# Hunting and Fishing in the Neolithic and Eneolithic

## Weapons, Techniques and Prey

Edited by Selena Vitezović
and Christoforos Arampatzis

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# Hunting and fishing weapons, land and marine resources, technology and ways of life in the Neolithic sites of the Strait of Gibraltar region

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**Abstract**

This chapter presents the interdisciplinary study (involving research on prehistoric archaeology, terrestrial fauna and marine fauna by the Universities of Cadiz, Córdoba, Cantabria and CSIC-Barcelona) of hunting and fishing implements from various periods of prehistory in the region around the Strait of Gibraltar, including along both European and North African shores. Recently excavated Neolithic sites include Benzú Cave (Ceuta) in North Africa, Campo de Hockey (San Fernando, Cádiz), La Esparragosa (Chiclana de la Frontera, Cádiz) and SET Parralejos (Vejer de la Frontera, Cádiz), on the Spanish coast. Using carbon dating, these sites have been dated to the 6th-4th millennium BC. The economies of these sites were largely agriculture based, but the hunting and fishing instruments are of special interest owing to proximity of the coast. This study investigates a wide range of issues, from the archaeobotanical, terrestrial and marine fauna records to lithic technology and functionality studies. Together with

hunting, the exploitation of marine resources (fish and shellfish) was important for people's diet in this Atlantic–Mediterranean region.

**Keywords:** Gibraltar Strait region; Hunter-gatherers; Neolithic societies; Microliths; Marine resources; Hunting; Fishing

## Introduction

The exploitation and consumption of marine resources is of great interest for prehistoric studies. In the Iberian Peninsula, it was believed until recently that these resources were exploited only by anatomically modern humans (Straus 1992). However, recent research in the region around the Strait of Gibraltar – at sites such as Gibraltar (Stringer *et al.* 2008; Fa *et al.* 2016), Bajondillo (Cortés *et al.* 2011) and along the Portuguese coast (Zilhao *et al.* 2020) – has demonstrated that they were also exploited by Neanderthal groups which used Mousterian-Mode 3 technology.

In North Africa, the exploitation of marine resources in the site of Benzú dates back to at least 270 Ka. (Cantillo 2017; Ramos *et al.* 2016). Anatomically modern humans have been attested at the nearby site of Djebel Irhoud (Hublin *et al.* 2017), but no human remains have been documented in Benzú to date, and, based on the technological features of the stone tools found, we believe that the site was occupied by Neanderthal groups (Ramos-Muñoz *et al.* 2019; Clemente-Conte *et al.* 2019b).

The continued exploitation of marine and hunting resources throughout the Upper Palaeolithic period in the region seems obvious, and is also attested by other sites such as Cueva de Nerja (Aura *et al.* 2001, 2016).

This chapter argues that, in parallel with hunting, the exploitation of marine resources played a significant role in the economy and everyday life of the last groups of hunter-gatherers and the earliest Neolithic agricultural tribal societies (Ramos Muñoz ed. 2008). For more than 20 years we have been studying, from the theoretical position of Social Archeology (Arteaga 1992; Bate 1998; Vargas 1987), the transition from hunter-gatherer to tribal societies in the Strait of Gibraltar region, during the Pleistocene and Holocene (Ramos Muñoz ed. 2008).

## The natural environment: The geohistorical region of the Strait of Gibraltar

The natural region of the Strait of Gibraltar is a mid-latitude warm zone straddling Europe and Africa. It extends over the Iberian Moroccan Gulf to the north (Vanney and Menanteau 2004), the Bay of Cadiz and the coastal area of Campo de Gibraltar to the west, and the Bay of Malaga to the east. In North Africa, it stretches from Tangier peninsula to the Alborán Basin, including the hinterland of Tangier, the coast of Tetouan and the Eastern Rif and Oued Moulouya.

The region's peculiar geographical features and historical evolution are a result of its unique location between the Atlantic and the Mediterranean (Arteaga and Hoffmann 1999; Arteaga *et al.*, 2008).

This chapter analyses several sites located along the Atlantic coast of Cádiz and its agricultural hinterland, as well as a site in Ceuta, North Africa.

All these areas are very similar in terms of geology (Gutiérrez *et al.* 1991; Gracia *et al.* 2000; Zazo and Goy 2000), geography, environment, climate, wildlife, vegetation and resources. These areas are regarded as

a historical region (Braudel 1988) because of their homogenous historical and economic development over time. The region's peculiar geographical features and historical evolution are a result of its unique location between the Atlantic and the Mediterranean (Arteaga and Hoffmann 1999).

Therefore, the area is of interest because of the presence of soils with great agricultural potential and great diversity in terms of land wildlife. As we shall see presently, the economic potential of the land (Guerra *et al.* 1963) was accompanied by the exploitation of marine resources from the Middle Pleistocene and, especially, the Holocene.

## The sites

This section presents the geographical location and a brief description of the sites that we shall be considering in more detail below. As illustrated in Figure 1, all of these sites are located along the Atlantic coast of Cádiz (Embarcadero del río Palmones, SET Parralejos, La Esparragosa, Campo de Hockey and El Retamar), except for the Benzú Cave, which is situated near the autonomous city of Ceuta, on the African shore of the Strait of Gibraltar.


*Figure 1. Sites with evidence of agricultural and fishing activity presented in the chapter.*

Except for Embarcadero de río Palmones, where no organic material suitable for radiocarbon dating was recovered, at least in the earliest excavation campaigns, all the remaining sites have yielded radiocarbon dates, which are presented in Table 1. These dates range from 6118/5701 cal BC in El Retamar to 3007/2854 cal BP in La Esparragosa (cf. Table 1).

### *The last hunter-gatherer groups*

*Embarcadero del río Palmones (Algeciras, Cádiz)*

This prehistoric settlement is located along the lower course of the Palmones River, in the northwest part of the Bay of Algeciras, Campo de Gibraltar (Figure 1:2) (Gutiérrez *et al.* 1991; Domínguez-Bella *et al.* 2004), on the southern tip of the Iberian Peninsula. In terms of environment and vegetation, the area presents the characteristics typical of the region of the Strait of Gibraltar.

The site is located on a fluvial terrace over the Palmones River (T 3, + 12-15 m), constituted by fluvial deposits. The excavation of Trench 2 (36 $m^2$) led to the discovery of a number of dismantled hearths. The lithic remains found at the site include a large proportion of geometric flakes and back-edged microliths characteristic of Epipaleolithic–Mesolithic contexts. The site has also yielded evidence for the exploitation of land fauna, molluscs and plants (Ramos Muñoz and Castañeda 2005).

Two TL dates taken from a fragment of burnt sandstone and a pottery fragment dated these archaeological contexts to the 4th millennium BC (Millán and Benéitez 2005: 346).

### *Early Neolithic tribal societies, 6th-5th millennium BC*

*El Retamar (Puerto Real, Cádiz)*

This site is located in an area of rolling hills in the northeast of the Bay of Cádiz, at 18 m.a.s.l., approximately 800 m from the current coastline (Figure 1:6). A rescue excavation in 1995-1996 documented numerous features, including 62 hearths, 10 shell middens and 24 stone clusters, as well as cardium, plain and grooved ceramic wares, and numerous lithic instruments and remains of terrestrial and marine fauna.

The site is dated to the 6th-5th millennium BC (Table 1) (Ramos Muñoz and Lazarich 2002; Ramos *et al.* 2004). The site is illustrative of a society in transition which practised animal herding, but for whom fishing, hunting and mollusc gathering were still significant economic activities.

*Campo de Hockey (San Fernando, Cádiz)*

The settlement of Campo de Hockey is located in the southeast of the Bay of Cádiz, at 15-20 m.a.s.l. During the Neolithic, this area was surrounded by water (Figure 1:5). The site is dated to the 5th-4th millennium BC (Vijande *et al.* 2015, 2018). This is one of the oldest permanent settlements in the south of the Iberian Peninsula, and has yielded evidence of agriculture and animal herding, but the exploitation of marine resources would also have played a prominent economic role.

TABLE 1. C14 DATES HAVE BEEN CALIBRATED WITH OXCAL 4.3.2 AND THE CURVES INTCAL13 AND MARINE13.

| Site | Laboratory | Dating System | Sample | Context | BP Date | Cal ANE date (2σ) | Bibliographic reference |
|---|---|---|---|---|---|---|---|
| El Retamar | Sac-1676 | Carbon-14 | Shell | Conchero 6 | 7400±100 | 6118/5701 calANE | Ramos Muñoz 2004: 78-79 |
| El Retamar | Sac-1525 | Carbon-14 | Shell | Hogar 18 | 7280±60 | 5936/5662 calANE | Ramos Muñoz 2004: 78-79 |
| El Retamar | Beta-90122 | Carbon-14 | Shell | Hogar 18 | 6780±80 | 5499/5203 calANE | Ramos Muñoz and Lazarich 2002: 172 |
| Benzú Cave (North Africa) | MAD-3076 | Thermoluminescence (TL) | Pottery | -AXIX-XX-2 / Stratum II | 7136±433 | | Millán and Benéitez 2003: 347 |
| Campo de Hockey | CAN 664 | Carbon-14 | Shell (*Phorcus lineatus*) | Double burial in megalithic mound Grave 11 UE 1406 | 5650±40 | 4221/3987 calANE | Vijande 2009 |
| Campo de Hockey | CAN 833 | Carbon-14 | Shell | Burial seven 7 (single) Trench 7 | 5665±50 | 4244/3982 calANE | Vijande et al. 2015 |
| Campo de Hockey | CNA 835 | Carbon-14 | Shell | Circular structure (pit) Corte 2 UE-205 | 5485±30 | 3986/3802 calANE | Vijande et al. 2015 |
| Campo de Hockey | ETH-88972 | Carbon-14 | Human bone | Double burial in megalithic mound Grave 11 (Individual 1) | 5364±24 | 4326/4066 calANE | Sánchez-Barba et al. 2019 |
| Campo de Hockey | CAN 360 | Carbon-14 | Human bone | Grave 10 (double) Trench 15 | 5020±50 | 3951/3705 calANE | |
| Set-Parralejos | CNA 4 | Carbon-14 | Shell | Silo 119-UE 1030 | 4930±50 | 3906/3638 calANE | Villalpando y Montañés 2016 |
| Set-Parralejos | CNA 1 | Carbon-14 | Human bone | Silo 106-UE 1025 | 4610±50 | 3622/3112 calANE | Villalpando and Montañés 2016 |
| Set-Parralejos | CNA 3 | Carbon-14 | Bone cánido | Silo 116-UE1031 | 4495±45 | 3356/3029 calANE | Villalpando and Montañés 2016 |
| Set-Parralejos | CNA 2 | Carbon-14 | Human bone | Silo 106-UE 1037 | 4480±50 | 3631/3362 calANE | Villalpando and Montañés 2016 |
| La Esparragosa | MAD-3961 | Thermoluminescence (TL) | Pottery | Estructura AV-2-(3) Enterramiento | 5255±433 | | Ramos Muñoz, coord. 2008: 344 |
| La Esparragosa | MAD-3962 | Thermoluminescence (TL) | Pottery | Estructura AV-2-(6) Enterramiento | 5129±476 | | Ramos Muñoz, coord. 2008: 344 |
| La Esparragosa | CNA 4238.1.1. | Carbon-14 | Shell | Estructura AV-2 Enterramiento | 4644±31 | 3007/2854 cal BC | Vijande et al. 2018 |
| La Esparragosa | Beta-501265 | Carbon-14 | Human bone | Silo DII-Enterramiento 2 | 4410±30 | 3309/2917 calANE | Vijande et al. 2019a |
| La Esparragosa | Beta-501262 | Carbon-14 | Bone fauna | Silo AIV-9-21 | 4390±30 | 3092/2918 calANE | Vijande et al. 2019a |
| La Esparragosa | Beta-501263 | Carbon-14 | Bone fauna | Silo AIV-9-43 | 4370±30 | 3089/2907 cal BC | Vijande et al. 2019a |
| La Esparragosa | Beta-501261 | Carbon-14 | Bone fauna | Silo BV-11 | 4350±30 | 3081/2901 calANE | Vijande et al. 2019a |

Two excavation campaigns were undertaken. The 2007-2008 season (Campo de Hockey 1) led to the discovery of two dwelling structures and five storage pits, as well as a large necropolis with 60 burials and 73 bodies (Vijande 2009). The presence of some exotic products (amber, variscite, turquoise, sillimanite, etc.) in the most elaborate burials suggests a degree of social inequality (Vijande *et al.* 2015; Sánchez-Barba *et al.* 2019). The second excavation campaign (Campo de Hockey 2) was undertaken in 2019, and it documented 15 hearths and three shell-middens. The large number of hearths and the abundance of malacological and ichthyological remains (some of them are thermoaltered) suggests that a fish-processing and consumption area may have existed in the settlement.

