New analyses and dating of partial skeletons from Samouqueira I, Portugal

Mary Jackes & David Lubell Department of Anthropology University of Waterloo <u>mkjackes@uwaterloo.ca</u> dlubell@uwaterloo.ca

Christopher Meiklejohn

Department of Anthropology University of Winnipeg c.meiklejohn@uwinnipeg.ca

Rick J. Schulting

School of Archaeology University of Oxford rick.schulting@arch.ox.ac.uk

Pablo Arias Cabal

Instituto Internacional de Investigaciones Prehistóricas Universidad de Cantabria-Gobierno de Cantabria-Santander pablo.arias@unican.es

Abstract

We provide new detailed contextual information for the human remains recovered in 1984 from the coastal site of Samouquiera, Alentejo, Portugal. The main focus is on two incomplete, but at least partially articulated, skeletons of adult males. AMS radiocarbon dating places both individuals in the range 7660-7505 calBP. One of the two results is from the same individual as previously dated to *ca.* 6950 calBP (TO-130); thus, the new date for this individual is considerably older, and confirms a Late Mesolithic attribution. Stable carbon and nitrogen isotope values indicate a stronger reliance on higher-trophic level marine resoures than seen in any other Portuguese Mesolithic site. Each of the two individuals has traumatic changes which might have reduced capability to an extent which cannot be known because of the incomplete state of the skeletons. This complicates answers to any questions about coastal adaptation along the central Portuguese Atlantic coast.

Introduction

The open-air site of Samouquiera (alternatively Samoqueira) lies on the Atlantic coast of the region of Alentejo in southern Portugal, *ca.* 12 km south-southeast of Sines and 2 km north of Porto Covo. It was identified on the basis of lithic artefacts exposed in a ploughed field (Soares and da Silva 2003), now a beach parking lot. Exploratory excavations were undertaken in 1984 by a Portuguese-Canadian team (Lubell *et al.* 2007) on the section identified as Samouquiera I, to the north of a stream dividing the overall area. This section was further excavated by a Portuguese team in 1985 and 1992 (da Silva and Soares 2006). Samouquiera II, south of the stream, was excavated by the Portuguese team in 1990 and 1992. This contribution deals only with the 1984 work, focussing on the two recovered partial human skeletons. We revisit the ¹⁴C dates originally obtained from the 1984 trench, and include new information on a date published by Soares (1995) from that same trench. Two new ¹⁴C dates on the human remains are presented and other new dates from an excavation adjacent to the original trench (Soares and da Silva 2018) are put in context. Stable carbon and nitrogen isotope data are presented for the two humans.

The 1984 excavation and nature of the site

This large site, with broad areas of ploughing, extended inland from a cliff-face marking the western edge. Four 1 m^2 test pits were opened, and a 6 x 2 m test trench was excavated in Sector XII at the very edge of the cliff, to avoid the ploughed area (see Figs 1, 2B and 3A; Lubell *et al.* 2007:225, Fig. 3). Datum was a concrete boundary marker just south of the site and the datum plane lay 4 m above the marker surface. Two further squares (A19/20) were dug during the last half of the short excavation campaign.



Figure 1: Location of the site $(37^{\circ}52'12'' \text{ N}, 8^{\circ}47'36.5'' \text{ W}, \text{ image May 2013}, C Google Earth). The grid of twenty-nine 20 m² squares was established 11th July 1984 parallel to the road at 5° west of magnetic north. Excavation areas are shown in black. The site is located between two freshwater sources.$



Figure 2: (A) The trench at the time of the initial examination of SAM H1 *in situ* (photo CM); (B) Looking west to record the exact position of the trench (prior to the excavation of the A squares) (photo 84.VI.29 DL).



Figure 3: (A) The location of the excavation above the cliffs is marked by a wall of hay bales (arrow). Porto Covo is in the distance to the south (photo 84.VI.13 DL); (B) view north from Samouqueira (photo 1983 DL).

The setting of Samouqueira is unique.¹ While most other Portuguese Mesolithic sites with human remains are often called "cemeteries" and are associated with estuaries, Samouqueira is located above high sea cliffs (Fig. 3B) and the burials are not comparable to those in either the Muge (Jackes and Lubell 2016b) or Sado site complexes (Peyroteo Stjerna 2016). We recovered two incomplete human skeletons at Samouquiera, one with few articulated joints, the other certainly buried in at least partial articulation, but with an unusual mode of deposition. The human remains were accompanied by sparse faunal and lithic material and smooth pebbles (similar pebbles are found at Muge sites – Roksandic and Jackes 2014; Jackes and Lubell 2016). No indications of any preparation of the ground (e.g. hollows, as at Moita do Sebastião) for receiving the bodies were noted, although a concentration of shells was observed under the left humerus of SAM H2.

Artefacts and faunal remains were found scattered throughout the excavated deposits of the test pits and the main trench, but the absence of visible differentiation in the sandy matrix made it impossible to discern a stratigraphic sequence. Observations suggest obliteration of colour and texture distinctions by a combination of geomorphic processes and disturbance from cultivation over many years. Neither the grainsize profiles, nor geochemical analyses, nor the size distribution of lithic artefacts, showed patterning reflecting post-depositional vertical redistribution. Samouqueira seems to represent a series of intermittent occupations over a relatively long period of time during which there was rapid deposition in a low energy environment (Lubell and Jackes, 1985; Lubell *et al.* 2007).

The Human Remains

Discovery and Context

Human remains were initially excavated but not recognized on 17th July, with further finds in the following days. When the first discoveries were made, the excavators were not keeping complete coordinate records. The finding of a human molar in a screen led to a request for assistance from Jackes and Meiklejohn, who were working in the nearby village of Porto Covo on human material from Moita da Sebastião. Jackes was unable to examine the molar but on 19th July was involved in the excavation (see fig. 2A), recording, plotting, photography and identification of many of the human remains. She also examined the contents of faunal bags and screens for further human material.



