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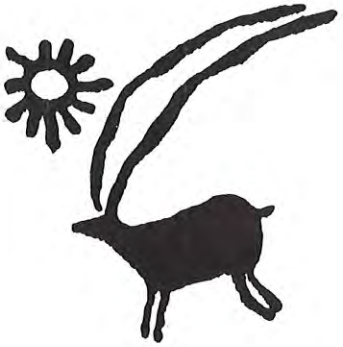

Nota de los editores

En su cuarto número, ARCHAEOFAUNA prosigue la publicación de los trabajos presentados en el quinto Simposio del I.C.A.Z. Fish Remains Working Group celebrado en Stora Kornö (Suecia), compromiso que adquirió en el último encuentro de este Grupo en Lovaina. En este caso se trata de los trabajos de: N. Benecke & L. Ván Thue, R. Larje, S. Hamilton-Dyer, R.C. Hoffmann, R.A. Nicholson and S. Sten. Nos consta que esta relación no agota la lista de manuscritos pendientes, algunos de los cuales podrán ir apareciendo en sucesivos volúmenes de la revista siempre y cuando cumplan los requisitos mínimos que resulta obligado exigir a toda publicación.

Los siete artículos restantes han seguido los cauces convencionales de revisión, con dos recensores, y creemos representan un variado espectro de información arqueozoológica, lo cual, unido a las características de sus autores, no viene sino a confirmar la progresiva consolidación de ARCHAEOFAUNA dentro de un amplio sector de la investigación arqueozoológica al tiempo que confirma lo oportuno de su creación.

Editor's Note

In this fourth volume, ARCHAEOFAUNA resumes the editing of papers presented at the Fifth Meeting of the I.C.A.Z. Fish Remains Working Group (Stora Kornö, Sweden), a compromise which it undertook during the last meeting of this group in Leuven (Belgium). Such compromise is exemplified by the works of N. Benecke & L. Ván Thue, R. Larje, S. Hamilton-Dyer, R.C. Hoffmann, R.A. Nicholson and S. Sten. This list does not exhaust the number of papers presented at that conference. We therefore expect additional manuscripts to appear on forth coming volumes of our Journal as long as they meet those minimum standards which all scientific literature must exhibit.

The remaining papers of this number have followed ARCHAEOFAUNA's conventional editing methods, with two reviewers, and present a rather wide spectrum of archaeozoological information. Such phenomenon, together with the diversified character of the authors themselves, testifies to the growing reception of ARCHAEOFAUNA within an ample sector of archaeozoological research and indirectly speaks about its timely birth.

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SEASONAL DATING OF FISH REMAINS FROM THE HOABINHIAN SITE CAN-CAVE (KY SON DISTRICT, HOA BINH PROVINCE, VIETNAM)

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ABSTRACT: The paper makes a series of cursory remarks on the archaeozoological analyses carried out on a Vietnamese site assigned to the mesolithic Hoabinian culture. Of particular relevance are the fish remains which altogether barely amount to 5% of the identified material. These bones evidence fishing activities concentrating on a single taxon of cyprinid, *Mylopharyngodon*. Through vertebral growth ring analysis one can see that such fishing was carried out during a restricted portion of the year coincident with the end of the dry monsoon and the start of the wet monsoon season.

KEYWORDS: CARPFISH, *Mylopharyngodon*, FISHING, SEASONALITY, VIETNAM, MESOLITHIC

RESUMEN: El trabajo comenta sucintamente los resultados de la investigación arqueozoológica preliminar llevada a cabo en un yacimiento vietnamita asignado a la cultura mesolítica Hoabiniense. De particular interés resultan los escasos restos de peces, apenas un 5% del material faunístico constatado, por cuanto no sólo evidencian una pesca exclusiva de la carpa vietnamita, *Mylopharyngodon*, sino que los patrones de líneas de incremento en los centros vertebrales demuestran que tal actividad se llevó a cabo en un momento posiblemente coincidente con el final del monzón seco y el comienzo del monzón húmedo.

PALABRAS CLAVE: CARPA, *Mylopharyngodon*, PESCA, ESTACIONALIDAD, VIETNAM, MESOLITICO

INTRODUCTION

The dominant archaeological culture found throughout Southeast Asia, dated between approximately 12000 and 5000 B.P., is usually referred to as the "Hoabinian" or the "Hoabinhian" Culture. The term "Hoabinhian" was originally coined at the First Congress of Prehistorians of the Far East, meeting in Hanoi in 1932, following the discoveries of archaeological artefacts in the limestone caves of Ton Kin, in the Hoa Binh Province of North Vietnam. Archaeological assemblages which have been assigned to the Hoabinhian Culture have an enormous geographical distribution which spans from Burma (and perhaps even Assam) to Vietnam, and from South China to North Sumatra. There are two types of sites which have been discovered:

1. caves in the limestone karst formations

2. coastal and riverine shell middens, particularly along both sides of Malacca Strait, and in the Red River Delta of North Vietnam and south along the Annam coast.

In spite of the scarcity of published material archaeological excavations in Indochina evidence the outlines of a distinctive Hoabinhian culture. We now know that such culture was based on hunting and food gathering with flaked stone artifacts made primarily from pebbles. As such it was a Mesolithic culture that exhibited "*no evidence of agriculture*".

The faunal evidence from Hoabinhian sites has been summarized by Gorman (1971), Higham (1977) and Pookajorn (1988). A large range of species is present, including pig, cattle, various species of deer, rhinoceros, several species of monkeys and carnivores, rodents, porcupine, ground and flying squirrels, bats, freshwater fish, tortoises and crabs on top of shell-fish and lizards. The

wide range of species suggests a broadly-based hunter-gatherer economy. Archaeozoological research on animal remains from Hoabinhian sites has concentrated on mammal bones. Little research has been done on fish, reptiles and molluscs remains.

In 1985 and 1987 Vietnamese archaeologists from the Institute of Archaeology at Hanoi carried out trial excavations on the Hoabinhian site of Can-cave. The site is located in the limestone mountains near Doc Tap in the Hoa Binh province of North Vietnam. In the vicinity of the cave there is a small river which has a fluctuating water level due to climatic conditions. The excavations yielded a large sample of animal remains, close to 58000 fragments. Both dry- and wet-sieving methods were used for collecting animal remains. The animal remains reported here come from a large pit, pit 1 of the Can-cave site (Figure 1). With the exception of the fish bones all faunal remains have been analyzed by one of us (Le Ván Thue, unpublished data).

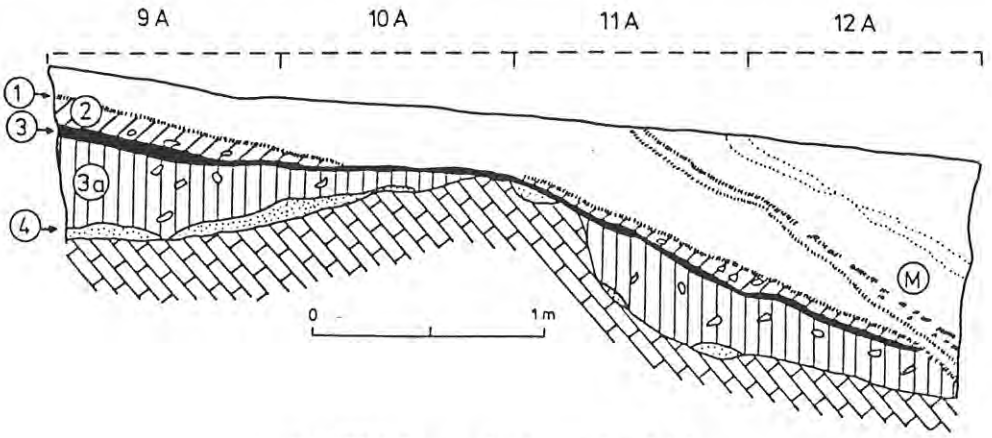

FIGURE 1. Can-cave. Northern section of pit 1.

RESULTS

Table 1 presents a preliminary list of the faunal material from pit 1. The animal remains belong to seven groups: snails, shell-fish, crab, fish, reptiles, birds and mammals. Table 2 shows the composition of the fauna according to these groups. The material is divided into 7 layers plus one sample, which contains mixed material. From this table it becomes clear that the animal remains of pit 1 from Can-cave consist mainly of shells from land and freshwater snails. Bones from small mammals are also frequent. Fish bones on the other hand, represent only 5% of the NISP (Figure 2).

Altogether 1097 fish bones were retrieved in pit 1. The material consists mostly of vertebrae (i.e. 1088 bones or 99.2%). One bone belongs to the cranium (operculare) and 8 bones to other categories of the postcranial skeleton. An explanation for the low number of bones from the cranium could be that the fish were prepared outside the cave and only the edible parts had been brought into the cave. The identification of the bones showed that most if not all bones belong to the genus *Mylopharyngodon* of the family Cyprinidae. The determination has been carried out with the help of recent fish material from the osteological collections of the Museum of Natural History (Berlin) and of the Institute of Zoology (Hanoi)[1].

(1) To control this determination we have sent the material to Prof. 'Chen Yi'yu, a fish specialist working at the Institute of Hydrobiology of the Academy of Sciences in Wuhan (China). He confirmed the determination.

Class Gastropoda: Land and fresh water snails

Class Bivalvia

Class Crustacea

Class Pisces
Family Cyprinidae: *Mylopharyngodon (piceus* ?)

Class Reptilia
Order Testudines
Family Testudinidae: *Testudo* spec.

Class Aves
Order Galliformes
Family Phasianidae: *Gallus* spec.

Class Mammalia
Order Chiroptera
Order Primates
Family Cercopithecidae: *Macaca* spec.
Family Pongidae: *Hylobates concolor*

Order Rodentia
Family Muridae: *Mus* spec., *Rattus* spec.
Family Hystricidae: *Hystrix* spec.
Order Carnivora
Family Viverridae:
Paradoxus hermaphroditus
Order Artiodactyla
Family Suidae: *Sus scrofa*
Family Cervidae:
Cervus spec., *Muntiacus muntjak*

TABLE 1. Can-Cave, pit 1. Preliminary fauna list (from spring 1989, according to the determinations from Le Ván Thue).

GROUP	Mixed	1	2	2/3	3	3a	3/4	4
Large mammals Macromammalia	840	10	449	363	35	218	32	108
Small mammals Micromammalia	7392	151	1684	1365	114	440	78	309
Birds Aves	11	-	2	2	-	-	2	1
Reptiles Reptilia	396	3	85	29	4	21	9	10
Fishes Pisces	789	5	182	92	-	16	-	13
Crab Crustacea	396	3	85	29	4	21	9	10
Shell-fish Bivalvia	17	-	-	13	-	11	1	1
Snails Gastropoda	17215	251	5741	9475	1230	7099	-	609
TOTAL	27056	423	8228	11368	1387	7826	131	1061

TABLE 2. Can-Cave, pit 1. Composition of the fauna according to animal groups by layers (number of fragments).

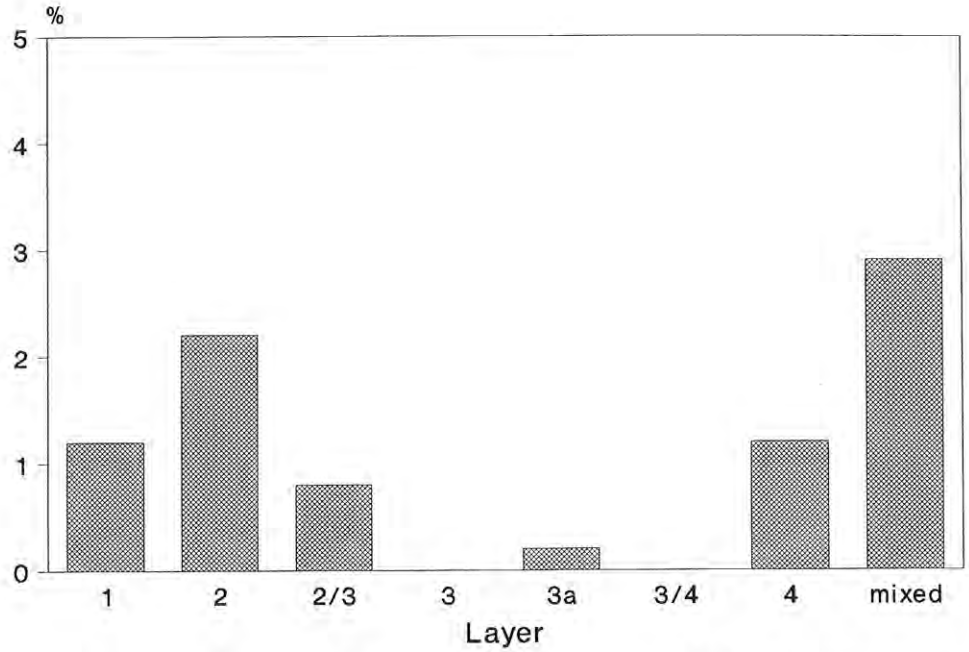

FIGURE 2. Percentage of fish remains within the different layers of pit 1 from Can-cave.

DISCUSSION

The genus *Mylopharyngodon* is a widespread cyprinid taxon in Southeast-Asia. The ichthyofauna of Vietnam, compiled by Mai Dinh Yên, describes only one species of the genus *Mylopharyngodon*. It is *Mylopharyngodon piceus* (Yên, 1969). In the volume "The Freshwater Fishes of China", edited by J.T. Nichols in 1943, this species is called *Mylopharyngodon aethiops* (Nichols, 1943). Possibly, then, all remains found in Can-Cave, pit 1, belong to this species. Today *Mylopharyngodon* is a very common freshwater species in North-Vietnam, living in lakes and rivers of the plains, but also in low- and middle-altitude mountains. Full-grown individuals reach lengths from 50-70 cm and weights ranging between 10-15 kg.

During the examination of the vertebrae it was noticed that all specimens showed a well-developed ring structure, indicating a periodicity in the growth rate, as recorded on many European freshwater species. The investigation of the outermost zone of the *Mylopharyngodon* vertebrae from pit 1 in Can-cave revealed that these could be classified into two groups (Table 3).

LAYER	GROUP 1	GROUP 2	Not Determined	TOTAL
Mixed	4 (4.0)	97 (96.0)	49	150
1	-	3	-	3
2	6 (11.8)	45 (88.2)	33	84
2/3	6 (13.3)	39 (86.7)	8	53
3a	2	8	2	12
4	-	7	1	8

TABLE 3. Can-Cave, pit 1. Classification of *Mylopharyngodon* vertebrae. Group 1: vertebrae with much growth after the narrow-ring. Group 2: vertebrae with the narrow-ring present on the margin.

The first one includes vertebrae with much growth after the narrow-ring (group 1) while a second group exhibits narrow-rings present on the margin (group 2). Most of the vertebrae within all layers (i.e. 86.7% of the recordable ones in layer 2/3, 88.2% in layer 2 and 96% in the mixed material) belong to group 2. This means that most specimens in the sample show the same season of death.

Under temperate climatic conditions wide and narrow rings on fish vertebrae correspond to periods of accelerated and retarded growth respectively, indicating seasons of higher and lower mean temperatures. How can the alternating zones of wide and narrow rings on the *Mylopharyngodon* vertebrae from Can-cave be explained? A climate-diagram from the meteorological station of Hanoi, which is only 30 km from the Can-cave site, gives an impression of the year-round climate in this region (Figure 3). There are two clearly distinct seasons:

- one season from April to October with heavy rain showers and high mean temperatures between 28° C and 32° C. This corresponds to the time of the summer monsoon.

- a second season from November to March with only little rain and lower mean temperatures of about 17° C. This is the time of the winter monsoon, which is also called the dry monsoon.

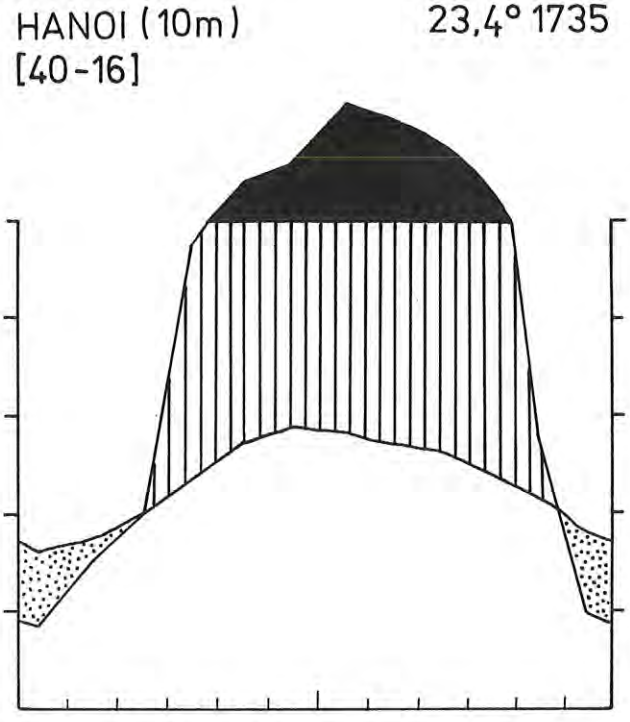

FIGURE 3. Hanoi, climate diagram (from Walter & Lieth, 1964). Lower curve: monthly means of temperature; upper curve: monthly means of precipitation; dotted area: precipitation goes below temperature (arid period, winter monsoon); hatched area: precipitation exceeds temperature (humid period, summer monsoon); black area: precipitations above 100 mm.

On the basis of this diagram one can assume that the wide rings correspond with the time of the summer monsoon. During that season rivers and lakes have much more water and food for fish are abundant. As a result of this growth is rapid. During the time of the winter monsoon lakes and rivers exhibit a dramatic drop in water level. Since certain foodstuffs are not available in the same quantities as during the summer growth is slower. If this explanation is accepted, then vertebrae with

narrow rings present on their margins should come from individuals which have been caught at the end of the winter monsoon season or at the beginning of the summer monsoon season (i.e. in the time between February and May).

According to Casteel (1976) in warmer tropical and subtropical waters other factors besides temperature, such as gonad maturation, may complicate the pattern of ring-formation. Among Californian fish, spawning stress between the months of March and June is the most likely cause for narrow ring formation. There are no data on the spawning-time of *Mylopharyngodon*. The only ones for *Cyprinus carpio*, indicate spawning between May and June.

CONCLUSIONS

From the data presented it can be inferred that at the Hoabinhian Can-cave site fishing was being carried out mostly during the period spanning from February to June. Such conclusion can be further supported by ethnographical evidence from a recent hunter-gatherer group living in remote regions of the limestone mountains in North-Vietnam, the so-called Mo. These people catch fish, *Mylopharyngodon piceus* among other species, mainly during the rainy season. As most vertebrae from Can-Cave have a full-developed narrow-ring present on the margin without any further amount of growth thereafter, one could possibly restrict the time of death of these individuals to the beginning of the rainy season. This result also coincides with the main season of occupation of Can-cave according to other sources of archaeological evidence (unpublished data).

BIBLIOGRAPHY

Casteel, R.W. (1976). *Fish Remains in Archaeology and Paleo-environmental Studies.* Academic Press, London.

Gorman, C.F. (1971). The Hoabinhian and after: Subsistence pattern in Southeast Asia during the Late Pleistocene and early Recent Periods. *World Archaeology* 3: 300-320.

Higham, C.F.W. (1977). Economic Change in Prehistoric Thailand. In: Reed, C.A. (ed.): *Origins of Agriculture*: 385-412. Mouton, Paris.

Nichols, J.T. (1943). The Fresh-Water Fishes of China. In: Tyler, R. (ed.): *Natural History of Central Asia* Vol 9. The American Museum of Natural History, New York.

Pookajorn, S. (1988). *Archaeological Research of the Hoabinhian Culture or Technocomplex and its Comparison with Ethnoarchaeology of the Phi Tong Luang, a Hunter-Gatherer Group of Thailand.* Archaeologica Venatoria 9. Verlag Archaeologica Venatoria, Tübingen.

Walter, H. & H. Lieth (1964). *Klimadiagramm-Weltatlas.* Gustav Fischer-Verlag, Jena.

Yên, M.D. (1969). Các loài cà kinh tê nu'óc ngot miên bac viêt nam. Nhà xuât ban khoa hoc, Hà nôi.

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FAVOURITE FISH DISH OF THE ROMANS IN CARTHAGE

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ABSTRACT: The paper comments on a series of fish remains retrieved from a building and a couple of cisterns of roman times in the city of Carthage. The dominance of marine species and, within them, of sea breams, basses and groupers, seems coincident with fish abundances at other sites in the Mediterranean and, on top of paleoecological connotations, discussed for the various taxa, it testifies to the existence of an affluent nucleus of inhabitants in the area.

KEYWORDS: FISH, CARTHAGE, ROMAN TIMES, FISHING, FISH CONSUMPTION

RESUMEN: En el presente trabajo se valoran los restos de peces recuperados en un edificio y unas cisternas de época romana en la ciudad de Cartago. La dominancia de especies marinas y, dentro de éstas de los espáridos, lubinas y meros, parece coincidir con hallazgos en otros puntos del mediterráneo e, independientemente de las connotaciones paleoecológicas evaluadas para cada taxón, evidencia la existencia de moradores con alta capacidad adquisitiva o, cuando menos, de posición acomodada.

PALABRAS CLAVE: PESCADO, CARTAGO, EPOCA ROMANA, PESCA, CONSUMO DE PESCADO

INTRODUCTION

"*Ceterem censeo Carthaginem esse delendam*". In 146 B.C. the Romans carried out this urging of Cato and destroyed the city. Carthage rose again from the ashes to be the capital of the Roman province of Africa until 439 A.D. when it had to be handed over to the Vandals. Although Carthage was the Vandal capital for almost 100 years there was a lingering Roman influence on the culture and everyday life clearly reflected in the monuments and finds from this period.

In our times the vestiges of the ancient Carthage faced the threat of being completely lost in the wake of constructions for the modern city. An approach to UNESCO in the early 1970s initiated the campaign "*Save Carthage*". Soon, many nations sent archaeologists to excavate and record what was left of the ancient city remarkable history.

In 1979 Swedish archaeologists started an investigation at the foot of the former acropolis. The excavations were carried out under the auspices of the Museum of Mediterranean and Near Eastern Antiquities (Medelhavsmuseet) in Stockholm and under the general direction of Dr Carl-Gustaf Styrenius with Miss Birgitta Sander as field director. The site owner had waited a long time to get permission to build on his premises so the digging had to be hurried up. Three campaigns during in all seven months uncovered the north-eastern part of the bottom floor of a Late Roman building (late 4^{th}/early 5^{th} c. A.D.) and the antique street crossing at which this building had been situated. Preliminary data from the Swedish excavations are published in Medelhavsmuseets Bulletin 14, 15 and 16 (1979, 1980, 1981).

The dating is based on in situ mosaics, finds related to the building and remains of an earlier building under the pavement of the yard. Some finds indicate that the building was still in use during the 6^{th} c. A.D. (Sander, 1981: 87).

The building (Figure 1) has two distinct parts; one with small rooms, the other with an open yard. The northern part with the small rooms has been preliminary interpreted as a minor Roman bath.

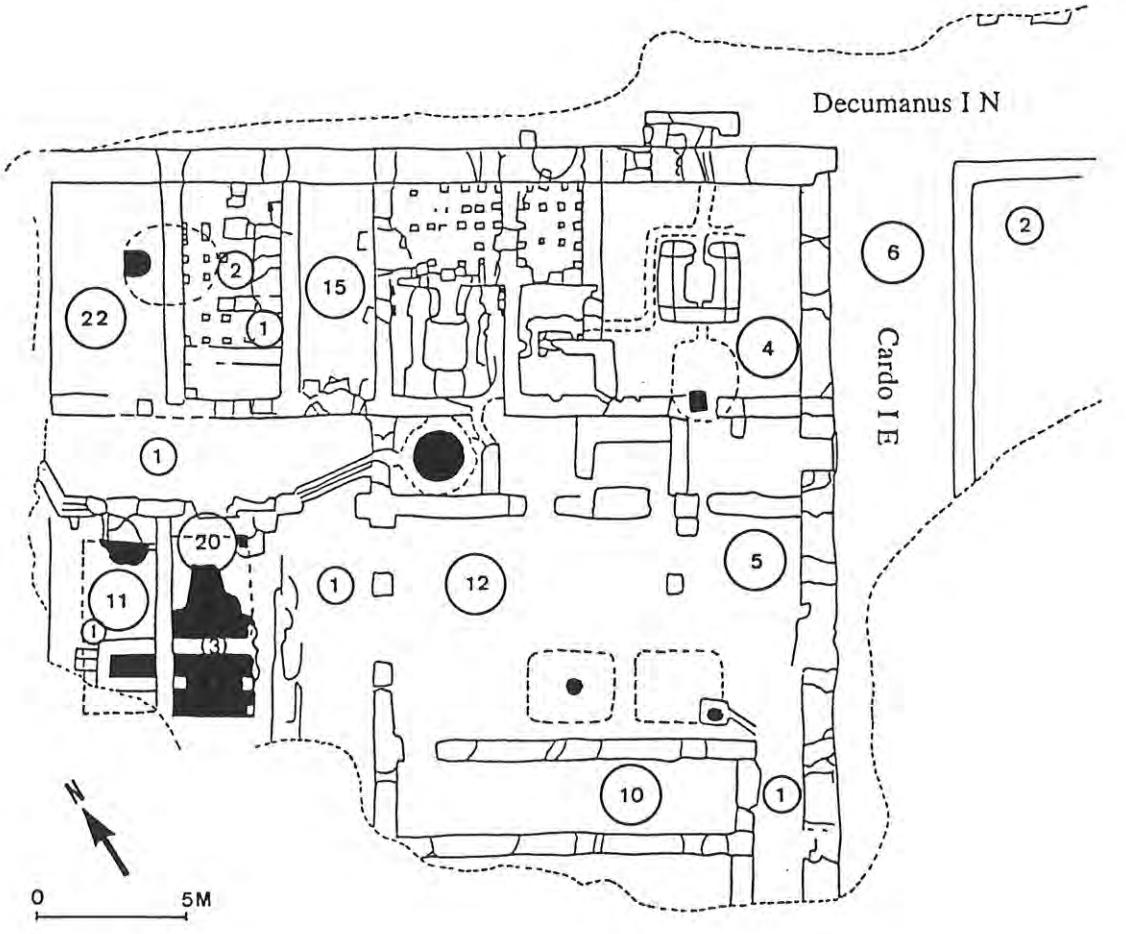

FIGURE 1. Simplified drawing of the Building from the plan of Site A after completed excavation in 1980, from Medelhavsmuseets Bulletin 16, 1980. Number of fish fragments found is indicated. (Four fragments are unaccounted for here because of unknown specific provenience).

The most interesting details here are a quite well preserved heating system, a so called hypocaust, and four small swimming pools. There is also a water channel system with drains, water cisterns and a well. The yard in the southern part is bordered by corridors.

The Roman streets crossing are those of Cardo I E and Decumanus I N, streets of a width of about 3.8 and 4.4 m respectively. Both had been paved with limestone flags (Sander, 1981: 85).

A large number of bones was found and are currently being analysed by the author. On top of mammal and bird bones there were also some fish remains. Their distribution indicated a preference of three species of sea fish, which could thus have been the leftovers of the favourite fish dish of the Romans in Carthage. But it would be unwise and bound to be criticized to pin-point a preference from the little material available. To increase the data on identified fish from Carthage I enlarge my

sample with those from the American excavation in 1977 of three cisterns from approximately the same period. A few other sites around the Mediterranean will also be presented for comparison.

MATERIAL

The Swedish Carthage campaigns produced 122 fish specimens with a total weight of 189.4 g. Of these, 81 fragments could be identified to genus or species level while 41 fragments, mostly spines, ribs and vertebrae, with a weight of 24.0 g had to remain unidentified. The material is well preserved and a comparatively large number of measurements could be taken.

The fragments were unevenly distributed within the building as indicated on Figure 1 but the spatial distribution will be interpreted later in connection with the analysis of the total bone material from the site. No sieving was undertaken so that all bones had to be retrieved by hand from the trenches (Sander, pers. comm.). The building was in use from late 4th/early 6th c. A.D. .

Nine taxa of sea fish could be identified, four to species level, four to genus with a suggestion of the most probable species involved and the last one only to genus level. The distribution of identified fragments is shown in Table 1.

TAXON	NF	%	W	%
Epinephelus (guaza)	23	28.4	78.8	47.7
Dicentrarchus (labrax)	29	35.8	41.1	24.8
Argyrosomus regius	3	3.7	15.3	9.3
Dentex (dentex)	1	1.2	2.6	1.6
Pagellus sp.	1	1.2	0.4	0.2
Sparus aurata	15	18.5	14.3	8.6
Sarda sarda	1	1.2	0.7	0.4
?Euthynnus alletteratus	4	5.0	10.1	6.1
Chelon labrosus	4	5.0	2.1	1.3
Total	81	100.0	165.4	100.0
Total NF unidentified	41		24.0	
Total NF recovered	122		189.4	

TABLE 1. The Swedish excavation in Carthage 1979-80. Dating: late 4th/early 6th century A.D. Number (NF) and weight (W) of identified fragments.

The American excavation of three cisterns (Wheeler, 1981: 231-237) produced 3000 fish fragments unevenly distributed. A total of at least thirteen taxa were identified. The bones were collected by wet-sieving. The collection in all was large, well preserved and could be well dated. The upper level in Cistern 1 was badly mixed but the lower level could be dated from mid to late 5th c. A.D. . This level produced 1406 fish bones. In Cistern 2 the deposits could be dated to the late 6th/early 7th c. A.D. and are likely to be entirely Byzantine. These deposits contained 1180 fish fragments. The upper level of Cistern 3 included 87 fish bones from late 5th/early 7th c. A.D. and the lower level, producing 139 fish bones, includes late 5th/early 6th c. A.D. material. For comparative purposes I will only use the well dated lower levels of Cisterns 1 and 3 and the earlier material in Cistern 2. Table 2 shows the distribution of specimens of identified taxa from the three cisterns.

TAXON Number of fragments	CISTERN 1 UL 18	 LL 93	CISTERN 2 83	CISTERN 3 UL 7	 LL 22/23
Cartilaginous fish	-		1	-	-
Squalus sp.	-		-	1	-
Conger conger	-		-	1	-
Epinephelus (guaza)	-	5	5	2	-
Dicentrarchus sp.	-	7	31	1	-
Pomatomus saltator	-	1	-	-	-
Trachurus sp.	-	2	-	-	-
Pagellus sp.	-	-	1	-	-
Pagrus pagrus	2	2	2	2	6
Sparus aurata	15	71	40	1	5
Labrus sp.	1	2	-	-	-
Symphodus (Crenilabrus) sp.	-	2	-	-	-
Mugil sp.	-	1	3	-	7
Barbus sp.	-	-	-	-	3/4
Total number of fragments identified			223/224		
Total number of fragments recovered			3000		

TABLE 2. The American excavation in Carthage 1977 of three cisterns (Wheeler, 1981). Distribution of identified specimens. UL = upper level; LL = lower level.

METHODS

The material from the Building and the Cisterns (Wheeler, 1981) are not directly comparable due to different excavation methods. The material from the Building was hand-collected. It is known that this method introduces a bias towards larger specimens with appreciable loss from smaller and/or more fragile remains. Nevertheless, even a heavily biased sample can yield some valuable information as long as we keep the biasing processes in mind.

The material from the Cisterns was collected by wet-sieving and has a mean fragment weight of less than 0.3 g compared to 1.5 g for the material from the Building.

The excavated context (Building and Antique Street Crossing) has been taken as the sampling unit (e g the Building) and the frequency of taxa of fish is analysed from the total number of fragments identified. This quantification method is easy but not ideal. Until the archaeological analysis of the excavated area is completed it seems to be a valid approach.

Another problem is that with a small sample it is also likely that the effort needed to identify as many specimens as possible will increase at the expense of manpower. To get as much information as possible out of the 122 fragments from the Building, vertebrae and even a few spines were identified. For the Cisterns, Wheeler (1981) provides information on number of vertebrae, spines and ribs but uses mostly jaw bones and other easily identified remains and only exceptionally identifies vertebrae (e.g., grey mullet). Around 66% of the fish fragments from the Building were identified compared to some 7% from the Cisterns.

Minimum number of individuals (MNI) has not been estimated on account of the few fragments scattered over the Building and Streets suspected to have been deposited during ca 200

years. Every specimen, with the probable exception of two vertebrae of sea bass, can be considered to come from a different individual.

Measurements were taken whenever appropriate. Three different methods had to be used and are referred to in connection with their application on various bones.

Specimens from the Building were identified with the comparative collections kindly provided by Leif Jonsson, Gothenburg and those kept at the Swedish Museum of Natural History, Stockholm.

The taxonomic nomenclature used follows Whitehead *et al.* (eds.) (1986). The nomenclature of skeletal elements is referred to Lepiksaar (1983).

ICHTHYOANALYSIS

Information on the fish identified from the Swedish excavation 1979-1980 (the Building) in particular, with a short description of ecology and economic importance is given below. Taxa identified only from the American excavation of the cisterns (Cistern 1-3) will be also presented.

Cartilaginous fish, shark or ray

There are two species of spurdog, *Squalus acanthias* Linnaeus, 1758 and *S. blainvillei* (Risso, 1826), in the Mediterranean today which are closely similar both in body form and biology. The second is smaller and the common one in Tunisia. Wheeler (1981) reports a dorsal fin spine of *Squalus* from the upper level of Cistern 3 which cannot be identified to species. An unidentifiable cartilaginous fish is present in Cistern 2.

***Conger conger* ([Artedi, 1738] Linnaeus, 1758),** conger eel

The conger eel is a strictly marine fish. It can reach a maximum length of 300 cm (Bauchot & Saldanha, 1986: 569). Conger is benthic on the shelf on rocky and sandy bottoms from 0-100 m. It is used as a food fish, although not appreciated by everybody (Davidson, 1987: 55). One fragmentary dentary of a fish ca 75-100 cm in length was identified in the mixed upper level of Cistern 3.

***Epinephelus guaza* (Linnaeus, 1758),** dusky grouper

The groupers are large or very large fishes belonging to the family Serranidae. There are four species of *Epinephelus* in the Mediterranean which could be found in Tunisian waters (Reese, 1981; Tortonese, 1986; Davidson, 1987). Most common and also the largest one is the dusky grouper *E. guaza*. It lives chiefly on rocky bottoms where it is found solitary in caves and crevices to depths from 8 to 200 m. The second most common is the white grouper, *E. aeneus* (Geoffroy Saint-Hilaire, 1817) and the third is the dogtooth grouper, *E. caninus* (Valenciennes, 1843). Both live on muddy and sandy bottoms in the southern Mediterranean. The exact distribution of *E. caninus* is not known because it has often been confused with the dusky grouper (Tortonese, 1986: 785). All groupers are appreciated as foodfishes (Tortonese, 1986: 783). The dusky grouper with a firm flesh free of bone is delicious and it may be considered as a North African speciality (Davidson, 1987: 70). The fourth species, although more common in the Aegean and eastern Mediterranean than in Tunisian waters, is the golden grouper *E. alexandrinus* (Valenciennes, 1828). The golden grouper has rather fibrous flesh (Davidson, 1987: 72) and might have been less appreciated as a food fish.

SKELETAL ELEMENTS	NUMBER OF FRAGMENTS			
	Left	Right	Undet.	Total
Dentale	2	2	-	4
Articulare	1	1	-	2
Premaxillare	2	-	-	2
Maxillare	-	-	1	1
Palatinum	-	-	1	1
Scapulae	-	-	1	1
Cleitrum	-	-	2	2
Ceratobranchiale	-	-	1	1
Pterygiophore	-	-	1	1
Precaudal vertebra	-	-	6	6
Caudal vertebra	-	-	2	2
Total identified	5	3	15	**23**

TABLE 3. The dusky grouper is represented by 23 specimens from the building.

The lack of comprehensive reference material hampers the translation of the measurements into total length of fishes. One caudal vertebra with a total body length of 14.5 mm from Kassope in Greece (Friedl, 1984: 194) is estimated to be from a fish of about 70 cm total length (TL). To judge from the measurements of the previous caudal vertebrae our specimens were somewhat larger.

No measurements have been published on the ten groupers from the Cisterns but Wheeler provides approximate weights which he bases on experience in handling whole specimens (Wheeler, 1981: 231). The fishes are from small- (about 1 kg) to medium-sized (6.8-9.1 kg) specimens.

The dusky grouper can reach a size of 150 cm standard length (SL) but are usually around 90 cm (Tortonese, 1986: 786). Considering the vertebral measurements the individuals from the Swedish excavation were not small but rather of medium-size between 60 and 100 cm SL.

	CATALOGUE NUMBER				
DENTALE	**5833.901**	**2914.901**			
Greatest length	76.8				
Inside length	44.9				
Anterior height	13.7	16.1			
ARTICULARE	**3340.902**	**5427.901**			
Greatest breadth	14.0	12.4			
PRECAUDAL VERTEBRA	**3006.901**	**4945.902**	**2911.901**	**2988.960**	**3856.901**
Gr. body length	15.6	13.2	20.1	21.3	15.6
CAUDAL VERTEBRA	**6365.901**	**3206.901**			
Gr. body length	20.6	19.4			

TABLE 4. Dusky grouper. The measurements used are defined by Morales & Rosenlund (1979). All measurements are given in mm.

***Dicentrarchus labrax* (Linnaeus, 1758)**, sea bass

There are two sea basses belonging to the moronid family (Tortonese, 1986: 793-795) to be found in Tunisian waters. They are moderate-size to large predatory fishes. The largest is the European sea bass *Dicentrarchus labrax* which can reach a maximum length of 100 cm. The spotted sea bass, *D. punctatus* (Bloch, 1792) is somewhat smaller, about 70 cm. Both species live on various kinds of bottoms along the coasts, in brackish waters and occasionally enter the lower reaches of rivers. Sea basses are excellent food fishes. According to Pliny the Romans preferred sea bass from the rivers. *D. labrax* is the most common of the two; *D. punctatus* is said to be more cunning and hard to catch (Davidson, 1987: 69).

SKELETAL ELEMENTS	NUMBER OF FRAGMENTS			
	Left	Right	Undet.	Total
Dentale	1	1	-	2
Articulare	1	2	-	3
Maxillare	1	-	-	1
Operculare	1	-	-	1
Interoperculare	-	-	1	1
Preoperculare	1	-	-	1
Hyomandibulare	2	-	-	2
Cleitrum	1	-	-	1
Ceratohyale	2	-	-	2
Hyale	-	1	-	1
Ceratobranchiale	-	-	1	1
Branchiostegal ray	-	-	2	2
Precaudal vertebra	-	-	3	3
Caudal vertebra	-	-	4	4
Urostyle	-	-	1	1
Dorsal fin spine	-	-	3	3
Total identified	10	4	15	**29**

TABLE 5. European sea bass is represented by 29 specimens from the Building.

Compared to measurements given for length of vertebral centra and estimated length of fishes from Kassope (Friedl, 1984: 124) and Fikirtepe in Turkey (Boessneck & von den Driesch, 1979: 55) the above fishes seem to have been of a total length of between 50 and 70 cm. Wheeler (1981) estimated the weight of the sea basses in Cistern 1 and 2. There were 27 small individuals of an approximate weight of 0.9 - 2.3 kg and 11 bigger ones with a weight of ca 2.3 -4.5 kg. For Cistern 3 only length estimates are given for three individuals, 40 cm, 50 cm and 75 cm of length respectively. The larger two are indicated to be *D. labrax*.

	CATALOGUE NUMBER			
DENTALE	**3884.902**			
Anterior height	5.8			
ARTICULARE	**4029.902**	**4181.902**	**2969.901**	
Greatest length	34.8			
Greatest height	24.5	17.9		
Gr. medio-lateral br.art. surface	7.8	5.0	10.4	
OPERCULARE	**3004.902**			
Gr. dorsi-ventral br. art. surface	3.9			
MAXILLARE	**3591.902**			
Greatest length	40.8			
CERATOHYALE	**5881.901**			
Greatest length	34.8			
HYALE	**2988.963**			
Greatest length	71.8			
PRECAUDAL VERTEBRA	**3726.908**	**2914.905**	**2914.906**	
Body length	16.7	13.4	16.1	
CAUDAL VERTEBRA	**4412.923**	**4029.904**	**4029.905**	**2915.903**
Body length	20.0	14.2	14.0	11.8

TABLE 6. European sea bass. The measurements used are defined by Morales & Rosenlund (1979). All measurements are given in mm.

***Pomatomus saltator* (Linnaeus, 1766)**, bluefish

The bluefish (family Pomatomidae) is a pelagic, swift and migratory fish which can reach a length of 110 cm but usually is 40-60 cm SL. It is of commercial importance today. Only one specimen was found in the lower level of cistern 1 (Wheeler, 1981: 232).

Trachurus sp., scad or horse-mackerel

There are three species of scad (family Carangidae) to be found in Tunisian waters, *T. mediterraneus* (Steindachner, 1868), *T. picturatus* (T.E. Bowdich, 1825) and *T. trachurus* (Linnaeus, 1758). They are preliminary benthopelagic species living at 20 to 500 m depth. Large schools can at times be found at the surface. The maximum length is about 60 cm fork length but a more usual size is around 30 cm (Smith-Vaniz, 1986: 841-843). The only carangid of economic importance today is *T. trachurus* (Reese, 1981: 240). Scad was found with one specimen in the lower level of Cistern 1 (Wheeler, 1981: 232).

***Argyrosomus regius* (Asso, 1801)**, meagre

The meagre belongs to the sciaenids and is a large fish with an elongate body. It reaches a maximum length of 200 cm but is commonly not more than 50 cm. The meagre inhabits the inshore and shelf waters both close to the surface and at the bottom down to 200 m. It also enters estuaries

and costal lagoons and congregates inshore to spawn. The species is distributed along the coasts of the entire Mediterranean (Chao, 1986: 867). The sciaenid fishes like the meagre (*A. regius*), the brown meagre (*Sciaena umbra*) and the shi drum (*Umbrina cirrosa*) are also noted for their large otoliths and the capability of producing a characteristic noise with the help of a sizeable air bladder (Davidson, 1987: 96).

The meagre has a white flesh, and is an excellent food fish, much like the grouper.

Argyrosomus regius is represented by three specimens from the Building. There is the distal part of a left dentary of considerable size, the distal part of an equally large maxillary and a precaudal vertebra with a body length of 14 mm. There is reason to believe that the fish fragments are from three individuals since the findspots are very far apart.

There are few reports on finds of *A. regius* but Boessneck & von den Driesch (1979) feel prone to assign four sciaenid bones from neolithic Fikirtepe to the meagre.

SPARIDAE, Sea bream family

The sparid family is a large one. At least 21 species are occuring in the Mediterranean. Most sea breams are excellent food fishes and of commercial importance today (Bauchot & Hureau, 1986: 883).

***Dentex* sp.**, dentex

There are four species of *Dentex* found in Tunisian waters. All but one, the large-eye dentex, can be up to 100 cm SL, but are usually smaller, 35-60 cm. They inhabit inshore waters on substrates of various kinds down to about 200-300 m. The common dentex *Dentex (Dentex) dentex* (Linnaeus, 1758) is a fine food fish.

One caudal vertebra with a body length of 17.1 mm was identified from the Building.

***Pagellus* sp.**, bream and pandora

At least three species of the genus *Pagellus* can be found in the Gulf of Tunis. They are usually around 25 cm of length, the red sea bream, *P. bogaraveo* (Brünnich, 1768) reaching a little larger. They are littoral species living over different tipes of bottoms down to ca 200 m. All *Pagellus* species make quite good food, grilled whole or used in fish soups depending on size.

One caudal vertebra with a centrum length of 10.4 mm was identified from the Building. Wheeler identifies one right dentary from a small individual of *Pagellus* sp. (Wheeler, 1981: 233).

***Pagrus pagrus* (Linnaeus, 1758),** couch's sea bream

This species is common in the Gulf of Tunis. It inhabits the shelf and continental slope down to about 250 m. The size can be up to 75 cm but usually is around 30-35 cm. Jaw bones of the species are easily identified. It is quite a good-tasting fish, but rarely fished in Tunisia today (Reese, 1986: 238).

Ten specimens were identified by Wheeler from Cisterns 1-3. They come from small to medium-sized *P. pagrus*.

***Sparus aurata* Linnaeus, 1758**, gilt-head sea bream

This beautiful species, once sacred to the goddess Aphrodite, is also an excellent food fish, widely regarded as the best of the sparids. It can grow up to 70 cm long but is usually between 30-35 cm. The gilt-head sea bream lives solitary on sandy bottoms along the coast down to ca 150 m and

also enters brackish waters. It is common throughout the Mediterranean. The dentition is characteristic and allows an easy identification at species level and the jaw bones are also found to preserve well in archaeological sites. Thus, it is not surprising that *Sparus aurata* is a very common species identified from sites around the area.

SKELETAL ELEMENTS	NUMBER OF FRAGMENTS			
	Left	**Right**	**Undet.**	**Total**
Dentale	3	-	-	3
Premaxillare	1	4	-	5
Maxillare	3	-	-	3
Tooth	-	-	1	1
Articulare	1	-	-	1
Supracleitrum	-	-	1	1
Ceratohyale	1	-	-	1
Total identified	9	4	2	**15**

TABLE 7. The gilt-head sea bream is represented by 15 specimens from the Building.

Wheeler (1981) altogether identifies 116 specimens as belonging to *Sparus aurata*, all but three being either dentary or premaxillary bones. He uses measurements of dentary length and premaxillary length and height to analyse the size of the individuals represented. The estimated fork length and total weight is then used to distribute the material in size groups. Since he is presenting only the frequency distribution and not the measurements and lengths of the recent reference specimens it is not possible to use his method for our material.

	CATALOGUE NUMBER				
DENTALE	**2922.901**	**4029.901**	**2988.967**		
B & D 1	31.2	17.2	19.2		
B & D 2	10.0	4.9	8.1		
W Dl	20.2	21.9			
PREMAXILLARE	**4790.901**	**2914.902**	**2898.901**	**5974.901**	**300.003**
B & D 1	26.6	ca 35 est.	27.9	20.0	
B & D 2	10.0	14.1	9.9	4.2	
W Pml	29.3	37.9	30.9	22.9	
W Pmh					23.1
MAXILLARE	**5242.902**	**4826.901**	**3884.904**		
M & R Gr.l	> 51	38.2	23.3		
M & R Gr.h	30.6				
CERATOHYALE	**3005.902**				
M & R Gr.l	25.1				
M & R Gr.h	17.2				

TABLE 8. Gilt head sea bream. The measurements used are defined by Boessneck & von den Driesch (B & D) (1979) and Wheeler (W) (1981) for dentale and premaxillare and by Morales & Rosenlund (M & R) (1979) for all other elements.

Boessneck & von den Driesch (1979) have used other measurements to estimate the length of gilt-heads found at the Neolithic site of Fikirtepe and also presented the reference measurements. This method proved useful for my material.

The measurements used are:

B&D 1 = the maximum length of the dental arcade, measured on the buccal side.

B&D 2 = the length of the largest molaroid tooth, the measuring points are on the outer rim of the tooth socket.

The measurement of the length of the dental arcade is multiplied by a factor 14.1 for premaxillary and 15.4 for dentary, as inferred from the relation between total length and length of the specific bone.

If the estimated sizes from the three finds are compared it can be seen that the few specimens from the Building show a size distribution broadly in agreement with the pattern shown in the cistern material. The gilt-heads from Fikirtepe, on the other hand, indicate the catch of larger individuals, some even of the known maximum size for the species.

	SIZE CLASSES (cm)					
	< 20	20-30	30-40	40-50	50-60	60-70
Carthage, the Building						
Premaxilare		1	2	1		
Dentale		2		1		
Carthage, Cisterns 1-3						
Premaxilare	5	39	5	1		
Dentale	5	23	13	2		
Fikirtepe						
Premaxilare			2	13	13	7
Dentale			1	8	13	7

TABLE 9. Estimated length of gilt-head sea breams.

LABRIDAE, wrasses

There are quite a number of species of wrasses (Quignard & Pras, 1986: 919-942) present in the Mediterranean. They are brilliant coloured fishes, mainly coastal. Most species belong to the genera, *Labrus* or *Symphodus*. Wrasses are mostly used for fish soup. Four specimens of wrasse were identified in the lower level of Cistern 1 but also one lower pharyngeal bone of a specimen of ca 45 cm length from the disturbed upper layer of the same cistern.

SCOMBRIDAE

***Sarda sarda* (Bloch, 1793),** bonito

The Atlantic bonito is a migratory species, often schooling near the surface of inshore waters. Spawning occurs from May to July in the Mediterranean. The bonito can be up to 90 cm fork length for a weight of 5 kg, but more commonly reaches only 50 cm and around 2 kg.

One scombrid caudal vertebra with a body length of 12.3 mm from the Building could be assigned to this species.

TUNA and LITTLE TUNNY

There are two species of tuna, the bluefin tuna, *Thunnus thynnus* (Linnaeus, 1785) and the albacore, *Thunnus alalunga* (Bonnaterre, 1788). Both are very large, migratory and schooling fishes of the high seas but move closer to the shores to spawn. They are caught in large numbers in special tuna traps during their breeding migrations. The tuna fishery in the Mediterranean is obviously of great antiquity, tuna traps being used already in neolithic times.

Euthynnus alletteratus (Rafinesque, 1810) is not as large as the tuna, reaching usually 85 cm and about 7 kg weight. It is epipelagic in coastal waters, schooling but less migratory than the large tunas.

There are four caudal vertebrae, three with a measurable body length of 18.5 mm, 15.2 mm and 15 mm respectively, identified as scombrids. The small size suggests the little tunny but a positive identification is not possible because of inadequate reference material. No scombrids were found in the Cisterns.

MUGILIDAE, grey mullet

There are six species of grey mullet to be found in Tunisisan waters. They are medium-sized fishes (25-100 cm) and usually school in costal waters, entering lagoons, estuaries and rivers for feeding on minute plants, invertebrates and debris. The mullet is of considerable economic importance (Ben-Tuvia, 1986: 1197-1204).

In the Building four specimens of thick-lipped grey mullet *Chelon labrosus* (Risso, 1826) representing four individuals have been identified.

SKELETAL ELEMENTS	NUMBER OF FRAGMENTS	
	Left	**Right**
Operculare	1	2
Hyale	1	

TABLE 10. Identified specimens of *Chelon labrosus*.

	CATALOGUE NUMBER		
OPERCULARE	**4266.901**	**2953.901**	**2988.966**
Gr. dorso-ventral heigth art. surface	5.8	7.5	6.5
HYALE	**4601.902**		
Greatest length	31.1		

TABLE 11. Thick-lipped grey mullet. Measurements: According to Morales & Rosenlund (1979) (in mm).

Wheeler (1981) identified mullets in all Cisterns. The size of the vertebral centra found in the lower level of cistern 3 suggests that a large species like *Chelon labrosus* or *Mugil cephalus* Linnaeus, 1758 was present (Reese, 1981: 240).

***Barbus* sp.**, barbel

The presence of pharyngeal bones of barbel in Cistern 3 indicates freshwater fishery, which is of interest in view of the richness of the marine fauna compared to the depauperate freshwater fish fauna of the region (Wheeler, 1981: 237).

DISCUSSION

Three kinds of fish seem to have been favoured by the inhabitants of Carthage with the evidence at hand. These are the sea breams, sea basses and groupers. Sea breams were retrieved from all levels in the Cisterns and all over the Building. The lower level of Cistern 1+3 is dominated by the finds of sparids which constitute 72.4% of the identified fragments (Table 12) (65% is represented by *Sparus aurata*, the gilt-head). Cistern 2 contained 51.8% sparids, the most common species being again the gilt-head. There is a comparatively large number of sparids from the Building as well. Here too the gilt-head is the most common, constituting 18.5% of the total number of identified fragments. Coach's sea bream *P. pagrus* is misssing in the Building.

TAXON	C1 + C3 LOWER LEVEL N 116 %	C2 N 83 %	B N 81 %
Cartilaginous fish	1.2	-	-
Epinephelus sp.	4.3	6.0	28.4
Dicentrarchus sp.	6.9	37.4	35.8
Pomatomus saltator	0.9	-	-
Trachurus sp.	1.7	-	-
Argyrosomus regius	-	-	3.7
Dentex (dentex)	-	-	1.2
Pagellus sp.	-	1.2	1.2
Pagrus pagrus	6.9	2.4	-
Sparus aurata	65.5	48.2	18.5
Labrus sp.	1.7	-	-
Symphodus sp.	1.7	-	-
Sarda sarda	-	-	1.2
?Euthynnus alletteratus	-	-	5.0
Chelon labrosus	-	-	5.0
Mugil sp.	6.9	3.6	-
Barbus sp.	3.5	-	-
	100.0	100.0	100.0

TABLE 12. Relative frequency of fish taxa based on identified specimens from the Cisterns 1977 (Wheeler) and the Building 1979-1980 (Larje). Dating: C1 + C3 mid 5th/early 6th c.A.D.; C2 late 6th/early 7th c.A.D.; B late 4th/6th c.A.D.

The most common fish in the Building is the sea bass, *Dicentrarchus labrax*, accounting for 35.8% of the finds which equals the distribution of sea bass in Cistern 2 (37.4% as opposed to the low occurrence (6.9%) in Cistern 1+3). The third most common species is the grouper, at least in the Building where 28.4% of remains are assigned to this species.

The differences of abundance of the three most common species between the Cisterns and the Building is seen in Figure 2. The gilt-head is far more abundant in the Cisterns than in the Building - where sea bass and grouper dominate. There is also a difference between the Cisterns shown as a declining number of gilt-head and an increasing number of sea bass in the earlier, Byzantine Cistern 2.

With the limited material at hand one must ask if these differences are real or not. One source of error is the different approach to identification of skeletal elements other than skull bones and jaws. Even if vertebrae and spines are omitted from the Building counts to make the data more comparable, however, the differences are still obvious (dotted line in Building bar in Figure 2).

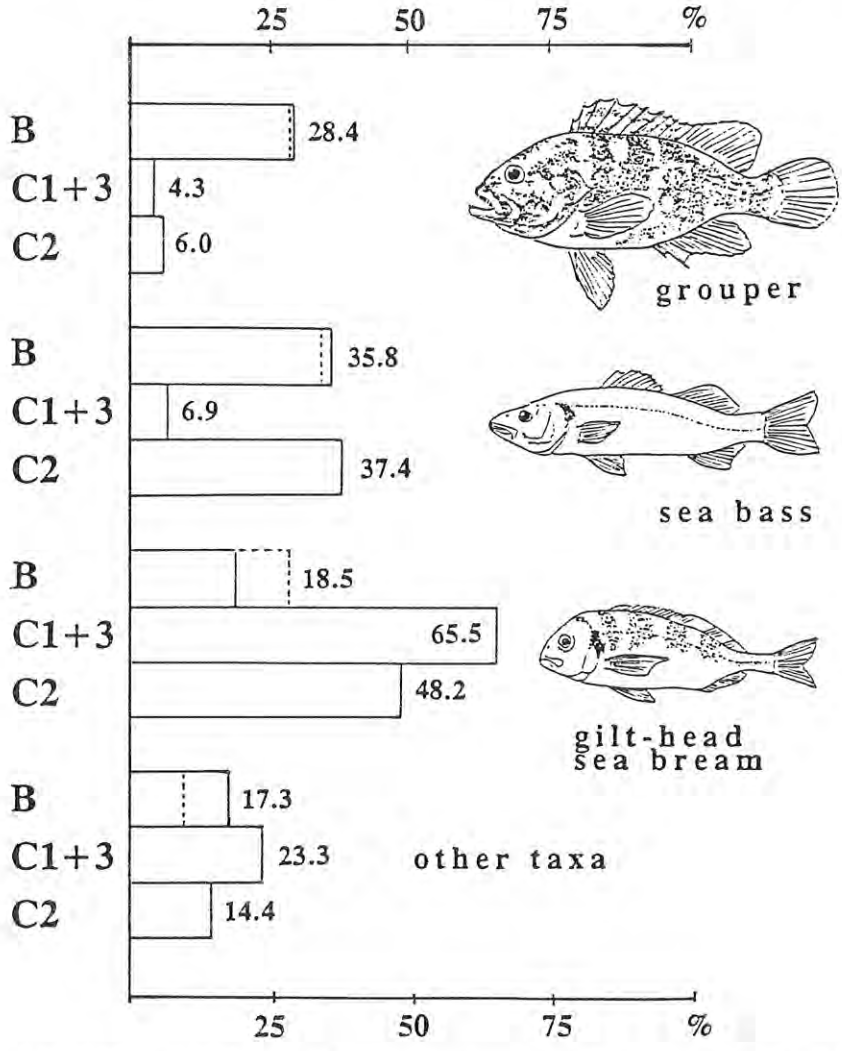

FIGURE 2. Relative distribution of fish taxa from Roman excavations in Carthage. **B** = The Building (late 4th/6th c. A.D.). **C1+3** = Cistern 1 and 3 (mid 5th/early 7th c. A.D.). **C2** = Cistern 2 (late 6th/early 7th c. A.D.).

Can the dissimilarities be explained as a result of different excavation techniques (i.e., sparid bones left unnoticed by the hurried Swedish excavation team)? Gilt-heads from the Cisterns ranged in estimated fork length between 150-500 mm with a maximum in 200-300 mm the size range (Wheeler, 1981: 236). The gilt-heads from the Building are estimated to be of a size between 200-500 mm (Table 9). (There is a slight difference in length estimation methods used. Wheeler (1981) refers to fork length whereas Boessneck & von den Driesch (1985) use total length, but this can only create a very minor problem given other biases involved). Jaw bones of gilt-head are very significant and other smaller fish fragments were in fact retrieved.

Wheeler (1981) regrets the lack of a comprehensive collection of comparative skeletal material. Jaw bones of *Sparus aurata* as well as *Pagrus pagrus* are so peculiar that they allow an easy identification at species level. This fact could give the sparids an advantage over taxa of more difficult identification. I am nevertheless prone to agree with Wheeler (1981: 235) that the picture of the faunal assemblage would probably not be altered even if vertebral centra and more bones from the head skeleton were identified.

There are other sites around the Mediterranean with identified fish remains, covering a period from the Neolithic to 850 A.D. (Figure 3). The distribution of grouper, sea bass and sea bream in those sites are shown in Figure 4.

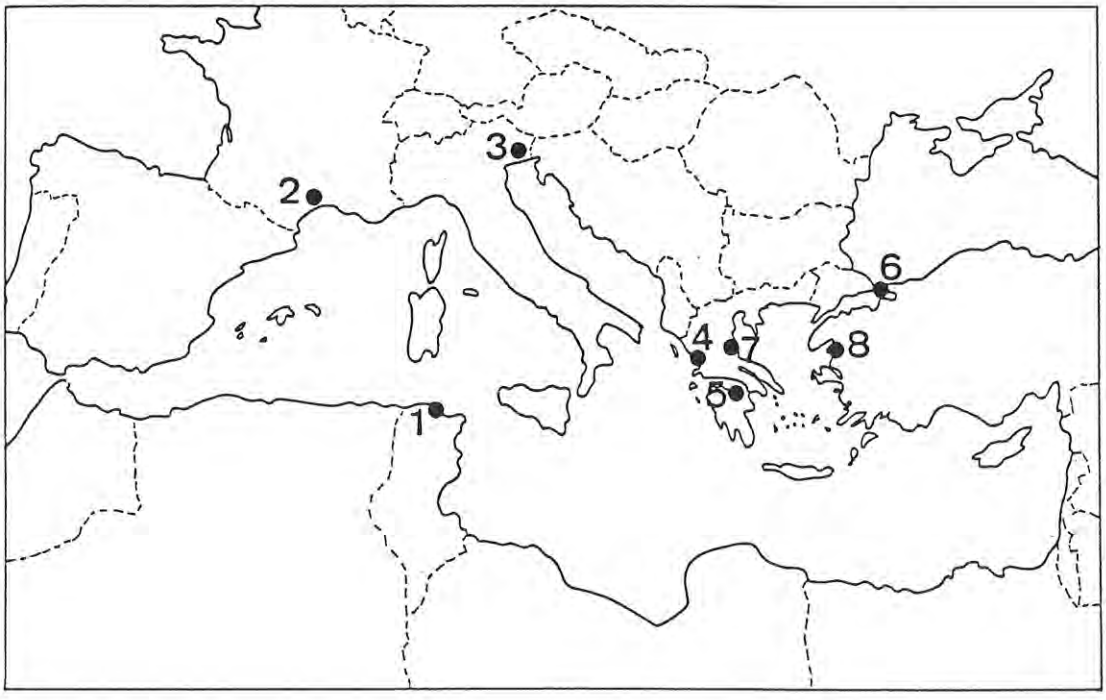

FIGURE 3. Location of sites mentioned in the text. **1.** Carthage (Building late 4th/early 6th c. A.D., Cisterns late 4th/early 7th c. A.D.). **2.** Lattes (3rd/1st c. B.C.). **3.** Invillino-Ibligo (ca 100-850 A.D.). **4.** Kassope (ca 400-100 B.C.) **5.** Corinth (1st/2nd c. A.D.). **6.** Fikirtepe (early Neolithic). **7.** Magula Pevkakia (late Neolithic). **8.** Pergamon (ca 350 B.C. to 500 A.D.).

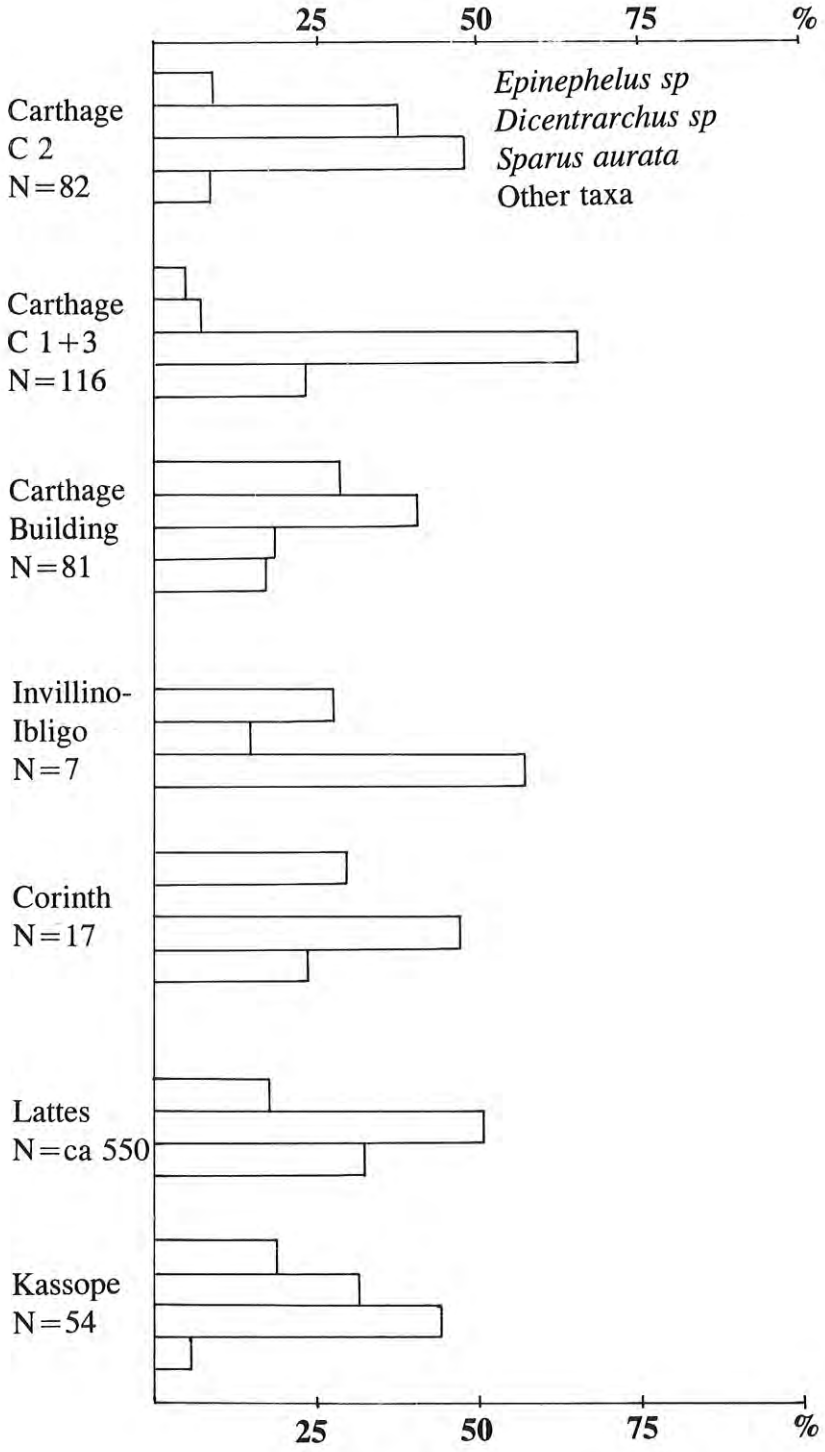

FIGURE 4. Distribution of fish taxa identified from sites around the Mediterranean, dated from ca 400 B.C. to 850 A.D. (The "bottom site" is the oldest.).

The bone material from Kassope in Greece is dated to 4^{th}-1^{st} c. B.C. Kassope was located on the Gulf of Ambrakia in the western part of the country. Very few specimens of fish are assigned to other than the above mentioned taxa (Friedl, 1984: 191-196).

Lattes in southern France, lying between Montpellier and the sea, is dated from 3^{rd} to 1^{st} c. B.C. Here ca 50% of the fish was gilt-head, ca 18% sea bass but just a few specimens could be identified as groupers. About 32% belongs to other taxa, preferably mullets, eel and sardine (Sternberg, 1989).

The few specimens from Corinth (1^{st}-2^{nd} c. A.D.) indicate the presence of gilt-head and grouper, the other taxa being meagre and bluefin tuna (Rose, 1987).

Invillino-Ibligo in Italy is an inland site dated to ca 100-850 A.D. Sea fish had to be imported. Three taxa of sea fish are identified (sea bass, gilt head and ombrine) but there are also finds of sturgeon and trout (Stark & von den Driesch, 1987).

Cisterns in Pergamon (ca 350 B.C. to 500 A.D.) had sea bass and dentex in the deposits but more abundant were specimens of cyprinids, sheat catfish (*Siluris glanis*) and pike-perch (*Stizostedion lucioperca*). The carp, *Cyprinus carpio,* was most common and might even have been cultivated (Boessneck & von den Driesch, 1985).

If one goes further back in time to take a look at Neolithic sites one finds that gilt-head is common in Fikirtepe and Magula Pevkakia where one also finds sea bass. In Fikirtepe the other taxa were mostly freshwater fish dominated by sheatfish. In Magula Pevkakia bluefin tuna was the most common catch (Lepiksaar, 1975; Boessneck & von den Driesch, 1979: 50-67).

The above mentioned fish finds are examples of little pieces of information that hopefully will multiply in the future to increase our knowledge and understanding of prehistoric fishery.

CONCLUSIONS

The marine fishes identified from Carthage represent two well differentiated ecological groupings, an inshore rocky habitat and an offshore, surface to midwater habitat (Figure 5). Our analysis allows some interpretation of fishing technology. Most of the fish were probably easy to obtain by hook and line from boats close to the shore. But there could also have been a mid-water and near surface fishing in the open sea as indicated by finds of spurdog, bluefish and little tunny. The occurence of grey mullets suggests the use of nets or some form of fixed traps, a fishery that was likely also to take sea bass, sea bream, grouper and meagre in good quantities - with less effort than high sea fishing.

The identification of at least 18 fish taxa reflects the abundance of species available over a wide area in the vicinity of Carthage, including freshwater lakes. We nevertheless know that these spectra of abundance must be taken as underrepresentations of even the amounts of taxa present in the taphocenosis due to poor retrieval methods. The ichthic diversity of sieved samples in sites such as Doña Blanca (Roselló & Morales, 1994) seems to confirm such claim.

Fish, especially sea fish, was expensive and not for ordinary people. The Roman emperor Diocletian made an attempt to stop inflation in the empire in 301 A.D. (Goodenough, 1986: 84). Maximum prizes were to be used for various merchandises. Diocletian's edict gives us an idea about costs. Fish from rivers and lakes were just as expensive as meat from cattle, sheep or goat but only

half the price of sea fish. A barber had to shave 24 customers to be able to buy one kilo of the cheapest of the sea fishes! (Goodenough, Op. cit.).

There are further hints that the Building excavated by the Swedish team had been the home of rich people. Maybe the bath was a private one and guests were treated with luxury meals at the "pool side". The head of the meagre was reputed to be particulary delicious (the dentary found was apparently butchered). So the presumption after all is that the good Romans did prefer the fishes we have been able to identify!

HABITAT	TAXON	
	Chelon labrosus	**thick-lipped grey mullet**
	Mugil sp	**grey mullets**
brackish water	*Dicentrarchus labrax*	**sea bass**
	Argyrosomus regius	**meagre**
	Sparus aurata	**gilt-head sea bream**
	Conger conger	**conger eel**
	Epinephelus gauza	**grouper**
	Dentex sp	**dentex**
inshore	*Pagrus pagrus*	**Couch's sea bream**
	Pagellus sp	**sea breams**
	Labrus sp	**wrasses**
	Symphodus sp	"
	Sarda sarda	**Atlantic bonito**
	Squalus sp	**spurdog**
offshore	*Pomatomus saltator*	**bluefish**
	Trachurus sp	**scad**
	?Euthynnus alletteratus	**little tunny**

FIGURE 5. Ecological grouping of identified marine fish taxa from Carthage.

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BIBLIOGRAPHY

Bauchot, M.L. & C. Hureau (1986). Sparidae. In: Whitehead, P.J.P; M.L. Bauchot; J.C. Hureau; J. Nielsen & E. Tortonese (eds.): *Fishes of the North-eastern Atlantic and the Mediterranean* vol. II: 883-907. UNESCO, Paris.

Bauchot, M.L. & L. Saldanha (1986). Congridae. In: Whitehead, P.J.P.; M.L. Bauchot; J.C. Hureau; J. Nielsen & E. Tortonese (eds.): *Fishes of the North-eastern Atlantic and the Mediterranean* vol. II: 567-574. UNESCO, Paris.

Ben-Tuvia, A. (1986). Mugilidae. In: Whitehead, P.J.P.; M.L. Bauchot; J.C. Hureau; J. Nielsen & E. Tortonese (eds.): *Fishes of the North-eastern Atlantic and the Mediterranean* vol. II: 1197-1204. UNESCO, Paris.

Boessneck, J. & A. von den Driesch (1979). *Die Tierknochenfunde aus der neolithischen Siedlung auf dem Fikirtepe bei Kadiköy am Marmaramer.* München.

Boessneck, J. & A. von den Driesch (1985). Knochenfunde aus Zisternen in Pergamon. München.

Chao, L.N. (1986). Sciaenidae. In: Whitehead, P.J.P.; M.L. Bauchot; J.C. Hureau; J. Nielsen & E. Tortonese (eds.): *Fishes of the North-eastern Atlantic and the Mediterranean* vol. II: 865-874. UNESCO, Paris.

Collette, B.B. (1986). Scombridae. In: Whitehead, P.J.P.; M.L. Bauchot; J.C. Hureau; J. Nielsen & E. Tortonese (eds.): *Fishes of the North-eastern Atlantic and the Mediterranean* vol. II: 981-997. UNESCO, Paris.

Davidson, A. (1987). *Mediterranean Seafood.* Penguin Books, Hammondsworth.

Friedl, H. (1984). *Tierknochenfunde aus Kassope/Griechenland (4.-1. Jh.v. Chr.).* München. (Inaugural-Dissertation).

Goodenough, S. (1986). *Antikens Rom. Dagligt liv för 2000å sedan.* Hamlyn/Seelig.

Lepiksaar, J. (1975). Fischreste aus der Magula Pevkakia. In: Jordan, B. (ed.): *Tierknochenfunde aus der Magula Pevkakia in Thessalien*: 181-188. München.

Lepiksaar, J. (1981). *Osteologia. Pisces.* Unpublished compendium.

Morales, A. & K. Rosenlund (1979). *Fish Bone Measurements. An Attempt to Standardize the Measuring of Fish Bones from Archaeological Sites.* Sttenstrupia. Copenhaguen.

Quignard, J.P. & A. Pras (1986). Labridae. In: Whitehead, P.J.P.; M.L. Bauchot; J.C. Hureau; J. Nielsen & E. Tortonese (eds.): *Fishes of the North-eastern Atlantic and the Mediterranean* vol. II: 919-942. UNESCO, Paris.

Reese, D.S. (1981). Faunal Remains from Three Cisterns (1977.1, 1977.2 and 1977.3). In: Resse, D.S.; G.E. Watson & A. Wheeler (eds.): *Excavations at Carthage 1977 Conducted by the University of Michigan VI*: 191-288. J.H. Humphry.

Rose, M. (1987). Appendix B: The fish bones. In: Reese, D.A. (ed.): *A bone assemblage at Corinth of the second century after Christ, Hesperia. Journal of Classical Studies at Athens* 56(3): 255-274.

Roselló, E. & A. Morales (1994). Castillo de Doña Blanca: Patterns of abundance in the Ichthyocoenosis of a Phoenician site from the Iberian Peninsula. *Archaeofauna* 3: 131-143.

Sander, B. (1981). Site A. A Field Report. In: The Swedish Carthage Excavations. Preliminary Report of the Third Campaign, March-June 1980. *Medelhavsmuseet Bulletin* 16: 75-94.

Smith-Vaniz, W.F. (1986). Carangidae. In: Whitehead, P.J.P.; M.L. Bauchot; J.C. Hureau; J. Nielsen & E. Tortonese (eds.): *Fishes of the North-eastern Atlantic and the Mediterranean* vol. II: 815-844. UNESCO, Paris.

Sternberg, M. (1989). La consommation du poison á Lattes (III^{e}-I^{er} s.av.n.é.). Méthode d'étude et premiers résultats. In: Py, M. (ed.): *Introduction à l'étude de l'environnement de Lattes antique. Lattara* 2: 101-120.

Stork, M. & A. von den Driesch (1987). Tierknochenfunde aus Invillino-Ibligo in Friaul/Italien. In: Bierbrauer, V. Invillino-Ibligo in Friaul I. Die Römische Siedlung und das spätantik-frûmittelalterliche Castrum. *Münchener Beiträge zur Vor. u. Frühgeschiehte* 33: 453-484.

The Swedish Carthage Excavations (1979). Preliminary Report of the First Campaign, April-June 1979. *Medelhavsmuseet Bulletin* 14: 57-86.

The Swedish Carthage Excavations (1980). Preliminary Report of the Second Campaign, September-October 1979. *Medelhavsmuseet Bulletin* 15: 73-98.

The Swedish Carthage Excavations (1981). Preliminary Report of the Third Campaign, March-June 1980. *Medelhavsmuseet Bulletin* 16: 75-94.

Tortonese, E. (1986). Serranidae. In: Whitehead, P.J.P.; M.L. Bauchot; J.C. Hureau; J. Nielsen & E. Tortonese (eds.): *Fishes of the North-eastern Atlantic and the Mediterranean* vol. II: 567-574. UNESCO, Paris.

Wheeler, A. (1981). The Fish Remains. In: Humphrey, J.H. (ed.): *Excavations at Carthage 1977 Conducted by the University of Michigan VI*: 231-237.

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FISH IN TUDOR NAVAL DIET - WITH REFERENCE TO THE *MARY ROSE*

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ABSTRACT: Fish remains retrieved in the orlop deck and the hold of the tudor man-of-war *Mary Rose*, which sank in 1545 outside Portsmouth, are evaluated with the help of documentary records concerning victualling of the english fleet during that historical period. Though the bones testify to the almost exclusive presence of processed cod, the biased skeletal spectra and other features of the samples prevent a detailed evaluation of specimens present as well as an estimation of their sizes.

KEYWORDS: FISH, COD, *Gadus morhua*, DIET, PROCESSING, TUDOR PERIOD, ENGLAND, HISTORICAL RECORDS

RESUMEN: Los restos de peces recuperados en las bodegas del buque de guerra inglés *Mary Rose*, hundido en 1545 en el puerto de Portsmouth, son evaluados a la luz de la documentación histórica de que se dispone sobre el avituallamiento y las ordenanzas de armada inglesa de ese periodo. Si bien los restos coinciden en señalar una dominancia de bacalao procesado con vistas a un consumo a medio o largo plazo, las características de la muestra ósea impiden una evaluación efectiva de número de ejemplares y de sus tamaños.

PALABRAS CLAVE: PESCADO, BACALAO, *Gadus morhua*, DIETA, PROCESADO, PERIODO TUDOR, INGLATERRA, REGISTRO HISTORICO

During the reign of Henry VIII (1509-1547 AD) the English naval fleet expanded from a mere 5 ships to over 80. In July 1545 this large and effective navy was defending the south coast against an invading French fleet (Davies, 1963). It was at this time that King Henry's previously successful warship the *Mary Rose* accidentally sank with almost all hands just outside Portsmouth harbour. The ship was carrying about 700 men and included some 300 armed infantrymen above the normal complement. Of these soldiers and sailors only 30 survived and 200 skeletons were recovered from the wreck during its excavation in the early 1980's.

The wreck lay on its side half buried in the silt until this surviving section was excavated. It was subsequently raised from the sea bed in October 1982. Although a great deal of work remains to be done, large amounts of finds have been recovered and studied including many animal bones. Over 30,000 of them were fish bones. Most of these were recovered from the stern of the vessel in an area of the orlop deck and the hold. These bones were in disarray, having been scattered with other items when the ship settled on the bottom, but remained within this storage area, some still in articulation. They had to be extracted from a matrix of fine, partially hardened, silt. As the exposed part of the wreck rotted away, that part buried in the silt was sealed by a layer of shelly clay. Beneath this were stratified deposits including the primary layers from which the bones in this study were recovered (Rule, 1983). We can be reasonably certain that all of the bones considered here were part of stores on the ship when she went down, rather than fish that had died and been incorporated in the deposits. This is confirmed on examination of the bones themselves.

Many thousands of these fragments were fin rays unidentified to species. Almost all of the other bones were identified to cod, *Gadus morhua*, and if it is accepted that the fin rays etc. were also of cod then this species constituted over 90% of the remains (Table 1). No cod jaws or cranial bones were recovered. There were, however, many cleithra (a large bone at the back of the head, behind the gills). Several of these were chopped, the cranial portion missing. The atlas (first precaudal vertebra) was absent along with most of the first 5 vertebrae. Some of the remaining precaudal vertebrae were chopped medio-laterally, so it seems the fish had been prepared by at least beheading (Table 2).

SPECIES	U4	M5	O8	O9	O10	O11	H3	H4	H5	H8	H9	H11	U/S	TOTAL
Conger conger, congrio	-	-	84	-	1	71	-	-	-	13	-	-	1	170
Gadus morhua, cod	4	1	47	1	22	729	-	162	21	25	4	2310	478	3804
GADIDAE	-	-	3	-	16	70	-	39	-	-	-	20	34	182
Unidentified	-	-	427	-	187	7186	20	2129	15	151	-	16014	458	26587
Other species	-	-	8	-	1	19	-	-	-	-	-	5	4	37
TOTAL	4	1	569	1	227	8075	20	2330	36	189	4	18349	975	30780

TABLE 1. *Mary Rose* fish bone: distribution of species. Key: U = upper deck; M = main; O = orlop; H = hold; numbered from stem to stern.

ANATOMY	Conger	Cod	Gadidae	Others	Unidentified	TOTAL
cranium/fragment	16	-	15	3	9	43
facial/opercular	68	-	3	1	1	73
dentary/premaxilla	9	-	-	-	-	9
pectoral (not fin)	2	616	91	-	72	781
precaudal vertebrae 1-5	14	-	1	2	-	17
other precaudal vertebrae	30	288	3	4	-	325
caudal vertebrae	15	2784	36	25	129	2989
vertebral fragments	16	114	33	-	400	563
other including fin rays	-	2	-	2	25976	25980
TOTAL	170	3804	182	37	26587	30780

TABLE 2. *Mary Rose* fish bone: distribution of anatomical elements.

Information about revictualling (i.e. resupplying) ships from various documentary sources had suggested the use of dried or salted cod but had not revealed whether they were with bone or filleted. This is not helped by the lack of precise information on the use of fish names, both of the species and of the end product. The term 'stockfish' in documents seems to mean dried cod but sometimes also salted cod and is possibly used as a generic term for fish prepared 'in the round', sometimes cleaned and beheaded but not completely de-boned or filleted which would normally have been the case for 'salt fish' (Cutting, 1955). 'Ling' is another confusing term which sometimes seems to mean dried cod rather than ling, *Molva molva*, while 'greenfish' was probably wet-salted cod ('green' often implies fresh, wet or unseasoned in English e.g. unsmoked bacon). 'haberdine' was probably salt dried fish, a corruption of Dutch and French words - not surprising as the records were often written by French speakers. In Southampton, for example, several merchants were Channel Islanders (Studer, 1913). We must look to Scandinavia for modern examples of this type of fish as it is almost unobtainable in England today.

The amount of fish originally on the ship is almost impossible to estimate, not least because there are still a number of silt samples awaiting processing. Large quantities of infill were sampled in order to understand the stratigraphy and processes of deposition. One big question is the amount of preparation of the fish before loading. Already we have seen that the cod were all beheaded. It is possible that different types and sources of prepared fish might differ in the methods used. Some may have had all or most of the bones removed, leaving little or no evidence. The estimation of the minimum number of cod individuals (MNI) based on cleithra is just over 100. The numbers of caudal vertebrae in cod are about 30, approximately twice the number of precaudal vertebrae. Only 288 cod precaudal vertebrae have been recovered so far as against 2,784 caudal. This would give MNI estimates of 19 and 93 respectively. If boned fillets were also present any calculation of MNI could be a considerable underestimate. Modern smoked 'Finnan' haddock and salt dried cod in Britain often contain all or part of the cleithrum similar to the findings of cod here. The vertebrae, however, are usually removed except for a short section at the tail end.

Although cod can be caught in considerable quantities locally in the Solent the fish may have been caught or traded from many sources to cope with the provisioning of such a large force. An Act of Parliament in 1542 gave free entry for fish imported from Ireland, Scotland, Orkney, the Shetlands, Iceland and Newfoundland (Cutting, 1955). The Port books and Brokerage accounts for Southampton, almost unique records of trade for this period, show that there was already a considerable trade in fish, both fresh and preserved, of all kinds in the preceding century. Records of cod and other Gadidae are common (eg. Studer, 1913; Cobb, 1961; Stevens & Olding, 1985; Coy unpublished).

State letters and papers relating to the war with France 1512-13 include lists of 'revytaylyng' for the *Regent*. This was to be for 700 men for 3 months and includes '1110 and 510 score (20) fisshe', at 2 different prices in addition to '500 dryelinges, 300 coddes and 1,000 mud-fysshe' (possibly small wet salted fish?). The list for another ship not only quotes large numbers of fish, some 'drye fisshe', some 'stokefisshe', but also 'Stepping fattys for the shippe : 2 greate fattys to water fisshe in : 2s.8d.' i.e. vats to reconstitute (steep) dried and/or salted fish (Spent, 1897). One documentary source in the British Museum for 1522 quotes a requirement of 18,000 salt fish per 3,000 men for eight weeks, being one piece a day to every 4 men on the 3 fish days in the week. What size the piece was to be is not recorded (Anon. 2.).

The observance of 'Fish days' (and Lent) is not unexpected despite the Reformation of the church - old habits have been slow to change even in the recent past, but the real reason for adherence to the laws of observance was probably economic; keeping a large number of people employed, ships built and relieving the pressure on the meat supply.

The household account books of Sir William Petre, Secretary of State, record stores for Lent in 1549 of 'haberdine 75 couple, ling 46 couple, red herring two cades (2 x 600 salted and smoked), white herring (pickled) a barrel, salted eels a barrel, salmon half a barrel and six salted congers' (Cutting, 1955). Presumably salt cod kept better than herrings :

'Spend herring first,save salt fish last:
for salt fish is good when Lent is past.'

says Thomas Tusser (1524-1580) (Cutting, 1955) and it is interesting that herring and eel bones were almost entirely absent from the wreck despite being extremely common from archaeological sites on land.

In a record for 1565 the naval victualler was contracted to supply each sailor with, amongst other things, 3/4lb (400g) stockfish per week (Davies, 1970). Samuel Pepys (of the diaries) includes in the record of a victualling contract of 1677 1/8 of a full sized 24" (60 cm) north sea cod for each man on Wednesday, Friday and Saturday and gives various alternatives including 1/4 haberdine of 16" (40 cm) (Tanner, 1920). There is an almost identical naval rations allowance of 1/8 of a 24" cod mentioned in the House of Commons journal for 1698 (Maybray King, 1968). To date I have insufficient evidence to tell whether this 24" size is with or without the head although later sources imply that the measurement is of a beheaded fish. As no atlas vertebrae were found it has not been possible to use Enghoff's regression curve on these bones in order to estimate the size of the fish (Bødker-Enghoff, 1983), nor were there any dentaries or premaxillae for the methods of Wheeler & Jones (1976). Comparison of the cod bones from the *Mary Rose* with fish in the collections of the Faunal Remains Unit, University of Southampton, imply a total length of 60-100 cm for the fresh fish, mostly around 80-90 cm. After beheading these would be around 24", depending on the butchery technique, and fit quite well with the later regulations of 24" cod. These estimates although tantalisingly similar must remain tentative as much work is still required, both in documentary research and in experimentation on modern fish. It would be most interesting to learn of any groups of cod head bones of this date for comparison.

Other fish were present in only very small quantities; conger, *Conger conger*; haddock, *Melanogrammus aeglefinus*; hake, *Merluccius merluccius*; and pollack, *Pollachius pollachius*. The 3 Gadidae were represented by single tail portions and may have been included only to make up the numbers in the consignment. The conger bones were mostly recovered from a different location on the orlop deck and may have been associated with a staved container. These fish had been butchered in a different way. They included the head and had been cut down the length of the fish, either side of the vertebral column and through the processes, presumably for the production of long flat fillets for speedier preservation; perhaps as a speciality for the captain's table? As many of the vertebral processes were found in the same group the bones probably represent the actual product rather than waste material.

As to the rest of the diet on board ship, many other animal bones were found on the *Mary Rose* including quantities of butchered pig and cattle. Again this fits well with available records of

salt beef and salt pork or bacon accompanied by beer, bread or wheaten biscuit, peas, oatmeal, butter, cheese and mustard. These last four are often listed for the 'fish days' (eg. Anon. 1.). In addition the sailors would have been able to supplement their diet with fresh fish, hand-line frames were among the finds from the ship (Steane & Foreman, 1988).

In conclusion the evidence seems to indicate the organised provision of specific types and amounts of fish as part of the regular diet on board naval ships. This precedes any records found so far of regulations to this effect. Victualling does not seem to have come under official control until 1550 (Davies, 1965). This unique find with its secure, single moment, provenance has been of great interest to historians and archaeologists alike but as usual many questions as well as answers have been raised along with the ship.

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BIBLIOGRAPHY

Anon., 1. (1731). Regulations and Instructions Relating to His Majesty's Service at Sea.

Anon., 2. Royal MSS. 7 C xvi f127 British Museum, London.

Bødker-Enghoff, I. (1983). Size distribution of cod (*Gadus morhua* L.) and whiting (*Merlangius merlangus* L.) (Pisces, Gadidae) from a mesolithic settlement at Vedbaek, North Zealand, Denmark. *Vidensk. Meddr Dansk Naturh. Foren.* 144: 83-97.

Cobb, H.S. (ed.) (1961). *The local port book of Southampton 1439-40*. University Press, Southampton.

Coy, J.P. (unpublished). Medieval documentation and the Southampton fish trade. Proceedings of the 4th ICAZ Fish Remains Working Group, York 1987.

Cutting, C.L. (1955). *Fish Saving. A History of Fish Processing from Ancient to Modern Times*. Hill, London.

Davies, C.S.L. (1963). The supply services of the English armed forces 1509-1550. Unpublished PhD Thesis. University of Oxford.

Davies, C.S.L. (1965). The administration of the Royal Navy under Henry VIII: the origins of the navy board. *English Historical Review* 80: 268-288.

Davies, C.S.L. (1970). Les rations alimentaires de l'armee et de la marine anglaises au XVIe siecle. In: Hmardinquer, J.J. (ed.): *Pour une histoire de l'alimentation*: 93-95. Cahiers des Annales, Paris.

Maybray King, H. (1968). *Before Hansard.*, Dent, London.

Rule, M. (1983). *The Mary Rose, The Excavation and Raising of Henry VIII's Flagship*. Conway Maritime Press, London.

Spent, A. (ed.) (1897). *Letters & Papers relating to the War with France 1512-1513*. Navy Records Society, London.

Steane, J.N. & M. Foreman (1988). Medieval Fishing Tackle. In: Aston, M. (ed.): *Medieval Fish, Fisheries and Fishponds in England*: 137-151. B.A.R. (British Series) 182i, Oxford.

Stevens, K.F. & T.E. Olding (eds.) (1985). *The brokage books of Southampton for 1477-8 and 1527-8*. University Press, Southampton.

Studer, P. (1913). *The port books of Southampton: accounts of Robert Florys, water bailiff and receiver of petty customs A.D. 1427-1430*. Southampton Records Society, Southampton.

