

Evidences of Interaction *Homo-Cuon* in three Upper Pleistocene Sites of the Iberian Mediterranean Central Region

Juan Vicente Morales Pérez*

*Departament de Prehistòria i Arqueologia, Universitat de València
Blasco Ibáñez 28, 46010 Valencia, Spain*

Alfred Sanchis Serra

*Museu de Prehistòria de València, Servei d'Investigació Prehistòrica
Diputació de València, Corona 36, 46003 Valencia, Spain*

Cristina Real Margalef, Manuel Pérez Ripoll,

Joan Emili Aura Tortosa, Valentín Villaverde Bonilla

*Departament de Prehistòria i Arqueologia, Universitat de València
Blasco Ibáñez 28, 46010 Valencia, Spain*

Journal of Taphonomy 10 (3-4) (2012), 463-505.

Manuscript received 15 March 2012, revised manuscript accepted 15 November 2012.

Several cuon bones were discovered recently in three Upper Pleistocene archeological sites in the central area of the Iberian Mediterranean. This has proved that there were different types of interactions between dholes and prehistoric human groups. Firstly, evidence found in the archeological sites of Cova Negra and Coves de Santa Maira shows the use of carcasses of dholes by human hunter-gatherers. Secondly, the dhole remains recovered in Cova del Parpalló shows the dholes and humans could occupy the same habitat. In this case, the dhole died by natural causes in a small and isolated gallery before the human groups occupied the cave during the gravettian period. Associated with the dhole bones, there were also many ungulate mammal remains found. Some of these bones shows carnivore tooth marks. Due to these findings, we can presume that the dhole might have been the predator responsible for the bones discovered within the chamber. With the data provided we can come to the conclusion that this species had a more prominent role than we originally thought.

Keywords: CUON, HUMANS, INTERACTION, ACCUMULATION, ANTHROPIC MARKS, UPPER PLEISTOCENE, IBERIAN MEDITERRANEAN

Introduction

There were two genera of large canid which inhabited the Iberian Peninsula during the Upper Pleistocene. These were the *Canis* and the *Cuon*. These predators not only might compete between themselves and other packs but also with humans for prey and for their habitats (Brugal & Fosse, 2004). Currently, there are several studies on taphonomic alterations produced by wolves on ungulate bones (i.e. Binford, 1981; Stiner, 1994; Nadal, 1996; Fosse *et al.*, 2004; Esteban-Nadal *et al.*, 2011), but we have hardly any data concerning the dhole.

Cuon remains have been found in three Pleistocene archeological sites in Iberian Mediterranean region. With these remains we are able to observe different kinds of interactions between humans and dholes. Cut marks have been found on some of the dhole remains that show carcasses were processed and used by human groups. Moreover, we have different bone remains with no alteration that belong to a dhole specimen that died from natural causes. This assemblage is associated to a deposit of ungulate mammal remains, mostly *Capra pyrenaica*, which present alterations that are characteristic of carnivore tooth marks (i.e. pits and punctures).

