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The Mas del Pepet experimental programme for the study of prehistoric livestock practices: Preliminary data from dung burning

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ABSTRACT

The research for referential data on current livestock contexts is essential for correctly interpreting archaeological records documented in prehistoric livestock spaces. Experimental programmes such as the one begun in 2014 in the Mas del Pepet pen (Rojals, Tarragona) has permitted an understanding, among other matters, of fold characteristics according to the type of livestock, the seasonality of occupations and herd management. This study also contributes to the identification of taphonomic processes that have taken place and to determine the representativeness of the botanical content in the deposit, in relation to the environment and pasture areas. Finally, the dung burning experiments conducted have provided data that will help to reveal the way manure was treated in prehistoric fold caves.

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1. Introduction

Archaeological sites related to livestock activities are a major source of information for the understanding of prehistoric societies. Several fold cave sites dated from between the Neolithic and Bronze Age in Europe are characterised by the periodic burning of manure in order to reduce its volume and to eliminate parasites (Brochier et al., 1992; Charles, 1998; Badal, 1999; Angelucci et al., 2009). This activity has been identified at numerous sites: Arene Candide in Italy (Maggi, 1997), Caune de Belesta; Grotte Antonnaire, in France (Argant et al., 1991; Brochier et al., 1998) and Cova de les Cendres (Badal, 1999), Los Husos (Alday-Ruiz et al., 2003), Cova Gran (Polo-Díaz et al., 2014), La Cova de la Guineu (Bergadà et al., 2005); El Mirón (Peña-Chocarro et al., 2005), and others on the Iberian Peninsula.

This practice led to a distinctive and complex series of stratigraphic deposits that are difficult to study due to the different actors and phenomena involved in their formation and also because of the dynamic nature of taphonomic processes. The characterisation of this sedimentological formation in animal enclosures is based on the identification of four criteria: presence of microlamination, dung spherulites, authigenic phosphate and some specific types of phytoliths (Shahack-Gross et al., 2003, 2005; Shahack-Gross, 2011).

Until now, the study of penning practices in prehistoric contexts has been approached by different disciplines with important implications for understanding the socio-economic practices of agro-pastoral groups (Shahack-Gross, 2011).

Generally, these kinds of accumulations are rich in archaeobotanical material because they were formed by the repeated burning of waste from different practices, including agriculture, livestock and domestic activities (Brochier et al., 1992; Canti, 1999; Vergès et al., 2008; Angelucci et al., 2009). Archaeobotany can therefore contribute to addressing topics such as: reconstructing past vegetation; determining the seasonality of the occupations;

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gaining knowledge of the existing plant resources; observing the use of domestic space, analyzing taphonomy and site formation processes; forest management; and the detection of the presence of domestic taxa linked to agriculture or to farming practices (Shahack-Gross et al., 2003, 2005; Albert and Henry, 2004; Albert et al., 2008; Allué et al., 2009; Cabanes et al., 2009; Portillo et al., 2009; Portillo and Albert, 2011; Lancelotti and Madella, 2012; Euba et al., 2016).

Soil micromorphology applied to fold caves has enabled some topics to be addressed, characterising the phases that make up a complete combustion cycle and providing information about the taphonomy and formation processes of these sequences (Bergadà, 1995, 2001; Macphail et al., 1997; Bergadà et al., 2005; Polo-Díaz and Fernández-Eraso, 2010; Polo-Díaz et al., 2014).

Several ethnoarchaeological studies have documented patterns which can be extrapolated to prehistoric contexts to compare and generate new hypotheses about pastoralism and folding spaces (Brochier, 1983; Shahack-Gross et al., 2003; Elliott et al., 2014; Portillo et al., 2014) and the use of dung as a by-product (Reddy, 1999; Silla, 2000; Zapata Peña et al., 2003).

Some experimental archaeological studies have examined specific issues (Macphail et al., 2004; Vergès, 2011; Schepers and Haaster, 2015). However, a systematic and comprehensive experimental programme dedicated to the study of the complexity of the multiple factors involved in pastoralism and animal enclosures has yet to be developed.

The study of livestock areas, in particular those managed differently from ones known in historical times, thus requires experimental reference data that can contribute to set out and contrast hypotheses and establish more precise interpretations for the archaeological context.

2. The Mas del Pepet experimental project

The Mas del Pepet experimental programme was set up in 2014, motivated by the need to obtain data to interpret prehistoric fold cave dynamics. The experimental program aims to characterise and interpret the formation processes and human activities related to livestock management and pen contexts (see below, Section 2.3).

