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Introduction

The coastal shelf of the Mediterranean and beyond: Corridor and refugium for human populations in the Pleistocene

1. Introduction

This volume is about the importance of the coastal zone in human evolution and the wide range of disciplinary perspectives and sources of evidence that are now being brought to bear on this issue. A proximate stimulus is the recent demonstration that Neanderthal populations survived in Gibraltar several thousand years later than elsewhere in Europe (Finlayson et al., 2006), a fact that prompts investigation of underlying causes, with particular emphasis on the distinctive environmental history of a coastal region that lies on the boundary between Africa and Europe, and between the Mediterranean and the Atlantic. New studies on the Gibraltar Caves also coincide with renewed interest in other parts of the world in the role of coastal environments in human evolution and dispersal, a growing realisation that they have been neglected or discounted in existing accounts, not least because most of the relevant evidence (~90% in Pleistocene times) is now submerged on the sea bed, and a recognition that coastal environments may have acted both as important population refugia and as primary corridors of population dispersal between and within continents.

Accordingly, the papers in this special issue take a thematic approach, focussing on four specific issues: the enhanced biodiversity associated with coastal regions; the Pleistocene use of marine resources and the ecological and geological factors that affect interpretation of the coastal archaeological record; sea crossings and associated problems of inference; and wider patterns of human evolution and dispersal in coastal environments. The majority of papers deal with different aspects of the evidence from Southwest Iberia and the Western Mediterranean as a primary case study, but others extend more widely, bringing in evidence from other parts of the world to broaden the comparative perspective.

2. Scientific background and rationale

After a long period of neglect throughout most of the 20th century, the role of coastal environments and resources in patterns of human evolution and dispersal has acquired new prominence within the past decade, especially in relation to the dispersal of Anatomically Modern Humans. For some, coastal adaptations involving greater reliance on marine resources and seafaring abilities are seen as a critical factor that gave a new competitive edge to Modern Humans (Klein, 1999; Stringer, 2000; Walter et al., 2000; Oppenheimer, 2003). For others, coastlines have a much deeper history of human significance, but one that has been obscured by differential destruction of evidence with sea-level change and by a variety of ethnographic and cultural preconceptions that have tended to treat coastal environments and marine resources as marginal even during the final stages of the Pleistocene and the early Holocene (Erlandson, 2001; Bailey and Milner, 2002; Bailey, 2004; Erlandson and Fitzpatrick, 2006). In any case, new ideas and new research findings are putting the spotlight on coastal environments as corridors of population movement and as potential refugia during periods of increased climatic stress.

The coast is the ecotone between land and sea. It is a super-ecotone where a rich mosaic of habitats and organisms coexists over small distances. Greater diversity and productivity of terrestrial resources, the addition of marine and avian resources in the terrestrial–marine contact zone, and improved water supplies are just some of the advantages frequently highlighted. The width of this zone is highly variable depending on regional and local circumstances, extending far inland in terms of oceanic climatic influences, confined to the immediate shore for many aquatic resources, and extending seawards for some others, as the case may be. The boundary between coast and hinterland is rarely a sharp one and we do not take a prescriptive view here about the definition of what constitutes the 'coastal' zone or how it should be studied. Nor do we suppose that the concept of a coastal adaptation necessarily presupposes an emphasis on marine resources. Each case has to be looked at in its own particular geographical and ecological settings.

Recent discussion has focussed on new evidence from southern Africa and the Red Sea Basin, stimulated by DNA modelling that appears to support a rapid dispersal of Modern Humans out of Africa through the 'southern corridor' (Lahr and Foley, 1994) – across the southern end of the Red Sea and around the rim of the Indian Ocean – fuelled by sea crossings and exploitation of marine resources (Walter et al., 2000; Beyin, 2006; Mellars, 2006; Bailey et al., 2007; Bulbeck, 2007; Marean et al., 2007; Petraglia and Rose, 2008). Indeed this idea has exercised such a powerful hold on both the scientific and popular imaginations (e.g. Stix, 2008) that it is threatening to become a new orthodoxy, obscuring the need to place human dispersal into a wider biogeographical, palaeogeographical, palaeoecological and evolutionary framework.

A focus on Southwest Europe and the southern Iberian Peninsula, where Africa meets Europe across the Strait of Gibraltar, offers a useful comparison and contrast with the sub-Saharan and Arabian evidence. Here, oceanic conditions have produced consistently milder climates than elsewhere in mainland Europe. In addition, sea currents created more productive conditions for marine resources along Atlantic shorelines during the Last Glacial cycle

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than in the Mediterranean, and more accessible shorelines than in Northwest Europe. This region is at similar latitude and in a similar geographic setting to Southwest Africa, and appears to have been an equally favourable region for human settlement during the Pleistocene.

