

## ISOLECTOTYPE OF *EUSTICHIA AFRICANA* (EUSTICHIACEAE, DICRANALES) DEPOSITED IN LW CONFIRMS THE SPECIES STATUS OF AFRICAN ENDEMIC SPECIES

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An isolectotype specimen of *Eustichia africana* deposited in the herbarium LW (Lviv, Ukraine) is discussed and illustrated here. The LW isolectotype of *Eustichia africana* is found to be the most complete (largest in terms of the number of plant fragments) original collection among initial syntypes (now the lectotype at PRE and numerous isolectotypes) of this taxon distributed in Rehmman's exsiccatae (and kept in W, PC, PRE, etc). A detailed description and illustration of the LW isolectotype specimen are provided. The special investigation of LW specimens of *Fissidens eustichium* found to confirm species status of *Eustichia africana*, which is different from *E. longirostris* (Brid.) Brid. to which sometimes *E. africana* was included as synonym since 1923 (while *Fissidens eustichium* Rehmman *nom. nud.* was included as synonym [to the latter taxon (= *E. longirostris*)] since 1894). Thus, the name and the accepted status of species *Eustichia africana* are resurrected.

Key words: Africa, bryophyte, *Diplostichum*, endemic taxa, *Fissidens*, syntype

### INTRODUCTION

Two species names, i.e. *Fissidens eustichium* Rehm. (invalidly published [as *nomen nudum*] in 1875–1877) and *Eustichia africana* (Müll. Hal.) Par. (validly published later by Müller (1897, 1899 as *Diplostichum africanum* Müll. Hal.)) are based on the same type specimens, collected by A. Rehmman in 'Prom. bonae spei, Orange Free State: in cavernis supra Kadziberg: Dr. A. Rehmman, 1875' and distributed in Rehmman's Musci Austro-Africani in 1875–1877 under the number 279.

Rehmman's Musci Austro-Africani including 860 numbers were distributed in 1875–1877 and 1886 (Dixon and Gepp 1923, Wiśniewski 1923). *Fissidens eustichium* Rehm. nov. sp. without description (as *nomen nudum*) from the vicinity of Kadziberg [now Katjiesberg or Catjasberg], Orange Free State, was mentioned in the first schedae of exsiccatae mentioned under number 279 (Rehmman 1875–1877). Unfortunately, a description of the taxon that name has never been published.

Geheeb (1878) listed 130 bryophyte species collected by A. Rehm during his first expedition to South Africa in 1875–1877, where some taxa were identified by A. Rehm himself and some of them were passed to C. Müller as a separate collection. *Fissidens eustichium* Rehm. was mentioned among these taxa as a ‘very interesting species somewhat similar to *Eustichium norvegicum*’.

Later the specimen of *Fissidens eustichium* from ‘Prom. bonae spei, Orange Free State: in cavernis supra Kadziberg: Dr. A. Rehm, 1875’ from Rehm’s *Musci Austro-Africani* in 1875–1877 under number 279 was designated as the type collection for another validly published taxon *Diplostichum africanum* Müll. Hal. (‘... foliis minutis recte apiculatis distinguitur’ Müller 1897: 95). An amended description of this taxon was published also two years later (Müller 1899). Since 1900 the latter taxon is included in the genus *Eustichia* (Brid.) Brid. (i.e.: *E. africana* (Müll. Hal.) Par.) (Paris 1900). This taxon has got a status of somewhat questionable since 1890s as far only small duplicates (small plant fragments) of Rehm’s collection were distributed in South African and European herbaria.

It should be mentioned that *Fissidens eustichium* Rehm. was considered as synonym of the *Eustichia longirostris* (Brid.) Brid. since 1894 (Paris 1894–1899). However, Sim (1926) has also emphasised that Rehm’s *Fissidens eustichium* is synonym of *Eustichia africana* (Müll. Hal.) Par., but not synonymous with *E. longirostris*.

After Sim (1926) the second specimen of *Eustichia africana* distributed in Rehm’s *Musci Austro-Africani* under no. 485 (as ‘Wittebergen, above Kadziberg, Rehm. 485 as *Eustichia longirostris* Brid.’) also belongs to *Eustichia africana*. Unfortunately the specimen 485 of Rehm’s exsiccates is hitherto not kept in LW.

*Eustichia africana* was accepted only in a few papers on bryophytes of the African continent (Müller 1899, Sim 1926), while the opinion that *E. africana* is synonymous with the South American species *E. longirostris* (Brid.) Brid. was more distributed in bryological papers (Paris 1894–1898, Dixon and Gepp 1923, Magill 1981, 1987, Magill and Van Rooy 1998).

