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THE PLEISTOCENE–HOLOCENE TRANSITION IN THE IBERIAN PENINSULA: CONTINUITY AND CHANGE IN HUMAN ADAPTATIONS[1]

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Data obtained from recent excavations (as well as from selected older excavations) are used to outline the principal environmental, technological and economic aspects of the Pleistocene–Holocene transition in three distinct regions of the Iberian Peninsula: Portugal, Cantabrian and Mediterranean Spain. The period covered extends from the terminal Paleolithic Magdalenian period to the initial Neolithic. Despite proximity to SW France and many similarities with that classic prehistoric culture area in terms of artistic/symbolic expression and technology, the Iberian regions show significant differences, especially in terms of subsistence strategies and their development during the Tardiglacial. While there are striking similarities among the three regions with respect to overall patterns of changes in technology, art and subsistence, there are interesting differences of detail, probably linked to environmental differences among these distinctive coastal zones. Changes in artistic activity are also examined, including the disappearance of cave art and the development of geometric motifs in mobile art in Cantabria, as well as a reinterpretation of Levantine art.

INTRODUCTION

The Iberian Peninsula is the extreme southwestern part of Europe. It is a geographical, if not always a cultural bridge between that continent, from which it is separated by the Pyrenees, and Africa, from which it is separated by the 10 km-wide Strait of Gibraltar. Iberia extends from 36 to 43° N latitude, straddling the climatically critical middle latitudes. For that reason and because of the Peninsula's large area (nearly 600,000 km^2), many high interior and peripheral mountain ranges (with maximum elevations up to 3500 m in both the far North and far South), vast tablelands, major river valley corridors, and four very different Atlantic and Mediterranean coastlines, Iberia is characterized by great diversity of climates, landforms, soils, vegetation communities and traditional lifeways. Yet, within this diversity, the Peninsula has always presented a certain degree of unity *vis-à-vis* other macro-regions of Europe. This is one of the conclusions one can draw from the following syntheses of its richest and best-studied prehistoric culture-areas: Portuguese Estremadura, Cantabrian and Mediterranean Spain (Fig. 1).

North coastal Spain, the setting of hundreds of classic Paleolithic and Mesolithic living sites and nearly 100 cave art loci, is the southwestern half of the Franco-Cantabrian region that borders the Bay of Biscay to the north of the Cantabrian Cordillera and western Pyrenees. In terms of utilitarian artifacts, ornaments and cave art, there are strong similarities between the Upper Paleolithic of Aquitaine-Pyrénées (land of reindeer and saiga) and that of Vasco-Cantabria (land of red deer and limpets). Yet their resource bases and subsistence strategies were significantly different, especially between 20,000 and 10,000 BP — and their trajectories of adaptive change diverged significantly. The ecological differences with SW France are even greater in Portugal, Levante and Andalucia. Yet all belonged to the wider world of Late Upper Paleolithic art themes, styles and canons — no doubt reflections of a pervasive worldview. And the parallel tendencies to intensively exploit a few key medium-size ungulates while in general also diversifying the subsistence base to include marine resources, for example, are common to all these Iberian regions and distinguish them as a group from Aquitaine. The parallels in technological developments (decreased importance of burins and osseous tools; increased microlitization) are unmistakable. So in the Ice Age there had been general unity throughout much of the Peninsula, but at a specific level there developed regional diversity in the face of the environmental changes that brought the end of that unifying world of Last Glacial hunting societies. Atlantic and Mediterranean, Europe but almost Africa, Iberia was a pivot, an innovator and a conduit of developments. So it was during the Pleistocene–Holocene transition that the great transformation to food production and settled life that closed the foraging chapter of the human experience in Europe.

PORTUGAL

Paleoenvironments

Data developed recently for the northern part of the Portuguese continental shelf (Dias, 1985; Rodrigues

[1] Assembled and partially written and translated by L.G. Straus

FIG 1. Map of the Iberian Peninsula showing major politico-geographic regions.

et al., 1991) allow us to calculate that during the glacial maximum the coastline was situated between the −130 and −140 m isobaths, rising to −100 m during the first phase of North Atlantic deglaciation, between 16 and 13 kya. During the following period, between 13 and 11 kya, the sea rose very rapidly to −40 m, falling back again to −60 m during Dryas III. The post-glacial transgression, during whose last part were formed very extensive brackish water estuaries in the lower courses of the larger rivers of the Atlantic coast of the Peninsula, ended between 5 and 3 kya, at which time the sea fell back to its present level.

Lake deposits in the Serra da Estrela began to accumulate, in the case of Candeeira Pond (at an altitude of 1400 m), before 12 kya (Van der Knaap and Van Leeuwen n.d.), implying, therefore, a relatively early deglaciation. In northwest Spain, according to the data of Turner and Hannon (1988), the melting of the glaciers was either already complete or at least very advanced in the period between 16 and 14.5 kya. (For example, the lacustrine basin of Ajo Lake, located at 1570 m in the Cantabrian Cordillera, was already free of ice by ca. 14 kya.) It is thus probable that the chronology of deglaciation in the mountains of northern Portugal was similar.

Along the Portuguese coast, environmental conditions had apparently become fully interglacial during the Bølling/Allerød interstadial (13–11 kya). According to Bard *et al.* (1987), ocean surface temperatures had reached virtually present levels by this time. And it is to this period that Mateus and Queirós (1993) date the development of Holocene pine forests on dunefields

formed along the coast during the Last Glacial Maximum. Based on palynological data from both bogs along the Alentejo coast and high-altitude lakes in the Serra da Estrela the same authors reconstruct an initial Holocene (10–8 kya) landscape with pine woods on the poor soils of interfluves, marcescent woodland on areas with richer soils, and Pyrenean oak (*Quercus pyrenaica*) forest covering the mountain slopes. Nevertheless, during the Postglacial transgression, aeolian sand accumulation continued along certain stretches of the coast, at least until the beginning of the Boreal, as shown by radiocarbon dates obtained at the base of the large consolidated dune at Magoito in Estremadura (Pereira and Correia, 1985).

Wood charcoal assemblages from the late Magdalenian open-air site of Cabeço de Porto Marinho (Figueiral, 1993) are compatible with the reconstruction proposed by Mateus and Queiros (1993). Thus, we can conclude that after ca. 12.5 kya the sandy soils of the Rio Maior region were covered with a dense pine forest (*Pinus pinaster/pinea*). Among the remains of carbonized wood from these levels are also Mediterranean taxa of shrubs and trees (*Arbutus unedo, Olea europea, Quercus suber, Quercus* of deciduous type), supporting the hypothesis that in this period the calcareous relief of the Serra de Candeeiros (Estremadura), in whose shadow lies the site of Cabeço de Porto Marinho, had already been recolonized by trees.

Paleoecological analysis of Level Eb in Caldeirão Cave, whose formation dates to the Magdalenian period, shows that in the small mountain chains of the coastal region between the Tagus and the Mondego, the process of arboreal recolonization began as early as ca. 16 kya. This is the same conclusion suggested by the terrestrial malacofauna (Callapez, 1992) which includes *Cepaea nemoralis* characteristic of wooded or semi-wooded habitats, by the rodent fauna from which the steppe species that are present in the underlying pleniglacial deposits are absent, but which now include high percentages of *Terricola duodecimcostatus, Apodemus sylvaticus* and *Eliomys quercinus* (Póvoas *et al.*, 1992). It is also suggested by the macromammalian fauna, from which alpine species (*Capra pyrenaica, Rupicapra rupicapra*) — abundant in the Solutrean levels — have disappeared, but which now include woodland-adapted species (*Castor fiber, Capreolus capreolus, Sus scrofa* (Zilhão, 1992).

Data on the rise of ocean surface temperatures reinforce the hypothesis of early and rapid environmental amelioration. According to Bard *et al.* (1987), in winter off Sines the ocean temperatures in the period right before 14.5 kya had reached ca. 12°C, which is to say, close to modern levels at ca. 15°C. This warming of the ocean is confirmed with summer temperatures calculated by Duplessy *et al.* (1992) from the same core for the period immediately after the Last Glacial Maximum. Analysis of variation in the amounts of sodium in the sedimentary sequence in Caldeirão Cave, at least 70–80 km from the Tardiglacial shore, shows that during deposition of level Eb there is a peak in oceanic influence, with values even higher than those recorded in levels deposited under recent Holocene conditions (Cruz, 1993). After about 16 kya, Estremadura was exposed to strong west winds with high humidity.

However, between around 14.5 and 12.5 kya, ocean surface temperatures off Sines declined to values identical to those which, according to Duprat (1983), must have existed ca. 18 kya, i.e. ca. 4°C (Bard *et al.*, 1987). At present, it is not possible to determine to what extent this marked decrease in ocean temperature would have affected reigning terrestrial environmental conditions, since the low level of resolution in the Magdalenian strata at Caldeirão does not permit stratigraphic separation and since there is a lack of information from open-air sites securely dated to this period. (The several Magdalenian loci excavated to date around Rio Maior date either to before 15 kya or to after 12.5 kya (Bicho, 1993)). Indeed, it is not excluded that this lacuna in the record is due to geomorphological processes that operated under the kind of cold conditions registered in the deep sea foraminifera record. The absence of terrestrial data also prevents us from detecting any evidence for the Dryas III cold crisis (11–10 kya) or its possible impact in Portugal. Temperatures registered in the foraminifera record from Atlantic cores indicate very low values for this period (6°C in winter off Sines ca. 10.4 kya), according to Bard *et al.* (1987). It is not impossible that these two crises led to momentary reversals in climatic conditions on land and thus in the kinds of temperate vegetation communities that had, at least at low altitude, established themselves by ca. 16 kya. We have, however, no real basis for reconstructing specific environmental conditions during this period for lack of relevant data.

Archeological sequence

Most of the presently known archeological sites for the period between 13 and 8 kya are in Portuguese Estremadura, specifically the region north of the Tagus above Lisbon (Fig. 2). Throughout this whole Tardiglacial period, human adaptations show a great degree of continuity (Zilhão, 1995; see also Bicho, 1994; Vierra, 1995). From the standpoint of material culture, Magdalenian and Epipaleolithic assemblages are characterized by miniaturized artifacts, with technologies oriented almost exclusively towards the production of flakes and bladelets, permitting an exhaustive exploitation of flint nodules. In contrast with what is seen in earlier periods, the lithic economy now seems to be based on the transport of cores. Functional analysis of lithic assemblages reveals a pattern of relative homogeneity. Almost all stages in the production system are represented in almost all sites and intersite variation is more quantitative than qualitative in nature.

