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The Mesolithic-Neolithic in the Alentejo: archaeological investigations, 1984-1986

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ABSTRACT

From 1984 through 1989, we undertook a program of interdisciplinary research on the "Archaeology and Human Biology of the Mesolithic--Neolithic Transition in Portugal", funded by the Social Sciences and Humanities Research Council of Canada (SSHRC). Some of the work done on human skeletal collections has been published (e.g., Jackes and Lubell, 1999; Lubell *et al.*, 1994). There has been only limited publication of the archaeological investigations conducted in the Alentejo at Medo Tojeiro, Samouqueira and Fiais (Hancock *et al*., 1989; Lubell & Jackes, 1988). A summary report on the 1984 excavations of the shell midden at Medo Tojeiro was published by Silva *et al*. (1985) based largely on their translation of a slightly abridged version of the full report we submitted to SSHRC. Because this publication did not include full data on fauna, raw material sourcing, stratigraphy and radiocarbon dates, it has been a source of both confusion and criticism (e.g., Zilhão, 1998). To our knowledge, a report on the excavations at Samouqueira has never been published. This paper will attempt to rectify some of these problems. The 1986 excavations of the Mesolithic bone bed at Fiais have not been published, although there have been preliminary reports by González Morales and Arnaud (1990), and Arnaud (1994). We will present here data from the taphonomic and faunal analyses, that are essential to an accurate interpretation of this unique European site.

KEYWORDS

Mesolithic; Neolithic; transition; Southern Portugal; Alentejo

INTRODUCTION

From 1984 to 1989, we were members of a project called "Archaeology and Human Biology of the Mesolithic-Neolithic transition in Portugal". Our goal was to understand early Holocene palaeodemography and subsistence ecology and included two related investigations: (a) study of previously excavated Mesolithic and Neolithic human skeletal collections from Muge and elsewhere in Portugal, and (b) interdisciplinary excavation and analysis of transitional sites in the Alentejo and Estremadura. The first has been dealt with in numerous publications (Bamforth *et al*., 2003; Jackes, 1988, 1992; Jackes and Lubell, 1988, 1992, 1996, 1999a, 1999; Jackes *et al*., 1997a, 1997b, 2001a, 2001b; Jackes and Meiklejohn, 2004; Lubell *et al*., 1986, 1994; Meiklejohn and Schentag, 1988; Meiklejohn and Zvelebil, 1991; Meiklejohn *et al*., 1986, 1988, 1992; Straus *et al*., 1988) and more are forthcoming. Here we will discuss only a part of the second aspect, the archaeological investigations undertaken in 1984-86 at three sites in the Alentejo: Medo Tojeiro, Samouqueira and Fiais (Fig. 1). These have been published previously only in summary form or not at all (Arnaud, 1994; Gonzáles Morales and Arnaud, 1990; Hancock *et al*., 1989; Lubell, 1984; Lubell and Jackes, 1985, 1988; Lubell *et al*., 1989; Silva *et al*., 1985). We will not discuss our 1986 research in the Estremadura (Zilhão and Lubell, 1987a, 1987b), which included tests at Toledo, subsequently investigated more thoroughly and published by Araújo (1998).

MEDO TOJEIRO

Medo Tojeiro was first described by Zbyszewski and Penalva (1979), who emphasized the presence of a macrolithic industry they thought dated to the Palaeolithic and which occurred in a cuvette within the dunes that form the main substrate of the site. They also mentioned the presence of a shell midden, possibly dating to the Neolithic. Lubell examined Medo Tojeiro in 1983[1] and collected a sample of *Mytilus* shell from the exposed face of the shell midden which was dated by the British Museum.

In 1984, we returned and excavated the site in collaboration with C. Tavares da Silva, J. Soares and C. Penalva. We concentrated our work on the remnant of shell midden located about 30 m ASL, and also excavated several of the small stone mounds in the blowout behind the midden that had been of paramount interest to Zbyszewski and Penalva.

The excavation used a grid system of 20 m^2 sectors oriented on a N-S axis with N-S rows numbered 1 to 20 from the SW corner of each sector and E-W rows labelled A to T starting at the NW corner of each sector. The excavation of the shell midden was limited to an area 2 m by 5 m in Sector 3, squares S1 to S5 and T1 to T5. We also mapped the blowout in the dunes behind the midden and plotted the location of four "mounds" and three "scatters" of greywacke – all relatively small, on the order of approximately 1 m diameter. The mounds were later sectioned and samples of greywacke taken for thermoluminescence (TL) and instrumental neutron activation analysis (INAA)[2].

Our excavations in the midden identified six strata, labelled as Couche 1 (C.1) at the top to Couche 6 (C.6) at the base. The very sparse artefact assemblage consisted of a few stone artefacts and ceramic fragments from the surface of C.1 that were assigned by Tavares da Silva to the Early Neolithic, and a small number of microlithic and macrolithic pieces more characteristic of the Mesolithic that were found scattered throughout the deposits. A preliminary report on some of these archaeological results, including a drawing of the main profile of the excavated area of the midden, was published by Silva *et al*. (1985). We will not reiterate what is in that report[3].

However, the radiocarbon chronology of the site requires discussion. Two samples from C.4 were analyzed. The first, *Mytilus* shell collected in 1983, was dated by the BMNH (BM 2275), but the date published in Silva *et al*. (1985: 13) is inaccurate. BM 2275 was subsequently declared incorrect due to internal laboratory errors and was re-evaluated. The correct result of 6820 ± 140 bp (BM 2275R) was published in *Radiocarbon* 32 (Bowman *et al*., 1990: 78). When this is calibrated the best estimate for the mean date is ca. 7070 calBP which is consistent with a Mesolithic age (Table 1).

The second sample consisted of six grams of charcoal collected from the base of C.4 and associated with a hearth. The result (Table 1) was reported correctly by Silva *et al*. (1985: 15) who rejected it as too young. The best estimate for the mean date of this sample (Beta 11723) is ca. 6200 calBP, consistent with an Early Neolithic age.

A third charcoal sample, from C.1, was also submitted to Beta Analytic but was too small to produce a reliable result.

The difference between the results obtained for BM 2275R and Beta 11723 is highly significant and, on present evidence, impossible to resolve. Because the sample of *Mytilus* shell collected in 1983 came from the exposed western face of the midden, we are unable to place it with absolute certainty in C.4. However, detailed examination of the site during excavation, and the original field drawing of the profile published by Silva *et al*. (1985: Fig. 3), seems to us consistent with the hypothesis that both samples came from the same stratigraphic horizon. Nonetheless, we cannot exclude other errors in the shell date, nor can we eliminate either the possibility of the old wood effect for the charcoal date or unobserved post-depositional disturbance.

The concentrations of greywacke in the dune cuvette were interpreted by Zbyszewski and Penalva (1979) as the remains of knapping stations that they attributed to the Mirensian facies of the Languedocian. Excavation and detailed examination of several of these concentrations suggests to us that they are more correctly interpreted as hearths, possibly contemporaneous with the shell midden. Sheppard used TL to analyze a number of samples of greywacke from both archaeological and non-archaeological contexts and found statistically significant differences. When the geological material was annealed, it produced a glow curve similar to the archaeological samples, suggesting the latter had been heated to between 350°C and 450°C, consistent with our field interpretation of these features as hearths. INAA of both archaeological and non-archaeological samples found them to have similar chemical composition.

The Medo Tojeiro faunal assemblage was composed exclusively of marine molluscs. The data on shellfish species are based on systematic excavation and sampling procedures. A 1-litre sample of matrix was removed from each excavation unit (initially from each 5 cm spit and, once the limits of the couches were defined, from each couche in each 1 metre square) and wet-sieved with seawater through

[1] In company with C. Devereux a geomorphologist working in the region (Devereux, 1982, 1983) and who submitted the sample for dating to the BMNH, C. Meiklejohn, C. Penalva, C. Tavares da Silva and J. Soares.

[2] At the close of the field season, originals of all field maps and plans were deposited with J. Soares and C. Tavares da Silva at the Museu de Arqueologia e Etnografia de Setúbal. Photocopies were made, but those available for this paper were insufficient and of too poor quality to construct an accurate map of the excavation areas at the site. The data on all surveyed points are in our field note books.

[3] Much of the article by Silva *et al.* is a translation of portions of the interim report on Research Operating Grant 410-84-0030 for the period 30 May 1984 to 31 January 1985 submitted to the Social Sciences and Humanities Research Council and sent as a courtesy to our Portuguese colleagues. We were never asked if this internal report could be translated and published, nor were we shown proofs prior to publication. Had this been done, confusion might have been avoided. The confusion was caused by the fact that in that report, we gave a preliminary rather than a final age for the sample. The final result for BM 2275 of 6570 ± 120 bp (now superseded by BM 2275R) was not reported to Devereux by the BMNH until 6.03.1987.

