Archaeomalacological remains from the Upper Pleistocene – Early Holocene record of the *Vestíbulo* of Nerja Cave (Malaga, Spain)

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Restos arqueomalacológicos del Pleistoceno superior – Holoceno inferior del *Vestíbulo* de la cueva de Nerja (Málaga, España)

KEY WORDS: Molluscs, cave deposits, shell-midden, food, personal ornaments.
PALABRAS CLAVE: Moluscos, depósito karstico, conchero, alimentos, adornos personales.
GAKO-HITZAK: Moluskuak, metaketa karstikoa, maskortegia, elikagaiak, apaingarri pertsonalak.

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ABSTRACT

During the Late Upper Pleistocene and the Early Holocene, an important stratigraphic series was deposited in the access (*Vestíbulo* chamber) to Nerja Cave (Malaga province, South of Spain). This series is characterized by the presence of a significant record of human activities from 30 ky to 6 ky cal BP, constituting one of the broadest archaelogical records in the Western Mediterranean zone in this age. These deposits contain artifacts typical of various cultural assemblages (Gravettian, Solutrean, Magdalenian, Epipalaeolithic and Neolithic) and appear together with plentiful plant remains (thirty taxa of conifers and angiosperms), almost a hundred species of invertebrates (Mollusca, Crustacea, Echinoidea), and vertebrates (more than hundred species of fish, reptiles, birds and mammals, including seals and dolphins) related to human activities in the Cave. Especially notable among the invertebrate remains is the abundant presence of marine and continental molluscs: 87 taxa and more than 135,000 specimens (80 kg of shells) of Gastropoda, Scaphopoda, Bivalvia and Cephalopoda. Many of these specimens were part of the human diet, but others were used as ornaments, and some species were introduced through non cultural processes.

RESUMEN

Durante el Pleistoceno superior final y el Holoceno inferior se depositó una potente serie estratigráfica en una de las salas (Vestíbulo) de la antigua entrada de la Cueva de Nerja (Málaga, España), caracterizada por contener importantes restos de actividad humana comprendida entre 30.000 y 6.000 años cal BP. Estas evidencias son el resultado de la ocupación antrópica de la cueva durante los periodos Gravetiense, Solutrense, Magdaleniense, Epipaleolítico y Neolítico, constituyendo una de las más importantes secuencias arqueológicas y paleobiológicas del Mediterráneo Occidental para esta cronología. Los restos tecnológicos están acompañados por un elevado número de restos de vegetales y de animales relacionados con las actividades antrópicas desarrolladas en la cueva. Entre los invertebrados destaca la abundante presencia de moluscos continentales y marinos: 87 taxones y más de 135.000 restos (80 kg de conchas) de Gastropoda, Scaphopoda, Bivalvia y Cephalopoda. En esta colección destaca la abundante presencia de moluscos utilizados para la alimentación, aunque también los hay utilizados como adornos-colgantes; algunas especies fueron introducidas en la cueva de forma accidental por el hombre y, finalmente, otras corresponden a moluscos troglófilos.

LABURPENA

Goi Pleistozenoaren amaieran eta Behe Holozenoan, Nerjako (Malaga, Espainia) haitzuloko antzinako sarrerako geletako batean (Vestibulo izenekoan) serie estratigrafiko mardul bat metatu zen, 30.000 eta 6.000 urte cal BP arteko giza jardueraren hondar garrantzitsuak dituena. Ebidentzia horiek adierazten dute Gravettiar, Solutrear, Magdaleniar, Epipaleolito eta Neolito periodoetan okupazio antropikoa izan zela haitzuloan, eta hori dela Mendebaldeko Mediterraneoko sekuentzia arkeologiko eta paleobiologiko garrantzitsuenetako bat, kronologia honi dagokionez. Hondakin teknologikoekin batera haitzuloan garatutako jarduera antropikoekin lotutako landareen eta animalien hondakin ugari agertu dira. Ornogabeen artean, kontinenteko eta itsasoko molusku ugariren presentzia nabarmentzen da: 87 taxon eta Gastropoda, Scaphopoda, Bibalbio eta Zefalopodoen 135.000 hondakin (80 kg maskor) baino gehiago. Bilduma horretan, atentzioa ematen du elikadurarako erabiltzen ziren moluskuak asko zirela, baina apaingarri-zintzilikaritarako ere asko erabiltzen zituzten; espezie batzuk ustekabean sartu zituen gizakiak haitzuloan, eta, beste batzuk, berriz, molusku troglofiloak ziren.

