



## The role of shellfish in hunter–gatherer societies during the Early Upper Palaeolithic: A view from El Cuco rockshelter, northern Spain

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### ABSTRACT

The role of coastal resources in the subsistence strategies of Palaeolithic human populations has only recently become an important topic in Old World archaeology. Information on the exploitation of these resources, both as foodstuffs and symbolic elements, can be used to infer the emergence of modern human behaviour as well as to track the diversification and intensification of human diet over time. The excavations carried out at El Cuco rockshelter, located in northern Spain have provided evidence for the exploitation of marine resources during the Early Upper Palaeolithic. The accumulation of *Patella* shells at El Cuco provides the largest accumulation and the first clear evidence of collection and consumption of molluscs during the Aurignacian on the Atlantic Façade of Europe. A deposit of ornamental shells appeared in a very homogeneous context dated to the Gravettian, suggesting that the shells belonged to the same item. The analysis of this evidence has allowed us to conclude that marine resources were systematically used at least from the beginning of the Upper Palaeolithic in the region. However, a comparison with the Mesolithic shows that intensive shellfish gathering did not occur until the end of the Upper Palaeolithic. Regarding the ornaments, it is interpreted that the identified shell beads were used as social or personal status markers.

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### Introduction

The oldest evidence of coastal resources in archaeological sites comes from Acheulean deposits in Europe and Africa. Nevertheless, the evidence is usually restricted to limited remains in sometimes unclear stratigraphic contexts (see Erlandson, 2001 for a summary and references). The limited evidence has supported the idea that coastal resources were not important in the diet of the first hominins. For the Middle Palaeolithic (MP) and Middle Stone Age (MSA), evidence has increased in recent years and new findings have provided more information regarding this issue in Europe and Africa. In Europe, coastal resource exploitation in MP sites is mainly related to Neanderthal occupations, such as for example El Bajondillo (150–65 kys, Cortés-Sánchez et al., 2008, 2011), Los Aviones (~45–38 kys, Zilhão et al., 2010), Gorham's cave (~30 kys), Vanguard cave (~42 kys) (Stringer et al., 2008) and Figueira Brava (~30 kys, Bicho and Haws, 2008) in Iberia, and Moscerini (~110 kys, Stiner, 1993) in Italy. On the other hand, in South Africa coastal resources were usually exploited by

anatomically modern humans (AMHs) during the MSA, for example at Pinnacle Point (~170–90 kys, Jerardino and Marean, 2010), Klasies River caves (115–60 kys, Rightmire and Deacon, 1991; Singer and Wymer, 1982) and Ysterfonktein (~110–50 kys, Avery et al., 2008; Klein et al., 2004). Human remains from northern Africa are now generally thought to represent an early African form of *Homo sapiens* (Straus, 2001) and coastal resources were exploited by these MP/MSA humans in sites such as Grotte des Contrebandiers (~120–90 kys, Jacobs et al., 2011; Roche, 1976) in Morocco, and Haua Fteah (~130–50 kys, McBurney, 1967) in Lybia amongst others (see Steele and Álvarez-Fernández, 2011 for a summary on both north and south African sites).

According to the evidence, the anatomical differences between MP Neanderthals in Europe and MSA anatomically modern humans in Africa do not seem to result in differences in behaviour regarding the role of coastal resources in their subsistence strategies. Thus, some scholars have conferred great importance to the role of these resources in the survival of Neanderthals until later dates in the Iberian Peninsula (Stringer et al., 2008), while others have related the emergence of modern human behaviour (MHB) and their expansion into Eurasia to the increase in the exploitation of coastal resources, as is shown in South Africa (Jerardino, 2010a;

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Klein et al., 2004). On the other hand, the evidence from Gibraltar, although criticised by some scholars (Klein and Steele, 2008) shows a similar exploitation pattern between MP and Upper Palaeolithic (UP) levels, based on relative proportions of the most heavily collected species (Fa, 2008). The evidence from South Africa shows marked differences between MSA strategies, based on a less intense and year-round exploitation pattern influenced by small population sizes and limited technological development, and that of the Later Stone Age (LSA), represented by the more intensive and effective exploitation of coastal resources. However, both cases show the use of coastal resources from the MP/MSA through to the UP/LSA. Another common point between Eurasia and Africa is the increased intensity of coastal resource exploitation during the Holocene (Dupont, 2006; Gutiérrez-Zugasti, 2009, 2011d; Gutiérrez Zugasti et al., 2011; Jerardino, 1997, 2010b).

The increased use of coastal resources at the end of the UP, as well as during the Mesolithic, has been related to the increase in the spectrum of exploited resources owing to population increase and climate instability. The Broad Spectrum Revolution (Binford, 1968; Flannery, 1969) hypothesis is often presented through different models. Thus, the definition and interpretation of diversification and resource intensification varies depending on each specific approach. Diversification can be understood as the broadening of the spectrum of animal and plant resources by adding new species to the diet (Straus and Clark, 1986) while from an optimal foraging theory (OFT) perspective means an expansion in dietary breadth to include less cost-effective resources (Munro and Atici, 2009; Stiner et al., 2000). For example, Bicho and Haws (2008) argue that diet diversification is visible in the late Middle Palaeolithic of Portugal and that this is demonstrated by the presence of shellfish and limited inclusions of marine mammals. On the other hand, Stiner et al. (2000) contend that the shellfish recovered from the MP do not constitute diet diversification, since they would be considered high-ranked prey. They suggest that diet diversification is visible from a switch to low-ranked prey in the Early Upper Palaeolithic (EUP) and onwards, and that low-ranked prey includes fish and other small, difficult-to-catch prey. Likewise, intensification can be understood as a greater use of traditional resources (Straus and Clark, 1986). From the OFT point of view, it means a decrease in the cost/benefit ratio invested in the human resource procurement, leading to a reduction in foraging efficiency (Munro and Atici, 2009). The onset of resource intensification in the eastern Mediterranean has been proposed to begin in the EUP and to be related with demographic pulses and small game use (Stiner, 2001; Stiner et al., 2000). However, some evidence suggests an earlier origin in the MSA (Kuhn and Stiner, 2006).

When it comes to intensification in Iberia, Aura et al. (2009) argue that intensification is only visible at the Pleistocene/Holocene boundary in Mediterranean Iberia and relate this process to an increase in the exploitation of marine resources. González-Sainz and González-Urquijo (2007) also argue that intensification can be seen from the Late Upper Palaeolithic (LUP) onwards, based in a number of social and economic changes related to population increase. However, Straus and Clark (1986), Bicho and Haws (2008), Cortés-Sánchez et al. (2008) and Manne and Bicho (2009) suggest that diversification and resource intensification may have begun earlier in the Upper Paleolithic. These assertions are based on the exploitation of marine resources, small game and intensive processing of animal carcasses. In most of the cases, diversification and resource intensification have been related to population growth. However, Hockett and Haws (2003, 2009), from a nutritional ecology perspective, have proposed a different view of the diversification. For them, by adopting a diversified diet Upper Palaeolithic people could have mitigated the fluctuations and perturbations in re-

source availability that came with rapid climate changes. Thus, diversification was the cause of increased human populations and not the other way round. This broadening of diet implemented by AMHs would have also provided an evolutionary advantage over Neanderthal populations and their predominately meat-based diet. Nevertheless, these scholars propose that the survival of Neanderthals until a relatively late date in the Iberian Peninsula could have been due to their adoption of this strategy, although in a less efficient way than the AMHs.

The use of shells as ornaments has been generally associated with the emergence of the UP and MHB. It has also been asserted that ornamental shells represent an increased symbolic capacity of AMH compared to previous hominin populations. These statements have been challenged by scholars who present evidence for the manufacture of symbolic objects by AMHs associated with Mousterian (Bar-Yosef Mayer et al., 2009), Aterian (Bouzouggar et al., 2007), and Middle Stone Age technologies (d'Errico et al., 2005, 2008), as well as some manufactured by Neanderthals (Zilhão et al., 2010). In the Atlantic Façade of Europe, the appearance of this kind of item is common from the EUP onwards (Álvarez-Fernández, 2006; Álvarez-Fernández and Jöris, 2007; White, 2007). However, the molluscs used as expressions of symbolic behaviour are usually single shells beads found in habitation levels. The recovery of multiple shells within a well-defined context is almost exclusively restricted to funerary (Vanhaeren and d'Errico, 2003) or hearth contexts (see Álvarez-Fernández, 2006 for examples).

In this paper, we present new evidence for the exploitation of molluscs during the EUP in the north of the Iberian Peninsula. El Cuco rock-shelter contains several stratigraphic units belonging to the Aurignacian and Gravettian periods. These units allow us to establish the main characteristics of shellfish gathering during the EUP in this region. Our research allow us to assess (1) the degree of intensity in the collection of these resources, (2) their presence in earlier and later periods as well as in other geographical areas, and (3) how this data fits into newly proposed models (Bailey and Flemming, 2008; Bicho and Haws, 2008).