1.5 mm mesh. The fraction < 1.5 mm was discarded. The fraction > 1.5 mm was air dried, passed through a 2 mm granulometric sieve, and separated by hand into mollusc species, artefacts and rock.

In all, 31 bulk samples were processed and studied using this procedure. No bone or vertebrate microfauna, and almost no artefacts, were found. Among the molluscs there was a significant component of very small non-edible species including numerous small gastropods (*Gibbula*) that live on seaweed, either *Laminaria* or *Zostera*. While their presence could be fortuitous, it does suggest collection of seaweed at Medo Tojeiro, perhaps for food, or as fuel for steaming molluscs, or for other domestic purposes such as bedding.

Overall, the assemblage of edible mollusc species was dominated by *Mytilus* and *Patella*, while *Thais* was present and *Monodonta* rare (Table 2). However, there were changes over the different levels and these are shown as standardized z scores (i.e. deviation around the mean) in Fig. 2. From this it can be seen that *Mytilus* and *Patella* co-vary, and that *Monodonta* and *Thais* are more common in the topmost level (which may be early Neolithic) than below. In addition to these four major shellfish species the assemblage also included sea urchins, barnacles, crustaceans, other bivalves and occasional oysters.

A second series of 38 1-litre bulk sediment samples, taken as described above, was used for both geochemical and sedimentological analyses. We first sieved each sample through a 2 mm sedimentological sieve, examined the > 2 mm fraction for artefacts and then discarded it. We sub-sampled the < 2 mm fraction to reduce shipping costs (the mean weight of these sub-samples was 215 g). In Canada, we removed a 50 g sample from each, weighed it, air-dried it at 80°C for eight hours, and weighed it again to determine moisture loss. The dried sample was then leached with 30% HCL until no further reaction occurred, washed, centrifuged, dried and weighed again to determine the amount of shell removed by leaching. A few samples were then put through standard grain-size analysis but the results were (predictably) of no use since the non-cultural matrix of Medo Tojeiro is dune sand.

The data derived from these procedures showed that shell, as a component of the site matrix, was more common in C.1 (20.3%) and C.2 (21.3%) than in C.3 (9.6%), C.4 (17.1%), C.5 (5.0%) or C.6 (4.2%). Viewed as standardized data, Fig. 2 shows increases in the frequency of shell fragments in C.2 and C.4, suggesting that these may have been exposed surfaces subject to trampling, deflation and compaction for unknown periods of time. The curves for calcium, iron, carbon, nitrogen and phosphorus all show a trend to decreased values with depth, although the peak in Ca, C and N in C.2 may be a reflection of more intensive occupation in that level. These data appear to confirm observations made in the field that the upper levels of the site were more deflated and compacted than the lower ones. It does not, in our opinion, say anything about intensity of use, but may indicate that there was a period of exposure following deposition of C.4, resulting in greater compaction and fragmentation of shell in that level.

Unfortunately, lack of a radiocarbon date for C.1 means that we are unable to assess length of occupation, nor can we attempt a reconstruction of deposition rates. What we can say is that the Medo Tojeiro shell midden represents a special purpose, probably seasonal, site that may have elements representing both the Mesolithic and the Neolithic of the Alentejo littoral. It is unfortunate that investigations to resolve the remaining uncertainties have not been possible.

SAMOUQUEIRA

The second site excavated in 1984 was Samouqueira, first identified by Tavares da Silva and Soares from lithic artefacts exposed in a ploughed field on the wave-cut terrace just north of Porto Covo.

As at Medo Tojero, a grid system of 20 m^2 sectors was established. Four 1 m^2 tests were made in Sectors XX, XXVI, XXVII and XXVIII, and a main trench, 2 m x 7 m, was excavated in Sector XII (Fig. 3).

Artefacts and faunal remains were found scattered throughout the excavated deposits of the test pits and the main trench, but the absence of visible stratigraphy made it impossible to discern a stratigraphic sequence in the field. Our observations suggest obliteration of colour and texture distinctions by a combination of geomorphic processes and disturbance from cultivation over many years. Neither the grain-size profiles determined in the laboratory from bulk samples taken during the field season, nor the size distribution of lithic artefacts, show patterning that reflects vertical redistribution. We believe that Samouqueira represents a series of intermittent occupations over a relatively long period of time during which there was rapid deposition in a low energy environment. This interpretation is reinforced by the disposition of the two fragmentary human skeletons, which suggest dragging and downslope disturbance, almost certainly by ploughing (Lubell and Jackes, 1985, p. 129).

Three radiocarbon dates are available. One on mammal bone and another on disturbed, but still partly *in situ*, human remains (Table 1) were collected during excavation and have precise provenance. They occurred at the same depth in adjacent squares but are at least 800 years apart. The mammal bone sample, although large, had very poor collagen preservation and had to be dated using AMS (one of the earlier uses of this method). Whether or not this accounts for the difference is unknown, but it seems unlikely. A third date on marine shell (ICEN-729) is of unknown provenance. If it is correct, then Samouqueira was used sporadically for at least 2000 years.

We have applied a 75%ΔR correction to the date for Samouqueira H2 (TO-130) because the stable isotope values for this individual are within the marine carnivore range and it represents an outlier to all the other human samples we have tested. It is worth noting that we found parts of two separate individuals at Samouqueira, and that both had traumatic pathologies (Lubell and Jackes, 1985, p. 131). Such pathologies are very rare among the several hundred Mesolithic and Neolithic Portuguese skeletons we have studied. Neither of these individuals could have functioned normally, and one has to wonder if there could be a relationship between pathological conditions that would have restricted movement and access to non-local food sources which would have produced the unusual stable isotope profile for H2. It is clear that the groups living at Samouqueira were able to provide support for individuals who would not have been able to participate fully in all subsistence activities. Beyond that speculation, there is little that can be said at present.

The Samouqueira lithic assemblage (Table 3) contains two distinct reduction sequences. One is based on fine-grained greywacke, cobbles of which could have been collected from the beach below the site. This raw material was used mostly for the macrolithic component which consists primarily of large flakes removed from pebble cores by direct percussion. The second reduction sequence used assorted fine grained or crystalline materials which, with the exception of fine-grained quartzite, do not occur locally today. These raw materials were used almost exclusively for the production of the microlithic component of the assemblage, although greywacke was used for a small number of bladelets and some blades. Core preparation was minimal, and bladelets were removed from single platform cores by a combination of direct and indirect percussion.

The number of retouched tools is very limited and consists mostly of microlithic pieces, especially backed bladelets (n. 7), geometrics (n. 21) and their by-products (n. 12). Of the 21 geometrics, half are trapeze forms (n. 11), and the other half is evenly divided between triangles and segments (n. 5 each).

Just as the size and variety of the lithic assemblage is a clear contrast to Medo Tojeiro, so is the molluscan fauna (Table 2) which has fewer *Mytilus*, increased frequencies of *Patella* and *Thais*, and now contains some *Cardium*. Whether this is simply a reflection of different local catchment environments or season of occupation cannot be determined on the evidence available. However, it does seem reasonable to interpret Medo Tojeiro as a short-term, specialized, site. Sea urchins, barnacles and crustaceans are also present, but again rare, at Samouqueira.

The Samouqueira faunal assemblage also contains both fish and terrestrial mammals. Among the fish we identified *Lamna nasus, Galeorhinus galeus, Myliobatidae* sp., *Gadoid* sp., *Sparus auratus, Sparidae* sp. and *Labrus* sp. The mammalian assemblage includes rabbit (*Oryctolagus cunniculus*), red deer (*Cervus elaphus*), wild boar (*Sus scrofa*) – mostly younger animals, hare (*Lepus capensis*), wolf (*Canis lupus*), red fox (*Vulpes vulpes*), lynx (*Lynx pardina*), wild cat (*Felis sylvestris*) and aurochs (*Bos primigenius*). There is also evidence for green turtle (*Chelonia mydas*), lizards and a few unidentified birds[4]. Sample sizes are too small for any statistical treatment, but the non-marine fauna suggests open parkland composed of areas of grassland and both deciduous and coniferous woodland, while the molluscan and other marine elements suggest physical conditions similar to the present.

Unfortunately, analyses of charcoal fragments recovered from bulk samples (Table 4) do not help in interpreting the variability in faunal assemblages because the sample size for Samouqueira is inadequate – preservation in these highly disturbed deposits was very poor. The more satisfactory sample from Medo Tojeiro is consistent with a local environment analogous to what prevailed prior to the disturbances caused by historical and modern developments.

FIAIS

The third site investigated was Fiais, a unique Mesolithic site located 100 m ASL and 10 km inland from the modern coast on a high terrace of the Rio Mira near Odemira. The work here was done in collaboration with J. M. Arnaud and we report here on the 1986 excavations (although R-C. has examined material from a 1987 excavation). In all the deposits examined at Fiais, the artefact remains were indisputably Mesolithic, and this was later confirmed by the radiocarbon dates (Table 1), which place the occupation between 7800 and 7000 calBP.