Figure 4: South profile after plots by Julio Costa. The numbers are cm bd (below datum) recorded by DL: x marks the approximate location of SAM H1 on the southern side of F19.

The area with the human remains was within the trench in level 2. The four levels in the trench (C.1 to C.4) are shown on the south profile drawn 27^{th} July 1984 (Fig. 4): the two partial skeletons lay on a relatively flat surface within level C.2. The human bones (see Appendix 1) were disturbed and in many cases apparently moved out of the original context, perhaps by earlier agricultural working of the soil. Burrowing of the type clearly evident at Fiais (Lubell *et al.* 2007) was not observed near the human remains. Both skeletons were

¹ The direct association with the perforated rock \sim 35 m offshore from the 21st century cliff face (Fig. 2B) is perhaps fortuitous, although the hole could be the remnant of a cave. A recent sign at the beach warns of the dangers of eroding cliffs, and waves of over 10 metres were recorded during 20th century storms along the Portuguese west coast (Ferreira *et al.* nd).

east of the major break in slope of the C.2 upper surface which occurred approximately at the F19/E19 line (Fig. 4). While slope wash must be considered, it should be noted that there is across slope, rather than down slope, movement. Nevertheless, Fig. 5 demonstrates the apparent westward movement of some elements (i.e., towards the sea but in a level area), probably from SAM H2. The right humerus in F20 and the SAM H1 right humerus together suggest that most of the human material in F20 would have been displaced from SAM H2 rather than from SAM H1. In other words, the F20 right humerus no doubt belongs to SAM H2, indicating movement to the west.



Figure 5: The distribution of human bones at Samouqueira (where known). The orientation of the photographs (84.VI.1; 84.V.30; 84.V.31 DL) follows the two available plots (drawn by JC and MJ).

The presence of two individuals is demonstrated by several instances of doubled bones – two right ulnae, two left radii, and two left humeral shafts as well as the two right distal humeri. Both were probably male, based on comparison with material from Moita do Sebastião (Lubell and Jackes 1985, Table 5). The left humeral and right ulnar shafts suggest that SAM H1 was slightly more robust than SAM H2. Besides the measurements reported in 1985, there are also length measurements for metacarpals, and they are above the Moita means (Table 1). An additional figure is for the SAM H1 right MTI: at around 57 mm, it was longer than the Moita right MTI mean length of 55.5 mm (sd = 3.28, n = 13).

	Moita do	Sebastião		Samouqueira (SAM H2)		
MC	mean	sd	n	right	left	
Ι	41.84	2.65	21	46 ^a	43°	
II	62.47	3.44	17	66	65	
III	61.96	3.77	17	66	65	
IV	56.29	2.71	4	-	-	
V	52.34	3.58	8	52	-	

^a estimate; ^b pathological

Table 1: Moita do Sebastião, pooled sex and side, metacarpal dorsal lengths (mm) for comparison with SAMH2.

Description and Analysis of the Burials

Samouqueira H1

The SAM H1 skeleton was highly fragmented, making it hard to confirm the original posture at burial. Some joints had clearly lain in articulation – at the right elbow, demonstrating that the arm lay palm upwards, and at the right ankle indicating a leg in dorsal decubitus (Fig. 6B). It might be possible to construe the position of the right knee outside the right elbow as indicating hyperflexion of the femur on the hip, somewhat reminiscent of instances at the Muge sites of Cabeço da Arruda or Cabeço da Amoreira (e.g. Jackes and Lubell, 2012, 2016, Roksandic and Jackes, 2014).



Figure 6: Samouqueira H1 bones viewed from the west, oriented to accord with a plot drawn by JC. The location of each bone as listed and numbered in Appendix 1 is seen, although not every bone is visible in both photographs. (A) SAM H1 initial excavation (photo 84.V.31 DL);



Figure 6 (B) SAM H1 after further excavation (photo 84.V.34 DL), showing the location of the right humerus (16), proximal ulna and shaft (15) and the two pieces of the right radius (17, 19). The tape is extended to 50 cm.

Figure 7: The east half of square E19, viewed from the west, showing the 24 cm long *Bos* tibial shaft fragment used for Beta-11722 (photo 84.V.35 DL). The material here was exposed 19th July and had a mean depth of 642 cm below datum, range 638-648 cm (n = 11). None was human.

As Appendix 1 makes clear, a limited array of skeletal elements was found, mainly ankle and foot bones and fragments of long bones, especially from the right arm and right lower leg. For a complete burial with soft tissues maintaining joint articulations, we should have found the proximal femora, the innominates and the sacrum still present in the vicinity of the articulated elbow and ankle. There can be no easy answer for the absence of these bones, or of vertebrae. Excavation in F19 on the 19th July, after the SAM H1 bones had been lifted, revealed only isolated non-human finds at depths from 637 to 642 cm below datum (bd). The adjoining section of E19, having apparently yielded only three skull fragments (perhaps on 18th July, see Appendix 1; the molar might also have been found in E19 on the same date), was also excavated on 19th July (Fig. 7), and was dug to 657.5 cm bd by the end of the season (27th July), well below the level of SAM H1 (Fig. 4). There is no reason to believe that there was increased slope at the SAM H1 level in E19 causing the missing bones to have been washed down to the west. The example of the SAM H1 right fibula fragment N° 10 having moved to the north from F19 is noteworthy. No mention is made of the discovery of further human bones in any Samouqueira location in discussions on later excavations (Soares 1995: 30-31; da Silva and Soares 2006:135; Soares and da Silva 2018).

No clear modern plough marks were evident, despite the shallow depth of SAM H1 (Fig. 2A and Fig.4), but disturbance is evident, suggesting earlier sediment reworking. For example, the right radius was found in two pieces – one (Fig.6B, bone N° 19) had rolled across to the medial side of the distal ulna, but the proximal portion (Fig.6B, bone N° 17) was displaced beyond the distal humerus.