1. INTRODUCTION

Nerja Cave is located in Malaga province (Spain), in the southern end of the Iberian Peninsula, on the Mediterranean coast of Andalusia known as *Costa del Sol Oriental*, and on the North side of Alboran Sea (Fig. 1.1). The cave is situated in the zone of contact between the Almijara mountains and the coastal plain, up to 158 metres above sea level and to one thousand metres away from the present coastline. Geologically, the cave developed in the Triasic dolomitic marbles of Almijara mountains, in contact

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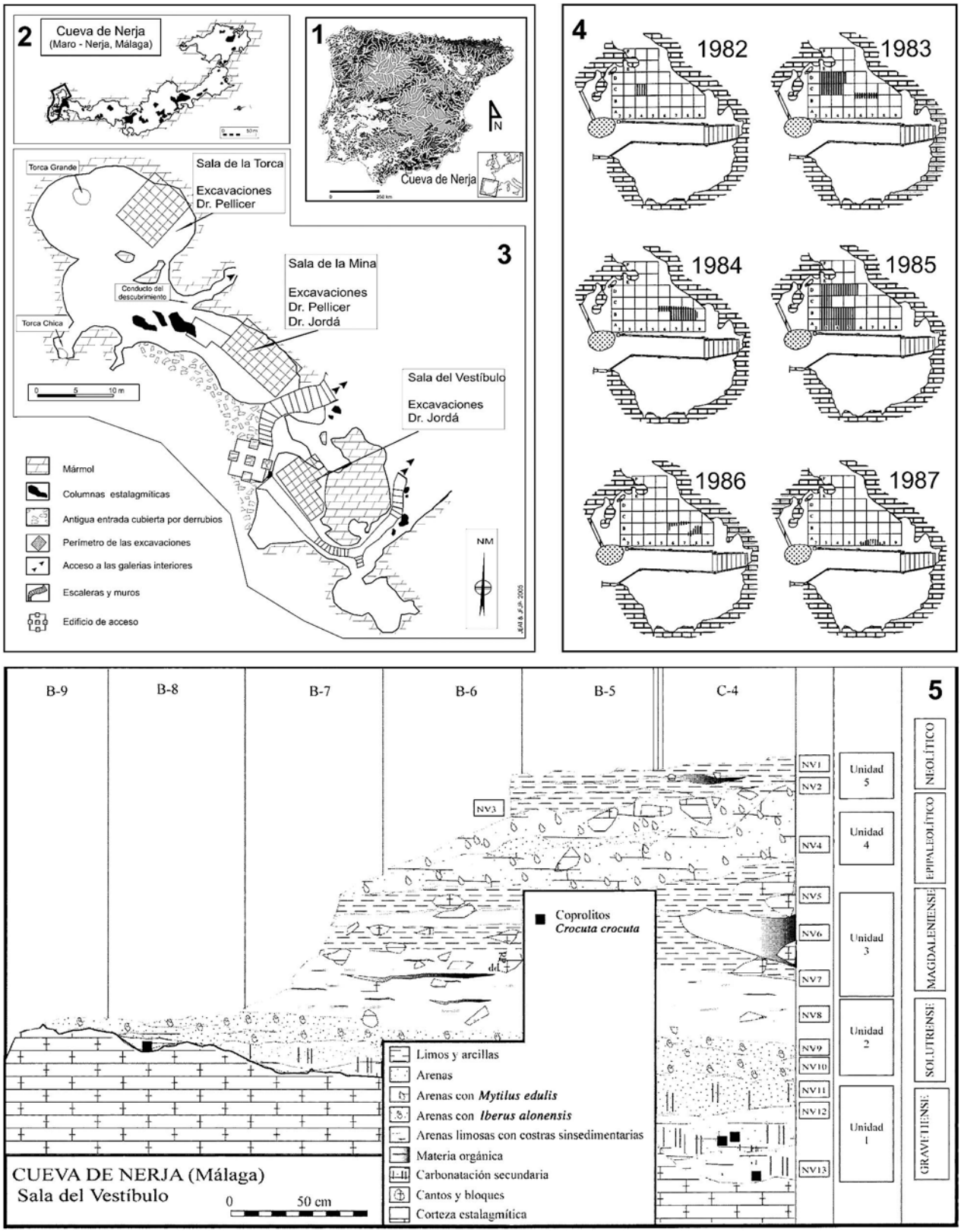