Excavation methods

We first established a grid of 10 m^2 sectors (right side of Fig. 4). Within each sector, we designated a series of one metre squares. Starting at the south-west corner of each sector, these were numbered 1 to 10 from west to east and A to J from south to north. We began with a 2 m^2 test excavation in XXIF1 and XXIG1 where we exposed a hearth (designated Feature 1) reminiscent of the one found at the base of the Medo Tojeiro midden but at least 1500 years older (TO-806, Table 1). At the same time we bored 40 soil auger holes at 2.5 m intervals in Sectors XI, XII, XVIII and XIX, and using these drew seven E-W soil profile sections through the site to locate and establish the extent of midden deposits (left side

[4] Identifications by A. Gautier and A. Lentacker.

of Fig. 4). Because this was intended as a short field season to test the potential of the site, and also because of what we could observe on the surface, we decided to open two more squares in XIXA9 and XIXB9. It was almost immediately apparent that the deposits here were rich in bone and so we decided to concentrate in this area, eventually expanding the excavations to 12 m^2.

The profiles based on the soil auger bores (Fig. 4) show there are extensive midden deposits at Fiais that we did not test in 1986. Unfortunately we have no knowledge of subsequent work by Arnaud, but the results of the 1986 work are sufficient to establish the importance of the site.

To demonstrate the approach taken, we will summarize Square A9 as an example of the methods and findings. This was the first square opened in what became the main excavation area. It contained the greatest density of lithics and bone and formed the centre of the major feature of the site. Fig. 5 shows that in A9 there was a dense concentration of bone around an open space. This square had the highest concentration of coordinated bone among the 12 excavated squares and this bone generally lay just beyond an area of compacted pink ash containing shell fragments, which was first observed in patches at around 35 cm below the surface and coalesced just below that.

The ground surface of A9 sloped nearly 10 cm from east to west. Two initial arbitrary 10 cm horizontal levels removed the overburden which was plough zone characterized by the excavators as disturbed with crushed shell in a brown sandy matrix. Bone fragments made up most of the excavated material (76%), with a few lithics (6%) and some marine fauna, mostly *Ostre*a and *Cardium*. After these surface levels, we excavated two more horizontal 5 cm levels to remove further plough zone deposits. Bulk samples were now taken and the lower of the 5 cm levels was dug by 50 cm^2 quadrants. Excavation within the next level brought the excavation onto what was recognized as *in situ* midden deposits, and both floor plans and profiles were drawn. Mammal bone had increased to just over 80%, there were fewer lithics, and the frequency of *Ostrea* and *Cardium* was halved among this uncoordinated material. From this point on, most material was given three-dimensional coordinates and was accurately recorded on detailed plots, with some attention paid to dip and orientation when bones were clearly not level. This final level brought the excavation of the square to ~40 cm below the surface. The coordinated and plotted material in the *in situ* midden deposits comprised over 200 pieces of mammal bone, a bladelet, a quartz crystal and a fish vertebra. The uncoordinated material consisted of 15% marine fauna (shellfish, fish, crab sea urchins, barnacles), 80% mammal bone and 1% lithics and shell beads. It must be made clear, however, that the distribution of material throughout the site varies dramatically. In the southern squares the representation of shell is higher than that of bone.

The dark brown sandy loam of the upper 20 cm in A9 contained dense shell fragments but only 30 mammal bone fragments, whereas the next 10 cm contained 49 mammal bones (we are excluding both microfauna and the bulk sample material from this discussion). Coordination began within the next and last 5 cm level (30-35 cm below highest surface) since it was now clear that material was *in situ* at ~33 cm. From the remaining deposits, ~30-43 cm below surface, 78 uncoordinated mammal fragments and 251 coordinated mammal bones were excavated. Of the identified coordinated sample, 77% are considered to be *C. elaphus* or of an equivalent size. A very few fish vertebrae, *Patella*, *Thais*, *Cardium* and *Ostrea* shells make up the total of the faunal sample from 30-40 cm below the surface.

Fig. 6 demonstrates the great concentration of bone in the western half of A9. A8 has very little bone except in the eastern section where the bone circle begins. A9 bone is truncated at the area of pink compacted ash and shell and A10 bone lies much deeper (several bones were, in fact, left in the ground at the end of the 1986 season in the lowest level of A10 at z = 55).

Was the coordinated bone in situ? The answer seems to be that it was not only fully *in situ*, but it lay undisturbed where it had been deposited originally, suggesting a one-time event. During excavation, as bones were plotted in place, it was clear that some could be joined: e.g., the distal humerus of a red deer found in two pieces, one 5-6 cm below the other in A10; widely dispersed pieces of a juvenile *Bos* proximal tibia (diaphysis and two epiphyses) in J9. There were also instances where bones remained in articulation, as in A9 for two epiphyses from a suid distal metapodial and a proximal phalanx.

There was, however, disturbance of some of the deposits, both from agricultural activities and possibly bioturbation. The latter is indicated by a series of truncated burrows with an average diameter of about 10 cm. The interpretation of these as part of a rabbit warren seems reasonable. They generally run from the south on an angle (15-25°) down into the ground oriented to the north. Although apparently concentrated on the higher western side of the main excavation area, a number of small features plotted by the excavators are likely to have had the same origin. Rabbit bones are found in the disturbed overburden, rarely in the *in situ* material, and then mostly within one concentration. In A9 between 20 and 30 cm below surface, the frequency of rabbit bones equalled or even exceeded the number of identified red deer remains (as the most common identified taxon): two were identified among the coordinated *in situ* A9 material, and 56 among the uncoordinated material (from the surface to 35 cm). Overall, considering all squares, 50% of the very few coordinated rabbit bones were found in the southwestern part of the main excavation area.

Faunal assemblage[5]

The *in situ* 1986 faunal assemblage was first identified in the field by Jackes (without benefit of a reference collection) and then it (and the uncoordinated material) was re-examined in 1987 in Lisbon by Rowley-Conwy. The material reported on here is from the 1986 excavation. About 75% of the assemblage are bones of red deer, roe deer and wild pig. The remainder consists of lagomorphs, aurochs and a small component of fur-bearing animals (Table 5).

Rowley-Conwy (n.d.) has also analyzed the vertebrate fauna from Cabeço do Pez (Sado), roughly contemporaneous and some 80 km to the north. The assemblages are broadly similar, with red deer and wild pig predominating, but there are some surprises. If there were any environmental differences in the Mesolithic, one might expect that the landscape would become progressively more open to the south. This should lead to an increase in open country species (e.g. equids) and a decrease in woodland species (e.g. roe deer) to the south. The reverse is however the case: equids are entirely absent at Fiais, and roe deer are more common than at Cabeço do Pez. This might indicate that the Fiais region was more wooded than the Sado.

The red deer at Fiais appear to have been the same size as those in the Sado valley. However, the Fiais pigs seem to have been smaller than the Sado specimens. These observations are based on astragalus length using measurement GLl (von den Driesch, 1976). The astragalus reaches maximum size quite early in life (Payne and Bull, 1988), so size differences are less likely to be age-dependent. This Fiais-Sado comparison continues a trend observed further north: the wild pigs from copper age Zambujal, north of the Tagus (von den Driesch and Boessneck, 1976) were still larger than those from the Sado (Rowley-Conwy, n.d.).

The position is less clear with regard to rabbit. Breadths of the Fiais distal humeri were compared to those from the Sado shell middens. The Sado mean is 8.24 mm, the Fiais mean 8.03 mm. The numbers are small, particularly from the Sado, and more work is needed before conclusions can be drawn.

Rabbit bone representation and fragmentation at Fiais is similar to that observed at other settlements. While we might conclude that the rabbits were definitely processed by humans, and do not represent intrusive natural deaths, it is worth noting that their distribution within the deposits is uneven.

Seasonality

Season of occupation is difficult to determine at Fiais, because jaws of immature animals are remarkably rare. Furthermore, pigs in southern Europe are frequently born outside the restricted spring birth season characteristic of this species in northern Europe.

A single aurochs mandible contained worn dP4 and M1, and M2 in an early stage of eruption. It has been argued that domestic cattle are remarkably consistent in their tooth eruption ages (Payne, 1984). If the domestic data can be applied to aurochs, and if aurochs were born in April (both assumptions may be incorrect) then the jaw comes from an animal killed in Higham's (1967) stage 8, aged 15-16 months, thus deriving from July or August[6].

One pig maxilla contained M3 erupted level with the jaw. Matschke (1967) states that maxillary M3 erupts on average at 29 months (range 26-33 months). If birth was in April, the animal was 29 months old in September (Matschke's full range gives June-January). Another contained a fully erupted but unworn P2, falling into Higham's stage 16 (15-16 months old). An April birth date would give a kill date of July or August.

