C. R. Palevol xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Comptes Rendus Palevol

www.sciencedirect.com

General Palaeontology, Systematics and Evolution (Vertebrate Palaeontology)

Palaeoecological implications of rodents as proxies for the Late Pleistocene–Holocene environmental and climatic changes in northeastern Iberia

Implications paléoécologiques des rongeurs comme indicateurs des changements environnementaux et climatiques du Pléistocène supérieur à l'Holocène dans le Nord-Est de la péninsule Ibérique

Mónica Fernández-García [a,b,*], Juan Manuel López-García [b], Carlos Lorenzo [a,b]

[a] *Àrea de Prehistòria, Universitat Rovira i Virgili (URV), Avenue Catalunya, 35, 43002 Tarragona, Spain*
[b] *Institut Català de Paleoecologia Humana i Evolució Social (IPHES), C/Marcel·lí Domingo s/n, Campus Sescelades URV (Edifici W3), 43007 Tarragona, Spain*

ARTICLE INFO

Article history:
Received 16 March 2015
Accepted after revision 20 August 2015
Available online xxx

Handled by Hugues A. Blain

Keywords:
Rodentia
MIS 2
Palaeoenvironment
Middle Palaeolithic
Upper Palaeolithic
Late Glacial Maximum

ABSTRACT

Rodents are among the most useful proxies for reconstructing the ecology and environment of the Quaternary. The present paper focuses on a series of fossil rodent assemblages from northeastern Iberia of the Late Pleistocene (ca. 128–11.7 ka BP) and the beginning of the Holocene (< 11.7 ka BP). Descriptive and multivariate statistical methods have been applied to expand what is known about the species involved and their palaeoecological implications. The results show the importance of the three predominant species: *Microtus arvalis*, *Microtus agrestis* and *Apodemus sylvaticus*. A transition in the ecological conditions is shown in the studied area during the course of this interval: from open environments and cooler climatic conditions to more forested landscapes and temperate conditions. The beginning of the Late Pleistocene and the Holocene share similarities, and both differ clearly from the end of the Late Pleistocene, showing the singular nature of the environmental conditions of Marine Isotope Stage 2 in the northeastern sector of the Iberian Peninsula.

Mots clés :
Rongeurs
SIM 2
Paléoenvironnement
Paléolithique moyen
Paléolithique supérieur
Dernier maximum glaciaire

RÉSUMÉ

Les rongeurs sont parmi les marqueurs les plus significatifs pour la reconstruction de l'écologie et de l'environnement du Quaternaire. Ce travail prend en compte une série d'assemblages de rongeurs fossiles du Pléistocène supérieur (environ 128 à 11,7 ka BP) et du début de l'Holocène (< 11,7 ka BP), provenant du Nord-Est de la péninsule Ibérique. Des méthodes statistiques descriptives et multivariées ont été appliquées, afin d'obtenir une meilleure connaissance des espèces concernées et de leurs implications paléoécologiques. Les résultats obtenus indiquent l'importance de trois espèces dominantes : *Microtus arvalis*, *Microtus agrestis* et *Apodemus sylvaticus*. Une transition des conditions écologiques est mise en évidence dans la région étudiée pendant cet intervalle : depuis des environnements

* Corresponding author. Institut Català de Paleoecologia Humana i Evolució Social, C/Marcel·lí Domingo s/n, Campus Sescelades URV (Edifici W3), 43007 Tarragona, Spain.
E-mail address: monica.fernandez.garcia.90@gmail.com (M. Fernández-García).

http://dx.doi.org/10.1016/j.crpv.2015.08.005
1631-0683/

ouverts avec un climat plutôt frais vers des paysages plus boisés traduisant un climat tempéré. Les ressemblances mises en évidence parmi les sites datant du début du Pléistocène supérieur et de l'Holocène se démarquent nettement de ceux de la fin du Pléistocène supérieur, soulignant la singularité des conditions environnementales pendant le stade isotopique marin 2 dans le Nord-Est de la péninsule Ibérique.

1. Introduction

The Late Pleistocene (128–11.7 ka BP) is an interval characterized by high climate instability, which alternates cold and warm phases and isolated climatic episodes (such as Heinrich Events or Dansgaard-Oeschger events) (Sánchez-Goñi and D'Errico, 2005). Theses fluctuations are likely to have had impacts on flora, fauna and human societies. The transition from the Latest Pleistocene to the Holocene, characterized by a sharp increase in temperatures occurring around 11,700 years ago, also constituted an environmental break with major consequences (Bradley and England, 2008).