Figure 1. Nerja Cave (Málaga province, South of Spain): 1: Geographical location. 2: Cave map. 3: Access chambers with archaeological excavations. 4: *Vestíbulo* chamber and its archaeological excavations by professor Francisco Jordá Cerdá. 5: Stratigraphy of *Vestíbulo* chamber.

with the quaternary conglomerates produced by alluvial fans that form the coastal plain.

The cave, discovered in 1959, has a large subterranean extension (Fig. 1.2), but the archaeological deposits are located in its external chambers. During their occupation by humans, these chambers (Fig. 1.3) formed a great rock shelter; while at the present these chambers are partially filled by sediments. At the moment, there are three outer chambers: *Torca, Mina* and *Vestíbulo*. This study focuses on the *Vestíbulo* chamber.

During the Late Upper Pleistocene and the Lower and Middle Holocene an important stratigraphical series was deposited in the entry of Nerja Cave (Jordá *et al*. 1990). This large vertical record constitutes one of the most important archaeological and palaeobiological sequences of the western Mediterranean, containing evidence in the Gravettian, Solutrean, Magdalenian, Mesolithic, Neolithic and Copper Age. A recent paper summarizes the extensive bibliography on the archaeological record of Nerja Cave (Villalba *et al.* 2007, with references).

The first excavations in the Vestíbulo chamber were undertaken by Ana M. de la Quadra Salcedo between 1962 and 1963. Later, Professor Francisco Jordá Cerdá carried out archaeological excavations between 1982 and 1987 (Fig. 1.4). The stratigraphic sequence of the *Vestíbulo* rests on a basal speleothem and is articulated in five lithostratigraphic units (Jordá *et al*. 1990) that correspond to different cultural periods: Gravettian, Solutrean, Mediterranean Upper Magdalenian, Mediterranean Microblade Epipalaeolithic and Neolithic (Fig. 1.5), and are separated by four hiatuses.

Between 1979 and 1986 we studied the molluscs of the archaeological record of Nerja Cave recovered during the excavations of Professor Francisco Jordá Cerdá at *La Mina* chamber (campaigns of 1979, 1980 and 1981) and the *Vestíbulo* chamber (campaigns of 1982, 1983 and 1984). This research has been extensively published. (Jordá 1981, 1982, 1983, 1984-85, 1986, González-Tablas *et al*. 1984; Jordá *et al*. 1987; Aura *et al.* 1993; Jordá *et al.* 2003). However, in this research, we studied only the mollusc record recovered in a square metres test unit in the *Vestíbulo* chamber (C-4). Later, other scholars studied the molluscs from the excavations of professors Manuel Pellicer Catalán (*La Mina* and *La Torca* chambers; see Serrano *et al*., 1995, 1997, 1998) and Ana M. de la Quadra Salcedo (*Vestíbulo* chamber; see Lozano-Francisco *et al.* 2003, 2004, Vera *et al*. 2003), with results similar to ours.

