

On the identity of *Ditrichum validinervium* (Bryophyta, Ditrichaceae)

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Abstract – *Ditrichum validinervium* Kaal., a species described from Île de la Possession and Île de l'Est in the Îles Crozet archipelago in Subantarctica, is assessed and some details of its gametophyte are illustrated. An examination of the type material of this species revealed that it is inseparable from *D. conicum* (Mont.) Mitt. and *D. validinervium* is the first heterotypic synonym of this name.

Bryophyta / distribution / *Ditrichum* / Îles Crozet / Kerguelen Province / Subantarctica / taxonomy

INTRODUCTION

The genus *Ditrichum* Hampe is well represented in the moss flora of the austral polar regions, both in terms of frequency and cover, as well as the number of species. Species richness and their importance in the vegetation cover in this biome resulted in relatively frequent interest of bryologists in this genus and it has been dealt with in a good number of taxonomic studies (e.g. Seppelt, 1980, 1982, 1991, 1996; Ochyra, 1994, 1996a, b, 1999a; Ochyra & Lewis Smith, 1998). As a consequence, it is quite well known taxonomically on subantarctic Macquarie Island in the Australasian sector (Seppelt, 2004) and in Antarctica and subantarctic South Georgia (Ochyra & Lewis Smith, 1998; Ochyra *et al.*, 2008a, b). In the former the genus is represented by three species, namely *D. brevirostre* (R.Br.bis) Broth., *D. punctulatum* Mitt. and *D. strictum* (Hook.f. et Wilson) Hampe, whereas in the latter five species are known to occur, including *D. heteromallum* (Hedw.) E.Britton, *D. conicum* (Mont.) Mitt., *D. hyalinum* (Mitt.) Kuntze, *D. hyalinocrepidatum* Cardot and *D. ditrichoideum* (Cardot) Ochyra.

In the Kerguelen biogeographical province in the African sector of Subantarctica *Ditrichum* is also relatively well known. It is represented in this region by six species, namely *D. strictum*, *D. conicum*, *D. ditrichoideum*, *D. hookeri* (Müll.Hal.) Hampe, *D. subaustrale* Broth. (syn. *D. immersum* Zanten) and *D. validinervium* Kaal. Of these the first five are well defined and generally accepted species, whereas the last is a poorly known and obscure species which has not been studied since its description.

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BRIEF HISTORY OF EARLY MOSS COLLECTIONS FROM ÎLES CROZET

Îles Crozet archipelago consists of five main volcanic islands situated in the Southern Ocean 2400 km south-east of South Africa. It lies just north of the Polar Frontal Zone at lat. 46°00'-46°30'S. In contrast to Îles Kerguelen and the Prince Edward Island, the other two archipelagos in the Kerguelen biogeographical province, the study of the bryophyte flora of Îles Crozet started only at the beginning of the twentieth century and in general this island group is still underexplored bryologically. Actually, for over sixty years the entire knowledge on bryophytes of this archipelago was based upon collections made by the German South Polar Expedition of 1901-1903 under the leadership E. von Drygalski and by the Norwegian sealing voyage of 1907-1908 on the ship *Solglimt* under the command of Captain Anders Harboe Ree. The only earlier bryological report from Îles Crozet is that by Kidder (1876) who incidentally mentioned "a moss believed to be *Andreaea marginata*" collected on Île de la Possession by the United States Transit-of-Venus Expedition of 1874-1875.

Mosses collected by the German expedition were studied by Brotherus (1906) who reported 11 species from Île de la Possession and Île de l'Est. Of these, two species (*Anomobryum werthii* Broth. and *Cratoneuron drepanocladoides* Broth.) and one variety (*Bryum argenteum* Hedw. var. *obtusifolium* Broth.) were described as new to science.

