Miller, Naomi F. 1999. Plant Remains from Neolithic Gritille: Food and Fuel in the Context of Animal Domestication. MASCA Ethnobotanical Laboratory Report 27. On file, University of Pennsylvania Museum.

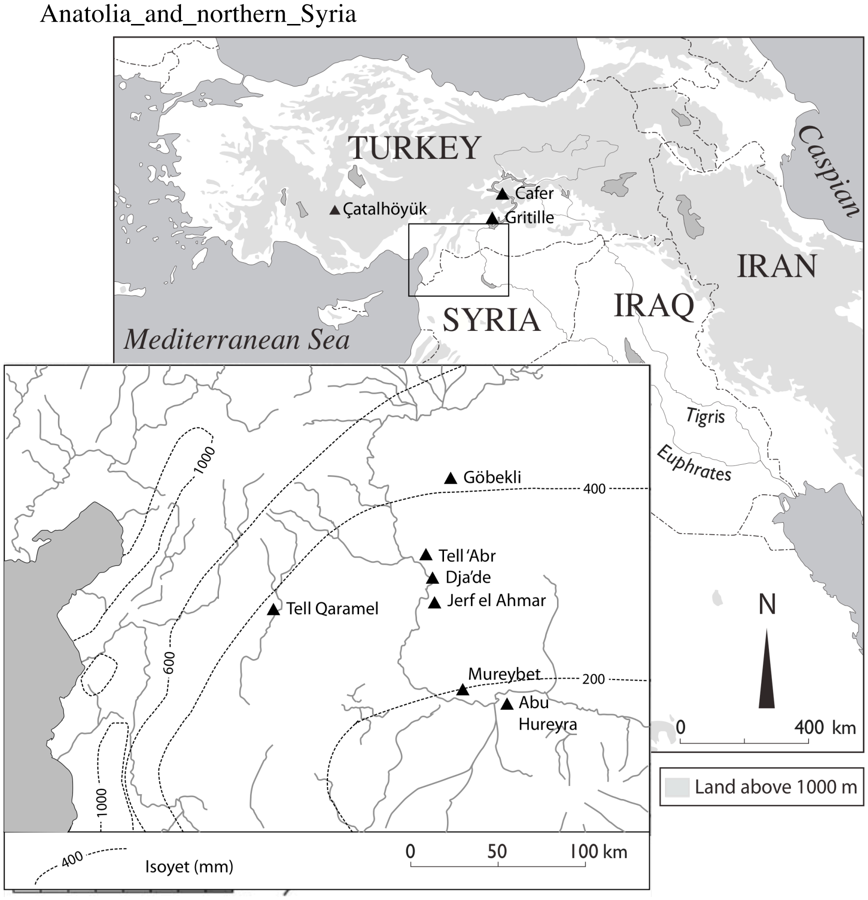
The following pages comprise the botanical report for the PPNB-related site of Gritille. The Neolithic excavation was directed by Mary M. Voigt. The Gritille excavations were conducted under the general direction of Richard Ellis, Bryn Mawr College. This report was completed in 1999. It formed the basis of Miller (2002), but the sample data have never been published. Although much more PPNB archaeobotanical information has become available in the intervening years, along with new approaches and interpretations. I have not updated this report, as the Gritille data themselves have not changed.

This report (and Miller 2002) considers the depositional contexts of the Gritille archaeobotanical samples to distinguish trash from food remains. It also demonstrates that plant remains reflect the development of the entire ancient agropastoral system. That is, changes in plant use and in the archaeobotanical assemblage have a direct relationship with the increasing dependence on domesticated animals during the Neolithic occupation. Perhaps obvious in 2013, the Gritille example was an early demonstration that the integration of the ancient plant and animal economy is reflected in the actualistic, archaeobiological remains of that economy.

Naomi F. Miller
University of Pennsylvania Museum, Philadelphia
February 15, 2013

Miller, Naomi F. 2002.Tracing the Development of the Agropastoral Economy in Southeastern Anatolia and Northern Syria. In *The Dawn of Farming in the Near East,* eds. R.T.J. Cappers and S. Bottema, pp. 85–94. Studies in Early Near Eastern Production, Subsistence, and Environment 6. Ex Oriente, Berlin.

Miller (2002) is available on line at two URLs:
http://www.sas.upenn.edu/~nmiller0/Miller%202002%20Gritille.pdf
http://www.academia.edu/1163129/Tracing_the_development_of_the_agropastoral_economy_in_southeastern_Anatolia_and_northern_Syria



Here are a few updates:

Miller (in press a) was published in 2002 (see above); Miller (in press b) was published in 1998.

GT Apiaceae-2 is cf. *Torilis*
GT unknown-4 is a *Poa bulbosa* bulblet
GT unknown-5 is cf. *Ziziphora*

Map source: Miller, Naomi F. 2010. Reconciling Nature and Culture after *Naissance des divinités / naissance d'agriculture*. *Paléorient* 37.1: 61–74.

Plant Remains from Neolithic Gritille: Food and Fuel in the Context of Animal Domestication

Naomi F. Miller, Senior Research Scientist
Museum Applied Science Center for Archaeology
University of Pennsylvania Museum

January 4, 1999

Introduction

Until it was inundated by the Atatürk Dam, Gritille was a small (ca. 1 ha) occupation mound on the north (right) bank of the Euphrates river in Adiyaman province, Turkey. It lay in the xerophilous deciduous steppe forest zone, which in antiquity was dominated by oak *(Quercus brantii;* Zohary 1973). With precipitation of about 470 mm/year, this area is well within the rainfall agriculture zone, though irrigation enhances crop security (Wilkinson 1990). The site was occupied during three major phases: Neolithic, Early Bronze Age, and Medieval. For the history of excavations and other background material see Voigt (1988); preliminary archaeobotanical results from the Neolithic (Miller in press a) and the final report on Medieval samples (Miller in press b) have been completed.

The material reported here comes from the Pre-Pottery Neolithic B (PPNB)-related deposits at Gritille. Voigt (1988) distinguished five stratigraphic phases--a "Basal" level that is not stratigraphically connected to somewhat later levels designated D, C, B, and A. An erosional surface between levels C and B separates the earlier phases (8500-8000 bp) from the later ones (8000-7500 bp). Calibration puts the entire PPNB-related occupation between about 7500 and 6500 calib. B.C. The sites for which plant remains are reported that seem to be most closely related to Gritille are Çayönü and Cafer. Abu Hureyra and a few other sites have also yielded plant remains that may be compared to the Gritille assemblage.

Fifty-two samples have been examined for this report. The earliest materials come from Operation 48/51, primarily from cobble-filled ashy pits. Overall, a variety of deposits was sampled, including pits, hearths, and trash (Table 1). Preservation of charred material in the analyzed samples was generally good, though not all samples had a high density of charred remains.

Methodology

Flotation

Flotation was carried out in the field with a SMAP-like machine (Watson 1976). A standard 8-liter sample was processed unless otherwise noted. Note that the amount floated is usually written on the "GT" tags, but not always. If no information is available, an assumed volume of 8 liters is indicated in boldface type.

Laboratory procedures

Flotation samples are comprised of a "light fraction" (the material that floats, and is caught in a cloth) and a "heavy fraction" (the material that sinks during the flotation procedure, but is caught in a window screen mesh of about 1 mm). For a description of laboratory procedures for processing the samples, see Appendix 1. The contents of the samples are listed in Appendices 2 and 3.

Despite the inconvenience and expense, the heavy fractions were shipped back to Pennsylvania because the efficiency of the flotation system for recovering the charred remains had not been evaluated. Available labor permitted only some of the heavy fractions associated with the light fractions to be examined to see how much and what kind of charred material sank; we concentrated on the basal deposits. This time-consuming, but important step in the analysis shows that even though charcoal floats fairly efficiently, as much as 46% of the charcoal larger than 2 mm might sink (Table 2). Differential recovery rates among the pulses, cereals, and other seeds are even more pronounced. Large, rounded seeds (e.g., bitter vetch) sink more readily than long, thin ones (e.g., einkorn). For example, in the samples that yielded the most pulses, (more than 0.07 g larger than 2 mm), as much as 42% of the pulses in a sample sank (Table 3). In contrast to the pulses, einkorn was extracted from the heavy fraction in only five of the samples, and then in only negligible quantities.

Much of the pistachio was retrieved from the heavy fractions, but because that type is found in such low densities, it is not clear that interpretations would be much different were the heavy fraction pistachio omitted from the analysis. Had we not examined the heavy fractions, however, we would have failed to include almond (which occurs in two of the samples) as one of the taxa.

Data from the heavy fractions are listed separately because not all were examined. For some samples, inclusion of the heavy fraction in the analysis would significantly change the quantities and proportions of some of the items. However, regardless of whether information from the heavy fraction is included in the analysis of the flotation samples,the main interpretations presented here still stand.

Plants (Table 4)

Cereals, wild and domestic

Einkorn wheat, wild and domesticated *(Triticum monococcum* and *T. boeoticum).* Most of the determinable wheats, including fragments, are domestic einkorn *(T. monococcum).* There is some representation of a very narrow-seeded type, generally less than 1 mm, which is most probably the wild type. It may be the one-seeded type *(T. boeoticum* ssp. *aegilopoides).* At Çayönü, this type is considered to be an introduced weed in the einkorn fields (van Zeist 1972). In addition to the einkorn grains, spikelet forks (rachis fragments) occur, mostly in the samples from the bottom of the excavation. The grains and spikelet forks do not appear to be correlated. The characters of emmer and einkorn spikelet forks overlap, but given the rarity of emmer in these samples, the spikelet forks most likely come from einkorn.

