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Taxonomic reassessment of *Blanus strauchi* (Bedriaga, 1884) (Squamata: Amphisbaenia: Blanidae), with the description of a new species from south-east Anatolia (Turkey)

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Abstract

The study of mitochondrial and nuclear DNA sequences reveals that the polytypic *Blanus strauchi* is a species complex including three well-defined allopatric clades, one of which consists of two sub-clades. Only the two sub-clades of the Western clade are morphologically diagnosable in the field, whereas obvious characters to distinguish the Central and the Eastern clades are lacking. However, all four clades show significant statistical differentiation on meristic traits, as well as in morphometric characters of the head when compared by means of the geometric morphometrics. The genetic distance between the three major mitochondrial clades is comparable to the *p*-distances for the same markers observed between *Blanus* species-pairs from Morocco and the Iberian Peninsula, respectively. The nuclear marker confirms the mitochondrial clades, and shows that the three major clades do not share any haplotypes, as an indication of restricted gene flow among them. On the basis of this evidence, the taxonomy of *Blanus strauchi* is re-assessed: the Western clade corresponds to *B. strauchi*, with two subspecies: *B. s. strauchi* and *B. s. bedriagae*. The Central clade corresponds to *B. aporus*, here elevated at the species rank. For the eastern clade there are no available names, and therefore it is described here as *Blanus alexandri* **sp. nov.**

Key words: *Blanus strauchi* complex, *Blanus alexandri* **sp. nov.**, *Blanus strauchi, Blanus aporus,* cryptic species, Anatolia, ND4, PRLR nuclear marker

Introduction

Blanus is a small genus of worm-lizard endemic to the Mediterranean basin. Previously included in the family Amphisbaenidae Gray, 1865, it is currently the only genus of the family Blanidae Kearney, 2003. The genus shows a widely fragmented range, occurring in the Iberian Peninsula, in Morocco and in the north-eastern Mediterranean: southern Anatolia, some eastern Aegean Islands, northern Iraq, north-western Syria, Lebanon and northern Israel (where it is considered extinct) (Sindaco & Jeremčenko 2008) (inset in Fig. 1). The current range of *Blanus* is clearly relict, since fossils are known at least from Austria, the Czech Republic, France, Germany, Italy, Portugal, Spain and Romania (Delfino 1997; Böhme & Ilg 2003).

Amphisbaena strauchi was described by Bedriaga (1884) on the basis of five specimens collected by Dr. Krüper from "Umgegend Smyrnas" (= surroundings of Izmir). Boulenger (1884) described *Blanus bedriagae* based on 12 specimens "from the river Xanthus, Asia Minor". F. Werner (1898) described *Blanus aporus* based on 10 specimens from "bei Mersina" (= near Mersin, now Içel).

The first revision of *B. strauchi* was made by Alexander (1966), who studied 167 specimens from the entire range of the species. This author grouped the specimens on the basis of geographical origin, i.e. areas separated from each other by mountain ranges and the sea, and concluded that *B. strauchi* is a polytypic species with at least three subspecies: *B. s. strauchi* from western Anatolia and adjacent eastern Aegean islands, *B. s. bedriagae* from

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Discussion

The current study shows that *Blanus strauchi* is a complex of three cryptic species, similarly to what was observed in the western *B. cinereus* complex (Albert *et al.* 2007).

The dataset is not suitable for safe and definitive conclusions on the historical biogeography of this species complex. More populations and molecular markers should be analyzed, and, subsequently, sophisticated analyses (e.g. estimation of divergence times) should be conducted in order to have a better picture of the evolutionary and biogeographical history of *Blanus* in the eastern Mediterranean (work in progress). For example, the three major clades identified in our phylogeny form a polytomy, which could be a result of poor data (soft polytomy) or could represent a true polytomy (hard polytomy), hiding simultaneous diversification events.

Nevertheless, the results of the present study agree with those from others which conclude that Anatolia is an important region for generating and sustaining biodiversity. Factors that render Anatolia a diversification centre, especially for reptiles and amphibians, are (a) its geomorphology and relief, (b) its old and complex palaeogeographical and palaeoclimatic history, and (c) its position, lying at the boundary between Europe and Asia (see Sindaco *et al.* 2000; Kornilios *et al.* 2011 and references therein). Anatolian mountains, especially in the south, have played an important role in speciation and definition of biogeographical subregions. These mountains have been defined as "hotspots" of biodiversity for many different organisms: they harbour both endemic species and also important subspecific genetic diversity (Çıplak 2003, 2004 and references therein).

In several studies, cryptic genetic lineages have been revealed within reptilian or amphibian species that have a continuous geographic distribution in Anatolia (Poulakakis *et al.* 2005, Kyriazi *et al.* 2008; Plötner *et al.* 2010; Akın *et al.* 2010; Fritz *et al.* 2007; Kornilios *et al.* 2011; Kornilios *et al.* 2012). A very similar result to that shown for Anatolian *Blanus* has been demonstrated for the Eurasian blindsnake, *Typhlops vermicularis* (Kornilios *et al.* 2011; Kornilios *et al.* 2012), another burrowing organism. The Anatolian areas that seem to have played a key role in the diversification of *T. vermicularis* (e.g. Aegean coast, Lycia, Pamphylia, Cilicia) are roughly the same as in *Blanus*, but also other herptiles (Kyriazi *et al.* 2008; Akın *et al.* 2010; Fritz *et al.* 2007, Kapli *et al.* 2013, Poulakakis *et al.* 2005). Especially the area of Lycia has appeared in a series of recent works (Poulakakis *et al.* 2005, Kyriazi *et al.* 2008, Veith *et al.* 2008, Kornilios *et al.* 2011) along with the present one, as an area of unexpected diversification in the apparent continuum of Anatolia. This observation deserves further research at both the levels of biological diversity and palaeogeographical history.

Although an estimation of divergence times was not conducted for *Blanus*, based on the levels of genetic distances among the three lineages which are comparable to those of Albert *et al.* (2007), we can infer that the split between the three clades occurred roughly at the same time as for the Iberian and Moroccan species-pairs, i.e. at the end of Miocene or beginning of Pliocene. This is also the time of divergence among *T. vermicularis* Anatolian lineages (Kornilios *et al.*, unpublished data), indicating that common factors, in geographical but also in temporal terms, affected the history of both fossorial reptiles.

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