The distinct tendency towards lithic raw material economization should not, however, be interpreted as a direct response to changes in environmental conditions. Given that the development of weaponry based

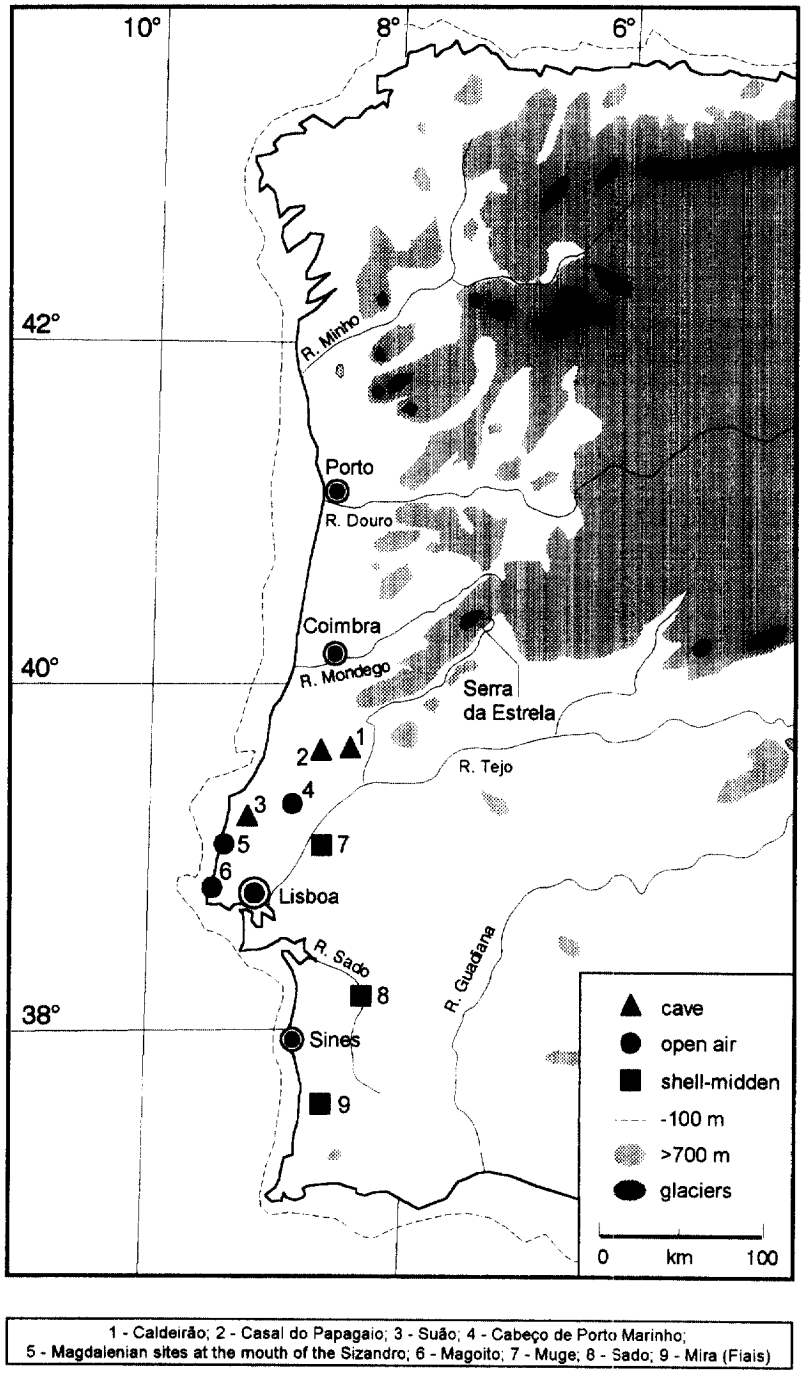


FIG 2. Map of Portugal, with sites mentioned in the text.

on bone/antler or wooden points barbed or tipped with lithic elements seems to have occurred more or less everywhere throughout Europe during the Tardiglacial in archeological contexts that were ecologically or adaptationally very diverse, the changes in lithics can be interpreted more correctly as the result of phenomena of convergence. This could have been a common response to long-term selective pressure for the optimization of group mobility. Independent of the scale at which this could be verified, the miniaturization of tools could serve to significantly minimize the constraints imposed on groups by the need to provision themselves with lithic raw materials, particularly in terms of decision-making concerning group spatial location.

Subsistence strategies

With regard to subsistence, the key game species since the beginning of the Magdalenian were red deer (*Cervus elaphus*) and rabbit (*Oryctolagus cuniculus*). The only significant change that seems to have occurred around the start of the Holocene was the increased importance of aquatic resources after ca. 10 kya. The role of these resources becomes apparent around the end of Dryas III and beginning of Preboreal, with shell

middens composed of estuarine and marine species in sites very far from the coastline of the time (as much as 40 km in the case of Casal Papagaio Cave near Fátima in Estremadura (Arnaud and Bento, 1988)). This is in marked contrast with the apparent rarity of such resources in Magdalenian cave sites (such as Suão Cave (Roche, 1982)), even when these were located much closer to the contemporary shore. Nor are there real shellmiddens at the Magdalenian open-air sites in the vicinity of the Sizandro estuary (Torres Vedras District, Estremadura), whose distance from the Tardiglacial shore between 16 and 10 kya would have oscillated between 15 and 10 km (Carvalho *et al.*, 1989).

The increased importance of aquatic resources in the subsistence of human groups reached its greatest extent during the Atlantic phase. The overwhelming majority of Mesolithic sites dated to the period beginning ca. 8–7.5 kya, are located along the edges of estuaries of the Tagus, Sado and Mira Rivers, suggesting a global reorientation of the settlement-subsistence system (González Morales and Arnaud, 1990; Straus *et al.*, 1990; Arnaud, 1993; Vierra, 1995, all with references). Stable isotope analyses of human skeletal remains indicate that diet was composed of ca. 50% aquatic foods, meaning that humans regularly depended on estuarine resources (Lubell *et al.*, 1994). This suggests the hypothesis that the densely wooded Portuguese interior was now barely exploited, and then only in the context of logistical expeditions. Residential camps located along the Flandrian estuary shores may have been sites inhabited for prolonged periods of time, even on a semi-sedentary basis, leading to the formation of very large shell middens in the center of which there are generally human burials — totally in the hundreds of individuals (Roche, 1972; Lentacker, 1994).

Beginning around 6.7–6.8 kya, and most certainly by 6.4 kya, the calcareous hills of the interior, abandoned by Mesolithic populations, were recolonized by groups with an agro-pastoral economy (Zilhão, 1993). For several centuries, these Neolithic groups lived contemporaneously with and adjacent to the last hunter-fisher-gatherers, whose territories fringed the estuaries of Estremadura and Alentejo. Along the lower courses of the Sado and Mira the traditional foraging economy and lifeway survived until ca. 6 kya (uncalibrated C14 age) (Straus, 1991; Arnaud, 1989, 1993). This pattern suggests an allochtonous origin for the Portuguese Neolithic, a conclusion that is also supported by the material culture, namely the Cardial ceramics which display notable similarities to those of the first farmers in Mediterranean Spain.

CANTABRIAN SPAIN

The Pleistocene–Holocene transition in Cantabrian and Mediterranean Spain has recently been the subject of two volumes of symposium papers edited by Moure and González Sainz (1995) and by Villaverde (1995), respectively. Here we summarize some of the main trends for each region and refer the reader to these volumes for more detail and further references.

Several factors converge to lend considerable interest in the study of the period between 14 and 9000 BP in the Cantabrian Region, which consists of the new autonomous political regions of Euskadi (coastal Spanish Basque Provinces), Cantabria (Santander) and Asturias. First, the semi-mountainous relief and Atlantic location of the narrow coastal strip created relatively temperate conditions which favored the development of optimal conditions for foraging societies due to the abundance of highly diverse resources (ungulates, marine molluscs, fish and, to a certain degree, edible plants). The montane relief gave rise to a great variety of exploitable ecosystems all lying within short distances of one another. All these factors led to relatively dense regional human occupations during the recent phases of the Upper Pleistocene.

Second, there are excellent preservation conditions for human occupation residues in the karstic cavities of the region, yielding, therefore, long, often continuous, rich sequences for the Upper Paleolithic and Epipaleolithic-Mesolithic. The main sites for this period that have recently been the object of interdisciplinary studies include the caves of La Paloma (Hoyos *et al.*, 1980), Tito Bustillo (Moure, 1975, 1989), La Riera (Straus and Clark, 1986), Los Azules (Fernández-Tresguerres, 1980, 1995), Morín (González Echegaray and Freeman, 1971, 1973), La Pila (Bernaldo de Quirós *et al.*, 1992), Rascaño (González Echegaray and Barandiarán, 1981), Piélago II (García Guinea, 1985), El Perro (González Morales and Díaz Casado, 1992), Laminak II (Berganza and Arribas, 1994), Ekain (Altuna and Merino, 1984), Erralla (Altuna *et al.*, 1985) and Berroberría (Barandiarán, 1990). The counterpoint to this fact, however, is the scarcity of open-air sites in this region, with its steep slopes and dense vegetation mat.

Third, the Paleolithic materials have been researched for over a century in the Cantabrian Region, since the work of Sanz de Sautuola at Altamira and other caves in the 1870s. As a result, we currently know of 47 habitation sites in caves that have clear evidence of late Magdalenian chronology (Breuil's stages IV–VI, ca. 14–11.2 kya) and 45 with Azilian levels (ca. 11.2–9 kya). Another dozen sites contained remains of less well-defined, less well-studied occupations probably pertaining to one or both periods. There are at least 77 sites in Asturias and western Cantabria with shell middens and cobble picks that are attributed to the Asturian Mesolithic (ca. 9–6.5 uncal. kya). The Basque country and eastern Cantabria have a growing number of late Epipaleolithic (post-Azilian) sites. In addition to technological remains, evidence of artistic and other types of human activity, there are a good number of paleontological studies of both macro- and microfauna, as well as avian, ichthyological and malacological studies for the Tardiglacial period in the Cantabrian Region (for recent syntheses, see Castaños, 1992; Altuna, 1995). There are also many palynological and sedimentological analyses (see Cearreta and

Ugarte, 1992; Hoyos, 1995). Finally, we have about 100 radiocarbon dates for levels pertaining to the period in question here.

