INTRODUCTION

The following chapter deals with the analysis of charcoal fragments recovered from a number of Neolithic sites (Wendorf et al. 1991) in the Nabta depression. The charcoal fragments were collected during the 1991, 1992 and 1994 excavation seasons by two archaeobotanists (including the author) who were permanent members of the expedition and whose aim was to recover, sample and sort both macro remains and charcoal fragments from eight different sites. Seeds and fruits were found in only three sites, E-7S-6, E-7S-8 and E-91-1. In Site E-7S-6 large quantities of charcoal fragments were also recovered.

Earlier anthracological analyses in northeastern Africa were limited to the numerous publications by K. Neumann (1987, 1989a, 1989b; Neumann and Schulz 1987). These publications report the results of a study of charcoal fragments from early and middle Holocene archaeological sites along a north-south transect through the Western Desert in Egypt and northwestern Sudan. The results have mainly been used to reconstruct past vegetation on a regional scale, furnishing evidence for a major change in vegetation during the Holocene. The sites from Egypt north of 25° N covered the period from 9000 until 5400 bp (Neumann 1989b). During this period the composition of the vegetation seems to have been similar to modern vegetation, though it covered a larger area. A very arid environment has prevailed from about 6000 bp to the present. Generally speaking, during the climatic optimum (ca. 6700 bp) the vegetation zones across North Africa were 500 – 600 km north of their present position. Assuming a parallel shift in the vegetation, semi-desert conditions would have prevailed on the Selima sand sheet, while Laqiya Arbain in northern Sudan would have harbored a thorn savanna.

The results of anthracological analysis are used in this chapter in several different ways, principally for the inference of phytogeographical homologues for the plant formations indicated during the occupation phases, and to discuss the use of those plants by the prehistoric occupants of Nabta Playa. Finally, human impact on the vegetation as interpreted from the anthracological record is discussed.

MATERIALS AND METHODS

THE AIM AND IMPORTANCE OF THE SAMPLING PROCEDURE

A systematic and intensive sampling and sorting procedure made it possible to recover those charcoal and plant macro remains often overlooked in other prehistoric sites in the region; the remains were precisely provenienced, and the volume of sediment was recorded to permit both qualitative and quantitative analyses.

THE RETRIEVAL OF CHARCOAL FRAGMENTS AND FIELD SAMPLING PROCEDURE

There are two types of samples:

1. Hand-picked samples were taken by project archaeologists in the field from particularly rich sediments where charcoal was visible during the excavation process (household in situ hearths). Charcoal was brought...
to the laboratory tent in film capsules; it needed little sorting and rarely contained other materials.

2. Bulk samples that have supplied most of the charcoal (and the plant macro remains), consist of the entire fill of a hearth which was brought to the laboratory tent in labeled plastic bags. Sorting was carried out as follows:
   a. The bulk sample was emptied into a plastic bucket and was carefully and thoroughly mixed.
   b. A known volume, e.g., 250 ml, was taken from one half of the bucket.
   c. This volume was sieved through a standard 1 mm sieve, the remaining sediment was further sieved 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 using soft tweezers.
   e. This procedure was repeated until the bucket was half empty.
   f. The remaining half was refilled into plastic bags and reburied for later processing.
   g. Samples of special interest were sorted completely.

Bulk sampling was carried out in all the excavated sites. The sampling procedure ensured that all features were sampled and that at least half of the deposit from each feature was processed. This standardized sampling and sorting procedure was adopted in order to facilitate comparison within and between sites.

**Laboratory Sub-Sampling of Charcoal**

This sorting procedure left us with such a large quantity of charcoal that it became necessary to devise a subsampling technique suitable for charcoal fragments. The aim was to determine the minimal representative size category of charcoal pieces and the minimum representative sub-sample, i.e., the minimum number of charcoal fragments to be examined per sample, in order to meet all taxa present in the sample.

The sample as described in the retrieval procedure corresponds to a field sample (a sample bag of standard volume); therefore, the fill of one feature was often divided into several field samples. After the recovery and sorting of charcoal fragments, field samples were regrouped so that those belonging to the same feature, hearth or pothole were considered as a single sample.

**The Minimum Representative Size Category**

Shrinkage and fragmentation vary from one taxon to another, so that every taxon may not be represented. Moreover, during random sampling, there is a tendency to choose larger charcoal fragments. In order to make sure that charcoal fragments from all size categories were included in the subsample, we adopted the size class theory, whereby the variation in taxa size is taken into consideration. Charcoal fragments from all the excavated sites were sieved through a series of 5 mm to 1 mm standard sieves, and each size category was separated and examined. However, after examining several samples only those charcoal fragments belonging to the size category greater than or equal to 2.5 mm were considered, since smaller fragments proved to be time consuming and rarely reliably identifiable. The number of taxa identified in the different size classes in each sample was plotted.

**The Minimum Representative Subsample**

Samples containing a small number of charcoal fragments were entirely identified, but the calculation of a minimum representative sample was necessary when dealing with samples containing a large number of fragments. A simple method for the subsample selection was carried out as described in Smart and Hoffman (1988:176). In each site, all charcoal fragments were examined in the first few samples, and for each sample the cumulative number of taxa was plotted against the percentage of charcoal fragments examined. In this way several curves were obtained, and the point at which the curve levels off indicated the percentage of identifications required to find all the taxa in the samples. This percentage could then be used to define the subsample size for samples from which a large number of charcoal fragments were retrieved, provided that all of the samples belonged to the same archaeological context within the same site.

The results of the experiments showed that the minimal size category was > 2.5 mm and that 10 - 20 percent of each size category needed to be examined in order to meet all taxa present in the sample. The minimum representative sample is quite small, and the low number of taxa per sample is quite striking and deserves an explanation. The minimum representative subsample lies between 10 and 20 percent of the whole sample, while the number of taxa identified per sample does not exceed three, even in sites where the total number of taxa from the different samples is much larger. Many samples contain only a single taxon. This is probably due to the fact that the sole source of charcoal fragments is in situ household hearths, which are a special case. The charcoal recovered from each hearth seems to be the result of a single fire event, the hearths were probably cleaned or wiped off regularly so that the charcoal fragments recovered from hearth fill result from the wood burnt during the last fire. Wood was probably gathered on a daily basis, from the same locality or even from a single tree or shrub. It is expected that a larger minimum representative sample would be required for analysis of charcoal fragments dispersed in archaeological sediments compared to these from discrete burning events.