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Los Batanes: A trap for the Pyrenean wild goat during the Late Pleistocene (Spain)

Víctor Sauqué [a], [b], [*], Ricardo García-González [c], Raquel Rabal-Garcés [a], Julia Galán [a], Carmen Núñez-Lahuerta [a], Mario Gisbert [d], Gloria Cuenca-Bescós [a]

[a] Grupo Aragosaurus-IUCA, Dpt. Ciencias de la Tierra, Universidad de Zaragoza, C/ Pedro Cerbuna 12, E- 50009, Zaragoza, Spain
[b] Laboratorio de Zooarqueología y Tafonomía de Zonas Áridas (LaZTA), IDACOR, CONICET/FFyH UNC, Av. H. Yrigoyen 174, 5000, Córdoba, Argentina
[c] Instituto Pirenaico de Ecología (IPE-CSIC), Avda. Nuestra Señora de la Victoria s/n, 22700, Jaca, Spain
[d] Centro de Espeleología de Aragón (CEA), Spain

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ABSTRACT

Los Batanes cave (1025 m.a.s.l.) is a karstic system formed by pressure ducts, near the locality of Biescas in the Upper Gallego Valley (Huesca, Spain). Many fossil remains were retrieved from the cave sediments. The minimum sediment calendar age was determined to be 12.770 ± 60 BP. This date indicates that the deposit was formed before the Late Pleistocene-Early Holocene transition at the Pyrenees. Here we analyze the faunal assemblage of the site that is only conformed by remains of Pyrenean wild goat (*Capra pyrenaica pyrenaica*), which is a recently extinct subspecies of Iberian wild goat (*C. pyrenaica*). In the site, 1079 remains of Iberian wild goat have been recovered being one of the most numerous both in minimum number of individuals (MNI) and number of identified specimens (NISP) recovered until now in a natural trap in the Spanish Pyrenees. The population of Los Batanes shows a wide range of ages between juvenile and senile individuals and the MNI estimated from the number of right metatarsus is nine.

The taphonomic features indicate that the cave acted as a trap for the goats which inhabited the vicinity of the cave. These goats probably stumbled and fell to the bottom of the pit and they could not get out, dying inside. Due to the origin of the accumulation numerous complete bones have been recovered. These fossil allow us to perform a biometric analysis that indicates that population of Los Batanes is in the range size of other goats from Late Pleistocene of Iberian Peninsula.

1. Introduction

The Pyrenean wild goat, *Capra pyrenaica pyrenaica* is a recently extinct subspecies of the Iberian wild goat. It has the popular name of “bucardo” in Spanish language and was scientifically defined by Schinz (1838). Cabrera (1911) reported the singularity and the little area of distribution of some Iberian subspecies, a fact that the author correlated with the intricate and diverse geography of the Iberian Peninsula. Unfortunately the last individual of the Pyrenean subspecies died in January 2000, leaving unstudied many of its biological and phylogenetic attributes (García-González and Herrero, 1999; García-González, 2012). Nevertheless, the taxonomy of extant *C. pyrenaica* at the subspecies level is still an open topic of discussion (Acevedo and Cassinello, 2009).

Three other subspecies, all of which are endemic to the Iberian Peninsula, are generally accepted: the extinct *C. p. lusitanica* from northwestern Iberia, *C. p. victoriae*, which is found in the mountains of central Spain, and *C. p. hispanica* from the south and western sierras of Spain. In this work, the taxonomic terms follow the nomenclature by Shackleton (1997). Some authors (Crégut-Bonnoure, 1992; Rivals, 2002) hypothesized that *C. pyrenaica* evolved during the second half of the Late Pleistocene from an ancestor related to *C. caucasica*, which would have migrated from the Middle East to western Europe at the beginning of the last glacial period (120–80 ky). Eventually, it reached southern France and the Pyrenees, where it evolved into *C. pyrenaica* during the Würm III/IV transition (18 ky). That aforementioned ancestor, named *C. caucasica praepyrenaica* (Crégut-Bonnoure, 2002), did not have contact with the ibex of the Alps (*C. i. ibex*), which evolved there after a previous migration about 300 ky earlier (Crégut-Bonnoure, 2009). On the other hand, the molecular data of extant

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[*] Corresponding author. Grupo Aragosaurus-IUCA, Dpt. Ciencias de la Tierra, Universidad de Zaragoza, C/ Pedro Cerbuna 12, E- 50009, Zaragoza, Spain.
E-mail address: vsauque@gmail.com (V. Sauqué).

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individuals indicates that *C. pyrenaica* and *C. ibex* do share a monophyletic origin (Manceau et al., 1999; Ureña et al., 2011).

Nowadays, there are very few paleontological sites analysed in the central part of Spanish Pyrenees: Coro Tracito (Rabal-Garcés et al., 2012; Rabal-Garcés, 2013), Brecha del Rincón (Rabal-Garcés and Sauqué, 2015), Chaves (Castaños, 1993), Gabasa (Blasco, 1995), Olopte B (Villalta, 1972), Ermitons (Maroto, 1993), L'Arbreda (Soler and Maroto, 1987), Cova 120 (Agustí et al., 1991) and Zatoya (Mariezkurrena and Altuna, 1989), and even some of them are not properly Pyrenean since they are located in the pre-Pyrenean chain, something more south. The scarcity of works shows a huge contrast with the enormous amount of sites analysed on the North Slope (French side) of the Pyrenean range (Clot, 1986; Clot and Evin, 1986) (Fig. 1). This asymmetry could be related with the lack of paleontological, archaeological and systematic studies until recent times, while in France this issue started being researched at the end of the XIX century (Philippe, 1852; Milne-Edwards, 1875).

In the last years, the research Group Aragosaurus, together with the Centro de Espeleología de Aragón (Speleology Centre of Aragon, CEA) discovered several fossil remains in different cavities of the Pyrenees of the Province of Huesca, in Aragon, Spain. The field work included in this paper took place during the summer campaign of 2015 (Sauqué et al., 2015). The collaboration between CEA speleologists and palaeontologists from Aragosuarus has been very successful in the Moncayo area, where interesting deposits have been discovered such as Los Rincones and Los Aprendices (Sauqué and Cuenca-Bescós, 2013; Sauqué et al., 2014, 2016a, 2016b). Also, in the last years, new discoveries have been done in their Pyrenean exploration zones (Sauqué et al., 2015).

The main objective of this study is to present a new fossiliferous site in the Spanish Pyrenees. This is of broad interest because paleontological (or archaeological) sites in high mountains are rarely preserved, although they provide important information of the paleoenvironment and paleobiology of the faunas in past times. In this case, Los Batanes presents an important fossil population *C. p. pyrenaica* in the Southern Pyrenees, a distinctive and almost unknown large mammal of the southern Pyrenean range. A palaeontological and taphonomical study of the *C. p. pyrenaica* remains was carried out with the aim of determining the accumulation and modification agent of the bone remains (natural trap or hunter accumulation). Also, we performed a biometrical comparison with bibliographic data from other *C. pyrenaica* remains in order to infer morphological similarity between Iberian lineages (or clades).

2. The karst-filling sediments from Los Batanes: geographical, geological and chronological location

Los Batanes cave (X: 720.080; Y: 4726.585. -WGS84-) is located at the east side of the Upper Gállego Valley and its entrance opens at 1025 m.a.s.l.. It is a small karstic cavity, shaped as a narrow descending pressure tube (1–4 m width). The site is placed at 12 m under the level based in the main entrance, which was developed on Maastrichtian limestone and currently drains a complex jumble of main and secondary central-southern Pyrenees valleys (Palacios et al., 2015).