Chronostratigraphy and paleoenvironments

Despite some discordances among data from different sources, Cantabrian paleo-climatic data can be interpreted within the framework provided by oxygen isotope analyses of deep sea cores done within the last couple of decades for the second-half of the Tardiglacial. This period was in general notably less cold than the preceding ones, with the beginning of a clear process of deglaciation, sea level rise and re-establishment of the Gulf Stream at this latitude (43° N) after about 13.5 kya, briefly interrupted between about 10.8 and 10.3 kya. But there are some nuances that have been detected from the terrestrial proxy paleoclimatic records in Cantabrian Spain (see González Sainz, 1994; Hoyos, 1995). Thus, we have indications that the Tardiglacial Interstadial was not a single, continuous environmental phenomenon, but rather a period consisting of several oscillations (Table 1). In several sites it is possible to identify:

(1) a temperate, very humid phase between ca. 13.4 and 13/12.8 kya (equivalent to part of the traditional Bølling or regional sedimentological Phase VI);
(2) a long period of cooler conditions until 12.3 kya;
(3) a short cold, dry episode between ca. 12.3 and 11.8 kya (equivalent to Dryas II or part of Phase VII), whose effects on the vegetation and faunas of this region were rather limited;
(4) a long temperate, often very humid oscillation between ca. 11.8 and 10.8 kya (Allerød or Phase VIII), during which irreversible changes occurred in regional vegetation and faunas, as well as in human adaptations;
(5) the cooling event of Dryas III (Phase IX), whose effects on the vegetation and faunas of this region were rather limited;
(6) after 10.2 kya evidence of accelerated reforestation is detected in the record, leading to the formation of dense Atlantic woodlands at the same time that the sea level rose dramatically, with consequent shrinkage in the habitable surface area of this coastal region.

Techno-cultural complexes

Detailed treatment of the cultural evidence for these periods may be found in monographic studies and syntheses by Clark (1983), Fernández-Tresguerres (1980), González Morales (1982), González Sainz (1989), Straus (1992) and Utrilla (1981), as well as papers in Moure and González Sainz (1995). The notion of Magdalenian and Azilian 'cultures' is still valid in this region as shorthand descriptions for successive adaptations. The limit between these two entities is determined by an acceleration of changes in technology and in subsistence strategies which occurred at the end of Phase VII and especially during Phase VIII (Allerød). The successive cultural phases (Fernández-Tresguerres, 1995; González Sainz, 1995; González Morales, 1995; Straus, 1992) include the following.

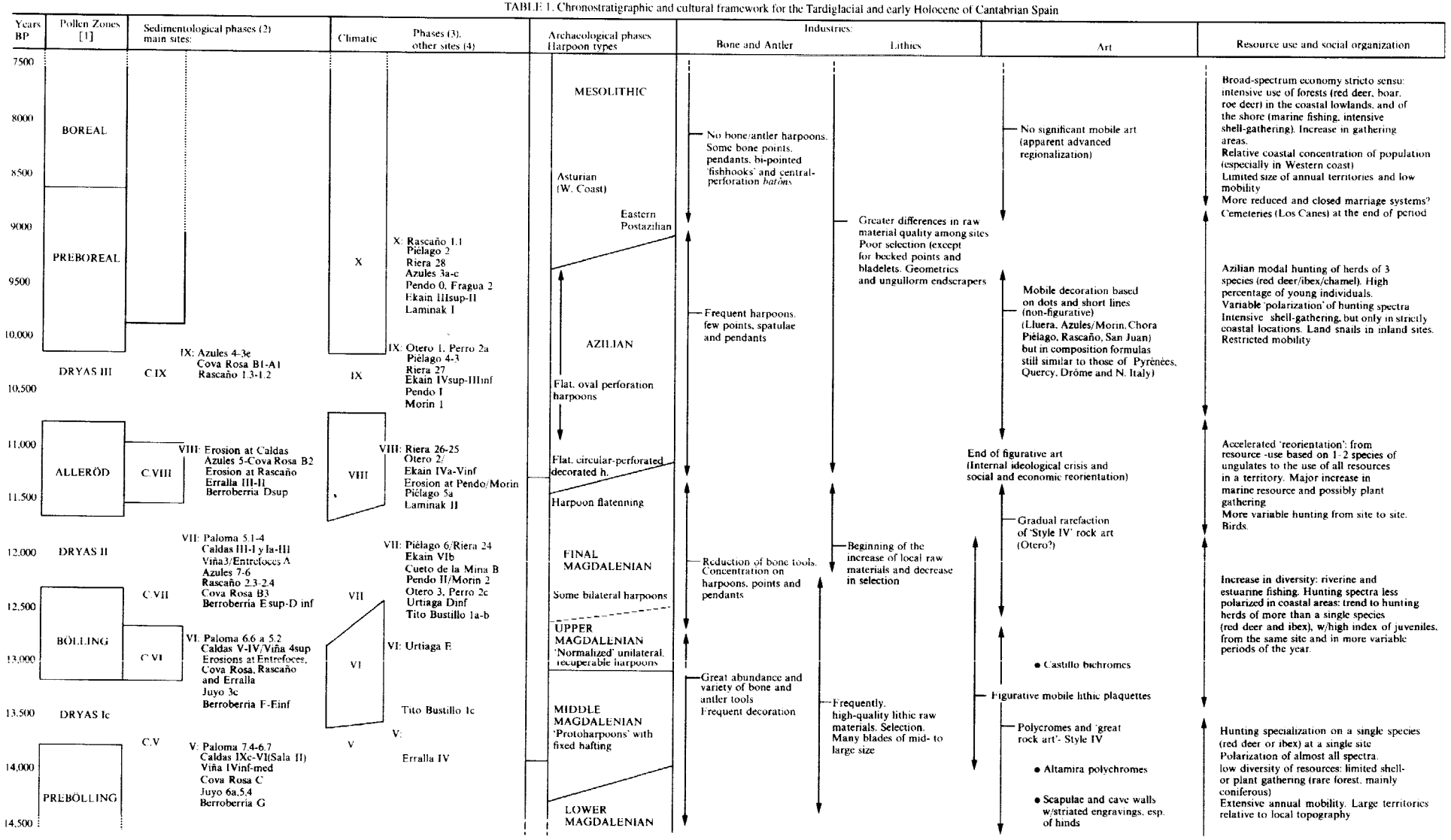
(1) *Middle Magdalenian*: 14–13 kya, with very rich, often decorated bone/antler artifact assemblages, including wands, perforated antlers, points and sometimes 'protoharpoons', lithic artifact assemblages often made on selected raw materials of good quality with relatively high percentages of blades and burins.

(2) *Upper-Final Magdalenian*: 13–11.5/11 kya, with high blade indices among the debitage components, many tools made on blades, burins outnumbering endscrapers, abundant perforators, retouched blades, composite tools and generally very high percentages of backed bladelets. The bone/antler industries are abundant and diversified, with a great variety of types of points (including split-base ones and single-bevel or pointed base ones with sub-triangular sections, as in the preceding phase), spatulas, awls, plano-convex section wands, uniserially barbed harpoons with lateral proximal projections for lanyard attachment that are often perforated in the western part of the region.

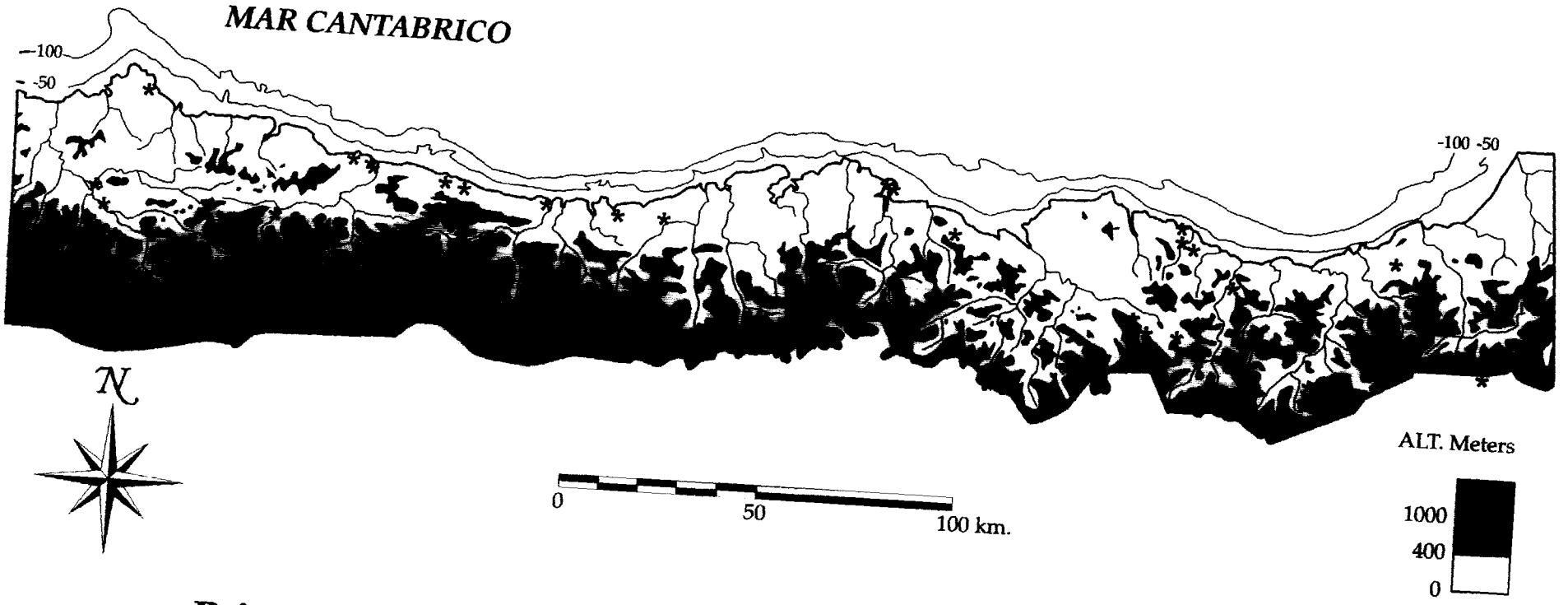
After about 12.5/12.2 kya some biserially barbed harpoons with double proximal attachment projections appear in the record especially in the Basque Country. The variety of bone industries tends to diminish, but with an increase in the relative frequencies of harpoons and awls — precisely the kinds of osseous types that continued to exist later on in the Azilian — while other types such as wands and spatulas became more scarce. In Cantabrian sites with more than one Upper-Final Magdalenian level (La Riera, El Rascaño, Urtiaga, Ekain, El Otero), the proportion of bone artifacts relative to lithic artifacts tends to decrease. Among the latter, the most notable change is a decrease in large and middle-size blades and an increase in the proportion of bladelets among the retouched pieces. There is a tendency for endscrapers to increase — including circular and thumbnail types, the latter made of better-quality raw materials. Burins decrease and are technically of poorer quality. In the final stages of the Magdalenian there seems to have been a generalized increase in microlaminar tools, accompanied by a change in the proportion of simple retouched bladelets versus points, which increase. Likewise the numbers of backed pieces (including double-backed elements) increase, but with intraregional differences between 'Azilian' and 'Micrograveste' points suggesting synchronic stylistic distinctions in weapon tips.