We understand that human decisions about what resources to exploit are not only determined by a cost/benefit ratio, but are also impacted by other environmental and social factors (García-Moreno, 2010; Hockett and Haws, 2009). In this paper we define diversification as the broadening of the resource spectrum by adding new species to the diet, and intensification as the increased use of these more diverse resources. Regarding coastal resources, intensification in the exploitation of shellfish is defined by (1) the presence of larger amounts of shells in the sites, (2) broadening of the number of species collected, (3) decrease in the size and age of the shells over time, (4) collection in lower and exposed intertidal areas as well as in areas of soft bottoms, and (5) the use of technology in the gathering process. In order to investigate the symbolic aspect of the shells, new data has been obtained on the context and use of shells as ornaments. Through this information we discuss the presence of shell beads at El Cuco rock-shelter and the symbolic and social implications for their use as ornaments.

### El Cuco rockshelter and the regional setting

El Cuco rockshelter is located near the cave of the same name, in the town of Castro Urdiales, Autonomous Community of Cantabria, in northern Spain (Fig. 1). In a broader sense, Cantabrian Spain is a geographical unit located in the north of the Iberian Peninsula, including the Autonomous Communities of Galicia, Asturias, Cantabria and the Basque Country. It is a region with abrupt relief, which can be divided into three zones; the coastal plain, the

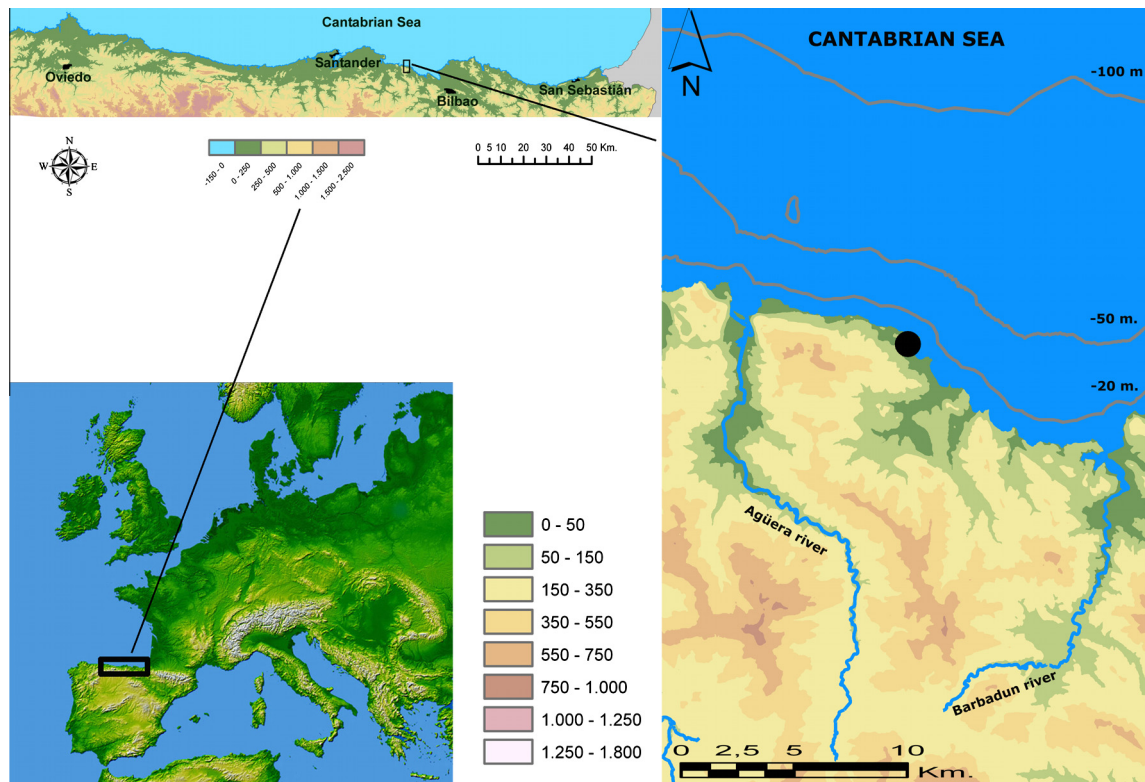


Fig. 1. Location of El Cuco rock-shelter in the north of the Iberian Peninsula.

interior valleys and the high mountains. The high land varies in altitude, generally between 2000 and 1500 m, decreasing towards the east where the highest peaks reach around 1200 m. The lithological and geological conditions are characterised by karst landforms, with a large number of caves and rockshelters that were available for occupation by hunter-gatherer groups. This fact implies significant consequences in terms of the occupation patterns in the region during prehistory and also in the visibility of the sites for research. At the present time the climate is oceanic. This climate type is characterised by mild temperatures with a small range of temperature variability between summer and winter. The majority of the precipitation occurs in winter. The mean annual temperature is about 13–14 °C and the mean precipitation is between 1200 and 1800 l/m<sup>2</sup> depending on altitude.

El Cuco rockshelter is located at the base of a Lower Cretaceous limestone and calcarenite cliff, on the southern slope of the Alto de San Andrés. The plan of the rockshelter is arc-shaped with a length of 35 m. The cliff includes two additional small caves, both located close to the rockshelter. The western cave contains an archaeological deposit with Mesolithic levels. The distance from the site to the current shoreline is approximately 350 m.

In 2005, two test pits were excavated in the site. A 2 × 1 m test pit was excavated in the rockshelter to a depth of 250 cm (Fig. 2). Fourteen stratigraphic levels were identified (Muñoz et al., 2007). Levels I and II were disturbed and contained limited archaeological material. Levels III, IV and V were composed of silty sediment and limestone blocks, with abundant lithics, mammal remains and shells. A bone splinter from level III (GrA-32097) has been dated to 23,400 ± 250 BP (28,200 ± 200 cal BP), which places the level in an advanced phase of the Gravettian. This date is consistent with the lithic typology and technology. Levels IV and V have been attributed to the Gravettian according to the lithics. Level VI is composed of a calcium carbonate crust with few archaeological

finds, so it is difficult to establish its proper chronology. However, its position and content signifies it as the marker between the Gravettian and the Aurignacian periods. Thus, levels VII to XIII are attributed to the Aurignacian sequence. They are a series of silty and silty-clayey levels (VII, X, XII, XIII and XIV), alternating with calcium carbonate crust levels (VIII, IX and XI), containing limestone blocks, lithic and osseous artefacts, mammal remains and shells. Level XIV was excavated in a very limited extension and produced lithic and mammal remains. A bone splinter (GrA-32436) from level XIII has been dated to 30,020 + 160–150 BP (34,300 ± 160 cal BP). This places the occupation in an evolved phase of the Aurignacian, with a strong Perigordian substrate. These designations are consistent with the lithic typology and technology also found in these levels. Both samples were dated by <sup>14</sup>C AMS and calibrated using CalPal Hulu 2007 (Weninger et al., 2007).

## Materials and methods

Molluscs, echinoids and crustaceans from the test pit in the rockshelter were analysed using an archaeomalacological methodology (Gutiérrez-Zugasti, 2009, 2011a, 2011c). The nomenclature proposed by the CLEMAM for North Atlantic marine species (<http://www.somali.asso.fr/clemam/index.clemam.html>) and by Kerney and Cameron (1999) for land snails were also applied. The NISP (Number of identified specimens) and the MNI (Minimum number of individuals) were calculated to estimate the abundance of each species. A method based on fragmentation patterns (Non-Repetitive Elements – NRE) and derived from that proposed by Moreno (1994) was used to establish the MNI for gastropods and bivalves. The main taphonomic processes affecting the shells have been identified. Fragmentation indexes have been calculated from the formulae Diagnostic Fragments × Fragmentation Coefficient/NISP (for

