



# The bird assemblage from the Middle Palaeolithic level I of Arbreda Cave: A taphonomic story



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## ABSTRACT

The Middle Palaeolithic avifaunal assemblage recovered from level I (c. 40 ka) of Arbreda Cave (northern Iberia) includes a high diversity of birds. The most abundant taxa are cliff-dwelling species represented mostly by choughs (*Pyrrhocorax* spp.) and pigeons (*Columba livia*). Forest species, especially corvids, are also well represented. Taphonomic analysis reveals a complex scenario with evidence of different agents acting as bird bone accumulators at the site. Cut marks, peeling and diagnostic fractures produced by overextension of articulations indicate that Neanderthals were involved in the consumption and disposal of the avian remains, especially choughs, pigeons and jackdaws. A substantial number of tooth/beak-marked bones and some digested remains also evidence the participation of other predators, probably raptors, in the formation of the assemblage. Other birds probably died naturally and were incorporated into the archaeological record.

This study provides further evidence of the exploitation of avian resources by Neanderthals. It also exemplifies the complexity of archaeological small-prey assemblages and the necessity of undertaking a detailed taphonomic analysis to establish the origin of faunal remains.

## 1. Introduction

Birds are well known to be valuable environmental indicators, and for this reason their remains recovered from archaeological sites have commonly been used to reconstruct the ecosystems of the past (e.g. Sánchez-Marco, 2004; Finlayson et al., 2011). Further, in recent decades birds have also contributed significantly to the clarification of important aspects of prehistoric hunter-gatherer behaviour and subsistence.

As far as subsistence is concerned, from the end of the Pleistocene innovative adaptations associated with anatomically modern humans have been identified in southern Europe and the Levant, manifest especially as a diversification of resources. This has been termed the *Broad Spectrum Revolution* (Flannery, 1969). The Broad Spectrum Revolution is characterized by an expansion of dietary breadth, resulting in the procurement of a larger number of species, particularly through the greater exploitation of small game such as birds (Villaverde et al., 1996; Pérez Ripoll, 2001; Hockett and Haws, 2002; Aura et al., 2002, 2009; Stiner and Munro, 2002; among others).

However, evidence of small-prey use prior to the arrival of anatomically modern humans in Europe has also been detected. Specifically,

the evidence of bird hunting by Neanderthal communities, with nutritional or ornamental purposes, has been pointed out by several researchers in recent years. Birds were used as food in some levels of Bolomor Cave (Blasco and Fernandez Peris, 2009; Blasco et al., 2013), Gorham's Cave (Blasco et al., 2014, 2016), Cova Negra (Martínez Valle et al., 2016), Fumane Cave (Fiore et al., 2016), Les Fieux (Laroulandie et al., 2016) and Grotte de L'Hortus (Mourer-Chauviré, 1972). In Vanguard Cave and Ibex Cave, cut marks have also been observed on corvid and diurnal raptor bones that could imply a search for feathers or other symbolic uses (Finlayson et al., 2012), similar to those that have been interpreted this way at Fumane Cave (Peresani et al., 2011). In Combe-Grenal, Les Fieux, Pech de L'Azé, Rio Secco Cave and Mandrin Cave, cut marks were also registered on talons and phalanges (Mourer-Chauviré, 1975; Morin and Laroulandie, 2012; Romandini et al., 2014; Laroulandie et al., 2016).

These examples suggest that the evolution of dietary breadth was not linear and that foraging strategies in the Middle Palaeolithic were more diverse than previously thought (Blasco and Fernandez Peris, 2009; Laroulandie et al., 2016). However, this is a topic that is still under discussion, and more studies on avian remains from sites in different regions are needed to be able to assess to what extent bird

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exploitation by Neanderthals was significant and systematic in nature.

The origin of archaeological avian remains is a key issue underlying this debate, as various taphonomic agents other than humans may have accumulated the remains at archaeological sites. On the one hand, birds are an important source of food for a large number of non-human predators. Diurnal and nocturnal raptors and terrestrial carnivores are regular visitors to caves and rock-shelters, where prey leftovers and pellets or scats containing bird remains may accumulate. On the other hand, bird accumulations could also be a consequence of natural deaths, especially in the case of cliff-dwelling species. Taphonomic studies of archaeological assemblages have shown that avian remains are often the product of combinations of anthropogenic and non-anthropogenic agents (e.g. Laroulandie et al., 2016; Romero et al., 2017). To understand the importance of birds in human subsistence activities in the past, it is thus essential to establish which taphonomic agents are responsible for a given accumulation. In recent years, systematic actualistic studies of modern bird remains originating from natural populations, terrestrial carnivores, raptors and humans have been conducted (e.g. Bochenki and Tomek, 1997; Laroulandie, 2000, 2001, 2005; Bochenki et al., 1997, 1998, 1999, 2009; Bochenki, 2005; Mallye et al., 2008; Lloveras et al., 2014a, 2014b, 2017; Rodríguez-Hidalgo et al., 2016). The results have provided essential reference data that are of great use in establishing which agent/s were responsible and in making accurate taphonomic interpretations.

Using taphonomic and zooarchaeological analysis and taking into account the above-mentioned reference data, our aims in this paper are: (1) to find out which taphonomic agents are responsible for the avian assemblage that accumulated in the Late Mousterian level (level I) of Arbreda Cave, and (2) to find out the extent of human predation on these taxa and provide new data concerning the human exploitation of birds in Mousterian contexts.

