic transpacific disjunction with South America to the northern Andes of Ecuador. It is rather difficult to ascertain whether *B. angustissima* should be considered as an amphipacific south-cool-temperate or subantarctic species, because the difference between these two categories of distribution patterns is sometimes subtle, especially in the case of rare species known from limited number of sites and specimens. Generally, they consist of taxa which are distributed in cool-temperate regions of southern South America and New Zealand, Tasmania and south-eastern Australia, extending to the subantarctic region through Macquarie Island and South Georgia, sometimes penetrating northward into the tropics where they occur at altimontane outposts (Ochyra, 1998; Ochyra *et al.*, 2008a). This is a relatively rare distribution pattern and its most typical examples are *Hypopterygium didyctyon* Müll. Hal. (Krujer, 2002),

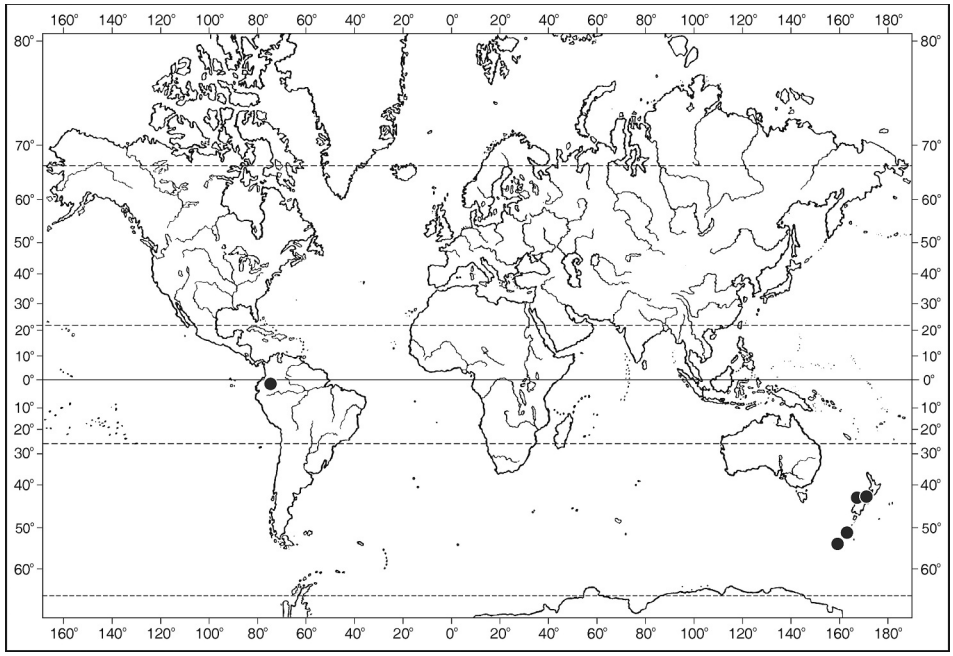


Fig. 71. Map of the global distribution for *Bucklandiella angustissima* Bednarek-Ochyra *et* Ochyra.

Dendroligotrichum dendroides (Hedw.) Broth. (Smith, 1971), *Ditrichum hyalinum* (Mitt.) Kuntze (Ochyra & Lewis Smith, 1998; Ochyra, 1999; Ochyra *et al.*, 2002), *Campylopus acuminatus* Mitt. and *C. chilensis* De Not. (Frahm, 1988), *Blindia robusta* Hampe (Bartlett & Vitt, 1986), *Racomitrium pruinosum* (Wilson) Müll. Hal. (Vitt & Marsh, 1988), *Bucklandiella ptychophylla* (Mitt.) Bednarek-Ochyra *et* Ochyra (Bartram, 1952), *Bryum mucronatum* Mitt., *B. australe* Hampe, *B. pachytheca* Müll. Hal., *B. campylothecium* Taylor, and *B. perlimbatum* (Ochi, 1982). The latter species was incorrectly reported from South Africa (Ochyra, 1989). In South America *B. angustissima* has so far not been recorded from the cool-temperate zone of the southernmost part of the continent but its discovery here is very likely with progress in field studies of this still undercollected area.

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