The excavation site is located at the bottom of the cavity, which

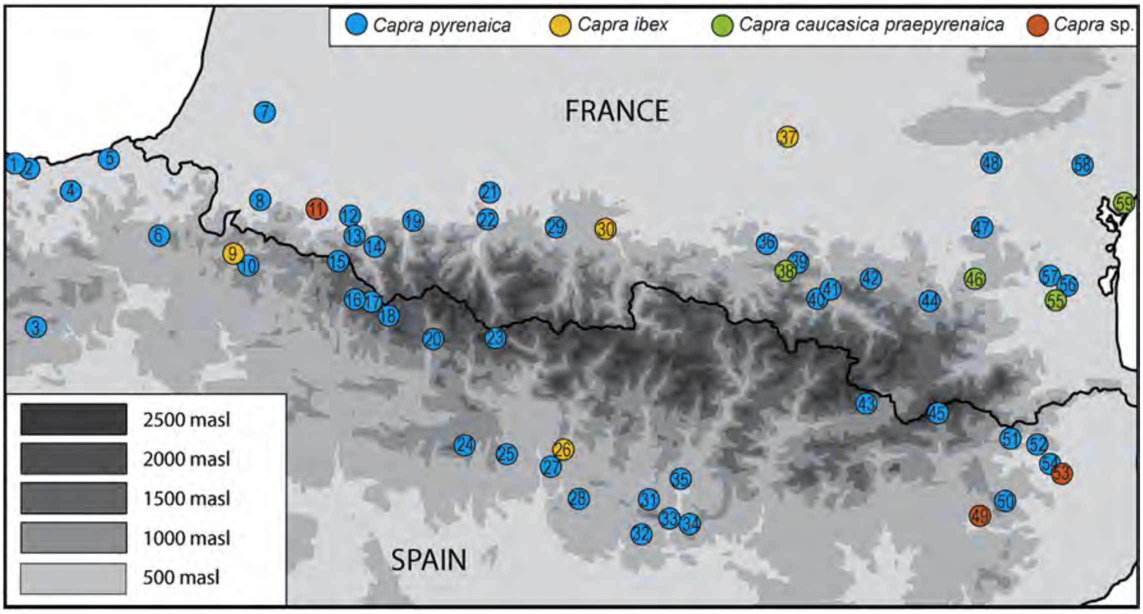

Fig. 1. Pyrenees site map. Dots represent the location of known paleontological sites with *Capra*: 1 Urtiaga (Altuna, 1990a), 2 Amalda (Altuna, 1990b), 3 Orcillas (Fernández et al., 2010), 4 Erralla (Altuna, 1990a), 5 Aitzbitarte IV (Altuna, 1963), 6 Abauntz (Altuna et al., 2001), 7 Duruthy (Delpech, 1983), 8 Grotte d'Har (Clot and Evin, 1986), 9 Aizpea (Utrilla and Mazo, 2014), 10 Zatoya (Mariezkurrena and Altuna, 1989), 11 Gatzarria (Ready, 2013), 12 Gouffre BSE21 (Clot and Evin, 1986), 13 Gouffre PT10 (Clot and Evin, 1986), 14 Gouffre des Bouquetins (Clot and Evin, 1986), 15 Larra (García-González, 2012), 16 J5 (Sauqué et al., 2015), 17 B8 (Sauqué et al., 2015), 18 Lecherines (Sauqué et al., 2015), 19 Marquisards (Clot and Duranthon, 1990), 20 Los Batanes (Sauqué et al., 2015), 21 Gouffre Béout (Clot and Evin, 1986), 22 Espélugues (Magniez, 2009), 23 Millaris (García-González, 2012), 24 Chaves (Castaños, 1993), 25 Fuente del Trucho (Mir and Salas, 2000), 26 Peña de las Forcas (Utrilla and Mazo, 2014), 27 Cueva del Moro (Castaños, 1991), 28 Gabasa (Utrilla et al., 2010), 29 bois de Cantet (Clot and Evin, 1986), 30 Gargas (Foucher et al., 2010), 31 Muricers (Yravedra, 2008), 32 Estret Tragó (Yravedra, 2008), 33 Cova Gran de Santa Linya (Martínez-Moreno et al., 2008), 34 Parco (Yravedra, 2002), 35 Muricecs (Yravedra, 2008), 36 Soulabé (Magniez, 2009), 37 L'Infernet (Fosse and Quiles, 2005), 38 Portel Ouest (Magniez, 2009), 39 La Vache (Pailhaugue, 1998), 40 Malarnaud (Magniez, 2009), 41 Grotte des Eglises, Rhodes II (Delpech, 1983), 42 Montségur (Crégut-Bonnoure, 1992), 43 Olopte B (Villalta, 1972), 44 Castel 2 (Pernaud et al., 2004), 45 Tut de Fustanyà (Álvarez and Lozano, 1999), 46 L'Arche (Rivals and Testu, 2006), 47 Belvis (Magniez, 2009), 48 Gazel (Magniez, 2009), 49 Roc del Migdia (Yll et al., 2015), 50 L'Arbreda (Soler and Maroto, 1987), 51 S'Espasa (Estévez, 1975–76), 52 Cova 120 (Agustí et al., 1991), Ermitons (Maroto, 1993), 53 Reclau Viver (Romero, 2009), 54 Bora Gran (Galobart et al., 1996), Roc Melca (Yravedra, 2002), 55 L'Arago (Magniez, 2009), 56 Conques (Magniez, 2009), 57 Padern (Magniez, 2009), 58 Tournal (Magniez, 2009), 59 Crouzade (Magniez, 2009).

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is slightly broader and consists of a body of sediments sealed under a calcite crust (Fig. 2). The recovered fossil remains were found at the upper sediment layer, down to 0.5 m deep.

The sedimentary deposits mainly consist on a clay matrix of mixed origin (both autochthonous decalcification clays and allochthonous mud coming from the outside), carbonate autochthonous clasts from the walls of the cavity and allochthonous clasts that probably came from the erosion of a close moraine, like granite clast which ultimately come from the Panticosa batholith (Fig. 3).

A radiocarbon dating of a bone embedded in the calcite crust closing the upper part of the sediment and classified as *C. p. pyrenaica* provides a radiometric age of 13.507–13.061 years cal BC with the probability of 95.4% (2σ) (15.234 ± 223 cal BP). Analysis were made at Poznan Radiocarbon Laboratory (lab. ref. Poz-75800) and calibrated with the OxCal v4.2.4 program (Bronk Ramsey and Lee, 2013).This date corresponds to the Late Pleistocene, more specifically to the last deglaciation of the Pyrenees that took place between the LGM (Last Glacial Maximum) and the beginning of the Holocene (see references in Hughes et al., 2013). At that time, the climate alternated warming up trends with some cold and generally dry periods that had an impact on the extent of ice-sheets and valley glaciers and also impacted on the flora, with forests declining during dry and cool episodes (which in Western Mediterranean areas basically correspond to the Older Dryas, Intra-Allerød Cold Period and Younger Dryas) (Fletcher et al., 2010; Palacios et al., 2015).

According to Palacios et al. (2015), at least two moments of glacial advance can be detected in the Gállego Valley: before approximately 17 ky (Fig. 3), and again at approximately 14–11.7 ky.

The climatic and environmental changes had an impact on the faunal associations, large and small mammals as well. In many archaeo-paleontological sites, the Late Pleistocene to the Holocene transition is signaled by the substitution of some taxa by others and by the increase of woodland habitats to the detriment of the open lands (Cuenca-Bescós et al., 2009; Carrión et al., 2010; López-García et al., 2015; among others).

The large mammal association recovered from Los Batanes is formed by *Capra pyrenaica pyrenaica*. By screening and washing the sediment from the cave, the following microfaunal remains were also recovered: *Corvus monedula*, *Pyrrhocorax* sp., *Pyrrhocorax graculus*, *Corvidae* indet., Passeriformes indet. Aves indet., *Rhinolophus euryale, Rhinolophus ferrumequinum, Rhinolophus* sp., *Myotis* sp., cf. *Miniopterus schreibersii*, (Sauqué et al., 2015; Núñez-Lahuerta et al., 2017).