Tanner, J.R. (1920). *Samuel Pepys and the Royal Navy*. Cambridge University Press, Cambridge.

Wheeler, A. & A.K.G. Jones (1976). Fish Remains. In: Rogerson, A. (ed.): *Excavations on Fullers Hill, Great Yarmouth*. East Anglian Archaeological Report 2., University of Sheffield.

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"CARPES POUR LE DUC ....:" THE OPERATION OF FISH PONDS AT LAPERRIÈRE-SUR-SAÔNE, BURGUNDY, 1338-1352

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ABSTRACT: Archaeozoological and historical investigations on the role played by fishing activities in the past are, to a large extent, complementary with archaeologists concentrating on "post-consumption" evidence and economic historians concentrating on "pre-consumption" (i.e., production and distribution) data. In order to exemplify such statement, the present paper discusses, from the standpoint of strictly documentary records, one of the most emblematic enterprises of medieval fish production systems, the operation of fish ponds, in one of the most emblematic regions of medieval Europe, the dukedom of Burgundy (France).

KEYWORDS: FISH, FISHPONDS, FRANCE, MIDDLE AGES, HISTORICAL RECORDS

RESUMEN: Las investigaciones arqueozoológicas e históricas acerca del papel desempeñado por las actividades pesqueras en el pasado son, en no poca medida, complementarias dado que los arqueólogos se ocupan de investigar la información posterior al consumo del pescado en tanto que los historiadores se concentran en los datos anteriores al consumo (es decir, lo relativo a la producción y distribución). A fin de demostrar tal aseveración, en el presente estudio se valora, desde una perspectiva estrictamente documental, una de las más emblemáticas actividades pesqueras medievales, la cría de pescado en estanques, en una de las más emblemáticas regiones de la Europa medieval, el ducado de Borgoña (Francia).

PALABRAS CLAVE: PESCADO, ESTANQUES DE CRIA, FRANCIA, EDAD MEDIA, REGISTRO HISTORICO

Fish remains examined by ichthyoarcheologists are usually recovered "samples" from what now survives of fishes humans once consumed. The evidence is precisely locatable and quantifiable but hazily dateable. From this "end product" archeologists infer antecedent taphonomic and economic processes whereby the fish had been disposed of, eaten, prepared, distributed, and produced or captured — to say nothing of the living fish population itself. Only rare finds of object identifiable as fishing gear or traces of structures like ponds or weirs give direct evidence of production.

An economic historian has much to gain from hearing archeologists extract meaningful social and ecological data from the "post-consumption" evidence. I am struck by the differences not in our intellectual processes of enquiry but in the places we begin. Our disciplines are complementary. For archeologists, consumption is easy, production hard, but for historians the reverse is more often true (Stuard, 1985). Hence I will, in turn, report to you about certain fish located precisely in time and space and counted with great care as they came out of the water en route to some of the most noble tables (and ultimately, midden heaps) in medieval France. In so doing I would establish a firm and well-documented datum or reference point for the scale, technology, and economic role of carp culture in western Europe, where the fish was not native, before the Black Death of 1348-51 and its demographic consequences set a well-known caesura in the history of the preindustrial European economy.

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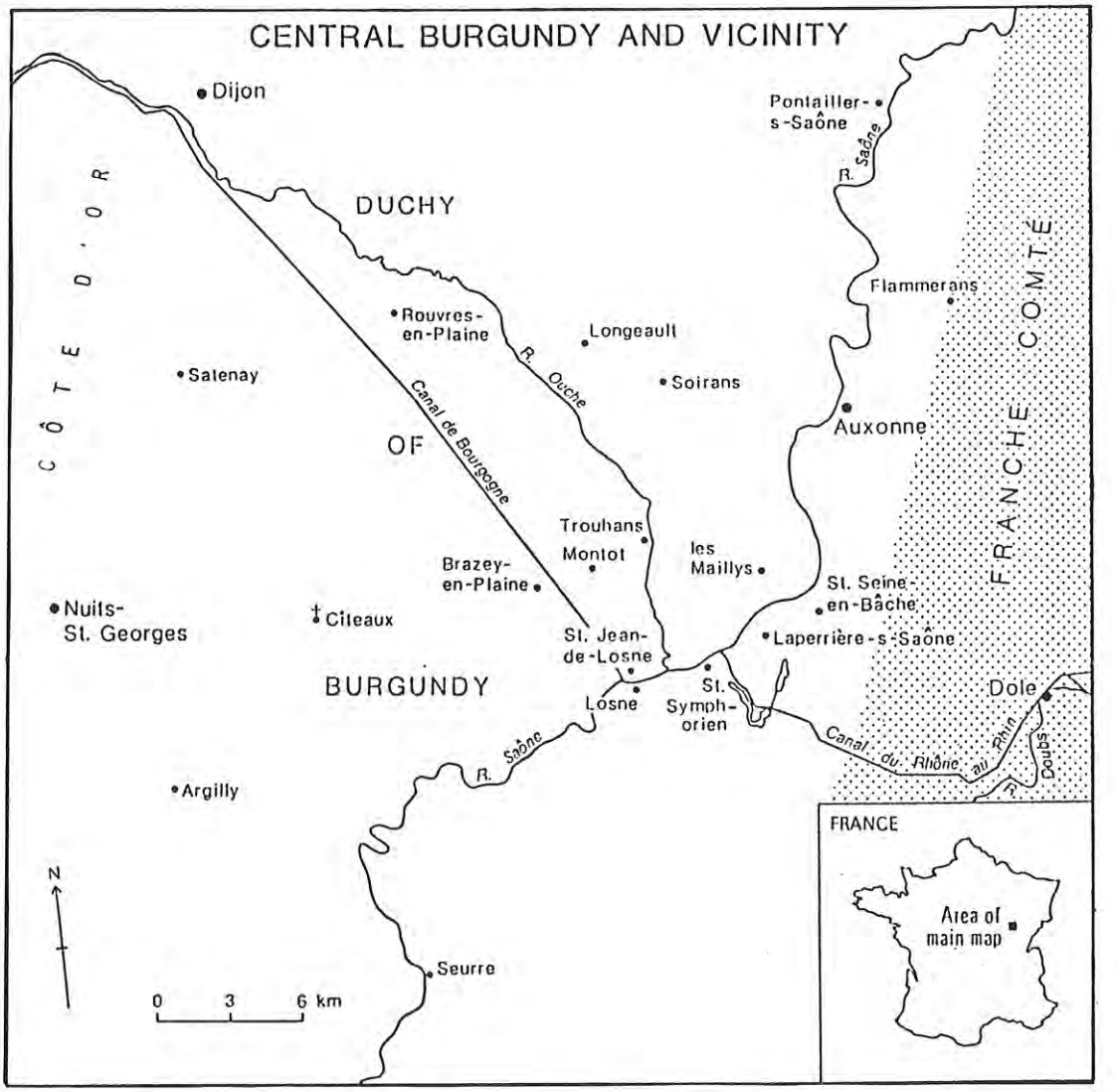
I work not with bits of bone but with pigmented markings on (in this case) dried calf skins — the account books kept in 1338-40 and 1344-52[2] for Robert de Saint Symphorien and Jean de la Roichote, successive castellans at Laperrière-sur-Saône for Eudes IV (1315-49), penultimate Duke of Burgundy from the Capetian house[3]. These officers were responsible to manage the duke's lands, rights, and affairs in a territory some 10-15 kilometers from the towns of Auxonne and Dôle along the duchy's eastern frontier with the Franche-Comté [Map 1]. By the early fourteenth century an inchoate Burgundian financial administration, the future *Chambre des comptes*, supervised the duke's local subordinates by having them keep and present for central review annual accounts of their activities.



MAP 1. Drawn by the Cartographic Drafting Office, Department of Geography, York University.

(2) Dijon: Archives Departmentales de la Côte-d'Or, B 5051 bis and B 5052. Henceforth cited by manuscript and leaf (fol.).

(3) Eudes was followed by his young grandson, Philippe de Rouvres, whose widowed mother Jeanne transferred the regency to her second husband, Jean, Duke of Normandy. Jean became King of France in 1350. Philippe died without issue in 1361.

The Chambre retained virtually undisturbed in its Dijon offices hundreds of these account books until, after the Revolution, appointed archivists of the French national state could take them over, catalog them, and preserve them for scholarly use (Jassemin, 1918: 102-41; Richard, 1954: 389-516; Rigaud, 1984: 12-16). This chain of events now lets us trace the incomes and expenditures handled on the duke's account by the mid-fourteenth-century castellans of Laperrière.

Like others of their colleagues, Robert and Jean managed for their lord some appreciable fisheries resources. Robert's account notes early on "Received from the sale of fish from the pond of St. Seine which was fished in Lent in the year 38" £203 11s from 4528 carp, £72 2s 6d for 2850 small bream sold by the hundred, and £13 for 40½ baskets of small bream (B 5051 bis, fol. 3r)[4]. In all, during that fishing season Robert accounted for 11,853 carp, 9350 small carp, 200 foot-long bream, and 2850 plus the 40½ baskets of smaller bream worth more than 657 livres, of which more than 294 livres were receipts from fishes sold. Jean then saw to the fishing of the St. Seine pond twice. As is laid out in Table 1, in 1345 it produced more than 11000 full-grown carp, 31000 young carp, and 400 pike, and in 1350 some 22000 young carp, baskets of bream, and more pike. These yields were two and more times greater than either the harvests of adult carp or the stockings of carp fry elsewhere reported from ponds in fourteenth-century France (Guérin, 1960: 131-36; Gresser & Hintzy, 1978: 140 and 148; Richard, 1983: 187-89)[5].

The pond of St. Seine no longer exists but its site can be precisely located. Two kilometers northeast of Laperrière the village of St. Seine en Bâche rests on a terrace about twenty meters above the Saône on its north and almost the same over a tributary valley on its south [Map 2]. From there that valley now curls southwest, then northwest around Laperrière, and is cut by the eighteenth-century Canal du Rhone au Rhin before emptying into the Saône between the latter village and St. Symphorien. In its ten kilometer course the valley now holds a stream draining two artificial ponds, the Etang de l'Aillon and the Etang du Milieu, and upstream between the latter and the village of St. Seine a basin called "les mareaux." The Cassini map of this region done 1744/60 [Map 3] also shows, each with its straight, man-made dam, the Etang de l'Aillon at the bottom of the valley, an unnamed pond in its middle reaches, and a third and uppermost one just south of St. Seine.

(4) Easter began the calendar year in medieval Burgundy, so what Robert thought February-March 1338 was already 1339 by modern reckoning. All remaining dates in this paper are modernized without further comment.

(5) Modern wild (feral) carp observed world-wide show no regional differences in length-weight relationships (information from McCrimmon, 1968: 12-13; Carlander, 1969: 370-80 obtained courtesy of E.J. Crossman, Royal Ontario Museum). Adults at 40 cm run about 1.5 kg (3.3 lbs) and fry aged I- about 100 g (3.5 oz). The normal length and sexual maturity of Year IV and Year V carp in fourteenth-century St. Seine pond correspond with modern records from regions with similar summer temperatures and growing seasons. If the modern weights also roughly apply, both of the complete harvests detailed for St. Seine (1339 and 1345) yielded in the range of 20,000 kg of carp. Relative to that biomass, other reported fish added very little. But note in Table 1 the consistent 1:100 ratio of numbers between pike and carp of a comparable size.

MAP 2. The St. Seine site today. Source: 1/50000, Seurre.

MAP 3. The St. Seine site ca. 1744/60. Source: Carte Cassini, feuillet 115: Dôle.

	1339	1345	1350
carp ("1 foot and 1 palm")[1]	11853	11419	-
small carp ("fry")[2]	9350	31600	22200
bream ("1 foot")[3]	200	-	-
small bream[4]	2850	-	-
smallest bream[5]	40½ baskets	-	26 baskets
pike[6]	-	112	6
small pike[7]	-	323	249

Source: B 5051 bis, fol. 9r; B 5052, fols. 10v and 40r.

(1) *Cyprinus carpio* L. Called "carpes ... la piece d'un piez et pleine palme de long," so perhaps about 40 cm (16 inches) long.
(2) Called "carpaz" or "norriens de carpes."
(3) *Abramis brama* L. Called "brames d'un piez de long cou et tete" at B 5051 bis, fol. 9r, so perhaps 25-30 cm (11 inches) long.
(4) "brames vendu au cent."
(5) "bramaz vendu au panier."
(6) *Esox lucius* L., "luz."
(7) Called "quaricales," "lancerons," and "boichoz," invariably with the three words grouped as a single label. "Quaricals," in other texts often "quarrels," looks like the word for a crossbow bolt, which were about 35 cm (15 inches) long. A "lanceron" is a lance head, and semantically related to what would become the normal French for *E. lucius*, "brochet" (as ambiguously a fish or a lance as the English "pike").

TABLE 1. Fish taken from the St. Seine pond.

The top body of water was, of course, the "Etang de St. Seine," then seemingly about 1 by 1.5 kilometers at its widest points and covering something like 80 hectares[6]. Modern physiography suggests a maximum depth of 6 to 8 meters. If these dimensions also applied in the fourteenth century, St. Seine pond then resembled in scale as it did in size of harvest the ponds managed for commercial carp production by Lower Austrian nobles about 1500 (Knittler, 1989: 155-58).

The pond at fourteenth-century St. Seine had been formed behind a dam of earth and faggots that also supported a water-powered grain mill. Its level could be controlled by a sluice with a moveable wooden gate or "stopper" which was lifted to drain the water down a wooden trough. A channel some 200 "fathoms" (*toises*) long took water diverted or drained from the pond[7]. The technology using adjustable sluices and bypass channels which is visible in the Laperrière accounts of the 1340s had been employed a century earlier in central France and in southern, but not northern, England (Devailly, 1973: 556-62; McDonnell, 1981: 35-36; Roberts, 1986: 132-35).

(6) Carte Cassini (1744-1760), feuillet 115: Dôle. This record also confirms fourteenth-century hints that the ditch now cutting through the terrace about 0.5 km west of St. Seine is a recent construction. Ponds of l'Aillon and Milieu are well-recorded in the castellans' accounts, the latter with the lexically equivalent name "Moitant." See, for instance, B 5051 bis, fols. 9r, 15r; B 5052, fols. 6r (with explicit reference to "les 3 estangs de la Perrière"), 10v, 34r, 35v, and 47r-47v. For unknown reasons their fisheries are never there accounted in detail.

(7) Dams and mills: B 5051 bis, fols. 14v and 20r; B 5052, fols. 3v, 24r, 33r, 34v, 37v, and 49v. The accounts repeatedly (e.g., B 5051 bis, fols. 15r, 20r; B 5052, fols. 3v, 34v) specify that the *paule* of the *tou* was lifted to release the water. In the dialect of early twentieth-century peasant fish culturists in the Dombes, a district some 90 km south of Laperrière, the latter term denoted the entire sluicegate construction (Egloff, 1937: 85). The wooden *paule*, plainly the gate or stopper itself, was made by a local carpenter but 4 men were needed to set it in place (B 5052, fol. 4v). Also mentioned are troughs (*auges*: B 5052, fols. 21v and 46r) of wood and purchases of timber and iron nails for repairs (B 5052, fol. 47v). For the channel (*bief*), "above and below the dam to discharge the water," see B 5051 bis, fol. 4r.

In the mid-fourteenth century the duke's officers had fish harvested from the St. Seine pond every fifth or sixth year: 1339, 1345, and 1350. Each time they did this during the season of Lent, the six late winter and early spring weeks before Easter, when proper religious observance forbade meat to Christians. In 1345 the workers had to break ice on the pond in order to lift the sluice gate and begin letting out the water on 22 January; they started taking fish on 2 February. Other harvests began on the third and the 22d of the same month. Fishing continued well beyond Easter to dates between mid-April and late May. The longest season accounted covered 116 days but the account for 1345 specifies that 36 were not worked; the shortest was 73 days[8].

A special team of paid workmen was assembled, comprising three or four fishers with their chief, Regnault le tarroillon, a couple of unskilled helpers, and a clerk. All stayed for the duration in a purpose-built hut at the pond, and each was issued with his own newly-made pair of leather boots worth 12 sous each in 1339. They first cleared the bypass and drainage channels and prepared special wooden barriers called "crosses" to prevent the fish from escaping the pond with the waters. These Regnault and his men placed before and also in the sluice before they "lift[ed] the paule of the sluice gate" to discharge the water. As the level of the pond fell they went to work with a "large net," probably a seine, measuring 54 fathoms in length and costing a hundred sous when a new one was required in 1339. Perhaps when the water fell still further they used a long-handled dip net called a trulle[9]. Small fry for restocking went into a 30 by 40 foot storage tank the 1339 crew had excavated beside the pond. Other of their catch went into special wicker baskets or were wrapped for shipment in many yards of cloth sheets purchased in advance. Fishing techniques thus differed little from those recorded at other European pond fisheries of comparable date (Guérin, 1960: 137-40; Gresser & Hintzy, 1978: 143-46; Richard, 1986: 99-100; Roberts, 1986: 130-34)10.

As the catch was completed the pond had nearly disappeared, replaced with arable just in time to plant summer crops. The dry bed was farmed for a year in 1339-40 and two in 1350-51, yielding barley, oats, and perhaps hemp[11]. In both those seasons, too, major repairs were undertaken to the sluice and dam[12].

The mid-fourteenth-century catch from St. Seine pond went to three purposes: consumption in the ducal households, reinvestment in the duke's ponds, and market sale (Table 2). Patterns typical of each fish variety and size were modified by special situations in each year[13].

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(8) B 5051 bis, fol. 4r-4v; B 5052, fols. 4r-4v and 34v. Fishing seasons at St. Seine thus well exceeded those during the following half-century on ponds in Franche-Comté, where the harvest took only several weeks to a month (Gresser & Hintzy, 1978: 145).

(9) *Ibid.* B 5052, fol. 34v, specifies "une trulle...pour peschez a bief du dit estang pour ce que l'on n'y pouvait peschez au grand filet;" compare Wartburg (1966: 342) (with thanks to J. Richard). Size and price of the "big net" are given in B 5051 bis, fol. 4v.

(10) The "saunour de xxx piez de large et xl piez de lonc pour reposer le norien de carpaz" was made in 1339 (B 5051 bis, fol. 4v), but the baskets and "wrapping sheets" (*linceux*) are often mentioned (e.g., *ibid.* and B 5052, fols. 4v, 5r, 21v, and 34v).

(11) Field crops "from the pond of St. Seine" appear in B 5051 bis, fol. 17v, and B 5052, fols. 9v, 17r-17v, 38r-38v, and 49v.

(12) Work on the sluicegate was being done in late spring, 1340 (B 5051 bis, fol. 15r). The miller was indemnified when lack of water prevented his work in both 1350 and 1351, with the extra year plainly connected to the reconstruction of dam, sluice, and mill race still going on in August 1351. But by November 1351, the pond was refilled and restocked with fish. B 5052, fols. 34v, 37v, 46v, 47r, and 61r.

(13) Hereafter details from entries for "Missions..." in B 5051 bis, fols. 3r and 9r, and B 5052, fols. 10v, 33v, 34r, and 40r.

	CONSUMED	RESTOCKED	SOLD	TOTALS
1339				
carp large	625	7100	4528	"11853"[1]
small		9350		9350
bream large			200	200
small			2850 + 40½ baskets	2850 + 40½ baskets
value [estimated]				[£657]
1345				
carp large	11319	100		11419
small		31600		31600
pike large	112			112
small	324			324
value [estimated]				[?£1278?][2]
1350				
carp small		14000	8200	22200
bream small		26 baskets		26 baskets
pike large	6			6
small			249	249
value [estimated]	£10 14s. 3d.		£131 17s. 10d.	£366 7s 4d

Sources: B 5051 bis, fols. 3r and 9r;
B 5052, fols. 10v, 33v, 34r, and 40r

(1) *Sic* B 5051 bis, fol. 9r. Numerical total of entries is 12353.
(2) No current values or prices are given in 1345, so the value is estimated from prices in other years.

TABLE 2. Disposition of fish taken from the St. Seine pond. (Numbers are of fishes except where otherwise labelled).

Most pike and large carp but no bream were sent to residences of the duke and his family. 450 carp were shipped "pour la depense de l'ostel de Mons. le duc" in 1339. Duke Eudes split Lent of 1345 between Dijon and Dôle, so 1000 carp from St. Seine were carted the 34km and 140 the 10 km respectively to serve his needs. But the duchess that year stayed at Argilly castle about 40 km to the west, where she had delivered 10,179 large carp and 107 large pike. The large numbers of carp surely fed many ducal followers and servants, but the fewer pike likely met a more prestigious end. In 1350, the new and still preoccupied regent Jean, Duke of Normandy, though in residence at Dôle, took from St. Seine only six fine big pike[14].

Most small carp plus some bream and large carp the duke's estate managers put back into the duke's ponds to ensure their continued productivity. Most from St. Seine commonly reentered the same water just downstream in the Milieu and l'Aillon ponds. These received, for instance, more than half the carp fry caught in both 1345 and 1350 and all the bream not sold. In 1339 and 1345, however, significant quantities of carp were also shipped to stock ("empoissoner") four ponds under the control of other ducal officers. In the first year the castellan at Brasey en Plaine received 2500 full-grown and 2500 young St. Seine carp for the pond at Montot. Those fish needed to be moved only some 7-8 km, but 2800 fry in 1339 and 3600 in 1345 went about 28 km overland past Rouvres en Plaine to that castellan's Satenay pond. The prévôt at Auxonne took shipments of 2500 and 2000 fry to stock water at Flammerans and 200 adult fish for Noirot pond near Soirans. No water elsewhere, however, received as many as half the fishes taken from St. Seine or, indeed, of those placed for further growth in the other local ponds[15].

(14) Promptly eaten were probably also the 175 carp given in 1339 to the garrison commander at Laperrière for his household and the 6 sent in 1345 to M. Pierre de Bourg at Dôle.

(15) Pike from St. Seine are not recorded as artificially stocked, but some catches of wild fish were put into l'Aillon (B 5051 bis, fols. 4r and 15r; B 5052, fol. 47r-v).

What remained to be sold were some carp, small bream, and small pike in some years. No regularities are detectable in these and no buyers are named or identified. In 1339 just over a third of the large carp went for cash, in 1350 a like proportion of the small. In 1339 the small bream were all sold and in 1350 the small pike. Hence in those two years sales accounted for around a third of the probable total value of the catch, but from the intervening 1345 harvest no sales were made. Plainly mid-fourteenth-century Burgundy had markets for fish of both consumable and stockable sizes, and the duke's St. Seine pond could supply considerable numbers at times, but it was not managed to cater to that market more than occasionally (contrast Gresser & Hintzy, 1978: 146-49; Richard, 1983: 189-90; Richard 1986: 99-100).

Interpretive caution is required. Details present in the castellans' account from three consecutive fishings at St. Seine should suffice to ascertain the technical and the economic bases of the fishery. But the situation in spring, 1350, was peculiar. The plague had just savaged local peasant populations. A new and strange regent was replacing the old duke. Recent floods had damaged local hydraulic installations so extensive repairs were needed[16]. Whether for these or other reasons, the pond then was fished a year earlier than before, yielded no large cyprinids at all, and would lie dry not one year but two. Those special circumstances inhibit inferences from this third round of the cycle.

General conclusions may still be drawn, especially as to the (continued?) dominance of the ducal household economy in management of the ponds. Fish culture was practiced at mid-fourteenth-century Laperrière to put a special food on the table of the lord and his company. Visible changes in seigneurial needs induced changes in disposition of the product. The second consideration was reinvestment to assure continued production. Just as a grain farmer kept a portion of the harvest to seed the following year, the managers of the pond put the fry into other waters to grow into a future harvest. Consumption and short-term reinvestment for future consumption absorbed the lion's share of output from St. Seine. When these needs were satisfied a surplus could be sold. Sales were valuable but occasional, not the raison d'etre for rearing carp in the Burgundian duke's ponds before the Black Death. In this respect the enterprise more closely resembled that of the contemporary Bishop of Winchester than of the Count of Burgundy (Franche-Comté) in the next generation (Gresser & Hintzy, 1978: 130; Roberts, 1986: 127-30).

Rewatering St. Seine pond in autumn 1351 also called for repopulating it with fish. Indeed, only on this occasion do the castellans' accounts unambiguously record the intentional restocking of this uppermost pond in the system. During 1351-52 more than 20,000 carp fry (and some adults) were placed therein after removal from the moats (fosses) then being drained for repairs at Laperrière castle17.

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(16) Effects of plague deaths in the castellany of Laperrière are detailed for the accounting year of Martinmas 1349 to Martinmas 1350 at B 5052, fol. 32v and 42r, while reports that "l'aiguer avait gate et rompue" dams, sluices, mills, and discharge channels then are on fols. 33r and 33br. For repair work and reconstruction on St. Seine pond during 1350-52 see fols. 34v and 46v.

Duke Eudes died on 3 April 1349. On 9 February 1350 Countess Jeanne, regent for her minor son, married the royal heir Jean, Duke of Normandy, whose officials quickly assumed key posts in Burgundy. It was a turning point in Burgundian administrative practice (Jassemin, 1918: 130-31).

(17) B 5052, fols. 46v, 47r, and 59v.

Earlier evidence for intentional planting of fish in St. Seine pond is disturbingly vague, confined to a 1345 mention of fry sent from Rouvres and Auxonne "a empoissoner les 3 etangs de la Perriere," and one from 1349 where a ditch at the castle was to store fry for the same purpose[18]. Was this meant to include St. Seine? References do abound to the carting of carp fry to other ponds at Laperrière, notably Milieu ("Moitant") and l'Aillon, and elsewhere in the vicinity[19]. But the only earlier fishes seen entering St. Seine itself were "carp and fry which had climbed to there from Milieu pond" in 1339 and cost twelve sous to be put back where they belonged[20].

Certainly the pond culture then practiced under authority of castellans of Laperrière did not rely wholly on domesticated stocks and reproduction of captive fishes. In autumn 1351 an impending water shortage caused some 4000 bream, 160 small pike, and 20 carp to be taken from the St. Symphorien marshes ("les mares de St. Symphorien") and from Aulterive pond for transfer to l'Aillon. Back in 1340 the castellan even paid 52 sous for 140 *lancerons* to put into l'Aillon[21]. The evidence is thus of an incompletely artificial fish culture, but also of one engaged in impressively complex manipulation of wild and captive populations over a considerable area and several drainage (and pond) systems belonging to the duke.

One more side of Burgundian fish culture seen in the Laperrière accounts from before the Black Death is a broad relationship with local wage labour supplies. Continual use was made of both skilled and general workers.

Some individuals had become expert in pond culture. Notable among those employed at Laperrière was Master Regnault "le tarroillon"[22], who is found working around the ponds in every year of the account. Regnault had charge of the fishing at St. Seine in 1345 and 1350. He handled the construction of the storage tank for fry there in 1339, worked eight days in 1345 to install a new paule at Milieu pond, refurbished the dam at l'Aillon in 1349, and improved the channel at St. Seine in 1350. Early accounts imply that Regnault had his own assistants. Later ones recognize his special expertise. In 1350 the four fishers at St. Seine followed his leadership "under authority of the Gruyer," the ducal officer newly emerging with general responsibility for waters and forests (Vignier, 1960; Vignier, 1975: 1-5). The next year he even worked on rebuilding the duke's four ponds at Longeault, a day's journey away[23]. Master Regnault was at least on the way to becoming a specialized fisheries manager like later river keepers, pond masters, or *Vischmeister*.

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(18) B 5052, fols. 6r and 21v.

(19) Besides the stockings with St. Seine fry mentioned above, the accounts for 1350-52 detail movement of young carp among the wholly separate 4-pond complex called Soherne at Longeault about 15km to the north (B 5052, fols. 41-42v and 53v).

(20) B 5051 bis, fol. 15r: Five workers took two days to remove "le norien et les carpes qui y etainent montes de lestang du Moitant."

(21) B 5052, fol. 47r-v; B 5051 bis, fol. 15r (and compare fol. 4r). Only here do the accounts refer to transfer of live pike from one water to another.

(22) Some other manuscripts (see Gresser & Hintzy, 1978: 136 note 18) spell it "terrailon," literally "earth worker".

(23) He is sometimes also called "Regnault le menestrier [the joiner or carpenter]," but collation of all references supports identification as the same individual. For the appearances mentioned and others see B 5051 bis, fols. 4r and 14v; B 5052, fols. 3v-5r, 21v-22r, 33r-35v, 38r, 47r-50r, 53r-53v, and 59v. A similar character, "Nicholas the Fisherman," ran the Bishop of Winchester's ponds in Hampshire during 1244-62 (Roberts, 1986: 131-32).

Regnault was most often mentioned at Laperrière, but fellow tarroillons like Jean Pichelin and Angrat "le Grand" Peletier also worked with him there. Another Regnault was tarroillon at Brasey en Plaine[24]. In the early 1340s these men received 1 sou a day for construction work and 1½ for fishing, but in 1349-52 after the plague their wages ran at 3 and 4 sous daily or they were paid by the job. Master Regnault got 6 livres (120 sous) and his meals for handling the fishing at St. Seine in 1350[25].

Other artisans provided needed skills and products. The fishers (*pescheurs*) mentioned with regularity were, except for the *tarroillons* themselves, less commonly identified by name — though in 1345 some were employed from les Maillys and others from St. Jean de Losne and St. Symphorien, all villages along the Saône near Laperrière. They, too, were paid in cash and meals, 35 sous each in 1339 and 25 each in 1350[26]. Other craftsmen were hired by the day or the task in most years. Estiennot "le chapus [the carpenter]" got 2 sous a day to make a new *paule* for the Milieu pond in 1344, and the smith Mathiot le Sauve from Laperrière 66 sous 8 denier for supplying 3000 iron nails in 1350. Women from several nearby villages sold baskets to carry the fish[27].

Less skilled local villagers also found work at the duke's ponds. The fishermen's helpers got only 15 sous and food for the 1339 season and some years later mere "hommes de bras" who dug earth for dams 9 deniers a day when artisans were getting 12[28]. Dozens of peasants also hauled fish to ducal residences or just from one pond to another. Local cartage paid about 4 deniers the trip in 1345, but the journey to Argilly brought 6-8 sous[29].

Though the production of the fish culture enterprises belonging to the Duke of Burgundy was still in the decade before the Black Death more dominated by concerns for household self-sufficiency than for commercial markets, their labour supply had wholly departed from older manorial models. One unintended consequence was a sharp rise in labour costs after the epidemic.

Narrow conclusions and broader research strategies may be drawn from this initial probe into details of a pre-plague fisheries account. Whatever may be inferred from these records of practice at Laperrière belongs in an ecological setting of human population pressures against resources rather than the labour shortages and higher per capita incomes characteristic of post-plague conditions. Regrettably, the evidence cannot quite sustain truly quantitative assessment of either the ecological or the economic productivity of this pond.

Fully detectable are important features of the fish production system in pre-plague Burgundy. Techniques of handling water and fish in the ponds and reliance on wage labour already ranked with the best recommended preindustrial European standards. So did the emphasis on *Cyprinus carpio*. But this exotic species in mid-fourteenth-century Burgundy recalls the still unsolved puzzle of its spread from a native range on the middle Danube into western European river basins. The diffusion was certainly associated with human agency and the technology of artificial ponds. Plainly, research priority should be placed on identification and excavation of datable artificial pond, dam, and sluiceway structures in western Europe.

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(24) See, for examples, B 5052, fols. 3v, 5r, 17v, 33br, 53r, and 62r.

(25) B 5051 bis, fol. 14v; B 5052, fols. 4v, 5r, and 34v.

(26) B 5051 bis, fol. 4r; B 5052, fols. 4r-5v and 34v.

(27) B 5051 bis, fols. 4r and 15r; B 5052, fols. 3r and 33bv.

(28) B 5051 bis, fol. 4r; B 5052, fol. 5v.

(29) Most details are for the many shipments to Argilly in 1345 (B 5052, fols. 5v-6r), but later parallels occur at, for example, B 5052, fol. 34v.

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Operation of the St. Seine pond in late Capetian Burgundy did not, however, wholly anticipate the advanced European carp culture of later centuries. Market production remained an afterthought. Captive fish stocks were still partly sustained from wild populations and by natural processes with no clear signs of artificial feeding or breeding. This relatively early evidence thus pushes explanation of key technical innovations — pond technologies and domesticated carp — back into self-sufficient seigneurial and traditional peasant economic situations. It suggests several further desiderata for research on actual fish remains. I propose identification, excavation, and study of continental European sites already known from written sources for their practice of fish culture and their extensive consumption of fish. With a view to correctly recognizing and codifying the material evidence I ask if cyprinid remains of high and late medieval date could for a time receive attention like that hitherto given cod and herring. And I call for investigation of osteological features plausibly associated with the domestication of carp (Balon, 1974: 22-23).

BIBLIOGRAPHY

MANUSCRIPT SOURCES:

Dijon: Archives Departmentales de la Côte-d'Or, B 5051 bis and B 5052.

SECONDARY STUDIES:

Balon, E. (1974). *Domestication of the Carp Cyprinus carpio L.*. Royal Ontario Museum Life Sciences Miscellaneous Publication, Toronto.

Carlander, K. (1969). *Handbook of Freshwater Fishery Biology*, Vol. 1: *Life History Data on Freshwater Fishes of the United States and Canada, Exclusive of the Perciformes*. Ames, Iowa.

Devailly, G. (1973). *La Berry du X^e siècle au milieu du XIII^e. Étude politique, religieuse, sociale et économique*. Paris.

Egloff, W. (1937). *Le Paysan Dombiste. Etude sur la vie, les travaux des champs et le parler d'un village de la Dombes*. Paris.

Gresser, P. & J. Hintzy (1978). Les étangs du domaine comtal en Franche-Comté d'apres les comptes de gruerie du XIVe siècle. *Société d'émulation du Jura. Travaux, 1975-1976*. Dôle, pp. 129-156.

Guérin, I. (1960). *La vie rurale en Sologne aux XIVe et XVe siècles*. Paris.

Jassemin, H. (1918). Le contrôle financier en Bourgogne sous les derniers ducs capetiens. *Bibliotheque de l'Ecole des Chartes* 79: 102-141.

Knittler, H. *Nutzen - Renten - Erträge: Struktur und Entwicklung frühneuzeitlicher Feudaleinkommen in Niederösterreich*. Wien.

McCrimmon, H. (1968). *Carp in Canada*. Fisheries Research Board of Canada, Bulletin 165. Ottawa.

McDonnell, J. (1981). *Inland Fisheries in Medieval Yorkshire 1066-1300.* Borthwick Papers, no. 60. York.

Richard, J. (1954). *Les ducs de Bourgogne et la formation du duché du XI^e^ au XIV^e^ siècle.* Paris.

Richard, J. (1983). Le commerce du poisson en Bourgogne et les étangs du la région Autunoise. *Mémoires de la Société Éduenne* 54: 181-197.

Richard, J. (1986). Les Etangs et la commerce du poisson en Bourgogne. In: *L'Eau en Bourgogne.* Cahiers du Centre d'etudes régionales en Bourgogne, no. 3. Dijon, pp. 97-101.

Rigaud, J. (1984). *Guide des Archives de la Côte-d'Or.* Dijon.

Roberts, E. (1986). The Bishop of Winchester's Fishponds in Hampshire, 1150-1400: Their Development, Function and Management. *Proceedings of the Hampshire Field Club and Archaeological Society* 42: 125-138.

Stuard, S. (1985). Medieval Workshop: Toward a Theory of Consumption and Economic Change. *Journal of Economic History* 45: 447-451.

Vignier, F. (1960). L'organisation forestière du duchè de Bourgogne au XIV^e^ siècle: Son application dans le bailliage de la Montagne. *Bulletin philologique et historique (jusqu'à 1610) du Comité des Travaux Historiques et Scientifiques*, année 1959. Paris, pp. 481-492.

Vignier, F. (1975). L'organisation forestière dans les bailliages d'Autun et Montcenis au XIV^e^ siècle. *Memoires de la Société Éduenne* 53: 1-20.

Wartburg, W. von. (1966). *Französisches Etymologisches Wörterbuch* 13, fascicle 2. Basel.

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OUT OF THE FRYING PAN INTO THE FIRE: WHAT VALUE ARE BURNT FISH BONES TO ARCHAEOLOGY?

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ABSTRACT: This paper examines both the effects on fish bone of heating to high temperatures and the potential information surviving for archaeologists after fishes have been burned.

Field and laboratory-based experiments were conducted using bones from a selection of fish species. Whole fishes were placed on fires which reached temperatures of up to 850°C; the colour of the bones and the representation of skeletal elements were examined. Bones were also heated in a muffle furnace to temperatures ranging from 200°-900°C and examined with regard to colour, strength and surface morphology, the last using the scanning electron microscope. The results were compared with archaeological material, and it is concluded that within limits the temperature which a bone reached during heating may be determined in an archaeological context.

Both experiments have important implications for the interpretation of archaeological burnt fish remains.

KEYWORDS: FISH, BONE, HEATING, ARCHAEOLOGY, TAPHONOMY

RESUMEN: El trabajo analiza tanto los efectos que sobre los huesos de peces produce la cocción a altas temperaturas como la información de potencial utilidad arqueológica que perdura una vez que los peces han sufrido tal proceso.

Experimentos de campo y de laboratorio, han sido realizados sobre una variada gama de pescados. Peces completos fueron colocados sobre hogueras en donde se registraron temperaturas de hasta 850°C; posteriormente, se examinaron las gamas de colores y los patrones de representatividad esquelética que presentaban las osamentas analizadas. Otros huesos fueron calentados en hornos cerrados a temperaturas que oscilaron entre los 200°-900°C calibrándose posteriormente su color, resistencia y morfología en superficie para lo cual se utilizó un microscopio electrónico de barrido. Los resultados se compararon con materiales arqueológicos concluyendo que, dentro de ciertos límites, resulta posible determinar en contextos arqueológicos la temperatura alcanzada por un hueso sometido a un proceso de calentamiento. Ambos experimentos poseen importantes connotaciones de cara a la interpretación de restos arqueológicos quemados de peces.

PALABRAS CLAVE: PEZ, HUESO, COCCION, ARQUEOLOGIA, TAFONOMIA

INTRODUCTION

Burnt bone is a common but little studied component of many archaeological sites. In some sites, where organic material is not preserved, it represents the sole evidence of animal bone (e.g. Castell Henlys; Gilchrist & Mytum, 1986). While many studies have examined the results of burning human and other large mammal bones, largely because of an interest in human cremation (e.g. Baby, 1954; Binford, 1963; Parker, 1985; McKinley, 1989) to date little attention has been paid to the effects of heating small mammal, bird and fish bones. Notable exceptions include the work of Richter (1986) who looked at the effects of cooking on fish bone collagen, and Spennemann & Colley (1989) who undertook limited field experiments.

In most archaeological instances burnt bone represents the direct exploitation of fish by man as food. Bone displaying evidence of heating is unlikely to have become incorporated into archaeological deposits by "natural" events. In most cases burnt bone probably originated either intentionally, as a result of rubbish disposal of unpleasant objects, or accidentally, during cooking.

This paper presents the results of field and laboratory experiments looking at the effects of burning bone in a natural, variable environment and under more controlled and carefully monitored

conditions in the laboratory. The experiments were designed to compare the effects of burning on skeletons from a selection of animals, including mammals, bird and fish, as well as between carcasses subjected to different methods of preparation, for example filleting, boiling and baking. Only the results of burning fish bones are presented in this paper. The work formed part of a more general investigation into the effects of a range of pre-depositional processes on animal remains (Nicholson, 1991). Within this taphonomic framework explanations are sought for variability within the archaeological record.

The major questions which this paper addresses are:

1. How much variation is there in the state of combustion of animal remains within a fire?

2. How much of the skeleton survives after burning? Do certain elements predictably survive or fail to survive?

3. Does the condition of the body before burning affect the way in which the bone will burn, and so can the state of the body be determined from the burnt remains?

4. Are the bones of different species differently affected by burning?

5. How well does the colour/temperature scale proposed for human and other large mammal remains apply to fish remains?

6. Can the temperature of burning be established from the surface morphology of fish bones, as is proposed for mammal bone?

7. What implications are there for the survival of heated bone?

METHODS AND MATERIALS

A. Field Experiments

Three fires were built, each in a shallow (200-300 mm deep) scoop of 1 m^2 area. The bases were lined with locally available sandstone slabs, and six glass marbles were placed at the base of each fire, one in each corner and two in the centre. These were used as a very crude guide to the temperature at the base of the fire, as glass begins to melt at 500°-550°C (Spennemann & Colley, 1989). A more precise indication of the fire temperature was obtained by a digital readout thermometer, the probe of which was placed approximately in the centre of each fire. The wood used on the fires was from a variety of sources, and from a wide range of tree species; much of the wood was driftwood, and some had been treated with preservative. All the fires were lit when the air temperature was 19°C and there was a slight breeze.

A variety of fish and fish remains were used; for a list of species and treatments see Table 1. Three fires (here referred to as Fire 1, 2 and 3) were used in order to keep separate individuals of the same species which had been prepared differently. With the exception of a complete haddock *Melanogrammus aeglefinus* all the fish and fish bones were thrown in after the fire had been alight for 15-20 minutes. The haddock was added after the fire had been alight for one hour. Temperatures were read every 15 minutes, although problems with the digital readout thermometer caused some readings of the Fire 1 to be missed (Figure 1).

Each fire lasted from 200-230 minutes. After the fire had cooled completely the ashes were carefully collected and sieved to 1 mm.

FIRE 1	
	One complete herring, total length 290 mm.
	One complete cod, total length 380 mm.
	One complete plaice, total length 350 mm.
	One filleted haddock frame, total length 370 mm.
	A selection of dry cod bones, from a fish of 600 mm total length, comprising: a complete cranium, one maxilla, two quadrates, two hyomandibulars, two palatines, one ectopterygoid, two ceratohyals, two epihyals, two hypohyals and one first vertebra.
FIRE 2	
	One boiled cod, total length 395 mm, boiled for 1 1/4 hours.
	One baked herring, total length 300 mm, baked at 200°C for 10 minutes.
	One filleted plaice frame, total length 360 mm.
FIRE 3	
	One filleted cod frame, total length 450 mm.
	One filleted herring frame, total length 290 mm.
	Four complete long rough dabs, total lengths 145-155 mm.
	Twenty complete whiting, total length 175-200 mm.

TABLE 1. Fish and Fish Remains Burned on Open-Air Fires.

B. Laboratory Experiments

Experiments were conducted in the laboratory, using a muffle furnace. In human bone work a colour/temperature scale, in which the colour of bone is related to the temperature at which it was cremated, has been generally accepted by, for example Baby (1954), Binford (1963) and Ubelaker (1978) and this scale was later verified experimentally for sheep bones by Shipman and colleagues in 1984. The scale describes the colour of bones with exposure to increasing temperatures, through brown to black at 250°-300°C, blue, grey, bluish grey, and finally white at temperatures of over 700°C. The colour achieved reflects the chemical changes which have taken place in the bone, an important determinant of which is the time of exposure to the maximum temperature.

To investigate whether the colour/temperature scale was applicable to non-mammal remains, and if so whether there was any variation in response between different types of bone, a range of skeletal elements were heated in a muffle furnace to temperatures between 200°C and 900°C, at 100 degree intervals. The tested bones included an articular, hyomandibular, opercular and 8-10 vertebrae from cod *Gadus morhua*, plaice *Pleuronectes platessa,* haddock *Melanogrammus aeglefinus,* herring *Clupea harengus* and salmon *Salmo salar*, as well as calcified vertebral centra from the dogfish *Scyliorhinus canicula.* The bones were heated for a total of two and a half hours, from cold, at which point previous trial experiments indicated that the remains had reached the maximum colour change which would be achieved at a given temperature.

To examine the effect of heating bones when oxygen was limited, similar groups of bones were heated under 30 mm of silver sand in a crucible with a fitting lid. The same temperatures were used as above, and two sets of experiments were run; the first heating the remains for two and a half hours, the second to five hours.

Thermometer broken 30-75 mins.

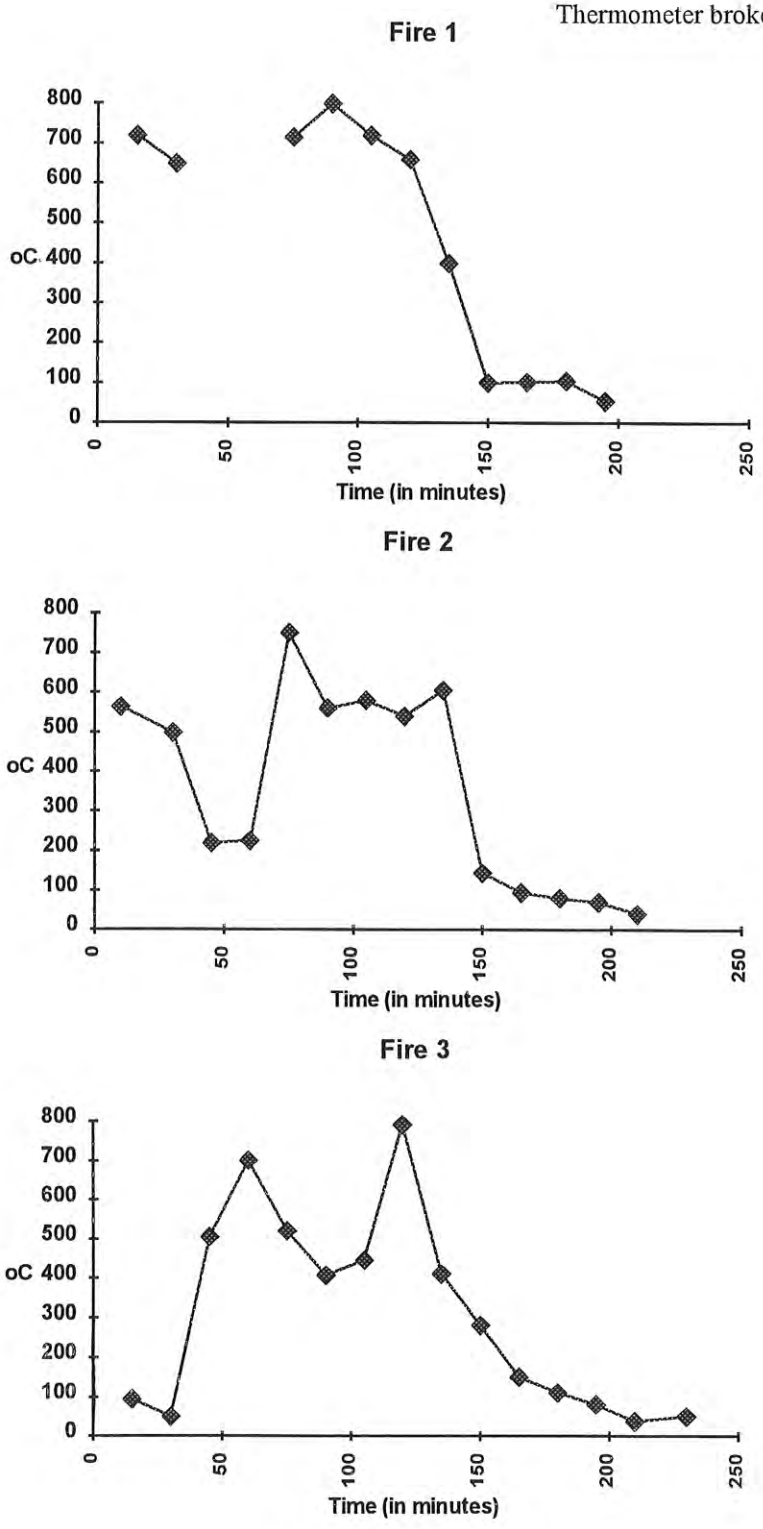


FIGURE 1. Fire temperatures.

Specimens were prepared for examination using the scanning electron microscope (S.E.M.) by cleaning with mild detergent in an ultrasonic tank, followed by brushing with alcohol and acetone, as recommended by Shipman *et al.* (1984). Fresh bones and bones heated to below 600°C were also shaken in a 1:2 mixture of methanol:chloroform for at least 12 hours to remove the extensive surface grease. Specimens were mounted on stubs and coated with gold in a Polaron coating unit to make them conductive, and viewed under the S.E.M. at magnifications from 25X to 15000X. The most useful magnifications were found to be between 1000X and 10000X. Archaeological samples from the Late Norse site of Freswick, in Caithness, Scotland (Batey, 1987) were cleaned in sodium pyrophosphate in an ultrasonic tank for ten minutes to remove adhering soil particles, and were then similarly mounted and examined.

RESULTS AND DISCUSSION

A. The Experimental Fires

i. Temperature

The temperatures for Fires 1-3 are given in Figure 1; mean readings are given, as the temperature could vary by up to 100°C during a very short space of time, depending on the movement of the flames. The maximum temperature reached by all the fires was in the range 750°C-825°C, although this temperature was not sustained for more than 15 minutes in any case. Only the glass marbles from the centre of Fire 3 showed evidence of surface melting, indicating that in all other cases temperatures at the base of the fires were never, or only briefly, in excess of 550°C.

ii. Skeletal Element Representation

The bones recovered were identified to skeletal element and species (terminology after Wheeler & Jones, 1989) and the numbers of bones recovered were compared with the number of bones in the fresh fish. Ribs, spines and rays were not counted, as identification to species is frequently very difficult or impossible. Figure 2 shows the relative abundance of skeletal elements recovered from the 20 whiting *Merlangius merlangus* and 4 long rough dab *Hippoglossoides platessoides* after burning on Fire 3, based on the expected numbers of bones. Table 2 details the recovered skeletal remains for the cod, haddock, plaice and herrings as well as for the whiting and long rough dab.

It is evident that a similar selection of skeletal elements are commonly represented in the burnt assemblages, irrespective of species or treatment of the corpse. The bones most well represented after burning were vertebrae in all cases. Bones also commonly recovered from all but the herrings were the jaw bones and jaw supports (the dentary, premaxilla, quadrate, and articular), and to a lesser degree the preopercular and post-temporal. The supracleithrum, ceratohyal, palatine and ectopterygoid were also recovered in small numbers from the gadid fish. The complete haddock (Fire 2) was added to the centre of the fire later than the other fish, after one hour, when the temperature had dropped, in a deliberate attempt to investigate the effect on the skeleton of incomplete incineration; as a result the head did not burn completely and was left as a black charred mass; however the spine was cremated entirely and most vertebrae were blue, grey or white with the paler colours found on bones towards the caudal peduncle. Some other fish were also incompletely burned;

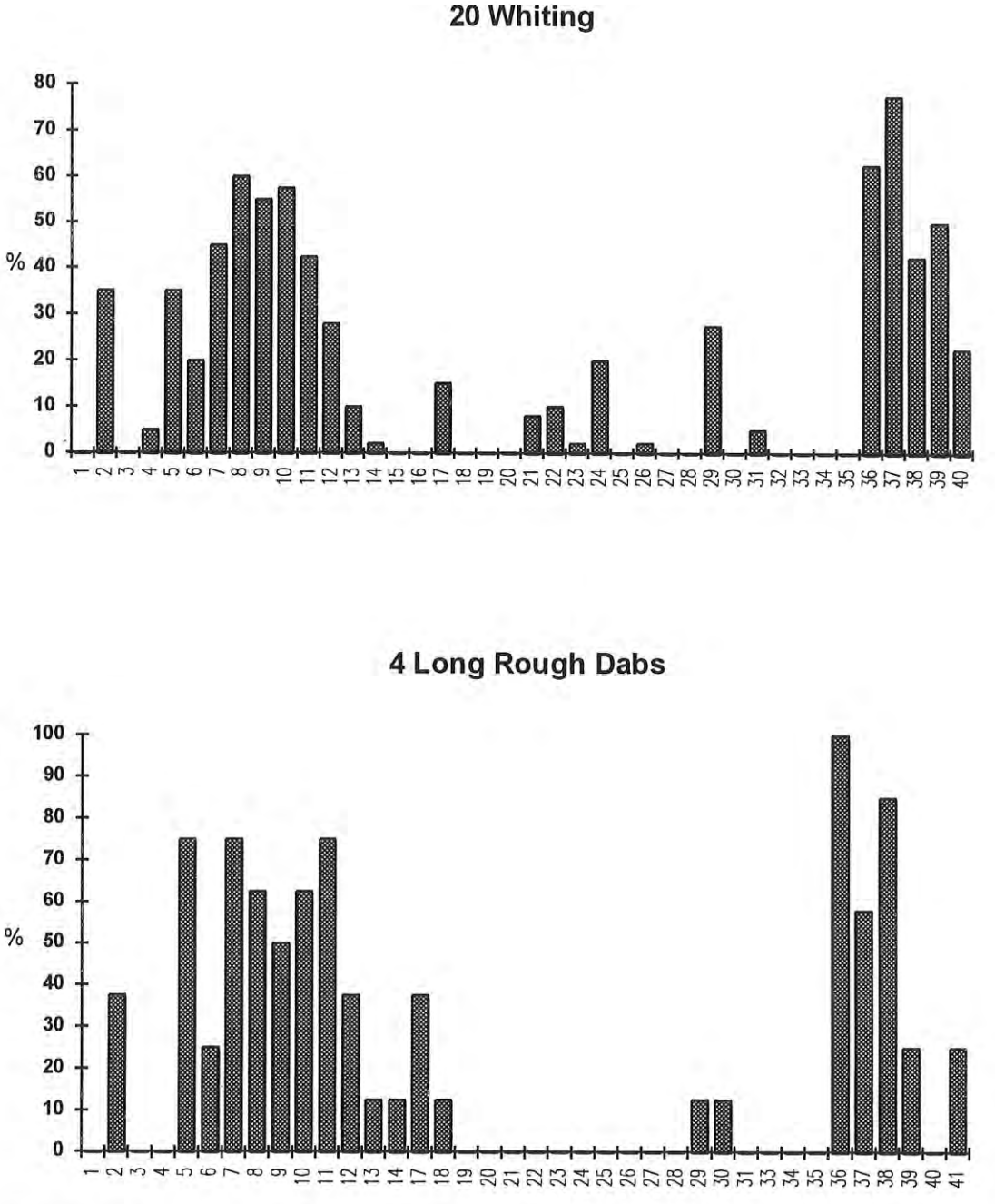


FIGURE 2. Percentage Relative Abundance of Skeletal Elements from 20 Whiting and 4 Long Rough Dab, after Burning on an Open-Air Fire. 1: Ethmoid; 2: Frontal; 3: Prefrontal; 4: Supraoccipital; 5: Prevomer; 6: Parasphenoid; 7: Basioccipital; 8: Premaxilla; 9: Maxilla; 10: Dentary; 11: Articular; 12: Quadrate; 13: Hyomandibular; 14: Symplectic; 15: Lacrimal; 16: Nasal; 17: Preopercular; 18: Opercular; 19: Subopercular; 20: Interopercular; 21: Palatine; 22: Ectopterygoid; 23: Epihyal; 24: Ceratohyal; 25: Hypohyal; 26: Infrapharyngeal; 27: Suprapharyngeal; 28: Urohyal; 29: Post-temporal; 30: Cleithrum; 31: Supracleithrum; 32: Postcleithrum; 33: Scapula; 34: Coracoid; 35: Basipterygium; 36: First vertebra (atlas); 37: Abdominal vertebra; 38: Caudal vertebra; 39: Hypural; 40: Otolith; 41: Anal pterygiophore

SKELETAL ELEMENT	No.	FIRE 1				FIRE 2				FIRE 3			
		COD C	HADDOCK F	HERRING C	PLAICE C	COD BO	HADDOCK C	HERRING BA	PLAICE F	COD F	HERRING F	WHITING C(n=20)	L.R.Dab C(n=4)
Ethmoid	2									1			
Prefrontal	2		2										
Frontal	2			1	2	1	1					2	
Prevomer	1		1				1			1		7	3
Parasphenoid	1		1	1	1							4	1
Basioccipital	1	1	1		1	1	1			1	1	9	3
Epiotic	2		2										
Prootic	2		2										
Otolith	2					1				2		9	
Premaxilla	2	2	2				2			2		24	5
Maxilla	2	2		1	1		1		1	1		22	4
Lachrymal	2												
Dentary	2	2	2	1	2		1			2		23	5
Angular	2												
Articular	2	2	2	2		1			1		1	17	6
Quadrate	2		1		1	1				2		11	3
Hyomandibular	2				1						1	4	1
Preopercular	2	1	2		1	1						6	3
Opercular	2	1	1						1			1	1
Subopercular	2												
Interopercular	2	1											
Palatine	2	1								1		3	
Ectopterygoid	2									1		4	
Entopterygoid	2												
Metapterygoid	2												
Symplectic	2	1	1							1		2	
Interhyal	2												
Epihyal	2		2		1					1		1	
Ceratohyal	2		1			1				1		8	
Basyhyal	2												
Infrapharangeal	2		2									1	
Suprapharangeal	6		1		4				1	1			
Urohyal	1				1				1				
Post-temporal	2		2		1		1			2		11	1
Supracleithrum	2	2	2		1		2		1	2		2	
Cleithrum	2	1	1		1		1		2				1
Posteleithrum	2												
Scapula	2												
Coracoid	2												
Basipterygium	2												
First Vertebra	1	1	1	1	1	1				1		12	4
Abdominal Vertebrae	17*	16	19	29	13	17	13	22	12	14	15	270	25
Caudal Vertebrae	33*	22	18	33	25	12	24	18	21	13	22	295	99
Hypural	1											2	
Otic Bullae (Herring only,	2			2							2		
Anal Pterygiophore Flatfish only)	1				1				1				1
Cranium**	1	1		1(Back)						1			

TABLE 2. Numbers of major skeletal elements recovered from experimental fires 1-3, compared with the numbers (No.) of the same selection of skeletal elements in a fresh fish.

(*) These figures refer to cod and whiting. Haddock have 19 abdominal and 32 caudal vertebrae, plaice have 12 abdominal and 28-30 caudal vertebrae and herring have between 51 and 58 vertebrae.

(**) These records refer to charred, incompletely burnt heads or parts of heads.

C = Complete; F = Filleted; BO = Boiled; BA = Baked; n = number of individuals (n=1 unless otherwise indicated).

lumps of black charred material represented parts of the corpse in several cases. These lumps sometimes contained dark brown, oily bones, but in many instances bones within the lumps were black, fragile and extremely difficult to separate or discern from the mass of charred flesh. The charred remains of skulls were particularly difficult to recognise, and if found archaeologically would be unlikely to be identified as fish. Looking at the whiting and long rough dabs, separating the head bones by side and counting only fragments which included the articular end, gave a Minimum Number of Individuals of 14 whiting (based on the dentary) and of 4 long rough dabs (based on the first vertebrae; a MNI of 3 was obtained from the dentary, premaxilla and articular).

The only bones to show substantial cracking and warping were those of the filleted cod on Fire 3. These were also, with the exception of the dry cod bones, the largest bones used for the experiment. Whether the distortion was a result of the higher temperatures on Fire 3, or the larger bones, is unclear. The bones of the herring and small dab and whiting recovered from Fire 3 were not noticibly distorted or cracked.

iii. Colour

Table 3 gives a summary of the major colours of the bones from Fires 1-3, by species. The proportions given are percentages of the total number of recovered bones of the fish which display the major colour.

A wide range of colours were displayed by the experimentally burned bones. The colours seemed to relate more to the position of the remains within the fire than to species or treatment of the corpse. In general, all the bones in the centre of the fire tended towards white or light grey, which is the expected colour based on the maximum fire temperatures of 750°- 825°C. Experiments by Spennemann & Colley (1989) suggest that the colour of a bone is related to its shape and density, with thin head bones attaining a lighter shade than vertebrae. This trend was not apparent from this study.

	DK BROWN	BLACK	BLUE	GREY	LT BLUE	LT GREY	WHITE
FIRE 1							
Complete Cod	0	48	1	0	0	3	49
Filleted Haddock	0	0	1	24	0	26	49
Complete Herring	0	11	8	44	8	0	29
Complete Plaice	0	1	1	22	0	12	64
Dry Cod Bones	2	0	20	9	2	2	67
FIRE 2							
Boiled Cod	0	21	7	14	14	2	42
Complete Haddock	0	36	47	6	0	9	4
Baked Herring	0	10	0	0	10	7	74
Filleted Plaice	0	11	7	11	4	20	48
FIRE 3							
Filleted Cod	0	4	12	3	7	25	49
Filleted Herring	0	0	0	2	12	48	38
Complete L.R.Dab	0	2	4	10	1	35	48
Complete Whiting	1	10	1	14	1	41	32

TABLE 3. Percentages of Major Colours on Fish Bones from Experimental Fires 1-3.

Although the whiting vertebrae did seem to be generally darker in colour than their head bones, this pattern was not observed for other fish: the caudal vertebrae towards the caudal peduncle of the haddock on Fire 1 were blue/grey while the headbones were mostly black, and the vertebrae from the boiled cod were a darker hue than most of its head bones. It is likely that the differences in colour of the whiting bones can be explained by the greater covering of flesh over the spine of the fish, protecting the vertebrae from oxygen and the maximum fire temperature for longer than the thinner covering over most of the head bones. While bone density will affect the speed at which the chemical changes which produce the characteristic colours in burned bone take place, all densities of bone should eventually reach the same colour for a given temperature, assuming an initially similar chemical composition, although the presence of soft tissue, particularly fat, will encourage combustion (McKinley, 1989).

There was no clear correlation between the proportions of mottled bones from a skeleton and the treatment of the carcass prior to burning. Although it might be expected that fleshed bones would appear more mottled than defleshed bones, due to uneven rates of heating and availability of oxygen (see below) this was not supported by the evidence. Almost half of the dry cod bones were mottled after burning on Fire 1 (Nicholson, 1991), a similar proportion to the originally fleshed cod bones, also from Fire 1. Mottling seemed to be determined more by the position of the remains within the fire than by the prior treatment of the carcass. Mottling was least frequent on skeletons where the predominant colour was white, indicating complete combustion; these skeletons were more commonly those of the smaller fish and/or those found in the heart of the fire.

B. The Laboratory Experiments

i. Colour

Table 4 gives the predominant and minor colours for the bones heated in open crucibles, and those heated under sand for two and a half and five hours; colours follow the Munsell soil colour chart notation (Munsell Colour Company, 1973).

While the results confirm that the colour/temperature scale obtained for mammal bone is broadly applicable to fish and bird bone, it was interesting that there were some differences in the colours achieved by the bones from the various animal groups. In particular, the colours achieved by fish bones at 400°C-600°C were consistently darker than the colours of mammal and bird bones heated in the same experiments, even though the fish bones were smaller and appeared to be more porous (Nicholson, 1991: 104-105). The dogfish mineralised vertebral centra crumbled on touch when heated to 700°C and above, but all other bones remained intact. There were no major differences in the colours achieved by the various skeletal elements from each species, suggesting that colour differences had more to do with the chemical composition of the bone - possibly with the amount of fat within the bone - than with differences in bone "density" or shape.

Turning to the bones heated in a reduced air supply, there was little difference in colour between the bones heated in open crucibles for two and a half hours and those heated for five hours under sand. Greater mottling occurred on those bones heated for two and a half hours under sand however, and at temperatures between 500°C and 700°C most bones were a darker hue. Presumably these bones had either not reached the maximum temperature all over or had had insufficient oxygen available to enable the chemical reactions to take place. In the complete absence of oxygen no combustion can occur. Conditions in nature are unlikely to be completely anaerobic, however, and a covering of 30 mm sand should approximate to naturally reducing conditions. In this situation, given

BONES HEATED IN OPEN CRUCIBLES FOR TWO AND A HALF HOURS

Temperature	Predominant Colour	Minor Colours
Salmon		
200°C	Strong Brown 7.YR 5/8	7.5YR 5/6, 2.5YR 5/8, 5YR 3/4, N2
300°C	Black N2	5YR 3/2,3/3, 5B 6/1
400°C	Black N2	
500°C	Black N2	10YR 3/2, 4/2, 6/2, 5YR 3/3, 5B 5/1, N4, N5
600°C	Black N2	10YR 3/2,5/2,3/1,4/2,5/1, 5B 6/1,7/1, N6, N7
700°C	Grey 2.5Y 6/0	5Y 3/1,6/1, 5B 7/1, N5, N8
800°C	White N8	
900°C	White N8	10R 6/3
Cod		
200°C	Yellowish Red 5YR 5/8	7.5YR 5/8, 2.5Y 8/2, 10YR 7/6
300°C	Black N2	
400°C	Black N2	
500°C	Black N2	10YR 3/1,4/2,5/1, 5YR 3/2, 5B 6/1
600°C	Very Dark Grey N4	10YR 3/2,4/2, N2, N5, N6, N7
700°C	White N8	N4, N5, N6, 5B 6/1, 7/1
800°C	White N8	
900°C	White N8	10R 6/3, 5G 7/2
Haddock		
200°C	Yellowish Red 5Y 5/8	5YR 4/6,3/3,3/6, N2, 10YR 6/8
300°C	Black N2	
400°C	Black N2	
500°C	Black N2	5YR 3/3, 2.5/1, 10 YR 7/2,4/1, 5B 7/1,
600°C	Dark Greyish Brown 10YR 4/2	10YR 3/1,3/3,4/1,4/3, N5, N6, N8, 5B 6/1,7/1
700°C	White 2.5Y 8/1	N6,N7, 5B 6/1,7/1
800°C	White N8	
900°C	White N8	
Plaice		
200°C	Brownish Yellow 10YR 6/6	5YR 3/2, N2, 10YR 5/8, 2.5YR 2.5/4
300°C	Black N2	
400°C	Black N2	
500°C	Black N2	10YR 3/3,4/1, 5YR 3/4,2.5/2
600°C	Black 10YR 2/1	10YR 2/2,3/1, N2, N4, N6, N8, 5B 6/1, 7/1
700°C	White 2.5Y 8/0	5B 6/1, 7/1, N6, N7, 5Y 4/1
800°C	White N8	
900°C	White N8	
Herring		
200°C	Very Pale Brown 10YR 7/3	10YR 7/6, 5YR 2/1,4/4, 2.5YR 3/6
300°C	Black 5YR 2/1	
400°C	Black N2	2.5YR 3/6
500°C	Very Pale Brown 10YR 8/4	10YR 7/3,6/2,4/3,4/4,2/2,3/2
600°C	Dark Greyish Brown 10YR 4/2	10YR 4/1,3/2,2/1, N8, 5B 6/1
700°C	White 5Y 8/1	5Y 6/1, 7/1
800°C	White N8	
900°C	White N8	
Dogfish		
200°C	Yellow 10YR 7/6	5YR 4/4, 2.5YR 2.5/2,2/0,3/4
300°C	Black N2	5Y 3/2
400°C	Black N2	
500°C	Black N2	5YR 3/4, N7, 5B 7/1
600°C	Dark Greyish Brown 10YR 4/2	N2, N8, 5B 7/1
700°C	White 2.5Y 8/0	N6,N7

TABLE 4. Major and Minor Colours for Fish Bones Heated in the Muffle Furnace. (Colours identified using the Munsell Soil Colour Chart in daylight).

	BONES HEATED UNDER SAND FOR TWO AND A HALF HOURS		BONES HEATED UNDER SAND FOR FIVE HOURS	
Temperature	**Predominant Colour**	**Minor Colours**	**Predominant Colour**	**Minor Colours**
Salmon				
200°C	Yellowish Red 5YR 4/6	5YR 3/3, 2.5/1	Yellowish Red 5YR4/6	5YR 2.5/1
300°C	Black N2		Black N2	
400°C	Black N2		Black N2	
500°C	Grey 5YR 5/1	5YR 4/1, 5/3, N2, 5B 7/1	Grey 10YR 5/1	10YR 4/1, 5B 7/1, N8
600°C	Grey N5	5YR 2.5/1,5B4/1 6/1, 7/1, N4	Bluish Grey 5B 6/1	N6,N5,5B 5/1 N8
700°C	White N8	5B 5/1, 6/1, 4/1, 5YR 2.5/1	White N8	10YR 5/1
800°C	White N8	N6, N7	White N8	
900°C	White N8		White N8	
Cod				
200°C	Dark Reddish Brown 5YR 3/2	5YR 2.5/2, N2	Dark Reddish Brown 5YR 3/2	5YR 2.5/1
300°C	Black N2		Black N2	
400°C	Black N2		Black N2	
500°C	Dark Grey 5YR 4/1	5YR 2.5/1, 2.5/2	Dark Grey N4	5YR 2.5/2
600°C	Dark Grey 5YR 4/1	5B 4/1	Grey N5	5B 5/1,6/1,7/1,N4,N8
700°C	Dark Bluish Grey 5B 4/1	5B 5/1,6/1,7/1,N8	Light Bluish Grey 5B 7/1	5B 6/1,N8 N7, N6
800°C	Bluish Grey 5B 5/1	5B 6/1,7/1,N8,5Y5/1	White N8	5B 7/1, 6/1
900°C	White N8		White N8	
Haddock				
200°C	Dark Reddish Brown 5YR 3/2	5YR 2.5/2, N2	Dark Reddish Brown 5YR 3/2	5YR 2.5/1
300°C	Black N2		Black 5YR 2.5/1	
400°C	Black N2		Black N2	
500°C	Dark Grey 5YR 4/1	5YR 2.5/2, 2.5/1	Dark Grey N4	10YR 2.5/2
600°C	Dark Grey 5YR 4/1	5B 5/1, 5YR 2.5/1	Grey N5	N4,10YR 5/1,5B 6/1
700°C	Dark Bluish Grey 5B 4/1	5B 5/1, 5YR 2.5/1	Bluish Grey 5B 6/1	5B7/1,N8
800°C	Bluish Grey 5B 5/1	N8, 5Y 5/1	White N8	
900°C	White N8		White N8	

TABLE 4 cont.

sufficient time all bones should eventually reach the same temperature related colour as bones freely supplied with oxygen.

The mottling seen on the bones burnt under sand for two and a half hours is similar to that seen on some of the bones from the experimental fires, and also on many archaeological bones. In these situations the mottling may occur because the bones were covered by ash, or flesh, which promoted uneven conditions of heat and oxygen supply, or because the uneven and sporadic nature of the heat within a fire had resulted in uneven exposure to temperature.

ii. Surface Morphology

As the colour of bone may be altered in the soil, for example by manganese staining, iron oxide staining or deposition of other minerals within the bone (Franchet, 1933) it is useful to be able to determine burning by other means. The use of the scanning electron microscope (S.E.M.) to

observe changes in surface micromorphology on bone after heating was first documented by Shipman *et al.* (1984) who looked at modern sheep and goat bones and teeth, and concluded that temperature of burning could be established from a study of the surfaces micromorphology of bone and dentine.

Temperature	Macroscopic appearance and Microscopic Appearance through the light microscope	Microscopic Appearance - through the S.E.M. (vertebrae only)
Stage 1 20°C	The surfaces of all bones were gently undulating and continuous.	The surfaces of all bones were gently undulating and continuous.
200°C	The surfaces of the bones were similar to fresh bone. The flat areas of the head bones were brittle and cracked.	The surfaces of the bones were undulating and continuous, and very similar to fresh bone.
Stage 2 < 300°C	The surfaces of all bones were covered with a black peeling char, which was particularly thick and bubbly on the articular surfaces.	The surfaces of all the vertebrae were obscured by peeling char which formed an undulating, sometimes cracked layer on all the surfaces, even after cleaning. Beneath this layer the plaice, herring and salmon bone surfaces were undulating, but were less regular than on fresh bone. No areas beneath the char could be viewed on the other species, as even after cleaning the layer was continuous.
> 400°C		
Stage 3 < 500°C	Most bone surfaces were extensively cracked. The subchondral surfaces of the articular and opercular bones were, where not covered in char (generally at temperatures above 500°C) extensively cracked.	It is difficult to categorise the range of surface forms observed on the bones in this stage, due to the variability in form between specimens. In general, the surfaces of the vertebrae were continuous and rather lumpy, or particulate.
< 700°C	All but the herring bones exhibited radial cracks. On all vertebrae not covered in bubbly char the growth rings were clearly visible.	Some of the variation appears to be related to species; while the surfaces of the salmon vertebrae appeared lichen-like, those of cod and haddock were lumpy, while herring bones had a regular undulating surface at 500°C, which became particulate by 600°C. A variety of forms were observed on the surface of the plaice vertebrae while the dogfish centra had very fissured and lumpy appearance. After heating to 600°C-700°C the examined surfaces of all the specimens appeared frothy.
Stage 4 > 700°C	All surfaces were smooth, chalky and featureless. All but the very deep cracks have disappeared.	At these high temperatures sintering of the mineral phase of bone produced distinctive enlarged crystals, the shape of which varied between species and with condition of burning and skeletal element. In general the pattern exhibited could be decribed as nodular, although flat, polygonal plates were also observed on a salmon vertebra. Haddock and herring exhibited a regular "knitted" appearance on the specimens studied. The surfaces of plaice and dogfish fell between these two forms.
> 900°C		

TABLE 5. Heating Stages in Bones: Fish Bone Surface Macroscopic and Microscopic Morphology.

Observations under the S.E.M. on a selection of vertebrae from cod, haddock, plaice, herring, salmon and the mineralised centra of dogfish, showed similar changes, although there was some variation within the stages particularly in samples heated to above 700°C. The stages observed on the fish vertebrae under the S.E.M. and under the light microscope are detailed in Table 5. Although in general the patterns observed are similar to those documented by Shipman *et al.* (1984), their Stage 2 (185°-<285°C) was not established with confidence on the samples I examined. At above 700°C a wide range of surface morphologies were observed. These included smooth polygonal plates, similar to the surface illustrated for sheep subchondral bone by Shipman and colleagues (*ibid.*) as well as nodular surfaces similar to Shipman's cortical bone samples, and a to-date undocumented regular "knitted" pattern. Other less regular surfaces were also observed. The surface morphologies did not appear to be species-specific, and more probably reflect variations in factors including rates of cooling, atmosphere within the heating device and shape of the bone surface. All have in common the fact of enlarged crystals, as a result of the recrystallisation of the hydroxyapatite mineral after sintering. A selection of these surfaces are illustrated in Figure 3, and are compared with archaeological samples. The dogfish centra crumbled to powder at temperatures above 700°C.

Having observed the stages on freshly burnt bone, archaeological samples were examined to see whether the same surface morphologies were present. The archaeological bones examined included a range of colours, and in general the surface morphology and the colour of the bone gave a similar picture of heating temperature (Table 6). There were exceptions, however. Some samples, although appearing burned on the basis of colour (white and black) had a surface micro-morphology resembling that expected for fresh bone. It is unclear whether this is due to diagenetic changes in the bone by staining or modifications to the surface, although the surfaces appeared to be uneroded. The two ambiguous white samples appeared to be only superficially white on examination under the light microscope, however, suggesting staining, bleaching or mineral efflorescence.

SITE CODE	BONE TYPE	COLOUR	APPEARANCE	INTERPRETATION
FL80 JJ 52 4 sq1	Vertebra of Molva cf. molva	Black & Dark Brown	Gently undulating, vitreous, small nodules lie on the surface	Heated to 300-400°C
FL80 JJ 52 4 sq1	Vertebra of Molva cf. molva	Black	Irregular, continuous	Uncertain if heated
FL80 JF 39 4 sq1	Gadid Vertebra	White	Enlarged needle-shaped and and nodular crystal	Heated to 700°C or above
FL80 JF 39 4 sq1	Gadid Vertebra	White	Gently undulating, continuous	Uncertain if heated
FL80 JM/R 4 sq1	Gadid Vertebra	Black	Continuous, gently undulating	Uncertain if heated
FL80 JJ 60 4 sq1	Gadid Vertebra	White & Grey	Frothy	Heated to 500-700°C
FL80 JJ 60 4 sq1	Gadid Vertebra	Grey, White, & Light Blue	Frothy	Heated to 500-700°C
FL80 JJ 56 4 sq1	Gadid Vertebra	White	Highly particulate, some areas nodular	Heated to 600-700°C
FL80 JJ 56 4 sq1	Gadid Vertebra	Brown	Gently undulating, continuous	Not heated
FL80 JJ 56 4 sq1	Gadid Vertebra	White	Enlarged, irregular crystals	Heated to 700°C or above
FL81 2ae 132 MD1	Gadid Vertebra	Black	Some areas viscous, some irregular	Heated to 300-400°C
FL80 JJ 52 4 sq1	Gadid Vertebra	Mid Blue	Particulate	Heated to 500-600°C

TABLE 6. Archaeological Samples from Freswick Links, Scotland: Surface Apperarance with the S.E.M.

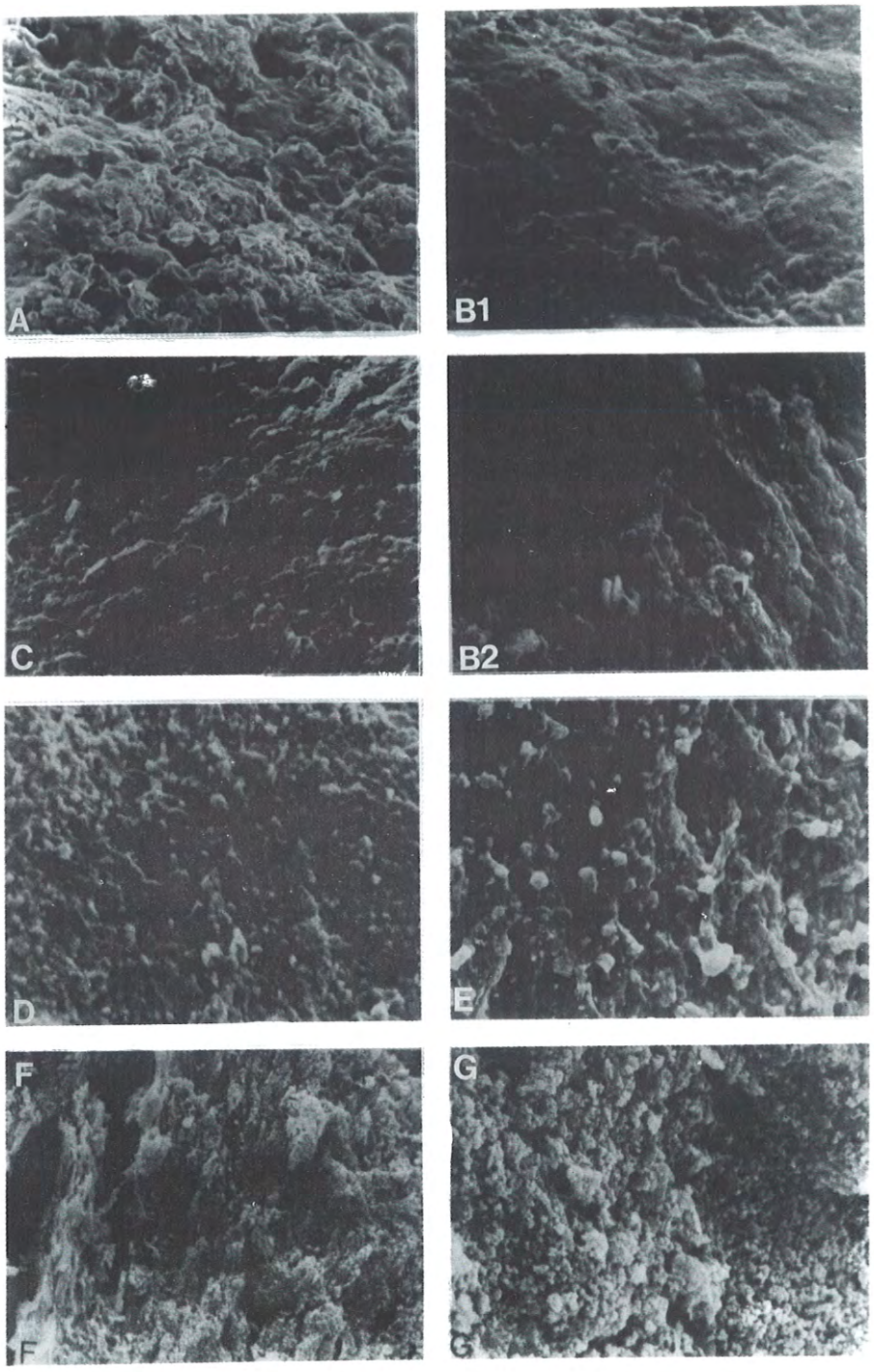
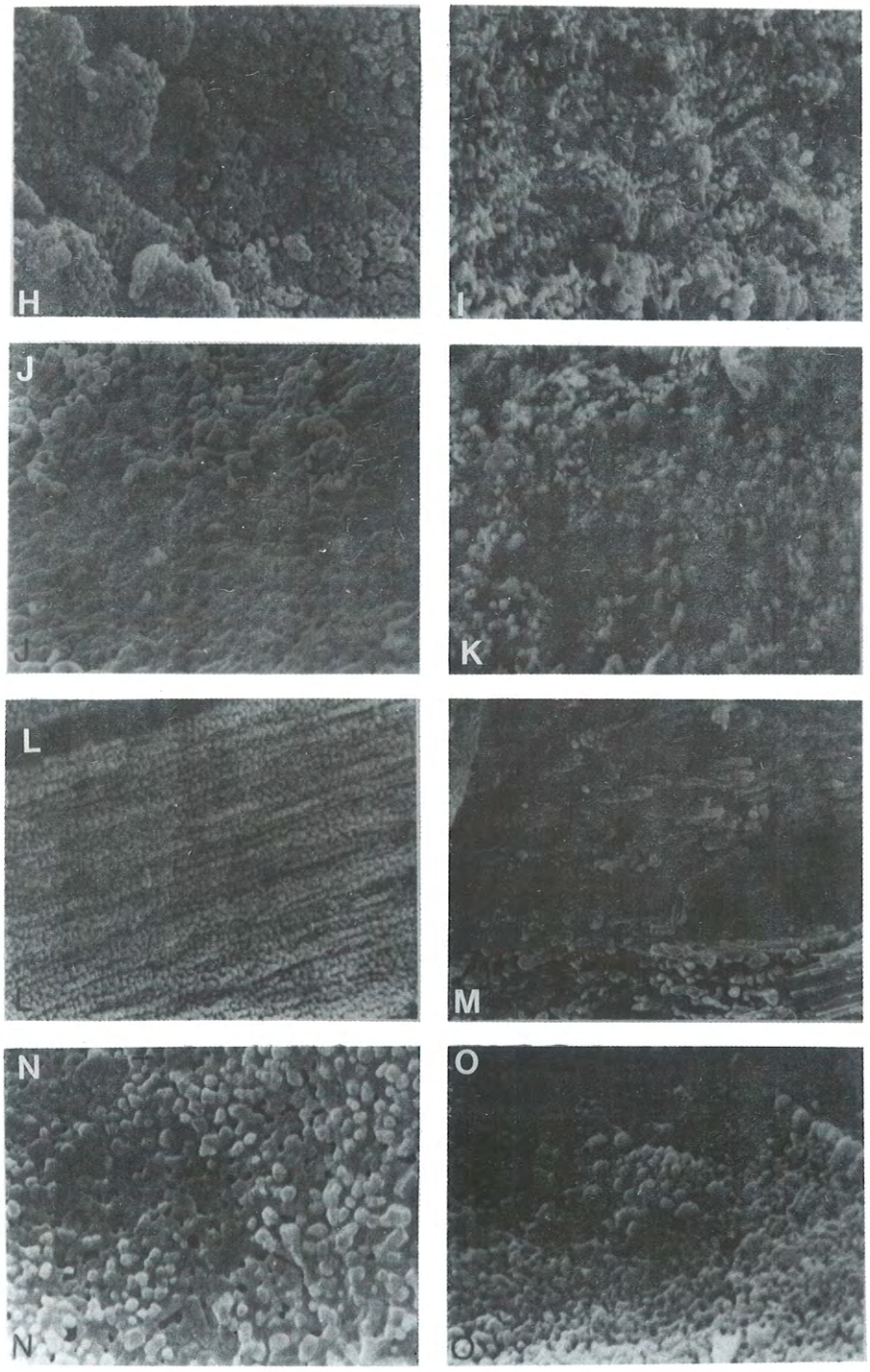


FIGURE 3. Fish Vertebrae, Surface Morphology of the Articulating Facets, Viewed through the SEM (scale bar = 1 micron). A. Contemporary cod, unheated; B1. Mid-brown gadid, from Freswick; B2. Same sample as B1, different area; C. Contemporary cod, heated to 200°C; D. Contemporary cod, heated to 400°C; E. Black and dark brown ling *Molva cf. molva*, from Freswick; F. Contemporary salmon, heated to 700°C; G. Light blue, white and grey gadid, from Freswick;



H. Contemporary haddock, heated to 900°C; I. White gadid, from Freswick; J. Contemporary salmon, heated to 900°C; K. White gadid, from Freswick; L. Contemporary herring, heated to 900°C; M. White gadid, from Freswick; N. Contemporary cod, heated to 900°C; O. Contemporary salmon, heated to 900°C.

iii. Strength

When burnt, fish remains are extremely fragile, especially thin head bones. Even if circumstances enabled them to become buried intact, excavation and sieving may destroy them. Burned material is best removed in a block of soil and carefully disaggregated in the laboratory. Once buried, changes induced by microorganisms are likely to be minimal on completely calcined bone (heated to 600°C-700°C and above). Once completely combusted, bone comprises solely mineral material (hydroxyapatite or possibly tricalcium phosphate). Incompletely incinerated bone is brown or black and contains some organic material, hence it is much more liable to attack by bacteria and fungi than completely calcined bone. Under all but the most acidic conditions charred bone is therefore likely to degrade more rapidly than completely calcined material.

To determine the strength of mammal bone heated to temperatures between 200oC and 900oC static bending tests were performed using the Instron model 1122 table testing instrument. The results indicated that bone heated to 900oC is marginally stronger in bending than bone heated to 500oC-800oC (Nicholson, 1991, 1993). This is due to the physical expansion of the hydroxyapatite crystals after sintering or vitrification, followed by recrystallisation at temperatures of about 800oC-900oC, with a corresponding decrease in pore space. Below about 500oC organic material left in the bone increases its resilience, as the strength of bone is a product of its composite structure of collagen fibres impregnated with mineral (Currey, 1984); even thermally denatured collagen appears to lend some structural support. Subjection to purely physical force (e.g. trampling) or to internal pressures due to the addition and removal and/or freezing and thawing of water (for example in bone exposed above ground or buried in the topsoil) will result in the rapid fragmentation of calcined bone, as experiments have demonstrated (Nicholson, 1991); less well burned bone will remain intact longer under these circumstances.

CONCLUSIONS

These experiments caution against using burnt bones to infer the history of a burning event. The condition of bones after burning on small open-air fires was very variable, and depended most upon the position of the remains within the fire and the degree and duration of the maximum fire temperature. Spacial variation in fire temperature was enormous; carcasses at the centre of the fire were almost all completely calcined while those towards the periphery were commonly only charred. At the periphery of the fire, the post-cranial portion of complete fish tended to burn more vigorously than the head, probably because burning fat raised the local temperature, hence vertebrae attained a paler hue than the head bones; however this result could also derive from the positioning of the animal within the fire. As this study demonstrates, even a small "campfire" may attain temperatures sufficient to calcine bones.

Although many bones were lost, or rendered completely unidentifiable by burning, a surprising number of bones survived, even from very small fish. Breakage was more common for larger bones. Vertebrae and bones of the jaw and jaw support were particularly well represented.

Looking at the surface morphology of bone burned when fresh should enable an approximate indication of the temperature reached by the bone, and can help to distinguish between burned and unburned bone in cases where colour may be equivocal. The colour and surface morphology of

individual bones can not be used to deduce the type of fire used, however, or the temperature which the fire reached. Bones from different species may not attain the same colour for a given maximum temperature, and the colour of different bones subjected to the same temperature may vary greatly depending upon the duration of the maximum temperature, size of the bone, type of the bone, and local atmospheric environment.

Because of the loss of some bone in burning, and the added complication of differential susceptibility to post-depositional destruction of bone heated to various temperatures, burnt bone clearly can not be treated in the same way as presumed unheated bone for quantification purposes. However, the preservation of even small bone after burning in a more-or-less undistorted form should allow speciation in many cases, and an approximation of fish size. In preferential circumstances of bone deposition and preservation it is possible that bone burnt in cooking may be distinguished archaeologically from bone burnt as rubbish; completely calcined bone (grey or white) would not be expected in a cooking accident, but unfortunately the reverse is not neccessarily true.

ACKNOWLEDGEMENTS

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BIBLIOGRAPHY

Baby, R.S. (1954). Hopewell Cremation Practices. Ohio Historical Society Papers in Archaeology 1.

Batey, C. (1987). Freswick Links, Caithness. B.A.R. (British Archaeological Reports) (British Series) 179. Oxford.

Binford, L.R. (1963). An analysis of cremations from three Michigan sites. *Winsconsin Archaeologist* 44 (2): 98-110.

Currey, J.D. (1984). *Mechanical Adaptations of Bones*. Princeton University Press.

Franchet, L. (1933). La coloration des os dans le sol: le bouillage des cadavres au moyen age. L'incineration et ses phenomines. *Revue Scientifique*: 483-495.

Gilchrist, R. & H. Mytum (1986). Experimental archaeology and burnt animal bones from archaeological sites. *Circaea* 4 (1): 29-39.

