

## “A Garden of Eden for the Gibraltar Neandertals? A reply to Finlayson et al.”<sup>☆</sup>

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### Abstract

Reflections on the possible role of climate in cultural change and human population replacement are still rare. In this respect, the comments provided by Finlayson and collaborators to our paper must be welcomed and considered as a valuable opportunity to go deeper into the mechanisms of such interactions. However, we find a number of contradictions and inconsistencies in the way in which they deal with the issue of Neandertal extinction, with minimal data to support their conclusions, and consider that in a number of instances they have inaccurately reported our views.

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### 1. Competition

Finlayson et al. quite rightly state, at the beginning of their comment, that the safest way to model Neandertal extinction is to consider Neandertals and Moderns as contemporary populations interacting in multiple ways “that would have depended on ecological and historical contingency”. We have made the same point many times (d’Errico et al., 1998, p. 22; d’Errico, 2003; Zilhão and d’Errico, 1999, 2000, 2003). We even went further by expressing the view that models seeking a biologically based intellectual inferiority of Neandertals as the main factor triggering their extinction must be rejected. This is precisely because these models are unable to account for the role played by ecological diversity and historical contingency. It is rewarding, reading Finlayson’s comments, to see how seminal our ideas were. However, it is less understandable why after maintaining these views in an often-hostile scientific environment, we should be blamed for the ideas we put forward in the first place.

The problem is that in the discussion that follows their statement Finlayson et al. completely forget historical contingency as a potential living factor in the process of substitution and only consider ecological competition as a hypothesis to test. This narrow ecological perspective leads them to expect that Neandertals must have been favoured over the expanding Moderns by their superior knowledge of available resources and might have never come into competition with them but just become extinct or “have gone” (where?) before their arrival. We see a major inconsistency here. How can one reasonably conceive an independent demographic implosion of a well-adapted human population, whilst accepting that another population was occupying neighbouring territories, but

refuse to establish any causal link between these two events? Competition between human populations cannot be modelled, as Finlayson et al. do, only in ecological terms and this was not the meaning this term was given to in our paper. It is a confrontation in which traditional knowledge, representations of oneself and the others, and even contingent decisions taken by individuals, blend with environmental constraints to produce, according to the moment and the place, mutual avoidance, cultural and/or biological interaction, genocide, etc. As suggested by recent research on hunter-gatherer societies (Price and Brown, 1985; Smith Eric and Winterhalder Boone, 1992; Read and LeBlanc, 2003) humans cannot escape the process that explains the evolution of other species and ecological communities, but at the same time we are cultural beings, engaging in symbolically constituted social networks adapting to our surroundings through symbolic filters of language and thought. Rather than a single model for population growth-carrying capacity-conflict Read and LeBlanc, for example, highlight the need for a multi-trajectory model taking into account the specificity of human cultures.

The “basic principle of ecology” mentioned by Finlayson et al. and their concerns about the unfounded “superior Modern competitive ability” cease to apply when the substitution process is seen through the eyes of history instead of those of Darwinian evolutionary theory. Hence, the issue becomes one of reconstructing the timing and patterns of interaction between societies, including the role of climatic changes, and not of designating—or preventing designating as in their case—a species condemned by evolution. And as suggested by a number of historical instances we do not need ecology to explain population models causing the disappearance of a human group. A second group may eventually invade the same area, but this can involve little contact between the two, and limited or no inter-group violence. Hunter-gatherer subsistence strategies and social organisations are often fragile yet may be critically affected by those of neighbouring human groups well before any physical contact intervenes. When observed from this perspective, whilst taking into account the available archaeological and dating evidence, (i.e. the east–west gradual progression of Moderns population, and not just the stratigraphic evidence from the South of Iberia as Finlayson et al. do when discussing this issue), it seems perfectly reasonable for us to propose, that it was “competition”, taken in its broad sense, that gave, in the southern Iberia the *coup de grâce* to the Neandertals. Whether this “competition” involved or not the partial or total eradication of one population by another that Finlayson et al., *and not us*, evoke we simply do not know. Ethnoarchaeology, however, suggests (Lee and DeVore, 1968; Burmeister, 2000) that such stochastic events leave little

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archaeological evidence and therefore their absence in the archaeological record does not demonstrate that they did not take place.

