

The taxonomic status of *Racomitrium capense* (Bryophyta, Grimmiaceae) from South Africa

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Abstract – *Racomitrium capense* Lorentz, a neglected moss species described from the Western Cape in South Africa, is taxonomically assessed and the most important characters of the type material are illustrated. This species is considered to be conspecific with *Bucklandiella lamprocarpa* (Müll.Hal.) Bednarek-Ochyra et Ochyra. African synonyms of *B. lamprocarpa* are summarised and some synonymous names are lectotyped. The global range of *B. lamprocarpa* is briefly considered and some comment on rheophytic mosses is included.

Bryophyta / *Bucklandiella* / *Capensis* / distribution / Grimmiaceae / nomenclature / *Racomitrium* / rheophytic mosses / taxonomy

INTRODUCTION

The first collections of bryophytes were made in South Africa by C. P. Thunberg in 1772-1775 during his stay in the Cape. In his *Prodromus plantarum capensium* he reported five species of liverworts and 13 species of moss, of which *Symphogyna podophylla* (Thunb.) Mont. et Nees was described as new to science (Thunberg, 1800). This region was quite intensively explored bryologically in the first decades of the nineteenth century by, among others, W. J. Burchell, C. F. Drège, J. F. Drège, C. L. P. Zeyher, L. Maire, J. L. L. Mundt (Mundt) and C. W. L. Pappe.

One of the most prolific plant collectors in South Africa was Ch. F. Ecklon (1795-1868), a Danish botanical collector and apothecary (Gunn & Codd, 1981). He was trained as a pharmacist and went to the Cape in 1823 to practice that profession. In his spare time he collected on Table Mountain and around Cape Town and sent his collections of herbarium specimens to the Unio Itineraria, a kind of botanical exchange club, established in 1825 in Esslingen, Germany. His cryptogams were sold to various herbaria and examined by European specialists. Ecklon's collections of mosses were studied by, among others, Hornschuch (1841) and Müller (1855, 1856, 1858, 1859, 1864), who described a number of new species, some being dedicated to the collector and are still accepted, for example *Bruchia eckloniana* Müll.Hal. and *Pleuridium ecklonii* (Müll.Hal.) Snider.

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Amongst the specimens collected by Ecklon in the Cape were also racomitrialean mosses. One was described by Lorentz (1864) as a new species, *Racomitrium capense* and it was the second record of a racomitrialean moss for South Africa. The first was *Racomitrium lanuginosum* (Hedw.) Brid., which had been collected and reported by Thunberg (1800) as *Trichostomum hypnoides* P.Beauv. This material was subsequently described by Müller (1869) as a separate species, *R. incanum* Müll.Hal. It is worth noting that the second syntype cited in the protologue and used for the description of this species is the specimen collected by Ecklon on Table Mountain. Currently, *R. incanum* is considered to be conspecific with the widely distributed bipolar species *R. lanuginosum* (Vitt & Marsh, 1988).

BRIEF HISTORY AND THE IDENTITY OF *RACOMITRIUM CAPENSE*

Since its description (Lorentz, 1864), *Racomitrium capense* has largely remained a poorly known and puzzling species. Brotherus (1902, 1924) placed it in the group of species lacking a hair-point but having an acute leaf apex, in the proximity of such species as *R. nigroviride* (Müll.Hal.) Paris and *R. austropatens* Broth. from South Africa and *R. lamprocarpum* (Müll.Hal.) A.Jaeger, *R. sublamprocarpum* (Müll.Hal.) Paris, *R. nigratum* (Müll.Hal.) A.Jaeger and *R. subnigratum* (Müll.Hal.) Paris from southern South America. Sim (1926), in his moss flora of South Africa, commented on this species as follows: "I have not seen specimen or description of *R. capense* Ltz., ... but I have no doubt it belongs here", i.e. to the broadly conceived *R. crispulum* (Hook.f. et Wilson) Hook.f. et Wilson. This suggestion was subsequently accepted by Clifford (1955) and Magill (1981).