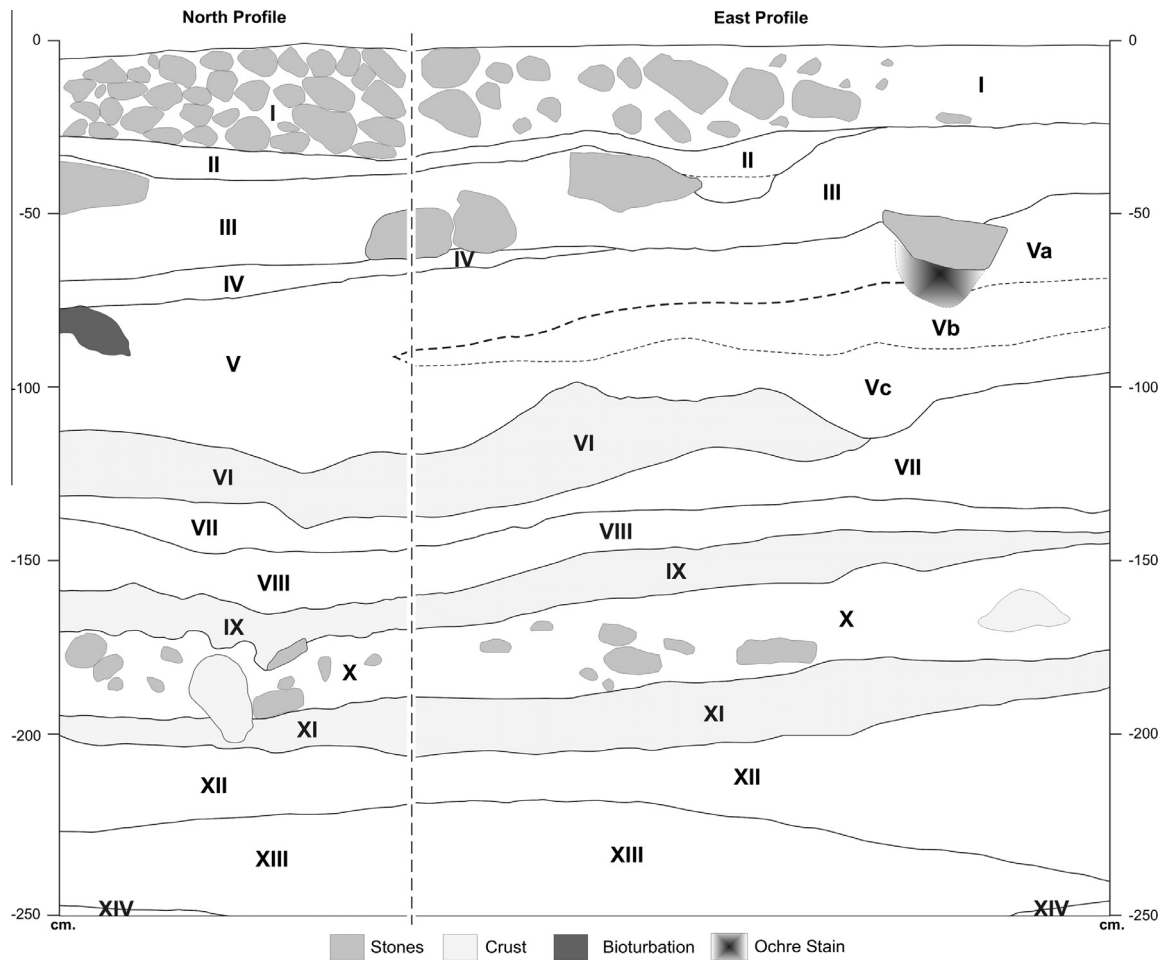


Fig. 2. Stratigraphic profile of sections north and east from El Cuco rock-shelter.

an explanation of these terms, see Gutiérrez-Zugasti, 2011c). To establish the source areas from which shells of *Patella vulgata* were collected, the degree of exposure and the zone have been estimated. For exposure, the equation developed by Bailey and Craighead (2003) was used after it was proved to have a 65% success when assigning modern limpets from northern Spain to sheltered/exposed shores. To establish zonation, we used Length/Height ratios ( $L/H$ ), which were also tested with a success of 82–84% when assigning limpets to low/high shore (Gutiérrez-Zugasti, 2009). Biometrical measurements (length, width, height) were taken from whole *Patella vulgata* examples using a digital caliper to the nearest 0.1 mm. The age was also calculated counting the external rings of the shells from the apex to the edge and the resulting values were expressed as year categories, as suggested by Craighead (1995).

In the case of the shell beads, every shell was taxonomically identified, measured, weighed, and observed both macroscopically and microscopically. The presence of ochre or other minerals was recorded. Perforations were thoroughly analysed. Measurements of the perforations were taken, and the edges were observed under stereoscopic and metallographic microscopes. The morphology and characteristics of the perforations were compared with that of specialised studies (d'Errico et al., 1993; Taborin, 1993; Vanhaeren and d'Errico, 2003; Vanhaeren et al., 2005) to establish the perforation technique. Leica MZ16A and Leica S8 APO stereoscopic microscopes were used to identify alterations under 5/80X, while a Leica DM 2500M metallographic microscope was used to analyse use wear under 50/200X. Pictures of the perforations and use-wear were taken using a Leica DFC 424 camera.

## Results

### Shellfish gathering during the Aurignacian

All the Aurignacian levels at El Cuco rockshelter contain shells and 15 taxa have been identified (Table 1). Nine of them have been identified at species level (the gastropods *P. vulgata*, *Patella intermedia*, *Patella ulyssiponensis* and *Ocenebra erinaceus*; the land snails *Cepaea nemoralis*, *Elona quimperiana*, *Oestophora silvae* and *Pomatias elegans*; and the echinoderm *Paracentrotus lividus*), five at genus level (the bivalve *Acanthocardia* sp.; the gastropods *Gibbula* sp. and *Patella* sp.; the land snails *Cochlostoma* sp. and *Oxychilus* sp.) and one at class level (*Stylommatophora*). Although it is likely that most of the specimens identified as *Patella* sp. belong to the species *P. vulgata*, only the specimens showing clear features were identified to species level.

Regarding abundance, there is a marked contrast between levels VII, VIII and IX, which only contain one or two individuals of *Patella*, levels XI and XIII, which contain just a few shells, and levels X and XII, which have larger assemblages with several species. The levels with larger numbers of molluscs are levels X and XII. Level X has a NISP of 1941, with an MNI of 773, the most abundant species being *Patella* (99.2% MNI), mainly *P. vulgata*, and to a lesser extent *P. intermedia* and *P. ulyssiponensis*. Other taxa have been identified in very small quantities, such as *Gibbula* sp. (0.4% MNI) and *O. erinaceus* (0.1% MNI), as well as the land snail *C. nemoralis* (0.1% MNI) and the sea urchin *P. lividus* (0.1% MNI). While Level XII has fewer shells than Level X, with a NISP of 603 and an MNI

**Table 1**  
Species representation (MNI and total NISP) from Gravettian and Aurignacian levels at El Cuco.

	Gravettian					Aurignacian						
	III	IV	Va	Vb	Vc	VII	VIII	IX	X	XI	XII	XIII
Marine bivalves												
<i>Acanthocardia</i> sp.	1										1	
<i>Ostrea edulis</i>	1											
Marine gastropods												
<i>Gibbula</i> sp.									3	1	2	
<i>Littorina littorea</i>	8		1									
<i>Littorina obtusata</i>			5									
<i>Littorina</i> sp.			1									
<i>Ocenebra erinaceus</i>									1			
<i>Osilinus lineatus</i>	6											
<i>Nucella lapillus</i>	2											
<i>Patella vulgata</i>	4						1	1	177	7	33	2
<i>Patella intermedia</i>	3								6		1	
<i>Patella ulysiponensis</i>									9			
<i>Patella</i> sp.	14	1		2	1	1	1	1	575	15	57	1
<i>Turritella</i> sp.	1											
Land snails												
<i>Cepaea nemoralis</i>	1								1	1	33	8
<i>Cochlostoma</i> sp.	1											1
<i>Cryptomphalus aspersus</i>	1											
<i>Elona quimperiana</i>											7	1
<i>Helicella itala</i>	1											
<i>Oestophora silvae</i>										1	3	
<i>Oestophorella buvinieri</i>	1											
<i>Oxychilus</i> sp.												1
<i>Pomatias elegans</i>	3											1
<i>Stylommatophora</i>										1	3	
Scaphopods												
<i>Antalis</i> sp.	1		18		1							
Equinoderms												
<i>Paracentrotus lividus</i>									1	1	1	
Crustaceans												
<i>Pollicipes pollicipes</i>	2											
Unidentifiable	4										1	1
Total MNI	51	1	25	2	2	1	2	2	773	27	143	13
Total NISP	237	18	38	12	14	8	8	2	1941	83	603	68

of 143, it does have a very similar number of species and predominance of *Patella* (62.9% MNI). In this level there are also *Acanthocardia* sp. (0.7% MNI), *Gibbula* sp. (1.4% MNI), the sea urchin *P. lividus* (0.7% MNI) and an unusual number of land snails, mainly *C. nemoralis* (23.1% MNI). To a lesser extent there are *E. quimperiana* (4.9% MNI), *Oxychilus* sp. (0.7% MNI), *P. elegans* (0.7% MNI) and *O. silvae* (2.1% MNI). Levels XI and XIII have even fewer shells, with NISPs of 83 and 68 respectively. While in Level XI, *Patella* (81.5% MNI) is the predominant taxa, in Level XIII the land snail *C. nemoralis* (61.5% MNI) is the most abundant.

While the examples of *Patella* and probably the sea urchin *P. lividus* were collected as food, the land snails are a natural death assemblage as these species usually live near rockshelters and caves. Only shells of the land snail *C. nemoralis* could have been used as food, although in this case it is difficult to establish if they were brought to the site by humans for food or reached the site by themselves. On the other hand, shells used as ornaments have not been identified, although *O. erinaceus*, *Gibbula* sp. and *Acanthocardia* sp. could have been collected for that purpose.

Some taphonomic processes have been identified on the shells. These processes are in some cases related to the sedimentary characteristics of the different stratigraphic levels. For example, shells found in levels of crust, such as Levels VIII, IX and XI, are usually coated with calcium carbonate. In the other levels, this process is present to a lesser extent. Biodegradation (dissolution of organic matrix produced by bacteria or other biological means) is a common process in all levels and affects the state of preservation of these materials. In addition, human pro-

cesses are also present. For example, in Levels X and XII traces of burning have been identified in some shells, which are probably related to the preparation of the shells for consumption. The calculation of fragmentation index (Fig. 3) shows similar results in levels with higher numbers of shells (X to XIII). However, the older the level, the greater the fragmentation, which is probably related to the compression of the sediment, trampling and other activities carried out on the site, although this does not exclude the influence of subsequent biodegradation on the preservation of the shells. This pattern could also be related to the limited use of the site over time.