## 2. The ghost of the living dead Neandertals

The observation that archaeologically undetectable Neandertal populations may have survived longer than indicated by radiocarbon evidence is a hypothesis that, by Finlayson et al. own admission, cannot be falsified and is for this reason of little help in resolving this debate. The same applies to the consideration that archaeological sites may represent source or sink populations. The possibility these authors raise of “living dead” Neandertal groups, implying a low residential mobility of isolated communities, is in contradiction with what is known about hunter-gatherer subsistence strategies (Testart, 1982; Price and Brown, 1985; Hayden, 2000). These societies may live in small areas only when they have access to rich food resources, available all over the year, or use substantial storage technology to accumulate resources only available seasonally. Ethnographic evidence indicates that highly productive and predictable resources are rapidly assimilated by new arrivals. Contrary to Finlayson et al. expectations, this causes increased and stressful residential mobility and fragmentation of autochthonous populations before their eventual rapid disappearance or migration.

## 3. The role of climate

According to Finlayson et al. it can be shown “that the second-half of the OIS 3 was the most climatically unstable period of the Pleistocene” and that “the high frequency and amplitude of the climatic fluctuations” characterising the second-half of OIS 3 would have fragmented Neandertal populations and contributed to their extinction. To support this view they present a graph with the coefficient of variation of  $^{18}\text{O}$  values from two North Atlantic ODP cores (Ruddiman et al., 1986) in which the bar indicated as OIS 3 shows the highest value over the last 850 ky (see also Fig. 6 in Finlayson, 2003). However, this value refers to the last 50 kyr. This means that it includes all of the OIS2, the deglaciation period, the Holocene, and only the second-half of OIS 3. Clearly, the high coefficient of variation obtained is due to the inclusion of the heaviest and lightest  $^{18}\text{O}$  values from glacial and interglacial conditions, and has little to do with the climatic variability of OIS 3. It goes without saying that for the same reason this evidence cannot be used to suggest a higher climatic variability at the end of the OIS 3 compared to the first part of this stage. In order to test this hypothesis the

authors should have compared variation in  $^{18}\text{O}$  values between 60 and 40 kyr with those from 40 and 25 ky, and used a more appropriate statistical tool such as spectral analyses (Berger et al., 1991; Yiou et al., 1996). May we suggest that this exercise would have been quite useless in the light of what we know about the pervasive millennial scale climatic cycles characterising the last glacial period (Johnsen et al., 1992; Bond et al., 1993; Dansgaard et al., 1993; Grootes et al., 1993; Cortijo et al., 1995; Bond et al., 1997; Elliot et al., 1998), indicating that neither the frequency nor the amplitude of the climatic shifts at the end of the OIS 3 were higher than those of the first part of this isotopic stage.

In summary we do not see how the evidence provided by Finlayson et al. might constitute a challenge to our hypothesis or support their view. Finlayson’s attempt to test the role of climatic change on the extinction of the last Neandertal populations seems to us paradigmatic of how one *should not* work in this field. That is to propose a population model so vague that it is impossible to test against data and supported only by unsubstantiated assumptions, whilst on the climatic approach, using outdated, global, and ill-represented palaeoclimatic evidence.

## 4. Marine cores. What for?

While acknowledging the effort made by Finlayson et al. to explain the limitations of marine cores for palaeoclimatic reconstructions, we cannot share their minimalist view of the potential of these records (Fig. 1). According to these authors, pollen spectra from the MD95-2043 core would only reflect vegetational changes occurring in the arid lands between Granada and Almeria in the North, and the North African coastal arid lands in the South; those from the Portuguese MD95-2042 core would only sample “meso-Mediterranean bioclimates” to the East. These two records would be therefore unable to represent all the mosaics of vegetation characterising southern Iberia.

In expressing these claims Finlayson et al. seem to ignore a large literature on the phytogeographical significance of pollen from marine sediments (Turon, 1984; Hooghiemstra et al., 1986; Heusser, 1988; Chmura et al., 1999; Dupont and Wypytta, 2003). These studies have clearly demonstrated that pollen from marine sequences, recruited through river discharge and/or wind transport, provide a reliable integrated image of the different vegetation zones on the adjacent continent.