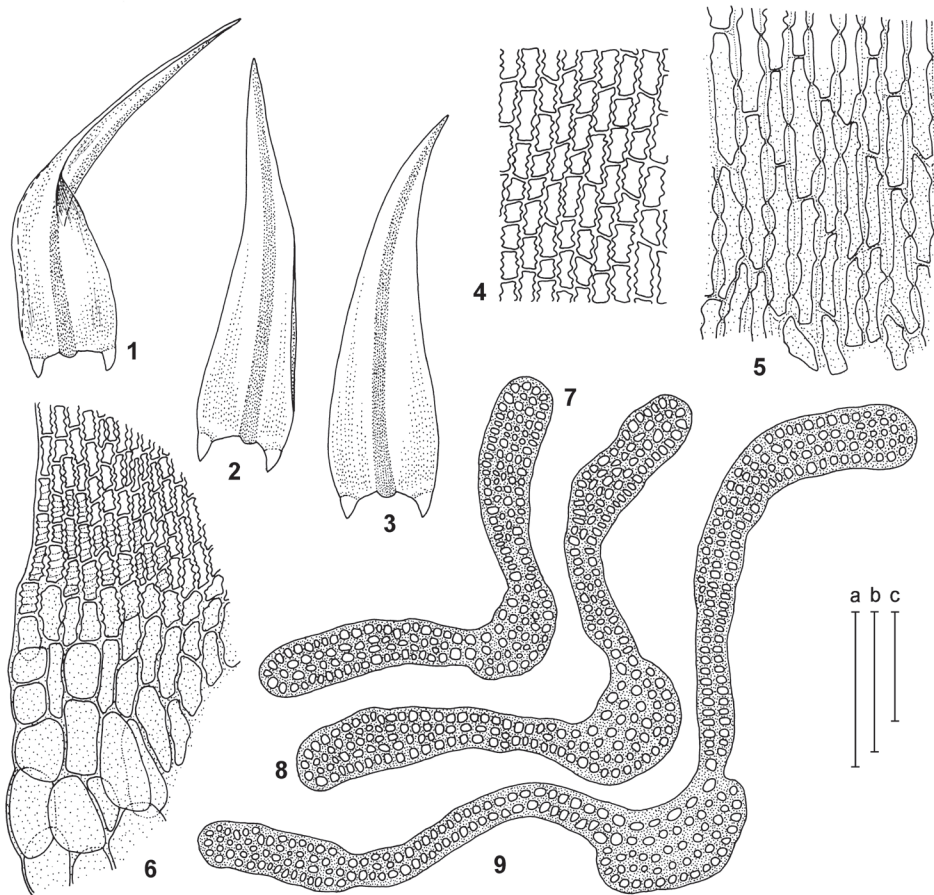
Although the name *Racomitrium crispulum* is very well known and in common use, this species is also poorly understood and needs a careful taxonomic re-assessment. For nearly a century it has served as a convenient repository for a great number of austral species whose names were lumped with *R. crispulum* (Dixon, 1926; Clifford, 1955; Lawton, 1973). However, studies by various authors have shown that many of these species are distinct and well defined taxa which are only distantly related to *R. crispulum* (e.g. Bell, 1974; Deguchi, 1984; Ochyra *et al.*, 1988; Bednarek-Ochyra *et al.*, 1999; Bednarek-Ochyra & Ochyra, 2010, 2011, 2012a; Ellis *et al.*, 2011a, b). The species is currently placed in the genus *Bucklandiella* Roiv. [as *B. crispula* (Hook.f. et Wilson) Bednarek-Ochyra & Ochyra], one of the segregates of the traditionally interpreted genus *Racomitrium* Brid., an unnatural and heterogeneous grouping (Bednarek-Ochyra *et al.*, 2001; Ochyra *et al.*, 2003).

