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Anthracological studies in the Northeastern Sahara: methodology and preliminary results from the Nabta Playa

Introduction

This paper is concerned with the study of charcoal from prehistoric sites in the Eastern Sahara. It deals specifically with charcoal from the Early and Middle Neolithic sites in the Nabta Playa. These sites are of special interest because they provide the earliest evidence for a Saharan exploitation of plants (an African plant-food complex). The sites have also been linked to the beginnings of pastoralism in the region (Wendorf et al. 1990; 1991; 1992; Wasylikowa & Kubiak-Martens 1993 [Table 1]).

Generally speaking charcoal is one of the most common plant material recovered during archaeological excavations (Dimbleby 1978) and although its importance for radiocarbon dating has been appreciated during the last couple of decades, the realisation of its importance as regards palaeoenvironmental as well as cultural implications have lagged behind. In this paper three main aspects of archaeoanthracology are considered: the retrieval of charcoal on the site, the sampling of charcoal in the laboratory and finally the identification of charcoal with preliminary palaeoenvironmental interpretation of the taxa presence and abundance.

The retrieval of charcoals or on site sorting

From Nabta there were two types of samples:

1. Hand-picked samples: hand-picked by the archaeologists in the field from particularly rich sediments where charcoal was visible during the excavation process. The charcoal was brought to the laboratory tent in film capsules, it needed little sorting and contained practically only charcoal.
2. Bulk samples: which have supplied most of the charcoal (and the plant remains); in this case the entire sediment of each feature was brought to the laboratory tent in labelled plastic bags.

	No. of samples where taxon occurs
TREES	
Ziziphus sp.	51
GRASSES	
Sub-family Panicoideae, tribe Paniceae	
Echinochloa type	18
Digitaria type	3
Urochloa/Brachiaria type	5
Panicum type	21
Setaria type	12
Sub-family Panicoideae, tribe Andropogoneae	
Sorghum bicolor (L.) Moench subsp. *arundinaceum* (Desv.) de Wet et Harlan	30
OTHER HERBS OR SHRUBLETS	
Cyperues/Fuirena type	5
Scirpus/Schoenoplectus type	5
Rumex type	1
Cucurbitaceae	23
Arnebia type	25
UNIDENTIFIED	
Leguminosae, several types	frequent
Cruciferae ?, one type	frequent
Chenopodiaceae ?	2
Malvaceae ?	1
Capparidaceae ?	frequent
Tubers (unidentified parenchymatous tissues)	
Several unidentified fruits and seeds	

Table 1. Plant taxa identified in the 1990 collection from E-75-6 (after Wendorf et al. 1991).

Sorting was carried out as follows:

a. The bulk sample was emptied into a plastic bucket, carefully and thoroughly mixed.
b. A known volume (e.g. 250 ml) was taken at a time from one bucket.
c. This volume was sieved through a standard 1 mm sieve; the remaining sediment was resieved through a 0.5 mm sieve for smaller plant macro-remains.
d. Charcoal fragments and plant macro-remains larger than 1 mm were picked out.
e. This procedure was repeated till half of the bucket was empty.
f. The remaining half was refilled into plastic bags and reburied for later processing.
g. Samples of special interest were entirely sorted.

This systematic and intensive sorting procedure has enabled us to recover all charcoal and plant macro-remains often overlooked at other prehistoric sites in the region. The remains were precisely localised and the volume of the sediment was recorded to permit qualitative as well as quantitative analyses.

Sub-sampling of charcoals

This thorough sorting procedure left us with a large quantity of charcoal and back in the laboratory it became necessary to device a sub-sampling technique suitable for charcoal from Nabta, but which could also be applied to charcoal from other prehistoric sites in the Sahara.

The large quantity of charcoal in addition to the large number of samples recovered from each site has allowed us some experimenting with the samples. The experiments were carried out in order to determine the minimal representative size which is the smallest size category necessary for examination in order to find all taxa present in a sample, as well as the minimum representative sub-sample which is the minimum number of charcoal fragments to be examined per sample in order to meet all taxa present in the sample.

Accordingly, charcoal from sites E-77-7, E-91-1 and E-75-8 were sieved through a series of 5 mm to 1 mm standard sieves, each size category was separated and examined. However, after examining several samples only charcoals belonging to the size category of more than or equal to 2.5 mm were considered, since smaller fragments proved to be time-consuming and rarely reliably identifiable. The results of the experiments, briefly mentioned in this paper showed that the minimal size category was $\geq$ 2.5 mm and that 20% of each size category needed to be examined in order to meet all taxa present in the sample.