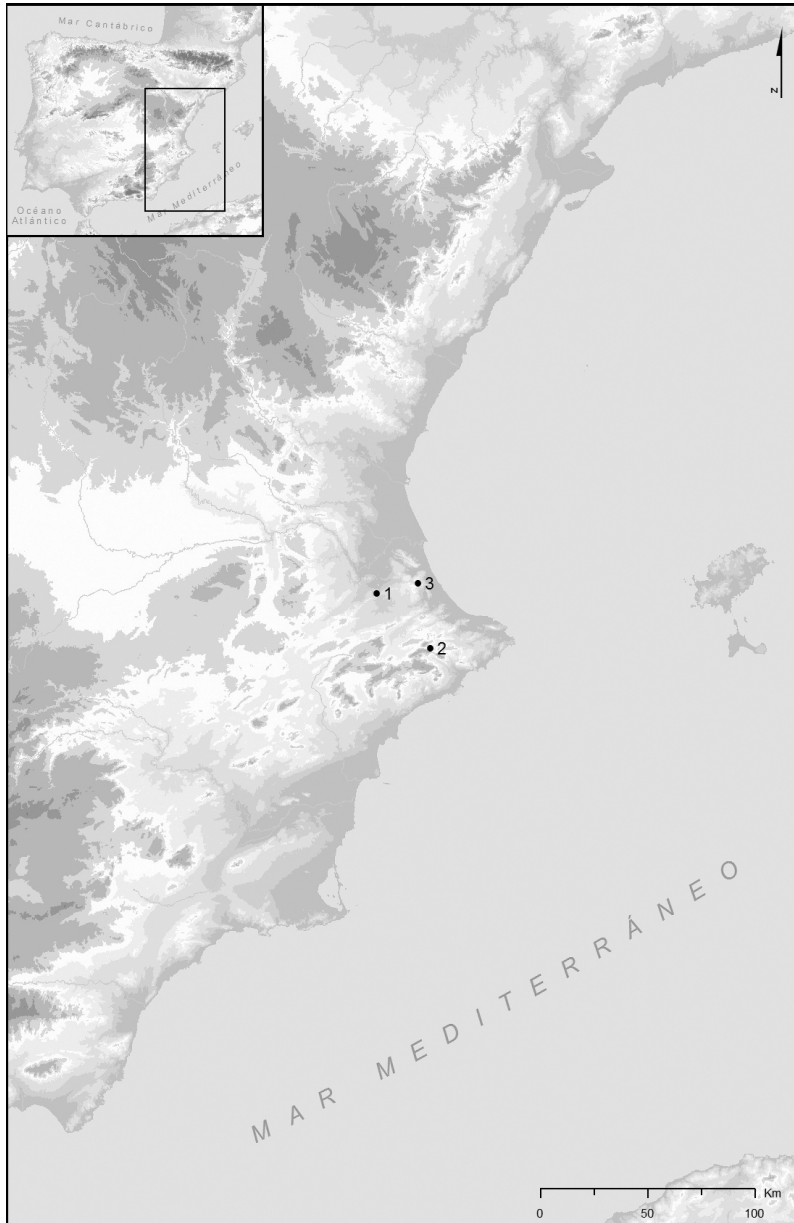
It is known that there are difficulties in distinguishing wolf bone remains from those from dholes because their morphology is very similar, especially in the postcranial skeleton, but there are hardly any studies focused on this topic. For this reason, in order to establish valid morphological and biometrical criteria we have carried out a work for the characterization of both canids. We also have a study of the distribution of the *Cuon* in the Iberian Peninsula and an initial description of the context where the remains were found (Pérez Ripoll *et al.*, 2010).

The dhole is a medium sized canid, which is smaller but more robust than a wolf, 40 to 55 cm high at the shoulders and it weighs 12 to 25 kg. Currently, it can be found in several biotopes in India, Western China and South-East Asia (Durbin *et al.*, 2004). During the Pleistocene it had a wider distribution and was present in most of Europe (Geraards, 1995; Crégut-Bonnoure, 1996; García, 2003; Pérez Ripoll *et al.*, 2010). Dholes mostly hunt in packs (Fox, 1984) but also they can be scavengers. They usually hunt medium size ungulate mammals, but their choice is often constrained by the availability of prey. Dholes show preference for ungulate adults (Karanth & Sunquist, 1995), but during some periods of the year also feed on smaller prey such as hares (Fox, 1984). Ethologic studies have shown that dholes consume prey rapidly and on the spot. They hardly transport any remains of the hunted animal (Domínguez Rodrigo, 1993).

