Available online at www.sciencedirect.com

ScienceDirect

Zoologischer Anzeiger 246 (2007) 91–101

ZOOLOGISCHER ANZEIGER

www.elsevier.de/jcz

Morphometric variation in nearly unstudied populations of the most studied mammal: The non-commensal house mouse (*Mus musculus domesticus*) in the Near East and Northern Africa

Markéta Slábová*, Daniel Frynta[1]

Department of Zoology, Faculty of Sciences, Charles University, Viničná 7, CZ-12844 Praha 2, Czech Republic

Received 24 November 2004; received in revised form 26 February 2007; accepted 27 February 2007
Corresponding editor D.G. Homberger

Abstract

The phenotypic consequences in the house mouse (*Mus musculus domesticus*) of the transition from an ordinary field-dwelling rodent to a species that is dependent on human populations was studied by investigating the morphometric variation of non-commensal populations of *M. m. domesticus* from Syria, Jordan, SW Iran, and Libya and comparing them with that of conspecific commensal populations from Eastern Turkey, Greece, and Bulgaria. Commensal populations of *M. musculus musculus* from the Czech Republic were used as an outgroup. About 849 adult specimens of *M. musculus* were analysed by multivariate procedures based on standard molar, skull and body measurements. As expected, there was considerable variation among the studied populations and a good correspondence between morphometric and geographic distances. The resulting morphometric tree was consistent with the hypothesis that the original radiation of *M. m. domesticus* took place somewhere in the Near East. Commensal populations of *M. m. domesticus* form a single derived branch. Specimens originating from four different sites in eastern Syria showed the greatest similarity to one another and possessed relatively bigger molars than the other studied populations. Commensal populations were characterised by longer tails when compared to non-commensal populations, which suggests an adaptation for living in a more three-dimensionally heterogeneous environment for commensal populations.

Keywords: Commensalism; Wild mice; Near East; *Mus musculus*

1. Introduction

The house mouse (*Mus musculus* Linnaeus, 1758) is without any doubt the most frequently studied mammal (e.g., Boursot et al. 1993; Sage et al. 1993). Due to the extraordinary ecological and evolutionary plasticity of this species and its ability to adopt a commensal way of life, its present distribution range encompasses all continents, except Antarctica. While the colonisation of

---

*Corresponding author. Present address: Faculty of Agriculture, Applied Ecology Laboratory, University of South Bohemia, Studentská 13, CZ-37005 České Budějovice, Czech Republic.
Tel.: +420 387 772 738.
E-mail addresses: mslabova@zf.jcu.cz, slabova@vsers.cz (M. Slábová), frynta@centrum.cz (D. Frynta).

[1] Tel.: +420 221951846.

0044-5231/$ - see front matter © 2007 Elsevier GmbH. All rights reserved.
doi:10.1016/j.jcz.2007.02.003

the New World was recent and corresponds well with the beginning of cargo shipping from Western Europe, our understanding of ancient mouse migrations in Eurasia is limited mostly to genetic evidence. Currently, three or four geographically and genetically more or less distinct subspecies are recognised and sometimes elevated to species level: *M. musculus* Linnaeus, 1758; *Mus musculus castaneus* Waterhouse, 1843; *Mus musculus domesticus* Schwarz et Schwarz, 1943; and *Mus musculus gentilulus* Thomas, 1919 (e.g., She et al. 1990; Boursot et al. 1993; Prager et al. 1996; Boissinot and Boursot 1997; Lundrigan et al. 2002; Guénet and Bonhomme 2003). Based on evidence from the molecular clock, the common ancestor of these subspecies probably much preceded agriculture and permanent settlement of human populations. The estimates of the divergence time are usually on the order of a few tens or 10000s year rather than just a few 1000 years (Boursot et al. 1993; Prager et al. 1998). This suggests that the commensal way of life has evolved independently in the *domesticus*, *musculus* and *castaneus* clades. It is presently understood that the ancestor of these *Mus musculus clades* originated somewhere in south-western Asia (e.g., Boursot et al. 1996). The precise location of the source area is uncertain, although phylogeographic arguments have favoured either the Indian subcontinent (i.e., the present range of *M. m. castaneus*) and adjacent areas in Central Asia (Boursot et al. 1996; Din et al. 1996) or the Near East within the range of *M. m. domesticus* (Prager et al. 1998).