The detailed pollen percentage diagram (Sánchez Goñi et al., 2002, p. 98) from MD95-2043, that Finlayson et al. seem to ignore, provides a further demonstration of this rule (Fig. 2). This diagram records

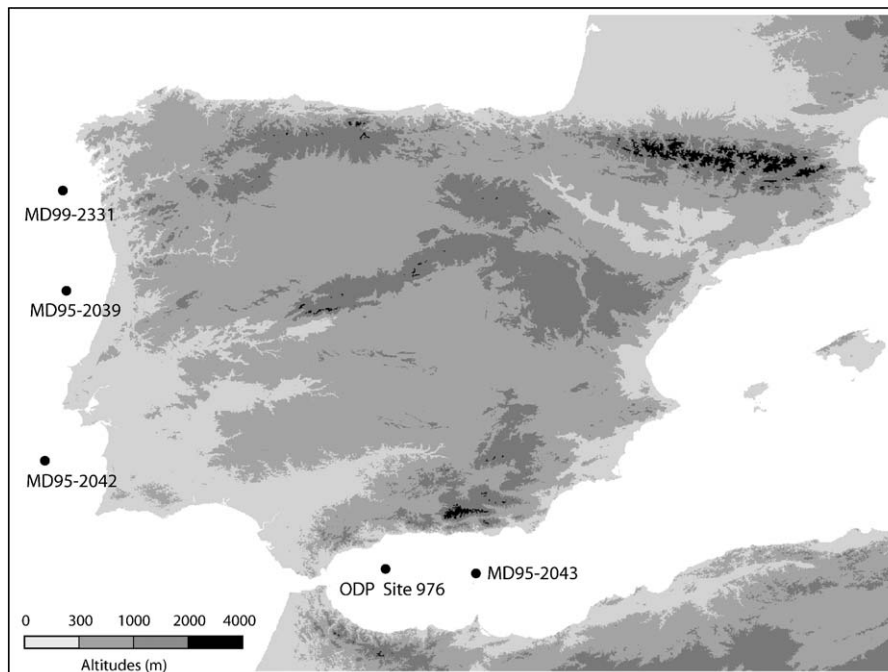


Fig. 1. Location of the marine cores cited in the text.

throughout the OIS 3 an almost continuous presence of pollen from humid trees and shrubs growing in southern Iberia's inner basins and high altitude zones. It detects for example *Abies*, *Acer*, *Betula*, *Fraxinus excelsior*-type, deciduous and evergreen *Quercus* as well as Ericaceae, all typical of meso-mediterranean and supra-mediterranean areas. *Abies* pollen, probably from the endemic species *A. pinsapo*, certainly comes from the high altitudes of the Betic mountain chain, some 50 km from the littoral zone. The record of this poorly dispersed taxon in the Alboran core is an additional indication that, contrary to Finlayson et al. claims, spectra from this sequence are representative of the vegetation history of a large region covering the whole of South-Eastern Spain. The same applies to the spectra from the Portuguese core (Sánchez Goñi et al., 2000, p. 397, Fig. 2), which record pollen of taxa typical of the thermo-Mediterranean belt such as *Pistacia*, *Phillyrea* and *Olea* as well as steppe or semi-desert representatives (*Artemisia*, Chenopodiaceae and *Ephedra*), and not only plants from the meso-Mediterranean vegetation, as suggested by Finlayson et al.

If these authors were correct in considering that the Mediterranean core was only sampling arid, local coastal lands, and the Atlantic eastern inland areas, this would result in very different pollen assemblages, which is not the case. The pollen diagrams from these two cores are remarkably similar, the only noteworthy difference being the lower percentage of *Cedrus*, and the higher values of Ericaceae in the Portuguese sequence. The continuous presence of *Cedrus*, a

taxon arriving from the Atlas Mountains, in the Portuguese core is a further indication of the wide regional provenance of the pollen recorded in these cores.