Analysis of charcoals from Nabta

Charcoals from 3 sites were examined:

The Early Neolithic sites E-77-7 which gave a radiocarbon date of 8963 b.p.; E-91-1 of radiocarbon dates 8500-8200 b.p. for area B; 7600-7400 b.p.

for area C. The Middle Neolithic site E-75-8 gave a radiocarbon date of 6870 ± 190 b.p. (Wendorf et al. 1991).

Charcoal was handled in the conventional way, without prior treatment, the charcoal fragments were broken and examined with the aid of a binocular to reveal the transversal, tangential longitudinal and radial longitudinal surfaces. The surfaces were then directly examined under an episcopic microscope (with incident lighting). Identification of charcoals was carried out using reference works on archaeological charcoal (Neumann 1989 a) as well as manuals of wood anatomy or trees and shrubs from the region (Fahn et al. 1986; Jagiella & Kürschner 1987) and confirmed by comparison with charred modern wood from Egypt and the Sudan in the reference collection. The results of the analyses are summarised as follows (Table 2).

TAXA	N° of samples	% of samples
E-91-1 Area B		
Acacia raddiana	2	22
Acacia ehrenbergiana	9	10
Tamarix sp	3	33
E-91-1 AREA C		
Acacia raddiana	1	6
Acacia nilotica	3	19
Acacia ehrenbergiana	1	6
Tamarix sp.	7	43
Ziziphus spina-christi	2	13
Capparidaceae	1	6
E-75-8		
Acacia raddiana	4	36
Acacia nilotica	9	80
Acacia ehrenbergiana	4	36
Tamarix sp.	8	10
Capparidaceae	2	18

Table 2.

E-77-7:
20 hand-picked samples and 4 bulks samples from which 626 fragments of charcoal were identified, some of which were in a very good state of preservation; only 1 taxon was present, namely *Tamarix sp.*

E-91-1 area B:

9 hand-picked samples were examined, more than 20% of each sample totalling to 78 fragments. Three taxa were identified: *Tamarix sp., Acacia raddiana* type and *Acacia ehrenbergiana*.

E-91-1 area C:

16 hand-picked samples, more than 20% of each sample were examined, a total of 185 fragments. Six taxa were identified: *Tamarix sp., Acacia raddiana* type, *Acacia ehrenbergiana, Accacia nilotica, Ziziphus sp.* and *Capparidacae cf. Maerua Crassifolia.*

E-75-8:

11 samples, from which a total of 522 fragments were examined. Five taxa were identified: *Tamarix sp., Acacia raddiana* type, *Acacia ehrenbergiana, Acacia nilotica* and a *Capparidaceae cf. Capparis decidua.*

Palaeo-environmental interpretation of the taxa assemblage

In order to interpret the presence of the taxa in the charcoals three qualitative approaches as defined by Smart & Hoffman (1989), were combined:

1. The identified taxa grew in the area.
2. The identified taxa indicate the plant communities growing in the area, consistently assume a relative stability of plant community composition through time.
3. The modern preferred habitats of the identified taxa indicate the type of former environments in the area.

Quantitative interpretation approach

Quantification in the form of number of fragments of charcoal has been avoided, instead, the presence of a taxon in all or most of the samples was considered as evidence that it was fairly common in the woody vegetation around the site (Godwin & Tansley 1941). However, the small amounts and/or presence in relatively small number of samples will not be used as evidence of relative abundance in the flora (Smart & Hoffman 1989). Two factors determine the unsuitability of charcoal samples for quantitative analysis: firstly, the selection by man (Western 1971; Miller 1985) which means that the amount of wood of a particular species brought to the site does not necessarily represent its relative abundance in the vegetation; secondly, burning and preservation of charcoal on the site, both of which alter the proportions of taxa in the charcoal samples (Smart & Hoffman 1989).

I will next attempt to use the presence and abundance of the taxa, for the reconstruction of the vegetation and in spite of the low number of taxa in the samples it seems plausible to try to suggest a chronology for the development of the vegetation in the Nabta playa.