Emmer wheat *(Triticum dicoccum).* A few grains of domestic emmer occur in these samples. This contrasts sharply with Aswad, where domesticated emmer is the major food plant in the assemblage (van Zeist and Bakker-Heeres 1982).

Free-threshing wheat *(Triticum aestivum/durum).* One sample, GT 20901, yielded bread wheat or hard wheat. These two types cannot be distinguished on morphological grounds alone, though the "hexaploid wheats have relatively plump grains with blunt tips" (Zohary and Hopf 1988: 46). Bread wheat, a hexaploid, is thought to have evolved relatively late, when a domesticated tetraploid wheat hybridized with a wild wheat (goat-face grass, *Aegilops squarrosa*) native to the Caucasus, northern Iran, and points east in central Asia (ibid., p. 49). The four measurable bread/hard wheat grains are plump with blunt tips, consistent with a hexaploid club wheat type (cf. van Zeist and Waterbolk-van Rooijen 1985). The rachis fragments of this type occur only in sample GT 20901. Note that *Triticum aestivum* has been recognized at Abu Hureyra, perhaps as early as level 2C (i.e., earlier than GT 20901) (de Moulins 1997).

Barley *(Hordeum vulgare).* The barley is most likely the domesticated two-row type, *H. vulgare* var. *distichum.* Its importance in the assemblage increases over time (discussion below).

Pulses

Pulses are large-seeded members of the pea family. Along with wheat and barley, they occur early in the archaeobotanical record of the Near East. Bitter vetch and lentil are the most important of the pulses in the early part of the Gritille Neolithic sequence, though grasspea and pea also occur. In the later part of the sequence, bitter vetch and grasspea decline in importance relative to lentil. Overall, pulses decline relative to cereals (discussion below).

Bitter vetch *(Vicia ervilia).* Nowadays bitter vetch is a minor crop grown primarily as fodder. There is no way to tell whether or not the seeds themeselves were cultivated (Zohary and Hopf 1988). The character of the assemblage and archaeological context, however, provide clues. In this case, there is one sample which is nearly pure vetch (GT 22206); it has very little charcoal or other seeds. This could merely mean that the plant was collected from the wild, but that seems unlikely. Two morphological types seem to be preserved. One compares well in size and shape with bitter vetch illustrated for other Neolithic sites. The other seems to be an underdeveloped seed; it tends to be smaller and more "dimpled" than the ordinary bitter vetch, and instead of having a tetrahedral shape, one end may be sharply truncated. A number of these seeds are more angular in cross-section than many of the larger ones. Grasspea was briefly considered as an alternative identification for these seeds, but the seeds in question are simply too small (Table 5).

Lentil *(Lens).* Most of the recovered lentils are small, under 3 mm, excluding the fairly large seeds from GT 20901, which average 3.4 mm in diameter, equivalent to or a little larger than the (somewhat later) Ramad phase II lentils.[1] Lentils from other early sites, such as Aswad and Çayönü, generally average 2.5-3.0 mm in diameter (Zohary and Hopf 1988).

Grasspea *(Lathyrus).* There are a few samples that yielded grasspea. One sample from the upper part of the sequence consists almost entirely of grasspea (GT 9453); M. Kislev (pers. comm. 1998) confirms the identification of *Lathyrus sativus/cicera.* By the logic applied to the bitter vetch, this would put grasspea into the category of harvested crop, at least in the upper Neolithic levels (see also Kislev 1989). Grasspea has a larger seed than bitter vetch, and seeds from the middle of the pod are more wedge-shaped (rather than tetrahedral). Like bitter vetch, grasspea is today grown as a fodder crop, and is generally

---

[1] Gritille lentil size in GT 20901: average diameter, 3.4 mm (1.6 mm-4.1 mm), SD=0.7, n=20; other lentils from Gritille: average diameter 2.6 mm (1.6 mm-3.5 mm), SD=0.4, n=57. Ramad (van Zeist and Bakker-Heeres 1982: 207): av. diam. 3.0 mm (1.8 mm-4.1 mm), n=222.

not eaten by humans. Indeed, when eaten in large quantities, a potentially deadly neural condition, lathyrism, results.

Pea *(Pisum).* Some tentatively identified pea has been identified.

Nuts and fruit

Nutshell occurs in low densities in 17 of the 52 light fractions examined. A thin, smooth type, tentatively identified as pistachio *(Pistacia)* is the most common. Two samples contained a thicker type tentatively identified as almond (*Prunus* sp.); one sample may even have walnut (*Juglans*).

In addition, two fig (*Ficus*) seeds, one charred and one uncharred, were recovered.

Flax

Several seeds of flax *(Linum* cf. *usitatissimum)* were recovered. Based on their size, they are most probably the domesticated type. They are larger than the (wild) *Linum bienne* found at Çayönü, with which they are roughly contemporary, and are about the same size as the early domesticated exemplars from Ramad, a somewhat later site (van Zeist 1972, van Zeist and Bakker-Heeres 1982).[2] Due to the small number recovered, however, this interpretation is not definitive. Flax seeds occur in 8 samples, but not all can be measured (Table 6).

Wild and weedy seeds

The wild and weedy seed assemblage is fairly diverse, representing over 50 genera from at least 25 plant families. Very few types, however, are numerous or common; only one genus, a grass *(Phleum/Eragrostis),* occurs in more than half the samples (27 of 52). Table 4b contains a list of the taxa recorded along with some of their common names; some are discussed in more detail below. It is very difficult to make meaningful statements about seeds designated only to family or even genus.

Capparidaceae. Several samples had seeds of caper (*Capparis*), a shrub. It has edible fruit, and despite extremely sharp and back-curving spines, it is sometimes grazed by animals (Townsend and Guest 1980: 140).

Chenopodiaceae. Goosefoot (*Chenopodium*) when green is commonly used as a potherb; as it matures, it is fine for animals. A small seed with a curved embryo has been tentatively identified as saltwort (cf. *Salsola*).

Cistaceae. Appearing in 16 samples, *Helianthemum* is one of the more common seed types; it dominates one sample (GT 17219). With regard to at least one species, Townsend and Guest (1980: 114) report that Iraqi "shepherds recognized it as a useful grazing plant for camels and sheep."

---

[2] Gritille flax size in GT 20901: average length, 3.3 mm (2.6 mm-3.9 mm), SD=0.5, n=7. Ramad (van Zeist and Bakker-Heeres 1982): average length, 3.2 mm (2.8 mm-3.6 mm), n=80.

Cyperaceae. *Carex* and other members of the sedge family are typically plants of moist ground. GT-Cyperaceae 1 has the form of the seed illustrated as *Scirpus* by van Zeist and others.

Fabaceae. A number of small-seeded legumes (*Astragalus*, *Medicago, Medicago radiata, Trifolium* or *Melilotus*, and *Trigonella* have been encountered. *Astragalus, Medicago,* and *Trigonella* are very common in undegraded steppe today, and so they can be considered an indicator of high quality pasture. Seeds of these plants, especially of *Astragalus* and *Trigonella,* can be common on sites of the steppe, as well (e.g., Abu Hureyra [de Moulins 1997], Ali Kosh [Helbaek 1969]).

Lamiaceae. Both *Ajuga* and cf. *Ziziphora* are small plants. The type designated cf. *Ziziphora* has a faint surface pattern visible under low magnification that matches the available comparative specimens of *Z. taurica* (see illustration).

Malvaceae. Most of the seeds of Malvaceae resembled *Malva*. One large type closely matches *Lavatera*, though *Alcaea* and *Malva* were also considered.

Poaceae. Many members of the grass family are difficult to identify from charred seed material. A number of unknown but moderately distinctive ones are illustrated. Among the others, the most secure identifications are of *Aegilops, Bromus*, *Hordeum* (although some of the larger examples may not be from the wild type), *Lolium,* and *Setaria.* One common morphological type has been designated *Phleum/Eragrostis.* It is a small rounded seed that occurs in many sites along the Euphrates (e.g., Medieval Gritille, Sweyhat and Hacinebi), as well as at Gordion.

The samples

The assemblage as a whole comes from a variety of deposits, but what unites it is the fact that the material is burnt. In theory, intra-site comparisons, especially of *in situ* contemporary samples, can sometimes point up spatial patterning of plant use or disposal practices. Indeed, some of the Gritille samples seem to come from *in situ* burned deposits, usually shallow cobble-filled ash pits, or from relatively intact trash levels that consist of burnt material. There is, however, no clear patterning in the distribution of charred remains that might link pits to food preparation.

Three samples contained unusually high concentrations of crop plants, and are treated separately. A fourth sample is unusual in its high number of wild/weed seeds. The remainder of the assemblage is the charred component of ordinary occupation debris.

Sample GT 20901: Large cobble-filled pit
Basal level; 1984, Operation 48/51, locus 14
Density: 0.50 g/l of charred material larger than 2 mm (from 8 liters of soil)
Seed material larger than 2 mm: 2.76 g
Wood charcoal larger than 2 mm: 1.21 g
Number of wild/weedy seeds: 208

This sample comes from pit /14 above a layer of ash and cobbles, and in a deposit that has blades that are very similar to ones found at Çayönü (M.M. Voigt, personal communication). It had a fair amount of barley mixed with other cultigens, wood charcoal, and a higher density wild seeds than other samples from the earlier phase. It therefore seems to be an *in situ* deposit of burnt material that includes wood fuel. The cultigens might come from seeds accidentally charred when they were roasted. Because they are a mixed group, their presence together in this pit probably derives from several depositional episodes. Alternatively, some portion of the seed assemblage might have come from dung burning or burnt crop-processing debris (see Hillman 1984). This sample was one of several that came from the same pit, but its high concentration of cultigens was unique in that feature.