3. Materials and methods

Several reference collections of the UZ (Universidad de Zaragoza) and the IPE (Instituto Pirenaico de Ecología) were used for the taxonomic identification of the remains. Coupled with these, various anatomy atlases have been used such as the Pales and Lambert (1971) and Fernandez (2001). In order to quantify the remains from Los Batanes the number of identified specimens (NISP), the minimum number of elements (MNE) and the minimum number of individuals (MNI) were used. In order to calculate the MNE, the shaft and epiphyses were used according to Marean and

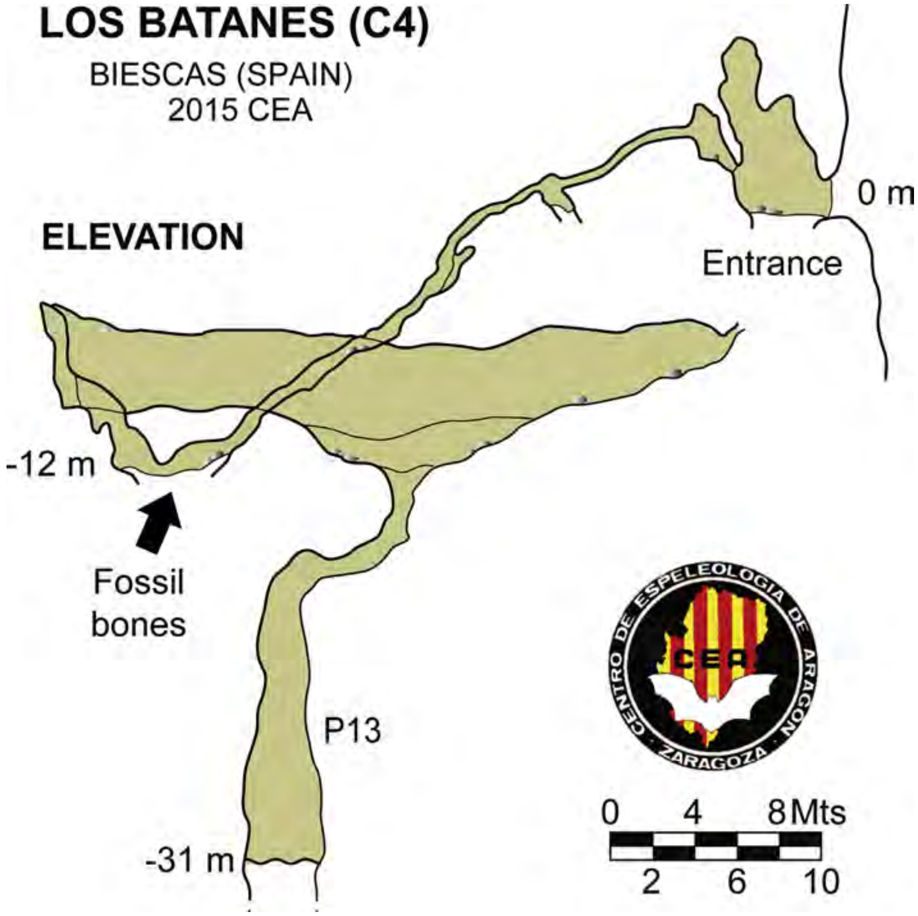

Fig. 2. Scheme of Los Batanes Cave morphology in elevation view, with the location of the fossil bone remains. Topographic map provided by the CEA.

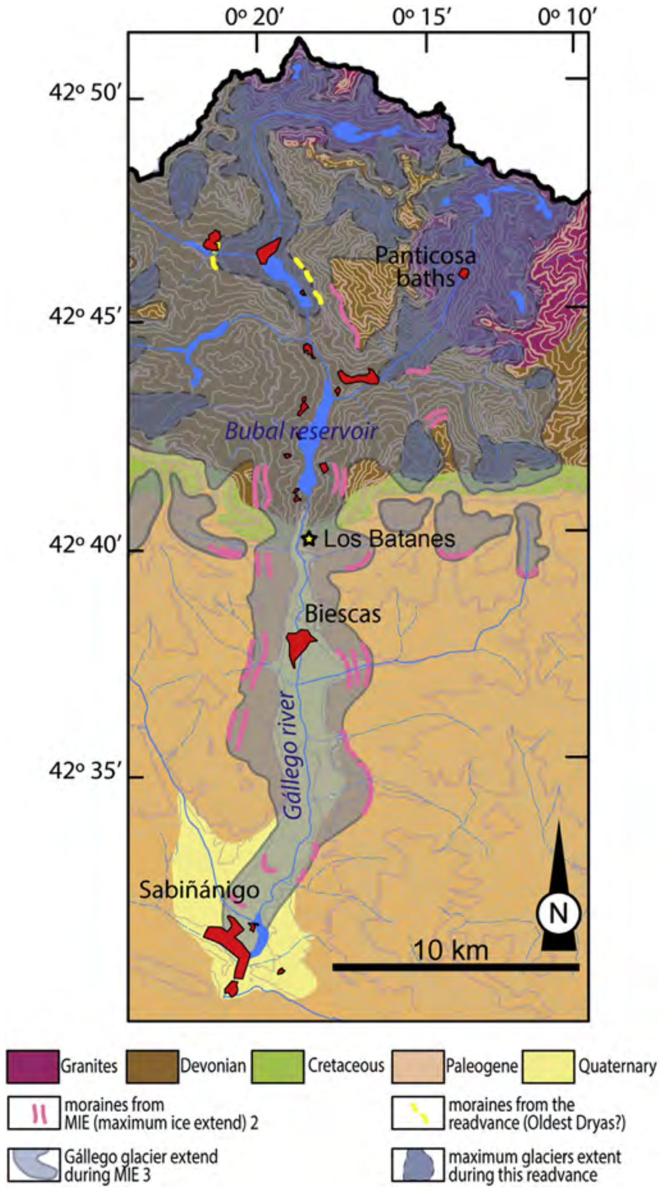

Fig. 3. Geological map of the Gállego Valley area. 1: granites; 2: Devonian; 3: Cretaceous; 4: Paleogene; 5: Quaternary; star: Los Batanes Cave. Modified from Palacios et al. (2015).

Kin (1998), or Yravedra and Domínguez-Rodrigo (2009). The anatomical representation of the different elements (% Surv) has been established in accordance with the studies of Brain (1981) and Lyman (1984). The % Surv is the ratio between the number of elements recovered and the number of elements expected. For this calculation the following formula has been used % Surv = MNE *100/number of these elements in the skeleton * MNI. To calculate the MNI, the scapulae and metatarsi have been used as these are the best preserved and most numerous anatomical elements. The age of death of the Pyrenean wild goat was determined using the criteria of Serrano et al. (2006) for the postcranial bone remains and Payne (1987) and Pérez Ripoll (1988) for the teeth.

To ascertain whether the bone fracture was caused perimortem or after burial of the carcasses, as well as the possible causes of this fracture, the criteria proposed by Villa and Mahieu (1991) were adhered to. This method considers the delineation (transverse, curved or intermediate), the angle (oblique, right or oblique/right) and the type of edge of the fractures (smooth or jagged) displayed in bones longer than 4 cm. Furthermore, the fracture index is contemplated, which refers to the area of conserved diaphysis with regards the total length of said bone, both in terms of length (L1: < from ¼ of total length, L2: between ¼ and ½ of total length, L3: between ½ and ¾ of total length, L4: >¾ of total length), and the circumference (C1: < from ½ of total circumference, C2: > from ½ of total circumference, C3: complete or practically complete at least in some part).

To distinguish the accumulations caused by carnivores from those of human origin, the criteria of Cruz-Uribe (1991), Stiner (2004) and Cáceres (2002), have been followed. The origin of the accumulation has been established using, among others, the studies by Domínguez-Rodrigo (1994a, b), Domingo et al. (2013) and Sauqué et al. (2014).

Measurements were taken with a digital calliper (Digimatic Caliper CD-8″CX) with a precision of 0.01 mm in accordance with von den Driesch (1976). All measurements are given in millimetres. Only elements of adult and subadult animals from Los Batanes (i.e. elements with fused epiphyses) were taken into account for the morphometric study. Attempts were made in order to identify and separate sexes to discount sexual variability but neither of the classical methods (Altuna, 1978; Meadow, 1999) yielded good results. As most of the published data do not distinguish between sexes, we preferred to present our data as a mix of adult measurements to compare with other published sites in the Iberian Peninsula, assuming that a strong internal variability can affect all of them. The morphometric data have been compared with data collections from the Iberian Peninsula published by a variety of authors (see citations in Table 2) as well as with our own data gathered directly from the collections of the Museo Nacional de Ciencias Naturales in Madrid (MNCN), the Museu de Prehistòria de València (MPV), the Instituto Pirenaico Ecología (IPE), the Museo Paleontológico de Zaragoza (MPZ) and the Museo Arqueológico Provincial de Huesca (MAPH).

The fossil remains under study in the present manuscript are provisionally housed at the University of Zaragoza.

