



Biogeography of Glandulocaudinae (Teleostei: Characiformes: Characidae) revisited: phylogenetic patterns, historical geology and genetic connectivity

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Abstract

The biogeography of the Glandulocaudinae (former Glandulocaudini) is reviewed. The major pattern of diversification presented by this group of freshwater fishes can be clearly associated to the main aspects of the tectonic evolution of the southern portion of the Cis-Andean South American Platform. The phylogenetic relationships within the group suggest that the clade represented by *Lophiobrycon* is the sister-group of the more derived clade represented by the genus *Glandulocauda* and *Mimagoniates*. *Lophiobrycon* and *Glandulocauda* occur in areas of the ancient crystalline shield of south-eastern Brazil and their present allopatric distribution is probably due to relict survival and tectonic vicariant events. Populations of *Glandulocauda melanogenys* are found in contiguous drainages in presently isolated upper parts of the Tietê, Guaratuba, Itatinga, and Ribeira de Iguape basins and this pattern of distribution is probably the result of river capture caused by tectonic processes that affected a large area in eastern and southeastern Brazil. The species of *Mimagoniates* are predominantly distributed along the eastern and southeastern coastal areas, but *M. microlepis* is additionally found in the rio Iguaçú and Tibagi basins. *Mimagoniates barberi* occurs in both SW margin of the upper rio Paraná basin and the lower Paraguay and *Mimagoniates sp.* occurs in the upper Paraguay river basin. Tectonic activations of the Continental Rift of Southeastern Brazil along the eastern margin of the Upper Paraná basin promoted population fragmentation responsible of the present day distribution presented by *Glandulocauda melanogenys*. We hypothesize that occurrence of *Mimagoniates* along the lowland area around the Paraná basin was due to a single or a multiple fragmentation of populations along the W-SW border of the upper Paraná Basin, probably due to the major tectonic origin of the Chaco-Pantanal wetland foreland basins since the Miocene as well as Cenozoic tectonic activity along the borders of the upper Paraná basin, such as in the eastern Paraguay, in the Asunción Rift. Distributional pattern of *Mimagoniates* suggests that its initial diversification may be related to the tectonic evolution of the Chaco-Pantanal foreland basin system and a minimum age of 2.5 M.Y are proposed for this monophyletic group. Previous hypotheses on sea level fluctuations of the late Quaternary as being the main causal mechanism promoting cladogenesis and speciation of the group are critically reviewed. Phylogeographic studies based on molecular data indicate significant differences among the isolated populations of *M. microlepis*. These findings suggest that a much longer period of time and a paleogeographic landscape configuration of the Brazilian southeastern coastal region explain the present observed phylogenetic and biogeographic patterns.

Key words: Biogeography, Glandulocaudinae

Introduction

The subfamily Glandulocaudinae (former Glandulocaudini) consists of three genera: *Lophiobrycon*, *Glandulocauda* and *Mimagoniates* (Fig.1). The biogeography of these Neotropical fishes has been previously dis-