*Benzú Cave (Ceuta)*

Benzú Cave is located on the African shore of the Strait of Gibraltar, in western Ceuta (Figure 1:1). The cave is barely 25 $m^2$ and is divided into two chambers. The archaeological deposits, approximately 1 m deep, consist of fine sands and include two occupational levels: Late Neolithic and Early Bronze Age. Excavations were undertaken annually from 2002 to 2005, and in 2007 (Ramos Muñoz *et al.* 2013). In total, we excavated 21 units of 1 × 1 $m^2$. These have enabled us to map the different areas of activity in the cave. Although Benzú Cave is not large, it has yielded a wide array of archaeological evidence that, as we shall demonstrate below, sheds new light on the ways of life of Neolithic communities in North Africa; however, the projectiles found during the excavation suggest that hunting continued (Cantillo 2017; Vijande Vila *et al.* 2019b).

The Late Neolithic contexts are TL dated (based on a ceramic fragment) 7136 ± 433 BP (Millán and Benéitez 2003) (Table 1). The material assemblage is characterised by plain pottery and rhomboid microliths, which is similar to that found in nearby caves such as Gar Cahal (Vijande *et al.* 2011), Caf That El Ghar (Ramos Muñoz *et al.* 2008) and Tangier (Gilman 1975).

***Sedentary Neolithic tribal societies, 4th millennium BC***

*La Esparragosa (Chiclana de la Frontera, Cádiz)*

The site of La Esparragosa is located a few kilometres from Chiclana de la Frontera (Ramos Muñoz *et al.* 2010). It is located on a prominent plateau over the Iro River and the associated marshland, at 27-30 m.a.s.l. The plateau is constituted by yellow Pliocene detritic sands, overlaid by a layer of red sands associated with a fluvial terrace (Figure 1:4).

The site is characterised by a large number of grain storage pits, subcircular in plan and variable in section (cylindrical and bell-shaped) and depth (1-1.40 m). The fills contained terrestrial fauna, malacofauna, lithic instruments and hand-worked ceramics. They correspond to a stratigraphically homogenous abandonment level. The excavation also attested a large burial feature (2 x 2 m) associated with stone tools, ceramics, terrestrial fauna and malacofauna (Vijande Vila *et al.* 2019a).

The chronology (Table 1) ranges from 3309/2907 cal BC (human bone from the burial) to 3007/2854 calBC. Therefore, the settlement was active at the turn of the 3rd millennium BC.

*SET Parralejos (Vejer de la Frontera, Cádiz)*

This site is located between the hamlets of Parralejos, La Muela and Patría, in the municipality of Vejer de la Frontera (Figure 1:3), on a hilltop that dominates the surrounding farmlands of La Janda, on the coast of Cádiz (Villalpando and Montañés 2009).

The site was discovered in 2008, during the construction of an electric substation. The site comprises an extensive field of silos, similar to that found in La Esparragosa. Two excavation campaigns were undertaken, in 2008-2009 and 2012 (Villalpando and Montañés 2009, 2016; Cantillo *et al.* 2017), and a total of 65 silos were identified, of which 40 were fully excavated. The silos are of various shapes (cylindrical, bell-shaped, rhomboid and sub-rectangular). Most silos were a single archaeological context, and contained knapped and polished stone tools, handmade ceramics (globular pans, ridged dishes, lenticular cups and semispherical bowls), fauna and marine malacofauna (Villalpando and Montañés 2016).

The site is carbon dated to the late 4th millennium calBC (Villalpando and Montañés 2016) (Table 1).

## Archaeological record: Malacofauna and ichthyofauna

Fishing and mollusc-gathering among the final hunter-gatherer societies on the northern shore of the Strait of Gibraltar have been attested in Embarcadero del río Palmones. The main species is the bivalve *Chamelea gallina* (297 remains; MNI: 119) (Table 2) (Cantillo 2017). Many of these remains were found in association with small burned pebbles, which suggests that these bivalves were cooked before they were eaten.

The Neolithic record, on the other hand, suggests that sea species played a prominent economic role. El Retamar, for example, seems to have been a seasonal settlement that specialised in the exploitation of marine resources. A total of 25 species have been attested, including 11 species of bivalves (MR: 3449 NR; MNI: 1850), 12 of gastropods (NR: 664; MNI: 589) and two of crustaceans (NR: 51; MNI: 44) (Table 2) (Cantillo 2017). The most abundant species are the bivalves *Solen marginatus* and *Ruditapes decussatus*, and the gastropods *Hexaplex trunculus* and *Bolinus brandaris*. It seems clear that priority was given to species that live in soft sandy soils. The reproduction cycle of sea breams, which takes place in shallow waters between October and December, may explain the seasonal nature of the settlement (Ramos Muñoz and Lazarich 2002: 429).

In Benzú Cave, the record is similar, and includes *Ostrea* sp., *Mytilus* sp., *Chlamys* sp. and patellae gastropods, and again there is evidence of cooking. This assemblage also presents a significant number of crustaceans (Vijande Vila *et al.* 2019a). It is also important to note the presence of perforated shells of *Patella* sp., *Trivia monacha* and *Nassarius pfeifferi*, which were probably used as personal adornments. This would be in line with the use of the cave as a funerary space.

In the 5th-4th millennium, the island site of Campo de Hockey presents an interesting faunal assemblage. The assemblage includes a wide variety of molluscs, of which 48 species have been identified (Table 2). Especially abundant are the *Phorcus lineatus* and the *Ruditapes decussatus*, both of which are very nutritious. The taphonomic studies undertaken on specimens of *P. lineatus* indicate that these molluscs were processed before being consumed (Cantillo 2017). There is also a large number of perforated shells, some of them found *in situ* in association with adult skulls and, in one case, near the neck of a child (Vijande *et al.* 2015).

Concerning the 4th millennium BC, the sites of La Esparragosa and SET Parralejos, both of which are characterised by the presence of a large number of silos, also present evidence for the systematic gathering of *R. decussatus* (Table 2). Especially of note is the presence of 477 specimens of this species, some of which were still closed, covering a burial in La Esparragosa (Cantillo 2017; Vijande Vila *et al.* 2019a).

Concerning ichthyofauna, the taxa identified reveal a clear preference for the Sparidae family (Table 2), including such species as *Lithognathus mormyrus*, *Diplodus* sp. and *Dentex* sp. in El Retamar (Soriguer *et al.* 2002); *Sparus aurata*, *Diplodus* sp. and *Pagrus* sp. in Campo de Hockey (Corona 2019); and undetermined sparids in Benzú Cave (Cantillo and Soriguer 2013). Other taxa are occasionally found: for instance, *Argyrosomus regius*, *Thunnus thynnus* and *Galeorhynus galeus* in El Retamar (Soriguer *et al.* 2002), and members of the Lamnidae and Clupeidae families and the Rajiforme order in Campo de Hockey (Corona 2019).

Sparidae are the predominant group. This family is composed of gregarious fish species that are found in demersal, pelagic and coastal waters. They reproduce in spring and summer (Lloris 2015), and seek the shelter of the coast (Pérez and Rodríguez del Valle 2001). The best time to capture them must have been autumn, summer and spring, especially at sundown, when the fish would have abandoned their daytime shelters (Espinar, M.C. online). The remaining taxa attested share certain features, such as coast-bound reproductive migrations (Pérez and Rodríguez del Valle 2001) in shoals (Lloris 2015).

Table 2: Marine species gathered and fished along the coast of Cádiz in late prehistory.

| Taxa | Embarcadero Río Palmones | | El Retamar | | Campo de Hockey | | Benzú Cave | | La Esparragosa | | SET Parralejos | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Marine bivalves** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** |
| *Acanthocardia* sp. | | | 1 | 0.04 | | | | | 2 | 0.13 | | |
| *Acanthocardia tuberculata* | 8 | 4.23 | | | 2 | 0.15 | | | | | | |
| *Aequipecten commutatis* | | | | | 2 | 0.15 | | | | | | |
| *Aequipecten* sp. | | | | | 2 | 0.15 | | | | | | |
| *Acanthocardia* sp. | | | | | | | | | | | | |
| *Anomia ephippium* | 1 | 0.52 | | | | | | | 25 | 1.64 | | |
| *Barbatia barbata* | | | | | 1 | 0.07 | | | | | | |
| Indeterminate bivalve | 1 | 0.52 | | | 6 | 0.47 | 6 | 15.4 | 2 | 0.13 | 1 | 0.47 |
| *Callista chione* | 1 | 0.52 | | | | | | | 1 | 0.06 | 24 | 11.32 |
| Cardiidae | | | | | | | | | 1 | 0.06 | | |
| *Cerastoderma edule* | 1 | 0.52 | 11 | 0.44 | | | | | 1 | 0.06 | 2 | 0.94 |
| *Chamelea gallina* | 119 | 62.96 | | | | | | | | | | |
| *Chlamys* sp. | | | 6 | 0.24 | 163 | 13 | 1 | 2.56 | 52 | 3.42 | 16 | 7.54 |
| *Chlamys varia* | | | | | 47 | 3.75 | | | | | 2 | 0.94 |
| *Crassostrea* sp. | | | | | | | | | 50 | 3.29 | | |
| *Crassostrea angulata* | | | 20 | 0.8 | 2 | 0.15 | | | | | | |
| *Donax trunculus* | 21 | 11.11 | | | | | | | | | | |
| *Glycymeris glycymeris* | | | | | 14 | 1.11 | | | | | | |
| *Glycymeris* sp. | 4 | 2.11 | 1 | 0.04 | 69 | 5.49 | | | 9 | 0.59 | 2 | 0.94 |
| *Laevicardium* sp. | | | | | 1 | 0.07 | | | 2 | 0.13 | | |
| *Lutraria lutraria* | | | | | 1 | 0.07 | | | | | | |
| Mactridae | | | | | | | | | 1 | 0.06 | | |
| *Mytilus galloprovincialis* | | | 1 | 0.04 | | | | | | | | |
| *Mytilus* sp. | | | | | 2 | 0.15 | 1 | 2.56 | | | | |
| *Ostrea edulis* | | | 1 | 0.04 | 32 | 2.55 | | | 1 | 0.06 | | |
| Ostreidae | | | | | 1 | 0.07 | 1 | 2.56 | 42 | 2.76 | | |
| *Panopea glycymeris* | | | | | | | 1 | 2.56 | 1 | 0.06 | 1 | 0.47 |
| *Pecten* sp. | | | 1 | 0.04 | 10 | 0.79 | | | | | | |
| *Pecten maximus* | | | | | 38 | 3.02 | | | 143 | 9.42 | 11 | 5.18 |
| *Pholas dactylus* | | | 3 | 0.12 | | | | | 23 | 1.51 | | |
| *Ruditapes decussatus* | 6 | 3.17 | 557 | 22.4 | 167 | 13.3 | | | 1081 | 71.21 | 130 | 61.32 |
| *Scrobicularia plana* | | | 73 | 2.94 | 1 | 0.07 | | | 25 | 1.64 | | |
| *Solen marginatus* | 2 | 1.05 | 1175 | 47.3 | 127 | 10.1 | | | 10 | 0.65 | 9 | 4.24 |
| Veneridae | | | | | 3 | 0.23 | | | | | 2 | 0.94 |
| *Venus verrucosa* | 5 | 2.64 | | | 2 | 0.15 | | | | | 1 | 0.47 |
| ***Total Bivalves*** | **169** | **89.41** | **1850** | **74.5** | **700** | **55.7** | **10** | **25.6** | **1472** | **96.96** | **201** | **94.81** |

