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Multilocus phylogeny and coalescent species delimitation in Kotschy's gecko, *Mediodactylus kotschyi*: Hidden diversity and cryptic species

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ABSTRACT

Kotschy's Gecko, *Mediodactylus kotschyi*, is a small gecko native to southeastern Europe and the Levant. It displays great morphological variation with a large number of morphologically recognized subspecies. However, it has been suggested that it constitutes a species complex of several yet unrecognized species. In this study, we used multilocus sequence data (three mitochondrial and three nuclear gene fragments) to estimate the phylogenetic relationships of 174 specimens from 129 sampling localities, covering a substantial part of the distribution range of the species. Our results revealed high genetic diversity of *M. kotschyi* populations and contributed to our knowledge about the phylogenetic relationships and the estimation of the divergence times between them. Diversification within *M. kotschyi* began approximately 15 million years ago (Mya) in the Middle Miocene, whereas the diversification within most of the major clades have been occurred in the last 5 Mya. Species delimitation analysis suggests there exists five species within the complex, and we propose to tentatively recognize the following taxa as full species: *M. kotschyi* (mainland Balkans, most of Aegean islands, and Italy), *M. orientalis* (Levant, Cyprus, southern Anatolia, and south-eastern Aegean islands), *M. danilewskii* (Black Sea region and south-western Anatolia), *M. bartoni* (Crete), and *M. oertzeni* (southern Dodecanese Islands). This newly recognized diversity underlines the complex biogeographical history of the Eastern Mediterranean region.

1. Introduction

The Palearctic "naked-toed geckos" include ~100 species distributed from North Africa across the southern Balkans and southwestern and central Asia to northern India, western China, and southern Mongolia (Agarwal et al., 2014; Bauer et al., 2013). The taxonomy of these geckos has been unstable and remains unresolved, because qualitative characters have been used for generic delimitation

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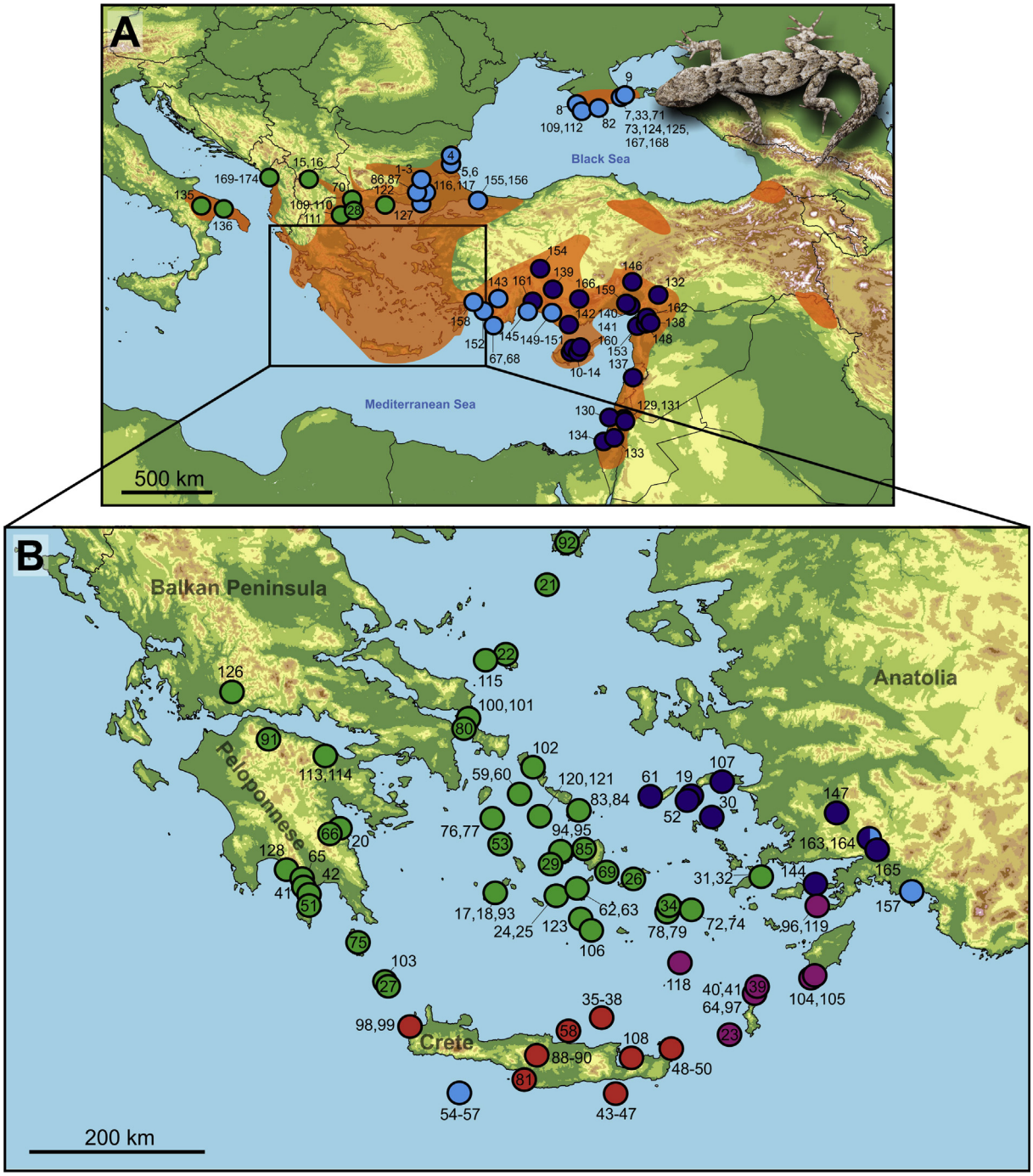