More efficient was the Norwegian expedition which operated from 25 November 1907 to 1 February 1908 on the two largest islands of Îles Crozet and Theodor Ring and Ola Raknes made a representative collection of liverworts and mosses. It was studied by B. Kaalaas who reported 15 species of hepatics, including four new to science (Kaalaas, 1911) and 26 species of moss, including seven species and one variety new to science (Kaalaas, 1912). Four of these eight taxa have hitherto been assessed taxonomically and only *Campylopus subnitens* Kaal. appears to be a good and accepted species, endemic to the Kerguelen province (Frahm, 1985, 1988). *Breutelia propinqua* Kaal. is conspecific with *B. pendula* (Sw.) Mitt. (Zanten, 1971), *Dicranella hookeri* (Müll.Hal.) Cardot var. *elongata* Kaal. (Ochyra, 1999b) is merely a luxuriant form of the type variety growing in permanently inundated sites in streams, and *Ptychomnion ringianum* Broth. et Kaal. is identical to *P. densifolium* (Brid.) A.Jaeger (Ochyra, 2002). The remaining four species, including *Ditrichum validinervium* Kaal., *Bryum crozetense* Kaal., *Philonotis angustifolia* Kaal. and *Ph. tenella* Kaal., have not been examined since their description and need re-assessment.

The purpose of this account is to clarify the identity of *Ditrichum validinervium* by the examination of the type material in the herbarium of the Botanical Institute of the University of Bergen (BG), where the collection of B. Kaalaas is kept.

DESCRIPTION OF THE TYPE SPECIMENS OF *DITRICHUM VALIDINERVIUM*

Ditrichum validinervium was described by Kaalaas (1912) on the basis of the specimens collected on Île de la Possession and Île de l'Est. The author indicated that on both sites the moss grew sparsely in tufts of *Jamesoniella*

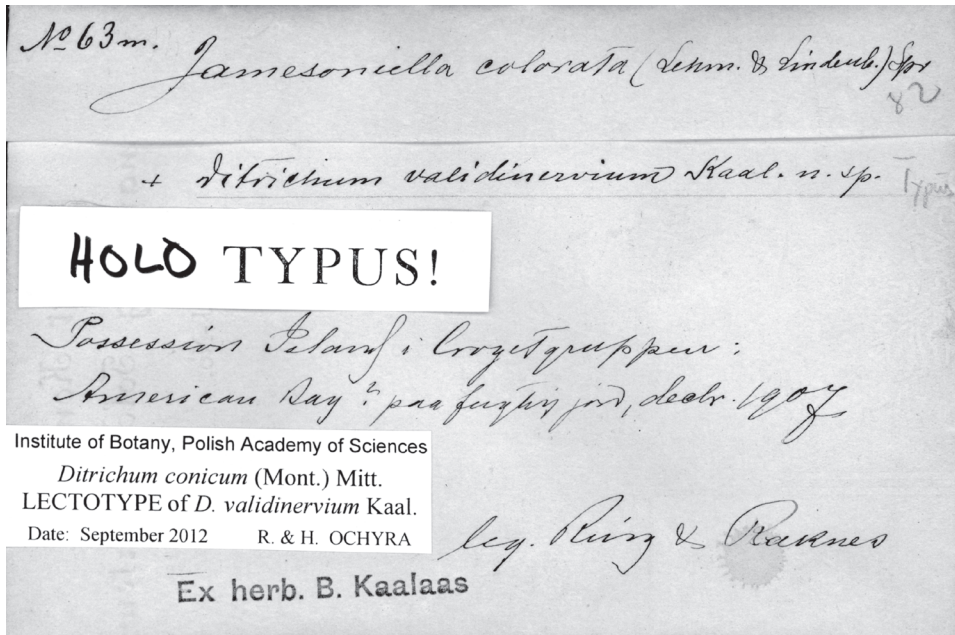


Fig. 1. Label of the lectotype specimen of *Ditrachum validinervium* from BG.

colorata (Lehm.) Schiffn. In the Kaalaas herbarium in BG there is a single original specimen of the species which was designated by someone as holotype (Fig. 1).

