



Former Iberian distribution of *Margaritifera auricularia* (Spengler) (Bivalvia: Margaritiferidae)

Antigua distribución de *Margaritifera auricularia* (Spengler) (Bivalvia: Margaritiferidae) en la Península Ibérica

Rafael ARAUJO* and Ruth MORENO**

Recibido el 18-I-1999. Aceptado el 10-III-1999

ABSTRACT

Several ancient fragments of shells undoubtedly belonging to the freshwater bivalve *Margaritifera auricularia* have been found at eight Iberian archaeological sites. All fragments are described according to fragmentation categories, and one specimen from each deposit is illustrated. *M. auricularia* lived in Spain from 5000 to 400 BC in four river basins: Duero, Ebro, Tago and Guadalquivir, with a much wider distribution than now. Our data for Spain coincide with the data recorded for the species in Western Europe, both indicating a continuing decline during the post-glacial period.

RESUMEN

Se han encontrado varios fragmentos antiguos de conchas pertenecientes al bivalvo dulce-acuicola *Margaritifera auricularia* en ocho yacimientos arqueológicos ibéricos. Todos estos fragmentos se describen según categorías de fragmentación y se ilustra un espécimen de cada yacimiento. Desde el año 5000 hasta el 400 DC *M. auricularia* vivía en España en cuatro cuencas hidrográficas: Duero, Tago, Ebro y Guadalquivir, con una distribución mucho más amplia que la actual. Nuestros datos de esta especie en España coinciden con los registrados en Europa occidental, ambos indicando un continuo declive durante el período post-glacial

KEY WORDS: *Margaritifera auricularia*, Iberian Peninsula, archaeological sites, distribution.

PALABRAS CLAVE: *Margaritifera auricularia*, Península Ibérica, yacimientos arqueológicos, distribución.

INTRODUCTION

Margaritifera auricularia (Spengler, 1793) is a large rare freshwater mussel that used to occur in Western Europe and North Africa (PREECE, BURLEIGH, KERNEY AND JARZEMBOWSKI, 1983). Fossil remains in Europe show a general recession during the post-glacial period

(PREECE ET AL., 1983) and no recent records of living specimens have existed since HAAS (1917), who studied a Spanish population from the Ebro River. Recently, ARAUJO AND RAMOS (1998a, b) reported the existence of a population in the Canal Imperial de Aragón in Zara-

* Museo Nacional de Ciencias Naturales. José Gutiérrez Abascal 2. 28006 Madrid. Spain.

** Laboratorio de Arqueozoología. Facultad de Ciencias. Departamento de Biología. Universidad Autónoma de Madrid. 28049 Madrid. Spain.

Table I. Proccedence of the revised freshwater mussels.

Tabla I. Proccendencia de las náyades (abmejas de agua dulce) revisadas.

SITE	LOCATION	CHRONOLOGY	SOURCE
Cueva de las Ventanas	Piñar, Granada	Uncertain	RIQUELME, in prep.
El Poblado de los Castillejos en las Peñas de los Gitanos	Montefrío, Granada	Late Neolithic-Final Chalcolithic	RIQUELME, 1996
Polideportivo de Martos	Martos, Jaén	Final Neolithic-Early Chalcolithic	LIZCANO, CAMARA, RIQUELME, CAÑABATE, SÁNCHEZ AND AFONSO, 1991-92
Los Bajos II	Vecilla de Trasmonte, Zamora	Chalcolithic	PEREZ, SANZ, MARCO, MARTIN AND MISIEGO, 1993
Las Bodegas	Colinas de Trasmonte, Zamora	Chalcolithic	PEREZ, SANZ, MARCO, MARTIN AND MISIEGO, 1993
Matillas Área A	Alcalá de Henares, Madrid	Chalcolithic	DIAZ, CONSUEGRA, PEÑA, MARQUEZ, SAMPEDRO, MORENO, ALBERTINI AND PINO, 1997
La Viña	Puerto de Santa María, Cádiz	Chalcolithic	MORENO, 1995c
Morra de Quintanar	Munera, Albacete	Bronze Age (XVII-XV BC)	MARTÍN MORALES, 1984
El Llanete de los Moros	Montoro, Córdoba	Bronze Age-Iron Age (1300-450 BC)	MARTÍN DE LA CRUZ, 1987
Ecce Homo	Alcalá de Henares, Madrid	Final Bronze-Iron Age	ALMAGRO, 1976
La Era Alta	Melgar de Abajo, Valladolid	Iron Age I	MORALES AND LIESAU, 1995
Soto de la Medinilla	Valladolid	Iron Age (VIII-V BC)	MORALES AND LIESAU, 1995
La Mota	Medina del Campo, Valladolid	Iron Age (VII-IV BC)	MORALES AND LIESAU, 1995
Barrac de Gáfols	Ginestar, Tarragona	Iron Age (VI BC)	BELARTE, MASCORT, SANMARTÍ AND SANTACANA, 1992-93
Aldovesta	Benifallet, Tarragona	Iron Age (VI BC)	MASCORT, SANMARTÍ AND SANTACANA, 1987-88
Plaza del Castillo	Cuellar, Segovia	Iron Age (VI-V BC)	BARRIO, 1993
Castilmontán	Somaén, Soria	Iron Age (II-I BC)	ARLEGUI, 1992
Calatrava la Vieja	Carrión de Calatrava, Ciudad Real	Medieval (XIII)	MORALES, MORENO AND CEREJIO, 1988

goza (Spain) and there appears to be another population living in the lower Ebro River in Cataluña (ALTABA, 1997). The species belongs to one of the oldest genera of the naiads (superfamily Unio-noidea), species of the genus *Margaritifera* being known as pearl mussels. *M. auricularia* is included on the list of wildlife species under the Council of Europe's Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1979) and Directive