The right MT II and III were found in the screens: it is not known where they were found or when they were lifted. The position of the right MT I (bone N° 1) is approximately known. It is shown in Fig.6A – in Fig. 6B the tape case covers its position before lifting – but it was plotted as lying closer to bone N° 17, apparently overlying the non-human fragment, N° 20. Whatever its exact location, the bone must have been dragged from its original position beyond the right talus (bone N° 5). Similarly, bone N° 2, the left MTIV, was dragged away from a location distal to the talus. It was also moved after excavation but before being photographed: it may not have lain as in Fig. 6A because it was plotted as abutting bone N° 19, i.e., by a fragment of the right radius.

As mentioned above, dragging, rather than slope wash, can be deduced from two fragments of the right fibula: bone N° 10 was found 65 cm north of the rest of that one fibula (N° 4, Fig. 6A marked by an asterix). Bone N° 8, the right patella, was plotted as noted in Figs 6A, B, beyond the right talus.

Pathology

The right arm was pathological (Fig. 8): a major fracture of the right distal humerus had led to osteomyelitis, the result of infection. The distal portion was deflected medially and the trochlea had rotated anteriorly. This had consequences for the radius, with the superior flexor pollicis longus origin being unusual and strongly developed. The attachment is to the anterior portion of the diaphysis beside the interosseous membrane: a possible explanation is that the elbow was held still, in a relatively fixed position to avoid pain, while the thumb was used to a greater extent than normal for reaching and grasping.

The medial left clavicle had a marked deltoideus insertion, the conoid tubercle was strongly developed and the pectoralis major insertion was well marked, indicating that the left shoulder was heavily used, perhaps to protect the right arm.

There is no suggestion here that the trauma to the humerus was caused by interpersonal violence: other Mesolithic Portuguese forearm and elbow abnormalities have been considered to result from childhood injuries (Jackes 2014). In this case, the fracture probably resulted from a fall.

The right MT III retrieved from the screen had bone reaction and destruction which showed most strongly, when radiographed, in the proximal volar portion of the bone. The indication is of an infection in the sole of the foot, perhaps a consequence of gathering sea urchins and other molluscs in the rock pools below the site and piercing the sole of the foot with a spine, shell or sharp rock.



Figure 8: Samouqueira H1 pathological distal right humerus, with radiograph. Photo DL.

Samouqueira H2

The positioning of the arms of SAM H2 is difficult to ascertain. The left distal humerus (N° 14) lay with the anterior surface facing up as seen in Figure 9 but the forearm and wrist were rotated. This means that the posterior surface of the radius (N° 17) is shown in the photograph and the palm of the hand is facing down. The thumb side, that is the radial side, has the left MC II and MC III in the correct positions, but the left MC I (N° 10) lies as though flexed under and beyond the left MC III (No. 8) to a degree not possible with complete soft tissue integrity. The left humerus could have rolled out to the side during decomposition: it is pinned in position by the right arm but decompositional movement in the right arm could have pushed against the left humerus. Nevertheless, there is the indication from the left MCI that soft tissues could have been partly decomposed when the body was placed for burial.

The right elbow (represented in part by the distal humerus fragment N° 13) is lying across the proximal third of the shaft of the left humerus. The right forearm could have moved during decomposition. The lateral surface of the ulna (N° 3) is exposed and the radius (N° 1) has rolled across to show its posterior surface. The right MC I lies correctly on the radial side, followed by the MC II and MC III, but the MC IV was not found. The right MC V (N° 2) was lying beside the right ulna with the palmar surface up, instead of the dorsal side as with all the other metacarpals – thus the MC V was pulled proximally and flipped over.

We might infer that SAM H2 was laid down in left lateral decubitus, not typical for the Muge sites: Cabeço da Amoreira skeletons CAM 2011-2 and CAM 2012-3, both in left lateral decubitus (Umbelino *et al.* 2016), are the best documented of the apparently very rare examples of lateral burials. However, some Sado bodies were laid on the left side (Peyroteo Stjerna, 2016). SAM H2 bones were still in partial articulation at burial, but the burial posture was unusual. Our interpretation is that the individual was on his left side, with his left arm raised above and beyond his head. Then the right arm fell across the torso and beyond the face suggesting that the body was not laid out in a defined burial posture, but simply placed down roughly, well after rigour had passed, with some tissues partly decomposed. In other words, while one can postulate

decompositional movement in the case of some bones, e.g., perhaps at the left elbow, there is also the suggestion of burial after a certain amount of decomposition had already taken place. It is doubtful that the skull was, in fact, in close association with the arm bones.

The mean level for the SAM H2 bones was 638 cm below datum, and the bottom of the smooth oval cobble close to the left hand (Figure 9) lay at 642 cm bd. While some bones of SAM H2 possibly ended up to the west in F20, they apparently did not lie at a lower level than the SAM H2 bones in G20 (based on the beginning elevation for F20, NE corner, 19th July) and no further bones were found when F20 was taken down several centimetres. Again, there is little evidence of movement of bones via slope wash. As with SAM H1 there is no simple explanation for the missing skeletal parts.

Pathology



Figure 9: Samouqueira H2 (G20): bones numbered as in Appendix 1 (photo 84.VI.1 DL). Note the shell concentration around the left humerus.

SAM H2 suffered severe arthritis at his right wrist. Since no carpal bones were present, we can gain only a partial idea of the extent of the problem. The distal joint surface of the right radius has a very heavy build-up of reactive bone around a central area of eburnation (Fig. 10), meaning that the cartilaginous protection of the joint had been destroyed so that bone was grinding on bone. Furthermore, the right ulna, MC I and III provide clear evidence of arthritic changes, as do the left distal radius and ulna and the left MC III (Lubell and Jackes 1985). The area of attachment of the joint capsule of the damaged right distal humerus - likely to belong to SAM H2 - has lipping along the margin of the septal aperture. The left humerus shows no changes to the joint surfaces, suggesting that this is not a condition, but one related systemic especially to trauma to the right arm. Use of either arm would have been difficult and painful.