The original specimen of *Fissidens eustichium* Rehm. (= *Eustichia africana*) collected by A. Rehm in ‘Prom. bonae spei, Orange Free State: in cavernis [Mont. Witteberge] supra Kadziberg: Dr. A. Rehm, 1875’ and distributed in Rehm’s *Musci Austro-Africani* in 1875–1877 under number 279, kept in LW (Lviv, Ukraine) was forgotten and neglected till now.

During the revision of herbarium specimens of Lviv herbarium of the Ivan Franko Lviv National University (LW, Lviv, Ukraine) well-preserved specimens of Rehm’s exsiccates were found and reinvestigated (Khmil *et al.* 2013).

The aim of this paper was to provide description and illustration of the LW isolectotype specimen of *Eustichia africana* as well as to emphasise the species status of *Eustichia africana* (Müll. Hal.) Par. on the basis of special investigation of LW specimens.

## MATERIAL AND METHODS

The South African bryophyte collection of Antoni Rehmman and the isolectotype of *Eustichia africana* are deposited in the LW herbarium of the Ivan Franko Lviv National University of LW (Lviv, Ukraine). Nomenclatural rules and recommendations of the latest Code (Turland *et al.* 2018) were considered for naming specimen. Abbreviations of herbaria follow Thiers (2008–onward).

## RESULTS AND DISCUSSION

*Eustichia africana* (C. Müll.) Par., Ind. Bryol. Supp. 152 (1900); Broth. in Natürl. Pfl.-Fam. 10: 421 (1924); Sim, Bryo. S. Afr. 287 (1926). – *Diplostichum africanum* Müll. Hal., in Hedwigia 38: 53 (1899). – Type: Orange Free State, in cavernis [Mont. Witteberge] above Kadziberg [now Katjiesberg or Catjasberg], 1875 A. Rehmman 279 (LW 00212048 – isolectotype, illustrated here; PRE – lectotype designated by Magill (1987) as ‘type’, correctable to the lectotype following Art. 9.10 of the ICN (Turland *et al.* 2018), not seen; PC – 0702880 [verified by Bruggeman-Nannenga, I.], and PC 0702881 [verified by Bescherelle, E.] – sub ‘Type of *Fissidens eustichium* Rehmman ex Geh.’, W 2010-01328 sub ‘specimen originale’ of *Fissidens eustichium* Rehmman’.

The descriptions of this taxon are provided in Müller (1899), in Sim (1926), as well as in Magill (1987 under *Eustichia longirostris* (Brid.) Brid.).

Ecology: on wet stone.

Distribution: so far known from three localities, two in Mt Witteberge (ap. 22° 17' 15.6" S, 21° 07' 09.0" E) (Rehmman (1875–1977), which is close to Outeniqua Centre of Moss diversity (after Van Rooy and Phephu 2016 and the ‘Cape’ centre of high endemism and bryodiversity in Africa after Tan and Pócs 2000), as well as one locality from Natal (Seetwaters Waterfall) (Sim 1926), which is close to the Kwazulu-Natal centre of moss diversity (after Van Rooy and Phephu 2016 and the ‘Drakensberge in Natal-Lesotho’ centre of high endemism and bryodiversity in Africa after Tan and Pócs 2000). That is highly likely illustrate that the further accumulation of data on distribution of *E. africana* this taxon will be also added to African endemic bryophytes of two mentioned centres of moss diversity.

Taxonomic notes: The original Rehmman’s specimen of *Fissidens eustichium* kept in LW including nine thalli is for the first time investigated in details, illustrated and confirmed here as isolectotype of *Eustichia africana* (Fig. 1). The LW isolectotype specimen of *Eustichia africana* including nine single specimens (= plant fragments) found to be the largest Remann’s specimens of the *Musci Austro-Africani* set number 279 so far known.

It should be mentioned that conclusion about status of *Eustichia africana* as somewhat ‘a depauperate form’ of *Eustichia longirostris* (sensu Magill 1987)

was particularly built on rather poor Rehmann specimens kept in PC, PRE, W and other herbaria. However, if we note that the best specimen which was probably selected by Rehmann for home herbarium as 'holotype' *Fissidens eustichium* kept in LW was the largest portion of this collection indeed, which unfortunately was neglected and forgotten for a long time.

According to a number plant fragments on that herbarium specimen, the LW isolectotype of *Eustichia africana* (sub *Fissidens eustichium* Rehman 279) is almost the same as isotype specimens of South American *Eustichia spruceana* (Müll. Hal.) Paris (Isotype of *Eustichia spruceana* (Müll. Hal.) Paris [family Eustichiaceae] <http://plants.jstor.org/stable/10.5555/al.ap.specimen.pc0702889>), or *E. poeppigii* (Müll. Hal.) Paris (Type of *Eustichia poeppigii* (Müll. Hal.) Paris [family Eustichiaceae] <http://plants.jstor.org/stable/10.5555/al.ap.specimen.pc0702885>, which previously considered to be included in the *E. longirostris*, too.