McKinley, J.I. (1989). Cremations: expectations, methodologies and realities. In: Roberts, C.; F. Lee & J. Bintliff (eds.): *Burial Archaeology, Current Research, Methods and Developments*: 65-76. B.A.R. (British Archaeological Reports) 211. Oxford.

Munsell Colour Company Inc. (1973). Munsell Soil Colour Charts. Baltimore, Maryland.

Nicholson, R.A. (1991). An Investigation into Variability within Archaeologically Recovered Assemblages of Faunal Remains: The Influence of Pre-Depositional Taphonomic Processes. Unpublished D.Phil. thesis, University of York, England.

Nicholson, R.A. (1993). A morphological investigation of burnt animal bone: an evaluation of its utility to archaeology. *Journal of Archaeological Science* 20: 411-428.

Parker, S. (1985). An experimental and comparative study of cremation techniques. Unpublished M.A. dissertation, Department of Prehistory and Archaeology. University of Sheffield, England.

Richter, J. (1986). Experimental study of heat-induced morphological change in fish bone collagen. *Journal of Archaeological Science* 13: 477-481.

Shipman, P.; G.F. Foster & M. Schoeninger (1984). Burnt bones and teeth: an experimental study of colour, morphology, crystal structure and shrinkage. *Journal of Archaeological Science* 11: 307-325.

Spennemann, D. & S. Colley (1989). Fire in a pit: the effects of burning on faunal remains. *Archaeozoologia* III (2.1): 51-64.

Wheeler, A. & A.K.G. Jones (1989). *Fishes*. Cambridge Manuals in Archaeology. Cambridge University Press, Cambridge.

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TRADING WITH FISH IN MEDIEVAL SWEDEN. SOME EXAMPLES FROM ARCHAEOLOGICAL BONE FINDS

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ABSTRACT: This note makes a brief overview of fish trade during medieval times in Sweden by surveying a series of fish remains finds and contextualizing them with the help of historical records.

KEYWORDS: TRADE, FISH, SWEDEN, VIKING PERIOD, MEDIEVAL PERIOD, HANSEATIC LEAGUE, PROCESSING TECHNIQUES

RESUMEN: Esta nota repasa someramente el fenómeno del comercio medieval de pescado en Suecia cotejando una serie de hallazgos arqueozoológicos con la información cultural derivada de la documentación histórica de tal actividad.

PALABRAS CLAVE: COMERCIO, PESCADO, SUECIA, PERIODO VIKINGO, MEDIOEVO, LIGA HANSEATICA, TÉCNICAS DE PROCESADO

During the last 20 years there has been an increasing number of excavations in Swedish cities and towns. At those sites animal remains usually account for a far greater volume than pottery and other artifacts. Nevertheless, fishbones seem to be clearly underrepresented in the faunal assemblages.

To a great extent, such contingency is due to the difficulties of extracting the tiny bone fragments of fish from large volumes of soil. The interpretation of the importance of fish in the household or in trade remains therefore uncertain. One of the inferences which can be usually drawn nevertheless, is that fish not occurring naturally in one area represent imported items. In Sweden the fish trade started to develop during the end of the Viking Period, i.e. 900-1050 A.D. (Niitemaa 1959 column 354 and 355) and it is known, for example, that the citizens of the medieval town of Sigtuna (Figure 2) were importing Baltic herring (*Clupea harengus*) from the archipelago outside Lake Mälaren. Later, this trade expanded and Sigtuna not only imported dried cod (*Gadus morhua*) from the west coast as well as from Norway but also dried pike (*Esox lucius*) from the northern Baltic.

FIGURE 1. Selling fish in the 16th century. Illustrated by the last Swedish Catholic Archbishop, Olaus Magnus (1490-1557), in his book "Historia om de nordiska folken" (Olaus Magnus 20: 26). The dried fish is hanging in bundles and the fishwoman is holding a big eel in her hand.

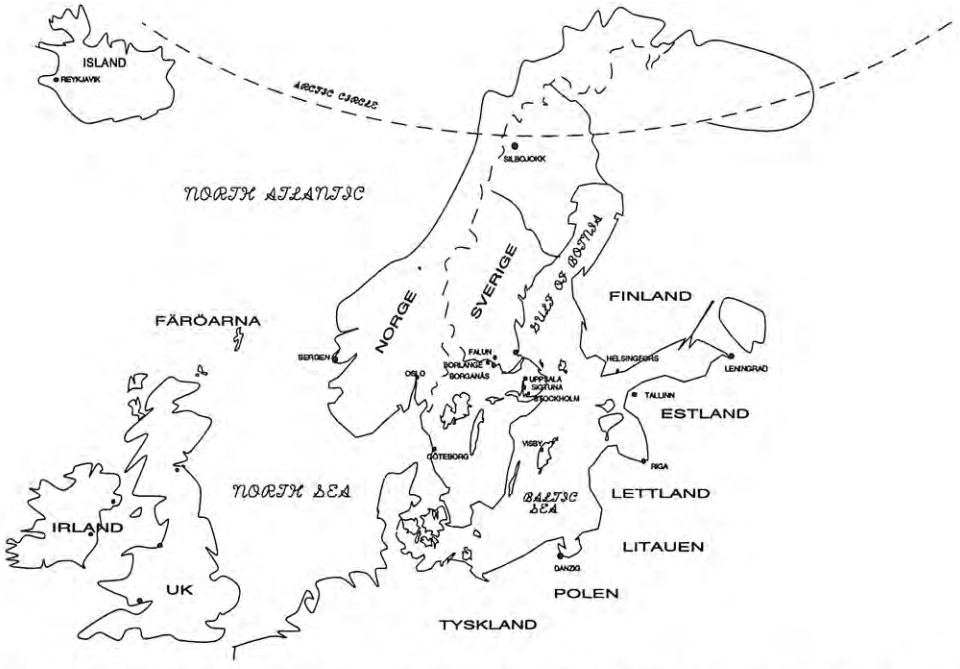

FIGURE 2. Map of Sweden. Excavations in Swedish towns where the fish bones retrieved suggest that fish was traded between the west coast and the Baltic area. (Drawing by Jon Lofthus).

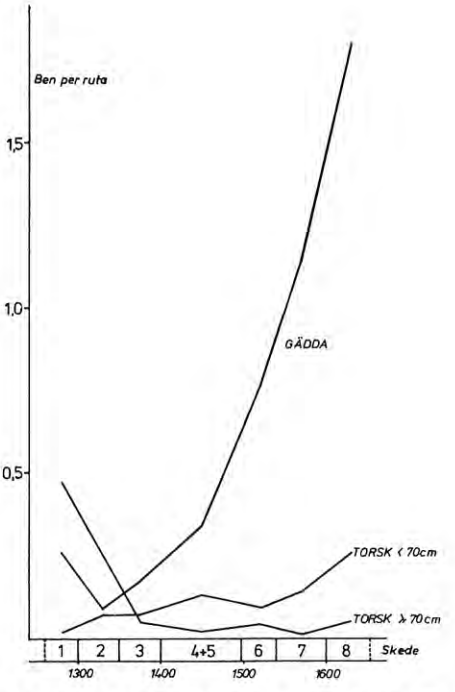

FIGURE 3. Finds of cod and pike from Uppsala levels spanning from about 1300 to 1600 A.D. The development of pike (sw. gädda) and the occurence of cod (sw. torsk) from phase (sw. fas) 1 - 8. The average number of bones per square (sw. ben per ruta) and 10 cm layer (0,4 m^3) of each fish species has been estimated for each phase (Jonsson, 1986: 135).

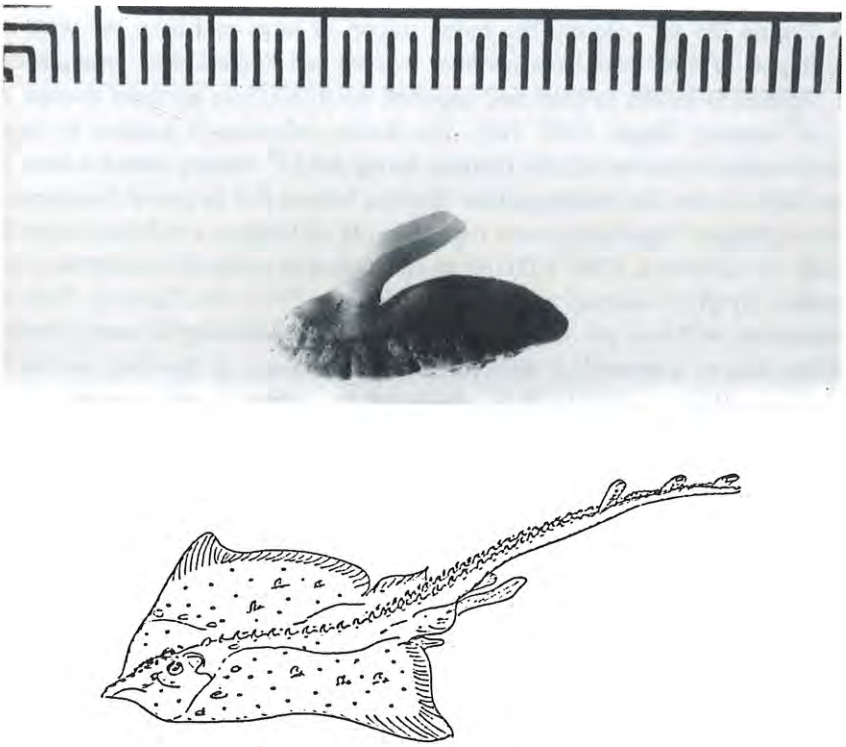

FIGURE 4. A buckler thorn from a thornback ray (*Raja clavata*) found in medieval Stockholm, shown three times its natural size. The thorns are protruding from the upper side of the body. (Photo: National Museum of Antiquities, Stockholm). (Drawing by Jon Lofthus).

Both the Hanseatic League and the church played a major role in raising the importance of fish in the diet. The League was a 13^{th}-14^{th} century medieval union of German tradesmen who were in control of foreign trade with different commodities such as day-to-day goods and exotic wares that were shipped from different sea ports (towns), not only around the Baltic, such as Wisby (Sweden) and Riga (Latvia) but also from Bergen (Norway). Dried fish was a very high ranking trade commodity in the Hanseatic League.

The church also contributed to the rise in the consumption of fish by proclaiming some 180 days of fasting a year during which the consumption of meat, but not fish, was forbidden (Järpe, 1985:124). Of the different methods of preserving fish, such as salting, smoking etc, drying seems to have been the cheapest and most commonly used (Magnus, 1555). Dried fish keeps well for a long time and it is light and easy to pack and transport. Being easy to carry without crumbling, dried fish proves to be ideal as provisions on journeys (Berg, 1974).

During the medieval period the most important exported product from Norway was dried cod, a major part of which was distributed through the Hanseatic League. The cod from the North Sea and the Atlantic is much larger than that from the Baltic Sea which rarely exceeds 1,2 m in length (Rosen & Molander, 1923: 63). The largest cod specimens can be often detected in archaeological assemblages. Thus, an excavation in medieval Uppsala yielded in the early layers bones from cods in excess of 70 cm (Figure 3). These large animals were probably imported from northwest Norway. An over-representation of vertebral centra at this site suggests that the fish had been dried (Jonsson,

1986: 133). During the 14th century the earlier import of large cod from the west coast ceased whereas the import of dried pike from northern Sweden and Finland went up markedly (Jonsson, 1986: 135). Uppsala is known to have had imported dried fish from northern Sweden and Finland during the 14th century (Järpe, 1985: 124). The drastic reduction in number of large cods and simultaneous increase in number of pike remains during the 14th century seems to have been caused by significant shifts in the fish trading pattern. We thus believe that large cod from layers postdating the 14th century (Figure 3) probably come from the Gulf of Bothnia and fishes below 70 cm come from the Baltic Sea (Jonsson, 1986: 135). At an excavation in medieval Stockholm a buckler thorn from a thornback ray (*Raja clavata*) was found (Vretemark, 1982: 291, Figure 4). This fish living in the Mediterranean as well as in the Atlantic is considered to be a delicacy for many gourmets since its meat resembles that of lobster. For different reasons remnants of this fish are rarely found in archaeological excavations. One of these reasons is that its skeleton is cartilaginous, and that the only part normally preserved is the buckler thorn which is a characteristic bony denticle. Another reason is that thornback ray was an exclusive dish that not everybody could enjoy. In an archaeological assemblage from Falun (Figure 2), dated to the year 1650, remnants of haddock (*Melanogrammus aeglefinus*, Figure 5) and ling (*Molva molva*) were found. Both species are believed to have been taken to the town from some place along the Atlantic coast, probably in west Norway (Sten, 1989a). The ling is consumed almost exclusively dried because of its rather coarse meat. It is still a Christmas tradition in Sweden to eat "Lutfisk", (i.e. dried ling softened in slaked lime and rinsed). Remains from the mid 17th century mining community of Silbojokk in Lappland (Figure 2) have been studied. They show that, in addition to local fish, cod from the Baltic was consumed (Sten, 1989b: 176). The same can be seen at two excavated forts, Grådö and Borganäs, in Dalarna (Figure 2) dated to 14th and 15th century respectively (Sten, 1988: 161-162).

FIGURE 5. Haddock (*Melanogrammus aeglefinus*). Dried haddock, like dried cod, was used in trading. Haddock usually attains a length of 50-60 cm but this specimen from Falun was about 70-75 cm SL. Here the haddock from Falun is compared with a recent haddock specimen which was about 25 cm long. (Photo: National Museum of Antiquities, Stockholm).

BIBLIOGRAPHY

Berg, G. (1974). Torkning. In: *Kulturhistoriskt lexikon* (vol. 18 column 354) för Nordisk Medeltid 1-22. Malmö 1956-1978.

Jonsson, L. (1986). Finska gäddor och Bergenfisk. Ett försök att belysa Uppsalas fiskimport under medeltid och yngre Vasatid. In: Cnattingius, N. & T. Neveus (ed.): *Uppsala stads historia VII.* Uppsala.

Järpe, A. (1985). Fiske. In: *Medeltidens ABC*. Stockholms historiska museum.

Niteemaa, V. (1959). Fiskhandel. In: *Kulturhistoriskt lexikon* (band 4) för nordisk medeltid 1-22. Malmö 1956-1978.

Olaus Magnus. Olaus Magnus, *Historia om de nordiska folken* 1-5 (1555). Uppsala och Stockholm 1909-1951 (Nytryck 1976).

Rosen, N. och A. Molander (1923). *Havsfiskar och havsfisken*. Stockholm.

Sten, S. (1988). Kosthållning och pälsjakt - osteologins vittnesbörd. In: *Bondeplågarens borg*. Riksantikvarieämbetet, Stockholm.

Sten, S. (1989a). Osteologisk analys av kvarteret Dalpilen i Falun. Osteologisk rapportserie 1989:16. Statens historiska museum.

Sten, S. (1989b). Husdjurshållning, jakt fiske i Silbojokk. In: *Silvret från Nasafjäll*. Stockholm.

Vretemark, M. (1982). Kött från husdjur och vilt, från fågel och fisk. In: Dahlbäck, G. (ed.): *Helgeandsholmen - 100 år i Stockholms ström*. Stockholm.

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SEX-RELATED CHARACTERS IN THE PELVIC BONE OF DOMESTIC SHEEP (*OVIS ARIES* L.)

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ABSTRACT: The os pelvis, in particular the thickness of the symphyses, the caudal angle between the ossa ischiae and the morphology of the os ilium from a collection of sheep with known age and sex has been examined. In ewes the os pubis develops the pecten ossis pubis as the animals become older. In rams and wethers this bone will increase in thickness although in the latter such development will be more moderate than in rams. In females the angle between the ossa ischiae will become larger with age whereas in males it will become smaller. These characters will prove of use in the analysis of sheep remains from archaeological sites.

KEYWORDS: SHEEP, PELVIS, DIMORPHISM, MORPHOLOGY, CASTRATION

RESUMEN: El trabajo analiza, en una serie de ovejas de edad y sexo conocido, la morfología de la pelvis especialmente en lo referido al grosor de la sínfisis, el ángulo caudal entre los huesos isquiáticos y la forma del ilion. En las hembras el pubis desarrolla el pecten ossis pubis a medida que el animal crece. En moruecos y carneros este hueso aumentará su grosor si bien en los segundos tal desarrollo será más moderado que en los primeros. En las hembras el ángulo inter-isquiático aumenta con la edad mientras que en los machos se opera el proceso inverso. Estos caracteres resultarán de utilidad al analizar muestras de ovino en yacimientos arqueológicos.

PALABRAS CLAVE: OVEJA, PELVIS, DIMORFISMO, MORFOLOGÍA, CASTRACIÓN

INTRODUCTION

For more than ten years a flock of gotlandic sheep has been kept at the Historical-Archaeological Research Center in Lejre, Denmark. Although the main purpose for keeping these animals was for the outdoor museum to resemble a real Iron Age farm, the sheep were also raised to become the basis of a comparative skeleton collection housed at the Zoological Museum of Copenhagen. A number of young males were castrated at different ages in order to monitor possible morphological changes on their skeleton. Up until now, 66 specimens of known sex and age from this breed have been collected. Of these 31 are males, 22 females and 13 wethers.

Partial results concerning tooth eruption, closure of epiphyses and the influence of castration on horncores have been reported elsewhere (Hatting, 1975, 1983). In this paper we will comment briefly on a series of morphological changes recorded on the pelvic bones as they relate to the castration of the specimens.

RESULTS AND DISCUSSION

A series of morphological features of the pelvis of sheep, on top of size, is known to be greatly influenced by both age and sex of the specimen as has been pointed out in studies such as those of Boessneck, Müller & Teichert (1964). Though the aim of this study was to focus on interspecific differences it did stress that the difficulties implicit in finding measurable characters were considerable so that a reliable assignal must take into account more than a single trait.

A. The os pubis

Sexual dimorphism in the os pubis is quite ample. Its thickness, for example, as recently evidenced by Barbara West (1988) is of variable magnitude, being thin in females, very thick in males and with an intermediate development in wethers.

These differences become more obvious when measurements are set up according to ontogenetical stages. In young individuals from both sexes this bone has a moderate size. With age in females the bone will become thinner and more so if the animal has been lambing. Eventually the female pelvis develops a "pecten" (Figure 1b, 1). In rams the os pubis will become progressively more robust and will develop a heavy ridge on its ventral margin (Figure 1c, 2). In wethers the bone will not be so robust and will not develop such rigde on its ventral margin (Figure 1d, 2). As a result of this the pelves of rams and ewes will progressively differ with increasing age whereas the wethers will lie between them (Figure 2).

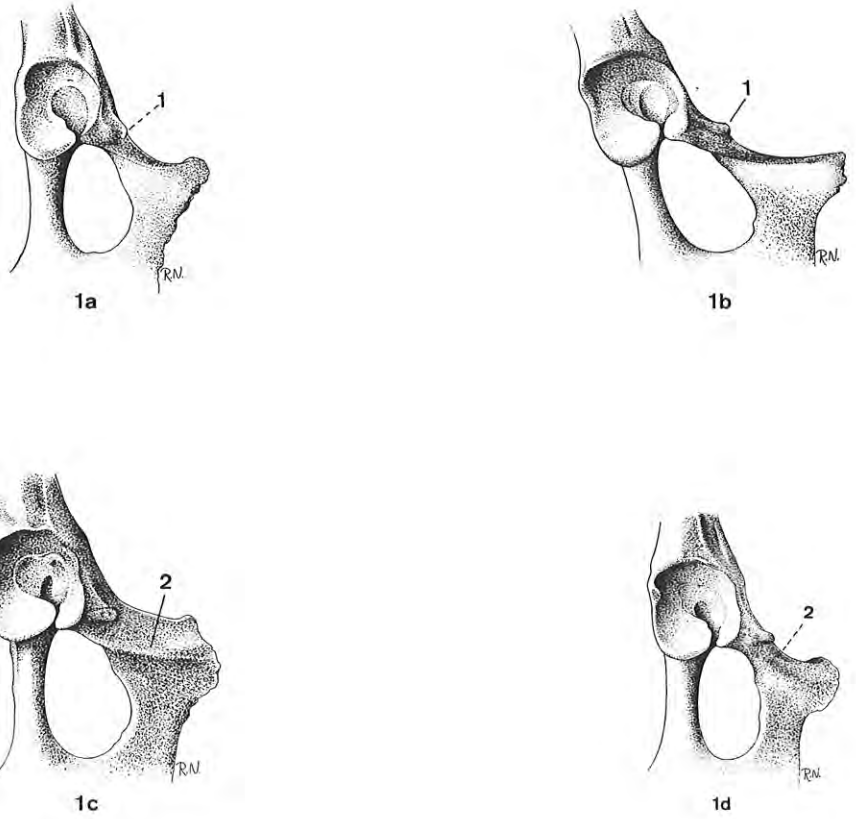

FIGURE 1. Central part of the pelvis (caudal view) [1, the pecten (a flat bony plate); 2, ventral ridge]. **a.** Young female, 1½ year old (dotted line indicates an incipient pecten). **b.** Old female, 2½ years old. **c.** Ram, 4 years old. **d.** Wether, 3 years old, castrated around the age of 3 weeks (dotted line indicates a poorly developed ventral ridge).

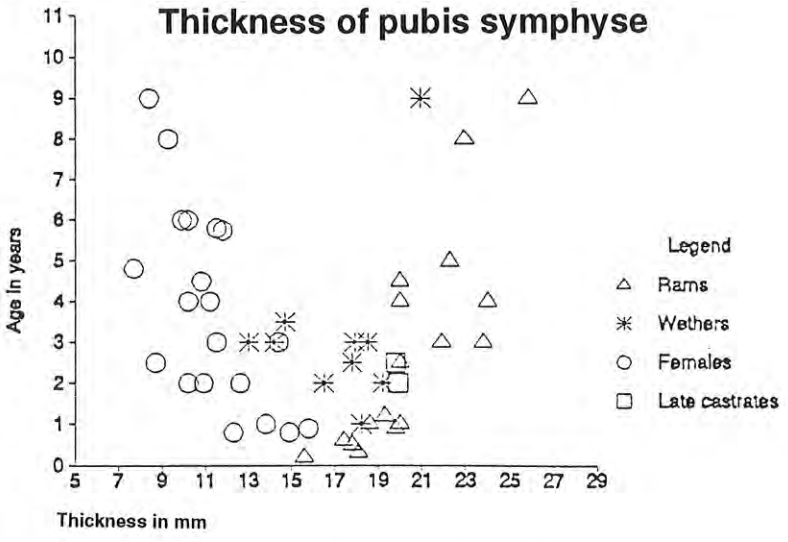

FIGURE 2. Thickness of the pubic symphysis plotted against age.

B. Interischiatic angle (Figure 4)

In young individuals (less than 1 year) the caudal angle between both ischium bones reaches about 85°. This angle will become larger in females with increasing age and oscillates between 85° and 110°. In contrast, in rams the angle will become smaller oscillating between 80° and 45°. In castrates the angle will become acute as in rams but never quite as small (Figures 3 and 4).

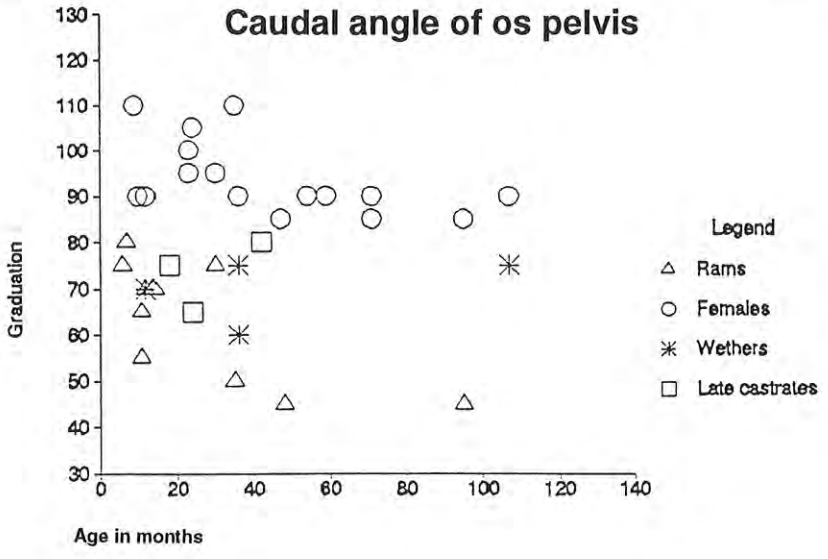

FIGURE 3. The interischiatic angle plotted against age. (Late castrates refers to individuals castrated more than half a year after being born).

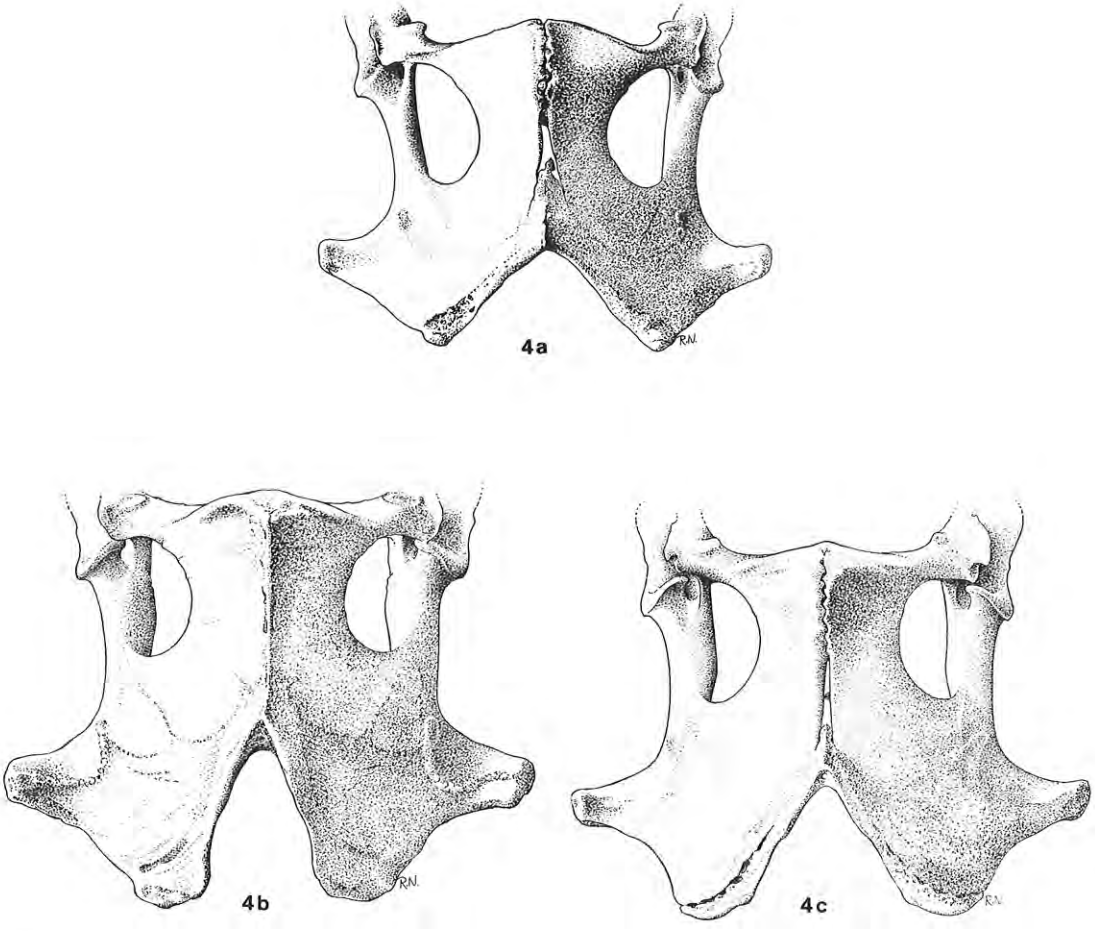

FIGURE 4. Caudal part of the os pelvis (caudal view). **a.** Female, 2½ years old. **b.** Ram, 4 years old. **c.** Wether, 3 years old, castrated around the age of 3 weeks.

C. Os ilium

Sex-related nonmetric characters can be seen in the cranial portion of the pelvic bone. In young individuals the os ilium has a triangular outline but in females the dorsal angle will become acute with increasing age. In rams this angle will be obtuse and the bone will grow heavier (Figure 5c). In wethers, although the angle tends to be more or less acute, the shape of the bone depends on the age at which the animal was castrated. In this way, males castrated at a very early age will exhibit feminine looking ilia (Figure 5e) whereas ilia from males castrated at later stages will be much more masculine in their morphology (Figure 5d).

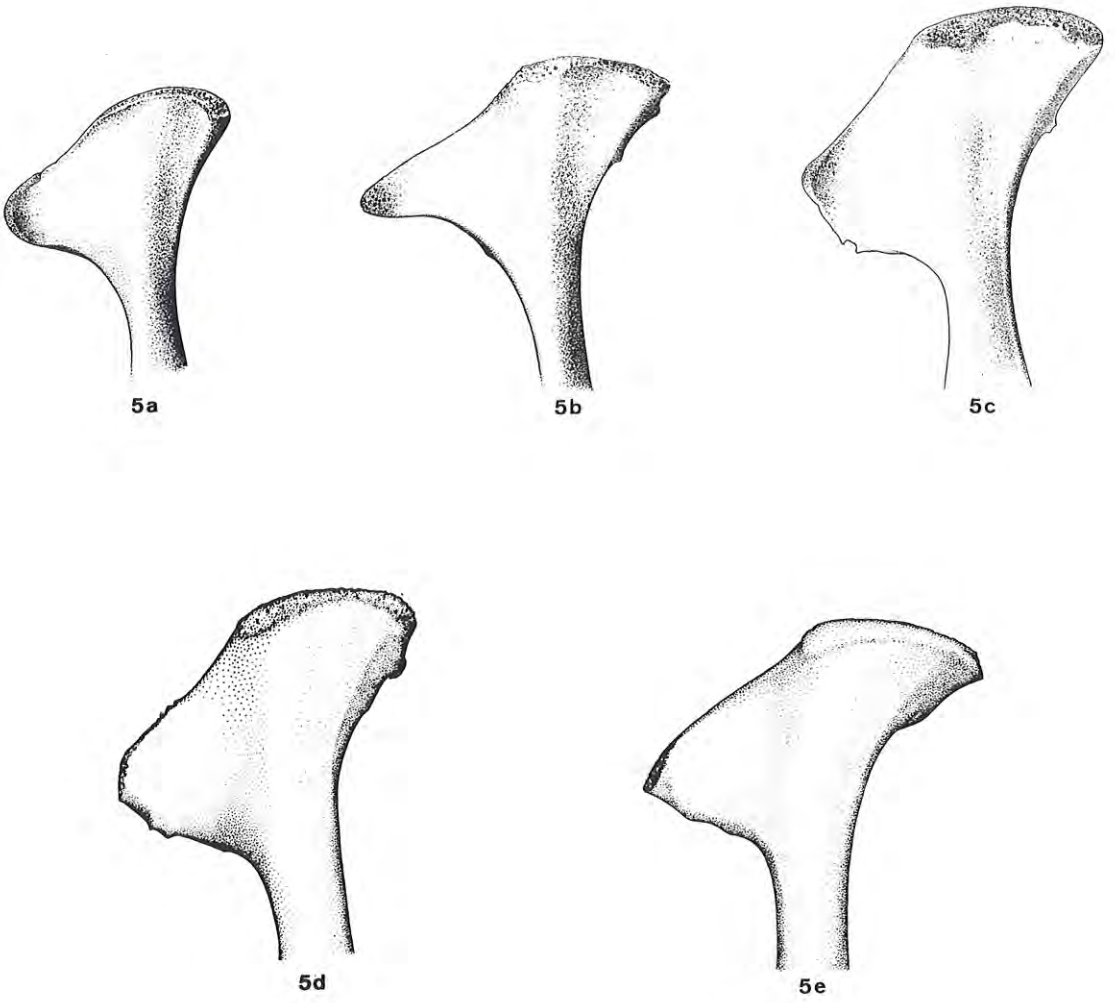

FIGURE 5. Os ilium (lateral view). **a.** Female, ½ year old. **b.** Female, 2½ years old. **c.** Ram, 4 years old. **d.** Wether, 3 years, castrated at the age of 1 month. **e.** Wether, 9 years old, castrated at the age of 1 week.

CONCLUSIONS

To decide whether a particular pelvic bone derives from a castrated animal one has to rely on several characters. The shape of the os pubis, the os ischium and the os ilium show more softly outlook on the castrates than on the non-castrates. Individuals castrated too late will exhibit more masculine characters than individuals castrated early. In young individuals there will be no sexually dimorphic differences in the morphology of the pelves.

BIBLIOGRAPHY

Boessneck, J.; H.H. Müller und M. Teichert (1964). *Osteologische Unterscheidungsmerkmale zwischen Schaf (Ovis aries Linné) und Ziege (Capra hircus Linné)*. Arbeiten aus der Landwirtschaftlichen Fakultät der Martin-Luther-Universität Halle-Wittenberg. Band 78. Heft 1/2. Akademie-Verlag, Berlin.

Hatting, T. (1975). The influence of castration on sheep horns. In: Clason, A.T. (ed.): *Archaeozoological Studies*: 345-351. Elsevier North-Holland, Amsterdam.

Hatting, T. (1983). Osteological investigations on *Ovis aries* L. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening* 144: 115-135.

Hatting, T. (1993). Fåret i Oldtid og Nutid. Forsøg med Fortiden 4. Historisk-Arkæologisk Forsøgscenter. Lejre.

West, B. (1990). A tale of two innominates. *Circaea* 6(2): 107-114.

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NUEVO HALLAZGO DE CASTOR, *CASTOR FIBER* L., EN EL SUR DE LA PENÍNSULA IBÉRICA

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RESUMEN: Se valora un resto óseo de castor de época ibérica aparecido en Ronda (Málaga, España). Sobre la base de los cortes que presenta se analiza su posible utilización como alimento. Asimismo se comentan algunas posibles implicaciones paleoambioentales derivadas de su presencia.

PALABRAS CLAVE: ANDALUCÍA, CASTOR, EDAD DEL HIERRO, PENÍNSULA IBÉRICA

ABSTRACT: A new find of beaver retrieved in Iron Age levels from the city of Ronda (Málaga, Spain) is presented and discussed from a paleocultural and paleobiological standpoint. Cutting marks indicate its use as a source of meat notwithstanding the fact that the pelt from this animal should have been also an appreciated item.

KEYWORDS: ANDALUCÍA, BEAVER, IRON AGE, IBERIAN PENINSULA

INTRODUCCIÓN

El castor es uno de los roedores más escasos de la Península Ibérica como ha quedado puesto de manifiesto en recientes revisiones sobre el tema (Alvarez *et al.*, 1992; Liesau, 1993). En este registro existen además una serie de lagunas llamativas tanto a nivel geográfico (con la mayoría de los hallazgos concentrados en la mitad septentrional del territorio) (Figura 1), como temporal ya que los hallazgos del Pleistoceno medio y superior presentan un hiato postpaleolítico que no vuelve a proporcionar evidencia hasta el Neolítico. Por todo lo que sabemos, el castor perdura en Iberia hasta época medieval como parece indicar el hallazgo de una fíbula en el yacimiento de Sant Pere de Gavá (Liesau, 1993).

FIGURA 1. Yacimientos peninsulares con restos de castor según Liesau (1993) incluyendo el resto de Ronda. **Pleistoceno med/sup**: 1-Dufaure; 2-Gatzarria; 3-Olha; 4-Lezetxiki; 5-Coscovilo; 6-Zatoya; 7-Cueva de las Hienas; 8-Els Muricecs; 9-Cueva de la Blanca; 10-Atapuerca; 11-Cueva Millán; 12-Cueva de las Figuras; 13-Cueva de los Casares; 14-Pinilla del Valle; 15-Aridos; 16-Cova Negra. **Meso/Neolítico**: 17-Cova del Barranco Hondo. **Eneolítico**: 18-La Peña; 19-Vilanova de S. Pedro. **Edad del Bronce**: 20-Sima del Ruidor?; 21-Cuesta del Negro. **Edad del Hierro**: 22-Ucero; 23-El Soto de Medinilla. **Ibérico**: 24-Ronda. **Romano**: 25-Bilbilis. **Medieval**: 26-Sant Pere de Gavá.

MATERIAL

Durante el análisis de las faunas recuperadas en una excavación urbana en el casco antiguo de la ciudad de Ronda (Málaga) se identificó un fragmento de fémur de castor (Figura 2). El nivel arqueológico al que se asocia el hueso corresponde contextualmente a una construcción de piedras (muro de una casa o terraza) de la segunda fase de época ibérica fechada en algún momento del siglo IV a.C. (Aguayo et al., 1992). La pieza se encontraba fracturada a mitad de la diáfisis y sólo conservaba su extremo distal que proporcionó una anchura distal (Ad=Bd) de 37.0 mm.

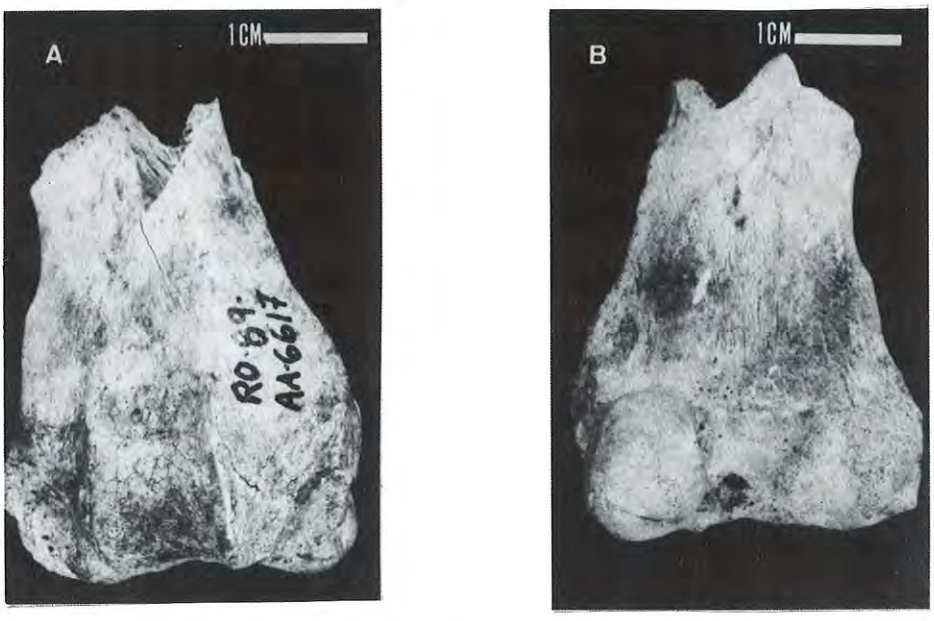

FIGURA 2. Fragmento distal de fémur en norma craneal (A) y caudal (B).

Un importante dato complementario es la presencia de una serie de cortes realizados a nivel de los cóndilos cuyo principal objetivo parece haber sido el despiece del animal y más concretamente la separación del muslo del resto de la pata posterior (Figura 3). La intencionalidad de los cortes, sin embargo, no constituyen pruebas inequívocas de su significado, si bien el desmembramiento del animal a este nivel parece ser más consecuente con un despiece tendente a un aprovechamiento de la carne que con un desollado del animal con vistas al aprovechamiento de su piel. Sabemos, a través de documentación histórica, que tanto la carne como la piel del roedor fueron muy apreciadas en la Antigüedad (Liesau, 1993) y no parecen existir razones de peso para pensar que tal aprecio no arranque de etapas protohistóricas.

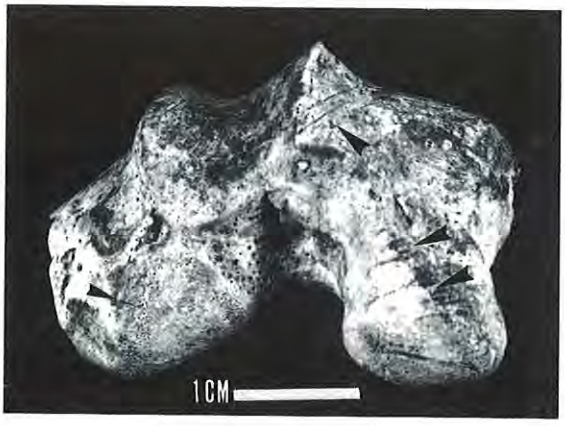

FIGURA 3. Fragmento distal de fémur en norma distal mostrando los cortes de desmembrado.

DISCUSION

Los únicos hallazgos previos de castor en la mitad meridional de la Península provienen de niveles correspondientes al Bronce Final del yacimiento de la Cuesta del Negro (Purullena, provincia de Granada). Se trata de dos fragmentos distales, uno de húmero y otro de fémur, descritos en su día por Boessneck (1974) y Lauk (1976). El fémur, con una Ad de 38.5 mm, coincide plenamente, por lo que a tallas se refiere, con el ejemplar recuperado en Ronda.

Si bien el registro fósil indica que el castor debió haber sido una especie francamente infrecuente en Andalucía (nuestra cita es la primera para Andalucía occidental) no parece ocurrir lo mismo con otras fuentes de información. Así, la existencia en las cercanías de Ronda de dos topónimos (río del Castor y río de los Castores), de indudable origen cristiano y relacionados directamente con el roedor, parecen indicar que, su presencia en la zona alcanzaría, cuando menos, el final de la época medieval. Por otra parte, el topónimo castor aparece asimismo denominando un río que nace en Sierra Bermeja, a poco más de 1.000 metros de altitud, y que, tras un corto y accidentado recorrido, desemboca en el Mediterráneo por la llamada Punta del Castor, situada entre Estepona (Oeste) y San Pedro Pedro de Alcántara (Este) siempre dentro de la provincia de Málaga (Marín *et al.*, 1986). En realidad, estos datos no resultan extraños toda vez que en la Serranía de Ronda, gracias al aporte pluviométrico que supone el paso de las borrascas atlánticas, se desarrolla, incluso en la actualidad, un bosque denso y húmedo que, además de una variada macrofauna silvestre, pudo haber albergado en su día sin mayores problemas una floreciente población de castores (Riquelme, 1994).

CONCLUSIONES

Si bien la información proporcionada no pasa del mero dato anecdótico confiamos en que la misma sirva para sentar las bases de un análisis en profundidad sobre las caracteristicas de las poblaciones de castores peninsulares así como la cronología y causas de su definitiva desaparición en Iberia.

BIBLIOGRAFÍA

Aguayo, P.; J. Castilla & B. Padial (1992). Excavaciones de urgencia en el casco antiguo de Ronda. Calle Armiñán nº 39, 41 y 43 y Aurora nº 16, 1989. Anuario Arqueológico de Andalucía, 1990/III: 339-342. Sevilla.

Alvarez, M. T.; A. Morales & C. Sesé (1992). Mamíferos del yacimiento del Pleistoceno Superior de Cueva Millán (Burgos, España). *Estudios Geológicos* 48: 193-204.

Boessneck, J. (1974). Ergänzungen zur einstigen Verbreitung des Bibers, *Castor fiber* (Linné 1758). *Säugetierkd. Mitt.* 22: 83-87.

Lauk, H.D. (1976). Tierknochenfunde aus bronzezeitlichen Siedlungen bei Monachil und Purullena (Provinz Granada). *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 6: 1-110.

Liesau, C. (1993). Contribución al estudio arqueofaunístico durante la Edad del Hierro en la Submeseta Norte de la Península Ibérica. Tesis Doctoral. Universidad Autónoma de Madrid (inédita).

Marín, F.; D. Montilla; D. López & G. Sierra (1986). Espacios naturales de la Serranía de Ronda, en Málaga. Tomo IV Medio ambiente: 1337-1390. Andalucía, Granada.

Riquelme, J.A. (1994). Estudio de la fauna recuperada en el yacimiento de Acinipo, Ronda (Málaga). Consideraciones económicas y medioambientales durante la primera mitad del II milenio. *Archaeofauna* 3: 21-51.

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SIZE INCREASE IN POST-MEDIEVAL ENGLISH SHEEP: THE OSTEOLOGICAL EVIDENCE

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ABSTRACT: From the end of the medieval period to the end of the 18th century, the economic priorities of sheep farming over much of England shifted from an emphasis on wool and milk to one which valued meat as never before. With this change in priority came attempts to increase the carcass size and to 'improve' the conformation, and many present-day breeds owe their origins to this process. A general increase in size of sheep is reported in documentary records from this period, but there is little published supporting evidence from the archaeological record. This paper draws together some biometrical data from post-medieval sheep, and shows the size increase to have been gradual, piecemeal, and a phenomenon of the late 18th-19th centuries.

KEYWORDS: BONES, SHEEP, BIOMETRY, POST-MEDIEVAL, AGRICULTURAL IMPROVEMENTS

RESUMEN: Desde finales del Medioevo hasta la conclusión del siglo XVIII, las prioridades de la cría de ovino en gran parte de Inglaterra derivaron desde usos que enfatizaban la producción de lana y leche hacia aquellos en donde la producción cárnica asumió un papel preponderante. Estos cambios de prioridades produjeron estrategias encaminadas a incrementar las canales y optimizar la aptitud cárnica, fenómenos que se sitúan en el origen de muchas de las razas actuales. Si bien los registros documentales constatan tal incremento general de tallas, el registro arqueológico del proceso es muy menguado hasta la fecha. En este trabajo agrupamos información biométrica sobre ovejas post-medievales y demostramos que la tendencia al aumento de tallas ha sido un fenómeno gradual y esporádico, que se produjo fundamentalmente desde finales del siglo XVIII y durante todo el XIX.

PALABRAS CLAVE: HUESOS, OVEJA, BIOMETRIA, POST-MEDIEVAL, MEJORA AGRÍCOLA

INTRODUCTION

Around the end of the 17th century, there were reckoned to be about twice as many sheep as people in England and Wales (Whitlock, 1978: 62), and it is a commonplace to regard the sheep as one of the cornerstones of national prosperity throughout the post-medieval period. Obviously there was substantial regional variation within the sheep population in England at any given time, but as a broad generalisation it can be said that the sheep of AD1500 was a different beast to that of 1800 or today. Through the post-medieval period, England, and to a lesser extent Wales and Scotland, saw the vigorous activities of the agricultural 'Improvers', at whose hands the appearance and productivity of the agrarian landscape was much changed. By 1630, the Earl of Bedford and his brilliant contractor Vermuyden had started work on the reclamation of the Fens, and the next few decades were to see a systematising of agricultural knowledge, and the dissemination of that information. In 1650, Richard Weston published his *Discours of Husbandrie*, and Blith's *English Improver Improved* appeared two years later. By the next decade, Forster and others were urging the use of the potato as a field crop, and Worlidge's *Systema Agriculturae* of 1669 brought ideas of mechanisation to the fore. Attention turned to livestock in Markham's *Cheap and Good Husbandry*, published in 1676. The second half of the 17th century also saw the introduction and rapid acceptance of a range of forage crops, notably turnips and legumes (Trow Smith, 1957: 256-257). It could fairly be said, then, that the period from 1650 to 1700 saw the Improvements thoroughly underway.

In parallel with the changes in drainage and cropping which were going on, new ideas about the breeding and feeding of livestock were coming in. The burgeoning urban markets encouraged the

droving of cattle and sheep, with specialist grass farmers setting up specifically to fatten driven stock to meet urban demands. Quite suddenly, cattle and sheep were seen as important for their carcass as much as for their milk, wool, dung, and labour. Improvement of the sheep was a complex affair, balancing the development of a heavier fleece against loss of wool quality, and these qualities against improved carcass characteristics. The emergence of 'Improved' sheep, as some of our earliest recognisable breeds, is an 18th century phenomenon. John Ellman began work on the Southdown breed in 1778, a couple of decades later than Allom and Bakewell's early work on the Leicester breed (Whitlock, 1965: 129, 134). It was these two breeds which were to contribute the most to the breeds which typify today's sheep in Britain and many of its former colonies.

It is the purpose of this paper to examine the archaeological evidence for the post-medieval Improvement of domestic sheep in England. The historical sources are first briefly examined to gain a view on what might be expected in the archaeological record and available data are then examined in the light of the historical evidence. In effect, this is a biometrical study of post-medieval sheep bones, but with the express aim of examining the evidence for changes in body size and conformation, and of assessing the timing of such changes.

HISTORICAL SOURCES

One of the phenomena of the Improvements era, as mentioned above, was the appearance of books and papers entreating farmers and husbandmen to adopt this or that new practice. Some of these publications also convey information about the livestock of the day, thus providing a series of snapshots of sheep of the 17th and 18th centuries. The usefulness of these accounts varies, as the degree of improvement of a flock was generally, and not unreasonably, reckoned in terms of the speed with which an acceptable meat carcass could be obtained, or the weight of wool to be clipped from a certain number of sheep. Thus Thomas Davis' description of the late 18th century Southdown sheep as being "*...very good in their back and hind quarters ... full of wool*" (Whitlock, 1965: 129) is less than specific. Even illustrations such as those given by Low (1842) give stylised representations which appear to project characters of fleece type and face colour onto more or less idealised body forms.

There is a further problem with the contemporary written sources. The agrarian Improvers were at the forefront of developments, and were often substantial landowners. It has to be asked whether their descriptions of the new livestock refer to general changes which were going on nationally or merely to the latest developments on the lands of a particularly go-ahead husbandman. Archaeological material, on the other hand, and particularly that from towns, may be drawn from quite a different population, representing the generality of contemporary livestock. It may be misleading, therefore, to assume either that Bakewell's records tell us much about 18th century sheep in the East Midlands, or that the introduction of Improved stock in a particular area necessarily led to the replacement of all unimproved stock.

Those caveats having been entered, we can briefly examine what is known about the Improvement of English sheep. In an attempt to give a thumbnail sketch of the situation in about 1700, Trow Smith (1959: 36) gives the impression of a land populated by diverse regional types, all of them unimproved with respect to carcass conformation. Elsewhere, the same author categorically

states that "*The history of the modern English sheep is almost entirely the tale of the modification of the ancient breeds by the blood of Bakewell's New Leicester Longwool and Ellman's new Southdown close wool*" (Trow Smith, 1951: 160). The raw material of Bakewell's work was the polled, long-woolled sheep of the East Midlands, probably of similar type to the sheep of the Cotswolds, and thought by some to have Roman antecedents (Trow Smith, 1957: 232). Bakewell succeeded in raising the carcass size appreciably, in an attempt to produce a large mutton carcass, but did so largely by developing a sheep inclined to deposit large amounts of fat, and at the expense of fleece quality. The main contribution of the New Leicester to the emerging Improved breeds, then, was an increase in overall size. Ellman's Southdowns were developed more for their short dense wool, but imparted to their descendants a rather stocky, short-limbed physique, and comparatively rapid growth. In osteological terms, then, we might expect to note Leicester-influenced sheep as being decidedly large, whilst Southdown-influenced sheep might have bones of appreciable robusticity, though not necessarily particularly long. In either case, we should not expect to see these influences in the archaeological record before the mid-18th century, and then, perhaps, only locally.

THE ARCHAEOLOGICAL DATA: FIRST FIND YOUR SHEEP

It is a curious yet consistent phenomenon of English archaeological sites that post-medieval deposits are seldom excavated in any manner worthy of that verb, and seldom produce well-stratified series of artefacts and bones. Occupation of 16th to 18th century date is often co-located with modern occupation, and often within modern towns. The shallow burial of post-medieval layers renders them susceptible to destruction by later excavation for cellars or foundation trenches, or to rapid removal by excavators in search of earlier occupation. There is something of a shortage of post-medieval 'finds' from English sites, and this limits the scope of the present paper. Happily, a few sites have yielded substantial bone assemblages of appropriate date and adequate stratigraphical integrity, and the study which follows depends heavily on the author's work on material from a number of sites in York.

Archaeological bone assemblages provide a data set which consists of the disarticulated, and often fragmented, elements of an unknown number of different individuals. Examination of size variation has to proceed by studying specific skeletal elements, rather than by examining the whole skeleton of each individual, and by utilising measurements taken on those isolated elements. We may decide that the sheep in a particular assemblage will be represented by their tibiae, and examine the size range represented by measurements from a sample of tibiae drawn from the assemblage, taking that sample of measurements to represent the size range and distribution of the sheep population represented by the tibiae. If we then draw from the same assemblage a sample of metatarsals and take appropriate measurements, we cannot assume that the population represented by the metatarsal measurements is the same as that represented by the tibiae, as there will probably be some individual sheep which are represented in the assemblage by tibiae but not by metatarsals, and viceversa. This difference in sampled populations may be most marked when systematic, large-scale butchery has led to the deposition of highly selected assemblages, characteristic of particular butchery processes (O'Connor, 1993). Measurements taken on different elements from the same assemblage may therefore give different information.

How useful are bone measurements as a measure of body size? Live sheep are measured and assessed in terms of variables such as weight or shoulder height, whereas archaeological ones are measured in terms of the length or width of isolated bones. One would intuitively expect a large sheep to have bigger bones than a small sheep, and a strong positive correlation between bone measurements and body size can be shown (e.g. see O'Connor, 1982: 82). There is something of a problem of scaling, however. The weight of an animal is directly proportional to its volume, which is in turn directly proportional to the cube of any linear dimensions, most animals being three-dimensional. The degree of univariate biometrical variation encountered in a given sample thus understates the variation in body weight or volume amongst the population which that sample represents. Thus if the largest and smallest individuals in a sample differ in linear measurements by a ratio of only 1:1.2, the ratio in body weight terms should be $1:(1.2)^3$, or 1:1.76. A relatively small difference in bone measurements can represent a quite substantial difference in gross size.

Growth rate, measured as the speed of attainment of adult body size, was one of the parameters on which the early Improvers judged their success, and it is a difficult variable to measure from archaeological material. Fortunately, some parts of the skeleton may reflect in their adult morphology the rate of growth during earlier stages of development. This is particularly the case with the metapodials of sheep, which Tschirvinsky (1909), Hammond (1932) and Palsson & Verges (1952) showed to develop adult characteristics related to the rate of growth pre- and post-weaning. To summarise their conclusions, gross bone size alone may reflect overall carcass size, but the relationship between gross size and length in the metapodials may yield information about the growth and maturation pattern of the sheep. Rapid growth *in utero* and pre-weaning will favour length growth in the metapodials, with circumferential growth 'catching up' as length growth decelerates towards the time of fusion of the epiphyses. Thus relatively short and thick metapodial bones may be typical of a fast maturing population, whilst relatively long and slender metapodials may be more typical of a slow-maturing, albeit large, breed.

METHODS OF ANALYSIS

Biometrical studies of bones utilise a wide range of analytical techniques, and this is not the place to attempt a full survey. Some methods will be more appropriate than others to the questions being addressed here, and these methods require brief description.

Simple univariate analysis, whether by the traditional histogram of a single measurement, or by the use of descriptive statistics such as the arithmetic mean, will allow sample values for a particular measurement to be summarised. This may itself be all that is required, though the problems mentioned above of relating bone size to body size have to be kept in mind. For most assemblages, it may be an acceptable starting assumption that the data are normally distributed, and thus that mean and standard deviation-based methods of analysis are appropriate. Bivariate plots, such as scattergrams, are widely utilised to examine variability in the relationship between two variables, often in order to identify morphological sub-groupings within the sample. Such an approach may be appropriate here if growth rate is to be considered by an analysis of size and length in the metapodials. A range of multivariate, mostly eigenvector-based, methods can be applied. Most present difficulties when missing data are encountered, as is usually the case with archaeological

bone measurements, and in any case may be more appropriate to studies of shape variation rather than the simple assessment of size which the present study requires. It is a common observation that principle components analysis of bone measurements shows size to be the main parameter of variation.

Analysis of a sample of measurements of a particular skeletal element requires that there should be enough specimens of that element in the assemblage to provide a sample large enough to bring the significance of any statistical results into an acceptable range. This may be a problem in all but the largest of archaeological assemblages, and techniques have been developed which allow measurements from different skeletal elements to be drawn together into one dataset. These are largely based on the 'standard animal' approach (O'Connor, 1991: 272-274), by which the sample measurements are compared with the corresponding measurements on a single complete individual, and are re-expressed as a ratio of the standard measurement. Measurements from a range of elements are thus reduced to a common base, and can be incorporated into a single sample to describe the sampled population. Derived from this is the log-ratio method, which plots individual sample measurements as the $\log_{10}$ of the ratio of the standard. These standard animal approaches also have the advantage that the known body size of the standard can be used to give some degree of calibration to the sample size range.

These are some of the methods available to a study of this kind. The most important thing in choosing the method to be used is to keep in view the questions being addressed, and not to be carried away on a magic carpet of software-package output.

THE DATA FROM YORK

Two decades of excavation in York have led to the recovery of very large quantities of often well-preserved animal bones. Amongst this embarras de richesses, there are several comparatively well stratified post-medieval assemblages which serve to give a series of samples spanning the period from the late 15th century to the early 19th century. For the most part, these are assemblages in which selective disposal has led to an over-abundance of sheep metacarpals, providing a large sample of biometrical data for this element. There is, of course, the possibility that selective disposal could indicate selection for slaughter in the first place, and thus that the sample will represent an atypical subset of the population. It is assumed here that this is a biasing factor which would arise only infrequently and which is unlikely to have a major effect on the analysis.

Five samples from York are used here, chosen for their good dating evidence and integrity, and are listed below in chronological order. It should be noted that the abbreviated sample codes given below apply only to this paper and not to the excavation archives.

BF2806 - Context 2806 Bedern Foundry site (Richards, 1993). A 'garden soil' dated to the late 15th century.

BSW5268 - Context 5268 Bedern South-West site (Richards, in prep.). A surface deposit dated to the late 15th to early 16th century. Similar in date and content to BF2806, and deposited only a few tens of metres away from it.

ALD9 - Period 9 deposits, 1-5 Aldwark (Hall *et al.*, 1988). A series of dumps and pit fills, apparently parts of the same extensive deposit with much bone debris. Dated to the early 16th century.

W1094 - Context 1094, 118-26 Walmgate (O'Connor, 1984). Part of an extensive deposit of sheep bones apparently related to a tannery, and dated to the early 18th century.

BSW5027 - Context 5027, Bedern South-West. A dump of refuse with much bone, dated to the early 19th century.

For each sample, measurements have been taken from adult metacarpals, following definitions given in Driesch (1976). Four variables have been taken as being the most useful for defining the overall size of specimens: the maximum length (GL), the proximal medio-lateral width (Bp), the distal medio-lateral epiphysial width (BFd), and the minimum medio-lateral shaft width (KD). Table 1 gives summary statistics for these four variables for the York samples, and gives comparative data for samples of Soay and Clun Forest sheep.

SAMPLE	MEAN	S.D.	N. CASES
BF2806			
GL	119.0	7.11	40
Bp	21.9	0.94	40
BFd	25.0	1.03	40
KD	13.3	0.80	40
BSW5268			
GL	120.5	13.97	25
Bp	22.5	1.23	25
BFd	24.7	1.10	25
KD	13.5	0.94	25
ALD9			
GL	115.8	8.87	60
Bp	21.7	1.08	60
BFd	24.3	1.34	60
KD	13.1	1.01	60
W1094			
GL	120.3	8.21	50
Bp	22.4	1.32	50
BFd	25.3	1.53	50
KD	13.4	1.16	50
BSW5027			
GL	129.5	8.17	25
Bp	25.2	1.39	28
BFd	27.2	1.74	22
KD	15.3	1.30	28
SOAY			
GL	116.2	4.93	69
Bp	19.8	1.01	70
BFd	22.2	1.10	70
KD	12.4	0.92	70
CLUN FOREST			
GL	131.0	8.19	22
Bp	26.2	2.32	22
BFd	29.2	2.40	22
KD	17.6	1.69	22

TABLE 1. Mean, standard deviation, and number of cases for measurements of sheep metacarpal samples from York post-medieval sites. Data for a sample of Soay sheep from Hirta, St Kilda, and a sample of Clun Forest sheep are given for comparison.

Table 1 shows there to be little difference in gross size between the five samples, other than between BSW5027 and the others, showing the early 19th century sample to be, on average, of larger bones than the earlier samples. Perhaps the simplest way to investigate both size and shape change with time is to utilise the log ratio method, and to re-express the sample mean values for the four variables considered here as log ratio values with respect to the Soay sample means. Table 2 gives the log ratio values.

	GL	Bp	BFd	KD
BF2806	.010	.044	.052	.029
BSW5268	.016	.057	.046	.036
ALD9	.002	.041	.040	.022
W1094	.015	.054	.056	.034
BSW5027	.047	.106	.088	.091

TABLE 2. York sample means expressed as log ratio values with respect to a modern Soay sample.

Table 2 makes clear several points. First, the 19th century sample BSW5027 stands out with respect to the others, confirming the overall greater size of individuals in this sample. Second, the log ratio values are generally lower for the greatest length measurement than for the other, medio-lateral, measurements, showing that the greatest development away from the unimproved 'wild' form of the Soay sample has been in developing the cross-sectional dimensions of the bone, not the length. Third, the log ratio value for the shaft width is appreciably higher in BSW5027, indicating an increase in the relative size of the diaphysis by the early 19th century. This last detail is quite important. Apart from reflecting overall body size as against shoulder height, a relatively short and robust metacarpal form may be indicative of fast growth and early maturity of carcass conformation (Palsson & Verges, 1952). In short, the modern form of the bone is developing by the early 19th century, and not before, at least in these samples. By way of confirmation, the sample means were reexpressed as log ratio values with respect to sample means obtained from 22 modern Clun Forest sheep (Table 3). The average of the four values obtained for BSW5027 was just -.027, with GL being particularly close to standard at -.001, whilst the averages for the other samples ranged between -.071 and -.086. These figures confirm that bones in sample BSW5027 approach the form of those of modern, 'Improved' sheep much more closely than those of the other samples.

	GL	Bp	BFd	KD	MEAN
BF2806	-.042	-.077	-.068	-.121	-.077
BSW5268	-.036	-.065	-.074	-.114	-.072
ALD9	-.054	-.081	-.080	-.128	-.086
W1094	-.037	-.067	-.064	-.116	-.071
BSW5027	-.001	-.016	-.032	-.060	-.027

TABLE 3. York sample means expressed as log ratio values with respect to a modern Clun Forest sample.

OTHER ASSEMBLAGES

To supplement the York data, samples have been assembled from five other English towns. In each case, the bones were measured by the author: the source of the material is given below. The five samples are:

LBC - late 15th century specimens from Site 100, Baynards Castle, London (Armitage, 1977). Access courtesy of Dr J. Clutton-Brock, Natural History Museum, London.

HM - 16th century material from Mytongate, Hull. Access courtesy of Town Docks Museum, Hull, and Humberside Archaeology Unit.

ST29 - 16th century material from feature 102, Stafford Castle. Access courtesy of Dr. Madeleine Hummler.

CTW - 16th century material from Coventry Town Wall excavations (Bateman & Redknap, 1983). Access courtesy of Barbara Noddle, University of Wales.

LBE - late 17th - early 18th century material from Broadgate East site, Lincoln. Access courtesy of City of Lincoln Archaeology Unit.

These five samples were measured to give a dataset directly comparable with that from York. The data are listed in Table 4 and should be examined in comparison with the Soay and Clun Forest data in Table 1. Overall, there is marked similarity in size across the five samples. The earliest sample,

	MEAN	S.D.	N. CASES
LBC			
GL	119.0	(9.89)	4
Bp	21.2	0.93	43
BFd	24.4	1.17	81
KD	13.0	0.89	58
HM			
GL	115.6	7.07	16
Bp	21.9	1.19	17
BFd	24.9	1.32	18
KD	13.2	1.26	18
ST29			
GL	120.9	6.34	26
Bp	21.7	0.88	26
BFd	23.7	1.09	26
KD	12.5	0.88	26
CTW			
GL	122.7	5.56	11
Bp	22.3	1.38	26
BFd	25.3	1.03	14
KD	13.7	0.90	27
LBE			
GL	123.9	(5.75)	5
Bp	21.8	1.12	13
BFd	25.5	1.56	17
KD	13.5	1.31	11

TABLE 4. Mean, standard deviation, and number of cases for measurements of sheep metacarpal samples from London, Hull, Stafford, Coventry, and Lincoln. For comparison with York data and modern standard samples see Table 1.

LBC, shows the lowest mean values, with the only markedly disparate value being the mean GL value for the HM sample from Hull. Interestingly, though perhaps only fortuitously, this is best matched by the ALD9 sample from York (Table 1), of similar date and only 60 km away across the Wolds. The data in Table 4 are generally consistent with all but the latest of the York samples.

Table 5 re-expresses the data in Table 4 as log-ratio distances from the Soay and Clun Forest standards. Seen as a summary, the CTW and LBE samples show the greatest distance from the Soay standard sample, but are still a long way away from the Clun Forest sample and from the early 19th century BSW5027 sample from York. Thus the 16th to 17th century samples are showing some change from the 'primitive' mean size and bone conformation, but not to the extent seen in the early 19th century sample. Obviously, this is only a brief examination of a few samples, but the general consistency between results from several different towns lends support to some preliminary conclusions.

	GL	Bp	BFd	KD	MEAN
From Soay sample					
LBC	.010	.030	.041	.021	.026
HM	-.002	.044	.050	.027	.030
ST29	.017	.040	.028	.003	.022
CTW	.024	.052	.057	.043	.044
LBE	.028	.042	.060	.037	.042
From Clun Forest sample					
LBC	-.042	-.092	-.078	-.132	-.086
HM	-.054	-.078	-.069	-.125	-.082
ST29	-.035	-.082	-.091	-.149	-.089
CTW	-.028	-.070	-.062	-.109	-.068
LBE	-.024	-.080	-.059	-.115	-.070

TABLE 5. Data from Table 4 re-expressed as log ratio distances from Soay and Clun Forest samples (data in Table 1).

CONCLUSIONS

By the end of the medieval period, English sheep seem to have been somewhat different to the unimproved Soay-like animals of prehistory, but still a long way short of their modern descendants. In terms of gross size, sheep of the 15th and 16th centuries seem to have been similar to the smaller modern hill breeds, and probably similarly slow-maturing. Differences from the Soay sample given here are more marked in the epiphysial measurements than in shaft length or breadth, suggesting that 16th century sheep were fairly bulky for their shoulder height, but not particularly big overall. The slower rate of change in diaphyseal morphology may indicate that maturation characteristics were still broadly similar to those of earlier 'unimproved' sheep, both in terms of rates of growth, and the timing and rate of epiphysial fusion. No great size increase is apparent in the slightly later LBE sample from Lincoln, nor in the W1094 sample from York, both of which belong to the half-century immediately pre-dating the historically-recorded Improvements. Only in the early 19th century sample from York do we see substantially larger sheep, clearly different to their post-medieval forebears, yet still appreciably smaller than the modern Clun Forest sample. In a way, then, the late

18th century date for the Improvement of English sheep is confirmed by the archaeological data to hand. The lack of substantial size increase in the LBE sample from Lincoln, in the heart of the East Midlands, would seem to indicate that the development of the relatively big Lincoln Longwool breed in the late 18th century involved more than just taking in hand an already large local variety and selecting for wool characteristics. Some systematic breeding-up of carcass size must also have taken place.

The size and morphology of the 16th-17th century samples is consistent with a continuing emphasis on wool and milk, rather than meat, production. There is little evidence of any attempt to increase either overall size or growth rate. This is not to say that there were no local experiments with developing larger or meatier sheep. Recognising that a particular ewe or ram tends to engender larger offspring than another requires only observation, not a deep knowledge of genetics, and local, or short-lived, experimentation must be allowed at any period. However, the archaeological data presented here are largely from towns, and thus from sites of marketing and consumption, where minor differences between flocks will have been obscured. The data therefore offer a series of samples of large catchments, and confirm that carcass improvement in English lowland sheep was essentially a late 18th century phenomenon, as changing demands altered the farmers' perception of that most versatile of domestic animals.

BIBLIOGRAPHY

Armitage, P.L. (1977). *Report on the mammalian remains from Baynard's Castle, London.* PhD thesis, University of London. Blackfriars, London.

Bateman, J. & M. Redknap (1983). *Coventry: excavations on the town wall 1976-1978.* Coventry Museums Monograph Series no. 2, Coventry.

Driesch, A. von den (1976). *A Guide to the Measurement of Animal Bones from Archaeological Sites.* Peabody Museum of Archaeology and Ethnology. Bulletin 1. Harvard.

Hall, R.A.; H. MacGregor & M. Stockwell (1988). *Medieval tenements in Aldwark and other sites. The Archaeology of York 10/2.* Council for British Archaeology, London.

Hammond, J. (1932). *Growth and development of mutton qualities in the sheep.* Edinburgh: Oliver & Boyd, Edinburgh.

Low, D. (1842). *Domesticated animals of the British Isles.* Longman, Green, Brown & Longman, London.

O'Connor, T.P. (1982). *The archaeozoological interpretation of morphometric variability in British sheep limb bones.* PhD Thesis, University of London.

O'Connor, T.P. (1984). *Selected groups of bones from Skeldergate and Walmgate. The Archaeology of York 15/1.* Council for British Archaeology, London.

O'Connor, T.P. (1992). *Bones from 46-54 Fishergate. The archaeology of York 15/4.* Council for British Archaeology, London.

O'Connor, T.P. (1993). Process and terminology in mammal carcass reduction. *International Journal of Osteoarchaeology* 3: 63-67.

Palsson, H. & J.P. Verges (1952). Effects of the plane of nutrition on the development of carcass quality in lambs. *Journal of Agricultural Science* 42: 1-149.

Richards, J.D. (1993). *The Bedern Foundry. The Archaeology of York 10/3.* Council for British Archaeology, London.

Richards, J.D. (in prep.) *The College of the Vicars Choral in the Bedern. The Archaeology of York 10.*

Trow Smith, R. (1951). *English husbandry from the earliest times to the present day.* Faber & Faber, London.

Trow Smith, R. (1957). *A history of British livestock husbandry to 1700.* Routledge & Kegan Paul, London.

Trow Smith, R. (1959). *A history of British livestock husbandry 1700-1900.* Routledge & Kegan Paul, London.

Tschirvinsky, N. (1909). Development of the skeleton of the sheep in normal conditions, conditions of inadequate nutrition, and after early castration of the males. *Annales de l'Institut Polytechnique de l'Empereur Alexandra II a Kiev* 3rd section: 1-304. (In Russian).

Whitlock, R. (1965). *A short history of farming in Britain.* John Baker, London.

Whitlock, R. (ed.) (1978). *Agricultural Records AD 220-1977.* John Baker, London.

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KILLING CATS IN THE MEDIEVAL PERIOD. AN UNUSUAL EPISODE IN THE HISTORY OF CAMBRIDGE, ENGLAND

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ABSTRACT: The partial skeletons of 79 medieval cats were recovered from a well in Cambridge, England. The animals had been killed by having their throats cut and were subsequently skinned and dismembered for consumption by the inhabitants of the town. A metrical study revealed the small stature of the cats in comparison with those from medieval Colchester and late medieval and early post-medieval Norwich, while an allometric analysis showed that the build of the animals was different from those excavated at the early medieval town of Haithabu, Germany, where even the female cats were much larger than the Cambridge males. Both the Haithabu and Cambridge cat assemblages are composed of almost equal proportions of males and females, and this, certainly in the case of the Cambridge sample argues against the slaughtered animals having been held in captivity.

KEYWORDS: CATS, KILLING, SKINNING, BUTCHERY, AGEING METHOD (M.E.S.), SEXING, SIZE

RESUMEN: Setenta y nueve esqueletos incompletos de gatos de época medieval se recuperaron de un pozo en Cambridge, Inglaterra. En primer lugar, los animales fueron degollados, luego desollados y por último descuartizados para consumo de los habitantes de la ciudad. El estudio métrico reveló el tamaño pequeño de estos gatos en comparación con los de la ciudad medieval de Colchester y los gatos tardo- y post-medievales de Norwich. A su vez, un análisis alométrico mostró que la constitución de los animales era diferente de aquellos excavados en la ciudad alto-medieval de Haithabu, Alemania, donde incluso las hembras eran mucho más grandes que los machos de Cambridge. Tanto el conjunto de Haithabu como el de Cambridge están formados por machos y hembras casi en igual proporción. Esto último, en el caso de la muestra de Cambridge, desde luego, sugiere que los animales sacrificados no se encontrarían en cautividad.

PALABRAS CLAVE: GATOS, SACRIFICIO, DESUELLO, DESPIECE, METODO PARA DETERMINAR EDAD (M.E.S.), SEXO, TAMAÑO

INTRODUCTION

The treatment of domestic cats in the medieval period (late 11th-15th-centuries AD) of England has not been determined satisfactorily. There is little documentary evidence available (Dr Mark Bailey, pers. comm.) and few sizeable bone assemblages have been recovered from archaeological sites (see section 5.1). Were they viewed mainly as pets or pests?. How important were they in the extermination of vermin?. How much value was put on their skins?. And were they ever eaten?

The few cat bones that occur on Romano-British sites (mid 1st-4th-centuries AD) are generally interpreted as being domestic (Luff, 1982: 265), and while numbers remain low in the Anglo-Saxon period (5th-mid 11th-centuries AD) (Appendix A), they do increase substantially on *some* sites in the post-conquest period of medieval England (O'Connor, 1982 and see section 5.1).

Clearly, the use of cats must have varied from one medieval town to the other, each town representing a specific ecosystem defined by a number of constraints including local topography, drainage, climate, density of settlement and systems of rubbish disposal. These variables may have had a considerable effect on the survival of rodents such as mice and black rats, which in turn might have had some influence on the incidence of cats. By the later medieval period, faunal evidence has demonstrated that there were sizeable populations of black rats (*Rattus rattus*) and house mice (*Mus musculus*) in towns across England (Armitage, West & Steedman, 1984).

It would be most interesting to know if cats increase on sites where there is an increased occurrence of the black rat, but currently this is open to speculation since not enough sieved material has been processed on urban sites.

QUALITY AND QUANTITY OF MATERIAL

This paper is based on the skeletal remains of 79 cats recovered from a 13th-century AD well in Cambridge, England.

The bones are in an excellent condition. Twenty-seven almost intact skulls were gathered, in addition to post-cranial material. The material was well-retrieved; all the deposits had been wet-sieved through a mesh of 0.5 mm and dried in natural conditions.

AIMS AND METHODS

The Bene't Court cranial material is important since it allows distinctions between wild and domestic felids, and this is very difficult to do with post-cranial bones. Therefore, the first aim of this study is to determine whether the remains are wild and/or domestic using the methods of Kratochvil (1973) and Kratochvil & Kratochvil (1976).

A detailed analysis of the skeletal element composition and butchery marks will inform on the following: methods of slaughter and skinning and whether the animals were prepared for human consumption.

Although it is known that skins from cats of native origin were used by medieval English skinners, it is not known *how* the beasts were procured or in *what quantity* (Veale, 1966: 58).

Methods of ageing (Smith, 1969; Berman, 1974) and also sexing the bones through metrical analysis will determine whether the cats had been selectively bred and culled.

A metrical analysis of the material, in particular the adult mandibles, using the measurements of von den Driesch (1976), will enable the size of the cats to be determined and permit a comparison with other cats of similar date, both in Britain and abroad. In addition, an allometric analysis concerning the shape of the mandibles might describe the 'breeds' or 'types' of cat that inhabited medieval towns.

THE CAT REMAINS FROM BENE'T COURT, CAMBRIDGE, ENGLAND

THE ARCHAEOLOGICAL SITE

The skeletal remains were excavated from a well (373) at the back of a medieval tenement, which is located by the Eagle Public House on Bene't Street, Cambridge. The excavation, which took place in the summer of 1993, was prompted by development of the area adjacent to the Eagle Public House and was directed by Dr G. Wait on behalf of the Cambridge Archaeological Unit, University of Cambridge.

The well contained some of the original wattle lining at its base, and in association with the cat skeletons was found highly distinctive, good quality pottery dated to the 13th-century AD.

The collection of cats appears to have been dumped in one episode. This was suggested by the state of bone preservation and its recovery from one layer within the well.

THE CAT BONES

Table 1 shows the representation of skeletal elements by both the number of bone fragments (NISP) and minimum number of individuals per skeletal element (MNI). Clearly, cranial remains predominate over post-cranial elements. Seventy nine cats are represented by skull fragments and of these, there are 27 almost complete skulls, while 75 individuals are represented by the mandible.

BONE	NISP	MNI
Skull	874 + 27 skulls	79
Mandible	142	75
Atlas	7	7
Axis	6	6
Cervical vertebra	14	-
Thorathic vertebra	25	-
Lumbar vertebra	41	-
Caudal vertebra	73	-
Vertebra indet.	32	-
Sacrum	-	-
Scapula	22	6
Humerus	32	14
Radius	54	25
Ulna	64	30
Carpal	10	-
Pelvis	18	4
Femur	29	7
Tibia	45	20
Fibula	27	-
Calcaneus	11	6
Astragalus	11	7
Tarsal	6	-
Metapodials	144	-
Ribs	90	-
Phalanges	130	-
Long bone fragments	9	-
TOTAL	1943	

TABLE 1. Skeletal element representation of cats from Bene't Court, Cambridge. **NISP:** number of identified bone fragments. **MNI:** minimum number of individuals per skeletal element.

There are discrepancies in the number of bones between the upper and lower limbs of the fore and hind legs, with more individuals being identified from the lower limbs. Indeed, few animals were distinguished by the shoulder and hip bones, and this information taken with the low occurrence of ribs, suggests that the meat-bearing parts of the cats are absent from the deposit. The ribs that were identified are not whole and constitute very small pieces of bone.

It would appear that whole crania and mandibles were dumped together since the MNI figures for both are very similar.

THE DETECTION OF WILD *(Felis silvestris)* VERSUS DOMESTIC CAT *(Felis domesticus)*

In 1127 Archbishop Corbyl decreed that abbesses and nuns could only wear fur of lamb or wild cat, and not anything of more value, and this suggests that the wild cat was fairly common. Later, in the 14th-century, Richard II granted a charter to the Abbot of Peterborough so that he might hunt and kill foxes and wild cats (Freethy, 1983: 165).

The wild cat is larger than the domestic cat although there is an overlap in size. Criteria for distinguishing wild from domestic cat were based on the research of Kratochvil (1973), Kratochvil & Kratochvil (1976) using cranial material. In comparison with Kratochvil's measurements for wild cat, the Bene't Court cats were much smaller and indeed were considerably smaller than the modern domestic sample (Kratochvil, 1973).

AGE AT DEATH

1. Mandibular ageing

Berman's data for tooth eruption was used to age the 75 mandibles (Berman, 1974). In his statistical study of 31 male and female domestic cats, the following points stand out:

1. teeth of both male and female cats erupt at similar ages
2. contra lateral teeth erupt at similar ages
3. the pattern of eruption is from the anterior to the posterior of the jaws, except for the lower molar.

The second and third premolars erupted at approximately 174 days (6 months) of age and the lower molar at 130 days (4.5 mths).

Approximately half the Bene't Court assemblage sports deciduous dentition (less than 6 mths) while the other half shows permanent dentition (greater than 6 mths) (Figure 1).

Following the methods of Ewbank and Grant, where the mandibles of domestic farm stock are aged by tooth eruption and wear (Ewbank, 1964; Grant, 1975, 1982), the deciduous lower third and fourth premolars (p3-p4) and lower molar (M1) were assigned numerical values from 1 to 6 as follows:

p3/p4: 1: deciduous tooth present

2: deciduous tooth present and perforation in crypt for permanent tooth visible

3: deciduous tooth present and permanent tooth below head of bone

4: permanent tooth erupting through bone

5: permanent tooth half erupted

6: permanent tooth at full height

M1: 1: perforation in crypt visible
2: tooth visible in crypt but below head of bone
3: tooth erupting through bone
4: tooth half erupted
5: tooth at full height

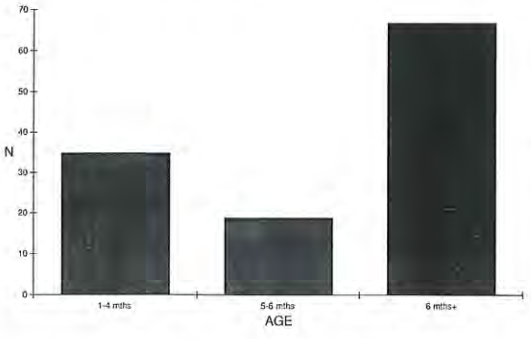

FIGURE 1. Age profile of mandibles. Bene't Court cats, Cambridge.

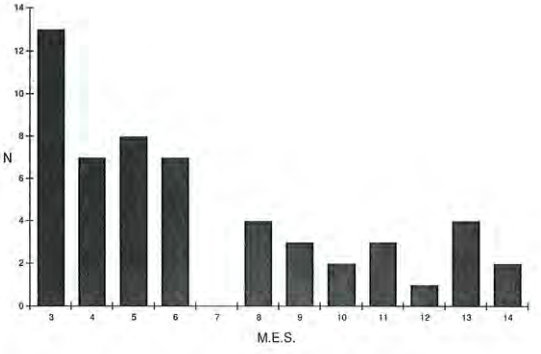

FIGURE 3. Mandibular eruption stages (M.E.S.) of immature mandibles. Bene't Court cats, Cambridge. M.E.S. of 3-6 correspond to 1 to 4 mths while M.E.S. of 8-14 correspond to 5-6 mths.

The sequence of tooth eruption can be seen in Figure 2. Once the eruption state was recorded, the numerical values of all the teeth in the jaw were added up and a sequence of mandibular eruption stages (M.E.S.) was obtained. For example, a mandible with p3 at 4, p4 at 2 and M1 at 5 (4+2+5) will have a M.E.S. of 11. It is assumed that the higher the M.E.S., the older the animal will have been at death. In such a way, an overview of the relative age structure of the immature mandibles is provided.

Mandibles of M.E.S. between 3 and 6 were assigned a relative age of 1 to 4 months since deciduous p3 and p4 were present and M1 was starting to erupt or had half erupted. By M.E.S. 8, M1 was at full height and permanent P3 and P4 had began to erupt, reaching full height by M.E.S. 17. This second group could be aged from the end of 4 months up to 6 months approximately, at which time the full adult dentition would have been present. Figure 3 shows how the kill-off pattern among immature individuals is biased towards very young animals of less than four months of age.

2. Long-bone epiphysial fusion

Long-bone epiphysial fusion data emphasises the presence of juvenile and very young adult animals (Table 2). For example, the ratio of unfused to fused proximal tibiae is 15:4. Most of these bones would have belonged to cats that died at less than 50-76 weeks (Smith, 1969: 526), which also was noted by O'Connor for medieval Lincoln (O'Connor, 1982).

THE DETECTION OF SEXES

1. The skulls

Although a minimum number of 79 skulls was estimated on the basis of the occurrence of the right frontal bone, only 27 almost complete skulls were recovered from the well. The less intact

specimens generally lacked the maxillary, premaxillary, and nasal bones, which, although present in the deposit, had fallen apart due to their unfused nature. Only 5 skulls were intact enough such that the total length from the Akrokranion to the Prosthion [after von den Driesch (1976), measurement 1] and the condylobasal length [after von den Driesch (1976), measurement 2] could be measured (Table 3).

EARLY FUSION (up to 7 months)	**UNFUSED**	**FUSED**	**% FUSED**
Distal Humerus	8	16	67
Proximal Radius	18	21	54
TOTAL	**26**	**37**	**59**
MIDDLE FUSION (7 months - 1 year)	**UNFUSED**	**FUSED**	**% FUSED**
Proximal Femur	5	-	-
Proximal Ulna	26	14	35
Distal Tibia	25	5	17
TOTAL	**56**	**19**	**25**
LATE FUSION (1 year - 2 years)	**UNFUSED**	**FUSED**	**% FUSED**
Proximal Tibia	15	4	21
Distal Femur	7	-	-
Distal Radius	27	7	20
Distal Ulna	33	2	6
Proximal Humerus	1	-	-
TOTAL	**83**	**13**	**13**

TABLE 2. Long bone epiphysial fusion of cats from Bene't Court, Cambridge (after Smith, 1969).

CRANIUM	**n**	**r**	**x**	**s**	**v**
Total length (1)	5	73.2 - 77.8	76.04	1.81	2.38
Condylobasal length (2)	5	71.6 - 74.5	72.98	1.22	1.67
Basal length (3)	5	63.4 - 65.2	64.08	.76	1.18
Facial length (9)	5	25.1 - 27.8	26.94	1.18	4.38
Greatest mastoid breadth (18)	24	31.6 - 37.3	34.38	1.56	4.53
Greatest breadth of the occipital condyles (19)	57	16.6 - 21.1	18.70	.95	5.08
Greatest breadth of the foramen magnum (20)	59	10.8 - 13.5	12.32	.58	4.70
Height of the foramen magnum (21)	54	9.6 - 12.8	11.36	.82	7.21
Zygomatic breadth (23)	16	50.7 - 57.0	53.30	1.63	3.05
Frontal breadth (24)	18	35.5 - 44.6	41.42	2.30	5.55

TABLE 3. Skull measurements of cats from Bene't Court, Cambridge in mm. **n:** number; **r:** range; **x:** mean; **s:** standard deviation; **v:** coefficient of variation. Numbers in parentheses refer to measurement definitions of von den Driesch (1976).

FIGURE 2. Eruption sequence of permanent premolars (P3/P4) and molar (M1). Bene't Court cats, Cambridge. From top to bottom: 1) deciduous p3 & p4 present; perforation in crypt for M1 visible. 2) p3 & p4 present; M1 visible in crypt but below head of bone. 3) p3 & p4 present; M1 erupting through bone. 4) p3 & p4 present; M1 half erupted. 5) perforation in crypt for P3 visible; p4 present; M1 at full height. 6) P3 & P4 below head of bone; M1 at full height. 7) P3 half erupted; P4 erupting through bone; M1 at full height. 8) P3, P4 & M1 at full height. Scale 1:1.

In contrast to the facial part of the skulls, the cranial region is very well preserved. Measurements of the greatest breadth of the occipital condyles (19), greatest mastoid breadth (18) and breadth and height of the foramen magnum (20, 21) were taken on 25 of the skulls [after von den Driesch (1976)]. In addition, 38 loose occipital bones were identified and measured (Table 3).

If histograms of the height and breadth of the foramen magnum are considered, as in Figures 4 and 5, a bimodality is apparent. Whether this is due to sexual variation or to the presence of different 'breeds' is difficult to answer. Jayne, in his vast study on the cat skeleton, observed how the shape of the foramen magnum varied from round to transversely oval and that there was much variation in size, but he did not account for the cause of this (Jayne, 1898: 173). It is worth noting that a non-metrical trait of this nature was observed in 24 of the occipital bones in the sample. A small indentation on the upper margin of the foramen magnum (Figure 6) could be responsible for most of the higher values observed in Figure 4, and perhaps this, in part, caused the bimodality.

A histogram of the greatest mastoid breadth (Figure 7) again shows bimodality, although the sample has now been reduced to 24 individuals.

The fact that we are dealing with very young adults and juveniles make it difficult to distinguish sexes according to size. One would expect males to be bigger than females, but it is likely that young males are confused with more mature females. As a consequence of this, the pattern emerging is not easy to interpret.

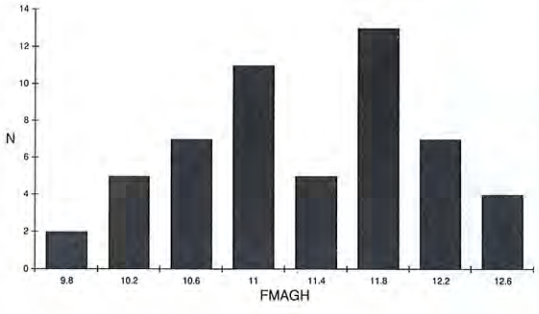

FIGURE 4. Histogram of foramen magnum height in mm (21, after von den Driesch 1976). Bene't Courtcats, Cambridge.

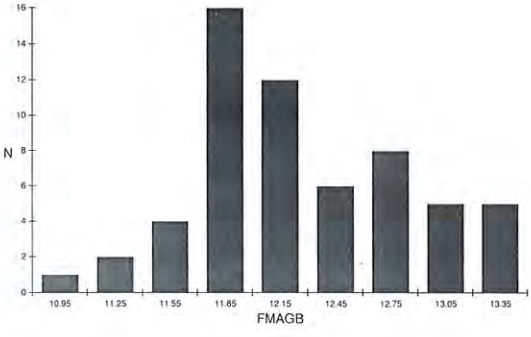

FIGURE 5. Histogram of foramen magnum breadth in mm (20, after von den Driesch 1976). Bene't Court cats, Cambridge.

2. The mandibles

The mandibular metrical data comprises 67 specimens with full adult dentition, 36 right and 31 left (Table 4). Juvenile mandibles (54 specimens) were not measured and consequently are not included in the following discussion.

Excellent preservation allowed the following measurements to be taken: the total length of the mandible and the height of the vertical ramus (measurements 1 and 8 after von den Driesch, 1976). A histogram of the total length demonstrates a definite bimodal distribution (Figure 8) while a scattergram of vertical ramus height against total length shows two clusters, a smaller group at the bottom left with a larger more disperse group to upper right (Figure 9). It is proposed that the smaller group in the histogram and scattergram represents females and the larger one males.

