Andreaea flexuosa R. Brown bis subsp. luisieri Sérgio et Sim-Sim (Andreaeaceae), a new taxon from Madeira Island

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Abstract – A taxonomic study of critical plants belonging to the ecostate Andreaea from Madeira Island is presented. A new taxon, Andreaea flexuosa R. Brown bis subsp. luisieri Sérgio et Sim-Sim, is proposed based on material from upland areas in the central ridge of Madeira. Characters discriminating the two subspecies are presented and illustrated; data on ecology and distribution of the two subspecies are discussed.

Bryopsida / Andreaea/new taxa / Taxonomy / Distribution / Madeira Island / Portugal

INTRODUCTION

While studying Andreaea from Madeira Island for preparation of the Iberian and Macaronesian cartography (Casas et al., 1996) and more recently for the Iberian Bryophyte Flora (Cros & Sérgio, 2007), we observed that some herbarium collections, most provisionally named Andreaea heinemannii Hampe et Müll. Hal. or A. alpestris (Thed.) Schimp., presented distinctive characteristics that allowed to describe a new taxon of Andreaea. These plants present slight similarities with other ecostate Andreaea like Andreaea acutifolia, A. mutabilis and A. rupestris complexes studied by Vitt in Hawaii (1980). Recently, Murray (2006) in Flora of Australia considered that some Madeiran specimens examined at different herbaria corresponded to A. flexuosa R. Brown bis, a species mainly distributed in the Southern Hemisphere.

After a re-examination of all available collections of ecostate Andreaea from Madeira Island, we confirm that the majority corresponds to A. flexuosa, although the Madeiran plants have important diagnostic characters that support a new infraspecific taxon of A. flexuosa. Therefore, we consider this Macaronesian taxon a distinct subspecies, Andreaea flexuosa R. Brown bis subsp. luisieri Sérgio et Sim-Sim subsp. nov.

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TAXONOMIC DESCRIPTION

Andreaea flexuosa R. Brown bis subsp. luisieri Sérgio et Sim-Sim subsp. nov.

Figs 1-13

Type: Madeira: Bica da Cana, 12.08.1936, Luisier (LISU234214 holotype and LISF s.n. isotype); Paúl da Serra, Bica da Cana, ± 1500 m, 12.08.1936, Luisier (S B80885 isotype sub A. flexuosa, rev. B. Murray 1993).

Planta parva Andreaea flexuosa similis, sed differens: 1) foliis ovatis-lanceolatis 1:3.5 to 1:5.5; 2) apice obtuso; 3) foliorum laminaribus cellulis infra supraque unistratosis, supra saepe bistratosis; 4) sporis minutissime papillosis, 15-22(24) μm.

Plants small, dark-brown frequently reddish in upper juvenile leaves, ca 4-8(10) mm long, in dense turfs. Leaves rigid, frequently broken at the apex, slightly appressed when dry, erect-spreading, some apices slightly flexuose-twisted when moist, ecostate, ovate-lanceolate, not panduriform, concave to an obtuse apex, ca (0.70-) 0.9-1.3 mm long, (0.17-) 0.20-0.35 mm wide, 1:3.5 to 1:5.5 as long as wide; margins entire in upper part with small rounded projections of cell walls (bulging), distal margins slightly incurved, clearly incurved at apex or slightly cucullate, obtuse rarely apiculate; lamina in section unistratose from base to one third length, frequently with small bistratose areas in upper half, margins in upper part thicker than those at the middle lamina (mostly in one margin); upper laminal cells rounded to square 3-5 μm long, 4-6.5 μm wide, with low papillae or with strongly bulging walls at the dorsal side; median laminal cells thick-walled, rectangular to rhomboid, slightly pitted, gradually increasing in length to mid leaf, ca. 12-18 (-20) μm long, (3-) 4.0-6.5 μm wide; all basal (median and marginal) cells long rectangular, lumen 15-25 (-32) μm long, (3) 4.0-6.5 (-8) μm wide, irregularly thickened with sinuous walls and pitted, lumina often scalariform; perichaetial leaves oblong-lanceolate, convolute, scarcely sheathing the pseudopodium, not much longer than the adjacent leaves, 0.9-1.3 mm long. Perigonal paraphyses absent. Pseudopodium suberect, ca. 0.7-1.0 mm long. Capsules elliptic, 0.4-0.7 mm, long exerted, 4 valves, splitting from tip to two thirds. Turgid spores rounded to polyhedral, light brown, weakly papillose, (15-)19-22(24) μm diameter. Spore abortion not observed.

