

Biogeographic variations in wood mice: testing for the role of morphological variation as a line of least resistance to evolution

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Introduction

Morphological variation is an important aspect of biodiversity, in particular because phenotypic variation is an important target of the screening by selection. Its study can bring light onto the adaptive component of morphological diversification, thus constituting a precious complement to the vastly and rapidly developing field of genetic and genomic analyses. Furthermore, morphological evolution can be studied on both modern and fossil species, and can thus help to bridge the gap between different temporal scales, from contemporary evolution to long-term trends along millions of years.

Patterns of morphological evolution have long been studied, including for deciphering rodent evolution (e.g. Misonne 1969; Michaux 1971; Butler 1985). This field of investigation has been renewed by the development of methods allowing the quantification of fine-scale shape variation, namely geometric morphometrics (e.g. Bookstein 1991; Rohlf and Marcus 1993; Mitteroecker and Gunz 2009). Such methods, based on landmarks or outline analyses, have been used to tackle many topics regarding rodent evolution: evolutionary patterns along fossil lineages (Renaud *et al.* 1996, 2005; Piras *et al.* 2009; Stoetzel *et al.* 2013), diversification among species, addressing the respective role of adaptation and neutral evolution (e.g. Cardini 2003; Monteiro *et al.* 2005; Macholan 2006; Michaux *et al.* 2007a); differentiation between populations, investigating the role of environmental variations (Renaud 1999; Fadda and Corti 2001; Renaud and Michaux 2003, 2007; McGuire 2010; Helvaci *et al.* 2012), processes favoring co-occurrence among species (Ledevin *et al.* 2012), patterns and route of colonization (Valenzuela-Lamas *et al.* 2011; Siahsarvie *et al.* 2012; Cucchi *et al.* 2013). Insular differentiation provided numerous models of pronounced morphological differentiation questioning the respective role of adaptation and random factors (Cardini *et al.* 2007b; Michaux *et al.* 2007b; Renaud and Michaux 2007; Renaud and Auffray 2010; Renaud *et al.* 2013). Even contemporary evolution and response to current anthropic changes can find a morphological signature in rodents (Pergams and Lacy 2008; Renaud *et al.* 2013).