Figure 10: Samouqueira H2 right radius which had a distal transverse diameter of 29 mm (bone No.1, Appendix 1). Despite the poor quality of the image, pathology of the distal joint surface is evident. The surface for articulation with the lunate has post-mortem damage, but the arthritic changes adjacent to the radial styloid process are clear (cf. Fig. 8 where the abnormality of the joint surface can also be seen). Photo MJ.

Dating the Site and the Burials

Dating of both the site and burials has been the subject of some disagreement, partly because of the ¹⁴C dates on material derived from the 1984 excavation (Meiklejohn *et al.* 2009). We can now confidently identify the burial context as Mesolithic: the archaeological association of the burials has been clarified by two new dates presented here. In addition, we note the recent publication of three other dates, two on marine shell and one on terrestrial mammal bone, by Soares and da Silva (2018).

(a) ^{14}C dates from the 1980s work

Three dates, from different laboratories, were obtained in the 1980s (Table 2).

sector, square, level	Lab ID	material	δ ¹³ C (‰)	¹⁴ C yr BP calBP (95.4%)	
S. XII, E19, C.2a	Beta 11722	tibial shaft <i>Bos</i> sp.	-17.0	5190±13 6272-5661 0	
S. XII, F20, C.2a	TO-130 ^a	human: SAM H1 fibula	-15.3	6370±70 7180-6750 ^b	
S. XII, D19, C.3b	ICEN-729	Patella sp.	-0.06	7520±60 8010-7740	

^a TO-130 was wrongly ascribed to SAM H2 in Lubell *et al.* 1994 and Jackes and Lubell 2016a: the sample was called "Samouqueira 2" on the submission forms, following sample 1, the *Bos* tibia sent to Beta.

^b calculated using δ^{13} C terrestrial and marine end points of -20‰ and -12‰, respectively (Richards and Hedges 1999), resulting in an estimated marine dietary contribution of 59%; $\Delta R = +95\pm15$ (Monge Soares and Dias 2006:59)

Table 2: Results of the original analyses of the Samouqueira bones and shell. Calibrated in OxCal v4.3 (Bronk Ramsey 2019).

The shell date (ICEN-729) was initially published by Soares (1995, 1996). The sample used was no doubt excavated in 1984 when level C.3b was identified in D19. Soares (1995: 30-31) specified that the date is

associated with this Mesolithic location which she termed Samouqueira I.² The corrected date has been published as 7140±70BP (Soares 1996, Table 7; Soares and da Silva 2003, Table 2; da Silva and Soares 2006), but that information is superseded by the following details for which we thank Dr. António Monge Soares. The sample, with the provenance as in Table 2, was composed of whole *Patella* shells. The outermost 30% by weight of the shells was discarded by controlled acid leaching (0.5M HCl at 25°C). Controlled acid hydrolysis was used to separate approximately equal volumes of CO₂ representative of the intermediate fraction and the inner fraction of the shell carbonate structure. The ¹⁴C content was measured by the liquid scintillation technique and stable isotope values (δ^{13} C) were determined for the CO₂ gas produced at the initial stage of benzene synthesis.

The intermediate fraction dated to 7600±60 ¹⁴C BP, δ^{13} C -0.26‰, and the inner fraction to 7520±60 ¹⁴C BP, with a δ^{13} C value of -0.06‰ (ICEN-729). The dates are not statistically different and Monge Soares (*in litt.* 21st August 2017) considers ICEN-729 to be "highly reliable". Its calibrated age is 7950-7825 calBP at 1 σ and 8010-7740 calBP at 95.4% confidence using OxCal 4.2 with the Marine13 calibration curve (Reimer *et al.* 2013) and a local Δ R offset of 95±15 ¹⁴C yr as specified by Monge Soares. The date clearly is from a Mesolithic context.

The faunal date (Beta-11722), on a large *Bos* tibia (Fig. 7), was first published by Lubell and Jackes (1985: 115), and has raised questions. A Beta report on 6^{th} February 1985, stated "insufficient carbon for analysis". In reference to a second attempt, Murry Tamers of Beta Analytic Inc. (*in litt.* 10th May 1985) stated that the sample was "very small", despite the fact that the submitted sample weighed 150 g. Reports of the same date on the second analysis specified that this was "an early use of the AMS (accelerator) technique".

Recent discussions about early Beta analyses (Jackes and Lubell 2015; Jackes *et al.* 2014) include questions about how the δ^{13} C value was generated. In 1985, Beta charged for separate δ^{13} C analysis for a charcoal sample (Medo Tojeiro, Beta-11723, Lubell and Jackes, 1985)³ but there was no such charge for the -17.0‰ value reported for the *Bos* tibia. As noted in a Beta report concerning early analyses, a δ^{13} C value was "an assumed value for typical bone" unless separate analysis was requested (Jackes and Lubell 2015). However, a δ^{13} C value of -17.0‰ is unrealistically high for a terrestrial herbivore in central Portugal (compare a Muge cervid at -20.7‰, Jackes and Lubell 2015, consonant with a faunal value reported below). With the large uncertainty value and the late calibrated date (6272-5661 cal BP, 95%), we can indeed propose that the date of the tibia be disregarded. The *Bos* tibia in E19 lay at 640 cm bd, around 40 cm away from dated human bones (TO-130, SAM H1) in F19, which lay at ~635-638 cm bd. A boar tusk was also found in F19 at 638 cm bd and worked antler pieces were found in level C.2a further down-slope in C19 at 664 cm bd.

The third date, TO-130, was on skeleton SAM H1: an important issue has always been the unexpected stable isotope results. The date was part of a series for which collagen extraction and stable isotope analyses were undertaken at McMaster University by Henry Schwarcz (Lubell *et al.* 1994), the sample being submitted in March 1985. We can therefore confirm that δ^{13} C was analysed separately and not produced during AMS measurement.