In this paper we present the preliminary results obtained from the study of the molluscs recovered during the archaeological excavations in *Vestíbulo* chamber of Nerja Cave made by Professor Francisco Jordá between 1983 and 1987 (Fig. 1.4), excluding the materials already published of the C-4 test unit, which were studied using a different methodology. These excavations recovered the archaeological record of the *Vestíbulo* sequence between the Gravettian and the Neolithic.

2. MATERIALS AND METHODS

The malacological collection of *Vestíbulo* occupied 77 standard trays (38 x 29 x 4 cm) that were housed in the Department of Prehistory, Archaeology and Ancient History at the University of Salamanca; when we completed our study, the collections were placed in the Provincial Museum of Malaga. The studied material was recovered directly during the excavation and from screened sediments; all the sediments were washed and selected by sizes across a triple sieve, and later sorted. The invertebrate remains were further sorted later in the laboratory, where the molluscs were separated from the rest of the invertebrates. The mollusc assemblage was packed in cardboard trays; every tray was identified with contextual information and/or the excavation unit. During the excavations from 1983 to 1987 (Fig. 1.4) in the Vestibulo, a series of tests left from the excavations of Ana M. de la Quadra in 1962 and 1963 were excavated. For this reason, some units correspond to portions of several grids; this is reflected in the labeling of the boxes. This differential excavation suggests that the volume of excavated sediment changes very much from one level to another, between 3,94 m^3 of the Solutrean levels and 1,22 m^3 of the Magdalenian ones. In relation to the archaeological levels, we have studied all the detected ones in the *Vestíbulo* during the excavations of Professor Francisco Jordá Cerdá: from the NV13 up to the NV 1, excluding the NV11, detected in C-4, but that does not appear in the rest of the excavation.

To identify the molluscs to species, as well as for information on habitat and distribution, we consulted a variety of references on both marine molluscs (Malatesta, 1963, 1974, Cox and cols., 1969-1972, Nordsieck, 1968, 1969; Parenzan, 1976, Ghisotti and Melone, 1975, Lindner, 2000; D'Angelo and Gargiullo, 1978, Luque, 1984, Riedl, 1986, Poppe and Goto, 1991, 1993, Mexía, 2000) and continental ones (Macan, 1969, Gasull, 1971,

Madurga, 1973, Kerney *et al*. 1983). We followed the systems of Bruschi *et al*. (1985), Lindner (2000), and online sources such as NatureServe (2008), Hardy's Internet Guide to Marine Gastropods (2005) and Fauna Ibérica (2008).

All the data were recorded in a database containing the following fields: location data, list of taxa recognized in every excavation unit, recognized elements of every taxon and ecological characteristics of every taxon. The **location data** contains the information of the recuperational context: site (Nerja Cave), chamber (*Vestíbulo*), year of excavation (1983, 1984, 1985, 1986, 1987), unit or sets of portions of several units (a prismatic test and a conic test), stratigraphic unit (NV1 a NV13, except NV11) and spit operar tire leves (from a to z). The **list of taxa** (Table 1) is composed of 12 taxa of continental snails, 34 of marine snails, 36 of marine bivalves, 3 of scaphopods and 1 of cephalopods. The **recognized elements** of every taxon can be seen in Table 2. From this information we calculated the **total number of remains** (NR) and the **minimum number of individuals** (MNI), for both the snails and for the bivalves, expressed in number and in weight. The MNI of the snails was obtained by the addition of the entire specimens with the major numeric value of the different identified fragments (apical extremes, aperture fragments of opening, columela and siphon channel). The MNI of the bivalves was obtained by the addition of the entire valves and articular extremes of valves divided by two. The MNI of the scaphopods was obtained by the addition of the entire specimens and the different fragments. The MNI of cephalopods is difficult to calculate as their fragments are not identifiable as unique parts of the shell; in addition, typically there was only one fragment in the excavation unit, and so for every set of remains in a unit of excavation we might say that the MNI is 1. Due to the difference of excavated volume in every level, to compare the content in molluscs of the different levels we calculated this content for unit of volume (m^3), and so obtained comparable values. The **ecological characteristics** used in the database can be seen in Table 3.

