THE INTERPRETATION OF BOTANICAL DATA FROM ARCHAEOLOGICAL SITES

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Before we can interpret our data we must collect it and before this we must ask ourselves what questions are we trying to answer. Although in the following paper the data are assumed to be fruits and seeds the same basic principles apply to the collection of pollen data from archaeological sites. The questions must be thought of both before and during excavation because a sampling strategy depends upon them. For example, if we wish to paint a broad picture of a site we might sample most contexts but if we are particularly interested in human diet then we might sample only pits. We must think whether we want a random sampling strategy (and thus possibly missing the "different" contexts), a subjective one (probably biasing our results) or a mixture of the two. We must consider the type of preservation of material and this will define the method of subsequent processing of that material. At a dry site seeds are usually only preserved through carbonisation or mineralisation and are generally at relatively low concentrations in the sample. This would need bulk processing of material and concentration by flotation. At a waterlogged site flotation would not help but usually a small (1kg or so) sample will contain adequate amounts of seeds for statistical analysis. At a more mundane level we must also take into account limitations due to time and money.

Returning to the questions we may ask, by definition archaeological sites are related to human activity and therefore some of the most common and basic questions are:

1) which plants were being used at this site

2) what were they used for

3) what was the surrounding landscape like

So we have decided upon our sampling strategy, sample processing and have spent several months of microscope work obtaining our botanical data - we have a data matrix consisting of numbers of fruits/ seeds in a given set of samples. These can be numbers of seeds counted or can take into account the overall volume or weight of sample processed. The latter makes comparisons more straightforward although may bear little relationship to the size of the original context.

To look simplistically at questions 1) and 3) we can look purely at those plant remains identified and, for example, separate them into exotic taxa and native taxa. Exotic taxa are those defined as not growing today in our region or country and therefore almost certainly relate to plants which were used. For Britain these would include such food plants as all cereals and *Ficus carica*, and drug plants such as *Papaver somniferum*. Native taxa are those which are local today. These may be grouped into ecological categories, and therefore it is vital to have present-day ecological information. This assumes that the ecological requirements of the individual taxa have remained constant for at least the last few thousand years. Such an ecological grouping can give us information about the local vegetation communities. In addition, some of these taxa will have been deliberately used - edible fruits from *Corylus avellana, Rubus fruticosus, Sambucus nigra*; drugs from *Digitalis purpurea, Atropa belladonna*; In addition, some of the ecological groups are themselves likely to have been used and high proportions of seeds or vegetative remains from heathland taxa or *Pteridium aquilinum* can indicate possible roofing or bedding material. High levels of grassland plant representatives can indicate hay, animal fodder, animal dung.

Such a analysis can therefore give important information at the purely botanical level. In order to tackle question 2 "what were the plants used for" we need to analyse the samples and to tie this analysis with the available archaeological information. Here we can typically use two methods of multivariate data analysis, and it is stressed that these methods use just the botanical results:

1) a classification to group together samples with similar assemblages of plant taxa. TWINSPAN (Two Way Indicator Species Analysis) was written by M.O Hill (1979a) principally for use with modern phytosociological data. It is an hierarchical, divisive classification - 1 group initially split into two, each of

those two split again and so on. Its powerful mathematics uses groups of indicator species and not just one species; and

2) an ordination to extract axes of variation from the botanical data and which may be interpreted in either ecological or archaeological terms. DECORANA (De-Trended Correspondence Analysis) again written by Mark Hill (1979b) is a useful program which has removed the "horseshoe" effect at the ends of the axes as often appears in other ordination methods.

Two very different case studies are presented below and which demonstrate the use of these multivariate analyses.

The Hirsel, a 12^{th}-14^{th} century rural site in Berwickshire, Scotland, was originally a farmstead but became a religious building. The plant remains were preserved by carbonisation and recovered by flotation of material from a variety of context types. Since fire is, in Britain, usually associated with human activity, most carbonised plant remains relate to economic taxa and particularly to cereals. This was true at the Hirsel where predominantly *Avena* spp but also *Hordeum, Triticum aestivum* and *Secale cereale* were recovered. *Pisum sativum* and *Vicia faba* were other exotics present. Chaff, in small amounts, from all 4 cereals was found suggesting that the crops were locally grown. The native habitats were represented by weeds and ruderals - in the Class Secalinetea with some Molinio-Arrhenartheretea.

Multi-variate analyses as above gave clear separation of the data and were interpretable in terms of the archaeology of the site. The classification produced 6 definable groups and these have been superimposed upon the ordination (fig 1). The ordination axes are themselves difficult to interpret although axis 1 depends upon the quantity of cereal grain - with high loadings for samples with few grains, whereas axis 2 has samples with *Avena fatua* floret bases with low loadings and samples with *Rumex obtusifolius, Plantago lanceolata* and *Polygonum persicaria* high loadings.