92/43/EEC (Habitats Directive) as one of the most threatened animal species in the world. Indeed, *M. auricularia* in Spain is included on the National Endangered Species List (Royal Decree 439/90) in the "threatened with extinction" category, being the first invertebrate species on that list.

Concerning the former distribution of the species, shell fragments have been recorded from the Last Ipswichian (interglacial) and Neolithic Ages in Britain by

Table II. Provenience and description of the fragmented shells of *M. auricularia* in Iberian archaeological sites. S: sinistral; D: dextral; UMBF: Umbonal fragment; ANCF: Anterior hinge fragment; POCF: Posterior hinge fragment; FRAG: Fragment; NISP: number of identified specimens.

Tabla II. Procedencia y descripción de los fragmentos de conchas de *M. auricularia* en yacimientos arqueológicos Ibéricos. S: izquierdo; D: derecho; NISP: número de especímenes identificados; Para otras abreviaturas ver Material y Métodos.

SITE	CHRONOLOGY	FRAGMENTATION CATEGORIES				NISP
		UMBF	ANCF	POCF	FRAG	
Poblado de los Castillejos en las Peñas de los Gitanos	Late Neolithic	1 S	1 D	1 S		3
	Early Chalcolithic	1 D; 1 S	1 S			3
	Middle Chalcolithic			1 S	1	2
	Late Chalcolithic	1 S				1
Polideportivo de Martos	Late Neolithic/Early Chalcolithic	1 S	1 D			2
La Viña	Chalcolithic	1 S		1 S	1	3
Las Matillas	Chalcolithic	1 S				1
El Llanete de los Moros	Late Bronze Age I	1 S	2 D		2	5
	Late Bronze Age II	1 S	1 S		1	3
Soto de Medinilla	Iron Age I	2 D				2
Barrac de Gáfols	Iron Age I			1 D		1
Aldovesta	Iron Age I	1 S				1

JACKSON AND KENNARD (1909), JACKSON (1911), HAAS (1910), KENNARD AND WOODWARD (1913), KENNARD (1943), KERNEY (1958), PREECE ET AL. (1983) and PREECE (1988); in sediments from the Mindel-Riss and Riss glaciation in the Tiber River, Italy (FUCINI, 1893 in MALATESTA, 1964; MALATESTA, 1964); in Holocene strata of the Rhine, near Ludwigshafen, Germany (HAAS, 1910); from the Lower Diluvial in Oppenheim, West Germany (HAAS AND WENZ, 1914); from Subboreal gravels (1800 BC) of the Leine river plain near Hanover, Germany (HUCKRIEDE AND BERDAU, 1970) and in a 1900- years-old Roman settlement on the Rhine River, Netherlands (KUIJPER, 1988). Other post-glacial fossils recorded in PREECE ET AL. (1983) are from the Maine River at Aschaffenburg, West Germany (Neolithic), Elster-Saale river system (Neolithic and Bronze Age), a kitchen-midden near Halle (Neolithic) and a Roman refuse site at Saalburg, the

latter three being in East Germany, and near Prague, Czechoslovakia (Neolithic or Sub-boreal). The specimens dredged from the Seine and Oise rivers (France) cited by KENNARD (1943) are probably from the Holocene. According to this author, the original specimen of *Unio auricularius* Spengler (= *Margaritifera auricularia*) is a fossil specimen from Berlingen-bei-Untersee in Switzerland. Therefore TURNER's note (1987) stating that the species never lived in Switzerland is surprising.

This paper deals with subfossil fragments of *M. auricularia* retrieved from archaeological deposits in several regions of the Iberian Peninsula, the only place in the world where the species currently lives. Knowledge of the real former distribution of the species in Europe may give us clues both to its decline and to the specific fish-host of the glochidium of this endangered freshwater mussel