(3) *Azilian*: 11.5/11.2–9/8 kya (Fig. 3), characterized by the generalization of flat red deer antler (and occasionally bone) wands for the fabrication of harpoons with coincident changes in barb shape and in the location and form of the basal attachment perforations. There are a few recent discoveries of Azilian harpoons with linear engraved decorations, but these are truly exceptional (Los Azules and La Lluera in Asturias). Except for the abundant harpoons, the osseous

TABLE 1. Chronostratigraphic and cultural framework for the Tardiglacial and early Holocene of Cantabrian Spain



(1) Mainly Arl. Leroi-Gourhan 1971–79, (2) After Hoyos 1984–1995, (3) After González Sainz 1987–1994, (4) From site analyses or general chronological syntheses, mainly González Sainz 1989.



Principales yacimientos cantábricos con niveles azilienses

FIG 3. Map of Cantabrian Spain showing the distribution of Azilian sites. Boxed area has a dense, linear cluster of Asturian shell midden sites too numerous to depict at this scale.

industry is very meager (a few pendants, awls, very rare points). The now-simplified lithic industries have ever more abundant small endscrapers and backed weapon tips/barbs (backed bladelets, Azilian points, etc.), ultimately including some geometric microliths in the final stages of the Azilian sensu lato. Tools on large blades become increasingly rare, as do burins — possibly in functional relationship with the decreased importance of osseous tools and works of art. In general, the use of local lithic raw materials sometimes of mediocre quality — increase from late Magdalenian times onward.

(4) *Mesolithic*: Post-Azilian in the eastern half of the region (Basque Provinces and eastern Santander) and Asturian in Asturias and western Santander), from ca. 9 kya until the beginning of the Neolithic some 3 ky later. The former shows a considerable degree of continuity with the regional Azilian (with a considerable emphasis on microlithic tools and weapon tips often made on selected raw materials and scarce bone artifacts). The latter is characterized by simple flake implements (often unretouched) associated with heavy-duty tools including cobble picks and choppers, plus a few simple bone fish gorges and awls in shell midden sites located usually within a couple of km of the shore and generally near estuaries. Other, often poorly known, Mesolithic sites are located in the mountainous interior (Fig. 4).

Subsistence strategies

Between the Middle Magdalenian and the Mesolithic there occurred a development that can be summarized in simplest terms as a change from heavy dependence on one or two main ungulate species (red deer and ibex) to a more diversified subsistence relying on the broad spectrum of available food resources in each group's territory. The transition from the specialized to the diversified form of economy was not always necessarily gradual. There was a significant acceleration in the pace of change, with an inflection point during the final Magdalenian/earliest Azilian (essentially at the end of Dryas II and early Allerød). In addition to a broader diversity of exploited resources (birds, marine molluscs, probably vegetal foods), there is a tendency for lithic raw materials to be collected in smaller areas, related to technological changes and probably to restrictions in the scope of annual exploitation territories. Figurative art also disappears at this time (though highly localized geometric motifs are common in both the final Magdalenian and Azilian). These phenomena might all be related to ever greater restrictions in the ranges over which individuals sought their mates, as groups saw their territories shrink in the face of reforestation, sea-level rise and relative increases in human population packing (Straus, 1990–1991, 1992; González Morales, 1992; González Sainz, 1992). Another indication of increasingly strict territorial boundedness in Mesolithic times might be the development of formal burial areas, such as in Los Canes Cave, Asturias (Arias, 1991).

Artistic activity

One of the most dramatic changes in the archeological record of the Late Glacial occurred in the realm of artistic expression. For a review of the ca. 100 cave art sites in the Cantabrian region, see González Echegaray and González Sainz (1994), and for comprehensive studies of the rich portable art of the region — mostly of Magdalenian age — see Barandiarán (1972, 1994) and Corchón (1986). During the Early Magdalenian, according to traditional views now confirmed by AMS dating (Valladas *et al.*, 1992), there was an important development of parietal and mobile decoration. Characteristic striated engravings both appear, for example, on deer scapulae at Altamira and Castillo, also on the walls of these and many caves. This particular technique and its stylistic conventions had long and widespread use, but its first expression corresponds to the Lower-Middle Magdalenian transition, ca. 15 kya.

Following this came the 'great rock art' of the polychrome figures in Altamira (ca. 14 kya) and other sites, the peak of Leroi-Gourhan's naturalistic 'Ancient Style IV', when Paleolithic people mastered the use of different techniques of painting and engraving, along with the incorporation of natural forms of the walls into animal representations. Portable art also reached a high level of variety and quality: figurative plaquettes became more frequent, along with decorated bone and antler tools.

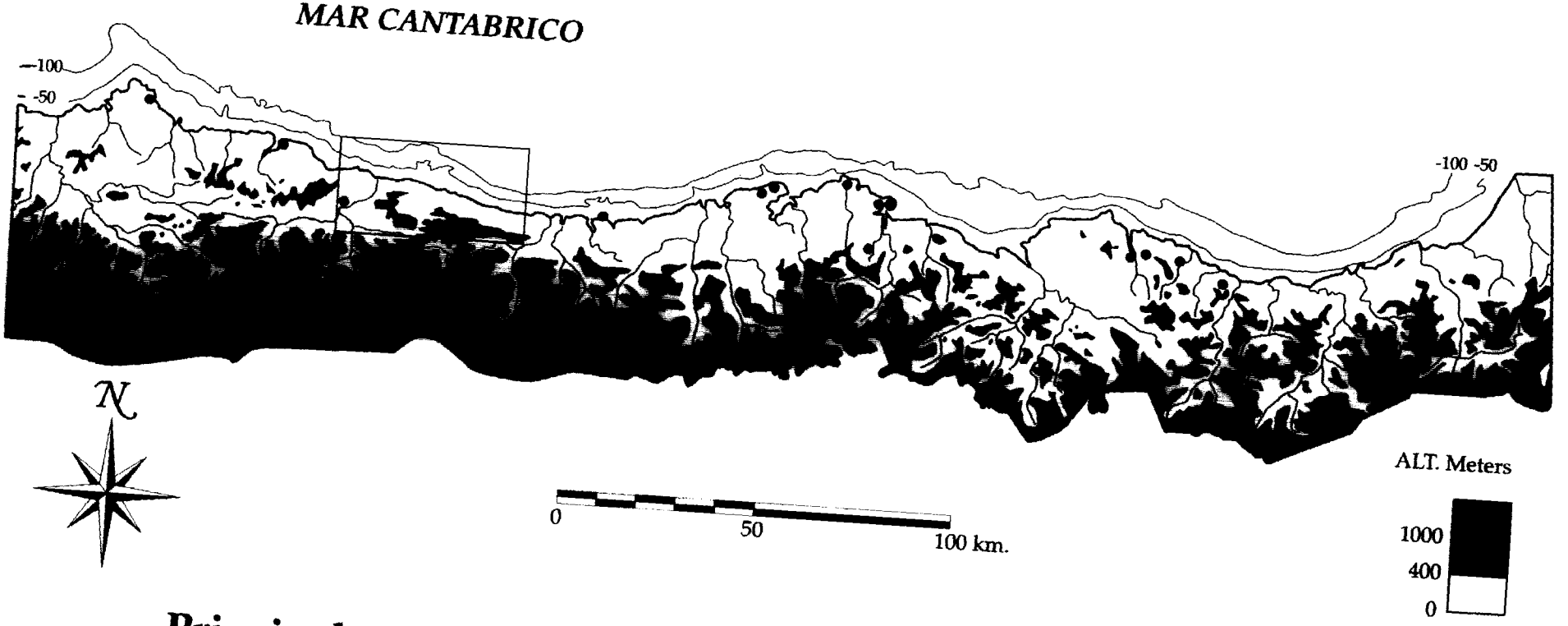
During the Upper Magdalenian, the same trend continues in parietal art, but with progressive simplification in the technical elaboration of figures, as represented by the bichrome bisons of Castillo, sometimes compared with those of Altamira, but now directly dated to about one millennium more recently. During the Late Magdalenian, a progressive rarefaction of parietal art is evident, while naturalistic portable art was still highly developed in form and detail in the beginning, but it decreased sharply by the end of the period. In Azilian times, only very simple geometric decoration of tools or pendants remains, mostly based upon series and combinations of dots or short traits. In strictly Mesolithic times, after ca. 9 kya, there is no evidence for portable art of any kind.

MEDITERRANEAN SPAIN

Mediterranean Spain includes the autonomous regions of Cataluña, País Valenciano, Murcia and Andalucía, stretching down the east (Levantine) and southern (Sea of Alborán) coasts from France to Gibraltar (Fig. 5).