The analysis of collection areas (Table 2) shows that the exploitation of *P. vulgata* in Level X was carried out mainly in higher and sheltered rocky shores, which are less dangerous and remained emerged for a longer period. In contrast to Level X, Level XII represents an exploitation practice dominated by the use of higher and more exposed shores. This result should be treated with caution, since the sample size is too small to be reliable.

The only level with a representative sample size for biometrical analysis of *P. vulgata* is Level X, which shows a mean size of 37 mm. If the mean size of the other levels is taken into account, despite the small sample sizes, it is possible to see that mean size in Level XI is similar (36.3 mm), and in Levels XII and XIII slightly smaller (32.6 and 32.9 mm respectively). Regarding the age distributions, the problems with sample size are the same. In this case, individuals from Level X show a mean age of 4.8 years, while individuals from Levels XI, XII and XIII show mean ages of 4, 4.6 and 4.5 years respectively (Table 3).

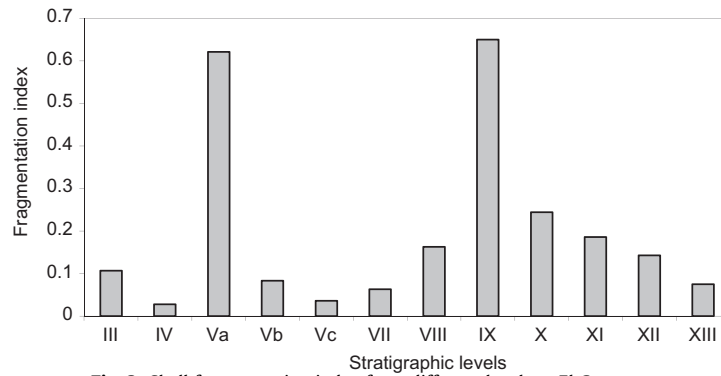


Fig. 3. Shell fragmentation index from different levels at El Cuco.

Table 2

*Patella vulgata* collection areas from Levels X and XII (Aurignacian) at El Cuco.

Level	n	Zonation		Exposure	
		High shore (%)	Low shore (%)	Exposed (%)	Sheltered (%)
X	128	66.4	33.6	26.6	73.4
XII	21	66.7	33.3	61.9	38.1

### Shellfishing during the Gravettian

All Gravettian levels at El Cuco rockshelter (III to Vc) have shells and 19 taxa have been identified (Table 1), thirteen to species level (the bivalve *Ostrea edulis*; the gastropods *Littorina littorea*, *Littorina obtusata*, *Osilinus lineatus*, *Nucella lapillus*, *P. vulgata* and *P. intermedia*; the land snails *C. nemoralis*, *Cryptomphalus aspersus*, *Helicella itala*, *Oestophorella buvinieri* and *P. elegans*; and the crustacean *Pollicipes pollicipes*), and six to genus level (the bivalve *Acanthocardia* sp.; the gastropods *Littorina* sp., *Patella* sp. and *Turritella* sp.; the land snail *Cochlostoma* sp.; and the scaphopod *Antalis* sp. Level III presents the highest number of shells, with a NISP of 237 and an MNI of 51. *Patella* species predominate in the assemblage (41.2% MNI), followed by *L. littorea* (15.7% MNI) and *O. lineatus* (11.8% MNI). There are also individuals of the bivalves *Acanthocardia* sp. (2% MNI) and *O. edulis* (2% MNI), the gastropods *N. lapillus* (3.9% MNI) and *Turritella* sp. (2% MNI), the scaphopod *Antalis* sp. (2% MNI) and the crustacean *P. pollicipes* (3.9% MNI), as well as the land snails *C. nemoralis* (2% MNI), *Cochlostoma* sp. (2% MNI), *C. aspersus* (2% MNI), *H. itala* (2% MNI), *O. buvinieri* (2% MNI) and *P. elegans* (5.9% MNI). The remaining levels present negligible numbers of shells, with only one or two individuals of *Patella* sp., as in Levels IV, Vb and Vc. In Level Vc a fragment of *Antalis* sp. was also found.

All the species found in Level III were collected for food, except *Acanthocardia* sp., *N. lapillus*, *Turritella* sp. and *Antalis* sp., which were probably collected to be used as ornaments, as usually happens in many Upper Palaeolithic sites, although in this case there are no obvious modification marks. It should be noted that land snails are too small to be used as food and also live near the caves and rockshelters. So their presence in the deposit is probably due

Table 3

Mean size and age of *Patella vulgata* from Aurignacian levels at El Cuco.

Level	Size		Age	
	n	Length	n	Years
X	126	37.0	113	4.8
XI	4	36.3	2	4.0
XII	21	32.6	26	4.6
XIII	2	32.9	2	4.5
Total	153	36.3	143	4.8

to natural causes, except perhaps in the case of *C. nemoralis*, which could have been used as food.

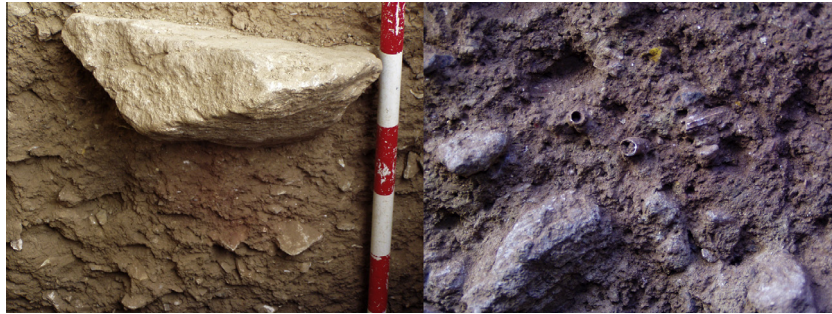
The main taphonomic processes identified in Level III are biodegradation, fragmentation, and burning, the latter being evident in *Patella* specimens. Levels IV and V show strong biodegradation and fragmentation, except in the case of Level Va (Fig. 3).

The shells from Level Va deserve a more detailed discussion since this is an unusual accumulation of 38 remains belonging to at least 25 individuals used for ornamentation. All the remains were found in a homogeneous context, under a big limestone block that included an ochre stain (Fig. 4). Unfortunately, the shells were found when the stratigraphic profile was being cleaned, so only a small part of the ochre stain has been excavated. The assemblage is composed of one *L. littorea*, five *L. obtusata* and one shell attributed to the genus *Littorina*, all of them perforated, together with 31 fragments of the genus *Antalis* (Fig. 5; Table 4). The state of preservation is good but the shells are slightly coated with calcium carbonate and filled with sediment. There are also fractures in the apex of the gastropods and the posterior ends of the scaphopods.

In spite of the fact that the shells were not collected as food there are not doubts about the anthropogenic character of the accumulation. Sea level during the Gravettian would have been between 50 and 70 m lower than today (although tectonic movements could have diminished the impact of sea level), so the coastline would be located between 6 and 10 km from the site. Thus, the shells were transported by humans from the coast to the cave, since there are no predators that transport shells this far from the coast. In addition, evidence of contamination from upper levels was not identified during the excavation. But the main argument supporting the anthropogenic hypothesis comes from the context itself, since the shells were found inside a large ochre stain. Thus, the shell surfaces show small reddish and yellowish stains. Black stains, probably due to the presence of manganese in the rockshelter, were also identified.

Regarding the method of manufacture and use wear, the perforations in *Littorina* shells were not made by marine predators, although this is a possibility for the individual of *Antalis* (Fig. 6h), as the hole is oval, very well shaped and very small to be produced by a lithic or bone perforator, or to insert a cord. In addition, an individual of *Littorina* sp. (Fig. 6a), does show differences to the other specimens both in the state of preservation and in the nature of the perforation. In this case, the perforation is located in a different area of the shell and presents several fresh fractures. However, it is not possible to completely reject the possibility of artificial perforation. Besides these outliers, the rest of the perforations were clearly produced by humans.

As the perforations in *Littorina* shells are slightly coated with calcium carbonate it has been a complex task to determine the manufacturing technique. However, taking into account the absence of abrasion, scraping and serrating, the morphology of the



**Fig. 4.** Archaeological context of the shell beads. Left: ochre stain where the shell beads were found. Right: detail of several *Antalis* sp. in the stratigraphic profile during the excavation.