4. Results

4.1. NISP, MNE, MNI

At the cave Los Batanes 1157 fossil remains have been recovered, of which 1079 have been taxonomically identified and 78 have been classified as indeterminate chips included in the small size category (Table 1). All the remains belong to *C. p. pyrenaica* (1079), being the only macrofauna taxa recovered at the studied site. 377 bones have been recovered from the appendicular, 572 bones from axial and 130 cranial bones. The MNE is 569. The most highly represented elements are vertebrae (115), phalanges (99), teeth (76), carpus/tarsal (69), ribs (52) and metapodials (28). The long bones have a similar representation, from most to less frequent being the humerus (11), tibia (11), femur (11), radius (9) and ulna (9). Complete or fragmented skulls and mandible have a very low representation (4), the scapula being more highly represented (7), as well as the pelvis (7) and sternum (14) (Table 1).

4.1.1. Minimum number of individuals (MNI)

Nine specimens have been recovered belonging to various age classes (Fig. 4): 1 juvenile individual, 2 subadults, 5 adults and 1 senile. The MNI has been calculated with 9 right metatarsus. The dental replacement and the fusion of the epiphyses were used to determine the age of death.

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Table 1
NISP, MNE, MNI by taxa from Los Batanes faunal assemblage. Mtcp.: metacarpus; Mtt.: metatarsus; 1st Pha.: first phalanx; 2nd Pha.: second phalanx; 3rd Pha.:third phalanx; dp2: lower second deciduous premolar; dp3: lower third deciduous premolar; dp4: lower fourth deciduous premolar; dm1: lower first deciduous molar; p2: lower second premolar; p3: lower third premolar; p4: lower fourth premolar; m1: lower first molar; m2: lower second molar; m3: lower third molar; P2: upper second premolar; P3: upper third premolar; P4: upper fourth premolar; M1: upper first molar; M2: upper second molar; M3: upper third molar; V.: vertebrae; indet.: indeterminate.

	Element	Taxa	NISP	NME	MNI	left	right
Mtcp/Mtt	Appendicular	*C. p. pyrenaica*	6				
Mtt		*C. p. pyrenaica*	26	15	9	6	9
Mtcp		*C. p. pyrenaica*	20	13	8	6	7
Pisiforme		*C. p. pyrenaica*	10	10			
3rd Pha		*C. p. pyrenaica*	24	24			
2nd Pha		*C. p. pyrenaica*	31	30			
1st Pha		*C. p. pyrenaica*	47	45			
Calcaneus		*C. p. pyrenaica*	20	13	9	6	7
Astragalus		*C. p. pyrenaica*	12	12	8	4	8
Radius		*C. p. pyrenaica*	13	9	5	5	4
Ulna		*C. p. pyrenaica*	13	9	6	3	5
Humerus		*C. p. pyrenaica*	22	11	6	5	5
Femur		*C. p. pyrenaica*	33	11	7	6	5
Tibia		*C. p. pyrenaica*	23	11		5	6
Patella		*C. p. pyrenaica*	4	4			
Pisiform		*C. p. pyrenaica*	9	9	5	5	4
Scaphocuboide		*C. p. pyrenaica*	8	8	7	1	7
Scaphoid		*C. p. pyrenaica*	6	6	4	2	4
Pyramidal		*C. p. pyrenaica*	4	4	3	2	2
Semilunate		*C. p. pyrenaica*	5	5	4	3	2
Capitato-Trapezoid		*C. p. pyrenaica*	8	8	6	3	5
Unciform (crochu)		*C. p. pyrenaica*	2	2	1	1	1
Malleolus		*C. p. pyrenaica*	5	5		4	1
Grand Cuneiform		*C. p. pyrenaica*	3	3	2	2	1
Petit Cuneiform		*C. p. pyrenaica*	3	3	2	2	1
Sesamoid		*C. p. pyrenaica*	20	20			
Skull	Cranial	*C. p. pyrenaica*	32	4	4		
Mandible		*C. p. pyrenaica*	11	4	3	3	1
Lower dentition		*C. p. pyrenaica*					
dp2		*C. p. pyrenaica*	1	1			
dp3		*C. p. pyrenaica*	1	1			
dp4		*C. p. pyrenaica*	1	1			
dm1		*C. p. pyrenaica*	1	1			
Incisives		*C. p. pyrenaica*	10	10	5	5	5
p2		*C. p. pyrenaica*	1	1	1	1	0
p3		*C. p. pyrenaica*	4	4	3	3	1
p4		*C. p. pyrenaica*	5	3	3	2	1
m1		*C. p. pyrenaica*	4	4	3	3	1
m2		*C. p. pyrenaica*	7	4	4	3	1
m3		*C. p. pyrenaica*	8	7	5	4	3
Upper dentition		*C. p. pyrenaica*					
P2		*C. p. pyrenaica*	7	7	5	3	4
P3		*C. p. pyrenaica*	6	6	5	3	3
P4		*C. p. pyrenaica*	7	7	5	3	4
M1		*C. p. pyrenaica*	8	8	5	5	3
M2		*C. p. pyrenaica*	8	5	3	3	2
M3		*C. p. pyrenaica*	8	6	4	4	2
Molars indet		*C. p. pyrenaica*					
Atlas	Axial	*C. p. pyrenaica*	4	3	2		
Axis		*C. p. pyrenaica*	5	5	4		
Cervical V.		*C. p. pyrenaica*	15	14			
Thoracic V.		*C. p. pyrenaica*	52	36			
Lumbar V.		*C. p. pyrenaica*	39	24			
Sacro		*C. p. pyrenaica*	7	7			
Caudal V.		*C. p. pyrenaica*	26	26			
Vertebrae indet		*C. p. pyrenaica*	65				
Ribs		*C. p. pyrenaica*	278	52			
Scapula		*C. p. pyrenaica*	27	7	4	4	3
Pelvis		*C. p. pyrenaica*	40	7	7		
Sternum		*C. p. pyrenaica*	14	14			
Total			1079	569	9		

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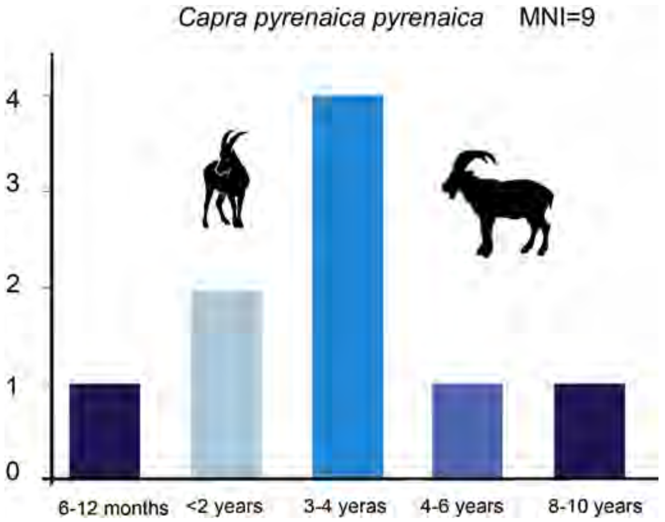

Fig. 4. Mortality profile of Pyreneean wild goat (*Capra pyrenaica pyrenaica*) from Los Batanes (MNI = 9).

4.2. Taphonomical study of Los Batanes

4.2.1. Survival profile (% Surv)

The *C. p. pyrenaica* % Surv in Los Batanes shows the predominance of pelvis and metapodials; long bones also render high representation values, such as the humerus (61.1%), femur (61.1%) and tibia (61.1%) and the radius (50%) and ulna (50%); the elements with the lowest values are those from the axial skeleton. In general the profile for skeletal survival is quite balanced and no bias can be observed towards any parts of the skeleton (Fig. 5).

4.2.2. Fracture patterns

The degree of fracturing in the sample is low given that 287 whole bones have been recovered, which represents more than half of the set (58.2%). Additionally, the bones present both old and recent fractures. The angle of the fracturing in Los Batanes sample is predominantly a right angle (48.6%), with a transverse delineation (56.4%) and a jagged fracture edge (78%), characteristics associated to post-depositional fractures. In terms of the diaphysis length and the conserved circumference, the most highly represented type in the sample is C3-L4 (28.2%), followed by C3-L3 (25.4%), C1-L1 (19.7%), C3-L2 (14%), C3-L1 (7%) and C1-L1 and C2-L1, each of them representing 2.8% (Fig. 6). The perimortem fractures are in the minority and appear not to be related to the action of carnivores neither related to human percussion marks.

