

Geometric morphometric comparison of the mandibles of three species of vole of the genus *Microtus* (Rodentia: Arvicolinae) from northern Iran

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Abstract. Morphological differences in the mandible among four populations of the genus *Microtus* belonging to three species from Iran (*M. socialis* from northwestern Iran, *M. paradoxus* from the Kopet-Dag Mountains, *M. paradoxus* from the Binaloud Mountains, and *M. transcaspicus* from northeastern Iran) were studied by the landmark-based geometric morphometric method. No significant difference was found in the mandible shape of the two different populations of *M. paradoxus*, nor in their mandible overall size (by estimation of the centroid size). The three species are significantly different on the basis of the total mandible size, while the differences in the mandible shape among *M. paradoxus* and *M. socialis* are non-significant. Both canonical variate analysis and UPGMA cluster analysis indicate a high morphometric distance among *M. transcaspicus* and the other taxa, conforming the division of social and Transcaspian voles into two different species groups, the *socialis*-group and *arvalis*-group respectively. Changes in the mandible shape are mostly localized in the coronoid and angular processes.

Key words. *Microtus paradoxus*, *M. socialis*, *M. transcaspicus*, geometric morphometrics, landmarks, mandible, systematics, Iran, Middle East.

Introduction

The voles of the genus *Microtus* Schrank, 1798 in Iran belong to the *arvalis* and *socialis* species groups, except for *M. schelkownikovi* and *M. majori* which both belong to the subgenus *Terricola* (MUSSEY & CARLETON 1993, 2005). This taxonomic ranking was recommended by ZAGORODNYUK (1990), who considered both groups to form the subgenus *Microtus* s.str., as did MILLER (1912), NIETHAMMER & KRAPP (1982) and MUSSEY & CARLETON (2005). Russian authors have mostly placed the latter species group in the subgenus *Sumneriomys* Argyropulo, 1933 (e.g. GROMOV & POLYAKOV 1977, PAVLINOV & ROSSOLIMO 1998, GOLENISHCHEV et al. 1999, 2000, 2002), while others have placed both in the genus *Microtus* with no subgeneric ranking (ELLERMAN 1948, ELLERMAN & MORRISON-SCOTT 1951, CORBET 1978, MUSSEY & CARLETON 1993).

The *arvalis* group is represented by the grey voles which are widespread in the Palaearctic region from Spain (*M. arvalis* Pallas, 1778) throughout Europe to the Lake Baikal in the east (*M. levis* Miller, 1908) (MUSSEY & CARLETON 1993, 2005, GOLENISHCHEV et al. 1999, KRYŠTUFEK & VOHRALIK 2005). In Iran this species group consists of *M. transcaspicus* Satunin, 1950 from Northern Khorassan (MUSSEY & CARLETON 1993, 2005, GOLENISHCHEV et al. 1999) and Kerman province (MUSSEY & CARLETON 2005; previously reported as *M. kermanensis* Roguin, 1988) as well as *M. arvalis* in north-eastern Iran (MUSSEY & CARLETON 2005). The taxonomic status of the *socialis* group, which inhabits south-eastern Europe to western and central Asia, is more controversial (discussed by KEFELIOĞLU & KRYŠTUFEK