3. RESULTS

The mollusc remains of the *Vestíbulo* of Nerja Cave record constitute an extraordinary collection, composed of more than 136,000 specimens that suggest more than 78 kg weight. More than 120,000 of these specimens (65 kg) originate from an Epipalaeolithic shell midden. From a descriptive standpoint (Table 1), the collection consists of 35 taxa of marine gastropods, 12 taxa of continental (freshwater and terrestrial) gastropodos, 36 taxa of marine bivalves, 3 taxa of scaphopods, 1 taxon of cephalopods and other one indeterminated mollusc (in total, eighty-six taxa of molluscs). In addition, we have detected numerous echinoid remains (presented in a recent paper; see Villalba *et al*., 2007) as well as crustaceans (E. Álvarez-Fernández, pers comm).

TABLE 1. NERJA CAVE. VESTÍBULO. MOLLUSCS TAXA

CONTINENTAL GASTROPODA (12 taxa)	MARINE GASTROPODA (35 taxa)		MARINE BIVALVIA (36 taxa)	
Melanopsis laevigata	*Fissurelidae indet.*	*L. obtusata*	*Glycymeris glycymeris*	*Ostreidae indet.*
Melanopsis sp.	*Patella vulgata*	*L. saxatalis*	*Glycymeris* sp.	*Bornia sebetia*
Theodoxus fluviatilis	*P. caerulea*	*Trivia arctica*	*Mitylus edulis*	*Acanthocardia tuberculata*
Hydrobia assimineiformensis	*P. ferruginea*	*Trivia* sp.	*Mitylus* sp.	*Acanthocardia* sp.
Hydrobia sp.	*P. intermedia*	*Cerithium vulgatum*	*Lithophaga lithophaga*	*Cerastoderma edule*
Rumina decollata	*P. nigra*	*Cerithium* sp.	*Modiolus adriaticus*	*C. glaucum*
Sphinterochilla cariosula hispanica	*P. rustica*	*Cerithiidae inder.*	*M. barbatus*	*Cerastoderma* sp.
Iberus alonensis	*P. ulyssiponensis*	*Phalium saburom*	*Modiolus* sp.	*Laevicardium norvegicum*
I. marmoratus	*Patella* sp.	*Charonia rubicunda*	*Mitylidae indet.*	*Cardidae indet.*
Iberus sp.	*Addisonia lateralis*	*Charonia* sp.	*Chlamys varia*	*Mactra stultorum*
Helicella unifasciata	*Monodonta articulata*	*Nucella lapillus*	*Chlamys* sp.	*Solen marginatus*
Gastropoda indet.	*M. turbinata*	*Stramonita haemastoma*	*Pecten maximus*	*Solen* sp.
	Monodonta sp.	*Buccinidae indet.*	*P. jacobeus*	*Solenidae indet.*
SCAPHOPODA (3 taxa)	*Gibbula richardi*	*Columbella rustica*	*Pecten* sp.	*Venus verrucosa*
Dentalium dentale	*Gibbula* sp.	*Cyclope neritea*	*Pectinidae indet*	*Tapes decussatus*
D. vulgare	*Trochidae indet.*	*C. pellucida*	*Spondylus* sp.	*Tapes* sp.
Dentalium sp.	*Littorina punctata*	*Conus mediterraneus*	*Ostrea edulis*	Veneridae indet.
		Gastropoda indet.	Ostrea sp.	Bivalvia indet.
CEPHALOPODA (1 taxon)				
Sepia sp.				

Table 1. Nerja Cave. Vestíbulo. Molluscs taxa.