These five jaws could all come from animals killed in the warmer half of the year. Two further pig maxillary fragments both contained M1 just touched by wear; these fall into Higham's (1967) stage 9, aged 7-8 months. An April birth would therefore indicate kills in November or December. However, as pigs may be born outside the spring, it is unclear whether these two animals really indicate occupation in the early winter, or are summer kills of animals born outside the spring.

What little evidence there is, therefore points to an occupation in the warmer part of the year, while occupation in the winter cannot be demonstrated. The rabbit bones may also support this. No studies of rabbit populations appear to be available from the Iberian peninsula, but in northern Europe as well as in Australia and New Zealand the majority of births take place in the 4 months leading up to midsummer (discussed in Rowley-Conwy, 1992). Most rabbit long bone epiphyses fuse at or before 6 months, the rest by 9 months (see *ibid*. for references). A site occupied in spring, summer and autumn should therefore contain more unfused long bones than one occupied in winter and spring. Cabeço do Pez is tentatively identified as a winter/spring site, and 14% of rabbit long bones are unfused (Rowley-Conwy, n.d.). The 1986 excavations at Fiais yielded a total of 26% unfused long bones, nearly double the proportion found at Cabeço do Pez. These figures may thus offer tentative support to the suggestion that Fiais was occupied in the warmer part of the year.

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5 Based on an unpublished 1987 report by PR-C.

6 Two red deer mandibles from the 1987 excavation come from animals probably killed in late spring – April or May.

Taphonomy

The Fiais bone assemblage is unusual in a number of ways. The shallow stratigraphy and restricted area have the appearance of a concentrated bone dump, not the more diffuse scatter usually associated with domestic refuse. Taphonomic analysis of the species that were unquestionably used as food (Table 6 and Fig. 7), shows a concentration on meat bearing elements and minimal disturbance by carnivores – some bones were still in anatomical position and only 10 of 1743 large mammal fragments (0.57%) were visibly gnawed. The presence of large numbers of podials (excluded from Fig. 7 to avoid obscuring the pattern), as well as cranial elements, indicates butchering at or near the bone bed.

Proximal and distal humeri of red deer are present in equal numbers (a minimum element count of 16 in each case); this lack of differential destruction of the proximal ends is also a sign that carnivore attrition was minimal (Binford, 1981, Fig. 5.09; Brain, 1981, Figs. 14 and 15). Domestic dogs were nearly or completely absent. Foxes were, however, present, and if the human group responsible for the bone assemblage had been absent for a period during the formation of the bone dump one would expect foxes to have moved in to the abandoned settlement and caused more modification to the bone assemblage. The fact that this did not occur raises the interesting possibility that people were present continuously throughout the period of accumulation of the bones, so that there was little or no fox access.

If this argument is correct, there are two possibilities. Either Fiais was permanently occupied, with the bone dump accumulating perhaps over a period of several years; or the site was seasonal, in which case the assemblage represents the bone waste from a single season of occupation.

The seasonality evidence put forward above permits only the most tentative suggestion that the site may have been occupied seasonally, during the warmer part of the year. If this is correct, the bone dump could represent debris from a single year's hunting.

Differences in the animal bones between excavation spits within the bone accumulation have not yet been examined. However, the 1986 and 1987 excavations (the upper and lower parts of the accumulation respectively) have been separately quantified. Among the large mammals, no significant differences were found between the two. However, when the adjusted rabbit totals are expressed as percentages of those of the large mammals, they amount to 51% in the 1986 assemblage, and only 19% in the 1987 assemblage.

If it is correct that the bone accumulation represents debris from a single occupation during the warmer part of the year, there is a possible explanation for this. It might be that the lower part of the accumulation (the 1987 assemblage) derives predominantly from the earlier part of the occupation, i.e. the spring. It may be significant that the two red deer jaws mentioned above which provided the evidence for spring occupation both derived from the 1987 excavation. If this is correct, it would suggest that rabbits were procured less frequently during the early (spring) period of the occupation. This would be not unexpected: during the spring the increased number of rabbit births would mean that many individuals would be very small, and so perhaps not worth hunting (or not worth returning to the settlement if trapped in a snare), and the adults would be in relatively poor condition. As the season progressed, the juveniles would approach adult size, and the condition of the animals would improve. This might lead to an increase in the attractiveness of rabbits as a resource as the suggested season of occupation progressed.

It must be stressed that this explanation for the differences in rabbit frequencies between the 1986 and 1987 excavations is tentative in the extreme. It is dependent on both the argument for season of occupation and that for a single season of accumulation being correct, and these are both in themselves tentative. It could be supported by (a) a more detailed consideration of the stratigraphic evidence at the site, and (b) studies of rabbit population dynamics and nutritional status more directly relevant to the area – as mentioned above, the studies known to the writer derive either from northern Europe or the Antipodes. The factors discussed in the previous section, the postulated truncated warren, with the majority of rabbit bones occurring in the plough zone, point to the need for further detailed examination of the site.

Site function

Body part representation of the larger mammals is an important source of information regarding site function. Outlying hunting camps may be distinguishable from base camps by means of the parts of animals consumed (Legge and Rowley-Conwy, 1988). Hunting camps often have a high proportion of skull and jaws, forelimbs and extremities, while base camps often have fewer cranial elements and more of the main meat-bearing bones such as the upper rear limb (see also Binford, 1978). Carnivore attrition can be a serious problem for such examinations, but as mentioned this played little or no part in the generation of the Fiais assemblage.

It was mentioned that jaws are rare. The 1986 excavation yielded a minimum element count of seven mandibles (eight if loose teeth are taken into account), as compared with 23 scapulae, 25 pelves and calcanei, and 31 distal tibias. The main meat bearing elements of the skeleton are present, while heads appear to have been differentially discarded elsewhere – either at the kill site or on an outlying hunting camp.

It is concluded that Fiais was a base camp. A further suggestion of a wider (longer-use) site comes from the identification of a piece of human skull with the characteristic coronal suture in A9: a human burial is likely to lie somewhere in the vicinity.

Marine fauna

The faunal assemblage at Fiais also included a significant marine component – predominantly *Ostrea* and *Scrobicularia plana* (Table 2) in the bulk samples, although *Cardium* is quite common in the level bags containing materials recovered on the screens. *Ostrea* and *Scrobicularia* are both found in estuarine and intertidal conditions. *Scrobicularia* can tolerate low salinities in thick mud or muddy sand and burrows up to 20 cm deep in sediments. *Ostrea* prefers firm bottoms of mud, rocks, muddy sand, muddy gravel with shells and hard silt (see data at www.marlin.ac.uk). Both would have been available fairly near the site, although *Ostrea* beds may have been further away than the areas in which *Scrobicularia* could be collected. Given the elevation as well as distance of the site from the present coastline, this may have implications for our understanding of early Holocene coastal morphology in the region.

Lithic artefacts[7]

The 1986 lithic artefact assemblage from Fiais totals 1025 pieces and is composed predominantly of debitage (890/1025 or 86.6%) of which the majority are bladelets (453/809 or 50.9%) struck from small prepared cores using a combination of punch and pressure technique. Cores (39/1025 or 3.8%) are almost as common as retouched tools (70/1025 or 6.8%), providing further support for the reconstruction of Fiais as an habitation site. Angular chunks or shatter and flakes comprise 25.3% (225/890) and 21.3% (190/890) respectively. Such a low ratio of shatter and flakes to bladelets indicates that little primary core preparation was carried out on the site. Hexagonal quartz crystals (14/890) which were used as sources of raw material are also included in the debitage totals although they are not strictly debitage

A variety of raw materials were used (Table 3). Chert predominates for the production of bladelets (90% of all bladelets) with crystal quartz the second most common material (4.6% of all bladelets). Coarse grained or poor quality materials such as greywacke and quartz (massive) most commonly occur as flakes and chunks.

Seven varieties of chert were identified, based initially on colour and structure and subsequently with INAA. Very high vanadium concentrations (up to 9.5 ppm) characterize all the Fiais cherts. Petrographic analysis shows the chert to be non-fossiliferous with a fine groundmass composed of microquartz while chalcedony fills any cracks or voids. Relic minerals such as calcite or clay are not found. The most common variety is a creamy white chert, similar to chert from Palheirões do Alegra (located on the coast to the west) and from Samouqueira.

Some of the variation in chert colour may be due to intentional heating. If colour change was caused by heating without direct burning (the incidence of heat crazing or potlid fractures is only 77/890 or 8.7%) it may suggest purposeful heating to improve the knapping qualities. Thermoluminescent analysis of a sample of debitage would resolve this question.