Moreover, the pollen analysis of a new marine pollen sequence (Combourieu-Nebout et al., 2002), located westward of MD95-2043 and only 50 km off eastern Gibraltar, provides results that are very similar to those recorded by our two cores. This ocean drilling programme (ODP) sequence, published after the submission of our paper to QSR, and of which Finlayson et al. seem unaware, clearly identifies the Dansgaard-Oeschger millennial scale climatic variability; Heinrich events are characterised by more than 60% of the pollen assemblage from semi-desert vegetation, while interstadials display 30–40% of temperate taxa. Although located further North off the Portuguese coast (40°34'N; 10°20'W), a pollen sequence from a fourth core (Roucoux et al., 2001), MD95-2039, provides results that are comparable to those from southern cores. What is more relevant is that it shows a close similarity to inland mountain pollen diagrams suggesting that relative proportions of arboreal and non-arboreal pollen in the marine spectra can be considered as a reliable index of broad scale vegetation changes. How many vegetation records from marine cores Finlayson et al. would require before accepting that these pollen sequences provide the most reliable, continuous, well dated, and multiproxy-related archives of environmental change available during the last glacial period in Iberia? We hope indeed that these records will help

## MD 95-2043 (Alboran Sea, isotope stage 3)

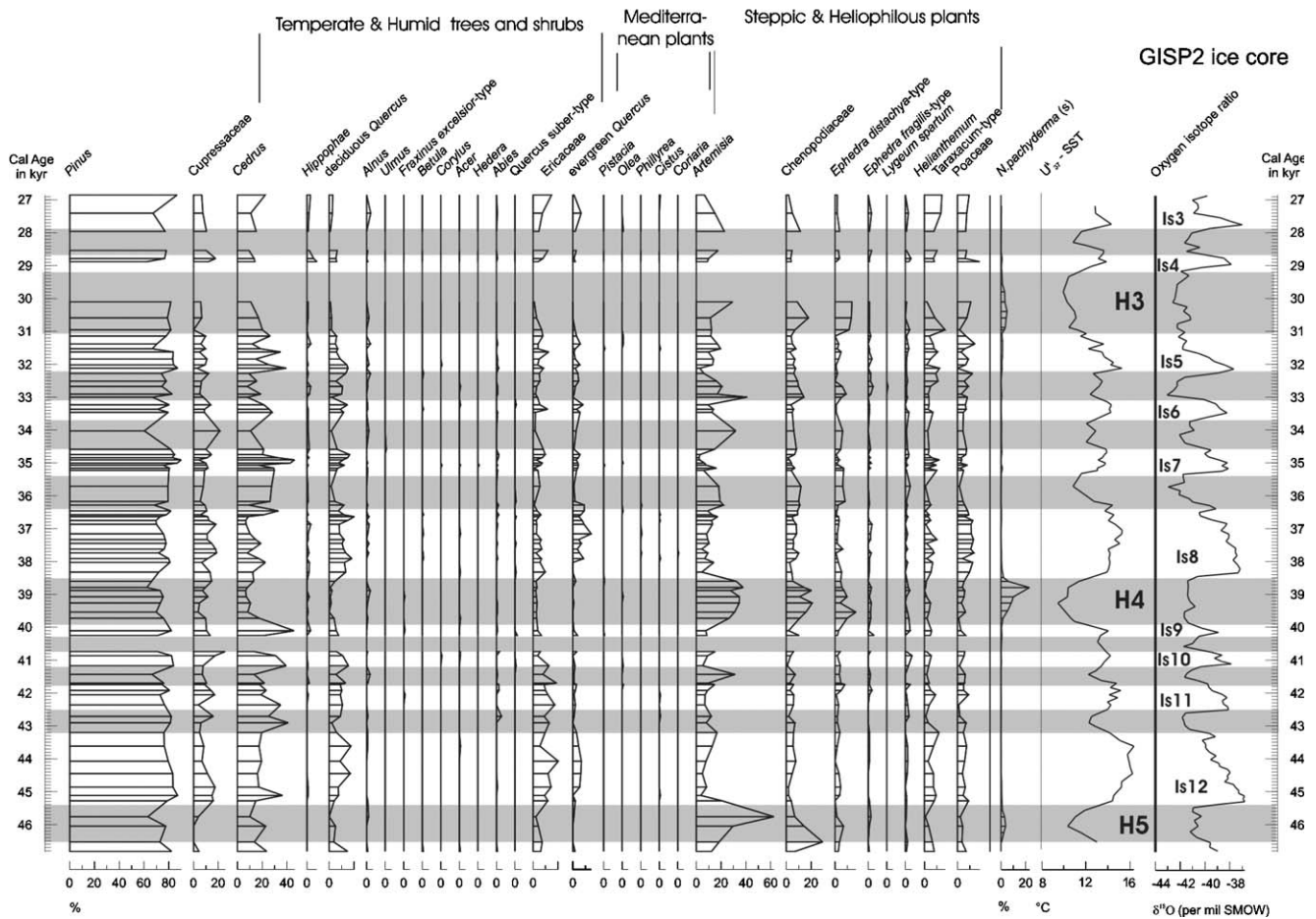


Fig. 2. Pollen percentage diagram with selected taxa, alkenone sea surface temperature and the polar foraminifera *N. pachyderma* (s) percentage curves from the last glacial section of marine core MD95-2043 along with oxygen isotope ratio in GISP2 ice sequence.

them in the future to gain a better understanding of Southern Iberian paleoecology, and paleoecology in general. They should realise, however, that this is already the case for a number of scholars working in this topic.

Unfortunately, while engaged in this blind demolition, they do not seem to realise that the only primary data they apparently have in their hand—the observation that the last Gibraltar Neandertals lived in a period of climatic deterioration—is consistent with our hypothesis that the last of these communities subsisted in Southern Iberia during the H4 event and disappeared at the end of this event or just after it.

Finally, Finlayson et al. give a misleading interpretation of, and at places misquote, what we wrote in our paper about the vegetation characterising the Heinrich events. It was never said that during these cold phases “much of the Mediterranean flora and fauna would have gone”. It is a fact, and not a matter of faith, that pollen spectra contemporaneous with

