Recovering Macroremains by Manual Flotation and Sieving

by Naomi F. Miller
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Archaeobotanical data can help us understand many aspects of ancient society, including economy, land use, diet, and environment. Like other artifacts, material remains of plants are distributed differentially on a site through time and space. It is easy to recover them, and they form the basis of paleoethnobotanical interpretation. For example, introduction of exotic species might suggest the development of new trading relationships; changes in charcoal species may reflect deforestation or a change in the availability of certain areas for exploitation by a population. In order to obtain the full benefit of a paleoethnobotanical study, it is important to keep the nature of the plant remains and their potential for interpretation in mind. The remainder of these instructions deals with the recovery of macroremains. The most efficient means of retrieving charred macroremains is "flotation," or "water separation." This set of instructions also describes a sieving procedure for retrieving desiccated remains.

Archaeobotanists use morphological criteria (size and shape of seed, ring patterns of wood, etc.) to identify plant remains excavated from an archaeological site. Unlike many other artifacts, such as pot sherds, plant remains are usually quite fragile, and their distinguishing features are easily destroyed.

Individual seeds and other charred bits are usually fairly meaningless, for much the same reasons that individual pot sherds are. Therefore, the unit of paleoethnobotanical analysis is ordinarily not the individual seed or piece of charcoal, but rather a sampling of the material available within a particular volume of sediment matrix from an archaeologically defined locus. Plant remains are frequently barely visible in the ground, so potential sampling locations may not be obvious. It is best to follow uniform procedures for the recovery of material to insure comparability between samples--unless of course there is a good archaeological reason for treating a locus or a sample differently. Between-sample comparisons of the proportions of different species provides insight into intra-site differentiation and temporal change. Absolute quantities of material are also useful indicators of functional variability. Needless to say, a paleoethnobotanical analysis can reach no finer level than that of the excavation itself.

INSTRUCTIONS FOR MANUAL FLOTATION

Sampling

In order to obtain as unbiased a collection of the extant plant remains as possible, take sediment samples from as wide a variety of loci as possible. In choosing locations from which to take samples, consider several criteria:

1. Take samples from a variety of archaeologically significant loci, in the hope of discovering functional and/or temporal variability in the distribution of plant remains.

2. Test at least some locations where you do *not* see or expect to find plant remains. As with much archaeological data, in order to understand the significance of artifact distribution, it is useful to have some idea of the relative importance of small quantities of material.

   If time and money permit only the sampling of features with carbon visible in them (hearths, for example), or some other restricted category of features, it is important to take at least a small sample from an adjacent area as a control. For example, even a rich deposit may yield only a handful of charcoal from 10 liters of sediment. An adjacent control sample allows the archaeobotanist to assess the significance of the amount of charcoal in the sample of primary interest.

3. Within any one locus, try to get a representative sample of the deposit. Clearly, common sense should dictate the boundaries of a sampling area -- a small defined patch filled with charred material should be

treated as a unit distinct from the surrounding sterile sediment. If there is a particularly charcoal-filled area, you might want to consider treating it as a separate, archaeologically significant area. A representative sample of the deposit is necessary in order to be able to interpret the density of material in the various samples.

4. Try to take samples that are fairly uniform in size, as relative density and species diversity can be more easily assessed if sample sizes are approximately equal.

The immediate object of the sampling procedures is to obtain approximately one bucket (ca. 10 liters) of sediment for flotation for each locus to be sampled. Samples taken specifically as control samples can be a good deal smaller--a liter or two will do. Sediment samples can be stored in buckets, heavy duty plastic bags, gunny sacks or similar containers. Site supervisors can be asked to take scoops or earth from several spots per sample, and be requested not to look for particularly ashy/charcoaly spots; they should of course be free to segregate such areas as separate loci. It is usually easier to take a sediment sample all at once from only one spot; that is acceptable, but a uniform procedure should be followed for the whole site.

Flotation

Prior to flotation, pour the soil through a 1 cm or 1/4-inch mesh. A bucket with liter-markings can be placed under the 1 cm mesh screen to catch the sediment to be floated.[1] The volume of sample is recorded as volume of sifted sediment. Bag charcoal caught in the mesh separately at this point. It is very important to remember that large pieces (greater than 1 cm) are *substantially* easier to identify than small pieces, and the identifications are likely to be more accurate, so take care with the large pieces caught in the screen. In particular, if the soil is damp, it is not a bad idea to keep a roll of toilet paper on hand for loosely wrapping the charcoal before placing it in a plastic bag. Remove the artifacts and bone found in the 1 cm screen as well, and give them to the appropriate staff member.