The handwritten label on the cover indicates that the material was collected from Baie Américaine on the north-eastern coast of Île de la Possession. Inside the cover there are two small packets without any labels bearing the shoots of *Ditrachum validinervium* intermixed with *Jamesoniella colorata* and three microscopic slides made by B. Kaalaas. Two of them were made on 29 December 1910 and bear the species name and the annotation "Original", whereas the third slide was made in January 1912. It bears no species name and only the collection number "63" written with pencil and the note "Crozet Islands 1908". There are several leaves mounted in this slide and they represent *Blindia magellanica* Müll.Hal., a species which has not been recorded by Kaalaas (1912) from Îles Crozet and which was only recently reported from this archipelago (Blockeel *et al.* 2010). Interestingly, no specimen of this species was encountered in tufts of all specimens of *Jamesoniella colorata* studied by Kaalaas and containing *Ditrachum validinervium* as an admixture.

Because two collecting sites are indicated in the protologue, the only specimen available in the Kaalaas collection in BG is here selected as a lectotype of *D. validinervium*. However, examination of the two specimens of *Jamesoniella colorata* collected by Ring and Raknes from Île de l'Est showed that some scattered shoots of a *Ditrachum* species are available and these perfectly agree with the original material of *D. validinervium*. It is obvious that they represent the specimens from the second site which is cited in the protologue and can be considered as syntypes.