Also, there are long cave sequences with archaeological evidence and human fossils, either newly discovered, or older sites that are now undergoing new investigations, most famously on the Rock of Gibraltar, where the extinction of the last populations of Neanderthals was played out, and which may have acted as a 'refuge within a refuge' (Finlayson, 2004; Finlayson et al., 2006; Finlayson and Carrión, 2007). A growing body of evidence for changes in physical landscapes, palaeoenvironments and palaeoclimates is also now available in this region from a variety of terrestrial and offshore records, informed in the case of plant and animal histories by new phylogenetic studies, to place the archaeological evidence in wider perspective.

3. Biodiversity

Biodiversity, and its vulnerability to climate change and human impact, is as much an issue in understanding past human survival (cf. Rick and Erlandson, 2008) as it is in the modern world, where fears about global warming and the destructive impact of industrial development have made this a hot topic of current debate. Whether we are concerned with past or present biodiversity, a key to understanding is the long-term perspective supplied by Quaternary records, which can identify patterns of long-term resilience by unravelling the complex interplay between climate changes, human impact, ecological tolerances, and evolutionary patterns of dispersal and extinction. A wide range of ecological and genetic studies of plants demonstrates the distinctiveness of the southwesternmost part of the Iberian Peninsula (Rodríguez-Sánchez et al., 2008). Here, the typical Mediterranean vegetation of sclerophyll forests and shrublands is greatly diversified and enriched by a high degree of endemism and by Tertiary relicts that have survived in moist, riverine locations, unscathed by the cycle of Quaternary glaciations.

This is extended back into the Pleistocene with pollen records from lacustrine, cave and deep-sea sediments, pollen from the coprolite remains of carnivores, and plant macrofossils (Carrión et al., 2008). Such a combination of different sources of information provides a sensitive measure of local and regional patterning and demonstrates that patches of trees persisted throughout the Last Glacial maximum in many parts of the Iberian Peninsula. In the south a unique range of species including many warmth-loving ones persisted as a mosaic of vegetation types comprising dry, moist, forested and open biotopes in a coastal zone extending for several hundred kilometres around the southern rim of the Peninsula. This has clear implications for human settlement in the region.

Similar trends are apparent in the faunal record, indicating refugial conditions for many species, though the 'cold mammal fauna' of northern Europe such as reindeer and woolly rhinoceros never reached the south of the Iberian Peninsula, easily traversing the barrier posed by the Pyrenees, but apparently unable to move into environments with summer drought conditions further south (O'Regan, 2008).

Modern studies in the Doñana National Park on the coast in Southwest Spain provide some insight into specific conditions of resource availability in a coastal setting, and the limitations and opportunities afforded by seasonal and inter-annual variability in an environment that has been sufficiently well protected from the pressure of modern development to provide a useful analogy for prehistoric conditions (Finlayson and Finlayson, 2008). Detailed surveys of vegetation, mammals, birds, and standing water provide a picture of an environment rich in resources but one subject to significant unpredictability in the timing of resource availability, and one in which water supplies rather than food would have been the main limiting factor on human settlement and movement.

4. Marine resources and coastal environments

One of the important advantages of living in the coastal zone is access to marine resources. Intertidal molluscs, sea mammals and aquatic and migratory birds all provide potentially rich sources of energy and protein that can be easily collected or scavenged with minimal technical equipment. These resources have often been underplayed in the Pleistocene or seen as the exclusive reserve of Modern Humans. However, during the lower sea levels that prevailed throughout most of the glacial cycle the food remains of these resources are now mostly lost to view. Geological evidence for relative sea-level changes and local crustal movements is critical to an assessment of the ways in which the archaeological record has been biased and the likelihood that remains will be preserved above modern sea level (Bailey and Flemming, 2008; Gracia et al., 2008). Gaps in the record increasingly point to the need for underwater exploration of submerged shorelines, and a growing body of evidence shows that archaeological sites can be preserved and discovered on submerged landscapes.

Systematic exploration of the submerged landscapes of the continental shelf has scarcely begun, but in the absence of such work, coastlines where the continental shelf is unusually narrow, with limited seaward displacement of the Pleistocene shoreline even at the maximum regression, provide the next best window into early patterns of marine resource-use. In this respect southern Iberia is unusually well provided with narrow shelves $\leq$5 km in width, and long archaeological sequences in adjacent coastal caves, in Gibraltar, at Gorham's and Vanguard Cave (Fa, 2008), at Nerja Cave in Spain (Cortés-Sánchez et al., 2008), and at Vale Boi amongst other sites in Portugal (Bicho and Haws, 2008). These sites show clear evidence for marine resource-use during periods of lower sea level, and by Neanderthals as well as Modern Humans. On Gibraltar there is little discernible difference in the marine signal between Mousterian and Upper Palaeolithic levels to suggest differing levels of human impact on intertidal molluscs (Fa, 2008). However, the interpretation of such sequences is complicated by many interweaving variables.