**Fig. 5.** Ornamental shells from level Va (Gravettian) at El Cuco. Numbers referred to Table 1. Scale: 1 cm.

perforations and the literature on experimental work (d'Errico et al., 1993; Taborin, 1993; Vanhaeren and d'Errico, 2003; White, 2007), the perforations were probably made by indirect percussion, using a small pointed object. One of the perforations shows a facet reflecting the fact that it was worked on two occasions (Fig. 6d). Wear related to the impact of creating the hole has not been identified owing to the coating, but it has been possible to identify some features related to the manufacture and/or use of the shells. Thus, it is possible that the perforations were regularised during manufacture to soften the outline, since the perforations show a regular rounded morphology. However, we have not detected wear clearly related to this process. On the other hand, five of the perforations (Fig. 6b–f) show wear probably produced by the suspension of the shell (see details in Fig. 7) and at least four perforations (Fig. 6b–f) show a semi-rounded erosion probably related to the use of a cord for suspension. Due to the state of preservation, it is not possible to establish if the shells were part of a necklace, clothes ornaments, or some other kind of adornment.

Regarding the *Antalis* sp. tubes, in most of the specimens there is evidence of fractures in the posterior end of the tube, caused by human actions to modify the shell for suspension. Despite the state of preservation, which has not allowed the identification of clear wear traces, the regular morphology suggests that the shells were

serrated with a lithic tool to cut the end of the tube (Fig. 8a). In contrast, fragmentation due to post-depositional processes has prevented the analysis of the posterior end on some shells.

The *Antalis* sp. morphology does not necessitate any working of the shell's anterior end to allow for suspension since its natural aperture is big enough. However, an irregular fracture on the edge has been identified in some examples. This is probably related to the position of the shells with respect to one another in a composite ornament with the previous one fitted into the next. This layout, together with the twisting caused by the suspension and the movement of the ornament would have caused the breakage of this area of the shell (Fig. 8b). On the other hand, the fastening can create semi-rounded notches, mainly at the anterior end. This could explain some of the morphologies at the anterior end recorded in the *Antalis* at El Cuco. This type of alteration has been experimentally described by other scholars (Álvarez-Fernández, 2006).

## Discussion and conclusions

### *Shellfish as food during the Early Upper Palaeolithic*

The evidence in northern Iberia shows that the exploitation of coastal resources is limited during the MP with no other evidence than a few molluscs from the sites of Morín, El Pendo and Amalda (Álvarez-Fernández, 2005–2006) and some fish remains (Baena et al., 2007). In the south and southeast there is more evidence, and sites of this period usually contain more shells than in the north, as can be seen at Los Aviones, Pernerás, Humo Complex, Bajondillo and Gibraltar sites (Cortés-Sánchez et al., 2008, 2011; Fa, 2008; Montes, 1988; Zilhão et al., 2010) and also at Figueira Brava, on the Atlantic coast of Portugal (Bicho and Haws, 2008). Nevertheless, in general all these sites are not true shell middens but layers with shells. Some of them, as with the Gibraltar sites, also contain fish and marine mammal remains (Stringer et al., 2008). Other sites showing exploitation of coastal resources during the MP in the Mediterranean basin are Üçağızlı II in Turkey (Stiner, 2009) and Haua Fteah in Lybia (McBurney, 1967).

The presence of molluscs in the archaeological record is also limited during the EUP. The deposit of *Patella* in Levels X to XIII at El Cuco is the largest accumulation of molluscs, and the first clear evidence of collection and consumption of these resources recorded in the Aurignacian both in Iberia and the Atlantic Façade of Europe. In northern Iberia, the mollusc assemblages during this period are reduced to rare specimens found in a few sites, such as El Pendo (Madariaga, 1971). Molluscs have been found in Mediterranean Iberia during the Aurignacian in Cova Foradada (Casabó, 1997) and Las Pernerás cave (Montes, 1993), but again only in small numbers. Other evidence during this chronological period comes from the Mediterranean at the site of Riparo Mochi (Italy) (Stiner, 1999), and also a possible consumption of land snails at

**Table 4**

Data on ornamental shells from level Va at El Cuco. Measurements given in mm.

Shell					Perforation				
Species	ID	Length	Width	Weight	Lmax	Lmin	Type	Use	Ochre
<i>Littorina</i> sp.	1	9.18	7.89	0.4	5.77	3	Natural?	?	●
<i>Littorina littorea</i>	2	12.7	10.9	1	4.76	4.7	Percussion	●	●
<i>Littorina obtusata</i>	3	12.84	14	0.8	7.49	5	Percussion	●	●
<i>Littorina obtusata</i>	4	13.95	13.57	1.2	5.42	3.55	Percussion	●	●
<i>Littorina obtusata</i>	5	12.52	14.46	1.1	2.67	2.32	Percussion	●	●
<i>Littorina obtusata</i>	6	10.77	13.65	0.7	4.53	4.1	Percussion	●	●
<i>Littorina obtusata</i>	7	12.87	13.69	1.3	4.29	2.74	Percussion	●	●
<i>Antalis</i> sp.	8	11.18	3.49	3.49	1.6	1.3	Predator?		●
<i>Antalis</i> sp.	9	10.4	2.9						●
<i>Antalis</i> sp.	10	11.9	3.6						●
<i>Antalis</i> sp.	11	10.7	3.3						●
<i>Antalis</i> sp.	12	14.5	3.9						●
<i>Antalis</i> sp.	13	11	3.4						●
<i>Antalis</i> sp.	14	10.6	3.5						●
<i>Antalis</i> sp.	15	8.6	3.9						●
<i>Antalis</i> sp.	16	6.7	3.9						●
<i>Antalis</i> sp.	17	8.6	3.4						●
<i>Antalis</i> sp.	18	7.5	3.4						●
<i>Antalis</i> sp.	19	13.3	3.7						●
<i>Antalis</i> sp.	20	12.1	3.9						●
<i>Antalis</i> sp.	21	14.6	4.2						●
<i>Antalis</i> sp.	22	13.4	4.5						●
<i>Antalis</i> sp.	23	10.5	4.2						●
<i>Antalis</i> sp.	24	13.2	4.3						●
<i>Antalis</i> sp.	25	15.2	4.6						●
<i>Antalis</i> sp.	26	14	4.6						●
<i>Antalis</i> sp.	27	19.3	4.2						●
<i>Antalis</i> sp.	28	15.1	4.6						●
<i>Antalis</i> sp.	29	16.5	4.6						●
<i>Antalis</i> sp.	30	13.6	4.4						●
<i>Antalis</i> sp.	31	15.8	3.3						●
<i>Antalis</i> sp.	32	13.9	4.1						●
<i>Antalis</i> sp.	33	17.5	3.8						●
<i>Antalis</i> sp.	34	7.5	4.1						●
<i>Antalis</i> sp.	35	13.2	3.9						●
<i>Antalis</i> sp.	36								●
<i>Antalis</i> sp.	37								●
<i>Antalis</i> sp.	38								●

the Greek site of Klisoura (Koumouzelis et al., 2001), although recent work at this site suggests that land snail exploitation began later (Starkovich and Stiner, 2010). Other sites with a similar chronology and number of molluscs to that of El Cuco are found in the eastern Mediterranean, such as Üçağizli I in Turkey and Ksar 'Akil in Lebanon (Kuhn and Stiner, 2001; Kuhn et al., 2009; Stiner, 2009). However, at most of these sites and others of similar chronology, molluscs were also used for ornamental purposes (Álvarez-Fernández, 2006; Taborin, 1993), in contrast to El Cuco, where shells were only used as food.