Many archaeobotanists say *never* pre-sieve the sediment sample, since they think sieving may break up the charred material. I think it can be equally bad to let large rocks and sherds bang around in the flotation tank. I mention this so you are aware of the disagreement. If you decide not to sieve the samples first, at least remove heavy objects like rocks and sherds before agitating the soil in the strainer. I think pre-sieving is less necessary with a machine assisted (that is, running water) system. Even if you do not pre-sieve, it is still important to measure the volume of sediment floated.

Bring the bucket of sieved, measured earth to the flotation tank (a clean oil drum filled with water). A little bit at a time (about 1 or 2 cups), pour the sediment into a 9-inch or larger diameter kitchen strainer (fine mesh; even 1 mm opening may be too big; if necessary, rig up your own mesh strainer. For example, you can line the 9-inch strainer with a square of small mesh material and attach with clothespins). Agitate the strainer carefully in a circular and an up-and-down motion, to let the sediment strain out. Make sure you always keep the rim of the strainer above the level of the water, so the charred and other floating material does not get dispersed in the oil drum. You can scoop up floating material with a tea strainer. If you see some bits of charcoal in the kitchen strainer, it is all right to pick up some of the sediment residue with the charcoal.

The light fraction (that is, the material scooped up in the tea strainer) can be tapped out onto a piece of light cotton cloth (muslin) and hung up with a label to dry in the shade--the samples should not be dried quickly in direct sunlight.

You can examine the heavy fraction (that is, that portion of sample left in the kitchen strainer) by eye on the spot. Remove interesting objects (rodent bones, artifacts, etc.). The rest of the heavy fraction can be disposed of. Alternatively, you can dump the heavy fraction onto newspaper to dry and examine it in the lab. If adequate help is available, it is probably best to save the heavy fraction. Workers can sieve the dried heavy fraction through nested geological sieves (4.75 mm and 2 mm). I suggest removing all bone, sherds, chipped stone, charred botanical material, and artifacts from the >4.75 mm size fraction, and diagnostic bone, charred botanical material, and artifacts from the >2 mm size fraction. The <2 mm size fraction should be scanned under a low-power microscope or magnifying glass by someone who would recognize a

seed if he or she saw one; if it becomes clear that there are only minor amounts of identifiable material less than 2 mm, this last step can be eliminated.

Between samples the flotation tank water is skimmed clean as completely as possible with the small tea strainer. Ideally, one would have two tanks, which would allow at least some of the sediment and debris to settle between samples. When the tank itself fills with mud, it can be emptied, rinsed out, and refilled with fresh water.

When dry, the light fraction is transferred to a hard container (like a film cannister) or a plastic bag to await further analysis. The light fraction should be treated carefully, in order to avoid breakage of the delicate charred material. If plastic bags are used for storage and shipping, they should be packed away in medium-sized boxes (say, shoeboxes), loosely enough to prevent crushing, but closely enough so that they keep each other from rattling around in the box. Try to pack the material so that it cushions itself. Zip-lock bags are not that good, because they tend to lie flat, spreading the delicate charred remains in a thin, vulnerable layer.

Equipment
1 or 2 clean oil drums, water supply
9-inch kitchen strainer (mesh < 1 mm or < 1/16 in)
tea strainer (small mesh)
1 cm or 1/4-inch mesh screen
cup
squares of cloth, safety pins, labels, etc.
film cannisters, plastic bags, small brushes, etc.
toilet paper

Miscellaneous remainders

If you understand why paleoethnobotany is interesting, and why retrieval of plant remains is important, you should use common sense in dealing with unforeseen circumstances, like unavailability of certain supplies, unsuitability of the techniques described above to particular sites or to particular deposits, or problems that arise in the course of excavation. I have found the above guidelines and instructions useful on Near Eastern town/city sites (that is, sites with architecture located in fairly arid environments).

1. Depending on the nature of the sediment, it may be advisable not to pre-screen samples. This is particularly the case if pre-screening seems to break up charred remains or if large numbers of charred seeds, such as olive pits, are getting caught in the screen.