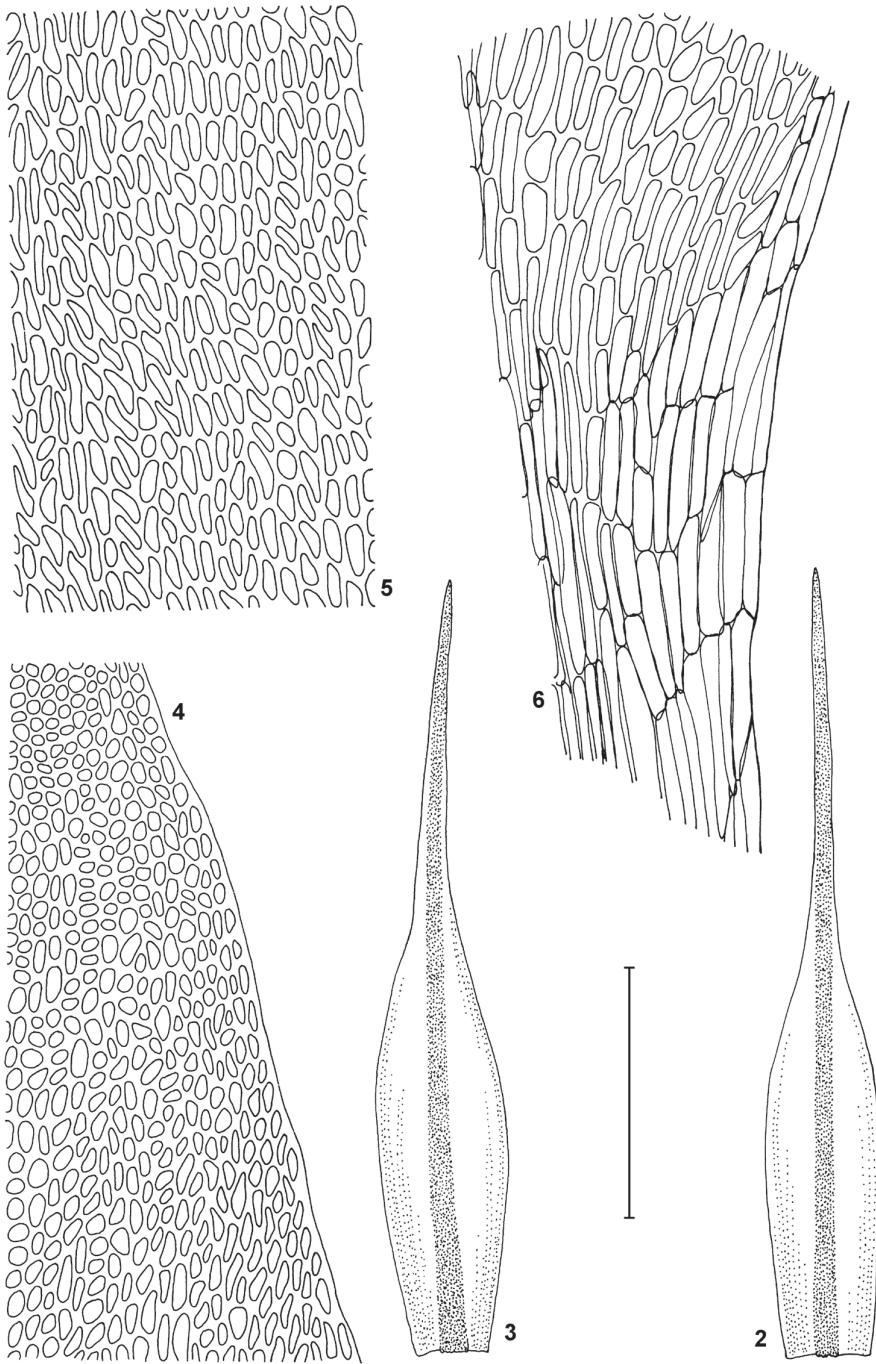
The plants are medium-sized and slender, dull, brownish below and yellowish-green above. The stems are 1-2 cm tall, simple or forked, erect, sparsely radiculose near the base with pale brownish rhizoids. The leaves are 2-3 mm long, 0.3-0.6 mm wide, densely set on the stem, erect and appressed, slightly altered on drying, from an oblong-ovate to oblong-lanceolate, concave sheathing base gradually narrowed into a channelled, smooth subula (Figs 2-3). The subula is rigid, strict and erect, and usually as long as or slightly longer than the leaf base. It is narrow, acute, entire or more or less denticulate at the apex. The leaf margins are entire, plane in the sheath and inflexed in the subula. The costa is single, pale yellowish-brown to brown, not sharply separated from the lamina cells, percurrent to excurrent, 120-140 μm wide at the base. It is flattened and fills most of the width of the subula, smooth on the abaxial surface and consists of a median row of large guide cells and 2 stereid bands as visible in transverse section. The lamina cells are smooth, non-porose, transparent, thin- to moderately thick-walled, randomly arranged, unistratose throughout and distinctly thinner towards the margins. They are rounded, subquadrate to transversely elliptical at the shoulders, 6-10 μm \times 6-12 μm (Fig. 4), becoming variable in shape below, irregular, elliptical, obliquely rhomboidal to short rectangular, 7-10 μm \times 10-35 μm (Fig. 5). The marginal cells are firm- to thin-walled, narrower towards the margin, oblong-rhomboidal to linear-rectangular, 4-6 μm \times up to 50 μm and usually form a distinct basal hyaline border, often extending as high as the mid-sheath (Fig. 6). The cells in the subula are unistratose, isodiametric to short-rectangular, rhombic, rounded or elliptic, 5-15 μm \times 4-8 μm . The angular cells are not differentiated.

When describing *Ditrichum validinervium* Kaalaas (1912) stated that it is closely related to *D. sub australe* Broth., a species described from Heard Island (Brotherus, 1906). As noted by Kaalaas himself, *D. sub australe* is a larger plant with a broader costa and a different leaf areolation. Actually, the two species have nothing in common and the latter is immediately distinct in its long leaves, 4-7 mm, with a long spirally twisted subula and narrowly rectangular to linear laminal cells, 60-110 μm . Although the plants of *D. validinervium* are consistently sterile, the gametophyte characters clearly indicate that *Ditrichum validinervium* is inseparable from *D. conicum* with which it matches in all details, especially in the leaf areolation. Consequently, the two must be considered conspecific, the latter having priority. It is worth noting that *D. validinervium* is the only known heterotypic synonym of *D. conicum* which is otherwise a very distinct species.

Ditrichum conicum (Mont.) Mitt., *Phil. Trans. R. Soc. London* 168: 25. 1879.