Social animals, such as the cheetah, wolf and the dhole itself hunt in packs. But once the hunt is over, individuals try to maximize what they ingest as they compete in the sharing of the prey (Dominguez-Rodrigo, 1994). Some studies point out that, after the killing of the prey, usually a few remains are to be found that could be of use to scavengers, with the exception of skin, long bones and fragments from the skull (Fox, 1984). Even when some of the prey is transported, some parts are consumed and the prey is dismembered.

Dholes do not dig their own dens, they inhabit existing ones made by other animals such as porcupines. Choice and location of dens is conditioned by the presence of water and by good visibility (Johnsingh, 1982). Fox (1984) has distinguished four types of dens: simple den with just one

Figure 1. Archeological sites of the central mediterranean region where have been identified Cuon remains. 1: Cova Negra, 2: Coves de Santa Maira, 3: Cova del Parpalló.



entrance, complex den with several entrances, simple den in a cave, under a rock or between two rocks, and finally a complex den in a cave with several connected entrances. Inside these dens faeces, hair and remains of regurgitated food from adults to feed the offspring can be found (Johnsingh, 1982). Some authors have claimed that bones found in dens were due to the presence of hyenas or porcupines (Johnsingh, 1982), but others, Fox among them, have pointed out that the bones could be there because of the offspring. Dholes, according to the characteristics of the pack, can occasionally transport part of the prey to their den. A study of five dens has shown that three of them had bone and skin remains found near the entrance (Fox, 1984).

Currently, the existing species (*Cuon alpinus*) have been identified for the first time in the Iberian Peninsula during the Middle Pleistocene (Schlosser, 1923; García & Arsuaga, 1998; Cervera *et al.*, 1999; García, 2003), although the evidence and references is more to the Upper Pleistocene (Altuna, 1973, 1981, 1986; Viñas & Villalta, 1975; Cardoso, 1992, 1993; Castaños, 1987; Blasco Sancho, 1995; Geraads, 1995; Martínez Valle, 1996, 2001; Martínez Valle & Sarrión, 2001; Barroso *et al.*, 2006; Pérez Ripoll *et al.*, 2010). A further study suggest the possibility that this species could have survived into the early stages of the Holocene in the Iberian Peninsula (Pérez Ripoll *et al.*, 2010).

Material

The sites which the dhole remains were found are located in the central Mediterranean region of the Iberian Peninsula: Cova Negra, Coves de Santa Maira and Cova del Parpalló (Figure 1).

Cova Negra (Xàtiva, València)

This Mousterian has one of the most complete Upper Pleistocene sequences in the region (Villaverde, 1984, 2009; Villaverde *et al.*, 1996; Aura *et al.*, 2002). Excavations carried out in the 1980s identify the presence of *Cuon alpinus* in layers corresponding to MIS 3 (Martínez Valle, 1996, 2001; Martínez Valle & Sarrión, 2001). During a previous excavation in the 1950s, a left hemimandible was found complete with premolar and molar series (Nº 30.246), which has been identified as a *Cuon cf. alpinus* (Pérez Ripoll *et al.*, 2010) (Figure 2a). This specimen was recovered in a MIS 5d-b context associated with paracheurean industry and remains from *Stephanorhinus hemithoecus*, Equidae, *Bos primigenius*, Caprini, *Cervus elaphus*, *Capreolus capreolus*, *Ursus arctos*, *Felis silvestris*, *Oryctolagus cuniculus* and an assemblage of coprolites of *Crocota crocuta*.

Coves de Santa Maira (Castell de Castells, Alacant)

These caves are part of a karstic complex with multiple entrances. The two main entrances have different but complementary archeological sequences. The Western entrance has deposits of the Late Magdalenian, Epipaleolithic, Mesolithic and Neolithic; while the Eastern entrance has mainly Magdalenian and Solutrean levels and a Neolithic *fumier* on the top (Aura *et al.*, 2006). In this Paleolithic deposit, a complete dhole neurocranium (SM07M7/6 II.2 inv.5) was recovered (Pérez Ripoll *et al.*, 2010) (Figure 2b) and dated in 17,130 ± 80 BP (OxA-23114).