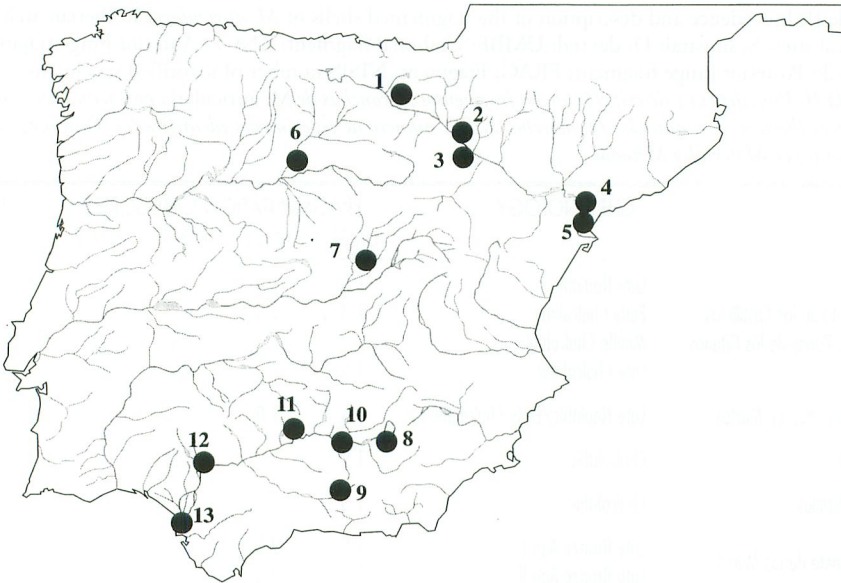


Figure 1. Former Iberian distribution of *M. auricularia*. 1: Castro de las Peñas del Oro (Alava) (ALTUNA, 1965); 2: Alto de la Cruz (Navarra) (NADAL, 1990); 3: Moncín (Zaragoza) (HARRISON, MORENO AND LEGGE, 1994); 4: Barranc de Gafols (Tarragona); 5: Aldovesta (Tarragona); 6: Soto de Medinilla (Valladolid); 7: Matillas (Madrid); 8: Cerro de la Encina (Granada) FRIESCH (1987); 9: Poblado de los Castillejos (Granada); 10: Polideportivo de Martos (Jaén); 11: Montoro (Córdoba); 12: Cerro Macareno (Sevilla) (AMBERGER, 1985); 13: Las Viñas (Cádiz). Localities 4-7, 9-11 and 13 from this paper. Localities 1 (doubtful specimen cited as *Margaritana margaritifera*), 2 (specimen checked by photograph), 3 (doubtful specimen cited as *M. margaritifera*), 8 and 12 (specimens not checked, but considered to be *M. auricularia* due to large size reported) from the literature.

Figura 1. Antigua distribución Ibérica de *M. auricularia*. 1: Castro de las Peñas del Oro (Alava) (ALTUNA, 1965); 2: Alto de la Cruz (Navarra) (NADAL, 1990); 3: Moncín (Zaragoza) (HARRISON, MORENO Y LEGGE, 1994); 4: Barranc de Gafols (Tarragona); 5: Aldovesta (Tarragona); 6: Soto de Medinilla (Valladolid); 7: Matillas (Madrid); 8: Cerro de la Encina (Granada) FRIESCH (1987); 9: Poblado de los Castillejos (Granada); 10: Polideportivo de Martos (Jaén); 11: Montoro (Córdoba); 12: Cerro Macareno (Sevilla) (AMBERGER, 1985); 13: Las Viñas (Cádiz). Localidades 4-7, 9-11 y 13, a partir de este trabajo. Localidades 1 (especimen dudoso citado como *Margaritana margaritifera*), 2 (especimen comprobado en fotografía), 3 (especimen dudoso citado como *M. margaritifera*), 8 y 12 (especímenes no comprobados, pero considerados como *M. auricularia* debido a su gran tamaño), a partir de la bibliografía.

MATERIALS AND METHODS

Study sites were selected by the presence of freshwater mussels. Special interest was devoted to studying the sites located near rivers with historic records of *M. auricularia* and its possible glochidial host fish, the sturgeon *Accipenser sturio* (ARAUJO AND RAMOS, 1998a, b). A revision of all freshwater material deposited at the LAZ (Archaeo-

zoological Laboratory, Universidad Autónoma de Madrid, Spain) was carried out. All the material examined belongs to the sites listed in Table I.

The main problem was the difficulty in distinguishing broken shells of *M. auricularia* and *Psilunio littoralis* (Lamarck), two freshwater mussels with very similar shell characters (especially the muscle scars and hinge area) occurring in Iberian fresh waters. *P. littoralis*