the Heinrich events are in all of these four cores characterised by high percentages of steppic and semidesert taxa indicative, based on modern pollen rain studies, of arid environments (Prentice et al., 1996; Tarasov et al., 1998). As we have clearly stated (2003, p. 777, 781), thermophilous taxa typical of the Mediterranean flora are also recorded in these cold spectra; their presence reflect refugium zones large enough to ensure species survival and a pollen dispersal detectable at a regional scale. It is precisely the data for the presence and relative proportion of these taxa in the four cores (sampled from key areas and latitudes off Iberia) that, once integrated into a global palaeoclimatic model, will help us reconstruct the features of the ecological mosaic that Finlayson et al. consider crucial for Neandertal adaptation. Discarding these data without an in-depth knowledge of their potential and with the pretext that they do not fit Finlayson et al. expectations will not help to attain this goal.

## 5. Iberian ecology and population density

The formula that Finlayson et al. attribute to us is a manifest misinterpretation of our view and of the model and timing we propose for the substitution process. We show (2003, p. 780 and Fig. 3) that the expansion of Moderns in Western Europe took place during and was probably favoured by the rigorous Heinrich 4 event. This clearly implies that we do not establish any unequivocal link between cold climate and low human population density or, vice versa, between warming and population increase. While constrained by ecological factors such as the available biomass, population density depends on the subsistence strategies peculiar to each human group and their adaptation to a particular environment. We argue that it was precisely the difference in the ecosystems between the North and the South of Iberia within the same cold episode that facilitated the successful spreading of Moderns in the North and prevented them occupying the South of the Iberian Peninsula.

Finlayson et al.'s argument that forest expansion in Southern Iberia was an "important contributory factor to the decrease in human populations" and that this would contradict our model is difficult to understand. Giles Pacheco et al. (2003, p. 4 and Fig. 1), cited by Finlayson et al. to support this idea, attribute the apparent decrease in site density during the Magdalenian (16.5–11 kyr BP) to the expansion of forests. However, the data presented in this work suffer the same drawback we have highlighted for their discussion of the OIS 3 climatic variability. The time span covered by the Magdalenian (ca 16.5–11 kyr BP) does not coincide with the lateglacial development of the southern Iberian forests, as indicated by many paleoecological studies (Pons and Reille, 1988; Carrión, 2002; Combourieu-Nebout et al., 2002; Turon et al., 2003), between 12.5 and 11 kyr BP. Since the Magdalenian encompasses both the rigorous Heinrich 1 event (15–12.5 kyr BP) and the following Bölling–Alleröd interstadial it is erroneous to interpret the overall low density of sites attributed to this period as the consequence of a phenomenon only covering the last third of the development of this culture.