Cova del Parpalló (Gandia, València)

This site has an archeological sequence with Gravettian, Solutrean and Magdalenian levels.

The collection of dhole remains (skull, mandible, left radius, right scapula and right femur; n. 24.210) (Figure 3) was found on basal levels inside a small gallery (Figure 4). This level must be prior to the first clear indications of human occupations (Gravettian levels) (Pericot, 1930, 1942; Aura, 1995). An ungulate bone assemblage (*Capra pyrenaica*, *Bos primigenius*, *Cervus elaphus*, *Equus ferus* and *Equus hydruntinus*) associated to these dhole remains was also found, and some *Oryctolagus cuniculus* bones too. Some of these remains show evidence of possible carnivore action (Figure 5). The location and taphonomic characteristics of the sample, as well as the absence of human activity shows that this assemblage is not a palimpsest.

Methods

The taxonomic identification of dhole remains mentioned in this paper has been carried out by using the collections from different institutions: *Museu de Prehistòria de València*, *Museo Arqueológico, Etnográfico e Histórico Vasco*, *Estación Biológica de Doñana* and

Museo Nacional de Ciencias Naturales, Madrid. Current specimens of *Canis lupus* and dhole and wolf fossils have been used. The exact data is described by Pérez Ripoll *et al.* (2010).

The taxonomical and anatomical identifications of the dhole specimen found in Cova de Parpalló have been carried out taking as a reference the collection from *Gabinet de Fauna Quaternària del Museu de Prehistòria de València*.

NISP of each taxon has been established as a primary unit of quantification. Also, the MNE for each anatomical element and MNI for each taxon has been calculated (Lyman, 2008; Reitz & Wing, 1999), as well as the percentage of representation (%R) proposed by Dodson & Wexlar (1979).

The age of spanish ibex has been established using the works of Pérez Ripoll (1988) for dental age estimation, and Serrano *et al.* (2004) for epiphyseal fusion. Four age stages have been established: young (less than a year old), subadult (1-3 years old), adult (>3 years old) and senile (8-10 years old).

Although mostly of the remains are complete, the origin of the scarce breakages



Figure 2. *Cuon* remains showing anthropic marks. a: hemimandible from Cova Negra, b: neurocranium from Coves de Santa Maira.

Figure 3. Cuon specimen from Cova del Parpalló, gallery, basal levels. Cranium and postcranial remains.

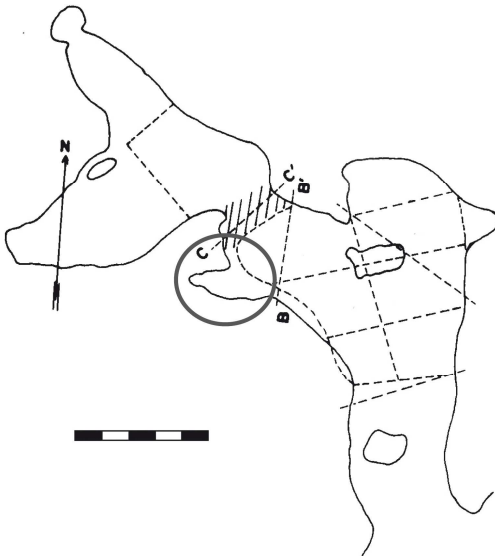


Figure 4. Plan of Cova del Parpalló. The circle indicates the small gallery where the dhole remains and the ungulate collection were recovered (modified from Pericot, 1942).

have been defined by means of the work of Villa & Mahieu (1991).

Alterations from tooth marks found in the remains of ungulate mammals have been described following Binford (1981). Punctures and pits measurements have been compared with those published by Selvaggio & Wilder (2001), Domínguez Rodrigo & Piqueras (2003), and Blasco & Fernández Peris (2010).

