

Pan-Amphisbaenia M. Kearney and K. de Queiroz, new clade name

Registration Number: 115

Definition: The total clade of the crown clade *Amphisbaenia*. This is a crown-based total-clade definition. Abbreviated definition: total ∇ of *Amphisbaenia*.

Etymology: Derived by adding the prefix *Pan-* (for Pan-Monophylum = total clade) to *Amphisbaenia* (see entry for *Amphisbaenia*, this volume, for the etymology of that name).

Reference Phylogeny: Figure 2b of Longrich et al. (2015) is the primary reference phylogeny. On that tree, *Pan-Amphisbaenia* applies to the clade that includes *Rhineuridae*, *Chthonophidae*†, *Oligodontosauridae*†, *Bipedidae*, *Blanidae*, *Cadeidae*, *Trogonophidae*, and *Amphisbaenidae*, as well as all extinct taxa (of which there are none on that tree) that are more closely related to them than to *Teius*, *Tachydromus*, and *Lacerta*. However, the definition stipulates that the name is to be applied to the total clade of *Amphisbaenia* regardless of which extant taxa are inferred to be its closest relatives.

Composition: *Amphisbaenia* (applied to a crown clade in this volume) and the members of its stem group. See entry for *Amphisbaenia* (in this volume) for the composition of the crown clade. Wu et al. (1993, 1996) considered the fossil taxon *Sineoamphisbaena hexatabularis* from the Upper Cretaceous of China to belong to the amphisbaenian stem group and thus part of the clade that is here named *Pan-Amphisbaenia*; however, subsequent analyses by Kearney (2003a), Lee (2005), and Gauthier et al. (2012) indicated that *Sineoamphisbaena* is not part of that clade. Müller et al. (2011) inferred the fossil

taxon *Cryptolacerta hassiaca* from the Eocene of Germany to be a stem amphisbaenian; however, a more recent analysis places *Cryptolacerta* closer to *Lacertidae* than to *Amphisbaenia* (Longrich et al., 2015). As noted in the Composition section for *Amphisbaenia* (this volume), some North American fossil amphisbaenians possess seemingly ancestral characters (e.g., a complete postorbital bar) not seen in any living amphisbaenians (see e.g., Berman, 1972, 1973, 1976); however, current phylogenetic inferences (e.g., Kearney, 2003a; Hembree, 2007; Gauthier et al., 2012) place those fossils as crown rather than stem amphisbaenians.

Diagnostic Apomorphies: As a maximum (and total) clade, *Pan-Amphisbaenia* may not have any apomorphies (de Queiroz, 2007); however, possession of any of the apomorphies of *Amphisbaenia* (see Kearney, 2003b) constitutes evidence for inclusion of a species or specimen within *Pan-Amphisbaenia*. Those apomorphies of *Amphisbaenia* that are most likely to be preserved in fossils include: enlarged median premaxillary tooth, elongated postorbital region of skull, braincase enclosed anteriorly by enlarged orbitosphenoid(s), absence of suborbital fenestra, absence of epipterygoid, reduction of hind limbs (and possibly fore limbs), short tail with caudal autotomy septa confined to a single vertebra. In the absence of well-supported assignments of fossils to the amphisbaenian stem group, the order of evolution of these apomorphies is currently unknown. Müller et al. (2011) inferred 19 characters to be synapomorphies of *Cryptolacerta* and *Amphisbaenia*, including a tongue and-groove articulation of the frontals, transversely widened frontal downgrowths, thickened frontals and maxillae, the absence

of a tympanic crest on the quadrate, very low vertebral neural spines, and a sutural prefrontal-postorbitofrontal contact. If *Cryptolacerta* is a stem amphisbaenian, then this list likely includes some of the earliest characters to evolve along the amphisbaenian stem lineage.

Synonyms: Most, if not all, of the names listed as approximate (and partial) synonyms of *Amphisbaenia* (see entry in this volume) are also approximate (and partial) synonyms of *Pan-Amphisbaenia*, given that authors who used those names rarely, if ever, clearly distinguished between the total clade and the crown. Wu et al. (1993) clearly applied both the names *Amphisbaenia* (see also Wu et al., 1996) and *Annulata* (treating them as synonyms) to a clade more inclusive than the crown, but it is not clear if they applied those names to the total clade.

Comments: See the Comments in the entry for *Amphisbaenia* (this volume) for historical information concerning recognition of the named group and support for its status as a clade (given that earlier authors rarely distinguished between the crown and total clades). The names *Amphisbaenia* and *Pan-Amphisbaenia* were selected for the crown and total clades, respectively, in the interest of developing an integrated system of names for those categories of clades (e.g., Meier and Richter, 1992; Gauthier and de Queiroz, 2001; de Queiroz, 2007). In this context, *Amphisbaenia* was selected for the crown clade because it appears to be the most widely used name (see Comments in the entry for *Amphisbaenia*, this volume), and the name of the total clade was then formed by adding the prefix *Pan-* to the name of the crown clade (*Amphisbaenia*). Moreover, none of the synonyms appear to have been used unambiguously for the total clade, and they remain available for application to nested clades between the total

clade and the crown. For example, the name *Annulata* could be applied to the clade originating in the first ancestor of *Amphisbaenia fuliginosa* Linnaeus 1758 that possessed the apomorphy of having the body scales arranged in rings.

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