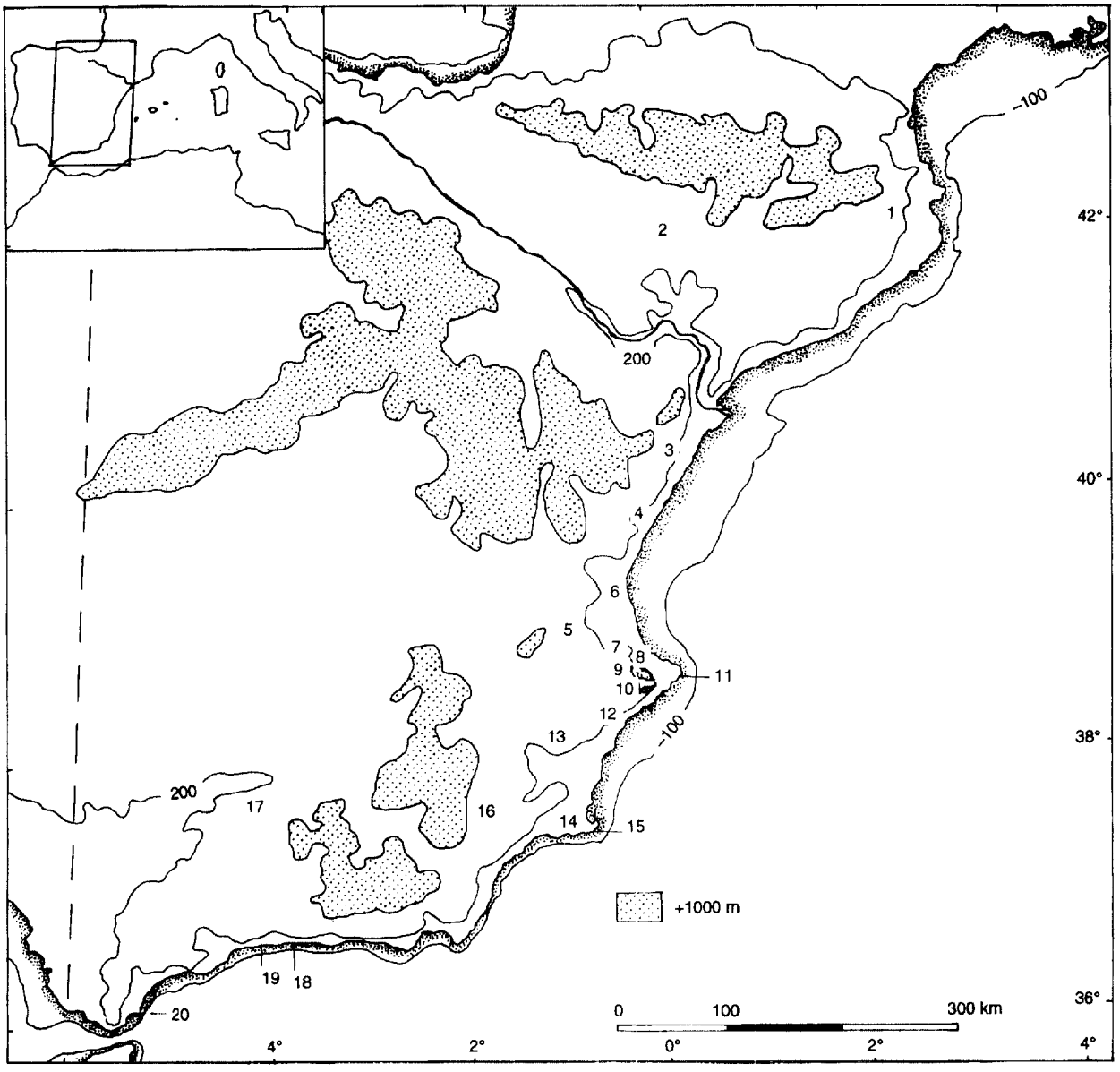
Paleoenvironments

When evaluating the bioclimatic conditions of the Mediterranean region of Spain during the Pleistocene–Holocene transition, one must take into



Principales yacimientos cantábricos con niveles mesolíticos

FIG 4. Map of Cantabrian Spain showing the distribution of Mesolithic sites.



1. *Bora Gran d' en Carreres.*
2. *Cueva de Chaves.*
3. *Cova Matutano.*
4. *Cova dels Blaus.*
5. *Abric de la Senda Vedada.*
6. *Cova del Volcán del Faro.*
7. *Cova del Parpalló Cova de Les Malladetes.*
8. *Cova Foradada d' Oliva.*
9. *Cova Beneito.*
10. *Abric del Tossal de la Roca.*
11. *Cova de les Cendres.*
12. *Ratlla del Bubo.*
13. *Barranco de los Grajos.*
14. *Cueva del Caballo Cueva del Algarrobo.*
15. *Cueva de los Mejilones.*
16. *Cueva Ambrosio.*
17. *El Pirulejo.*
18. *Cueva de Nerja.*
19. *La Cala.*
20. *Gorham's Cave.*

FIG 5. Map of Mediterranean Spain, with sites mentioned in the text.

consideration its low latitude (42–36° N), its location outside the glacial zone of Europe and the effects of the sea on the coastal environments of eastern and south-eastern Iberia. There is evidence of Tardiglacial glaciation only in the highest mountains of the region, notably moraines in the Betic Range above 2350 m. Outside such restricted areas, the only manifestations of significant bioclimatic changes were variations in the coastline and in the grade of humidity versus aridity, with only subtle changes in temperature.

At ca. 18 kya the shore line was situated at ca. −100/120 m, with a constant rise up to −40 m by ca. 9 kya (Shackleton and van Andel, 1985). The progressive flooding of the continental margins was accompanied by the movement of submarine bars up toward the first coast ridges causing the formation of lagoons (Fumanal *et al.*, 1993). The marine transgression had uneven consequences however, depending on local lithology, coastal bathimetry and morphology. Along the Gulf of Valencia there was a loss of a Pleniglacial coastal strip some 10–20 km wide. while along the shore of eastern Andalucia the loss by inundation was of no more than 5 km in some stretches.

Paleobotanical data from the montane Padul bog (Granada) and from archeological sites show a continuous increase in warmth-loving taxa from 16 kya onwards (Dupré, 1988; Pons and Reillé, 1988). In Padul there is a clear, significant amelioration between 13 and 11 kya, with a major presence of the deciduous *Quercus*, *Quercus ilex* and *Pistacia*, although between 11 and 10 kya there was possibly a local manifestation of Dryas III with an increase in *Pinus*, *Juniperus* and *Artemisia* (Pons and Reillé, 1988).

Analyses of wood charcoal from archeological deposits also show the presence of thermophile taxa, but the association of *Pinus* and *Juniperus* is especially characteristic of the Tardiglacial in the Mediterranean region. For the period between 16 and 7 kya there is a north–south gradient in the vegetational associations from southern France and Gibraltar. In both regions the environment is described as having been open, with conifers and junipers in the Tardiglacial, with more temperate, arid conditions to the south of the 40th parallel (Vernet and Thiébault, 1987; Badal, 1990). The deciduous Mediterranean woodland did not reach its climax until the end of the Boreal–Atlantic transition.

The macro- and mesofauna have no biostratigraphic significance in the Tardiglacial of Mediterranean Spain, although there had been traces of Eurosibirian taxa during the Upper Pleniglacial in northern Cataluña and southeastern France (e.g. *Rangifer*, *Elephas*, *Crocuta*) but never to the south of the Ebro (Estévez, 1987). In the southern region, *Equus*, *Bos* and especially *Cervus* and *Capra pyrenaica* had already become the basic game species by ca. 20 kya (Davidson, 1989; Villaverde and Martínez, 1992; Aura and Pérez, 1992). Only during the Tardiglacial–Holocene transition can one perceive a degree of increase in woodland species: *Rupicapra*, *Capreolus*, *Sus* — indications of an increase in temperature and humidity.

There are some bioclimatic indicators of cold conditions among the marine and avian faunas of terminal Paleolithic sites in eastern Andalucia (Nerja and Gorham's Caves) which could be related to the flow of cold Atlantic waters into the Mediterranean via the Strait of Gibraltar. This seems to be confirmed by the analysis of foraminifera in the Sea of Alborán, which indicate the existence of cold species between 12 and 10 kya (Pujol and Verganaud, 1989).

All these data testify to differences *vis-à-vis* the Eurosibirian regions. However, despite the paleoenvironmental differences, there are clear chronological similarities and parallel technological developments in the archeological records of Mediterranean Spain and more northerly regions of western Europe, especially the Pyreneo-Cantabrian regions.

The archeological sequence

The archeological industries dated between 13 and 9 kya underwent a relatively rapid process of development, perceptible especially in changes in manufacturing techniques, in the dimensions and morphology of lithic and antler projectile points (Table 2).

The most significant analytical developments in recent years have been the study of the old collections from the Magdalenian levels in Parpalló Cave (Valencia) and the increase in discoveries of sites with Magdalenian harpoons in the Mediterranean region (Aura, 1988).

After ca. 14 kya microlaminar artifacts became very abundant and typologically diverse in most assemblages; they include scalene triangles, truncated backed bladelets, denticulated bladelets, etc. However, the uniformity of the lithic assemblages and their quantitative inequality make it difficult to use them to propose a developmental model for the industries of the Upper Magdalenian. This fact has led to the creation of a cultural sequence based in large part on the presence/absence of certain diagnostic types of osseous artifacts: harpoons, points, wands, needles and fish gorges. The most frequent points are single-bevel base types with either circular/oval or quadrangular cross-sections, although double-bevel base points, harpoons, and, to a lesser degree, wands, are most typical of this period (Fortea, 1973; Villaverde, 1981; Aura, 1992, 1995). These terminal Magdalenian industries developed between ca. 14 and 10.5 kya, with no clear-cut inflection point in the development of these Magdalenian industries towards the microlaminar Epipaleolithic.

Since the work of Fortea in the 1970s, the early Holocene industries of the Mediterranean region have been divided into two complexes: Microlaminar Epipaleolithic and Geometric Epipaleolithic. The former is clearly related typologically and technologically to the industries of the Magdalenian, equivalent to a sort of regional Azilian or Epimagdalenian. The main differences between the two complexes lie in the relative proportions of the main typological groups, in the decrease in diversity of microlaminar tools and in the practical disappearance of bone artifacts. However, there is considerable continuity between the two complexes, a fact that is reinforced by the occupation of the same sites in both the Upper Magdalenian and Microlaminar Epipaleolithic and by similar subsistence strategies (Aura and Pérez, 1992, 1995; Aura, 1995).