\equiv *Aschistodon conicus* Mont., *Ann. Sci. Nat. Bot.*, Sér. 3, 4: 110. 1845 \equiv *Cynodontium conicum* (Mont.) Mitt., *J. Linn. Soc. Bot.* 15: 528. 1877. **Type citation:** In provinciis meridionalibus Chiles à cl. C. Gay lectus. [**Lectotype** (*vide* Ochyra *et al.*, 2008b: p. 148): “Herb. Mus. Paris Herbier du Chili austral envoyé par M. Gay (3^e envoi) *Aschistodon* nov. gen. Mont. A. conicum Montag.” – PC-Montagne!; isotypes: BM-Hooker!, BM-Schimper!, BM-Dixon!, PC-Montagne! (2 specimens)].

$=$ *Ditrichum validinervium* Kaal., *Nyt Mag. Naturvidensk.* 50: 98. 1912. **Type citation:** [Îles Crozet] Possession Island und East Island. [**Lectotype** (*selected here*): “N^o 63 m. Jamesoniella colorata (Lehm. & Lindenb.) Spr. + *Ditrichum validinervium* Kaal. n. sp. Possession Island i Crozetgruppen: American Bay ? paa fuktig jord, Decbr. 1907 leg. Ring & Raknes Ex herb. B. Kaalaas” – BG-Kaalaas (M-17872)! **Syntypes:** (1) “N^o 51 m. Jamesoniella colorata (Lehm. & Lindenb.)



Figs 2-6. *Ditrichum conicum*. 2-3. Leaves. 4. Laminal cells at leaf shoulders. 5. Cells in middle of sheathing base. 6. Basal cells of leaf sheath. [All from lectotype of *D. validinervium*]. Scale bar: 1 mm (2-3) and 100 μ m (4-6).

Spr. East Island i Crozetgruppen, januar 1908 leg. Ring & Raknes Ex herb. B. Kaalaas” – BG-Kaalaas (M-18018)! (2) “M-18019-18023 N^o 51 m. Jamesoniella colorata (Lehm. & Lindenb.) Spr. (M-18018) + Sphenolobus leucorhizus (Mitt.) M-18020 + Lepidozia laevifolia Tayl. M-18021 + Lophocolea humilis (Hook.f. & Wils.) Steph. M-18022 + Tylimanthus viridis Mitt. M-18023 East Island i Crozetgruppen, januar 1908 leg. Ring & Raknes Ex herb. B. Kaalaas” – BG-Kaalaas!, **syn. nov.**

PHYTOGEOGRAPHICAL REMARKS

Ditrichum conicum is an amphiatlantic temperate species which is widespread in the *Nothofagus* zone along the western coast of southern South America from the Valdivian region at lat. ca 40°S to Tierra del Fuego. It is also known from subantarctic South Georgia (Ochyra *et al.*, 2002) and extends to the volcanic Visokoi Island in the South Sandwich Islands archipelago and Deception Island in the South Shetland Islands in the maritime Antarctic (Ochyra *et al.*, 2008a, b). Additionally, it occurs on Tristan da Cunha (Dixon, 1960) and subantarctic islands in the Kerguelen biogeographical province, including the Prince Edward Islands (Ochyra, 2008), Heard Island (Bergstrom & Seppelt, 1988), Îles Kerguelen (Hébrard, 1970; Ochyra, 1992), and recently it was also recorded from Île de la Possession in the Îles Crozet archipelago (Blockeel *et al.*, 2010).