4.3. Description and study of Capra pyrenaica pyrenaica from Los Batanes

The Pyrenean wild goat is the only macromammal recovered at the site of Los Batanes.

The sample includes almost all of the anatomical elements with the exception of a complete skull and horn-core, which is an obstacle, since the taxonomy of the genus *Capra* is based principally on the morphological characteristics of these elements (Veinberg, 1993; Pidancier et al., 2006). In the absence of these elements, M3 has been one of the most-used elements, most specifically, whether the metastylar wing is developed or not and the width of the interstylar surfaces (Crégut-Bonnoure, 1992). Crégut-Bonnoure (1992, 2006) proposed, based on those features, that *C. pyrenaica* is derived from a common ancestor with the Caucasian goat (*C. caucasica praepyrenaica*) which arrived at the Massif Central in France during the Eemian and evolved into *C. pyrenaica*. Subsequently, this new species moved to the south and reached the Pyrenees in the Magdalenian. Following this hypothesis, *C. pyrenaica* colonized the Iberian Peninsula starting from the Pyrenees. As of lately, this theory has lost some strength (García-González, 2011; Sauqué et al., 2016b) in the light of the presence of *Capra* in Iberia for more than 100 ky, the high variability of the distinguishing morphological characters proposed by Crégut-Bonnoure (Magniez, 2009) and the recently discovered kinship of *C. ibex* and *C. pyrenaica* (Pidancier et al., 2006; Ureña et al., 2011).

All things considered, the precise taxonomic classification of the Iberian goat is still to be determined, but it is most likely that *C. pyrenaica* was already present in the Iberian Peninsula in the Late

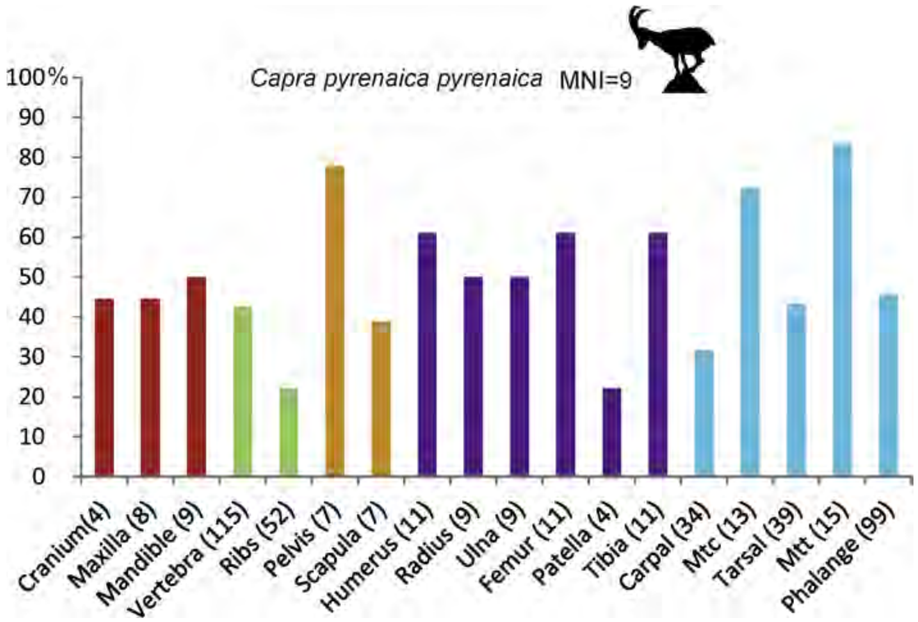

Fig. 5. Graphical representation of skeletal survival rate (% Surv) according to skeletal elements found in Los Batanes faunal assemblage.

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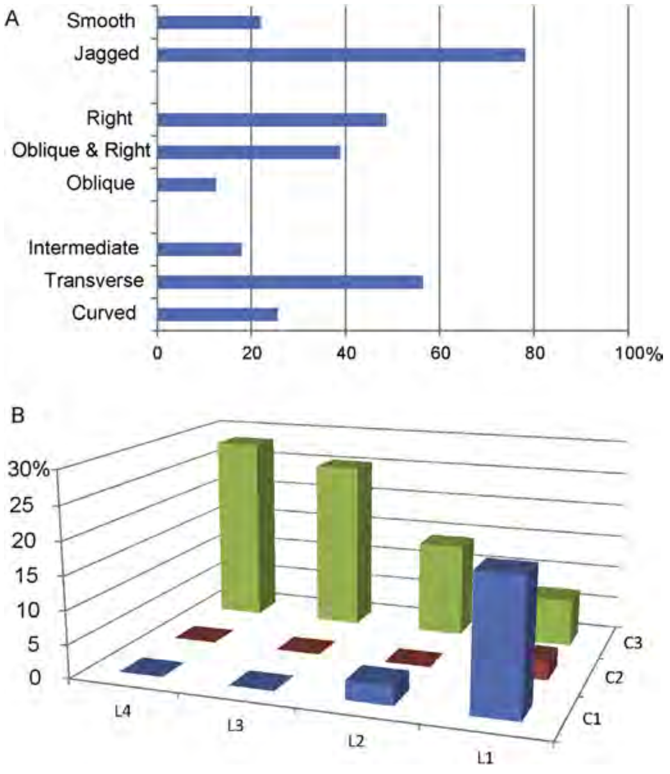

Fig. 6. a) Analysis of the breakage of long bones from Los Batanes, showing the abundance of each type of fracture according to the criteria analysed: delineation, angle and edge of the breaks. b) Analysis of the breakage of the diaphyses in terms of circumference and length from Los Batanes.

Pleistocene. Thus, the remains found at Los Batanes site have been assorted to *Capra pyrenaica*, likely pertaining to the Pyrenean subspecies *C. pyrenaica pyrenaica* (Cabrera, 1911) taken into account the strong similitude with modern individuals (see Figs. 7–9), and the situation and age of the site.

Due to its origin, the accumulation of Los Batanes has enabled the recovery of numerous complete remains. Therefore this deposit has a great value for any biometric analysis. The data of Los Batanes assemblage has been compared with the two non-extinct Iberian subspecies *Capra pyrenaica victoriae* and *Capra pyrenaica hispanica* as well as with fossil remains of *Capra pyrenaica* of the Late Pleistocene (Table 2). Teeth were not included in the biometric analysis because does not allow us to classify the remains to the level of the species (Llorente and Quiralte, 2016).

Our own data and those available in the bibliography of post-cranial elements measurements for *C. pyrenaica* (fossil and extant) from Iberian sites are showed in Table 2. Sizes of extant subespecies (*C. p. victoriae* and *C. p. hispanica*) are quite similar and clearly smaller than those of fossil materials. This fact was also noted for extant and fossil individuals of *C. ibex* (Chaix and Desse, 1983).

The size of Los Batanes limb bones fall in general within the range of sizes of Iberian fossil goats (Table 2), taking into account the high internal site variability due to sexual dimorphism (Figs. 7–9). Two sites in the North of Spain stand out for their higher sizes, Erralla (Altuna and Mariezkurrena, 1985) and Urratxa (Llorente and Quiralte, 2016) from the Magdalenian and the initial Holocene, respectively.

The sizes of the sites in the southern half of the Iberian Peninsula: Cova Fosca (Llorente and Quiralte, 2016), Parpalló (Davidson, 1989), Racó del Duc and Nerja (Morales and Martin, 1995), are usually smaller than those in the North, except the remains of Parpalló, perhaps a little older than the rest (Upper Paleolithic).

5. Discussion

5.1. Origin of the accumulation

The presence of faunal remains in cavities may be due to different factors. Most of the accumulations of bones generated during the Late Pleistocene - Holocene are due to the action of predators, either carnivorous or humans (Brain, 1981; Blumenschine, 1988; Sauqué et al., 2014; Llorente and Quiralte, 2016; Yravedra and Cobo-Sánchez, 2015; Sauqué et al., 2017a, 2017b; Sauqué and Sanchis, 2017). The accumulations generated by human beings show characteristics such as the high degree of bone fracture and the presence of cut marks as well as the presence of lithic industry in the assemblage (Brain, 1981; Cáceres, 2002; Stiner, 2004). One of the main features of Los Batanes is the total absence of human processing. There are no percussion or cut marks on the remains, in spite of the fact that the bones are fractured.