Regardless of the details of the phylogeographic history of *M. musculus*, the subspecies exhibiting the widest range and the greatest impact on human populations, namely *M. m. domesticus*, has its origin in the Near East (Auffray et al. 1988), where agriculture was invented. In this area, *M. m. domesticus* has invaded homes and grain storage buildings, and has eventually adopted a commensal way of life. Further dispersal of *M. m. domesticus* to the Mediterranean and other parts of Europe proceeded probably *in tandem* with the spread of agricultural civilisations through the expansion and migrations of human populations, farming, and trade. Although the fossil evidence is still fairly fragmentary, there are findings of *domesticus*-like *M. musculus* on Cyprus from 9 to 8th millennium B.C. (Cucchi et al. 2002), suggesting that mice accompanied human dispersal already in the early Neolithic period. Nevertheless, the further spread of *M. domesticus* populations was probably somewhat delayed. The oldest findings of this species in various sites of the western Mediterranean and north-western Europe are from the Bronze or even early Iron Age (i.e., the first to second millennium B.C.; Auffray et al. 1990a, b; Auffray and Britton-Davidian 1992; Auffray 1993; Somerville 1999).

In spite of the fact that the Near East obviously plays a key role in the evolution of the *M. m. domesticus*, the populations of this area are almost completely ignored by scientists, except for some DNA sequence data (see, e.g., Prager et al. 1998; Gündüz et al. 2000). These studies support the key role of Mesopotamia in present-day Iraq and the surrounding territories in the formation of the *domesticus* species and subspecies complex (Prager et al. 1998).

In the Near East, only some populations of *M. musculus* have adopted a fully commensal way of life inside buildings and grain stores (Atallah 1977). Other populations are non-commensal and free ranging outside buildings and urbanized areas. In the same area, there is also another mouse species, namely *Mus macedonicus* Petrov et Ruzic, 1983 (see Vohralík et al. 1996, 1998; Orth et al. 2002a, b; for its taxonomy and ecology), which is highly aggressive (Frynta and Čiháková 1996) and apparently displaces non-commensal *M. musculus* from habitats in wet Mediterranean parts of Israel (Auffray et al. 1990a, b) and Western Syria (unpublished personal observation). This displacement of *M. musculus* does not take place in the dryer habitats further east, where *M. macedonicus* is probably absent. In these areas, such as in eastern Syria, the Turkish part of Mesopotamia (district Sanli Urfa, Turkey), and southwestern Iran (Khuzestan province), we frequently captured *M. musculus* in fields, shrubs, and vegetated areas along rivers. In these habitats, *M. musculus* was undoubtedly a dominant rodent species. Although we have no data from captures in the winter months and, therefore, cannot exclude the possibility that some wild mice occasionally spend the winter in human settlements, the capture data in the summer months show no sign of commensalism, and *M. musculus* has been found in open agricultural landscapes irrespective of the presence of buildings. In adjacent desert areas, as well as in Libya, *M. musculus* was mostly confined to oases and palm plantations (e.g., the Palmyra oasis in Syria). This distribution pattern is probably a function of their need to drink water, and in these areas no obvious biological relationship to buildings has been recorded. Occasionally, *M. musculus* has been found even in true semi-desert habitats, such as Wadi Al-Hiddan in Jordan (Benda and Sádlová 1999).

Earlier authors (see Marshall and Sage 1981; Harrison and Bates 1991) assigned mostly non-commensal *M. musculus* specimens inhabiting desert and semi-desert areas of the Near East and North Africa to the subspecies *Mus musculus praetextus* Brants, 1827 (the *Terra typica* being Syria). Recently, the name *praetextus* has been used by Mezhzherin et al. (1998) for the mice inhabiting the steppes of Azerbaijan and showing some allozyme differences from both *domesticus* and *musculus* populations. However, light brown or sandy-coloured mice with slender skulls may be just an ecological form of *M. m. domesticus* as suggested by Britton-Davidian (1990). She examined allozyme variation in several