Changes in the distance between an archaeological deposit and the nearest shoreline with changes in sea level can introduce significant variations in the quantity and type of food remains visible in different levels of an archaeological deposit (Bailey and Flemming, 2008). Changes in the resources available and their productivity can also occur because of changes in shoreline ecology, climate or ocean currents. This is a potent factor on the Atlantic coastlines of Southwest Spain and Portugal, where the upwelling currents that charge inshore waters with a rich supply of nutrients have waxed and waned in broad synchrony with the glacial–interglacial cycle (Bicho and Haws, 2008). Spatial variations in ecological productivity can have an equally powerful effect. The difference in tidal amplitude between Mediterranean and Atlantic coastlines has a major demonstrable impact on the abundance and reliability of intertidal molluscs, with potentially far-reaching ecological effects on human settlement and dispersal as well as more obvious implications for the numbers of mollusc shells likely to be preserved in archaeological deposits (Fa, 2008).

Fish are potentially a more technically demanding resource, which usually (though not universally so) require hooks, lines, or nets if they are to be caught in abundance. In this respect, the large assemblages of fish bones recovered from Nerja Cave in Solutrean levels dating from about 24,000 cal BP onwards are of particular interest, being the earliest example of substantial fishing activity

in a coastal context in Europe or the Mediterranean (Cortés-Sánchez et al., 2008). The visibility of fish remains in cave deposits at this period is no doubt due in part to the narrowness of the adjacent shelf, as is true for other early evidence of fishing (Bailey and Flemming, 2008). At Nerja, however, the fish assemblages appear at a time when the seacoast would have been at its maximum distance from the cave, and there are no precedents for similar material in earlier deposits in the sequence. This does look like a genuine case of intensification, rather than a response to climatic or ecological changes, perhaps associated with the development of new technical skills. However, interpretation of cave sequences is complicated by many other confounding variables that can operate independently of changes in human behaviour, such as change in site function within a wider settlement system, or differential preservation resulting from varying rates of sediment accumulation, and Cortés-Sánchez et al. (2008) are suitably cautious in their assessment.

We should, of course, beware of supposing that the appearance of abundant food remains of marine resources denotes the appearance of specialised marine economies. In the Pleistocene context, as indeed in later periods, obligate fishermen and beachcombers were probably unknown, and marine resources were most likely combined with collection of plant foods and hunting of mammals – and birds – on land, although the proportions no doubt varied widely according to ecological circumstances. Marine foods are not the only attraction of coastal environments. In addition to the ecotonally generated biodiversity often found there, emerged coastal regions during periods of lower sea level may have acted as oases, with greatly increased spring activity (Faure et al., 2002), and consequent impacts on the distribution of water supplies and a wide range of potential food resources.

5. Sea crossings

Another hot topic in the wider archaeological literature is the origins of seafaring (Anderson et al., in press). What evidence do we have for early sea crossings across the Strait of Gibraltar? The channel is narrow, no more than ca 11 km, the opposite shores are easily visible from each other, and there are many cases of people successfully swimming across the channel today (Flemming, pers. comm., 2004). Lowered sea levels had little impact on the width of the crossing but would have extended the length of the channel and exposed a series of low islands as potential stepping stones to the west of the present opening. However, Gracia et al. (2008) caution against making too much of such palaeogeographical reconstructions, without taking account of local crustal movements that would have moderated relative sea-level change in some of the relevant areas.

Genetic and phylogeographic studies of the flora (Rodríguez-Sánchez et al., 2008) and fauna (O'Regan, 2008) of the region provide some interesting insights into this issue, although vectors of dispersal and ecological barriers are clearly highly variable as between different taxonomic groups. A number of claims have been made for Pleistocene sea crossings by land mammals, which provide the closest proxy for human movement, but as O'Regan (2008) shows, none of these cases are decisive because the presence of similar species on opposite shores of the Strait could equally well be explained by dispersal around both shores of the Mediterranean from a common source of origin in the Near East. Equally, similarities of stone tools can be explained by diffusion from a common origin in the Near East or by technical convergence, rather than by direct contacts across the Strait (Ramos et al., 2008).