| Taxa | Embarcadero Río Palmones | | El Retamar | | Campo de Hockey | | Benzú Cave | | La Esparragosa | | SET Parralejos | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Marine gastropods** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** |
| *Astraea rugosa* | | | 4 | 0.16 | | | | | | | | |
| *Bolinus brandaris* | 8 | 4.23 | 113 | 4.55 | 17 | 1.35 | | | | | | |
| *Calliostoma zizyphium* | | | 2 | 0.08 | | | | | | | | |
| *Capulus ungaricus* | | | | | | | | | 11 | 0.72 | | |
| *Cerithium vulgatum* | | | 64 | 2.57 | 47 | 3.75 | | | | | | |
| *Charonia lampas* | 2 | 1.05 | | | 16 | 1.28 | | | 1 | 0.06 | 1 | 0.47 |
| *Columbella rustica* | | | | | 1 | 0.07 | 1 | 2.56 | | | | |
| *Conus mediterraneus* | | | | | 1 | 0.07 | 1 | 2.56 | | | | |
| *Cymatium parthenopeum* | | | | | 1 | 0.07 | | | | | | |
| *Cymbium olla* | | | | | | | | | 4 | 0.26 | | |
| Cypraeidae | | | | | 1 | 0.07 | | | | | | |
| Indeterminate gastropods | | | | | 2 | 0.15 | 1 | 2.56 | | | | |
| *Hexaplex trunculus* | 4 | 2.11 | 350 | 14.1 | 155 | 12.3 | | | | | 1 | 0.47 |
| *Hinia reticulatus* | | | 7 | 0.28 | 11 | 0.87 | | | 1 | 0.06 | | |
| *Hydrobia ulvae* | | | 18 | 0.72 | | | | | 1 | 0.06 | | |
| Muricidae | | | | | 1 | 0.07 | | | | | | |
| *Nassarius pfeifferi* | | | | | | | 2 | 5.12 | | | | |
| *Ocenebra erinaceus* | | | 1 | 0.04 | 2 | 0.15 | | | | | | |
| *Omalogyra* sp. | | | 1 | 0.04 | | | | | | | | |
| *Patella* sp. | 2 | 1.05 | 6 | 0.24 | 7 | 0.55 | 14 | 35.9 | | | 5 | 2.35 |
| *Patella caerulea* | 2 | 1.05 | | | | | 1 | 2.56 | | | | |
| *Patella ferruginea* | | | | | | | 1 | 2.56 | | | | |
| *Patella nigra* | | | | | | | | | | | 1 | 0.47 |
| *Patella rustica* | | | | | 1 | 0.07 | | | | | | |
| *Patella ulyssiponensis* | | | | | 1 | 0.07 | | | | | | |
| *Phorcus lineatus* | 2 | 1.05 | 21 | 0.84 | 250 | 19.9 | | | 1 | 0.06 | | |
| *Phorcus* sp. | | | | | 2 | 0.15 | | | | | | |
| *Phorcus turbinatus* | | | | | 5 | 0.39 | | | | | | |
| *Rissoa* sp. | | | 2 | 0.08 | | | | | | | | |
| *Siphonaria pectinata* | | | | | 3 | 2.23 | 1 | 2.56 | | | | |
| *Stramonita haemastoma* | | | | | 5 | 0.39 | 1 | 2.56 | | | 1 | 0.47 |
| *Trivia monacha* | | | | | | | 3 | 2.56 | | | | |
| *Turritella communis* | | | | | | | | | 1 | 0.06 | | |
| *Zonaria pyrum* | | | | | 5 | 0.39 | | | | | 1 | 0.47 |
| **Total Gastropods** | **20** | **10.59** | **589** | **23.7** | **534** | **42.5** | **26** | **66.7** | **20** | **1.31** | **10** | **4.71** |
| **Freshwater bivalves** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** |
| *Potomidas littoralis* | | | | | | | | | 1 | 0.06 | | |
| *Melanopsis* sp. | | | | | | | 2 | 5.12 | | | | |
| **Total Freshwater bivalves** | | | | | | | **2** | **5.12** | **1** | **0.06** | | |
| **Crustaceans** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** |
| *Brachyura* sp. | | | 35 | 1.41 | 3 | 0.23 | 1 | 2.56 | 12 | 0.79 | | |
| *Balanus balanoides* | | | 9 | 0.36 | | | | | | | | |
| *Balanus* sp. | | | | | 16 | 1.28 | | | 4 | 0.26 | | |
| **Total Crustaceans** | | | **44** | **1.77** | **19** | **1.51** | **1** | **2.56** | **16** | **1.05** | | |
| **Echinoderms** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** |
| *Paracentrotus lividus* | | | | | | | | | 9 | 0.59 | | |
| **Cephalopods** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** |
| *Sepia* sp. | | | | | 1 | 0.07 | | | | | | |
| **Cnidarians** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** | **NMI** | **%** |
| Coral | | | | | 2 | 0.15 | | | | | 1 | 0.47 |
| **TOTAL** | **189** | **100** | **2483** | **100** | **1256** | **100** | **39** | **100** | **1518** | **100** | **212** | **100** |
| | | | | | | | | | | | | |
| **Ichthyofauna** | **NR** | **%** | **NR** | **%** | **NR** | **%** | **NR** | **%** | **NR** | **%** | **NR** | **%** |
| *Argyrosomus regius* | | | 4 | 0.22 | 5 | 1.49 | | | | | | |
| Clupeidae | | | | | 1 | 0.29 | | | | | | |
| *Dentex* sp. | | | 9 | 0.51 | | | | | | | | |
| *Diplodus* sp. | | | 7 | 0.39 | 5 | 1.49 | | | | | | |
| *Galeorhynus galeus* | | | 2 | 0.11 | | | | | | | | |
| Indeterminates | | | | | 14 | 4.17 | | | | | | |
| Lamnidae | | | | | 1 | 0.29 | | | | | | |
| *Lithognathus mormyrus* | | | 5 | 0.28 | | | | | | | | |
| *Pagrus* sp. | | | | | 5 | 1.49 | | | | | | |
| Rajiforme | | | | | 10 | 2.98 | | | | | | |
| Sparidae | | | | | 286 | 85.4 | 4 | 100 | | | | |
| *Sparus aurata* | | | 1725 | 98.2 | 8 | 2.38 | | | | | | |
| *Thunnus thynnus* | | | 4 | 0.22 | | | | | | | | |
| **Total Ichthyofauna** | | | **1756** | **100** | **335** | **100** | **4** | **100** | | | | |

## Terrestrial fauna

The site of Embarcadero del río Palmones (Algeciras), occupied by one of the last hunter-gatherer groups in the region, has yielded a few remains of *Equus ferus*, *Cervus elaphus*, *Canis lupus* and *Bovidae indet.* (Ramos *et al.* 2004).

Concerning the first Neolithic tribal societies, in the 6th-5th millennium BC, we have evidence provided by El Retamar (Puerto Real), Campo de Hockey (San Fernando) and Benzú Cave (Ceuta). In El Retamar, wild animals were more abundant than domesticated animals; the economic strategy of the inhabitants of this settlement seems to have been based on fishing and hunting, but some domesticated animals were also kept (Cáceres 2003) (Table 3).

In Campo de Hockey, the assemblage found in the site's 'production area' (trenches 1-5) predominantly constitutes wild fauna, including rabbits, deer, lynxes and horses. Domesticated species include cows, sheep, goats, pigs and dogs, which are present from the earliest layers. The key species is the rabbit, although many of the remains correspond to young individuals in anatomical connection with no trace of hunting or butchering marks, so they may be later intrusions. It is curious the presence of articulated remains of wild species, either partially (in the case of deer) or totally (in the case of the lynx) represented, without any relation with human remains either in burials (Morris 2011) or in hut floors. In this case, wild species were maybe exploited for food and/or other raw-materials, as hide. Such activities can be understood as part of the economy of groups that gradually assimilated domestication techniques, but for which hunting continued to be an everyday practice (Vijande *et al.* 2015) (Table 3).

The analysis of the remains of wild fauna in Benzú Cave has led to the identification of species which are still common in the area (such as hedgehogs), and none of the remains can be safely attributed to domesticated species. Therefore, the existing remains should likely be linked to the occupation of the cave by wild animals, rather than to human activity. The human use of the cave is, however, beyond doubt, as it was used as a funerary space, and, in fact, some of the human bones found appear to have been gnawed by hedgehogs after burial. The absence of bones corresponding to domesticated animals, therefore, suggests that the cave was used as a shelter by various species of carnivores and rodents. The presence of occasional burnt bone remains must be associated with funerary activity (Riquelme Cantal 2013) (Table 3).

Finally, concerning the 4th-millenium BC tribal societies, our evidence comes from La Esparragosa (Chiclana de la Frontera) and SET Parralejos (Vejer de la Frontera). In the case of La Esparragosa, the analyzed materials indicate a predominance of skeletal remains belonging to domesticated animals: cattle, ovicaprines, pigs and dogs. Advanced sheep- and goat-herding techniques were implemented: for instance, the preferential slaughter of young males, whereas females were slaughtered only at an advanced age to maximise their by-products and reproductive capacity. Sheep may have outnumbered goats. Concerning pigs, the fact that most were slaughtered young suggests that they were primarily used as a source of meat after a short rearing period. However, the discovery in silos A-IV and C-III of large suidae remains (no exact measurements could be taken) indicates that wild boars may have been hunted. Cow remains are scarce in comparison to those of other domesticated species. Most were slaughtered when adults. All the bones present traces of fire, which suggests that the meat of these animals was also consumed as food. The most abundant remains correspond to dogs, which are found in anatomical position. Wild fauna is represented by deer and two species of lagomorph: rabbit and hare. These animals, along with the wild boar, were hunted for food (Vijande Vila *et al.*, ed. 2019a) (Table 3).

In SET Parralejos, again, domesticated species clearly outnumber wild species. The remains of sheep and goats are the most abundant in terms of number, bulk weight of remains and MNI. Sheep and

TABLE 3. NUMBER AND PERCENTAGE OF IDENTIFIED REMAINS (NIR) IN THE SITES EXAMINED IN THE CHAPTER.

| | El Retamar | | C. Hockey | | Benzú | | La Esparragosa | | SET Parralejos | |
|---|---|---|---|---|---|---|---|---|---|---|
| | NRD | % | NRD | % | NRD | % | NRD | % | NRD | % |
| *Bos taurus* | 4 | 0.65 | 14 | 1.21 | | | 11 | 2.90 | 17 | 5.69 |
| *Ovis aries* | 5 | 0.80 | | | | | 3 | 0.79 | 5 | 1.67 |
| *Ovis/Capra* | 8 | 1.29 | 31 | 2.70 | | | 80 | 21.05 | 130 | 43.48 |
| *Capra hircus* | 12 | 1.93 | | | | | | | 1 | 0.33 |
| *Sus domesticus* | 5 | 0.80 | 8 | 0.70 | | | 58 | 15.26 | 38 | 12.71 |
| *Canis familiaris* | 7 | 1.13 | 1 | 0.09 | | | 117 | 30.79 | 72 | 24.08 |
| *Equus ferus* | 3 | 0.49 | 1 | 0.09 | | | | | | |
| *Rhinocerontidae indet.* | | | | | 1 | 0.08 | | | | |
| *Bovidae* indet. | | | | | 4 | 2.27 | | | | |
| *Cervus elaphus* | 77 | 12.40 | 63 | 5.49 | | | 55 | 14.47 | 8 | 2.68 |
| *Sus scrofa* | | | | | 4 | 2.27 | | | | |
| *Oryctolagus c.* | 489 | 78.74 | 933 | 81.27 | 13 | 7.39 | 55 | 14.47 | 28 | 9.36 |
| *Lepus capensis* | 6 | 0.97 | | | 2 | 1.14 | 1 | 0.27 | | |
| *Gazella* sp. | | | | | 74 | 42.04 | | | | |
| *Gazella/ Ammotragus* | | | | | 75 | 42.61 | | | | |
| *Ammotragus lervia* | | | | | 1 | 0.57 | | | | |
| *Hyaena cf. hyaena* | | | | | 1 | 0.57 | | | | |
| *Lynx pardina* | | | 97 | 8.45 | | | | | | |
| *Canis sp.* | | | | | 2 | 0.17 | | | | |
| *Genetta genetta* | | | | | 1 | 0.08 | | | | |
| *Hystrix cristata* | | | | | 24 | 2.00 | | | | |
| *Herpestes ichneumon* | | | | | 1 | 0.57 | | | | |
| *Carnivorae* sp. | | | | | 1 | 0.57 | | | | |
| *Alectoris rufa* | 5 | 0.80 | | | | | | | | |
| | | | | | | | | | | |
| Determinated | 621 | 100 | 1148 | 100 | 176 | 100 | 380 | 100 | 299 | 100 |

goats have been primarily identified through joints and diagnostic sections of long bones. Pigs are also abundantly represented. The size of some of the pig bones is more characteristic of wild boars, but the evidence is inconclusive. Large mammals are sparsely represented, the only identifiable species being the cow, which would have been used in agricultural tasks and only slaughtered at an advanced age. Dog bones were also found, but not in large numbers; most of these remains correspond to animals found in anatomical position and probably buried in a ritual fashion. Wild fauna is rare and involves only two species, deer and rabbits, although, as noted above, it is possible that wild boars were also present (Riquelme Cantal 2019) (Table 3).

Except for Embarcadero del río Palmones and Benzú Cave, domesticated animals are present from the beginning of all stratigraphic sequences and constituted the main source of meat. In 6th-5th-millennium BC sites, their remains are not the most numerous, but in terms of biomass their presence is significant. In 4th-millenium BC sites, in comparison, domesticated animals clearly predominate (cows, sheep, goats and pigs), which confirms the keeping of substantial herds and the use of well-established herding techniques. Wild fauna, on the other hand, are sparsely represented and limited to a few species: deer, rabbits and wild boars. It is possible that these animals were hunted to defend cultivated fields and to limit the competition posed to domesticated animals in grazing areas (Table 3).

## Tools and/or weapons related to hunting and/or fishing used by Neolithic agricultural societies along the Atlantic coast of Cádiz and Ceuta (North Africa)

### *Microliths, geometric flakes/arrowheads*

The development of productive economies in the region around the Strait of Gibraltar is in many ways a *sui generis* process, including the lithic industries. Although significant regularities exist in this regard across all Western Mediterranean societies (emergence of regional exchange hubs, which channelled the circulation of raw materials and finished products, growing specialisation in production and the widespread adoption of pressure flaking), not all changes were adopted at the same pace in all areas, and significant regional differences exist.