Beginning around 10 kya, there appears a Geometric Epipaleolithic of Sauveterrian type in Catalonia (e.g. at Balma del Gai or Filador), while in the Valencian Region, Murcia and Andalusia some geometrics (circle segments and triangles) also appear in the assemblages. This situation suggests a degree of continuity among the microlaminar industries to the south of the Ebro, even if the addition of a few geometrics may one day allow us to recognize the existence of a regional Sauveterrian. The definitive transformation of the industries of Magdalenian 'tradition' took place ca. 8 kya with the appearance of the Tardenoisian-like Cocina type of Geometric Epipaleolithic. It was this industry that was the substrate for the development of the regional Neolithic lithic industries ca. 7000 BP.

TABLE 2. Chronostratigraphic and cultural framework for the Tardiglacial and early Holocene of Mediterranean Spain

Pollen chronozones: BP	Pollen chronozones	Spanish Mediterranean region: Archaeological sequence			Sites	Industries	Art	Subsistence	Settlement
7500	Atlantic	Epipaleolithic/Mesolithic	Geometric	Tardenoid Facies				Decrease in Lagomorph remains; Incorporation of forest species: wild boar, roe deer and chamois; More diversified animal spectra	Open-air sites on lake and marsh shores
8000	Boreal				Cocina, Botiqueria, Costalena	Trapezes, triangles and segments; Montbani blades; Microburin technique; Notches-denticulates	Non-figurative Portable Art; Plaquettes of la Cueva de la Cocina		
9000	Preboreal			Sauveterroid Facies	Filador, Balma del Gai	Triangles and segments; Microburin technique; Notches-denticulates	Epipaleolithic–Mesolithic Art		
10,000	Dryas III		Microlaminar	Epimagdalenian	Malladetes, St. Gregori, Tossal Roca	No bone tools; Standardized bladelet tools; More regional diversity	Some continuity of the non-figurative Portable Art of Paleolithic tradition		
11,000	Alleröd	Upper/Terminal Magdalenian		C	Matutano, Tossal Roca, Caballo, Nerja	Few bone and antler points; Standardized bladelet tools; Signs of regional diversification; Great variability in the lithic industry	End of Parietal Art; Increase of the number of sites with Portable Art, especially plaquettes, although with few items: Parpalló, Matutano, Tossal, Cendres, Nerja, Pirulejo	Broadened spectrum: birds, sea resources and plants	Sites in caves and shelters located on the coastal plain and the coastal hills; Few data on open-air sites; Little evidence of differentiation between sites: similar sizes and contents
12,000	Dryas II			B	Bora Gran, Matutano, Parpalló, Cendres, Mejillones, Nerja, Pirulejo	Bone and antler points with quadrangular section; Unilaterally barbed harpoons; Flat-convex wands; Blade technique; Diversified bladelet-based toolkit	Parietal Art: Pileta, Nerja, Trinidad; Portable Art: Parpalló	Evidence of specialized deer and ibex hunting; Significant presence of Lagomorph	
13,000	Bölling								
14,000	Dryas Ic			A	Matutano, Parpalló	Bone and horn points with angular section; Flat-convex wands; Blade technique; Diversified bladelets equipment	Palaeolithic Art Style IV		
	Probölling								

Paleoeconomy

At this stage in our research, we can only reach provisional conclusions concerning changes in economic patterns across the Pleistocene–Holocene transition in Mediterranean Spain (Villaverde and Martinez, 1995). This is because the subsistence record is dominated by archeozoological data and these come mainly from non-coastal sites. With regard to terminal Pleistocene sites, the significance of marine resources can only be judged from the single site of Nerja Cave (Málaga), and this is due to the accident of a steep, narrow continental shelf with only slight variations in the shoreline within the littoral catchment area of this site during the Tardiglacial (Aura, 1989). In Nerja the numbers of fish remains are high throughout the entire stratigraphic sequence: five times greater than the number of lagomorph bones in the Upper Magdalenian and 10 times higher than in the Microlaminar Epipaleolithic. In contrast, other sites in the region, nowadays strictly coastal in location, as is the case of Cendres Cave (Alicante), have yielded far fewer fish remains, probably because the coastline had been much farther away during the Tardiglacial than in the case of Nerja (Fumanal and Viñals, 1988; Fumanal *et al.*, 1993).

With respect to the first stages of the Holocene, there are both sites in steep, rocky habitats such as the Caves of la Cocina (Valencia) and Tossal de la Roca (Alicante), as well as others such as Collado and Albufera d'Anna (Valencia), Estany Gran d'Almenara (Castellón), Arenal del la Virgen and Casa de Lara de Villena (Alicante) that are located along pond or lagoon shores, sometimes with real shell middens. This fact testifies to a diversification of habitats exploited by humans after ca. 10 kya (Aura and Pérez, 1992, 1995).

The use of vegetal foods is testified fundamentally in the Magdalenian and Epipaleolithic levels at Nerja, with the documented presence of pinions, olive seeds and acorns (M. Hopf, *pers. comm.*; Badal, 1990). The only other indications are from Cingle Vermell (Catalunya) (Vila *et al.*, 1985) and Tossal de la Roca (Cacho, 1986).

Despite the limitations of the database, and basing our conclusions basically on the macro- and mesofaunal assemblages, there seem to be some interesting changes between the economies of the Upper Magdalenian/Microlaminar Epipaleolithic and those of the Geometric Epipaleolithic. With respect to the large herbivores, there was a high degree of specialization in the hunting of red deer and ibex in the Magdalenian, with evidence of intensive carcass processing suggesting maximal utilization of prey (Davidson, 1989; Aura and Pérez, 1992; Villaverde and Martínez, 1992).

The significant role of lagomorphs in all these Mediterranean sites could help explain the functioning of the human groups which camped at them, with territories that included both the coastal lowlands and the coastal mountain ranges, a pattern that structured group mobility along the river valleys linking the two zones. During the transitional stages toward the Holocene and within the general condition of specialized hunting of single principal species per site, one nonetheless does observe an increase in the number of prey species, both among the medium- and larger-size mammals (roe deer, chamois, boar, aurochs and horse) and among small game (hare, partridge, hedgehog, etc.), suggesting a shrinking in the size of territories perhaps partly related to the environmental changes of the period. During the Geometric Epipaleolithic the subsistence role of rabbits increased dramatically: they became the species best represented in terms of numbers of remains and dietarily came in third place only after ibex and red deer despite their small body size and weight. The possible subsistence alternatives provided by the newly forested environments of the Preboreal–Boreal may have been the explanation for such a marked change in the role of rabbits in the overall diet, since this animal had always been a part of the game bag throughout the whole Upper Paleolithic of the region, from Valencia to Murcia and Andalucia, but until now in small numbers. The increased general importance of ibex among the medium-size ungulates of the early Holocene period may in part be a sampling effect, since most of the sites which have provided subsistence data so far for the Geometric Epipaleolithic happen to be located in mountainous contexts (Aura and Pérez, 1995).

Artistic manifestations

With respect to artistic activity, Mediterranean Spain follows the same general pattern as other Western European regions across this period of environmental and adaptational transition. During the Later Magdalenian the number of mobile art objects decreases in absolute terms at Parpalló, Cendres, Blaus and Pirulejo. The scarcity of art pieces constitutes, however, the most notable characteristic of the Microlaminar Epipaleolithic.

This fact confirms the continuity of a tradition spanning the Magdalenian and Microlaminar Epipaleolithic of the region. The represented subjects, the techniques and styles of engraving all belong strictly to the Paleolithic tradition (Villaverde, 1994a,b). A clear break in the artistic tradition seems to have occurred in the early Holocene, correlated with changes in technology, subsistence, and, to some extent, physical environments.

During the following period, the Geometric Epipaleolithic, we know of only the engraved plaques from La Cocina, the sole surviving evidence for artistic activity at this time (Fortea, 1973; Hernández, 1995). The existence of a hiatus between Paleolithic and Levantine art seems to be supported by the superposition of Levantine-style figures atop Macroschematic ones in some open-air rupestral panels such as those of La Sarga (Alicante) (Aura, 1983; Hernández, 1995). Independent of the question of parallels between the Macroschematic rupestral art and decorative themes on Cardial Neolithic ceramics — a fact which solidly suggests a late date for at least some of the Levantine

rupestral art — the greater age of the Macroschematic tradition provides a reference point for supporting an argument for significant thematic and stylistic differences *vis-à-vis* the Paleolithic art of the region (Martí and Hernández, 1988). A detailed analysis of these concepts can be generalized into a comparison of Levantine art, with its conventions, techniques and themes, with the very different art of the final Magdalenian and Microlaminar Epipaleolithic.

CONCLUSIONS

The Iberian Peninsula witnessed both the continuity and change in aspects of environments, resources, human settlement–subsistence systems and technologies across the Pleistocene–Holocene transition. Compared to regions of western Europe even as close as southern France, the ecological changes that occurred in Iberia after the Bølling oscillation were relatively subtle and indeed humans had long been diversifying their subsistence strategies, certainly since the Magdalenian or even the Solutrean. There is a significant degree of parallelism among the regions of Portuguese Estremadura, Cantabrian and Mediterranean Spain, despite interesting differences in detail. One of the unanswered questions concerns the nature of the connections among these peripheral, coastal regions, separated by the high, often inhospitable mesetas and cordilleras of Spain. Further research is clearly required along the valleys of the great rivers of the Peninsula, the Ebro, Duero, Tagus and Guadalquivir, as well as along the coastal plains of Galicia, western Andalucia and Algarve. Developments such as the recent discoveries of late Upper Paleolithic habitation sites in Cadiz León and Lugo and open-air rock art in the interior provinces of Segovia, Salamanca and Beira Alta, may help prehistorians forge the links of prehistoric social contacts that transcend the ecological differences among the peripheral regions, in a manner analogous to the artistic similarities between southern France and Cantabrian Spain on the one hand and Mediterranean Spain on the other. When the Ice Age world ended — dramatically in France and more subtly in Iberia — the ideological, social and economic *raisons d'être* for the art disappeared. The next broad-scale ideological system to encompass Iberia would be that of the Neolithic with its impressed ceramic wares or its megalithic monuments.

REFERENCES

Altuna, J. (1995). Faunas de mamíferos y cambios ambientales durante el Tardiglacial cantábrico. *In*: Moure, A. and González Sainz, C. (eds), *El final del Paleolítico cantábrico*, pp. 77–117. Universidad de Cantabria, Santander.

Altuna, J., Baldeón, A. and Mariezkurrena, K. (1985). Cazadores magdalenienses en Erralla (Cestona, País Vasco). *Munibe*, **37**, San Sebastián.