In addition, Finlayson et al. statement that there is no relationship between warming and population density increase is, ironically, contradicted by the paper they cite in which is concluded that all over the Upper Pleistocene "there is a significant increase in site density with increase in temperature" (Giles Pacheco et al., 2003).

In conclusion, we see little in Finlayson et al. comment that increases our knowledge of the factors that may have triggered Neandertal extinction. They rightly point out that there is, so far, no archaeological

evidence of active competition between Moderns and Neandertals. That was known already. The evidence for supporting their claim that Neandertal extinction was due to higher climatic variability characterising the end of the OIS 3 has been shown to be flawed. This period was not more climatically unstable than the first part of this isotopic stage, thus invalidating their hypothesis. They suggest that the disappearance of Neandertals in southern Iberia was favoured by the fragmentation of their environment. However, they supply no evidence to support this view and discard with no apparent reason that made available by a number of well-dated high resolution multi-proxies sequences, including ours, which are providing consistent results and represent one of the best palaeoecological records that we have on the planet for this period.

We are not surprised after displaying such an obsolete vision of the OIS 3 climatic variability, and apparent refusal to examine carefully primary data such as radiocarbon evidence, that Finlayson et al. find it difficult to grasp our argument about the role of climate in Neandertal extinction. Only when one accepts to take into account and discuss the available evidence does it appear that Neandertal retreat and eventual extinction cannot be attributed to a *particular* climatic event within the OIS 3 climatic variability. Contrary to Finlayson et al. claims, we do not discard climate as a factor in this process (2003: 781, 784) but believe that climatically driven environmental changes conditioned the timing of the substitution process at a regional scale. We also supply data and a tentative ecological model of how this may have happened. Finlayson's proposition that the "fragmentation" of Neandertal environments should be seen as responsible for this extinction in Southern Iberia is in our view not in opposition with our model but rather complements it. The question is how and with what data are these authors going to test this hypothesis.

We see from this point of view a remarkable difference in our respective epistemological stands. They believe that research on this topic should only "understand the large scale processes that affected the dynamics of the various human populations that inhabited Eurasia" and that it is illusory to try and go further. We believe instead that to progress in this field we need explicit scenarios that we may test against high quality palaeoclimatic and archaeological data.

## References

- Berger, A., Mélice, J.L., Hinnov, L., 1991. A strategy for frequency spectra of Quaternary climate records. *Climate Dynamics* 5, 227–240.

