



Taxonomic validity and phylogenetic relationships of a newly-described tooth-carp, *Aphanius mesopotamicus* Coad, 2009 (Teleostei: Cyprinodontidae)

MOHAMMAD SADEGH ALAVI-YEGANEH¹, YAZDAN KEIVANY^{2*}, JAFAR SEYFABADI¹, BAHRAM KAZEMI³ & GRAHAM P. WALLIS⁴

¹Faculty of Marine Science, Tarbiat Modares University, Noor, Iran

²Department of Natural Resources (Fisheries Division), Isfahan University of Technology, Isfahan 84156-83111, Iran

³Cellular & Molecular Biology Research Center and Biotechnology Department, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

⁴Departement of Zoology, University of Otago, Dunedin, New Zealand

Abstract

Variation among complete *cytb* sequences (1140 bp) of *Aphanius mesopotamicus* Coad, 2009 was compared with closely related species, to investigate the validity of this taxon as a newly-described tooth-carp based on morphological characteristics. Maximum likelihood and Bayesian likelihood trees supported the monophyly of *A. mesopotamicus* and its sister group relationship to *A. sophiae*. Some 10–16 differences were found when compared to four different population samples of *A. sophiae*, whereas, intraspecific differences were only up to 6 bp. These distances suggest divergence from a common ancestor with *A. sophiae* at roughly 1 million years ago. These results are congruent with morphology-based hypotheses, indicating a recent speciation event.

Key words: Cyprinodontidae - cytochrome *b* - genetic distance – killifish -mtDNA

Introduction

Killifish species of the genus *Aphanius* Nardo (Cyprinodontiformes) were widely distributed along the Tethys Sea coastlines before its enclosure at the Oligocene/Miocene boundary (Smith *et al.* 1995) and forms two major clades which correspond to the former eastern and western Tethys Sea ancestor species (Hrbek & Meyer 2003). *Aphanius* is the only native genus of the Cyprinodontidae found in Iran and many described species of this genus are restricted to Iran (Keivany *et al.* 2014).

Aphanius mesopotamicus Coad, 2009, was described on the basis of museum specimens from southern Mesopotamia in Iran and Iraq. Due to lack of diagnostic morphological characteristics, the description was based on a suite of morphometric and meristic characteristics in a multivariate analysis. *Aphanius mesopotamicus* has been confused with *A. sophiae*, but the latter is endemic to the endorheic basin of southern Iran. Females of *A. sophiae*, however, have fine spotting on the flank and lower dorsal fin ray counts (5–7) (Coad 1980). Coad (2009) found 14 meristic characteristics in males and 13 in females to be significantly different from *A. sophiae* ($P < 0.05$), but their ranges overlapped.

Influence of some environmental factors such as temperature (Beacham 1990), diet and feeding (Currens *et al.* 1989; Day *et al.* 1994; Robinson & Wilson 1995) have been shown to influence morphological characteristics in various fish species. Also, length-weight relationship within different populations of some *Aphanius* species and populations were significantly different in different locations (Alavi-Yeganeh *et al.* 2011). Huber (1996) suggested a cyprinodont species definition, which includes possession of at least one stable phenotypic characteristic (such as male color), supported where possible by karyology, biochemical techniques or breeding experiments.

mtDNA sequences have been widely used as genetic markers for measurements of intraspecific and interspecific diversity. This genome has a higher rate of mutation than nuclear DNA, which usually results in an accumulation of

1. * Corresponding author: Yazdan Keivany (Keivany@cc.iut.ac.ir); Cellphone: +98-913-316-3351; Fax: +98-311-391-2840

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