Most bladelets (60%) are broken. Of the 281 proximal ends available for analysis, 32% exhibit platform faceting. While this may indicate the use of indirect percussion or pressure, faceting alone can not be considered conclusive evidence of the use of either of these techniques (Sollberger and Patterson, 1976). Only a very few bladelets show evidence of careful trimming of the core edge before removal of the blank. Although the production technique does not appear to have been very elaborate the blanks produced exhibit parallel sides with a single or double arris.

All of the debitage from Fiais is quite small. Bladelets are very short (mean = 20.7 mm), narrow (mean = 7.5 mm) and thin (mean = 2.8 mm). The small size of the bladelets and the very high ratio of bladelets to chert flakes and shatter (1:1) may reflect the difficulties of securing high quality raw material. Under conditions of raw material scarcity such as those encountered when a group is at some distance from the source of raw material, conservation may be practised by reducing the size of blanks and tools and by careful working of cores, resulting in the low production of shatter.

The frequency of cores is high relative to the frequency of retouched tools (core/tool ratio of .56). Cores exhibiting only bladelet scars make up 87.2% (34/39) of the total, however the five cores with flake scars are most probably exhausted bladelet cores from which a few flakes were removed as a result of striking error immediately before the cores were abandoned.

The majority of the cores are single platform unidirectional forms (30/39). Preparation of the striking platform using edge faceting and invasive retouch is common (47.3%) suggesting the use of a striking technique that required seating of either a punch or a pressure tool. Careful trimming of the core edge to remove overhang and isolate platforms is not common. However, since the cores were abandoned when exhausted, one would not expect to see signs of edge trimming. The majority of cores were heavily worked and only abandoned after all suitable platforms and angles had been exhausted.

[7] Based on an unpublished 1986 report by PS.

The majority of the cores exhibit no cortex or rolled surfaces, and this may indicate the use of bedrock sources. However, if the source was at some distance from the site, all traces of rolled cortex may have been removed prior to bringing the cores to the site. A few cores do have pebble or cobble surfaces (24.3%), but even fewer show the angular cortical surfaces characteristic of bedrock sources (8.1%). Whatever the nature of the source it is clear from the raw material variation in the cores, that a source of creamy white chert provided virtually all of the material used for bladelet production.

The frequency of retouched tools is very low (Table 3). If we exclude microburins and pieces with edge damage, the total is only 56. Over 75% of these are either triangles or trapezes, and just under 25% are segments. Some trapezes have a distinctive concave or "notched" short side, and although they appear similar to those found with the Aceramic Neolithic at Lugar do Canto (Veiga Ferreira and Leitão, 1985: 125), the Fiais trapezes are made on bladelets instead of the wider blades used at Lugar do Canto. All the retouched tools are microlithic and made of chert while two utilized pieces are made of greywacke and one of quartzite.

Spatial Distribution of Artifacts

Fiais has been ploughed, and since 72% of the artifacts occur within the first 30 cm the majority cannot be considered to have been in primary context. The frequency of artifacts decreases steadily from the surface downwards, but there is no evidence of any distinct concentration below the modern plough zone. Examination of the proportions of tool forms, blank types and raw materials occurring above and below 30 cm also indicates no departure from a random distribution of artifacts above and below this level.

There are differences in the frequency of lithic waste among excavation units. The adjacent squares A9 and J9 have the highest incidence of waste and there is a general fall-off in the number of pieces of waste toward the periphery of the excavated area. This pattern holds if only the frequency of bladelets is plotted, indicating that it is not simply a function of differential recognition of shatter influencing the proportions recovered from each square. This type of patterning is not consistent with the randomizing effect one would expect if the site was severely disturbed (cf. Roper, 1976).

The incidence of burnt waste is potentially an indicator of the location of a hearth. The frequency of burnt waste is highest in the NE part of the excavation area (A8, A9, A10, B10) and declines to the south-west. This is consistent with the distribution of burnt bone and rocks and by the large area of compacted pink ashy soil in the north-east of the trench. This may indicate the presence of a hearth in the unexcavated adjacent area.

The incidence of crystal quartz also indicates the possibility of non-random concentrations of this material. Four contiguous squares (J8, I8, I9, I10) all show higher than average percentages; interesting because this is outside both the concentration of burnt waste and the central area with the highest number of waste pieces.

There is no discernible pattern to the distribution of cores. This may reflect their original distribution or it may be a function of the increased amount of plough transport suffered by larger objects. The distribution of retouched tools shows a pattern similar to that of waste – they are most common in the central area of the excavation.

The distribution of artifacts therefore allows us to tentatively suggest that the main excavation area may be divided into three zones: (1) hearth (?) edge in the B10 corner; (2) main area of knapping and tool production in the centre; (3) a low density area behind (2) with a higher than average amount of crystal quartz working. However, because the majority of artifacts are not *in situ* in the bone bed, the interpretation of these patterns requires further investigation.

CONCLUSIONS

Our research on Medo Tojeiro and Samouqueira did not provide data for firm conclusions, but it does seem likely that both Mesolithic and Neolithic occupations along the Alentejo coast were often of short duration and, in the case of the Neolithic, often targeted at specific subsistence pursuits, perhaps seasonally. We attempted to source the raw materials used for the microlithic component of the assemblages but the results were inconclusive. It does, however, appear that resource territories were fairly broad and we cannot rule out seasonal movement/settlement between coastal and inland areas.

This interpretation is reinforced by the much more complete data for Fiais where the large and well-preserved faunal assemblage might indicate a short duration, seasonal utilization of resources, and there is a large amount of non-local raw material in the microlithic assemblage.

In the absence of data from one or more Neolithic habitation sites other than Medo Tojeiro, it is not possible to say definitively whether or not the patterns identified here represent continuity or discontinuity. Our bioarchaeological data from Mesolithic and Neolithic sites such as Melides, Moita do Sebastião, Cabeço da Arruda, Fontainhas, Casa da Moura, Feteira, Furninha and Caldeirão, all suggest unequivocally that population continuity is the preferred hypothesis. But our archaeological data from the Alentejo remain unsatisfactory in resolving the question for this part of Iberia.

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TABLE 1. Radiocarbon dates.

Site	Provenance	Lab. ID	Material	$^{13}C/^{12}C$	ΔR[a]	years bp	years calBP[b] 1 δ range
Medo Tojeiro	exposed face (C.4?)	BM 2275R	*Mytilus*		253 ± 29 (100%)	6820 ± 140	7231-6908
Medo Tojeiro	S.III, S3, C.4	Beta 11723	charcoal	-23.1‰		5450 ± 160	6401-5998
Samouqueira	S.XII, E19, C.2a	Beta 11722	mammal bone	-17.0‰		5190 ± 130	6169-5752
Samouqueira	S.XII, F20, C.2a	TO -130	*Homo sapiens*	-15.3‰	253 ± 29 (75%)	6370 ± 70	6800-6633
Samouqueira	unknown	ICEN-729	shell		253 ± 29 (100%)	7520 ± 70	7647-7791
Fiais	S.XIX, B8, z. 243	TO-705	charcoal			6840 ± 70	7729-7591
Fiais	S.XIX, A10, z. 244	TO-706	mammal bone	-21.0‰		6260 ± 80	7126-7026
Fiais	S. XXI, G1, Feature 1	TO-806	charcoal			7010 ± 70	7931-7754
Fiais	unknown	ICEN-141	bone			6180 ± 110	6913-7233
Fiais	unknown	ICEN-110	bone			6870 ± 220	7510-7935
Fiais	unknown	ICEN-103	shell		253 ± 29 (100%)	7310 ± 90	7452-7610

(a) This is the region mean ΔR for Portugal published at http://radiocarbon.pa.qub.ac.uk/marine/ and based on Monges Soares (1993).
(b) Calibrated using CALIB 4.4. Correction for ΔR follows procedures recommended in http://radiocarbon.pa.qub.ac.uk/calib/manual/chapter2.html#MARINEHELP.

TABLE 2. Molluscan faunal assemblages from Medo Tojeiro, Samouqueira and Fiais.