The δ^{15} N result (16.5‰) was a striking outlier in Central Portuguese burials of the period, beyond other Mesolithic and Early Neolithic extreme cases, leading to speculation whether outlier individuals were characterised by disabilities (e.g. Jackes and Lubell 2016a). The percent collagen is unknown and information on the condition of the collagen is not available. Initial samples analysed at McMaster University fell within the accepted C:N atomic ratio range of 2.9 to 3.6 (Lubell *et al.* 1994: 204; cf. DeNiro 1985), but which of the submitted samples were assessed for collagen preservation is unknown. The %C value was 47.2% (Martin Knyf, *in litt.* 23rd March 1992), but Jackes and Lubell (2015) note that there were early difficulties in the McMaster laboratory with measurement of nitrogen content.

²Soares has also stated (1996:115) "*A camada arqueológica mais profunda (C.3) foi datada a partir de amostra de Patella spp. recolhida no Q.P2 do S.XXXI*" which would indicate a provenance 40-60 metres further north and outside the 1984 grid of twenty nine 20 m² squares.

³ At that period, Beta δ^{13} C analysis for normalisation, correction for isotopic fractionation, required additional payment (Jackes and Lubell, 2015).

b) New ^{14}C dates from the human material



OxA-36994

ICEN-729

7800

8000

calBP

7600

Figure 11: A) right patella (bone No.8) from SAM H1 and B) left MC I from SAM H2 (bone No.10) chosen for analyses reported here (photos PAC).

Figure 12: Comparison of the new human bone dates with that from a sample of *Patella* sp. Dates plotted in Calib 7.0.4 (Reimer *et al.* 2013) with a local marine reservoir offset of $+95\pm15$ yr.

Given the issues arising from the earlier analysis of SAM H1, a discussion among Jackes, Lubell, Arias and Schulting in September 2015 led to agreement that Arias would arrange to visit the Setúbal Museum and choose, with permission from Joaquina Soares, samples from the human material for new analysis (Fig. 11). Apart from the general questions surrounding the dates and stable isotope values, there was also the issue that the human bone sample, TO-130, provided a date, *ca.* 6950 calBP, very close to the accepted timing of the transition from Mesolithic to Neolithic in this part of Portugal (Carvalho 2010), although the stable isotope results indicated one of the highest contributions of marine protein known for the Portuguese Mesolithic.

8400

8200

The results (Table 3) show that the previous δ^{15} N value of 16.5‰, while very high, is approached by the new values, both at 15.7‰, still well beyond all other reported Portuguese Mesolithic δ^{15} N values (see below). There can be little doubt that the individuals buried at Samouqueira were strongly reliant on marine protein for dietary resources. In addition, the new dates suggest a mean age for both individuals of *ca*. 7600 calBP, considerably older than the TO-130 date and well before the Mesolithic-Neolithic transition in the area.

1 7400

MM 27:1 (December 2019)

Individual	Lab ID	¹⁴ C yr BP	δ ¹³ C (‰)	$\delta^{15}N$ (‰)	C:N	Marine Contribution % ^a	calBP (95.4%)
H1 patella	OxA-36994	6995±36	-15.9	15.7	3.3	51	7700-7490
H2 metacarpal	OxA-36936	7015±38	-15.2	15.7	3.3	60	7690-7475
H1 & H2 R_combined	OxA-36994, 36936	7004±27	χ^2 df=1, T=0.036(5% 3.84)			7700-7510	

^a calculated using δ^{13} C‰ terrestrial and marine endmembers of -20‰ and -12‰, respectively, with ±10% uncertainty; note that the marine endpoint of -12‰ may be too high for coastal Portugal (see below), in which case the contribution of marine protein in the diets of these individuals would be even higher.

Table 3: Results of new analyses of the Samouqueira skeletons and calibrated age ranges before the present using OxCal 4.3 (Bronk Ramsey 2019) with mixed Intcal13 and Marine13 curves (Reimer *et al.* 2013) and a local reservoir offset of $\Delta R = +95 \pm 15$ yrs (Monge Soares and Dias 2006:59).

c) New ¹⁴C dates from non-human material

Finally, we note the recent publication of three dates on non-human material, two on marine shell and one on terrestrial mammal bone, by Soares and da Silva (2018). We might presume that all three dated samples come from the same square, identified as S.XII, D18 in Soares and da Silva (2018, Table 1). However, the comparable marine mollusca distribution specified in that paper was earlier stated to be from S.XII, E18, C.3 (Soares 1996 Table 3). When calibrated, using ΔR 95±15 ¹⁴C yr for the shells, as specified by Monge Soares, the three shell dates (i.e., including ICEN-729) are statistically the same (8000–7828 calBP at 95.4% confidence, χ^2 -test, df=2, T=0.7(5% 6.0)). The mammal bone confirms that the δ^{13} C value associated with the Beta-11722 date for the Samouqueira bovid (Table 2) is unlikely to be correct.

Sector, Level	Square,	Lab ID	Material	$\delta^{13}C$	¹⁴ C yr BP	calBP (95.4%)
S. XII, D18 (Lower laye	s er)	Beta-452075	Terrestrial mammal bone	-20.6‰	7120±30	8006-7870
Lower laye	r	ICEN-1232	Patella sp.	0.0‰	7550±60	8046-7769
Lower laye	r	ICEN-1233	Thais haemostoma	+0.39‰	7590±60	8110-7821

Table 4: Results of most recent analyses of Samouqueira bones and shell (Soares and da Silva 2018). The ICEN dated samples may come from S.XII, E18, C.3. Calibrated in OxCal v4.3 (Bronk Ramsey 2019) using a local reservoir offset of $\Delta R = +95 \pm 15$ yrs for the shells (Monge Soares and Dias 2006:59).