The possible differential preservation of the bones has been estimated by means of the Pearson correlation between density and representation of each bone (Lyman, 1985).

Study of the ungulate assemblage

Due to the excavation process in the 1930s, these bone remains are seriously fragmented. So, in the first place, we had to reassemble all the bones that have recent fractures in

order to avoid inaccurate estimations. Therefore we have used the minimum number of anatomical elements (MNE) as the quantifying unit. Total MNE recovered is 123. The main taxon (MNE=97; MNI=19) is *Capra pyrenaica*; *Bos primigenius* and *Cervus elaphus* show MNE=13 and 10 respectively, and MNI=2 for both. Finally *Equus ferus* and *Equus hydruntinus* were only represented by MNE=2 and MNI=1 for both (Figure 6).

Of all the remains of these species only those of Spanish ibex are sufficiently abundant to make a representative study. So we have carried out a study of the distribution of anatomical elements, the age and sex of specimens, and finally the degree of fragmentation and alterations for Spanish ibex remains.

The most abundant elements in Spanish ibex remains are (Figure 7): skulls and horn cores (84.2% of MNE); maxilla, mandible,



Figure 5. Ungulate remains associated to Cuon specimen. Cova del Parpalló, gallery, basal levels.

isolated molars; tibia and metatarsal represent 20 to 30%; scapula, humerus, radius and femur, between 10 and 20%; ulna, metacarpals, vertebrae, coxal bone and phalanges are under 10%; finally, other elements such as ribs or carpal and tarsal bones are not present (Figure 8). The Pearson correlation between the maximum density of each element and its percentage of representation is not significant ($r=0.342$; $p=0.252$), so the differential preservation of bones is not the cause of abundance or absence of the different bones.

The morphology and size of Spanish ibex skulls and horn cores have made it possible to identify 10 males and 6 females. In three cases the sex of the specimens has not been possible to establish. Regarding age, more than half of the individuals were adults (5 over three years old, 1 senile), while young and subadult individuals were 25% respectively (Figure 9).

The fragmentation study has discarded recent fractures. Most remains are well preserved, many bones are complete and fragmentation rate is low. Skull, mandible, axial skeleton, radius, femur, metatarsals and phalanges are complete in between 75 to 100% of cases. But the bones most frequently fragmented are humerus and tibia, between 33% and 36% of them complete respectively.

Fragmentation categories of the humerus are dominated by distal parts (50%), while for tibia diaphysis fragments are more prominent (42.8%). Longitudinal fragmentation of tibia is probably due to the diagenetic processes. That is also the case for transversal fractures of radius and femur. Fresh fractures have only been documented in three humerus, one skull and one scapula (Figure 10).

As for the alterations documented, 17 Spanish ibex remains have clear carnivore

tooth marks (Figure 11). The most important characteristics of the remains studied are the absence of fractured diaphysis, the occurrence of punctures and pits located at articulation ends, and some scrapes on mandibles, scapula, humerus, femur and tibia. These alterations are smaller than those of the lion and hyena (Domínguez Rodrigo & Piqueras, 2003); but are not different from those produced by predators such as wolves (Blasco & Fernández Peris, 2010, Selvaggio & Wilder, 2001) (Figure 12).

Discussion

The accumulations of dhole remains from anthropic origin (Cova Negra and Coves de Santa Maira) correspond to isolated bones, both complete and fragmented. They are from archeological levels where other elements of human activity have been documented, such as lithic tools, combustion structures or ungulate remains with butchering marks. The anthropic origin of dhole remains is confirmed when cut marks on them were found, as is the case of the hemimandible from Cova Negra and the skull from Coves de Santa Maira.