Group A samples were from inside the structure and represent its partial use as a grain store. The remains were predominantly cereal grain although wheat chaff fragments were also recovered and they suggested that the building was also used during the cleaning and processing of the wheat. With large doors on either side the floor may have been used for winnowing. Group B samples likewise were internal but from a period of dereliction as evidenced from the numerous owl pellets recovered during excavation. They contained large numbers of seeds of ruderal species including *Urtica dioica* etc. The nettles indicating high levels of nutrient. The remaining groups contained samples from outside the building and represented the general farming activity in the vicinity. They contained predominantly ruderal and weed seeds amongst badly preserved cereal grains.

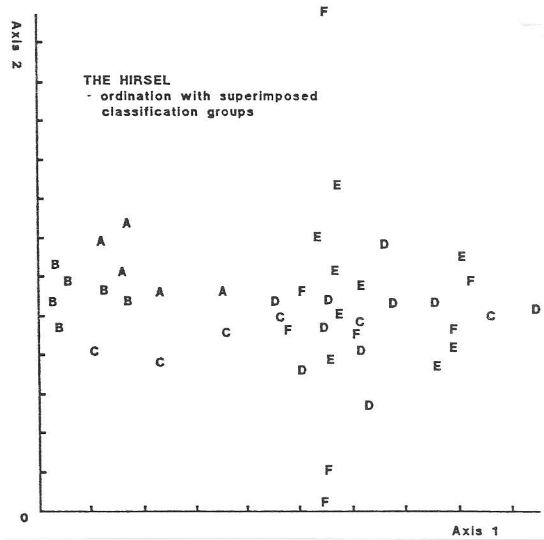

Fig 1. The Hirsel ordination with superimposed groups, axes 1 and 2 see text.

Similar analyses were performed upon data from a 1^{st}-2^{nd} century AD Roman fort with some overlying 12-13^{th} century urban material. The majority of the site was waterlogged and situated near the center of modern Carlisle, Cumbria. Here the results were very different.

More variety of exotic taxa were recovered - no doubt as a result of waterlogged preservation - and they included carbonised *Hordeum vulgare* from bulk samples as well as waterlogged *Ficus carica, Olea europea, Coriandrum sativum* and *Anethum graveolens* - these latter all suggesting a flourishing trade with the Mediterranean area. A wide range of native habitats showed that the Romans were exploiting many local communities including grassland, heathland, woodland and, to a limited extent, the salt marshes of the Solway. In addition the extremely high ruderal (Chenopodietea and Artemisietea) and trampled ground (Plantaginetalia maioris) components in several suggested that even alleyways, open areas etc within the fort, or at least very close to it, were vegetated. It seems that the picture was rather different to our vegetation-sterile modern British towns. Many of the Carlisle samples con-