MANDIBLE	n	r	x	s	v
Total length (1)	59	44.9 - 54.1	49.48	2.11	4.26
Length of the cheektooth row, P3-M1 (5)	67	16.2 - 19.6	17.90	.73	4.07
Height of the vertical ramus (8)	57	17.3 - 21.7	19.48	1.15	5.90
Height of the mandible behind M1 (9)	67	7.09 - 9.49	8.38	.57	6.80
Height of the mandible in front of P3 (10)	66	6.8 - 9.1	7.78	.49	6.29

TABLE 4. Mandibular measurements of cats from Bene't Court, Cambridge in mm. **n:** number; **r:** range; **x:** mean; **s:** standard deviation; **v:** coefficient of variation. Numbers in parentheses refer to measurement definitions of von den Driesch (1976).

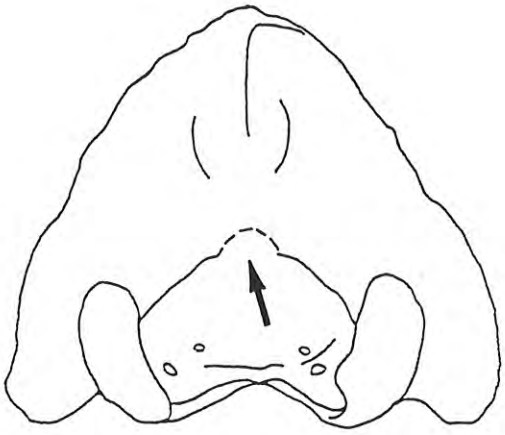

FIGURE 6. The occipital area of cat skull showing indentation (arrow). Bene't Court cats, Cambridge.

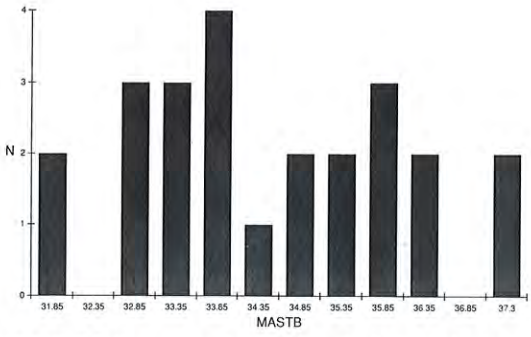

FIGURE 7. Histogram of mastoid breadth in mm (18, after von den Driesch 1976). Bene't Court cats, Cambridge.

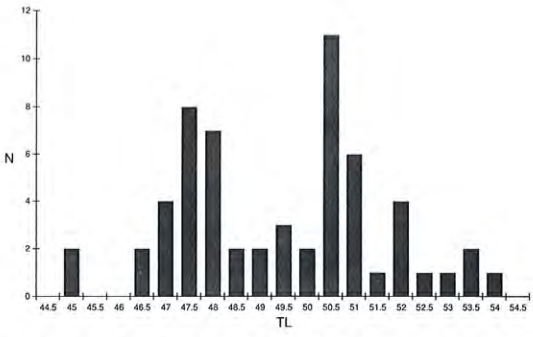

FIGURE 8. Histogram of total length of mandible in mm (1, after von den Driesch 1976). Bene't Court cats, Cambridge.

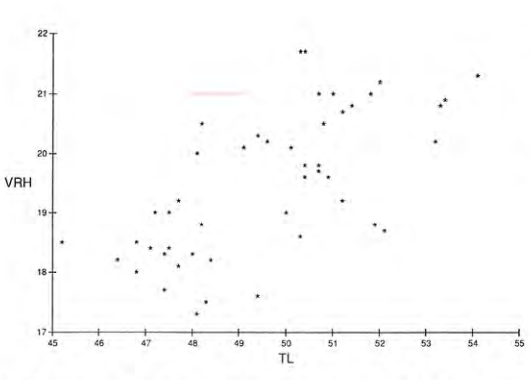

FIGURE 9. Scattergram of the vertical ramus height against total length of the cat mandible in mm (8, 1 after von den Driesch 1976). Bene't Court cats, Cambridge.

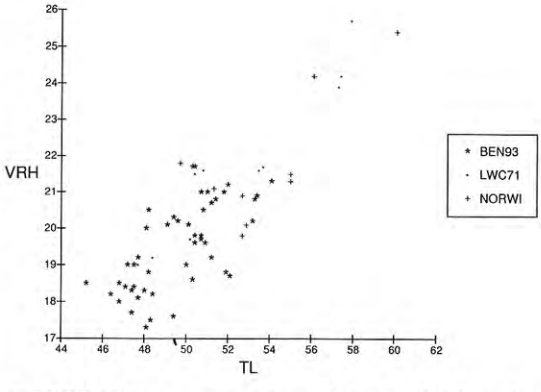

FIGURE 10. Scattergram of the vertical ramus height against the total length of the mandible in mm. A comparison of the Bene't Court cats with those from Lion Walk, Colchester and Norwich.

THE SIZE AND BUILD OF THE BENE'T COURT CATS

1. Mandibular data

The Bene't Court cat mandibles were compared with those from Lion Walk, Colchester (1150-1300 AD) and Castle Mall, Norwich (the Flint Shaft, late 15th/early 16th-century AD; Moreno García, unpublished) (Table 5 & Figure 10). The late medieval/early post-medieval mandibles from Norwich are clearly much larger than those from Bene't Court and fall into two groups, male (upper) and female (lower). The Lion Walk sample, which is of similar date to Bene't Court, also splits into two groups interpreted as females (the larger lower group) and males (the smaller upper group); again the Lion Walk females are much larger than those from Bene't Court and some individuals are even larger than the Bene't Court males. A significant difference in size was found using the Student's t-test at .05 level of probability.

The small size of the Cambridge cats is also emphasised when the mandibles are compared with those from Germany (Table 5) and there is an appreciable difference in size, using total length, between Bene't Court and Höxter (13th-century AD) which is significant at .01 level of probability using the Student's t-test.

A very large assemblage of cat bones was recovered from the early medieval town of Haithabu (9th-11th-centuries AD), Schleswig-Holstein, Germany including 79 mandibles (Johansson & Hüster, 1987). Figure 11 compares the Bene't Court mandibles with those from Haithabu and it is immediately apparent that the former are much smaller than the latter. Both samples fall into two groups, males and females but the Haithabu females are, in general, much larger than the Bene't Court males. The Student's t-test was performed on the total length of mandibles and a significant difference in size was found at .01 level of probability.

The striking difference in size between the Bene't Court cats and those from Haithabu was investigated further via an allometric analysis. The data was logarithmically transformed and regression lines calculated for both sites which are plotted in Figure 12. The statistics calculated for the allometric analysis are tabulated in Table 6. The important points to notice in Figure 12 are as follows. While the values of the slopes are similar, Haithabu has a slightly steeper slope and its regression line is transposed above that of Bene't Court. The average value of vertical ramus height to total length are such that Haithabu (.427), in comparison to Bene't Court (.394) demonstrates a greater depth of jaw. This could indicate a genetic difference in the sense of different 'breeds' but great care is needed in this interpretation, because of the values of the coefficient of determination (R^2), which is the square of the correlation coefficient. The coefficient of determination indicates the strength of the relationship between the vertical ramus height and total length of mandible. The values shown in Table 6 mean that there is a much greater variation in the dispersion of data points around the regression line for the Bene't Court cats (58%) than the Haithabu ones (36%). A more in depth analysis will be performed at a later date with more data.

2. Cranial data

Cranial measurements from both Odense, Denmark and Höxter, Germany indicated the smaller size of the Bene't Court cats (Table 5).

MANDIBLE	Total length (1)					Height of the vertical ramus (8)				
	n	r	x	s	v	n	r	x	s	v
Haithabu C9th - C11th	56	48.9 - 61.6	55.0	2.6	4.7	56	20.0 - 26.6	23.5	1.7	7.2
Höxter C13th	13	50.6 - 56.7	53.9	1.9	3.5	12	19.2 - 23.2	21.3	1.2	5.6
Bene't Court C13th	59	44.9 - 54.1	49.5	2.1	4.2	57	17.3 - 21.7	19.5	1.1	5.6
Colchester	11	47.7 - 57.9	52.7	3.6	6.8	10	19.0 - 25.7	21.8	2.2	10.0
Castle Mall (Norwich) C15th - C16th	9	49.7 - 60.1	53.9	3.0	5.5	10	19.8 - 25.4	21.7	1.7	7.8

CRANIUM	Condylobasal length (2)					Greatest mastoid breadth (18)					Greatest breadth of the occipital condyles (19)				
	n	r	x	s	v	n	r	x	s	v	n	r	x	s	v
Odense (C11th)	4	71.0-79.2	75.6	3.4	4.4	8	34.8-38.6	36.9	1.3	3.5	8	17.9-21.5	19.5	1.2	6.2
Höxter (C13th)	7	70.2-78.8	75.6	2.7	3.5	7	36.1-38.0	36.8	.8	2.1	7	17.2-20.7	19.3	1.2	6.1
Bene't Court (C13th)	5	71.6-74.5	72.9	1.2	1.6	24	31.6-37.3	34.3	1.5	4.5	50	16.7-21.1	18.7	.9	4.8

TABLE 5. A comparison of mandibular and cranial measurements of medieval cats in mm.

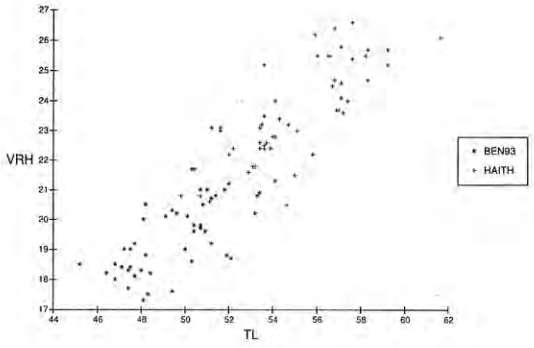

FIGURE 11. A scattergram of vertical ramus height against total length of the mandible in mm. A comparison of the Bene't Court cats with those from Haithabu.

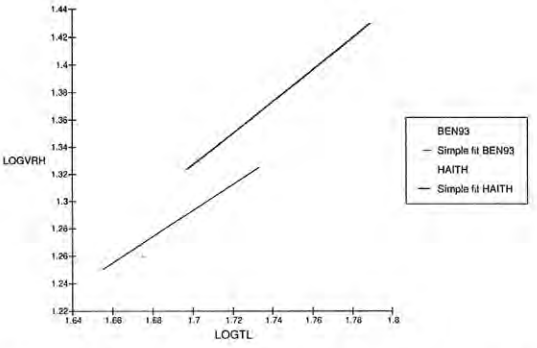

FIGURE 12. Plot of logged vertical ramus height against total length of the mandible showing regression lines for medieval

	BENE'T COURT	HAITHABU
Coefficient of determination (R^2)	0.422	0.640
Correlation coefficient	0.649	0.796
Coefficient AO (intercept)	-0.337	-0.640
Coefficient A1 (slope)	0.959	1.157

TABLE 6. Summary statistics used in allometric analysis.

SIGNS OF BUTCHERY

1. Methods of killing

The Viking cats from Odense, Denmark were killed by wrenching their heads off the top of the spine so that much of the occipital area was removed (Hatting, 1990: 184). This was not observed with the Bene't Court cats and almost all the skull remains demonstrated intact occipital regions.

One of the methods used to dispatch the Bene't Court cats was to slit the throat as evidenced by knife-cuts on the ventral portion of 5 out of 7 of the atlas bones (Figure 13). Cats were killed in similar fashion at the Anglo-Saxon site of West Stow, Suffolk (Crabtree, 1990: 104-105).

2. Skinning

Twenty-four of the semi-complete cat skulls sported knife-cuts on both sides of the cranium behind the orbits, and across the frontal/maxillary/nasal bones (Figures 14 and 15). In addition, 60% (n=48) of the separate frontal bones and 49% (n=38) of the parietal bones show *very fine* knife cuts. Similar marks were also observed on the labial surface of 24% (n=67) of the adult mandibles and 13% (n=54) of the juvenile mandibles (Figure 16). The marks occur in areas where there is little flesh, thus it is relatively easy to nick the bone as the skin is being removed. The same cut-marks were recorded by Hatting on cat bones from Odense, Denmark (Hatting, 1990), Anglo-Scandinavian cats from York (O'Connor, 1989: 186) and also early medieval Lion Walk, Colchester where a cess-pit contained the remains of several cats dated to 1150-1300 AD.

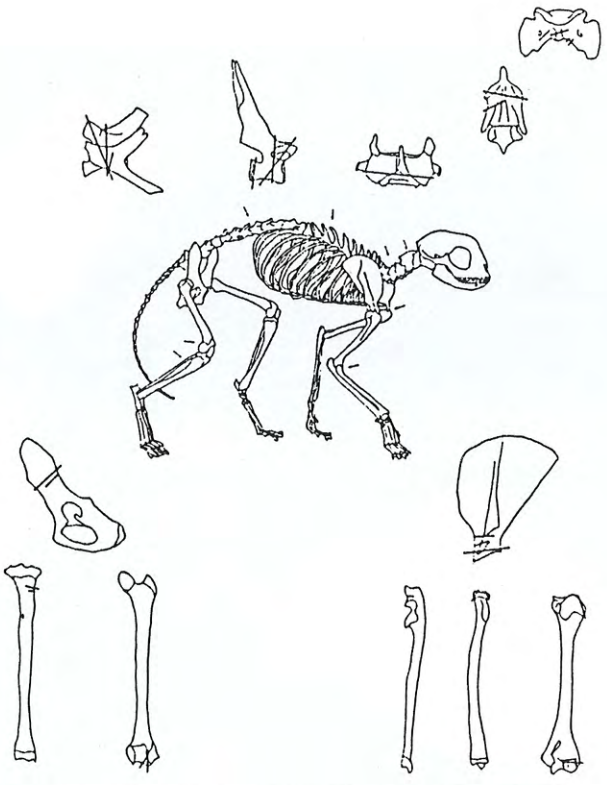

FIGURE 13. Butchery marks on the post-cranial skeleton. Bene't Court cats, Cambridge. Lines going across bone outlines are chop-marks while those inside bone outlines are knife-cuts.

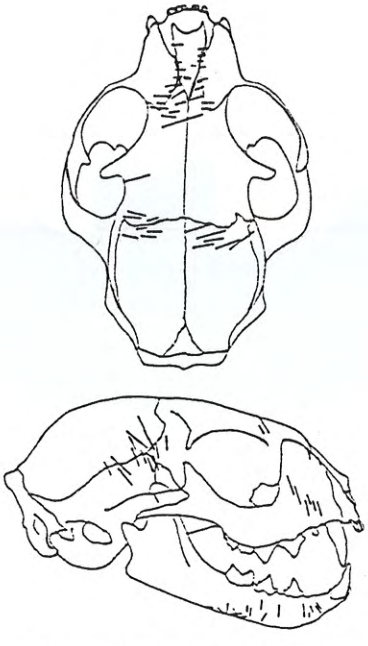

FIGURE 14. Knife-cuts on skull, dorsal view (above) and lateral view (below). Bene't Court cats, Cambridge.

FIGURE 15. Knife-cuts on frontal/maxillary/nasal bones. Bene't Court cats, Cambridge.

FIGURE 16. Knife-cuts on the labial side of adult mandible. Bene't Court cats, Cambridge. Scale 1:2.5.

An English law was laid down in 1363 stating that the common people should not wear any fur except lambskin, coney, cat and fox (Ewing, 1981: 30).

There is a lack of references to skinners in the literature until the end of the 12th-century. London became the centre for the manufacture of furs from the 13th-century onwards, however, as well as this, there would have been trade at a lower scale organised by small traders (Veale, 1966).

Veale mentions that the small pedlar was often a useful intermediary between village and town, and the pedlar of whom Langland wrote was even ready to kill cats, if he could catch them, for the sake of their skins (Veale, 1966).

A duty of 1d per dozen skins of *catti silvestres* (wild cat) was levied at Ipswich in 1303, compared with 4d per thousand skins of *catti igni* (domestic cat) (Veale, 1966: 218). Cat skins are mentioned in export licenses granted to a group of London fellmongers, to export coney, cat, hare and fox skins to Flanders during the late 14th-century (Veale, 1966).

At Fishamble St, Dublin, the high incidence of juvenile animals was interpreted as indirect evidence for the culling of cats for their fur (McCormick, 1988). The age profile of the Bene't Court cats is composed of immature and very young adults and is supportive of this notion.

The small size of cat skins would have rendered them suitable for making gloves or hats.

3. Famine or fare - cats as food

Chop-marks were observed through the odontoid process of the axis (3 specimens), atlas (1), cervical vertebrae (3), thoracic vertebrae (3), lumbar vertebrae (11, Figure 17), scapula neck (3, Figure 18), the ilium of the pelvis (2), the proximal (2) and distal epiphysis (2) of the humerus, the distal epiphysis (2) of the femur and proximal posterior part of the tibia shaft (1) (Figure 13). Knife-cuts were recorded on the proximal radius (2), ulna (4) and a caudal vertebra (1) (Figures 13 & 17). All these chop and knife-cuts are indicative of the dismemberment of the carcasses, most likely for food. This latter observation is supported by the low occurrence of bones reflecting high meat-yield, for example, humeri/scapulae, femora/pelves and ribs/vertebrae.

FIGURE 17. Chop-mark through lumbar vertebrae. Lateral caudal view. Bene't Court cats, Cambridge. Scale 1:3.

FIGURE 18. Chop-marks through scapulae necks. Lateral view. Bene't Court cats, Cambridge. Scale 1:2.5.

After the animals were skinned and butchered, heads and the less meaty parts were discarded. The lack of gnaw marks and the good bone preservation indicate that these carcasses were dumped quickly into the well.

A few cut marks were found on both cat and dog bones from Bedford (St John's Street site) and Grant has suggested that these animals may have provided an occasional meal (Grant, 1979: 107).

The sparse archaeological evidence of the consumption of cats seems to be associated with starvation periods. At the Kent Blaxill site on the High St of Colchester, abundant cat bones were

interpreted as belonging to the starvation conditions of the 1648 siege of Colchester (Hull, 1955: 59), a harrowing episode in the English Civil War.

Many of the cat bones from Odense, Denmark exhibit dog gnawing and dogs were cited as the culprits in removal of the more meaty parts (Hatting, 1990). With regard to the Bene't Court assemblage, none of the bones demonstrate dog gnawing, although, curiously, one proximal humerus has marks of cat gnawing. However, in McCormick's wide Irish survey he makes no mention of cats being used for food (McCormick, 1988).

Conclusive evidence of the consumption of cat flesh has not yet been published on other comparable sites and is of considerable interest in the Bene't Court context, because it opens up wider questions concerning the adequacies of the town's food supply and possibly the reliability of its butchers. Cat strongly resembles the meat of hare and some unscrupulous individuals may have tried to deceive unsuspecting customers. Schmid, in her description of Roman bones from Augst in Switzerland describes a practice still existing in the present day, 'as is the case today, already in Roman times hares were sold without fur but with the fur on the paws. This was done to avoid deception with cats (in Germany and Switzerland known as 'roof hares'). Before roasting, the paws were cut off and thrown away' (Schmid, 1972: 36).

THE WIDER IMPLICATIONS OF THE BENE'T COURT CATS

The quality of the Bene't Court bone is complemented by its abundance. This is the largest collection of cat bones ever to have been excavated in England.

A COMPARISON WITH OTHER BRITISH SITES

Collections of cat bones were excavated from Middleton Stoney, Oxfordshire (Levitan, 1984a) and Southampton (Bourdillon, 1979), dated to the 12th and 13th -centuries AD (Grant, 1988: 184), but none of these assemblages approach the size of the Bene't Court one. For example, the Middleton Stoney assemblage is comprised of only 12 partially complete skeletons.

Cat remains are usually present in small numbers on British medieval sites (Table 7). Most of these remains belong to partially-complete skeletons. No bias towards any particular skeletal element is mentioned in any of the reports. The ageing information available indicates that a high proportion of the cats were immature and/or young animals, which is the case with Bene't Court and Irish urban sites of the same period (McCormick, 1988).

Different hypotheses have been put forward in the literature to explain the presence of high numbers of juvenile cats on medieval urban sites: 1. they could have been killed because they were in excess of requirements (Noddle, 1974: 333), 2. they were not looked after with any degree of care (O'Connor, 1982: 38 and 1989: 186) and may have been unhealthy (Noddle, 1977: 398) 3. the archaeological evidence may simply be representing the natural mortality rates of the animals (Maltby, 1979a: 65) and 4. they could have been killed for their skins (Noddle, 1974: 333; Noddle, 1977: 389; Maltby, 1979a: 65).

The first hypothesis is unlikely since large numbers of immature/juvenile dogs are not generally recovered from sites, and these animals would surely have been more of a nuisance factor in medieval towns than scavenging cats, the latter being valuable as rodent exterminators. Further there is no documentary evidence to support this.

SITE	PERIOD	%
Exeter (Maltby, 1979a)	1000 - 1500	3.0
Flaxengate, Lincoln (O'Connor, 1982)	c. 870 - 1500	2.0
Southampton (Bourdillon, 1979)	pre - C13th C13th	.2 1.0
King's Lynn (Noddle, 1977)	1050 - 1250 1250 - 1350 1350 - 1500	.6 .5 .4
Aylesbury (Jones, 1981)	Medieval	2.0
Middleton Stoney, Oxfordshire (Levitan, 1984a)	C12th - C13th	1.0
St Martin-at-Palace Plain, Norwich (Cartledge, 1987)	C12th - C15th	.8
Alms Lane, Norwich (Cartledge, 1985)	C13th - C15th	.7
North Elmham (Noddle, 1980)	Medieval	2.0
St John's St, Bedford (Grant, 1979)	C11th - C13th	.5
Bramber Castle, Sussex, (Westley, 1977)	Medieval	.1
Portchester Castle, Outer Bailey (Grant, 1977)	Saxo - Norman Early medieval Late medieval	3.0 .4 .8
Portchester Castle, Inner Bailey (Grant, 1985)	Pre 1320 C14/15th	.1 .1
Bishop's Palace, Lincoln, (Ellison, 1975)	C15th	7.0
Baile Hill, York (Rackham, 1977)	C12 - 13th	.7
Westgate, Gloucester, (Maltby, 1979b)	C10th - C13th	.6
East and North Gates of Gloucester (Maltby, 1983)	C10th - C15th	.2
Priory Barn, Taunton (Levitan, 1984b) Benham's Garage, Taunton (Levitan, 1984b)	C12th - 13th C15th C10th - 11th C12th - 13th	.2 3.0 .3 .5
Silver St, Glastonbury (Levitan, 1982b)	C10th - C12th C13th - C15th	.1 1.0
Lion Walk, Colchester (Luff, 1993)	C11th - 14th	1.0

TABLE 7. Medieval cat bones (England).

Cats were not kept widely as pets in medieval times (Thomas, 1983) and thus the animals most likely led a feral existence. Nowadays, most urban establishments house a large number of feral cats. In 1898 Hudson claimed that of an estimated total of some 400,000 domestic cats in London, no fewer than 80,000 to 100,000, that is approximately one quarter of the population, led a feral existence and in 1944 Matheson estimated that there were approximately 6,600 feral cats in Cardiff, out of a total population of 23,500, that is just over a quarter of the population (Lever, 1979: 143).

Little is known of the mortality of feral cats but feline panleucopaenia (also known as feline distemper, feline infectious enteritis or cat flu) is widespread nowadays (Macdonald, 1991: 440) and cats living in the wild may live only for two years or more (Alderton, 1983). In the absence of neutering, the exhausting nature of tomcats' sexual activities rapidly affects the animals' condition (Bradshaw, 1993), leaving somewhat shattered hulks. Therefore, feral cats in medieval Cambridge or elsewhere would not be expected to live for lengthy periods.

Although the Bene't Court cats were very small, none of the bones exhibited any pathologies and the mandibles appeared in a healthy condition, showing no evidence of tooth overcrowding or alveolar resorption. The age profile of the Bene't Court cats does not include neonatal or extremely young kittens which would be indicative of fatalities at, or around birth.

The fourth hypothesis that cats were exploited for their skins would appear the most likely explanation for the high incidence of juvenile cats on archaeological sites, and indeed absence of butchery marks might well indicate a highly skilled skinner. Certainly there is no doubt that the Bene't Court cats were skinned.

FARMING CATS IN THE MEDIEVAL PERIOD, FACT OR FICTION?

Hatting has proposed that the Odense cats were kept in captivity, since there was a predominance of animals less than one year old, and also a number of bones had been identified as mature females for breeding stock (Hatting, 1990). However, the sexual separation of the Bene't Court cats favours slightly more male animals, and this, taken with the age structure of the sample and the low life expectancy of feral cats is more akin to a random culling pattern.

It is highly likely that most of the cats were feral beasts and not pets since it was not until the Stuart period that pets were held in high esteem (Thomas, 1983). At Lincoln, slightly more female than male cats occurred. O'Connor has pointed out that there is no archaeological or documentary evidence of the neutering of tomcats, and if they were feral, there would be neither opportunity nor reason to carry out this practice (O'Connor, 1982: 38). He has intimated that cats in medieval Lincoln were in the main neglected and were most likely scavengers (O'Connor, 1982) but this still needs to be proved.

HUNTING/STALKING CATS IN THE MEDIEVAL PERIOD

For medieval hunters, beasts of the warren included foxes, hares and cats and Oliver Rackham has stated, most intriguingly, that there is no evidence to support the contention that the cats were wild cats, and indeed the usual word for the cat as a huntable beast was *murilegus* meaning 'mouse-taker', thus signifying the ex-domestic cat (Rackham, 1986: 40).

If food was scarce in medieval times, perhaps it would have been quite natural for the town-dwelling cat to adjourn to the countryside in search of prey. In the wild, descendants of domestic cats often increase considerably in size and frequently become as fierce as the wild cat.

CONCLUSIONS

Research on the Bene't Court cats has shown that the animals were killed by slitting their throats, and then they were skinned and dismembered for human consumption. The cats consist mainly of juveniles and young adults and are significantly smaller in stature compared with individuals from Colchester of similar date, and Haithabu, where the specimens date much earlier. It is not known whether the build of the cats is reflecting the stunted nature of other domestic stock, which is so widespread across Europe in the early medieval period (Bökönyi, 1974; Armitage, 1982). This is worthy of further investigation.

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BIBLIOGRAPHY

Alderton, D. (1983). *The Cat.* London.

Armitage, P. (1982). Developments in British cattle husbandry. *Ark* 9: 50-54.

Armitage, P.; B. West & K. Steedman (1984). New Evidence of Black Rat in Roman London. *The London Archaeologist* 4(14): 375-383.

Berman, E. (1974). The time and pattern of eruption of the permanent teeth of the cat. *Laboratory Animal Science* 24(6): 929-931.

Bökönyi, S. (1974). *History of domestic mammals in Central and Eastern Europe.* Akademiai Kiado, Budapest.

Bourdillon, J. (1979). The Animal Bone. In: Walker, J.S.F.: Excavations in medieval tenements on the Quilter's Vault site in Southampton. *Proceedings of the Hampshire Field Club and Archaeological Society* 35: 207-212.

Bourdillon, J. & J.P. Coy (1980). The Animal Bones. In: Holdsworth, P. (ed.): *Excavations at Melbourne Street, Southampton, 1971-1976.* Council for British Archaeology. Research Report 33: 79-121, London.

Bradshaw, J. (1993). *The true nature of the cat.* London.

Cartledge, J. (1985). The Animal Bones. In: Atkin, M.: Excavations on Alms Lane (Site 302N). Excavations in Norwich 1971-78. Part II. *East Anglian Archaeology* 26: 220-222.

Cartledge, J. (1987). Mammal Bone. In: Ayers, B.: Excavations at St. Martin-at-Palace Plain, Norwich, 1981. *East Anglian Archaeology* 37: 111-113.

Crabtree, P.J. (1990). *West Stow, Suffolk: Early Anglo-Saxon Animal Husbandry.* East Anglian Archaeology. Report No. 47.

Driesch, A. von den (1976). *A guide to the measurement of animal bones from archaeological sites.* Peabody Museum Bulletin 1. Harvard University, Harvard.

Ellison, A. (1975). The Animal Remains. In: Chapman, H.; G. Coppack & P. Drewett: Excavations at the Bishop's Palace, Lincoln. 1968-72. *Lincolnshire History and Archaeology.* Occasional Paper: 33-37.

Ewbank, J.M.; D.W. Phillipson; R.D. Whitehouse & E.S. Higgs (1964). Sheep in the Iron Age: a method of study. *Proceedings of the Prehistoric Society* 30: 423-426.

Ewing, E. (1981). *Fur in dress.* London.

Freethy, R. (1983). *Man and Beast.* Blandford Press, London.

Grant, A. (1975). The Animal Bones. In: Cunliffe, B.W. (ed.): *Excavations at Portchester Castle, vol I. Roman.* Reports of the Research Committee, Society of Antiquaries of London 32: 437-450.

Grant, A. (1976).- The Animal Bones: In: Cunliffe, B.W. (ed.): *Excavations at Portchester Castle, vol II. Saxon.* Reports of the Research Committee, Society of Antiquaries of London 33: 262-287.

Grant, A. (1977). The Animal Bones. Mammals. In: Cunliffe, B.W. (ed.): *Excavations at Portchester Castle, vol III. Medieval, the Outer Bailey and its Defences.* Reports of the Research Committee, Society of Antiquaries of London 34: 213-233.

Grant, A. (1979). The Animal Bones. In: Hassall, J.: St John's Street. *Bedfordshire Archaeological Journal* 13: 103-107.

Grant, A. (1982). The use of tooth wear as a guide to the age of domestic ungulates. In: Wilson, B.; C. Grigson & S. Payne (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 91-108. B.A.R. (British Series) 109. Oxford.

Grant, A. (1985). The large mammals. In: Cunliffe, B.W. & J. Munby (eds.): *Excavations at Portchester Castle, vol IV. Medieval, the Inner Bailey.* Reports of the Research Committee, Society of Antiquaries of London 43: 244-256.

Grant, A. (1988). Animal Resources. In: Astill, G. & A. Grant (eds.): *The Countryside of Medieval England*: 149-187. Oxford.

Hatting, T. (1990). Cats from Viking Age Odense. *Journal of Danish Archaeology* 9: 179-193.

Hull, M.R. (1955). The South Wing of the Roman Forum at Colchester: recent discoveries. *Transactions of the Essex Archaeological Society* 25: 24-61.

Jayne, H. (1898). *Mammalian Anatomy. The Skeleton of the Cat.* London.

Johansson, F. & H. Hüster (1987). Untersuchungen an Skelettresten von Katzen aus Haithabu (Ausgrabung 1966-1969). *Berichte über die Ausgrabungen in Haithabu* 24. Neumünster.

Jones, G.G. (1981). The Medieval Animal Bones. In: Allen, D. & C.H. Dalwood: Iron Age occupation, a Middle Saxon cemetery and 12th to 19th century urban occupation. Excavations in George Street, Aylesbury. *Records of Buckinghamshire* 25: 31-49.

Jones, G.G. (1984). Animal Bones. In: Rogerson, A. & C. Dallas: Excavations in Thetford 1948-59 and 1973-80. *East Anglian Archaeology* 22: 187-192.

Kratochvil, Z. (1973). Schädelkriterien der Wild- und Hauskatze (*Felis silvestris silvestris* Schreb. 1777 und *F. s. f. catus* L. 1758). *Acta Scientiarum Naturalium Brno* 7(10): 1-50.

Kratochvil, J. & Z. Kratochvil (1976). The origin of the domesticated forms of the genus *Felis* (Mammalia). *Zoologické Listy* 25(3): 193-208.

Lever, C. (1979). *The naturalised animals of the British Isles.* London.

Levitan, B. (1982a). The Faunal Remains. In: Leach, P.: *Ilchester. Volume 1: Excavations 1974-5.* Western Archaeological Trust. Excavation Monograph 3: 269-284, Bristol.

Levitan, B. (1982b). The Animal Bones. In: Ellis, P.: Excavations at Silver Street, Glastonbury 1978. *Somerset Archaeology and Natural History* 126: 17-31.

Levitan, B. (1984a). The Vertebrate Remains. In: Rahtz, S. & T. Rowley (eds.): *Middleton Stoney. Excavation and Survey in a North Oxfordshire Parish 1970-1982*: 108-148. University of Oxford, Oxford.

Levitan, B. (1984b). Faunal Remains from Priory Barn and Benham's Garage. In: Leach, P.: *The Archaeology of Taunton.* Western Archaeological Trust. Excavation Monograph 8: 167-193, Bristol.

Luff, R.M. (1982). *A Zooarchaeological Study of the Roman North-western Provinces.* B.A.R. (International Series) 137. Oxford.

Luff, R.M. (1993). *Animal bones from excavations in Colchester, 1971-1985.* Colchester Archaeological Report 12. Colchester Archaeological Trust.

Macdonald, D.W. (1991). Feral Cat. In: Corbet, G.B. & S. Harris: *The Handbook of British Mammals.* Oxford.

Maltby, J.M. (1979a). *The Animal Bones from Exeter 1972-1975.* Exeter Archaeological Reports 2. University of Sheffield.

Maltby, J.M. (1979b). The Animal Bones. In: Heighway, C.M.; A.P. Garrod & A.G. Vince: Excavations at 1 Westgate Street, Gloucester. *Medieval Archaeology* 23: 182-185.

Maltby, J.M. (1983). The Animal Bones. In: Heighway, C.: *The East & North Gates of Gloucester.* Western Archaeological Trust. Excavation Monograph 4: 228-245. Bristol.

McCormick, F. (1988). The domesticated cat in early Christian and Medieval Ireland. In: MacNiocaill, G. & P.F. Wallace (eds.): *Keimelia. Studies in Medieval Archaeology and History in memory of Tom Delaney.* Galway University Press.

Moreno García, M. (unpublished). Animal bones from the Flint Shaft, Castle Mall, Norwich.

Noddle, B.A. (1974). The Animal Bones. In: Platt, C. & R. Coleman-Smith (eds.): *Excavation in Medieval Southampton 1953-1969* 1: 332-339.

Noddle, B.A. (1976). Report on the animal bones from Walton, Aylesbury. *Records of Buckinghamshire* 20: 269-287.

Noddle, B.A. (1977). Mammal Bone. In: Clarke, H. & A. Carter (eds.): *Excavations at King's Lynn, 1963-1970.* The Society for Medieval Archaeology. Monograph Series 7: 378-399.

Noddle, B.A. (1980). The Animal Bones. In: Wade-Martins, P.: North Elham Park. *East Anglian Archaeology* 9: 375-409.

O'Connor, T.P. (1982). Animal Bones from Flaxengate, Lincoln, c. 870-1500. *The Archaeology of Lincoln.* vol. XVIII-1. Council for British Archaeology, London.

O'Connor, T.P. (1989). Bones from Anglo-Scandinavian Levels at 16-22 Coppergate. *The Archaeology of York* 15/3. Council for British Archaeology, London.

Rackham, D.J. (1977). The Faunal Remains. In: Addyman, P.V. & J. Priestly: Baile Hill, York. *Archaeological Journal* 134: 146-152.

Rackham, O. (1986). *The History of the Countryside.* London.

Reichstein, H. (1986). Einige Anmerkungen zu Katzenknochen und weiteren Haustierresten aus einer mittelalterlichen Kloake an der Holenbergstrasse in Höxter, Westfalen. *Neue Ausgrabungen und Forschungen in Niedersachsen* 17: 311-318.

Schmid, E. (1972). *Atlas of Animal Bones/Knochenatlas.* Amsterdam.

Smith, R.N. (1969). Fusion of ossification centres in the cat. *Journal of Small Animal Practice* 10: 523-530.

Thomas, K. (1983). *Man and the Natural World.* Harmondsworth.

Veale, E.M. (1966). *The English Fur Trade in the Later Middle Ages.* Oxford University Press, Oxford.

Westley, B. (1977). Animal Bones. In: Barton, K. & E. Holden: Excavations at Bramber Castle, Sussex, 1966-7. *Archaeological Journal* 134: 67-68.

SITE	PERIOD	%
Walton, Aylesbury	Saxon	.2
(Noddle, 1976)	Saxo-Norman	.5
Portchester Castle, Hants.	Early-Mid Saxon (C5th-C8th)	-
(Grant, 1976)	Mid- Late Saxon (C8th-C10th)	.1
	Late Saxon (C10th-C11th)	1.4
North Elham Park, Norfolk	Mid-Saxon	.4
(Noddle, 1980)	Late C9th-C10th	.4
	Late Saxon-early medieval	.5
Melbourne St, Southampton		
(Bourdillon & Coy, 1980)	Mid-Saxon	.3
Flaxengate, Lincoln	Anglo-Scandinavian	.4
(O'Connor, 1982)	TI-II (c.870-930/40)	.1
	TIII (c.930/40-970)	.2
	TIV-V (c.970-1040)	.4
Thetford, Norfolk		
(Jones, 1984)		
- Knocker's Excavations	Late Saxon	1.2
- Site 1092		.1
West Stow, Suffolk	Phase 1 (C5th)	.1
(Crabtree, 1989)	Phase 2 (C6th)	.8
	Phase 3 (Late C6th-C7th)	-
Coppergate, York	Anglo-Scandinavian	.2
(O'Connor, 1989)	Period 3 (mid C9th-early C10th)	.2
	Period 4 (C10th)	.1
	Period 5A (c. 975)	.2
	Period 5B (975 -early-mid C11th)	.2
	Period 5C (mid-late C11th)	.1

APPENDIX A. Saxon cat bones.

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WILD LIFE IN ANCIENT KHINGAR, MUSTANG ARCHAEOLOGICAL EVIDENCE FOR LOCALLY EXTINCT ANIMAL SPECIES IN THE DZONG KHOLA VALLEY, NORTHERN NEPAL

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ABSTRACT: Faunal analyses carried out in the settlement mound of Khingar, evidence the presence of a series of macromammalian species whose habitat optima do not correspond with the present landscape of the area. Assuming that the hunting and breeding of these species took place not far from the site itself, such inconsistency can best be accounted for through habitat changes, in particular deforestation, brought about as a combination of human and domestic animal activities.

KEYWORDS: FAUNA, NEPAL, MIDDLE AGES, HABITAT DEGRADATION

RESUMEN: Los análisis faunísticos llevados a cabo en el poblado de Khingar evidencian la presencia de una serie de macromamíferos cuyos óptimos ecológicos en absoluto se corresponden con la fisionomía del paisaje actual en la zona. Partiendo de la base que la caza y la cría de estas especies se produjo en los alrededores del asentamiento, tal inconsistencia podemos explicarla en términos de cambios ambientales, en especial deforestación, operados como consecuencia de la actividad combinada del hombre y de sus especies domésticas.

PALABRAS CLAVE: FAUNA, NEPAL, EDAD MEDIA, DEGRADACION AMBIENTAL

INTRODUCTION

In 1991 and 1992 the German Archaeological Institute in co-operation with HMG Department of Archaeology excavated the settlement mound of Khingar, a village situated halfway between Kagbeni and Muktinath on the left slope of the Dzong Khola creek (Figure 10). The excavations were carried out within the frame of the Nepal-German Project on High Mountain Archaeology under the direction of Dr. H.G. Hüttel (KAVA, Bonn). The old settlement of Khingar was inhabited over a long time span. The dating is based mainly upon imported ceramics from Kathmandu valley, Terai and Northern India, but also by means of radiocarbon dates. So far three periods of occupation can be established. Whereas the first settling period (I) was limited to the center of the mound, its occupation probably ending during the 2nd century A.D., a more extended habitation due to an increased population has been observed for the period II (3th/4th to 8th century A.D.) and for the subsequent period III dating approximately from the 10th to the 13th/14th century (see in detail Hüttel, 1993, 1993a, 1994).

During the excavations a great amount of faunal material was sampled which consists mainly of bones and bone fragments of slaughtered and hunted animals, and which can be considered kitchen refuse of the former settlers. A preliminary report on the bone material excavated in 1991 has already been published (von den Driesch, 1993). Twice as much material was collected in 1992 so that the total number of bone fragments of the ancient village now exceeds 18.000 bone specimens.

Based on my report on the material excavated in 1991, the faunal assemblage consists primarily of domesticated animals. Sheep, goat, cattle, yak and yak-cattle-hybrids played a dominant role in the economy of the settlement. People also kept horses, mules, donkeys and to a minor extent pigs, chickens, dogs and cats. Evidence for hunting activities is scarce and the percentage of bones of wild animals relative to the total amount of remains is below 3.

Due to the extensive sample which is now available, our knowledge of wild life has increased considerably. Apart from the species recognised on the basis of the 1991 samples, such as blue sheep, *Pseudois nayaur*, musk deer, *Moschus moschiferus*, marmot, *Marmota bobak*, wooly hare, *Lepus oriostolus*, mouse-hare, *Ochotona roylei*, and some wild birds (see table 1 in von den Driesch, 1993), the new material contains other species of mammals and birds expected in the region (Table 1). Additionally it reveals some species of game and one domestic species which are not known to occur at present or to have occurred in the more recent past in the Muktinath valley and adjacent areas (Final Report, 1994). These extraordinary remains include the following species:

1) Water buffalo, *Bubalus arnee f. bubalis*
2) Himalayan tahr, *Hemitragus jemlahicus*
3) Goral, *Nemorhaedus goral*
4) Red deer, *Cervus elaphus*
5) Barking deer, *Muntiacus muntjak*
6) Wild boar, *Sus scrofa*
7) Himalayan weasel, *Mustela sibirica*
8) Weasel, *Mustela nivalis*

The purpose of this contribution is to describe the material and to illustrate the criteria used for identification. The presence of these species not only contributes to our knowledge of their former zoogeographic distribution, but it also helps to reconstruct the former landscape and the natural environment of the valley at the time of its early occupation.

An overview of the wild species collected from Khingar is given in Table 1. Those animals which conform to our knowledge of species' distribution in the study area do not need further discussion here.

MAMMALS	BIRDS
Blue sheep or Bharal, *Pseudois nayaur* (K)	Eurasian wigeon, *Anas penelope* (J)
Tahr, *Hemitragus jemlahicus* (K)	Garganey, *Anas querquedula* (J)
Goral, *Nemorhaedus goral* (K)	Common teal, *Anas crecca* (J)
Red deer, *Cervus elaphus* (K)	Black kite, *Milvus migrans* (K)
Barking deer, *Munticaus muntjak* (K, J)	Himalayan griffon, *Gyps himalayensis* (K, J)
Musk deer, *Moschus moschiferus* (K, J)	Chukar partridge, *Alectoris graeca chukar* (K, J)
Wild boar, *Sus scrofa* (K)	Snow partridge, *Lerwa lerwa* (K)
Grey wolf, *Canis lupus***	Indian gallinule, *Gallinula chloropus* (J)
Red fox, *Vulpes vulpes* (K)	Common crane, *Grus grus* (K)
Himalayan weasel, *Mustela sibirica* (K)	Snow pigeon, *Columba leuconta* (K, J)
Weasel, *Mustela nivalis* (K)	Blue rock or hill pigeon, *Columba livia* or *C. rupestris* (K, J)
Bobak, *Marmota bobak* (K)	Thrush, *Turdus sp.* (J)
Rat, *Rattus rattus* (K, J)	Red-billed cough, *Pyrrhocorax pyrrhocorax* (K,J)
Tree mouse, *Apodemus flavicollis* (K, J)	Tree sparrow, *Passer montanus* (K, J)
Wooly hare, *Lepus oriostolus* (K, J)	
Mouse-hare, *Ochotona roylei* (K, J)	

TABLE 1. Wild species identified from the bone find from Khingar (K) and the cave system from Jharkot (J)*, (*) Most of the small mammal and bird bones from the cave system of Jharkot can be considered as regurgitated pellets from owls. (**) Identified from the faunal material from Dzar, 16th century.

MATERIAL AND OSTEOMETRIC DATA

1) Water buffalo

Table 2 lists the skeletal parts which on the basis of their size and morphology can be assigned to domestic water buffalo. Figures 1 and 3 demonstrate the morphological differences of proximal metacarpus and phalanx 2 between water buffalo and other related species of large bovids, such as cattle, *Bos primigenius f. taurus*, yak *Bos mutus f. grunniens*, and gaur, *Bibos gaurus*. As can be seen, the morphology of the bones from Khingar fits best with the one observed in water buffalo. The notch between the proximal articular facets of the metacarpal in water buffalo and in cattle is considerably more pronounced than in that of yak and gaur (Figure 1), and the ridge between the two facets, considerably shorter than in the former species. Differences between *Bubalus* and *Bos primigenius* can be found in the two proximal articular facets being much more flattened in relation to the anterior-posterior length of the proximal articular surface in the first species (Figure 1 c-e). *Bubalus* possesses a strong tuberositas at the palmar margin of its articular surface which is also seen in the fossil specimen from Khingar.

The four water buffalo bones must derive from four different individuals because of their different location and dating. None of them is dated to the latest period. The metacarpal bone is large, the two phalanges even larger. The measurement of the metacarpus falls into the size range given for corresponding prehistoric water buffalo bones from Northeastern Thailand (Higham, 1975; Tables 1 and 4). Unfortunately no measurements of the 2nd phalanx from fossil and subfossil water buffalo could be found in the literature. But despite their large size, we consider the bones as belonging to the domesticated form of water buffalo, hence *Bubalus arnee f. bubalis* (see below).

LOCATION	PERIOD	SKELETAL PART	MEASUREMENTS*
BXXII 79/11	II late	fragment of frontal bone with part of the basis of the horncore of a male	-
BXXI 87/14	II	phalanx 3	-
BXXI 344	II late	proximal end of right metacarpus	Bp: 73.0; Dp: 44.0; Figure 1d
BXXII 5.3/25 I	I	phalanx 1 posterior, partially damaged, male	GLpe: (68.0); Bp: (37.0); Bd: (39.5)
BXXI 88/16 II	II	phalanx 2 anterior, male	GL: 47.5; Bp: 41.5; SD: 30.0; Bd: 33.0; Figure 3c

TABLE 2. Bone material from water buffalo. (*) Abbreviations as listened in von den Driesch (1976).

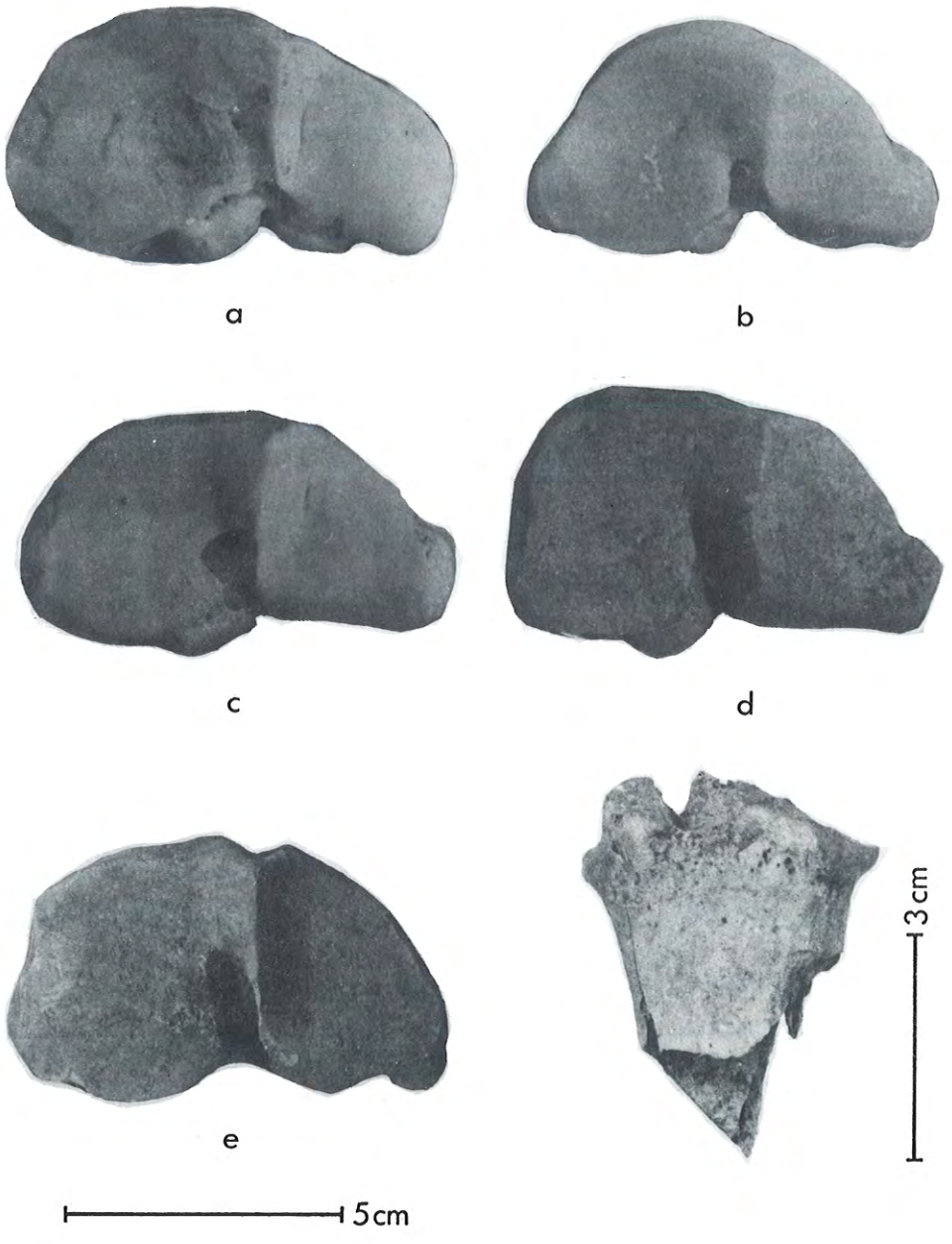

FIGURE 1. Proximal right metacarpi from large bovids in comparison. a. Bibos gaurus male recent; b. Bos mutus grunniens male recent; c. Bubalus arnee f. bubalis male recent; d. *Bubalus bubalis* from Khingar. e. *Bos primigenius* fossil from Bulgaria. Bp a-e: 74.5 mm, 69.0 mm, 74.0 mm, 73.0 mm, 73.0 mm.

FIGURE 2. Proximal radius from tahr, Khingar.

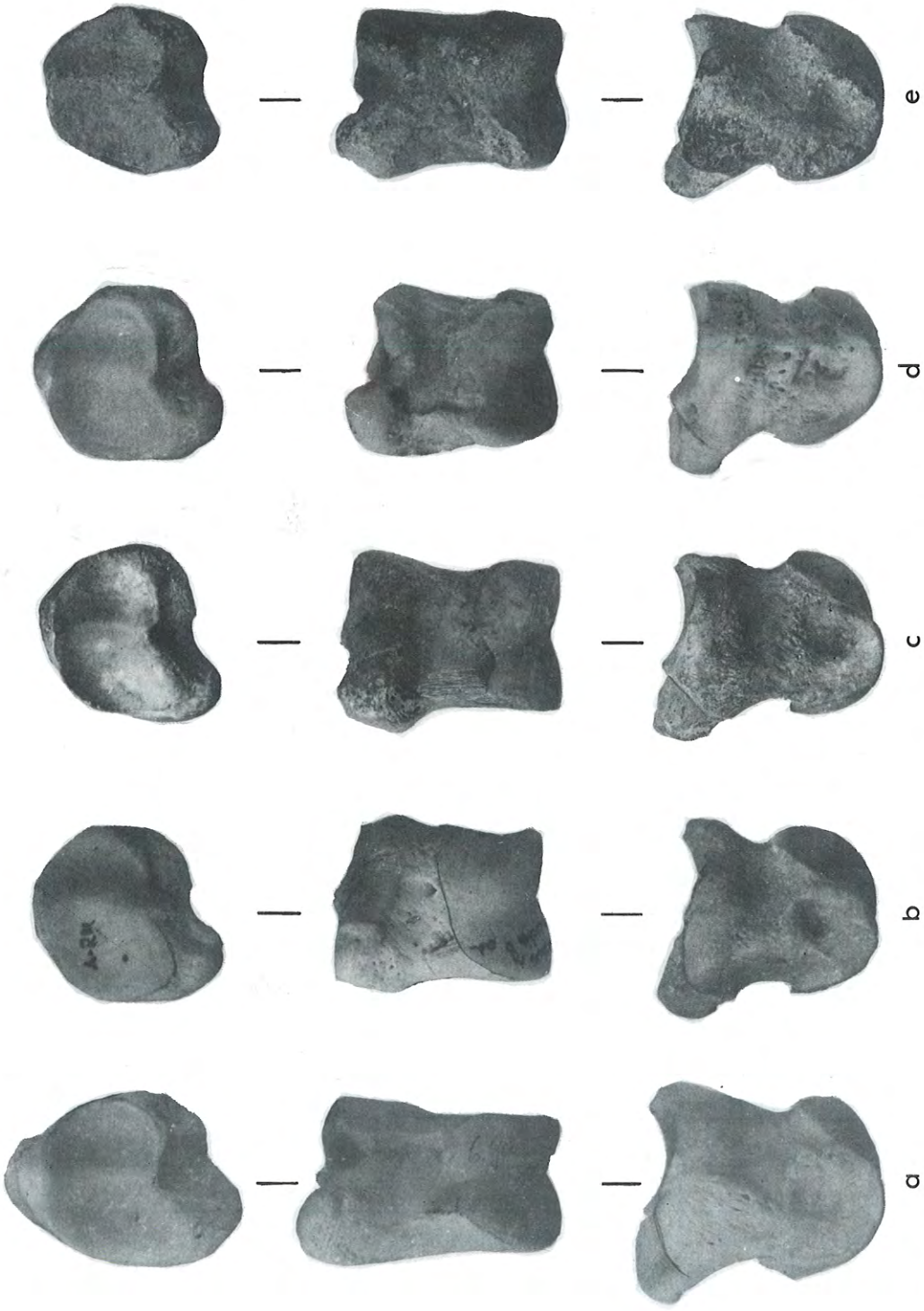

FIGURE 3. Second anterior phalanges from large bovids in comparison. a. *Bibos gaurus* male recent; b. *Bubalus arnee f. bubalis* male recent; c. *Bubalus bubalis* from Khingar; d. *Bos mutus grunniens* male recent; e. *Bos primigenius* fossil from Bulgaria. GLpe a-e: 53.0 mm, 46.0 mm, 47.5 mm, 41.0 mm, 47.0 mm.

2) **Himalayan tahr**

The faunal material from Khingar also contains bones of a wild caprid (Table 3) which considerably surpass the corresponding bones of domestic goats in size and show different morphological features. In the first stage of the investigation I thought that they pertain to ibex, *Capra ibex sibirica*, or to markhor, *Capra falconeri*, but these two species do not belong to the indigenous fauna of the Nepalese Himalayas. Regarding the ibex Prater (1971: 254) writes: "*The Himalayan ibex inhabits the western Himalayan range, and the mountain range which lie beyond in Kashmir and Baluchistan. Its eastern limits are set by the upper reaches of the Sutlej river east of which it does not occur*" (see also Haltenorth & Trense, 1956). The markhor is known to inhabit the Himalayas from the valley of Kahsmir westwards, and the Hindukush (Prater, 1971: 257).

Intensive osteological comparison with skeletons of modern specimens revealed the three first bones listed in Table 3 belong to the tahr (Figures 2 and 4 e,f). This wild species is now extinct in the mountains surrounding the Muktinath valley but occurs on the southern flanks of the Himalayas (see below).

3) **Goral**

Two bone fragments of this medium size goat-antelope are identified (Table 3). Although the right scapula, dated to period III, is damaged, one can see the straight crest at the caudal margin of the column and the almost circular articular surface of the cavity process which is characteristic of members of the *rupicaprini* group.

LOCATION	PERIOD	SKELETAL PART	MEASUREMENTS
tahr: AXI 64/47	III	right scapula of a male	SLC: 29.0; GLP: 47.0; LG: 39.5; BG: 32.0; Figure 4f
BXXII 37/1	III	right proximal radius, male	Bp: 41.0; BFp: 37.5; Figure 2
BXXII R 5.3/23	II early	left centroquartale	GB: 35.0
goral: AXI 51/32	III	right scapula	BG: 21.2
BXXI 62,72/24	I (-II)	right distal metatarsus, probably male	Bd: 27.0

TABLE 3. Bone material from tahr and goral.

LOCATION	PERIOD	SKELETAL PART	MEASUREMENTS
BXXII R 7.1/20	II	right scapula of a male	GLP: 29.8; LG: 21.5; BG: 21.0
AXI 72/39	III	right adult mandibula	-
AXI H 1.6/47	II-III	right juvenile mandibula (M3 not yet errupted)	-

TABLE 4. Bone material from muntjak.

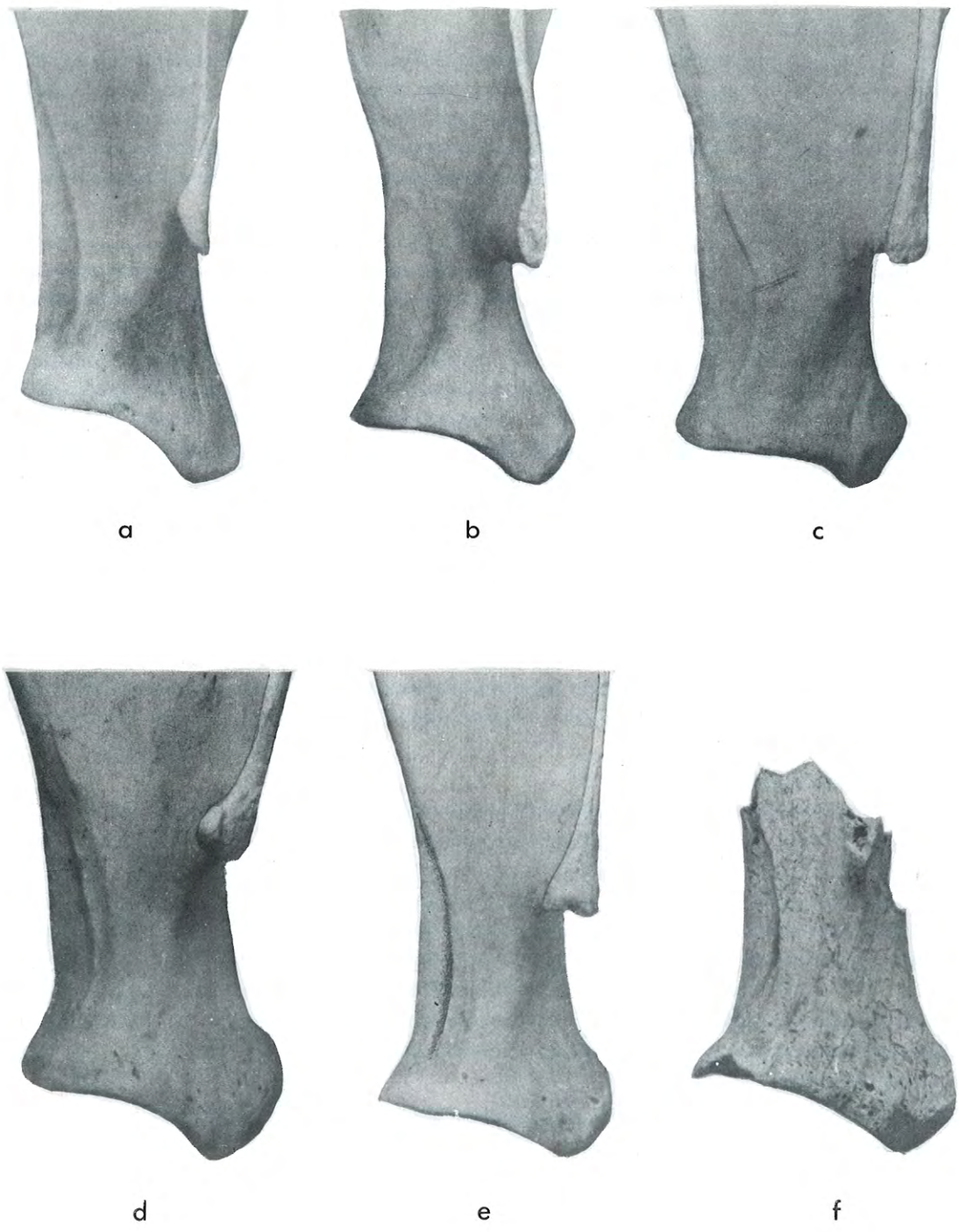

FIGURE 4. Right scapulae from ovicaprini in comparison. a. *Pseudois nayaur* male recent; b. *Ovis ammon hodgsoni* male recent; c. *Capra falconeri* male recent; d. *Capra ibex sibirica* male recent; e. *Hemitragus jemlahicus* male recent; f. *Hemitragus jemlahicus* Khingar. GLP a-f: 40.5 mm, 39.0 mm, 41.2 mm, 45.0 mm, 44.0 mm, 47.0 mm.

4) **Red deer**

Completely unexpected are two bone fragments from a large deer species. One represents a small piece from the crista ischiadica of a pelvic bone from BXXII 34/1, typical of the family *Cervidae* with its pronounced muscle attachment lines. The second find is a distal end of a right radius measuring 52.5 mm Bd (Figure 5d). It was found in BXXII 74, 64/2. Both finds date to period III. However, the excavator suggests that the archaeological material from these two locations is mixed up and could contain older material.

As no species of large deer is reported to live in the southern part of the Mustang district, I first tried to establish from what species the radius might derive. Osteological comparison with deer species of about the same size and occurring in the Indian and Central Asiatic region clearly reveals that the bone in question belongs to the red deer group. As can be ascertained, the most distinctive osteological feature are the two sharp ridges on the dorsal side of the bone which are shorter and stand closer together in *Cervus elaphus* than in the other two species, the barasingha or swamp deer, *Cervus (Rucervus) duvauceli* and the sambar, *Cervus unicolor* (Figure 5 a, b). The distribution and habitats of the two latter species can exclude them from consideration as part of the fauna of the Muktinath valley or the nearby Kali Gandaki valley, even in prehistoric times.

The distal breadth of 52.5 mm falls within the variation known from radii of prehistoric red deer from southeastern Turkey. Following Pietschmann (1977; Table 1) the size range of the distal radius of Chalcolithic and Early Bronze Age turkish red deer, belonging to the subspecies *maral* varies from 51.0 mm to 64.0 mm. The maral whose distribution reaches eastwards as far as Pakistan, belongs to the largest subspecies of red deer known from the Old World. As quoted by Kurt & Zhiwotschenko (1988: 194) red deer is represented in Central Asia and in the Himalayas with relatively small subspecies. Unfortunately bone measurements from other subspecies of red deer from Central Asia, e.g. from the hangul, *Cervus elaphus hangul*, or the somewhat larger shou, *Cervus elaphus wallichi*, are not available.

5) **Barking deer**

Those skeletal parts which are attributed to this small deer are listed in Table 4. Identification is possible by means of intensive osteological comparison of the small deer bone material excavated in Khingar with recent skeletons of musk deer and muntjak. Whereas remains of musk deer, a species which still lives today in the scrub covered ravines of the Dzong Khola, are much more abundant in the faunal material from Khingar, three bone specimens turned out to be from muntjak. The presence of the scapula indicates that the whole carcass was brought into the settlement and that we are not dealing with a traded skin. However, it must be noted that in some tombs excavated in the cave system of Jharkot isolated upper canines of male musk deer and muntjak were found. These teeth are often perforated and have served as jewellery. No doubt, these finds represent trade object.

6) **Wild boar**

Two broken halves of a jaw of a male wild boar are identified from BXXII 79/9-11 (period II). The following measurements could be taken:

Length of the molar row: 83 mm

Length of M3: 44.5 mm (left), 45 mm (right)

Breadth of M3: 17.5 mm (left), 18 mm (right)

The third molars show medium wear (Figure 6b). The tooth dimensions leave no doubt that this huge jaw comes from a wild boar and not from a domestic pig.

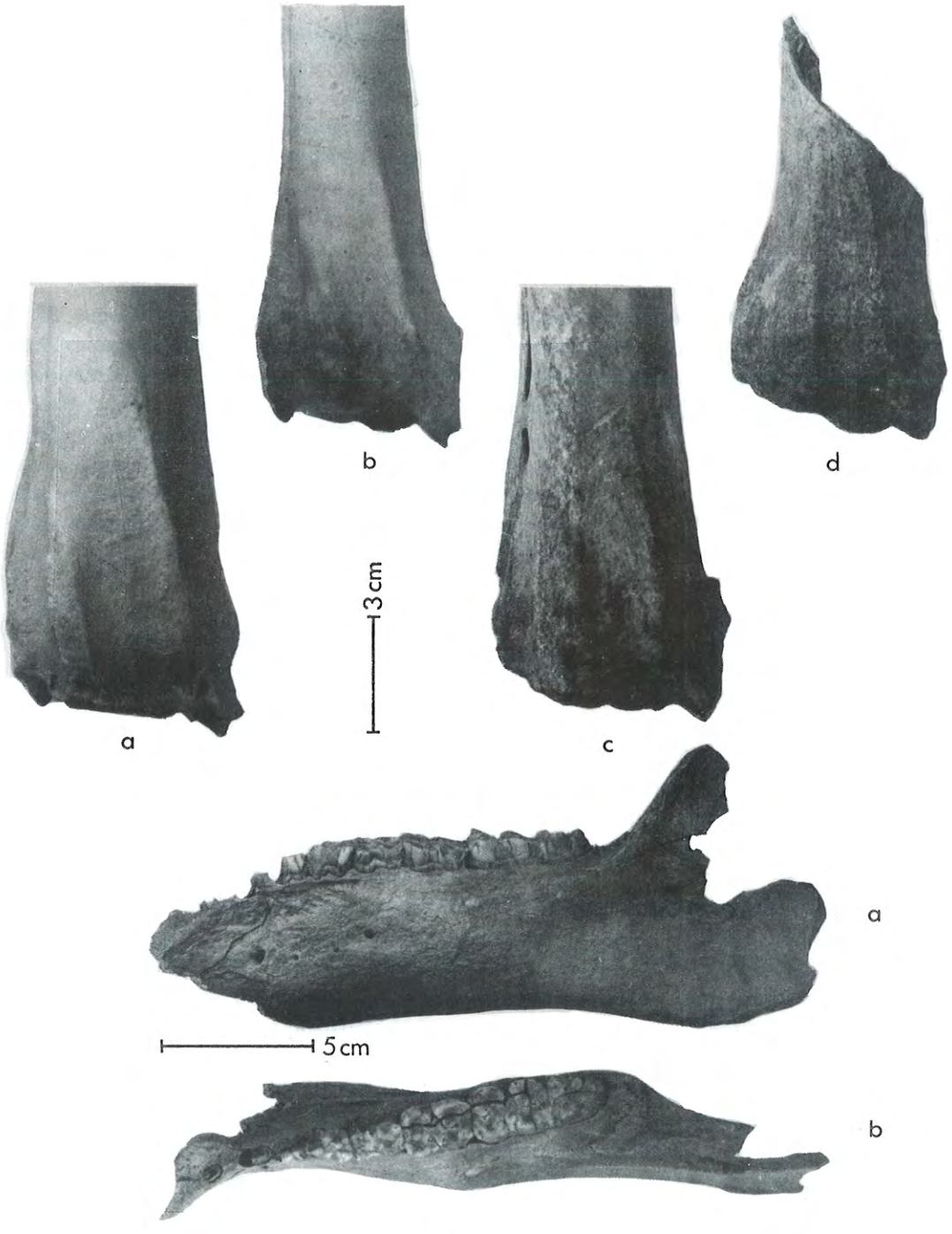

FIGURE 5. Right distal radii from large deer in comparison. a. Cervus duvauceli male recent; b. Cervus unicolor male recent; c. *Cervus elaphus maral* fossil from Turkey; d. *Cervus elaphus ssp.*, Khingar. Bd a-e: 56.0 mm, 50.0 mm, 58.0 mm, 52.5 mm.

FIGURE 6. Left jawbone of *Sus scrofa ssp.* from Khingar.

7) **Himalayan weasel**

The faunal material from Khingar reveal the complete jaw (right and left side) of a rather large weasel originating from AXI 61/31, period III. Measurements: total length of one half 29 mm, greatest height of the coronar process 13.2 mm, length of the tooth row (M2-J) 19.3 mm, length of the tooth row (M2-P1) 14 mm, length of M1 15.5 mm. These dimensions fit well into the size range given for modern Siberian weasels, *Mustela sibirica*, (Glover, 1938: 372 ff) which is the largest of the weasels from the Indomalayan region (Prater, 1971: 157). Its recent distribution is given by Corbet & Hill (1992, map 90, see also Figure 9).

8) **Weasel**

From BXXI F 348 (period I) comes a very small left femur of a weasel: GL = 25.0 mm, SD = 1.9 mm, Bd = 4.7 mm. These dimensions fit best to the weasel, *Mustela nivalis* (see Reichstein, 1993; table 112 f). According to Corbet & Hill (1992: 195) the range of *Mustela nivalis* in Central and Eastern Asia comprises "N Vietnam, and high altitude in Sichuan, SW China and throughout most of the Palaearctic and Nearctic regions; approaching this region in Afghanistan but apparently absent from the high Himalayas" (see also Figure 9). Two other species of weasel occurring in the Annapurna conservation area, the yellow-bellied weasel, *Mustela kathiah*, and the stoat, *Mustela erminea*, grow larger than the animal from which this small femur derived, but no postcranial bone measurements for the yellow-bellied weasel are available.

ZOOGEOGRAPHIC DISTRIBUTION AND NATURAL HABITAT

As stated by Prater (1971: 248) tall grass jungles and reed brakes in the neighbourhood of swamp provide the ideal habitat for the **wild buffalo**. It is, therefore, a typical inhabitant of the grass jungles of the Nepal Terai and the plains of the Brahmaputra in Assam. Pools of water to lie in, and mud wallows in which to roll and cake themselves with earth is the environment still required for its domestic descendant, the **water buffalo**. Judging from their habitat preference wild buffalo probably did not penetrate into the Kali Gandaki valley as far and high as the upper Thakkola in earlier times. In spite of the large size of the bones found at Khingar (see measurements in Table 2), it is more likely to assume that the early settlers who reached the Muktinath valley in the very early Middle Ages brought dometic water buffalo with them; a fact which from an ecological point of view is interesting, since today the keeping of water buffalo is no longer possible in the area. We saw water buffalo in the lower parts of the Kali Gandaki valley between Tatopani and Ghasa. Today the animals are kept at lower altitudes, generally not higher than 2.500 m above sea level.

In Nepal the **Himalayan tahr** ranges from the broad-leaved forest zone to the alpine meadows but favours grassi cliffs with patches of trees (Corbet & Hill, 1992: 272). All authors agree that the animals select the most inaccessible ground to live in and are found on cliffs, rocks, in dense scrub, and forest (Figure 7). It is known to prefer forests of oak, rungal and cane, generally favouring altitudes of 2.500 m to 4.400 m. According to recent investigations on distribution, status and factors responsible for population trends (Bauer, 1990), the Himalayan tahr inhabits a narrow strip along the southern flanks of the Himalayas (Figure 7). Tahr seems to be much more abundant in the eastern regions of Nepal with high precipation rates. This does not correspond with Schallers (1977)

observations that the animal is not able to tolerate warmer and more humid conditions (Bauer, 1990). In western Nepal the tahr is restricted to rugged terrain at lower altitudes, and is not found at high altitudes where it has been replaced by the bharal. Nowadays the whole Mustang district is without any occurrence of tahr (Figure 7).

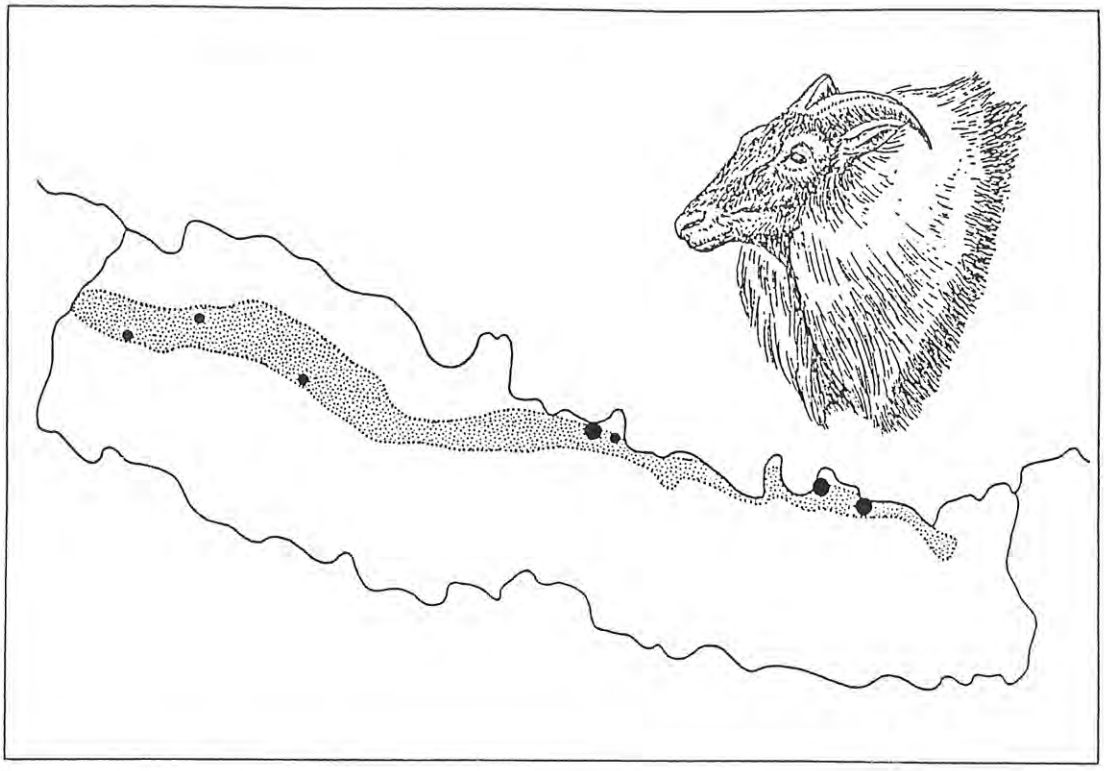

FIGURE 7. Distribution of tahr, *Hemitragus jemlahicus*, in Nepal (according to Bauer, 1990, figure 1.).

A similar picture emerges for the **goral**. Like tahr, goral also is confined today to the southern flanks of the Himalaya. It shows high climatic flexibility ranging from 300 m in the subtropical Terai to the cold himalayan regions in 4.000 m above sea level. Bauer (1990) argued that its present distribution -mainly on steep, dry southern and western slopes between altitudes of 2.000 m to 2.800 m- suggests that this species now occupies more marginal habitats, whereas it has disappeared from many regions of the densely populated middle hills and in the northern valleys. Goral still occurs in considerable numbers in the lower altitudes of Langtang National Park. The Bio-diversity Conservation Data Project of the Annapurna Conservation Area (1994) has recorded the goral throughout the southern slopes of the Annapurna range (see also Figure 8).

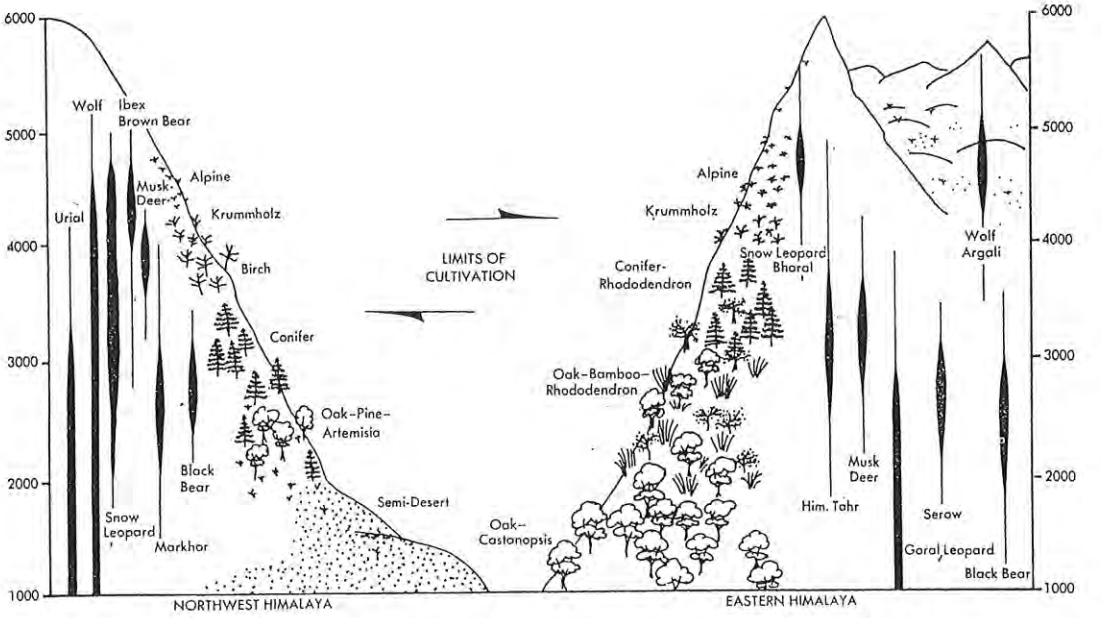

FIGURE 8. The vertical zonation of the vegetation and the altitudinal distribution of large mammals in the northwestern and eastern Himalayas (according to Schaller, 1977, figure 19).

Of all the members of the family *Cervidae* **red deer** once occupied the widest distribution area comprising Europe, Asia and North America. Due to deforestation, overhunting and ever extending usurpation of land by man, the territory has shrunk considerably and red deer has disappeared from regions where they were common. Although very adaptable, their habitat depends on grazing conditions and season, they are mainly inhabitants of forests or grass jungles. Deer are never found in desert and open land. The Kahsmir stag for example, now limited to the north side of the valley of Kashmir and some adjacent valleys (Prater, 1971: 287), seldom remains long in one area but roams from forest to find good grazing. Winter is spent at lower altitudes, summer on the heights going uphill as far as the snow-line.

As such, the presence of bones of red deer in an archaeological context always indicates forests or high vegetation where the animals could find sufficient covering.

Like all other deer species **muntjak** also need protection through vegetation and avoids dry steppe biotope. It keeps to more or less thick jungle and comes out to graze in the outskirts of forest or in open clearings (Prater, 1971: 294). Although it occurs up to altitudes of 2.500 m and even higher, it can no longer live in the surroundings of the Dzong Khola valley with its poor cover and scarce vegetation, and therefore has disappeared from the region.

The Bio-diversity Conservation Data Project (1994) reported **Indian wild boar**, *Sus scrofa cristatus*, as occurring in the past in Lamjung area. Now it is supposed to be exterminated as no recent reports are available from the Annapurna Conservation Area where it was presumably found as high as 1.500 m. The jaw bones of *Sus scrofa* (Figure 6) excavated in Khingar from layers of period II show clearly that the distribution area reached further north and probably at higher altitudes, at least during the earlier Middle Ages. Boar require grass or scanty bush jungle or forest. This type of

biotope can be postulated along the Kali Gandaki river from Jomsom northwards before deforestation by people and overgrazing by their domestic stock destroyed the vegetation.

As can be seen from Figure 9 the **Himalayan weasel** at present ranges in the E Himalayas, -mostly above 2.400 m-, and from there east to the northern parts of Burma, Thailand, Laos and Vietnam, most of China, Taiwan also throughout N China, much of Siberia and Japan (Corbet & Hill, 1992: 196). Interesting to note that evidences for the **weasel**, *Mustela nivalis*, are known on the one hand from N Vietnam and at high altitudes in SW China and on the other hand from Afghanistan westwards (Figure 9). The species' apparent absence from the high Himalayas may be due to lack of records especially when considering the fact that *Mustela nivalis* is generally very rare in Eastern Asia.

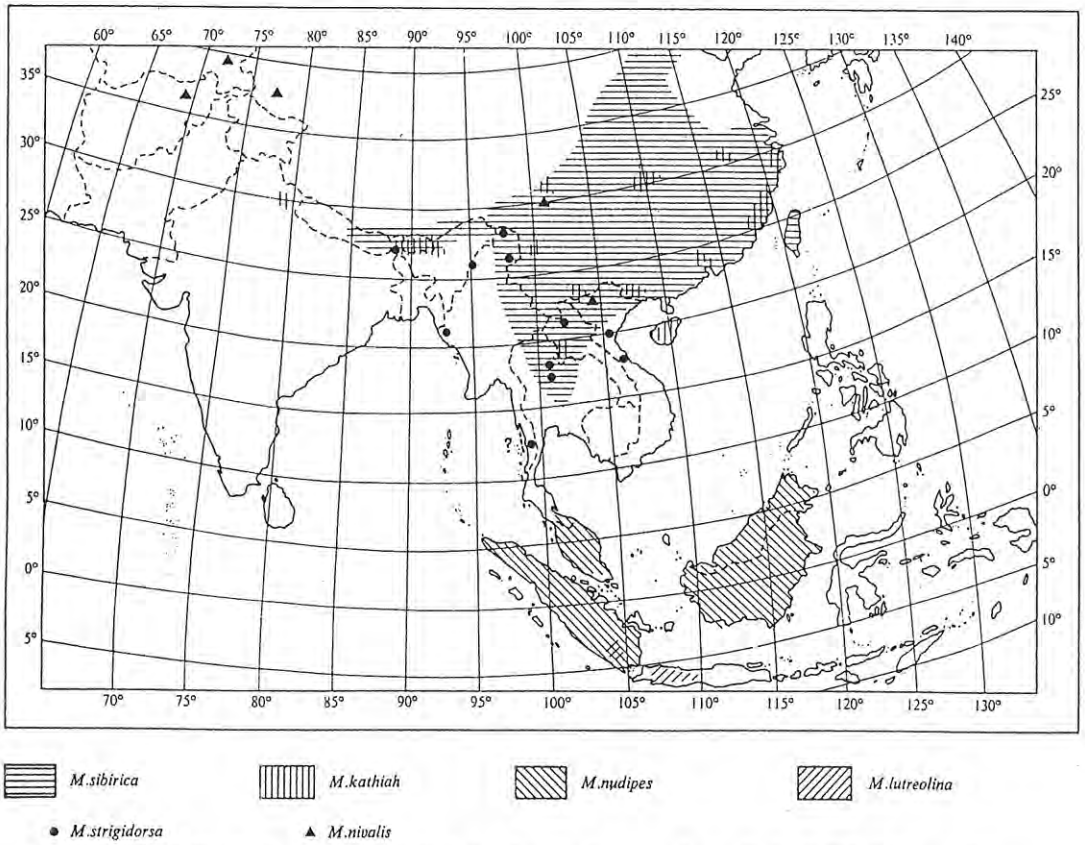

FIGURE 9. Distribution of *Mustela* in the Indomalayan region (according to Corbet & Hill, 1992, map 90).

CONCLUSIONS

Today Khingar lies in a semi-desert environment with little precipitation and scarce vegetation. Apart from willows, mostly populars are found only in and near the villages and are cultivated and exploited intensively. The natural vegetation includes shrubs of junipers, caragana, rosa, and cotoneaster. This type of biotope is also found around Kagbeni in the Kali Gandaki valley.

The region above Kalopani up to Jomsom is designated as a transition zone with a similar plant cover known for the sub-alpine and alpine characteristics. This area connects the humid type of environment in the south with the dry-arid or tundra type in the north. Two important valleys cross the transitional area, i.e. Manang valley and Kali Gandaki valley (Figure 10). The Manang valley east to the Thorung La and Tilichio himal receives comparatively higher precipitation than the Kali Gandaki valley near Jomsom (200-300 mm/year). As such the Manang valley retains better greenery than the Thakkola valley. Seen zoogeographically, the transition zone acts as a bridge for migratory fauna. The Thakkola passageway seems to represent a better migratory route than the Manang valley (Final Report, 1994).

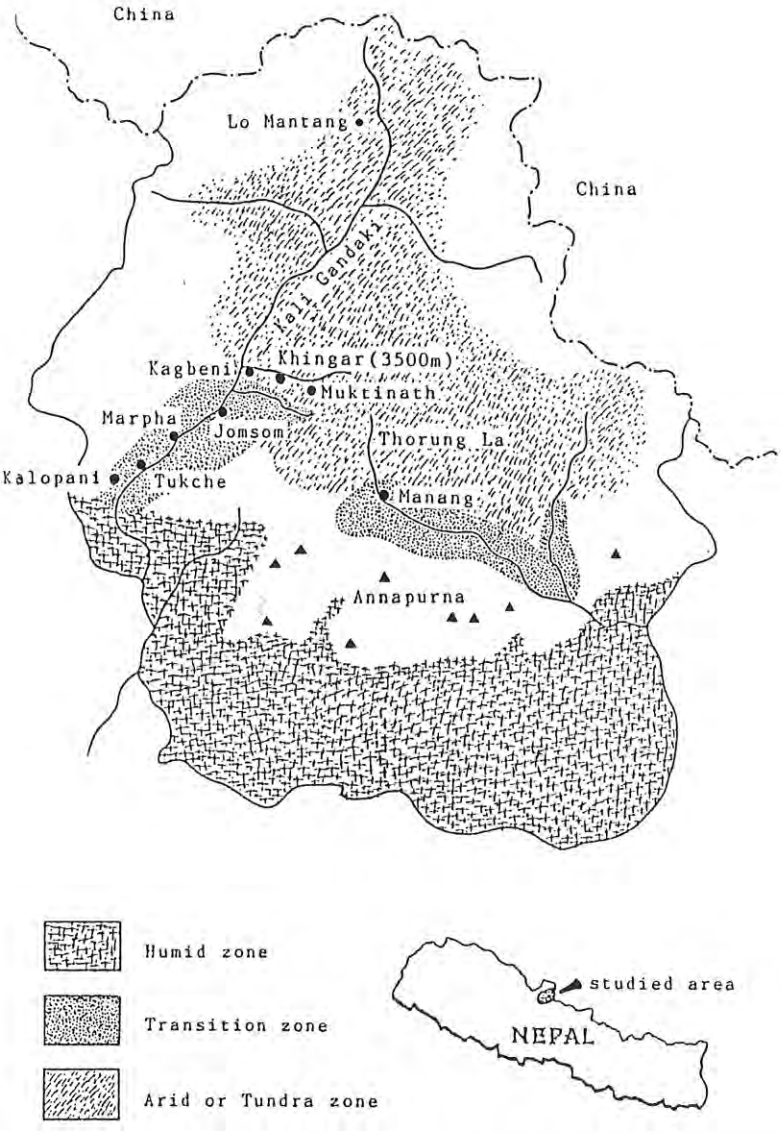

FIGURE 10. Zoogeographical regions for the Annapurna Conservation Area (according to Final Report, 1994, figure 4.2).

The faunal material from ancient Khingar dates back as far as the early Middle Ages or even earlier. So far, the faunal samples yielded seven wild mammal and one domestic species which do not belong the recent fauna known from the area and which are now distributed either in more southern (tahr, goral muntjak, wild boar and water buffalo) or in more eastern and northwestern regions (red deer, weasels). All eight species mentioned above cannot live under arid or tundra like conditions. Especially big game species such as tahr, red deer and wild boar, need forest or grass jungles with patches of trees where they can find refuge. Judging from their preferred habitat, the assessment is allowed that the land north of Jomsom up to Kagbeni and the Muktinath valley should have supported forests and thickets comparable to those vegetational structures found on the eastern slopes of the Nilgiri himal opposite to Marpha and Tukche. Thus it can be deduced from the fauna identified in ancient Khingar that the sparse vegetational cover of present day is solely the result of human activities, especially the cutting of bushes and trees. Whereas deforestation continued, the soil became exposed to wind and water erosion. The little precipitation did not favour the growing of new wood. Combined with overgrazing by domestic animals, in particular by sheep and goat, one can imagine that all those factors transformed the region into a habitat of arid and sparsely vegetated conditions.

ACKNOWLEDGEMENTS

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BIBLIOGRAPHY

Bauer, J.J. (1990). Status of the caprini in the Central Himalaya with special reference to game conservation/management of high altitude species in Nepal. Unpublished report.

Corbet, G.G. & J.E. Hill (1992). *The Mammals of the Indomalayan region*. Natural History Museum Publications, Oxford University Press, Oxford.

Driesch, A. von den (1976). *A guide to the measurements of animal bones from archaeological sites*. Peabody Museum Bulletin 1. Harvard University, Cambridge.

Driesch, A. von den (1993). Faunal remains from early houses in Khingar. *Ancient Nepal* 134: 18-22.

Final Report (1994). King Mahendra Trust for Nature Conservation. Annapurna Conservation Area Bio-Diversity Conservation Data Project. Kathmandu.

Glover, M.A. (1938). The Mammals of China and Mongolia. Natural History of Central Asia XI/1. The American Museum of Natural History, New York.

Haltenorth, T. & W. Trense (1956). *Das Grosswild der Erde und seine Trophäen*. Bayerischer Landwirtschaftsverlag, München.

Higham, C. (1975). Non Nok Tha, the faunal remains from the 1966 and 1968 excavations at Non Nok Tha, Northeastern Thailand. *Studies in prehistoric Anthropology* 7: 1-187. University of Otago, Otago.

Hüttel, H.G. (1993). Excavations at Khingar Mound 1991. *Ancient Nepal* 134: 1-17.

Hüttel, H.G. (1993a). Archälogie am Rand der Ökumene. *Archäologie in Deutschland* H.2: 10-15.

Hüttel, H.G. (1994). Zur Chronologie von Khingya-Khalon. *Berichte zur Allgemeinen und Vergleichenden Archäologie* 14. (In press).