Discussion

As noted above, the new ¹⁴C determination of *ca*. 7610 calBP (OxA-36994) for SAM H1 is significantly older than the previously reported date of *ca*. 6975 calBP (TO-130), which is now retracted. The difference may relate to the improved removal of younger contaminants (e.g., soil humics) by the ultrafiltration process now in place at Oxford (Brock *et al.* 2013). The two new OxA dates on individuals SAM H1 and H2 are statistically indistinguishable (χ^2 test, df=1, T=0.036(5% 3.84)), with a mean pooled age of 7004±27 ¹⁴C yr BP. We can therefore postulate the burial of two adult males around 7600 calBP, both with traumatic

sequelae, both incomplete when discovered. Whether buried at exactly the same time cannot be known, but it is of interest that they lie within two metres of each other in a large site, with the surface find spread suggesting an area of *ca*. 120m by 140m (Lubell and Jackes 1985).

The earlier radiocarbon determinations for the faunal samples (e.g., ICEN-729 at ~7900 calBP, Fig. 12) suggest use of the site intermittently for at least four hundred years. As noted above, the ICEN-729 sample consisted of a number of whole shells: a single shell could have been dropped by a bird or thrown up by a storm but, in fact, the most common shellfish in Bed 3 was *Patella* $(44.9\%)^4$. Together with evidence of fish, turtles, lizards, birds and terrestrial mammals, as well as lithics, the suggestion is of at least intermittent occupation, perhaps short-term and seasonal, over a long period. That there were indeed short-term occupations is supported by the nearby small coastal site of Medo Tojeiro (Lubell *et al.* 2007), with evidence for use of marine resources only.

The differences in the δ^{15} N values for the two SAM H1 analyses could result from the fact that the fibula is a compact bone with very little trabecular tissue, whereas the patella has thinner cortex and relatively more trabecular bone. Sealy *et al.* (1995) demonstrate different levels of δ^{15} N between rib and femur in two individuals who had migrated, with a resulting marked change in diet. They postulated that ribs "with their greater proportion of cancellous bone, reflect changes in diet during later life to a greater extent than slow remodelling compact bone" (*op cit.* 298). In this case, however, it is the SAM H1 bone with a greater compactum proportion that apparently showed a higher δ^{15} N value. We can only speculate as to whether SAM H1 had actually had a higher marine content to his diet earlier in life and had come to rely more on terrestrial resources with increasing disability. The indication is that he had spent many years on the coast: Hedges *et al.* (2007) show that collagen turnover rate varies, differing markedly between adolescents and adults in males and reflects a long period of life, more than ten years, especially in males.

An alternative possibility is that the divergent results may be due to problems with the original $\delta^{15}N$ value. In 1986 Henry Schwarcz undertook to improve the collagen of three Cabeço da Arruda samples: re-analysis after further removal of humic acids showed that only the $\delta^{13}C$ values were altered (in two cases) while the $\delta^{15}N$ values (and the dates) did not differ. In addition, repeat stable isotope analysis of two samples (Lagar I and Amoreira 2000-01), with the collagen extraction and isotope analyses done by separate laboratories 15 years apart, gave consistent results (Jackes *et al.* 2016, Jackes and Lubell 2016a). Nevertheless, interlaboratory $\delta^{15}N$ values can be considerable: the difference in results between the two $\delta^{15}N$ analyses for SAM H1 approaches, but does not quite reach, the level suggested as indicating biological information rather than inter-laboratory differences (Pestle *et al.* 2014). The difference is certainly less than a noted indication of change in diet demonstrated by a comparison of rib and femur values (Lamb *et al.* 2014).

The δ^{13} C and more particularly the δ^{15} N results suggest a diet strongly based on high-trophic-level marine resources, constituting an estimated 60% of dietary protein (Table 3). By contrast, the highest Sado δ^{15} N values range from 13‰ to 13.5‰ (Peyroteo Stjerna 2016). The highest Cabeço da Amoreira result, at 13.9‰, is that of a young child around two years of age (Umbelino *et al.* 2016), and hence possibly still reflects a partial or residual breastfeeding signal (Jackes *et al.* 2016). Peyroteo Stjerna (2016) reports a value of 14‰ for Moita do Sebastião 25: this individual is also an infant (Jackes and Lubell 2016b Fig. 5). The highest reported Cabeço da Arruda δ^{15} N value is 12.5‰. The unique position of the two Samouqueira individuals is apparent when plotted against other Portuguese Mesolithic humans (Fig. 13). While only two values, they hint at a more marine-focused life on the Alentejo coast.

Soares *et al.* (2017: 32) have stated that Samouqueira I was a large base camp, though this can be questioned since the site was unprotected from winter storms, in a location markedly different from the contemporary inland estuarine late Mesolithic Portuguese sites which are more likely to have been base camps, as suggested by the palaeodemography of Cabeço da Arruda (Jackes and Meiklejohn 2004). Indeed, Marques-

⁴ The figures given by Soares (1996) differ from this. Her sample consisted of 264 g of Bed 3 marine shell from one square. The 1984 Bed 3 *Mytilus*, *Patella*, *Cerastoderma* and *Thais* sample of 9107 g referred to here was derived from the >2 mm fractions of 19 one litre bulk samples from all squares, identifications by Achilles Gautier (see Lubell & Jackes 1985; Lubell *et al.* 2007).

Gabriel (2015:255-56) concludes that the overwhelming majority of fish species from Samouqueira indicate a spring to summer catch. Movement to more sheltered winter habitation areas is possible, but no such site is known in the vicinity: "occupation in the winter cannot be demonstrated" (Lubell *et al.* 2007: 214) at Fiais, along the estuary of the Mira River, located some 16 km to the south. The shell midden at Vidigal, certainly occupied around 7675-7416 calBP (94.7% confidence; Ly-4695, 6640±90 on bone collagen, LeGall *et al.* 1994) with limited mammalian fauna that suggests an occupation in the early spring (Straus *et al.* 1990). It is true that there are sites with winter habitation based on the fauna: Cabeço do Pez, far inland from the sea on the Sado River, around 58 km from Samouqueira as the crow flies, has winter kill fauna (Rowley-Conwy 2015). But the δ^{15} N values for Muge and Sado sites (Figure 12) do not indicate the long years of consumption of coastal resources suggested by the Samouqueira burials.