It has been argued that the adoption of productive economic systems did not lead to a radical change in the ways of life in the early stages of the Neolithic (Ramos Muñoz 2006). As such, hunting implements remain among the most common finds in archaeological contexts, including geometric microliths and arrowheads (Figure 2).

In Retamar and Embarcadero de río Palmones, most of the geometric microliths found are trapezoidal in shape (Figure 2); these pieces tend to be fairly symmetric with straight or slightly concave retouches. A total of 107 geometric microliths were found, accounting for 11.22% of all retouched tools. The percentage of hunting-related tools in Embarcadero de río Palmones is much lower (4.47%; 17 pieces in total) (Ramos Muñoz and Castañeda 2005). In both cases, these were made *in situ* and probably abandoned after use, as indicated by use-mark analysis (Clemente Conte and Pijoan 2005). The remains of terrestrial fauna found in El Retamar have been identified as belonging to *Oryctolagus cuniculus* (30%) and *Cervus elaphus* (7.4%); it is likely that the projectiles were used largely to hunt the latter of these species. In this case, the presence of a greater number of remains of wild fauna than of domesticated animals (12.6%) strongly suggests that hunting was still a key economic activity.

Trapezoidal shapes are found across a wide area, especially in the coastal regions of the Iberian Peninsula in both Mesolithic and Neolithic contexts (Clemente Conte *et al.* 2020). Narrower and asymmetric shapes

are also found in the Mesolithic of Alentejo, along the Atlantic coast of Portugal (Soares *et al.* 2018), although the arrival of the Neolithic witnessed the widespread adoption of segments with abrupt retouches (Soares *et al.* 2016). These are the most characteristic hunting weapon in the southern Iberian early Neolithic (Cortés Sánchez *et al.* 2012; Rodríguez-Rodríguez *et al.* 2013), alongside segments with abrupt retouches on the Mediterranean coast of Africa (Broich *et al.* 2020), as attested in Ifri n'Etsedda (Eastern Rif). Within this context, the geometric microliths in El Retamar and Embarcadero de río Palmones, which are inspired by Mesolithic traditions, are exceptional.

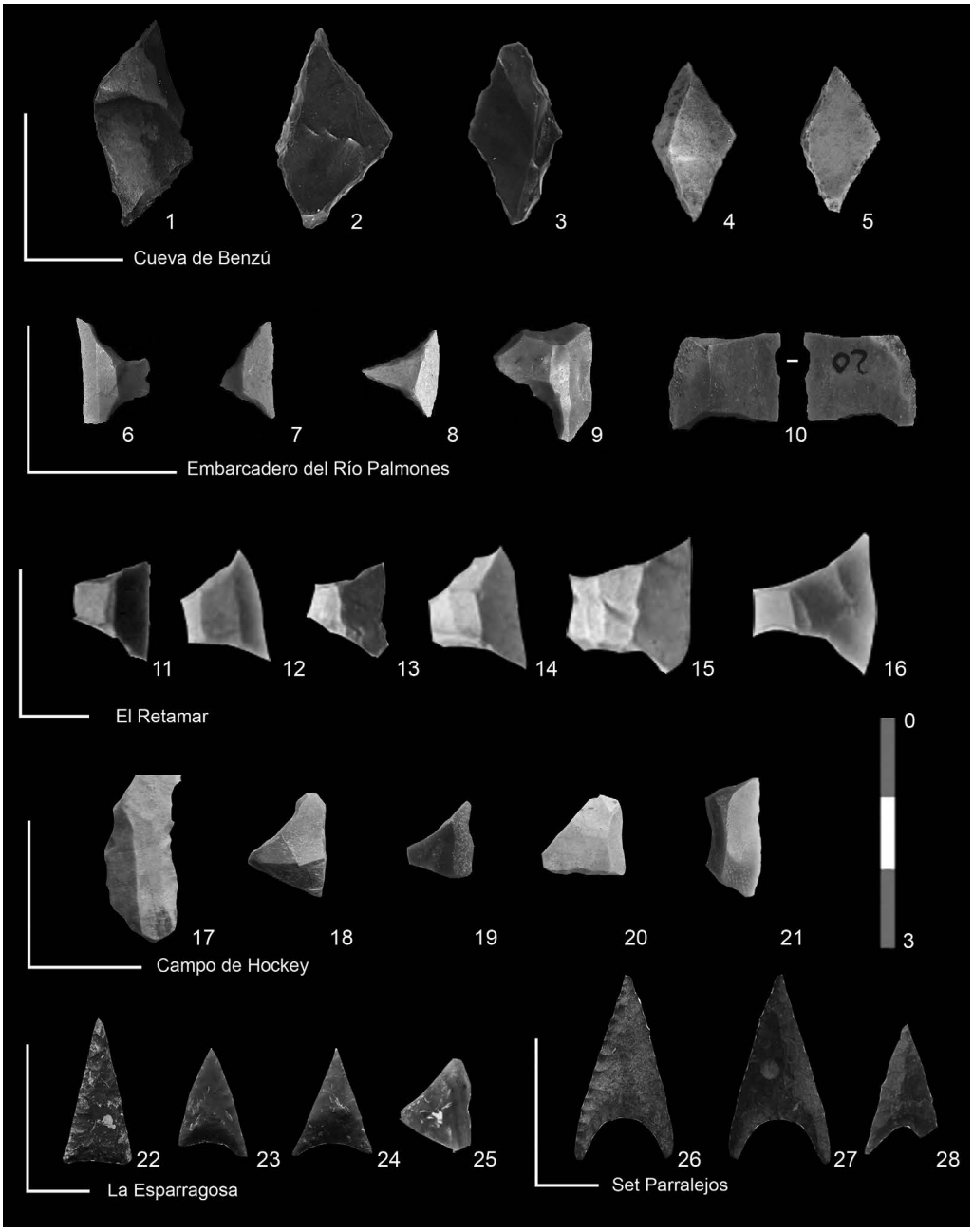


*Figure 2. Microliths and arrowheads from the sites under consideration. 1-5: Benzú Cave (Ceuta); 6-10: Embarcadero del río Palmones (Algeciras); 11-16: El Retamar (Puerto Real); 17-21: Campo de Hockey (San Fernando); 22-25: La Esparragosa (Chiclana de la Frontera); and 26-28: SET Parralejos (Vejer de la Frontera).*

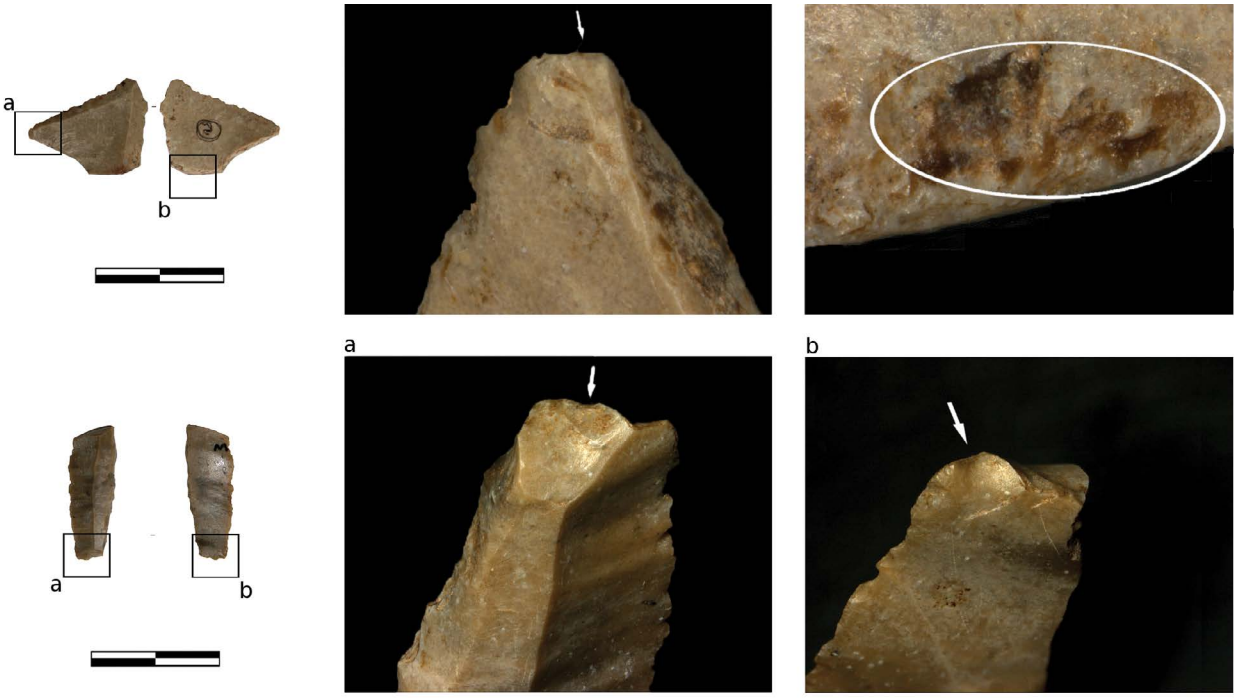


*Figure 3. Small fractures, probably due to impact, and potential remains of resin used for hafting.*

The lithic typology attested in Benzú Cave is found elsewhere in North Africa but not in the Iberian Peninsula (Gilman 1975; Ramos *et al.* 2008; Vijande 2017; Vijande *et al.* 2011; Vijande Vila *et al.* 2019a, 2019b). Rhomboid, retouched flake-based points, generally worked on three sides (only one example has two worked sides instead of three) and leaving one side free of retouches to fit the haft (Figure 2: 1-5). Similar pieces are documented in Caf Taht el Ghar Cave, in Tetouan, in association with cardial ceramics, in contexts that have been dated to the 7th-6th millennium BC (Bouzouggar and Barton 2006; Ramos *et al.* 2008). Most of the animal remains found in Benzú Cave correspond to wild fauna, with *Gazella* sp. and *Gazella/Ammotragus* being especially abundant. Although the preservation of organic remains in Benzú is generally poor (the animal remains are small and heavily fragmented), other data from North Africa suggest that hunting was an important economic activity for early Neolithic societies (Ramos *et al.* 2008). Use-wear analysis confirms that these points were used as arrowheads, and the traces of resin and, potentially, ochre offer some interesting evidence for hafting (Figure 3).

Based on this evidence, it is argued that a variety of technical traditions coexisted, probably rooted in the persistence of hunter-gatherer-fisher cultural habits and lithic technologies.

The Late Neolithic was characterised by increasing technical complexity. Pressure flaking predominated in La Esparragosa, including lever-assisted pressure flaking (Morgado and Pelegrin 2012). Hunting implements become rarer over time, accounting for barely 3% of all lithic instruments found (Clemente-Conte *et al.* 2020). Geometric shapes are still found during this period, pressure-flaked leaf-shaped forms being the most abundant (Ramos Muñoz 2006). The species found are largely the same as those found in the earlier contexts (*Cervus elaphus* and *Oryctolagus cuniculus*), although their remains are much less numerous than those of domesticated species in the Late Neolithic (Table 3) (Ramos Muñoz *et al.* 2013).

The use of leaf-shaped points as arrowheads is also attested in the nearby SET Parralejos (Figure 2: 26-28). The study of lithic remains from this site is ongoing, but no geometric shapes have been found to date; hunting implements are, thus far, represented by three leaf-shaped points with retouches on two

sides and a concave base. Geometric shapes are attested in Campo de Hockey, including BT-geometric-trapeze and segments (Vijande 2009). At both sites, faunal remains include domesticated species, but wild fauna predominates, including *Cervus elaphus*, *Lynx pardina* and *Oryctolagus cuniculus*.

***Lithic tools: Use-wear analysis as evidence of productive activities***

In general, the archaeological sites presented in this chapter are found on sandy soils which, alongside the strong winds that are characteristic of the region, have subjected prehistoric remains to significant taphonomic processes that hamper use-wear analysis. As a result, only two of our sites have yielded sufficient evidence: La Esparragosa and SET Parralejos.

These taphonomic processes are attested in Embarcadero del río Palmones (Clemente Conte and Pijoan 2005). Of 649 lithic implements, only 29 edges presented solid evidence for use wear, and another 36 were labelled 'possible', in addition to the above-noted microliths (cf. Figure 2). Most of the pieces that can be securely labelled as tools were used to work mid-hard/hard tissues (wood or bone), which left substantial use traces. The sandy soils tend to polish the stone surface, obscuring use traces of work on soft tissues. In Benzú, similar taphonomic processes have also blurred use-wear marks, and only impact fractures could be attested (cf. *supra*, Figs. 2 and 3). The lithic remains from El Retamar and Campo de Hockey are still pending analysis, so the information presented in this chapter is, in this regard, partial. However, the evidence from La Esparragosa and SET Parralejos is valuable; the remains suggest that, in addition to herding (cf. Table 3), the economic system of these 4th-millenium human groups involved agricultural tasks, butchering, the processing of animal by-products, and fish processing and storing activities (Clemente Conte *et al.* 2010).

