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## Notes on the distribution and phylogeography of two rare small Gerbillinae (Rodentia, Muridae) in Morocco: *Gerbillus simoni* and *Gerbillus henleyi*

*Notes sur la distribution et la phylogéographie de deux rares petites gerbilles (Rongeurs, Muridae) au Maroc : Gerbillus simoni et Gerbillus henleyi*

Oussama Bouarakia<sup>a</sup>, Christiane Denys<sup>c,\*</sup>, Violaine Nicolas<sup>c</sup>,  
Loubna Tifarouine<sup>a</sup>, Touria Benazzou<sup>b</sup>, Abdelaziz Benhoussa<sup>a</sup>

<sup>a</sup>Laboratory 'Biodiversity, Ecology and Genome', Research Center 'Plant and Microbial Biotechnology, Biodiversity and Environment', Faculty of Sciences, Mohammed V University in Rabat, 4, avenue Ibn-Battouta, B.P. 1014 RP, Rabat, Morocco

<sup>b</sup>Faculty of Sciences, Mohammed V University in Rabat, 4, avenue Ibn-Battouta, B.P. 1014 RP, Rabat, Morocco

<sup>c</sup>Institut Systématique Évolution Biodiversité (ISYEB), Sorbonne Université, MNHN, CNRS, EPHE, 57, rue Cuvier, CP 51, 75005 Paris, France

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### ABSTRACT

Even though Gerbillinae rodents represent an important part of the mammalian fauna in North Africa, many gaps remain in our understanding of the distribution, ecology, evolution, and systematics of some lesser known species in this family. We present in this study the most recent findings on two of these species. The first species, *Gerbillus simoni* Lataste, 1881, is a short-tailed, small gerbil, endemic to North Africa. In Morocco, it is present only in a small area in the northeast, where it has not been caught since 1970. In 2014, we captured a small gerbil in this region that was identified as *G. simoni* based on morphology and molecular data (cytochrome *b* gene sequencing). This study represents the first genetic characterization of *G. simoni* in Morocco and the first one outside Tunisia. Populations from Morocco and Tunisia (mainland and Kerkennah Islands) show very little genetic differentiation. The second species, *Gerbillus henleyi* de Winton, 1903, is a long-tailed small gerbil that lives in the Sahel and North Africa with an extension to the Middle East. In Morocco, this species was only known in the southwest. Between 2014 and 2015, we have captured four gerbils in the northeast of the country, which were confirmed genetically and morphologically as belonging to this species. This represents an extension of its known distribution of about 370 km to the northeast of the country. These new Moroccan specimens form a distinct lineage. High genetic diversity is observed throughout the geographic range of *G. henleyi*, suggesting the existence of several cryptic species.

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\* Corresponding author.

E-mail address: [denys@mnhn.fr](mailto:denys@mnhn.fr) (C. Denys).

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## R É S U M É

Bien que les rongeurs Gerbillinae représentent une part importante de la faune mammalienne d'Afrique du Nord, il subsiste des lacunes dans notre connaissance de leur distribution, écologie, évolution et systématique, notamment en ce qui concerne les espèces les plus petites et les plus rares. Cette étude présente les dernières connaissances sur deux de ces espèces. Ainsi, *Gerbillus simoni* Lataste, 1881 est une petite gerbille à queue courte endémique d'Afrique du Nord. Au Maroc, elle est présente uniquement dans le Nord-Est du pays, où elle n'avait pas été capturée depuis 1970. Un nouveau spécimen collecté en 2014 a été attribué à *G. simoni* sur la base de sa morphologie et des données moléculaires (séquençage du cytochrome *b*). C'est la première caractérisation génétique de l'espèce au Maroc et la première à l'extérieur de la Tunisie. Les populations du Maroc et de la Tunisie (continent et îles de Kerkennah) montrent une différenciation génétique très faible. Une seconde espèce, *Gerbillus henleyi* de Winton, 1903, est une petite gerbille à longue queue qui vit au Sahel, en Afrique du Nord jusqu'au Moyen-Orient. Au Maroc, cette espèce était connue uniquement du Sud-Ouest. Entre 2014 et 2015, nous avons capturé quatre spécimens dans le Nord-Est du pays, et leur identification est confirmée morphologiquement et génétiquement dans ce travail. Cela représente une extension de l'aire de répartition de cette espèce d'environ 370 km vers le Nord-Est du pays. Ces nouveaux spécimens constituent une lignée distincte. Une forte diversité génétique est observée le long de la distribution géographique de *G. henleyi*, ce qui suggère l'existence de plusieurs espèces cryptiques.