During the first part of the Early Neolithic period, as interpreted from E-77-7, the remarkable presence of *Tamarix sp.* in the samples indicates an arid environment; the genus can stand drought and high salinity (Kassas 1952; Quezel

1965; Neumann 1987; 1989 a). However it also indicates the proximity of a shallow water table. A comparable situation has been described from the wells' area in the southern part of the western desert in Egypt (Bornkamm 1986) where vegetation is ground-water dependent. In addition it forms monotypic stands around wells; a similar case has been noted from the central Saharan mountains where *Tamarix articulata* grows around open water bodies in almost pure stands (Quezel 1965). This explains perhaps the absence of other taxa in the charcoal samples from this period.

During the next part of the Early Neolithic period between 8500 years and 7400 years b.p. as seen in site E-91-1 areas B and C, the situation changed considerably. The taxa combination, disregarding for a moment the presence of *Acacia nilotica* in the samples, indicates a plant formation belonging to the Acacia desert scrub (Smith 1949) or low-land savannah (Lebon 1965), the steppe of the Sahara-Sahelian zone (Le Houérou 1980) and in any case falls within the semi-desert (*Acacia tortilis - Maerua crassifolia* desert scrub) according to Harrison & Jackson (1958).

These plant formations are characterized by the presence of a variable scatter of scrub bushes up to 2 meters high interspersed with bare areas. The vegetation is described as diffuse (in contrast to desert vegetation which is contracted *sensu* Monod [1954]), very similar to that of desert wadis but evenly spread. *Acacia tortilis (=A. raddiana subsp. tortilis*) could be the only constant feature of the vegetation. There is *Acacia ehrenbergiana, Capparis decidua, Maerua crassifolia, Ziziphus spina-christi* and *Balanites aegyptiaca* on clayey soils, in addition to the perennial grass cover *of Panicum turgidum, Lasiurus, Aristida* and *Cyperus conglomeratus* and a postpluvial annual grass cover. These formations are confined to areas receiving 100-200 mm annual summer rainfall such as are met with at 15° N in the Omdurman semi-desert, Sudan (Kassas 1956).

In such an environment, non-climatic factors such as topography and edaphic factors could play an important role in controlling the amount of available water (Rognon 1980) creating specific microhabitats supplied with a volume of water out of proportion to the average rainfall received by the locality, and thus permitting the area to harbour plant species belonging to other plant formations. This would explain the presence of *Acacia nilotica* in the charcoal samples. *Acacia nilotica* grows among plants of the Acacia tall grass country (Smith 1949) in areas receiving 250-750 mm annual rainfall, in the Sahelo-Saharan, Sahelo-Sudanese and Sudanese zones, often constituting woody bells around permanent or semi-permanent fresh water surfaces (Baumer 1983) or associated with seasonally flooded basins (El Amin 1976; 1990). However, it could also be found in drier areas but confined to well-watered sites with sufficient and permanent water supply, as around or in the middle of more or less permanent ponds (Baumer 1983).

In the Nabta Playa, the depression has acted as a catchment area accumulating rainwater which combined with the artesian ground-water created an aquifer, concentrating huge volumes of water which had fallen over a large area into a permanent lake or several small ones (the oasis effect) allowing the penetration of Sahelian elements such as *Acacia nilotica*.

During the Middle Neolithic as interpreted from E-75-8, the situation has not changed much, the pertinence of the favourable conditions could be recognized in the taxa combination; the high frequency of *Acacia nilotica* in the samples indicates the abundance of the species in the vegetation around the site.

Conclusion

Charcoal from Nabta provides evidence for the presence of an Acacia semi-desert scrub in the playa during the later part of the Early and during the Middle Neolithic periods (ca. 8500 yrs-6700 yrs b.p.). It is noteworthy to mention that this part of the world belongs nowadays to the "absolute desert" (White 1986). This reconstruction of the vegetation fits in and complements the reconstruction of the vegetation in the region during the period of 10000 - 6500 yrs b.p. (Haynes 1987; Ritchie & Haynes 1987; Neumann 1989 b, 1991) confirming the northward shift of the sparsely wooded desert savanna by four degrees (450 km). In other regions, similar migrations of more southerly vegetation types have been indicated e.g.: in the Sahel (Lézine 1989).

On the other hand, the results of charcoal analysis from Nabta show the importance of the role of non-climatic factors in creating specific microhabitats harbouring species from even more southerly plant formations.

Finally, the individuality of archaeobotanical material from each site is emphasized by the analysis of charcoals from Nabta and emphasises the necessity of intensive sampling of each site as well as the extensive study of material from several sites.

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