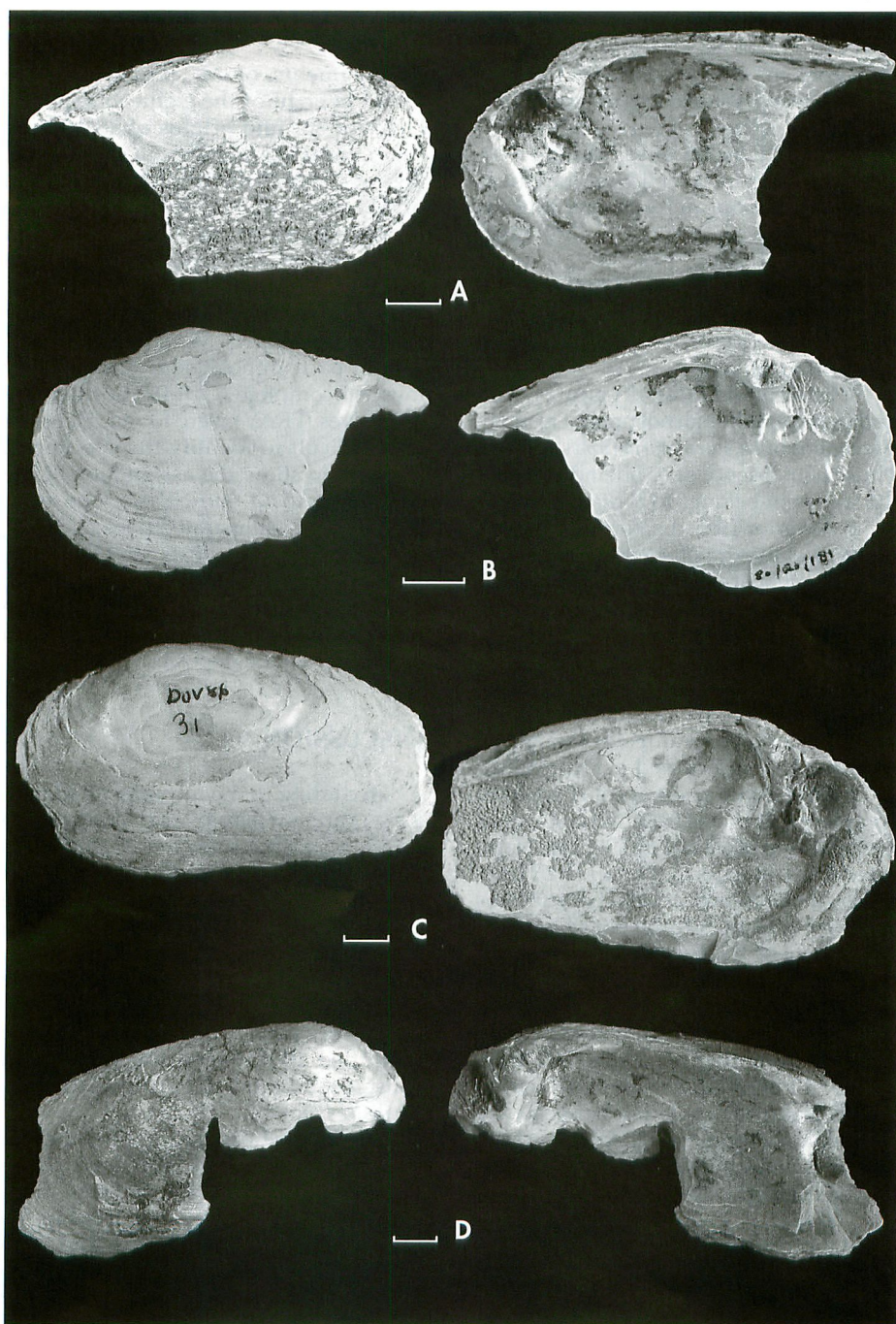


Figure 2. Fragmented Iberian shells of *M. auricularia*. A: Polideportivo de Martos (Jaén); B: Montoro (Córdoba); C: Aldovesta (Tarragona); D: Soto de Medinilla (Valladolid). Scale bar 1 cm.
 Figura 2. Conchas Ibéricas fragmentadas de *M. auricularia*. A: Polideportivo de Martos (Jaén); B: Montoro (Córdoba); C: Aldovesta (Tarragona); D: Soto de Medinilla (Valladolid). Escala 1 cm.

in Spain can reach a large size although never as big as *M. auricularia*. To solve this problem, several conchological characters were selected and compared between specimens of the two species:

1- Shell size. Because adults of *M. auricularia* can be over 15 cm long (it is the biggest European freshwater mussel) and it is very uncommon to find small specimens.

2- Umbonal sculpture. Smooth in *M. auricularia* and with typical undulations in *P. littoralis* (KENNARD, SALISBURY AND WOODWARD, 1925).

3- Inner muscle scars. Typical of Margaritiferidae, although not present in many specimens of *M. auricularia* (SMITH, 1983). Thus, their absence does not indicate that the fragment belongs to *P. littoralis*.

4- Anterior ribbed sculpture. As this is a typical feature of some specimens of *M. auricularia*, its presence indicates that the shell fragment belongs to this species, but its absence is not a definitive character.

5- Umbo shape. Depressed in *M. auricularia* and convex in *P. littoralis*.

6- Posterior lateral teeth. Straight in *M. auricularia* and curved in *P. littoralis*.

All these characters were checked in complete specimens from the collections of the Museo Nacional de Ciencias Naturales (Madrid, Spain). For all shell fragments, the presence of each character was recorded and each fragment was assigned to one of the two species when correspondence was found for more than half of the characters. The main character was specimen size, which was sometimes derived from fragment size. All fragments of intermediate size in which selected characters could not be seen were deemed undetermined. Therefore, we are sure that no fragments of any other species were assigned to *M. auricularia*.

The material was described by fragmentation categories as follows (modified from MORENO, 1994):

COMV: Completed valve.

FRAV: Fragmented valve.

UMBF: Umbonal fragment.

ANCF: Anterior hinge fragment.

POCF: Posterior hinge fragment.

FRAG: Fragment.

