



General palaeontology, systematics and evolution (Biostratigraphy)

Cricetodontini from the Calatayud–Daroca Basin (Spain): A taxonomical description and update of their stratigraphical distributions



*Les Cricetodontini du bassin de Calatayud–Daroca (Espagne):
description taxonomique et mise à jour biostratigraphique*

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ABSTRACT

The most updated stratigraphical distributions of the Cricetodontini from the Calatayud–Daroca Basin are presented. *Cricetodon sansaniensis* (local biozone F, MN6, middle Aragonian) and *Cricetodon jotae* (local biozone G1, G2 and G3, MN6–MN7/8, Middle–Upper Aragonian) from the middle Miocene are described and discussed. Generally, the genera of Cricetodontini were used to define large time intervals, whereas the species were neglected in the local biostratigraphical studies. The results presented herein show that, for the Calatayud–Daroca Basin, most of the stratigraphical distributions of the species of Cricetodontini are strongly linked with the local biozonation. That reveals that they could be used as good biostratigraphical indicators. Moreover, the unusually long local biozone G3 could be redefined and subdivided based on the distributions of the four species of Cricetodontini present in it. However, it is recommended to complete the study of the whole rodent fauna before proposing a new biozonation.

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R É S U M É

Une mise à jour détaillée des distributions stratigraphiques des espèces de Cricetodontini présentes dans le bassin de Calatayud–Daroca est proposée. Les espèces *Cricetodon sansaniensis* (biozone locale F, MN6, Aragonien moyen) et *Cricetodon jotae* (biozones locales G1, G2 et G3, MN6–MN7/8, Aragonien moyen et supérieur) du Miocène moyen sont décrites et discutées. Généralement, les genres de Cricetodontini ont été utilisés dans la définition des grands intervalles de temps, tandis que les espèces ont été négligées dans les études biostratigraphiques locales. Les résultats présentés ici montrent que la plupart des distributions stratigraphiques des espèces de Cricetodontini du bassin de Calatayud–Daroca sont

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étroitement liées à la biozonation locale. En conséquence, leur importance est soulignée dans le cadre d'études biostratigraphiques à une échelle fine. De plus, la biozone locale G3, d'une durée inhabituellement longue, pourrait être redéfinie et subdivisée en fonction de la distribution des quatre espèces de *Cricetodontini* présentes. Cependant, une étude détaillée de la faune complète des rongeurs est nécessaire avant qu'on puisse proposer une nouvelle biozonation.

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1. Introduction

The tribe *Cricetodontini* is a group of large-sized rodents found in Europe, northern Africa and Asia (De Bruijn and Ünay, 1996; Jaeger et al., 1973; Rummel, 1999). Their biogeographical distribution follows a symmetrical model in which the first occurrence of the tribe is in a small area (region of Anatolia) during the Early Miocene (Álvarez-Sierra et al., 2013; De Bruijn and Ünay, 1996; Rummel, 1999). In the Middle Miocene, there is a gradual expansion into central Europe and France followed by a period of stasis in which the taxon is distributed over most Europe and Asia Minor (Álvarez-Sierra et al., 2013; De Bruijn and Ünay, 1996; Rummel, 1999). Their extinction at the end of the Pliocene was preceded by a period of fragmentation and contraction of their distribution area since the late Middle Miocene (Álvarez-Sierra et al., 2013; De Bruijn and Ünay, 1996; Rummel, 1999).

This tribe includes eight genera; three of them—*Cricetodon* Lartet, 1851, *Hispanomys* Mein and Freudenthal, 1971a, and *Ruscinomys* Depéret, 1890—are recorded in the Aragonian and Vallesian from the Calatayud–Daroca Basin.