Frisvoll (1984) lectotypified and precisely defined *Dryptodon crispulus* Hook.f. et Wilson, the basionym of *Bucklandiella crispula*. This species is well characterised by having small, 0.8-1.2 × 0.6-0.7 mm, subglobose to ovoid capsules and small, weakly papillose spores, 14-17(-20) µm in diameter. The vegetative leaves are terminated by a short, to 0.4 mm, yellowish to yellowish-hyaline, edentulate, erect to slightly recurved, thorn-like hair-point. The leaf margins are broadly recurved on one side to about three quarters of the leaf length and narrowly recurved on the other side to about mid-leaf. They are bistratose, or seldom partly unistratose on one side, for 1-9 cell rows in the distal portion and form a thickened limbidium. The basal marginal cells are esinuose and pellucid

and form a 1(-2)-seriate, yellowish-hyaline border composed of 15-25 cells. The basal marginal cells are not enlarged or auriculate.

When describing *Racomitrium capense* Lorentz (1864) indicated that his new species was similar to *R. protensum* (Duby) Bruch *et* Schimp. [= *Codriophorus aquaticus* (Schrad.) Bednarek-Ochyra *et* Ochyra] in habit but differed in its acute, not rounded-obtuse leaf apices. In addition, he compared it to *Grimmia lamprocarpa* Müll.Hal. [= *Bucklandiella lamprocarpa* (Müll.Hal.) Bednarek-Ochyra *et* Ochyra] from southern South America, from which it differed in having narrower, straight or subfalcate and not erect-appressed leaves, enlarged alar cells with less thickened walls and more robust, black-brown capsules.

The original material of *Racomitrium capense* was located in the Hampe herbarium at BM (Fig. 1). The plants are coarse and rigid, dark olive-green above and blackish below. The leaves are epilose, straight to falcate, 3.0-3.5 × 0.9-1.1 mm, entirely 2-4-stratose distally, with a 2-5-layered marginal border of many



Figs 1-9. *Bucklandiella lamprocarpa* (Müll.Hal.) Bednarek-Ochyra *et* Ochyra. **1-3.** Leaves. **4.** Mid-leaf cells. **5.** Alar cells. **6.** Basal juxtacostal cells. **7-9.** Transverse sections of leaves. [All drawn from the lectotype of *Racomitrium capense* Lorentz, Caput Bonae Spei, *Ecklon s.n.*, BM-Hampe.] Scale bars: a – 100 µm (5, 7-9); b – 50 µm (4, 6); c – 1 mm (1-3).

rows of cells which extend from the base to the apex and merge imperceptibly with the laminal cells in the distal part. The laminal cells are entirely smooth throughout the whole lamina and bear no hint of pseudopapillosity. The alar groups are composed of large and moderately thick-walled cells and form pronounced, orange-brownish, pellucid decurrencies. The costa is stout, strongly convex on the abaxial side and reniform on the adaxial side in the proximal part. The capsules are obloid, 1.8-2.0 mm long, lustrous and blackish-brown, and the spores are coarsely papillose and large, 20-28 μm in diameter.

All the aforementioned traits exclude any alliance of *Racomitrium capense* with *Bucklandiella crispula* but they are all typical of *B. lamprocarpa*. This species was originally described by Müller (1849) as *Grimmia lamprocarpa* Müll.Hal. from material collected by J. D. Hooker on the Falkland Islands during the course of the British Antarctic Expedition of 1839-1843 commanded by Captain J. C. Ross and which operated around this archipelago in 1842 (Hooker, 1847). This taxon is a rheophyte growing mainly on rocks in swiftly flowing water in streams, brooks, rivers and waterfalls and, as is typical of mosses occurring in such habitats, exhibits a remarkable morphological plasticity. As a result, many subsequent records of this species were described as separate taxa, mostly at the species level. Ochyra *et al.* (1988) recognised no fewer than ten heterotypic synonyms and subsequent studies (Ochyra, 1993; Bednarek-Ochyra & Ochyra, 1994) revealed three additional synonyms of *Bucklandiella lamprocarpa*. However, one of these, *Racomitrium looseri* Thér., from Chile, has to be excluded from this list because it is actually conspecific with *Bucklandiella orthotrichacea* (Müll.Hal.) Bednarek-Ochyra *et* Ochyra (Bednarek-Ochyra & Ochyra, 2012a).