The sample dates to about 8500 bp (7400 calib. B.C.), yet in several ways it stands out as a "modern" assemblage. First, barley is common in the Levant, but it is fairly rare in the southeastern Anatolian sites in the Middle PPNB. Second, there is more free-threshing wheat than einkorn in this sample, which is unusual for Gritille. Free-threshing wheat occurs as early as Aswad II, PPNB-related levels. If the Gritille wheat is the hexaploid *aestivum*-type, rather than the tetraploid *durum*-type, it would be an early example of the evolution of bread wheat through hybridization with the eastern Anatolian wild wheat. Though exciting, this interpretation will require greater taxonomic study, and the remains may not be sufficiently distinctive to allow for certainty. Third, the flax seeds are as large as those from Ramad, a PPNB site in the Damascus Basin in Syria though they may be a century or two older. Fourth, the lentils are large compared to others in the earliest Gritille deposits as well as in other PPNB sites. And finally, unlike most of the other samples, cereals outweigh pulses by a factor of about six to one. This sample therefore exemplifies the PPNB as a time of agricultural expansion and crop development.

Sample GT 22206: Burnt layer
Basal level; 1984, Operation 48/51, locus 43
Density: 0.37 g/l of charred material larger than 2 mm (from 8 liters of soil)
Seed material larger than 2 mm: 2.40 g
Wood charcoal larger than 2 mm: 0.52 g
Number of wild/weedy seeds: 28

This is a nearly pure sample of bitter vetch roughly contemporary with or a little earlier than the mixed one discussed above (burnt layer /43 cuts into pit /14. Unlike that one, there are very few wild seeds. Since bitter vetch has a large seed of regular dimensions, sieving by ancient people could easily have removed weed seeds, so this sample may well be an accidentally burned deposit of cleaned crop seeds. This finding agrees with the conclusion of van Zeist (1988: 55) that bitter vetch was first domesticated in southeastern Anatolia. Best evidence of its early use comes from Çayönü. With about 500 whole seeds plus fragments equivalent to about 150 seeds, the Gritille concentration adds another site with early evidence of bitter vetch cultivation.

Sample GT 9453: Trash deposit
Phase B; 1983, Operation 16, locus 60
Density: 3.00 g/l of charred material larger than 2 mm (from 8 liters of soil)
Seed material larger than 2 mm: 23.93 g
Wood charcoal larger than 2 mm: 0.05 g
Number of wild/weedy seeds: 4

This is a nearly pure sample of grasspea; in fact, it had over 800 whole seeds along with a substantial number of identified fragments, but almost no charcoal or weed seeds. It is somewhat more recent than the other two samples, and dates to between 8000 and 7500 bp. Following Kislev (1989: 263), such a large quantity of grasspea is likely to be from a crop, so this Gritille cache is among the earliest evidence for grasspea cultivation.

Sample GT 17219: Hearth/ash deposit
Phase C; 1983, Operation 16, locus 37
Density: 0.03 g/l of charred material larger than 2 mm (from 8 liters of soil)
Seed material larger than 2 mm: 0.03 g
Wood charcoal larger than 2 mm: 0.20 g
Number of wild/weedy seeds: 2424

Although several samples have fairly large concentrations of wild seeds, GT 17219 stands out. Despite the high number of seeds, the diversity is low--more than 1800 come from a single taxon, *Helianthemum.* Most of the remainder are small legumes.
Bearing in mind that a single fruit capsule of *H.elianthemum salicifolium* produces a large number of seeds (at least dozens, and maybe a few hundred--informal personal observation), one can imagine that a few such plants were burned or eaten by flocks whose dung was burned. Due to the disproportionate number of seeds in this sample, it is not included in some of the summary statements below.

If we exclude the three crop seed concentrations and look at the ordinary occupation debris (as represented by the remaining 49 samples), we can get a more general picture of plant use at Gritille, and how that might have changed over time. Considered as isolated finds or samples, archaeobotanical data are difficult to interpret. The small size of most charred remains allows them to move in the soil matrix, and contamination between samples during excavation or in processing is always a possiblility. The low densities of material most commonly recovered can be interpreted only in the most general way. Absence or paucity of material is not that useful for the archaeobotanist. Even fairly rich samples (say, a film cannister's volume, or about 35 ml) have the most meaning in relation to other samples. Most of the analyzed samples from the early part of the Gritille sequence come from cobble-filled ashy pits or other lensed ashy deposits, those from the later part are mostly from trashy deposits (Table 1). Archaeobotanical data usually do not lend themselves to rigorous statistical methodologies mostly because of between-sample variability and low numbers of seeds. In order to use the available information, I have treated most of the samples as though their contents could be added together by phase. The only justification is that some form of quantification does make possible relatively objective comparisons between sites and time periods.

Fuel and food

Wood charcoal could come from a variety of sources: fuel, building debris, or tools. Since *in situ* burning in the Gritille basal Neolithic layers comes from pits and trash layers, spent fuel seems the most likely source. But was it burned for cooking, heating, or industrial purposes? Although pyrotechnology was important in the PPNB, especially for the manufacture of lime plaster, the location of these remains in a residential context or in open-air cobble-filled pits suggests that crop processing or cooking was a major reason that this wood was burnt. Given the absence of pottery and the toxicity of many of the pulses (especially bitter vetch and grasspea), it seems likely that that many of the firepits were used in stone-boiling.

Reconstruction of the vegetation is based partly on the proportions of charcoal relative to seeds (both food plants and weeds) and partly on the types of woods. Relatively high amounts of charcoal in these samples suggests that wood was readily available. If the charcoal turns out to be mostly oak and other forest woods, as at Çayönü, that suggests the natural vegetation was relatively intact not too far from the site. If, instead, riverine types or scrub predominate, then one would have to visualize an landscape in which dense stands of trees are restricted to the rivers and wadis, and other types would be scattered over the landscape. Intermediate proportions would suggest wood was collected from both types of environments. A few charcoal samples analyzed in 1987 (Miller 1987) suggest that this is the case.

In other venues I have stressed the usefulness of the seed to charcoal ratio as a way to assess dung relative to wood as fuel. If the numerator of that ratio is seed weight, it generally consists of large seeded plants like the cultigens. Alternatively, the number of wild seeds can be used. The validity of that measure depends on both seeds and wood originating in fuel. For the Gritille Neolithic, it seems likely that a substantial portion at least of the pulses was charred during food processing, so the seed (weight) to charcoal ratio partly measures food to fuel, rather than fuel to fuel.

Weed seeds can come from a variety of sources: crop cleaning residue, impurities in crops processed as food, brush or dung fuel (cf. Hillman 1984, Miller 1991). The Gritille assemblage is particularly intractable in this regard. Given the current understanding of the charcoal assemblage, it is difficult to make a strong case that the people of Gritille were so short of wood that they *had* to burn brush or dung for fuel. The question remains, what does this seed assemblage mean?

Pulses

As more PPNB and PPNB-related sites are excavated, it becomes increasingly clear that pulses are an important part of many of these early assemblages (Miller 1991). Although pulses are grown andmake a significant contribution to human and animal nutrition in the Middle East, they generally occur in low proportions in later archaeobotanical assemblages. Gritille fits this pattern: pulses represent about 65% of the cultigens by weight in the earlier phase. The later Neolithic levels at Gritille have reduced proportions of pulses relative to cereals (20%). Over the course of millennia the circumstances under which legumes are being deposited in fires seems to change, pulses decline in importance, or both. Several questions about pulse use at Gritille and elsewhere may be addressed.

First, were the pulses cultivated or uncultivated? Morphological criteria are not clear for most types of pulses (Zohary and Hopf 1988), although at least the lentil at Gritille seems to be large enough to count as cultivated. The densities in some of the samples, especially of bitter vetch in sample GT22206 and grasspea in GT 9453, are high enough to suggest that legumes were intentionally collected, and probably grown.

Second, were legumes fed to husbanded animals, and are legumes recovered in archaeobotanical samples the residue of dung fuel? Clearly, this interpretation does not apply to obvious caches of seeds. It is my opinion, at least for the later periods, that the occasional pulse found in an ordinary mixed flotation sample probably had been eaten by an animal (sheep, goat, or cow) and is showing up in dung. The proportions of seed to charcoal, and of weed seeds to to charcoal, are relatively high at Gritille, which might ordinarily indicate dung fuel burning (Table 7). But the seed component of the assemblage looks more like a result of food processing than fuel burning (cf. Hillman 1984): the food/crop seeds are mainly large pulses with some grain, and the weed seeds are for the most part quite tiny, well under a millimeter. A further argument against the Gritille seed assemblage as primarily fodder/dung fuel is that morphologically altered domesticated animals have not been recognized in the basal Neolithic levels (Stein 1989). Insofar as dung could be collected from wild herds (cf. Miller 1996a) and initial domestication is primarily a behavioral change (Russell 1988), the recognized presence of domestic animals may not be significant.

Third, were legumes food? On nutritional grounds, legumes would nicely complement the protein provided by grain, especially in the absence of domestic animals for a steady supply of meat and/or milk. If the Gritille cereals and pulses come from food, it would seem that einkorn was a minor part of the diet relative to pulses, if the two types were processed in similar ways. Alternatively, legumes were processed with or near fire and einkorn was not. In this context, it is interesting that pulses decline in importance as fully domesticated animals become a more reliable source of protein (from meat and, as the population developed lactose tolerance, from milk as well) (Miller in press a). It therefore seems likely that the amount of land devoted to pulse production declined over time.

Comparisons and Interpretations

Inter-site comparisons can show differences in plant and land use patterns across space. They are sometimes difficult because rarely are samples processed and recorded in the same way. Çayönü, Cafer, and Abu Hureyra provide interesting comparisons (see Miller in press a).