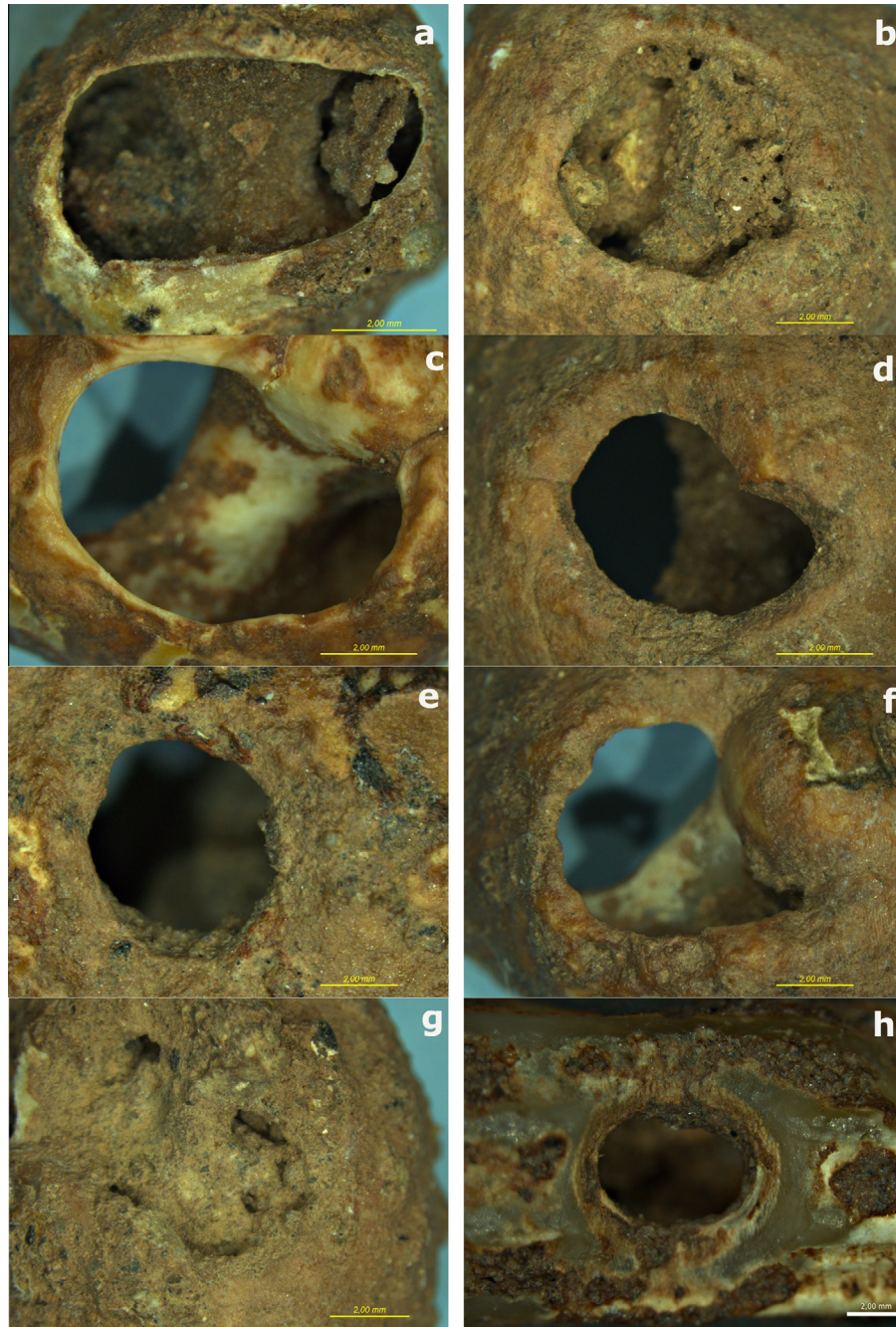
In the same way, the evidence for mollusc exploitation as food during the Gravettian is also limited in the Atlantic Façade of Europe and the Mediterranean. There are only a few sites that contain examples of this activity, as at La Garma A and Fuente del Salín in northern Spain (Álvarez-Fernández, 2007; Gutiérrez-Zugasti et al., in press), Vale Boi in Portugal (Bicho et al., 2010; Manne and Bicho, 2009) and Riparo Mochi in Italy (Stiner, 1999). However, shells are commonly used as ornaments during this period (Álvarez-Fernández, 2006; Stiner, 2001; Vanhaeren and d'Errico, 2003).

The scarcity of evidence during the EUP has been traditionally explained by the limited importance of coastal resources for hunter-gatherers (Osborn, 1977). Thus, molluscs were considered secondary resources in comparison with terrestrial resources, and they were only consumed in periods of food shortage. So, molluscs and other coastal resources would have become important only in the Late Palaeolithic, and mainly during the Mesolithic, due to the increase in human population and the increased pressure on ter-

restrial resources. This situation would have been solved through dietary diversification and resource intensification. However, in recent years new models have been proposed that take into account factors like the rise in sea level, tectonic processes, and variations in marine productivity (Bailey and Flemming, 2008; Bailey and Milner, 2002; Bicho and Haws, 2008). These models are based on three main propositions: (1) A large number of UP sites were submerged under the sea because of the sea level rise during the Holocene, and this fact is masking the real intensity of mollusc exploitation; (2) marine productivity was higher in the Late Pleistocene than in the Holocene, so a lot of marine resources would have been available to hunter-gatherers during the UP; and (3) some UP sites show that the exploitation of marine resources, evidence of dietary diversification, and resource intensification became increasingly visible between 30 and 40 kys (Manne and Bicho, 2009; Stiner, 2001; Stiner et al., 2000).

The influence of sea level rise on the visibility of UP coastal sites seems unquestionable, although tectonic processes might have reduced its impact in some periods. On the other hand, steep coastlines as that of northern Spain tend to be near the coast irrespective of sea level changes, hence their value for testing ideas about early shellfish exploitation, particularly for glacial periods. Other examples of sites located in steep coastlines include Riparo Mochi (Italy) and Üçağizli I (Turkey). However, some indicators can provide information on the changing intensity of shellfish gathering through time independently of sea level change. For example, given the low number of molluscs, crustaceans and



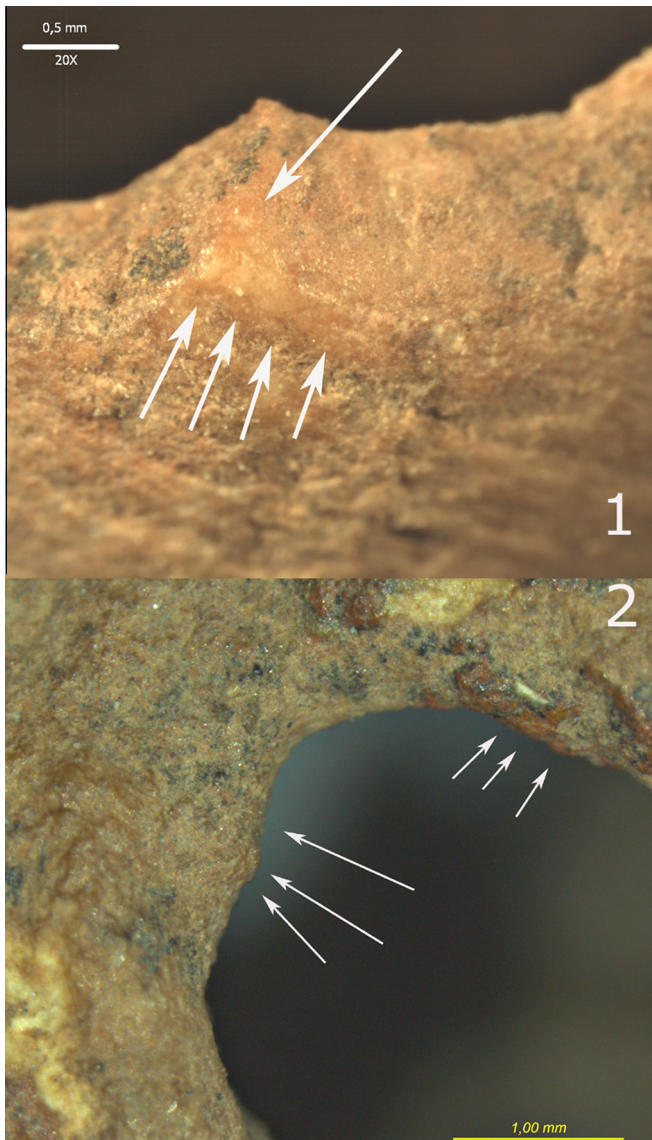


**Fig. 6.** Detail of perforated shells from Level Va (Gravettian) at El Cuco. Ordered as in Table 1.

echinoids recovered in Aurignacian and Gravettian sites from northern Spain, as well as the morphology and volume of the deposits (limited shell layers, unlike the huge Holocene shell middens), the exploitation of these resources appears to have been carried out with low intensity. Even so, it is true that submerged sites might contain larger numbers of molluscs and form true shell middens. Nevertheless, other factors independent of sea level rise are informative.

The analysis of *P. vulgata* collection areas at El Cuco shows the exploitation of higher and sheltered shores during the Aurignacian. This is in agreement with data from the Gravettian site of Fuente del Salín (Gutiérrez-Zugasti et al., in press). This shows a relatively low level of exploitation intensity since these areas are easier to exploit, because they are exposed for longer periods of the tidal cy-

cle and pose fewer risks. Data for later periods suggests the exploitation of more sheltered shorelines during the Solutrean (Bailey and Craighead, 2003) as before, but also lower zones of the sea-shore. However, all types of shores and zones were exploited with similar intensity during the Late Magdalenian and the Azilian, while exploitation during the Mesolithic and early Neolithic was focused on lower and exposed shores, suggesting a cumulative trend towards more intensive collection of these resources (Gutiérrez-Zugasti, 2009, 2010). The presence of the sea urchin *P. lividus* in the Aurignacian levels at El Cuco might be evidence of collection on lower and more exposed shores, however, the scarcity of remains suggests that the more likely explanation for their presence is that they represent just a few specimens collected from rock-pools at higher levels of the intertidal zone. In the case of size



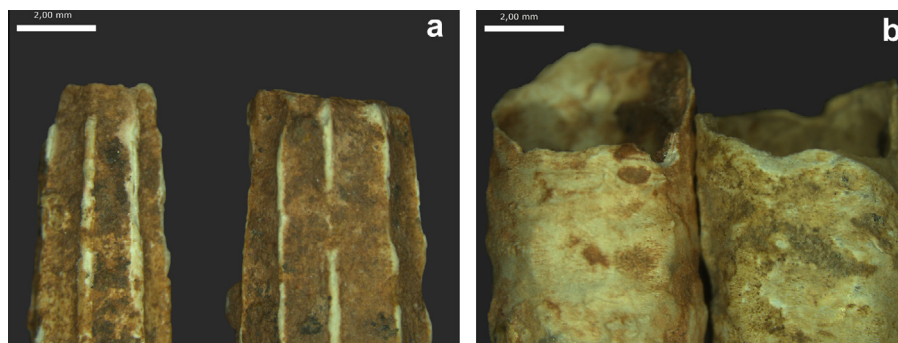
**Fig. 7.** Detail of perforations with evidence of use-wear. Lines are showing the location of use-wear.

distributions, *P. vulgata* from Aurignacian and Gravettian levels in northern Spain are slightly smaller than those of later UP periods, such as the Solutrean or the Lower Magdalenian. However, the age distributions are similar throughout the UP, suggesting that these

size variations are due to climatic or environmental factors rather than variations in exploitation pressure.