The absence of carnivores remains at Los Batanes does not rule out the action of carnivores as accumulators and/or modifiers of the bone remains found there (Yravedra, 2006; Sauqué et al., 2014; Sauqué and Sanchis, 2017). Considering the characteristics of the large carnivores that inhabited the Pyrenees during the last part of the Late Pleistocene, the brown bear, the wolf and the red fox could be agents responsible for the taphocenosis on Los Batanes. Main characteristics of these, and their ability to transport and modify bone remains in caves, are as follows: The brown bear (*Ursus arctos*) is a large carnivore that lives today and in the past in caves, as it is a common element in assemblages of the Late Pleistocene in the Iberian Peninsula (Valdiosera et al., 2008; Villaluenga, 2009). This animal uses caves as a shelter during the hibernation periods. (Kurten, 1976; Stiner, 1998). The bear has an omnivorous diet and can consume the meat of medium size mammals such as wild goats, but does not transport the carcasses and therefore it cannot contribute to the accumulation of bones in their hibernation dens (Stiner, 1999; Pinto Llona et al., 2005; Saladié et al., 2013; Sala and Arsuaga, 2013, 2016). As a result, there is not any single reason to consider its participation in the accumulation of Los Batanes assemblage.

The wolf (*Canis lupus*) is a social carnivore that was widely distributed across the Iberian Peninsula during the Late Pleistocene and Holocene (Sommer and Benecke, 2005). Although its diet covers a very wide spectrum, it shows a preference for small and medium size herbivores like wild goats (Jêdrzejewska and Jêdrzejewski, 1998; Ansorge et al., 2006). Wolves usually consume their preys at the very same place of the kill. Only during the breeding period do they transport their preys to dens. In such cases, the remains are usually regurgitated bone fragments that do not create large accumulations (Domínguez-Rodrigo, 1994b). So far, the wolf is not known to have created any significant bone accumulation (Domínguez-Rodrigo, 1994b; Yravedra et al., 2011; Castel et al., 2010), but it is a taphonomic agent that is able to modify bone groups (Stiner, 2004; Castel et al., 2010; Utrilla et al., 2010). In the rare occasions when wolves and bears may cause bone accumulations, they are recognised because of the tooth marks left on the bones of their prey (Sala and Arsuaga, 2013; Arilla et al., 2014; Sala et al., 2014).

In the last years numerous studies analyse the potential of foxes as bone collectors and as bone modifiers (Mondini, 1995, 2000, 2001, 2002, 2003, 2005; Krajcarz and Krajcarz, 2014; Yravedra et al., 2014).

During the Pleistocene and until now, the Iberian Peninsula has been inhabited by the red fox (*Vulpes vulpes*), that is a medium-

Fig. 7. Remains of *Capra pyrenaica pyrenaica* from Los Batanes. (A, B, C) Left femur. (D, E, F) Right femur. (G, I, J) Left tibia. (H) Right tibia.

sized social carnivore. This taxa is one the most widely distributed carnivore in the world (Larivière and Pasitschniak-Arts, 1996; Wilson and Reeder, 2005). This carnivore presents a great ability to adapt to different environmental conditions, and for that reason it became one of the most common carnivores in Europe during Pleistocene (Sommer and Benecke, 2005; Krajcarz and Krajcarz, 2014). They are considered generalist predators or opportunistic feeders because they can feed on a wide prey and food spectrum, depending on supply. However, leporids and in particular rabbits may be the most important resource of their diets (Lloveras et al., 2012). This carnivore usually visits caves, where they accumulate large numbers of prey. Red foxes do not clear their dens (Goszczyński, 1995), and therefore produce large collections of bones over many years (Krajcarz and Krajcarz, 2014). Regarding the damage that fox produced in carcass, it is low alteration and destruction of indexes on ungulate remains (Krajcarz and Krajcarz, 2014). Bone accumulations made by fox also present tooth marks, ranging between 10 and 26% (Nasti, 2000; Mondini, 2001, 2003, 2009; Muñoz, 2009; Yravedra et al., 2014) and more than 50% (Krajcarz and Krajcarz, 2014). In Los Batanes assemblage there are no presence of red foxes in the association, or any kind of carnivore marks, so it is easy to exclude the red fox as a possible accumulator of the goats present in Los Batanes cave.

The cave hyena (*Crocuta spelaea*) is a common taxa in the Iberian Peninsula during the Late Pleistocene (Arribas, 2004; Arribas et al., 2010; Sauqué et al., 2017a). This taxa has a great potential as a bone accumulator and there are several examples of sites made by the action of this carnivore (see references in Sauqué and Sanchis, 2017). The sites related with the action of cave hyenas usually present one or more of these features: presence of cave hyena remains, presence of decidual teeth of cave hyena, coprolites, presence of digested bone and bones of herbivores with tooth marks (see references Sauqué and Sanchis, 2017). In the case of Los Batanes, none of these features have been found so it is possible to rule out the action of cave hyena as a possible accumulator.

In Los Batanes assemblage, tooth marks have not been found in the remains, so the origin of the accumulation cannot be attributed to the action of carnivores.

Another potential bone accumulator in the area that the site is placed at is the bearded vulture (*Gypaetus barbatus*). The

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Table 2

Selected comparative measurements on *Capra pyrenaica* postcranial elements. Hum.: humerus; Ra.: radius; Mtcp.: metacarpus; Fe.: femur; Tib.: tibia; Ast.: astragalus; Cal.: calcaneus; Mtt.: metatarsus; GL: maximum length; GB: maximum width; Bd: distal width; Bp: proximal width. Mag: Magdalenian; Sol: Solutrean; Gra: Gravettian; Aur: Aurignacian; UPa:Upper Paleolihitc; Neo: Neolithic. [a] This study; [b] Sauqué et al., 2016a; [c] Álvarez-Lao, 2014; [d] Altuna, 1976; [e] Altuna, 1986; [f] Altuna, 1972; [g] Castaños, 1993; [h] Blasco-Sancho, 1995; [i] Castaños, 1984; [j] Castaños, 1986; [k] Altuna and Mariezkurrena, 1985; [l] Llorente and Quiralte, 2016; [m] Pérez-Ripoll, 1977; [n] Sauqué (unpublished data); [o] Davidson, 1989; [p] Morales and Martín, 1995.