- Bond, G., Broecker, W., Johnsen, S., McManus, J., Labeyrie, L., Jouzel, J., Bonani, G., 1993. Correlations between climate records from North Atlantic sediments and Greenland ice. *Nature* 365, 143–147.
- Bond, G., Showers, W., Cheseby, M., Lotti, R., Almasi, P., deMenocal, P., Priore, P., Cullen, H., Hajdas, I., Bonani, G., 1997. A pervasive millennial-scale cycle in North Atlantic Holocene and Glacial Climates. *Science* 278, 1257–1266.
- Burmeister, S., 2000. Archaeology and migration. *Current Anthropology* 41, 539–567.
- Carrión, J.S., 2002. Patterns and processes of Late Quaternary environmental change in a montane region of southwestern Europe. *Quaternary Science Reviews* 21, 2047–2066.
- Chmura, G.L., Smirnov, A., Campbell, I.D., 1999. Pollen transport through distributaries and depositional patterns in coastal waters. *Palaeogeography, Palaeoclimatology, Palaeoecology* 149, 257–270.
- Combourieu-Nebout, N., Turon, J.-L., Zahn, R., Capotondi, L., Londeix, L., Pahncke, K., 2002. Enhanced aridity and atmospheric high-pressure stability over the western Mediterranean during the North Atlantic cold events of the past 50 ky. *Geology* 30, 863–866.
- Cortijo, E., Yiou, P., Labeyrie, L., Cremer, M., 1995. Sedimentary record of rapid climatic variability in the North Atlantic Ocean during the last glacial cycle. *Paleoceanography* 10, 911–926.
- Dansgaard, W., Johnsen, S.J., Clausen, H.B., Dahl-Jensen, D., Gundestrup, N.S., Hammer, C.U., Hvidberg, C.S., Steffensen, J.P., Sveinbjörnsdóttir, A.E., Jouzel, J., Bond, G., 1993. Evidence for general instability of past climate from a 250-kyr ice-core record. *Nature* 364, 218–220.
- d'Errico, F., 2003. The invisible frontier. A multiple species model for the origin of behavioral modernity. *Evolutionary Anthropology* 12, 188–202.
- d'Errico, F., Zilhão, J., Baffier, D., Julien, M., Pelegrin, J., 1998. Neandertal acculturation in western Europe? A critical review of the evidence and its interpretation. *Current Anthropology* 39, S1–S44.
- Dupont, L.M., Wyputta, U., 2003. Reconstructing pathways of aeolian pollen transport to the marine sediments along the coastline of SW Africa. *Quaternary Science Reviews* 22, 157–174.
- Elliot, M., Labeyrie, L., Bond, G., Cortijo, E., Turon, J.-L., Tisnerat, N., Duplessy, J.-C., 1998. Millennial-scale iceberg discharges in the Irminger Basin during the last glacial period: relationship with the Heinrich Events and environmental settings. *Paleoceanography* 13, 433–446.
- Finlayson, C., 2003. The role of climate in the spatio-temporal pattern of human colonization and extinction in the Pleistocene with specific reference to the Mediterranean Region. In: Ruiz Zapata, M.B., Dorado Valiño, M., Valdeolillos Rodríguez, A., Gil García, M.J., Bardaji Azcarate, T., Bustamante Gutiérrez, I., Martínez Mendizabal, I. (Eds.), *Quaternary Climatic Changes and Environmental Crises in the Mediterranean Region*. Universidad de Alcalá-MCYT-INQUA, Alcalá de Henares, pp. 57–66.
- Giles Pacheco, F., Finlayson, C., Santiago Pérez, A., Fa, D., Gutiérrez Lopez, J.M., Finlayson, G., 2003. The effect of climate change on the distribution of humans in southern Iberia in the Late Quaternary. In: Ruiz Zapata, M.B., Dorado Valiño, M., Valdeolillos Rodríguez, A., Gil García, M.J., Bardaji Azcarate, T., Bustamante Gutiérrez, I., Martínez Mendizabal, I. (Eds.), *Quaternary Climatic Changes and Environmental Crises in the Mediterranean Region*. Universidad de Alcalá-MCYT-INQUA, Alcalá de Henares, pp. 67–80.
- Grootes, P.M., Stuiver, M., White, J.W.C., Johnsen, S., Jouzel, J., 1993. Comparison of oxygen isotope records from the GISP2 and GRIP Greenland ice cores. *Nature* 366, 552–554.
- Hayden, B., 2000. On territoriality and sedentism. *Current Anthropology* 41, 109–112.
- Heusser, L., 1988. Pollen distribution in marine sediments on the continental margin off northern California. *Marine Geology* 80, 131–147.