The hemimandible has on its lateral side some short and oblique lithic scrapes

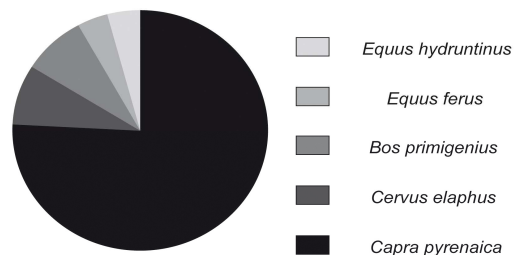


Figure 6. Taxonomical representation of the ungulates (MNI).

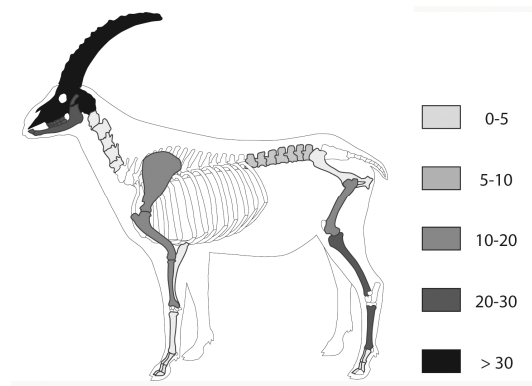
Figure 7. Anatomical representation of the *Capra pyrenaica* (NISP, MNE, MNI and %R).

Anatomical representation	NISP	MNE	MNI	%R
Skull and horn core	24	16	16	100
Maxilla and upper molars	8	8	8	25
Mandible and lower molars	14	11	9	34,37
Scapula	9	7	5	21,87
Humerus	7	6	4	18,75
Radius	6	6	5	18,75
Ulna	1	1	1	3,12
Metacarpals	2	2	1	6,25
Cervical vertebrae	3	3	1	2,67
Lumbar vertebrae	9	9	3	9,37
Coxal bone	2	2	1	6,25
Femur	7	7	4	21,87
Tibia	11	10	7	31,25
Metatarsals	9	8	6	25
Second phalanges	1	1	1	0,78
	113	97	16	-

(Figure 2a). For the skull, a thin and oblique incision has been identified on the right parietal bone (Figure 2b), Like the marks found on the hemimandible, this seem to be associated to the skinning of the animal, as current studies demonstrate (Pérez Ripoll & Morales, 2008). So far, these marks are the only ones found on dhole bones in the Iberian Peninsula.

The accumulations of *Cuon* remains from natural origin present similar characteristics to those in paleontological contexts: individuals might appear more or less complete; there is no evidence of human action; anatomical elements are usually preserved whole and without alterations from predators (in the case of death from natural causes) or with marks left by the action of non-human predators. This is the case of the individual found in Obarreta (Altuna, 1983), the hemimandible from Duranguesado (Castaños, 1988), and the remains recovered in Cova de Parpalló that are presented in this paper. All these remains belong to an adult individual, and include complete bones and others that were fragmented in the excavation process. They have no marks from predators, and probably died of natural causes.

Figure 8. Anatomical representation of the *Capra pyrenaica* (%MNE).

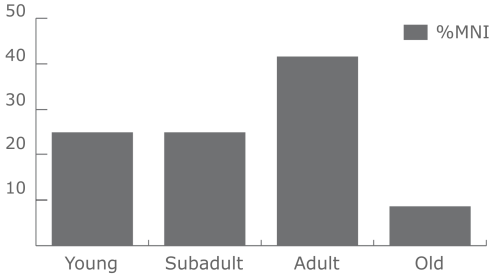


Regarding the assemblages of ungulate mammals associated to the dhole in Cova de Parpalló, the spanish ibex is the main species, with a selection of adults (more males than females). The anatomical description of remains indicates that some parts were transported: skull with cervical vertebrae, hind limbs, and fore limbs with lumbar vertebrae. The scarcity of ribs and thoracic vertebrae might be due to the selective transport, consumption or loss of those parts. This pattern of consumption *in situ*, dismembering and transport can be observed in some actual works that described wolf behavior (for example, Esteban-Nadal *et al.*, 2011; Nadal, 1996) and other gregarious animals (for example, Domínguez-Rodrigo, 1994).