In any case, mean size and age during the UP are much larger than during the Holocene (Gutiérrez-Zugasti, 2011b, 2011d), which supports the hypothesis that shellfish gathering intensified at the end of the UP and further increased during the Mesolithic and the early Neolithic. Although other factors, such as upwelling, changes in coastline morphology, or occurrence of predators could influence the size of the molluscs and the degree of exposure of the coast, the available information depicts a pattern of increasing intensity in shellfish gathering through time. Other indicators of coastal resource intensification during the Mesolithic are the increase in the exploitation of molluscs from muddy bottoms (Gutiérrez-Zugasti, 2009) and the use of advanced gathering technologies (Clemente-Conte et al., in press).

On the other hand, according to recent studies on the coast of Portugal (Bicho and Haws, 2008) marine productivity would have been greater during the Late Pleistocene than in the Holocene. Compared to the Holocene, the greater availability of molluscs could have mitigated the effects of human impact on shell populations. In addition, this could be the reason that the mean size and age of shells during the UP shows a less intensive pattern of collection than in later periods. However, the western coast of the Iberian Peninsula currently benefits from upwelling and greater biological productivity than the northern coast (Álvarez et al., 2010), something that might also have been the case during the Late Pleistocene. Therefore, the northern coast would have always been more vulnerable to human predation, especially during the Holocene when upwelling intensity decreased. Even if marine productivity during the Late Pleistocene was higher than previously supposed, the range of consumed shellfish species in the UP is lower than in the Mesolithic and the early Neolithic (Gutiérrez-Zugasti, 2009, 2011a; Gutiérrez-Zugasti and Cuenca-Solana, in press). It remains unclear whether highly productive estuaries existed in northern Spain during the UP. If they did exist, species living in that environment, such as mussels, oysters and clams, are barely found in UP shell assemblages. It is of course possible that some of these species were not present on the coast of northern Spain during the UP due to the cold climate, but the mussel, *Mytilus edulis*, is a cold-loving species, so this argument is not supported. Besides, estuaries would be more accessible from sites located inland (and not affected by the sea level rise), making for their easier exploitation. However, the only evidence for such a pattern of behaviour is found during the Late Magdalenian and Azilian at the sites of La Chora and El Otero (Madariaga de la Campa, 1963, 1966), although both sites have stratigraphic and chronological problems that hinder their data interpretation. Therefore, the existence of highly productive estuaries before the Holocene in northern Spain cannot be supported if the available information from the archaeological



**Fig. 8.** Alterations in individuals of *Antalis* sp. in Level Va (Gravettian) at El Cuco. (a) Example of serrated posterior end; (b) example of fracture by use in the anterior end.

record is taken into account (Gutiérrez-Zugasti and Cuenca-Solana, *in press*).

Thus, it seems that the exploitation of molluscs was carried out from the MP onwards in Iberia, although the data from the northern coast is very limited. It has been usually suggested that Neanderthals had a meat-based diet and they were able to hunt only large herbivorous mammals (Richards et al., 2001; Bocherens et al., 2001). However, coastal resources were exploited by Neanderthals during the MP in Iberia and Italy, showing that these resources were not the exclusive preserve of AMHs (Cortés-Sánchez et al., 2011; Brown et al., 2011; Stiner, 1993; Stringer et al., 2008).

In terms of diversification, the available evidence show that small game, birds, molluscs, fish and marine mammals were present in the diet of MP and EUP humans in the Mediterranean and southern Iberia (Aura et al., 2009; Brown et al., 2011; Cortés-Sánchez et al., 2011; Fa, 2008; Manne and Bicho, 2009; Stringer et al., 2008; Villaverde et al., 1996, 1998) which suggests the use of dietary diversity in both periods. Some scholars have suggested that the late survival of Neanderthals in the south of the Iberian Peninsula was due to the adoption of dietary diversity. Nevertheless AMHs were more efficient at developing such broad-spectrum strategies, giving them an advantage over the Neanderthals (Hockett and Haws, 2009).

In northern Spain evidence of exploitation of molluscs and fish in the MP is limited and this situation led to some scholars to propose the start of the diversification during the Upper Palaeolithic. Thus, data from La Riera cave was used by Straus and Clark (1986) to suggest a two-step diversification process in northern Iberia. A first moment during the Solutrean, with the addition of ibex, marine molluscs, rabbits and anadromous fish to the diet, and a second moment in the late Magdalenian that implied a broadening of the resource spectrum including marine fish, birds, plant remains and a higher range of mammals. González-Sainz and González-Urquijo (2007) proposed that although a variety of resources was exploited during the UP, it was only from the late Magdalenian that diversification and intensification were clearly visible. However, recent studies show that at least marine molluscs, fish and birds were already exploited during the Gravettian (Álvarez-Fernández, 2007; González Morales and Moure Romanillo, 2008; Gutiérrez Zugasti et al., *in press*) and the Aurignacian (Adán et al., 2009; Perea and Droadio, 2009; Sánchez-Marco, 2009), suggesting that diversified diets were usual during the EUP. Because of the limited evidence, further research is needed to test if this model is valid for the MP in northern Spain.

Bicho and Haws (2008) and Manne and Bicho (2009) proposed that resource intensification is visible in southern Iberia as early as 25 kys (although it probably started at least as early as 30 kys with the last Neanderthals of Iberia). This included not only a broadening of the dietary spectrum, but also an increase in the amount of fat and other essential nutrients obtained from the marrow of medium-sized ungulates and the long bones of rabbits. For Mediterranean Iberia, intensification during the LUP has been proposed based on high bone breakage and the extension of the prey types to include marine fish, shellfish and marine mammals (Aura et al., 2002). For example, demersal and pelagic fishing and molluscs were exploited since the Solutrean at Nerja cave, which increased throughout the Magdalenian and early Holocene, as well as evidence of marine mammal exploitation from the Magdalenian onwards. This is also supported by the exploitation of birds and rabbits, which also begins in the Solutrean and increase during the Tardiglacial (Cortés-Sánchez et al., 2008; Jordá, 1986; Morales-Muñiz and Roselló-Izquierdo, 2008).

In northern Iberia, Straus and Clark (1986) proposed that resource intensification was visible from the Solutrean in a double strategy of specialisation (in the hunting of red deer and ibex)

and diversification, with an increase in the exploitation of marine resources at the LUP. This process was related to population increase. Straus (2005) tracked demographic pulses in the region using density of sites per millennium showing really low densities during the Aurignacian (1.25) and the Gravettian (2), a considerable increase during the Solutrean (18) and the early Magdalenian (17), and a second increase during the Late Magdalenian (24.5) and the Azilian (24.5). Thus, northern Spain acted as a refugia for human populations during the Late Glacial Maximum (LGM) which enabled a demographic increase in the region and the start of the intensification in subsistence strategies. A second great pulse of intensification resulted again from the interaction between environment and population density during the late Magdalenian (Straus, 2005, 2008). However, the use of density of sites per millennium as indicator of demographic changes is controversial because of the effect of sea level rise in the visibility of UP sites. On the other hand, González-Sainz and González-Urquijo (2007) proposed that population increase and resource intensification was only visible from the late Magdalenian. Thus, a higher diversity of exploited large mammals, an increase in hunting and processing efficiency (González-Sainz and González-Urquijo, 2007; Marín-Arroyo, 2009; Nakazawa et al., 2009), a more intensive use of fish, birds, molluscs and vegetables (González-Sainz and González-Urquijo, 2007; Straus and Clark, 1986), a reduction in mobility patterns and a simplification in technology (González-Sainz and González-Urquijo, 2007) have been identified from the Magdalenian onwards and related to increasing populations and resource intensification.

With regard to coastal resource intensification, the evidence for the exploitation of molluscs and other littoral resources in northern Spain suggests that, despite the continuous presence of such coastal resources since the EUP (and very limited evidence in the MP), their exploitation remains at a relatively low intensity until the last phases of this period, and that it is not until the Azilian and the Mesolithic that clear evidence of increasing intensity is visible in the archaeological record (Álvarez-Fernández, 2011; Gutiérrez-Zugasti, 2009, 2011a, 2011b, 2011d). A similar increase in the importance of marine resources through the UP has been identified on the Mediterranean coast of the Iberian Peninsula (Aura et al., 2009). This is consistent with the data from the Gibraltar sites, where the MP and UP exploitation patterns identified at Vanguard's and Gorham's caves show that the number of shells exploited is very low, suggesting that in both periods shell resources were not exploited intensively (Fa, 2008). Therefore, it seems that coastal resource intensification in Iberia was related to the demographic increase (and the intensification pulse) occurred from the late Magdalenian onwards. Following this tendency, the role of coastal resources in hunter-fisher-gatherer diet reached their maximum expression during the Mesolithic. Shellfish was given importance by human populations since early times because of the low risk and limited energy expenditure involved in their collection and preparation, their nutritional value (Manne and Bicho, 2011) and their added value as raw material for manufacturing ornaments and tools (Cuenca-Solana et al., 2011). These features made molluscs and other littoral resources into highly valued resources for human populations (Chenorkian, 1988; Erlandson, 1988; Perlman, 1980; Yesner, 1980).