Food plants--Gritille and Çayönuu

The archaeobotanical assemblage from Çayönü (van Zeist 1972, Stewart 1976, van Zeist and de Roller 1991/1992) is not comparable to Gritille in a quantifiable way. Nevertheless, the distribution of food plants at the two sites is similar, but by no means identical (Table 8). In both the early Gritille phases and contemporary analyzed levels of Çayönü there were fairly high proportions of legumes relative to cereals. Pulses decline in importance in the later levels. As for the cereals, both emmer and einkorn constitute a significant portion of the wheat at Çayönü, whereas einkorn predominates at Gritille. Bread wheat or hard wheat makes an appearance at Gritille only. Domesticated barley is absent from Çayönü; its presence and increasing importance at Gritille is consistent with both ecology (barley tends to be more common in drier areas) and economy (it is more likely to be a fodder plant than wheat--Çayönü has no domesticated sheep, goat, or cattle). Nuts and fruits show differences that are most readily explained on phytogeographical grounds. Namely, the Çayönü assemblage is characterized by a greater emphasis on forest products: pistachio, almond, and oak. Since Çayönü is located deeper in the oak forest zone, this is not surprising.

Economy and Environment along the Euphrates

It is possible to make rough quantifiable comparisons among the assemblages of three sites that partially overlap in time, and that are situated along a precipitation cline in the Euphrates valley: Cafer, Gritille and Abu Hureyra. These sites span the PPNB, the time when animals became domesticated. Several patterns reflecting both environmental and economic factors can be discerned (Miller in press a). In general, the proportions of pulses relative to cereals and of wheat relative to barley decline at the three sites. That wheat, and to a lesser extent pulses, seem at least initially to be less important on the steppe than in wetter climes reflects rainfall. As suggested above, the overall decline in pulses is more likely a result of increasing availability of animal protein. The increase in barley could reflect the growing of fodder as animal husbandry becomes more important.

In short, as animal husbandry became integrated into the pre-existing farming system, the relationship between people, plants, and animals hit a new balance. Archaeobotanical data allow one to trace these processes even before morphological changes in the animal bones emerge.

Acknowledgments:
Mary Voigt provided the stratigraphic information and advice on stratigraphic interpretation and dating. Gil Stein set up and organized the flotation in the field.

Bibliography

de Moulins, Dominique
1997 *Agricultural Changes at Euphrates and Steppe Sites in the MId-8th to the 6th Millennium B.C.* BAR International Series 683. Oxford.

Helbaek, Hans
1969 Plant-Collecting, Dry-Farming, and Irrigation Agriculture in Prehistoric Deh Luran. In *Prehistory and Human Ecology of the Deh Luran Plain*, eds. F. Hole, K.V. Flannery, and J.A. Neely, pp. 383-426. *University of Michigan Museum of Anthropology Memoir* 1. University of Michigan Museum of Anthropology, Ann Arbor.

Hillman, Gordon C.
1984 Interpretation of Archaeological Plant Remains: The Application of Ethnographic Models from Turkey. In *Plants and Ancient Man*, ed. W. van Zeist and W.A. Casparie, pp. 1-41. A.A. Balkema, Rotterdam.

Kislev, Mordechai E.
1989 Origins of the cultivation of *Lathyrus sativus* and *L. cicera* (Fabaceae). *Economic Botany* 43: 262-270.

Miller, Naomi F.
1987 Gritille Charcoal: Preliminary Analysis. Ethnobotanical Laboratory Report 1. On file, MASCA, University Museum, Philadelphia.

1991 The Near East. In *Progress in Old World Palaeoethnobotany*, ed. W. van Zeist, K. Washlikowa, and K.-E. Behre. A.A. Balkema, Rotterdam.

1996a Seed-Eaters of the Ancient Near East: Human or Herbivore? *Current Anthropology* 37: 521-528.

1996b Hacinebi 1993: Archaeobotanical Report. *American Journal of Archaeology* 100: 248-257. (part of "Uruk Colonies and Anatolian Communities: An Interim Report on the 1992-1993 Rxcavations at Hacinebi, Turkey," by Gil J. Stein et al.)

in press a Tracing the Development of the Agropastoral Economy in Southeastern Anatolia and Northern Syria. Prepared for workshop volume, *Transitions from Foraging to Farming in Southwest Asia.* Groningen.

in press b Patterns of Agriculture and Land Use at Medieval Gritille. In *The Archaeology of the Frontier in the Medieval Near East: Excavations at Gritille, Turkey*, by Scott Redford. Archaeological Institute of America Monograph.

Russell, K. W.
1988 *After Eden: The Behavioral Ecology of Early Food Production in the Near East and Norht Africa.* BAR International Series 391. Oxford.

Stein, Gil J.
1989 Strategies of Risk Reduction in Hunting and Herding Systems of Neolithic Southeast Anatolia. In *Early Animal Domestication and Its Cultural Context*, eds. P.J. Crabtree, D. Campana, and K. Ryan, pp. 87-97. *MASCA Research Papers in Science and Archaeology*, supp. to vol. 6.

Stewart, Robert B.
1976 Paleoethnobotanical Report-Çayönü 1972. *Economic Botany* 30: 219-225.

Townsend, C. C. and E. Guest
1980 *Cornaceae to Rubiaceae. Flora of Iraq*, vol. 4. Ministry of Agriculture and Agrarian Reform, Baghdad.

van Zeist, Willem
1972 Palaeobotanical Results of the 1970 Season at Çayönü, Turkey. *Helinium* 12: 13-19.

1988 Some Aspects of Early Neolithic Plant Husbandry in the Near East. *Anatolica* 25: 49-67.

van Zeist, W. and J. A. H. Bakker-Heeres
1982 Archaeobotanical Studies in the Levant 1. Neolithic Sites in the Damascus Basin: Aswad, Ghoraifé, Ramad. *Palaeohistoria* 24: 165-256.

van Zeist, W. and G. J. de Roller
1991/1992 The Plant Husbandry of Aceramic Çayönü, SE Turkey. *Palaeohistoria* 33/34: 65-96.

van Zeist, W. and W. Waterbolk-van Rooijen
1985 The Palaeobotany of Tell Bouqras, Eastern Syria. *Paléorient* 11(2): 131-147.

Voigt, Mary M.
1988 Excavations at Neolithic Gritille. *Anatolica* 15: 215-232.

Watson, Patty Jo
1976 In Pursuit of Prehistoric Subsistence: A Comparative Account of Some Contemporary Flotation Techniques. *Mid-continental Journal of Archaeology* 1: 77-100.

Wilkinson, T. J.
1990 *Settlement and Land Use at Kurban Höyük and Other Sites in the Lower Karababa Basin. Town and Country in Southeastern Anatolia,* vol. 1. Oriental Institute Publications 109. Oriental Institute, Chicago.

Zohary, Daniel and Maria Hopf
1988 *Domestication of Plants in the Old World.* Clarendon Press, Oxford.

Zohary, Michael
1973 *Geobotanical Foundation of the Middle East.* Fischer Verlag, Stuttgart.

Table 1. Description of sample provenience

GT no.	Op.	Locus	Lot	Phase	Description
1983					
3928	17	5	8	A	TRASH (occupation), against WALL /8
4236	17	7	13	A	PIT (cobbles)
4406	16	25	33	A	FILL
5118	16	31	53	B	TRASH
7076	16	33	114	B	TRASH
8214	16	50	150	B	TRASH
8318	16	50	163	B	TRASH
9453	16	60	190	B	TRASH
1984					
15679	16	14	29	C	WASH & COLLAPSE (bricky, ash layer)
16350	16	20	58	C	no description
16373	16	3	63	B	TRASH (layers)
16869	17	22	51	B	(listed by MMV as 16870)
17154	48	3	3	basal	PIT (charcoal and burnt clay)
17157	48	3	3	basal	PIT (charcoal and burnt clay)
17168	48	13	8	basal	PIT (ash and cobbles)
17219	16	37	99	C	ASH LENS (or casual HEARTH in /34)
17252	16	34	106	C	TRASH layer
17791	16	56	129	C	HEARTH/PIT (roasting) in SURFACE /57
18127	17	54	92	B	PIT (roasting)
18918	17	62	101	B	TRASH (deposits)
19287	17	64	114	B	AREA (outside)
19392	16	84	181	C	no description
19619	50	10	20	B	PIT (layered trash, ash lenses)
19905	48/51	18	13	basal	PIT (cobbles)
19912	48/51	21	16	basal	DEPOSIT between walls /28 and /29
19926	48/51	25	18	basal	COLLAPSE
19929	48/51	26	19	basal	AREA between /22 and /23
19939	48/51	21	21	basal	DEPOSIT between /22 and /23
20261	48/51	28	25	basal	CLAY MATRIX inside /23
20264	48/51	30	23	basal	FILL above pit /14
20267	48/51	31	26	basal	PIT (ash and cobbles, above pit /14)
20271	48/51	32	27	basal	PIT (with cobbles, burning, below floor /9 and equivalent to locus /31 in stratigraphic position
20275	48/51	30	28	basal	FILL above pit /14
20283	48/51	30	30	basal	FILL above pit /14
20730	48/51	14	40	basal	PIT (lensed, cobbles and ash)
20739	48/51	37	43	basal	PIT (ashy, on east side of op. 48)
20795	50	27	48	B	COLLAPSE (interior)
20799	50	37	49	B	OVEN? (small oval)
20901	48/51	14	44	basal	PIT (deep, lensed, cobbles and ash)

Table 1. Description of sample provenience (cont.)