Soares and da Silva (2018) propose that a coastal plain of ca. 1 km in width may have existed below the Samouqueira cliffs at the transition to the Middle Holocene (proposed as 8200 calBP, Walker *et al.* 2012). But a coastal plain seems unlikely, based on the work of Alday *et al.* (2006). Their study of sediments 3.5 km inland from the present mouth of the Mira River demonstrates that "an open-marine environment", representing the Holocene transgressive maximum, characterized the area from before 8000 calBP until after 6500 calBP (using the 95.4% confidence ranges for the stage C ¹⁴C dates, Beta-167493 and Beta-181920). Marques-Gabriel (2015:310) notes that the fish remains from Fiais (now over 10 km from the modern coast) are comparable to those from Samouqueira and Vidigal, though the percentage representation of the main taxa, Chondrichthyes, Triakidae, Lamnidae and Sparidae differs among the sites.



Figure 13. Plot of δ^{13} C and δ^{15} N values on human bone collagen from Mesolithic Portugal (data from: Lubell *et al.* 1994; Roksandic 2006; Bicho *et al.* 2013; Fontanals-Coll *et al.* 2014; Guiry *et al.* 2015; Peyroteo-Stjerna 2016). Four infants from the Sado and Muge are excluded as they may be subject to a nursing effect. The vertical and horizontal lines mark the proposed limits for the significant consumption of: marine resources (upper right quadrant, URQ); freshwater aquatic resources (ULQ); C₄ or in this case, low-trophic-level marine/estuarine resources (LRQ); and terrestrial resources (LLQ). Average ± 1SD modern flesh values (adjusted by +4‰ for δ^{13} C to make values more comparable with pre-modern bone collagen) on fish/crustacean (n = 523) and bottlenose dolphins (*Tursiops truncatus*) (n = 7) from coastal Portugal are shown for comparison (date from: Borrell *et al.* 2006; França *et al.* 2011; Vinagre *et al.* 2012; see Schulting in press for discussion). Herbivores (n = 29) are from Neolithic/Chalcolithic sites (Guiry *et al.* 2016).

The issue of whether or not Samouqueira was on the coast, above cliffs and rock pools, is relevant to the types of marine resources easily available for consumption. The shellfish assemblage, apart from rare Cerastoderma edule, represents a rocky coast habitat (Lubell et al. 2007), as does the barnacle Pollicipes pollicipes (Soares and da Silva 2018), a crustacean that clings to intertidal rocks. An analysis of the fish assemblage by Marques-Gabriel (2015:255-56) indicates the presence of a limited sandy shore, but many of the fish also, or exclusively, inhabit areas with a rocky substrate. The coastal environment was clearly similar to that illustrated in Figure 1. In terms of shellfish, Samouqueira was somewhat comparable to Vidigal (about 6 km distant), which also had Stramonita (Thais) haemastoma and Mytilus, but close to 80% of the Vidigal shells belonged to Patella (Straus et al. 1990: 471). As with Samouqueira, mollusc shells far outweighed mammal bone, even though it, like Vidigal, included Bos primigenius. While fish bones make up a small collection in terms of weight, it must be noted that many of the most common fish at these sites are cartilaginous. The Samouqueira cartilaginous fish are represented only by vertebrae, but the Sparidae by cranial elements, particularly the premaxilla and the dentary (Marques-Gabriel 2015:255). Whether we have a full picture of the icthyofauna is an important question, given limited excavations and taphonomical concerns. More pressing is the need to have more information on the $\delta^{15}N$ values of the fish. For example, specimens of modern Diplodus vulgaris (a sparid seabream, common on eastern Atlantic rocky coasts, feeding on crustaceans and molluscs) from the Mira estuary exhibit a mean δ^{15} N value of 14.6 ± 2.6‰ (França *et al.* 2011:208, Mira sample), which would contribute to higher δ^{15} N values in human consumers of this resource. Sparidae (including *Diplodus vulgaris*), are the most frequent fish at Samouqueira 1 based on the %MNI (Marques-Gabriel 2015:249) and would have been available in the spring and summer (see also LeGall *et al.* 1994 on Vidigal). Similarly, high δ^{15} N values ranging 13.2‰ to 13.6‰ were established for four species of fish collected in central Portugal in the late 1980s and analysed by Henry Schwarcz (in litt. 17th August, 1990), again implying higher values in constant consumers.

Summary

Two partial skeletons were uncovered at Samouqueira I. SAM H1 is likely to be male, based on the tibial measurements, while SAM H2 is a more robust male. The two were possibly buried around the same time, as their radiocarbon dates are not significantly different. The new dates demonstrate that they belong to the Mesolithic rather than to the complex Mesolithic-Neolithic transition period. Soares and da Silva (2015; Soares *et al.* 2016) have argued that the transition may be as early as ~7350 calBP in the Sines area, but the Samouqueira skeletons at ~7580 calBP are older. In fact, they predate the earliest known Neolithic in Portugal in either Estremadura or Algarve; Almeida (2017) notes that no Portuguese Early Neolithic dates predate 7500 calBP.

The evidence is that SAM H2 was buried with some intact soft tissue as suggested by generally *in situ* arms and hands (but lacking any carpal bones) and that SAM H1 was also dispersed, perhaps partly by dragging action during historic horticulture. SAM H2 probably had at least part of his cranium buried with him, although not in anything approaching an anatomical position. It was fragmented and dispersed when found. SAM H1 probably had a partial skull, too, although no more than a few fragments screened from square E19 were found (see Appendix 1). The dispersal, together with the excavation circumstances, makes full interpretation of the burial disposition difficult. Earlier papers on the material mention the possibility of plough action or slope wash, but deep ploughing by heavy machinery does not seem likely in the complete absence of plough marks. Nevertheless, light cultivation may well have caused movement, and wash from Atlantic winter storms is possible, although this depends on the sea level and the extent of sea cliff erosion over time. Whatever the causes, they led to something more complex than simple down slope seaward movement of skeletal elements.