Medo Tojeiro: grams of shell/species (% in bulk samples)										
Level	*Patella*	*Mytilus*	*Monodonta*	*Thais*	*Cardium*	*Scrobicularia*	*Ostrea*	*Venerupis*	*Solen*	Total n
C.1	18.91	81.09	1.85	13.95	-.-	-.-	-.-	-.-	-.-	1190
C.2	18.48	81.52	1.21	3.58	-.-	-.-	-.-	-.-	-.-	2067
C.3	23.92	76.08	0.67	3.59	-.-	-.-	-.-	-.-	-.-	2090
C.4	14.91	85.09	0.68	3.42	-.-	-.-	-.-	-.-	-.-	1610
C.5	18.35	81.65	3.73	6.05	-.-	-.-	-.-	-.-	-.-	992
Samouqueira: grams of shell/species (% in bulk samples)										
Level	*Patella*	*Mytilus*	*Monodonta*	*Thais*	*Cardium*	*Scrobicularia*	*Ostrea*	*Venerupis*	*Solen*	Total n
C.1	25.93	17.46	-.-	49.74	6.88	-.-	-.-	-.-	-.-	945
C.2a	22.90	22.90	-.-	48.09	6.11	-.-	-.-	-.-	-.-	1310
C.2b	31.63	15.82	-.-	44.28	8.27	-.-	-.-	-.-	-.-	2055
C.3a	52.81	13.67	-.-	32.54	0.97	-.-	-.-	-.-	-.-	6362
C.3b	52.28	10.93	-.-	36.79	-.-	-.-	-.-	-.-	-.-	2745
C.3c-e	64.31	14.79	-.-	20.90	-.-	-.-	-.-	-.-	-.-	1555
Fiais: grams of shell/species (% based on weight in bulk samples and on n in level bags)										
	Patella	*Mytilus*	*Monodonta*	*Thais*	*Cardium*	*Scrobicularia*	*Ostrea*	*Venerupis*	*Solen*	Total n
Bulk	2.2	1.7	-.-	2.5	2.7	49.5	39.4	1.8	0.2	1608
Level	9.7	4.7	-.-	3.9	20.2	2.5	58.6	0.4	-.-	793

TABLE 3. Lithic assemblages from Samouqueira and Fiais.

Retouched tools	**Samouqueira** **n**	**%**	**Fiais** **n**	**%**		
Endscrapers	-.-	-.-	2	2.1		
Burins	1	1.4	-.-	-.-		
Borers/becs	3	4.2	-.-	-.-		
Backed bladelets	7	9.7	3	3.1		
Geometrics	21	29.2	43	44.8		
Truncations	2	2.8	-.-	-.-		
Notches & denticulates	16	22.2	3	3.1		
Retouched & utilized	8	11.1	17	17.7		
Choppers	2	2.8	-.-	-.-		
Microburins	12	16.7	28	29.2		
Total n	72		96			
Raw materials	**Flint/chert %**	**Greywacke %**	**Quartzite %**	**Crystal %**	**Other[(a)] %**	
Samouqueira						
Retouched tools	8.0	3.3	3.5	-.-	-.-	
Cores& fragments	20.2	13.6	15.1	29.6	-.-	
Unretouched debitage	71.8	83.1	81.4	70.4	-.-	
Total n	600	455	258	27	-.-	1340
Fiais						
Retouched tools	11.6	11.8	2.7	-.-	-.-	
Cores& fragments	4.5	-.-	2.7	2.1	-.-	
Unretouched debitage	83.9	88.2	94.6	97.9	100.0	
Total n	801	17	37	95	75	1025

[(a)] Quartz (67) + Rhyolitic (3) + Silicified slate (5)

TABLE 4. Tree species identified from charcoal fragments in bulk samples.

	Medo Tojeiro **n**	**%**	**Samouqueira** **n**	**%**
Pinus or cf. *Pinus*	820	64.57	29	54.72
Juniperus or juniper type	160	12.60	1	1.89
unidifferentiated conifer	87	6.85	15	28.30
Pistachia cf. *Pistachia*	9	0.71		
Hedera helix type	1	0.08		
Rosaceae type and two others	25	1.97		
cf. *Ficus carica*	1	0.08		
Acer type	3	0.24		
Cistus type	1	0.08		
unidifferentiated hardwood	49	3.86	4	7.55
unidentifiable	114	8.98	4	7.55
Total n	1270		53	

Identifications by C. T. Shay and J. Zwiazek, University of Manitoba

TABLE 5. Species representation in the Fiais vertebrate assemblage.

	NISP	%
Red deer (*Cervus elaphus*) + "medium"	1318	55.15
Wild pig (*Sus scrofa ferus*)	207	8.66
Roe deer (*Capreolus capreolus*)	90	3.77
"small" (either *Sus* or *Capreolus*)	43	1.80
Aurochs (*Bos primigenius*) + "large"	140	5.86
Rabbit (*Oryctolagus cuniculus*)	425	17.78
Hare (*Lepus* sp.)	13	0.54
Badger (*Meles meles*)	1	0.04
Dog or wolf (*Canis* sp.)	1	0.04
Fox (*Vulpes vulpes*)	19	0.79
Wild cat (*Felis sylvestris*) & Lynx (*Felis pardina*)	12	0.50
unidentified	121	5.06
Total	2390	100.00

TABLE 6. Taphonomy of the Fiais vertebrate assemblage (%).

Species	skull & maxilla	mandible	axis & atlas	scapula	forelimb	axial	pelvis	hindlimb	podials	n
Sus & Capreolus	6.1	1.5	1.5	3.0	8.5	10.1	2.4	7.0	59.8	328
Cervus	12.6	2.1	1.8	2.2	8.6	17.8	4.3	9.8	40.8	1185
Bos	5.4	3.1	0.8	-.-	8.5	33.1	6.2	10.8	32.3	130
Oryctolagus & Lepus	4.3	9.4	0.2	5.7	21.3	0.9	15.6	13.0	29.5	437
Canis, Felis, Vulpes, Meles	-.-	9.1	-.-	3.0	18.2	-.-	6.1	12.1	51.5	33
Sus & Capreolus	15.2	3.8	3.8	7.6	21.2	25.0	6.1	17.4	-.-	132
Cervus	21.3	3.6	3.0	3.7	14.6	30.1	7.3	16.5	-.-	701
Bos	8.0	4.5	1.1	-.-	12.5	48.9	9.1	15.9	-.-	88
Oryctolagus & Lepus	6.2	13.3	0.3	8.1	30.2	1.3	22.1	18.5	-.-	308

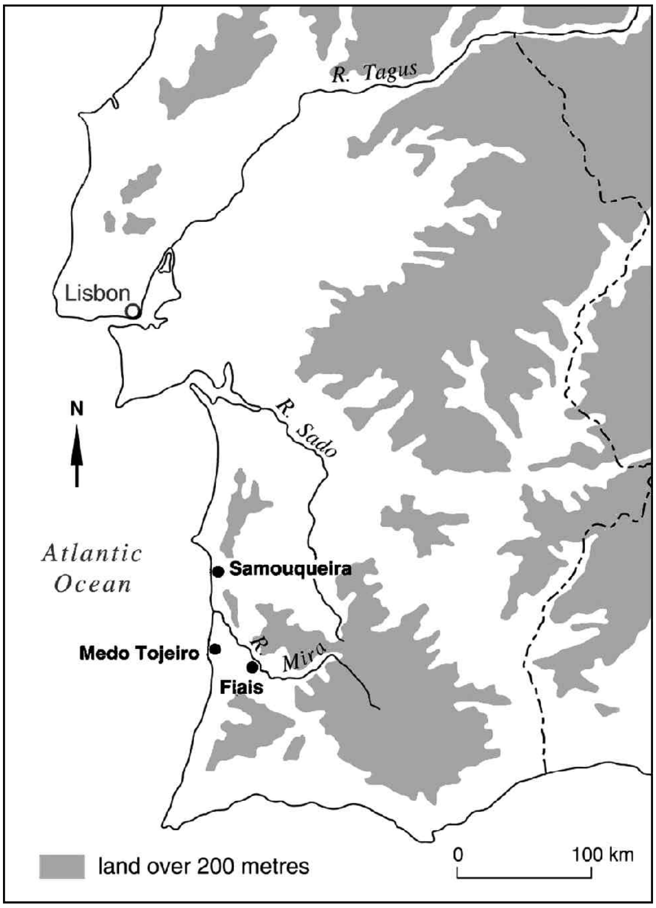

FIGURE 1. Map of Portugal showing locations of sites discussed.

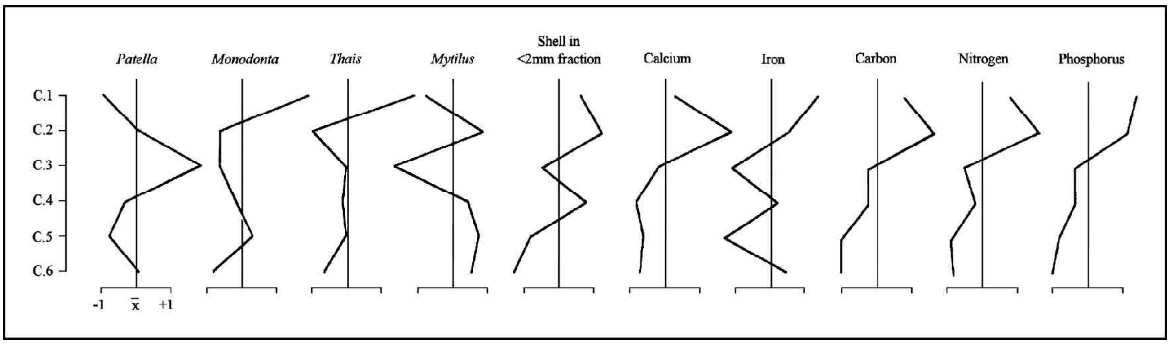

FIGURE 2. Summary of faunal and geochemical analyses of the Medo Tojeiro shell midden using Z scores (deviation around the mean). For description of levels, see text.