GT no.	Op.	Locus	Lot	Phase	Description
20906	48/51	14	44	basal	PIT (deep, lensed, cobbles and ash)
20911	48/51	14	45	basal	PIT (ashy layer at base of /14)
20945	48/51	44	53	basal	PIT (shallow, with cobbles and ash)
22206	48/51	43	52	basal	BURNT LAYER
22215	48/51	40	55	basal	PIT or shallow depression (cobbles)
22224	48/51	43	57	basal	BURNT LAYER
22243	48/51	48	62	basal	PIT (shallow, cobbles and ash, just below /14)
22248	48/51	49	63	basal	PIT (large cobble pit)
22304	50	44	58	B	OVEN
22418	48/51	53	68	basal	LENSES, COLLAPSE, ASH (bottom of excavation)
22423	48/51	53	68	basal	LENSES, COLLAPSE, ASH (bottom of excavation)
22424	48/51	53	68	basal	LENSES, COLLAPSE, ASH (bottom of excavation)
22755	50	43	68	B	HEARTH PIT (in TRENCH /40)

Table 2. Differential recovery of charcoal larger than 2 mm in the samples containing the most charcoal

Sample no. (GT)	Light fraction (g)	Heavy fraction (g)	% of charcoal missed by flotation
8318	0.57	0.06	10
17154	0.76	0.04	5
17157	1.46	0.03	2
17168	1.73	0.06	3
19939	0.90	0.40	31
20264	0.55	0.12	18
20267	1.61	0.64	28
20271	6.08	0.32	5
20795	1.31	0.04	3
20901	1.21	0.09	7
20911	1.44	1.24	46
22206	0.52	0.01	2
22243	1.01	0.12	11
22248	3.94	0.58	13

Table 3. Differential recovery of pulses larger than 2 mm in the samples containing the most pulses

Sample no. (GT)	Light fraction (g)	Heavy fraction (g)	% of pulses missed by flotation
9453	23.70	0.65	3
20283	0.06	0.04	31
20730	0.29	0.08	22
20901	0.44	0.27	38
20906	0.17	0.10	37
20945	0.08	0.03	27
22206	2.42	1.50	38
22224	0.07	0.02	22
22248	0.11	0.08	42
22418	0.18	0.09	33
22423	0.10	0.01	9
22424	0.11	0.00	0

Table 4a. Cultigen and food plants

Family	Type	Common name
Cereals (Poaceae)	*Hordeum* cf. *distichum*	(two-row) barley
	Triticum aestivum/durum	naked wheat (bread/hard)
	Triticum dicoccum	emmer
	Triticum monococcum	einkorn
Pulses (Fabaceae)	*Lathyrus sativus/cicera*	grasspea
	Lens	lentil
	cf. *Pisum*	pea
	Vicia ervilia	bitter vetch
Nuts/Fruit		
Anacardiaceae	*Pistacia*	pistachio
Moraceae	*Ficus*	fig
Rosaceae	*Prunus* sp.	(wild) almond
Fiber/Oil (Linaceae)	*Linum*	flax/linseed

Table 4b. Wild and weedy types

Family	Type	Common name (*=illustrated)
Apiaceae	misc.	carrot family (GT-Apiaceae 2)
Asteraceae	misc.	daisy family (GT-Asteraceae *1, 2, 5, *6)
Boraginaceae	*Heliotropium*	heliotrope
Brassicaceae	misc.	mustard family
Capparidaceae	*Capparis*	caper
Caryophyllaceae	*Gypsophila*	
	Silene	
	other	pink family
Chenopodiaceae	*Chenopodium*	
	cf. *Salsola*	
	other	goosefoot family (GT-Chenopodiaceae 1, *2)
Cistaceae	*Helianthemum*	*(was GT-unknown 8)
Cyperaceae	*Carex*	
	other	sedge family (GT-Cyperaceae 1, could be *Scirpus)*
Fabaceae	*Astragalus*	
	Medicago	medick
	Medicago radiata	
	Trifolium/Melilotus	clover/melilot
	Trigonella	fenugreek (wild)
	other	pea family (GT-Fabaceae 1, *10)

Table 4b. Wild and weedy types (cont.)

Lamiaceae	*Ajuga*	
	Ziziphora	*(was GT-unknown 5)
	other	mint family
cf. Liliaceae	misc.	lily family
Malvaceae	cf. *Lavatera*	*
	cf. *Malva*	mallow
Papaveraceae	*Fumaria*	fumitory
	Glaucium	
	Papaver	*poppy
Poaceae	*Aegilops*	goat-face grass
	Bromus	brome grass
	cf. *Echinaria*	
	Hordeum	(wild) barley
	Hordeum cf. murinum	wild barley
	Lolium	ryegrass
	cf. *Phalaris*	canary grass
	Phleum/Eragrostis	
	Setaria	
	Triticum boeoticum	wild einkorn
	misc.	grass family (GT-Poaceae 2, 5, *7, *8, *13, *14, *15, *16)
Polygonaceae	cf. *Polygonum*	smartweed
	Rumex	dock
Ranunculaceae	cf. *Adonis*	
Rubiaceae	*Galium*	bedstraw
	other (?)	
Solanaceae	cf. *Hyoscyamus*	
	Solanum	*
	misc.	nightshade family
Thymelaeaceae	*Thymelaea*	
Valerianaceae	*Valerianella*	valerian
	Valerianella coronata-type	
Verbenaceae	*Verbena*	verbena
Unknowns	misc.	*GT-9, *29

Table 5. Some bitter vetch from Gritille (a representative, but not random sample)*

		Length (mm)	Breadth (mm)	Thick-ness (mm)	L/B	L/T	T/B
"developed"	(N=27)	2.23	2.30	2.33	0.97	1.05	0.99
"underdeveloped"	(N=18)	1.98	1.92	2.16	1.02	1.11	0.90

*measured "developed" seeds come from GT17157; GT17168; GT20275; GT20906. "Underdeveloped" ones are from GT20267; GT20739; GT20730; GT22215; GT22243; GT22248.

Table 6. *Linum* measurements

Sample no.	Length (mm)	Breadth (mm)
GT 20901 (basal)*	2.6	1.3
	2.7	1.4
	2.8	1.3
	3.7	2.0
	3.9	1.8
	3.7	-
	3.8	-
GT 22202 (basal)	2.7	1.0
GT 22206 (basal)	2.7	1.0
GT 22243 (basal)	2.4	1.0
GT 22755 (B)	2.9	-
	3.0	-
	3.1	-
	3.2	-

* GT 20901: average length, 3.3 mm (2.6 mm-3.9 mm), SD=0.5, n=7.
Ramad (van Zeist and Bakker-Heeres, 1982): average length, 3.2 mm (2.8 mm-3.6 mm), n=80.

Table 7. Comparisons of seed amounts and numbers of wild seeds with charcoal (source: Miller in press b, Miller 1996b, this report)

	N	seed/charcoal (g/g)	wild seed/charcoal (number/g)
Gritille Neolithic			
Basal, C	20	0.16	653
B, A	10	0.24	258
Gritille Medieval			
phase 2	2	0.08	19
phase 3 & 4	11	0.25	61
phase 5 & 6*	14	1.74	1273
phase 7 & 8*	6	4.12	533
Hacinebi			
Chalcolithic	26	0.24	57

* presumably post-deforestation

Table 8. Comparison between the Çayönü, Cafer, Gritille, and Abu Hureyra Neolithic assemblages, with subjective estimates of relative importance of different food plants (source: van Zeist 1972, Stewart 1976, de Moulins 1997, this report)*

	Çayönü	**Cafer**	**Gritille**	**Abu Hureyra**
bitter vetch	++	+	++	+ (?)
lentil	++	++	++	+ (wild)
pea	++	+	+	+ (?)
grasspea	+	+	+	+ (?)
chickpea	+	-	-	-
einkorn (domesticated)	++	++	++	++
emmer (domesticated)	++	+	+	+
bread/hard wheat	-	-	+	+
barley (domesticated)	-	+?	+	++
pistachio	++	++	+	+
almond	+	+ (cf.)	+	+
oak	+	-	-	-
hackberry	+	+	-	-
fig	-	-	+	+
grape	+	-	-	+ (wild)
flax	+ (cf. wild)	-	+ (cf. dom.)	+ (cf. wild)

* -(absent), +(present), ++ (common)

Table 9. A comparison of assemblages from Gritille, Cafer, and Abu Hureyra Neolithic levels

a. Data for Cafer and Abu Hureyra upon which comparisons are based

	SEED COUNT		SEED COUNT		SEED COUNT	
	Cereal	Pulse	Wheat	Barley	Small legume	Other wild
Cafer*						
III (n=33)	168	206	133	0	36	342
II (n=16)	102	13	68	0	10	38
I (n=13)	269	10	174	4	5	287
Abu Hureyra†						
2A (n=38)	460	50	158	100	3618	2841
2B (n=44)	521	85	97	138	3720	2695
2C (n=9)	416	13	53	72	120	801

b. Data for Gritille upon which comparisons are based¶

	SEED WEIGHT (GRAMS)		SEED WEIGHT (GRAMS)		SEED COUNT	
	Cereal	Pulse	Wheat	Barley	Small legume	Other wild
Early (n=32)¬	1.14	2.08	0.47	0.02	65	656
Late (n=17)	1.95	0.48	0.31	0.51	207	1955
Medieval 5/6 (n=14)	3.45	3.69	1.59	0.71	389	2232
Medieval 7/8 (n=17)	0.48	0.29	1.15	1.31	172	303

* Cafer (de Moulins, 1993)

† Abu Hureyra (de Moulins, 1997)

¶ Gritille (this report; Miller in press b). Note that one cereal grain weighs about 0.01 g.

¬ Sample GT 17219 has been excluded from the small legume/other wild composite figure; if included, the totals would be 506 small legumes and 2639 other)

Appendix 1. Instructions for Analysis and Recording of Light and Heavy Fractions from Gritille

LIGHT FRACTION
1. Fill in GT data sheet provenience information.