Fig. 1. The study area and the sampling localities of the samples used in this study. Numbers correspond to the sampling localities codes given in Table S1. The map is redrawn based on the *Mediodactylus kotschyi* distribution according to Sindaco and Jeremčenko (2008) in order for the shaded area (A) to indicate the distribution range of the species. For clarity reasons, the specimens from the Aegean region and south continetntal Greece are presented in B. Populations of the different phylogenetic clades as presented in Fig. 2 are indicated with differently colored dots. Inset: *Mediodactylus kotschyi* (Vlorë, Albania); photo: Daniel Jablonski. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

(Bauer et al., 2013 and references therein). Indicative of the great confusion is that the species of the genus *Mediodactylus* were initially assigned to the genus *Gymnodactylus,* later on to *Cyrtodactylus* and then removed to *Tenuidactylus* as a distinct subgenus (Szczerbak and Golubev, 1984). At present, *Mediodactylus* has been recognized as a full monophyletic genus (Bauer et al., 2013; Macey et al., 2000).

The genus *Mediodactylus* comprises 13 species (Uetz, 2018) with *M. kotschyi* (Steindachner, 1870) being its type species. *Mediodactylus kotschyi* is a thermophilic and xerophilic species inhabiting the Mediterranean and sub-Mediterranean landscapes and associated mainly with stony habitats at heights up to 1700 m a.s.l. (Böhme et al., 2009). It is a small gecko distributed in the Eastern Mediterranean and Black Sea regions from southeastern Italy in the west to Turkish Transcaucasian provinces in the east, and from south Greece, Cyprus and Israel in the south to the Danube River valley at the central and eastern Balkans (in the limits of Serbia and Bulgaria) and Crimea in the north (Böhme et al., 2009; Fig. 1). It is considered introduced in Italy, Serbia and Hungary (Böhme et al., 2009; Urosevic et al., 2016).

Mediodactylus kotschyi displays great morphological variation which is reflected in the at least 26 (Baran and Gruber, 1982; Szczerbak, 1960;