TABLE 2. NERJA CAVE. RECOGNIZED ELEMENTS					
GASTROPODS			**BIVALVES**		
complete specimens	infantile	not burned	complete valve (left or right)	infantile	not burned
		burned			burned
	juvenile	not burned		juvenile	not burned
		burned			burned
	adult	not burned		adult	not burned
		burned			burned
complete specimens with perforation	apical	not burned	articular extreme		not burned
		burned			burned
	dorsal	not burned	fragments		not burned
		burned			burned
	labial	not burned	sea rolled fragment		
		burned	bivalve specimen		
identified fragments	apical extreme	not burned	crusted valves		
		burned			
	aperture fragment	not burned	SCAPHOPODS		
		burned	complete specimens		
	columela	not burned	fragments (proximal, mesial, distal)		
		burned			
	siphon chanel	not burned	SCAPHOPODS		
		burned	inner shell fragments		
fragments		not burned			
		burned			
crusted specimens					

Table 2. Nerja Cave. Recognized elements.

The number of specimens has overcome our initial forecasts that were based on our previous work (Jordá, 1981, 1982, 1983, 1984-85, 1986, González-Tablas *et al*. 1984, Jordá *et al*. 1987; Aura *et al*. 1993, Jordá *et al*. 2003); our results so far contrast enormously with the data presented by other authors for other chambers of Nerja Cave (Serrano *et al*. 1995, Lozano-Francisco *et al*. 2004), in spite of the similarity in age with the assemblage analysed here.

In relation with the **vertical distribution** of the molluscs in the *Vestibulo* archaeological record, during the Gravettian the terrestrial snails, used as food, dominate; in the Solutrean levels terrestrial snails continue to dominate, but marine snails begin to be consumed; during the Magdalenian the marine molluscs (bivalves) dominate. The marine molluscs reach their maximum during the Epipalaeolithic, giving rise to a shell midden, formed primarily by *M. edulis* and diverse species of *Patella*. The variation of the number of specimens by cubic metre in percentage expresses the change that happens in the transition between Solutrean – Magdalenian (Fig. 2.A).

Of the more than 136,000 remains of molluscs coming from the Vestíbulo of Nerja Cave, a small, but nonetheless important, part is made up of those specimens that were used as **personal ornaments.** Almost all of the personal ornaments from the *Vestíbulo* (136 of 137) are made from molluscs. The distribution of the molluscs used as personal ornaments along the *Vestíbulo* archaeological sequence is as follows (the Epipalaeolithic personal ornaments are currently being studied):

- **Gravettian** (Fig. 2.B): The chosen species are two gastropods, *L. obtusata* and *T. fluviatilis*, and one scaphopod, *Dentalium* sp. *L. obtusata* is represented by three complete specimens, *T. fluviatilis* by two complete specimens and a fragment, and finally we count three specimens of *Dentalium* sp. We must add for this period two fragments of marine gastropods that we cannot identify, which bear traces of manufacture. In addition there is one singular hanging object whose nature we have not been able to identify.

- **Solutrean** (Fig. 2.C): Among the 85 personal ornaments from this chronological period we once again find L. *obtusata*, this time, represented by 21 specimens that conserve the complete perforation and 8 broken/fragmented specimens; T. *fluviatilis* is represented by 24 perforated specimens and

TABLE 3. NERJA CAVE. ECOLOGICAL CHARACTERISTICS	
DOMAIN	continental, marine
HABITAT	terrestrial, freshwater, bentonic (epifauna and infauna), nectonic
ENVIRONMENT	fluvial, lacustrine, fluvio-lacustrine, palustrine, karstic, fluvio-karstic, litoral, continental platform
SUB-ENVIRONMENT	dtuary, delta, lagoon, beach, dune, clif
VERTICAL DISTRIBUTION	supralitoral, mesolitoral, sublitoral, supratidal, intertidal, subtidal
DEPTH	in intervals or above or below a concrete value in meters
SUBSTRATUM	rocky, gravelly, sandy, siltly, organic, algal, coralline, shells
WATER ENERGY	quiet, trouble, swell,
WATER CLARITY	turbid, clear
SALINITY	fresh water, salty, marine, hipersaline
SALINITY TOLERANCE	eurihaline, stenohaline
WATER TEMPERATURE	in ºC, warm, cold, temperate
TEMPERATURE TOLERANCE	euritermic, stenotermic
HABITS	troglophilus, drill-hole, fixed, mobile
FOOD	carnivorous, herbivorous, carrion
GEOGRAPHIC DISTRIBUTION	cosmopolitan, Alboran Sea, Mediterranean Sea, Black Sea, Atlanthic Ocean, etc

Table 3. Nerja Cave. Ecological characteristics.

