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Identifying the generic limits of the Cheilanthoid genus *Doryopteris*

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Abstract

Morphology-based delimitation of genera in the Cheilanthoid ferns has proved to be problematic and understanding of the phylogeny and relationships amongst Cheilanthoid ferns based on morphological characters has posed even further difficulties, owing perhaps in large part to adaptation by many taxa to xeric habitats, as well as convergent evolution. It is only now with the application of DNA sequence data that relationships of species and genera are becoming clear. Here, we present results of cpDNA sequence data from species that have been traditionally placed in the genus *Doryopteris* and, based on both these results, and morphological and distribution data, this study helps clarify the concept of the genus *Doryopteris* its position within the Cheilanthoid ferns and the status of *Lytoneuron*. As a result, three genera are redefined: *Doryopteris, Lytoneuron* and *Ormopteris*.

Key words: Cheilanthoid ferns, cpDNA, *Doryopteris*, geographic distribution, *Lytoneuron*, morphology, *Ormopteris*, phylogeny, taxonomy

Introduction

The phylogeny of the cheilanthoid ferns using DNA sequences of plastid genome regions has been studied extensively in recent years (Gastony & Rollo 1995, Gastony & Rollo 1998, Zhang *et al.* 2005, Kirkpatrick 2007, Prado *et al.* 2007, Schuettpelz *et al.* 2007, Zhang *et al.* 2007, Rothfels *et al.* 2008, Windham *et al.* 2009, Beck *et al.* 2010, Bouma *et al.* 2010, Yesilyurt & Schneider 2010, Eiserhardt *et al.* 2011, Lehtonen 2011, Link-Perez *et al.* 2011, Sigel *et al.* 2011, Li *et al.* 2012, Grusz & Windham 2013, Prado *et al.* 2013). These studies have provided not only new insights in the evolution of xeric ferns, such as the evolution of convergences, but also cytological and morphological evidence concerning the generic classification of these unusual ferns. Comparison of the results of these studies with the most recent pre-cladistic classification (Tryon *et al.* 1990) reveals several trends. Firstly, some genera, *Cheilanthes* Swartz (1806: 126) and *Pellaea* Link (1841: 59) as defined in Tryon *et al.* (1990), were found to be polyphyletic (Gastony & Rollo 1995, Gastony & Rollo 1998, Kirkpartick *et al.* 2007, Prado *et al.* 2007, Schuettpelz *et al.* 2007, Zhang *et al.* 2007, Windham *et al.* 2009, Eiserhardt *et al.* 2011). In turn, the segregation of *Argyrochosma* (Smith 1841: 50) Windham (1987: 38) and *Notholaena* Brown (1810: 145), which was not accepted by Tryon *et al.* (1990), was confirmed (Rothfels *et al.* 2008, Sigel *et al*. 2011). Some previously recognized genera, such as *Adiantopsis* Fée (1852: 145) (Link-Perez *et al.* 2011) and *Notholaena* (Rothfels *et al.* 2008), required relatively minor re-circumscription, whilst other genera were either re-established, such as *Allosorus* Bernhardi (1805: 36) (Christenhusz 2012) and *Myriopteris* Fée (1852: 148) (Grusz and Windham 2013), or introduced, such as *Calciphilopteris* Yesilyurt & Schneider (2010: 52) and *Gaga* Pryer, F.W.Li & Windham in Li *et al.* (2012: 855). In summary, the classification of these ferns has changed substantially as a result of these studies.

Relatively little attention has been given so far to the genus *Doryopteris* Smith (1841: 404), despite the existence of several DNA sequence based studies (Prado *et al.* 2007, 2013, Zhang *et al.* 2007, Eiserhardt *et al.* 2011). These studies found evidence for polyphyly of the genus as defined in the past. Consequently, the *Doryopteris ludens* (Wallich ex Hooker 1858: 210) Smith (1875: 289) group (Yesilyurt 2004, Schuettpelz *et al.* 2007, Windham *et al.* 2009) was

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