Kurt, F. & V. Zhiwotchenko (1988). *Asiatische und nordafrikanische Rothirsche*. In: Grzimeks Enzyklopädie Säugetiere 5, 194 f. Kindler Verlag, München.

Prater, S.H. (1971). *The book of Indian animals*. Bombay Natural History Society, Bombay.

Reichstein, H. (1993). *Mustela erminea* Linne, 1758 - Hermelin und *Mustela nivalis* Linne, 1766 - Mauswiesel. Handbuch der Säugetiere Europas 5/II, Raubsäuger 2: 533-626. Wiesbaden.

Schaller, G.G. (1977). *Mountain Monarchs*. Wildlife Behaviour and Ecology Series. The University of Chicago Press, Chicago.

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RESTES ANIMAUX HOLOCÈNES ET DU PALÉOLITHIQUE MOYEN (MSA) DE LA GROTTE DE LEBA SUR LE PLATEAU DE HUMPATA (ANGOLA)

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ABSTRACT: A small collection of animal remains, mainly mammals is described from strata with late MSA artefacts overlain by later and mixed deposits in the so called Leba Cave, southern Angola. As usual several taphonomic groups are present, but most of macromammal remains would be derived from game killed by MSA-people.

KEYWORDS: ANGOLA, CAVE FAUNA, MIDDLE PALAEOLITHIC, MSA

RESUMEN: El artículo describe una reducida muestra faunística, fundamentalmente de mamíferos, recuperada en niveles con artefactos del Paleolítico medio (MSA) tardío cubiertos por estratos posteriores y revueltos en la denominada Cueva Leba en Angola meridional. Como suele ser norma, la muestra contempla varios grupos tafonómicos si bien la mayoría de los macromamíferos parecen ser producto de la actividad cinegética de los cazadores paleolíticos.

PALABRAS CLAVE: ANGOLA, FAUNA CAVERNÍCOLA, PALEOLÍTICO MEDIO, MSA

INTRODUCTION

La brève étude qui suit concerne les restes animaux recueillis par J. Camarate França (1964) lors de ses fouilles de 1950-53 dans la caverne de Leba sur le plateau de Humpata, en Angola (Figure 1). Dans son article sur l'évolution des industries lithiques au Paléolithique moyen et supérieur de l'Angola, Ramos (1984) présente le site et donne une coupe systématique de la séquence stratigraphique. En 1985, le même préhistorien nous invita à entreprendre l'analyse de la faune recueillie par Camarate França. Cette analyse fut retardée par le fait qu'il ne s'avéra pas toujours facile d'établir la provenance exacte des échantillons et les résultats de l'analyse archéozoologique ne furent prêts qu'en 1989. M. Ramos devait les compléter par une introduction sur le site et son contexte, mais malheureusement ce dernier décéda en 1991, suite à une grave maladie. Ses collègues au *Centro de Pré-história e Arqueologia* de l'*Instituto de Investigaçao cientifica tropical* à Lisbonne n'ayant pas pu fournir les données nécessaires pour compléter l'étude, le manuscrit est resté inédit jusqu'au début de cette année, quand nous nous sommes décidés à présenter les résultats avec une introduction sommaire sur le site et son contexte d'après les données que notre regréte collègue avait déjà transmises et complétées par quelques données extraites de la litérature.

La grotte de Leba est creusée dans les calcaires dolomitiques du Paléozoique inférieur, sur le versant gauche de la riviere du même nom, au nord-ouest du haut plateau de Humpata (Do Amaral, 1973: 30, fig. 1; 31, fig. 2). Lors des fouilles entreprises par Camarate França (*ibid.*), un four à chaux était installé en contrebas de la grotte dont l'entrée était utilisée comme entrepôt; les installations résidentielles de la compagnie exploitant les calcaires se trouvaient à un kilomètre du site. Do Amaral (*ibid.*, Pl. IA et Pl. IIIA & B) présente des vues de la vallée avec la grotte, de l'entrée et de la première salle.

Le climat de la région est caractérisé par une saison de pluie d'octobre à avril et une saison sèche de mai à septembre, avec une précipitation annuelle moyenne de quelque 800 mm ou plus et une température moyenne de 15°-16°C, avec des extrêmes de plus de 30°C (octobre à janvier) et de

-2°C (juin, juillet). La végétation naturelle, assez dégradée par les exploitations agricoles, semble appartenir à la grande catégorie des savannes boisées (*woodlands*) avec *Brachystegia* et *Julbernalia*, de type *miombo*. Sur le plateau et ses bordures, on trouve quelques sources plus ou moins permanentes et pendant la saison des pluies, des mares avec leur végétation caractéristique se forment dans les dépressions à sol peu perméable; souvent elles persistent toute l'année. Sur les hauteurs à roches silicieuses et à sols squelettiques, la végétation appartient plutôt au type des prairies alpines. Les couches calcaires affleurant sur de grandes étendues du plateau sont affectées par des phénomènes karstiques divers et se caractérisent sans doute par un microclimat plus sec que ne le suggère la précipitation; cela pourait expliquer la présence d'éléments "exotiques" de type aride, tel que *Euphorbia*.

Les remplissages de structures karstiques forment une catégorie bien définie de sites à vertébrés terrestres. Dans les brêches ossifères du plateau de Humpata, des collections ont déjà été constituées avant la Deuxième Guerre Mondiale (Dart, 1950) et divers mammifères fossiles ont été attribués au Quaternaire ancien (Arambourg & Mouta, 1955; Telles Antunes, 1961, 1965; Breuil & Almeida, 1964; Minkoff, 1972). Les recherches récentes ont livré une riche moisson de fossiles de cercopithèques, d'herbivores, de suidés etc. ainsi que des micromammifères, que l'on attribue à la fin du Pliocène et au Quaternaire ancien (Pickford *et al.*, 1990, 1992, 1994).

D'après le schéma fourni par M. Ramos fin 1989, la séquence stratigraphique de la grotte se lit comme suit.

Couche I: déblais du four à chaux qui était installé devant la grotte; tessons de poterie et charbons de bois; épaisseur maximum: 20 à 30 cm.

Couche II: dépôts d'un abri sous roche qui existait à l'entrée de la grotte; terre grise riche en matière organique; mélange desordonné d'artéfacts lithiques et d'objets en fer et en céramique; restes de faune d'aspect récent; épaisseur: 30 à 40 cm.

Couche III: terre brun foncé, riche en matière organique avec lentilles de cendres et charbons et traces de foyers entamant la couche sous-jacente; industrie sur quartz de type Stillbay/Magosien; riche en restes de faune; épaisseur: 20 cm.

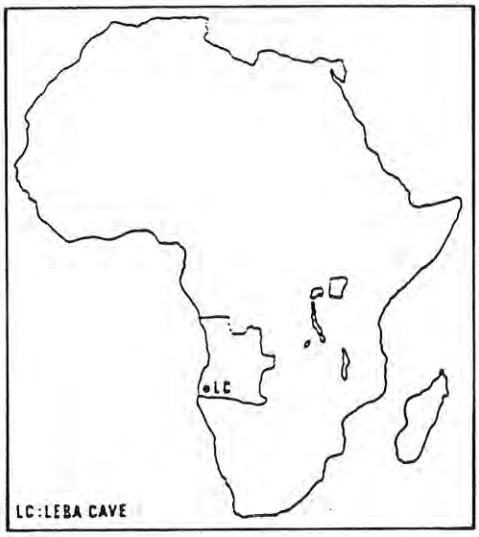

FIGURE 1. Localisation de la grotte de Leba au sud de l'Angola.

Couche IV: marnes rougeâtres avec de nombreuses concrétions calcaires jusqu'au fond de la grotte; industrie de type MSA évolué, avec de grandes lames dans la partie supérieure et des éclats triangulaires dans la partie médiane; restes de faune; épaisseur: 70 cm.

Couche V: dépôts rougeâtres comparables à ceux de la couche III quasi stériles; épaisseur: 30 cm.

Couche VI: Idem, avec MSA de tradition acheuléenne, visible jusqu'à quelques deux mètres de profondeur de la surface actuelle.

Le lecteur notera que les épaisseurs des diverses couches ne correspondent pas exactement à celles de la coupe systématique déjà publié (Ramos, 1984: 406, fig. 4A), mais que la séquence générale est comparable. L'analyse des artéfacts a sans doute obligé notre collègue de modifier quelque peu l'attribution des couches du paléolithique moyen.

Les restes de faune ont été groupés en cinq assemblages établis essentiellement d'après les données sur les étiquettes: I-II; II-III; III, III-IV et V. Les assemblages I-II, c'est-à-dire couches I ou II, etc., combinent des trouvailles que ce dernier n'a pas su attribuer de façon précise et des échantillons dont les étiquettes se sont avérées incomplètes.

Les restes animaux de Leba sont très fragmentaires et se divisent en trois catégories assez mal définies d'après leur état de conservation: (1) restes de couleur jaunâtre clair, sans encroûtements; (2) restes de couleur brun rougeâtre ou brun foncé, sans encroûtements; (3) restes comparables à ceux de la deuxième catégorie, encroûtés de calcaire rougeâtre ou blanchâtre. Les catégories 1 et 2 se rencontrent en principe dans l'assemblage III, la catégorie 3 dans l'assemblage IV; les assemblages I-II et III-IV contiennent des mélanges. Camarate França (1964) ne donne pas de précisions sur la méthode d'échantillonnage, mais le ramassage à la main a vraisemblablement été combiné dans certains cas avec un tri sur tamis à mailles de quelques millimètres, sinon comment expliquer le grand nombre de restes de petits rongeurs (I-II)?

LA FAUNE

Un premier tri des restes peut-être identifiables a été effectué en 1987 à Lisbonne par Mme A. Lentacker, qui préparait alors un doctorat sur plusieurs sites de la préhistoire tardive de Portugal (voir Lentacker, 1991). Les identifications définitives ont été obtenues à l'aide des collections de comparaison du Laboratoire de paléontologie à Gand, de celles du Musée royal de l'Afrique Centrale à Tervuren et de diverses publications concernant l'ostéologie des vertébrés africains, telles que Cooke (1943), Churcher & Richardson (1978), Gentry (1978), Gentry & Gentry (1978), Peters (1986a, 1986b, 1988), Walker (1985), Van Neer (1989). Le fait que les couches se rapportent au MSA évolué ou sont clairement beaucoup plus récentes, indique que leur contenu faunique appartient probablement à des espèces récentes. Nous avons donc pu utiliser, avec prudence toutefois, des arguments biogéographiques pour nos identifications. La systématique, la répartition et l'écologie de la faune africaine actuelle sont résumées dans Dorst et Dandelot (1972), Haltenorth et Diller (1979), Meester et Setzer (1971-78). La faune d'Angola est décrite par Hill et Carter (1941), mais nous avons également consulté avec profit le guide des mammifères récents de l'Afrique du Sud (Smithers, 1983). Pour les oiseaux nous nous sommes fiés aux travaux de Traylor (1963) et Eck et collaborateurs (1986).

L'identification du seul reste de poisson a été faite par le Dr. W. Van Neer (Musée royal de l'Afrique Centrale, Tervuren). Dr. E. Van Der Straeten (Rijksuniversitair Centrum Antwerpen,

Laboratorium voor Algemene Dierkunde, Anvers) et Dr. R. Hutterer (Zoologisches Forschungsinstitut und Museum A. Koenig, Bonn) ont bien voulu se charger de celle des rongeurs et des insectivores. Nous remercions ces chercheurs pour l'aide apportée.

Vu l'absence de données exactes sur la fouille, il ne nous a pas paru nécessaire de présenter la faune en détail et nous nous sommes limité à un résumé sous forme de tableau (Tableau 1) et quelques photos (Planche 1). Quelques notes sur certaines identifications proposées et sur les traces observées suivent. Le matériel sera déposé dans les collections du Centro de Préhistória e Arqueologia de l'Instituto de Investigaçao cientifica tropical à Lisbonne sous le numéro A355-2F; quelques restes de petits rongeurs seront incorporés dans les collections de référence du Laboratoire de paléontologie à Gand (numéro P3834). Les restes crâniens de Crocidura ont été déposés au Zoologisches Forschungsinstitut und Museum A. Koenig de Bonn, sous les numéros ZFMK 89.46, 47 et 48.

Les collections comparatives de micromammifères africains en Europe sont incomplètes; ainsi les identifications des micromammifères ne sont pas toujours très précises. Comme le lecteur peut voir, plusieurs de nos propres identifications sont également incomplètes. Cela est dû au fait que le matériel ne se prête pas à une analyse approfondie, que le matériel de comparaison à notre disposition ne suffit pas ou que le groupe d'animaux concerné présente de nombreux problèmes d'identification. Ainsi le bivalve marin n'est représenté que par un fragment d'une grande valve. Les *Achatina* sont tous des coquillages dont la croissance n'est pas terminée; en outre, trop d'espèces ont été décrites dans ce genre, dont une révision rigoureuse est souhaitable. Les restes de babouins seraient conspécifiques avec les babouins que l'on rencontre encore aujourd'hui en Angola, *Papio cynocephalus* d'après Haltenorth et Diller (1979), mais paraissent provenir d'individus de forte taille (Pl. 1, fig. 5 et 6). Vu les problèmes de classification des babouins, nous ne proposons pas de nom spécifique. Quant au rhinocéros, il n'est représenté que par deux fragments d'émail de dents jugales. Les restes de buffle proviennent du squelette postcrânien et ne s'avèrent pas exceptionnellement grands; peut-être s'agit-il donc de restes de *Syncerus caffer*. Toutefois les variations de taille de *Syncerus* et du buffle antique (*Pelorovis antiquus*) sont mal connues et nous ne sommes pas convaincu que *Pelorovis antiquus* appartienne à une autre lignée que *Syncerus* (Gautier & Muzzolini, 1991). Dans un autre article récent (Peters *et al.*, 1994), l'hypothèse a été avancée que les deux buffles appartiennent à la même espèce évoluant de la grande forme *antiquus* à celles des *Syncerus caffer* récents. Klein (1994) a contesté cette vue, mais accepte que *Pelorovis antiquus* et *Syncerus caffer* appartiennent probablement au même genre.

Parmi les antilopes, une seule identification spécifique nous paraît sujette à caution. Il s'agit d'une troisième molaire inférieure qui semble provenir d'une antilope tragélaphine de taille moyenne, peut-être le guib d'eau (*Tragelaphus spekei*). Cette espèce ne semble plus exister en Angola. On l'a signalée toutefois près de la frontière avec la Namibie et la Zambie, mais aussi à l'intérieur du pays, près de la Cuanza etc. (Hill et Carter, 1941). Le guib harnaché (*Tragelaphus scriptus*) paraît avoir été plus répandu dans le pays autrefois et Hill et Carter (*ibid.*) le signalent de la région de Humpata. Cette dernière antilope préfère les terrains couverts tels que la savanne boisée, les lisières de bois et la forêt-galerie, la savanne herbeuse ou arbustive et même les terrains marécageux. Elle est toutefois moins liée à l'eau que son parant, le guib d'eau, qui montre une franche préférence pour les endroits humides et marécageux, auxquels ses sabots sont d'ailleurs adaptés. Le guib harnaché est en moyenne de taille plus petite (65-100 cm) que le guib d'eau (75-125 cm); la dent de Leba pourrait éventuellement provenir d'un très grand mâle du guib harnaché.

ASSEMBLAGE ANIMAL	I-II	II-III	III	III-IV	IV	Totaux
BIVALVE MARIN	-	-	-	-	1	1
GASTÉROPODE TERRESTRE:						
Achatina sp.	37	-	-	-	-	37
POISSON:						
perciforme de petite taille (b)	1	-	-	-	-	1
AMPHIBIENS	3	-	-	-	-	3
OISEAUX:						
tourterelle du Cap (*Oena capensis*)?	2	-	-	-	-	2
petit duc africain (*Otus scops senegalensis*)	6	-	-	-	-	6
petits oiseaux divers	78	-	-	-	1	79
MAMMIFERES SAUVAGES:						
babouin (*Papio* sp.)	-	-	-	267	41	308
lagomorphe (*Lepus* sp., *Pronolagus* sp.)	-	-	1	-	-	1
Crocidura deserti (c)	1	-	-	-	-	1
Crocidura parvipes (c)	2	-	-	-	-	2
Crocidura fuscomurina (c)	1	-	-	-	-	1
Elephantulus insectivora? (c)	18	-	-	-	-	18
Mastomys spp.(d)	F	-	-	-	-	F
Aethomys spp.(d)	14	-	-	-	-	14
Rhabdomys pumilio? (d)	3	-	-	-	-	3
Tatera brantsii (d)	8	-	-	-	-	8
Otomys irroratus? (d)	2	-	-	-	-	2
Cryptomys hottentotus (d)	3	-	-	-	-	3
Graphiurus (d)	1	-	-	-	-	1
petits rongeurs non-identifiés	FF	-	-	-	-	FF
porc-épic (*Hystrix africae-australis*)	-	-	2	-	-	2
oryctèrope (*Orycteropus afer*)	-	-	2	-	-	2
hyène tachetée (*Crocuta crocuta*) (e)	+	-	-	-	+	+
lion (*Felis leo*)	-	-	-	-	2	2
léopard (*Panthera pardus*)	-	-	-	2	-	2
renard du Cape (*Vulpes chama*)	-	-	1(?)	-	3	4
petit viverridé (Viverridae sp. indet.)	-	-	-	-	2	2
rhinocéros (*Diceros bicornis/Ceratotherium simum*)	-	-	-	-	2	2
phacocère (*Phacochoerus aethiopicus*)	2	-	1	-	2	5
zèbre de Burchell (*Equus burchellii*)	3	-	1	2	11	17
buffle (*Syncerus caffer/Pelorovis antiquus*)	-	-	1	-	2	3
hippotrague (*Hippotragus equinus*)	1	-	-	-	2	3
grand koudou (*Tragelaphus strepsiceros*)	-	-	-	-	7	7
antilope alcélaphine, bubale (*Alcelaphus buselaphus*)?	2	-	1	1	3	7
grandes antilopes (f)	1	1	1	-	24	27
guib d'eau (*Tragelaphus spekei*)?	-	-	-	-	1	1
éléotrague (*Redunca arundinum*)	-	-	1	3	2	6
springbok (*Antidorcas marsupialis*)	-	-	1	-	2	3
antilopes de taille moyenne (g)	-	1	1	-	9	11
oréotrague (*Oreotragus oreotragus*) (h)	-	-	1	1	4	6
céphalophe couronné (*Sylvicapra grimmia*)	2	-	3	-	-	5
MAMMIFERES DOMESTIQUES:						
chien (*Canis lupus f. domestica*) (i)	21	-	1	-	-	22
TOTAUX RESTES OSSEUX IDENTIFIÉS	212	2	19	276	120	629
RESTES OSSEUX NON-IDENTIFIÉS (j)	1100	5	50	3500	1100	5750

TABLEAU 1. Répartition des divers animaux dans les couches de la grotte de Leba (comptages de fragments) (a). (a) F: fréquent, quelques dizaines de restes; FF: très fréquent, plus de cent; (b) identification par Dr. W. VAN NEER (Tervuren); (c) idem Dr. HUTTERER (Bonn); (d) idem Dr. E. VAN DER STRAETEN (Anvers), (e) présent sous forme d'ichnofossiles (voir texte); (f) éléotrague, guib harnaché (*Tragelaphus scriptus*) et autres antilopes de taille comparable; (g) oréotrague, céphalophe et autres antilopes de taille comparable; (h) le fragment de l'assemblage III-IV peut être recollé avec un des restes de l'assemblage IV; (i) restes d'un squelette dans l'assemblage I/II et III; (j) comptages approximatifs.

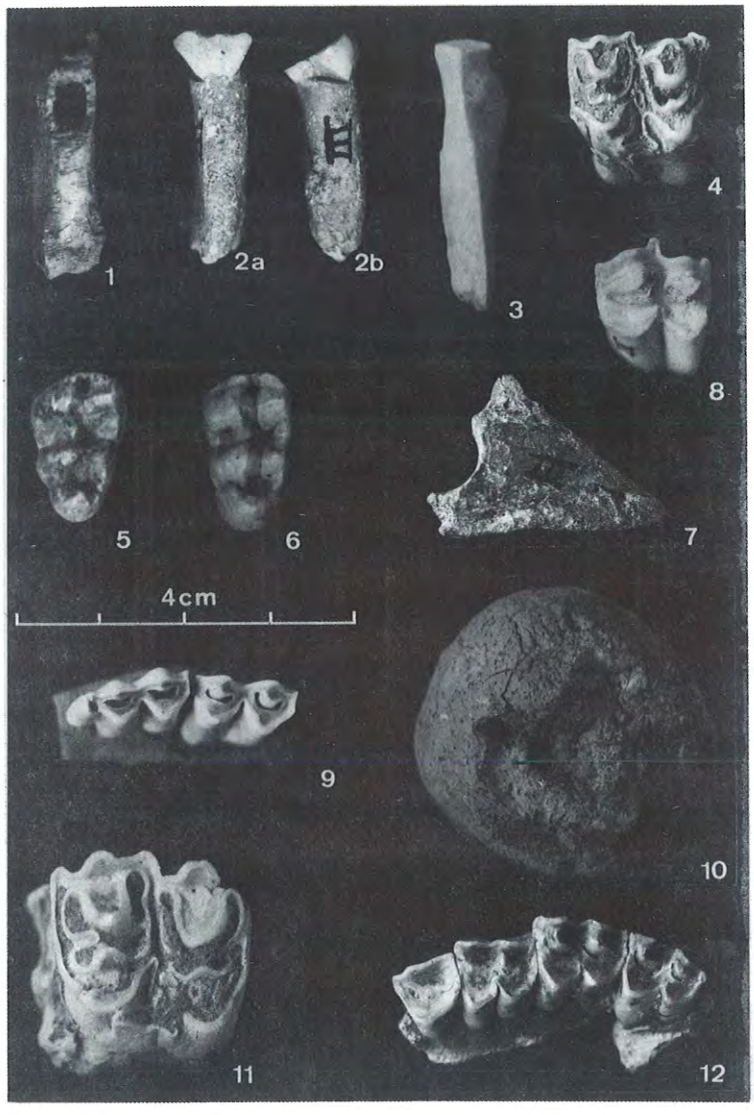

PLANCHE 1

Fig. 1. Première phalange de céphalophe couronné (*Sylvicapra grimmia*), Leba I-II.

Fig. 2. Incisive très usée d'antilope de grand taille, avec rainures latérales causées par le passage de tiges de pleinte entre les dents; (a) vue orale, (b) vue latérale gauche; Leba III.

Fig. 3. Esquille d'os avec traces de dissolution marquées, due à son passage par le système digestif d'une hyène; Leba IV.

Fig. 4. Molaire supérieure d'oliotrague (*Redunca arrundinum*); Leba III-IV.

Fig. 5. Germe d'une troisième molaire inférieure de babouin (*Papio* sp.); Leba III-IV.

Fig. 6. Troisième molaire inférieure de babouin (*Papio* sp.), très légèrement usée; Leba III-IV.

Fig. 7. Troisième phalange de springbok (*Antidorcas marsupialis*); Leba IV.

Fig. 8. Molaire supérieure de springbok (*Antidorcas marsupialis*); Leba IV.

Fig. 9. Troisième et deuxième molaires inférieures de céphalophe couronné (*Sylvicapra grimmia*); Leba III.

Fig. 10. Coprolite d'hyène tacheté (*Crocuta crocuta*); Leba I-II.

Fig. 11. Molaire supérieure d' hippotrague (*Hippotragus equinus*); Leba IV.

Fig. 12. Mâchoire supérieure avec P4-M3 d'oréotrague (*Oreotragus oreotragus*); Leba III-IV.

Quant au seul animal domestique dans la collection, le chien de l'assemblage I-II, son identification n'a pas posé de problèmes. Il s'agit d'un canidé nettement plus grand (hauteur au garrot 50 cm ou plus) que le chacal à flancs rayés (*Canis adustus*) ou le chacal à chabraque (*C. mesomelas*); de plus, les dents jugales recoltées sont moins tranchantes que celles des chacals. Nous hésitons toutefois à incorporer le chien de Leba dans la vaste tribu des chiens parias africains, qui sont généralement de taille plus modeste (en moyenne 40 cm; Degerbøl, 1967; Boessneck & Meyer-Lemppenau, 1969; Epstein, 1971). Peut-être s'agit-il un chien d'origine européenne ou d'origine mixte. Epstein (*ibid.*: 42) mentionne la présence de grand chiens parias de couleur noir en Angola; ils descendraient d'animaux importés par les Portuguais.

Signalons pour terminer les notes sur les divers animaux rencontrées, un cas pathologique. Une incisive fort usée et provenant d'une antilope de taille moyenne porte une rainure distincte sur une des faces latérales (Pl. 1, fig. 2). D'après Poplin (1983), de traces de ce type sont provoquées par le passage répété de tiges de plantes entre les dents, mais des phénomènes de dissolution *intra vitam* contribueraient également à leur formation (Müller, 1990).

Les restes osseux sont accompagnés de quelques ichnofossiles. Dans les dépôts supérieurs (I-II), un coprolite témoigne de la présence d'un grand carnivore incluant une quantité considérable de matière osseuse dans sa diète (Pl. 1, fig. 10). La forme du coprolite et sa taille indiqueraient qu'il provient d'une grande hyène, donc vraisemblablement de l'hyène tachetée (*Crocuta crocuta*). Une esquille d'os de la couche IV porte les stigmates d'un séjour dans un système digestif à liquide gastrique très acide; elle pourrait donc également provenir de l'hyène tachetée (Pl. 1, fig. 3). Un petit rongeur est sans doute responsable des séries de fines stries parallèles observées sur une première phalange attribuée au céphalophe couronné (I-II; Pl. 1, fig. 1). La fragmentation poussée et la fine couche de calcaire enveloppant les restes ne laissent pas voir des traces dues à l'homme. Parmi les restes non identifiés, Mme An Lentacker a toutefois noté une quantité appréciable de restes montrant des décolorations et autres modifications apparemment causées par le feu. Quant aux ossements travaillés, on peut les considérer comme une catégorie spéciale de traces fossiles (Gautier, 1993); cela nous permet de signaler la présence dans la couche III d'un fragment d'os travaillé. Il s'agirait d'un reste d'une sorte de spatule, façonnée à partir d'une diaphyse d'os long, vraisemblablement d'une petite antilope telle que l'oréotrague ou le céphalophe. Malheureusement, nous ne pouvons pas donner de description plus complète ni de photo de cet artéfact, car il fut renvoyé à Lisbonne afin que M. Ramos puisse l'inclure dans sa description sommaire des artéfacts (lettre à M. Ramos du 1er janvier 1982).

Hormis les fossiles animaux, la collection renferme encore un fruit dans l'assemblage II-III. Il a été identifié par le Dr. E.S. Martins (Lisbonne) et nous le remercions pour l'aide apportée. Il s'agit d'un fruit de *Parinari excelsa* Sabine 1924, un arbre très répandu dans les forêts de l'Afrique tropicale; ses fruits sont comestibles. L'aspect frais du fruit de Leba suggère une origine récente et donc sa provenance de la couche II plutôt que de la couche III.

TAPHONOMIE ET PALÉOÉCOLOGIE

L'origine complexe et polygénétique des faunes de cavernes et d'autres phénonèmes karstiques a été soulignée mainte fois (Zapfe, 1954; Sutcliffe, 1969; Brain, 1981 et autres). Dans la grotte de Leba nous pouvons distinguer plusieurs groupes taphonomiques (Gautier, 1986a), mais le

matériel trop restreint ne permet pas de délimiter ces groupes de façon précise. Une importante partie de ce matériel comprend sans doute les restes de consommation laissés par l'homme dans la grotte et dans l'abri-sous-roche situé originellement devant celle-ci. Quelques restes de proie d'hyènes pourraient être mélangés à ce premier groupe taphonomique, mais le faible nombre de traces d'hyène (un coprolite; une esquille à traces de dissolution) indique clairement que les hyènes n'ont pas séjourné longuement dans la grotte ou dans l'abri-sous-roche; peut-être même ces hyènes venaient-elles attirées par les déchets de l'homme et n'y apportaient-elles pas d'os. Les restes de babouins, dont le nombre minimum se chiffre à cinq, pourraient bien être des victimes de léopards, qui laissent souvent une grande quantité de restes osseux de leur victimes, y compris les crânes (Brain, *ibid.*). Cette particularité pourrait expliquer le grand nombre de restes de babouins. L'étiquette d'un échantillon suggère que la couche IV aurait contenu six crânes : *ossos encontrados na camada de cascalho calcareo cimentado, juntamente com os craneos A a F.* Il pourrait s'agir de crânes de babouins, mais malheureusement ces crânes ont disparu, à moins que les fragments crâniens et les dents de babouins dans notre collection en soient les restes.

L'assemblage I-II est remanié. Il paraît contenir des restes de consommation attribuables au MSA et peut-être des restes de proies d'hyènes de l'abri devant la grotte. En outre recèle-t-il des restes de micromammifères et d'oiseaux dérivés de pelotes de régurgitation de hiboux; nous avons identifié le petit duc africain (*Otus scop senegalensis*) dans l'assemblage, mais, à notre avis, ce rapace, étant de petite taille, ne peut être responsable de l'accumulation de tous les restes de micromammifères. Les coquilles d'*Achatina* peuvent provenir de l'entrée de ce même abri: les gastéropodes terrestres semblent s'installer volontiers sur des sites anthropiques, à cause de leur végétation luxuriante (Gautier, 1983). D'après sa taille et la couleur de ses restes, le chien de l'assemblage I-II est un élément tardif, c'est-à-dire de la période coloniale. Les restes micromammifères ont la même couleur et pourraient donc être également très récents, tout comme le fruit de *Parinari excelsa* de l'assemblage II-III.

Depuis plusieurs années, divers chercheurs s'évertuent à préciser les capacités cynégétiques des hommes du MSA (voir par exemple Klein, 1975; Binford, 1984). Il sera clair au lecteur que les trouvailles de Leba ne peuvent apporter aucun argument au débat engagé. Toutefois, comme nos assemblages préhistoriques se sont apparemment constitués au cours du MSA évolué, nous pouvons probablement accepter qu'elles représentent principalement un tableau de chasse. Nous y voyons un éventail de gibier très diversifié, comprenant probablement un lagomorphe, le porc-épic, 1 oryctérope, plusieurs carnivores, un rhinocéros, le phacochère, le zèbre de Burchell, le buffle et plusieurs antilopes. De pareils éventails de gibier, grand et petit, sont connus de sites du MSA en Afrique du Sud, tel que Die Kelders et Klasies River Mouth (Klein, *ibid.*, voir aussi Klein, 1984), mais des sites utilisables au titre de comparaison manquent en Angola et dans les régions limitrophes.

Quant à l'aspect paléoécologique, les résultats sont également restreints. Toutes les espèces rencontrées semblent être connues de l'Angola actuel ou y ont été signalées autrefois. Le cas douteux du guib d'eau a déjà été discuté; sa présence n'est toutefois pas exclue, car on signale des lacs quasi permanents dans les dépressions à sous-sol peu perméable sur le plateau de Humpata. Les différences entre l'assemblage III et l'assemblage IV paraissent négligéables, surtout si l'on considère l'échantillon de la couche III est très restreint. Remarquons quand même que le zèbre de Burchell et le grand koudou montrent une baisse de taux appréciable tandis que le céphalophe couronné n'apparaît que dans la couche III. Le céphalophe couronné préfère les savannes humides et boisées, tandis que le grand koudou serait plutôt adapté aux savannes plus sèches, où le zèbre de Burchell

pourrait être également plus à l'aise. Nous possèderions donc là quelques indications d'une augmentation de la pluviosité pendant la formation de la couche III, mais il pourrait aussi s'agir d'un phénomène aléatoire dû au petit nombre de restes de grands mammifères dans nos échantillons.

En guise de conclusion générale, l'on peut insister sur le fait que l'exploration du plateau de Humpata promet de résultats intéressants, non seulement en ce qui concerne la paléontologie des périodes autour de la limite Pliocène-Pléistocène mais aussi du point de vue de la préhistoire récente.

BIBLIOGRAPHY

Arambourg, C. et F. Mouta, F. (1955). Les grottes et fentes à ossements du Sud de l'Angola. In: *Actes II^e Pan-Afrique Congr. Préhist., Alger* 1952: 301-304.

Binford, L.R. (1984). *Faunal Remains from Klasies River Mouth*. Acad. Press, Orlando.

Boessneck, J. et U. Meyer-Lemppenau (1969). Eine Sammlung von Hundeschädeln aus Papualand. *Säugetierkundl. Mitteil.* 17: 356-368.

Brain, C.K. (1981). *The Hunters or the Hunted ? An Introduction to African Cave Taphonomy*. Univ. Chicago Press, Chicago.

Breuil, H. et A. de Almeida (1964). Introduçâo à pré-historia de Angola. Mem. Junta Invest. *Ultram.* (2) 50: 157-163.

Camarate França, J. (1964). Nota preliminar sobre uma gruta pré-historica do Planalto da Humpata (Angola). Estudos Sobre Préhistoria do Ultramar Portuquês. 2. *Memorias da Junta de Investigaçoês du ultramar* (Lisboa) 50.

Churcher, C.S. et M.L. Richardson (1978). Equidae. In: Maglio, V.J. & H.B.S. Cooke (eds.): *Evolution of African Mammals*: 379-422. Harvard Univ. Press, London.

Cooke, H.B.S. (1943). Cranial and dental characters of the recent South African Equidae. *South African Journ. Science* 40: 254-257.

Dart, R.A. (1950). A Note on The Limestone Caves of Leba, Near Humpata, Angola. *South African Archaeol. Bull.* 5: 149-151.

Degerbol, M. (1967). B. Dogs from the Iron Age (c. A.D. 950-1000) in Zambia with Remarks on Dogs from Primitive ultures. In: Fagan, B.M. (ed.): *Iron Age Cultures in Zambia (Kalomo and Kalinga)*: 198-207. Chatto & Windus, London.

Dorst, J. et P. Dandelot (1972). *Guide des grands mammifères d'Afrique*. Delachaux & Niestlé, Neuchâtel.

Do Amaral, I. (1973). Nota sobre o 'karst' ou carso do planalto da Humpata (Huila), no Sudoeste de Angola. *Garcia de Orta, Sér. Geogr.* (Lisboa) 1(2): 29-36.

Ek, O.; H.C. Fry et S. Keith (1986). *Birds of Africa. Vol. II.* Acad. Press, London.

Epstein, H. (1971). *The origin of domestic animals of Africa. Vol. 1 & 2*. Africana Publ. Corp., New York.

Gautier, A. (1983). Animal life along the prehistoric Nile : the evidence from Saggai 1 and Geili (Sudan). *Origini* (Roma) 12: 50-115.

Gautier, A. (1986a). Taphonomic groups : How and Why? In: Actes du 5e Congrès International d'Archéozoologie, Bordeaux Août 1986. *Archeozoologia* I(2): 45-52.

Gautier, A. (1993). Trace Fossils in Archaeozoology. *Journal of Archaeological Science* 20: 511-523.

Gautier, A. et A. Muzzolini (1991). The life and times of the giant buffalo alias *Bubalus/Homoioceras/Pelorovis antiquus* in North Africa. *Archaeozoologia* 4(1): 39-92.

Gentry, A.W. (1978). Bovidae. In: Maglio, V.J. & H.B.S. Cooke (eds.): *Evolution of African Mammals*: 540-572. Harvard Univ. Press, Cambridge.

Gentry, A.W. et A. Gentry (1978). Fossil Bovidae (Mammalia) of Olduvai Gorge, Tanzania. *Bull. Brit. Mus. Nat. Hist. (Geol.)* 29: 289-446.

Haltenorth, Th. et H. Diller (1979). *Elseviers Gids van de Afrikaanse Zoogdieren*. Elsevier, Amsterdam.

Hill, J.E. et T.D. Carter (1941). The Mammals of Angola, Africa. *Bull. Amer. Mus. Nat. Hist.* 48: 1-121.

Klein, R.G. (1975). Middle Stone Age Man-Animal Relationships in Southern Africa : Evidence from Die Kelders and Klasies River Mouth. *Science* 190: 265-267.

Klein, R.G. (1984). The large mammals of Southern Africa: Late Pliocene to Recent. In: Klein, R.G. (ed.): *Southern African Prehistory and Paleo-environments*: 107-146. Balkema, Rotterdam.

Klein, R.G. (1994). The Long-Horned African Buffalo (*Pelorovis antiquus*) is an Extinct Species. *J. Archaeol. Sci.* 21(6): 725-733.

Lentacker, A. (1991). *Archeozoölogisch onderzoek van Laat-Prehistorische Vindplaatsen uit Portugal*. Mémoire de Doctorat, Laboratorium voor Paleontologie, Universiteit Gent.

Meester, J. et W. Setzer, W. (1971-78). *The mammals of Africa. An identification manual*. Smithsonian Institution Press, Washington.

Minkoff, E.C. (1972). A fossil baboon from Angola, with a note on *Australopithecus*. *J. Paleont.* 46(6): 836-844.

Müller, H.H. (1990). Keilförmige Defekte an Fossilen und Subfossilen Tierzähnen und ihre Bedeutung für die archäologische Forschung. In: Schilber, J.; J. Sedlmeier & H. Spycher (eds.): *Festschrift für Hans R. Stampfli. Beiträge zur Archäozoologie, Archäologie, Anthropologie, Geologie und Paläontologie*: 147-152. Helbing & Lichtenhahn, Basel.

Peters, J. (1986d). Osteomorphology and osteometry of the appendicular skeleton of African Buffalo, *Syncerus caffer* (SPARRMAN, 1779) and Cattle *Bos primigenius f. taurus* BOJANUS, 1827. *Occasional Papers, Lab. voor Paleontologie, Rijksuniversiteit Gent* 1: 83 p.

Peters, J. (1986e). Osteomorphology and osteometry of the appendicular skeleton of Grant's Gazelle, *Gazella granti* BROOKE, 1872, Bohor Reedbuck, *Redunca redunca* (PALLAS, 1767) and Bushbuck, *Tragelaphus scriptus* (PALLAS, 1766). *Occasional Papers, Lab. voor Paleontologie, Rijksuniversiteit Gent* 2: 65 p.

Peters, J. (1988). Osteomorphological features of the appendicular skeleton of African buffalo, *Syncerus caffer* (Sparrman, 1779) and of domestic cattle, *Bos primigenius f. taurus* Bojanus, 1827. *Z. Säugetierkunde* 53: 108-123.

Peters, J.; A. Gautier; J.S. Brink et W. Haenen (1994). Late Quaternary Extinction of Ungulates in Sub-Saharan Africa: a Reductionist's Approach. *Journal of Archaeological Science* 21: 17-28.

Pickford, M.; T. Fernandes et S. Aco (1990). Nouvelles découvertes de remplissages de fissures à primates dans le "Planalto da Humpata", Huila, Sud de l'Angola. *C.R. Acad. Sci. Paris* 310: 843-848.

Pickford, M.; P. Mein & B. Senut (1992). Primate bearing Plio-Pleistocene cave deposits of Humpata, Southern Angola. *Journal of Human Evolution* 7(1): 17-33.

Pickford, M.; P. Mein et B. Senut (1994). Fossiliferous Neogene karst fillings in Angola, Botswana and Namibia. *SuidAfrikaanse Tijdskrif vir Wetenskap* 90: 227-230.

Poplin, F. (1983b). Incisives de renne sciées du Magdalénien d'Europe Occidentale. *Mém. Soc. Préhist. Française* 16: 55-67.

Ramos, M. (1984). L'évolution des industries lithiques en Angola à partir de la fin du Paléolithique inférieur. *L'Anthropologie* 88(3): 403-412.

Simons, E.L. & E. Delson (1978). 7. Cercopithecidae and Parapithecidae. In: Maglio, V.J. & H.B.S. Cooke (eds.): *Evolution of African Mammals*: 100-119. Harvard Univ. Press, Cambridge.

Smithers, R.H.N. (1983). *The Mammals of the South African Subregion*. Univ. of Pretoria, Pretoria.

Sutcliffe, A.J. (1969). A Section of an Imaginary Bone Cave. *Studies in Speleology* 2(2): 79-80.

Telles Antunes, M. (1961). Note sommaire sur quelques de mammifères quaternaires de l'Angola. *Colloques int. Cent. nat. Rech. Scient.* 104: 377-379.

Telles Antunes, M. (1965). Sur la faune de vertébrés du Pléistocène de Leba, Humpata, Angola. *Actes V^e Congr. Pan-Afr. Préhist.* (Tenerife 1963): 127-128.

Traylor, M.A. (1963). Check-list of Angolan birds. Museu do Dundo Diamang. *Publ. Cult.* (Lisboa) 61.

Van Neer, W. (1989). Contribution to the Archaeozoology of Central Africa. *Ann. Mus. roy. Afriq. Centrale, Sci. Zool.*, 259.

Walker, R. (1985). *A Guide to Post-cranial bones of East African Animals*. Hylochoerus Press, Norwich.

Zapfe, H. (1951). Beiträge zur Erklärung der Entstehung von Knochenlagerstätten im Karstspalten und Höhlen. *Geologie* (Berlin) 12: 1-58.

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CATÁLOGO DE MALACOFAUNAS DE LA PENÍNSULA IBÉRICA

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RESUMEN: En este catálogo provisional se recogen las malacofaunas arqueológicas asociadas a ocupaciones humanas de la Península Ibérica. Se incluyen un total de 142 análisis malacológicos, y un anexo de 68 yacimientos donde los conjuntos son estrictamente ornamentales o se encuentran en fase de estudio. Se encuentran reseñadas casi 200 especies de moluscos marinas, de agua dulce y terrestres. Además se ofrecen datos inéditos de 6 yacimientos (Abrigo de la Peña del Perro, Termas romanas de Gijón, Cabezo Pequeño del Estaño, Pico Ramos, Almonte y La Viña). Consideramos que un trabajo de estas características resulta imprescindible en el actual estado de conocimiento arqueozoológico en la Península Ibérica y confiamos en que el catálogo se convierta en una referencia básica en estudios futuros.

PALABRAS CLAVE: FAUNA, MOLUSCOS, PLEISTOCENO, HOLOCENO, CATALOGO, PENINSULA IBERICA

ABSTRACT: This catalogue provides a comprehensive review of mollusc remains from archaeological sites in the Iberian Peninsula. A total of 142 malacological analyses, including six unpublished faunas (i.e., Abrigo de la Peña del Perro, Termas romanas de Gijón, Cabezo Pequeño del Estaño, Pico Ramos, Almonte and La Viña) has been included. 68 additional sites, where the molluscs are strictly ornamental elements or still under analysis, appear as an appendix. The number of species is close to two hundred and includes taxa of marine, freshwater and terrestrial environments. We believe that a work such as this is a necessary tool in the present stage of archaeozoological development in the Iberian Peninsula and we hope that this catalogue will become a basic reference for future research.

KEYWORDS: FAUNA, MOLLUSCS, PLEISTOCENE, HOLOCENE, CATALOGUE, IBERIAN PENINSULA

INTRODUCCIÓN

Dentro de la línea de investigación sobre arqueomalacofaunas que el Laboratorio de Arqueozoología de la U.A.M. viene desarrollando desde 1985, la información sobre este tipo de faunas en nuestro marco geográfico ha constituido un objetivo primordial, del que este inventario constituye un claro reflejo.

La exposición de los datos se ha sistematizado sobre la base de una serie de criterios que exponemos a continuación:

1. Los yacimientos considerados se encuentran ordenados alfabéticamente, con el fin de facilitar su búsqueda. Se utiliza el topónimo *sensu stricto* evitándose nombres de carácter generalizador como "cueva", "cerro", "castro", etc.

2. Dentro de cada uno de los yacimientos la información se estructura en tres apartados:

2a. Fuentes bibliográficas: relación de trabajos sobre un yacimiento determinado que ofrecen datos arqueomalacológicos. No se contemplan los trabajos generales sobre el yacimiento o los estudios de otros tipos de restos del yacimiento, que si pueden ir citados en el siguiente apartado.

2b. Inclusión de un breve resumen de las características generales del yacimiento: situación geográfica, cronología, campañas de excavación, distancia a la costa, etc.

2c. Malacofauna: relación y abundancia de las especies representadas en el yacimiento. La nomenclatura específica se cita textualmente del/los autor/es. También se mantiene el estimador de abundancias utilizado por cada uno de los autores. Las siglas de los estimadores de abundancia utilizados se han homogeneizado y son las siguientes:

Estimadores de abundancia relativa: **X:** Presente y/o escaso; **XX:** Abundante; **XXX:** Muy abundante.

Estimadores de abundancia absoluta: **NE:** Número de ejemplares. Categoría amplia y variable que se acompaña de la metodología de cuantificación, cuando el autor la explicita; **NR:** Número de restos; **NMI:** Número mínimo de individuos.

Los restos malacológicos considerados exclusivamente ornamentales se diferencian con un asterisco. No se incluyen datos biométricos, pero se especifican las fuentes bibliográficas en que éstos quedan detallados.

No se han considerado yacimientos donde: (1) el conjunto arqueomalacofaunístico es **exclusivamente** ornamental, (2) se cita la presencia de moluscos, sin especificarlos taxonómica ni cuantitativamente y/o (3) los restos malacofaunísticos se encuentran en estudio. Pero si se ha elaborado una lista de los mismos, que se recoge como un apartado al final de la descriptiva (?).

DESCRIPTIVA

YACIMIENTO DE ABAUNTZ (ARRAIZ, NAVARRA)

Fuentes bibliográficas: ALTUNA, J. & MARIEZKURRENA, K. (1982).

La Cueva de Abauntz está situada en Arraiz (Ulzama) a 610 m de altitud sobre el mar y a 32 m sobre el valle. Es un pequeño covacho de un par de metros de anchura en la entrada por uno de altura. Se ensancha en un pequeño vestíbulo de unos 10 m^2 de extensión y luego se prolonga en una galeria de unos 60 m más. La excavación ha sido efectuada en el vestíbulo por P. Utrilla. La estratigrafía abarca desde el Magdaleniense Inferior hasta el Eneolítico.

Malacofauna

Se han recuperado en el nivel b1-b2 varios restos de la familia Unionidae. Este nivel ha sido fechado por C^{14} en el 4.240 +/- 140 B.P.

CUEVA DE ABITTAGA (AMOROTO, VIZCAYA)

Fuentes bibliográficas: BARANDIARAN (1969, 1971) en GONZALEZ, C. (1989).

Cueva situada en la margen izquierda del río Oiz, a unos 3 Km de su desembocadura. Se encuentra a 100 metros de altitud y 2 Km de la costa actual. Yacimiento descubierto en 1929 por J. M. de Barandiarán ha sido excavado en 1964-1966. Su estratigrafía abarca desde el Magdaleniense a la Edad del Hierro.

Malacofauna

Relación de especies por niveles:

Nivel IV (sin atribución cultural): lapas

Niveles epipaleolíticos: Nivel V: "*Littorinas obtusatas*"
Nivel VI: "*Littorinas obtusatas*"
Nivel Magdaleniense Superior Cantábrico: Nivel VII: lapas y fósil de bivalvo.

CUEVA DE AITZBITARTE IV (RENTERIA, GUIPUZCOA)

Fuentes bibligráficas: HARLE (1908b) en ALTUNA, J. (1972) y ALTUNA, J. (1972).

Esta cueva es una de las cinco que se abren en la ladera SO del monte del mismo nombre, en el término municipal de Rentería, y a 20 metros sobre el nivel del Landarbaso, afluente del Urumea. Se encuentra a 220 m sobre el nivel del mar y a unos 7 Km de la costa actual. M. del Valle, Conde de Lersundi realiza las primeras excavaciones en 1892. P.M. de Soraluce realiza varias campañas de excavación de 1896 a 1901 y, junto a G. de Reparáz y E. Rotondo las continúa en 1902. Rotondo continuará las excavaciones en 1906. Finalmente en 1960 J.M. de Barandiarán reiniciará las excavaciones, llevándose a cabo 6 campañas de excavación. La cronología abarca desde el Auriñaciense (?) al Aziliense, encontrándose en el nivel superficial removido algunos materiales del Mesolítico, Neo-eneolítico y de tiempos modernos.

Malacofauna

En la primera publicación sobre la fauna de Harlé (1908b en Altuna, 1972) se citan "una docena de conchas de *Patella vulgata*, parecidas a las que viven hoy en la próxima costa".

Excavaciones 1960-1964

Abundancia relativa por niveles:

NIVELES	1	2	3
Patella	x	abundantes	abundantes
Littorina littorea	x	pocas	-
Littorina obtusata	-	pocas	pocas
Aporrhais pespelicani	-	pocas	-
Nassa reticulata	-	-	pocas
Triton	-	pocas	-
Mytilus	x	pocas	-
Ostraea	x	-	-

1. Aziliense. **2.** Magdaleniense Superior y Final
3. Solutrense Medio y Superior

EL POBLADO IBERICO DE ALORDA PARK (CALAFELL, TARRAGONA)

Fuentes bibliográficas: ALBIZURI, S. & NADAL, J. (1992).

Poblado ibérico situado en el barrio marítimo de Calafell, a 15 m sobre el nivel del mar y a unos 300 metros de la línea de costa actual. Las primeras fases del poblado datan de la Edad del Hierro (VII a.C.) y parece producirse el despoblamiento definitivo a finales del 3er cuarto del siglo I a.C. Se han realizado campañas de excavación ininterrumpidamente desde 1983 a 1989.

Malacofauna

Se han publicado los resultados preliminares de la fauna recuperada hasta 1989 inclusive.

Relación de especies:

- *Glycymeris*
- *Murex (Bolinus) brandaris* L.
- *Donax*
- *Acanthocardia*
- *Mactra (Mactra) corallina stultorum* L.
- *Mytilus* (seguramente *M. (Mytilus) galloprovincialis*)
- *Pinna (Pinna) nobilis* L.
- *Thais (Stramonita) haemastoma* L.
- *Pecten (Pecten) jacobaeus* L.
- *Cerastoderma edule* L.
- *Phalium (Tylocassis) granulatum undulatum* Gmelin
- *Chamelea gallina* L.
- *Charonia nodifera* Lamarck
- *Sepia officinalis* L.
- *Rumina decollata* L.
- *Cyclostoma elegans* Müller

En cuanto a abundancia se especifica que los dos géneros mejor representados, con diferencia, son *Donax* y *Glycymeris*, los cuales también aparecían en los sacrificios fundacionales.

YACIMIENTO DE ALMONTE (HUELVA)

Fuentes bibliográficas: MORENO, R. (Inédito).

Yacimiento situado en el casco urbano de Huelva fué objeto de excavaciones de urgencia en 1982 y 1983. Se detectaron varios fondos de cabaña correspondientes al III milenio a.C.

Malacofauna

Abundancia absoluta por fondos:

TAXONES	IV		IX-2		XIX		XLI		XLV	
	NR	NMI	NR	NMI	NR	NMI	NR	NMI	NR	NMI
Acanthocardia sp	-	-	-	-	-	-	1	1	-	-
Glycymeris sp	-	-	-	-	-	-	1	1	-	-
Familia Ostreidae	-	-	-	-	-	-	5	1	3	1
Pecten sp	-	-	1	1	-	-	-	-	-	-
Familia Pectinidae	-	-	7	1	-	-	-	-	-	-
Tapes decussatus	3	1	50	7	2	1	-	-	4	1
Suborden Unionacea	-	-	1	1	1	1	-	-	-	-
Charonia sp	-	-	1	1	-	-	-	-	-	-
Rumina decollata	-	-	2	2	-	-	-	-	-	-
TOTAL	3	1	62	13	3	2	7	3	7	2

TAXONES	LIV		LVI		LXII		LXVI		LXX	
	NR	NMI	NR	NMI	NR	NMI	NR	NMI	NR	NMI
Acanthocardia sp	-	-	-	-	-	-	-	-	1	1
Ostrea edulis	2	1	-	-	-	-	-	-	-	-
Familia Ostreidae	-	-	1	1	-	-	21	1	7	1
Pecten sp	3	1	-	-	3	1	2	1	3	1
Familia Pectinidae	-	-	-	-	3	1	1	-	-	-
Solen marginatus	377	42	152	16	-	-	65	9	-	-
Tapes decussatus	80	21	3	3	2	1	5	3	29	3
Charonia sp	-	-	1	1	-	-	-	-	-	-
Rumina decollata	-	-	-	-	-	-	-	-	1	1
S.I.							1		1	
TOTAL	462	65	157	21	8	3	95	14	42	7

CUEVA DE ALTAMIRA (SANTILLANA DEL MAR, CANTABRIA)

Fuentes bibliográficas: HARLE (1881, 1908, 1909) y BREUIL & OBERMAIER (1935) en ALTUNA, J. (1972).

El vestíbulo contenía un importante yacimiento arqueológico, que en buena parte ha sido excavado por Sautuola, Alcalde del Río y Obermaier, principalmente. La secuencia estratigráfica consta de un nivel Magdaleniense Inferior Cantábrico y otro Solutrense Superior. En la base del depósito se han señalado restos líticos semejantes a los de la época Musteriense y Auriñaciense, sin

que existan suficientes elementos de juicio para una fechación cronológica y cultural más precisa (González Sainz & González Morales, 1986).

Malacofauna

(1) La primera lista de malacofauna fué publicada por E. Harlé, quien determinó los restos en colaboración con M. Fischer.

Abundancia absoluta de las especies:

ESPECIES	NE
Patella vulgata	600
Littorina littorea	130
Littorina obtusata	2
Helix quimperiana	2
TOTAL	734

(2) Breuil y Obermaier publicaron en 1935 los siguientes niveles y malacofauna:

1.1. Magdaleniense. Mucha mayor cantidad que en el Solutrense y casi exclusivamente *Patella vulgata* var. *sautuolae* (de tamaño muy grande), *Littorina littorea* (de tamaño muy grande) y *Buccinum* (raro).

1.2. Solutrense. *Patella vulgata*

CUEVA DE AMALDA (CESTONA, GUIPUZCOA)

Fuentes bibliográficas: BORJA, A. (1990).

La cueva de Amalda está situada en la ladera occidental del valle de Alzolaras, a 110 m de altitud sobre el fondo del valle y a 205 m sobre el nivel del mar. Se han realizado un total de 6 campañas de excavación desde 1979 a 1984 bajo la dirección de J. Altuna. Su cronología abarca desde el Musteriense al Tardorromano (Altuna, 1990).

Malacofauna

El autor incluye una lista taxonómica de las especies determinadas, aunque asigna los datos cuantitativos exclusivamente a nivel de género.

Relación de especies:

Patella vulgata L., 1758

Patella ulyssiponensis Gmelin, 1791

Gibbula sp

Littorina littorea (L., 1758)

Littorina obtusata (L., 1758)
Littorina rudis (Maton, 1797)
Littorina saxatilis (Olivi, 1792)
Trivia monacha (Da Costa, 1778)
Nucella lapillus (L., 1758)
Dentalium vulgare (Da Costa, 1778)
Mytilus edulis L., 1758.

Abundancia absoluta (NR) por niveles:

TAXONES	VII	VI	V	IV	III
Patella	1	3	-	2	-
Gibbula	-	-	-	1	-
Littorina	10	44	4	15	4
Trivia	-	1	-	2	-
Nucella	-	1	-	-	-
* *Trozos*	2	1	3	2	3
Dentalium	-	-	-	-	8
Mytilus	-	-	-	6	2
Terrestres	-	4	-	8	16
TOTAL	13	54	7	36	33

Nivel VII: Musteriense. **Nivel VI:** Perigordiense V. **Nivel V:** Perigordiense VII.
Nivel IV: Solutrense Superior. **Nivel III:** Calcolítico sepulcral.
* Incluyen dos gasterópodos que no ha sido posible identificar debido a su estado

EL DEPOSITO VOTIVO IBERICO DE EL AMAREJO (BONETE, ALBACETE)

Fuentes bibliográficas: MORALES, A. & MORENO, R. (1989).

El depósito votivo ibérico de El Amarejo corresponde a un pozo de 4,20 m de profundidad y 150 cm de diámetro exterior. Fué excavado en la campaña de 1985 bajo la dirección de S. Broncano. Constituye un pozo de ofrendas dedicadas a una divinidad femenina y utilizado por los habitantes del poblado entorno al siglo III a.C. (Broncano, 1989).

Malacofauna

Todos los restos se han recuperado entre las capas 11 a 23, fechadas entre el 160 y 150 a.C. (capa 23 = 2.110 +/- 40 años; capa 12 = 2.100 +/- 40 años). Todos los restos presentaban algún tipo de alteración *post morten*, a excepción del cefalópodo y el pulmonado.

Abundancia absoluta de las especies:

ESPECIES	NR	NMI
Thais haemastoma *	15	1
Columbella rustica *	3	3
Haminia quadridens	2	2
Cerastoderma edule *	4	3
Sepia officinalis	3	1
S.I.	9	
TOTAL	36	10

CUEVA DE AMBROSIO (VELEZ-BLANCO, ALMERIA)

Fuentes bibliográficas: FISCHER, P.H. (1923).

Yacimiento Paleolítico.

Malacofauna

Restos recogidos por el Abate Breuil y por Obermaier.

Relación de especies:

Cardium tuberculatum L.

Pecten jacobaeus L.

Leucochroa candidissima Drap.

CABEÇO DA AMOREIRA (MUGE, RIBATEJO)

Fuentes bibliográficas: LENTACKER, A. (1991).

Yacimiento mesolítico situado en la orilla S del río Muge, en una pequeña colina a 22 m sobre el nivel del mar. Forma parte del conjunto de los concheros de Muge (**Ver Mugue**).

Malacofauna

Se han contabilizado exclusivamente los individuos completos, los ápices de gasterópodos y los fragmentos umbonales de bivalvos, estos últimos sin diferenciar parasagitalmente.

Abundancia absoluta (NR) de las especies, según las categorías establecidas por A. Lentacker:

TAXONES	A	B	C	X
Pecten maximus	3	5	10	-
Crassostrea angulata	4	6	3	4
Ostrea sp/Crassostrea sp	12	11	4	8
Laevicardium norvegicum	10	7	6	4
Cerastoderma edule/C. glaucum	7502	3479	3587	10704
Venerupis decussata	2	1	3	5
Scrobicularia plana	871	716	229	765
Solen sp/Ensis sp	89	19	25	22
Bivalvos S.I.	1	4	1	1
Trivia europaea	75	23	14	5
Charonia lampas	-	1	-	-
C. lampas/Thais haemastoma	-	1	1	1
Hinia reticulata	9	4	6	8
Gasterópodos S.I.	-	-	-	2
Helicella sp	46	21	33	106
Theba pisana	389	122	156	612
Helix sp/Cepaea sp	52	6	26	92
Pulmonados S.I.	-	-	3	-
Theodoxus fluviatilis	74	92	93	21
Hydrobia sp	3	3	42	30
Sepia officinalis	4	3	2	2
TOTAL	9146	4524	4244	12392

A: Nivel superficial. **B:** Vestigios enterrados en el suelo. **C:** Hogares. **X:** ?

ARIDOS-1 (ARGANDA, MADRID)

Fuentes bibliográficas: ROBLES, F. (1980).

Los sitios de ocupación achelense de la terraza de Aridos se localizan dentro de la unidad litoestratigráfica de Arganda I. Geográficamente se encuentran en la orilla izquierda del río Jarama, a menos de 3 Km al SE de su confluencia actual con el Manzanares. Este yacimiento (JR-AR-01) fué descubierto en 1971 por los obreros de Aridos, S.A. Ha sido objeto de dos campañas de excavación, la primera bajo la dirección de A. Perez González y N. López en 1971 y la segunda en 1976, bajo la dirección de M. Santonja y A. Querol. Se han detectado dos ocupaciones con una separación temporal muy reducida englobadas en el Achelense (Santonja & Querol, 1980).

Malacofauna

La fauna descrita posee dos procedencias distintas: una pequeña parte de los ejemplares han sido recogidos aislados durante la realización de las excavaciones y durante la selección de micromamíferos (nivel arqueológico indiferenciado). Los restantes han sido recogidos directamente por el autor en ese mismo nivel.

Abundancia absoluta de las especies:

TAXONES	NR	NMI
Anisus (Anisus) sp	2	2
Vallonia costata	90	90
Cochlicopa sp	ftos	4
Discus ruderatus	-	14
Punctum (Punctum) pygmaeum	98	98
Limax sp	26	26
Clausiliidae	ftos	8
Cepaea (Cepaea) nemoralis	13	13
TOTAL	229+ftos	255

CUEVA DE ARNERO (LLANES, ASTURIAS)

Fuentes bibliográficas: CLARK, G.A. (1976).

Yacimiento situado al sudeste de Posada de Llanes, a 70 metros sobre el nivel del mar y a 2,4 kilómetros de la costa. Se abre al noroeste y está constituída por una sola cámara de 13 metros en la entrada, una altura de 3-4 metros y 10 metros de profundidad. Fué descubierto por Vega del Sella en 1914, quien lo excavó en 1919 junto a Obermaier. Posteriormente Clark realiza un sondeo en 1969. En las excavaciones antiguas se detectaron tres periodos de ocupación: Musteriense, Auriñaciense y Asturiense. Clark se limita al sondeo de este último periodo.

Malacofauna

Abundancia absoluta (NE) de las especies del conchero Asturiense (Nivel A):

TAXONES	NE
Patella vulgata, etc.	163
Trochocochlea crassa	91
Litttorina littorea	1[f]
Helix nemoralis	6
Helix arbustorum	2
Gasterópodos marinos S.I.	40[a]
TOTAL	303

a: Especímenes fragmentarios o con características específicas oscurecidas por $CaCO_3$; probablemente la mayoría es *Trochocochlea crassa*.
f: Discutible por ser de carácter fragmentario.

CABEÇO DA ARRUDA (MUGE, RIBATEJO)

Fuentes bibliográficas: LENTACKER, A. (1991).

Conchero mesolítico situado en la orilla norte del río Muge, a 4,5 Km de la ciudad del mismo nombre, en una pequeña loma a 13 m sobre el nivel del mar. Este yacimiento forma parte del conjunto de los concheros de Mugue (**Ver Mugue**).

Malacofauna

La autora realiza el análisis del material malacológico correspondiente a las excavaciones de los años treinta y los años sesenta. El primero se encuentra depositado en el Laboratorio de Antropología de la Universidad de Oporto (OPORTO), y el segundo en el Instituto Geológico de Lisboa (LISBOA). Se han contabilizado exclusivamente los individuos completos, los ápices de gasterópodos y los fragmentos umbonales de bivalvos, estos últimos sin diferenciar parasagitalmente.

Abundancia absoluta (NR) de las especies de moluscos según las categorías establecidas por A. Lentacker:

TAXONES	OPORTO				LISBOA
	A	B	C	X	
Mytilus edulis	1	-	-	-	1
Pecten maximus	2	2	1	-	10
Ostrea sp	1	1	-	-	-
O. edulis/Crassostrea angulata	-	-	-	-	29
Laevicardium norvegicum	4	2	2	1	21
Cerastoderma edule/C. glaucum	1102	31	122	4	972
Venerupis decussata	3	2	-	-	2
Scrobicularia plana	103	15	18	6	152
Solen sp/Ensis sp	6	3	3	2	20
Eastonia rugosa	-	-	-	-	1
Bittium sp	1	2	1	-	-
Trivia europaea	7	6	2	5	-
Semicassis saburon	-	-	-	-	1
Helicella sp	9	1	5	2	-
Theba pisana	77	41	26	44	109
Cepaea nemoralis	-	-	-	-	3
Helix sp/Cepaea sp	1	1	1	2	-
Acicula fusca	-	-	-	-	1
Rumina decollata	-	-	-	-	1
Theodoxus fluviatilis	55	27	45	209	2
Hydrobia sp	1	1	-	15	-
Unio tumidus	4	-	-	1	-
Unio pictorum	-	-	-	-	2
Unio sp	-	-	-	-	11
Sepia officinalis	2	-	-	-	-
TOTAL	1379	135	226	291	1338

A: Nivel superficial. **B:** Vestigios enterrados en el suelo. **C:** Hogares. **X:** ?

ASSUT D'ALMASSORA (ALMAZORA, CASTELLON)

Fuentes bibliográficas: ESTEVE (1969) en MATEU BELLES, J.F., MARTI OLIVER, B., ROBLES CUENCA, F. & ACUÑA HERNANDEZ, J.D. (1985) y APARICIO, J. (1990).

Abrigo en la orilla izquierda del rio Millars, entre el azud de Castelló y el de Almassora, a unos 10 Km del mar. Yacimiento descubierto por Esteve en 1924, en su opinión el nivel de conchas correspondería a los restos dejados por una comunidad de recolectores preneolíticos. Lo que supone, pues, un amplio espectro que iría desde el Paleolítico Superior hasta el inicio de los tiempos cerámicos, hacia el 7.000 B.P., dadas las escasas informaciones aportadas por los materiales recogidos. J. Aparicio adscribe el yacimiento al Mesolítico IIIA.

Malacofauna

Según Esteve, el nivel de conchas llegaba a sobrepasar los 80 cm de potencia en algún punto del corte excavado. Las conchas de moluscos eran en su inmensa mayoría de "*Cardium*", destacando el hallazgo de una *Columbella* perforada para usarse como adorno, junto a algunas especies terestres.

Según J. Aparicio el Nivel II: "*... es un auténtico conchero, con predominio de "cardium" entre las conchas marinas y el "helix" entre las terrestres, siendo ambas abundantísimas, en menor proporción hay pectúnculos y 1 único ejemplar de "natica" y "cyprea", estando una "columbela" perforada para la suspensión.*"

CUEVA DE ATXETA (FORUA, VIZCAYA)

Fuentes bibliográficas: BARANDIARAN (1961c) & BARANDIARAN (1967) en ALTUNA, J. (1972).

La cueva de Atxeta se abre en la ladera norte del cerro del mismo nombre, en el barrio de Arxondo, a menos de 1 Km de la ría de Guernica. Yacimiento descubierto en 1959 por J.M. de Barandiarán, quien lo excavó en 1959-60. La estratigrafía abarca desde el Solutrense (?) a la Edad del Bronce.

Malacofauna

Relación de especies por niveles:

Nivel a. Edad del Bronce.

Patella
Monodonta
Scrobicularia
Solen
Mytilus
*Pectuncu*lus

Nivel b. Neolítico ?

Moluscos como en a, si bien menos numerosos y con algún ejemplar de *Cardium*.

Nivel c. Campiñiense ?

Restos de mariscos no determinados.

Nivel d. Aziliense.

Restos de mariscos no determinados.

CUEVA DE ATXURI (MUGARRA, MAÑARIA, VIZCAYA)

Fuentes bibliográficas: NOLTE (1957) & BARANDIARAN (1964b) en ALTUNA, J. (1972).

Yacimiento descubierto por J.M. Barandiarán en 1929, ha sido explorado por E. Nolte en 1956 y excavado por J.M. Barandiarán en 1960-1961. Según este último autor, la cueva probablemente estuvo habitada durante el Neolítico y el Calcolítico.

Malacofauna

E. Nolte cita la presencia de conchas como "Monodontas".

CUEVA DE ATXURRA (BERRIATUA, VIZCAYA)

Fuentes bibliográficas: BARANDIARAN (1961a, 1974a) & BARANDIARAN (1967) en ALTUNA, J. (1972).

Cueva descubierta por J.M. de Barandiarán en 1929. Las primeras excavaciones se realizaron en 1934-1935 bajo la dirección de J.M. Barandiarán y T. de Aranzadi. La cronología abarca desde el Solutrense al Neolítico ?.

Malacofauna

Relación de especies por unidades culturales según I. Barandiarán:

a. Neolítico ?

Patella

b. Aziliense

Patella

CUEVA DE LOS AZULES I (CANGAS DE ONIS, ASTURIAS)

Fuentes bibliográficas: FERNANDEZ-TRESGUERRES, J.A. (1980).

Cueva situada en las proximidades de la zona de confluencia del río Sella con el Güeña, en la vertiente sur del monte de Llueves. Fué descubierta en 1971, comenzándose los trabajos de excavación dos años después. Su estratigrafía abarca el Magdaleniense Superior y el Aziliense.

Malacofauna

Los restos malacológicos fueron estudiados por B. Madariaga. Los moluscos terrestres eran los más abundantes, al ser un yacimiento interior, aunque también se han encontrado moluscos marinos. Se identificaron únicamente los moluscos marinos y sólo se cuantificaron los elementos ornamentales.

Relación de especies y NE por niveles:

NIVELES / ESPECIES	NIVEL 2	NIVEL 3		
		Capas superiores	3e	Enterramiento
Patella vulgata	x	x	x	-
P. vulgata sautuolae	-	-	x	-
Patella aspera	x	x	-	-
Patella depressa	x	x	x ?	-
Helcion pellucidus	-	-	x	-
Monodonta lineata	-	x	x	-
Littorina littorea	-	-	x	-
Littorina obtusata	-	-	x (3*)	-
Trivia europaea	-	x	x (56*)	-
Nassa reticulata	-	-	x	-
Mytilus edulis	x	x	x	-
Modiolus barbatus	-	x	-	10 ó 12

Todos los niveles son Azilienses, incluido el enterramiento. La datación absoluta del nivel 3 ha dado las siguientes fechas: 9.430 ± 120 B.P. (subnivel 3a), 9.540 ± 120 B.P. (subnivel 3d) y 11.320 ± 360 B.P. (subnivel 3e).

CUEVA DE BALMORI (BALMORI, LLANES, ASTURIAS)

Fuentes bibliográficas: HERNANDEZ PACHECO (1919), OBERMAIER (1925) & VEGA DEL SELLA (1930) en ALTUNA, J. (1972), CLARK G.A. & CLARK V.J. (1975) y CLARK, G.A. (1976).

Yacimiento situado a 40 m sobre el nivel del mar y 500 m del estuario de Barro, en la cara sur de la plataforma de la Llera, a unos 600 m al nordeste del pueblo de Balmori. Descubierto en 1908 por Alcalde del Río, no fué excavado en gran escala hasta 1914, excavación llevada a cabo por el Conde de la Vega del Sella, en parte con la colaboración de Obermaier, y que continuó esporádicamente hasta 1917. Posteriormente G. Clark realizó cinco catas en el verano de 1969. Se encuentran representados depósitos del Solutrense Superior, Magdaleniense Final, Aziliense y Asturiense.

Malacofauna

1. Excavaciones de 1914-1917

1.1. Moluscos por niveles según Obermaier:

c. Magdaleniense antiguo.

Cyprina islandica

1. Asturiense

Trochus

Littorina

1.2. La malacofauna citada por Vega del Sella no es asignada a ningún nivel.

Relación de especies:

Littorina obtusata

Littorina littorea

Patella vulgata (gran tam.)

Cardium mucronatum

Cyprina islandica

Cypraea europea

Pecten maximus

Quenopus pespelecani

Nassa reticulata

2. Sondeos de 1969

Abundancia absoluta (NE) de la malacofauna por catas y niveles:

CATAS	A	B	C	
NIVELES	A1		C1	C2
Patella spp	43	34	-	2
P. vulgata sautuola	14	113	1	-
Littorina littorea	7	7	-	-
Trochococlea crassa	9	-	-	1
Moluscos marinos S.I.	-	5	-	-
Helix nemoralis	1	2	-	-
Helix arbustorum	4	-	-	-
TOTAL	78	161	1	3

A1: Nivel removido. **B:** Magdaleniense III. **C1:** No asignado. **C2:** Asignado a una fecha postpleistocena en base a la fauna.

CATA	D				
NIVELES	D0	D1	D3	D4	D5
Patella spp	24	106	-	-	6
P. vulgata sutuola	65	2	243	36	381
P. indeterminada	-	-	-	5	1
Littorina littorea	3	10	15	4	20
Trochococlea crassa	11	2	-	-	-
Ostrea edulis	5	-	-	-	-
Moluscos marinos S.I.	3	1	1	-	-
Helix nemoralis	9	5	2	-	-
TOTAL	120	126	261	45	408

DO: Nivel revuelto. **D1:** Asturiense. **D3:** Magdaleniense III. **D4:** Sin asignar. **D5:** Magdaleniense III.

CATA	E				
NIVELES	E1	E2/3	E3	E4	E5
Patella spp	11	145	58	20	8
P. vulgata sautuola	10	17	41	55	675
Littorina littorea	-	5	11	8	78
Trochococlea crassa	3	15	4	2	-
Molusco marino S.I.	-	-	2	-	-
Helix nemoralis	-	3	2	-	1
Helix arbustorum	-	-	1	-	-
TOTAL	24	185	119	85	762

E1: Asignado al Asturiense (*). **E2/3:** Magdaleniense III. **E3 y E4:** No asignados. **E5:** Magdaleniense III.
* La asignación al Asturiense se basa en la inversión en las proporciones de *Patella vulgata/P. spp* y *Littorina littorea/Trochococlea crassa*.

BARROSINHA (SETUBAL, ALTO ALENTEJO)

Fuentes bibliográficas: LENTACKER, A. (1991).

Yacimiento situado en la orilla S del estuario del Sado, casi enfrente de la ciudad de Setubal. Consta de cuatro niveles arqueológicos, el más antiguo neolítico, fechado en el 4.730 +/- 50 B.P.

Malacofauna

Abundancia relativa (% Peso) de las especies por niveles:

ESPECIES	2	4
Mytilus sp	6.60	2.90
Pecten maximus	1.60	0.00
Cerastoderma edule	0.04	0.06
Venerupis decussata	52.00	96.90
Solen sp/Ensis sp	33.20	0.04
Thais haemastoma	6.00	0.10
Mollusca S.I.	0.18	0.04

COVACHO O ABRIGO DE BERROBERRIA (ALKERDI, URDAX, NAVARRA)

Fuentes bibliográficas: MARQUES DE LORIANA (1940, 1943) & MALUQUER DE MOTES (1965) en ALTUNA, J. (1972).

Cueva situada en un pequeño cerro calizo de la cabecera del río Nivelle, al pie del puerto pirenaico de Otxondo, a poco más de 20 Km de la costa. Fué descubierta en 1930 por N. Casteret, quien la excavó junto con el Marqués de Loriana en 1939. Posteriormente Maluquer de Motes realizó seis campañas de excavación a partir de 1959. Finalmente, I. Barandiarán reemprendió las excavaciones realizando dos campañas de excavación en 1977 y 1979.

Malacofauna

1. Excavación de 1939

Relación de especies por niveles, según el Marqués de Loriana:

Nivel B. No asignado culturalmente.

Helix nemoralis

Mytilus edulis

Patella (pequeñas)

Almejas

Niveles D y E. Magdaleniense Final o Aziliense.

Los moluscos casi desaparecen. Se cita la presencia de *Patella* y *Helix*.

2. Excavaciones de Maluquer de Motes

Nivel II (Neolítico atípico): conchero con muchos *Helix nemoralis*.

CUEVA DE BOLINKOBA (ATXARTE, ABADIANO, VIZCAYA)

Fuentes bibliográficas: MARQUES DE LORIANA (1941), BARANDIARAN J.M. (1950a) & BARANDIARAN (1967) en ALTUNA, J. (1972).

Cueva situada en el interior de la Sierra de Amboto, en el camino entre los pueblos de Urquiola y Abadiano, a 65 m sobre el nivel del río Asuntze. J.M. de Barandiarán la descubrió en 1930, excavándola, junto con Aranzadi, de 1932 a 1933. El Marqués de Loriana realizó otra campaña de excavación en 1934. La estratigrafía abarca desde el Gravetiense a la Edad del Bronce.

Malacofauna

1. Excavaciones de 1932-1933

Relación de especies por niveles, según Barandiarán:

b. Aziliense indistinguible del Magdaleniense Final.

Littorina obtusata

Cypraea "trivia arctica"

Turritella

c. Magdaleniense Inferior Cantábrico.

Turritella (7 ejemplares *)

Littorina obtusata (2 ejemplares *)

d. Solutrense Medio avanzado y Superior.

Littorina obtusata (1 ejemplar *)

Cypraea (2 ejemplares *)

Turritella (1 ejemplar *)

e. Solutrense Inferior

Littorina obtusata (22 ejemplares *)

f. Gravetiense con elementos auriñacienses.

Nassa reticulata (4 ejemplares *)

Littorina obtusata (15 ejemplares *)

2. Excavación de 1934

Relación de especies según el Marqués de Loriana, quien no las asigna estratigráficamente:

Littorina obtusata

Trivia

Turritella

Ostraea

Este autor indica expresamente que no se han hallado restos de *Helix*.

CUEVA DE BRICIA (POSADA, LLANES, ASTURIAS)

Fuentes bibliográficas: JORDA CERDA (1954) en ALTUNA, J. (1972) y CLARK, G.A. (1976).

Cueva situada en la ladera sur del macizo de la Llera en el término de Posada, a unos 60-70 metros sobre el nivel del mar y 1,6 Km de la costa. Cavidad con una sola entrada orientada al sur,

presenta dos salas separadas por una gruesa columna estalagmítica. Descubierta a principios de siglo, fué excavada en 1953 por Jordá Cerdá. En 1969 G.A. Clark realizó una pequeña cata en el nivel Asturiense. Contiene niveles Magdalenienses y un conchero Asturiense fechado en el 6.800 +/- 160 B.P.

Malacofauna

1. Excavación de 1953

Fauna de moluscos por niveles según Jordá Cerdá:

a) Conchero Asturiense.

Patella (pequeño tam.)
Cardium edule
Trochus lineatus
Oricium

b) 2. Subnivel Magdaleniense.

Patella
Cardium

2. Sondeo de 1969

Abundancia absoluta (NE) de las especies:

ESPECIES	NE
Patella vulgata sautuola	1
Patella vulgata, etc.	1237
Trochocochlea crassa	280
Cardium edulis	6
Oricium sp	1
Gibbula umbilicalis	2
Litttorina littorea	3
Helix nemoralis	57
Helix arbustorum	30
Gasterópodos marinos S.I.	237[a]
TOTAL	1854

a: Especímenes fragmentarios o con características específicas oscurecidas por $CaCO_3$; probablemente la mayoría es *Trochocochlea crassa*.

CUEVA DEL CABALLO (CARTAGENA, MURCIA)

Fuentes bibliográficas: MAS, J. (1989).

Cueva situada en la rambla del Cañar a 2 Km de su desembocadura y a la misma distancia de la localidad de Isla Plana. Se encuentra enclavada en la cota de 135 metros sobre el nivel del mar y

orientada al S.SO. Se iniciaron las excavaciones en 1983 bajo la dirección de M. Martínez Andreu, y en el estudio de que disponemos se consideran las realizadas hasta 1985 inclusive. Se pueden distinguir dos periodos de ocupación del Magdaleniense Superior, el más reciente fechado en el 10.780 +/- 370 B.P. (Nivel 2).

Malacofauna

Abundancia absoluta (NE) por niveles:

ESPECIES	2	4
Mytilus galloprovincialis	30	10
Monodonta turbinata	17	21
Pinna nobilis	12	8
Glycymeris glycymeris	10	1
Trivia monacha	6	1
Bithynia tentaculata	3	-
Turritella communis	5	-
Patella caerulea	19	5
Astraea rugosa	2	-
Arca tetragona	4	1
Pecten jacobaeus	6	3
Cerastoderma glaucum	1	1
Cyclope donovani	-	2
Planobarius corneus	-	1
Omalogyra atomus	-	2
Chlamys varia	7	2
Familia Pectinidae	1	-
Murex trunculus	1	-
Venerupis rhomboides	1	-
Tapes decussatus	2	1
Rumina decollata	2	1
Naticarius hebraeus	4	3
Cerithium sp	-	1
Dentalium dentalis	1	-
Acanthocardia echinata	1	-
Paludinella littorea	-	2
Conus ventricosus	1	-
Superfamilia Cardioidea	1	-
Chamalea gallius striatula	1	-
Hinia costulata	1	-
Arca noae	-	1
Lima sp	-	1
Anomia ephippium	-	1
Acteon tornatilis	1	-
TOTAL	149	69

CERRO DE LAS CABEZAS (VALENCINA DE LA CONCEPCION, SEVILLA)

Fuentes bibliográficas: HAIN, F.H. (1982).

Poblado de la Edad del Cobre situado en un cerro a unos 163 m sobre el nivel del mar, entre la vertiente oriental de Sierra Morena y el Gaudalquivir. Fué excavado por F. Fernández Gómez en 1975 y 1976. Ha sido datado por radiocarbono hacia el 2.100 a.C.

Malacofauna

Los moluscos corresponden al material recuperado en las campañas de excavación de 1975 y 1976. Las abundancias absolutas de las especies recuperadas se exponen por estructuras.

ESTRUCTURAS	A		C		C_{a-b}		D	
Taxones	NR	NMI	NR	NMI	NR	NMI	NR	NMI
Patella spec.	2	2	2	2	-	-	-	-
Murex brandaris	1	1	-	-	-	-	-	-
Glycymeris spec.	6	6	-	-	-	-	-	-
Pecten maximus	27	12	3	3	3	3	-	-
Ostrea edulis	-	-	-	-	2	2	-	-
Rudicardium tuberculatum	4	4	-	-	1	1	-	-
Venerupis decussata	975	325	42	9	48	16	31	12
Solen marginatus	14	5	-	-	-	-	-	-
Donax vittatus	1	1	-	-	-	-	-	-
Rumina decollata	3	3	2	2	2	2	4	4
Cepaea nemoralis	17	16	-	-	-	-	61	41
Unio crassus	13	5	-	-	-	-	-	-
TOTAL	1063	380	49	16	56	24	96	57

ESTRUCTURAS	F		F_1		F_{31}		TC_4/C_5	
Taxones	NR	NMI	NR	NMI	NR	NMI	NR	NMI
Patella spec.	4	4	1	1	2	2	-	-
Truncolariopsis trunculus	-	-	-	-	1	1	-	-
Glycymeris glycymeris	1	1	-	-	-	-	-	-
Glycymeris spec.	1	1	2	2	-	-	-	-
Mytilus galloprovincialis	-	-	-	-	3	2	-	-
Pecten maximus	2	2	2	2	1	1	-	-
Spondylus gaederopus	-	-	-	-	1	1	-	-
Rudicardium tuberculatum	1	1	1	1	-	-	-	-
Venerupis decussata	19	8	296	55	51	23	1	1
Pholas dactilus	-	-	1	1	-	-	-	-
Rumina decollata	-	-	2	2	2	2	4	4
Unio crassus	9	4	11	3	11	6	-	-
TOTAL	37	21	316	67	72	38	5	5

CUEVA DE LAS CALAVERAS (BENIDORM, ALICANTE)

Fuentes bibliográficas: FISCHER, P.H. (1923).

Yacimiento donde el Abate Breuil y H. Obermaier recogieron algunos restos, los cuales asignaron al Paleolítico Superior.

Malacofauna

Relación de especies:

Leucochroa candidissima Drap.

? *Helix vermiculata* Müller.

CUEVA DE CAN MONTMANY (PALLEJA, BARCELONA)

Fuentes bibliográficas: MADORELL (1956) en RUBIO de MIGUEL, I. (1976).

Yacimiento sin estratigrafía en el que aparece material de varias épocas, desde cerámica cardial hasta material de la Edad del Hierro.

Malacofauna

Relación de especies:

Cardium

Venus

Cardita

Patella

COVACHA DE LA PEÑA DE CANDAMO (SAN ROMAN DE CANDAMO, PRAVIA, ASTURIAS)

Fuentes bibliográficas: HERNANDEZ PACHECO (1919) y BREUIL & OBERMAIER (1935) en ALTUNA, J. (1972).

Pequeña cueva descubierta por E. Hernández Pacheco y Wernert. Sólo el primer nivel ha sido asignado culturalmente (Solutrense).

Malacofauna

1. Fauna de moluscos citada por Hernández Pacheco:

Nivel 1. Solutrense.

Cardium tuberculatum Lin.

Patella

2. Breuil y Obermaier citan en esta cueva *Cyprina islandica.*

CASTELEJO (BILA DO BISPO, ALGARVE)

Fuentes bibliográficas: LENTACKER, A. (1991).

Yacimiento situado 15 Km al Norte del Cabo de San Vicente, en la orilla del río que desemboca en la playa de Castelejo. Se encuentra a 200 metros de la costa actual y a 25 m del nivel del mar. Devereux lo descubrió en 1983 y fué excavado por D. Lubell, en colaboración con J. Soares y Tavares da Silva. Este conchero mesolítico contiene numerosos niveles que han sido fechados entre el 8.040 +/- 100 y el 7.450 +/- 90 B.P.

Malacofauna

Abundancia relativa (% NR) por niveles (+ < 0.01):

ESPECIES	1	2	3	4	5	6
Striarca lactea	-	-	-	-	-	+
Mitylus sp	1.5	11.8	52.5	39.4	26.1	35.3
Cerastoderma edule	0.3	0.1	-	+	-	-
Solen sp/Ensis sp	0.1	-	-	-	-	-
Patella sp	36.8	65.4	35.4	45.4	59.5	46.3
Osilinus sp	0.9	0.3	-	0.1	-	0.1
Charonia lampas/Thais haemastoma	0.2	2.7	9.8	7.8	10.5	6.4
Thais haemastoma	1.3	0.9	0.4	0.6	0.7	0.4
Ocinebrina edwardsi	0.4	0.1	-	-	-	+
Cochlicella acuta	0.1	-	-	-	-	-
Theba pisana	-	-	-	+	-	-
Theodoxus fluviatilis	-	+	-	-		-
Bivalvia S.I.	0.1	+	-	-	-	+
Gastropoda S.I.	0.1	-	-	+	-	-
Pulmonata S.I.	-	-	-	+	-	+

ESPECIES	7	8	9	10	11	12
Striarca lactea	+	-	-	-	-	-
Mitylus sp	52.7	62.9	50.3	10.1	2.2	2.2
Venerupis decussata	-	-	-	-	+	1.1
Patella sp	25.4	16.1	21.4	31.8	27.9	17.2
Osilinus sp	0.1	2.4	2.4	35.3	48.8	55.9
Charonia lampas/Thais haemastoma	5.7	8.4	6.6	16.8	15.2	7.5
Thais haemastoma	1.1	1.2	1.1	0.2	+	1.1
Ocinebrina edwardsi	0.1	-	-	-	+	-
Cochlicella acuta	-	+	-	0.2	-	-
Theba pisana	+	0.1	+	0.1	-	-
Theodoxus fluviatilis	+	0.1	0.2	0.1	+	-
Bivalvia S.I.	+	-	-	0.2	+	-
Gastropoda S.I.	-	0.1	-	0.1	0.2	-
Pulmonata S.I.	+	0.1	0.2	0.1	+	-

CASTELLON ALTO (GALERA, GRANADA)

Fuentes bibliográficas: MILZ, H. (1986).

Yacimiento situado en la orilla sur del río Galera, en una cresta montañosa a 900 m sobre el nivel del mar. Pertenece a la cultura del Argar fechado entre el 1.800 al 1.500 a.C. Se ha realizado una campaña de excavación, bajo la dirección de F. Molina.

Malacofauna

Abundancia absoluta (NR) de las especies por contextos:

ESPECIES	POBLADO	FOSAS
Sepia officinalis	2	-
Monodonta turbinata	1	-
Thais haemastoma	3	-
Conus ventricosus	1	1
Columbella rustica	1	5
Glycymeris insubricus	11	-
Glycymeris spec	8	-
Planorbarius corneus	1	-
Planorbarius spec.	2	1
Theodoxus fluviatilis	3	85
Unio mancus	3	-
Moluscos de agua dulce indeterminados	2	-
Rumina decollata	1	-
Iberus alonensis	87	1
Melanopsis dufourii	52	11
Cepaea hortensis	2	-
Cernuela spec.	3	-
Moluscos S.I.	2	-
TOTAL	185	104

POBLADO DE LOS CASTILLEJOS DE MONTEFRIO (MONTEFRIO, GRANADA)

Fuentes bibliográficas: FALKNER, G. (1990).

Yacimiento situado en las inmediaciones de Montefrío, donde se han realizado dos campañas de excavación en 1971 y 1974. En la primera campaña se diferenciaron seis estratos con una

cronología que abarca desde el Neolítico Tardío al Cobre Final-Bronce Inicial ?. Durante la segunda campaña se diferenciaron nueve estratos entre el Neolítico Medio y el Bronce Inicial.

Malacofauna

Abundancia absoluta (NR) por estratos:

TAXONES	I	IV	IV/V	V	V/VI	VI/VII
Unionídos	1	-	1	1	-	-
Unio sp	-	1	-	-	-	-
Potomida littoralis	-	1	-	1	-	-
Glycymeris pilosa	-	1	-	-	1	1
Pecten maximus	-	-	-	2	-	-
Patella ferruginea	-	1	-	-	-	-
TOTAL	1	4	1	4	1	1

CUEVA DEL CASTILLO (PUENTE VIESGO, CANTABRIA)

Fuentes bibliográficas: CARBALLO (1910) & OBERMAIER (1925, 1934) en ALTUNA, J. (1972) y FISCHER (1923-24) en CABRERA VALDES, V. (1984).

Cueva situada en el monte "Castillo" a unos 20 Km de la costa actual. Fué descubierta en 1903 por H. Alcalde del Río, quien ya realizó un primer sondeo. H. Obermaier y H. Breuil realizan excavaciones durante 1910-1914, que fueron seguidos por unos sondeos realizados por J. Carballo en 1950. A partir de 1980 V. Cabrera reemprende las excavaciones del yacimiento. La estratigrafía abarca desde el Achelense Inferior al Eneolítico.