The placement of *Racomitrium capense* in synonymy with *Bucklandiella lamprocarpa* does not change the total number of its heterotypic synonyms which still consists of 13 names. Five of these refer to taxa described from South America, one from Gough Island in the South Atlantic Ocean, two from Europe, one from East Africa and four from South Africa. Müller (1899) described from the latter region two species and one variety from the Western Cape province. They are listed below because their names are either typified or the former typifications are rectified.

Although *Bucklandiella lamprocarpa* was described as a species in its own right only in 1849 from the Falkland Islands (Müller, 1849), it is evident that the first collections of this species originate from South Africa. It appears that this species may have been separately described as *Racomitrium capense* (Lorentz, 1864) and *Grimmia pseudoacicularis* (Müller, 1899) from material collected much earlier than the type specimens of *B. lamprocarpa*. In all likelihood Ecklon collected the type specimen of *R. capense* in the Cape of Good Hope area between 1823 and 1827 (Gunn & Codd, 1981).

According to Müller (1899), the type material of *Grimmia pseudoacicularis* Müll.Hal. was collected by 'Drège' also in the Cape region but "ante plus quam 60 annos", *i.e.* in the 1830s. The exact collector is unknown because in this period two brothers Drège made botanical collections: Carl Friedrich Drège (1791-1864) and Johan Franz Drège (1794-1881). Possibly, it was the younger brother because the elder one left South Africa in 1833 (Gunn & Codd, 1981). Sim (1926) erroneously interpreted this species as identical to *Racomitrium aciculare* (Hedw.) Brid. and actually it is conspecific with *B. lamprocarpa* (Ochyra *et al.*, 1988; Bednarek-Ochyra, 2004).

The South African synonyms of *Bucklandiella lamprocarpa* are summarised as follows:

Bucklandiella lamprocarpa (Müll.Hal.) Bednarek-Ochyra *et* Ochyra in Ochyra, Żarnowiec *et* Bednarek-Ochyra, *Cens. Cat. Polish Mosses*: 145. 2003.

Racomitrium capense Lorentz in Lorentz, *Moosstudien*: 163. 1865, **syn. nov.** **Type citation:** Ad Cap. B. Sp. leg. Eklon [sic!] ad cortices arborum. **Lectotype** (*selected here*): “*Rhacomitrium capense* Lorentz C. B. S. leg. Ecklon” - BM-Hampe!; **isotypes:** PC!, W!

Grimmia pseudoacicularis Müll.Hal., *Hedwigia* 38: 120. 1899 [‘pseudo-acicularis’]. ≡ *Racomitrium pseudoaciculare* (Müll.Hal.) Paris, *Index Bryol. Suppl.*: 294. 1900. **Type citation:** Prom. bonae spei, sine loco speciali, Drège legit ante plus quam 60 annos. **Lectotype** (*selected here*): “*Racomitrium* ‘pseudo-aciculare CM’ nigroviride (CM). C. B. Sp. leg. Drège” – H-Brotherus!; **isotypes:** BM!, W! First synonymised with *Racomitrium lamprocarpum* by Ochyra *et al.* (1988: 240).

