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Taxinomie/Taxonomy

Étude craniométrique du complexe d'espèces *Meriones shawii–grandis* (Mammalia : Rodentia) au Maroc, en Algérie et en Tunisie

Craniometrical study of the species complex of Meriones shawii–grandis *(Mammalia: Rodentia) in Morocco, in Algeria and in Tunisia*

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RÉSUMÉ

En Afrique du Nord, les rongeurs du genre *Meriones* ont un intérêt considérable sur le plan écologique, économique et épidémiologique. Jusqu'à présent, la systématique de ces espèces est sujette à discussion en raison de la présence de populations fortement différenciées. Ainsi, on parle au Maghreb du complexe d'espèces *M. shawii–grandis*. À l'aide d'une approche de morphométrie traditionnelle basée sur des distances crâniennes et en utilisant la méthode des ratios de conformation, nous tentons dans ce travail de caractériser morphologiquement les deux taxons. Les résultats montrent des différences significatives de taille et de conformation entre les spécimens du Maroc, d'une part, et ceux d'Algérie et de Tunisie, d'autre part. Les individus du Maroc (Clade *grandis*) ont des grandes dimensions des rangées dentaires et du crâne, une boîte crânienne étroite et des bulles tympaniques relativement petites. En revanche, ceux de l'Algérie et de la Tunisie (Clade *shawii*) se caractérisent par des petites rangées dentaires et un crâne moins long, une boîte crânienne large et des bulles tympaniques développées. La distance morphologique est forte (79,5 %) entre les deux groupes qui correspondent aux clades moléculaires. Cependant, l'analyse discriminante après apprentissage sur les individus typés moléculairement ne permet de bien classer en validation croisée que 91,8 % des spécimens.

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A B S T R A C T

In North Africa, the rodents of the species complex *Meriones shawii–grandis* have a considerable ecological, economic and epidemiological importance. Until now, the systematics of these species was subject to discussion due to the presence of populations displaying high morphological variability. By means of an approach of traditional morphometrics based on cranial distances and by using the method of the log shape-ratio, we attempt to characterize morphologically these two taxa. The results show significant differences in size and shape between the specimens of Morocco, on the one hand, and those of Algeria and Tunisia, on the other hand. The samples of Morocco that have been molecularly typed and attributed to *M. grandis* have larger tooth rows and narrower skulls, as well as relatively small tympanic bullae. On the other hand, those of Algeria and Tunisia assigned to *M. shawii* are characterized by small tooth rows and wide skulls with well-developed tympanic bullae. The morphological distance is relatively strong between both clades (79.5%), which corresponds to the molecular distance. However, the discriminant analysis performed after molecularly-typed specimens allows the correct classification of only 91.8% of the individuals.

Abridged English version

Introduction

Among North African rodents, *Meriones shawii* constitutes one of the most abundant species in its range and it is present in all countries from South Morocco to Egypt [1–4]. Its distribution is limited in the South by arid environments and the Sahara. It has been declared an agricultural pest and a host of rodent-borne diseases [5–22], but its taxonomy is not yet stabilized. Different morphological revisions [23–25] have attempted to clarify the generic and specific taxonomy, but failed to reach a consensus in the so-called species complex *M. shawii–grandis*. Different authors have proposed the existence of at least two valid species within the complex: *M. grandis* Cabrera, 1907 and *M. shawii* Duvernoy, 1842 [23–26], while many species or subspecies names are available in the literature. Both species had been put in synonymy until a morphometric revision by Pavlinov [27] who considered *M. grandis* as valid and present in Morocco to Egypt in sympatry with *M. shawii*. Other authors limit *M. grandis* to western Morocco. The morphological variability of *M. grandis* was explored based upon small samples [27–29] while for *M. shawii* no extensive study throughout its distribution area has yet been performed. In Morocco, a recent molecular and population genetic study has described two close molecular clades in Morocco and one in Algeria and those clades were considered respectively as *M. grandis* in Morocco and *M. shawii* in Algeria–Tunisia, the two main clades being sympatric in the Oriental region of Morocco close to the Algerian border [30]. The aim of the present work is to better explore the morphological variability among specimens of the species complex by using a classical morphometrics approach (size and shape with log-shape ratio method [31]) in a large sample from Morocco, Tunisia, Algeria, based upon distances calculated from craniometric measurements. Some of these specimens employed here have been molecularly typed. We will attempt to clarify the morphological characters characterizing the two species.

Material & methods

In total, 159 adult specimens characterized by dental wear stages 3 to 6 [32] from 18 localities were selected including 67 that were molecularly sequenced [30] (Table 1, Fig. 1). Some specimens are housed in the MNHN collections, while others are stored in El Bayadh (Algeria) and provisionally housed at the MNHN (cf. Appendix). Nine skull distances were selected following previous studies [33] Our classical multivariate morphometric analyses were conducted on log transformed skull distances, while log-shape ratios [34] were calculated in order to separate isometric size from shape and to thereby explore allometric patterns [35–38]. Isometric size differences between localities and sexual dimorphism were tested with two factor ANOVA and Fisher LSD tests. The visualization of the isometric size variability per localities was made through boxplot graphs [39–42]. Sexual dimorphism and geographic variation were also tested with MANOVA on size and shape characters. A principal component (PCA) on log-shape ratios allowed us to visualize the global variability trends of the data set. A discriminant analysis (noted AFD) based upon log-shape ratios allowed us to verify specific attributions in regard with molecular information and cross-validation [31]. Finally, a UPGMA was performed to visualize Euclidian distances between populations and build a phenetic tree. The morphometrical analyses were performed by using Statistica software version 10.0.228.2.

Results

Isometric size analysis

The ANOVA on the isometric size shows the absence of sexual dimorphism so that we could combine male and females in the same analyses. There is a significant

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