Genera of *Cricetodontini* have been used, as biostratigraphical indicators, in many studies for the Calatayud–Daroca Basin (e.g., Álvarez Sierra et al., 2003; Daams et al., 1999; Hernández-Ballarín et al., 2011; Van der Meulen et al., 2011, 2012), although mainly to define large time intervals and limits between major continental units. For instance, the first occurrence (FO) of *Cricetodon* coincides with the beginning of the local biozone E in the Calatayud–Daroca Basin (Daams et al., 1999; Van der Meulen et al., 2012), and the relative abundance of *Cricetodon* and *Hispanomys* characterizes the faunas from the Late Aragonian and the Early Vallesian in the same basin (Daams et al., 1999).

By contrast, the species of *Cricetodontini* has been not traditionally used for local biostratigraphical subdivisions in the Calatayud–Daroca Basin. De Bruijn et al. (1993) pointed out that the mosaic morphology displayed by the species of *Cricetodontini* precludes their use for the proposal of detailed biostratigraphical scales. Nevertheless, the recently exhaustive study of the species of *Cricetodontini* has served as a source to establish biostratigraphical subdivisions. For instance, the species of *Byzantinia* and *Cricetodon* were used in the local biostratigraphy of the Neogene from Turkey (Ünay and De Bruijn, 1984; Ünay et al., 2003). Furthermore, in the workshop of the Regional Committee of Stratigraphy of the Neogene in May 2012, the biostratigraphy of the uppermost Early Badenian (Middle Aragonian) from the German Molasse were updated from those proposed by Heissig

(1997). Three species of *Cricetodon* were used to define three local biozones: *Cricetodon meini*, *Cricetodon aureus* and *Cricetodon sansaniensis* which correspond to OMS units E', F, and F' (Böhme et al., 2012). Moreover, Kálin and Kempf (2009) also used a similar approach in the biostratigraphy of the Swiss Molasse. Therefore, it seems that a better knowledge of the species of *Cricetodontini* could reveal them as good local biostratigraphical and biochronological indicators. Furthermore, the local biozonation of Van der Meulen et al. (2012), based mainly on cricetids (e.g., *Megacricetodon* and *Democricetodon*), could be extended towards the Late Aragonian and the Early Vallesian; indeed, the most updated distribution of the *Cricetodontini* will be useful in the redefinition of the local biozonation.

Several works have recently focused in the systematics of the tribe *Cricetodontini* from the Calatayud–Daroca Basin (López-Guerrero et al., 2008, 2009, 2013a, 2014), but a number of localities and species from the earliest part of the Late Aragonian still lacked a detailed revision. Thus, the first aim of this paper is to review this material of *Cricetodon*.

The second aim is to evaluate the updated stratigraphical distributions of the *Cricetodontini* from the Calatayud–Daroca Basin and assess whether or not they are good biostratigraphical markers.

2. Material and methods

We have studied 503 upper and lower molars belonging to 18 sites. Table 1 contains all the information about the different localities. Within the total sample, 89 specimens from five localities belong to *C. sansaniensis* Lartet, 1851 and the other 414 molars correspond to *Cricetodon jotae* Mein and Freudenthal, 1971a, recovered from 13 localities (Table 1). We observed personally the material of several species summarized in Table 2. The information about the other species of *Cricetodontini* from the Calatayud–Daroca Basin has been found in López-Guerrero et al. (2008, 2009, 2013a, 2014). The numerical ages of the localities are after Daams et al. (1999), Van Dam et al. (2006) and Van Dam (in prep.). The nomenclature used follows López-Guerrero et al. (2013a). Length and width measurements for each specimen were taken (in mm) using a Nikon Measuroscope 10 microscope with digital micrometer, following the procedure suggested by López-Guerrero et al. (2013a). The photographs from Figs. 1 and 2 were taken with an environmental Scanning Electron Microscope FEI Quanta 200 at the Museo Nacional de Ciencias Naturales–CSIC, Madrid (Spain) except for those from ARM7 and VT2C, taken with a digital camera attached to a Leica Microscope at Naturalis Biodiversity Center, Leiden (The Netherlands).

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