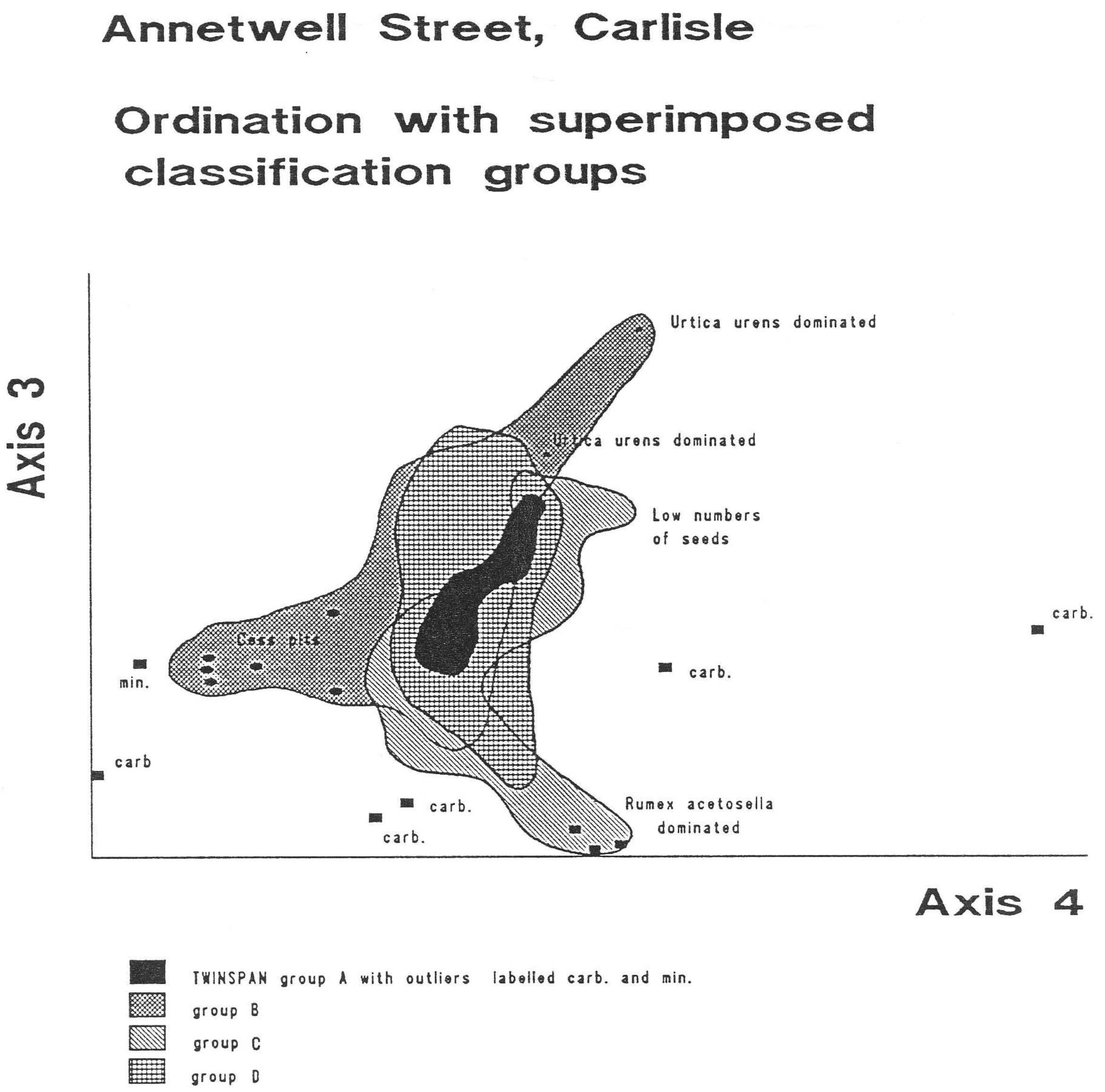

Fig 2. Annetwell Street, Carlisle. Ordination with superimposed classification groups.

tained several of these habitat types - indicating a heterogeneous origin of the context. This is often a problem with archaeobotanical material and makes interpretation difficult since we do not know how the context was formed hence do not know exactly what we are sampling.

The classification did produce botanical groups but they contained either very many or only 1-2 samples - emphasising their heterogeneous origin. In only a few cases could these analytical groups of samples be associated with archaeological features, for example, samples from Medieval deposits were grouped together due to a range of *Brassica* species being present in them, although the group itself was not isolated from the remainder. It still had many similarities with Roman material. The ordination (fig 2) confirmed these results and showed several large, central, overlapping groups with only a few outliers.

More than two hundred samples were analysed from this site and although the majority were not clearly distinguishable from each other, the few that were isolated indicated some further lines of work.

Material dominated by *Ficus carica* and from pits was considered to be largely faecal in origin and this was confirmed by colleagues in York who demonstrated the presence, in huge numbers, of eggs of parasitic tape and round worms - *Trichuris* and *Ascaris* species. When analysed, the matrix of this material was clearly cereal bran. In two different pits - one a late first century, the other a late 2nd century *Triticum/Secale* type periderm was the most common with a little *Hordeum* and *Avena*. From the later pit were also some amounts of *Brassica* species plus *Agrostemma githago*. This dominance of *Triticum/Secale* did not tie in with the carbonised data which was predominantly *Hordeum* species. These results suggested that the carbonised barley was not primarily eaten by people. It was thought most likely to have been horse-feed - perhaps not surprising since the site was a Roman cavalry fort.

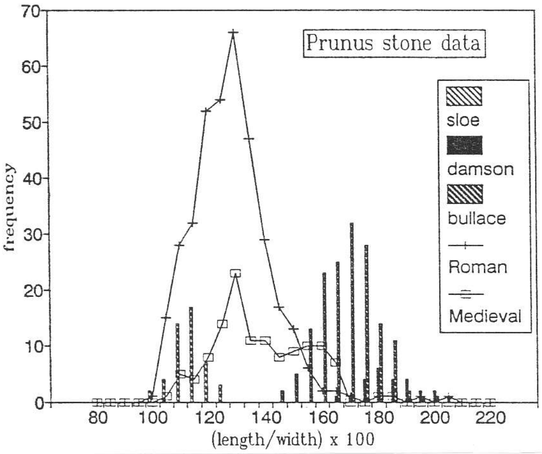

Fig 3. Sizes and shapes of *Prunus* stones from Roman and Medieval deposits.

Other lead-on work looked at the sizes and shapes of *Prunus* stones - comparing material from the Roman and Medieval deposits (fig 3). Whilst the Roman material broadly corresponded to large *Prunus spinosa* with only a little *P. domestica* ssp. *insititia*, the Medieval had considerably more *P. domestica* ssp. *insititia* some approaching the size and shape of modern plum, *P. domestica* ssp. *domestica*.

Although these two sites are not really comparable, the fact is that multivariate analyses can be applied to a wide range of archaeobotanical data and will produce results although these are not always clear or obvious. It emphasizes that all of the available information - botanical and archaeological - must be used in order to carry out a full interpretation of those data (the holistic approach) and that perhaps a step forward is to use a method such as canonical correlation analysis which will allow the botanical and archaeological data to be analysed together.

References

Hill, M.O. 1979a *TWINSPAN*: a FORTRAN program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes. Cornell University Press.

Hill, M.O. 1979b *DECORANA*: a FORTRAN program for arranging multivariate data using detrended correspondence analysis. Cornell University Press.