- Hooghiemstra, H., Agwu, C.O.C., Beug, H.-J., 1986. Pollen and spore distribution in recent marine sediments: a record of NW-African seasonal wind patterns and vegetation belts. *Meteor Forschungs-Ergebnisse C* 40, 87–135.
- Johnsen, S.J., Clausen, H.B., Dansgaard, W., Fuhrer, K., Gundestrup, N., Hammer, C.U., Iversen, P., Jouzel, J., Stauffer, B., Steffensen, J.P., 1992. Irregular glacial interstadials in a new Greenland ice core. *Nature* 359, 311–313.
- Lee, R.B., DeVore, I., 1968. *Man the Hunter*. Aldine-Atherton, Chicago.
- Pons, A., Reille, M., 1988. The Holocene and Upper Pleistocene pollen record from Padul (Granada, Spain): a new study. *Palaeogeography, Palaeoclimatology, Palaeoecology* 66, 243–263.
- Prentice, I.C., Guiot, J., Huntley, B., Jolly, D., Cheddadi, R., 1996. Reconstructing biomes from palaeoecological data: a general method and its application to European pollen data at 0 and 6 ka. *Climate Dynamics* 12, 185–194.
- Price, T.D., Brown, J., 1985. *Prehistoric Hunter-Gatherers: the Emergence of Cultural Complexity*. Academic Press, New York.
- Read, D.W., LeBlanc, S.A., 2003. Population growth, carrying capacity, and conflict. *Current Anthropology* 44, 59–85.
- Roucoux, K.H., Shackleton, N.J., de Abreu, L., Schönfeld, J., Tzedakis, P.C., 2001. Combined marine proxy and pollen analyses reveal rapid Iberian vegetation response to North Atlantic millennial-scale climate oscillations. *Quaternary Research* 56, 128–132.
- Ruddiman, W.F., McIntyre, A., Raymo, M., 1986. Palaeoenvironmental results from North Atlantic Sites 607 and 609. *Initial Reports of the Deep-Sea Drilling Project* 94, 855–878.
- Sánchez Goñi, M.F., Eynaud, F., Turon, J.-L., Gendreau, S., 2000. European climatic response to millennial-scale climatic changes in the atmosphere-ocean system during the Last Glacial period. *Quaternary Research* 54, 394–403.
- Sánchez Goñi, M.F., Cacho, I., Turon, J.-L., Guiot, J., Sierro, F.J., Peyrouquet, J.-P., Grimalt, J.O., Shackleton, N.J., 2002. Synchronicity between marine and terrestrial responses to millennial scale climatic variability during the last glacial period in the Mediterranean region. *Climate Dynamics* 19, 95–105.
- Smith Eric, A., Winterhalder Boone, J.L., 1992. *Evolutionary Ecology and Human Behavior*. Aldine de Gruyter, New York.
- Tarasov, P.E., Cheddadi, R., Guiot, J., Bottema, J., Peyron, O., Belmonte, J., Ruiz-Sanchez, V., Saasi, F., Brewer, S., 1998. A method to determine warm and cool steppe biomes from pollen data; application to the Mediterranean and Kazakhstan regions. *Journal of Quaternary Science* 13, 335–344.
- Testart, A., 1982. The significance of food storage among hunter-gatherers: residence patterns, population densities, and social inequalities. *Current Anthropology* 23, 523–537.
- Turon, J.-L., 1984. Le palynoplancton dans l'environnement actuel de l'Atlantique nord-oriental. *Evolution climatique et hydrologique depuis le dernier maximum glaciaire*. Mémoires de l'Institut de Géologie du bassin d'Aquitaine, Bordeaux.
- Turon, J.-L., Lézine, A.-M., Denèfle, M., 2003. Land-sea correlations for the last glaciation inferred from a pollen and dinocyst record from the Portuguese margin. *Quaternary Research* 59, 88–96.
- Yiou, P., Baert, E., Loutre, M.F., 1996. Spectral analysis of climate data. *Survey in Geophysics* 17, 619–663.

- Zilhão, J., d'Errico, F., 1999. The chronology and taphonomy of the earliest Aurignacian and its implications for the understanding of Neandertal extinction. *Journal of World Prehistory* 13, 1–68.
- Zilhão, J., d'Errico, F., 2000. La nouvelle bataille aurignacienne. Une révision critique de la chronologie du Châtelperronien et de l'Aurignacien ancien. *L'Anthropologie* 104, 17–50.
- Zilhão, J., d'Errico, F., 2003. The chronology of the Aurignacian, Transitional technocomplexes. Where do we stand? In: Zilhão, J., d'Errico, F., (Eds.), *The Chronology of the Aurignacian and of the Transitional Technocomplexes. Dating, Stratigraphies, Cultural Implications*. Instituto Português de Arqueologia, Lisbon, pp. 313–349.

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