RESULTS

Fragments of *M. auricularia* were found in eight of the eighteen deposits. Descriptions and origins of all *M. auricularia* remains are shown in Table II. Figure 1 shows the former distribution of *M. auricularia* in Spain joining the results obtained in this paper and references of the malacofaunas from Iberian archaeological sites (AMBERGER, 1985; FRIESCH, 1987; MORENO 1995a, b).

The number of *M. auricularia* muscels in each deposit was always very low. No complete (COMV) or fragmented valves (FRAV) were found. Hence, it was difficult to identify the specimens. In order to show the assignation of the fragments to *M. auricularia*, one from each deposit is illustrated (Figs. 2, 3).

All analysed contexts are Holocenic. Although shell material was not dated, we assume that the gathering of these molluscs was contemporaneous with occupation of the deposits.

DISCUSSION

According to the recommendation of KENNARD, SALISBURY AND WOODWARD (1925) regarding selection of characters of specific value to identify British fossil fragments of Unionoidea, only the umbonal rugae resulted useful in distinguishing between *M. auricularia* and *P. littoralis* due to the fact that the muscle scars and hinge in both species are very similar in Spanish specimens. Thus, we identified all umbonal fragments with conspicuous wavy lines (rugae) as *P. littoralis*.

Our data show that, on the Iberian Peninsula, *M. auricularia* used to be more widely distributed. In Spain, from 5,000 to 400 BC, the species lived in the Duero, Ebro, Guadalquivir and Tajo basins. Currently, there are only two known populations, both living in the Ebro basin. In the Iberian distribution of *M. auricularia* illustrated on the ALTA-BÀ's map (1990), there are four records: one in the Guadalquivir, one in the Tet (North-eastern Pyrenees) and two in the

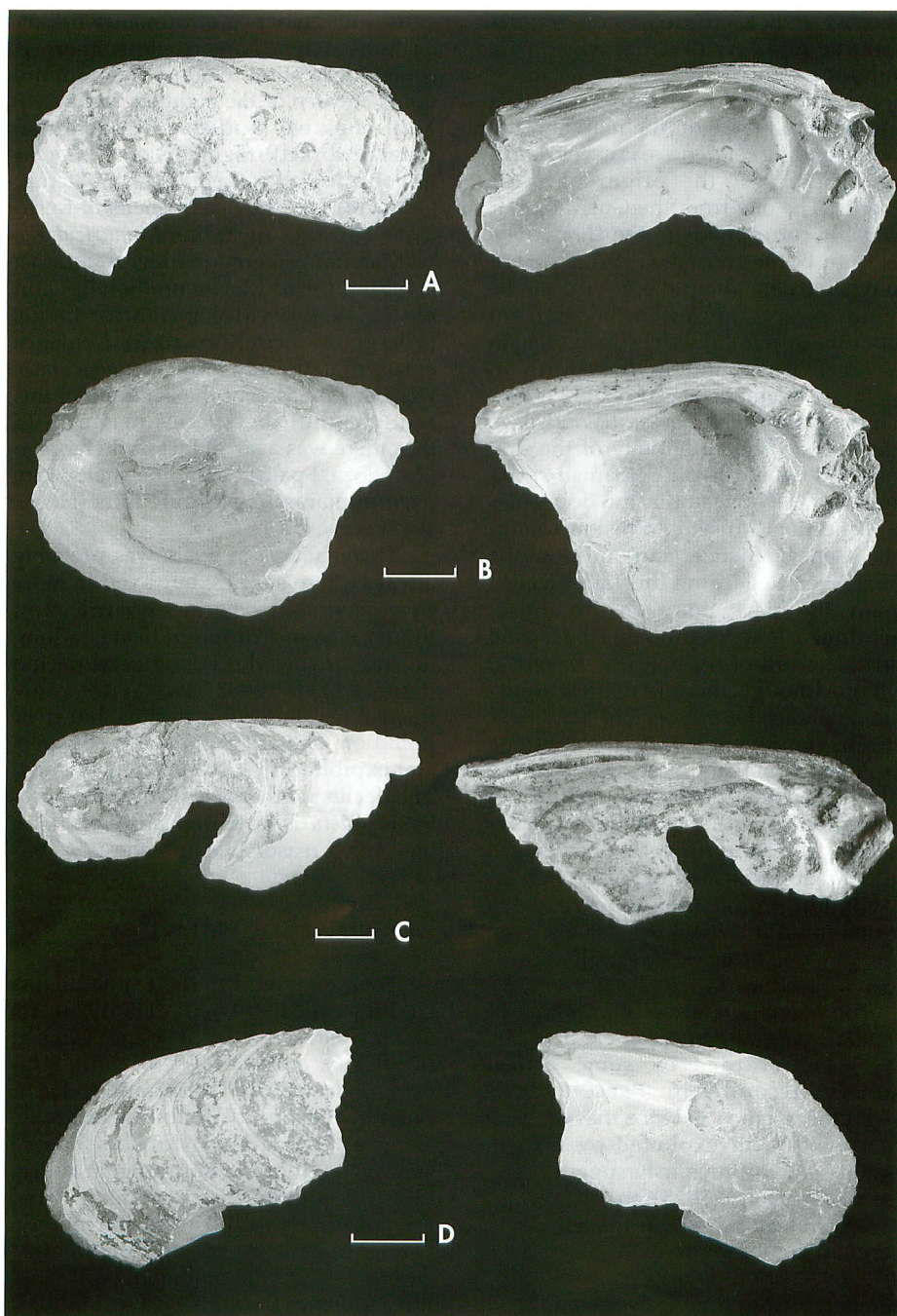


Figure 3. Fragmented Iberian shells of *M. auricularia*. A: Poblado de los Castillejos (Granada); B: Las Viñas (Cádiz); C: Matillas (Madrid); D: Barranc de Gafols (Tarragona). Scale bar 1 cm.