We are at present hampered in pursuing this issue further by the imbalance of research between European and African shores, with a longer history of research and many new investigations on the European side, but fewer on the African side (but note Barton et al., 2001). In this respect, the Benzú rockshelter in Ceuta, on the shoreline directly opposite Gibraltar, offers some promise for the future (Ramos et al., 2008). Here the sequence extends from 250 ka to 70 ka, and techniques are being developed to highlight possible links across the Strait. A convincing 'smoking gun' for direct contacts would be evidence of conjoining flakes of worked stone found on opposite shores, or artefacts made of raw materials that could be sourced to the opposite shoreline, or stylistic similarities of stone-tool working that could not be explained by technological convergence. Such patterns are likely to require subtle and sophisticated techniques of analysis, and these are being developed for the Benzú material, though work is still only at the preliminary stage. Even if such evidence is not eventually forthcoming, new work on the African side will provide much needed comparative data on the role of the coastal zone. For the time being, all that can be said about Pleistocene crossings of the Gibraltar Strait is that the evidence from all currently available sources fails to provide decisive support or refutation.

6. Evolution and dispersal

The coastal strip has been proposed as a corridor that opened up expansion routes for Modern Humans out of Africa, and a case can be made for a significant coastal element in all the subsequent major extensions of the human habitat, into Australia and New Guinea, into the Americas, and into the high latitudes of the northern hemisphere. Erlandson et al. (2008) give a clear overview of the evidence now available in support of a coastal colonization of the Americas, as well as some of the remaining difficulties of interpretation, including the major difficulty shared in common with all earlier cases for coastal dispersal that much of the relevant evidence needed to provide a decisive resolution of existing uncertainties lies buried on the submerged shelf.

Little has been made of the coastal factor in the earliest entry of humans into Europe, perhaps because the Mediterranean is a relatively closed basin whose shores can easily be approached by land from any direction, and where Pleistocene sea crossings are neither necessary nor supported by current evidence. Yet, a coastal strip of varying extent would have been exposed around the rim of the Mediterranean throughout long periods of the Pleistocene, offering potential attractions for settlement and dispersal, and buffers against the rigours of continental climate.

A pan-European review of Neanderthal distributions shows the importance of coastal regions (Finlayson, 2008), and a pattern of progressive Neanderthal extinction that followed a clear continental to oceanic gradient. In the Levant it is clear that the coastal zone provided a belt of Mediterranean vegetation that allowed the survival of human populations against the encroaching desert (Shea, 2008). In Europe, the Southwest was the most buffered against the ravages of the continental glaciations. Even so the advantages of these coastal regions were not sufficient to fully protect their inhabitants against the most severe climatic conditions. The Neanderthals eventually succumbed in southern Iberia at 28 ka (Finlayson et al., 2006), and two local extinction events took place in the Levant, of early Modern Humans at 75 ka and of Neanderthals at 45 ka, both periods associated with pulses of extreme aridity (Shea, 2008).

The implication of these extinction events is that either the advantages of the coastal zone were not sufficient to buffer against episodes of extreme climate, or that the favoured refugia contracted to an area too small to support viable populations. When conditions improved again the previously vacated territory was re-occupied by new human populations. That the replacement populations had different biological or behavioural characteristics from their predecessors may be quite irrelevant to the underlying processes of species turnover, and does not require us to assume competitive interactions in which one human species triumphed

over the other because of superior adaptive powers (Finlayson, 2004; Shea, 2008).

7. Conclusion

Much of the debate about Pleistocene patterns of human evolution has become mired in disputes about the taxonomic status of a meagre fossil record, or about the relative cognitive and behavioural abilities of different hominin species. DNA techniques have introduced a new dimension to interpretation of dispersal patterns, but provide, at best, models in need of testing against other sources of evidence. The papers in this volume take as axiomatic the need for an approach rooted in principles of behavioural ecology and examined in the context of a richly diverse and variable record of Quaternary environmental, geological and climatic change. Comparative studies incorporating these principles are needed across the widest possible temporal and geographical range if existing debates are to be moved forward.

The coastal zone offers a powerful focus for such a study. As its role and importance in patterns of evolution and dispersal become increasingly apparent, so new questions are beginning to emerge and new challenges to methods of investigation. Many areas of coast that were emerged for much of the Pleistocene are now submerged. What difference did that extended coastal zone make to human survival under different climatic circumstances, how far did it facilitate long-distance contact and biological and cultural integration, and what was the impact when this additional increment of land was removed by sea-level rise? These are difficult questions to answer with the data currently available because the answers will require new evidence and investigation of more subtle patterns to unravel the complex interplay between local ecological circumstances, sea-level change and climatic cycles. And much of that evidence will have to be sought through underwater archaeological and palaeoenvironmental research in strategic areas, using the widest possible combination and integration of Quaternary disciplines, techniques and sources of evidence.

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