## 2. Archaeological context

Arbreda Cave forms part of the Reclau cave system (Serinyà, Catalonia, Iberian Peninsula), a clustered formation located in a small talus on a somewhat karstic travertine cascade above the Serinyadell Stream at an altitude of about 200 masl (Fig. 1). The cave contains sedimentary deposits ranging from the end of the Middle Pleistocene to the Early Holocene (Soler and Maroto, 1987; Maroto et al., 1996), constituting an important archaeological record for understanding the prehistoric occupation of north-eastern Iberia. In fact, this archaeological site preserves one of the longest continuous stratigraphic and cultural sequences in the area with an over 9 m-thick exposed stratigraphic sequence that spans from Mousterian, Archaic Aurignacian, Evolved Aurignacian to Gravettian and Solutrean levels (Soler and Maroto, 1987; Maroto et al., 1996; Soler Subils et al., 2014) (Fig. 2). The Late Mousterian level (level I) presents a minimum average thickness of 60 cm. It should be taken into account that the data from this level were obtained before the end of the archaeological excavation and are therefore not definitive. Calibration of the  $^{14}\text{C}$  dates using the OxCal 4.1.7 software (Bronk Ramsey, 1995) yielded a value of 45,840–41,410 cal BP (Wood et al., 2014). Level I of the Arbreda sequence demonstrates typical Mousterian industry oriented to flake production mostly from Llevalois and discoidal cores. Raw materials are of local origin and include quartz (75.9% of the total), quartzite (6.1%), flint (4.4%) and other materials. The retouched tools ( $N = 638$ ) were classified by categories as scrapers (376, 58.9%), denticulates (244, 38.2%) and others tools such as Chatelperronian points (4, 0.6%). The Chatelperronian tools were recovered in the highest layers of level I (Fig. 2) indicating the terminal nature of the Mousterian sequence from the top of level I, which is also consistent with the radiocarbon dates obtained (Bischoff et al., 1989; Maroto et al., 1996; Wood et al., 2014).

The very large number of tiny blow remains indicates that the tool-making took place within the cave. Retouched tools make up 37.4% of all findings over 1 cm in length (Maroto et al., 1996).

The faunal remains analysed from the Late Mousterian level (Table 1) show that rabbits (*Oryctolagus cuniculus*) are the most abundant taxon (Soler and Maroto, 1987; Maroto et al., 1996; Lloveras et al., 2010), constituting approximately 87% of the NISP of large and medium-sized mammals. Carnivores are also relevant, especially the cave bear (*Ursus spelaeus*, represented mainly by new-borns and cubs). Other carnivores, such as the wolf (*Canis lupus*), the red fox (*Vulpes vulpes*), the spotted hyena (*Crocuta crocuta*), the Iberian lynx (*Lynx pardinus*), the wildcat (*Felis silvestris*) and the leopard (*Panthera pardus*), are also recorded. Among the ungulate remains, the red deer (*Cervus elaphus*), aurochs (*Bos primigenius*) and horse (*Equus ferus*) stand out. Hedgehog (*Erinaceus europaeus*) and hare (*Lepus* sp.) remains are also present but in low numbers. Fish remains were also recovered; specifically 18 fish bone fragments representing at least five different species were identified (Múñoz and Casadevall, 1997). Finally among the faunal remains, birds were moderately abundant with > 395 identified specimens (García, 1995).

## 3. Material and methods

The bird remains studied in this paper come from the Late Mousterian level (level I) of Arbreda Cave (Fig. 2). The cave deposits were entirely wet-sieved through a 1 mm-mesh. The sample is composed of more than five hundred bird bones, most of which were identified in a preliminary study conducted by one of the authors (García, 1995). Here the sample has been expanded with new identified specimens.

Taxonomic determinations were made using the avian osteological collections of the Institut de Paléontologie Humaine in Paris and by consulting the osteological research of Bacher (1967), Fick (1974), Kraft (1972), Otto (1981), Schmidt-Burger (1982) and Woelfle (1967). For taxonomy, we follow the IOC World Bird List (Gill and Donsker, 2015). The number of identified specimens present (NISP), the minimum number of elements (MNE) and the minimum number of individuals (MNI) were calculated, as well as the relative frequencies. Calculation of MNI took into account the laterality and maturity of the bones. MNI was calculated for each species where possible, but for higher-level taxa when the skeletal elements did not fit with low-level taxa. For example, MNI was estimated for undetermined Passeriformes because all the bones in question are small and cannot be linked to the specific taxa in this order.

The analysis conducted was based on published methodologies conventionally used in zooarchaeological and taphonomic studies (e.g. Bochenki and Tomek, 1997; Laroulandie, 2001, 2005, 2010; Bochenki, 2005; Lloveras et al., 2014b). The maturity of the birds was estimated using the relative porosity of the bone. It was assumed that a clearly porous texture belongs to an immature bird, with an age from hatchling to nearly fledgling (Serjeantson, 2009).

Relative abundance (RA%) was calculated using the formula advocated by Dodson and Wexlar (1979) for standardising anatomical profiles and comparing the frequencies of several elements by taxa. In addition, the following ratios were calculated: (a) to assess the differential representation of wings and legs (following Ericson, 1987), the number of wing elements (humeri, ulnae, carpometacarpi) was divided by the sum of wing and leg elements (femora, tibiotarsi, tarsometatarsi), and expressed as a percentage; (b) to evaluate the presence of proximal and distal elements (Bochenki and Nekrasov, 2001), the number of proximal elements (scapulae, coracoids, humeri, femora, tibiotarsi) was divided by the sum of proximal and distal fragments (ulnae, radii, carpometacarpi, tarsometatarsi), and expressed as a percentage; (c) to establish the proportions of core and limb elements (Bochenki, 2005), the number of core elements (sterna, pelvis, scapulae, coracoids) was divided by the sum of core and limb elements (humeri, ulnae, radii, carpometacarpi, femora, tibiotarsi, tarsometatarsi), and expressed as a percentage.

All the ratios were calculated using MNE. A Z-test was used to

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