2. Measure approximate volume of sample in ml. If sample is larger than about 1 film cannister full (ca. 35 ml), weigh entire sample. Use sample splitter to obtain about one film cannister of material, and weigh the material to be sorted. (For each halving, put in separate containers so that it will be possible later to do additional fractions of approximately equal size).

Exceptions: Even large Basal Neolithic samples were sorted completely. Until the fall of 1990, I did not record volume before sorting; I realized that many archaeobotanists find this a useful measure for estimating quantity of charred material.

3. For portion to be identified, sift into >2 mm (4.75 mm and 2 mm sieves) and <2 mm parts; also it is ok to get rid of the dust. Totally sort >2 mm into charcoal, seed, straw, bone/shell, other.

a. weigh charcoal and record on line 2 of form.
b. weigh seeds and seed fragments as a group and record on line 2 of form.
c. put straw, bone/shell, identifiable and unidentifiable carbonized material in separate containers with labels (GT # and substance; for bone and shell put full provenience.
d. identify the large seeds and count (don't weigh), and record on separate sheet.

4. sift into 3 sizes classes: x<0.5 mm, 0.5 m<x<1 mm and 1<x<2 mm. Pull whole seeds, identifiable seed fragments (mainly cerealand nutshell), and rachis internodes from >1 mm. Scan x<0.5 mm (probably nothing in it), and pull whole seeds and identifiable rachis internodes from <1 mm.

5. identify seeds and record.

6. Recording

a.Taxa that are frequently found in identifiable fragments include cereals (wheat, barley, cereal indet.), legumes (grass pea, bitter vetch, lentil et al.), nutshell, grape (not in the Neolithic, however). They should be recorded by count and weight (of whole ones and of fragments)

b. plant parts should be recorded separately (e.g., rachis internodes, straw, fruit skins, etc.

c. obviously modern and/or uncharred seeds should be recorded as such.

HEAVY FRACTION
7. Sift into >2 mm (4.75 mm and 2 mm sieves) and x<2 mm parts; also it is ok to get rid of the dust. Totally sort >2 mm into charcoal, seed, straw, bone/shell, other.

a. weigh charcoal and record on line 2 of form.
b. weigh seeds and seed fragments as a group and record on line 2 of form.
c. put straw, bone/shell, identifiable and unidentifiable carbonized material in separate containers with labels (GT # and substance; for bone and shell put full provenience.
d. identify the large seeds and seed fragments; count and weigh as above.

8. Follow procedures for light fraction, except for two things. First, pull charcoal fragments 1<x<2mm from heavy fraction, and then, after all size fractions have been scanned and material removed, it is ok to dispose of the residual dirt.

App. 2

GT Neo ELR-27 data, no hf

GT no.	17154	17157	17168	20730	20901	20911	20906	19905	19912	19939	19929	19926	20261
Phase	basal	basal	basal	basal	basal	basal	basal	basal	basal	basal	basal	basal	basal
Operation	48	48	48	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51
locus...lot	3...003	3...003	13...008	14...004	14...044	14...044	14...045	18...013	21...016	21...021	25...019	26...018	28...025
type	pit	pit	pit-cobble	pit 14-cobble	pit 14-cobble	pit 14-base	pit 14-cobble	pit-cobble	room int.	struc. int	bet. walls	collapse	wall
volume (l)	8	8	8	8	8	8	8	8	8	8	8	8	8
density (g/l)	0.10	0.19	0.22	0.07	0.50	0.19	0.09	0.00	0.02	0.12	0.05	0.00	0.02
charcoal >2mm (g)	0.76	1.46	1.73	0.25	1.21	1.44	0.48	0.02	0.15	0.90	0.38	0.02	0.17
seed >2mm (g)	0.05	0.03	0.02	0.27	2.76	0.04	0.25	0.01	+	0.05	0.00	0.00	0.01
wild seed (#)	34	21	51	4	208	13	47	0	2	1	0	0	0
seed/charcoal (g/g)	0.07	0.02	0.01	1.08	2.28	0.03	0.52	0.50	+	0.06	0.00	0.00	0.06
wild seed/charcoal (#/g)	45	14	29	16	172	9	98	0	13	1	0	0	0
Cultigen/food													
Hordeum					1.12		+						
Triticum aestivum/durum					0.41								
Triticum dicoccum						0.01							
Triticum monococcum	0.01	0.01	+	0.02	0.13	0.01	0.09						
Triticum dicoccum						0.01							
Triticum sp.		0.02			0.07								
Cereal, indet.	0.08	0.02	+	0.04	1.49	+	0.09				+		
Lathyrus				0.05			0.03						
Lathyrus/Vicia				0.04	0.04								
Lens	0.01			0.05	0.23	0.01	0.06						
cf. Pisum							0.02						
Vicia ervilia	0.03	0.01	0.04				0.07						
Pulse, indet.	0.03	0.01	0.03	0.15	0.25	0.02	0.08	0.01	0.01	0.05			0.01
cf. Pistacia				+	+	+	0.02					+	
Juglans???													
Linum					13								
Ficus					2								
Wild and weedy													
GT-Apiaceae 2					2								
Apiaceae													
GT-Asteraceae 1							1						
GT-Asteraceae 2													
GT-Asteraceae 5													
GT-Asteraceae 6													
Asteraceae													
Heliotropium				1									
Brassicaceae					2								
Gypsophila					1								
Silene													
Vaccaria													
Caryophyllaceae													
Capparis					1								

GT no.	17154	17157	17168	20730	20901	20911	20906	19905	19912	19939	19929	19926	20261
Chenopodium													
cf. Salsola					1								
GT-Chenopodiaceae 1													
GT-Chenopodiaceae 2													
Chenopodiaceae							4						
Helianthemum	6	2	24										
Helianthemum													
Carex													
GT-Cyperac. 1 (Scirpus?)					1	1							
Cyperaceae													
Astragalus										1			
Medicago													
Medicago radiata													
Trifolium/Melilotus						1							
Trigonella	2				8	1	1						
GT-Fabaceae 1													
GT-Fabaceae 10													
Fabaceae	1			2									
Ajuga													
Ziziphora													
Lamiaceae					5								
cf. Liliaceae					1								
cf. Lavatera	1												
cf. Malva													
Glaucium													
Fumaria													
Papaver													
Aegilops				1	1								
Bromus													
cf. Echinaria													
Hordeum													
Hordeum cf. murinum													
Lolium					1		1						
cf. Phalaris													
Phleum/Eragrostis	17	13	1		85	4	35						
Setaria													
Triticum boeoticum	2				1		1						
GT-Poaceae 2					1				2				
GT-Poaceae 5													
GT-Poaceae 7					26		1						
GT-Poaceae 8					11								
GT-Poaceae 12													
GT-Poaceae 13													
GT-Poaceae 14						4							
GT-Poaceae 15													
GT-Poaceae16					1								
Poaceae	5	2	26		10	2							

GT no.	17154	17157	17168	20730	20901	20911	20906	19905	19912	19939	19929	19926	20261
cf. Polygonum													
Androsace													
Rumex													
cf. Adonis													
Galium					1								
GT-Rubiaceae 1													
Scrophularia-flat													
Verbascum													
cf. Hyoscyamus													
Solanum													
Solanaceae							1						
Thymelaea													
Valerianella													
V. coronata-type													
Verbena													
GT-unk. 5 (Lamiaceae?)													
GT-unk. 29													
unknown (misc.)		4			48		2						
Plant parts													
Aegilops glume base													
Hordeum int.													
T. aestivum/durum gb					22								
T. monococcum/dicoccum sf													
Hordeum/Triticum int.					1								
Grass culm node					1								
Asteraceae head													
Uncharred--modern?													
Lithospermum													
Boraginaceae		1		2	1	3							
Capparis													
Chenopodiaceae													
Ficus (mineralized?)													
Fumaria													
Glaucium													
Papaver-white				3		1	1						
Portulaca					2								
n/c=not calculable; coll=collapse													
int.=internode; gb=glume base; sf=spikelet fork													

GT no.	20283	20264	20275	20267	20271	20739	22215	22206	22224	20945	22243	22248
Phase	basal	basal	basal	basal	basal	basal	basal	basal	basal	basal	basal	basal
Operation	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51
locus...lot	30...003	30...023	30...028	31...026	32...027	37...043	40...055	43...052	43...057	44...053	48...062	49...063
type	pit 14-above	pit 14-above	pit 14-above	pit 14-above	pit-cobble	pit	pit-cobble	burnt layer	burnt layer	pit-cobble	pit, below 14	pit-cobble
volume (l)	8	8	8	8	8	8	8	8	8	8	4	8
density (g/l)	0.04	0.07	0.04	0.21	0.77	0.01	0.02	0.37	0.05	0.05	0.26	0.51
charcoal >2mm (g)	0.21	0.55	0.31	1.61	6.08	0.02	0.15	0.52	0.33	0.34	1.01	3.94
seed >2mm (g)	0.07	0.02	0.03	0.03	0.05	0.02	0.04	2.40	0.07	0.07	0.02	0.11
wild seed (#)	3	0	1	2	6	7	3	28	14	7	4	9
seed/charcoal (g/g)	0.33	0.04	0.10	0.02	0.01	1.00	0.27	4.62	0.21	0.21	0.02	0.03
wild seed/charcoal (#/g)	14	0	3	1	1	350	20	54	42	21	4	2
Cultigen/food												
Hordeum												
Triticum aestivum/durum												
Triticum dicoccum	0.01											
Triticum monococcum	+			+	+	+	+	0.02	0.01	0.01	0.01	
Triticum dicoccum	0.01											
Triticum sp.												
Cereal, indet.	0.01		+				0.01		0.01			0.01
Lathyrus					0.01			0.06				
Lathyrus/Vicia						0.01						
Lens	0.01	0.01	0.01			0.01	+	0.05		0.02		
cf. Pisum								0.06		0.01		0.06
Vicia ervilia			0.02		0.01		0.02	2.68	0.02	0.02	0.05	0.02
Pulse, indet.	0.08	0.01	0.01	0.02	+		0.03	2.43	0.07	0.05		0.03
cf. Pistacia	+		+		+	+				+		+
Juglans???												
Linum							1	3			1	
Ficus												
Wild and weedy												
GT-Apiaceae 2												
Apiaceae												
GT-Asteraceae 1												
GT-Asteraceae 2												
GT-Asteraceae 5												
GT-Asteraceae 6												
Asteraceae												
Heliotropium												
Brassicaceae								2			1	
Gypsophila												
Silene												
Vaccaria												
Caryophyllaceae												
Capparis						7						