The moss flora of Îles Crozet is the least studied of all islands in the Kerguelen province. The only other collection, after the first two made at the beginning of the twentieth century (Brotherus, 1906; Kaalaas, 1912), was made only in 1969 by J.-P. Hébrard who recorded about 40 species from Île de la Possession and Île de l’Est (Hébrard, 1970; Desplanques & Hébrard, 1972). Additional collections made in the 1979 by B. G. Bell and in 2006 by R. Ochyra yielded additional 11 species, including *Hennediella antarctica* (Ångstr.) Ochyra *et* Matteri (Blockeel *et al.*, 2006), *Anomobryum julaceum* (P.Gaertn., B.Meyer *et* Scherb.) Schimp. (Blockeel *et al.*, 2007a), *Pohlia nutans* (Hedw.) Lindb. (Blockeel *et al.*, 2007b), *Bucklandiella pachydietyon* (Cardot) Bednarek-Ochyra *et* Ochyra (Blockeel *et al.*, 2008), *B. striatipila* (Cardot) Bednarek-Ochyra *et* Ochyra and *Hymenoloma immersa* Broth. (Blockeel *et al.*, 2009), *Blindia magellanica*, *Ditrichum conicum* and *Drepanocladus longifolius* (Mitt.) Paris (Blockeel *et al.*, 2010), *Catagonium nitens* (Brid.) Cardot (Ellis *et al.*, 2010), and *Willia calobolax* (Müll.Hal.) Lightowers (Ellis *et al.*, 2012). Thus, at present about 60-65 species of moss are known from this archipelago. This does not seem to be the final number of species and field studies should result in further discoveries. Considering the similar size, climate and vegetation, one can assume that the moss flora of Îles Crozet consists of about 90-100 species which have been detected in the adjacent Prince Edward Islands archipelago (Ochyra, 2008).

