



Biogeography and divergence time estimation of the relict Cape dragonfly genus *Syncordulia*: global significance and implications for conservation

JESSICA L. WARE^{1,3,4}, JOHN P. SIMAIKA² & MICHAEL J. SAMWAYS²

¹Department of Entomology, Rutgers University, New Brunswick, NJ, USA

²Department of Conservation Ecology and Entomology, Stellenbosch University, South Africa

³Division of Invertebrate Zoology, American Museum of Natural History, New York, USA

⁴Corresponding author. E-mail: jware@amnh.org

Abstract

Syncordulia (Odonata: Anisoptera: Libelluloidea) inhabits mostly cool mountainous streams in the Cape Floristic Region of South Africa. It is found at low densities in geographically restricted areas. *Syncordulia* is endemic to South Africa and, until recently, only two species were known, *S. venator* (Barnard, 1933) and *S. gracilis* (Burmeister 1839), both considered Vulnerable by the World Conservation Union (IUCN). Two new species, *S. serendipator* Dijsktra, Samways & Simaika-2007 and *S. legator* Dijsktra, Samways & Simaika 2007, were described from previously unrecognized museum specimens and new field collections. Here we corroborate the validity of these two new species using multiple genes and propose intergeneric relationships within *Syncordulia*. Molecular data from two independent gene fragments (nuclear 28S and ribosomal and cytochrome oxidase subunit I mitochondrial data) were sequenced and/or downloaded from GenBank for 7 libelluloid families, including 12 *Syncordulia* specimens (2 *Syncordulia gracilis*, 4 *S. serendipator*, 2 *S. legator* and 4 *S. venator*). The lower libelluloid group GSI (*sensu* Ware *et al.* 2007), a diverse group of non-corduliine taxa, is strongly supported as monophyletic. *Syncordulia* is well supported by both methods of phylogenetic analyses as a monophyletic group deeply nested within the GSI clade. A DIVA biogeographical analysis suggests that the ancestor to the genus *Syncordulia* may have arisen consequent to the break-up of Gondwana (>120 Mya). Divergence time estimates suggest that *Syncordulia* diverged well after the breakup of Gondwana, approximately 60 million years ago (Mya), which coincides with the divergence of several Cape fynbos taxa, between 86 – 60 Mya. DIVA analyses suggest that the present distributions of *Syncordulia* may be the result of dispersal events. We relate these phylogenetic data to the historical biogeography of the genus and to the importance of conservation action.

Key words: *Syncordulia*, Odonata, Biogeography, Divergence Times, Conservation

Introduction

Corduliid dragonflies, often known as “emeralds” for the metallic green body and eye color of many species, are members of the large superfamily, Libelluloidea. Previously considered to be one family (Rambur 1842; Hagen 1861; Kirby 1890; Selys-Longchamps 1892; Needham 1908; Martin 1914; Tillyard 1917 1928; St. Quentin 1939; Gloyd 1959; Lieftinck 1971; Lieftinck 1977; Carle 1982; Davies & Tobin 1985; Bridges 1994; Steinmann 1997) or divided into two or more families (Fraser 1957; Carle 1995; Bechly 1996; Lohmann, 1996a, b; Pfau, 2005), Corduliidae has not been found to be monophyletic in modern phylogenetic analyses (May 1995b; Misof *et al.* 2001; Carle & Kjer 2002; Ware *et al.* 2007; Bybee *et al.* 2008; Letsch unpubl.). ‘Corduliidae’ (*sensu* Fraser 1957) consists of at least three distinct clades, the Corduliinae, the Macromiinae, and a diverse group of non-corduliine taxa, informally called the “GSI” by Ware *et al.* (2007) after the subfamilies Gomphomacromiinae, Synthemistinae, and Idionychinae. Within the GSI are Australian endemics, as well as African, South American, European, and Indomalayan genera, and the presumably relict South African genus *Syncordulia*.