GT no.	20283	20264	20275	20267	20271	20739	22215	22206	22224	20945	22243	22248
Chenopodium							1					
cf. Salsola												
GT-Chenopodiaceae 1												
GT-Chenopodiaceae 2												
Chenopodiaceae												
Helianthemum	1				2					2	1	
Helianthemum												
Carex												
GT-Cyperac. 1 (Scirpus?)												
Cyperaceae												
Astragalus												
Medicago									1			
Medicago radiata												
Trifolium/Melilotus	2											
Trigonella												
GT-Fabaceae 1												
GT-Fabaceae 10												
Fabaceae								3				
Ajuga												
Ziziphora												
Lamiaceae												
cf. Liliaceae												
cf. Lavatera												
cf. Malva			1									
Glaucium												
Fumaria								1				
Papaver												
Aegilops												
Bromus												
cf. Echinaria												
Hordeum												
Hordeum cf. murinum												
Lolium									1			
cf. Phalaris												
Phleum/Eragrostis				1	3		1	15	10	5		3
Setaria												
Triticum boeoticum					+							1
GT-Poaceae 2												
GT-Poaceae 5												
GT-Poaceae 7												
GT-Poaceae 8												
GT-Poaceae 12												
GT-Poaceae 13												
GT-Poaceae 14												
GT-Poaceae 15												
GT-Poaceae16												
Poaceae												1

GT no.	20283	20264	20275	20267	20271	20739	22215	22206	22224	20945	22243	22248
cf. Polygonum												
Androsace												
Rumex												
cf. Adonis								2				
Galium												2
GT-Rubiaceae 1												
Scrophularia-flat												
Verbascum												
cf. Hyoscyamus											1	
Solanum												
Solanaceae												
Thymelaea												
Valerianella												
V. coronata-type												
Verbena												
GT-unk. 5 (Lamiaceae?)				1					2			
GT-unk. 29												
unknown (misc.)					1		1	5			1	2
Plant parts												
Aegilops glume base												
Hordeum int.												
T. aestivum/durum gb												
T. monococcum/dicoccum s									1			
Hordeum/Triticum int.												
Grass culm node												
Asteraceae head												
Uncharred--modern?												
Lithospermum	1										1	1
Boraginaceae	1	11							2			
Capparis												
Chenopodiaceae												
Ficus (mineralized?)												
Fumaria												
Glaucium												
Papaver-white												
Portulaca												
n/c=not calculable; coll=colla												
int.=internode; gb=glume ba												

GT no.	22418	22423	22424	15679	16350	17252	17219	17791	19392	16373	5118	7076	8214
Phase	basal	basal	basal	c	c	c	c	c	c	b	b	b	b
Operation	48/51	48/51	48/51	16	16	16	16	16	16	16	16	16	16
locus...lot	53...068	53...068	53...068	14...029	20...058	34...106	37...099	56...129	84...181	3...063	31...053	33...114	50...015
type	coll, lenses	coll, lenses	coll, lenses	wash, coll	wash, coll	trash	hrth/ash	r. pit	wash, coll	trash	trash	trash	trash
volume (l)	8	8	8	8	8	8	8	8	8	8	8	8	8
density (g/l)	0.04	0.03	0.05	0.08	0.14	0.11	0.03	0.01	0.06	0.07	0.55	0.01	0.77
charcoal >2mm (g)	0.02	0.06	0.24	0.62	1.12	0.90	0.20	0.00	0.48	0.56	3.66	0.06	6.16
seed >2mm (g)	0.28	0.14	0.16	0.01	0.00	0.00	0.03	0.04	0.01	0.00	0.75	+	0.02
wild seed (#)	101	87	91	41	163	4	2424	3	0	21	90	1	5
seed/charcoal (g/g)	14.00	2.33	0.67	0.02	0.00	0.00	0.15	n/c	0.02	0.00	0.20	+	0.00
wild seed/charcoal (#/g)	5050	1450	379	66	146	4	12120	n/c	0	38	25	17	1
Cultigen/food													
Hordeum	0.02										0.45		
Triticum aestivum/durum											0.08		
Triticum dicoccum		0.01											
Triticum monococcum	0.15	0.03	0.09						+				
Triticum dicoccum		0.01											
Triticum sp.	0.04	0.03	0.03				+	0.02			0.04		
Cereal, indet.	0.11	0.05	0.05	+			0.03				0.21		0.01
Lathyrus	0.01												
Lathyrus/Vicia		0.02											
Lens	0.03	0.02	0.04				0.03	0.02	0.01			+	0.01
cf. Pisum		0.03											
Vicia ervilia	0.02	+	0.03					0.01					
Pulse, indet.	0.17	0.07	0.10					0.04	+				0.01
cf. Pistacia	+	+	+								+		
Juglans???											0.08		
Linum					1								
Ficus													
Wild and weedy													
GT-Apiaceae 2													
Apiaceae													
GT-Asteraceae 1													
GT-Asteraceae 2	1												
GT-Asteraceae 5													
GT-Asteraceae 6											11		
Asteraceae			1										
Heliotropium		5					30						
Brassicaceae													
Gypsophila													
Silene			4								4		
Vaccaria											2		
Caryophyllaceae											2		
Capparis							1						

GT no.	22418	22423	22424	15679	16350	17252	17219	17791	19392	16373	5118	7076	8214
Chenopodium					6								
cf. Salsola													
GT-Chenopodiaceae 1				4	6								
GT-Chenopodiaceae 2													
Chenopodiaceae													
Helianthemum	18	31	26				1841	1			1		
Helianthemum													
Carex		1	1										
GT-Cyperac. 1 (Scirpus?)	3		1	1			1				1		
Cyperaceae													
Astragalus				10	20	2	223						
Medicago													
Medicago radiata			1	1			1						
Trifolium/Melilotus		1	2				3				7		
Trigonella					1		1				2		
GT-Fabaceae 1													
GT-Fabaceae 10	1												
Fabaceae					13		213	1			2		
Ajuga							1						
Ziziphora		2											
Lamiaceae							3						
cf. Liliaceae													
cf. Lavatera							1						
cf. Malva		2									12		
Glaucium			1	1									
Fumaria													
Papaver			2	1			1			1			
Aegilops				2								1	
Bromus											4		
cf. Echinaria													
Hordeum	1	2											
Hordeum cf. murinum													
Lolium				1	7		7						3
cf. Phalaris													
Phleum/Eragrostis	50	35	34	4	7		8			4	7		
Setaria				1							1		
Triticum boeoticum	11	5											
GT-Poaceae 2										1			
GT-Poaceae 5													
GT-Poaceae 7										1	1		
GT-Poaceae 8											1		
GT-Poaceae 12				4	87					1			
GT-Poaceae 13				11	7	1					5		
GT-Poaceae 14					1					11			
GT-Poaceae 15													
GT-Poaceae16					1								
Poaceae	8		7				7				10		2

GT no.	22418	22423	22424	15679	16350	17252	17219	17791	19392	16373	5118	7076	8214
cf. Polygonum							1						
Androsace											1		
Rumex													
cf. Adonis			1										
Galium	3		2								2		
GT-Rubiaceae 1													
Scrophularia-flat													
Verbascum							1				1		
cf. Hyoscyamus													
Solanum													
Solanaceae													
Thymelaea													
Valerianella	1	1	1										
V. coronata-type							1				1		
Verbena			1				1						
GT-unk. 5 (Lamiaceae?)	4	2	1										
GT-unk. 29											3		
unknown (misc.)			5		7	1	78	1		2	9		
Plant parts													
Aegilops glume base													
Hordeum int.											20		
T. aestivum/durum gb													
T. monococcum/dicoccum s	16	7	28										
Hordeum/Triticum int.											1		
Grass culm node											5		
Asteraceae head													
Uncharred--modern?													
Lithospermum	3	3			1							1	1
Boraginaceae													
Capparis													
Chenopodiaceae													
Ficus (mineralized?)					1								
Fumaria													
Glaucium		1											
Papaver-white							1						
Portulaca													
n/c=not calculable; coll=collε													
int.=internode; gb=glume ba													