Is cultivation or slope wash sufficient explanation for the condition of the two skeletons? It seems very likely that there was disturbance – perhaps, indeed, after death but before burial. Were partial bodies and body parts retrieved after the men had been washed off the rocks below the site? The position of some of the SAM H2 bones suggests the possibility that the body was not laid carefully in an approved position, but was

perhaps was placed down quite roughly, longer than usual after death.

Both skeletons are important because of evidence of trauma and subsequent pathology, unusual compared to the large Muge samples (Jackes 2004). There can be suggestions as to the original postures, but there is no explanation for the complete absence of major portions of the skeletons expected to underlie the excavated bones. Nothing like the post-burial manipulation of human remains (such as in the Capsian, Jackes and Lubell 2014) has been suggested for Portugal. Retrieval of body parts from different locations for reburial is a possibility. We were not able to extend the excavation in 1984 and circumstances allowed only cursory examination of the bones, excluding proper photography of details. The material deserves closer study, perhaps even searching for evidence of perimortem or postmortem damage or manipulation.

The earlier analyses of bones from the site raised questions as to dating and diet, but also whether individuals with disabilities were exceptional in terms of dietary regime and burial disposition. New analyses were therefore undertaken and show that these two individuals do indeed have a high marine component to their diet, indicating that they spent a good deal of the later years of their lives on the coast, rather than in estuarine or inland environments seen in other late Mesolithic central Portuguese sites. The icthyofauna for Samouqueira and Vidigal, studied in great detail by LeGall *et al.* (1994) and Marques-Gabriel (2015), indicates warm weather occupation: in the absence of additional information, the explanation for the contradiction remains uncertain. Do their disabilities and unusual burial context suggest that these individuals were somehow unique, or were there groups, as yet unknown, with distinct coastal adaptations during the greater part of each year? Samouqueira is a fascinating site providing many more questions than answers about diversity of habitation and of burial during the Late Mesolithic of Central Portugal.

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Date	Square	Source	Level	Description
17.vii	F20	faunal bag	1b	medial half left clavicle, fits with clavicle found in F20, ?18.vii, faunal bag
l7.vii	F20	faunal bag	lb	right coracoid of scapula
17.vii	F20	faunal bag	lb	right temporal process of zygomatic arch, fits with temporal (11.) from F20
?	?	screen	?	molar (not seen by MJ or CM)
18.vii	F19	excavation		SAM H1 BURIAL
The following plotted by Julio	is the list of Costa and id	bones excavated entified by MJ 19	18 th July, 9 th July).	1984 (mostly on field map N° 1: F19/F20 C.1b & 2a
18.vii	F19			1. right first metatarsal - overlay SAM H1
18.vii	F19			2. left fourth metatarsal - overlay SAM H1
18.vii	F19			3. right tibia - SAM H1
18.vii	F19			4. right fibula- SAM H1 (TO-130)
18.vii	F19			5. right talus - SAM H1
18.vii	F19			6. fragmentary right calcaneus - SAM H1
18.vii	F19			7. unidentified fragment
18.vii	F19			8. right patella - SAM H1 (OxA-36994)
18.vii	F19			9. left proximal humeral shaft - SAM H1
18.vii	F20			10. right fibula distal fragment part of 4. above - SAM H1 (Fig. 5, star)
18.vii	F20			11. right temporal fragment with tempero-mandibular joint - SAM H2(?) (zygomatic root found in faunal bag)
18.vii	F20			12. right scapula fragment SAM H2(?)
18.vii	F20			13. distal right humerus - comparable to SAM H2
18.vii	F20			14. supra-mastoid portion of left temporal SAM H2(?)
18.vii	F19			15. right ulna - SAM H1
18.vii	F19			16. distal right humerus - SAM H1
18.vii	F19			17. proximal right radius - SAM H1
18.vii	F19			18. part of 15. above
18.vii	F19			19. part of 17. above
18.vii	F19			20. non human fragment

Appendix 1: Listing of human remains from Samouqueira, 1984

?18.vii	F20			clavicle on map N° 2 drawn by JC (map not available to MJ); apparently lay below N° 13 above; fits with clavicle fragment from faunal bag (17.viii, see above)
?18.vii	E19			two parietal fragments: on field map N° 2 (not available to MJ)
?18.vii	E19	screen		fragment of sagittal suture region of parietal
18.vii	D19	faunal bag	2a	left navicular
18.vii	E19	excavation		?cuneiform at SAM H1 level
19.vii	E19	excavation	2b	phalanx II manus X=75 Y=37 Z=637
?18.vii	F19	faunal bag	2a	right second metatarsal broken in excavation, underlying SAM H1
?18.vii	F19	screen	2a	right third metatarsal, underlying SAM H1
19.vii	G20	excavation		SAM H2
The following	is the list of bo	ones on field map	o Nº 3 G2() C.2b, 19 th July 1984 (drawn by MJ).
			2b	1. right radius
			2b	2. right fifth metacarpal
			2b	3. right ulna
			2b	4. right first metacarpal and first and second phalanges of thumb
			2b	5. right second metacarpal and first and second phalanges of digit 2 (and third phalanx from bulk sample)
			2b	6. right third metacarpal and first phalanx of digit 3
			2b	7. possibly second phalanx of digit 3
			2b	8. left third metacarpal
			2b	9. left second metacarpal
			2b	10. left first metacarpal (OxA-36936) and first phalanx of digit 1
			2b	11. left ulna
			2b	12. left radius
			2b	13. distal fragment of right humerus
			2b	14. left humerus
22.vii (?)	E19	faunal bag	2b	manus: a first phalanx