Site	(mm)	Hum. GL	Hum. Bp	Hum. Bd	Ra. GL	Ra. Bp	Ra. Bd	Mtcp. GL	Mtcp. Bp	Mtcp. Bd	Fe. GL	Fe. Bp	Fe. Bd	Tib. GL	Tib. Bp	Tib. Bd	Ast. GLl	Ast. Bd	Cal. GL	Cal. GB	Mtt. GL	Mtt. Bp	Mtt. Bd
Los Batanes [a]	Mean (n)	200	49.8	37.3 (8)	190.8 (2)	36.9 (5)	36.2 (4)	137.5 (5)	30.1 (5)	34 (7)	233	53.3	44.6 (7)	266.4 (3)	51.2 (8)	33.1 (5)	35.9 (12)	23.7 (12)			147.1 (6)	26 (8)	32 (8)
	Min-max			33.9–39.5	190–191.5	32.7–40	35.1–38.1	134.2–145.5	29.2–30.8	32.3–35.5			41.7–46.7	263–272	47.3–54.2	31.6–34.8	32.1–38.5	21–26.5			141.5–153.4	24.3–28.2	29.8–34.6
Los Rincones [b]	Mean (n)			39.3 (10)		39.9 (6)	42.4 (4)	152.6 (6)	33.7 (12)	38.1 (8)						34.2 (8)	36 (15)	23.9 (16)			150.4 (1)	26.5 (4)	32 (4)
	Min-max			34.8–45.9		38.5–41.5	40.2–45.3	145.6–158.3	28.5–37.8	31.6–40.7						29.8–37.9	34.2–40.6	21.9–28.2				24.1–30.2	29.6–35.6
Jou Puerta [c]	Mean (n)								34.2 (4)	37.6 (3)						38.3 (2)							
	Min-max								27–36.3	36.7–38.1						37.7–38.8							
Tito Bustillo [d]	Mean (n)			40.8 (5)		42.5 (1)			35.5 (1)	35.8 (2)						33.5 (1)	35.7 (7)	23.4 (7)					32.2 (3)
	Min-max			34.5–45						34–37.5							32–40	21–27					31–33.5
La Riera [e]	Mean (n)								29 (2)	35.7 (3)						31 (6)							
	Min-max								28–30	30–39						29.5–34.5							
Urtiaga D [f]	Mean (n)			43.7 (13)		41.5 (1)		145 (1)	34.9 (6)							36.5 (1)	37 (29)	24.2 (27)					
	Min-max			39.5–48.5					33.3–39								34.3–40.5	21.5–28					
Chaves (Mag) [g]	Mean (n)			36.7 (5)		42.3 (4)	31.25 (2)		35 (1)	34.3 (5)						32 (9)	34.1 (5)		73.8 (2)	26.5 (2)	147.5 (1)		28.8 (3)
	Min-max			31–41.5		36.5–45	27.5–35			28.5–41.5						27–36.5	31–35.5		68.5–79	26–27			27.5–30
Gabasa (Mus) [h]	Mean (n)			43 (11)		40 (8)	37.4 (3)	142.9 (5)	31.3 (12)	35.2 (5)						35.3 (12)	37.6 (34)	24.5 (30)			148.1 (4)	28 (10)	32.2 (5)
	Min-max			38.2–48.6		37.8–42.8	37–37.9	129–156	24.7–37.4	27.4–41.4						31.8–39.1	32.2–41.7	21.5–27.5			143–151.1	25.7–29.9	29.7–37
Santimamiñe [i]	Mean (n)			39.1 (22)		40.8 (2)	30.5 (1)			35.3 (5)			40.5 (1)		45.5 (1)	35.3 (3)	35.9 (13)	23.5 (13)	74.1 (4)	25.9 (4)		25.5 (1)	35.1 (9)
	Min-max			32.5–48		37–44.5				30.5–41						33.5–38.5	30–40.5	19.4–27.5	70–77.5	23–29			31–38
Bolinkoba [j]	Mean (n)			38.8 (2)	36 (1)				29.7 (3)	39.5 (3)							36.6 (31)	23.9 (28)	75.3 (9)	25.3 (10)		24 (2)	30.5 (1)
	Min-max			38.5–39					29.5–30	33–43.5							33.5–40.5	21–27.5	65–84	20–30		23.5–24.5	
Lumentxa [j]	Mean (n)			35.5 (3)		43 (1)		156.5 (1)	40 (1)	40.5 (2)						29.3 (2)	32.1 (8)	21.1 (9)	67.5 (1)	23.5 (1)			32.3 (2)
	Min-max			32.5–41						35–46						29–29.5	30.5–33.5	18.5–23					30.5–36
Erralla (Magd.) [k]	Mean (n)		54.5 (1)	39.6 (7)	220 (2)	39.4 (6)	41 (1)	149.7 (3)	34.7 (3)	37.5 (4)	243.5 (1)		54 (2)	294 (3)	53.5	34.5 (8)	38.8 (6)	26.2 (5)	76.5 (9)	26.4 (12)	152.3 (2)	29.4 (4)	35.2 (3)
	Min-max			37–42.5	209–231	32–48		141–154	33.4–35.5	33–41			50–58	288–305		29–39	37.5–40.5	24.5–28	69–89	23–31	150–154.5	27–31.5	32.5–39
				40.6 (8)		41.5 (1)				33 (5)					45 (2)	32.1 (9)	35.2 (8)						32.5 (5)

(*continued on next page*)

Table 2 (*continued*)

Site	(mm)	Hum. GL	Hum. Bp	Hum. Bd	Ra. GL	Ra. Bp	Ra. Bd	Mtcp. GL	Mtcp. Bp	Mtcp. Bd	Fe. GL	Fe. Bp	Fe. Bd	Tib. GL	Tib. Bp	Tib. Bd	Ast. GLl	Ast. Bd	Cal. GL	Cal. GB	Mtt. GL	Mtt. Bp	Mtt. Bd
Urratxa [l] (13-7 ky)	Mean (n)																	22.6 (10)					
	Min-max			36.5–43.5						28.5–39.5					42.5–47.5	29–36	31–40	19.2–27					32-36.5
Cova Negra (MIS 5) [m]	Mean (n)			43.4 (3)			41 (2)	136.8 (6)	31.6 (8)	34.3 (7)			49 (1)			32.7 (4)	37.3 (6)	23.8 (5)	76.8 (1)		153.5 (1)	28 (1)	33.3 (3)
	Min-max			41.1–48			37.5–44	127.1–161.2	29–37	31.6–42.5						31.3–35	32.2–41	20.3–26.4					31.9–34.2
Parpalló (UPa) [n.o]	Mean (n)			37.5 (135)		38.1 (77)	36.4 (31)	137.6 (29)	29.5 (49)	33.0 (113)			45.1 (20)		46.9 (44)	31.7 (63)	34.4 (169)		71.9 (31)	26.5 (29)	149.9 (29)	25.1 (57)	29.6 (95)
	Min-max			30.5–42.5		31.9–45.9	28.4–41	123.8–148.5	25.4–32.1	26–37.1			39.6–50.2		38.1–56.4	27.9–35.2	28.9–36.5		60–79	23.1–28.7	133–161	21–27.5	26–33.8
Recolduc (Sol-Gra) [n]	Mean (n)							128.6 (6)	27.3 (9)	30.6 (9)											143.4 (5)	24 (5)	28.3 (5)
	Min-max							123.4–143.1	26.3–28.9	27.2–34.7											132.2–157.5	21.6–26.6	26.7–31.6
Mallaetes (UPa) [n]	Mean (n)							131.1 (1)	28.4 (6)	32.3 (7)											137.1 (2)	23.9 (2)	29.5 (8)
	Min-max								25.7–30.1	31.6–33.8											133.4–140.9	23.1–24.7	27.9–31
Nerja (Mag)[p]	Mean (n)								27.3 (1)	34.5 (3)							36 (1)	23 (1)					28.6 (1)
	Min-max									33.1–37.2													
Cova Fosca (Neo) [l]	Mean (n)			36.2 (50)		37.6 (12)	32.1 (12)	124 (1)	27.2 (4)	29.8 (24)			42.8 (2)			29.5 (25)	33 (61)	21 (55)				22.2 (2)	28.9 (10)
	Min-max			29.5–44		31–43	21.3–42		25–29.5	24.5–34.9			38.5–47			25–34	28.5–36.5	18–24.5				20.5–24	25.8–32.5
C. pyrenaica hispanica extant [n.l]	Mean (n)	183.7 (24)	46.6 (24)	35.2 (28)	179.7 (18)	36.8 (18)	34.4 (18)	130.7 (69)	29.4 (69)	33 (69)	216.2 (2)	51.5 (2)	43.5 (2)	252 (21)	47.6 (21)	29 (21)	32.1 (17)	20.5 (17)			142.9 (70)	24.8 (70)	29.7 (70)
	Min-max	159.3–210	37.9–54	31–40	150–200.5	31.8–40.5	28.5–38.5	115–140	26.5–33.3	25.8–37.9	198.5–264	47.5–55.5	39–48	215–273.8	41.5–54	20.5–33	27.3–34.5	18.5–23			127.8–155.5	21.4–27.3	26–32.6
C. pyrenaica victoriae extant [n.l]	Mean (n)	175.6 (13)	46 (13)	37.5 (18)	163.2 (12)	36.8 (12)	34.1 (12)	117 (56)	25.9 (56)	29 (56)				238 (10)	49.98 (10)	28.8 (10)	33.5 (21)	21.9 (21)			128.4 (60)	22.1 (60)	26.3 (60)
	Min-max	161–187.2	36–51.7	33.6–42.1	148–188.5	32–44	31–40.5	104–126	23.2–28.2	25.9–32.7				220.5–278	43.5–55	26–33	30–36	19.5–24.5			118.5–138.2	19.8–25	23.6–29.9

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accumulations made by this bird present some characteristics such as digestion marks in the bone surface and skeletal part frequencies highly unbalanced in favour to third phalanges. Consequently, the taphonomic signature of the bearded vulture as defined by all these features cannot be mistaken with any known taphonomic signature, either animal or human (Robert and Vigne, 2002). These features do not fit at all in the bone accumulation present in Los Batanes, where there are no bones with digestion marks and the third phalanxes are not overrepresented so the bearded vulture is not a possible accumulator for Los Batanes bone assemblage.