Figura 3. Conchas Ibéricas fragmentadas de M. auricularia. A: Poblado de los Castillejos (Granada); B: Las Viñas (Cádiz); C: Matillas (Madrid); D: Barranc de Gafols (Tarragona). Escala 1 cm.

Tajo, as well as the common reports from the Ebro. As this map was made without a critical revision of the specimens, and without a clear correlation between the marks on the map and the corresponding references, it is very difficult to unravel the origin of these records. The one from the Guadalquivir probably corresponds to the *Unio sinuatus* from BOURGUIGNAT (1866) although no reliable data about this record can be found except the author's comment about the species' presence in Sevilla, in the Ebro River and in the North of Spain. As the latter was probably mistaken for *Margaritifera margaritifera* (L), we may suspect the authenticity of the first record. Indeed, the only Spanish specimens of *M. auricularia* in the Bourguignat collection (Muséum d'histoire Naturelle, Genève, Switzerland) are from the Ebro River. Regarding the Tajo River in Spain, the black point on the above-mentioned map is probably based on the old record of the species (AZPEITIA, 1933). Although there is no new information about the presence of *M. auricularia* in the Spanish Tajo, there is one specimen from this river, stored at the Museo Nacional de Ciencias Naturales of Madrid (Spain). The other record for the Tajo is from Portugal, which is also on the map published by PREECE ET AL. (1983), but no reliable references have been found for it in an extensive survey made by one of us (R. A.) in the Portuguese collections.

The possible relation of *M. auricularia* and Man in archaeological deposits has been recorded by some British authors. According to PREECE ET AL. (1983) there is no evidence that *M. auricularia* was ever exploited by man in Britain, as was previously suggested by KENNARD ET AL. (1925) and KENNARD (1943). This author states that there are German Holocene fossils of the species with two different origins: articles of commerce (from Roman times) and food debris (from a tufa near Hamburg associated with Stone Age pottery). Regarding the Spanish shells of *M. auricularia* studied in this paper, in no case do they

show any evidence of human-working or food items. Nevertheless, there is some information relating Man to unionoids at three of the eighteen archaeological sites we studied. We identified human-worked fragments of *P. littoralis* in Poblado de los Castillejos (Montefrío, Granada) and the use of shells of freshwater mussels, including *M. auricularia*, by Man has been reported by AMBERGER (1985) in Cerro Macareno (Sevilla) and by HARRISON, MORENO AND LEGGE (1994) in Moncín (Zaragoza). Evidence exists that the nacre of *M. auricularia* was used by Man at the beginning of this century until the species declined. In fact, there was a small factory in Sástago (Zaragoza, Spain) where the shells were used to manufacture knife hilts (HAAS, 1917).

M. auricularia in Spain was probably always a rare species, but lived in more rivers than today. Former occurrence of the species in Europe indicates a long decline during the post-glacial period (PREECE ET AL., 1983). We do not know the real reason for this decline, but river pollution, climatic factors and commercial exploitation have been suggested. The decline of the specific host fish, probably *A. sturio*, in European rivers, may be another reasonable hypothesis.

ACKNOWLEDGEMENTS

We are grateful to the Fauna Ibérica III Project (SEUI-DGICYT PB92-0121) and to Spanish National Science Council (DGICYT), project PB-94-0186 for supporting this study. Thanks also to Dr. Y. Finet (Muséum d'Histoire Naturelle, Genève, Switzerland) for the loan of specimens from the Bourguignat collection. The authors wish to thank J. Nadal for lending material from Barranc de Gáfols and Aldovesta, and the Madrid Regional Government and T. A. R. S. L. for lending material from Las Matillas. Thanks also to Dr. M. A. Ramos for her comments, which improved the manuscript. Lesley Ashcroft reviewed the English version.