2. Labeling and good field notes are very important. Labels should list not only locus number, but also the **volume of sediment floated** and the type of deposit or sample (hearth? control?). In any case, field notes available to the archaeobotanist should contain this information, as well as mention why the sample was taken, and where it comes from (one spot in the locus? a general sample from over the entire locus?).

3. Charcoal chunks found in the course of excavation should be saved and treated carefully, but should not be put into the nearest bucket of flotation sample if not part of that sample.

4. When excavating, processing and packing the material, remember it is delicate--don't put charcoal in the bottom of a sherd bucket (you laugh!). Also, make sure samples are dry before packing in plastic containers--soft moldy plant remains cannot be dealt with.

Some flotation references

Hastorf, Christine and Virginia Popper (editors)
1988 *Current Paleoethnobotany*. Chicago: University of Chicago Press. [see article by Gail Wagner on comparisons of flotation systems]

Minnis, Paul and Steven LeBlanc
1976 An Efficient, Inexpensive Arid Lands Flotation System. *American Antiquity* 41: 491-93. (Basically the same system described above)

Pearsall, Deborah M.
2000 *Paleoethnobotany*. 2nd ed. Orlando: Academic Press. [extensive instructions and discussion about flotation]

Streuver, Stuart
1968 Flotation Techniques for the Recovery of Small-Scale Archaeological Remains. *American Antiquity* 33: 353-62. (An early example; inserted here for historical reasons)

Watson, Patty Jo
1976 In Pursuit of Prehistoric Subsistence: A Comparative Account of Some Contemporary Flotation Techniques. *Midcontinental Journal of Archaeology* 1: 77-100. (Includes discussions of machine assisted systems)

Wagner, Gail E.
1982 Testing Flotation Recovery Rates. *American Antiquity* 47: 127-132. (She adds a known quantity of an exotic seed to samples before floating them)

SIEVING FOR DESICCATED PLANT REMAINS

If your site has very good dry preservation, sampling for botanical remains will have to include a non-flotation component.

Large remains
In general, the easiest remains to identify are seeds (including nutshell) and charcoal. Wood can be identified, as can cereal spikelet fragments and fruits. Stems of grasses, reeds, and sedges can generally be distinguished from each other, but are not identifiable to genus without the inflorescence. In general, it is the reproductive parts of plants that are most distinctive (flowers, fruits, and inflorescences), although other distinctive plant parts (such as odd-shaped leaves) may be identifiable as well. If you have a lot of these types of remains, I would recommend screening (2 cm or 1/4-inch mesh) selected portions of selected deposits. As with sampling for flotation, try to get representation from a variety of deposit types, and include some control samples. If your excavation does not already include plans for screening, this would have the additional advantage of providing control for other kinds of small remains as well, such as the smaller animal bones and smaller sections of tools.

Small remains
In order to obtain the smaller plant remains, C.W. Cowan (p.c. 1979) suggested taking one-liter soil samples, and putting them through a series of geological sieves. You might try the following:

Using the same criteria for sampling suggested above (representativeness and economy of time and money), take one-liter sediment samples. In the laboratory, run them through a series of geological sieves--for example, 1 cm, 4.75 mm, 2 mm. Material caught in the largest mesh can be seen and removed by hand. A microscope (7-10x magnification) should be used for sorting through the remaining three size fractions. The smallest fraction, that which goes through all three screens, can be scanned quickly, and just whole

seeds and spikelet fragments need be removed. If no microscope is available, save the 4.75 mm, 2 mm, and < 2 mm fractions in their entirety, unless obvious uninteresting items, such as pebbles, can be easily removed.

The purpose of this kind of sampling is not to get the larger, clearly visible types of organic remains (such as corn cobs, whole fruits, sandals, ceiling beams, or household furnishings and other manufactured goods. Rather, it is to get the small remains, possibly of food, possible of other organic debris that one finds in settlements, like seeds of local weeds. Therefore, this approach would be most effective in midden or other trash deposits. You might additionally want to take samples from some or all primary deposits, or from areas that are obviously full of plant remains. Remember, if a very restricted sampling program is all you can afford, control samples associated with more obviously interesting samples will increase the value of the latter immeasurably.

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[1] May 8, 2012. I think it is fine to omit the 'sieving' stage prior to flotation, as long as you remove the rocks, sherds, and other large objects before floating. The volume should be recorded for the entire sample.