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# Early divergence of an Azorean endemic species in the moss genus *Rhynchostegiella* (Brachytheciaceae)

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## Abstract

Using the moss genus *Rhynchostegiella* (Brachytheciaceae) as a model, we address the question of whether taxonomic shortcomings account for the extremely low rates of endemism reported in the Azorean bryophyte flora. Eight accessions initially assigned to three of the four previously reported species in the Azores were identified as a distinct species using the Generalized Mixed Yule Coalescent method in the context of a molecular phylogenetic analysis of the genus. *Rhynchostegiella azorica* sp. nov. is therefore described as a new species that is endemic to the Azores. Its morphological features intergrade with those observed in other species, with a seta that ranges from almost smooth to rough; a length to width ratio of the laminal cells that matches the one of the *R. curviseta* group; but a leaf apex that is typical of the *R. tenella* group. This suggests that previous reports of four *Rhynchostegiella* species from Azores are erroneous and that a single, morphologically variable species, *R. azorica*, occurs in the archipelago. *Rhynchostegiella azorica* is sister to the remainder of the species of the genus, whose most recent common ancestor was dated at 4–20 Ma. This points to a more ancient origin in comparison with other Macaronesian endemic species of the genus. The unexpected discovery of an Azorean endemic species in *Rhynchostegiella* suggests that patterns of endemicity in the Azorean bryophyte flora are not well estimated from traditional taxonomic knowledge and point to the necessity of an extensive integrative taxonomic revision.

**Key words:** integrative taxonomy, Macaronesia, bryophyte

## Introduction

Since DNA sequence data have become more widely used and accessible, traditional species concepts have been increasingly challenged (see Kadereit *et al*. 2012 for review). This might have substantial consequences for our understanding of biogeographic patterns of biodiversity. For example, studies based on the analysis of distribution data from checklists found that the flora of the Azores differs from other island floras in the exceptionally low number of radiations and the low number of single-island endemics (Carine & Schaefer 2010), which has been an area of controversial interpretations (see Carine *et al.* 2012 for review). Schaefer *et al*. (2011) attempted at further understanding the mechanisms underlying this pattern by exploring the molecular phylogeography of endemic Azorean angiosperms and found a strong geographic structure in patterns of genetic variation. If the lineages identified on a molecular basis were recognized taxonomically, the spatial pattern of endemic species distributions would be much similar to that reported in other archipelagos (Schaefer *et al*. 2011).

Taxonomic issues in describing and understanding biodiversity patterns are expected to culminate as organisms decrease in size and morphological complexity (Whittaker *et al*. 2005). In bryophytes, DNA-based investigation (e.g., Bell *et al*. 2012; Hutsemékers *et al.* 2012; Medina *et al.* 2012, 2013) increasingly helped identifying unexpected species differentiation within widely circumscribed species exhibiting trans-oceanic disjunct distribution patterns. These new species often proved to be unambiguously distinguishable morphologically (Medina *et al.* 2012, 2013), although strong morphological overlap among similar species makes it sometimes necessary to implement barcoding techniques (Buczkowska & Dabert 2011; Stech *et al.* 2013). Such results might offer an explanation for one of the

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