DIFFERENTIATION

Andreaea flexuosa is part of the A. rupestris complex, which includes species with ecostate leaves that have been recently considered as independent taxa. According to Murray (2006) it was not recognized in Australasia since its description in 1893 although it is a widespread and locally common plant. The Madeiran subsp. luisieri is a small plant with straight and rigid leaves rarely slightly flexuose-twisted when moist, and frequently with fragile apices. On the other hand, tips of intact leaves are rounded or blunt (Figs 1-11). The leaf apices are in addition, as Murray described for Australian plants, slightly incurved, but in subsp. luisieri they can be sometimes weakly cucullate and with more clearly incurved margins. However, one of the major features differentiating subsp. luisieri from subsp. flexuosa is the frequent occurrence of bistratose laminal cells, mainly in the marginal areas of the upper half of leaves (Figs 1-11). The above leaf
character was not mentioned by Vitt (1980) for any taxon of this group, but Murray (2006) considered that some specimens of A. flexuosa could present locally bistratose laminal cells.

The leaves are lanceolate or oblong-lanceolate in the two subspecies. However, in subsp. flexuosa the vegetative leaves are mainly 1:5 to 1:8-times as long as wide (Murray, 2006) in the Australian plants, while they are shorter in subsp. luisieri: 1:3.5 to 1:5.5-times as long as wide. On the other hand, the two subspecies can be readily distinguished when fertile since subsp. luisieri produces smaller spores. The larger turgid spores observed in subsp. luisieri were 15-22(24) µm diameter, while subsp. flexuosa had turgid spores 22-32 µm in Australian plants (Murray, 2006). We also have observed spores with a diameter ranging from 24 to 34 µm in some studied specimens from New Zealand and Australia.

In conclusion, the morphological distinction involving Murray’s description of A. flexuosa from Australia and New Zealand, as well as recent observations of subsp. luisieri by us are clear (Fig. 1), and some key characters support their discrimination (Table 1). Consequently, we consider the plant populations from Madeira Island a distinct subspecies representing an important northern geographic extension of A. flexuosa.

Table 1. Diagnostic characters of Andreaea flexuosa subsp. flexuosa and A. flexuosa subsp. luisieri Sérgio et Sim-Sim subsp. nov.

<table>
<thead>
<tr>
<th>Character</th>
<th>Andreaea flexuosa subsp. flexuosa</th>
<th>Andreaea flexuosa subsp. luisieri</th>
</tr>
</thead>
<tbody>
<tr>
<td>[*data based on Murray 2006]</td>
<td>[*revised material]</td>
<td>[data based on Madeira specimens studied] (Fig. 1)</td>
</tr>
<tr>
<td>Plant size (mm)</td>
<td>2.5-5.0 (-9.0) *</td>
<td>3-10 (12)</td>
</tr>
<tr>
<td>Mature leaf form</td>
<td>linear-lanceolate wider at base, blade gradually narrowed to apex (ribbon-like), straight, flexuose-twisted when moist, sinus hardly contracted •*</td>
<td>ovate-lanceolate, not flexuose-twisted when moist, sinus often contracted</td>
</tr>
<tr>
<td>Mature leaf size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>long (mm)</td>
<td>0.8-1.5*</td>
<td>0.7-1.0 (1.3)</td>
</tr>
<tr>
<td>- width (mm)</td>
<td>0.20-0.25•*</td>
<td>0.20-0.35</td>
</tr>
<tr>
<td>Leaf length/width ratio</td>
<td>1:5 to 1:8•*</td>
<td>1:3.5 to 1:5.5</td>
</tr>
<tr>
<td>Leaf apex</td>
<td>acute, often rounded, margin distally plane and not cucullate •*</td>
<td>apices rounded and with clearly incurved margins in distal part, weakly cucullate tips</td>
</tr>
<tr>
<td>Upper laminal cells transverse section</td>
<td>Entirely 1-stratose, or only with locally 2-stratose cells in sporadic areas in the upper half •*</td>
<td>Frequently 2-stratose in patches, mainly in margins or in laminal areas in the upper half</td>
</tr>
<tr>
<td>Turgid spore size (diameter/ µm)</td>
<td>22-32• or 24-34•*</td>
<td>15-22(24)</td>
</tr>
</tbody>
</table>
**ECOLOGY AND DISTRIBUTION**