Malacofauna

1. Excavaciones de 1910-1914

V. Cabrera Valdés recopila las relaciones de fauna de las listas de P.H. Fischer (1923-24). Abundancia relativa de las especies, según la secuencia cronológica establecida por dicha autora:

ESPECIES	2	4	6	7	8	10	12	13	14	16b	24
Cyclostoma elegans	XX	X	X	-	X	-	-	-	-	-	-
Hyalinia cellaria	X	X	-	-	-	-	-	-	-	X	-
Helix nemoralis	XX	XX	X	X	XX	-	-	-	X	-	-
Helix lusitanica	X	X	-	-	-	-	-	-	-	-	-
Helix barbula	-	-	-	-	X	-	-	-	-	X	-
Helix variabilis	-	-	-	-	-	-	-	-	-	-	X
Helix limbata	-	X	-	-	-	-	-	-	-	-	-
Helix rotundata	-	X	-	-	-	-	-	-	-	-	-
Helix quimperiana	-	XX	-	-	-	-	-	-	-	-	-
Pomatia rudicosta	-	X	-	-	-	-	-	-	-	-	-
Clausilia sp	-	X	-	-	-	-	-	-	-	-	-
Cardium edulis	X	-	-	-	-	-	-	-	-	-	-
Ostrea edulis	X	X	X	-	X	-	-	-	-	-	-
Mytilus edulis	X	-	X	-	-	-	-	-	-	-	-
Cyprina islandica	-	-	X	-	X	X	-	-	-	-	-
Pectunculus bimaculatus	-	-	X	-	X	-	-	-	-	-	-
Pecten sp	-	-	X	-	X	-	-	-	-	-	-
Cardium echinatum	-	-	-	-	X	-	X	-	-	-	-
Cardium sp	-	-	-	-	-	X	-	-	-	-	-
Pecten jacobaeus	-	-	-	-	-	-	-	-	X	-	-
Unio sp (*)	X	-	-	-	-	-	-	-	-	-	-
Patella vulgata	X	-	XXX	X	X	XX	XXX	X	X	-	-
Littorina littorea	-	-	XX	X	X	-	-	-	X	-	-
Turritella communis	-	-	X	X	X	X	-	-	-	-	-
Cassis saburon	-	-	X	-	X	-	-	-	-	-	-
Calliostoma conuloides	-	-	-	-	X	-	-	-	-	-	-
Littorina obtusata	-	-	-	-	X	-	X	-	-	X	-
Purpura lapillus	-	-	-	-	-	X	-	-	-	-	-
Nassa mutabilis	-	X	-	-	-	-	-	-	-	-	-
Septa nodifera	-	-	-	-	-	-	-	-	X	-	-

2: Bronce Pleno. **4:** Aziliense. **6:** Magdaleniense Superior. **7:** Magdaleniense. **8:** Magdaleniense Antiguo. **10:** Solutrense ?. **12:** Perigordiense Superior. **13:** Sin atribución. **14:** Perigordiense Superior/Gravetiense. **16b/18:** Auriñaciense. **24:** Achelense Superior. * Segun Obermaier

2. Recopilación de J. Altuna

Abundancia relativa de la "fauna principal" por niveles:

ESPECIES	d	f	h	k	m
Cyclostoma elegans	X	X	-	-	-
Pomatia rudicosta	X	-	-	-	-
Hyalinia cellaria	X	-	-	-	-
Helix nemoralis	XXX	-	XX	-	X
Helix limbata	X	-	-	-	-
Helix rotundata	X	-	-	-	-
Helix lusitanica	X	-	-	-	-
Clausilia sp	X	-	-	-	-
Cyprina islandica	-	X	X	X	-
Pectunculus bimaculatus	-	X	-	-	-
Pecten sp	-	X	-	-	X
Ostrea edulis	-	-	X	-	-
Cardium sp	-	-	-	X	-
Turritella communis	-	X	X	-	-
Littorina littorea	-	XX	-	-	-
Cassis saburon	-	X	X	-	-
Patella vulgata	-	-	-	XX	X
Purpura lapillus	-	-	-	X	-

d: Aziliense. **f:** Magdaleniense Superior. **h:** Magdaleniense Antiguo. **k:** Solutrense Inferior. **m:** Auriñaciense Superior.

CUEVA 120 (LERIDA)

Fuentes bibliográficas: AGUSTI, B., ALCALDE, G., GÜELL, A., JUAN-MUNS, N., NEBOT, J., RUEDA, J.M. & TERRADAS, X. (1992).

Cueva situada al NE de Cataluña, en la comarca de la Garrotxa en un valle subsidiario del Llierca. Su periodo de ocupación abarca desde el Paleolítico Medio hasta la Edad del Bronce.

Malacofauna

El material estudiado se restringe a los dos niveles paleolíticos que no han sido fechados directamente, pero sí la capa de carbonato que los cubre y que ha sido datada por el método del Uranio/Torio en el 57.900 + 6800 - 6500.

Abundancia absoluta (NMI) de la fauna malacológica por niveles:

ESPECIES	NIVEL IV	NIVEL V
O. cellarius	4	13
B. subarcuata	-	1
H. limbata	-	2
E. strigella	-	10
H. obvoluta	-	1
C. obscurum esseranum	-	1
H. lapicida andorrica	6	14
C. squamantinum	-	1
C. nemoralis	34	550
Familia Zonitidae	-	3
TOTAL	44	596

COVA DE LES CENDRES (TEULADA, ALICANTE)

Fuentes bibliográficas: LLOBREGAT, E., MARTI, B., BERNABEU, V., VILLAVERDE, V., GALLART, M.D., PEREZ, M., ACUÑA, J.D. & ROBLES, F. (1981) y MARTI, B., FORTEA, J., BERNABEU, J., PEREZ, M., ACUÑA, J.D., ROBLES, F. & GALLART, M.D. (1987).

Cueva situada en la punta de Moraira, donde se abre en unos pronunciados escarpes sobre el mar, orientada hacia el SE. Conocida como yacimiento arqueológico desde principios de siglo, Breuil recogió diversos materiales, ha sido excavada en 1974 y 1975 por el Museo Arqueológico Provincial de Alicante, bajo la dirección de E. Llobregat. La secuencia estratigráfica del sondeo de 1974 abarca desde el Neolítico antiguo y medio hasta los inicios de la Edad del Bronce.

Malacofauna

Los restos malacológicos han sido estudiados por Jose Daniel Acuña Hernández y Fernando Robles Cuenca.

1. Campaña de 1974

Abundancia absoluta (NE y fragmentos) de las especies, por niveles:

NIVELES	I	II	III	IV	V	VI
Patella sp	1	-	19	7 + 1f	81 + 1f	18
Monodonta turbinata	-	1	3	12 + 2f	14	-
Thais haemastoma	-	-	-	-	1	-
Sphinterochila sp	-	-	-	-	-	1
Theba pisana	-	-	-	-	1	-
Iberus alonensis	-	-	-	-	4	3 + 1f
Glycymeris gaditanus	-	-	-	-	1	-
Mytilus edulis	-	-	-	-	1 + 1f	2f
Pecten maximus	-	-	-	1f	2f	5f
Spondylus gaederopus	-	-	-	-	1	-
TOTAL	1	1	22	19 + 3f	104 + 4f	22 + 8f

I: Eneolítico/Edad del Bronce. **II:** Sin asignación. **III:** Neolítico final. **IV-VI:** Neolítico antiguo y medio.

2. Campañas posteriores

Acuña y Robles ofrecen resultados preliminares de las recientes campañas de excavación en Martí *et al.* (1987); donde especifican que el conjunto malacológico de este yacimiento presenta escasa diversidad y es relativamente homogéneo a lo largo de la secuencia estratigráfica. Relación de especies:

Patella gr. cerulea
Monodonta turbinata
Glycymeris gaditanus *
Pecten maximus *
Spondilus gaederopus *
Mytilus edulis
Rumina decollata
Pomatias elegans
Iberus alonensis
Theba pisana
Spincterochila candidissima

EL CIERRO (EL CARMEN, ASTURIAS)

Fuentes bibliográficas: CLARK, G.A. (1976).

Yacimiento situado a 500 metros al NO de El Carmen, a 100 metros sobre el nivel del mar y 1,6 kilómetros de la costa actual. Es una cueva derrumbada parcialmente con dos entradas que se

abren al norte y al este. El yacimiento fué prospectado por F. Jordá Cerdá y J.A. Alvarez en 1958 ó 1959, sin que se llegaran a publicar resultados del mismo. Clark realiza un muestreo del conchero en 1969. La estratigrafía excavada abarca desde el Auriñaciense al Magdaleniense Superior o Aziliense (conchero). La roca madre no fué alcanzada por lo que existe la posibilidad de que existan depósitos más antiguos.

Malacofauna

Los datos que poseemos se restringen al conchero superior estudiado por Clark con la colaboración de B. Madariaga.

Abundancia absoluta, individuos completos (ICOM) y fragmentos (FTOS), de las especies:

ESPECIES	ICOM	FTOS
Patella vulgata sautuola	124	145
Patella spp	1	-
Littorina littorea	36	9
Mytilus edulis	-	10
Trivia europaea	1	-
Helix nemoralis	62	56
Helix arbustorum	3	2
TOTAL	227	222

LE "CINGLE VERMELL" (VILANOVA DE SAU, BARCELONA)

Fuentes bibliográficas: VILA i MITJA, A. (1985).

Yacimiento situado en el término de Vilanova de Sau, comarca de Osona, al N-NO del macizo granítico de Les Guilleries. Descubierto por J. Valls y F. Ferrés, quienes practicaron una primera cata, fué excavado sistemáticamente en el año 1978. Ha sido fechado por C^{14} en el 9.760 +/- 160 B.P.

Malacofauna

Abundancia absoluta (NMI) de las especies por estratos:

ESTRATOS	9	10
Cepaea nemoralis	21	27
Helicigona lapicida	1	3
Rumina decollata	-	1
Moluscos marinos:		
Cardium echinatum		
Cardium prob. norvegicum		
Pecten jacobaeus		3
Dentalium vulgare		
TOTAL	22	34

CUEVA DE COBERIZAS (POSADA, LLANES, ASTURIAS)

Fuentes bibliográficas: MADARIAGA, B. (1973).

La Cueva de Coberizas se sitúa en la ladera NE de Cuesta la Sabina, un promontorio de 140 m de alto localizado a 1,5 Km al oeste de Posada de Llanes. Más que una cueva es un pequeño abrigo de 7 m de anchura máxima por otros 7 m de longitud y 2,6 m de altura máxima. Descubierta por Obermaier y Vega del Sella en 1919, G.A. Clark realizó una pequeña cata en 1969. Se encuentran representados los periodos culturales Magdaleniense, Solutrense y Asturiense (Clark & Cartledge, 1973).

Malacofauna

Con respecto a las especies de la Familia Patellidae, el autor especifica lo siguiente: *Patella vulgata* representa las especies modernas del género *Patella*, *P. vulgata var sautuola* se utiliza para representar la forma pleistocena y, cuando no se puede diferenciar entre las dos categorías anteriores, se utiliza la categoría *P. vulgata* indeterminada.

Abundancia absoluta (NE), por niveles:

ESPECIES	A1	A3	A4	B1	B2	B3
Patella vulgata	1	20	53	2205	64	1
P. vulgata var sautuola	-	9	22	2	3	5
P. vulgata indeterminada	-	22	-	-	-	4
Trochococlea crassa	1	2	-	775	9	-
Littorina littorea	-	-	-	3	2	-
Nassa reticulata	-	-	-	1	-	-
Halyotis tuberculata	-	-	-	1	-	-
Mytilus edulis	-	-	-	69	2	-
Cardium edule	-	-	-	12	-	-
Ostrea edulis	-	-	-	2	-	-
Molusco marino S.I.	-	1	2	119	3	3
Helix nemoralis	-	5	10	184	124	17
Helix arbustorum	3	8	2	40	6	-
Pulmonado S.I.	-	4	4	8	4	-
TOTAL	5	71	93	3421	217	30

A1: No asignado culturalmente. **A3:** Magdaleniense. **A4:** Solutrense.
B1: Asturiense. **B2:** Magdaleniense. **B3:** Atribuido al Magdaleniense según los datos faunísticos.

EL COLLADO (OLIVA, VALENCIA)

Fuentes bibliográficas: APARICIO, J. (1990).

Yacimiento situado en las inmediaciones de la ciudad de Oliva. Fué descubierto a principios de siglo por D.A. Boscá Casanoves. En 1975 J. Aparicio realiza las primeras exploraciones y

recogida de materiales de superficie, realizándose posteriormente dos campañas de excavación de urgencia (1987-1989) bajo la dirección de J. Alcina. Se adscribe al Mesolítico.

Malacofauna

Los análisis malacológicos de la primera campaña de excavación (1987-88) fueron realizados por los Dres Cuerda y Gasull, la segunda campaña se encuentra en estudio, a destacar en esta última campaña la localización de pequeños caracoles de agua dulce en los enterramientos.

Relación de especies según J. Aparicio:

Murex brandaris L.
Murex trunculus L.
Purpura haemastoma sub consul Lamk.
Triton nodiferus Link.
Cerithium vulgatum Brug.
Columbella rustica L.
Nassa reticulata L.
Melanopsis tricarinata Brug.
Pseudotachea splendida Drap.
Pectunculos violascense Link.
Venus gallina L.
Cardium glaucum Brug. (formas costero-lagunares)
Spondilus gaederopus L.
Cardium tuberculatum L.
Pecten jacobaeus L.
Arca noae

CUEVA DE CUARTAMENTERO (LLANES, ASTURIAS)

Fuentes bibliográficas: MORALES, A. (1979a).

Yacimiento situado a 600 metros al SO de Llanes, a unos 40-50 metros sobre el nivel del mar y a 1 Km del puerto de LLanes. Cavidad de grandes dimensiones con tres salas principales y dos entradas, descubierta por el grupo espeleológico Querneto de la Escuela de Minas de Madrid. Grupo espeleológico que la excavó en 1967. Se ha reconocido un nivel con abundante industria asturiense, mientras que el resto fué asignado provisionalmente al Paleolítico Superior (Clark, 1976).

Malacofauna

Abundancia absoluta de las especies:

ESPECIES	NMI
Triton nodifer	3
Littorina littorea	13
Patella sp	19
Cardium edule	4
Helix nemoralis	3
TOTAL	42

CUESTA DEL NEGRO (PURULLENA, GRANADA)

Fuentes bibliográficas: LAUK, H.D. (1976) y DRIESCH, A. von den (1976).

Poblado de la Edad del Bronce situado a 7 Km al oeste de Guadix, en la altiplanicie del valle del río Fardes (cuenca de Guadix-Baza). Se han detectado cuatro fases correspondientes al Argar (I-IV) y la presencia de Bronce Final. Fué excavado por A. Arribas Palau.

Malacofauna

Driesch se encargó del estudio de los materiales aparecidos en las fosas de enterramiento, los cuales corresponden a la Fase II; el estudio de moluscos se debe a Falkner.

Abundancia absoluta (NR) por periodos y fases:

	ARGAR			BRONCE FINAL	?
FASES	I+II	III+IV	FOSA 9		
Monodonta turbinata	2	-	-	-	-
Semicassis undulata	-	-	1	-	-
Charonia lampas	2	-	-	1	-
Thais haemastoma	1	-	-	2	-
Conus mediterraneus	-	-	-	-	2
Glycymeris violascens	7	2	1	18	2
G. violascens (fosil ?)	-	-	-	3	1
Spondylus gaederopus	-	-	-	1	-
Rudicardium tuberculatum	1	-	-	1	-
Rumina decollata	-	-	-	-	2
Iberus alonensis	2	-	-	-	-
Potomida littoralis umbonata	-	-	-	-	1
TOTAL	15	2	2	26	8

CUEVA DE CUETO DE LA MINA (POSADA, LLANES, ASTURIAS)

Fuentes bibliográficas: VEGA del SELLA (1916, 1917), CABRERA (1919), OBERMAIER (1925) & WERNERT (1956) en ALTUNA (1972).

Yacimiento situado a poco más de 10 m del curso actual del rio Calabres, en la cara sur del macizo de La Llera. Se encuentra a 1,7 Km de la costa actual. Fué descubierto en 1914 por el Conde de la Vega del Sella, quien lo excavó ese mismo año y el siguiente. F. Jordá realizó un corte en 1960 siendo excavado posteriormente por M. de la Rasilla Vives. La estratigrafía abarca desde el Auriñaciense Superior al Asturiense.

Malacofauna

Se indican con mayúsculas los niveles establecidos por Vega del Sella y con minúsculas los establecidos por Obermaier.

Abundancia relativa por niveles:

ESPECIES	A-a	B-c	C-d	D-e	E-f	G-j	H-i
Patella sp	XX	-	X	X	X	-	-
Patella vulgata	-	X	-	-	-	X	X
Trochus lineatus	X	-	-	-	-	-	-
Littorina littorea	-	X	XX	XX	X	-	-
Littorina obtusata	-	-	X	*	*	*	*
Trivia europaea	-	-	*	-	*	-	-
Purpura lapillus	-	-	-	X	-	-	-
Turritella triplicata	-	-	-	XX	*	-	-
Buccinum undatum	-	-	-	X	-	-	-
Sypho sp	-	-	*	-	-	-	-
Mytilus edulis	X	-	-	-	-	-	-
Cyprina islandica	-	X	-	X	-	-	-
Cardium tuberculatum	-	X	-	-	-	-	-
Pecten islandicus	-	-	X	-	-	-	-
Pecten maximus	-	-	-	X	-	-	-
Dentalium sp	-	-	*	-	-	-	-
Helix nemoralis	X	-	-	-	-	-	X

A.a: Asturiense. **B.c:** Magdaleniense Superior. **C.d:** Magdaleniense Medio. **D.e:** Magdaleniense Inferior. **E.f:** Solutrense Superior. **G.j/H.i:** Auriñaciense Superior.

LA LOMA DE CHICLANA (PALOMERAS, MADRID)

Fuentes bibliográficas: SANCHEZ MESEGUER, J., FERNANDEZ VEGA, A., GALAN SAULNIER, C. & POYATO HOLGADO, C. (1983).

Cerrete con "fondos de cabaña" situado a una altitud de 679 metros sobre el nivel del mar. Según los autores podría asignarse al Bronce Inicial.

Malacofauna

Relación de especies reseñadas:

Tapes decussatus fuscus

Artenus exoleta

Ostrea edulis

Venus ovata

CUEVA DE LA CHORA (VOTO, CANTABRIA)

Fuentes bibliográficas: MADARIAGA (1963) en ALTUNA, J. (1972).

La Cueva de la Chora se encuentra en el término de San Pantaleón de Aras y fué descubierta por A. García Lorenzo en 1953. Fué excavada en el verano de 1962 por el Seminario "Sautuola", bajo la dirección de P. González Echegaray y García Guinea.

Malacofauna

El estudio malacológico fué realizado por B. Madariaga, el cual especifica que gran parte de los moluscos se recuperaron en la segunda capa del yacimiento y, que existe también un importante conchero en el interior de la cueva, que no ha sido tenido en cuenta para este estudio. La fauna malacológica reseñada pertenece en su totalidad al nivel VIa, asignado al Magdaleniense. También ofrece datos biométricos.

Abundancia relativa de las especies recuperadas:

ESPECIES	ABUNDANCIA
Gryphaea angulata	xx
Ostrea edulis	xx
Patella vulgata	xx
Patella lusitanica	x
Patella depressa	x
Tapes decussatus	x
Mytilus edulis	x
Trochus lineatus	x
Littorina littorea	x
Turritella communis	x
Helix	x

CASTRO DE A DEVESA (RIBADEO, LUGO)

Fuentes bibliográficas: CANO PAN, J. & VAZQUEZ VARELA, J.M. (1991).

Castro Galaico-romano. No ha sido excavado.

Malacofauna

Relación de especies:

Ostrea edulis
Thais haemastoma
Ocinebra erinacea
Patella vulgata
Patella aspera
Mytilus edulis

Monodonta lineata
Charonia lampas
Cassis saburon

CASTRO DE DOMAIO O DE MONTEALEGRE (PONTEVEDRA)

Fuentes bibliográficas: VAZQUEZ VARELA, J.M. (1975).

Castro situado en la orilla norte del estrecho de Rande, sobre la colina de Montealegre que se levanta inmediata a la costa a 90 m de altura.

Malacofauna

El material corresponde a una pequeña cata en la ladera sur del poblado en la proximidad de un muro, donde se diferenciaron dos niveles.

Abundancia absoluta (NE) por niveles:

ESPECIES	NIVEL 1	NIVEL 2
Patella vulgata	133	66
Tapes decussatus	23	52
Solen marginatus	10	12
Mytilus edulis	10	5
Littorina littorea	4	4
Ostrea edulis	2	3
TOTAL	182	142

CASTILLO DE DOÑA BLANCA (PUERTO DE SANTA MARIA, CADIZ)

Fuentes bibliográficas: MORENO, R. (1994).

El Castillo de Doña Blanca se encuentra en el término municipal de El Puerto de Santa María, al pie de la sierra de San Cristóbal, de relieve suave y escasa altura (cota máxima de 24 metros) y al borde de un antiguo estuario. Este yacimiento se cita en 1923 en el *Diario del Guadalete*, donde D. Ventura indica la necesidad de su excavación. Las excavaciones se iniciarán en 1979, bajo la dirección de D. Ruíz Mata. El inicio de ocupación de este poblado fenicio tiene lugar en la primera mitad del siglo VIII a.C., verificándose una ocupación prácticamente ininterrumpida, hasta el abandono paulatino del asentamiento a finales del siglo IV y primera mitad del siglo III a.C.

Malacofauna

Los restos malacológicos corresponden a los recuperados en la Fosa 30, excavada en 1986.

Abundancia absoluta:

TAXONES	NR	NMI
Patella intermedia	16	16
Patella sp	175	141
Patella vulgata	25	24
Calliostoma zizyphinum	1	1
Monodonta spp	342	227
Zonaria pyrum	1	1
Familia Muricidae	3	2
Bolinus brandaris	45	9
Hexaplex trunculus	17	5
Nassarius reticulatus	3	3
Thais haemastoma	6	4
Columbella rustica	2	2
Cymbium olla	2	1
Cecilioides acicula	16	15
Ferussacia follicula	62	61
Rumina decollata	69	58
Subfamilia Helicellinae	178	175
Cernuela spp	649	625
Cernuela virgata	120	112
Candidula gigaxi	1	1
Cochlicella spp	436	408
Caracollina lenticula	609	595
Theba pisana	2747	2415
Otala lactea	56	21
Glycymeris sp	128	38
Mytilus galloprovincialis	2	1
Familia Pectinidae	39	5
Pecten sp	191	22
Chlamys sp	10	5
Chlamys varia	1	1
Familia Ostreidae	24	6
Ostrea edulis	30	5
Crassostrea angulata	4	2
Familia Cardiidae	2	1
Acanthocardia sp	5	3
Cerastoderma sp	12	5
Cerastoderma edule	70	17
Familia Solenidae	12	4
Solen marginatus	1488	324
Scrobicularia plana	5888	680
Tapes/Venerupis	10	1
Tapes decussatus	1435	138
Panopea glycymeris	6	1
Suborden Unionacea	1	1
Familia Sepiidae	1	1
S.I.	975	
TOTAL	15.919	6.183

LA RABITA CALIFAL DE LAS DUNAS DE GUARDAMAR (GUARDAMAR DEL SEGURA, ALICANTE)

Fuentes bibliográficas: RICO ALCARAZ, L. & MARTIN CANTARINO, C. (1989).

Rábita califal a unos 28 Km al S de la ciudad de Alicante, en la población costera de Guardamar. La estratigrafía abarca desde la segunda mitad del siglo IX al primer cuarto del siglo XI. Hasta el momento, tenemos en el yacimiento dos niveles culturales claramente definidos, el nivel I corresponde al momento de abandono del yacimiento, que quedaría sellado por el estrato de descomposición de los muros junto con materiales de las paredes, y el nivel II que correspondería al momento anterior o coetáneo al año 994, fecha que porta la lápida de fundación de la mezquita III. Se han realizado tres campañas de excavación, de 1984 a 1987 (Azuar, 1989).

Malacofauna

Los restos malacológicos corresponden a las campañas de excavación de 1985 y 1987. Se relacionan los individuos y fragmentos de cada especie por estructuras: mezquitas (I-V y M), estancias (K), calle y muros.

MEZQUITAS	I	II	III	IV	V	M
Glycymeris gaditanus	9	-	-	-	6	171
Arca noae	-	-	-	-	-	17+1f
Arca barbata	-	-	-	-	-	2
Chlamys varia	-	1	-	-	-	-
Ostrea sp	1f	-	-	-	1f	-
Unio umonatus	2	-	-	-	-	32+8f
Venus gallina	-	-	-	-	-	7
Venus verrucosa	1	-	-	-	-	-
Dosinia exoleta	-	-	1	-	-	-
Tellina planata	-	-	2	-	1	-
Donax trunculus	1	-	-	-	-	29
Mactra stultorum	18	-	-	-	-	20
Cardium edule	316	185	330	179	12	-
Murex trunculus	1	-	-	-	2+3f	-
Murex brandaris	-	-	-	4	-	3
Purpura haemastoma	2	-	-	1	-	29+1f
Columbella rustica	-	1	2	-	2	-
Conus mediterraneus	-	-	-	-	-	42
Monodonta turbinata	2	-	-	-	9	21+6f
Patella sp	1	-	-	-	9	36
Cerithium vulgatum	-	-	-	-	1	7
Cypraea spurca	1	-	1	-	-	-
Cassis ondulata	-	-	1	-	-	-
Helix aspersa	-	-	16	-	-	-
Otala punctata	24	118	42	41	6	-
Iberus gualterianus f. alonensis	226	40	90	46	94	-
Sphinterochila candida	17	22	19	19	7	-
Theba pisana	40	20	20	27	44	-
Leonia mannilaris	2	1	18	6	23	-
Rumina decollata	2	1	2	9	-	-
TOTAL	674+1f	389	544	332	216+4f	416+16f

M: Restos recuperados en las mezquitas, pero de los que no se especifica en cual de ellas.

Además, se citan cuatro fragmentos de *Ostrea sp* sin asignación a estructura alguna.

ESTANCIAS	KI	KII	KIII	KIV	KV	CALLE	MUROS
Glycymeris gaditanus	-	1	28	21	-	33	-
Arca noae	-	-	1	5	-	2	-
Arca barbata	-	-	-	-	-	1	-
Spondylus gaederopus	-	-	-	1	-	2	-
Ostrea sp	-	-	2	1	-	3f	-
Unio umonatus	-	-	10	9	-	5	-
Venus gallina	-	-	-	-	-	2	-
Tellina planata	-	-	2	1	-	-	-
Donax trunculus	-	-	1	3	-	2	-
Mactra stultorum	-	-	11	8	-	5	-
Cardium edule	23	12	71	118	-	68	-
Murex trunculus	-	-	-	-	-	2	-
Murex brandaris	-	-	-	-	-	2	-
Purpura haemastoma	-	-	15	8	-	23	-
Columbella rustica	-	-	-	-	-	2	-
Conus mediterraneus	-	-	5	1	-	-	-
Monodonta turbinata	-	1	17	11	-	20	1
Patella sp	-	-	15	20	-	11	1
Cerithium vulgatum	-	1	1	2	-	3	-
Cypraea spurca	-	-	-	-	-	2	-
Cassis ondulata	-	-	-	-	-	1	-
Otala punctata	7	18	68	71	-	39	-
I. gualterianus alonensis	96	17	523	166	-	67	7
Sphinterochila candida	-	-	105	43	-	5	-
Theba pisana	-	1	689	247	-	38	6
Leonia mannilaris	-	-	33	26	-	-	-
Rumina decollata	-	-	7	7	10	3	1
TOTAL	126	51	1604	769	10	338+3f	16

CUEVA DE EKAIN (DEBA, GUIPUZCOA)

Fuentes bibliográficas: LEOZ, I. & LABADIA, C. (1984).

Cueva situada en el término de Deba, a ocho kilómetros de la costa actual en linea recta y a 90 m de altitud sobre el nivel del mar. Descubierta en 1969 por A. Albizuri y R. Rezabal, ha sido excavada por J.M. Barandiarán y J. Altuna entre 1969 y 1972 y por J. Altuna entre 1973 y 1975. Es considerado un yacimiento estacional, pero ocupado intensamente desde el Magdaleniense Inferior hasta el Aziliense más tardío, al que se realizaron visitas muy esporádicas durante las primeras fases del Paleolítico Superior.

Malacofauna

Abundancia absoluta (NR y NMI) de las especies por niveles:

NIVELES	II		III		IV	
ESPECIES	NR	NMI	NR	NMI	NR	NMI
Monodonta lineata	141	113	43	27	-	-
Patella vulgata	40	40	5	5	2	2
Patella depressa	27	27	5	5	-	-
Patella aspera	63	63	5	5	-	-
Patella sp	63	18	14	4	-	-
Mytilus edulis	1	1	-	-	-	-
TOTAL	335	262	72	46	2	2

II/IV: Aziliense

NIVELES	V		VIIf		VIIIa		Xa	
ESPECIES	NR	NMI	NR	NMI	NR	NMI	NR	NMI
Monodonta lineata	-	-	-	-	4	4	2	2
Patella vulgata	1	1	-	-	-	-	-	-
Patella depressa	1	1	1	1	-	-	-	-
TOTAL	2	2	1	1	4	4	2	2

V: Aziliense. **VII:** Magdaleniense Inferior Cantábrico. **X:** Indicios Chatelperronienses.

Los autores incluyen datos biométricos de todos los individuos completos recuperados.

CERRO DE LA ENCINA (MONACHIL, GRANADA)

Fuentes bibliográficas: LAUK, H.D. (1976) y FRIESCH, K. (1987).

Poblado de la Edad del Bronce situado en las estribaciones de Sierra Nevada, a 7,5 Km de Granada y aproximadamente a 780 m sobre el nivel del mar. Ha sido excavado por A. Arribas. Se detectaron varias fases del Argar (fases I, IIa y IIb) y del Bronce Final (III y IV).

Malacofauna

1. Abundancia absoluta (NE) de las especies por culturas y fases, según Lauk:

CULTURAS	ARGAR			BRONCE FINAL	
FASES	IIa	IIb	?	III	IV
Semicassis undulata	1	-	-	-	-
Glycymeris violascens	2	4	1	-	-
Rudicardium tuberculatum	-	1	-	1	1
Rumina decollata	9	25	-	2	-
Cernuella cf. virgata	-	3	-	-	-
Iberus alonensis	1	1	-	-	-
Potomida littoralis umbonata	-	1	-	1	-
Moluscos S.I.	-	2	-	1	-
TOTAL	13	37	1	5	1

2. Abundancia absoluta (NE) de las especies por culturas y fases según Friesch:

CULTURAS	ARGAR			Bronce Final	Ibérico
FASES	0	Ia	Ic	II	III
Rumina decollata	-	-	3	3	-
Cernuella virgata	-	-	21	2	-
Iberus alonensis	-	-	-	-	1
Melanopsis dufourii	-	-	1	-	-
Patella ferruginea	2	-	-	-	-
Patella spec.	-	-	-	1	-
Luria lurida	-	-	-	-	-
Truncullariopsis trunculus	-	-	2	-	-
Thais haemastoma	-	-	1	-	-
Margaritifera auricularia	1	-	-	-	-
Glycymeris insubricus	-	-	4	-	-
Glycymeris spec.	-	-	6	6	-
Mytilus gallopronvincialis	-	-	1	-	-
Acanthocardia tuberculata	1	-	3	-	-
Dentalium vulgare	3	1	3	-	-
Dentalium spec.	-	-	-	4	-
Moluscos S.I.	-	-	7	-	-
TOTAL	7	1	52	16	1

También se ha recuperado un ejemplar de *Conus ventricosus* en el periodo argárico, no asignado a ninguna de las fases.

CUEVA DE ERMITTIA (DEBA, GUIPUZCOA)

Fuentes bibliográficas: ARANZADI & BARANDIARAN (1928) en ALTUNA (1972).

Cueva situada en la ladera oeste del monte del mismo nombre a 125 m sobre el nivel del mar y a 3 Km de la linea de costa actual. El yacimiento fué descubierto por J.M. de Barandiarán en 1924, quien lo excavó junto T. de Aranzadi desde ese mismo año a 1926. Posteriormente I. Barandiarán y J. ALtuna realizan una cata en 1965. La estratigrafía abarca desde el Solutrense al Neo-eneolítico.

Malacofauna

Los moluscos eran muy abundantes en el primer nivel. Relación de especies por niveles:

NIVELES	N-E	AZ	MAG	SOL
Patella vulgata	x	x	x	-
Patella striata	x	x	x	-
Monodonta lineata	x	x	x	-
Monodonta reticulata	x	x	x	-
Monodonta sagittifera	x	x	x	-
Turritella	-	x	x	-
Pectunculus	-	-	x	x
Mytilus edulis	x	x	x	-
Mytilus minimus	x	x	x	-
Cardium	-	-	-	x

N-E: Neo-eneolítico. **AZ:** Aziliense.
MAG: Magdaleniense IV (con algunas piezas del Magdaleniense III). **SOL:** Solutrense.

CUEVA DE ERRALLA (CESTONA, GUIPUZCOA)

Fuentes bibliográficas: ALTUNA, J. (1985).

Cueva situada en el monte Ezkurruaitz a unos 9 Km de la costa en linea recta, entre las sierras de Pagoeta y Gazune, en un entorno bastante abrupto. Fué excavada en 1977 y 1978 por J. Altuna. Cronológicamente abarca todo el Magdaleniense.

Malacofauna

Abundancia absoluta por niveles y lechos:

NIVELES	V						II	
LECHOS	22-24		19-21		15-18			
ESPECIES	NR	NMI	NR	NMI	NR	NMI	NR	NMI
Patella vulgata	51	35	83	62	22	20	-	-
P. cf. intermedia	-	-	-	-	-	-	1	1
Pecten maximus	-	-	-	-	2	2	-	-
Littorina littorea	8	8	13	11	2	2	-	-
Monodonta lineata	-	-	-	-	1	1	1	1
Nassa reticulata	1	1	-	-	-	-	-	-
Dentalium vulgare	-	-	1	1	-	-	-	-
TOTAL	60	44	97	74	27	25	2	2

V: Magdaleniense Inferior. **II:** Magdaleniense Final.

CABEZO PEQUEÑO DEL ESTAÑO (GUARDAMAR DEL SEGURA, ALICANTE)

Fuentes bibliográficas: MORENO, R. (Inédito).

Yacimiento situado al este de Guardamar, junto al río Segura y a unos 2 Km del la linea costera. Ocupa una pequeña loma alargada orientada en dirección SO-NE a 26 metros del nivel del mar, en la vertiente más oriental de la partida de la "Rinconada". Ha sido objeto de una campaña de urgencia (1989) y tres campañas ordinarias de 1990 a 1992. El poblado se adscribe al Hierro Antiguo, existiendo también un núcleo de hábitat de época tardorepublicana.

Malacofauna

Abundancia absoluta:

CRONOLOGIA	HIERRO		ROMANO	
TAXONES	NR	NMI	NR	NMI
Patella caerulea	138	137	1	1
Monodonta articulata	35	35	-	-
Monodonta turbinata	99	89	1	1
Luria lurida	2	2	-	-
Bolinus brandaris	1	1	-	-
Thais haemastoma	2	2	-	-
Columbella rustica	2	2	-	-
Conus mediterraneus	1	1	-	-
Bulla striata	1	1	1	1
Cepaea nemoralis	-	-	1	1
Theba pisana	82	78	2	2
Pseudotachea splendida	-	-	1	1
Albea candidissima	2	2	29	28
Otala punctata	-	-	38	31
Iberus alonensis	71	71	103	102
Rumina decollata	-	-	12	8
Cecilioides acicula	-	-	4	4
Caracollina lenticula	-	-	3	3
Familia Helicidae	-	-	1	1
Ferussacia follicula	-	-	1	1
Barbatia barbata	7	6	-	-
Arca noae	6	4	-	-
Glycymeris glycymeris	2	1	-	-
Glycymeris insubrica	-	-	1	1
Glycymeris sp	3	2	-	-
Spondylus gaederopus	2	1	-	-
Cerastoderma glaucum	41	25	47	25
Donax trunculus	1	1	-	-
Venus verrucosa	1	1	-	-
Sepia officinalis	1	1	-	-
Sepia sp	8	0	-	-
S.I.	0		2	
	508	463	256	221

CASTRO DE FAZOURO (FOZ, LUGO)

Fuentes bibliográficas: CANO PAN, J. & VAZQUEZ VARELA, J.M. (1991). Castro Galaico-romano.

Malacofauna

Relación de especies:

Thais haemastoma
Crassostrea angulata
Charonia lampas

CUEVA DE FONFRIA (POSADA, LLANES, ASTURIAS)

Fuentes bibliográficas: VEGA del SELLA (1916, 1923) en ALTUNA, J. (1972) y CLARK, G.A. (1976).

Cueva situada a unos 20 metros del río Calabres, a unos 30 metros sobre el fondo del valle. Fué descubierta y prospectada por el Conde de la Vega del Sella en 1915. Se detectan niveles magdalenienses recubiertos por restos de un conchero asturiense.

Malacofauna

1. Excavación de 1915

El único nivel que presenta moluscos es el que corresponde al Asturiense, denominado nivel a por el Conde de la Vega del Sella.

Relación y abundancia relativa de las especies:

Patella sp (abundante)
Cardium edule (abundante)
Trochus lineatus (abundante)
Mytilus sp (escaso)
Helix nemoralis (escaso)

Clark, por su parte atribuye al Conde la cita de *P. vulgata* sautuola en el nivel D (Magdaleniense Inferior).

2. Revisión de Clark

Material de una muestra pequeña depositada en el Museo Arqueológico de Madrid.

Abundancia absoluta (NE) de las especies:

ESPECIES	Nivel B
Patella vulgata, etc.	5
Trochocochlea crassa	8
Mytilus edulis	1
Cardium edulis	5
Ostrea edulis	2
Helix nemoralis	5
TOTAL	26

YACIMIENTO ARQUEOLOGICO DE LA FONOLLERA (TORROELLA DE MONTGRI, GERONA)

Fuentes bibliográficas: MARTINELL, J. & PONS, E. (1989).

Yacimiento arqueológico al aire libre donde se han detectado cuatro niveles importantes de ocupación, de los cuales el segundo y el tercero (de época Bronce Final y Romano Republica) son los periodos de más larga duración. Ha sido objeto de diez campañas de excavación durante los años 1975-1984.

Malacofauna

Se han realizado trabajos malacológicos anteriores que se restringen a una identificación de las especies (Martinell, 1977 y 1980; Pons, Toledo y Colomer, 1985).

Abundancia absoluta de los restos de moluscos recuperados durante la campaña de 1984:

CATA 1/1984

NIVELES	5B			5A/B			5A		
ESPECIES	NT	Nf	Ni	NT			NT	Nf	Ni
Spondylus "pulidos"	8	-	8(4)	4	-	4(2)	3	1	3(2)
Spondylus sp	-	-	-	3	3	3(2)	1	1	1(1)
Acanthocardia t.	18	15	9(5)	7	7	4(2)	12	10	5(3)
Cardium sp	2	2	2(1)	-	-	-	2	2	2(1)
Glycymeris insubrica	5	-	5(3)	12	10	5(3)	2	2	1(1)
Glycymeris sp	5	5	3(2)	-	-	-	-	-	-
Glycymeris glycymeris	2	-	2(1)	-	-	-	-	-	-
Pecten sp	3	3	2(1)	-	-	-	1	1	1(1)
Venerupis sp	2	2	1(1)	2	2	2(1)	-	-	-
Pinna nobilis	-	-	-	4	4	1(1)	-	-	-
Patella sp	1	-	1(1)	-	-	-	-	-	-
Patella caerulea	1	-	1(1)	-	-	-	2	-	2(2)
Natica sp	1	1	1(1)	-	-	-	-	-	-
Triton nodiferus	-	-	-	-	-	-	1	-	1(1)
Otros	-	-	-	-	-	-	3	3	3(2)
TOTAL	48	28	35(21)	32	26	19(11)	27	20	19(14)

NT: Número bruto total. **Nf:** Número de fragmentos. **Ni:** Número de individuos: máximo (mínimo).

COVA FOSCA (ARES DEL MAESTRE, CASTELLON)

Fuentes bibliográficas: OLLER, J. (1988).

Cueva situada a unos 50 Km al NO de Castellón de la Plana, a una altitud de 980 m y a 60 Km de la línea de costa. Cronológicamente abarca desde el Mesolítico precerámico al Neolítico (7.190 B.P.) (Vilette, 1983).

Malacofauna

Abundancia absoluta (NMI) de los taxones representados por niveles:

NIVELES	N-S	N-I	N-II	N-III	S.R.
Columbella rustica	10	27	3	1	1
Cerithium rupestre	1	3	-	-	-
Cerithium vulgatum	-	1	-	-	1
Nassa reticulata	1	-	-	-	1
Murex trunculus	-	-	-	-	1
Patella vulgata	-	-	-	-	1
Glycymeris violascens	-	-	2	-	1
Glycymeris sp	2	9	3	1	7
Mytilus edulis	-	-	-	-	2
Cardium edule	-	-	2	1	1
Cardium tuberculatum	-	-	-	-	2
Cardium sp	-	-	-	8	-
Pecten jacobaeus	-	-	-	-	1
*Chlamys sp**	-	-	-	1	-
Dentalium sp	-	-	-	-	1
Pomatias elegans	74	264	26	44	15
Rumina decollata	3	19	2	4	4
Oxychilus sp	1	-	-	-	-
Helicigona arbostorum	-	1	3	1	-
TOTAL	92	324	41	61	39

N-S: Nivel removido. **N-I y N-II:** Neolítico. **N-III:** Mesolítico precerámico.
* Negativo fósil. (**S.R.** = sin referencia).

CUEVA FRIGILIANA (FRIGILIANA, MALAGA)

Fuentes bibliográficas: VIVAS, V.E.M. (1987).

Cueva situada en el término municipal de Frigiliana, a 5 Km de la costa y a 40 metros sobre el cauce del río Higuerón y 250 m sobre el nivel del mar. Ha sido objeto de una intervención de urgencia ante el sistemático expolio a que venía siendo sometida. Se han detectado ocupaciones durante el Neolítico Final y Calcolítico.

Malacofauna

Se ofrecen resultados preliminares de la cata realizada. El estudio faunístico está pendiente de realización. Abundancia absoluta (NR) por capas:

ESPECIES	CAPA I	CAPA V	CAPA VI	CAPA VII
Patella	6	27	-	2
Pectúnculo	1	-	-	-
Cyclope neritea	-	-	-	1
Mytilus edulis	-	-	-	1
Iberus alonensis	-	-	3	1
TOTAL	7	27	3	5

CAPA I: Fase A (Calcolítico). **CAPAS V-VII:** Fase C (Neolítico Final).

FUENTE ALAMO (LOS CAMPOS, ALMERIA)

Fuentes bibliográficas: DRIESCH, A. von den, BOESSNECK, J., KOKABI, M. & SCHÄFFER, J. (1985).

Poblado en cerro situado al sur de Sierra Cabrera, entre los ríos Almanzora, Antas y Aguas. Yacimiento con siete fases, que abarcan desde el Bronce temprano (Fase I + II, Argar A: 1850-1.600 a.C.) al periodo Islámico (Fase VII). Ha sido excavado desde 1977 por H. Schubart y O. Arteaga.

Malacofauna

Se recuperaron moluscos a lo largo de todas las fases de ocupación del yacimiento. Aunque, al no existir diferencias significativas entre los moluscos de cada una de ellas, los autores ofrecen datos globales de la malacofauna recuperada hasta 1985. Los restos malacofaunísticos de excavaciones posteriores se encuentran actualmente en fase de estudio.

Abundancia absoluta de las especies:

ESPECIES	NR
Rumina decollata	47
Sphinterochila candidissima	14
Cernuela virgata	1
Theba pisana	4
Iberus alonensis	250
Otala lactea	16
Melanopsis dufourii	1
Patella ferruginea	27
Patella vulgata	15
Patella caerulea	2
Monodonta turbinata	48
Monodonta articulata	1
Luria lurida	9
Phalium granulatum	6
Cymatium parthenopus	2
Charonia rubicunda	3
Charonia spec.	5
Trunculariopsis trunculus	8
Thais haemastoma	11
Columbella rustica	1
Conus mediterraneus	3
Arca noae	2
Barbatia barbata	1
Glycymeris violascescens	200
Glycymeris spec.	165
Pecten jacobaeus	1
Spondylus gaederopus	3
Anomia ephippium	1
Ostrea edulis	1
Acanthocardia tuberculata	23
Cerastoderma glaucum	2
Chamelea gallina	2
Dentalium vulgare	1
Sepia officinalis	8
TOTAL	883

CUEVA GENISTA (GIBRALTAR)

Fuentes bibliográficas: RUBIO DE MIGUEL, I. (1976).

Una de las denominadas en conjunto Cuevas de Gibraltar. Las noticias sobre este conjunto de cuevas y sus materiales son muy confusas. Carecen de estratigrafía. Según San Valero pertenecerían al Neolítico I hispánico.

Malacofauna

La autora cita los siguientes géneros:

Murex
Buccinus
Cardium
Mytilus
Pecten, y de tierra la especie *Helix pomatia.*

CUEVA DE GOIKOLAU (MERELUDI, BERRIATUA, VIZCAYA)

Fuentes bibliográficas: BARANDIARAN (1961a, 1964a) en ALTUNA, J. (1972).

Cueva situada en el monte Gastelu'ko-atxa, en la margen derecha del arroyo Zuleta. Yacimiento descubierto por J.M. Barandiarán en 1935, quién lo excavó en 1962. Su cronología abarca desde el Magdaleniense Superior al Romano del Bajo Imperio.

Malacofauna

Abundancia relativa o absoluta (NE) por periodos culturales:

PERIODOS CULTURALES	Romano	Bronce Final /Hierro	Eneolitico	Paleolítico
Patella	x	225	1432	123
Monodonta	-	x	-	-
Mytilus	-	3	24	x

CUEVA DE HORNOS DE LA PEÑA (SAN FELICES DE BUELNA, CANTABRIA)

Fuentes bibliográficas: FISCHER, P.H. (1923).

Cueva situada en el valle de los Corrales de Buelna sobre el arroyo Tejas. Fué descubierta en 1903 por Alcalde del Río, quien realiza un primera excavación. Posteriormente el Institud de

Paleontologie Humaine se encargará de las excavaciones durante 1909 y 1910. La estratigrafía abarca desde el Musteriense al Neolítico.

Malacofauna

La malacofauna que reseñamos corresponde a los restos recogidos por el el Abate Breuil y por Obermaier en una de sus visitas a la cueva.

Relación de especies:

Pectunculus glycymeris L.
Patella vulgata L.
Littorina littorea L.

CUEVAS DE JENTILLETXETA (OLATZ, MOTRICO, GUIPUZCOA)

Fuentes bibliográficas: BARANDIARAN (1927, 1946 y 1953) en ALTUNA, J. (1972).

Conjunto de cuatro cuevas descubiertas por J.M. de Barandiarán en 1927, de las cuales excavó la correspondiente a un yacimiento sepulcral del Eneolítico.

Malacofauna

Relación de especies:

Patella
Trochus
Mytilus
Ostraea

CUEVA DEL CERRO DE JUAN BARBERO (TIELMES, MADRID)

Fuentes bibliográficas: MOLERO, G., BREA, P. & BUSTOS, V. (1984).

Cueva eneolítica sobre la que no existen datos estratigráficos.

Malacofauna

Aparecen varios fragmentos de valva de almeja de rio (género *Unio*).

CUEVA DEL JUYO (IGOLLO, CAMARGO, CANTABRIA)

Fuentes bibliográficas: GONZALEZ *et al.* (1958) en ALTUNA, J. (1972) y MADARIAGA, B. & FERNANDEZ PATO, C.A. (1985).

Cueva situada al pie de la colina de la Peña (92 m sobre el nivel del mar) en Igollo, Ayuntamiento de Camargo, a unos 8 Km de la ciudad de Santander y a unos 5 Km del mar en línea

recta. Es una cavidad de proporciones medias con un intrincado recorrido de más de 600 m. El yacimiento prehistórico se sitúa en las salas cercanas a la entrada. La cueva fué descubierta en 1953, realizándose la primera campaña de excavación en 1955 bajo la dirección de Paul Janssens y J. González Echegaray, quienes realizaron una segunda campaña en el verano del siguiente año. En 1957 tiene lugar una nueva campaña, esta vez dirigida por P. Janssens y P. Azpeitia, cuyos resultados no llegaron a publicarse. Finalmente L.G. Freeman y J. González Echegaray reanudan las excavaciones, realizando dos primeras campañas en 1978 y 1979 y otras dos en los años 1982 y 1983. Esta cueva presenta una completa estratigrafía del Magdaleniense III, radiodatada desde el 14.440 +/- 180 B.P. al 13.920 +/- 240 B.P. Después de un hiato los niveles superficiales presentan elementos de la Edad del Bronce y "Tardo-Romano".

Malacofauna

1. Campañas de 1955-1956

El estudio malacológico lo realiza P. Azpeitia, que sólo analiza una pequeña muestra, básicamente de lapas y bígaros.

Abundancia relativa de la malacofauna por trincheras y niveles según Madariaga & Fernández:

TRINCHERA	NIVELES	*Patella vulgata*	*Littorina littorea*
I	IV	+++	+
	V/VI	+	+
	X	+	-
	XI	+	+
II	I	+	+
	II	-	+
	III-V	++	+
	VI-VIII	+	+

1. Niveles IV-XI: Magdaleniense III. **2. Niveles I-II:** Industria mal definida, si bien Paleolítica. **3. Niveles III-VIII:** Magdaleniense III.

2. Campañas de 1978-1979

Abundancia absoluta (NE) por niveles:

NIVELES	4	5	6	7	8	9
Patella vulgata	3892	16	3761	1146	666	3283
Littorina littorea	1696	9	1039	837	311	45
L. neritoides	1	-	-	-	-	-
L. littoralis	24	-	21	8	3	-
L. saxatilis	-	-	1	-	-	-
Gibbula sp	1	-	-	-	-	-
Buccinum undatum	2	-	-	-	-	-
Trivia arctica	3	-	1	1	-	-
Purpura lapillus	1	-	-	-	-	-
Aporrhais pespelicani	-	-	1	-	-	-
Turritella communis	-	-	1	-	-	-
Nassarius mutabilis	-	-	1	-	-	-
Pecten maximus	1	-	2	-	-	-
Chlamys varia	-	-	-	-	1	-
Cerastoderma edule	1	-	-	-	-	-
Cyprina islandica	-	-	1(1f)	-	-	-
Macrocallista chione	-	-	1	-	-	-
Dentalium novencostatum	2	-	-	1	-	-
Dentalium vulgare	-	-	1	-	-	-
Teredo navalis	-	-	1	-	-	-
Helix sp	9	-	3	-	-	-
Azeca sp	1	-	-	-	-	-
Azeca goodalli	1	-	-	-	-	-
TOTAL	5635	25	4835(1f)	1993	981	128

Niveles 4-9: Magdaleniense III

Se incluyen datos biométricos de *Patella vulgata* y *Littorina littorea*.

Además Barandiarán cita una serie de colgantes en concha, todos correspondientes al nivel 4. Relación de colgantes:

- 10 *Littorina obtusata*
- 3 *Trivia europaea*
- 1 bivalvo (¿ del orden Veneroidae ?)
- 6 fragmentos de moluscos con perforaciones dudosamente de origen antrópico (1 *Turritella*, 2 *Patella* y 3 *Littorina littorea*).

Trinchera I	Campañas 1978-83
I-II	3
III	4 ?
IIIa	5 ?
IIIb	6-7 ?
IV	8-9

Correlación entre la trinchera I y los niveles de las excavaciones de los años 70, según González (1985).

CUEVA DE LAS LAPAS (LIENDO, CANTABRIA)

Fuentes bibliográficas: GUTIERREZ (1968) en ALTUNA, J. (1972).

Cueva explorada por V. Gutiérrez Cuevas. Presenta cuatro niveles pero únicamente uno ha sido atribuido culturalmente.

Malacofauna

Relación de especies por niveles:

1. II.A. Bronce
   - *Mytilus edulis* (?)
   - *Littorina littorea*
   - *Patella vulgata*
   - *Patella depressa*
   - *Ostraea edulis*
   - *Helix quimperiana*
2. II.B. Este nivel no tiene asignación cultural. La misma abundancia de moluscos que en II.a.

LECEIA (LISBOA, ESTREMADURA)

Fuentes bibliográficas: LENTACKER, A. (1991).

Yacimiento situado a unos 3-4 Km del estuario del Tajo y a unos 10 Km al oeste de Lisboa. Asignado al Calcolítico, se diferencian dos momentos de ocupación, el más antiguo entorno al 2.700-2.500 B.P. y el más reciente al 2.300-2.100 B.P.

Malacofauna

Según la autora los análisis son parciales. Se han contabilizado exclusivamente los individuos completos, los ápices de gasterópodos y los fragmentos umbonales de bivalvos, estos últimos sin diferenciar parasagitalmente.

Abundancia absoluta (NR) de las especies por estratos:

ESPECIES	C2	C3
Mytilus edulis	10	3
Pecten maximus	41	18
Ostrea edulis	16	9
Laevicardium norvegicum	5	1
Cerastoderma edule	8	-
Venus verrucosa	30	15
Dosinia lupinus	6	2
Venerupis decussata	52	262
Eastonia rugosa	1	-
Solen sp/Ensis sp	-	1
Bivalvia S.I.	10	2
Patella sp	356	63
Gibbula sp	1	-
Osilinus sp	-	2
Littorina littorea	-	1
Turritella communis	-	1
Charonia lampas/Thais haemastoma	14	8
Murex sp	4	1
Gastropoda S.I.	1	-
Helicella sp	1	-
Helix sp/Cepaea sp	2	-
TOTAL	558	389

COVACHA DE LLATAS (ANDILLA, VALENCIA)

Fuentes bibliográficas: JORDA CERDA & ALCACER GRAU (1948) en RUBIO DE MIGUEL, I. (1976).

Carecemos de datos arqueológicos.

Malacofauna

En cuanto a moluscos se han encontrado dos columbelas y un pectunculus perforados, que fueron utilizados, sin ningún género de duda, como objetos de adorno. Se encontró también un *Cardium edule* y varios ejemplares de *Helix (albea) candidissima* y *Helix (ilnus) alonensis*. Las determinaciones fueron hechas por D. Manuel Vidal López.

CAVERNA DE LLEDIAS O DEL CUETU (LLANES, ASTURIAS)

Fuentes bibliográficas: CLARK, G.A. (1976).

Cueva situada al sureste del pueblo de Posada, en la ladera norte de El Cuetu a unos 50-60 metros del nivel del mar y 3,1 kilómetros de la costa actual. Aunque el abrigo era conocido desde

finales del siglo pasado, la mayor parte de la cueva fué descubierta por Cesáreo Cardín en el verano de 1936, quien recogió materiales y los envió al Dr. Uría-Riú de la Universidad de Oviedo. Este investigador, junto a Vega del Sella, realiza una excavación en 1940 y posiblemente en 1941. Posteriormente Jordá realiza otras campañas durante los primeros años de la década de los 50. El yacimiento fué ocupado desde el Solutrense Superior al Neolítico.

Malacofauna

Los únicos datos de que disponemos provienen de la revisión que Clark realiza en 1969 de dos fragmentos de conchero desprendidos del nivel B (Asturiense).

Abundancia absoluta (NE) de las especies:

ESPECIES	B
Patella vulgata	420
Trochocochlea crassa	82
Helix nemoralis	37
Helix arbustorum	6
S.I.	1[e]
TOTAL	546

e: *Tapes decussata*

CUEVA DE LA LLOSETA, DE LA MORIA O DEL RIO (ARDINES, RIBADESELLA, ASTURIAS)

Fuentes bibliográficas: OBERMAIER (1925), JORDA CERDA (1958) & HERNANDEZ PACHECO (1959) en ALTUNA, J. (1972) y CLARK, G.A. (1976).

Cueva situada en las colinas de la ribera occidental del río Sella, a 12 metros sobre el nivel del mar y 500 metros de la costa. Se abre al SO y consiste en una sala única, de unos 35 metros de longitud y 16 de anchura. Descubierta por Hernández Pacheco en 1913, fué excavada por él y Wernnert en 1916. Se detectaron ocupaciones del Magdaleniense Inferior y posiblemente Aziliense. Redescubierta por J.M. Fernández Vuelta, Jordá Cerdá realizó una prospección en 1955 e inició las excavaciones al año siguiente, realizando otra campaña en 1958. Jordá asignó los niveles excavados al Magdaleniense, excepto el conchero que atribuyó al Asturiense. En 1969 G.A. Clark realizó una cata, que atribuye al Paleolítico Superior (15.200 +/- 400 B.P).

Malacofauna

1. Excavación de 1916

La fauna de moluscos se recuperó en el nivel Aziliense (?).

Relación de especies:

Patella vulgata
Littorina littorea
Trochus lineatus
Mytilus edulis

2. Excavaciones de los años 50

Adheridos a las paredes de la cueva se hallaron moluscos de los géneros *Patella, Trochus, Oricium* etc.

Relación de especies por niveles:

Nivel I. Magdaleniense (?).

Patella sp

Littorina sp

Nivel II. Magdaleniense Inferior

Patella sp

Pecten maximus

Littorina littorea

3. Sondeo de 1969

Los restos malacológicos corresponden a muestras de los depósitos adheridos a las paredes y bóvedas de la sala principal. Fueron determinadas por Clark con la colaboración de B. Madariaga.

MUESTRAS	A		B		C	
ESPECIES	**ICOM**	**FTOS**	**ICOM**	**FTOS**	**ICOM**	**FTOS**
Patella vulgata sautuola	5	81	-	-	1	-
Patella spp	59	48	136	27	219	43
Littorina littorea	74	46	-	-	-	-
Trochocochlea crassa	-	-	8	5	12	4
Mytilus edulis	-	1	108	46	122	76
Ostrea edulis (?)	-	-	-	-	-	1
Helix nemoralis	-	-	4	2	11	-
Gasterópodos marinos S.I.					23	
TOTAL	138	176	256	80	388	124

A: Magdaleniense ?. **B y C:** Post-asturiense.

CUEVA DE LUMENTXA O DEL CALVARIO (KAKUETA, LEQUEITIO, VIZCAYA)

Fuentes bibliográficas: ARANZADI & BARANDIARAN (1935), BARANDIARAN (1965c) y BARANDIARAN (1967) en ALTUNA, J. (1972).

Cueva situada en el monte del mismo nombre a unos 70 m de altitud, en la margen izquierda de la desembocadura actual del río Oiz. Descubierta por J.M. Barandiarán en 1921, quién la excavó, en colaboración con Aranzadi (1926-1929) y en solitario en 1963-1964. La estratigrafía abarca desde el Auriñaciense típico al Postneolítico.

Malacofauna

Relación de especies según los niveles establecidos por I. Barandiarán:

NIVELES	II	III	IV	V
Patella	x	-	x	-
Littorina littorea	-	xxx	x	x
Littorina obtusata	-	-	x	-
Trochus	x	x	-	-
Purpura lapillus	-	-	x	-
Purpura haemastoma	-	-	x	x
Triton	-	x	-	-
Cypraea o Trivia	-	x	-	-
Haliotis	x	x	-	-
Astralium	-	-	x	-
Mytilus	x	x	-	-
Cardium	-	*	-	-
Pecten	-	-	-	x
Dentalium	-	-	-	x

II: Neolítico. **III:** Aziliense. **IV:** Magdaleniense Final. **V:** Magdaleniense Superior.

Correspondencia con los estratos establecidos por T. de Aranzadi y J.M. Barandiarán:

II. Neolítico: mitad inferior del estrato A y mitad superior del estrato B.

III. Aziliense: mitad inferior del estrato B y parte superior del estrato C.

IV. Magdaleniense Final: resto del estrato C.

V. Magdaleniense Superior: estrato D.

CERRO MACARENO (SEVILLA)

Fuentes bibliográficas: AMBERGER, G. (1985).

Yacimiento cercano a Sevilla, enclavado en una loma. Su estratigrafía abarca desde el Bronce Final hasta época Ibero-romana. Ha sido excavado por M. Pellicer en 1976.

Malacofauna

Abundancia absoluta de especies por periodos:

PERIODOS	Fenicio	Ibérico	Ibero-romano
Unio mancus	-	1	-
Unionacea indet.	5	7	-
Potomida littoralis umbonata	-	2	2
Margaritifera (P.) auricularia	-	-	2(*)
Rumina decollata	1	-	-
TOTAL	6	10	4

* Concha cortada y alisada (Lauk, 1976)

MALHADAS (SETUBAL, ALTO ALENTEJO)

Fuentes bibliográficas: LENTACKER, A. (1991).

Yacimiento situado al SE de Palmela, aproximadamente a 8 Km del estuario del río Sado. Constituye un conchero que sólo se excavó parcialmente. Se adscribe al Calcolítico Inicial.

Malacofauna

Se han contabilizado exclusivamente los individuos completos, los ápices de gasterópodos y los fragmentos umbonales de bivalvos, estos últimos sin diferenciar parasagitalmente.

Abundancia absoluta de las especies:

ESPECIES	NR
Mytilus edulis	6
Pecten maximus	1
Ostrea edulis	4
Venerupis decussata	1628
Solen sp/Ensis sp	3
Semicassis saburon	1
Rumina decollata	1
TOTAL	1644

LES MALLAETES (GANDIA, VALENCIA)

Fuentes bibliográficas: DAVIDSON, I. (1989).

Cueva situada en el macizo cretácico de Mondúver a 1000 metros de altitud. Pericot y Jordá realizaron campañas de excavación de 1946 a 1949 y este último investigador, junto con Fortea, reinician las excavaciones en 1970. El periodo de ocupación abarca del Auriñaciense (30.570 +/- 560 B.P.) al Epipaleolítico (10.681 +/- 105 B.P.).

Malacofauna

No existen estudios detallados sobre la malacofauna de este yacimiento. Davidson registró la abundancia absoluta (NE) de los restos malacológicos, incluidos entre el material óseo de la campaña de 1970.

NIVELES	Caracoles *Turritella*	*Helix*	Conchas marinas	Otros	S.I.
ENEOL	-	3	1	-	4
NEOL	-	12	-	7	5
EPIP	15	1	3	2	25
S-G	3	11	1	20	10
P de M	-	-	3	-	27
A y P	33	4	15	1	-
ESTERIL	-	-	-	-	5
SOL	-	1	22	-	25
GRAV	-	-	3	-	3
AUR	-	-	2	-	-
TOTAL	51	32	52	30	104

ENEOL: Eneolítico. **NEOL:** Neolítico. **EPIP:** Epipaleolítico. **S-G:** Solútreo-Gravetiense. **P de M:** Puntas de muesca. **A y P:** Puntas de Aletas y Pedúnculo. **SOL:** Solutrense. **GRAV:** Gravetiense. **AUR:** Auriñaciense.

CUEVA DE MARIZULO (URNIETA, GUIPUZCOA)

Fuentes bibliográficas: LABORDE BARANDIARAN, J.M., ATAURI, T. & ALTUNA, J. (1966) y ALTUNA, J. (1972).

Cueva situada en la ladera SO del monte Pardaki a una altura de 260 m sobre el nivel del mar, del que dista 12 Km en línea recta. M. Laborde descubrió el yacimiento en 1961 y la Sociedad "Aranzadi" realiza una primera cata ese mismo año, bajo la dirección de J.M. Merino, posteriormente J.M. de Barandiarán dirige las excavaciones, que se realizarán de 1962 a 1967. El periodo más reciente corresponde a un nivel sepulcral que, según J.M. Apellániz coincide con el Bronce I de Los Husos (5.285 +/- 65 B.P.). El resto de los niveles, algunos poco definidos arqueológicamente, se adscriben al Mesolítico.

Malacofauna

1. Campaña de 1964

Abundancia relativa y absoluta (NE) por niveles:

ESPECIES	IV	III	II	I
Lapas	38	56	32	x
Mejillones	34	44	x	x
Magurios	-	-	x	x
Solen	-	1	1	-
Scrobicularia	60	4	-	-
Tapes/Chirlas	-	-	x	-
Ostras	9	-	-	-
Pholax	-	-	1	-
Helix nemoralis	306*	357	x	-

Nivel IV-III: Mesolítico ?. **Nivel II:** Neolítico. **Nivel I:** Eneolítico.
*: NE en el cuadro B5. No se han cuantificado en su totalidad.

2. Recopilación de J. Altuna.

Nivel I: Abundan los moluscos, especialmente las lapas. Hay también algunos mejillones, ostras, almejas y magurios.

Nivel II: Las lapas abundan mucho. Hay también ostras, mejillones y ejemplares de *Scrobicularia*, *Pholas* y *Solen*, así como numerosos *Helix nemoralis*.

Nivel III: Disminuyen los moluscos marinos en relación con el nivel II, pero aumentan grandemente los individuos de *Helix nemoralis* que forman en la parte alta del nivel verdaderos mantos. Sólo en los cuadros 3A y 3B se recogieron más de 500 ejemplares.

PLAZA DEL MARQUES (GIJON, ASTURIAS)

Fuentes bibliográficas: MORENO, R. (1994).

Yacimiento situado en la ciudad de Gijón, fué excavado durante los meses de febrero y marzo de 1991 bajo la dirección de C. Fernández Ochoa. Cronológicamente abarca desde el siglo III-V d.C. hasta época medieval.

Malacofauna

El material malacológico estudiado se recuperó a extramuros de la ciudad romana y procede exclusivamente de un basurero, fechado entre los siglos III al V d.C.

Abundancias absolutas por "estructuras":

	DESMONTE S MURO B		ENTRE MURO C Y D		DERRUMBE S MURO D	
ESPECIES	NR	NMI	NR	NMI	NR	NMI
Patella aff. vulgata	3	3	70	70	-	-
Patella sp	1	1	65	62	9	9
Monodonta lineata	-	-	6	6	-	-
Phalium saburon	-	-	-	-	1	1
Charonia lampas	-	-	9	7	4	3
Thais haemastoma	-	-	2	1	-	-
Mytilus galloprovincialis	-	-	1	1	-	-
Anomia ephippium	-	-	-	-	1	1
Ostrea edulis	-	-	16	8	-	-
Cerastoderma edule	2	2	2	1	-	-
TOTAL	6	6	171	156	15	14

CUEVA DE MAZACULOS O DE LA FRANCA (VIDIAGO, LLANES, ASTURIAS)

Fuentes bibliográficas: VEGA del SELLA (1916) en ALTUNA, J. (1972), CLARK, G.A. (1976) y ORTEA, J.A. (1980).

La Cueva de Mazaculos se encuentra en el macizo que domina, desde su orilla derecha, el río Cabra, en el punto en que éste se abre para formar la pequeña ría por la que desemboca en el mar Cantábrico, bordeando la playa de La Franca. Dista 300 m del mar. La caverna fué descubierta por H. Alcalde del Río en 1908. El Conde de la Vega del Sella, en colaboración con H. Breuil, realizó algunas prospecciones en 1915. M. González Morales y Mª del C. Márquez Uría llevaron a cabo varias campañas de excavación durante los años 1977-78. Este conchero es atribuido al período Asturiense, fechado en el 9.290 +/- 440 B.P. (González Morales & Márquez Uría, 1978).

Malacofauna

1. Prospecciones de 1915

Relación de especies:

Trochus lineatus
Patella vulgata
Ostrea edulis
Mytilus edulis
Triton nodiferus
Helix nemoralis

Clark analiza un pequeño fragmento de conchero del nivel B depositado en el Museo Municipal de Madrid, con los siguientes resultados: 60 ejemplares de *Patella vulgata* y 20 ejemplares de *Trochocochlea crassa.*

2. Campañas de 1977-78

Los datos reseñados a continuación corresponden a los moluscos marinos recogidos en la campaña de 1977. Las piezas de la campaña de 1978, dada su gran abundancia, están aún en estudio.

Abundancia absoluta (NR) de las especies "dominantes":

NIVELES	1	2	3
Trochococlea crassa	718	346	1264
Patella vulgata	1127	411	1342
Patella intermedia	671	192	-
TOTAL	2516	949	6606

Además de estas especies dominantes se han identificado contados individuos de otras, cuyos recuentos se unirán a los de las muestras en estudio.

CUEVAS DE MEAZA (RUISEÑADA, COMILLAS, CANTABRIA)

Fuentes bibliográficas: ANDEREZ (1953) en ALTUNA, J. (1972).

Anderez atribuye los niveles excavados esencialmente al Aziliense, aunque habla de indicios de Magdaleniense, Asturiense y Eneolítico.

Malacofauna

No se asigna la malacofauna a ningún nivel. Relación de especies:

Patella vulgata
Trochus lineatus
Mytilus edulis
Ostraea edulis
Tapes decussata
Tellina tenuis

CASTRO DE MEDELLIN (MEDELLIN, BADAJOZ)

Fuentes bibliográficas: MORALES MUÑIZ, A. (1977).

Medellín se haya situado a 38° 57' 50'' de latitud N y 2° 16' 40'' de longitud O del Meridiano de Madrid. El poblado ocupó el cerro denominado "Cerro del Castillo", situado a la orilla izquierda del Guadiana. Este yacimiento fué descubierto gracias al hallazgo casual de una copa ática al abrir un pozo de riego. M. Almagro Gorbea realizó una primera prospección en 1969, realizándose una segunda campaña de excavación en 1970. Abarca una cronología que va desde el Bronce Final, antes del 800 a.C., hasta que se convierte paulatinamente en una ciudad romana, con el asentamiento realizado por Cecilio Metelo, que da su nombre a este castro como plataforma en sus luchas contra Sertorio en la Lusitania el 79 a.C. (Almagro Gorbea, 1977).

Malacofauna

Abundancia absoluta (NR) de los restos de moluscos por estratos:

TAXONES	5	6	7	7/8	8	10	12	13	14	14b	16
CERSPS	-	-	-	-	1	-	-	-	-	-	-
PECJAC	-	-	-	-	-	-	-	-	1	-	-
UNISPS	47	65	16	24	258	23	15	16	21	6	17
ANOSPS	9	23	8	12	88	9	9	3	5	3	5
S.I.	1	3			11	1	1	4		1	
TOTAL	57	91	24	36	357	33	25	23	27	10	22

CERSPS: *Cerastoderma sp* (=*Cardium sp*). **PECJAC:** *Pecten jacobaeus*. **UNISP:** *Unio sp*. **ANOSPS:** *Anodonta sp*

MEDO TOJEIRO (BEJA, BAIXO ALENTEJO)

Fuentes bibliográficas: LENTACKER, A. (1991).

Yacimiento situado en un acantilado sobre la costa atlántica a 30 metros sobre el nivel del mar, y a unos 2 km al sur de Almograve. Fué descubierto por G. Zbyszewsky y C. Penalva. C. Tavares de Silva y D. Lubell realizaron una campaña de excavación en el verano de 1984. Se considera ocupado en una fecha entre el 6.570 +/- 120 B.P. y el 5.420 +/- 160 B.P., aunque ha existido controversia sobre la validez de la primera fecha y ha sido asignado al Neolítico.

Malacofauna

Abundancia relativa de las especies:

ESPECIES	ABUNDANCIA RELATIVA
Mytilus sp	FF
Palliolum sp	RR
Ostrea edulis/Crassostrea angulata	RR
Cardita calyculata	RR
Cerastoderma edule	R
Cerastoderma glaucum	R
Irus irus	RR
Patella sp	F
Gibbula sp	R
Osilinus sp	RR
Tricolia picta	RR
Bivonia sp ?	RR
Bittium reticulatum	RR
Charonia lampas/Thais haemastoma	F
Ocinebrina edwardsi	R
Buccinum sp	RR
Hinia reticulata	R
Hinia sp	R
Monacha cantiana	RR
Cochlicella acuta	RR
C. conoidea	RR
Theba pisana	R
Pulmonados S.I.	RR

F: Frecuente. **FF:** Muy frecuente. **R:** Raro. **RR:** Muy raro.

MERTOLA (MERTOLA, BAIXO ALENTEJO)

Fuentes bibliográficas: MORENO, R. (1993).

Ciudad medieval.

Malacofauna

El material malacológico analizado corresponde a las campañas de excavación de 1990 y 1991. Abundancia absoluta por unidades estratigráficas:

ESTRATIGRAFIA	Q16B		Q17A		Q17C	
ESPECIES	NR	NMI	NR	NMI	NR	NMI
Hinia reticulata	1	1	-	-	-	-
Theba pisana	-	-	-	-	1	1
Rumina decollata	-	-	-	-	3	3
Parmacella valencienni	-	-	-	-	2	2
Pecten sp	1	1	-	-	8	2
Ostrea edulis	1	1	-	-	5	1
Acanthocardia tuberculata	1	1	-	-	1	1
Cerastoderma edule	1	1	6	5	2	1
Tapes decussatus	14	8	4	3	42	3
TOTAL	19	13	10	8	64	14

LOS MILLARES (SANTA FE DE MONDUJAR, ALMERIA)

Fuentes bibliográficas: PETERS, J. & DRIESCH, A. von den (1990).

Yacimiento calcolítico (2.400-2.000 a.C.). Se realizaron excavaciones de 1978 a 1985.

Malacofauna

La malacofauna se ha recuperado en varios sectores del yacimiento, concretamente a lo largo de cuatro muros defensivos y en dos fortines.

Abundancia absoluta (NR) por estructuras:

ESPECIES	FORTIN 1	FORTIN 5
Rumina decollata	7	1
Sphincterochila candidissima	3	2
Iberus gualterianus	350	495
Melanopsis praemorsa	2	-
Patella spp	182	3
Monodonta turbinata	15	-
Monodonta sp	51	-
Charonia rubicunda	1	-
Thais haemastoma	17	-
Arca noae	1	-
Glycymeris violacescens	9	1
Glycymeris sp	7	2
Mytilus galloprovincialis	1	-
Pecten jacobaeus	5	-
Ostrea edulis	1	-
Acanthocardia tuberculata	1	2
S.I.	6	1
TOTAL	659	507

LINEAS DEFENSIVAS / ESPECIES	1	2	3	4
Rumina decollata	4	24	3	4
Sphinterochila candidissima	2	1	-	2
Cernuella sp	-	1	-	-
Iberus gualterianus	824	211	49	16
Melanopsis praemorsa	14	40	7	4
Patella spp	61	65	42	88
Monodonta turbinata	30	19	15	156
Monodonta sp	11	7	4	19
Cerithium vulgatum	-	-	-	1
Cypraeidae	-	-	-	1
Phalium granulatum	12	5	10	5
Charonia rubicunda	4	-	-	-
Charonia sp	30	22	21	12
Murex brandaris	1	1	-	-
Trunculariopsis trunculus	14	5	3	6
Thais haemastoma	18	8	9	20
Columbella rustica	2	2	5	5
Conus mediterraneus	1	5	6	2
Arca noae	10	6	3	2
Barbatia barbata	1	-	3	-
Glycymeris violacescens	39	31	24	13
Glycymeris sp	68	60	25	46
Mytilus galloprovincialis	1	1	2	-
Pinna nobilis	-	3	1	2
Pecten jacobaeus	3	2	4	5
Chlamys sp	-	-	-	1
Spondylus gaederopus	15	13	8	6
Ostrea edulis	1	1	-	1
Cerastoderma edule	-	-	-	1
Acanthocardia tuberculata	8	4	6	3
Cardiidae	2	3	8	-
Venus sp	1	-	1	-
Donax sp	-	-	1	19
Dentalium vulgare	-	1	-	-
Sepia officinalis	-	-	-	1
S.I.	17	13	15	12
TOTAL	1194	554	275	453

MOITA DO SEBASTIAO (MUGE, BAIXO ALENTEJO)

Fuentes bibliográficas: LENTACKER, A. (1991).

Conchero mesolítico situado en la orilla izquierda del río Muge, a 4 Km de su confluencia con el Tajo. Se encuentra a 22 m sobre el nivel del mar. El yacimiento fué parcialmente destruido en 1952

por la construcción de edificios, quedando las capas más antiguas. El nivel ha sido datado por C^{14} en el 7.350 +/- 350 B.P.

Malacofauna

Abundancia absoluta de las especies:

ESPECIES	NR
Pecten maximus	6
Ostrea edulis	9
O. edulis/Crassostrea angulata	9
Cerastoderma edule/C. glaucum	942
Scrobicularia plana	132
Unio sp	1
Rumina decollata	6
Theba pisana	33
Helix sp/Cepaea sp	33
TOTAL	1171

CUEVA DE MORIN (VILLANUEVA, VILLAESCUSA, CANTABRIA)

Fuentes bibliográficas: VEGA DEL SELLA (1921) y CARBALLO (1923) en ALTUNA, J. (1972) y MADARIAGA, B. (1971 y 1978).

Cueva situada en el pequeño valle del Obregón-Solía, a unos 14 Km de la costa actual. El yacimiento fué descubierto por H. Obermaier y P. Wernert en 1910. J. Carballo, entre 1912 y 1917, y el Conde de la Vega del Sella, entre 1918 y 1920, realizaron distintos sondeos. Posteriormente González Echegaray y Freeman excavaron este yacimiento en 1966 y 1968-1969. La estratigrafía abarca desde el Musteriense al Aziliense.

Malacofauna

1. Excavaciones de 1912-1920

Malacofauna por niveles según Vega del Sella:

1. Aziliense. "Fauna revuelta con la superficie"

Ostraea edulis
Mytilus edulis
Scrobicularia
Littorina littorea
Unio
Trochus o Monodonta sagitifera

2. Excavaciones de 1966-1969

Los estudios malacológicos publicados por Madariaga en 1971 y 1978 son idénticos y parecen corresponder a las excavaciones de 1966 a 1968. Madariaga especifica en su informe la colaboración de Julio Alvarez, quién clasificó los moluscos continentales.

Abundancia absoluta (NR) de las especies por periodos culturales y niveles:

Musteriense	De tradición Achelense		Denticulado
NIVELES	17	16	12
Patella vulgata	-	1	-
Patella depressa	-	1	-
Oxychilus sp	-	-	1
Cochlicella acuta	1 (?)	-	-
Pulmonado S.I.	1	-	-
Ostrea edulis	-	1	-
TOTAL	19	3	13

Auriñaciense	0					I	II
NIVELES	9	8	Ocupación A	Estructura	?	6	5b
Patella	-	-	2	4	1	-	1+f
Patella vulgata	-	-	-	2(?)	-	-	-
Patella depressa	-	-	-	1	-	-	-
Patella aspera ?	-	-	2	-	-	-	-
Littorina littorea	-	-	-	5	-	-	-
Trochocochlea	-	-	1	-	-	-	-
Mytilus edulis	-	-	2	-	-	1	-
Crassostrea	-	-	3	7	-	-	-
Ostra	-	-	1	7	1	-	-
Tapes decussatus	-	-	-	4	-	-	-
Tapes	-	-	3	-	-	-	-
Scrobicularia plana	-	-	-	3	-	-	-
Solen	-	-	-	1	-	-	-
Cardium ?	-	-	-	-	-	1	-
Pecten ?	-	-	-	-	-	1	-
Oxychilus sp	-	-	-	1	-	-	-
Hyalinia	1	-	-	-	-	-	-
Helicella lapicida	-	-	-	1	-	-	-
Pulmonados S.I.	-	f	4	4	-	-	-
TOTAL	1	f	18	40	2	3	1+f

PERIODOS	Gravetiense		Magdaleniense V
NIVELES	5a	4	2
Patella	1 + f	3	3
Patella vulgata	-	2	3
Littorina obtusata	-	1*	-
Nassa reticulata	-	1*	-
Mytilus edulis	-	-	4
Ostrea edulis	-	2	-
Crassostrea	-	1	-
Cardium	-	1*	1
Tapes decussatus	-	-	2
Scrobicularia plana	-	-	1
Pulmonados S.I.	-	-	f
TOTAL	1 + f	15	16 + f

Relación de especies no asignadas estratigráficamente:

Trochococlea
Ostrea edulis
Patella depressa
Littorina littorea
Mytilus
"Ostra"
Elona quimperiana
Cyclostoma elegans
Eryphya
Oxychilus sp

LA PENYA DEL MORO DE SANT JUST DESVERN (BARCELONA)

Fuentes bibliográficas: MIRO, C., MOLIST, N. & SOLIAS, J.M. (1982). Poblado ibérico.

Malacofauna

Se ofrece el análisis preliminar de la malacofauna.

Abundancia absoluta (NR) de las especies por sectores:

SECTORES	A	D ALT	B EST
Glycymeris violascens	-	18	-
Glycymeris bimaculatus	-	3	1
Glycymeris sp	13	143	8
Cardium sp	-	14	-
Donax trunculus	-	?	-
Cerastoderma glaucum	-	?	-
Venus gallina	-	3	-
Mactra sp	-	1	-
Murex sp	-	2	-
Dentalium	*	*	-
S.I.	1	-	-

Se especifica que los 13 restos de *Glycymeris sp* recuperados en el sector A se reparten entre los dos taxones del género representados.

CONCHEROS DE MUGE

Conjunto de tres concheros mesolíticos: Moita do Sebastião, Cabeço da Amoreira y Cabeço da Arruda. Situados a orillas del río del mismo nombre. Han sido tratados en conjunto en la bibliografía.

Descubiertos en 1863 por Ribeiro, es este autor quién realizó las primeras prospecciones. Durante 1985 Pereira Da Costa realiza las primeras excavaciones en Cabeço da Arruda. En 1880 Ribeiro excava Moita do Sebestião y Cabeço da Arruda, realizándose una segunda campaña de excavación en estos dos concheros en 1890, bajo la direción de Paula e Oliveira.

Se retoman las excavaciones de los concheros de Muge en 1930. Mendes Corrêa, Sherpa Pinto, Santes Junior y Ataide excavan estos yacimientos de 1930 a 1933. En 1952, ante la inminente destrucción del conchero de Moita do Sebastião, Roche y Veiga Ferreira realizan una excavación de urgencia que durará hasta 1954. Posteriormente Roche realiza varias campañas de excavación en Cabeço da Amoreira en 1960-1967, y en Cabeço da Arruda en 1964-1965. En otoño de 1966 una crecida del río Muge dañó este último yacimiento, por lo que se paralizaron las excavaciones para conservar parte del conchero como testigo.

Los materiales de las excavaciones del siglo pasado y de los años 60 se encuentra depositados en el Instituto Geológico de Lisboa. Y los materiales de las campañas de los años 30 en el Laboratorio de Antropología de la Universidad de Oporto. Recientemente, A. Lentacker (1991) ha hecho una revisión de los mismos. Los resultados malacofaunísticos han sido considerados en cada uno de los yacimientos por separado:

Moita do Sebastião

Cabeço da Amoreira

Cabeço da Arruda

MUNIGUA (MULVA, SEVILLA)

Fuentes bibliográficas: BOESSNECK, J. & DRIESCH, A. von den (1980).

Ciudad romana, al parecer, reconstruida después de un terremoto hacia el año 190 d.C. Se sitúa a 50 Km al norte de Sevilla y 120-150 m sobre el nivel del mar.

Malacofauna

Abundancia absoluta de las especies:

ESPECIES	NR	NMI
Ostrea edulis	2	2
Thais (Stramonita) haemastoma	1	1
TOTAL	3	3

CUEVA DE NERJA (NERJA, MALAGA)

Fuentes bibliográficas: JORDA, J.F. (1986).

Cueva situada en el extremo oriental de la provincia de Málaga, en las proximidades del pueblo de Maro. Está ubicada en la vertiente S de la Sierra de Almijara, a 158 m de altitud sobre el nivel del mar y a una distancia de la costa próxima al kilómetro en línea recta. Yacimiento descubierto en 1959, Pellicer inició las excavaciones ese mismo año en la Cámaras del Belén, de la Cascada y de los Fantasmas. Quadra Salcedo realiza un sondeo en la Sala del Vestíbulo en 1962, cuyos resultados no se llegaron a publicar. Posteriormente, F. Jordá y Arribas realizan un sondeo, durante los años 1965-1968, en la Sala de la Mina. Finalmente, a partir de 1979, Jordá Pardo y colaboradores han retomado la excavación del yacimiento. Se han publicado los resultados de las excavaciones de 1979 a 1984. Cronológicamente este yacimiento abarca desde el Auriñaciense al Calcolítico.

Malacofauna

La fauna malacológica estudiada corresponde a los restos aparecidos en las excavaciones arqueológicas llevadas a cabo por el equipo del Pr. Jordá Cerdá en las campañas de 1979 a 1984. El material estudiado puede agruparse en dos bloques: materiales procedentes de la Sala de la Mina y materiales procedentes de la Sala del Vestíbulo. Se ofrecen los datos del último trabajo de síntesis. Los análisis previos en Jordá Pardo (1981, 1982, 1983, 1985) y González Tablas *et al.* (1984).

Abundancia relativa de las especies por periodos culturales y estratos en cada una de las salas:

1. Sala de La Mina.

Auriñaciense	% NE		
NIVELES	**19**	**18**	**17**
Patella sp	-	-	0,90
Cyclope neritea	-	1,85	-
Theodoxus fluviatilis	-	-	1,80
Melanopsis sp	12,50	-	-
Rumina decollata	-	1,85	9,90
Iberus alonensis	62,50	90,74	81,08
Cerastoderma edule	-	-	2,70
Tapes decussata	12,50	3,70	3,60
Gasterópodos S.I.	12,50	1,85	-
TOTAL ABSOLUTO	8	54	111

Magdaleniense	% NE		
NIVELES	**16**	**15**	**14**
Patella sp	1,05	2,93	9,03
Monodonta turbinata	0,24	0,15	2,07
Thais haemastoma	-	0,30	0,37
Cerithium vulgatum	0,08	-	-
Columbella rustica	0,08	-	-
Cyclope neritea	5,77	2,62	1,88
Theodoxus fluviatilis	0,08	-	-
Melanopsis sp	2,43	3,70	3,01
Rumina decollata	2,03	2,47	4,70
Iberus alonensis	25,36	15,30	17,32
Helicella unifasciata	0,16	6,18	1,88
Glycymeris violacescens	-	-	0,18
Mytilus edulis	4,47	10,81	29,56
Pecten maximus	0,32	0,92	0,18
Ostrea sp	-	-	0,37
Acanthocardia tuberculata	0,16	1,23	1,50
Cerastoderma edule	2,76	7,72	5,83
Tapes decussata	52,68	38,63	14,31
Lutraria lutraria	-	-	0,18
Dentalium sp	-	-	0,18
Gasterópodos S.I.	0,08	3,10	7,34
Bivalvos S.I.	-	1,85	0,18
TOTAL ABSOLUTO	1230	647	531

Epipaleolítico	% NE	
NIVELES	13	12
Patella sp	9,69	41,77
Monodonta turbinata	0,82	9,66
Thais haemastoma	-	0,11
Columbella rustica	0,07	-
Cyclope neritea	0,22	-
Conus mediterraneus	-	0,11
Melanopsis sp	0,37	2,41
Rumina decollata	3,13	0,11
Iberus alonensis	19,90	3,79
Helicella unifasciata	0,07	0,11
Mytilus edulis	54,95	34,06
Pecten maximus	1,91	0,80
Acanthocardia tuberculata	0,77	0,34
Cerastoderma edule	2,97	-
Tapes decussata	3,43	0,46
Gasterópodos S.I.	4,02	632
TOTAL ABSOLUTO	**1341**	**869**

Calcolítico	% NE		
NIVELES	3	2	1
Patella sp	55,70	54,29	21,05
Monodonta turbinata	15,35	25,33	63,90
Thais haemastoma	6,57	8,59	8,27
Columbella rustica	2,63	-	0,75
Conus mediterraneus	1,31	-	0,75
Theodoxus fluviatilis	0,43	-	-
Melanopsis sp	7,45	1,35	-
Iberus alonensis	1,31	-	-
Helicella unifasciata	2,19	1,35	-
Mytilus edulis	6,14	9,04	5,26
Cerastoderma edule	0,87	-	-
TOTAL ABSOLUTO	228	221	133

Neolítico	% NE					
NIVELES	11-10	9-8	7	6	5	4
Patella sp	44,81	53,75	50,06	55,72	60,10	64,65
Monodonta turbinata	12,76	8,78	4,84	6,99	7,79	9,92
Cymatium parthenopus	-	-	-	0,19	-	-
Charonia rubicunda	-	0,06	-	-	-	-
Thais haemastoma	-	4,69	6,64	6,60	4,62	8,51
Cerithium vulgatum	-	0,06	-	-	-	-
Trivia europaea	-	-	0,09	-	-	0,11
Buccinum undatum	-	-	-	-	-	0,11
Columbella rustica	0,48	1,83	2,46	1,16	0,66	0,70
Cyclope neritea	0,08	-	-	-	-	-
Conus mediterraneus	0,04	0,12	0,09	-	0,26	0,70
Theodoxus fluviatilis	-	0,06	0,27	-	-	-
Melanopsis sp	2,55	13,11	7,88	10,67	9,90	5,43
Iberus alonensis	2,95	2,36	1,99	-	0,92	,59
Helicella unifasciata	0,12	0,36	1,13	2,71	4,88	1,18
Succinea debilis	-	-	-	-	-	0,13
Glycymeris violacescens	0,04	-	-	-	-	0,13
Mytilus edulis	24,87	14,03	16,23	15,72	6,07	4,72
Pecten maximus	0,16	-	-	0,19	-	-
Spondylus gaederopus	-	-	-	-	0,13	-
Acanthocardia tuberculata	0,32	0,06	-	-	-	0,11
Gasterópodos S.I.	8,06	0,18	-	-	3,83	3,07
Bivalvos S.I.	-	-	1,85	-	0,18	-
TOTAL ABSOLUTO	2468	1639	1053	515	757	846

2. Sala del Vestíbulo

Paleolítico Superior indiferenciado	% NE					
NIVELES	13	12	11	10	9	8
Patella sp	-	-	-	-	-	4,55
Cyclope neritea	-	-	-	-	-	0,37
Melanopsis sp	-	-	-	-	-	2,08
Rumina decollata	-	0,69	0,29	-	0,42	0,94
Iberus alonensis	100	96,52	98,95	100	98,31	52,21
Mytilus edulis	-	2,08	0,74	-	0,84	20,30
Pecten maximus	-	-	-	-	-	0,18
Cerastoderma edule	-	0,34	-	-	0,42	5,69
Tapes decussata	-	-	-	-	-	6,26
Dentalium sp	-	0,34	-	-	-	0,18
Gasterópodos S.I.	-	-	-	-	-	4,17
TOTAL ABSOLUTO	11	288	1343	333	238	527

Magdaleniense	% NE		
NIVELES	7	6	5
Patella sp	12,96	17,56	7,92
Cerithium vulgatum	-	-	0,49
Cyclope neritea	1,85	1,94	0,49
Melanopsis sp	4,16	4,54	1,98
Rumina decollata	0,46	-	0,49
Iberus alonensis	-	1,29	2,47
Helicella unifasciata	-	-	0,99
Glycymeris violacescens	0,46	-	-
Mytilus edulis	50,46	30,50	57,42
Pecten maximus	-	-	0,49
Ostrea sp	-	-	0,49
Acanthocardia tuberculata	-	0,64	0,49
Cerastoderma edule	7,40	16,88	10,89
Tapes decussata	2,77	1,94	2,47
Gasterópodos S.I.	19,44	24,67	12,87
TOTAL ABSOLUTO	216	154	202

Epipaleolítico	% NE				
NIVELES	4-II	4-G	4-F	4-E	4-D
Patella sp	3,27	1,91	2,87	3,55	4,52
Monodonta turbinata	0,72	0,10	0,07	0,11	0,13
Cyclope neritea	-	0,10	-	-	0,13
Melanopsis sp	-	0,20	0,11	0,63	0,93
Rumina decollata	0,18	-	-	0,03	-
Iberus alonensis	6,72	5,74	3,44	3,07	4,12
Helicella unifasciata	0,18	0,06	-	0,39	0,26
Mytilus edulis	86,00	90,93	92,84	91,40	86,83
Pecten maximus	-	0,06	0,03	0,03	1,32
Cerastoderma edule	2,00	0,06	-	0,11	-
Mactra sp	-	0,03	0,03	0,03	-
Tapes decussata	0,36	0,03	-	-	-
Gasterópodos S.I.	0,54	0,73	0,57	0,78	1,59
Bivalvos S.I.	-	-	-	-	0,13
TOTAL ABSOLUTO	550	2879	2614	2535	752

Neolítico	% NE				
NIVELES	3-C	3-B	3-A	2-B	2
Patella sp	14,58	11,11	10,86	23,52	36,36
Monodonta turbinata	2,08	2,33	4,34	-	3,03
Melanopsis sp	0,69	4,67	21,73	23,52	11,11
Iberus alonensis	3,47	4,67	2,17	-	-
Helicella unifasciata	-	-	-	-	2,02
Mytilus edulis	77,77	74,85	56,52	52,94	37,37
Pecten maximus	-	0,58	2,17	-	-
Cerastoderma edule	-	-	-	-	1,01
Gasterópodos S.I.	1,38	1,75	2,17	-	7,07
TOTAL ABSOLUTO	144	171	46	17	99

Materiales malacológicos del sondeo C4.