Altuna, J. and Merino, J.M. (1984). *El yacimiento prehistórico de la cueva de Ekain (Deba, Guipúzcoa)*. Sociedad de Estudios Vascos, San Sebastián.

Arias, P. (1991). *De cazadores a campesinos. La transición al neolítico en la región cantábrica*. Universidad de Cantabria, Santander.

Arnaud, J. (1989). The Mesolithic communities of the Sado Valley, Portugal, in their ecological setting. *In*: Bonsall, C. (ed.), *The Mesolithic in Europe*, pp. 614–631. John Donald, Edinburgh.

Arnaud, J. (1993). O Mesolítico e a Neolitização: balanço e perspectivas. *In*: Carvalho, G., Ferreira, A., Senna-Martinez, J. (eds), *O Quaternario em Portugal*, pp. 173–184. Colibri, Lisbon.

Arnaud, J. and Bento, J.D.A. (1988). Caracterização pré-histórica da Gruta do Casal do Papagaio (Fátima, Villa Nova de Ourén). *Algar*, **2**, 17–34.

Aura, J.E. (1983). Aportaciones al estudio de la Sarga (Alcoy, Alicante). *Lucentum*, **2**, 5–16.

Aura, J.E. (1988). La Cova del Parpalló y el Magdaleniense de facies ibérica o mediterráneo. Propuesta de sistematización de su cultura material: industrial lítica y ósea. Doctoral Dissertation. Universitat de Valencia, Valencia, unpublished.

Aura, J.E. (1989). A preliminary report on marine resources exploitation on the Andalucian Coast: the gorges from the Cave of Nerja (Málaga, Spain). Fifth Meeting of the ICAZ Fish remains Working Group. Göteborg, Sweden.

Aura, J.E. (1992). El Magdaleniense Superior Mediterráneo y su Modelo Evolutivo. *In*: Utrilla, P. (ed.), *Aragón/Litoral Mediterráneo. Intercambios Culturales durante la Prehistoria*, pp. 167–177. Institución Fernando el Católico, Zaragoza.

Aura, J.E. (1995). *El Magdaleniense mediterráneo: La Cova del Parpalló (Gandia, Valencia)*. Servei d'Investigació Prehistorica, Trabajos Varios 94, Valencia.

Aura, J.E. and Pérez, M. (1992). Tardiglaciar y Postglaciar en la región mediterránea de la Península Ibérica (13.500–8.500 BP): transformaciones industriales y económicas. *Saguntum*, **25**, 25–47.

Aura, J.E. and Pérez, M. (1995). El Holoceno inicial en el Mediterráneo español (11.000–7.000 BP). Características culturas y económicas. *In*: Villaverde, V. (ed.), *Los últimos cazadores*, pp. 119–146. Instituto de Cultura Juan Gil-Albert, Alicante.

Badal, E. (1990). Aportaciones de la antrocología al estudio el paisaje vegetal y su evolución en el cuaternario reciente en la costa mediterránea del País Valenciano y Andalucia (18.000–3.000 BP). Doctoral Dissertation, Universitat de Valencia, Valencia, unpublished.

Barandiarán, I. (1972). *Arte Mueble del Paleolítico Cantábrico*. Monografías Arqueológicas XIV. Universidad de Zaragoza, Zaragoza.

Barandiarán, I. (1990). Revisión estratigráfica de Berroberria. Datos en 1990. *Veleia*, **7**, 7–33.

Barandiarán, I. (1994). Arte mueble del paleolítico cantábrico: una visión de síntesis en 1994. *Complutum*, **5**, 45–79.

Bard, E., Arnold, M., Maurice, P., Duprat, J., Moyes, J. and Duplessy, J.-C. (1987). Retreat velocity of the North Atlantic polar front during the last deglaciation determined by ^{14}C accelerator mass spectrometry. *Nature*, **328**, 791–794.

Berganza, J.L. and Arribas, J.L. (1994). Excavación, cronología, análisis de las industrias lítica y ósea. *Kobie*, **XXI**, 7–83.

Bernaldo de Quirós, F., Gutiérrez Saez, C., Heras, C., Lagüera, M.A., Pelayo, M., Pumarejo, P. and Uzquiano, P. (1992). Nouvelles données sur la transition Magdalénien Supérieur-Azilien. La grotte de "La Pila" (Cantabria, Espagne). *In*: Rigaud, J-P., Laville, H. and Vandermeersch, B. (eds), *Le Peuplement magdalénien. Paléogéographie physique et humaine*, pp. 259–269. Editions du C.T.H.S., Paris.

Bicho, N. (1993). Late Glacial prehistory of central and southern Portugal. *Antiquity*, **67**, 761–775.

Bicho, N. (1994). The end of the Paleolithic and the Mesolithic in Portugal. *Current Anthropology*, **35**, 664–674.

Cacho, C. (1986). Nuevos datos sobre la transición del Magdaleniense al Epipaleolítico en el País Valenciano: el Tossal de la Roca. *Boletín del Museo Arqueológico Nacional*, **4**, 117–129.

Callapez, P. (1992). Moluscos terrestres das camadas A/B/C/-Eb da Gruta do Caldeirão. *In*: Zilhão, J. (ed.), *Gruta do Caldeirão. O Neolítico Antigo*, pp. 223–229. Instituto Portugués do Património Arquitectónico e Arqueológico, Lisbon.

Carvalho, E., Straus, L., Vierra, B., Zilhão, J. and Araújo, A. (1989). More data for an archeological map of the county of Torres Vedras. *Arqueologia*, **19**, 16–33.

Castaños, P.M. (1992). Evolución de los macromamíferos durante el Tardiglaciar cantábrico. *In*: Cearreta, A. and Ugarte, F.M. (eds), *The Late Quaternary in the Western Pyrenean region*. Universidad del País Vasco, Bilbao.

Cearreta, A. and Ugarte, F.M. (eds) (1992). *The Late Quaternary in the Western Pyrenean Region. Proceedings of the International Conference on the Environment and the Human Society in the Western Pyrenees and the Basque Mountains during the Upper Pleistocene and the Holocene.* Universidad del Pais Vasco, Bilbao.

Clark, G. (1983). *The Asturian of Cantabria.* University of Arizona Press, Tucson.

Corchón, M.S. (1986). El Arte Mueble Paleolítico Cantábrico: contexto y análisis interno. *Centro de Investigación y Museo de Altamira*, Monografías 16. Madrid.

Cruz, A.J.C. (1993). Estudo geoquímico de preenchimentos sedimentares de grutas da Estremadura com vestígios de occupação humana pré-histórica. Doctoral Dissertation, Universidade de Lisboa, Lisbon, unpublished.

Davidson, I. (1989). *La Economía del Final del Paleolítico en la España oriental.* Servei d'Investigación Prehistórica, Trabajos Varios 85, Valencia.

Dias, J.M.A. (1985). Registos da migração da linha de costa nos últimos 18,000 anos na plataforma continental portuguesa setentrional. *In: Actas da 1 Reunião do Quaternário ibérico*, pp. 281–295. Lisbon.

Duplessy, J.C., Labeyrie, L., Arnold, M., Paterne, M., Duprat, J. and Van Weering, T.C.E. (1992). Changes in surface salinity of the North Atlantic Ocean during the last deglaciation. *Nature*, **358**, 121–144.

Duprat, J. (1993). Les formanifères planctoniques du Quaternaire terminal d'un domaine péricontinental (Golfe de Gascogne, Côtes Ouest-Ibériques, Mer d'Alborán): Ecologie Biostratigraphie. Doctoral Dissertation, Université de Bordeaux I, Talence, unpublished.

Dupré Olivier, M. (1988). *Palinología y Paleoambiente. Nuevos datos españoles.* Servei d'Investigacio Prehistorica, Trabajos Varios 84, Valencia.

Estévez, J. (1987). Dynamique des faunes préhistoriques au NE de la péninsule Ibérique. *Archaeozoologia*, **1**(2), 197–218.

Fernández-Tresguerres, J.A. (1980). *El Aziliense en las provincias de Asturias y Santander.* Centro de Investigación y Museo de Altamira, Monografías 2. Santander.

Fernández-Tresguerres, J. (1995). El Aziliense de la región cantábrica. *In:* Moure, A. and González Sainz, C. (eds), *El Final del Paleolítico Cantábrico*, pp. 199–224. Universidad de Cantabria, Santander.

Figueiral, I. (1993). Cabeço de Porto Marinho: une approche paléoécologique. Premiers résultats. *Estudios sobre Cuaternario*, pp. 167–172. Valencia.

Fortea Perez, F.J. (1973). *Los complejos microlaminares y geométricos del Epipaleolítico mediterráneo español.* Seminario de Prehistoria y Arqueología, Memorias 4, Salamanca.

Fumanal, M.P. and Viñals, M.J. (1988). Los acantilados marinos de Moraira: su evolución pleistocena. *Cuaternario y Geomorfología*, **2**, 13–22.

Fumanal, M.P., Viñals, M.J., Ferrer, C., Aura, J.E., Bernabeu, J., Casabo, J., Gisbert, J. and Senti, M.A. (1993). Litoral y poblamiento en el País Valenciano durante el Cuaternario reciente: Cabo de Cullera-Punta de Moraira. *Estudios sobre Cuaternario* 1993, pp. 249–259. Valencia.

Garcia Guinea, M.-A. (1985). Las cuevas azilienses de el Piélago y sus excavaciones de 1967–1969. *Sautuola*, **4**, 11–154.

González Echegaray, J. and Barandiarán, I. (1981). *El Paleolítico Superior de la Cueva del Rascaño.* Centro de Investigación y Museo de Altamira, Monografías 3, Santander.

González Echegaray, J. and Freeman, L.G. (1971). *Cueva Morín. Excavaciones 1966–1968.* Patronato de las Cuevas Prehistóricas de la Provincia de Santander, Santander.

González Echegaray, J. and Freeman, L.G. (1973). *Cueva Morín. Excavaciones 1969.* Patronato de las Cuevas Prehistóricas de la Provincia de Santander, Santander.

González Echegaray, J. and González Sainz, C. (1994). Conjuntos rupestres paleolíticos de la Cornisa Cantabrica. *Complutum*, **5**, 21–43.

