



## Molecular systematics and biogeography of the genus *Zizina* (Lepidoptera: Lycaenidae)

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### Abstract

Butterflies of the genus *Zizina* are widely distributed in all zoogeographical regions except the New World (North and South America) and the northern part of Eurasia. We address some of the problems in regard to the taxonomy and biogeography of the genus. We inferred phylogenetic relationships for all four species in the current classification of this genus from the ND5 region of mtDNA. From our molecular analyses and morphological evidence, we concluded that this genus contains three species; *Z. otis*, *Z. oxleyi* and *Z. emelina*. The status of the latter species is revised, while *Z. labradus* and *Z. antanossa*, which were formerly treated as specifically distinct, are regarded as subspecies of *Z. otis*. Based on our analyses, we also employ phylogeography to discuss possible speciation events in the genus. Each of the three *Zizina* species appears to have branched from the common ancestor, with a divergence time estimated to be about 2.5 million years ago. The ancestors of *Z. oxleyi* and *Z. emelina* are postulated to have adapted to a temperate climate, diverged in the northern and southern hemispheres, and resulted in the extant species from New Zealand and East Asia, respectively. In contrast, the ancestor of *Z. otis* adapted mainly to tropical and subtropical zones, and the extant *Z. otis* dispersed into the Afrotropical, Oriental and Australian regions. Feeding adaptations in the larvae also might have had an effect on speciation within *Zizina*. In addition, our results indicated that there is a possibility that the distribution of the New Zealand *Z. oxleyi* was reduced in extent by the introduction of *Z. otis*, which immigrated recently from Australia or its surroundings.

**Key words:** classification, conservation, evolution, introduction, lycaenid butterfly, molecular clock, molecular phylogeny, mtDNA, phylogeography, Polyommata, speciation

### Introduction

Members of the lycaenid butterfly genus *Zizina* Chapman occur in tropical to temperate zones of the Palaearctic, Oriental, Australian and Afrotropical regions (Chapman 1910; Corbet & Pendlebury 1956, 1992; Parsons 1999). Although the genus is widely distributed, it includes some species or subspecies that have shown recent range-size decreases. This is because they often occur in environments that are easily degraded, such as natural grasslands, riversides and coastlines.

In appearance, this genus is similar to two allied genera, *Zizeeria* Chapman and *Pseudozizeeria* Beuret, but is characterized by asymmetrical androconia with a concave distal margin, a black postdiscal dot shifted