COVA DE L'OR (BENIARRES, ALICANTE)

Fuentes bibliográficas: MARTI, B. (1977), ACUÑA, J.D. & ROBLES, F. (1980) y MARTI, B., FORTEA, J., BERNABEU, J., PEREZ, M., ACUÑA, J.D., ROBLES, F. & GALLART, M.D. (1987).

Cueva situada en el término municipal de Beniarrés, en la partida denominada de "La Barcella". Se encuentra enclavada en las estribaciones sur-orientales de la Sierra de Benicadell, entre las provincias de Alicante y Valencia, a unos 650 metros sobre el nivel del mar y unos 30 Km de la costa actual. Se trata de una cavidad amplia orientada de SO a NE, con un vestíbulo que da paso a una gran sala y con otra pequeña sala a la derecha de la entrada, limitada por una gran columna. Citada por Almarche a principios de siglo, será R. Pardo Ballester quien localizaría definitivamente el yacimiento en 1933, dando noticia de su situación e importancia. Este investigador realiza dos primeras catas durante el verano de ese mismo año y en 1936 una nueva excavación mucho más amplia. A continuación será Vicente Pascual quien realizará numerosas visitas a la cueva para la recogida de materiales, y llevará a cabo, junto a J. San Valero varias campañas de excavación de 1955 a 1958. Veinte años después, en 1975 el Servicio de Investigación Prehistórica reanuda los trabajos de excavación bajo la dirección de V. Pascual con la colaboración de B. Martí. Este último investigador continuará con las excavaciones. A excepción de los materiales más superficiales la industria corresponde en su totalidad al Neolítico. Las fechas de C^{14} disponibles corresponden a las excavaciones de 1975 (cuadro J-14) y son:

Capa 6: 5.980 +/- 260 B.P. (C11-M1)
Capas 14 y 15: 6.630 +/- 290 B.P. (C12-M2)
Capas 16 y 17: 6.720 +/- 380 B.P. (C13-M3)

Malacofauna

1. Prospecciones de 1933 y 1936

Los datos malacológicos de que disponemos sobre estas prospecciones corresponden al resumen de los principales hallazgos expuestos por B. Martí en la publicación de 1977. En la prospección de 1933 no se ofrecen datos malacológicos, de la prospección de 1936 todos los moluscos citados corresponden a elementos de adorno:

" ... *además de las cuentas de collar de forma oval hechas de concha, se encontraron Columbellas y pequeños Conus con perforación*, ...".

2. Material depositado en el Museo de Alcoy

2.1 - Materiales depositados por V. Pascual (1952-1955)

Relación de elementos malacológicos, según Martí (1977):

- Cinco *Pectunculus*. Dos de ellos con perforación en el natis.
- Concha de *Cardium* con perforación en el natis.
- Cuenta de collar de forma oval, con perforación.
- Fragmento de *Pecten*.

2.2 - Prospección de 1967-68

Prospección realizada por un grupo de aficionados alcoyanos. No existe indicación de donde se realizó la cata. Los materiales se encuentran depositados en el Museo de Alcoy. Toda la malacofauna consignada es ornamental. Para detalles sobre cada uno de los elementos ver Martí (1977).

Relación de elementos malacológicos (NE) por capas:

MOLUSCOS	1ª	2ª	3ª	4ª
Columbella	1	4	8	-
Cyprea	-	1	-	-
Conus	-	3 (1 ?)	3	-
Pectunculus	2	1	5	-
Cardium	-	1	6	-
Dentalium	-	1	9	-
Moluscos S.I.	-	3	3	1

2.3 - De origen indeterminado

Relación de elementos malacológicos según Martí (1977):

- Tres *Cardium*, uno con perforación en el natis.
- Pequeño *Cardium*, muy pulido.
- Cinco *Pectunculus*. Dos con perforación en el natis.
- Treinta *Columbella*, la mayor parte perforadas.

- Cinco *Cypraea* perforadas.
- Pequeño *Conus* con perforación en la parte superior.
- Dos *Littorina* con perforación
- Fragmento de *Pecten*.
- Nueve cuentas de collar obtenidas a partir de la parte superior de pequeños *Conus* con perforación central.
- Ocho anillos obtenidos a partir de grandes *Conus*, con restos de ocre en su interior.
- Fragmento de concha. Probable anillo en curso de fabricación.
- Dos fragmentos de concha.
- Varias cuentas de collar de forma ovalada.

3. Campaña de 1975

Relación de ejemplares por cuadros y capas:

CUADRO J-4 CAPAS	1	2 a	2 b	5	6 a	7 a	7 b	8 a	8 b	9 a	9 b	10 a	10 b	11 a	11 b
Columbella rustica	1	-	-	-	1	3	1	-	1	-	-	-	1	1	3
Conus mediterraneus	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Glycymeris gaditanus	3	-	-	1	-	-	-	1	-	-	-	-	-	-	-
Acanthocardia tuberculata	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Dentalium sp	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Theodoxus fluviatilis	-	-	-	-	-	2	-	1	-	-	1	-	1	-	1
Melanopsis graellsi	3	-	1	1	1	-	-	-	-	-	-	-	-	-	-
Melanopsis sp	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-
Rumina decollata	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-
Oestophora boscae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Iberus alonensis	-	4	-	-	-	-	-	-	-	-	-	-	2	-	-
I. aff. carthaginiensis	-	-	-	1	1	-	-	1	-	-	-	-	-	1	1
Iberus sp	-	-	1	1	1	1	1	1	1	1	1	1	-	-	1
Unionacea	1	-	-	-	-	-	-	-	-	-	-	-	-		-
Bivalvia indet.	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	9	7	3	6	5	7	2	4	2	1	2	1	5	3	7

J-4 Continuación CAPAS	12 a	12 b	13 a	14	15 a	15 b	16 a	16 b	17 a	17 b	18 a	18 b
Columbella rustica	2	1	3	4	1	1	-	1	1	-	-	-
Conus mediterraneus	1	-	1	-	-	-	-	-	-	-	-	-
Pecten jacobaeus	-	-	-	1	-	-	-	-	-	-	-	-
Theodoxus fluviatilis	-	2	-	-	-	-	-	-	-	-	-	-
Rumina decollata	-	-	-	3	1	4	-	-	-	2	2	1
Cernuela virgata	-	-	-	-	-	-	-	-	-	-	3	-
Trochoidea murcica	-	-	-	-	1	-	-	-	-	-	-	-
Oestophora sp	-	-	-	-	-	-	-	3	-	-	-	1
Iberus alonensis	-	-	-	8	4	11	4	-	4	4	2	4
I. aff. carthaginiensis	-	-	-	3	4	4	1	-	1	2	1	3
Iberus sp	1	1	1	-	-	-	-	3	-	-	-	-
Helicidae	-	-	-	-	-	2	-	1	-	-	1	-
Bivalvia indet.	-	-	-	-	-	-	-	-	1	-	-	-
TOTAL	3	4	5	19	11	22	5	8	7	8	9	9

CUADRO J-5 CAPAS	2	3	4	7	8	9	10	11	12	13
Columbella rustica	-	-	-	-	-	-	-	-	-	1
Gibberula miliaria	-	1	-	-	-	-	-	-	-	-
Glycymeris gaditanus	-	1	1	-	-	-	2	-	-	1
Acanthocardia tuberculata	1	-	-	-	-	-	-	1	-	-
Dentalium sp	-	-	-	-	-	-	-	-	-	-
Theodoxus fluviatilis	-	-	-	-	-	-	1	-	-	-
Melanopsis graellsi	-	-	-	-	-	-	-	-	-	1
Rumina decollata	-	-	1	-	-	-	-	2	-	1
Trochoidea murcica	1	-	-	-	-	-	-	-	-	1
Oestophora boscae	-	-	-	-	-	-	-	1	-	1
Oestophora sp	1	-	-	-	-	-	-	-	-	-
Iberus alonensis	-	-	-	-	-	1	-	-	-	-
I. aff. carthaginiensis	1	-	1	-	-	-	-	-	-	-
Iberus sp	1	1	1	1	2	1	2	2	2	1
Bivalvia indet.	-	1	1	-	-	-	-	-	-	1
TOTAL	5	4	5	1	2	2	5	6	2	8

J-5 Continuación CAPAS	14	15	16	17	18	19	20	21	22	23
Luria lurida	-	-	-	1	-	-	-	-	-	-
Columbella rustica	-	4	3	2	-	6	1	-	-	-
Arcularia gibbosula	-	-	-	-	1	-	-	-	-	-
Conus mediterraneus	1	1	1	-	-	-	-	-	-	-
Glycymeris gaditanus	-	-	-	-	-	1	-	-	-	-
Acanthocardia tuberculata	-	-	1	-	-	-	-	1	-	-
Dentalium sp	-	-	1	1	1	-	-	-	-	-
Theodoxus fluviatilis	-	1	2	2	2	-	-	-	-	1
Melanopsis sp	1	-	-	-	-	-	-	-	-	-
Oxychilus mercadali	-	-	-	-	-	1	2	-	-	-
Ferussacia folliculus	-	1	-	-	-	-	-	-	-	-
Rumina decollata	-	-	-	-	1	-	1	-	-	1
Trochoidea murcica	-	1	-	-	1	1	1	-	-	1
Iberus alonensis	-	-	-	-	-	-	-	-	-	2
I. aff. carthaginiensis	1	-	-	-	-	-	1	-	-	4
Iberus sp	-	-	2	-	3	1	3	1	1	1
Helicidae	-	1	-	1	-	-	-	1	-	-
TOTAL	3	9	10	7	9	10	9	3	1	10

CUADRO J-5-T CAPAS	2	3	5	6	7N	8	9	10	T-R
Columbella rustica	-	1	2	-	-	-	1	-	1
Glycymeris gaditanus	-	-	-	-	-	-	-	-	1
Pecten jacobaeus	-	-	1	-	-	-	-	-	-
Acanthocardia tuberculata	-	1	-	-	-	-	-	-	-
Cerastoderma edule	-	-	1	-	-	-	-	-	-
Theodoxus fluviatilis	-	-	-	-	-	1	-	-	-
Rumina decollata	-	-	-	1	1	-	-	-	-
Iberus alonensis	1	-	-	-	2	2	-	1	3
I. aff. carthaginiensis	-	-	-	-	3	1	-	2	1
Iberus sp	-	-	1	1	-	-	-	-	-
TOTAL	1	2	5	2	6	4	1	3	6

T-R: Materiales recuperados por cribado de la tierra desmoronada del testigo.

4. Campañas de excavación posteriores a 1975

Los restos malacológicos están siendo estudiados por Jose Daniel Acuña Hernández y Fernando Robles Cuenca, al igual que la campaña precedente. Se ofrecen datos preliminares de los materiales en curso de análisis.

Relación taxonómica:

CONJUNTO ORNAMENTAL

Columbella rustica
Familia Cardiidae
Conus mediterraneus
Luria lurida
Dentalium sp
Pecten benedictus
Glycymeris gaditanus
Gibberula miliaria
Theodoxus fluviatilis

CONJUNTO NO ORNAMENTAL

Oxychilus mercadali
Oestophora boscae
Ferussacia folliculus
Rumina decollata
Trochoidea murcica
Iberus alonensis
I. aff. carthaginiensis
Pseudotachea splendida
Melanopsis graellsi
Cernuela virgata

Probablemente para impresión de cerámica:

Acanthocardia tuberculata
Cerastoderma edule
Glycymeris gaditanus

CUEVA DEL OTERO (SECADURA, VOTO, CANTABRIA)

Fuentes bibliográficas: MADARIAGA (1966) en ALTUNA, J. (1972).

Cueva situada en el promontorio calizo de "El Otero", sobre el arroyo Clarón, a unos 4 Km de la ría de Rada y a unos 12 Km de la linea de costa actual. L. Sierra la descubrió en 1909, siendo

posteriormente prospectada por J. Carballo. J. González Echegaray, M.A. García Guinea y A. Begines llevan a cabo excavaciones sistemáticas en 1962-1963. Los nueve niveles excavados abarcan desde el Musteriense (?) al Aziliense (?).

Malacofauna

Relación de especies por niveles, según J. Altuna:

Periodos culturales	AZI (?)	MAG VI	MAG V	AUR V
Gryphaea angulata	x	x	x	-
Ostrea edulis	x	x	x	x
Mytilus edulis	x	x	x	-
Tapes decussatus	1f	x	-	-
Scrobicularia plana	1f	x	-	-
Solen marginatus	-	x	x	-
Solen	1f	-	-	-
Venus o Dosinia	-	-	x	-
Patella vulgata	x	x	x	x
Patella depressa	x	x	x	-
Patella lusitanica	x	x	-	-
Patella aspera	-	x	-	-
Trochus lineatus	x	x	-	-
Triton nodiferus	-	x	-	-
Littorina littorea	-	x	x	-
Turritella	-	-	-	1f
Helix nemoralis	x	x	-	-
Helix coquandi	-	x	-	-
Euparypha pisana	x	x	-	-
Planorbis cornutus	x	-	-	-
Cyclostoma elegans	x	-	-	-

AZI (?): Aziliense (?). **MAG:** Magdaleniense. **AUR:** Auriñaciense.

Madariaga precisa que es la ostra la más abundante, seguida de las lapas y de los mejillones. Estos son superados por los magurios (*Trochus*) en el nivel 1 (Aziliense ?). En el nivel 3 (Magdaleniense V), los mejillones ocupan el segundo lugar y los magurios son sustituidos por *Littorina littorea*. En cuanto a moluscos terrestres, los ejemplares más abundantes son *Helix nemoralis* y *Euparypha pisana*.

CUEVA DE LAS PAJUCAS (PEÑA COLORADA, LANESTOSA, VIZCAYA)

Fuentes bibliográficas: ALTUNA (1967) en ALTUNA, J. (1972).

Yacimiento descubierto por Nolte y Ugarte en 1965 y excavado por Apellániz y Nolte en 1966. Los estratos han sido asignados al Mesolítico ?, Eneolítico sepulcral (fechado en el 3.700 +/- 130 B.P.) y Moderno.

Malacofauna

Abundancia absoluta (NMI o fragmentos) por niveles:

NIVELES	Moderno	Eneolítico
Mytilus sp	1 f	-
Cardium sp	ftos	-
Helix nemoralis	16	117

PAPA UVAS (ALJARAQUE, HUELVA)

Fuentes bibliográficas: LUQUE, A.A. (1985), LUQUE, A.A. & MORALES, A. (1985), MORALES, A. (1986) y MORENO, R. (1992).

El yacimiento arqueológico de Papa Uvas está situado sobre un cerro, a 54 metros de altitud, en la margen derecha del estuario de los ríos Tinto y Odiel. Es un complejo de estructuras de hábitat que incluye fondos de cabaña, silos, empedrados, así como zanjas, al parecer de función defensiva. Su estratigrafía abarca desde el Neolítico Final (3.200\3.100-2.800 a.C.) hasta el Calcolítico Inicial (2.900-2.600\2.500 a.C.). Se han realizado campañas de excavación desde 1976 a 1987, bajo la dirección de J.C. Martín de la Cruz.

Malacofauna

Tres son los estudios del material malacólogico publicados: **(1)** los correspondientes a las campañas de excavación de 1976-1979 (Luque, 1985, Luque & Morales, 1985) **(2)** campañas de 1980-1981 (Morales, 1986) y **(3)** las campañas de excavación 1986-1987 (Moreno, 1992). En este último trabajo se realiza una recopilación de los resultados de todas las campañas de excavación, que es la que reflejamos a continuación.

Abundancia absoluta de las especies:

CAMPAÑAS DE EXCAVACION	1976-1979		1980-1981	1986-1987	
ESPECIES	NR	NMI	NR	NR	NMI
Bolinus brandaris	3	3	-	-	-
Hexaplex trunculus	9	5	-	15	15
Cymbium olla ?	1	1	-	-	-
Familia Helicidae	6	6	-	413	404
Rumina decollata	27	23	1	407	355
Glycymeris sp	3	2	1	1	1
Pecten sp	13	6	2	19	8
Anomia ephippium	-	-	1	-	-
Familia Ostreidae	7	4	1	35	19
Acanthocardia tuberculata	2	2	3	-	-
Cerastoderma edule	-	-	-	3	2
Eastonia rugosa	4	3	-	2	2
Solen marginatus	136	35	138	366	108
Venus verrucosa	1	1	-	-	-
Tapes decussatus	2759	1023	132	6561	3253
Panopea glycymeris	8	3	-	-	-
Pholas dactylus	-	-	-	16	9
TOTAL	2979	1117	279	7838	4176

CUEVA DE PARPALLO (GANDIA, VALENCIA)

Fuentes bibliográficas: FISCHER, P.H. (1923), PERICOT (1942) y VIDAL (1947) en DAVIDSON, I. (1989).

Cueva situada al oeste de Gandía forma parte del sistema kárstico del macizo cretácico de Mondúver. Se encuentra a 8 Kms del Mediterráneo y a una altitud de 450 metros. Yacimiento visitado por Obermaier y el Abate Breuil en los años veinte, recogieron algunos restos que asignaron al Paleolítico Superior. Pericot realizó tres campañas de excavación en los años 1929, 1930 y 1931. Presenta una amplia estratigrafía, las primeras ocupaciones datan desde hace poco más de 20.000 años y en los niveles superiores se han encontrado materiales neolíticos, ibéricos y romanos.

Malacofauna

1. Material de Obermier y Breuil

Relación de especies:

Cardium edule L. var. lamarcki Reeve.

Pecten jacobaeus L.

Natica hebraea Martyn

Helix vermiculata Müller

2. Excavaciones de 1929-31

Abundancia absoluta (NE) de los taxones de acuerdo a la estratigrafía de Pericot, según Davidson:

ESTRATOS profundidad (m)	MIV 0-0,8	MIII 0,8-2,5	MII 2,5-3,5	MI 3,5-4	SG 4-4,5	US 4,5-5,2	MS 5,2-6,2	LS 6,2-7,2	G >7,2
Pecten	82	35	4	-	14	11	39	1	2
Cardium	81	47	5	1	4	12	13	1	-
Pectunculus	13	8	-	-	-	1	2	-	-
Nassa	7	-	3	-	3	2	8	-	-
Turritella	2	5	2	-	-	-	1	-	-
Patella	-	-	-	-	-	2	-	-	-
Chlamys	1	2	-	-	1	2	-	-	-
Trivia	1	1	-	-	1	-	-	-	-
Littorina	1	1	-	1	1	-	-	-	-
Purpura	1	1	3	-	5	19	60	-	-
Dentalium	4	6	3	3	41	101	28	-	-
Murex	-	1	-	-	-	-	-	-	-
Cassis	1	-	-	-	-	-	-	-	-
Loripes	-	1	-	-	-	-	-	-	-
Albea	1	1	-	-	-	-	-	-	-
Jagonia	1	-	-	-	-	-	-	-	-
Cerithium	2	3	-	-	-	-	-	-	-
Pinna	3	-	-	-	-	-	-	-	-
Donax	-	2	-	-	-	-	-	-	-
Jujubinus	3	-	-	-	-	-	-	-	-
Lutraria	-	2	-	-	-	-	-	-	-
Helix	7	10	7	-	-	5	7	-	-
Stenogyra	21	-	-	-	-	-	-	-	-
Melanopsis	6	2	1	-	1	1	3	-	-
Theodoxus	3	-	1	-	3	5	2	-	-
TOTAL	241	129	28	5	74	161	163	2	2

M: Magdaleniense. **SG:** Solútreo-Gravetiense. **US:** Solutrense Superior.
MS: Solutrense Medio. **LS:** Solutrense Inferior. **G:** pre-Solutrense.

Las fechas de C^{14} disponibles, que son posteriores al análisis malacológico se ofrecen en relación a la profundidad con el fín de que sean comparables con la estratigrafía considerada.

PROFUNDIDAD (m)	FECHAS
1-1,5	13.558 ± 323
1,5-2	14.224 ± 281
2-2,75	15.057 ± 237
3,5-4	16.056 ± 206
4-4,5	16.888 ± 204
4,5-5,25	17.554 ± 221
5,25-6	18.387 ± 257
6-7,25	19.386 ± 317
+ 7,25	20.718 ± 411

POBLADO DE PEDRADO (SETUBAL, ALTO ALENTEJO)

Fuentes bibliográficas: BERROCAL-RANGEL, L. (1992).

Pequeño castro tardío, excavado en extensión y con materiales de contacto itálico.

Malacofauna

Relación de especies:

Patella, Cardium, Solen vag., Pecten max.

LES PEDROSES (EL CARMEN, ASTURIAS)

Fuentes bibliográficas: CLARK, G.A. (1976).

Cueva situada en el valle del Sella, a 100 metros sobre el nivel del mar y 1,7 kilómetros de la costa actual. Fué excavada por Jordá y Alvarez a mediados de los años 50, pero los resultados nunca fueron publicados. En 1969 Clark realiza un sondeo. La cueva contiene arte paleolítico que parece ser del "Solutrense Final, de transición al Magdaleniense Inferior". Los únicos datos disponibles corresponden a un conchero post-asturiense.

Malacofauna

La malacofauna fué estudiada por Clark con la colaboración de B. Madariaga.

Abundancia absoluta (individuos completos y fragmentos):

ESPECIES	ICOM	FTOS
*Patella spp**	345	237
Trochocochlea crassa	98	108
Mytilus edulis	43	73
Tapes decussatus	1	-
Gibbula umbilicalis	1	-
Cardium edulis	1	3
Helix nemoralis	3	3
Helix arbustorum	2	11
TOTAL	494	435

* : *P. aspera* es la más común.

CUEVA DEL PENDO (ESCOBEDO-CAMARGO, CANTABRIA)

Fuentes bibliográficas: CARBALLO & GONZALEZ ECHEGARAY (1952) en ALTUNA, J. (1972) y MADARIAGA, B. (1980).

Cueva situada al pie de un acantilado, a unos 3 Km del río Pas, entre éste y el canal de la Mina-Ría de Solía. La costa se encuentra actualmente a 8-9 Km. Descubierta por M.S. de Sautuola en 1878, se han realizado en ella un gran número de prospecciones y excavaciones (ver González Echegaray *et al.*, 1980). Abarca una cronología que va desde el Achelense al Asturiense.

Malacofauna

1. Excavaciones de 1924-1932

Carballo reseña la presencia de "patellas", "littorinas" y "mytilus".

2. Excavaciones de 1953-1957

La fauna malacológica fué estudiada por B. Madariaga. Abundancia relativa de las especies por niveles:

NIVELES	I	II	II a-b	II c-g	III	IV	V	XI-XIII
Patella vulgata	x	x	x	x	-	x	x	x
Patella depressa	-	-	x	-	-	-	-	-
Patella sp	f	f	f	x	f	-	-	f
Littorina littorea	-	-	-	-	-	x	-	-
Littorina obtusata	-	-	x	-	-	-	-	-
Littorina	f	f	f	f	f	-	-	-
Gibbula sp	x	-	-	-	-	-	-	-
Turritella communis	-	x	-	-	-	-	-	-
Arctica islandica(?)	-	1f	-	-	-	-	-	-
Cardium tuberculatum	-	-	x	-	-	-	-	-

Nivel I: Aziliense. **Nivel II:** Magdaleniense Final. **Nivel II (a-b y c-g):** Magdaleniense Superior. **Niveles III y IV:** Auriñaciense Tardío. **Nivel V:** Gravetiense. **Niveles XI al XIII:** Musteriense.

En el nivel **II (a-b)** apareció un ejemplar de *Monodonta lineata* que los autores suponen equivocado y más propio del Asturiense.

CASTRO DE A PENEDA (REDONDELA, VIGO)

Fuentes bibliográficas: VAZQUEZ VARELA, J.M. (1975).

Castro enclavado en el monte de A Peneda, dentro del término de la Parroquia de Santa María del Viso, a 324 m de altitud y a 1700 m de la costa actual. Ha sido objeto de diversas prospecciones, las cuales han dado materiales que cronológicamente abarcan desde el Bronce final hasta la época romana.

Malacofauna

La muestra estudiada se tomó del conchero situado en la vertiente sureste del monte, hacia la mitad del primer tramo de pista que sube hacia la ermita. En él aparecen trozos de cerámica propiamente castreña, así como un pequeño fragmento de ánfora romana.

Abundancia absoluta de las especies:

ESPECIES	NE
Tapes decussatus	189
Solen marginatus	54
Ostrea edulis	35
Mytilus edulis	7
Patella vulgata	1
Littorina littorea	1
TOTAL	287

PENEDO DE LEXIM (LEXIM, ESTREMADURA)

Fuentes bibliográficas: DRIESCH, A. von den & RITHCHER, B. (1976).

Fortificación neolítica y eneolítica situada a 25 Km Lisboa y a 11 Km del Atlántico. J.M Arnaud, V.S. de Oliveira y V. de Oliveira Jorge realizaron una campaña de excavación en 1970.

Se distinguen en este yacimiento cuatro estratos:

A (0-0,10 m)

B (0,10-0,40 m): Eneolítico: 2.500-2.250 a.C.

C (0,40-1,20 m): Megalítico tardío: 2.750-2.500 a.C.

D (1,20-2,00 m)

Malacofauna

Los restos no son asignados a ningún nivel. Abundancia absoluta de las especies:

ESPECIES	NR
Pecten maximus	13
Venerupis decussatus	43
Ostrea edulis	4
Cardium edule	4
Mytilus edulis	4
Patella vulgata	3
Rumina decollata	1
TOTAL	72

CUEVA DE PENICIAL (NUEVA, LLANES, ASTURIAS)

Fuentes bibliográficas: CLARK, G.A. (1976).

Esta cueva es una de las que ha formado el río Nueva en sus dos orillas, denominadas colectivamente "Cuevas del Mar". Se encuentra a 10 metros sobre el nivel del mar y a 1,5 kilómetros de la costa actual. Fué excavada por el Conde de la Vega del Sella, quién definió el Asturiense en esta cueva. Clark realiza una excavación en el verano de 1969.

Malacofauna

1. Excavación de Vega del Sella

Relación de especies por niveles según Clark (parcialmente modificado de Vega del Sella 1914):

Nivel C: 120-170 cms:

Patella vulgata
Littorina littorea

2. Excavación de 1969

Los restos corresponden a una muestra del conchero Asturiense conservado en la entrada superior, fechado en el 8.909 +/- 185 B.P.

Abundancia absoluta de las especies representadas en el conchero:

ESPECIES	NE
Patella vulgata, etc.	1494
Trochocochlea crassa	117
Mytilus edulis	6
Nassa reticulata	2
Gibbula umbilicalis	2
Helix nemoralis	24
Helix arbustorum	5
Gasterópodos marinos S.I.	42[a]
TOTAL	1692

a: Especímenes fragmentarios o con características específicas oscurecidas por $CaCO_3$; probablemente la mayoría es *Trochocochlea crassa*.

ABRIGO DE LA PEÑA DEL PERRO (SANTOÑA, CANTABRIA)

Fuentes bibliográficas: MORENO, R. (inédito).

Yacimiento situado en la ladera SE del monte Buciero, macizo que domina la población de Santoña y cierra por el N, junto con el istmo de Berria, la zona de las marismas de la desembocadura del río Asón. Se trata de una cavidad de planta triangular, de una docena de metros de frente y otros tantos de fondo máximo, cuya abertura se orienta hacia el sureste. Fué descubierto en agosto de 1984, iniciándose las excavaciones en 1985 que culminaron en 1990, bajo la dirección de M.R. González Morales. La secuencia estratigráfica abarca desde el Magdaleniense al Epipalelítico (9.260 +/- 110 B.P.).

Malacofauna

Abundancia absoluta por periodos culturales:

PERIODOS	Magdaleniense		Aziliense		Epipaleolítico	
TAXONES	NR	NMI	NR	NMI	NR	NMI
Patella sp	5.839	591	32.324	5.186	22.880	4.931
Theodoxus sp	-	-	2	2	-	-
Haliotis tuberculata	-	-	-	-	3	2
Callistoma sp	-	-	1	1	-	-
Gibbula spp	26	22	82	57	306	95
Monodonta lineata	143	28	668	114	17.017	1.907
Tricolia pullus	-	-	-	-	1	1
Familia Turritellidae	1	1	-	-	-	-
Littorina sp	-	-	-	-	-	-
Littorina obtusata/mariae	2	2	179	148	45	28
Littorina littorea	1.170	261	34.316	7.683	311	55
Littorina neritoides	-	-	-	-	1	1
Littorina c. saxatilis	9	9	217	192	33	31
Trivia sp	2	2	2	2	1	1
Familia Naticidae	-	-	-	-	1	1
Charonia lampas	-	-	-	-	8	1
Ocenebra erinaceus	-	-	-	-	1	1
Ocinebrina aciculata	-	-	-	-	4	4
Nucella lapillus	16	8	747	164	18	9
Nassarius spp	-	-	4	4	52	38
Nassarius reticulatus	4	3	-	-	-	-
Cochlostoma sp	-	-	1	1	3	3
Pomatias elegans	-	-	1	1	1	1
Subclase Pulmonata	-	-	-	-	-	-
Familia Helicidae	50	17	805	309	3.003	238
Striarca lactea	-	-	-	-	1	1
Mytilus edulis	150	45	1.318	573	14.416	7.274
Anomia ephippium	-	-	1	1	-	-
Ostrea edulis	7	3	1.467	73	10.639	770
Familia Cardiidae	-	-	16	7	-	-
Cerastoderma edule	1	1	11	5	30	4
Familia Tellinidae	-	-	1	1	-	-
Scrobicularia plana	-	-	-	-	3	1
Familia Veneridae	-	-	63	14	1.366	71
Tapes/Venerupis	1	1	-	-	-	-
Tapes decussatus	-	-	-	-	-	-
Irus irus	-	-	-	-	3	2
Petricola lithophaga	-	-	1	1	12	3
Hiatella spp	-	-	-	-	5	3
Familia Pholadidae	-	-	-	-	2	1
Dentalium sp	-	-	1	1	-	-
S.I.	67		359		214	
TOTAL	7.488	994	72.587	14.541	70.380	15.484

CASTRO DE PEÑAS DE ORO (ZUYA, ALAVA)

Fuentes bibliográficas: ALTUNA, J. (1965).

Yacimiento excavado por A. Llanos y J. Fariña presenta una cronología que abarca del Bronce Final/Hierro a Romano.

Malacofauna

Abundancia absoluta (NR) por niveles:

ESPECIES	II	III
Patella vulgata	-	2
Pecten maximus	-	1
Unio sp	5	-
Margaritana margaritifera	1	-
TOTAL	6	3

Nivel II: Hierro. **Nivel III:** Bronce Final/Hierro.

PICO RAMOS (MUSKIZ, VIZCAYA)

Fuentes bibliográficas: MORENO, R. & ZAPATA L. (1995) y MORENO, R. (inédito).

La cueva de Pico Ramos se localiza en la alineación montañosa Pico Ramos-Janeo, en la margen izquierda de la desembocadura del río Barbadun, sobre la zona de marisma que en la actualidad ocupa la refinería de Petronor. Esta cavidad es de reducidas dimensiones y se sitúa a 190 metros de altura. La cueva fué localizada en 1989 por los miembros de Harribaltzaga Kultur Elkartea, en el marco del proyecto Mendebalde. Se han realizado campañas de excavación de 1990 a 1992, bajo la dirección de L. Zapata. Esta cueva muestra una primera ocupación durante el Neolítico (fechada en el 3910 +/- 65 BC (nivel 4)) y un nivel sepulcral del Calcolítico, cuya cronología va del 2.850 a.C. al 2.150 a.C. (nivel 3).

Malacofauna

Abundancia absoluta por niveles:

TAXONES NIVEL 3	NR	NMI
Patella sp	43	19
Monodonta lineata	5	3
Trivia arctica/monacha	17	16
?Bolinus brandaris	1	1
Nassarius reticulatus	2	2
Mytilus sp	4	1
Familia Ostreidae	4	1
Cerastoderma sp	2	1
Venus aff. casina	1	1
Tapes/Venerupis	25	1
Tapes decussatus	1	1
S.I.	1	
TOTAL	130	69

Nivel 3: Calcolítico Sepulcral.

TAXONES NIVEL 4	NR	NMI
Patella sp	1300	658
Patella intermedia	248	248
Patella ulyssiponensis	269	269
Patella vulgata	73	73
Familia Trochidae	31	6
Gibbula pennati	1	1
Gibbula umbilicalis	1	1
Monodonta lineata	703	500
Littorina neritoides	3	3
Bittium sp	1	1
Pulmonata	8	1
Familia Helicidae	105	13
Cepaea nemoralis	1	1
Dentalium sp	1	1
Familia Mytilidae	1	0
Mytilus edulis	1940	152
Familia Ostreidae	11	0
Ostrea edulis	617	131
Familia Cardiidae	1	0
Superfamilia Solenacea	57	8
Familia Pharidae	1	1
Solen marginatus	36	15
Familia Veneridae	7	0
Tapes/Venerupis	18	1
Tapes decussatus	1101	126
S.I.	91	
TOTAL	6.626	2.210

Nivel 4: Neolítico.

CUEVAS DE EL PIELAGO I Y EL PIELAGO II (MIRONES, CANTABRIA)

Fuentes bibliográficas: VEGA, J.J. (1985).

Cuevas situadas en el valle interior del río Miera, a unos 18 Km de la costa actual y unos 1200 metros de altitud, cerca de Mirones. Fueron excavadas por García Guinea de 1967 a 1969. Piélago I era conocida desde los años 50, no así Piélago II. Ambas cuevas presentan una cronología similar, donde se encuentran representadas industrias protoazilienses y azilienses.

Malacofauna

1. Piélago I

Malacológicamente más pobre que Piélago II, la distribución de moluscos responde al mismo patrón.

- nivel de *Helix* homólogo aunque de menor espesor.
- presencia de lapas
- 1 ejemplar de *Littorina* en el nivel 1
- 1 ejemplar de *Turritella communis* Risso, de carácter ornamental en el nivel 5.

2. Piélago II

Abundancia absoluta (NE) y relativa por niveles:

ESPECIES	1	2	3	4	5
Patella vulgata	2	-	4	10	7
Littorina obtusata	-	-	-	3	-
Mytilus edulis	-	1 fto	-	-	-
Ostrea edulis	-	-	-	1	-
Helix nemoralis	-	++++	-	1	-
Dentalium vulgare •	1	-	-	-	-
TOTAL	3	?	4	15	7

Niveles 1-4: Aziliense. **Nivel 5:** Protoaziliense.

CUEVA DEL PINDAL (PIMIANGO, COLOMBRES, ASTURIAS)

Fuentes bibliográficas: JORDA CERDA & BERENGUER (1954) en ALTUNA, J. (1972).

Descubierta por Alcalde del Río en 1908, ha sido excavada por Jordá Cerdá y Berenguer.

Malacofauna

Estos autores señalan la fauna de moluscos por niveles, sin ninguna asignación cronológica.

1. "Patellas".

2. Abundantes "Patellas" y algún *Trochus*. El tamaño de las "Patellas" es pequeño y semejante a las que se recogen en concheros asturienses de esta región.

3."Patellas" (pocas).

CUEVA DEL PINTO (LIENDO, CANTABRIA)

Fuentes bibliográficas: GUTIERREZ CUEVAS (1968) en ALTUNA, J. (1972).

Fué explorada por V. Gutiérrez Cuevas.

Malacofauna

Se señalan tres niveles, solo el segundo contiene fauna. No se indica cronología.

Relación de especies:

Mytilus edulis
Littorina littorea
Patella depressa
Patella vulgata
Helix quimperiana

EL POYO DEL CID (EL POYO DEL CID, TERUEL)

Fuentes bibliográficas: CASTAÑOS UGARTE, P.M. (1981).

Yacimiento situado al norte de la Ermita de San Esteban (El poyo del Cid), en la depresión entre Daroca y el norte de la provincia de Teruel, en el centro del Sistema Ibérico. Ha sido objeto de dos campañas de excavación durante los años de 1976 y 1978, bajo la dirección de F. Burillo Mozota. La zona excavada corresponde a dos casas y un torreón de este poblado romano de la primera mitad del siglo I.

Malacofauna

No se citan restos malacofaunísticos en los resultados de la primera campaña de excavación. Abundancia absoluta de las especies recuperadas en la campaña de 1978:

ESPECIES	NR
Crassatella sp	31
Hidrobia sp	33
Helix sp	10
TOTAL	74

PUERTO 6 (HUELVA)

Fuentes bibliográficas: MORENO, R. (1989).

Excavación de urgencia en el solar 6 de la calle del Puerto, perteneciente al casco antiguo de Huelva. Los trabajos se centraron en un cuadro de 10.5 x 5.5 m, llegándose a una cota de -4.50 m. Se pusieron al descubierto distintas estructuras que evidencian la continua actividad desarrollada durante los siglos VII y VI a.C. (García Sanz, 1988-1989).

Malacofauna

Abundancia absoluta (NR y NMI) de las especies por periodos culturales y niveles:

PERIODOS	TARTESICO MEDIO III-a			TARTESICO MEDIO III-b	
NIVELES	Ia	Ib	IIa	IIb	IIc
Cerithium vulgatum	-	-	-	1(1)	-
Murex brandaris	1(1)	-	-	2(2)	1(1)
Phyllonotus trunculus	-	-	-	2(2)	-
Glycymeris violacescens	2(1)	-	-	-	-
Glycymeris sp	7(5)	7(7)	7(4)	63(32)	1(1)
Pecten sp	-	-	-	1(1)	-
Ostrea edulis	11(4)	13(4)	1(1)	16(9)	-
F. Ostreidae	-	1	-	-	-
Acanthocardia aculeata	-	1(1)	-	-	-
Acanthocardia sp	-	-	1(1)	-	-
Cerastoderma edule	-	1(1)	-	-	-
Venerupis decussata	-	3(3)	-	-	-
Panopea glycymeris	-	-	-	1(1)	-
Sepia officinalis	-	-	-	1(1)	-
TOTAL	21(11)	26(16)	9(6)	87(49)	2(2)

Tartésico Medio
III-a: 725/700-650 a.C. **III-b:** 650-625/600 a.C.

PERIODOS	TARTESICO FINAL I	TARTESICO FINAL II	TARTESICO FINAL III
NIVELES	III	IV	V
Murex brandaris	-	-	2(2)
Glycymeris sp	2(2)	13(10)	5(3)
Ostrea edulis	4(2)	39(22)	47(32)
F. Ostreidae	-	6	2
TOTAL	6(4)	58(32)	56(37)

Tartésico Final
I: 625/600-590 a.C. **II:** 590-570/560 a.C. **III:** 570/560-540/530 a.C.

PUERTO 29 (HUELVA)

Fuentes bibliográficas: MORENO, R. (1990).

Yacimiento situado en el casco antiguo de Huelva en la calle Puerto nº 29 donde se llevó a cabo una excavación de urgencia en 1987. Se identificaron diferentes estructuras constructivas

antiguas y dos pozos modernos. Una de las estructuras parece corresponder a un almacén. Se establecieron cuatro niveles arqueológicos que abarcan una cronología del Tartésico Medio IIIb (650-625/600 a.C.) al Tartésico Final II (590-570/560 a.C). (Fernández & Rufete, 1987 y García Sanz, 1990).

Malacofauna

Se utilizó un sistema de flotación para la recuperación de material malacológico. Todo el material se recuperó en los dos primeros niveles (Tartésico Medio IIIb), por debajo del posible almacén, sin encontrarse asociados a estructura constructiva alguna.

Abundancia absoluta de las especies:

ESPECIES	NR	NMI
Murex brandaris	8	5
Phyllonotus trunculus	19	11
Familia Muricidae	23	-
Thais haemastoma	4	3
Hinia reticulata	8	8
Theba pisana	18	9
Pulmonados	9	-
Glycymeris glycymeris	6	4
Glycymeris violascens	3	3
Glycymeris sp	59	11
Mytilus sp	2	1
Pecten sp	8	5
Chlamys sp	19	11
Familia Pectinidae	23	-
Ostrea edulis	4	3
Crassostrea angulata	8	8
Familia Ostreidae	18	9
Acanthocardia tuberculata	9	-
Acanthocardia sp	6	4
Cerastoderma edule	3	3
Eastonia rugosa	59	11
Solen marginatus	2	1
Scrobicularia plana	16	6
Dosinia sp	10	4
Tapes decussatus	9	-
Panopea glycymeris	70	12
Dentalium sp	17	10
Sepia officinalis	70	-
TOTAL	4013	663

PUNTA DO CASTRO (BARREIROS, LUGO)

Fuentes bibliográficas: CANO PAN, J. & VAZQUEZ VARELA, J.M. (1991).

Carecemos de datos arqueológicos complementarios.

Malacofauna

Relación de especies:

Thais haemastoma
Monodonta lineata
Patella vulgata
Patella aspera
Ostrea edulis

CASTRO DE QUEIRUGA (LA CORUÑA)

Fuentes bibliográficas: VAZQUEZ VARELA, J.M. (1975b).

Castro situado en un pequeño promontorio conocido como "Punta del Castro" en la orilla sur de la Ría de Muros y Noya. Pertenece a la cultura castreña del Noroeste Peninsular, en una fase anterior a la romanización. Ha sido objeto de prospecciones realizadas por diversos investigadores.

Malacofauna

Se ha estudiado el conchero situado en la ladera norte del yacimiento, mediante selección azarosa de muestras en varios puntos y a diferentes profundidades.

Abundancia absoluta de las especies:

ESPECIES	NE
Patella (aspera/intermedia/vulgata)	2737
Mytilus edulis	306
Purpura haemastoma	2
Gibbula umbilicalis	4
Trochocochlea crassa	9
Littorina saxatilis	3
Solarium hybridum	1
Triton nodifer	1
TOTAL	3063

RAMALHA (SETUBAL, ALTO ALENTEJO)

Fuentes bibliográficas: LENTACKER, A. (1991).

Yacimiento situado en la orilla sur del estuario del Tajo a algunos kilómetros del río, entre la Península de Lisboa y Setubal. El yacimiento está constituido por seis acúmulos diferentes, tres de ellos de conchas. Fué excavado un vertedero asignado al Neolítico.

Malacofauna

Se han contabilizado exclusivamente los individuos completos, los ápices de gasterópodos y los fragmentos umbonales de bivalvos, estos últimos sin diferenciar parasagitalmente.

Abundancia absoluta de las especies (NR):

ESPECIES	1	2	3	4	5	5/6	6	7
Mytilus edulis	2	2	371	56	130	9	22	35
Pecten maximus ?	-	-	4	-	-	-	-	-
Ostrea edulis	2	5	480	215	23	1	12	37
Crassostrea angulata	1	-	1	1	1	-	-	-
O.edulis/C. angulata	16	78	1410	113	11	-	4	18
Cerastoderma edule	2	2	32	1	-	-	-	1
Venus verrucosa	-	-	3	-	-	-	-	-
Venerupis decussata	4	74	1051	69	16	2	5	8
Solen sp/Ensis sp	-	2	47	5	1	-	1	-
Haliotis sp	-	-	1	-	-	-	-	-
Patella sp	2	-	-	-	-	-	-	-
Osilinus sp	-	-	1	-	-	-	-	-
Bittium sp	-	-	8	-	1	-	-	-
Rumina decollata	1	-	15	3	1	-	-	-
Theba pisana	-	-	1	-	-	-	-	-
Helix aspersa	4	-	27	13	1	-	-	1
Cepaea nemoralis	1	-	-	-	-	-	-	-
TOTAL	35	163	3452	476	185	12	44	100

CUEVA DEL RASCAÑO (MIRONES, CANTABRIA)

Fuentes bibliográficas: GONZALEZ ECHEGARAY, J. & BARANDIARAN, I. (1981).

Cueva situada en el acantilado del valle profundo y estrecho sobre el cauce del río Mirones. Siguiendo su curso la costa actual dista 25 Km. Desde su descubrimiento en 1912, año en que J. Carballo realiza la primera excavación, se han llevado a cabo diferentes excavaciones más o menos amplias, culminando con la excavaciòn sistemática de J. González Echegaray e I. Barandiarán en 1974.

Cronología absoluta por niveles:

Nivel 2. Magdaleniense Superior (V).

subnivel 2-3 = 12.896 B.P.

subnivel 2-1 = 12.282 B.P.

Nivel 3. Magdaleniense Inferior evolucionado.

Se señala que no corresponde a un verdadero Magdaleniense Medio, está fechado en el 15.173 B.P.

Nivel 4. Magdaleniense Inferior Cantábrico (III). Fechado en 15.988 B.P.

Nivel 5. Magdaleniense Inferior tradicional.

Fechado en 16.433 B.P.

Malacofauna

La fauna consignada a continuación corresponde a las excavaciones llevadas a cabo por Gonzalez Echegaray y Barandiarán en 1974. El análisis arqueomalacológico fué realizado por Madariaga, en lo que se refiere a moluscos marinos, y Alvarez a los de agua dulce.

Abundancia relativa o número de fragmentos por niveles:

NIVELES	2	3	4
Patella vulgata	-	1(?)	x
Patella sp	-	-	1f
Littorina littorea	*	-	1f
Littorina obtusata	-	2+1(?)	-
Ocinebra	-	-	x
Pecten	-	-	1f
Moluscos de agua dulce	3f	-	-

EL RECUENCO (CERVERA DEL LLANO, CUENCA)

Fuentes bibliográficas: MORALES, A. (1979b).

Yacimiento localizado en el cerro de "El Recuenco" a 850-950 m sobre el nivel del mar. Los materiales recogidos en el poblado ofrecen grandes analogías con los del llamado "Bronce Valenciano", con cuya cronología posiblemente coincida (Chapa *et al.*, 1979).

Malacofauna

"Hay que añadir a estos restos los del berberecho (*Cerastoderma edule* L.), que indicaría una relación con el Mediterráneo, posiblemente por el valle del Júcar".

CUEVA DE LA RIERA (POSADA, LLANES, ASTURIAS)

Fuentes bibliográficas: VEGA del SELLA (1930) en ALTUNA, J. (1972); CLARK, G.A. (1974) y STRAUS, L.G., ALTUNA, J., CLARK, G.A., GONZALEZ MORALES, M., LAVILLE, H., GOURHAN, A.L., MENENDEZ DE LA HOZ, M. & ORTEA, J.A. (1981) y STRAUS, L.G. & CLARK, G.A. (1986).

La cueva de La Riera se abre en el acantilado sur de La LLera, a unos 5 m por encima del río Calabres. Fué descubierta en 1916 por Vega del Sella, quién realizó las primeras excavaciones durante los años 1917-1919. Posteriormente, Clark, G.A. realizó un sondeo en 1969 y M. Pérez, en colaboración con J.M. Gómez Tabanera, en 1972. Finalmente L.G. Straus, G.A. Clark y M.R. González Morales han desarrollado varias campañas de excavación durante los años 1976-1979. La amplia estratigrafía de esta cueva abarca desde momentos anteriores al Solutrense (el nivel 1 ha sido datado en el 20.860 +/- 410 B.P.) hasta el Asturiense, el conchero asignado a este periodo ha sido datado en el 8.650 +/- 300 B.P.

Malacofauna

1. Excavaciones de 1917-1918

Relación de especies por niveles:

NIVELES	b	c	d
Patella vulgata	x	x	x
Littorina littorea	x	x	x
Littorina obtusata	-	x	x
Trivia europaea	-	x	-
Turritella triplicata	-	x	-
Pectumculus glycymeris	-	x	-

Nivel b: Aziliense. **Nivel c:** Magdaleniense. **Nivel d:** Solutrense Superior.

2. Excavación de 1969

Durante esta campaña sólo se excavaron niveles pertenecientes al periodo Asturiense.

Abundancia absoluta de las especies por niveles:

NIVELES	A1	A2	A3	B1
Patella vulgata sautuola	3	-	-	-
Patella spp	219	323	14	872
Littorina littorea	2	-	-	-
Trochococlea crassa	62	63	7	345
Nassa reticulata	-	-	-	6
Cardium edule	1	2	-	4
Helix nemoralis	2	2	-	31
Helix arbustorum	2	4	1	24
Especies marinas SI	24	56	-	20
Especies terrestres SI	1	1	1	6
TOTAL	316	449	23	1308

Además se cita material de colecciones de museos, así como moluscos correspondientes a las muestras del conchero. Abundancia absoluta de las especies:

ESPECIES	MUSEOS	CONCHERO
Patella spp	-	1427
Trochococlea crassa	8	406
Nassa reticulata	-	2
Halyotis tuberculata	2	-
Triton nodiferus	3	-
Cardium edule	8	-
Mytilus edulis	2	-
Helix nemoralis	4	76
Helix arbustorum	-	20
Especies marinas SI	-	52
Especies terrestres SI	-	2
TOTAL	27	1985

3. Campañas de 1976-1979

Ortea realizó los estudios de fauna malacológica. Se identificaron y estudiaron 19.062 restos de moluscos, del 85 al 90% del total recolectado durante estas campañas. Se encontraban representadas 20 especies.

Relación de especies:

Patella vulgata (LINNE, 1758)
Patella intermedia (MURRAY, 1857)
Gibbula umbilicalis (DA COSTA, 1778)
Monodonta lineata (DA COSTA, 1778)
Littorina obtusata (LINNE, 1758)
Littorina littorea (LINNE, 1758)
Littorina saxatilis (OLIVI, 1792)
Trivia monacha (DA COSTA, 1778)
Nucella lapillus (LINNE, 1758)
Nassa reticulata (LINNE, 1758)
Colus sp
Cepaea nemoralis (LINNE, 1758)
Cochlostoma berilloni (FAGOT, 1880)
Eumphalia brigantina (DA SILVA MENGO, 1867)
Oestophorella buvinieri (MICHAUD, 1841)
Pomatias elegans (MÜLLER, 1880)
Oxichilus sp

Mytilus edulis (LINNE, 1758)
Cardium edule (LINNE, 1767)
Cardium tuberculatum (LINNE, 1758)

"Cuando el estado de conservación permitió la identificación de las faunas de *P. vulgata*, éstas pertenecían a las variedades aurea (DAUTZEMBERG y DUROCHOUX, 1906) y mayor (DAUTZEMBERG y DUROCHOUX, 1906) (= sautuolae)" (Ortea, 1985).

Abundancias relativas (% NMI) de las especies principales de moluscos comestibles por niveles:

NIVEL	n	*Littorina littorea*	*Monodonta lineata*	*Patella vulgata*	*Patella intermedia*
1	34	-	-	100,00	-
2	23	-	-	100,00	-
3	99	2,02	-	97,98	-
4	1050	0,47	-	99,53	-
5	1380	0,74	-	99,25	-
6	127	-	-	100,00	-
7	587	0,80	-	99,20	-
8	589	2,20	-	97,79	-
9	117	-	-	100,00	-
10	106	-	-	100,00	-
11	18	-	-	100,00	-
12	66	-	-	100,00	-
13	209	0,47	-	99,53	-
14	571	0,70	-	99,30	-
15	188	-	-	100,00	-
16	147	2,04	-	97,95	-
17	211	0,47	-	99,52	-
18	66	15,15	-	84,84	-
19	56	15,38	-	84,61	-
20	206	5,82	-	94,17	-
19/20	208	9,61	1,92	84,61	3,84
21-23	94	5,55	1,38	86,11	6,94
24	71	18,30	-	81,69	-
26	545	11,74	0.55	86,97	0,73
27 inferior	3781	2,48	0,52	96,00	1,00
27 superior	526	3,04	0,38	95,44	1,14
27	4076	13,60	2,13	77,38	6,89
28	3279	3,32	8,05	44,72	43,91
29	653	0,12	21,00	5,28	73,60
Conchero	492	-	27,85	13,82	58,33
TOTAL	19575				

1: Presolutrense. **2/17:** Solutrense Superior. **18/20:** Magdaleniense Inferior. **21/24:** Magdaleniense Superior. **25-29:** Magdaleniense/Aziliense (?). **Conchero:** Asturiense.

Abundancias absolutas (NR) de las "especies raras" de La Riera por niveles:

1. Niveles Presolutrenses y Solutrenses

NIVELES	1	3	4	6	7	8	14	16	17
Cepaea nemoralis	5	-	-	-	-	1	-	-	-
Oestophorella bouvinieri	-	-	2	-	-	-	-	1	-
Cochlostoma berinolli	-	-	1	-	-	5	-	-	1
Littorina saxatilis	-	-	-	1	1	-	-	-	-
Littorina obtusata	1	2	-	-	-	-	2	-	-
Colus sp	-	-	-	-	-	-	1	-	-
Pecten maximus	1	-	-	-	-	-	-	-	-
Patella rustica	-	-	2	-	-	-	-	-	-
TOTAL	7	2	5	1	1	6	3	1	1

1: Presolutrense. **2/17:** Solutrense Superior.

2. Niveles Magdaleniense al Asturiense

NIVELES	20	19/20	21-23	24	26	27	28-29	Conchero
Cepaea nemoralis	-	-	-	1	-	8	8	21
Cardium edule	-	-	-	-	-	1	4	4
Gibbula umbilicalis	-	-	-	-	-	-	2	2
Oestophorella bouvinieri	-	-	-	-	1	2	1	3
Eumphalia brigantina	-	1	-	-	-	17	3	2
Oxychilus sp	-	-	-	-	-	10	4	2
Cochlostoma berinolli	-	-	-	-	1	46	3	6
Pomatias elegans	-	-	-	1	-	-	1	4
Nassa reticulata	-	-	-	-	-	-	-	1
Trivia europaea	-	-	1	-	-	-	-	-
Littorina saxatilis	1	-	-	-	1	2	4	-
Littorina obtusata	1	2	-	-	-	1	1	-
Nucella lapillus	-	-	-	-	-	3	-	-
Cardium tuberculatum	-	1	-	-	-	-	-	-
Mytilus edulis	-	-	-	-	-	2	2	-
TOTAL	2	4	1	2	3	92	33	45

19/20: Magdaleniense Inferior. **21/24:** Magdaleniense Superior.
26-29: Magdaleniense/Aziliense (?). **Conchero:** Asturiense.

ROTURA (SETUBAL, ALTO ALENTEJO)

Fuentes bibliográficas: LENTACKER, A. (1991).

Yacimiento situado sobre la ladera sur del monte San Luis, a 100-120 m sobre el actual estuario del Sado, a 2,5 Km al NE de Setubal. Veiga Ferreira y Tavares da Silva realizaron campañas de excavación durante los años 1966 y 1968-1970. La estratigrafía abarca todo el periodo Calcolítico.

Malacofauna

El material malacológico estudiado es el recuperado durante las campañas de excavación de 1966 y 1968. La potencia total excavada fué de 1,7 metros.

Abundancia absoluta (NR) por estratos:

ESPECIES	1	2	2/3	3	4	5	6
Glycymeris glycymeris	-	-	-	-	-	-	5
Mytilus galloprovincialis ?	-	8	6	35	4	-	53
Pecten maximus	-	6	5	2	14	1	22
Ostrea edulis	1	5	3	-	-	-	30
Laevicardium norvegicum	-	-	-	-	2	-	4
Cerastoderma edule	1	9	8	1	1	1	11
Acanthocardia echinata	1	-	-	-	-	-	-
Dosinia lupinus	-	-	-	-	-	-	2
Venus verrucosa	-	1	-	2	2	-	-
Venerupis decussata	8	36	52	93	218	11	358
Lutraria lutraria	-	-	-	-	2	-	-
Psammophila magna	-	-	-	-	1	-	-
Solen sp/Ensis sp	-	3	-	15	10	1	30
Panopea glycymeris	-	-	3	-	1	1	-
Pholas dactylus	1	7	6	31	26	1	-
Patella sp	6	28	57	50	461	10	322
Clanculus sp	-	-	-	-	1	-	1
Osilinus sp	-	-	1	2	12	1	30
Charonia lampas ?	-	-	-	1	-	-	-
Buccinum sp	-	-	-	-	-	-	1
Hinia reticulata	1	-	2	-	-	-	-
Rumina decollata	1	1	-	-	-	-	-
Pulmonata S.I.	-	-	-	-	1	-	1
TOTAL	20	104	143	232	756	27	870

1: Calcolítico Final. **3/4:** Calcolítico Medio. **6:** Calcolítico Inicial. **2/5:** Periodos de transición.

SACAOJOS DE LA BAÑEZA (LA BAÑEZA, LEON)

Fuentes bibliográficas: DRIESCH, A. von den & BOESSNECK, J. (1980b).

Colonia del Hallstat-Hierro temprano, siglos XI-VI a.C., emplazada en un pequeño cerro. M.P. Morillo y J. Meseguer realizaron varias campañas de excavación de 1971 a 1975.

Malacofauna

Se han recuperado dos valvas de *Anodonta spec.*.

CUEVA DE SAGASTIGORRI (BASONDO, CORTEZUBI, VIZCAYA)

Fuentes bibliográficas: BARANDIARAN, J.M. (1964h) en ALTUNA, J. (1972).

Cueva sepulcral excavada por J.M. Barandiarán en 1958.

Malacofauna

Relación de especies:

Tapes
Monodonta
Mytilus

SALACIA (ALCACER DO SAL, SETUBAL, ALTO ALENTEJO)

Fuentes bibliográficas: BERROCAL-RANGEL, L. (1992).

Carecemos de datos arqueológicos.

Malacofauna

Relación de especies:

Mytilus
Solen
Cardium ed.
Scrobicularia po.
Ostrea
Pecten max.
Patella

LOS SALADARES (ORIHUELA, ALICANTE)

Fuentes bibliográficas: DRIESCH, A. von den (1973).

Yacimiento enclavado en una zona esteparia a 5 Km de Orihuela. Se realizó una campaña de excavación en 1972 bajo la dirección de O. Arteaga. Se han establecido tres fases culturales:

Fase I: Bronce terminal (700-500 a.C.)

Fase II: parece asimilarse a la fase púnica (650-500 a.C.)

Fase III: Ibérica (500-300 a.C.)

Malacofauna

Los restos malacológicos no son signados cronoestratigráficamente.

Abundancia absoluta de las especies:

ESPECIES	NR
Glycymeris bimaculata	1
Glycymeris violacescens	1
Iberus alonensis	3
TOTAL	5

SAMOUQUEIRA (SETUBAL, ALTO ALENTEJO)

Fuentes bibliográficas: LENTACKER, A. (1991).

Yacimiento situado a 10 metros de altura en el acantilado sobre la playa de Samouqueira, a 2 km al norte de Porto Covo. Los restos en superficie parecen indicar que el yacimiento tenía una extensión de 120 x 140 metros, pero la mayoría se encuentra bajo un terreno cultivado y sólo la periferia mantiene los estratos *in situ*. C. Tavares y J. Soares, del Museo Etnográfico y Arqueológico de Setubal, lo prospectaron por primera vez publicando los resultados en 1981, posteriormente llevaron a cabo varias campañas de excavación con D. Lubell, cuyos resultados se publicaron en 1985. Existen dos momentos de ocupación, el primero sobre el 7.200 B.P. y el segundo sobre el 5.800 B.P., por lo que parece que fué ocupado ininterrumpidamente durante el Mesolítico-Neolítico.

Malacofauna

Abundancia relativa de las especies:

ESPECIES	ABUNDANCIA
Striarca lactea	RR
Glycymeris glycymeris	RR
Mytilus sp	FF
Ostrea edulis/Crassostrea angulata	RR
Cerastoderma edule	R
C. glaucum	R
Venus verrucosa	RR
Venerupis decussata	RR
Donacilla cornea	RR
Patella sp	FF
Diodora graeca	RR
Calliostoma conulus	RR
Calliostoma sp	RR
Gibulla sp	R
Osilinus sp	R
Bittium reticulatum	RR
Cerithiopsis sp	RR
Trivia europaea	RR
Luria lurida	RR
Charonia lampas/Thais haemastoma	RR
Ocinebrina edwardsi	R
Ceratostoma erinaceum	RR
Buccinum sp	RR
Hinia sp	R
Cochlicella acuta	RR
C. conoidea	RR
Theba pisana	R
Zenobiella sp	R
Pulmonata S.I.	RR

R: Raro. **RR:** Muy raro. **FF:** Muy frecuente.

SAN ANTONIO (ASTURIAS)

Fuentes bibliográficas: CLARK, G.A. (1976).

Cueva situada en la orilla este del río Sella, a 45 metros sobre el nivel del mar y 1,1 kilómetros de la costa. Presenta una entrada orientada al norte, y consta de una sala principal de unos 17 metros de anchura y una serie de galerías menos amplias, una de las cuales contiene pinturas. No ha sido excavada, aunque se conocía su existencia al menos desde los años 50 (Jordá, 1958). Clark realiza análisis de los remanentes del conchero.

Malacofauna

El conchero fué extraido para delimitar jardines, y los datos ofrecidos por Clark corresponden a observaciones de las estructuras constructivas y de los restos que quedaron en el ángulo sudeste de la zona principal. Según este autor:

"*... el conchero estaba compuesto principalmente por grandes valvas (más de diez centímetros de longitud) de Mytilus edulis; se observaron también con alguna frecuencia Trochocochlea crassa, Patella vulgata y Patella aspera. Hay ejemplares más escasos de ostras (Ostrea edulis) y de conchas de cardium (Cardium edulis). ... La configuración descrita anteriormente y la ausencia de Littorina littorea y Patella vulgata sautuola nos condujeron a la conclusión de que el conchero de San Antonio es post-asturiense.*" (Clark, 1976: 128).

CABEZO DE SAN PEDRO O DEL CASTILLO (HUELVA)

Fuentes bibliográficas: DRIESCH, A. von den (1973).

Yacimiento también conocido como Cabezo del Castillo ha sido objeto de dos sondeos bajo la dirección de M. del Amo y M. Fernández. Posteriormente fué excavado en 1972. Cabezo de San Pedro corresponde a una urbe tartésica con niveles que abarcan desde el Hierro (700 a.C.: niveles I-VI) al periodo romano (100 a.C.: nivel VII).

Malacofauna

Abundancia absoluta de las especies representadas:

ESPECIES	NR
Glycymeris spec.	8*
Venerupis (Amygdala) decussata	14
Cerastoderma (Cardium) glaucum	1
Ostrea edulis	7
Charonia lampas (Tritonium nodiferum)	2
Pecten spec.	3
Truncolariopsis (Murex) spec.	1
Truncolariopsis (Murex) trunculus	1
Solen marginatus/Ensis siliqua	6
TOTAL	43

EL CONCHERO DEL MONTE DE SANTA TECLA (PONTEVEDRA)

Fuentes bibliográficas: MERGELINA, C. de (1940).

Conchero situado al SE del poblado del mismo nombre, concretamente al pie de la puerta del Sur, siguiendo la dirección de los muros. Atribuido al Asturiense.

Malacofauna

Relación de especies y abundancia relativa por capas:

B. Nivel formado por conchas de moluscos diversos, pero sobre todo, en cantidad realmente asombrosa *Patella vulgata*, a los que se unen los de *Mytilus edulis*, alguna *Ostrea edulis* y varias especies de *Trochus*.

C. Restos en la misma proporción que en el anterior y con igual predominio de lapas.

D. Nivel formado por conchas de las mismas especies.

E. Unicamente algunas lapas.

F. Proporciona idénticos restos de moluscos.

CUEVA DEL SANTIAN (PUENTE ARCE, CANTABRIA)

Fuentes bibliográficas: ANDEREZ (1954) en ALTUNA, J. (1972).

Conocida desde fines del siglo pasado, Alcalde del Río la exploró en 1905 y Breuil en 1908. V. Anderez publicó los hallazgos de A. García Lorenzo en 1953 y atribuye las piezas al Auriñaciense Inferior.

Malacofauna

Relación de especies:

Littorina o Trochus
Patella
Cardium
Helix

CUEVA DE SANTIMAMIÑE (BASONDO, CORTEZUBI, VIZCAYA)

Fuentes bibliográficas: ARANZADI, T. de (1919), ARANZADI, BARANDIARAN & EGUREN (1931), ARANZADI & BARANDIARAN (1935) & BARANDIARAN (1962c) en ALTUNA, J. (1972).

Cueva situada en la ladera meridional del monte Ereñusarre, en la margen derecha de la ría de Oca a unos 8 Km de la costa actual y a 150 m de altitud. Descubierta en 1916, las primeras excavaciones fueron realizadas durante los años 1918-1926 por J.M. de Barandiarán, E. Eguren y T. Aranzadi. De 1960 a 1962 J.M. de Barandiarán realiza tres nuevas campañas de excavación. Los ocho niveles detectados se engloban desde el Perigordiense Inferior ? (con elementos del Auriñaciense típico) hasta el nivel superficial, que presenta indicios de romanización de la época de Constantino.

Malacofauna

1. Malacofauna según J. Altuna.

En el nivel IV se especifica el NE de los "taxones principales" de una muestra de 25.000

ejemplares. Presencia y abundancia absoluta (NR) de la malacofauna:

NIVELES	I-III	IV	V
Lapas	x	-	-
Patella	-	-	x
Patella vulgata/aspera/lusitanica	-	858	-
Littorina littorea	-	+	-
Littorina obtusata	-	+	x
Monodonta	-	-	x
Monodonta lineata/sagittifera/reticulata	-	183	-
Purpura haemastoma	-	+	-
Nassa reticulata	x	+	x
Murex erinaceus	-	+	-
Haliotis tuberculata	-	+	-
Turbo (Astralium) rugosus	-	+	-
Triton nodifer	-	+	-
Casis saburon	-	-	x
Piramidella	-	-	x
Ostras	x	-	-
Ostrea edulis/Gryphaea angulata	-	18724	-
Pecten	x	-	-
Pecten jacobaeus	-	+	-
Chlamys varia	-	+	-
Cardium	x	-	-
Cardium edule	-	+	-
Mytilus edulis/M. minimus	-	248	-
Scrobicularia plana	-	468	-
Tapes decussata/aurea/rhomboides/pullastra	-	4219	-
Solen marginatus	-	+	-
Ensis siliqua	-	+	-
Ceratisolen ?	-	+	-
Solecurtus ?	-	+	-
Pholas dactylus	-	+	-
Mya arenaria	-	+	-
Cytherea chione	-	+	-
Eastonia rugosa	-	+	-
Pinna ?	-	+	-
Gastrochaena ?	-	+	-
Unio	x	+	-
Rissoa sp	-	+	-
Helix nemoralis/quimperiana/adspersa	-	195	-
Cyclostoma elegans	-	+	-
Clausilia	-	-	+
Dentalium vulgare	x	+	-

I/III: Niveles con cerámica. El I puede pertenecer al Hierro, el II es Bronce y Eneolítico y el III Neolítico.
IV: Conchero, Preneolítico o Postaziliense. **V:** Aziliense.

SETEFILLA (LORA DEL RIO, SEVILLA)

Fuentes bibliográficas: REESE, D. (1983).

Él yacimiento de Setefilla está situado a unos 40 Km al NE de Sevilla y a unos 130 Km de la costa atlántica. Sus 14 niveles de ocupación, de ocho metros de potencial total, abarcan desde mediados de la segunda centuria a la cuarta centuria antes de Cristo. La necrópolis fué identificada por primera vez por Bonsor quien, en colaboración con R. Thouvenot, realizó dos campañas de excavación en 1926 y 1927. Posteriormente, Mª E. Aubet y colaboradores realizaron otras dos campañas de excavación en 1973 y 1975. Los primeros sondeos en busca del poblado prerromano también se realizan en 1975, iniciándose en 1976 las excavaciones del mismo y una segunda campaña de excavación en 1979.

Malacofauna

La malacofauna que ha sido estudiada corresponde a las campañas de excavación de 1973-1979. Todos los restos estudiados proceden del Corte 3 y de una única sepultura de incineración del Túmulo A. Las conchas marinas aparecen por primera vez durante el periodo Orientalizante, en unos momentos en que el yacimiento mantiene un estrecho contacto con las colonias fenicias y posiblemente griegas del litoral de Andalucía.

Abundancia absoluta (NR) por estratos:

FASES	II	III			IV		V
ESTRATOS	XII	IX	VIII	VII	VI	V	IV
F. Unionidae	2	-	2	-	1	1	-
Acanthocardia tuberculatum	-	2	2	-	-	-	1
Glycycmeris glycymeris	-	1	-	1	-	-	5
Eobania vermiculata	-	-	-	-	1	-	-
TOTAL	2	3	4	1	2	1	6

FASES:
II: Bronce Final. **III:** Orientalizante. **IV:** Transición a la cultura Ibérica. **V:** Ibérica.

Además se ha recuperado una concha de *Glycymeris* en la tumba nº 65 del Túmulo A, fechado en el siglo VII a.C., en el periodo denominado Orientalizante.

TEJADA LA VIEJA (ESCACENA DEL CAMPO, HUELVA)

Fuentes bibliográficas: MORENO, R. (1987) y MORENO, R. (Inédito).

Tejada la Vieja es un poblado protohistórico amurallado que se localiza en las coordenadas 37° 29' 58'' de latitud norte y 6° 21' 40''de longitud oeste, ocupando una pequeña elevación del

terreno (170 m de altitud), en el límite entre la Campiña y la Sierra. El yacimiento se ocupó ininterrumpidamente desde fines del siglo VIII a.C. hasta el siglo IV a.C. Este yacimiento ha sido objeto de excavaciones desde 1983.

Malacofauna

1. Campaña de 1985

NIVELES	IIb		IIc		IIIb		IVa	
ESPECIES	**NR**	**NMI**	**NR**	**NMI**	**NR**	**NMI**	**NR**	**NMI**
Glycymeris spp	2	2	2	1	2	1	1	1
Tapes decussatus	-	-	-	-	-	-	25	3
TOTAL	2	2	2	1	2	1	26	4

2. Campaña de 1987

Los escasos restos malacológicos correspondientes a esta campaña se recuperaron en la habitación 15 del cuadro A-8. Se recuperaron tres valvas derechas completas del género *Pecten*, que se encontraban quemadas.

TERMAS ROMANAS (GIJON, ASTURIAS)

Fuentes bibliográficas: MORENO, R. & PELLUS, P. (Inédito).

Las termas de Gijón se localizan en la parte oriental del cerro de Santa Catalina, delante de la iglesia de San Pedro, junto a la playa de San Lorenzo. Fueron descubiertas en 1903 por C. Alvargonzález y J. Somoza, quienes realizan una excavación parcial de las mismas. En 1938, García y Bellido realizan una visita exploratoria, pero no será hasta 1990 cuando se inicien las excavaciones que, bajo la dirección de C. Ochoa, resultarán en la exhumación de gran parte del edificio termal. De acuerdo con la estratigrafía, los restos más antiguos se fechan con anterioridad al último cuarto del siglo I d.C., produciéndose una ampliación y reforma del conjunto a partir del siglo II d.C. Por último, todo el espacio termal estuvo ocupado por una necrópolis medieval.

Malacofauna

Abundancia absoluta por periodos culturales:

	TARDORROMANO		MEDIEVAL	
TAXONES	**NR**	**NMI**	**NR**	**NMI**
Patella intermedia	352	352	14	14
Patella rustica	2	2	-	-
Patella ulyssiponensis	799	799	28	28
Patella vulgata	456	456	22	22
Patella sp	2566	2088	102	89
Monodonta colubrina	1	1	-	-
Monodonta lineata	87	73	19	14
Monodonta sp	1	1	-	-
Bolma rugosa	1	1	1	1
Phalium saburon	-	-	3	1
Phalium sp	-	-	1	1
Familia Cassidae	-	-	2	1
Charonia lampas	43	14	11	2
Thais haemastoma	32	28	1	1
Albea candidissima	-	-	2	1
Familia Helicidae	6	3	6	2
Theba pisana	1	1	-	-
Helix aspersa	26	21	4	2
Familia Mytilidae	2	1	-	-
Mytilus galloprovincialis	4	2	-	-
Familia Ostreidae	7	1	-	-
Ostrea edulis	371	162	48	14
Acanthocardia tuberculata	7	2	-	-
Acanthocardia sp	2	1	-	-
Cerastoderma edule	-	-	2	1
S.I.	2		2	
TOTAL	4.768	4.010	268	196

TERRERA DEL RELOJ (GRANADA)

Fuentes bibliográficas: MILZ, H. (1986).

Yacimiento de la Edad del Bronce situado en el extremo oeste de la Cuenca de Baza-Huéscar, a unos 8 Km al este de Dehesas de Guadix y 590 m sobre el nivel del mar. En sus inmediaciones desemboca el río Fardes en el Guadiana.

Malacofauna

Abundancia absoluta de las especies:

ESPECIES	NR
Monodonta turbinata	1
Glycymeris insubricus	2
Ostrea edulis	2
Ostra S.I. (Fósil)	1
Rumina decollata	1
Iberus alonensis	5
Moluscos S.I.	1
TOTAL	13

CABEZO DE LA TIÑOSA (LEPE, HUELVA)

Fuentes bibliográficas: MORALES, A. (1978).

Cabezo situado en el término municipal de Lepe, en la margen izquierda del río Piedras, muy próximo a su desembocadura. El yacimiento se sitúa en la zona más alta del cabezo, entre las cotas de 30 y 44 m. Conocido desde los años 20 merced a una nota de G. Bonsor, Garrido Roiz realizó una primera prospección de superficie en 1975. Posteriormente M. Belén, M. Fernández-Miranda y A. Limón realizan dos campañas de excavaciones sistemáticas durante los años 1976 y 1977. Es una estación pesquera cuya vida se inicia en torno al siglo IV a.C. (Belén & Fernández-Miranda, 1978).

Malacofauna

El material malacológico de las campañas de excavación de 1976 y 1977 no ha sido estudiado en su totalidad. Abundancia absoluta (NR) de las especies por cortes y niveles:

CORTES	C3						C4
NIVELES	N1a	N1b	N2	N4	N5	N6	
Ostrea edulis	22	-	13	1	1	6	-
Pycnodonta sp	-	1	6	-	-	8	-
Cardium edule	-	-	1	1	-	-	3
Solen siliqua	-	-	4	-	-	-	-
Venerupis sp	3	1	20	4	1	1	4
Mya sp	-	-	-	-	1	-	-
Chlamys sp	-	-	-	1	-	-	-
Pecten jacobaeus	2	-	-	1	-	1	-
Murex trunculus	-	-	2	-	-	-	2
Murex brandaris	-	1	-	-	-	-	-
Cassia corimbosa	-	1	-	-	-	-	-
Nassa reticulata	-	-	1	-	-	-	-
Sepia officinalis	-	-	-	-	-	1	-
S.I.			1				1
TOTAL	27	4	48	8	3	17	10

CATA 3. Solamente esta cata proporcionó una clara secuencia estratigráfica.
N1: Principios del siglo II a.C. ?. **N2:** Entre los siglos III y II a.C. (Nivel de abandono).
N4-6: Siglo IV a.C. (Primera mitad ?).

El peso total de los moluscos es de 2.680 g, lo que supone el 23,97 % del peso total de los restos faunísticos del yacimiento.

CUEVA DE TITO BUSTILLO O DEL RAMU (ARDINES, RIBADESELLA, ASTURIAS)

Fuentes bibliográficas: MADARIAGA, B. (1975a y b); DEIBE BALBAS, M.A. (1985) y MORENO, R. & MORALES, A. (1987).

Cueva situada en el Macizo de Ardines, en el que el río San Miguel ha excavado galerías a diferentes alturas antes de desembocar en el margen izquierdo del Sella. Se encuentra a solo un kilómetro de la costa actual, en línea recta. Comunica con "La Cuevona". Fué descubierta en 1968 por el Grupo Espeleológico "Torreblanca". Ha sido excavada en 1970 por M.A. García Guinea y desde 1972 a 1982 por A. Moure. La cronología absoluta del yacimiento ha aportado las siguientes fechas:

Nivel 1a y 1b:		
TB 2	CSIC 154	12.300 +/- 300 a.C.
TB 3A	CSIC 155 A	13.230 +/- 300 a.C.
TB 3B	CSIC 155 B	13.450 +/- 300 a.C.
Nivel 1c:		
TB 4	I-8331	11.920 +/- 300 a.C.
TB 5	I-8332	11.570 +/- 300 a.C.
Sala de las pinturas:		
TB 1	CSIC 80	12.400 +/- 300 a.C.
TB 8 (Dat. paleomagnética)		12.800 a.C.

Todos los niveles han sido atribuidos al Magdaleniense Superior Cantábrico, fase que podría ser equivalente al Magdaleniense V del sistema de Breuil (Moure, 1976).

Malacofauna

Benito Madariaga realizó el análisis arqueomalacofaunístico de las campañas de excavación correspondientes a 1970, 1972, 1974 y 1975. Los moluscos recuperados durante las campañas de excavación correspondientes a 1977, 1979, 1981 y 1982 han sido estudiados por R. Moreno, A. Morales y A. Deibe.

1. Campaña de 1970

Abundancia absoluta (NE) por niveles:

NIVELES	I	II	III	IV
Littorina littorea	92	14	1	3
Littorina obtusata	1	2	-	2
Littorina rudis	-	-	-	1
Patella vulgata	236	102	31	61
Patella vulgata var. sautuola	6	4	-	5
Patella lusitanica	4	-	-	-
Trivia europaea	1	-	-	-
TOTAL	340	122	32	72

Además se citan dos ejemplares de *Trivia europaea* en la sala de pinturas.

2. Campañas de 1972-1974

Abundancia absoluta de las especies representadas:

ESPECIES	NE
Patella vulgata	1112
Patella lusitanica	15
Littorina littorea	794
Littorina obtusata	23
Mytilus edulis	3
Pecten maximus	2
Purpura lapillus	1
Solen sp (?)	1
Modiola	1
Gibbula sp	1
Turritella communis	1
TOTAL	1954

3. Campaña de 1975

Abundancia absoluta (NE) por niveles:

NIVELES	1				2
SUBNIVELES	1a	1b	1c	Capa roja	
Patella vulgata	73	443	1446	291	86
Littorina littorea	60	209	646	198	24
Littorina obtusata	3	10	112	24	1
Trivia europaea	3	3	18	4	-
Purpura lapillus	1	2	2	1	-
Nassa reticulata	2	-	4	3	-
Aporrhais pes-pelecani	-	-	1	-	-
Gibbula sp	-	-	1	-	-
Cyclostrema serpuloides ?	-	-	Varias	-	-
Calyptraea chinensis	-	-	-	1	-
Mytilus edulis	-	4	5	5	-
Cardium norvegicum	-	-	1	-	-
Cardium sp	-	-	1f	-	-
TOTAL	142	671	2236+1f	527	111

Madariaga estima que el número real de ejemplares de *Mytilus edulis* sería superior ya que en esos niveles aparecieron diversos fragmentos de conchas.

4. Campañas de 1977 a 1982

Durante éstas últimas campañas de excavación, se han localizado, en algunas cuadrículas, capas intercaladas (1c1, 1c3), y el nivel originalmente denominado 1c, sería igual a 1c2 y 1c4 juntos (Moure, Op. cit).

4.1 - Relación y frecuencia absoluta (NMI) de la malacofauna "alimentaria" por niveles:

NIVELES	1a	1a-b	1b	1b-c
Patella vulgata	875	45	1509	103
Gibbula sp	1	-	-	-
Littorina littorea	773	53	1166	91
Littorina obtusata	18	-	41	4
Turritella communis	1	-	1(?)	-
Aporrhais pes-pelecani	-	-	1	-
Trivia monacha	-	-	1	-
Phalium saburon	1	-	-	-
Nucella lapillus	-	-	3	-
Hinia reticulata	1	-	6	-
Helicella itala	1(?)	-	2	-
Mytilus sp	8	1	9	-
Pecten sp	-	-	1	-
TOTAL	1679	99	2740	198

NIVELES	1c	$1c_1$	$1c_2$	$1c_3$	$1c_{3+4}$
Patella vulgata	174	413	693	33	173
Littorina littorea	122	368	310	54	68
Littorina obtusata	5	12	21	3	8
Trivia monacha	2(?)	2	-	-	-
Nucella lapillus	1	-	-	-	-
Euomphalia brigantina	1	-	-	-	-
Mytilus sp	3	-	1	-	1
TOTAL	308	795	1025	90	250

4.2 - Abundancia absoluta de las especies ornamentales:

ESPECIES	NE
Aporrhais pespelecani	1
Calyptraea chinensis	1
Cardium norvegicum	1
Cyclonassa neritea	2
Cyclope neritea	2
Cyclostrema serpuloides	10
Dentalium vulgare	1
Gibbula umbilicalis	2
Littorina littorea	6
Littorina obtusata	24
Littorina saxatilis	1
Nassarius reticulatus	9
Nucella lapillus	13
Patella vulgata	3
Pectumculus glycymeris	2
Trivia europaea	46
Turritella communis	1
TOTAL	125

TORRE D'ESPIOCA (PICASSENT, VALENCIA)

Fuentes bibliográficas: APARICIO, J. (1990).

Yacimiento desaparecido que se localizaba a unos 800 metros al oeste de dicha Torre defensiva medieval. Fué descubierto por Martí Oliver, quien recogió algunos materiales que le permitieron apuntar una cronología preneolítica para el yacimiento.

Malacofauna

Se recogieron muestras del conchero observable en un corte al realizarse desmontes para transformaciones agrícolas.

Abundancia relativa de las especies:

Cerastoderma edule glaucum (muy abundante)

Cerithium vulgatum (escaso)

Truncullariopsis trunculus (escaso)

TOSCANOS (TORRE DEL MAR, MALAGA)

Fuentes bibliográficas: UERPMANN, M. (1972) y UERPMANN, H-P. von & UERPMANN, M. (1973).

Factoría en la que se han desarrollado ocupaciones fenicias (a partir del siglo VIII a.C.) y romanas. Se han realizado tres campañas de excavación (1964, 1967 y 1971).

Malacofauna

Abundancia absoluta (NR) de las especies por periodos culturales:

ESPECIES	Fenicio	Fenicio Romano	Romano
Patella spec.	534	13	-
Monodonta turbinata	31	-	-
Turritella spec.	1	-	-
Cerithium spec.	1	-	-
Cassis saburon	-	1	1
Cassis sulcosa	5	1	1
Charonia nodifera	40	31	-
Charonia tritonis	1	1	-
Ranella gigantea	-	1	-
Murex brandaris	41	21	5
Murex trunculus	10	18	1
Purpura haemastoma	120(7*)	14(1*)	1
Philbertia spec.	1	-	-
Conus mediterraneus	1	-	-
Glycymeris spec.	656(404*)	67(46*)	5(4*)
Mytilus spec.	149	5	-
Pecten jacobaeus	2	1	-
Pecten maximus	5	-	-
Pecten spec.	10	-	-
Chlamys glabra	43	-	-
Spondylus gaederopus	1*	8(1*)	13
Ostrea plicata ?	148	65	38
Cardium tuberculatum	222(123*)	15(9*)	-
Cardium aculeatum	1	-	-
Venus gallina	30	-	-
Venus verrucosa	1	-	-
Venerupis decussata	1	-	-
Donax politus	5	-	-
Mactra corallina	2	-	-
Mactra spec.	7	-	-
Mesodesma spec.	7	-	-
Gasterópodos S.I.	26		
Bivalvos S.I.	72(12*)	4	
TOTAL	2173(547*)	266(57*)	65(4*)

ABRIGO DEL TOSSAL DE LA ROCA (VALL D'ALCALA, ALICANTE)

Fuentes bibliográficas: APARICIO, M.T. & RAMOS, M.A. (1982).

Yacimiento situado en el Vall d'Alcalá, al norte de la provincia de Alicante. Se trata de un abrigo bajo roca que se abre en las dolomitas calcáreas de la facies del Penegrí, de 5 a 10 metros de profundidad y con una amplia entrada, de aproximadamente 45 m, orientada a poniente. El abrigo

presenta restos de ocupación del Magdaleniense Superior Final y del Epipaleolítico. Las fechas de C^{14} van del 15.110 B.P. (nivel IV) al 7.500-7.600 B.P. (nivel I). Directora de las excavaciones Carmen Cacho.

Malacofauna

Los restos malacológicos no son asignados cronoestratigráficamente. Abundancia absoluta de las especie representadas:

ESPECIES	NR
Glycymeris sp	2
Glycymeris sp ?	4
Pecten jacobaeus	5
Pecten sp	8
Acanthocardia (Rudicardium) tuberculatum	4
Acanthocardia tuberculatum (?)	4
Cerastoderma glaucum	2
Littorina obtusata	1
Cyclope donovani	1
Hinia reticulata mamillata	1
Melanopsis sp	1
Dentalium vulgare	1
Iberus alonensis	2
Bivalvo (?) S.I.	1
TOTAL	37

CUEVA TRUCHE (BUÑOL, VALENCIA)

Fuentes bibliográficas: FISCHER, P.H. (1923).

Cueva donde el Abate Breuil y H. Obermaier realizaron una visita en la que recogieron materiales del Paleolítico Superior.

Malacofauna

Relación de especies:

Leucochroa candidissima Drap.

Helix (Macularia) punctata Müller (non Born)

Helix (Macularia) alonensis Férussac

Melanopsis grälssi Villa (xxx).

CUEVA DE TXOTXINKOBA (LARIS, GUIZABURUAGA, VIZCAYA)

Fuentes bibliográficas: ALTUNA, J. (1972).

Yacimiento sepulcral a 100 m de altitud sobre el nivel del mar. Fué descubierta por E. Nolte, quién la excavó en 1966 en colaboración con Apellániz. Este yacimiento se asigna al Eneolítico sepulcral.