Different proxies (such as Greenland ice cores, marine pollen cores or continental records) have increased what is known of the Quaternary environment. In the continental domain, the temporal discontinuity of sedimentary records limits the reconstruction of reliable climatic parameters. Many proxies have been developed in order to quantify climatic parameters, on the basis either of palaeobiological approaches or geochemical methods. Over the last two decades, multidisciplinary approaches have been developed in order to improve the reconstruction of continental climate models and understand the responses of living organisms to climatic changes (Sánchez-Goñi and D'Errico, 2005; Sánchez-Goñi et al., 2008). For the Iberian Peninsula, climatic particularities have been discussed that differed from the dynamics of the rest of Europe on account of geographical situation and as a consequence of the condition of southern Europe as particularities that can also be found in the Italian Peninsula and the Balkans (Fletcher et al., 2010; Harrison and Sánchez-Goñi, 2010).

Rodents are one of the most noteworthy groups of mammals in the European Quaternary, and they have become one of the most useful tools for reconstructing the ecology and environment of the Quaternary. Species from this order tend to undergo an accelerated evolution and are generally characterized by short life spans (Van Dam et al., 2006), a close relationship with their environment and strict ecological requirements. These factors make them extremely good markers for studies that focus on evolution, biochronology and particularly for inferring a record of their local living environments. Moreover, their widely ranging geographical distribution and the high presence of their remains in Quaternary sedimentary deposits makes it possible to apply multiple statistical approaches and quantitative methods (Alcalde and Galobart, 2002; Chaline, 1988; López-García, 2011). In the present study, the statistical analysis of rodent assemblages from Late Pleistocene (128–11.7 ka BP) and Holocene (< 11.7 ka BP) sites from the northeastern Iberian Peninsula increases what is known of the species in question during this time frame, taking into account the specific palaeoecological implications of the assemblages with the aim of understanding the environmental evolution of this region. On the basis of this methodology, our aim is to ascertain the differences and similarities between these sites/levels depending on the occurrence of species and also establish which species assemblages are the most common and which are the dominant ones.

2. Materials and methods

2.1. Data matrix

The data matrix employed corresponds to specimens recovered from 37 levels from 12 archaeological sites from the Northeast of the Iberian Peninsula, chronologically located in the Late Pleistocene and the beginning of the Holocene. For each species, the minimum number of individuals (MNI) has been taken into account. Only levels with an NMI greater than or equal to 15 have been included in these analyses. This NMI limit has been decided as the optimal point to remove the assemblages with low individuals but not loss to many levels from this region (Fig. 1; Table 1) (Appendix A1).

Corrections have been applied to the data matrix in order to simplify the interpretation and reduce the dispersion of the results. Firstly, the specimens of *Microtus arvalis* and *Microtus agrestis* are integrated into a single group because it is common, especially in older publications, not to differentiate between these two species (identified as *Microtus arvalis-agrestis*). In order not to overlook the importance of the presence of these two species, the adopted solution is to put these categories into a single group. As regards the ecological restrictions on the two species, both are mid-European species associated with cool climates, high altitudes and open landscapes; they only differ in their preference for moisture (Palomo et al., 2007; Sans-Fuentes and Ventura, 2000).

Secondly, all specimens identified as *Arvicola* sp. in previous publications (Alcalde, 1986) have been interpreted as belonging to the species *Arvicola sapidus*, because this is the only species from this genus present during this interval in the Northeast of Iberia (López-García, 2011). The only example of *Arvicola terrestris*, the other extant species from this genus, is located in Cova d'Olopte B (Villalta, 1972), and this is probably misidentified, also corresponding to *A. sapidus*, a species widely extended in Catalonia during the Late Pleistocene–Holocene. Finally, the specimens identified as *Terricola* sp. have been considered to be *Microtus (Terricola) duodecimcostatus*. The other known species of

Please cite this article in press as:Fernández-García, M., et al., Palaeoecological implications of rodents as proxies for the Late Pleistocene–Holocene environmental and climatic changes in northeastern Iberia. C. R. Palevol (2015), http://dx.doi.org/10.1016/j.crpv.2015.08.005