During the Pleistocene, fauna accumulations in caves and shelters were mainly related to the activity of carnivores and humans (Brain, 1981; Blumenschine, 1988). In terms of human activity, there are some criteria that allow us to relate a bone assemblage to the human activity. The age patterns show such a high degree of variation that they are not diagnostic to establish whether an accumulation is of natural origin, carnivorous biological origin or natural anthropic biological origin (Domínguez-Rodrigo, 1996, 1999, 2002). The skeletal profiles are also subject to multiple factors and are not diagnostic when isolated (see Yravedra, 2000; Domínguez-Rodrigo, 1999, 2002). Regarding the percussion marks, these may appear in anthropic accumulations or in natural accumulations generated by carnivores, with secondary human action. In contrast to these evidences, the cut marks are the main direct evidence of meat exploitation, and the location, distribution and frequencies of cut marks are the main tool to elucidate whether humans had primary or secondary access to bone assemblages (Domínguez-Rodrigo, 1996; Barba and Domínguez-Rodrigo, 2005). In the case of Los Batanes cave, we did not find any percussion mark, cut mark or lithic tool, that is, we did not find any evidence of human activity in the bone assemblage.

The sample shows a low fragmentation level of 41.8%, with 287 complete remains (Figs. 7–9). The breakage data was compared with key sites studied by Villa and Mahieu (1991). Those Neolithic sites are: Fontbrégoua, where the breakage is anthropic in origin; Sarrians, where the breakage was caused by the weight of the sediment load; and Besouze, where the breakage was produced by the impact of falling blocks (Villa and Mahieu, 1991). The bones recovered at sites where the breakage occurred on fresh bone (green bone) display a fracture pattern mainly composed by oblique

Fig. 8. Remains of *Capra pyrenaica pyrenaica* from Los Batanes. (A, B, C) Right humerus. (D, E) Left humerus. (F, G) Right radius. (H, I) Left radius.

Fig. 9. Remains of *Capra pyrenaica pyrenaica* from Los Batanes. (A, B, C) Right metacarpus. (D, E, F, G) Left metacarpus. (H, I, J, K) Left metatarsus. (L, M, N, O, P) Right metatarsus.

angles, smooth edges and curved delineations. In these cases the main agents of breakage are the primary consumers, such as humans extracting the marrow or carnivores that gnawed on the bones (Díez et al., 1999; Villa and Mahieu, 1991; Arsuaga et al., 2012). In the case of Los Batanes, the fracture pattern is mainly composed by right angles, jagged edges and transverse fractures outlines. The most frequent shaft fragmentation type is the C3 shaft circumference. This pattern is similar to Sarrians site, where the breakage was only due to sedimentary load and no other breakage process affected the bones (Villa and Mahieu, 1991). This data supports the idea that the accumulation took place without the intervention of any accumulating agent, and this indicates that the cave acted as a trap for the Pyrenean wild goats like is frequent in many French Pyrenean goat fossils sites (Clot and Evin, 1986). Once the goats were covered by sediment, the bone suffered post-depositional breaking, although it cannot exclude that part of the break was produced by the fall of blocks on the carcasses before their burial. This may be the reason that no complete skulls have been recovered.

The survival profile of the assemblage of Pyrenean wild goats from Los Batanes is quite balanced and differs from those created by geological origins since phenomena resulting in differential preservation, such as transportation in a watery medium, are directly related to the density of the bones (Voorhies, 1969; Coard, 1999). The balanced survival profile indicates that the carcasses entered completely into the pit, this could be concordant with the natural trap hypothesis. The mortality profile in Los Batanes is a “living structures” one, in which the individuals are represented more less in the proportion to their natural abundance; this type of pattern is related with catastrophic death (Stiner, 1998; Steele, 2003). Social carnivores such as wolves create profiles with an abundance of potentially weak individuals such as the young and the senile (Steele, 2003). This data also support the idea that carnivores are not related to the origin of the accumulation of the Pyrenean wild goat in Los Batanes site.

There are two modes of faunal concentration in natural traps

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developed in caves: accidental falls (passive accumulation) and intentional entrance (active accumulation) (Domingo et al., 2103). In our case, the Pyrenean wild goats are not animals with cave-dwelling habits, although during storms or under hard weather conditions they may use the entry of the cavities as a shelter (Sánchez Hernández, 2006), they accidentally trip over and fall into the pit. There are other sites where the goats enter to the caves to consume the salt present in the rocks and they also fall accidentally (Griggo, 2015). Once a goat falls to the bottom of the pit, it is really difficult for it to get out, due to the verticalized and polished walls.

In the Pre-Pyrenean region, specifically in the Basque Country, there are deposits with remains of Iberian wild goat that died inside the cavity as in the case of level IV of Erralla (Altuna and Mariezkurrena, 1985), while in other sites, such as the Amalda Level VII-IV, the accumulation of goats had both anthropic and carnivorous origin (Altuna and Mariezkurrena, 2010; Yravedra, 2006). The sites with Pyrenean goats in the southern Pyrenees studied until now had an anthropic origin, such as Chaves (Castaños, 1993) and Gabasa (Blasco-Sancho, 1995), or only presented isolated goat remains, such as the skull from Millaris (García-González, 2012) or the skeletons from Lecherines (Sauqué et al., 2015). Los Batanes site, however, appears as the most important accumulation of fossil *C. p. pyrenaica* with a non-anthropic origin. As a result, this site presents a higher number of complete bones than carnivores or anthropic accumulations, and for this reason we consider that site of Los Batanes may be a reference for future studies in the biometry and palaeontology of the extinct Pyrenean wild goat.

5.2. Biometric analysis of Capra pyrenaica in the Iberian Peninsula

In spite of the scarcity of sites with published morphometric data and the high variability of the measurements within the sites (due above all to the sexual dimorphism), it can be said that, in the fossils of the Iberian wild goat known until now, a north-south gradient related to size seems to be appreciated, those of the North being bigger. This variability in size had already been mentioned by some authors (Davidson, 1989; Sauqué et al., 2016a) and would have been reproduced in the Holocene (Castaños, 2004). At present, for this and other characteristics, it was recognized in the present-day subspecies (Cabrera, 1911).

Crégut-Bonnoure (2009) established the influence of the Bergmann's rule on the size of extant *Capra* species. Two groups were identified: one in the North of the Mediterranean basin, *C. sibirica*, *C. cylindricornis*, *C. caucasica*, *C. falconeri* and *C. pyrenaica*, which are bigger, with massive limb bones, and a second group "arabo-mediterranean", whose species are smaller with elongated limb bones: *C. pyrenaica* (from Middle and South of the Iberian Peninsula), *C. nubiana*, *C. walie* and *C. aegagrus*.

Whether this difference in size amongst Iberian goats in the Late Pleistocene correspond to phylogenetic differences or not is still undetermined, as is the subspecific differentiation of *C. pyrenaica* (Acevedo and Cassinello, 2009), and even the systematics regarding the specific level may probably undergo further revision (García-González, 2011). The north-south size gradient of the Iberian goats might have been caused by the abundance of trophic resources in the Eurosiberian (temperate and fertile) and Mediterranean (arid and poor) environments, instead of being a temporary case of Bergmann's rule. This theory is supported by the size gain experienced by *C. pyrenaica* during the interglacial period (MIS5) at Cova Negra (Pérez-Ripoll, 1977) and during the Holocene (García-González, 2012). However, cautions must be taken into account when analysing and interpreting a data set with such a high temporal, spatial and biological heterogeneity (sex-age class differences). More data and new analysis are necessary to clarify the observed biometric variability of the Late Pleistocene Iberian goats.

6. Conclusions

The paleontological site of Los Batanes is one of the first examples of a natural trap in the Spanish Pyrenees. The accumulation was generated by Pyrenean wild goats that accidentally fell into the pit, so the origin of this site is not related with the action of humans or carnivores. Los Batanes is the site with the largest amount of *C. p. pyrenaica* fossil remains to the South of the Pyrenees. The biometric study of the Pyrenean wild goats from Los Batanes shows that they were larger than present-day Iberian wild goats and the fossil goats of the South of the Iberian Peninsula. The population of Los Batanes has a slightly smaller size than the goats from Late Pleistocene Cantabric area.

Whether this difference in size amongst Iberian goats in the Late Pleistocene corresponds to phylogenetic differences or to environmental factors is unknown. More data and new analysis knowing the sex dimorphism effect on size of different bone elements are required to elucidate the taxonomical status of Iberian goats and their phylogenetic relationships with other European goats.

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