Grimmia nigroviridis Müll.Hal., *Hedwigia* 38: 121. 1899 [‘nigro-viridis’]. ≡ *Racomitrium nigroviride* (Müll.Hal.) Paris, *Index Bryol. Suppl.*: 294. 1900. **Type citation:** Prom. bonae spei, Mte. Tabularis et in montibus supra Worcester, Nov. 1875: Dr. A. Rehmman in Musc. austro-afr. No. 139. **Lectotype** (*vide* De Sloover 1977: 170): “Dr. A. Rehmman: Musci austroafricani (1875-77). Nr. 139.b. *Grimmia nigro-viridis* C. M. n. sp. In montibus supra Worcester” – BM!; **isotype:** BM-Bescherelle! **Syntypes:** “Dr. A. Rehmman: Musci austroafricani (1875-77). Nr. 139. *Grimmia nigro-viridis* C. M. n. sp. In Monte Tabulari” – BM!, H-Brotherus!, S! First synonymised with *Racomitrium lamprocarpum* by Ochyra *et al.* (1988: 240).

Grimmia nigroviridis Müll.Hal. var. *robusticula* Müll.Hal., *Hedwigia* 38: 121. 1899. ≡ *Racomitrium nigroviride* (Müll.Hal.) Paris var. *robusticulum* (Müll.Hal.) Paris, *Index Bryol. Suppl.*: 294. 1900. **Type citation:** Devilspeak: Dr. A. Rehmman, Musc. a. a. No. 139 c. **Lectotype** (*vide* Ochyra *et al.* 1988: 240 as holotype [Art. 9.8]): “Dr. A. Rehmman: Musci austroafricani (1875-77). Nr. 139.c. *Grimmia nigro-viridis* C. M. n. sp. Devilspeak” – BM!; **isotypes:** BM-Bescherelle!, H-Lindberg! First synonymised with *Racomitrium lamprocarpum* by Ochyra *et al.* (1988: 240).

ECOLOGICAL AND PHYTOGEOGRAPHICAL REMARKS

Bucklandiella lamprocarpa is taxonomically an isolated species which, together with the Fuegian *B. bartramii* (Roiv.) Bednarek-Ochyra *et* Ochyra, Brazilian *B. visnadae* (W.R.Buck) Bednarek-Ochyra *et* Ochyra and European *B. elliptica* (Turner) Bednarek-Ochyra *et* Ochyra, constitutes the type section within the genus. Although the infrageneric classification of *Bucklandiella* still needs refinement, this section is diagnosed primarily by having coarsely papillose and large spores, leaves that consistently lack hair-points, and the absence of basal marginal borders. However, the most spectacular and conspicuous characters of *B. lamprocarpa* are a strong costa confluent with similarly strong marginal borders and a tendency to polystratosity of the laminal cells. These features are typical ecological adaptations of mosses in rheophytic habitats. They are typical for a number of grimmialean mosses, including some species of *Codriophorus* P.Beauv., such as *C. norrisii* (Bednarek-Ochyra *et* Ochyra) Bednarek-Ochyra *et* Ochyra (Bednarek-Ochyra & Ochyra, 2000) and some expressions of *C. acicularis* (Hedw.) P.Beauv. (Sérgio *et al.*, 1995; Bednarek-Ochyra, 2006). Likewise, they are present in some species of *Bucklandiella*, such as the Brazilian *B. visnadae* (W.R.Buck) Bednarek-Ochyra *et* Ochyra (Bednarek-Ochyra *et al.*, 1999) and the

Holarctic *B. macounii* (Kindb.) Bednarek-Ochyra *et* Ochyra (Bednarek-Ochyra, 1995), and *Schistidium* Bruch *et* Schimp., such as *S. deguchianum* Ochyra *et* Bednarek-Ochyra from Peru (Ochyra & Bednarek-Ochyra, 2011), *S. lewis-smithii* Ochyra from the Antarctic (Ochyra, 2003), *S. falcatum* (Hook.f. *et* Wilson) B.Bremer from South America and Subantarctica (Ochyra & Bell, 1984), *S. frahmianum* Ochyra & Afonina from Beringia (Ochyra & Afonina, 2010) and *S. riparium* H.H.Blom, Shevock, D.G.Long *et* Ochyra and *S. mucronatum* H.H.Blom, Shevock, D.G.Long *et* Ochyra from China (Blom *et al.*, 2011).