González Morales, M. (1982). *El Asturiense y otras culturas locales. La explotación de las áreas litorales de la Región Cantábrica en los tiempos Epipaleolíticos.* Centro de Investigación y Museo de Altamira, Monografías 7, Santander.

González Morales, M. (1992). Mesolíticos y megalíticos: la evidencia arqueológica de los cambios en los formas productivas en el paso al Megalítico en la Costa Cantábrica. *In:* Moure, A. (ed.), *Elefantes, Ciervos y Ovicaprinos*, pp. 185–202. Universidad de Cantabria, Santander.

González Morales, M. (1995). La transición al Holoceno en la Región Cantábrica: el contraste con el modelo del Mediterráneo español. *In:* V. Villaverde (ed.), *Los últimos cazadores*, pp. 63–78. Instituto de Cultura Juan Gil-Albert, Alicante.

González Morales, M. and Arnaud, J. (1990). Recent research on the Mesolithic in the Iberian Peninsula. *In:* Vermeersch, P. and Van Peer, P. (eds), *Contributions to the Mesolithic in Europe*, pp. 451–461. Leuven University Press, Leuven.

González Morales, M. and Díaz Casado, Y. (1992). Excavaciones en los Abrigos de la Peña del Perro (Santoña, Cantabria). *Veleia*, 8–9, 43–64.

González Sainz, C. (1989). *El Magdaleniense Superior-Final de la región cantábrica.* Tantín-Universidad de Cantabria. Santander.

González Sainz, C. (1992). Aproximación al aprovechamiento económico de las poblaciones cantábricas durante el Tardiglacial. *In:* Moure, A. (ed.), *Elefantes, ciervos y ovicaprinos*, pp. 129–147. Universidad de Cantabria, Santander.

González Sainz, C. (1994). Sobre la cronoestratigrafía del Magdaleniense y Aziliense en la región cantábrica. *Munibe*, **46**, 53–68.

González Sainz, C. (1995). 13.000–11.000 B.P. El final de la época Magdaleniense en la región cantábrica. *In:* Moure, A. and González Sainz, C. (eds), *El Final del Paleolítico Cantábrico*, pp. 159–198. Universidad de Cantabria, Santander.

Hernández Pérez, M.S. (1995). Arte rupestre en el País Valenciano. Bases para un debate. *Actes de les Jornades d'Arqueologia d'Alfàs del Pi*, Valencia, pp. 89–118.

Hoyos, M. (1995). Paleoclimatologia del Tardiglacial en la Cornisa Cantábrica basada en los resultados sedimentológicos de yacimientos arqueológicos kársticos. *In:* Moure, A. and González Sainz, C. (eds), *El Final del Paleolítico*, pp. 15–75. Universidad de Cantabria, Santander.

Hoyos, M., Martínez Navarrete, M.I., Chapa, T., Castaños, P. and Sanchiz, F.B. (1980). *La cueva de La Paloma. Soto de las Regueras (Asturias).* Excavaciones Arqueológicas en España 116, Madrid.

Lentacker, A. (1994). Fish remains from Portugal. *In:* Van Neer, W. (ed.), *Fish Expoitation in the Past*, pp. 263–271. Annales du Musée Royal de l'Afrique Centrale, Sciences Zoologiques, no. 274, Tervren.

Lubell, D., Jackes, M., Schwarcz, H., Knyf, M. and Meiklejohn, C. (1994). The Mesolithic-Neolithic transition in Portugal: isotopic and dental evidence of diet. *Journal of Archaeological Science*, **21**, 201–206.

Martí, B. and Hernández, M. (1988). *El Neolític Valencià: Art Rupestre i Cultura Material.* Servei d'Investigació Prehistòrica, Valencia.

Mateus, J. and Queirós, P. (1993). Os estudos de vegetação quaternária em Portugal; contextos, balanço de resultados, perspectivas. *In:* Carvalho, G., Ferréna, A. and Senna, J. (eds), *O Quaternário em Portugal*, pp. 105–131. Colbri, Lisbon.

Moure, A. (1975). *Excavaciones en la cueva de Tito Bustillo (Ribadesella, Asturias). Campañas de 1972–1974.* Instituto de Estudios Asturianos, Oviedo.

Moure, A. (1989). La caverne de Tito Bustillo (Asturies, Espagne). Le gisement paléolithique. *L'Anthropologie*, **93**, 407–434.

Moure, A. and González Sainz (eds) (1995). *El Final del Paleolítico Cantábrico.* Universidad de Cantabria, Santander.

Pereira, A.R. and Correia, E.B. (1985). *Dunas consolidadas em Portugal. Análise da bibliografia e algumas reflexões.* Centro de Estudos Geográficos, Lisbon.

Pons, A. and Reille, M. (1988). The Holocene and Upper Pleistocene pollen record from Padul (Granada, Spain). A new study. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **66**, 243–263.

Póvoas, L., Zilhão, J., Chaline, J. and Brunet-Leconte, P. (1992). La faune de rongeurs du Pléistocène Supérieur de la Gruta do Caldeirão. *Quaternaire*, **3**(1), 40–47.

Pujol, C. and Verganaud, C. (1989). Palaeoceanography of the last Mediterranean deglaciation in the Alborán Sea (Western Mediterranean). Stable isotopes and planktonic foraminiferal records. *Marine Micropaleontology*, **15**, 153–179.

Roche, J. (1972). Les amas coquilliers (concheiros) mésolithiques de Muge. *In:* Lüning, H. (ed.), *Die Anfänge des Neolithikums von Orient bis Nord Europa*, Vol. 7, pp. 72–107. Fundamenta, Cologne.

Roche, J. (1982). A gruta chamada Lapa do Suão (Bombarral). *Arqueologia*, **5**, 5–18.

Rodrigues, A., Magalhães, F. and Dias, J.A. (1991). Evolution of the North Portuguese coast in the last 18,000 years. *Quaternary International*, **9**, 67–74.

Shackleton, J.C. and van Andel, T.H. (1985). Late Palaeolithic and Mesolithic coastlines of the western Mediterranean, *Cahiers Ligures de Préhistoire et Protohistoire*, **2,** 7–19.

Straus, L.G. (1990–1991). An essay at synthesis: tardiglacial adaptative systems in the vasco-cantabrian and pyrenean regions of S.W. Europe. *Kobie*, **XIX,** 9–22.

Straus, L.G. (1991). The Mesolithic-Neolithic transition in Portugal. *Antiquity*, **65,** 899–903.

Straus, L. (1992). *Iberia before the Iberians*. University of New Mexico Press, Albuquerque.

Straus, L., Altuna, J. and Vierra, B. (1990). The concheiro at Vidigal: a contribution to the late Mesolithic in southern Portugal. *In*: Vermeersch, P. and Van Peer, P. (eds), *Contributions to the Mesolithic in Europe*, pp. 451–461. Leuven University Press, Leuven.

Straus, L. and Clark, G. (1986). *La Riera Cave*. Anthropological Research Papers no. 36, Tempe, Arizona.

Turner, C. and Hannon, G.E. (1988). Vegetational evidence for late Quaternary climatic changes in southwest Europe in relation to the influence of the North Atlantic Ocean. *Philosophical Transactions of the Royal Society of London B*, **318,** 451–458.

Utrilla, P. (1981). *El Magdaleniense Inferior y Medio en la Costa Cantábrica*. Centro de Investigación y Museo de Altamira, Monografías 4. Santander.

Valladas, H., Cachier, H., Maurice, P., Bernaldo de Quirós, F., Clottes, J., Cabrera, V., Uzquiano, P. and Arnold, M. (1992). Direct radiocarbon dates for prehistoric paintings at the Altamira, El Castillo and Niaux Caves. *Nature*, **357,** 68–70.

Van der Knaap, W.O. and Van Leeuwen, J.F.N. (n.d.). The vegetation succession since Late-Glacial times in Serra da Estrela, Portugal, studied on the lake of Charco da Candeeira (1400 m.a.s.l.). Unpublished manuscript.

Vernet, J.L. and Thiebault, S. (1987). An approach to north-western Mediterranean recent prehistoric vegetation and ecologic implications. *Journal of Biogeography*, **14,** 117–127.

Vierra, B. (1995). *Subsistence and stone tool technology: An old world perspective*. Anthropological Research Papers 47, Tempe, Arizona.

Vila, A., Yll, R., Estévez, J., Alcalde, G., Faro, A., Oller, J. and Vilette, P.H. (1985). *El "Cingle Vermell": Assentament de caçadors-recol.lectors del Xè. mil. lenni B.P.* Excavacions Arqueològiques a Catalunya 5, Barcelona.

Villaverde, V. (1981). El Magdaleniense de la Cova de les Cendres (Teulada, Alicante) y su aportación al conocimiento del Magdaleniense Mediterráneo peninsular. *Saguntum*, **16,** 9–35.

Villaverde, V. (1994a). *Arte Paleolítico de la Cova del Parpalló. Estudio de la colección de plaquetas y cantos grabados y pintados*. Servei d'Investigació Prehistòrica, Valencia.

Villaverde, V. (1994b). Arte mueble de la España mediterránea: algunas consideraciones teóricas y breve síntesis. *Complutum*, **5,** 139–162.

Villaverde, V. (ed.) (1995). *Los Ultimos Cazadores*. Instituto de Cultura Juan Gil-Albert, Alicante.

Villaverde, V. and Martínez, R. (1992). Economía y aprovechamiento del medio en el Paleolítico de la región central del Mediterráneo español. *In*: Moure, A. (ed.), *Elefantes, Ciervos y Ovicaprinos*, pp. 77–95. Universidad de Cantabria, Santander.

Villaverde, V. and Martínez, R. (1995). Características culturales y económicas del final del Paleolítico superior en el Mediterráneo español. *In*: Villaverde, V. (ed.), *Los Ultimos Cazadores*, pp. 79–117, Instituto de Cultura Juan Gil-Albert, Alicante.

Zilhão, J. (1992). *Gruta do Caldeirão. O Neolítico Antigo*. Instituto Português do Património Arquitectónico e Argueológico, Lisbon.

Zilhão, J. (1993). The spread of agro-pastoral economies across Mediterranean Europe: a view from the Farwest. *Journal of Mediterranean Archaeology*, **6**(1), 5–63.

Zilhão, J. (1995). O Paleolítico Superior da Estremadura portuguesa. Doctoral Dissertation, Universidade de Lisboa, Lisbon, unpublished.