BIBLIOGRAPHY

- ALMAGRO GORBEA, M., 1976. Informe sobre las excavaciones en el Ecce Homo Alcalá de Henares, Madrid. *Noticiario Arqueológico Hispánico (Prehistoria)*, 5: 295-300.
- ALTABA, C. R., 1990. The last known population of the freshwater mussel *Margaritifera auricularia* (Bivalvia, Unionoida): A conservation priority. *Biological Conservation*, 52: 271-286.
- ALTABA, C. R., 1997. Al límit de l'extinció: *Margaritifera auricularia* (Bivalvia: Unionoida). *Butlletí de la Institució Catalana d'Història Natural*, 65: 137-148.
- ALTUNA, J., 1965. Fauna del yacimiento "Castro de Peñas de Oro" (Valle de Zuya, Alava). *Boletín "Sancho el Sabio"*, IX (1-2): 3-28.
- AMBERGER, G., 1985. Tierknochenfunde von Cerro Macareno/Sevilla. *Studien über frühe Tierknochenfunde von der Iberischen Halbinsel*, 9: 76-105.
- ARAÚJO, R. AND RAMOS, M. A., 1998a. Description of the glochidium of *Margaritifera auricularia* (Spengler, 1793) (Bivalvia, Unionoida). *Philosophical Transactions of The Royal Society of London B*, 353: 1553-1559.
- ARAÚJO, R. AND RAMOS, M. A., 1998b. *Margaritifera auricularia* (Unionoida, Margaritiferidae), the giant freshwater pearl mussel rediscovered in Spain. *Graellsia*, 54: 129-130.
- ARLEGUI, M., 1992. El yacimiento celibérico de Castilmonán, Somaén (Soria): El sistema defensivo. *II Simposio de Arqueología Soriana (Soria 1989)*, I: 495-513.
- AZPEITIA, F., 1933. *Conchas bivalvas de agua dulce de España y Portugal*. Memorias del Instituto Geológico y Minero de España, Madrid, Vol. 1, 458 pp.
- BARRIO MARTÍN, J., 1993. Estratigrafía y desarrollo poblacional en el yacimiento prerromano de la Plaza del Castillo (Cuéllar, Segovia). In: *Arqueología Vaccaea. Estudios sobre el mundo prerromano en la Cuenca Media del Duero* (F. Romero, C. Sanz, and Z. Escudero, eds): 173-212. Consejería de Cultura y Turismo. Junta de Castilla y León.
- BELARTE, M. C., MASCORT, M. T., SANMARTÍ, J. AND SANTACANA, J., 1992-93. L'assentament protohistòric del barranc de Gàfols (Ginestar, Ribera d'Ebre). *Tribuna d'Arqueologia* 1992-93: 63-72.
- BOURGUIGNAT, M. J. R., 1866. Mollusques nouveaux, litigieux ou peu connus. *Revue de Zoologie*, ser 2, XVIII: 6-23.
- DÍAZ DEL RÍO, P., CONSUEGRA, S., PEÑA CHOCARRO, L., MARQUEZ, B., SAMPEDRO, C., MORENO, R., ALBERTINI, D. AND PINO, B., 1997. Paisajes agrarios prehistóricos en la Meseta peninsular: el caso de "Las Matillas" (Alcalá de Henares, Madrid). *Trabajos de Prehistoria*, 54 (2): 93-111.
- 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.
- FUCINI, A., 1893. L'Unio sinuatus nelle antiche alluvioni del Tevere presso Città di Castello. *Atti della Società Toscana di Scienze Naturali. Processi Verbali*, 9: 59-61.
- HAAS, F., 1910. On *Unio*, *Margaritana*, *Pseudanodonta*, and their occurrence in the Thames Valley. *Proceedings of the Malacological Society of London*, 9: 106-112.
- HAAS, F., 1917. Estudios sobre las Náyades del Ebro. *Boletín de la Sociedad Aragonesa de Ciencias Naturales*, XVI: 71-82.
- HAAS, F. AND WENZ, W., 1914. *Unio pachyodon* Ludwig=*Margaritana auricularia* (Spengler). *Jahresberichte und Mitteilungen des Oberrheinischen Geologischen Vereines*, 4 (2): 88.
- HARRISON, R. J., MORENO LOPEZ, G. C. AND LEGGE, A. J., 1994. Moncín: un Poblado de la Edad del Bronce. Gobierno de Aragón. Departamento de Educación y Cultura. *Colección Arqueología*, 16.
- HUCKRIEDE, R. AND BERDAU, D., 1970. Die süd- und westeuropäische fluss-perlmuschel *Margaritifera auricularia* (Spengler) im Holozän von Hannover. *Geologica et Paleontologica*, 4: 195-200 + 1 Taf.
- JACKSON, J. W., 1911. On the occurrence of *Unio sinuatus* Lam. in the British Isles. *Journal of Conchology*, 13 (5): 142-143.
- JACKSON, J. W. AND KENNARD, A. S., 1909. On the former occurrence of *Unio* (*Margaritana*) *margaritifera* Linné in the River Thames. *Journal of Conchology*, 12 (12): 321-322.
- KENNARD, A. S., 1943. Examples of *Unio auricularius* from the Holocene of Mortlake near London and L'Isle Adam (Seine-et-Oise) compared with recent specimens from the river Gironde, S. W. France. *Proceedings of the Geological Association*, 54: 121.
- KENNARD, A. S. AND WOODWARD, B. B., 1913. Non-marine mollusca from the old bed of the Thames at Barn Elms with *Margaritana* (*Pseudunio*) *auricularius* (Speng.). *Proceedings of the Malacological Society of London*, 10: 332.
- KENNARD, A. S., SALISBURY, A. E. AND WOODWARD, B. B., 1925. Notes on the British post-Pliocene Unionidae, with more especial regard to the means of identification of fossil fragments. *Proceedings of the Malacological Society of London*, 16: 267-285.
- KERNEY, M. P., 1958. On the occurrence of *Margaritifera auricularia* (Spengler) in the English Pleistocene. *Journal of Conchology*, 24 (7): 250.