Taxa with similar rheophytic adaptations are not confined only to acrocarpous mosses but they are present in many distantly related genera of pleurocarpous mosses. The similar leaf structure with fleshy, multistratose limbidia extending from the base to the apex and entirely, or nearly so, polystratose laminal cells are present in the monotypic genera *Hypnobartlettia* Ochyra from New Zealand (Ochyra, 1985a), *Koponenia* Ochyra from Bolivia (Ochyra, 1985b), *Handeliobryum* Broth. from the Sino-Himalayan region (Ochyra, 1986a; Ochyra & Shevock, 2012), *Sciaromiella* Ochyra from Haiti and *Sciaromiopsis* Broth., from China (Ochyra, 1986b), *Richardsiopsis* Ochyra from Peru and Chile (Ochyra, 1986c; Ochyra & Mahu, 1988) which is now considered to be congeneric with *Drepanocladus* (Müll.Hal.) G.Roth (Ochyra & Matteri, 2001), *Vittia* Ochyra from South America, South Africa and subantarctic islands (Ochyra, 1987a; Ochyra & Lightowers, 1988), and *Platylomella* A.L.Andrews from eastern North America (Ochyra, 1987b), as well as in the bitypic genera *Limbella* (Müll.Hal.) E.B.Bartram, consisting of two species from the Hawaiian Islands and Oregon in western North America (Ochyra, 1987c) and *Gradsteinia* Ochyra with two species from Colombia and the Canary Islands (Ochyra, 1990; Ochyra *et al.*, 1998). Moreover, species with rheophytic adaptations are known in some large genera, for example in four species of *Neckeropsis* Reichdt., namely *N. moutieri* (Broth. & Paris) M.Fleisch. from Vietnam and *N. boniana* (Besch.) Touw & Ochyra from Myanmar and Vietnam (Touw & Ochyra, 1987), *N. takahashii* Higuchi, Z.Iwats., Ochyra *et* X.-J.Li from China (Higuchi *et al.*, 1989) and *N. touwii* Ochyra *et* Enroth from Papua New Guinea (Ochyra & Enroth, 1989) and in some species *Platyhypnidium* M.Fleisch., for instance *P. mutatum* Ochyra & Vanderpoorten from Germany (Ochyra & Vanderpoorten, 1999) and *P. lusitanicum* (Schimp.) Ochyra *et* Bednarek-Ochyra (Ochyra & Bednarek-Ochyra, 2006).

The geographical range of *Bucklandiella lamprocarpa* is somewhat anomalous but it can be otherwise designated as bipolar. The species has the main centre of its distribution in the Southern Hemisphere where it has a pan-Holantarctic temperate range. It has maximum occurrence in southern South America at the western fringes of the continent, ranging from lat. ca 39°S in the Valdivian province to the Cape Horn area and the Falkland Islands (Ochyra *et al.*, 1988; Bednarek-Ochyra *et al.*, 1996), with isolated stations in the Juan Fernandez Islands (Robinson, 1975), and along the Andean chain in Bolivia (Blockeel *et al.*, 2009), Ecuador (Blockeel *et al.*, 2002), Peru, Colombia and Venezuela (Churchill *et al.*, 2000). It recurs in the Cape area of South Africa and on some islands in the Southern Ocean, including Gough Island in the South Atlantic (Ochyra *et al.*, 1988), Marion Island in the Prince Edward Islands archipelago (Ellis *et al.*, 2011b), Îles Kerguelen (Bednarek-Ochyra & Ochyra, 1998) and Heard Island (Ellis *et al.*, 2010) in the Kerguelen Province of the Subantarctic and on Macquarie Island in the Australasian sector of Subantarctica (Blockeel *et al.*, 2007). In the Northern Hemisphere *B. lamprocarpa* has a narrow geographical range on the Iberian Peninsula (Casas *et al.*, 1992).

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