One of the specific goals of the experimental program is related to the *in situ* burning of dung in pens. Up to now, some experiments involving the burning of dung heaps have been conducted and have provided data leading to the identification of some relevant variables related to the dung burning process (Vergès, 2011). However, it is necessary to address *in situ* burning to characterise the impact of combustion on the substrate where the burning event took place. In order to resolve this specific problematic, we present here the preliminary results from *in situ* dung combustion, including in the Mas del Pepet experimental program.

2.1. The Mas del Pepet pen

The area where the prehistoric livestock experimental program was carried out was in the Mas del Pepet pen, located in the village of Rojals, in the municipality of Montblanc (Tarragona, Catalonia) (Fig. 1). The Mas del Pepet pen is located on the left bank of the Mas d'en Llorc cliff, at 880 m a.s.l. This was the old farmyard of the Pepet farmhouse, now in ruins, and recently refurbished to accommodate the flock of Pere Domenech. The enclosure is at the foot of the cliff wall. It encompasses areas with different conditions that allow much of the variability observed in the archaeological sites. Between these are two spaces that are enclosed by walls which prevent the lateral movement of manure and ensure that the surfaces remain flat and even. There is one covered area and one open-air area. The former prevents rain and other meteorological

conditions from affecting the interior of the pen. In addition, there is a large space around the buildings that includes a sloping area that has been subjected to the phenomena of gravity erosion, and another flat area surrounded by a metal perimeter fence, where accumulation phenomena are commonplace.

2.2. Livestock and pasture areas

The Mas del Pepet herd consisted of 400 heads of livestock, made up of approximately 350 goats and 50 sheep (Fig. 2). The flock grazed in the eastern sector of the Natural Area of National Interest (PNIN) of Poblet (Tarragona, Catalonia), in order to control the undergrowth. This activity is part of a government forest-fire prevention plan. This involves traditional extensive grazing, with the herd accompanied by a shepherd who stays in the pen during the night. This practice of staying in the pen is seasonal and usually starts in April/May and lasts until October/November.

The vegetation of the area is open woodland of *Quercus ilex-coccifera* and *Quercus pubescens* that includes *Genista scorpius*, *Ulex parviflorus*, *Cistus albidus*, *Ruscus aculeatus*, *Smilax aspera*, *Euphorbia dendroides*, *Rubia peregrina*, *Brachypodium* sp., *Pinus* sp. and other characteristic species of sclerophyllous brush and grasses typical of Mediterranean mixed-oak forests.

2.3. The objectives of the Mas del Pepet experimental program

The experimental program has included a series of experiments intended to provide information on a wide range of variables for managing livestock and enclosures. It is a long-term project, promoted by the Institut Català de Paleocologia Humana i Evolució Social (IPHES), with the support of the Natural Area of National Interest of Poblet as the managing body. Here we present the main research objectives that are addressed. Although they are described individually to facilitate the organisation of information, many of them actually overlap and experiments and analysis were shared.

The experimental project is currently in progress. Since 2014 we have developed annual experimental fieldwork sessions, during the period when the pen is abandoned. We are carrying out general sampling, including archaeobotany, micromorphology, archaeomagnetism and humidity samples, representative of before and after the *in situ* dung burning. Also, we are performing a number of experiments in relation to the analysis of spatial distribution, site formation processes and dung accumulation rates, inside the pen.

In this section we introduce the principal aims of the experimental project, for which we have, at present, only preliminary results concerning the *in situ* dung combustion.

2.3.1. Estimate of the rate of dung accumulation

Based on the volume of dung accumulated, we do not currently have reliable data to offer an estimate about the relationship between the number of livestock and the length of stay in the enclosure necessary to generate deposits similar to those documented in the archaeological sites. Our aim is therefore to study the rate of dung deposition in the pen according to the occupied area, the time span of the occupation and how many heads of livestock there were.

The documentation of the volume of excrement accumulated during the livestock's stay is carried out by comparing 3D models of the floor of the pen before the arrival of the flock and after its departure. The 3D models are generated from data captured with a FARO Focus 3D laser scanner. This procedure allows to obtain precise numerical data of the volumetric increase of the deposits over time. Based on the variable volume of waste, the number of livestock and the length of stay in the enclosure, an accurate picture of the amount of waste deposited by the animals daily in the pen can

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