



## Cladistic, biogeographic and environmental niche analysis of the species of *Agathemera* Stål (Phasmatida, Agathemeridae)

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### Abstract

The endemic southern South American genus *Agathemera* Stål, which contains eight species, is analyzed in a cladistic context in order to establish a hypothesis regarding the phylogenetic relationships among its species. The cladistic analysis is based on adult and immature morphological characters belonging to both sexes. A biogeographical analysis is also performed to reconstruct the biogeographic history of the genus, and an environmental niche analysis to determine the potential distribution of the species, estimate niche overlap among species, and to find the most important variables that explain its present distribution. One tree of 51 steps was obtained that supports the monophyly of the genus. The species *A. elegans* and *A. mesoauriculae* distributed in southern Chile are situated at the base of the cladogram and they are the sister group to both the Argentinian (*A. claraziana*, *A. luteola*, *A. maculafulgens* and *A. millepunctata*) and the Chilean species (*A. grylloidea* and *A. crassa*). The Biogeographic analysis using DIVA 1.1 found 1 optimal reconstruction that involves a vicariant event at each node. The vicariant event of the most apical node of the tree can be correlated to the uplifting of the Andes. The basal species are distributed in the southern regions of Chile and in the Patagonian Steppe, while the remaining species are distributed in northern highlands. Environmental Niche Models showed that the soil variable was important for all eight species. According to the models, *A. claraziana* and *A. millepunctata* have large potential geographic distribution covering almost all the Patagonian area, and have similar niche requirements, while the six remaining species showed a more restricted geographic distribution.

**Key words:** Dispersion-vicariance analysis, environmental niche modelling

### Introduction

*Agathemera* Stål, 1875 is a genus of the family Agathemeridae (suborder Agathemerodea) that contains eight endemic species from Southern South America. The monophyly of the genus has clearly been established (Camousseight 1995, 2005); however the phylogenetic relationship among its species has never been treated in a cladistic analysis. Similarly, there are no previous hypotheses regarding the biogeographical history of the species of the genus.

The *Agathemera* species are distributed at both sides of the Andes Mountain range, approximately between parallels 23° and 50° S (Fig. 1), and they are found inhabiting areas at very different altitudes, from near to the sea level to the altitudinal limit of vegetation (4,000 m.a.s.l.). This amplitude in habitats and environmental conditions does not mean that different species can be found intermingled in some areas. There are species geographically closer that must show some environmental separation, making the environmental niche modelling and niche overlap an interesting task.