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REFERENCES

- BERGSTROM D.M. & SEPPELT R.D., 1998 — The moss flora of Heard Island: revised checklist, annotations and phytogeographical considerations. *Lindbergia* 14: 184-190.
- BLOCKEEL T.L., CHLEBICKI A., HÁJKOVÁ P., HÁJEK M., HRADÍLEK Z., KÜRSCHNER H., OCHYRA R., PAROLLY G., PLÁŠEK V., QUANDT D., TOWNSEND C.C. & VANDERPOORTEN A., 2006 — New national and regional bryophyte records, 12. *Journal of bryology* 28: 68-70.
- BLOCKEEL T.L., BEDNAREK-OCHYRA H., OCHYRA R., DÜZENLI A., ERDAĞ A., ERZBERGER P., EZER T., HESPANHOL H., KARA R., MATTERI C.M., MÜLLER F., SÉNECA A., SÉRGIO C. & VÁŇA J., 2007a — New national and regional bryophyte records, 15. *Journal of bryology* 29: 139-142.
- BLOCKEEL T.L., BEDNAREK-OCHYRA H., OCHYRA R., GARILLETI R., GLIME J.M., LARA F., MAZIMPAKA V., RUSIŇSKA A., SCHAEFER-VERWIMP A., SHABBARA H.M., SÖDERSTRÖM L., STEBEL A., TOWNSEND C.C., VÁŇA J., YAYINTAŞ Ö.T. & ŻARNOWIEC J., 2007b — New national and regional bryophyte records, 17. *Journal of bryology* 29: 277-283.
- BLOCKEEL T.L., BEDNAREK-OCHYRA H., OCHYRA R., DUCKETT J.G., ERZBERGER P., HEDENÅS L., HUGONNOT V., MAIER E., MARKOVÁ I., MATCHAM H.W., PLÁŠEK V., PÓCS T., SEPPELT R.D., SZÚCS P., THOUVENOT L. & VAN ZANTEN B.O., 2008 — New national and regional bryophyte records, 18. *Journal of bryology* 30: 161-167.
- BLOCKEEL T.L., PASSOS BASTOS C.J., BEDNAREK-OCHYRA H., OCHYRA R., DULIN M.V., FOVET L., GARCIA C., HEDENÅS L., HUGONNOT V., KIRMACI M., KOPONEN T., LÉBOUVIER M., MARTINS A., MÜLLER F., SABOVLJEVIĆ M., LAKUŠIĆ D., SCHÄFER-VERWIMP A., SÉRGIO C., SURINA B. & YAYINTAŞ Ö.T., 2009 — New national and regional bryophyte records, 22. *Journal of bryology* 31: 201-210.
- BLOCKEEL T.L., BEDNAREK-OCHYRA H., CYKOWSKA B., OCHYRA R., DÜZENLI A., EZER T., HOLYOAK D.T., HUGONNOT V., KARA R., LARRAIN J., LÉBOUVIER M., PRESTON C.D., SCHÄFER-VERWIMP A., SMITH V.R., SPITALE D., ŞTEFĂNUŢ S. & VÁŇA J., 2010 — New national and regional bryophyte records, 23. *Journal of bryology* 32: 140-147.
- BROTHERUS V.F., 1906 — Die Laubmoose der Deutschen Südpolar-Expedition 1901-1903. In: E. von Drygalski (ed.), *Deutsche Südpolar-Expedition 1901-1903 im Auftrage des Reichsamtes des Innern*. 8 (Botanik). Berlin, Georg Reimer, pp. 83-96.
- DESPLANQUES A. & HÉBRARD J.-P., 1972 — Complément à l'étude des muscinées récoltées aux Iles Kerguelen et Crozet (campagne d'été des T.A.A.F. 1969) et notes pédologiques. *Riviera scientifique* 3: 59-76.
- DIXON H.N., 1960 — Mosses of Tristan da Cunha. In E. Christophersen (ed.), *Results of the Norwegian Scientific Expedition to Tristan da Cunha 1937-1938. No. 48*. Oslo, Kommissjon hos H. Aschehoug & Co. (W. Nygaard), pp. 1-49.
- ELLIS L.T., ASTHANA A.K., SAHU V., BEDNAREK-OCHYRA B.H., OCHYRA R., CANOM J., COSTA D.P., CYKOWSKA B., OCHYRA R., PHILIPPOV D.A., DULIN M.V., ERZBERGER P., LÉBOUVIER M., MOHAMED H., OCHYRA R., ORGAZ J.D., PHEPHU N., VAN ROOY J., STEBEL A., SUÁREZ G.M., SCHIAVONE M.M., TOWNSEND C.C., VÁŇA J., VONČINA G., YAYINTAŞ Ö.T., YONG K.T. & ZANDER R.H., 2010 — New national and regional bryophyte records, 25. *Journal of bryology* 32: 311-322.
- ELLIS L.T., BEDNAREK-OCHYRA H., OCHYRA R., CYKOWSKA B., DULIN M.V., EZER T., KARA R., FLORES J.R., SUÁREZ G.M., GARCIA C., MARTINS A., SÉRGIO C., GARILLETI R., KIRMACI M., AGCAGIL E., KURBATOVA L.E., LÉBOUVIER M., PAPP B., SZURDOKI E., PHILIPPOV D.A., PLÁŠEK V., PÓCS T., SABOVLJEVIĆ M., SAWICKI J., SIM-SIM M., SZÚCS P., BIDLÓ A., VÁŇA J., VIGALONDO B., LARA F., DRAPER I., VIRCHENKO V.M. & WOLSKI G.J., 2012 — New national and regional bryophyte records, 33. *Journal of bryology*, 34: 281-291.
- FRAHM J.-P., 1985 — Afrikanische *Campylopus*-Arten (Dicranaceae, Musci). *Bryophytorum bibliotheca* 31: 1-216.
- FRAHM J.-P., 1988 — The subantarctic and southern hemispheric species of *Campylopus* (Dicranaceae), with contributions to the origin and speciation of the genus. *Journal of the Hattori botanical laboratory* 64: 367-387.
- HÉBRARD J. P., 1970 — Muscinées récoltées aux Iles Kerguelen and Crozet pendant la campagne d'été des Terres Australes et Antarctiques Françaises (1969). *Revue bryologique et lichénologique, nouvelle série* 37: 135-162.