As noted, use-wear analysis is an experiential technique (Semenov 1964; Clemente Conte 1997) that can be combined with various observation methods. We used binocular magnifying glasses (5X to 75X) and reflected light or metallographic microscopes (50X and 400X) for both stone and shell implements (cf. *infra*). This methodology also provides important evidence concerning the degree of technological development and the economy of the human groups that used these implements (Clemente Conte 2017). Let us examine the differences and similarities between the productive activities attested in these two sites. We will also explain how we have reached our conclusions, given that these sites are also found in predominantly sandy sediments. Both sites La Esparragosa and SET Parralejos, are silo fields, and the silos were cut into clayey or silty layers. The silos were used as refuse pits after use (Vijande Vila *et al.* 2019a), and were not subject to further taphonomic processes; as a result, the lithic implements found within were better preserved. Although both sites yielded flakes with cutting edges on which use-wear marks were identified, most of the implements bearing use-wear marks correspond to microblades that were shaped using different techniques and were mostly attached to some kind of haft, alone or in combination with others to form a long and sharp blade. Some of them still bear traces of the resin used for this purpose (Clemente Conte and García Díaz 2008). Use-wear analysis of blades and microblades reveal the versatility of these instruments. Blades allows for the production of long as well as short edges (with angles between 25º and 40º) which are easy to haft on either side (Figure 4). They were often refreshed and thoroughly reused, and some of the examples found in archaeological contexts were heavily retouched and worn.

The results of the macro- and microscopic use-wear analysis in La Esparragosa are consistent with the exploitation of plant, animal and mineral resources. The processing of animal tissue included deboning and filleting fish, suggesting that fishing was an important economic activity during this period (Clemente Conte and Mazzucco 2019). Nearly 30% of the 388 remains analysed present use-wear traces.

Most of these are blade and microblade fragments (*c*.80%), which greatly outnumber the flakes (5.2%); the remainder (4.3%) are arrowheads.

A total of 164 edges bearing use marks were attested, but the specific use could not be discerned for 18 of them, and so the percentages will be calculated using the remaining 146 specimens (cf. Table 4). A small number of edges (3) were related to mineral-working (2%), and 24 edges bear traces of having been used on vegetal fibres. About half of them exhibit traces of having been used on hard fibres (wood or bark). In all cases, this activity was attested on central or distal edges, and involved longitudinal motions (cutting, sawing), and only two present signs of scrapping motions. The remaining edges (12; 8.2%) used on plant materials belong to sickles and present the typical polished lustre which is often associated with cereal harvesting.

Of the 146 edges included in this analysis, 119 edges on 76 different implements are likely or very likely to have been used to process animal tissues. Nearly all of them are on blades, and mostly on the central or proximal sides. Of these, only four (2.7%) are related to butchering. We should try to explain why so few edges are related to this productive activity. These micro traces are often invisible owing to preservation issues; an important proportion of the pieces from La Esparragosa present thermo alterations or are polished by the sandy soil, and this may be masking the most subtle traces. Butchering activities take longer to leave traces, and often they are limited to miniscule notches on the sharpest blades. It is also very likely that hafted blades were used for multiple purposes; they were used first for butchering and then for other activities, such as deboning fish, which leave greater traces on the blades. In general, use-wear analysis can only be used to determine the latest use to which a lithic instrument was put.

Hide-working was identified on 19 edges (13%) on 12 blades, generally on central and distal sides. Various actions were attested. Five present traces of lateral motions, which generally appear on edges with an angle of 40º or more. Another 10 edges present angles between 25º and 35º, used in cutting motions and, in one case, longitudinal-lateral motion. In La Esparragosa, we also found two blades (LE-CII-1-Nº1 and AIV-9-Nº2) which were retouched on one end to bore holes in hides.

The remaining edges on which use traces were found are related to fish processing (García Díaz and Clemente Conte 2011; Clemente-Conte *et al.* 2020). This includes 96 edges, accounting for 65.7% of the total at La Esparragosa. This suggests that fish played a primary role in the diet of this human group.

In SET Parralejos, 39 edges with use-wear traces were found on 23 implements. One tool with three edges (2012-E4-UE400-18) used to work on hard matter, probably wood, is not included in the percentages. Most activities attested are related to agricultural tasks, especially cereal harvesting; 41.6% (15) of the edges that were found to have use marks are related to activities on non-woody plants (such as cereals), and a not-inconsiderable 36.1% (13) are related to fish processing. In addition, 19.4% (7) were related to butchering, and 2.8% (1) to woodworking (Table 4).

### *Shell tools*

Traditionally, use-wear analysis has been used to study lithic instruments, but its application for tools made from other materials, such as bone and shell, is much more limited. However, the number of use-wear studies on shell instruments has slowly increased during recent years (Cuenca-Solana and Clemente-Conte 2017). These new developments have allowed us to identify the use of these tools among Iberian hunter-gatherer groups in both the Palaeolithic and the Mesolithic (Cuenca-Solana *et al.* 2013a; Cuenca-Solana 2015; Cuenca-Solana *et al.* 2016a, 2016b), as well as among Neolithic farmers (Clemente

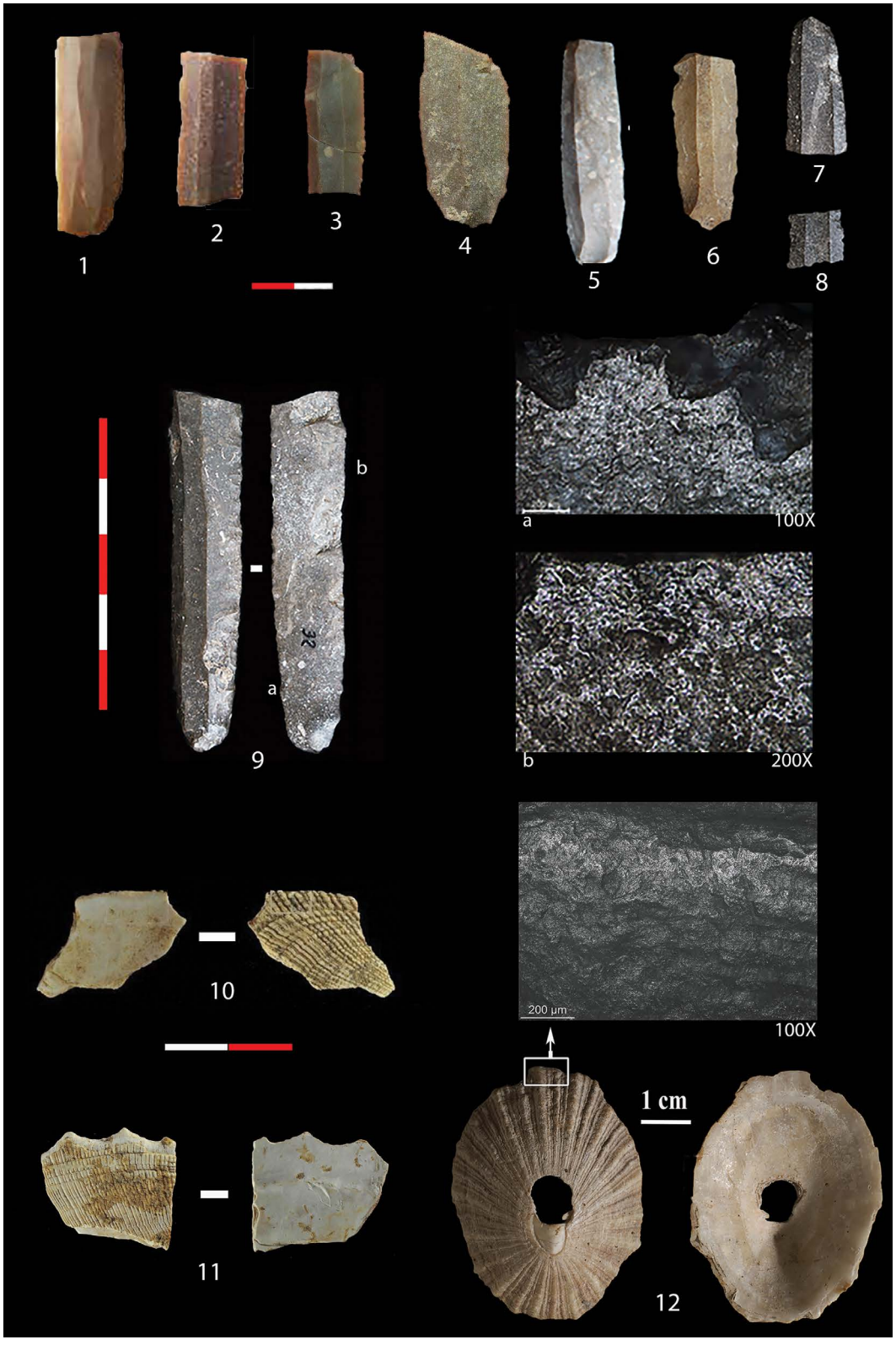


*Figure 4: 1-4: Blades/fragments from La Esparragosa; 5-8: Blades/fragments from SET Parralejos; 9: Blade from SET Parralejos with fish-processing wear traces; 10: Fragment of* Ruditapes decussatus *used as a tool from Campo de Hockey; 11: Fragment of* Ruditapes decussatus *with denticulated edge from SET Parralejos; and 12:* Patella *sp. or perforated limpet with wear traces related to pottery production.*

and Cuenca-Solana 2011; Clemente-Conte *et al.* 2014; Cuenca-Solana *et al.* 2010, 2014; Gutiérrez-Zugasti *et al.* 2011). Recently, malacological remains found in archaeological contexts in the region of the Strait of Gibraltar (Figure 1) have been subject to this methodology, including Embarcadero del río Palmones (62 remains), Campo de Hockey (356), La Esparragosa (233) and SET Parralejos (1,413); a selection of 14 well-preserved implements from Benzú was also analysed. Therefore, the analysed assemblage amounts to 2,078 remains (whole shells or fragments), and 13 shell tools were identified. No evidence for the use of shell tools was attested in Embarcadero del río Palmones and Esparragosa; 7 were found in SET Parralejos, and 3 each in Campo de Hockey and Benzú. These use wear were found in shells of *Ruditapes decussatus* and, in Benzú, also *Patella* sp., which were also consumed as food. Most of the traces found correspond to lateral transversal actions (scraping) on plant, animal and mineral matter. By comparing these use wear traces with similar ones attested archaeologically and experimentally, we have been able to link the traces found in a perforated shell of *Patella* sp. found in Benzú with pottery production (Figure 4: 12) (Vijande Vila *et al.* 2019a), and similar traces were found in a specimen from Coro Trasito (Tella-Sin, Huesca) (Clemente Conte *et al.* 2019a). A shell fragment of *R. decussatus* from SET Parralejos has been associated with the processing of plant fibres (Cuenca-Solana 2013), which may be indirectly related to hunting and/or fishing activities, in which plant fibres played a key role. From a different perspective, SET Parralejos has also yielded one of the few knapped shell tools found in the Iberian Peninsula. It is a fragment from a *R. decussatus* shell, which was worked to present a denticulate edge (Figure 4:11). Unfortunately, the marks are not sufficiently developed to determine the matter processed with this implement. None of the shell fragments yielded by our five sites can be linked to hunting practices. However, 2 of the tools analysed can be associated indirectly with hunting as they were used to process animal by-products. Specifically, 2 fragments of *R. decussatus* from Campo de Hockey were used for scraping fresh hide (Figure 4:10) (Cuenca-Solana 2013).

It is likely that preservation issues, especially in open-air sites, has greatly reduced the number of shell tools found, as well as limited our ability to ascertain their function and economic role.

## Discussion: Functional and historical analysis

The sites examined present a clear diachronic picture of late prehistoric hunting and fishing in the region of the Strait of Gibraltar (Table 1), including the latest groups of hunter-gatherers and the earliest agricultural groups.

The size and characteristics of the sites under study and the areas of activity attested reveal considerable functional variability (Ramos Muñoz 2004, 2006, 2008).

Hunting, fishing and shellfish gathering played an important economic role in open-air seasonal sites located near a river: for instance, Embarcadero del río Palmones (Ramos Muñoz and Castañeda 2005).

We also possess evidence of societies in transition from hunter-gatherer practices to more sedentary groups for which shellfish gathering and fishing were a central economic activity, but which also present evidence for herding (but not agriculture): for instance, in El Retamar (Ramos Muñoz and Lazarich 2002).

We have attested seasonal sites where hunting and shellfish gathering was the specialty, but where evidence for agriculture and herding is also present: for instance, in Benzú (Ramos Muñoz *et al.* 2013; Clemente Conte and Mazzucco 2013; Vijande 2017).

Other sites were clearly permanent settlements, such as Campo de Hockey, in which economic, domestic and funerary practices were spatially differentiated (Vijande *et al.* 2015).