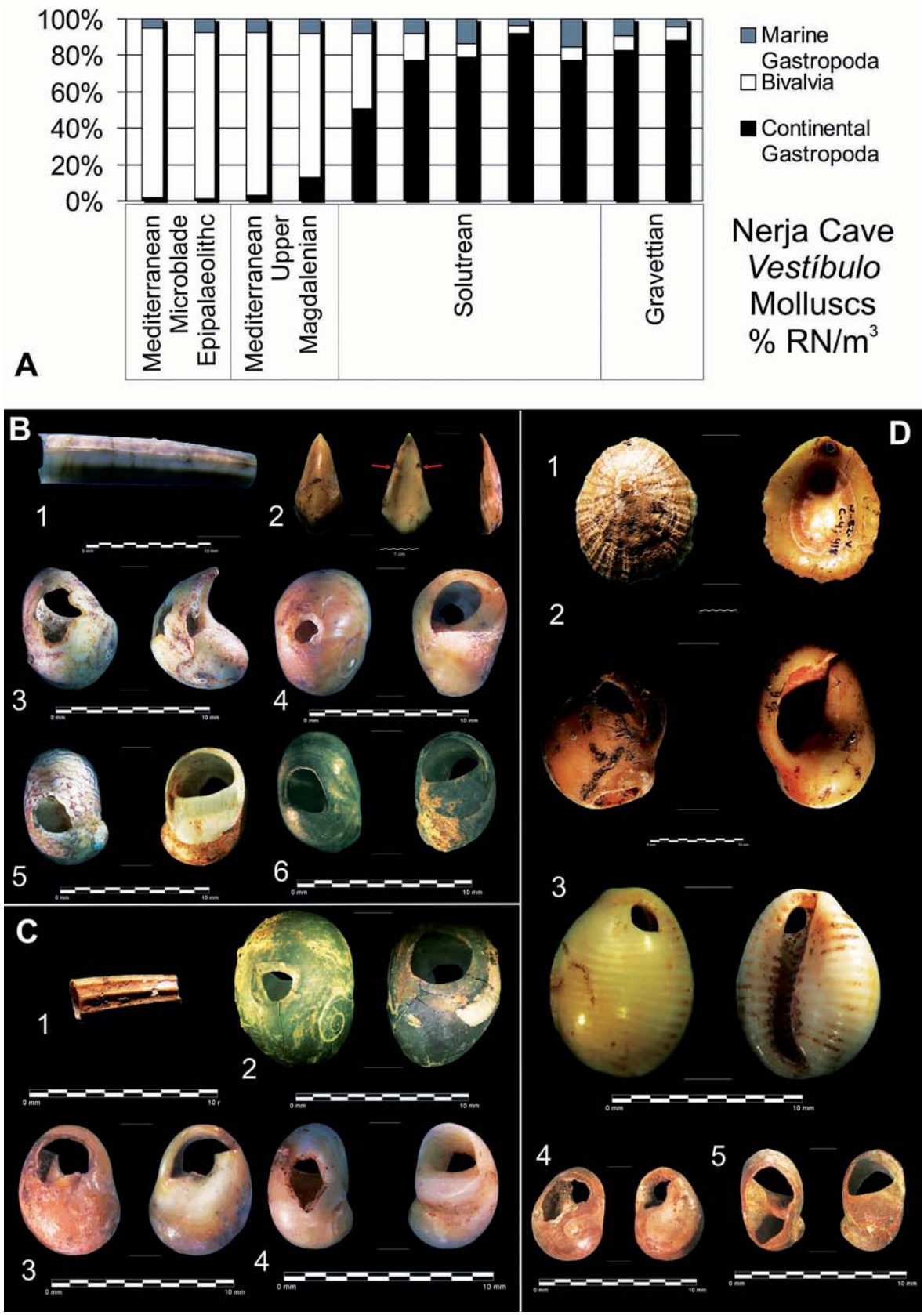

Figure 2. A: Distribution of the molluscs from the archaeological levels of *Vestíbulo* chamber of Nerja Cave in % Number of Remains (NR) / m3 of sediment. B: Gravettian personal ornaments: 1, *Dentalium* sp.; 2, singular hanging object whose nature we have been unable to identify, with two lateral marks; 3 and 4, *Littorina obtusata*; 5 and 6, *Theodoxus fluviatilis*. C: Solutrean personal ornaments: 1, *Dentalium* sp.; 2, *L. obtusata*; 3, *Cyclope neritea*; 4, T. *fluviatilis*. D: Magdalenian personal ornaments: 1, *Patella* sp.; 2, *Nucella lapillus*; 3, *Trivia arctica*; 4, *C. neritea;* 5, *T. fluviatilis*.

there are 10 examples of *Dentalium* sp. Some new species of gastropods were used as personal ornaments such as 16 *Cyclope* (2 *neritea*, 10 *pellucida*, 4 sp.), 1 *C. rustica*, 1 *L. saxatalis*, 1 indeterminate complete specimen and 1 undetermined fragment.

- Magdalenian (Fig. 2.D): The most frequently represented species in the previous levels are also present in the Magdalenian. Among these, the most common species is *Cyclope*: in its *neritea* variant, 15 specimens; in *pellucida*, 11 speciments. We found also 2 fragments of *L. obtusata,* 10 T. *fluviatilis*, 2 *Patella sp.*, 1 *N. lapillus* and 1 *T. arctica*.

Except *Dentalium*, which because of its morphology does not need a perforation to be suspended, all the examples have only one perforation, which is not always complete. In many cases we identified the techniques used to make the perforations but in other cases because of the eroded condition of the shells' surface and the wearing down of the perforations, we have not been able to establish these techniques. We do not show the results of the technological analysis of the perforations here because of the lack of space but we will do it soon in a more detailed publication.