Conclusions

The dhole remains recovered in the Valencia sites Cova Negra, Cova del Parpalló and Coves de Santa Maira show two different interaction processes between dholes and

Figure 9. Age structure of the *Capra pyrenaica* (%MNI).



humans: on the one hand, dholes may be prey for humans (for food or skin), as this seems to be the case in Coves de Santa Maira and Cova Negra. On the other hand, dholes might have competed with humans groups for resources and the use of shelters, as in Cova del Parpalló.

The collection of ungulate remains recovered in Cova del Parpalló is mainly made up of Spanish ibex (*Capra pyrenaica*) and it is associated with the remains of a dhole that died there from natural causes. This, plus the fact that the Spanish ibex bones present carnivore tooth marks suggest the possibility that the

accumulation of bones was due to the dhole, a taphonomic agent that will have to be taken into account. Authors coincide that wolves do not usually transport bones to their refuges (Castel *et al.*, 2010), but we do not know if that is a characteristic we can also extend to dhole behavior.

Spanish ibex remains with carnivore tooth marks account for 20% of our findings. The degree of fragmentation is low for most elements and many articular ends are complete. The accumulation characteristics and the absence of deciduous teeth and coprolites suggest an occasional occupation of the basal levels of the gallery by dholes. This could have been due to intraspecific competition for resources, something that occurs frequently among dholes (Fox, 1984). This type of sporadic occupation has also been described in anthropic contexts, such as level X of Cova del Bolomor (Blasco & Fernández Peris, 2010). Scarce alteration in the ungulate bones might be explained by an early phase of prey consumption (meat and soft tissues). The characteristics of these alterations are different from the more abundant and intensive marks usually found in prey consumed by

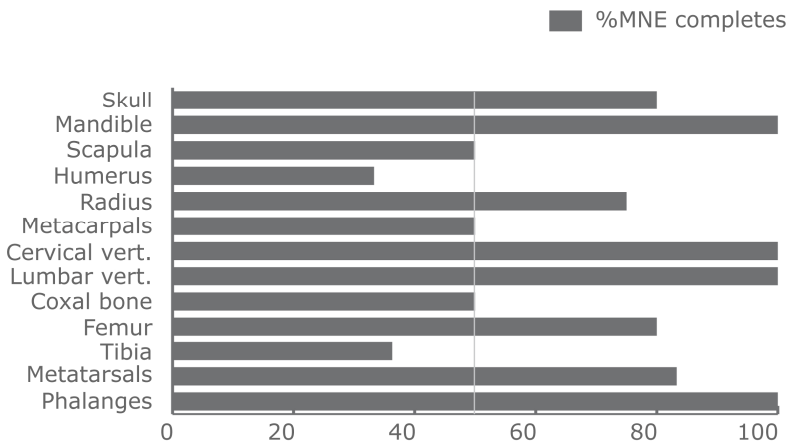


Figure 10. Fragmentation index of the different bones of *Capra pyrenaica* (%MNE).

Figure 11. Carnivore marks (tooth marks) on *Capra pyrenaica* bones (in bold the most abundant marks). Cova del Parpalló, gallery, basal levels. The images show the marks on a distal scapula fragment (a, c) and a femur head fragment (b).