We also have important settlements, with storage facilities and permanent occupation, such as La Esparragosa (Vijande Vila *et al.* 2019a) and SET Parralejos (Cantillo *et al.* 2017).

We have argued that shellfish gathering and fishing played an important economic role for these groups. The use of the shells as tools and elements of personal adornment, as well as food, supports this idea: the fact these shells were used as tools, adornment and food means these resources were systematically exploited and had multiple functions.

The fact that the assemblages include multiple taxa, with different biological and ecological features, suggests the use of various types of fishing tackle, and the predominance of remains of members of the Sparidae family demonstrates not only that these human groups exploited shore areas but also had a profound knowledge of the habits of seasonal fish species.

The fact that other fish species also feature in the assemblages can mean two things: that the inhabitants of these sites took advantage of the fish shore-bound migrations to capture them, or that they used less selective fishing tackle, such as nets and traps, in combination with more selective ones such as harpoons. It is possible that some of the geometric microliths identified were used in harpoons (Rozoy 1978; Ramos Muñoz and Lazarich 2002; González and Cerrillo 2015). No evidence for traps has been found at our sites, but they have been attested in waterlogged sites: for example, at the Mesolithic site of Oleslyst (Halsskov, Dinamarca) (Pedersen 1995), where an underwater fence made with wooden posts and plant screens surrounded a cluster of traps (Pedersen 1995).

We have direct evidence for the use of fishing nets in El Retamar, specifically a sandstone net weight (Ramos and Lazarich 2002) similar to those found in the late prehistoric site of Canalejas I (Cáceres) (González and Cerrillo 2015). Generally, these weights are the only evidence of the use of fishing nets, as the remaining elements were made of plant fibre and have not survived. The presence of members of the Clupeidae family in Campo de Hockey is also indirect evidence of the use of nets, as this species can only be captured in this way (Pérez and Rodríguez del Valle 2001).

The results indicate that 4th-millenium BC settlements on the coast of Cádiz had a mixed economic regime (Figure 5) that combined agriculture and advanced herding with fishing, which had a significant presence in the diet. However, although all these activities are attested in both SET Parralejos and La Esparragosa, the evidence corresponding to them appears in very different proportions. For example, herding (Table 3) is much more abundantly documented in SET Parralejos than in La Esparragosa; in SET Parralejos, sheep and goat remains clearly predominate the overall bone assemblage (45.4%) whereas they account for only 21.8% in La Esparragosa. It can also be argued that agricultural activities were

Table 4. Functions assigned to the lithic instruments found in La Esparragosa (Chiclana de la Frontera) and SET Parralejos (Vejer de la Frontera).

| | Mineral | % | Hide | % | Butchering | % | Fish | % | Wood | % | Non-woody plants | % | N. of edges used | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| La Esparragosa | 3 | 2% | 19 | 13% | 4 | 2.7 % | 96 | 65.7% | 12 | 8.2% | 12 | 8.2% | 146 | 100% |
| Set Parralejos | 0 | - | 0 | - | 7 | 19.4% | 13 | 36.1% | 1 | 2.8% | 15 | 41.6% | 36 | 100% |

more important in SET Parralejos than in La Esparragosa: 41.6% of use-wear marks in SET Parralejos are related to cereal harvesting, compared to 8.2% in La Esparragosa. Conversely, use-wear marks related to fish processing are much more numerous in La Esparragosa (65.7%) than in SET Parralejos (36.1%) (Table 4). This is clearly related to the coastal location of the site. Significant evidence for the exploitation of marine resources is also present in El Retamar and Campo de Hockey.

The combination of zooarchaeological and technological evidence (essentially microliths) reveals that, although in El Retamar and Campo de Hockey wild fauna was predominant, the use of leaf-shaped microliths in 4th-millenium BC contexts (for instance in La Esparragosa or SET Parralejos) tends to increase over time, suggesting that the economic weight of hunting decreased and that hunting practices became more selective.

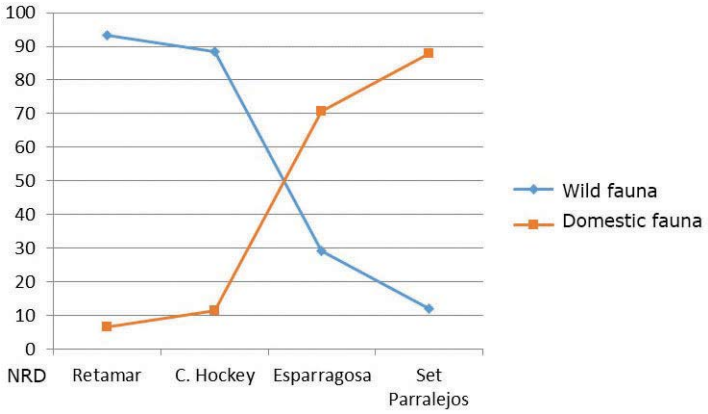


*Figure 5. Percentage of wild and domesticated animal species in sites on the Atlantic coast of Cádiz.*

## Conclusions

This chapter analyses the last hunter-gatherer groups and the earliest agricultural societies in the region around the Strait of Gibraltar and is concerned with chronology, settlement patterns, technology and faunal remains.

The topic presents very interesting future avenues of research, such as the potential contacts between human groups in North Africa and in the south of the Iberian Peninsula (Ramos Muñoz 2012).

It is argued, based on the evidence available, that fishing and shellfish gathering played a significant role in the *modus vivendi* of these societies.

Also, attention has been paid to faunal remains, distinguishing between domesticated and wild species, especially in sites dated to the 6th-5th millennia BC.

The technological sequences presented by these sites is similar, including geometrical and leaf-shaped microliths and multifunctional tools, which would have been used both for the processing of fish and as arrowheads.

The funerary record in Campo de Hockey has also yielded evidence for social differentiation, which is a characteristic feature of permanent settlements. These were the beginnings of the processes of social hierarchisation that eventually led to the development of stratified societies in the south of the Iberian Peninsula (Arteaga *et al.* 2008).

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## References

Arteaga, O. 1992: Tribalización, jerarquización y estado en el territorio de El Argar. *Spal* 1: 179-208.

Arteaga, O. and G. Hoffmann 1999. Dialéctica del proceso natural y sociohistórico en las costas mediterráneas de Andalucía. *Revista Atlántica-Mediterránea de Prehistoria y Arqueología Social* II: 13-121.

Arteaga, O., H. Schulz and A.M. Roos2008. Geoarqueología Dialéctica en la Bahía de Cádiz, in O. Arteaga and H Schulz (eds) *Geoarqueología y proceso histórico en la Bahía de Cádiz, Revista Atlántica-Mediterránea de Prehistoria y Arqueología Social* 10: 21-116. Cádiz.

Aura, J.E., J.F. Jordá Pardo,M. Pérez and M.J. Rodrigo 2001. Sobre dunas, playas y calas. Los pescadores prehistóricos de la Cueva de Nerja y su expresión arqueológica en el tránsito Pleistoceno-Holoceno. *Archivo de Prehistoria Levantina* XXIV: 9-39.

Aura, J.E., J.F. Jordá Pardo, E. Alvarez-Fernández, E. Pérez Ripoll, B. Avezuela, J.V. Morales-Pérez, M.J. Rodrigo García, R. Marlasca, J.A. Alcover, P. Jardón, C.I. Pérez Herrero, S. Pardo Gordo, A. Maestro, M.P. Villalba and D.C. Salazar-García 2016. Palaeolithic-Epipalaeolithic Seapeople of the southern Iberian coast (Spain): an overview in C. Dupont and G. Marchand (eds) *Archéologie des chasseurs-cueillerus maritimes. De la function des habitats à l'organisation de l'espace littoral. Séances de la Societé Prehistorique Française*, 6: 69-92. Paris.

Bate, L. F., 1998. *El proceso de investigación en Arqueología.* Crítica. Barcelona.

Broich, M., A. Poti, J. Linstädter, J.F. Gibaja, M. Mazzucco, M. Vadillo Conesa, A. Mikdad and G.-C. Weniger 2020. The Early and Middle Holocene Lithic Industries of Ifri n'Etsedda (Eastern Rif, Morocco). *African Archaeological Review* 38: 49–71. https://doi.org/10.1007/s10437-020-09377-8

Bouzouggar, A. and N. Barton2006. Les cultures préhistoriques du Maroc Nord-Occidentale vers la fin du Pléistocène Supérieur dans leur cadre régional, in D. Bernal, B. Raissouni, J. Ramos and A. Bouzouggar (eds) *Actas del I Seminario Hispano-Marroquí de Especialización en Arqueología* 121-132. Universidad de Cádiz.

Braudel, F. 1988. *El Mediterráneo*. Madrid: Espasa Calpe.

Cáceres, I. 2003. *La transición de las sociedades cazadoras-recolectoras a pastoras-agricultoras en el mediodía peninsular a través de los restos óseos.* Oxford: BAR International Series.

Cantillo, J.J. 2017. *Las primeras sociedades mariscadoras del Estrecho de Gibraltar: El Abrigo y Cueva de Benzú (Ceuta)*. Ceuta: Instituto de Estudios Ceutíes.

Cantillo, J.J. and M. Soriguer 2013. La fauna marina de la Cueva de Benzú, in J. Ramos, D. Bernal, E. Vijande and J.J. Cantillo (eds) *El abrigo y la cueva de Benzú. Memoria de los trabajos arqueológicos de una década en Ceuta (2002-2012):* 299-315. Servicio de publicaciones de la Universidad de Cádiz.

Cantillo, J.J., J. Ramos, M. Pérez, E. Vijande, S. Domínguez-Bella and M. Montañés 2017. Las sociedades prehistóricas en el término municipal de Vejer de la Frontera, in E. Ferrer and J.J. Cantillo (eds) *Arqueología en Vejer de la Prehistoria al período andalusí*: 29-53. Editorial Universidad de Sevilla, Ayuntamiento de Vejer de la Frontera. Sevilla.

Clemente Conte, I. 1997. Los instrumentos líticos de Túnel VII: una aproximación etnoarqueológica. *Treballs d'Etnoarqueologia* 2. Madrid: CSIC.

Clemente Conte, I. 2017. El por qué y para qué de la 'Traceología' en la Arqueología prehistórica, in F. Martínez and N. N. Skakun (eds) *Integrated Experimental-Traceological Study of Ancient Tools. Cuadernos de Prehistoria y Arqueología de la Universidad de Granada* 27: 27-53. Granada: Universidad de Granada.

Clemente Conte, I. and J. Pijoan 2005. Estudio funcional de los instrumentos de trabajo lítico en el embarcadero del río Palmones, in J. Ramos and V. Castañeda (eds) *Excavación en el asentamiento prehistórico del Embarcadero del río Palmones (Algeciras, Cádiz)*: 252-282. Cádiz: Universidad de Cádiz, Ayuntamiento de Algeciras.

Clemente Conte, I. and García Díaz, V. 2008. Yacimientos arqueológicos de la Bahía de Cádiz. Aplicación del análisis funcional a los instrumentos de trabajo líticos del Embarcadero del río Palmones, La mesa y La Esparragosa, in J. Ramos (ed.) *La ocupación prehistórica de la campiña litoral y banda atlántica de Cádiz. Aproximación al estudio de las sociedades cazadoras-recolectoras, tribales comunitarias y clasistas iniciales*: 185-198. Sevilla: Arqueología Monografías. Junta de Andalucia.

Clemente Conte, I., V. García, J. Ramos, S. Domínguez-Bella, M. Pérez, E. Vijande, J.J. Cantillo, M. Soriguer, C. Zabala and J. Hernando 2010. The lithic tools of the La Esparragosa site (Chiclana de la Frontera, Cádiz, Spain, fourth millennium BC): A methodological contribution to the study of lithic tools for the consumtion of fish in T. Bekker-Nielsen and D. Bernal (eds) *Ancient nets and fishing gear*. Monographs of The Sagena Project 2: 275-285. Cádiz: Servicio de Publicaciones Universidad de Cádiz y Aarhus University Press.

Clemente-Conte, I. and D. Cuenca-Solana 2011. Instrumentos de trabajo de concha en el yacimiento neolítico de La Draga, in A. Bons Lloret., J. Chinchilla Sánchez and J. Tarrús Galter (eds) *El poblat lacustre del Neolític antic de La Draga. excavacions 2000-2005*. Monografies del CASC 9: 106-112. Barcelona: Museu d'Aarqueologia de Catalunya Centre d'Arqueologia Subaquàtica de Catalunya.

Clemente Conte, I. and N. Mazzucco 2013. Funcionalidad de los productos líticos. Elementos de proyectiles in J. Ramos Muñoz, D. Bernal Casasola, E. Vijande Vila and J.J. Cantillo (eds) *El abrigo y la cueva de Benzú. Memoria de los trabajos arqueológicos de una década en Ceuta (2002–2012)*: 639-650. Cádiz: Ciudad Autónoma de Ceuta: Servicio de Publicaciones de la Universidad de Cádiz.