*Andreaea flexuosa* subsp. *luisieri* grows on rocks forming dense red to brown tuffs. Even though we revised more than 15 specimens collected by different collectors at different dates, all Madeiran records appeared in upland areas in the central ridge of the Island in a small number of localities (Fig. 14). A large part of this collection is old, so our knowledge on the ecology of this *Andreaea* is still incomplete. However, we can establish that the plants mainly grow above 1400 to 1850 m in very small crevices of large and isolated volcanic blocks, generally in shady slopes. The colonies develop in very restricted microhabitats associated with *Andreaea heinemannii* and different species of immature tuffs of *Grimmia* spp., such as *Grimmia ovalis* (Hedw.) Lindb and *G. trichophylla* Grev. Other species found in the vicinity included *Isothecium prolixum* (Mitt.) Stech, Sim-Sim, Tangney et D. Quandt, *Pseudotaxiphyllum*...
Presently Andreaea flexuosa subsp. luisieri is only known from Madeira Island although in Madeira the genus Andreaea includes 5 species: A. alpestris (Thed.) Schimp., A. heinemannii Hampe et Müll. Hal., A. rothii F. Weber et D. Mohr. and A. rupestris Hedw. (Sérgio et al., 2006). Its occurrence in the Azores is very unlikely according the study of different collections since only A. rupestris Hedw. has been reported from two Azorean Islands (Gabriel et al., 2005). For the Canary Islands only A. heinemannii had been indicated in three islands (González-Mancebo, 2008) until recently Dirkse & Losada-Lima (2010) considered the presence of A. crassifolia Luisier on this archipelago. From a conservation perspective A. flexuosa subsp. luisieri appears to be particularly endangered for having a very restricted area on Madeira Island. This taxon was perhaps overlooked due to the small size of its colonies; anyway the area for potential occurrence is without doubt very limited.

Andreaea flexuosa subsp. flexuosa has a wide temperate distribution in the Southern Hemisphere including South Australia, Tasmania and New Zealand. It was also reported from New Guinea, Chile and Argentina, Gough Islands, Falkland Islands, Reunion, Madagascar, Southern Africa and Hawaii (Murray, 2006). In this latter area it has been reported as A. acutifolia by Vitt & Hoe (1980).

The present geographic distribution patterns of paleoaustral taxa results from a combination of factors acting in place and time, which include vicariance due to continental isolation, and step by step transoceanic dispersal, specific evolutionary rate and species extinction events (Devos & Vanderpoorten, 2009). Conjectures proposed by Sim-Sim et al. (2005) suggest that the occurrence of endemic or relic bryophytes in Madeira might be due to a combination of events during the quaternary lineage extinction in the Northern Hemisphere and postglacial expansion.

Selected specimens examined

More important areas according to Fig. 14.


Additional specimens

Andreaea flexuosa R. Brown bis

NEW ZEALAND: The Wilderness, open Dacrydium bidwillii scrubland, ca 1000 ft., 06.06.1972, Schofield 48621 (S B80897, rev. B. Murray 1996); Kelly’s Hill, 03.1874,
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AUSTRALIA: Victoria, Mt Buller, 36 km ESE of Mansfield, 1790 m, 30.12.1992, Strehmann 50716 (KRAM 137325, det. Murray 1993).

TASMANIA: Mt. Wellington, 4000 ft, 1903, Weymougth (BM000919878); Mt. Wellington, Hobart, along the trail to Fern Glade and Silver Falls, 740-800 m, 04.12.1981, Vitt 28995 (ALTA sub A. acutifolia); Mt Wellington, Hobart, along the trail to Fern Glade and Silver Falls, 04.12.1981, Vitt 28994 (ALTA sub A. acutifolia); Mt Field National Park, Lake Dobson area, 3400 ft, 06.12.1981, Vitt 29157 (ALTA sub A. acutifolia).

MARION ISLAND: Feldmark 60 m, Huntley 180 (BM sub A. acutifolia det. van Zanten).

HAWAII: Maui, Haleakala National Park, between Kipahulu Valley and Paliku, 7000 ft., Hoe 3792.0 (NY sub A. acutifolia det.Vitt).

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RÉFÉRENCES