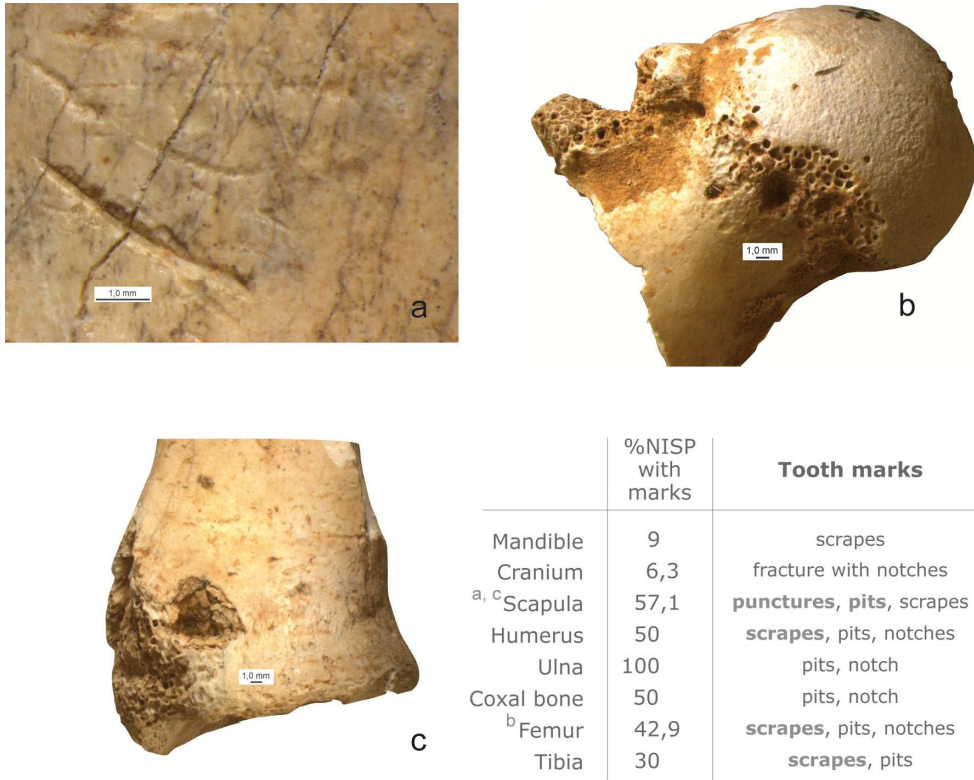


Figure 12. Punctures and pits measurements (length and width in mm).

Elements	Length	Width
Scapula (distal)	3,48	4,03
Ulna (proximal)	4,23	3,2
Femur (proximal)	3,77	4,37
Tibia (proximal)	2,11	2,64
Coxal bone (proximal)	6,74	3,3

hyenas, and are more similar to those due to felines, such as leopards (Domínguez-Rodrigo & Pickering, 2010). The characteristics of dhole dentition, closer to that of felines, present a more pronounced development of the trigonid and a smaller talonid and that might be reflected in the bone assemblage described.

As we have already pointed out in a previous paper (Pérez Ripoll *et al.*, 2010), the presence of the dhole in the Upper Pleistocene seems to be more important than previously thought, and that is shown by the data obtained in our study of several sites. So these canids might have been important competitors for humans and other carnivores, but also sporadic prey for the former. In relation to this, a new project is being carried out. This is focused on the study of some dhole postcranial remains found in Cova de les Malladetes (Early Upper Paleolithic) which have been found associated to leopard and lynx remains. These set of data seems to give support to an important role for dholes, and carnivores in general, in the early stages of the Upper Paleolithic. Similar facts have been documented in some Portuguese sites of the same chronology (Valente, 2004) that are characterized by sporadic, discontinuous and short human occupations.

Acknowledgements

The results of the site of Santa Maira were obtained within the framework of the research project HAR2008-03005: *La Transición Solutrense-Badeguliense-Magdalenense en la Península Ibérica*. Ministerio de Ciencia y Tecnología, Gobierno de España. Support for this work has been provided in part by the research project HAR2011-24878: *Paleolítico medio final y Paleolítico superior inicial en*

la región central mediterránea ibérica (Valencia y Murcia). We would to thank Rachel Wood, who took the samples of the dhole skull from Santa Maira for dating. We are grateful to Glenn Harrington for his help in translating and correcting this paper. We also thank two anonymous reviewers for their helpful comments on earlier drafts of the manuscript.

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