Clemente Conte, I., D. Cuenca-Solana, M. Oliva Poveda, R. Rosillo Turrà and A. Palomo Pérez 2014. Comparative analysis of Mytilus shell implements from two Neolithic sites in Ne Iberia: La draga and Serra del Mas Bonet (Girona) in J. Marreiros, J. Gibaja and N. Bicho (eds) *International Conference on Use-Wear Analysis. Use-Wear 2012*: 615-626: Springer.

Clemente-Conte, I., N. Mazzucco, D. Cuenca-Solana, M. Mozota Holgueras and S. Díaz Bonilla 2019a. Cerámica prehistórica y el kit instrumental para su producción. Descripción del registro arqueológico de Coro Tránsito (Tella-Sin, Huesca). *Treballs d'arqueologia* 23: 117-152.

Clemente Conte, I., J. Ramos-Munoz, S. Dominguez-Bella, E. Vijande-Vila, A. Barrena-Tocino, S. Almisas-Cruz, D. Bernal-Casasola, D. Fernandez-Sanchez and M.D. Fernandez Ropero 2019b. Raw materials,

technology and use-wear analysis of scrapers and points of the rock shelter of Benzu. *Quaternary International* in press https://doi.org/10.1016/j.quaint.2019.11.013

Clemente-Conte, I. and N. Mazzuco 2019. Uso de los instrumentos líticos tallados: aportes para una interpretación socioeconómica a partir de los procesos productivos in E. Vijande Vila, J. Ramos Muñoz, D. Fernández Sánchez, J.J. Cantillo Duarte and M. Pérez Rodríguez (eds) *La Esparragosa (Chiclana de La Frontera, Cádiz). Un campo de silos neolítico del IV milenio a.n.e.*: 155-165. Sevilla: Arqueología Monografías. Junta de Andalucía.

Clemente-Conte, I., N. Mazzucco, J. Soares, C. Tavares da Silva, J. Ramos Muñoz, E. Vijande Vila, J.J. Cantillo, and M. Montañés 2020. Fish Resource Exploitation in the Southern Atlantic Coast of the Iberian Peninsula: A View From the Traceological Analysis of Flaked Stone Tools (Sixth-Fourth mill. cal BCE). *Quaternary International* 541: 141-151. https://doi.org/10.1016/j.quaint.2020.01.006

Corona, J.M. 2019. Estudio arqueoictiológico del yacimiento insular Campo de Hockey (San Fernando, Cádiz). Unpublished MA Thesis. Universidad de Cádiz.

Cortés Sánchez, M., A. Morales, M.D. Simón, M.C. Lozano, J.L. Vera, C. Finlayson, J. Rodríguez-Vidal, F. Delgado, F.J. Jiménez, F. Martínez, A. Martinez-Aguirre, A. Pascual, M. Bergadá, J.G. Gibaja, J.A. Riquelme, J.A., A. López, M. Rodrigo, S. Sskai, S. Sugosaki, G. Finlayson, D. Fa and N. Bicho 2011. Earliest known use of marine resources by neanderthals. *PLoS One* 6 (9): 1-15 e24026.

Cortés, M., F.J. Jiménez Espejo, M.D. Simón Vallejo, J.F. Gibaja, A.F. Carvalho, F. Martinez-Ruiz, M. Rodrigo Gamiz, J.-A. Flores, A. Paytan, J. López Sáez, L. Peña-Chocarro, J. Carrión, A. Muñiz, E. Roselló Izquierdo, J. Riquelme Cantal, R. Dean, E. Salgueiro, R. Martínez Sánchez, J. De la Rubia de Gracia, M. Lozano, L. Vera Peláez, L. Llorente Rodríguez and N.F. Bicho 2012. The Mesolithic-Neolithic transition in southern Iberia. *Quaternary Research* 77(2): 221-234.

Cuenca-Solana, D. 2013. *Utilización de instrumentos de concha para la realización de actividades productivas en las formaciones económico-sociales de los cazadores- recolectores-pescadores y primeras sociedades tribales de la fachada atlántica europea*. Publican. Servicio de Publicaciones de la Universidad de Cantabria. Serie Tesis Doctorales 4.

Cuenca-Solana, D. 2015. The use of shells by hunter-fisher-gatherers and farmers from the early upper Palaeolithic to the Neolithic in the european Atlantic façade: a technological perspective. *Journal of Island and Coastal Archaeology* 10 (1): 52-75.

Cuenca-Solana, D., Clemente-Conte, I. and I. Gutiérrez-Zugasti 2010. Utilización de instrumentos de concha durante el Mesolítico y Neolítico inicial en contextos litorales de la región cantábrica: programa experimental para el análisis de huellas de uso en materiales malacológicos. *Trabajos de Prehistoria* 67 (1): 211-225.

Cuenca-Solana, D., J.J. Cantillo Duarte, E. Vijande Vila, M. Montañés Caballero, I. Clemente-Conte and A. Villapando Moreno 2013a. Utilización de instrumentos de concha para la realización de actividades productivas en sociedades tribales comunitarias del sur de la Península Ibérica. El ejemplo de Campo de Hockey (San Fernando, Cádiz) y SET Parralejos (Vejer de la Frontera, Cádiz). *Zephyrvs* 72: 95-111.

Cuenca-Solana, D., I. Gutiérrez Zugasti, M.R. González Morales, J. Setién, E. Ruíz, A. García Moreno and I. Clemente-Conte 2013b. Shell technology, rock art and the role of coastal resources in the upper Palaeolithic. *Current Anthropology* 54 (3): 370-380.

Cuenca-Solana, D., I. Gutiérrez-Zugasti and I. Clemente-Conte 2014. Shell tools in an early Neolithic coastal site in the Cantabrian region (northern Spain): experimental program for use-wear analysis at Santimamiñe cave in K. Szabó, C. Dupont, V. Dimitrijević, L. Gómez-Gastélun and N. Serrand (eds) *Archaeomalacology: Shells in the Archaeological Record*: 101-110. British Archaeological Reports International Series 266.

Cuenca-Solana, D., I. Gutiérrez Zugasti, A. Ruíz Redondo, M.R. González Morales, J. Setién Marquínez, E. Ruíz Martínez, E. Palacio Pérez, C. De las Heras Martín, J.A. Prada Freixedo and A. Lasheras Corruchaga 2016a. Painting Altamira Cave? Shell tools for ochre-processing in the Upper Palaeolithic in northern Iberia. *Journal of Archaeological Science* 74 :135–151.

Cuenca-Solana, D., I. Gutiérrez-Zugasti and M.R. González-Morales 2016b. Shell tools and subsistence strategies during the Upper Palaeolithic in northern Spain, in C. Dupont and G. Marchand (eds) *Archaeology of maritime hunter-gatherers: From settlement function to the organization of the coastal. Actes de la Séance de la Société Préhistorique Française, Société préhistorique française*: 59-68. Paris.

Cuenca-Solana, D. and I. Clemente-Conte 2017. Pasado, presente y futuro del análisis funcional aplicado al estudio de los instrumentos de concha prehistóricos. *Cuadernos de Prehistoria y Arqueología de la Universidad de Granada* 27: 293-314.

Domínguez-Bella, S., J. Ramos, V. Castañeda, M.E. García, M. Sánchez, G. Jurado and F. Moncayo 2004. Lithic products analysis, raw materials and technology in the prehistoric settlement of the River Palmones (Algeciras, Cádiz, Spain). *BAR International Series* 1270: 47-55. Oxford.

Espinar, M. C. *Diplodus sargus* (Linnaeus, 1758).*Unioviedo.es* [en línea], in https://www.unioviedo.es/bos/Asignaturas/Villegas/fichas/Dsargus.htm(Consulta: 07/04/20).

Fa, D., J.C. Finlayson, G. Finlayson, F. Giles-Pacheco, J. Rodríguez-Vidal and J.M. Gutiérrez-López 2016. Marine mollusc exploitation as evidenced by the Gorham's Cave (Gibraltar) excavations 1998e2005: the Middle-Upper Palaeolithic transition. *Quaternary International* 407: 16-28.

García Díaz, V. and I. Clemente Conte 2011. Procesando pescado: reproducción de las huellas de uso en cuchillos de sílex experimentales in A. Morgado, J. Baena and D. García. (eds) *La investigación experimental aplicada a la arqueología*: 153-159. Málaga: Universidad de Granada, Universidad Autónoma de Madrid, Asociación Experimenta.

Gilman, A. 1975. *A Later Prehistory of Tangier. Morocco*. American School of Prehistoric Research. Peabody Museum. Harvard University. Bul. 29. Cambridge Mass.

González, A. and E. Cerrillo. 2015. Los anzuelos de la Cueva de la Canaleja (Romangordo, Cáceres). *ARPI*, 03 (EXTRA): 56-72.

Gracia, F.J., C. Alonso, J. Benavente and F. López-Aguayo 2000. Evolución histórica de la línea de costa en la Bahía de Cádiz, in J.R. De Andrés and F. J. Gracia (eds) *Geomorfología litoral. Procesos activos.* Monografía 7. SEG. IGME: 225-234. Cádiz: Universidad de Cádiz, Sociedad Española de Geomorfología.

Guerra, A., G. Peneque, J.L. Mudarra and C. Baños 1963. *Estudio agrobiológico de la provincia de Cádiz*. Cádiz: Excma. Diputación Provincial de Cádiz.

Gutiérrez, J.M., A. Martin, S. Domínguez-Bella and J.P. Moral. 1991. *Introducción a la geología de la provincia de Cádiz*. Cádiz: Servicio de Publicaciones de la Universidad de Cádiz.

Gutiérrez Zugasti, I., D. Cuenca-Solana, I. Clemente Conte, C. González Sainz and J. C. López Quintana 2011. Instrumentos de trabajo y elementos de adorno en conchas de molusco de la cueva de Santimamiñe (Kortezubi, Bizkaia), in J. C. López Quintana (ed.) *La cueva de Santimamiñe: revisión y actualización (2004-2006)*: 155-170: Kobie serie anejos. Diputación Foral de Bizkaia.

Hublin, J.J., A. Ben-Ncer, S.E. Bailey, S. Freidline, S. Neubauer, M. Skinner, I. Bergmann, A. Le Cabec, S. Benazzi, K. Harvati and P. Gunz 2017. New fossils from Jebel Irhoud, Morocco and the pan-African origin of Homo sapiens. *Nature* 546 (7657): 293-296.

Lumbreras, L.G. 1974. *La Arqueología como Ciencia Social*. Ediciones Histar. Lima.

LLoris, D. 2015. *Ictiofauna marina. Manual de identificación de los peces marinos de la Península Ibérica y Baleares.* Barcelona: Editorial Omega.

Millán, A. and P. Benéitez 2003. Datación absoluta por Termoluniscencia de material cerámico de la Cueva de Benzú, in J. Ramos, D. Bernal and V. Castañeda (eds) *El Abrigo y Cueva de Benzú en la Prehistoria de Ceuta*: 345-347.Ciudad Autónoma de Ceuta. Cádiz: UNED, Universidad de Cádiz.

Millán, A. and P. Benéitez 2005. Datación absoluta por Termoluniscencia de materiales procedentes del asentamiento del Embarcadero del río Palmones (Algeciras, Cádiz), in J. Ramos and V. Castañeda (eds) *Excavación en el asentamiento prehistórico del Embarcadero del río Palmones (Algeciras, Cádiz). Una nueva contribución al estudio de las últimas comunidades cazadoras y recolectoras*: 343-347. Cádiz: Universidad de Cádiz-Fundación Municipal de Cultura de Algeciras.

Morgado, A. and J. Pelegrin 2012. Origin and Development of Blade Pressure Production at the South of The Iberian Peninsula (ca. VIth-IIIrd millennium BC), in P.M. Desrosiers (ed.) *The Emergence of Pressure Blade Making. From Origin to Modern Experimentation*: 219-235: Springer-Verlag.

Morris, J. 2011. *Investigating Animal burials. Ritual, mundane and beyond.* Oxford: BAR British Series 535.

Pedersen, L. 1995. 7000 years of fishing: stationary fishing structures in the Mesolithic and afterwards, in A. Fischer (ed.) *Man and Sea in the Mesolithic. Coastal settlement and below present sea level*. Proceedings of the Int. Symp., Kalundborg, Denmark (1993), Oxbow.

Pérez, P. and F. Rodríguez del Valle (eds) 2001. *Especies de Interés Pesquero en el Litoral de Andalucía*. Sevilla: Consejería de Agricultura y Pesca. Junta de Andalucía.

Ramos-Muñoz, J. 2004. Últimas comunidades cazadoras, recolectoras y pescadoras en el suroeste peninsular. Problemas y perspectivas del «transito epipaleolítico-neolítico», con relación a la definición del cambio histórico. Un análisis desde el modo de producción, in C. Sánchez de las Heras (ed.) *Sociedades recolectoras y primeros productores. Actas de las Jornadas Temáticas andaluzas de Arqueología*: 71-89. Sevilla: Junta de Andalucía.