Malacofauna

Abundancia relativa de las especies:

Patella (pocos ejemplares)

Helix nemoralis (abundante)

CUEVA DEL VALLE (RASINES, RAMALES, CANTABRIA)

Fuentes bibliográficas: OBERMAIER (1925) en ALTUNA, J. (1972).

Cueva descubierta en 1905 por L. Sierra, la excavó en colaboración con Obermaier, Breuil y Bouyssonie en 1909 y 1911. Se han detectado ocupaciones del Magdaleniense Superior y del Aziliense.

Malacofauna

Abundancia relativa de las especies por niveles:

NIVELES	b	c
Patella vulgata	x	xxx
Littorina littorea	-	x
Trivia arctica	-	x
Mytilus edulis	x	-
Unio sp	x	-
Helix nemoralis	x	x
Helix asturica	-	x

Nivel b: Aziliense. **Nivel c:** Magdaleniense Superior.

CUEVA DE VENTA LAPERRA O DEL POLVORIN (CARRANZA, VIZCAYA)

Fuentes bibliográficas: BARANDIARAN J.M. (1958) en ALTUNA, J. (1972).

Yacimiento descubierto y excavado por Aranzadi y Barandiarán en 1931. Se detectaron cinco niveles posiblemente Auriñacienses y uno del Bronce Antiguo.

Malacofauna

Relación de especies por niveles:

Nivel a - Bronce Antiguo:

Tapes

Nivel b - Nivel arqueológico poco caracterizado.

Littorina littorea

Nassa

YACIMIENTO DE TERRERA VENTURA (TABERNAS, ALMERIA)

Fuentes bibliográficas: DRIESCH, A. von den & MORALES, A. (1977).

Aldea eneolítica que abarca un periodo de 700 años, dividido en las siguientes fases cronológicas:

Fase II.- 2.700, Horizonte neo-eneolítico.

Fase III.-2.700-2.400, Horizonte eneolítico precampaniforme.

Fase IV.- 2.400-2000, Horizonte eneolítico, con campaniforme e incipiente metalurgia del cobre en su momento final.

Malacofauna

Abundancia absoluta (NR) por fases:

FASES	II	III	IV
Arca noae	-	2	-
Cerastoderma sp	-	-	1
Glycymeris sp	1	36	27
Ostrea edulis	-	1	-
Spondylus sp	-	3	-
Unio sp	1	-	-
Cypraea sp ?	-	-	1
Monodonta turbinata	-	4	-
Murex brandaris	1	-	2
Nassa sp	-	2	-
Purpura haemastoma	-	4	-
Patella sp	-	35	13
Triton nodifer	-	4	2
Loligo sp	-	3	-
Pulmonados S.I.	-	5	3
TOTAL	3	100	49

ABRIGO DE VERDELPINO (CUENCA)

Fuentes bibliográficas: MOURE, J.A. & FERNANDEZ-MIRANDA, M. (1977).

Cueva abrigo con una cronología que abarca desde el Magdaleniense hasta el Neolítico.

Malacofauna

Corresponde al material recuperado durante la campaña de excavación de 1976.

Relación de restos por niveles:

1 - Nivel II (Se corresponde con el nivel II del corte II de 1972). Datado por C^{14} en el 2.680 +/- 130 a.C. (CSIC-151B). Se han recogido dos fragmentos de conchas de moluscos, pertenecientes a los géneros *Cardium* y *Pecten*, respectivamente, sin que sea posible una determinación a nivel de especie. Estos moluscos, lo mismo que el colgante descubierto en el Nivel IV, han sido clasificados por Don Benito Madariaga, a quien agradecemos su colaboración. Se ignora si las conchas fueron utilizadas como elementos de adorno, como alimento o para la decoración de la cerámica. En todo caso, su presencia evidencia un contacto con el Mediterráneo, alejado casi 200 Km.

2 - Nivel IV (Se corresponde con el nivel IV del corte II de 1972). Datado por C^{14} en el 6.000 +/- 150 a.C. (CSIC-153B). Colgante natural. Se trata de una concha de *Columbella rustica* con perforación irregular, casi cuadrangular, en la parte convexa, o más concretamente, en la zona opuesta a la abertura. La fragmentación que presenta en punta debe ser casual, ya que el hilo de suspensión suele pasar, en este tipo de moluscos, por la perforación citada y la abertura natural.

CUEVA DE VIDIAGO O DE EL BUFON (LLANES, ASTURIAS)

Fuentes bibliográficas: CLARK, G.A. (1976).

Cueva situada en la meseta al SE de Llanes. Fue investigada por el Conde de la Vega del Sella entre 1917-1922. Posteriormente Clark revisa el material de esas excavaciones depositado en el Museo Arqueológico provincial de Oviedo, asignando el conchero al Asturiense.

Malacofauna

Abundancia absoluta (NE) de las especies según Clark:

ESPECIES	Conchero
Patella vulgata, etc.	92
Trochocochlea crassa	31
Cardium edulis	1
Helix nemoralis	15
Helix arbustorum	2
TOTAL	141

LA VIÑA (PUERTO DE SANTA MARIA, CADIZ)

Fuentes bibliográficas: MORENO, R. (en prensa).

Yacimiento situado sobre un cerro natural, a una altura de 45 metros sobre el nivel del mar y a menos de un kilómetro de la costa. El Servicio Arqueológico de la Delegación Provincial de cultura de la Junta de Andalucía en Cádiz, realizó varias campañas de excavación de urgencia de 1984 a 1986. En este yacimiento se localizaron enterramientos y silos calcolíticos, tumbas romanas y material árabe disperso en superficie.

Malacofauna

El material malacológico se recuperó exclusivamente en el tercer nivel del yacimiento, en los silos calcolíticos. Abundancia absoluta de las especies:

TAXONES	NR	NMI
Patella sp	144	123
Patella intermedia	3	3
Gibbula divaricata	1	1
Monodonta sp	79	50
Monodonta lineata	1141	1072
Monodonta turbinata	12	12
Cerithium vulgatum	2	2
Turritella communis	1	1
Familia Cassidae	1	1
Phalium granulatum	1	1
Phalium saburon	2	2
Charonia lampas	81	39
Bolinus brandaris	13	12
Hexaplex trunculus	10	10
Thais haemastoma	85	53
Cymbium olla	18	12
Siphonaria pectinata	1	1
Rumina decollata	121	80
Subfamilia Helicellinae	1	1
Caracollina lenticula	2	2
Theba pisana	943	774
Otala lactea	1	1
Familia Arcidae	1	1
Glycymeris sp	124	44
Glcycymeris violacescens	2	1
Familia Pectinidae	1	1
Pecten sp	18	13
Spondylus gaederopus	2	2
Familia Ostreidae	2	2
Ostrea edulis	2	2
Crassostrea angulata	1	1
Acanthocardia sp	5	4
Acanthocardia tuberculata	1	1
Mactra stultorum	1	1
Eastonia rugosa	5	3
Gastrana fragilis	1	1
Scrobicularia plana	16	7
Tapes decussatus	3239	1069
Panopea glycymeris	1	1
Suborden Unionacea	5	1
Margaritifera auricularia	5	4
Unio sp	1	1
Potomida littoralis	1	1
S.I.	7	
TOTAL	6104	3414

COVA DEL VOLCAN DEL FARO (CULLERA, VALENCIA)

Fuentes bibliográficas: CUERDA & GASULL (1971) en DAVIDSON, I. (1989).

Abrigo situado en el cerro kárstico que domina el pueblo de Cullera a 122 metros sobre el nivel del mar, al norte de la desembocadura del río Júcar y al sur de la Albufera de Valencia. Fué descubierto a principios de la década de los sesenta por el "Centre Cullerenc de Cultura". Las excavaciones comenzaron en 1968 y han continuado anualmente, dentro de un proyecto del Servicio de Investigación Prehistórica de la Diputación Provincial de Valencia, hasta 1984. Trece años de investigación cuyos resultados se exponen en Aparicio (1990). Yacimiento con niveles paleolíticos así como un nivel superior con cerámicas de distinta atribución. No existe consenso sobre las atribuciones culturales, parecen encontrarse representados estratos magdalenienses, mesolíticos y epipaleolíticos.

Malacofauna

1. Campaña de 1968

Durante esta campaña se excavó la covacha o sector N, donde se pueden diferenciar tres grandes niveles, cuya cronología exponemos a continuación:

Nivel I (capas 1-4) - Edad de los metales

Nivel II (capa 5) - estéril

Nivel III (capas 6-30) - Paleolítico Superior

Relación de especies por capas:

ESPECIES	2	3	4	6	7	10	11
Cypraea lurida	X	-	-	-	-	-	-
Patella lusitanica	X	X	X	-	-	-	-
Patella caerulea	-	X	-	-	-	-	-
Patella aspera	-	X	-	-	-	-	-
Patella safiana	-	X	-	-	-	-	-
Murex trunculus	-	X	-	-	-	-	-
Murex brandaris	-	X	-	-	-	-	-
Purpura haemastoma	-	X	X	-	-	-	-
Cardium tuberculatum	-	-	X	-	-	-	-
Cardium edule	-	X	X	-	-	-	-
Pectunculus sp	-	X	-	-	X	-	-
Pectunculus violascens	-	-	X	X	-	-	-
Pecten maximus	-	-	X	-	X	-	-
Pecten sp	-	-	-	X	-	-	-
Mytilus edulis	-	-	-	-	X	-	-
Tapes carnonensis	-	-	-	-	X	-	-
Cardium echinatum	-	-	-	-	-	-	X
Ciclostoma elegans	-	-	-	-	X	-	-
Archelix punctata	-	-	-	-	X	-	-
Iberus alonensis	-	-	-	-	X	X	X
Helix splendida	-	-	-	-	X	-	X
Rumina decollata	-	-	-	-	X	-	X
Pseudotachea splendida	-	-	-	-	-	-	X

ESPECIES	20	21	22	24	25	26	27
Pectunculus violascens	-	-	-	X	-	X	X
Nassa sp	X	-	-	-	-	-	-
Dentalium sp	-	X	X	X	X	X	-
Chlamys opercularis	-	-	-	-	-	-	-
Turritella biplicata	-	-	-	-	X	-	-
Pseudotachea splendida	X	-	-	-	X	-	X

Según su excavador (Aparicio, 1973), en la campaña de 1968 se observó gran abundancia de conchas en el primer nivel del yacimiento, entre las que predominaban *Pectunculus*. El tercer nivel aportaba ya industria paleolítica, contrastando ahora la escasez de conchas marinas (Mateu *et al.*, 1985).

2. Campañas de 1971 y 1972

El estudio malacológico corresponde a los restos incluidos entre la fauna de mamíferos.

Abundancia absoluta (NE) por capas o presencia (en la capa 29 y de los moluscos marinos) según las categorías establecidas por Davidson:

CAPAS	Tipo *Helix sp*	*Rumina decollata*	Otras*	Conchas marinas
18	-	-	-	x
19	121	143	229	x
20	87	67	276	Lapa
21	1	-	1	-
22	3	8	6 (?)	-
23	10	3	1	x
24	14	6	7	-
25	32	10	71	Lapa
26	27	25	99	-
26A	13	1	2	-
27	1	-	3 (?)	-
27A	1	-	-	-
27B	-	-	-	-
27C	-	-	-	-
28	-	-	-	-
28A	-	1	-	-
28B	-	-	-	-
29	x	x	x	x
TOTAL	310	264	694	-

* : Incluida *Pomatias elegans*.

CASTRO DO ZAMBUJAL (TORRES VEDRAS, ESTREMADURA)

Fuentes bibliográficas: DRIESCH, A. von den & BOESSNECK, J. (1976).

Ciudad fortificada en cerro, comprende cinco fases (las cuatro primeras de la Edad del Cobre y la última del Bronce), que abarcan desde el 2.000 a.C. al 1.600 a.C. Se realizó un primer estudio en 1964, aunque es a partir de 1966 cuando se realizan diferentes campañas de excavación.

Malacofauna

Todos los moluscos se han recuperado en las fases pertenecientes al Cobre.

Abundancia absoluta por Fases:

FASES	1-2		3		4	
ESPECIES	NR	NMI	NR	NMI	NR	NMI
Patella spec	178	110	55	36	34	20
Charonia lampas/nodifera	3	2	1	1	2	2
Thais (Stramonita) haemastoma	18	10	10	6	4	3
Ceratostoma (Ocenebra) erinaceum	1	1	-	-	-	-
Monetaria (Cypraea) moneta	-	-	1	1	-	-
Glycymeris glycymeris	27	18	9	5	8	6
Mytilus edulis	90	40	28	12	177	35
Chlamys varia	1	1	-	-	-	-
Pecten maximus	193	50	63	20	33	10
Ostrea edulis	108	60	34	10	14	5
Cerastoderma (Cardium) edule	124	62	58	30	25	15
Rudicardium tuberculatum	5	3	-	-	-	-
Venerupis (Amygdala) decussata	1230	166	560	90	500	80
Eastonia rugosa	70	35	20	10	3	3
Solen marginatus/Ensis siliqua	39	20	15	8	1	1
Phollas callosa	2	2	-	-	-	-
Unio mancus	3	3	-	-	-	-
Rumina decollata	2	2	1	1	4	4
Helix (Cryptomphalos) aspersus	3	3	1	1	4	4
Cepaea nemoralis	-	-	-	-	3	3
Theba pisana	-	-	-	-	7	7
Helicellinae	-	-	-	-	1	1
Moluscos marinos S.I.	167	-	45	-	18	-
TOTAL	2264	588	901	231	838	199

RELACION DE YACIMIENTOS CON FAUNA DE MOLUSCOS ORNAMENTALES (OR), EN CURSO DE ESTUDIO (ES) O EN DONDE LA MISMA NO QUEDE EXPLICITADA NI CUANTITATIVA NI TAXONOMICAMENTE

1-AGUA, CUEVA DEL (GRANADA)
2-AJALVIR (MADRID)
3-ALKERDI, CUEVA DE (NAVARRA) (**ES**)
4-ALBEGA 2, CASA DE LA (MADRID)
5-ALBUFERA DE ANNA (VALENCIA)
6-ALCAZABA, SOLAR DE LA CALLE DE (SEVILLA)
7-ALGARROBO, CUEVA DEL (MALAGA) (**OR**)
8-ALMENDRICOS, EL POBLADO DE EL RINCON DE (MURCIA)
9-AMARGUILLO II, YACIMIENTO DE (SEVILLA) (**OR**)
10-AMBROSIO, CUEVA DE (ALMERIA) (**OR**)
11-ARBIL, CUEVA DE (GUIPUZCOA)
12-ARENERO DE LOPEZ CAÑAMERO (MADRID)
13-BALMA DE LLERA (LERIDA) (**OR**)
14-BARRANC FONDO, COVA DEL (VALENCIA)
15-BARRANC DEL CASTELLET (VALENCIA) (**OR**)
16-BARRANCO 10, CALLE DE (CADIZ)
17-BERNARDA, COVA (VALENCIA)
18-BONICA, COVA (BARCELONA)
19-BORIJOS, CUEVA DE LOS (MALAGA) (**OR**)
20-BOTIQUERIA DELS MOROS (TERUEL) (**ES**)
21-CAMPOS, YACIMIENTO DE (ALMERIA) (**OR**)
22-CAN TINTORER, MINES DE
23-CANTARRANAS (MADRID)
24-CAP GROS, COVA AMPLA DEL (ALICANTE) (**ES** ?)
25-CAPITAN, CUEVA DEL (GRANADA)
26-CAPOTE, CASTREJON DE (BADAJOZ) (**OR**)
27-CAPURRI, EL (VALENCIA)
28-CARIGUELA DE PINAR, CUEVA DE LA (GRANADA)
29-CASTILLICO, CUEVA DEL (ALMERIA) (**OR**)
30-CHAVES, CUEVA DE (HUESCA) (**OR**)
31-CIAVIEJA, YACIMIENTO DE (ALMERIA)
32-DALT, COVA DE (ALICANTE) (**OR**)
33-EMPARETA, COVA (VALENCIA) (**OR**)
34-ESQUERDA DE LES ROQUES DEL PANY (BARCELONA) (**OR**)
35-FONT MAJOR, CUEVA DE LA (TARRAGONA) (**OR**)
36-GUIXERES DE VILOVI, LES (BARCELONA)
37-HIGUERAL, CUEVA DEL (CADIZ)
38-LARA, CASA DE (ALICANTE) (**OR**)
39-LES QUIMERES, CUEVA III DE LA SIERRA DE (TARRAGONA) (**OR**)
40-LLADRES, COVA DE LES (BARCELONA) (**OR**)
41-LLOP, COVA DEL (VALENCIA) (**ES**)
42-LOPEZ, CERRO DE LOS (ALMERIA) (**OR ES**)
43-MAJOLICAS, LAS (GRANADA) (**OR**)
44-MARAVELLES, COVA DE LES (VALENCIA) (**OR**)
45-MARIVER, COVA (GERONA) (**OR**)
46-MARMOLES, CUEVA DE LOS (CORDOBA) (**OR ES**)
47-MOLAR, LA NECROPOLIS IBERICA DE EL (ALICANTE) (**OR**)
48-MONSERRAT, CUEVAS DE (BARCELONA) (**OR**)
49-MONTEROLS, FONDOS DE CABAÑA DE (TARRAGONA) (**OR**)
50-MUJER, CUEVA DE LA (GRANADA)
51-NEGRON, EL (SEVILLA) (**ES**)
52-PECHO REDONDO, CUEVA DE (MALAGA) (**OR**)

53-PEDRO FERNANDEZ, CUEVA DE (MADRID)
54-PENYA ROTJA DE CATAMARRUCH (ALICANTE) (**OR**)
55-PERNERAS, CUEVA (MURCIA)
56-PICADO, CUEVA DE (CADIZ)
57-PILETA, CUEVA DE LA (MALAGA) (**OR**)
58-PINTO, CUEVA DEL (CANTABRIA) (**OR**)
59-PLA, EL (ALICANTE) (**ES**)
60-QUATRE CARRETERES, FONDO DE CABAÑA DE (TARRAGONA) (**OR**)
61-RECAMBRA, COVA DE LA (VALENCIA) (**OR**)
62-SANTORCAZ (MADRID)
63-SANT ANTONI (VALENCIA) (**ES**)
64-SIERRA PALACIOS (CORDOBA)
65-TAPADA, CUEVA (MALAGA) (**OR**)
66-TESORO, CUEVA DEL (MALAGA) (**OR**)
67-VEGA DE SANTA LUCIA, FONDOS DE CABAÑA DE (CORDOBA) (**ES**)
68-VIÑAS, EL POBLADO DE EL CERRO DE LAS (MURCIA) (**OR**)
69-ZORRERA, CUEVA DE LA (MALAGA) (**OR**)

BIBLIOGRAFÍA

Acuña, J.D & F. Robles (1980). La Malacofauna. En: Martí, B.; V. Pascual; M.D. Gallart; P. López; M. Pérez; J.D. Acuña & F. Robles (eds.): *Cova de L'Or (Beniarrés-Alicante)*. Servicio de Investigaciones Prehistóricas, Serie de Trabajos varios 65(II): 257-283.

Agusti, B.; G. Alcalde; A. Güell; N. Juan-Muns; J. Nebot; J.M. Rueda & X. Terradas (1992). Caracoles terrestres en la Cueva 120. *Revista de Arqueología* XII (131): 8-11.

Albizuri, S. & J. Nadal (1992). Estudi preliminar de les restes faunístiques. En: Sanmartí, J. & J. Santacana (eds.): *El Poblat Ibèric D'Alorda Park. Calafell, Baix Penedés. Campanyes 1983-1988. Excavacions Arqueològiques a Catalunya* 11: 289-298.

Almagro Gorbea, M. (1977). El Bronce Final y el periodo orientalizante en Extremadura. *Bibliotheca Praehistorica Hispana* XIV.

Altuna, J. (1965). Fauna del yacimiento "Castro de Peñas de Oro" (Valle de Zuya, Alava). *Boletín "Sancho el Sabio"* IX (1-2): 3-28.

Altuna, J. (1972). Fauna de mamíferos de los yacimientos prehistóricos de Guipúzcoa. *Munibe* XXIV.

Altuna, J. (1985). Los moluscos marinos de Erralla. En: Altuna, J.; A. Baldeón & K. Mariezkurrena (eds.): *Cazadores Magdalenienses en la Cueva de Erralla (Cestona, Pais Vasco). Munibe* (Antropología y Arqueología) XXXVII: 119-121.

Altuna, J. (1990). *La Cueva de Amalda (Zestoa, Pais Vasco). Ocupaciones paleolíticas y postpaleolíticas*. Colección Barandiarán 4. San Sebastián.

Altuna, J. (1993). Archaeozoological research in the Iberian Peninsula. *Archaeozoologia* V(2): 93-100.

Altuna, J. & K. Mariezkurrena (1982). Restos óseos del yacimiento prehistórico de Abauntz (Arraiz-Navarra). *Trabajos de Arqueología Navarra* 3: 347-353.

Amberger, G. (1985). Tierknochenfunde vom Cerro Macareno/ Sevilla. *Studien über frühe Tierknochenfunde von der Iberischen Hanbinsel* 9: 76-105.

Aparicio, J. (1990). Yacimientos arqueológicos y evolución de la costa valenciana durante la Prehistoria. *Academia de Cultura Valenciana. Aula de Humanidades y Ciencias. Serie Histórica* 5: 7-91.

Aparicio, M.T. & M.A. Ramos (1982). Notas sobre la malacofauna del yacimiento paleolítico del Tossal de la Roca (Alicante). *Trabajos de Prehistoria* 39: 69-72.

Azuar Ruíz, R. (ed.) (1989). *La Rabita Califal de la Dunas de Guardamar (Alicante)*. Memorias de la Diputación Provincial de Alicante, Alicante.

Belén, M. & M. Fernández-Miranda (1978). La Tiñosa (Lepe, Huelva). *Huelva Arqueológica* IV: 197-281.

Berrocal-Rangel, L. (1992). Los Pueblos célticos del Suroeste de la Península Ibérica. *Complutum* (ext.) 2.

Boessneck, J. & A. von den Driesch (1980). Knochenfunde aus dem römischen Munigua (Mulva), Sierra Morena. *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 7: 160-184.

Borja, A. (1990). La Malacofauna de La Cueva Amalda. En: Altuna, J.; A. Baldeón & K. Mariezkurrena (eds.): *La Cueva de Amalda (Zestoa, País Vasco): Ocupaciones paleolíticas y postpaleolíticas*: 267-270. Colección Barandiarán 4.

Broncano Rodríguez, S. (1989). El Depósito Votivo Ibérico de El Amarejo. Bonete (Albacete). *Excavaciones Arqueológicas en España* 156.

Cabrera Valdés, V. (1984). El yacimiento de la Cueva del Castillo (Puente Viesgo, Santander). *Bibliotheca Praeshistorica Hispanica* XXII.

Cano Pan, J. & J.M. Vázquez Varela (1991). El aprovechamiento del mar en los castros costeros de Lugo (Galicia). *Paleoecologia e Arqueologia* II: 71-75.

Castaños, P.M. (1981). Estudio de los restos óseos del poblado de San Esteban (El Poyo del Cid, Teruel). *Noticiario Arqueológico Hispánico* 12: 275-286.

Chapa Brunet, T. *et al.* (1979). El poblado de la Edad del Bronce de "El Recuenco" (Cervera del Llano). *Arqueología Conquense* 4.

Clark, G.A. (1974). La ocupación Asturiense de la Cueva de La Riera (Asturias, España). *Trabajos de Prehistoria* 31: 2-30.

Clark, G.A. (1976). El Asturiense Cantábrico. *Bibliotheca Praehistorica Hispanica* XIII.

Clark, G.A. & T.R. Cartledge (1973). Recent excavations at the Cave of Coberizas (Province of Asturias, Spain). *Quaternaria* 17: 387-411.

Clark, G.A. & V.J. Clark (1975). La Cueva de Balmori. *Trabajos de Prehistoria* (Nueva Serie) 32: 35-77.

Davidson, I. (1989). *La Economía del final del Paleolítico en la España Oriental.* Servicio de Investigación Prehistórica. Serie de Trabajos Varios 85. Diputación Provincial de Valencia, Valencia.

Driesch, A. von den (1973). Nahrungsreste Tierischer Herkunft aus einer tartessischen und einer spätbronzezeitlichen bis iberischen Siedlung in Südspanien. *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 4: 9-31.

Driesch, A. von den (1976). Die tierischen Beigaben in den Gräbern de Siedlung "Cuesta del Negro" bei Purullena/Granada. *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 6: 112-117.

Driesch, A. von den (1991). Joachim Boessneck. *Archaeozoologia* IV(1): 9-10.

Driesch, A. von den & J. Boessneck (1976). Die Fauna vom Castro du Zambujal. *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 5: 4-127.

Driesch, A. von den & J. Boessneck (1980). Tierknochenfunde aus Sacaojos bei La Bañeza (prov. León). *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 7: 122-155.

Driesch, A. von den & A. Morales (1977). Los restos animales del yacimiento de Terrera Ventura (Tabernas, Almeria). *Cuadernos de Prehistoria y Arqueología* 4: 15-34.

Driesch, A. von den & B. Richter (1976). Tierknochenfunde aus Penedo de Lexim. *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 5: 144-157.

Driesch, A. von den; J. Boessneck; M. Kokabi & J. Sachäffer (1985). Tierknochenfunde aus der bronzezetlichen Höhensiedlung Fuente Alamo, Provinz Almeria. *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 9: 1-75.

Deibe Balbas, M.A. (1985). Los colgantes magdalenienses de la Cueva de Tito Bustillo. Tesis de Licenciatura. Universidad de Cantabria. (Inédita).

Falkner, G. (1990). Weichtiere. Tierreste aus der prähistorischen Siedlung von Los Castillejos bei Montefrío (Prov. Granada) (Ziegler, R.). *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 12: 15.

Fernández Jurado, J. & P. Rufete Tomico (1987). Informe de la excavación de urgencia realizada en el solar nº 29 de la calle del Puerto de Huelva. *Anuario Arqueológico de Andalucía 1987* III: 274-276.

Fernández-Tresguerres Velasco, J.A. (1980). *El Aziliense en las provincias de Asturias y Santander.* Centro de Investigación y Museo de Altamira. Monografía 2.

Fischer, P.H. (1923). Mollusques quaternaires recoltés por M. l'Abbé Breuil dans diverses stations prehistoriques d'Espagne. *Journal of Conchyology* 67: 160-167.

Friesch, K. (1987). Die Tierknochenfunde von Cerro de La Encina bei Monachil, Provinz Granada (Grabungen 1977-1984). *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 11.

García Sanz, C. (1988-89). El urbanismo protohistórico de Huelva. *Huelva Arqueológica* X-XI(3): 143-176.

García Sanz, C. (1990). Introducción arqueológica. *Huelva Arqueológica* XII: 75-77.

González Echegaray, J. (1985). Introducción geográfica e histórica. En: Barandiarán, I. *et al.* (eds.): *Excavaciones en la Cueva del Juyo*: 7-14. Centro de Investigación y Museo de Altamira. Monografía nº 14. Madrid.

González Echegaray, J. & I. Barandiarán (1981). *El Paleolítico superior de la Cueva del Rascaño (Santander).* Centro de Investigación y Museo de Altamira, Monografía 3, Santander.

González Echegaray, J.; L.G. Freeman; I. Barandiarán; J.M. Apellániz; K.W. Butzer; C. Fuentes Vidarte; B. Madariaga; M.R. González Morales & A. Leroi-Gourham (1980). El yacimiento de la Cueva de El Pendo (Excavaciones 1953-1957). *Bibliotheca Praehistorica Hispana* XVII: 241-245.

González Morales, M.R. & C.M. Márquez Uría (1978). The Asturian Shell Midden of Cueva de Mazaculos II (La Franca, Asturias, Spain). *Current Anthropology* 19(3): 614-615.

González Sainz, C. (1989). *El Magdaleniense Superior-final de la Región Cantábrica.* Ediciones Tantin, Santander.

González Sainz, C. & M.R. González Morales (1986). *La Prehistoria en Cantabria.* Ediciones Tantin, Santander.

González Tablas, F.J.; J.F. Jordá & A. Guillén (1984). Aspectos económicos, funcionales y ambientales de los niveles paleolíticos de la Cueva de Nerja: interrelación entre la industria, la malacología y la palinología. *I Jornadas de Metodología de Investigación Prehistórica*, Soria 1981: 405-416. Ministerio de Cultura, Madrid.

Grayson, D.K. (1984). *Quantitative Zooarchaeology. Topics in the Analysis of Archaeological Faunas.* Academic Press, Inc. Orlando.

Hain, F.H. (1982). Kupferzeitliche Tierknochenfunde aus Valencina de la Concepción/Sevilla. *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 8: 1-171.

Jordá Pardo, J.F. (1981). La malacofauna de la Cueva de Nerja (I). *Zephyrus* 32-33: 87-99.

Jordá Pardo, J.F. (1982). La malacofauna de la Cueva de Nerja (II). *Zephyrus* 34-35: 89-98.

Jordá Pardo, J.F. (1983). La secuencia malacológica de la Cueva de Nerja (Málaga). Excavaciones de 1982. *Cuadernos do Laboratorio Xeoloxico de Laxe* 5: 55-71.

Jordá Pardo, J.F. (1985). La malacofauna de la Cueva de Nerja (III), Evolución medioambiental y técnicas de marisqueo. *Zephyrus* 37-38: 143-154.

Jordá Pardo, J.F. (1986). La fauna malacológica de la Cueva de Nerja. En: Jordá Pardo, J.F. (ed.): *La Prehistoria de la Cueva de Nerja.* Trabajos sobre la Cueva de Nerja 1: 145-177. Patronato de la Cueva de Nerja, Málaga.

Laborde, M.; J.M. Barandiarán; T. de Atauri & J. Altuna (1966). Excavaciones en Marizulo. *Munibe* XVII (1-4): 33-36.

Lauk, H.D. (1976). Tierknochenfunde aus Bronzezeitlichen Siedlungen bei Monachil und Purullena (Provinz Granada). *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 6: 1-109.

Lentacker, A. (1991). Archeozoölogisch onderzoek van laat-prehistorische vindplaatsen uit Portugal. Rijksuniversiteit Gent. Tesis Doctoral, (inédita).

Leoz, I. & C. Labadia (1984). Malacología marina de Ekain. En: Altuna, J. & J.M. Merino (eds.): *El yacimiento prehistórico de la Cueva de Ekain (Deba, Guipúzcoa)*: 287-296. Colección Barandiarán 1.

Llobregat, E.; B. Martí; V. Bernabeu; V. Villaverde; M.D. Gallart; M. Pérez; J.D. Acuña & F. Robles (1981). Cova de Les Cendres (Teulada, Alicante). Informe preliminar. *Instituto de Estudios Alicantinos* 34: 87-111.

Luque, A.A. (1985). Estudio malacológico. En: Martín de la Cruz, J. (ed.): *Papa Uvas I. Aljaraque, Huelva. Campañas de 1976 a 1979*: 259-263. *Excavaciones Arqueológicas en España* 136.

Luque, A.A. & A. Morales (1985). Conclusiones generales sobre la fauna. En: Martín de la Cruz, J. (ed.): *Papa Uvas I. Aljaraque, Huelva. Campañas de 1976 a 1979*: 263-264. *Excavaciones Arqueológicas en España* 136.

Madariaga de la Campa, B. (1971). La fauna marina de la Cueva de Morín. En: González, J. & L. Freeman (eds.): *Cueva Morín, excavaciones 1966-1968*: 399-415. Patronato de las cuevas Prehistóricas de la provincia de Santander II.

Madariaga de la Campa, B. (1975a). Estudio de la fauna marina de la Cueva de Tito Bustillo (Oviedo). En: Moure Romanillo, J.A. (ed.): *Excavaciones en la Cueva de Tito Bustillo (Asturias). Campañas 1972-1974*: 89-107. Instituto de Estudios Asturianos.

Madariaga de la Campa, B. (1975b). Representación malacológica de la Cueva de Tito Bustillo o de "El Ramu" (Oviedo). En: García Guinea, M.A. (ed.): *Primeros sondeos estratigráficos en la Cueva de Tito Bustillo (Ribadesella, Asturias). Excavaciones de 1970*: 71-74. Patronato de las cuevas Prehistóricas de la provincia de Santander XII.

Madariaga de la Campa, B. (1976). Estudio de la fauna marina de la Cueva de Tito Bustillo (Oviedo). Campaña de 1975. *Boletín del I.D.E.A*: 208-227.

Madariaga de la Campa, B. (1978). Los moluscos de Cueva Morín. En: González Echegaray, J. (ed.): *Vida y Muerte en Cueva Morín.* Institución Cultural de Cantabria, Santander.

Madariaga de la Campa, B. (1980). Estudio de las comunidades de moluscos de la Cueva de El Pendo. En: González Echegaray, J. (ed.): *El yacimiento de la Cueva de "El Pendo" (Excavaciones 1953-57)*: 239-245. *Bibliotheca Praehistorica Hispana* XVII.

Madariaga de la Campa, B. & C.A. Fernández Pato (1985). Estudio malacológico de la Cueva de "El Juyo". En: Barandiarán, I.; L.G. Freeman; J. González Echegaray & R.G. Klein (eds.): *Excavaciones en la Cueva de El Juyo*: 77-95. Centro de Investigación y Museo de Altamira. Monografía 14.

Martí Oliver, B. (1977). *Cova de L'Or (Beniarrés, Alicante), I.* Trabajos varios del S.I.P. 51.

Martí Oliver, B.; J. Fortea Pérez; J. Bernabeu Auban; M. Pérez Ripoll; J.D. Acuña; F. Robles Cuenca & M.D. Gallart Martí (1987). El neolítico antiguo en la zona oriental de la Península Ibérica. *Premiéres Communautés Paysannes en Méditerranée Occidentale, Colloque Internationsl du C.N.R.S., Montpellier 1983*: 607-619.

Martinell, J. (1977). Característiques geològiques de la Fonollera i Estudio de la fauna malacológica encontrada en la cala 1/1975. En: Pons, E. *et al.* (eds.): *La Fonollera (T. de M.) Un poblado al aire libre del Bronze Final*: 9-18. CIAG Sèrie Monogràfica 1.

Martinell, J. (1980). Característiques de la fauna trobada a les excavacions arqueológiques realitzades al Puig Mascaró (Baix Empordá-Girona). *Cypsela* 3: 99-102.

Martinell, J. & E. Pons (1989). Restes malacológiques del jaciment arqueológic de La Fonollera (Torroella de Montgrí). *Cypsela* VII: 41-48.

Mas Hernández, J. (1989). Malacología. Listado de especies. En: Martínez Andreu, M. (ed.): *El Magdaleniense Superior en la costa de Murcia* 180. Ed. Regional de Murcia, Murcia.

Mateu Belles, J.F.; B. Martí Oliver; F. Robles Cuenca & J.D. Acuña Hernández (1985). Paleogeografía litoral del Golfo de Valencia durante el Holoceno Inferior a partir de yacimientos prehistóricos. *Pleistoceno y Geomorfología litoral. Homenaje a Juan Cuerda*: 77-101. Universidad de Valencia.

Mergelina, C. de (1939-40). El Pseudo Asturiense de La Guardia (Pontevedra). *Boletín del Instituto de Estudios de Arte y Arqueología* VI: 23-33.

Milz, H. (1986). Die Tierknochenfunde aus drei argarzeitlichen Siedlungen in der Provinz Granada (Spanien). *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 10.

Miro Alaix, C.; N. Molist Capella & J.M. Solias Aris (1982). La Fauna. En: Barbara, J. & E. Sanmarti (eds:): *Excavacions al Poblat Iberic de la Penya del Moro; Sant Just des vern 1974-1975-1977-1978*: 123-133. Ser. Monographies Arqueologique I.

Molero Gutierrez, G.; P. Brea López & V. Bustos Pretel (1984). Estudio faunístico de la Cueva del Cerro de Juan Barbero (Tielmes, Madrid). *Estudios de Prehistoria* 41: 91-98.

Morales Muñiz, A. (1977). Apéndice I. Los restos animales de Castro de Medellín. En: Almagro Gorbea, M. (ed.): *El Bronce Final y el Periodo Orientalizante en Extremadura*: 513-515. *Bibliotheca Praehistorica Hispana* XIV.

Morales Muñiz, A. (1978). Análisis faunístico del yacimiento de La Tiñosa (Huelva). *Huelva Arqueológica* IV: 282-289.

Morales Muñiz, A. (1979a). Informe sobre los restos faunísticos de la Cueva de Cuartamentero (Asturias). *Trabajos de Prehistoria* 36: 497-509.

Morales Muñiz, A. (1979b). Análisis faunístico del yacimiento del Recuenco (provincia de Cuenca). *Arqueología Conquense* IV: 52-54.

Morales Muñiz, A. (1986). Informe faunístico del yacimiento de Aljaraque (Huelva): Corte C-4.3. Fondo nº 3. Sector C. En: Martín de la Cruz, J.C. (ed.): *Papauvas II*: 345-350. *Excavaciones arqueológicas en España* 149.

Morales, A. & R. Moreno (1989). Informe faunístico del depósito votivo de El Amarejo. En: Broncano, S. (ed.): *El depósito votivo Ibérico de El Amarejo. Bonete (Albacete)*: 64-77. *Excavaciones Arqueológicas en España* 156.

Moreno Nuño, R. (1986). Análisis de la malacofauna de Tito Bustillo. Un análisis comparado de las malacofaunas de Asturias y Cantabria. Tesis de Licenciatura. Universidad Autónoma de Madrid. (Inédita).

Moreno Nuño, R. (1987). Estudio Malacológico de Tejada La Vieja. En: Fernández, J. (ed.): *Tejada La Vieja: una ciudad protohistórica*: 261-264. *Huelva Arqueológica* IX.

Moreno Nuño, R. (1988-1989). Puerto 6: los moluscos. En: Fernández, J. (ed.): *Tartessos y Huelva. Huelva Arqueológica* X-XI(3): 245-268.

Moreno Nuño, R. (1990). Los moluscos recuperados en Puerto-29 (Huelva). *Huelva Arqueológica* XII: 107-141.

Moreno Nuño, R. (1992). La explotación de moluscos en la transición Neolítico-Calcolítico del yacimiento de Papa Uvas (Aljaraque, Huelva). *Archaeofauna* 1: 33-44.

Moreno Nuño, R. (1993). El conjunto malacológico del yacimiento portugues de Mértola (Campañas 1990/1991). *Arqueología Medieval* 2: 285-287.

Moreno Nuño, R. (1994a). Conjunto malacológico de la Plaza del Marqués (Gijón). En: Fernández Ochoa, C. (ed.): *La industria de salazones de época romana en la Plaza del Marqués*: 199-204. Ayuntamiento de Gijón, Gijón.

Moreno Nuño, R. (1994b). Los Moluscos. In: Roselló, E. & A. Morales (eds.): *Castillo de Doña Blanca. Archaeo-environmental investigations in the Bay of Cádiz, Spain (750-500 B.C.)*: 143-182. B.A.R. (International Series) 593. Tempus Reparatum, Oxford.

Moreno Nuño, R. (en prensa). Estudio malacológico del yacimiento calcolítico de La Viña (Puerto de Santa María, Cádiz). 14 pp., 6 tablas y 3 figuras. *Noticiario Arqueológico de Andalucía.*

Moreno, R. & A. Morales (1987). Análisis de la malacofauna recuperada en la Cueva de Tito Bustillo (Ribadesella, Asturias). *Boletín del Instituto de Estudios Asturianos* 123: 662-688.

Moreno, R. & L. Zapata (1995). Malacofauna del depósito sepulcral de Pico Ramos (Muskiz, Bizkaia). *Munibe* 47: 187-197.

Moure Romanillo, A. (1976). El santuario paleolítico de Tito Bustillo. *Periplo* 7: 48-53.

Moure Romanillo, A. & M. Fernández-Miranda (1977). El Abrigo de Verdelpino (Cuenca). Noticia de los trabajos de 1976. *Trabajos de Prehistoria* 34: 31-68.

Oller, J. (1988). Estudio conquiliológico y malacológico. En: Olaria, C. (ed.): *Cova Fosca: un asentamiento meso-neolítico de cazadores y pastores en la serranía del Alto Maestrazgo*: 345-353. Monografies de Prehistoria i Arqueologia Castellonenques 3.

Ortea, J.A. (1980). Fauna marina. En: González Morales, M.R. *et al.* (eds.): *El conchero asturiense de la Cueva de Mazaculos II (La Franca, Asturias): campañas de 1976 a 1978*: 60. *Noticiario Arqueológico Hispánico* 9: 60.

Ortea, J.A. (1986). The malacology of La Riera Cave. In: Straus, L. & G. Clark (eds.): *La Riera Cave. Stone Age Hunter-Gatherer Adaptations in Northern Spain*: 289-298. *Anthropological Research Papers* 36.

Peters, J. & A. von den Driesch (1990). Archäozoologische Untersuchung des Tierreste aus des kupferzeitlichen Siedlung von Los Millares (Prov. Almeria). *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 10: 51-110.

Pons, E.; Toledo & A. Colomer (1985). La Fonollera. 10 anys d'investigació arqueológica. *Papers del Montgrí* 4.

Reese, D.S. (1983). Estudio de las conchas del corte 3. En: Aubet, M.E. *et al.* (eds.): *La Mesa de Setefilla, Lora del Río (Sevilla). Campaña de 1979*: 172-173. *Excavaciones Arqueológicas en España* 122.

Rico Alcaraz, J. & C. Martín Cantarino (1989). Malacofauna. En: Azuar, R. *et al.* (eds.): *La Rabita Califal de la Dunas de Guardamar (Alicante)*: 137-163. Memorias de la Diputación Provincial de Alicante, Alicante.

Robles, F. (1980). Los moluscos del Pleistoceno medio de Aridos-1 (Arganda, Madrid). En: Santonja, M.; N. López & A. Pérez (eds.): *Ocupaciones Achelenses en el valle del Jarama (Arganda, Madrid)*: 81-91. Arqueología y Paleoecología 1. Diputación Provincial de Madrid, Madrid.

Rubio de Miguel, I.L. (1976). Aspectos socioeconómicos del Neolítico Peninsular. Universidad Autónoma de Madrid. Tesis Doctoral (inédita).

Sánchez Meseguer, J.; A. Fernández Vega; C. Galán Saulnier & C. Poyato Holgado (1983). *El Neolítico y la Edad del Bronce en la región de Madrid.* Arqueología y Paleontología 3.

Santonja, M. & A. Querol (1980). Yacimientos de la terraza de Aridos: proceso de excavación. En: Santonja, M.; N. López & A. Pérez (eds.): *Ocupaciones achelenses en el Valle del Jarama (Arganda, Madrid)*: 63-79. Arqueología y Paleoecología 1. Diputación Provincial de Madrid, Madrid.

Straus, L.G.; J. Altuna; G.A. Clark; M. González Morales; H. Laville; A.L. Gourhan; M. Menéndez de la Hoz & J.A. Ortea (1981). Palaecology at La Riera (Asturias, Spain). *Current Anthropology* 22(6): 655-682.

Straus, L.G. & G.A. Clark (eds.) (1986). La Riera Cave. *Anthropological Research Papers* 36.

Straus, L.G.; G.A. Clark; J. Altuna & J. Ortea (1980). Ice-Age Subsistence in Northern Spain. *Scientific American* 242(6): 120-129.

Straus, L.G.; G.A. Clark & M.R. González (1978). Cronología de las industrias del Wurm tardio y del Holoceno temprano en Cantabria: Contribuciones del Proyecto Paleoecológico de La Riera. *Serie Universitaria* 77: 37-43.

Uerpmann, M. (1972). Archaeologische Auswertung der Meeresmolluskenreste aus der westphonizischen Faktorei von Toscanos. *Madrider Mitteilungen* 13: 1-46.

Uerpmann, H.P. & M. Uerpmann (1973). Tierknochenfunde aus der phönizischen Faktorei von Toscanos und anderen phönizisch beeinflubten Fundorten der Provinz Málaga in Südspanien. *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 4: 35-100.

Vázquez Varela, J.M. (1975a). Estudio de los concheros de los castros de A Peneda y Montealegre (Pontevedra). *Gallaecia* 1: 142-146.

Vázquez Varela, J.M. (1975b). El Conchero del Castro de Queiruga (La Coruña). *Boletín del Seminario de Estudios de Arte y Arqueología de la Universidad de Valladolid* 40/41: 500-503.

Vega de la Torre, J.J. (1985). Estudio malacológico de las cuevas de Piélago I y Piélago II. *Sautuola* 4: 123-126.

Vila i Mitja, A. (1985). Cingle Vermell: assentament de caçadors-recol.lectors del Xè. mil.lenni B.P. Excavacions Arqueológiques a Cataluña 5.

Vivas, V.E.M. (1987). Valoración de la intervención arqueológica en Cueva Frigiliana. *Anuario Arqueológico de Andalucia 1987* III: 417-423.

Archaeofauna 4 (1995): 273 - 284

VARIABILITY AND SYNCHRONY OF SEASONAL INDICATORS IN DENTAL CEMENTUM MICROSTRUCTURE OF THE KAMINURIAK CARIBOU POPULATION

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ABSTRACT: It has recently been established that microstructural variations in dental cementum indicate not only age, but also the season of death of mammals in highly seasonal environments. Because dental microstructure often remains intact in even fossilized teeth, these phenomena are of particular interest to zooarchaeologists. In this paper the degree to which these seasonal indications vary within one modern population of caribou is assessed. While broad temporal synchrony in cementum growth cycles within the population is demonstrated, variation is exhibited. The sources of variation derive from the mechanical error in specimen preparation and analysis and the different feeding behaviors of the socially segregated caribou.

KEY WORDS: DENTAL ANNULI ANALYSIS, CARIBOU, *Rangifer tarandus*, SEASONALITY, SKELETOCHRONOLOGY, TEETH

RESUMEN: Ha quedado recientemente demostrado que las variaciones microestructurales en el cemento dentario no sólo son indicadores de la edad sino también del momento de muerte de mamíferos que viven en ambientes con cambios estacionales marcados. Dado que con frecuencia la microestructura dentaria permanece intacta, incluso en dientes fosilizados, tales fenómenos resultan de especial interés en arqueozoología. En este estudio se calibra el grado de variación de estos indicadores estacionales dentro de una población extante de caribúes. Si bien se demuestra la existencia de una amplia sincronía en los ciclos de deposición del cemento dentro de dicha población, constatamos asimismo variaciones. Tales fuentes de variación derivan tanto de errores mecánicos en la preparación y análisis de las muestras como de las estrategias alimentarias evidenciadas por las diferentes agregaciones sociales que exhibe esta especie.

PALABRAS CLAVE: ANÁLISIS DE ANILLOS DENTARIOS, CARIBU, *Rangifer tarandus*, ESTACIONALIDAD, ESQUELETOCRONOLOGÍA, DIENTE

INTRODUCTION

Background to the Study

The skeletochronological study of the incremental structures in teeth has a long history in wildlife biology and paleontology. From the early 19th century work of Retzius (1837), to Laws's (1952) presentation of "a new method of age determination in mammals", to the pivotal works of Klevezal' and Kleinenberg (1967), Morris (1972), Spinage (1973), and Grue & Jensen (1979), to innumerable recent studies (see Gordon 1991 for bibliographic review) it has been recognized that variations in the microstructure of dental cementum and dentine may serve as a record of age at death in mammals. The fact that the same microstructural variations in cementum may unambiguously indicate the *season* of death has been more recently established. This information is of particular importance interest to archaeologists investigating prehistoric settlement and subsistence strategies (e.g., Saxon & Higham, 1969; Bourque *et al.*, 1975; Spiess, 1976, 1979; Gordon, 1982, 1988; Stallibrass, 1982; Savelle & Beattie, 1983; Koike & Ohtaishi, 1985, 1987; Pike-Tay, 1989, 1991a, 1991b, 1993; Beasley *et al.*, 1992; Burke, 1992, 1993; Lieberman & Meadow, 1992; Lieberman, 1993a, 1993b, 1994; O'Brien, 1994). Modern control samples of the same (or at least two closely related) species from broadly similar environmental and ecological conditions are a necessary prerequisite for any seasonality study of archaeofauna. However, the procurement of sufficient numbers of animals for appropriate control samples of known age and season-of-death is a difficult and time intensive undertaking. Therefore, when my colleagues at New York University and I were able to obtain a collection of right mandibular teeth of an entire population of *Rangifer tarandus*

groenlandicus individuals from the Canadian Wildlife Service, a research project was designed to record skeletochronological and other metrical data (Pike-Tay *et al.*, n.d.) of relevance to zooarchaeology. In this report, I present the degree to which the seasonal indications gained from dental cementum vary within one population of barren-ground caribou, inhabitants of a highly seasonal environment.

Background to Dental Cementum Biology

Teeth are composed of three distinct types of mineralized tissue: dentine, cementum, and enamel. Each tissue is made up of two components: the inorganic crystallites of dahllite (a carbonate hydroxyapatite) and the proteins and lipids that comprise the organic matrix of the tissue. Each tissue is incremental in structure (Boyde & Jones, 1972; Hillson, 1986; Carlson, 1990). The physical and optical expressions of incremental "lines," or growth layers in teeth are due to differing patterns of collagen fiber organization and cell content (Castanet, 1981; Francillon-Vieillot *et al.*, 1990). In the case of dental cementum the differentiation of growth layers is the result of seasonal rhythms of cementoblast activity and quiescence, i.e., variable growth rates, and of occlusal strain (Lieberman, 1993a, 1993b). Generally, two types of growth increments are recognized in cementum: *annuli*, the narrow, relatively more mineralized increments that temporally correspond to "winter" and a physiological period of slow growth; and *zones*, the wider, relatively less mineralized increments that correspond to the onset and fruition of the warm season, a period of relatively rapid growth (Klevezal' & Kleinenberg, 1967; Castanet, 1981; Francillon-Vieillot *et al.*, 1990).

The Kaminuriak Control Sample

The study collection is comprised of the right mandibular teeth of 999 members of the Kaminuriak population of barren-ground caribou and is housed at New York University's Department of Anthropology. The caribou were collected by the Canadian Wildlife Service (CWS) during the months of April, May, June, July, September, November, and December, from the spring of 1966 through the summer of 1968 (Parker, 1972; Dauphiné, 1974; D.R. Miller, 1974; F.L. Miller, 1974). A major goal of the CWS project was to obtain animals during their major life history phases. A total of 563 females and 436 males were collected. The sexually mature segment (46 months and over) comprised 306 females and 178 males. Ages of the animals were determined by a combination of methods: 1) records of animals tagged at birth; 2) microscopic analysis of histologically prepared slides of cementum annuli of the mandibular incisors; and 3) eruption and wear estimates and linear dental measurements. Results from all three were in agreement (F.L. Miller, 1974). The demographic data was used by the CWS to assess the effects of natality and mortality on the population as well as the ages and sexes of the caribou grouping together during different seasons of the year. Observations of group structuring were made throughout the collection period. A high degree of segregation in the caribou bands was noted, particularly in spring, leading to the conclusion that caribou are socially cohesive (*Ibid*).

Changes in diet, specifically, hardness of food and its nutritional content, have been shown to effect dental cementum microstructure by causing variations in collagen fiber orientation and/or

collagen mineralization in controlled laboratory experiments by Lieberman (1993a, 1993b, 1994). His study suggests that the two dietary variables may operate independently. The harder the substance chewed, the more vertically oriented relative to the dentine-cement border (Figure 1) the Sharpey's fibers (extrinsic collagen fibers of cementum that originate in the periodontal ligament) become in order to accommodate the higher tensile strains of mastication. This is consistent with cementum's primary function of anchoring the tooth in the alveolar socket. The lower the protein and mineral value of the food, the more mineralized (denser) is the cementum layer that is deposited. The rate of mineralization remains constant, but the rate of formation (the growth rate) of the collagen matrix is greatly reduced with poorer quality diet (Klevezal', 1980; Jones, 1981; Lieberman, 1993a, 1993b).

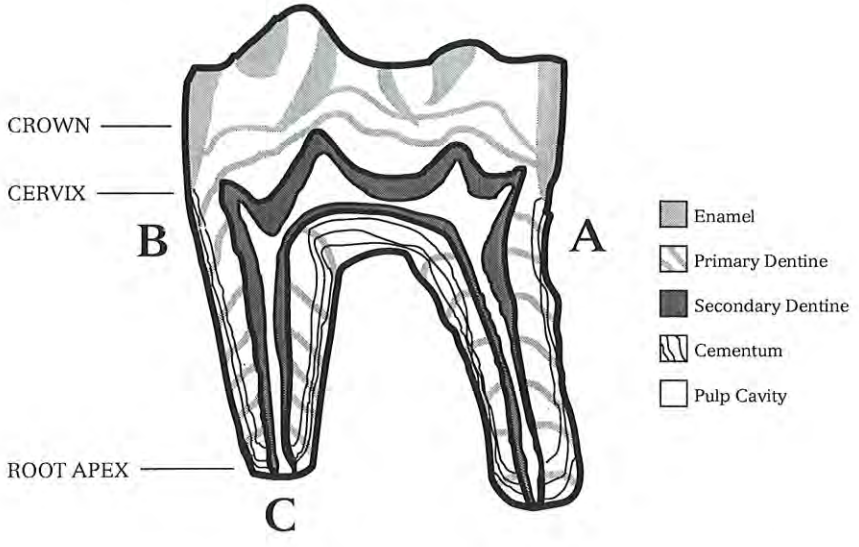

FIGURE 1. Drawing of a longitudinal section of a *Rangifer* molar indicating dental tissues and areas of cementum analyzed, where A and B are the distal side and mesial areas (respectively) of acellular cementum that extends from the root-enamel junction towards the root apices and C is the root apex area of cellular cementum. The interradicular arch ("root pad") is the other area of acellular cementum.

The diet of Kaminuriak caribou varies greatly with local geography and the seasons. The study area of the CWS project encompassed the total range of the Kaminuriak population, some 282,000 km^2 of northern Manitoba, northeastern Saskatchewan, and the southeastern district of Keewatin, Northwest Territories —- area covered with bogs and muskegs. Environmental and ecological aspects of various portions of the study area have been described in detail (Beckel, 1958a, 1958b; Rowe, 1959; D.R. Miller, 1974). The most pronounced difference in food quality is that of winter compared to the warmer months. Rowe (1959) places the range of the Kaminuriak population within three floristic types; tundra, forest-tundra, and the Northwestern Transition sections of the boreal forest. Winters are severe and long (temperatures consistently below -29°C, often below -40°C), springs are wet and cool, and summers are relatively dry and moderate (24-26). As a general rule, the animals seek out plants with the highest available protein and fat content wherever they range. In spring the caribou feed on herbaceous plants newly uncovered by snow, growing willow leaves (*Salix*) and other buds, and new sedge (primarily *Carex*) and grass shoots. In summer they

feed on nearly all available growing green plants, especially willow shoots and leaves. The bases of sedges and grasses remain green for sometime after the arrival of the autumn frosts while herbaceous plants and willows lose most of their available protein. Thus, there is a notable dietary shift to a harder textured diet of grass and sedge during late fall into early winter for caribou still outside of the forest. Caribou that move into the boreal forest at this time search intensely for a range of fungi, which have substantially higher protein and fat content than other available plants. After the snow has covered the fungi and any remaining green plants the caribou wintering in the forest turn to (primarily arboreal) lichens including *Alectoria jubata* and *Cladonia*. While lichen protein content is lower than that of forage consumed in other seasons, it is higher than that of other winter-available plants which lie dormant (Kelsall, 1968; Dauphiné, 1974; D.R. Miller, 1974; F.L. Miller, 1974).

METHODS

Given the variable feeding behaviors among the sexes and ages of caribou, I tested for the synchrony of dental cementum growth rates among population members. Results of this initial skeletochronological study of the Kaminuriak collection are based on subsamples of 875 longitudinal (mesio-distal radial) ground thin sections of 677 teeth of 348 male and female animals. The breakdown of this sample is presented in Table 1. Initial preparation of the fresh mandibles by the CWS included soaking in hot water for several days to loosen soft tissue and any foreign material and allow easy removal. The molariform teeth were then gently removed with tooth extractors, fixed in 5% formalin solution, rinsed in H_2O, and dried. At NYU the teeth were embedded in epoxy, sectioned in the mesio-distal plane, ground to a thickness of 30-50 μm, and polished.

AGE CLASS	of thin sections	of teeth	of individuals	sex
Calves (0-9 months)	53	47	26	(11F, 15M)
Yearlings (10-23 months)	104	89	46	(21F, 25M)
Juveniles (24-35 months)	161	135	60	(25F, 35M)
Subadults (36-59 months)	78	61	34	(12F, 22M)
Prime adults (60-119 months)	407	287	158	(107F, 51M)
Post-prime (> 120 months)	72	58	24	(22F, 2M)
TOTAL	875	677	348	(198F, 150M)

TABLE 1. Sub-Sample of Right Mandibular Kaminuriak teeth for results discussed here.

Seasonal growth increments are clearly visible in the dental cementum of teeth of the Kaminuriak population with backscattered SEM (Figure 2), reflected light microscopy, white transmitted light, and polarized transmitted light (Figure 3). The wider increments of cementum were formed during the warmer months and appear light in color value and opaque under reflected light microscopy; light (bright) with backscattered SEM and transmitted polarized light (where increments are oriented at a 45° angle to the primary N-S axis of polarization), and dark under transmitted white

light. The narrow increments of cementum were formed during the winter months and appear: dark in color value and transluscent under reflected light microscopy; dark with backscattered SEM and transmitted polarized light; and bright under transmitted white light. Because of its efficiency and cost effectiveness, I employed polarized transmitted light microscopy for the analysis of the 30-50 μm thick "dry" ground and polished longitudinal sections of teeth. Magnifications of 100x and 250x were most commonly employed. For image and data recording: 1) video images of the thin section were directly transferred from the microscope to the computer; 2) each cementum zone 's (i.e., growth layer's) width was measured in sequence at two or three transects per tooth; 3) measurements were then converted from pixels to microns and standardized so that different magnification scales could be compared. The mean, variance, and standard deviation were computed, and the relationship of the final cementum increment's width to the widths of the preceding increments was established. Since cementum grows in consecutive sheaths around the dentine core of a tooth, the final, outermost layer deposited is that which provides seasonal information.

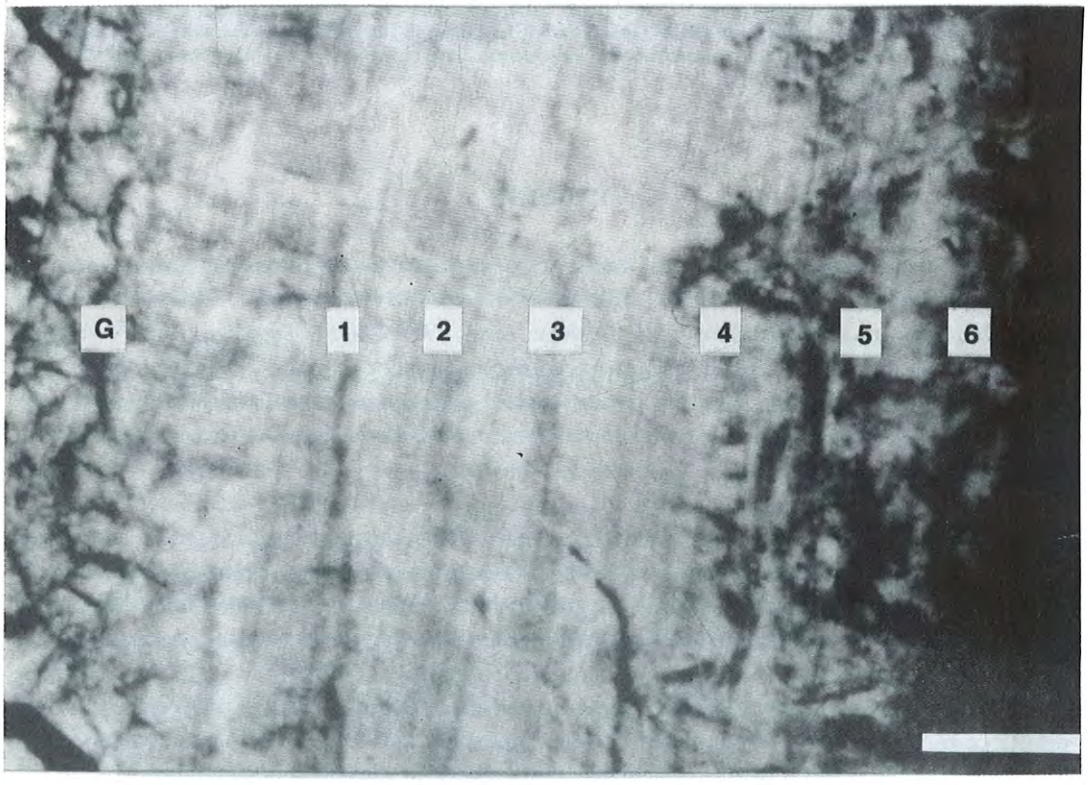

FIGURE 2. Backscattered Electron Image of a longitudinal thin section (40 μm thick) just below the root-enamel junction of an M_2 of a 7 year old female killed on June 20, 1966. Scale bar, 10 μm. Cementum-dentine border (granular layer of Tomes) (G); winter-formed *annuli* are numbered, with final growth *zone* just beginning after the 6^{th} annuli.

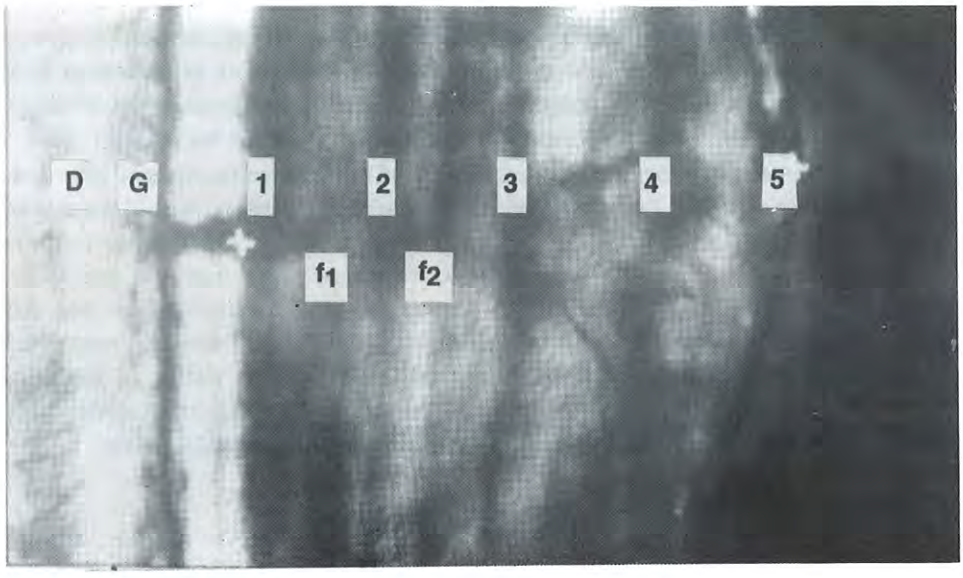

FIGURE 3. Transmitted polarized light micrograph (mag. 250X) of ground longitudinal thin section (40 μm thick) of the P_4 of a 6.4 year old female killed on November 25, 1966. Dentine (D), cementum-dentine border (granular layer of Tomes) (G), winter-formed annuli are numbered, the final (5^{th}) annuli is just beginning to form; "false" or secondary lines (f_1, f_2) are marked. The false lines are easily distinguished from the winter annuli because the former are discontinuous while the latter extend around the entire root.

RESULTS

Dental cementum is comprised of two types of collagen fibers: Sharpey's fibers, which are formed by fibroblasts of the periodontal membrane and are therefore extrinsic fibers and intrinsic fibers which are formed by the cementoblasts (Noyes *et al.*, 1938; Scott & Symons, 1977). Two types of cementum are recognized based upon the presence or absence of cells. Acellular (often called "primary") cementum extends from the cement-enamel junction and extends toward the root apex (Figure 1). Most of the collagen in acellular cementum consists of Sharpey's (extrinsic) fibers (3). Cellular ("secondary") cementum increases in thickness toward the root apices and at the interradicular arch, i.e., the "root pad". Lacunae are commonly and irregularly distributed throughout cellular cementum. Incremental layers may be counted in both types of cementum. Accurate age estimates of animals from examination of areas of cellular or acellular cementum are obtained by adding the age of the animal at the time the particular tooth erupts to the number of visible annuli. However, it is argued that accurate assessments of *season* of death, in ungulates at least, can only be taken from measurements of acellular cementum (Gordon, 1982; Pike-Tay, 1991a; Lieberman, 1993a). To test the latter, I took measurements from areas of cellular and acellular cementum from the teeth of forty-one adult caribou killed in June, September, and November. Measurements of the growth zone widths along transects of acellular cementum near the cement-enamel junction for site "A" on the distal side and site "B" on the mesial side, as well as of cellular cementum, at site "C," at the root apices (Figure 1) demonstrate that for *Rangifer*, cementum is deposited at a fairly regular seasonal rate only in areas of acellular cementum (Table 2).

A - Site	
Distal side	1.9
B - Site	
Mesial side	2.7
C - Site	
Root apex	16.8

TABLE 2. Mean Standard Deviation of Cementum Growth Zone Widths of teeth of 41 prime adult caribou killed in June, September & November.

To assess the role of mechanical error in the orientation and placement of the "cut" from which a thin section is made, three consecutive and longitudinally oriented slices of the tooth root were made and measurements of cementum growth zones from each were compared. 'A' was the buccal-most (cheek side) and superficial slice, 'B' next, and 'C' at, or nearest to, the mesio-distal midline of the tooth. The original thick sections of tooth were approximately 1 mm thick, and then were ground and polished to the 30-50 μ thickness. A standard error percent calculation was performed on the widths of final growth zone relative to the previous annual zone widths along two transects for each slice. Analysis of 24 thin sections comprised of 3 slices per tooth from 8 teeth revealed that the maximum width difference between final cementum zones from slice B and slice C (the midline) was 21%, while the maximum width difference between outermost buccal slice A and slice C was 33%. Therefore, in order to standardize results obtained, mesial-distal sections were taken only from the mid-line of each tooth for this study.

To test the assumption that any given tooth from an animal should reveal identical information regarding age and season of death, relative widths of the final cementum zone of two premolars and two molars from the same animals were compared to one another. Sections taken from the mid-line of 48 teeth, 4 each per 12 individuals, showed a range of variation of 3% to 19% in the percentage completeness of the outermost growth zone. In the teeth of ten out of twelve animals, however, the range of difference among the teeth of each animal was less than 10% (Table 3).

RANGE	3% - 19%
MEAN Standard Deviation of % Complete of Final Growth Zones:	
	mean = 3.49
	standard error = .6
	variance = 4.4

TABLE 3. Range of variation in % completeness of the final cementum zone among 4 teeth of the same animal based on 48 teeth from 12 individuals.

These results reveal that some difference does exist among the measured widths of increments at the sites of acellular cementum from the various teeth of an individual. The difference did not appear to be systematic or predictable and is assumed to be as much a result of the unavoidable mechanical error of specimen preparation and data recording as of actual variation among teeth. Important perhaps is the qualitative assessment that anomalous and very individual "fingerprints" such as false or secondary annuli can be identified in the same location on each tooth of an individual.

Within the total sample examined no sex-linked differences in the initiation of the 'true winter rest line' (annulus) or in the many occurrences of secondary or false annuli (Figure 3) (sometimes called rutlines) were detected. This is notable since rutting male caribou lose body weight and fat reserves from October to December and female caribou continue to gain weight and store fat during the same period (this confirms the observations of F.L. Miller, 1974).

In terms of the timing of initial cementogenesis, my findings concurred with those of F.L. Miller (1974) per his examination of the incisors of Kaminuriak juveniles. Miller notes that the apposition of 'light' cementum in the incisors begins by the fifth month of the *Rangifer* calves' life and the first annulus forms during the first winter of life. For Rangifer, i1 begins eruption at 9 months and is in occlusion by 13 months; with i2 and i3 beginning eruption at 11 months and in full occlusion by 15 months. Examination of the mandibular teeth revealed the pre-eruptive deposition of what has been called intermediate cementum at the dentine margin. This is a dense collagen-poor layer of cementum that is deposited at the dentine margin after formation of the tooth root but before the tooth is in occlusion. This pre-eruptive zone of irregular width has been reported for a wide range of mammals, including *Cervus* (Mitchell, 1963; Pike-Tay, 1989); *Rangifer* (Reimers & Nordby, 1968); and others cited in Lieberman (1993b). Formation of the first annulus of the Kaminuriak samples occurred during the first winter of the tooth's life.

A summary of the timing of cementum growth and annuli formation for the Kaminuriak sample and the variation observed among the teeth of 216 non-juvenile individuals (ages and sex per Table 1) is presented in Table 4. For statistical integrity this sub-sample was limited to sub-adult, adult, and post prime adult animals where cementum had more than three complete growth zones. It is important to note that cementum increments in the teeth of the post-prime adult caribou often (30% of sample) reveal substantial differences in width between the earlier deposited layers which become "compressed" and those that follow. When this phenomenon occurred it was after the seventh annuli that the increments became wider. This pattern has also noted by McEwan (1963) and F.L. Miller (1974) for *Rangifer*; Klevezal' & Pucek (1987) for *Bos/Bison* and Pike-Tay (1991) for *Cervus*. For this reason, season of death measurements from the teeth of post-prime adults in the Kaminuriak sample are restricted to the more recently formed, "un-compressed" increments of acellular cementum, which were of surprisingly even widths.

MONTH	MEAN	STANDARD DEVIATION	most commonly observed	total range	predicted growth*
April	6.5%	4	4% - 9%	0%- 17%	11%
May	-	-	-	-	22%
June	15%	10	16% - 25%	0%-32%	33%
July	-	-	-	-	44%
August	-	-	-	-	55%
September	68%	8	60% - 78%	53%-86%	66%
October	-	-	-	-	77%
November	93%	7.5	84% - 100%	78%-100%	88%
December	94%	6	94% - 100%	85%-100%	99%
January			*in winter annuli*		
February			*in winter annuli*		
March			*in winter annuli*		

TABLE 4. *Rangifer* Cementum: % Final Growth Zone Complete of the Kaminuriak Sample.
* **predicted growth:** if rate of growth is constant from April through December.

The seasonal indications gained from various members of the Kaminuriak population reveal a maximum difference of 33% in the widths of the final cementum zones of teeth from animals killed during the same month of the year (Table 4). If the hypothesis that dietary changes in food hardness and nutritional content effect dental cementum microstructure by causing variations in collagen fiber orientation and/or collagen mineralization (Lieberman, 1993a, 1993b) is valid, then the amount of variation observed is not surprising. As noted above, a high degree of social segregation was observed in the caribou bands. Therefore, dietary behaviors and geographic range of the caribou vary along sex and age lines at any given season. Nonetheless, the dramatic changes in cementum microstructure of teeth from caribou in the highly seasonal environment of the barren-grounds reveal no overlap between the early and late segments of the warm season. Moreover, the initiation of the winter annulus is fairly synchronized. The cessation of the winter annulus and initiation of the growth zone occurs most commonly in early April with 100% completion of the zone attained from mid-November through the end of December (It is not possible to subdivide the winter-formed annuli of this sample of *Rangifer* with the mechanical means employed; i.e., polarized transmitted light images measured with the National Institute of Health's public domain software IMAGE 1.43). If the rate of cementum deposition is constant across a zone, about 11% growth per month is expected. As can be seen in Table 4, the mean actual growth per month is close to the estimated constant rate with *all* predicted values falling within the observed range with the exception of the one percentile lag in June. Deposition of the growth zone is slightly slower in the beginning of the warm season but attains a fairly constant rate by mid-summer.

DISCUSSION

The seasonal indications gained from dental cementum of this population of barren-ground caribou were found to vary and concur along several lines. First, it was found that due to mechanical error involved in the orientation and slicing of the tooth, standardized results could only be obtained from longitudinal sections at the mesial-distal midline of a tooth.

Second, testing for the synchrony and constancy of cementum growth rates among the *Rangifer* population members revealed that: 1) cementum is deposited at a regular rate only in areas of acellular cementum; 2) the initiation of the growth zone is well synchronized with deposition being slightly slower early in the warm season but then assuming a roughly constant rate by mid-summer; 3) No overlap exists between the early and late segments of the warm season; 4) the initiation of the winter annulus is less well synchronized than its cessation and, 5) Multiple teeth from a given individual vary little from one another tooth in regard to the seasonal indications provided by cementum annuli analysis. Frequent occurrences of 'false' or 'secondary' annuli could not be linked to sex differences. Yet, these stigmata tend to occur in the same position on all the teeth of an individual. Such 'fingerprints' may prove useful in linking isolated archaeological teeth to the same individual.

Third, the teeth of the post-prime adult caribou often yield substantial differences in width between the earlier deposited cementum layers (which become "compressed") and those that follow. The same has been observed by other researchers of *Rangifer*, *Bos/Bison* and *Cervus* (McEwan, 1963; Miller, 1974; Klevezal' & Pucek, 1987; Pike-Tay, 1991). For this reason, season of death

measurements from the teeth of post-prime adults should be restricted to the more recently formed, "un-compressed" increments of acellular cementum.

Fourth, evidence from the juveniles examined demonstrates that pre-eruptive cementogenesis yields intermediate cementum at the dentine margin and is followed by the apposition of the first annulus during the first winter of the tooth's existence.

If dietary changes including hardness of food and its nutritional content affect dental cementum microstructure by 1) causing variations in collagen fiber orientation as a result of the orientation and degree of tensile forces, and 2) affecting the rates of collagen matrix production (Lieberman, 1993a, 1993b); then, the variation in dental cementum growth rates observed among members of the Kaminuriak population is understandable.

CONCLUSIONS

Notable differences in feeding behaviors and local range of the two sexes and seasonally-changeable caribou social groupings exist, eventhough the caribou occupy a highly seasonal environment. At the same time the overall seasonal synchrony of cementum development among population members underscores the potential of cementum annuli analysis as an indicator of age, season of death, and related life history variables in both modern and archaeological faunas where the cementum microstructure is preserved. However, in addition to working with modern control samples the zooarchaeologist must take complex taphonomic variables into account when examining archaeological teeth. I have recently begun controlled taphonomic experiments assessing the impact of a range of variables (boiling, freezing, fire, trampling, etc.) on dental cementum. I hope that this work will contribute to the refinement of the investigative techniques of skeletochronology for archaeology.

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BIBLIOGRAPHY

Beckel, D.K.B. (1958a). A pilot study of caribou winter range, Brochet, Manitoba. *Canadian Wildlife Service Report* 919.

Beckel, D.K.B. (1958b). A pilot study of caribou summer range (calving ground) Kaminuriak, NWT. *Canadian Wildlife Service Report* 920.

Boyde, A. & S. Jones (1972). Scanning Electron Microscopic Studies of the Formation of Mineralized Tissues. In: Slavkin, H. & L. Bavetta (eds.): *Developmental Aspects of Oral Biology*: 243-274. Academic Press, New York.

Burke, A. (1992). *Prey Movements and Settlement Patterns During the Upper Palaeolithic in Southwestern France*. PhD thesis, New York University. University Microfilms, Ann Arbor, Michigan.

Burke, A. (1993). Observation of Incremental Growth Structures in Dental Cementum Using the Scanning Electron Microscope. *Archaeozoologia* V/2: 41-54.

Carlson, S. (1990). Vertebrate Dental Structures. In: Carter, J. (ed.): *Skeletal Biomineralization: Patterns, Processes and Evolutionary Trends*, Vol. 1: 531-556. Van Nostrand Reinhold, New York.

Castanet, J. (1981). Nouvelles données sur les lignes cimentantes de l'os. *Archives Biologiques* 92: 1-24.

Dauphiné, T.C. (1974). Biology of the Kaminuriak Population of barren-ground caribou. Part 3: Growth, reproduction and nutritional condition. *Canadian Wildlife Service Report Series* 31.

Francillon-Vieillot, H.; V. de Buffrénil; J. Castanet; J. Géraudie; F.J. Meunier; J.Y. Sire; L. Zylberberg; A. de Ricqlès (1990). Microstructure and Mineralization of Vertebrate Skeletal Tissues. In: Carter, J. (ed.): *Skeletal Biomineralization: Patterns, Processes and Evolutionary Trends* Vol. 1: 471-530. Van Nostrand Reinhold, New York.

Gordon, B. (1982). Tooth Sectioning as an Archaeological Tool. *Canadian Studies Report* 14. National Museum of Man, Archaeological Survey of Canada, Ottawa.

Gordon, B. (1988). *Of Men and Reindeer Herds in French Magdalenian Prehistory*. B.A.R. (International Series) 390, Oxford.

Gordon, B. (1991). Archaeological Seasonality Using Incremental Structures in Teeth: An Annotated Bibliography. *Zooarchaeological Research News Supplement.*

Grue, H. & B. Jensen (1979). Review of the Formation of Incremental Lines in Tooth Cementum of Terrestrial Mammals. *Danish Review of Game Biology* 11: 1-48.

Hillson, S. (1986). *Teeth*. Cambridge University Press, Cambridge.

Jones, S.J. (1981). Dental Tissues. In: Osborne, J.W. (ed.): *Dental Anatomy and Embryology*: 66-209. Blackwell, Oxford.

Kelsall, J.P. (1968). The migratory barren-ground caribou of Canada. *Canadian Wildlife Service* Monograph No.3.

Klevezal', G. (1980). Layers in the Hard Tissues of Mammals as a Record of Growth Rhythms of Individuals. *Report of the International Whaling Commission,* Special Issue 3: 89-94.

Klevezal', G. & S. Kleinenberg (1967). *Age Determination of Mammals by Layered Structure in Teeth and Bone*. Canada Foreign Languages Translations, Quebec.

Klevezal', G. & Z. Pucek (1987). Growth Layers in Tooth Cement and Dentine of European Bison and its Hybrids with Domestic Cattle. *Acta Theriologica* 32(9): 115-128.

Laws, R.M. (1952). A New Method of Age Determination for Mammals. *Nature* 169: 972.

Lieberman, D. (1993a). *Mobility and Strain: the Biology of Cementogenesis and its application to the Evolution of Hunter-Gatherer Seasonal Mobility in the Southern Levant during the Late Quaternary*. PhD thesis, Harvard University. University Microfilms, Ann Arbor, Michigan.

Lieberman, D. (1993b). Life History Variables Preserved in Dental Cementum Microstructure. *Science* 261: 1162-1164.

Lieberman, D. (1994). The Biological Basis for Seasonal Increments in Dental Cementum and Their Application to Archaeological Research. *Journal of Archaeological Science* 21: 525-539.

Lieberman, D. & R. Meadow (1992). The Biology of Cementum Increments (an Archaeological Perspective). *Mammal Review* 22: 57-77.

McEwan, E.H. (1963). Seasonal Annuli in the Cementum of the Teeth of Barren Ground Caribou. *Canadian Journal of Zoology* 41(1): 111-113.

Mitchell, B. (1963). Determination of Age in Scottish Red deer from Growth Layers in Dental Cementum. *Nature* 198: 350-351.

Miller, D.R. (1974). Biology of the Kaminuriak Population of barren-ground caribou. Part 4: Taiga winter range relationships and diet. *Canadian Wildlife Service Report Series* 31.

Miller, F.L. (1974). Biology of the Kaminuriak Population of barren-ground caribou. Part 2: Dentition as an indicator of age and sex; composition and socialization of the population. *Canadian Wildlife Service Report Series* 31.

Morris, P.A. (1972). A Review of Mammalian Age Determination Methods. *Mammal Review* 2: 69-104.

Noyes, F.; I. Schour & H.J. Noyes (1938). *A Text-Book of Dental Histology and Embryology.* Lea & Febiger, Philadelphia.

O'Brien, C. (1994). *Determining Seasonality and Age in East African Archaeological Faunas: An Ethnoarchaeological application of Cementum Increment Analysis.* PhD thesis, University of Wisconsin, Madison. University Microfilms, Ann Arbor, Michigan.

Parker, G.R. (1972). Biology of the Kaminuriak Population of barren-ground caribou. Part 1: Total numbers, mortality, recruitment, and seasonal distribution. *Canadian Wildlife Service Report Series* 20.

Pike-Tay, A. (1989). *Red Deer Hunting in the Upper Paleolithic of Southwest France: A Seasonality Study.* PhD thesis, New York University. University Microfilms, Ann Arbor, Michigan.

Pike-Tay, A. (1991a). *Red Deer Hunting in the Upper Paleolithic of Southwest France: A Study in Seasonality.* B.A.R. (International Series) 569. Tempus Reparatum, Oxford.

Pike-Tay, A. (1991b). L'Analyse du cement dentaire chez les cerfs: l'application en Préhistoire. *Paléo* 3: 149-166.

Pike-Tay, A. (1993). Hunting in the Upper Périgordian: A Matter of Strategy or Expedience?. In: Knecht, H.; A. Pike-Tay & R. White (eds.): *Before Lascaux: The Complex Record of the Early Upper Paleolithic.* CRC Press, Boca Raton.

Pike-Tay, A.; R. White; C.A. Morcomb & M. O'Farrell (in preparation). Reconsidering the Potential of the Quadratic Crown Height Method of Age Estimation for Archaeological Faunas: Implications of the Kaminuriak Control Sample.

Reimers, E. & Ø. Nordby (1968). Relationship between age and tooth cementum layers in Norwegian Reindeer. *Journal of Wildlife Management* 32(4): 957-961.

Retzius, A. (1837). Bemerkungen über den innern Bau der Zähne, mit besonderer Rücksicht auf den in Zahnknochen vorkommenden Röhrenbau. *Archiv für Anatomie und Physiologie* 1837: 486-565.

Rowe, J.S (1959). Forest regions of Canada. *Canadian Department of Northern Affairs Natural Resources, Forestry Bulletin* 123.

Scott, J.H. & N.B.B. Symons (1977). *Introduction to Dental Anatomy.* Churchill Livingstone, Edinbourgh.

Spiess, A. (1976). Determining the Season of Death of Archaeological Fauna by Analysis of Teeth. *Arctic* 29: 53-55.

Spiess, A. (1979). *Reindeer and Caribou Hunters: An Archaeological Study.* Academic Press, New York.

Spinage, C.A. (1973). A Review of Age Determination of Mammals by Means of Teeth, with Especial Reference to Africa. *East African Wildlife Journal* 11: 165-187.

Book Review

Benecke, N. (1994). *Der Mensch und seine Haustiere. Die Geschichte einer Jahrtausendenalten Beziehung.* Theiss, Stuttgart. 470 pages, 32 tables, 263 photos and drawings, hard cover with jacket. DM 128, till 31-12-1994 DM 98.

This book is certainly not the first comprehensive history of domestic animals (Keller, 1902, 1905, 1919; Hilzheimer, 1926; Zeuner, 1963) and it will probably not be the last, but it is a good, scholarly written and readable book, with a wealth of information.

It was Keller who in the early 20th century (1902, 1905, 1909) wrote about domestic animals and more specifically about their history which was at that time not yet clear for several species. Nowadays this is no longer a question but a known fact in most cases. This book shows the progress of the discipline of *Archaeozoology* which at the turn of the century was known in the German speaking world as *Haustierkunde*, the study of domestic animals.

In the first chapter, *Quellen zur Haustiergeschichte's* (sources of the history of domestic animals), Benecke gives a short summary of the way in which archaeozoologists obtain data. This is basically made by studying subfossil animal remains. Firstly, the species are identified, secondly, whenever possible, the specimens are aged and sexed and thirdly they are quantified. Different quantification methods are available, i.e. bone weight, number of bones and the estimation of minimum numbers of individuals. He also comments on the possibility of direct dating of bone by C^{14} and the indirect dating of bone assemblages by their archaeological or geological context. Finally, descriptions of the contemporaneous domestic species are another important source to understand their role in the past.

In the following chapter Benecke discusses the zoological aspects of domestic animals. In the first place he deals with the question of what constitutes a domestic animal and the different aspects of domestication, taming and the use of tamed animals. One point of interest here is the observation that in Moravian there are indications that as early as the Late Palaeolithic wolves lived among the inhabitants of Dolni Vestonica Pretnosti and Mezin. Although not truly domesticated, such animals lived together with people in an environment created by man.

In the third chapter Benecke discusses the role of human hunters and early domestication in the Near East, Asia and South America. A substantial part of the book is devoted to the beginning of animal husbandry in southern Europe, the colonisation of Europe by farmers in the Neolithic, and the subsequent history up to the Middle Ages. Much attention is given to the composition of the domestic species and the percentages of wild and domestic species in faunal assemblages from archaeological sites. Benecke stresses that in southern Europe stockbreeding retained its Near Eastern form with predominantly sheep/goat, which by the Bandceramic stockbreeders was adapted to Mid-and Northwest-European conditions with an emphasis on cattle. He deals with the use of domestic animals by man, first as providers of meat, fat, hides, bone and horn, and later of milk, wool and traction. The ways in which domestic animals were kept, bred and what their phenotype was, is also discussed.

This chapter is followed by descriptions of each of the domesticated animal species, including birds, fishes and insects.

In the 5th chapter the newly domesticated Elk, Fallow deer, and Musk ox

are described, while the last chapter discusses the use of tamed animals such as Elephants, Cheetahs, Mongooses, Cormorants and birds of prey.

One misses a discussion about the fact that animals were not domesticated in North America and the fact that stockbreeding reached Japan at a late date, ca. 100 BC, although the inhabitants of the Japanese islands had produced and used pottery and lived a sedentary life since 7000 BC. Why did this Jomon period lasted for so long and why hunting-gathering was abandoned virtually overnight by animal husbandry and the cultivation of rice some 2000 years ago?.

It is annoying to see that of the literature on which the book is based only part is to be found in the references, so that in many instances it is impossible to find the publications if one wants to use the information in another context. However, for readability it is a good formula to quote every reference within the text.

All in all as I mentioned at the beginning, *Der Mensch und seine Haustiere* is a good reference providing excellent overview of archaeozoological knowledge at the end of the twentieth century. I wish that this work could be translated into English in the way that Zeuner's work was translated from English into German in the sixties, but preferably with a more complete bibliography than in the present edition.

Literature

Hilzheimer, M. (1926). *Natürliche Rassengeschichte der Haussäugetiere*. Walter de Gruyter & Co., Berlin.

Keller, C. (1902). *Die Abstammung der ältesten Haustiere*. Zürich.

Keller, C. (1905). *Naturgeschichte der Haustiere*. Paul Parey, Berlin.

Keller, C. (1919). *Die Stammesgeschichte unserer Haustiere*. 2. Aufl. Leipzig.

Zeuner, F.E. (1963). *A history of domesticated animals*. Hutchinson and Co Ltd., London.

A.T. Clason

Announcements

MEETINGS:

The XIII Congress of the International Union of Prehistoric and Protohistoric Sciences will take place in Forli, Italy, September 8-14, 1996. For further information contact:

Secretaria
Casa Saffi - Via S. Marchesi, 12
I 47100 Forli
Italia

In Memoriam

SANDOR BÖKÖNYI
(Died December 25, 1994)

In recognition of his many contributions to archaeozoology

1) April 22, 1974. Groningen. Sandor Bökönyi (right) with Prof. Gejvall at the Reception Hall of the Biologisch-Archaeologisch Instituut on the occasion of the 2nd International I.C.A.Z. Conference. Photo A. Clason

2) June 6, 1992. Veluwe. Sandor Bökönyi taking pictures of Przewalskii horses at the Veluwe National Park in the Central Netherlands. Photo A. Clason.

INFORMACION A LOS AUTORES

a) Los originales pueden redactarse en español, inglés, alemán o francés. Los editores pueden considerar, en determinadas circunstancias, la publicación de originales en otros idiomas. En cualquier caso se proporcionará un resumen y palabras clave en español y en inglés.

b) Los originales no deberían sobrepasar 20 páginas A4 (29'5 x 21 cm) incluyendo tablas y figuras. En caso de trabajos más extensos contáctese con el editor. Los manuscritos deberán remitirse en diskette en WordPerfect (5.0, 5.1) con un formato de 2'5 cm para todos los márgenes. Se remitirán asimismo tres copias en papel (para uso editorial y recensión), a doble espacio, incluyendo tablas, pies de figuras y referencias.

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Ruiz, L. (1980) . *The ecology of infectious diseases*. Siglo XXI, 3d. edition. Madrid.

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c) Figures and tables must be of high quality and should be submitted on separate sheets of paper with the number of the figure or table indicated lightly in pencil at the bottom of the page. Figure legends should be numbered with arabic numerals and given on a separate sheet of paper. Figure and table legends should be concise and informative

d) Papers should be organized as follows: Title, name and mailing address(es) of author(s), Abstract (not more than 300 words), Keywords, Introduction, Materials and Methods, Results, Discussion, Conclusions, Acknowledgements, References. Results and Discussion may be treated together if this is appropiate. Non-experimental works can be organized in the way which the authors(s) think(s) is the most appropiate one.

e) Citations in the text should be with author and date of publication, e. g., (Smith, 1992) or (Smith & Jones, 1992) with comma between author and date; for two-author papers, cite both authors; for papers by three or more authors, use Martín *et al.*, 1993. For two or more papers with the same author(s) and date, use, a, b, c, etc. after the date.

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