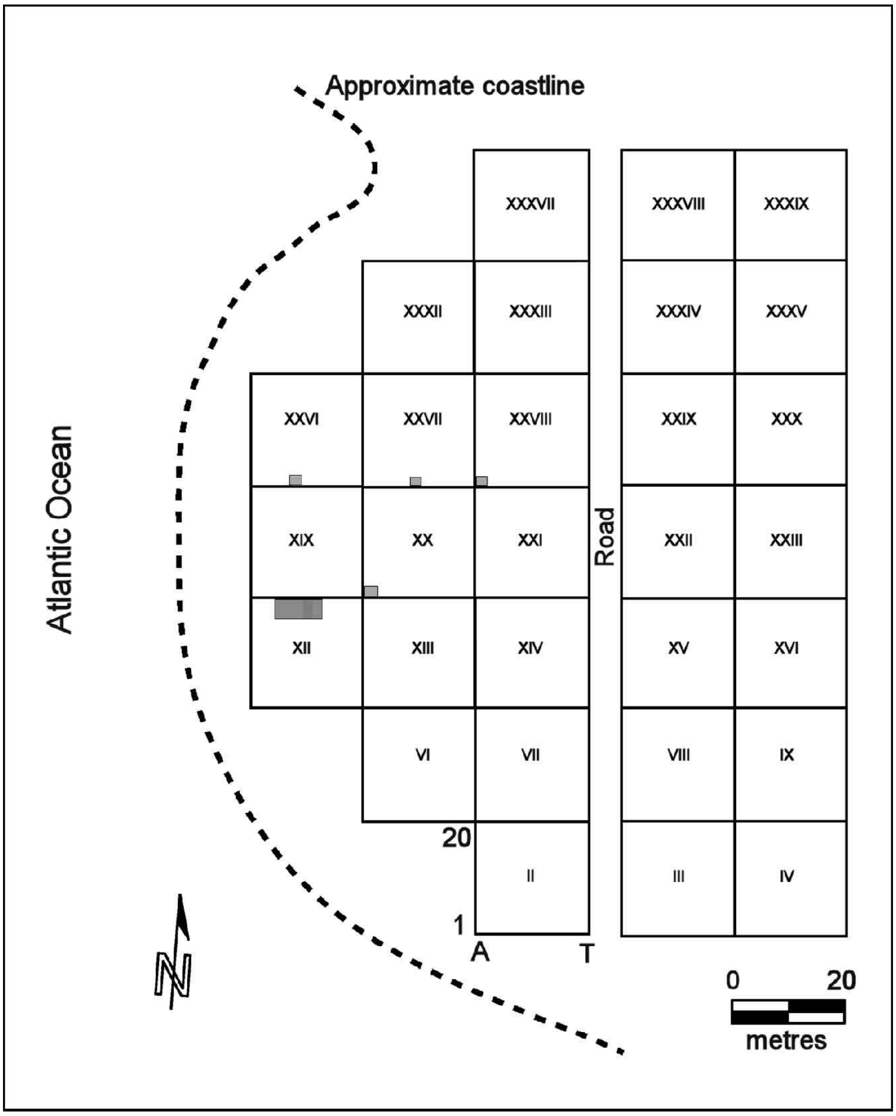

FIGURE 3. Sketch map of Samouqueira using field data and based on sheet 526 (Provença, Sines) of the 1:25,000 series of the Carta Militar de Portugal, Serviços Cartográphicos de Exército.

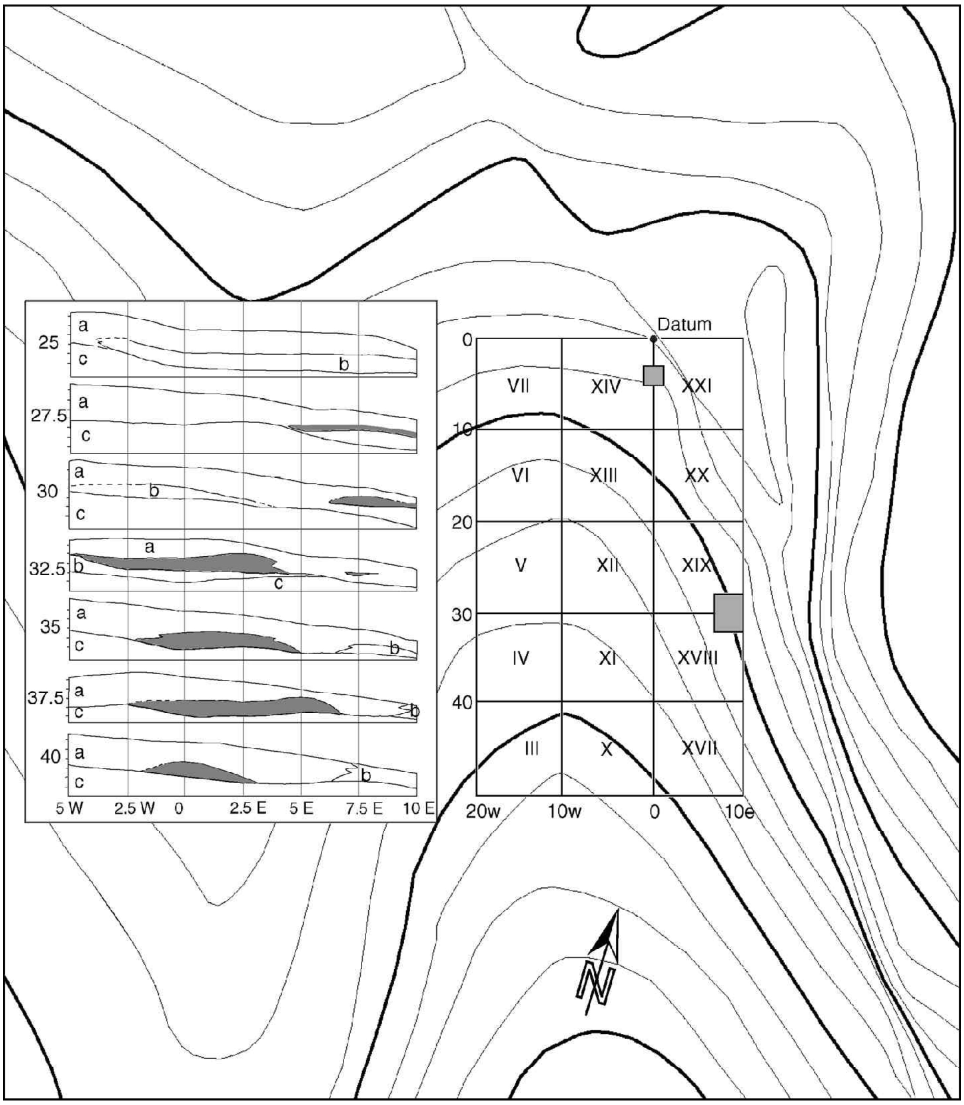

FIGURE 4. Map of Fiais. On the right is the location of the 10 m^2 grid and the two areas excavated in 1986 based on a 1:200 map prepared in July 1986 by the Gabinete de Planeamento e Gestão Urbanística, Câmara Municipal de Odemira. Heavy contour lines are 1 metre intervals. The grey area in XIV and XXI is G1/F1. The grey area in XVII and XIX is the main excavation in which the bone bed shown in Fig. 5 was exposed. On the left are sections based on a series of soil auger cores, taken at 2.5 m intervals from north to south and east to west, beginning at 25 m south of the 0 line shown on the right side. The deposits are: (a) grey brown and sandy (including the plough zone); (b) grey and sandy; (grey shading) estimated extent of midden deposits; (c) sterile yellow sand.

