



Phylogenetic relationships of the gray-toad agama, *Phrynocephalus scutellatus* (Olivier, 1807), species complex from Iran

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Abstract

The gray toad agama, *Phrynocephalus scutellatus* (Olivier, 1807) species complex is confined to the Iranian plateau, and forms one of the most widespread, but rarely studied species of the family Agamidae. It represents a complex with many local populations inhabiting a variety of habitats, and exhibiting considerable morphological, genetic and ecological variations. We analyzed sequences of the mitochondrial ND2 gene and tRNA-Trp and tRNA-Ala derived from 89 geographically distant populations. The sequences data strongly support a basal separation of the populations of southeastern—south-central Iran from those occurring in the North. The subsequent radiation, fragmentation, and evolution of these major assemblages have led to four discernible geographical lineages in Iran: southeastern—south-central, west-central, east—northeastern and Khaf. The southeastern—south-central radiation is the earliest lineage and Khaf lineage is probably related to the Afghan plateau. Separation of northern clades from each other can be explained by the presence of large deserts in central Iran. Due to the lack of sufficient geological information, the divergence between the northern and southern clades cannot be explained by the present data.

Key words: ND2, Agamid lizards, Systematics, *Phrynocephalus*, Iran, Zoogeography

Introduction

The agamid Lizard genus *Phrynocephalus* Kaup, 1825 comprises about 40 distinct species that inhabit Palearctic desert regions (Anderson 1999; Barbanov & Ananjeva 2007; Guo & Wang 2007). Toad-headed agamas show a wide range of distribution from northwestern China to the western side of the Caspian Sea, across the Tibetan plateau, and southwest Asia to the Arabian peninsula (Anderson 1999; Arnold 1999; Barbanov & Ananjeva 2007; Guo & Wang 2007). Taxonomically, it is considered as a complicated group among Palearctic Lizards because the highly polymorphic degree of toad headed agamas has stimulated description of numerous forms as species and/or subspecies (Barbanov & Ananjeva 2007). In order to solve the controversial systematics of this group, the modern revisionary works have used not only traditional methods of systematics (morphology and morphometrics), but also new methodologies such as genetic sequence analysis, protein electrophoresis, cytogenetics or ethology (Barbanov & Ananjeva 2007). Although sequence divergence does not give a direct indication of the taxonomic status of a population, it can be a source of useful information in cases when the taxonomy based on morphology and ecological criteria appears doubtful (Rastegar Pouyani *et al.* 2010).

Previous studies used different data sets i.e., morphological, biochemical, allozyme, karyological, osteological, ethological and genetics to investigate phylogeny and taxonomy of the *Phrynocephalus* species (e.g., Witheman 1978; Lichnova 1992; Macey *et al.* 1993; Zhao & Adler 1993; Dunayev 1996; Arnold 1999; Pang *et al.* 2003; Pang *et al.* 2003; Dunayev *et al.* 2007; Guo & Wang 2007; Solovyeva *et al.* 2014). However, little information is available concerning the *Phrynocephalus* species within Iranian plateau, and there are still large gaps in the