The origin of the species used, except the *T. fluviatilis* which is a freshwater gastropod, is marine and could be Mediterranean, so they could have been gathered on the coast closest to the site. The only species to which this might not apply is *L. obtusata* and *N. lapillus*. In the present, this species are only present along the Atlantic coast. This factor makes the presence of this species and the possible Mediterranean origin of the collection more problematic. The first hypothesis to explain its presence is that in cold periods, species that today are found only in the Atlantic may have colonized the Mediterranean Sea (Álvarez-Fernández 2006, Taborin 1993). Another hypothesis would involve long distance trade or other contact. We do not have any data to reject either of the hypotheses, so for the moment both explanations stand.

4. CONCLUSIONS

- Nerja Cave archaeological record is distinguished by the abundant presence of human transported marine and continental molluscs: 86 taxa and more than 136,000 specimens (more than 78 kg) of Gastropoda, Scaphopoda, Bivalvia and Cephalopoda.

- Terrestrial snails were consumed as food during Gravettian and Solutrean. Marine molluscs were consumed from Late Solutrean and Mediterranean Upper Magdalenian through the Mediterranean Microblade Epipalaeolithic, with development during this period of an important shell midden.

- Others molluscs, like snails and scaphopods, were used as personal ornaments, from the Gravettian to Magdalenian and the Epipalaeolithic. The species most represented throughout the sequence (*L. obtusata, T. fluviatilis* and *Dentalium* sp.) appear in all levels, except *C. neritea* and *pellucida* which are absent during the Gravettian. All these species appear recurrently in Palaeolithic levels of several European sites.

- Finally, some species were introduced in the cave accidentally.

5. ACKNOWLEDGEMENTS

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