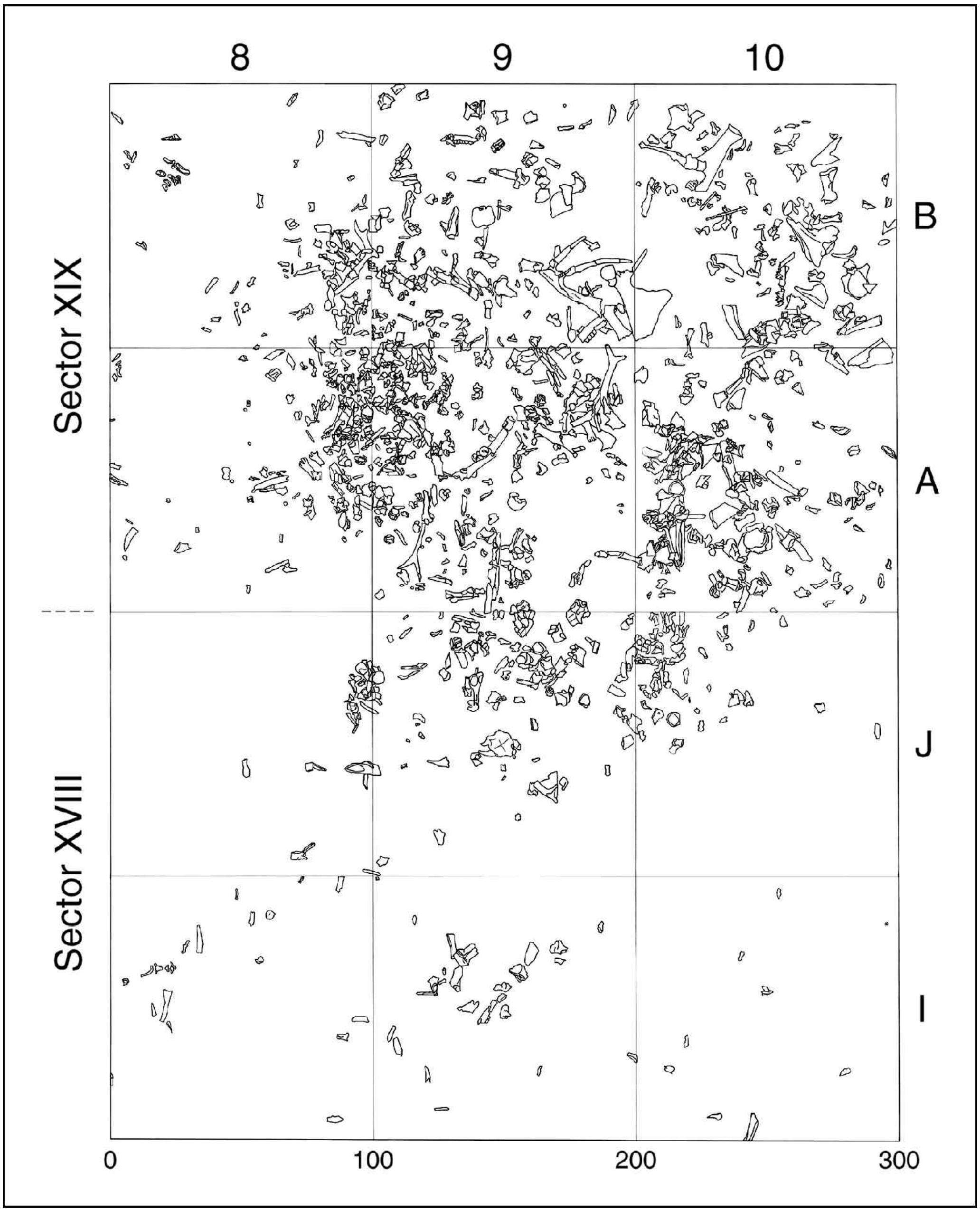

FIGURE 5. Plot of the bone bed at Fiais (prepared by J. Franco in Edmonton in 1988 using field plots by M. Jackes, R. Lello, K. Jackes and J. Woollett).

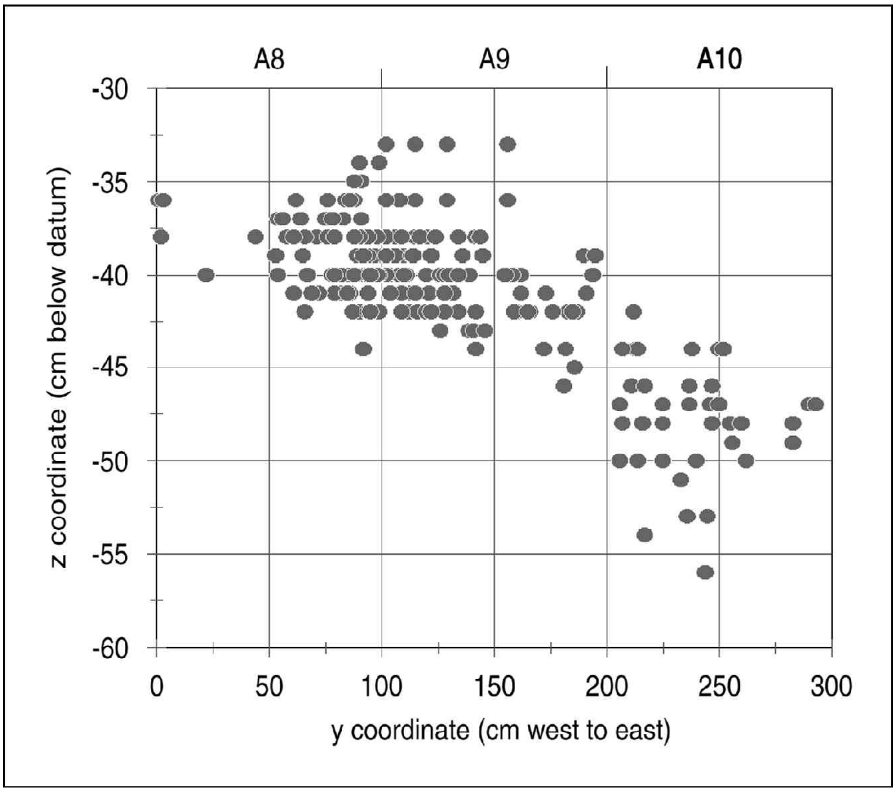

FIGURE 6. Distribution of coordinated bones between x = 40 and x = 80 in squares A8, A9 and A10, showing changes in density and dip of the bone bed. The dip appears to be correlated with the topography of the site as shown in Fig. 4.

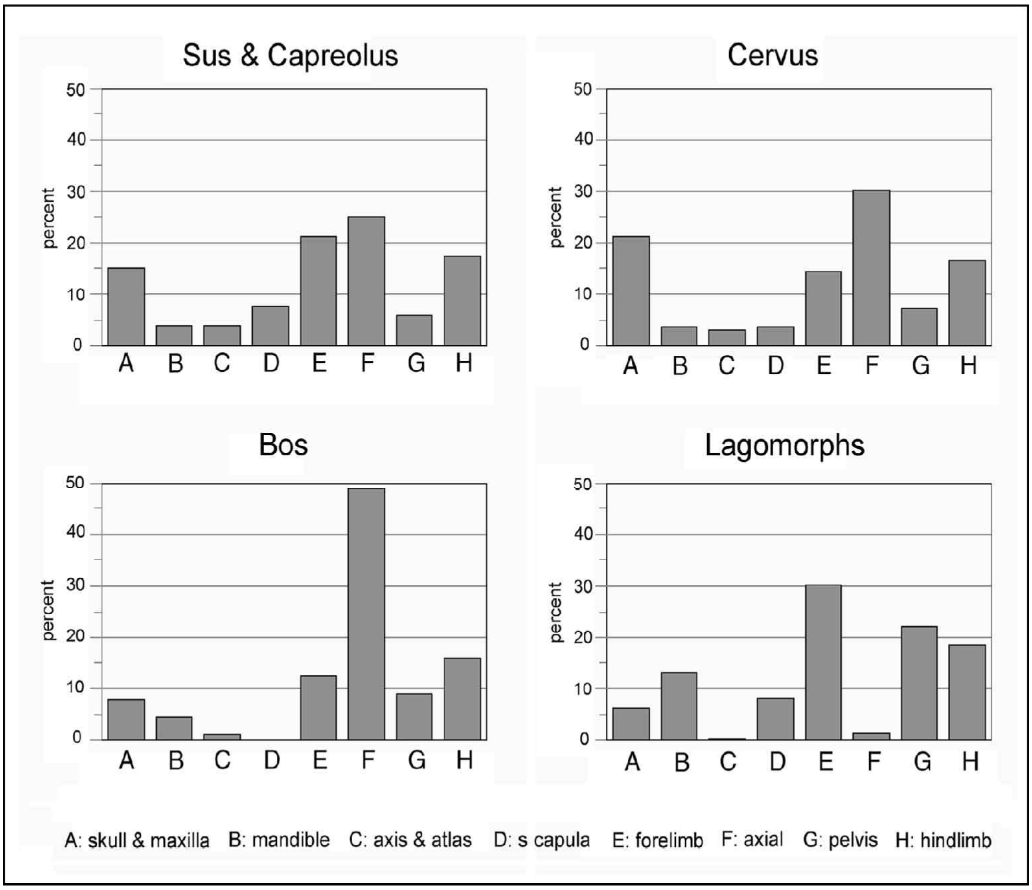

FIGURE 7. Taphonomy of the 1986 mammalian assemblage from the Fiais bone bed (see Fig. 5).
Podials, the most frequent anatomical element, have been excluded to clarify the pattern.