

# Historical biogeography and historical paleoecology of Amiidae and other halecomorph fishes

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## Abstract

The historical biogeography of the family Amiidae is reviewed, and cast in a vicariance model, based on much recently published phylogenetic information on the group. We believe that vicariance studies are a logical first step in any rigorous historical biogeographic study. Consequently, a hypothesis of relationships based on non-biogeographical data is also a necessary initial step in a thorough study of historical biogeography. Recently we published a comprehensive phylogenetic study of amiid fishes, which divided the family into four subfamilies: Amiinae, †Vidalamiinae, †Solnhofenamiinae, and †Amiopsinae. Among these subfamilies, †Vidalamiinae show the strongest vicariant patterns.

The historical paleoecology of the family (focussing on freshwater vs. marine origins for taxa) is also explored within a phylogenetic framework. Although the extant *Amia calva* (and apparently the subfamily Amiinae) is freshwater, the family Amiidae appears to primitively have been marine.

## Introduction

Until recently, rigorous historical biogeographic studies that included a search for vicariance patterns have not been practical for Mesozoic (and other) amiid fishes. This is because the interrelationships of Amiidae were very poorly known (PATTERSON & LONGBOTTOM 1989, GRANDE 1996) and detailed descriptions of many currently known species were lacking. Hypotheses of monophyletic groups and phylogenetic relationships are a necessary first step in producing testable hypotheses of historical biogeography, particularly vicariance historical biogeography (NELSON & PLATNICK 1980, 1981, 1984, GRANDE 1985, 1990). Such phylogenetic controls are also an important first step in developing empirical hypotheses about historical paleoecology (i.e., the changing ecological parameters of a taxon through time). Recently, we (GRANDE & BEMIS 1998) completed the first comprehensive phylogenetic study of all fossil and Recent amiid species known at the time of publication. Based on new detailed comparative morphological descriptions of many taxa (e.g., Fig. 1), we produced the first well-supported phylogeny for the group (Fig. 2). Based on the phylogeny we produced, and on biogeographic and paleoecological data, we proposed some historical biogeographic and historical paleoecological hypotheses for Amiidae and other halecomorph fishes. In this paper we discuss previous biogeographic studies of halecomorph fishes and then review some of the relevant hypotheses developed in GRANDE & BEMIS (1998) concerning the historical biogeography and historical paleoecology of Halecomorphi. *Vicariance* here refers to disjunction of a biota or range by non-dispersal processes (e.g., plate tectonics or “drift vicariance” sensu LUNDBERG (1993), aquatic transgression or intrusion, glaciation, climatic change, and orogeny). *Dispersal* refers to the migration from one place to another and/or geographic range expansion of a group of organisms. In this paper we are concerned with vicariance biogeography for two main reasons. First, a vicariance approach has not previously been taken for Amiidae, because a lack of phylogenetic resolution previously made vicariance studies impractical within the family. Consequently, all previous biogeographic hypotheses for the family have been dispersal scenarios. Second, we consider that repeating (congruent) vicariant patterns provide the most empirically robust type of historical biogeographic hypotheses. Dispersal, as a mechanism (or process explanation) can be construed for any distribution of organisms, but vicariance as an explanation can be supported only by certain types of empirical data (i.e., resolved, phylogenetically derived area

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