GT no.	8318	9453	16869	18127	18918	19287	19619	20795	20799	22755	22304	4406	4236	3928
Phase	b	b	b	b	b	b	b	b	b	b	b	a	a	a
Operation	16	16	17	17	17	17	50	50	50	50	50	16	17	17
locus...lot	50...163	60...190	22...051	54...092	62...101	64...114	10...020	27...048	37...49	43...068	44...058	25...033	7...013	5...008
type	trash	trash	r. pit	r. pit	trash	outside	trash	int. coll.	oven?	hrth	oven	fill	pit	trash
volume (l)	8	8	1	8	8	8	8	8	8	8	8	8	8	8
density (g/l)	0.07	3.00	1.49	0.05	0.04	0.06	0.03	0.17	0.71	0.03	0.09	0.01	0.22	0.02
charcoal >2mm (g)	0.57	0.05	1.46	0.38	0.10	0.48	0.16	1.31	5.61	0.22	0.23	0.10	1.62	0.09
seed >2mm (g)	+	23.93	0.03	0.01	0.22	0.00	0.06	0.02	0.04	0.05	0.48	0.01	0.11	0.03
wild seed (#)	1	4	9	2	882	705	115	1	7	31	232	1	55	4
seed/charcoal (g/g)	+	478.60	0.02	0.03	2.20	0.00	0.38	0.02	0.01	0.23	2.09	0.10	0.07	0.33
wild seed/charcoal (#/g)	2	80	6	5	8820	1469	719	1	1	141	1009	10	34	44
Cultigen/food														
Hordeum		0.08								+	0.01		0.05	
Triticum aestivum/durum					+									
Triticum dicoccum					+				0.02					
Triticum monococcum		0.10			0.03		0.03				0.12		0.03	
Triticum dicoccum					+				0.02					
Triticum sp.		0.01	0.01	0.01	0.06		0.01			+	0.16	0.01	0.02	0.02
Cereal, indet.		0.01	+	+	0.13		0.09	+	+	0.01	0.31	+	0.03	+
Lathyrus		21.87												
Lathyrus/Vicia		0.01												
Lens		0.21			0.01				+	0.02	0.13			+
cf. Pisum														
Vicia ervilia					0.01					0.02	0.03		0.01	
Pulse, indet.	+	1.61	0.01	+	0.11			+	0.02	0.01	0.07		0.01	
cf. Pistacia					0.03		+							
Juglans???														
Linum					38					8	3			
Ficus														
Wild and weedy														
GT-Apiaceae 2														
Apiaceae					1									
GT-Asteraceae 1														
GT-Asteraceae 2													2	
GT-Asteraceae 5					1						2			
GT-Asteraceae 6														
Asteraceae														
Heliotropium													2	
Brassicaceae					2						1		3	
Gypsophila														
Silene													1	
Vaccaria													1	
Caryophyllaceae														
Capparis					1						2			

GT no.	8318	9453	16869	18127	18918	19287	19619	20795	20799	22755	22304	4406	4236	3928
Chenopodium					3	23								
cf. Salsola														
GT-Chenopodiaceae 1											1			
GT-Chenopodiaceae 2					10									
Chenopodiaceae						192								
Helianthemum					4				1		2			
Helianthemum														
Carex														
GT-Cyperac. 1 (Scirpus?)						2			1					
Cyperaceae						2								
Astragalus					9	86	3		1		9		1	1
Medicago														
Medicago radiata					1									
Trifolium/Melilotus			3		23		5				11		4	
Trigonella						14					1		2	
GT-Fabaceae 1		4												
GT-Fabaceae 10														
Fabaceae					1	3	3			1	14			
Ajuga														
Ziziphora														
Lamiaceae					2									
cf. Liliaceae														
cf. Lavatera											1			
cf. Malva									1					
Glaucium														
Fumaria														
Papaver					27					6	1			
Aegilops											1			1
Bromus											3			
cf. Echinaria					1									
Hordeum														
Hordeum cf. murinum													1	
Lolium	1			1	12		2	1	1	2	44		2	
cf. Phalaris					7									
Phleum/Eragrostis					53	5	3			10	97		2	
Setaria														
Triticum boeoticum					1									
GT-Poaceae 2														
GT-Poaceae 5					1									
GT-Poaceae 7					5		98				1			
GT-Poaceae 8					2						2		1	
GT-Poaceae 12					5	357				1				
GT-Poaceae 13					17					1				
GT-Poaceae 14					460					1				
GT-Poaceae 15					8					1				
GT-Poaceae16														
Poaceae			5	1	204				1	2	11	1	11	1

GT no.	8318	9453	16869	18127	18918	19287	19619	20795	20799	22755	22304	4406	4236	3928
cf. Polygonum														
Androsace														
Rumex											3		1	
cf. Adonis														
Galium											1		2	
GT-Rubiaceae 1					1									
Scrophularia-flat					1									
Verbascum											1			
cf. Hyoscyamus														
Solanum											1			
Solanaceae														
Thymelaea									1					
Valerianella														
V. coronata-type											1			
Verbena					1								1	
GT-unk. 5 (Lamiaceae?)														
GT-unk. 29														
unknown (misc.)			1		18	21	1			6	21		18	1
Plant parts														
Aegilops glume base											1			
Hordeum int.														
T. aestivum/durum gb														
T. monococcum/dicoccum s			1								18			2
Hordeum/Triticum int.														
Grass culm node													1	
Asteraceae head													2	
Uncharred--modern?														
Lithospermum						1	1		1			1		
Boraginaceae														
Capparis													4	
Chenopodiaceae									1					
Ficus (mineralized?)														
Fumaria													1	
Glaucium														
Papaver-white													2	
Portulaca														
n/c=not calculable; coll=coll														
int.=internode; gb=glume ba														

App. 3 GT Neo ELR-27 hf

GT no.	17154	17157	17168	20730	20901	20911	20906	19905	19912	19939	19929	19926	20261	20264
phase	basal	basal	basal	basal	e	basal	basal	basal	basal	basal	basal	basal	basal	basal
Operation	48	48	48	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51
locus...lot	3...003	3...003	13...008	14...040	14...044	14...044	14...045	18...013	21...016	21...021	25...019	26...018	28...025	30...023
phase	basal	basal	basal	basal	e	basal	basal	basal	basal	basal	basal	basal	basal	basal
volume (l)	8	8	8	8	8	8	8	8	8	8	8	8	8	8
type	pit	pit	pit-cobble	pit-cobble	pit-cobble	pit-base	pit-cobble	pit-cobble	room int.	struc. int	bet. walls	collapse	wall	pit 14-above
HF charcoal > 2mm	0.04	0.03	0.06	0.09	0.09	1.24	0.20	0.07	0.15	0.40	0.04	0.04	0.13	0.12
HF seed > 2mm	+	0.00	0.04	0.03	0.15	0.04	0.07	0.00		0.00	0.00	0.00	0.02	+
Hordeum														
Triticum dicoccum						+								
Triticum monococcum														
Triticum, indet.														
Cereal, indet.			+		0.01									
Lathyrus														
Lathyrus/Vicia					0.10									
Lens				0.02	0.03	0.02	0.04				+			
cf. Pisum														
Vicia ervilia	+		0.04	0.02		0.02	0.05							
Pulse, indet.			0.02	0.04	0.14	0.03	0.01						0.02	+
Pistacia			0.01		+	+	0.02		+			+		0.02
Prunus (almond)														
Nutshell, indet.														
Triticum cf. boeoticum														
Triticum monococcum sf														
	note: Gil Stein and Irene Good sorted the heavy fractions; Naomi Miller identified and recorded them.													

GT no.	20275	20283	20267	20271	20739	22215	22206	22224	20945	22243	22248	22418
phase	basal	basal	basal	basal	basal	basal	e	basal	basal	basal	basal	basal
Operation	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51	48/51
locus...lot	30...028	30...030	31...026	32...027	37...043	40...055	43...052	43...057	44...053	48...062	49...063	53...068
phase	basal	basal	basal	basal	basal	basal	e	basal	basal	basal	basal	basal
volume (l)	8	8	8	8	8	8	8	8	8	4	8	8
type	pit 14-above	pit 14-above	pit 14-above	pit-cobble	pit	pit-cobble	burnt layer	burnt layer	pit-cobble	pit, below 14	pit-cobble	coll, lenses
HF charcoal > 2mm	0.07	0.04	0.64	0.32	0.02	0.24	0.01	0.01	0.07	0.01	0.58	0.01
HF seed > 2mm	0.02	0.03	0.02	0.01	0.00	0.03	1.50	0.02	0.06	0.04	0.08	0.19
Hordeum												
Triticum dicoccum												
Triticum monococcum						+		0.01	+	0.01		
Triticum, indet.										+		
Cereal, indet.	+									0.02		+
Lathyrus							0.13					
Lathyrus/Vicia			0.01		+							
Lens						+	0.05					0.01
cf. Pisum							0.12		0.06		0.01	0.03
Vicia ervilia	0.02	0.01		0.01		0.01	1.75				0.03	0.03
Pulse, indet.		0.03		+	0.01		1.15		0.03	0.01		0.04
Pistacia	+	0.01		0.01		+				0.01		0.02
Prunus (almond)										0.07		
Nutshell, indet.						+					0.01	
Triticum cf. boeoticum			1	+								
Triticum monococcum sf												

GT no.	22424	22423	8318	20795	7076	9453
phase	basal	basal	b	b	b	b
Operation	48/51	48/51	16	50	16	16
locus...lot	53...068	53..068	50...163	27...048	33...114	60...190
phase	basal	basal	b	b	b	b
volume (l)	8	8	8	8	8	8
type	coll, lenses	coll, lenses	trash	int. coll.	trash	trash
HF charcoal > 2mm	0.03	0.12	0.06	0.04	0.07	0.20
HF seed > 2mm	0.06	0.02	0.00	0.00	0.00	1.99
Hordeum						0.01
Triticum dicoccum						0.93
Triticum monococcum	+					
Triticum, indet.	+					0.19
Cereal, indet.						0.04
Lathyrus						0.04
Lathyrus/Vicia						
Lens	+					
cf. Pisum						
Vicia ervilia		0.02				
Pulse, indet.	+					0.61
Pistacia	0.01					
Prunus (almond)	0.06					
Nutshell, indet.						
Triticum cf. boeoticum						
Triticum monococcum sf	3					

Some seeds from Neolithic Gritille