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## 1. Introduction

Situated at the western side of North Africa and receiving both Mediterranean and Atlantic influences, Morocco is today considered as a zone of high endemism and biodiversity [1], and it represents one of the Global 200 priority ecoregions for global conservation [2]. For mammals, the last synthesis by Aulagnier et al. [4] confirmed this richness, and some recent molecular works have highlighted important intra- and interspecific rodent diversity in that region (Ndiaye et al. [5,6] for *Gerbillus*, Nicolas et al. [7] for *Gerbillus campestris*, Lalis et al. [8] for *Meriones shawii*).

The order Rodentia is the most diverse group of mammals, as it contains nearly half of the mammalian species. In this group, the Gerbillinae subfamily, among which the genus *Gerbillus*, represents an important component of the fauna of the arid and semi-arid regions in Africa and Asia [9]. However, the systematics of this subfamily and genus are still a subject of debate [6]. Some of the smallest species of the genus are considered rare or at least difficult to trap and their relationships are far from known. Furthermore, many gaps remain in our understanding of the distribution, ecology, evolution of some lesser known species in this subfamily, especially in Morocco. In this study, we present the most recent findings on two rare dwarf Gerbillinae species: *Gerbillus simoni* and *Gerbillus henleyi*.

The lesser short-tailed gerbil or Simon's gerbil (*Gerbillus simoni*) was first reported and described by Lataste [10], and its type locality is Oued Magra in Algeria. It was often placed into the genus *Dipodillus*, whom which it is the type species [11–14]. Recent molecular analyses have demonstrated

that the genus is no longer valid and it is now included into *Gerbillus* [6,15–17]. *Gerbillus kaiseri*, described by Setzer [18] in Egypt and present in the East of Libya and in Egypt, is now considered as synonymous with *G. simoni* [14]. Another species, *Gerbillus zakariai*, was described by Cockrum et al. [19] as being endemic to the island of Kerkennah (Tunisia). It was later included within *G. simoni* by some authors [15,16,20,21], and considered as a separate insular species by others [14,19,22]. Ndiaye et al. [6] sequenced a specimen from mainland Tunisia (Kairouan) and showed that it clusters unambiguously with specimens from Kerkennah Islands. We follow Ndiaye et al. [6] and Happold [16], and consider *G. zakariai* as a synonym of *G. simoni*.

Simon's gerbil is endemic to North Africa and has a discontinuous range. The first part of its range goes from the Northeast of Morocco to the Northwest of Libya, through the North of Algeria and central Tunisia. In Algeria, it is found in the northern edge of the High Plateaux, but not in the coastal regions. The second part of the range goes from the northeastern coast of Libya to the west of the Nile Delta in Egypt [3,16]. In Morocco, this species was previously only captured by Schlitter & Setzer [23] in Oriental Morocco near Ain Beni Mathar, which represents the most western limit of this species. Simon's gerbil occurs in many habitats, especially with clay or loam soils. It is not found in sandy habitats, like many other gerbils. It inhabits lowlands and sporadically vegetated littoral desert, Chotts and salt marshes, steppe grassland vegetation (Alfa and Artemisia), steppes replaced by cropland and fallow fields, vegetated slopes and grassy valleys. It also inhabits relatively humid environments [3,4,16,24].

The Pigmy gerbil or Henley's gerbil was first reported and described by de Winton [25], and its type locality is

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