- KAALAAS B., 1911 — Bryophyten aus den Crozetinseln. I. *Nyt magazin for naturvidenskaberne* 49: 81-98.
- KAALAAS B., 1912 — Bryophyten aus den Crozetinseln. II. *Nyt magazin for naturvidenskaberne* 50: 97-119.
- KIDDER J.H., 1876 — Crozet flora. In: J.H. Kidder, *Contributions to the natural history of Kerguelen Island, made in connection with the United States Transit-of-Venus Expedition, 1874-75. 2. Botany. Bulletin of the United States National Museum* 3: 31.
- OCHYRA R., 1992 — A new synonym of *Blindia magellanica* (Musci, Seligeriaceae). *Fragmenta floristica et geobotanica* 37: 221-225.
- OCHYRA R., 1994 — Antipodal mosses: II. The identity of *Ditrichum perporodictyon* (Musci, Ditrichaceae). *Fragmenta floristica et geobotanica* 39: 113-116.
- OCHYRA R., 1996a — *Ditrichum lewis-smithii* (Ditrichaceae, Bryopsida), a new species from Antarctica. *Annales botanici fennici* 33: 303-309.
- OCHYRA R., 1996b — Rhizoid gemmae in *Ditrichum brotherusii* (Musci, Ditrichaceae) from Antarctica. *Fragmenta floristica et geobotanica* 41: 1013-1015.
- OCHYRA R., 1999a — *Ditrichum austrogeorgicum*: a synonym of *D. hyalinum* (Ditrichaceae, Bryopsida). *Cryptogamie, bryologie* 20: 247-253.
- OCHYRA R., 1999b — Antipodal mosses: XI. Additional new synonyms of *Anisothecium hookeri* (Musci, Dicranaceae). *Fragmenta floristica et geobotanica* 44: 233-238.
- OCHYRA R., 2002 — *Ptychomnion ringianum* Broth. & Kaal., synonymous with *P. densifolium* (Brid.) A.Jaeger (Ptychomniaceae). *Journal of bryology* 24: 87-88.
- OCHYRA R., 2008 — Mosses of the Prince Edward Islands. In S.L. Chown & P.W. Froneman (eds), *The Prince Edward Islands: land-sea interactions in a changing ecosystem*. Stellenbosch, Sun Press, pp. 383-389.
- OCHYRA R. & LEWIS SMITH R.I., 1998 — Antarctic species in the genus *Ditrichum* (Ditrichaceae, Bryopsida), with a description of *D. gemmiferum* sp. nov. *Annales botanici fennici* 35: 33-53.
- OCHYRA R., BEDNAREK-OCHYRA H. & LEWIS SMITH R.I., 2002 — New and rare moss species from subantarctic South Georgia. *Nova Hedwigia* 74: 121-147.
- OCHYRA R., BEDNAREK-OCHYRA H. & LEWIS SMITH R.I., 2008a — New and rare moss species from the Antarctic. *Nova Hedwigia* 87: 457-477.
- OCHYRA R., LEWIS SMITH R.I. & BEDNAREK-OCHYRA H., 2008b — *The illustrated moss flora of Antarctica*. Cambridge, Cambridge University Press. xvii + 685 p. [+ 24 p. with plates].
- SEPPELT R.D., 1980 — The taxonomic status of *Pseudoditrichium* Card. (Ditrichaceae). *Lindbergia* 6: 126-128.
- SEPPELT R.D., 1982 — A monographic revision of the genus *Ditrichum* (Musci: Ditrichaceae). I. Australian and New Zealand species. *Journal of the Hattori botanical laboratory* 51: 99-150.
- SEPPELT R.D., 1991 — *Ditrichum subaustrale* var. *robustum* Card., is a *Dicranoweisia*. *Journal of bryology* 16: 607-610.
- SEPPELT R.D., 1996 — A re-examination of *Ditrichum immersum* van Zanten. *Journal of bryology* 19: 267-277.
- SEPPELT R.D., 2004 — *The moss flora of Macquarie Island*. Kingston, Tasmania, Australian Antarctic Division. [14] + 328 pp.
- ZANTEN B. O. VAN, 1971 — Musci. In: E.M. van Zinderen Bakker, Sr., J.M. Winterbottom & R.A. Dyer (eds), *Marion and Prince Edward Islands. Report on the South African Biological and Geological Expedition 1965-1966*. Cape Town, A. A. Balkema, pp. 173-227.