Fig. 1. *Eustichia africana* (Müll. Hal.) Par. (LW 00212048, isolectotype). General view of original nine specimens (plant fragments)



Finding of LW specimens of *Eustichia africana*, which are the largest portion of this collection (i.e. among other isolectotypes) gives additional arguments to make a conclusion that *Eustichia africana* is a good taxon, of which PC, PRE, W and other specimens of Rehmann's collection are much smaller duplicate of this collection.

Thus here we disagree that *Eustichia africana* is synonymous to *Eustichia longirostris* and *Eustichia africana* should be accepted as a good species. The distinguished features of the two taxa have been previously described in Müller (1899), as well as Sim (1926).

It should be emphasised that there are no previous notes that LW specimens of Rehmann exsiccates were reinvestigated by any bryologists before.

It should be also mentioned that description of *Eustichia longirostris* in Magill (1987) includes also morphological and ecological features of *Eustichia africana*.

Unfortunately a number of as forgotten taxa bryophytes as recently described lichens are still not included in the assessment of centres of biodiversity and centres of endemism of African continent. Situation is better with bryological data (see Tan and Pócs 2001, Van Rooy and Phephu 2016, etc.), while recently described endemic to African continent lichen genera *Ovealmbornia* S. Y. Kondr., Fedorenko, S. Stenroos, Kärnefelt, Elix et A. Thell, *Xanthokarroa* S. Y. Kondr., Fedorenko, S. Stenroos, Kärnefelt, Elix et A. Thell, *Langeottia* S. Y. Kondr., Kärnefelt, Elix, A. Thell et J.-S. Hur, *Rehmanniella* S. Y. Kondr. et J.-S. Hur (Fedorenko *et al.* 2009, 2012, Kondratyuk *et al.* 2014, 2015, 2018) are hitherto not included in consideration of biodiversity centres, while we are at initial stage of the study of species diversity of genera mentioned and a number of new taxa are hitherto in preparation for publication. It is illustrated that recent data on lichen diversity of African continent may considerably add illustrations on importance of African centres of evolution of various groups of plants and fungi.

Many species and genera of plants and fungi occur disjunctively in South America and in Africa and there are discussions whether the disjunct distribution patterns result from a vicariance event such as the break-up of the Gondwana continent or whether they are the result of long-distance dispersal events (Delgadillo 1993, McLoughlin 2001, Orbán 2000, Sanmartín and Ronquist 2004).

The genus *Eustichia* is an example of rare genera (similarly to the genera *Karooia* Hale (reference), *Xanthomendoza* S. Y. Kondr. et Kärnefelt s. str., *Josefpoeltia* S. Y. Kondr. et Kärnefelt\* (Kondratyuk and Kärnefelt 1997), which have

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\* The genus is included in the South American and South African genera because single collection of *Josefpoeltia parva* (Räsänen) Fröden et L. Lindblom from Madagascar (coll. O. B. Blum, KW-L, Ukraine) was recently found (it is recorded here for the first time), while *J. parva* and *J. sorediosa* S. Y. Kondr. et Kärnefelt were hitherto known only from the South American continent.

relict distribution in the continents South Africa and South America and are remnants of the old continent Gondwana. The genus *Eustichia* similarly to the genera *Bryopteris* (Nees) Lindenb., *Ceratolejeunea* Jack et Steph., *Leptocyphus* Crawford, *Leptolejeunea* Heinrichs et Schäf-Verw. and *Marchenisia* can be included in the future special study of biogeographical long-distance dispersal events including molecular phylogeny methods (Bechteler *et al.* 2017, Devos and Vanderpoorten 2009, Hartmann *et al.* 2006, Heinrichs *et al.* 2009, Patiño and Vanderpoorten 2018, Scheben *et al.* 2016).

We propose to include *Eustichia africana* in the WWF Red List of endemic species of South Africa (<https://www.worldwildlife.org/ecoregions/at1316>), as well as to include this species in the list of scarcely known bryophytes, which are in urgent need of the further clarification of their conservation status assessment.

## CONCLUSION

The finding of an original specimen of *Fissidens eustichium* Rehm., nom. inval. (= which is also an isolectotype of *Eustichia africana*) kept in LW (Lviv, Ukraine) provides additional arguments that *Eustichia africana* is a separate taxon, distribution and conservation status of which have to be clarified especially in the future.

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