Ramos-Muñoz, J. 2006. La transición de las sociedades cazadoras-recolectoras a las tribales comunitarias en el sur de la península Ibérica. Tecnología y recursos, in A. Alday (ed) *El Mesolítico. Cuenca del Ebrio. Litoral Mediterráneo. Memorias de yacimientos Alaveses* 11: 15-61. Vitoria.

Ramos Muñoz, J. (ed.) 2008. *Memoria del proyecto de investigación "La ocupación prehistórica de la campiña litoral y banda atlántica de Cádiz"*. Sevilla: Arqueología Monografías, Junta de Andalucía.

Ramos Muñoz, J. 2012. *El Estrecho de Gibraltar como puente para las sociedades prehistóricas*. Ronda (Málaga). Editorial La Serranía.

Ramos Muñoz, J. and M. Lazarich (eds) 2002. *El asentamiento de 'El Retamar' (Puerto Real, Cádiz). Contribución al estudio de la formación social tribal y a los inicios de la economía de producción en la Bahía de Cádiz*. Cádiz: Universidad de Cádiz y Ayuntamiento de Puerto Real.

Ramos, J., M. Lazarich, N. Herrero, V. Castañeda, M. Pérez, S. Domínguez-Bella, M.E. García and I. Cáceres 2004. Le gisement néolithique de "El Retamar". Un exemple des communautés du VI$^{e}$ millénaire avant notre ère dans la Baie de Cadix (Espagne), in *Section 9: Le Néolithique au Proche Orient et en Europe / The Neolithic in the Near East and Europe, Section 10: L'âge du cuivre au Proche Orient et en Europe / The Copper Age in the Near East and Europe. Sessions générales et posters / General Sessions and Posters. Acts of the XIVth UISPP Congress, University of Liège, Belgium, 2-8 September 2001:* 135-145. BAR International Series 1303. Oxford.

Ramos Muñoz, J. and V. Castañeda (eds) 2005. *Excavación en el asentamiento prehistórico del Embarcadero del río Palmones (Algeciras, Cádiz). Una nueva contribución al estudio de las últimas comunidades cazadoras y recolectoras*. Cádiz: Universidad de Cádiz-Fundación Municipal de Cultura de Algeciras.

Ramos, J., M. Zouak, D. Bernal and B. Raissouni (eds) 2008. *Las ocupaciones humanas de la cueva de Caf Taht el Ghar (Tetuán). Los productos arqueológicos en el contexto del Estrecho de Gibraltar.* Colección de Monografías del Museo Arqueológico de Tetuán (I). Cádiz: Servicio de Publicaciones de la Universidad de Cádiz, Servicio de Publicaciones de la Diputación de Cádiz y Dirección Regional de Cultura Tánger- Tetuán del Reino de Marruecos.

Ramos Muñoz, J., M. Pérez, S. Domínguez-Bella, M. Soriguer, C. Zabala, J.A. Hernando, B. Ruiz Zapata, M.J. Gil and D. Jiménez 2010. Las formaciones sociales tribales y clasistas iniciales en la Bahía de Cádiz. Medio natural y recursos, in J.M. Gutiérrez (ed.) *De la Prehistoria a La Rábita y la Villa. Arqueología de Rota y la Bahía de Cádiz*: 43-75. Cádiz: Fundación Alcalde Zoilo y Universidad de Cádiz.

Ramos Muñoz, J., D. Bernal Casasola, E. Vijande Vila and J.J. Cantillo (eds) 2013. *El abrigo y la cueva de Benzú. Memoria de los trabajos arqueológicos de una década en Ceuta (2002–2012).* Cádiz. Ciudad Autónoma de Ceuta: Servicio de Publicaciones de la Universidad de Cádiz.

Ramos-Muñoz, J., J.J. Cantillo-Duarte, D. Bernal-Casasola, A. Barrena-Tocino, S. Domínguez-Bella, E. Vijande-Vila, I. Clemente-Conte, I. Gutiérrez-Zugasti, M. Soriguer-Escofet and S. Almisas-Cruz 2016.

Early use of marine resources by Middle/Upper Pleistocene human societies : the case of Benzú rockshelter (northern Africa). *Quaternary. International* 407: 6-15.

Ramos-Muñoz, J., A. Barrena-Tocino, J.J. Cantillo Duarte, E. Vijande-Vila and P. Ramos-García 2019. Similarities and differences in the lifestyles of populations using mode 3 technology in North Africa and the south of the Iberian Peninsula. *Quaternary International* 515: 66-79.

Riquelme Cantal, J.A. 2013. La fauna terrestre, in J. Ramos Muñoz., D. Bernal Casasola, E. Vijande Vila and J.J. Cantillo (eds) *El abrigo y la cueva de Benzú. Memoria de los trabajos arqueológicos de una década en Ceuta (2002–2012)*: 560-575. Cádiz. Ciudad Autónoma de Ceuta: Servicio de Publicaciones de la Universidad de Cádiz.

Riquelme Cantal, J.A. 2019. Fauna terrestre, in E. Vijande Vila, J. Ramos Muñoz, D. Fernández Sánchez, J.J. Cantillo Duarte and M. Pérez Rodríguez (eds) *La Esparragosa (Chiclana de La Frontera, Cádiz). Un campo de silos neolítico del IV milenio a.n.e.:* 70-90.Sevilla: Arqueología Monografías. Junta de Andalucía.

Rodríguez-Rodríguez, A., J. F. Gibaja, U. Perales Barrón and I. Clemente Conte 2013. Comunidades campesinas, pastoras y artesanas. Traceología de los procesos de trabajo durante el Neolítico andaluz. *Menga* 4: 35-51.

Rozoy, J.-G. 1978. *Typologie de l'Epipaléolithique (Mésolithique) franco-belge.* Reims: Bulletin de la Société Archéologique Champenoise.

Sánchez-Barba, L., E. Vijande Vila, A. Rubio Salvadora, I. Alemán Aguilera, M. Díaz-Zorita, A. Moreno Márquez, S. Dominguez-Bella, J. Ramos Muñoz, M. Botella López 2019. Possible interpersonal violence in the Neolithic necropolis of Campo de Hockey (San Fernando, Cadiz, Spain). *International Journal of Paleopathology* 27: 38-45.

Semenov, S.A. 1964. *Prehistoric Technology.* London: Cory, Adams and Mackay.

Soares, J., N. Mazzucco and I. Clemente-Conte 2016. The first farming communities in the Southwest European Coast: A traceological approach to the lithic assemblage of Vale Pincel I. *Journal of Anthropological Archaeology* 41: 246-262.

Soares, J. and C. Tavares da Silva 2018. Living in the southwest Portuguese coast during the Late Mesolithic: The case study of Vale Marim I. *Journal of Archaeological Science: Reports* 18: 1011-1025.

Soriguer, M., C. Zabala and J. Hernando 2002. Características biológicas de la fauna marina del yacimiento de "El Retamar", in J. Ramos and M. Lazarich (eds) *El asentamiento del "El Retamar" (Puerto Real, Cádiz). Contribución al estudio de la formación social tribal y a los inicios de producción en la Bahía de Cádiz*: 175-192. Cádiz: Servicio de Publicaciones de la Universidad de Cádiz.

Straus, L. G. 1992. *Iberia Before the Iberians: The Stone Age Prehistory of Cantabrian Spain.* Alburquerque: University of New Mexico Press.

Stringer, C., J.C. Finlayson, R.N. Barton, Y. Fernández Jalvo, I. Cáceres, R.C. Sabin, E. Rhodes, A. Currant, J. Rodríguez Vidal, F. Giles and J.A. Riquelme 2008. Neanderthal exploitation of marine mammals in Gibraltar. *Proceedings of the National Academy of Sciences* 105 (38): 14319-14324.

Vanney, J.-R. and L. Menanteau 2004. *Géographie du Golfe Ibéro-Marocain.*Lisboa-Madrid: Instituto Hidrográfico y Casa de Velázquez.

Vargas, I., 1987: La formación económico social tribal. *Boletín de Antropología Americana* 5: 15-26.

Vijande, E. 2009. El poblado de Campo de Hockey (San Fernando, Cadiz): resultados preliminares y líneas de investigación futuras para el conocimiento en las formaciones sociales tribales en la Bahía de Cádiz (transito V-IV milenios a.n.e.). *Revista Atlantica-Mediterranea de Prehistoria y Arqueologia Social* 11: 265-284.

Vijande, E. 2017. *Sociedades neolíticas en la Cueva de Benzú (Ceuta).*Ceuta: Instituto de Estudios Ceutíes.

Vijande, E., J. Ramos, M. Zouak, J.J. Cantillo, A. El Idrissi, S. Domínguez-Bella and A. Maate 2011. Revisión de los productos arqueológicos de la cueva de Gar Cahal depositados en el Museo Arqueológico de Tetuán, in D. Bernal, B. Raissouni, M. Arcila, Y. Idrissi, J. Ramos, M. Zouak, J.A. López, M. Maatouk, A. El Khayari, B. El Moumni, M. Ghottes and A. Azzariohi (eds) *Arqueología y turismo en el Círculo del*

*Estrecho*: 265-278. Cádiz: Editorial Universidad de Cádiz, Diputación de Cádiz, Dirección Regional de Cultura Tánger-Tetuán.

Vijande, E., S. Dominguez-Bella, J.J. Cantillo, J. Martinez and A. Barrena 2015. Social inequalities in the Neolithic of southern Europe: the grave gods of the Campo de Hockey necropolis (San Fernando, Cadiz, Spain). *C. R. Palevol* 14: 147-161.

Vijande, E., J. Ramos, M. Pérez, A. Moreno, J.J. Cantillo, S. Domínguez-Bella, S. Almisas, J.A. Riquelme, M. Soriguer, I. Clemente, V. García, A. Barrena, B. Ruiz, M.J. Gil and D. Fernández 2018. Estudio interdisciplinar de la tumba AV del asentamiento neolítico de La Esparragosa (Chiclana de la Frontera, Cádiz, España. *Revista de Arqueología Iberoamericana* 37: 40-47.

Vijande Vila, E., J. Ramos Muñoz, D. Fernández Sánchez, J.J. Cantillo Duarte and M. Pérez Rodríguez (eds) 2019a. *La Esparragosa (Chiclana de La Frontera, Cádiz). Un campo de silos neolítico del IV milenio a.n.e.* Sevilla: Arqueología Monografías. Junta de Andalucía.

Vijande Vila, E., J.J. Cantillo Duarte, J. Ramos Muñoz, D. Bernal Casasola, S. Domínguez-Bella, S. Almisas Cruz, I. Clemente-Conte, N. Mazzucco, M. Soriguer Escofet, B. Ruíz Zapata, M.J. Gil, P. Uzquiano, D. Zurro, J.A. Riquelme, A. Sánchez Marco, A. Rosas, A. Estarlich, M. Bastir, D. Cuenca-Solana, A. Moreno-Márquez, R. Martínez-Cuesta and P. Ramos-García 2019b. The occupation of Benzú cave (Ceuta, Spain) by Neolithic and Bronze age societies. *African Archaeological Review* 36: 317-338 https://doi.org/10.1007/s10437-019-09335-z

Villalpando, A. and M. Montañés 2009. Avance de resultados de las excavaciones arqueológicas realizadas en Set Parralejos. *Revista Atlántica-Mediterránea de Prehistoria y Arqueología Social* 11: 257-264.

Villalpando, A. and M. Montañés 2016. El yacimiento de SET Parralejos, Vejer de la Frontera (Cádiz). Un núcleo de poblamiento de la prehistoria reciente en las estribaciones del río Salado de Conil de la Frontera, in J. Ramos Muñoz, J.J. Cantillo and E. Vijande (eds) *Las ocupaciones prehistóricas y la Arqueología de Conil en el contexto de la banda atlántica de Cádiz*: 115-134. Málaga: Ediciones Pinsapar.

Zazo, C. and J.L. Goy 2000. Cambios eustáticos y climáticos durante el Cuaternario. Una síntesis sobre su registro en los litorales del sur y sureste peninsular, Islas Canarias y Baleares (España), in J.R. De Andrés and F.J. Gracia (eds) *Geomorfología litoral. Procesos activos.* Monografía 7. SEG. IGME: 187-206. Cádiz: Universidad de Cádiz, Sociedad Española de Geomorfología.

Zilhao, J., D.E. Angelucci, M. Araújo Igreja, L.J. Arnold, E. Badal, P. Callapez, J.L. Cardoso, F. D'Errico, J. Daura, M. Demuro, M. Deschamps, C. Dupont, S. Gabriel, D.L. Hoffmann, P. Legoinha, H. Matias, A.M. Monge Soares, M. Nabais, P. Portela, A. Queffelec, F. Rodriguez and P. Souto, P. 2020. Last Interglacial Iberian neandertals as fisher-hunter-gatherers. *Science* 367, 1433. Doi: 10.1126/science.aaz.7943.