In summary, dietary diversity in Iberia is visible during the MP, the UP and the Mesolithic. If diversification is understood as part of the intensification process, then the available data suggest that intensification was present during the MP and EUP in Iberia. But if intensification is specifically defined as the increase in the use of already exploited resources, a slightly different interpretation can be drawn about the onset of the intensification. Thus, a first pulse of intensification could have occurred during the EUP in some areas of Iberia (Bicho and Haws, 2008; Manne and Bicho,

2009), while remarkable intensification occurred in a second (and more general, geographically speaking) pulse during the LUP and the Mesolithic (Aura et al., 2009; González-Sainz and González-Urquijo, 2007; Gutiérrez-Zugasti, 2011d). This second pulse was probably related to environmental change and population pressure, which led to dramatic changes in hunter–gatherer economic and social strategies, not only in northern Spain but also elsewhere in the Iberian Peninsula and Europe. These changes involved a reorganization of hunter–gatherer lifeways, and are visible in the archaeological record from northern Spain in changes in lithic and bone technology, symbolic practices, settlement patterns and subsistence strategies in general (Fano, 2007; Fernández-Tresguerras, 2007; González-Sainz and González-Urquijo, 2007; Straus, 2005; Straus and Clark, 1986).

#### *Shell beads, their context and the symbolic behaviour during the early Upper Palaeolithic*

The use of shells as ornaments in Western Europe has usually been attributed to populations of anatomically and behaviourally modern humans from the UP (Álvarez-Fernández and Jörís, 2007). However, a large debate currently exists on the capacity of Neanderthals to also show MHB through the creation of symbolic expressions (Zilhão, 2007; Zilhão and d'Errico, 1999). Recently, some evidence has been presented supporting this idea. Specifically, Neanderthal populations from the Iberian Peninsula (Zilhão et al., 2010) show a similar behaviour to that of the AMHs from the MP/MSA in Africa and the Near East (Bar-Yosef Mayer et al., 2009; Bouzouggar et al., 2007; d'Errico et al., 2005), in that they use naturally perforated shells and ochre in a symbolic way.

Gathering shells not only for ornaments but also as keepsakes has been described as a MHB feature (Jerardino and Marean, 2010). In this case, the shells would be collected because of their aesthetic characteristics. However, this behaviour has also been documented in MP sites, such as Moscerini (Stiner, 1993) in Italy and Lezetxiki (Arrizabalaga et al., 2009) and Los Aviones (Zilhão et al., 2010) in Iberia, although the presence of striking shells, like *Nassarius incrassatus* and *Gibbula* sp., at the latter site have been interpreted as accidental, as they were transported to the site along with edible species in water-soaked algae, a technique used for preserving the molluscs.

Materials used to communicate social identity, as is the case with shells, usually share some visual aesthetic characteristics (colour, bright, shape, size, etc.) and therefore they should have a meaning for the societies that produce them (Vanhaeren and d'Errico, 2003; White, 2007). This idea can also be applied not only to shell beads, but also to shells collected as curiosities or keepsakes. In the Aurignacian at El Cuco, although shells used as ornaments have not been identified, there are some species, usually considered inedible, which could have been collected because of their aesthetic characteristics. These are the gastropods *O. erinaceus* and *Gibbula* sp., and the bivalve *Acanthocardia* sp., both of which have a striking morphology and colour. *Gibbula* sp. can usually be found between algae in the rocky intertidal, so it could have been brought to the site as part of the preservation technique described by Zilhão et al. (2010), if this method were applied to the collection of limpets. In the case of *O. erinaceus*, although it can be found in the rocky intertidal, its morphology, typical of deep sandy bottom specimens (Rolán, pers. comm.), together with the erosion of the shell and the occurrence of a perforation made by a marine predator, suggest that the shell was collected dead on the beach. *Acanthocardia* sp. lives in deep sandy bottoms and it is usually found dead on the beach. Therefore, the available evidence supports the hypothesis that hunter–gatherers visited the beaches and collected specimens with specific visual and aesthetic characteristics. A similar behaviour can be seen in Level III (Gravettian) at

El Cuco as the shell assemblage includes remains of *Acanthocardia* sp., *N. lapillus*, *Turritella* sp. and *Antalis* sp., species that could have been collected for their rarity value or as raw material for manufacturing ornaments.

During the EUP, the use of shell beads as ornament and ochre as colouring is common among hunter–gatherer populations in Europe. Shell beads are usually found isolated in habitation sites, both in the Aurignacian and the Gravettian, while the finding of concentrations is not so common. The examples of concentrations attributed to the Aurignacian are limited, while they are more common in Gravettian layers. These deposits are usually related to structures, such as hearths (e.g. in the Aurignacian of Isturitz), burials (e.g. in the Gravettian of Lagar Velho) (see Álvarez-Fernández, 2006 and Taborin, 1993 for a compilation of sites showing different types of deposit) or human-made shelters (e.g. in Klissoura cave 1) (Stiner, 2010). At El Cuco, the deposit of Gravettian shell beads is included in a red ochre stain, under a big limestone block, so the context suggests four possible explanations: (1) a workshop for manufacturing ornamental shells; (2) use of the shells as grave goods, which would entail the existence of a burial in the adjacent squares, not excavated yet; (3) the practice of some kind of ritual, involving burial of the shells and sealing them up with the limestone block; or (4) the accidental loss of the shells. Hypothesis 1 seems unlikely, since the deposit is very limited and shells in process of manufacturing have not been found. Hypothesis 2 cannot be proved without more fieldwork, although it cannot be rejected because the shells were found while cleaning a stratigraphic profile. However, sedimentary evidence of a pit/grave was not identified during the cleaning, so the red stain could simply have been produced by the ochre pigment impregnating the shells or any other perishable material associated with the shells. The absence of evidence of a pit would minimise the validity of hypothesis 3, although the deposit shows some similarity with that of the Klissoura cave 1. Thus, according to the available information, hypothesis 4 is the most likely, although it is not possible to reject the other hypotheses until more extensive excavation is carried out. Regarding the type of ornament, it could be a necklace or at least a group of shells that were used as a composite ornament. White (2007) has pointed out that these materials are usually associated with body ornaments from a traditional typo-morphological perspective, while ethnographic information shows that they could have been used as non-body-ornament objects adapted for suspension/attachment on baskets, bags, blankets, dwellings, etc. so this could also be the case with the El Cuco shells.

From a social point of view, shell beads have been defined as objects identifying human groups (Kuhn et al., 2001; Stiner, 1999, 2003), social status (Vanhaeren and d'Errico, 2005), social and personal identities (White, 2007) or even ethno-linguistic groups (Vanhaeren and d'Errico, 2006). Current ethnographic evidence supports the idea that the ethnic dimension of human groups can be recognised through the use of different bead types, and their combination and arrangement on the body and on other objects. Thus, the meaning of the ornaments would be shared by one or more neighbouring groups. This would allow the communication of social identity as members of the same group, or gender, or other grouping related to age, marital status, role in society, etc. (Kuhn et al., 2001, 2009; Vanhaeren and d'Errico, 2006). In the case of the species identified in the Gravettian deposit at El Cuco, ornamental shells such as *L. obtusata* and *L. littorea* have been recorded in other Gravettian sites in northern Spain (Álvarez-Fernández, 2006), however, *Antalis* sp. has been found only in the site of Alkerdi (Cava et al., 2009). Nevertheless, these species are also usually found in Gravettian sites in France (Taborin, 1993; Vanhaeren and d'Errico, 2003), so El Cuco shell assemblage shows great similarity with other ornamental assemblages identified in Gravettian sites along the Atlantic Façade of Europe, and also in other parts

of Central Europe (e.g. *Antalis* sp. en Brno 2). Obviously, the type of shells used as ornament in every region is determined by what is available in the nearby environment. Hence, the species identified at El Cuco must have been present in northern Spain during the Gravettian. However, the type of shells used would also have been determined by the mobility of human groups and the characteristics of social systems, which would allow for exchange over greater distances. To consider a group of artefacts as part of a communication system, these symbolic elements must be widely shared (Kuhn et al., 2001), and this seems to happen at least in France and northern Spain throughout the UP. Therefore, it seems more probable that symbolic elements in these regions, occupied by groups sharing the same meaning for these elements, have a meaning related to social or personal status. Finally, data from El Cuco support the idea that utilisation of symbolic systems by human societies is widely present from the EUP, probably because human groups would have needed means of differentiation, both at an individual and a territorial level (Zilhão, 2007).

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