



A nine-family classification of caecilians (Amphibia: Gymnophiona)

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Abstract

We propose a new family-level classification of caecilians that is based on current understanding of phylogenetic relationships and diversity. The 34 currently recognised genera of caecilians are diagnosed and partitioned into nine family-level taxa. Each family is an hypothesised monophylum, that, subject to limitations of taxon sampling, is well-supported by phylogenetic analyses and is of ancient (Mesozoic) origin. Each family is diagnosed and also defined phylogenetically. The proposed classification provides an alternative to an exclusive reliance upon synonymy in solving the longstanding problem of paraphyly of the Caeciliidae.

Key words: amphibians, herpetology, phylogeny, systematics, taxonomy

Introduction

Until 1968, all caecilian amphibians (Gymnophiona) were included, by default, in a single family, the Caeciliidae. Since 1968, classifications of between three and ten families (e.g., Table 1) have been proposed by different authors (Taylor, 1968, 1969; Nussbaum, 1977, 1979; Wake & Campbell, 1983; Duellman & Trueb, 1986; Laurent, 1984, 1986; Lescure *et al.*, 1986; Nussbaum & Wilkinson, 1989; Hedges *et al.*, 1993; Frost *et al.*, 2006; Wilkinson & Nussbaum, 2006). Nussbaum & Wilkinson (1989) reviewed the several substantially different classifications proposed in the 1980s (Wake & Campbell, 1983; Duellman & Trueb, 1986; Lescure *et al.*, 1986; Laurent 1986) and advocated adoption of a 'conservative' six-family system to stabilise caecilian classification.

A major problem with Nussbaum & Wilkinson's (1989) conservative classification was that the Caeciliidae, essentially what is left when the other proposed families are differentiated, was paraphyletic with respect to the Typhlonectidae (Nussbaum, 1979). Nussbaum & Wilkinson (1989) argued that this paraphyly should be accepted until understanding of phylogeny had progressed sufficiently to enable a more meaningful and useful revised classification based only upon monophyla. Subsequent phylogenetic studies, morphological and molecular (Hedges *et al.*, 1993; Wilkinson & Nussbaum, 1995; Wilkinson, 1997; Wilkinson *et al.*, 2002, 2003; San Mauro *et al.*, 2004, 2009; Frost *et al.*, 2006; Roelants *et al.*, 2007; Loader *et al.*, 2007; Zhang & Wake, 2009), have confirmed the paraphyly of the Caeciliidae with respect to the Typhlonectidae, and raised the possibility that the Caeciliidae is paraphyletic also with respect to the Scolecomorphidae (Wilkinson, 1997; Wilkinson *et al.*, 2003; Frost *et al.*, 2006; Loader *et al.*, 2007). Whereas most subsequent workers adopted Nussbaum & Wilkinson's (1989) classification, some proposed to resolve the paraphyly of the Caeciliidae solely through synonymy. Thus, Hedges *et al.* (1993) proposed synonymy of Typhlonectidae with Caeciliidae, and Frost *et al.* (2006) treated both Scolecomorphidae and Typhlonectidae as synonyms of Caeciliidae.

Molecular phylogenetic studies (Gower *et al.*, 2002; Frost *et al.*, 2006; Roelants *et al.*, 2007; Zhang & Wake, 2009) have also revealed that the Ichthyophiidae (*sensu* Nussbaum & Wilkinson, 1989) is paraphyletic with respect to the Uraeotyphlidae. Frost *et al.* (2006) removed this paraphyly by placing the Uraeotyphlidae in the synonymy of the Ichthyophiidae. Frost *et al.* (2006) succeeded in producing a family-level classification based only on monophyla but recognised just three families. In contrast, Wilkinson & Nussbaum (2006) persisted with the six-family