- KUIJPER, W. J., 1988. Over het vroegere voorkomen van de rivierparelmossel *Margaritifera auricularia* in Nederland. *Basteria*, 52: 133-137.
- LIZCANO, R., CAMARA, J. A., RIQUELME, J. A., CANABATE, M. L., SANCHEZ, A. AND AFONSO, J., 1991-92. El Polideportivo de Martos. Producción económica y símbolos de cohesión en un asentamiento del Neolítico Final en las campiñas del alto Guadalquivir. *Cuadernos de Prehistoria de Granada*, 16-17: 5-101.
- MALATESTA, A., 1964. Über einige pleistozäne Süßwassermollusken aus Mittel-Italien, I. *Archiv für Molluskenkunde*, 93 (3/4): 151-162.
- MARTÍN DE LA CRUZ, J. C., 1987. El Llanete de los Moros: Montoro, Córdoba. *Excavaciones Arqueológicas en España*, 151.
- MARTÍN MORALES, C., 1984. La Morra del Quintanar. *Al-Basit. Revista de Estudios Albacetenses*, 15: 57-73.
- MASCORT I ROCA, M., SANMARTI I GREGO, J. AND SANTACANA I MESTRE, J., 1987-88. L'establiment protohistòric d'Aldovesta (Benifallet, Baix Ebre). Un punt clau del comerç fenici a la Catalunya meridional. *Tribuna d'Arqueologia*, 1987-88: 69-76.
- MORALES MUÑIZ, A. AND LIESAU VON LETTOW-VORBECK, C., 1995. Análisis comparado de las faunas arqueológicas en el valle medio del Duero (prov. Valladolid) durante al Edad del Hierro. In: *Arqueología y Medio Ambiente. El Primer Milenio A. C. en el Duero Medio*. (G. Delibes, F. Romero and A. Morales, eds): 455-514. Junta de Castilla y León. Valladolid.
- MORALES, A., MORENO, R. AND CEREJIO, M. A., 1988. Calatrava La Vieja: Primer informe sobre la fauna de vertebrados recuperada en el yacimiento almohade. Primera parte: Mamíferos. *Boletín de Arqueología Medieval*, 2: 7-48.
- MORENO NUÑO, R., 1994. Análisis arqueomalaológicos en la Península Ibérica. *Contribución metodológica y biocultural*. Universidad Autónoma de Madrid. (unpublished Thesis).
- MORENO NUÑO, R., 1995a. Catálogo de Malacofaunas de la Península Ibérica. *Archaeofauna*, 4: 143-272.
- MORENO NUÑO, R., 1995b. Arqueomalaofaunas de la Península Ibérica: un ensayo de síntesis. *Complutum*, 6: 353-382.
- MORENO NUÑO, R., 1995c. Estudio malacológico del yacimiento calcolítico de La Viña (Puerto de Santa María, Cádiz). *Anuario Arqueológico de Andalucía*, 1992/III: 152-158.
- NADAL LORENZO, J., 1990. Análisis faunístico. Campaña 4/ 1998. *Trabajos de Arqueología Navarra*, 9: 173-198.
- PÉREZ RODRÍGUEZ, F. J., SANZ GARCÍA, F. J., MARCOS CONTRERAS, G. J., MARTÍN CARBAJO, M. A. AND MISIEGO TEJEDA, J. C., 1993. Algunos aspectos de la Edad del Cobre en el valle medio del río Tera. *Instituto de Estudios Zamoranos "Florian de Ocampo"*, Anuario 1993: 49-78.
- PREECE, R. C., 1988. A second British interglacial record of *Margaritifera auricularia*. *Journal of Conchology*, 33 (1): 50-51.
- PREECE, R. C., BURLEIGH, R., KERNEY, M. P. AND JARZEMBOWSKI, E. A., 1983. Radiocarbon age determination of fossil *Margaritifera auricularia* (Spengler) from the River Thames in West London. *Journal of Archaeological Science*, 10: 249-257.
- RIQUELME CANTAL, J. A., 1996. *Contribución al Estudio Arqueofaunístico durante el Neolítico y la Edad del Cobre en las Cordilleras Béticas: el Yacimiento Arqueológico de los Castillejos en las Peñas de los Gitanos, Montefrío (Granada)*. Universidad de Granada. (unpublished Thesis).
- SMITH, D. G., 1983. On the so-called mantle muscle scars on shells of the Margaritiferidae (Mollusca, Pelecypoda), with observations on mantle-shell attachment in the Unionoida and Trigonoida. *Zoologica Scripta*, 12 (1): 67-71.
- TURNER, H., 1987. *Margaritifera auricularia* in der Schweiz - eine Fehlmeldung und ihre Aufklärung. *Mitteilungen der Deutschen Malakozoologischen Gesellschaft*, 40: 21-23.