An Examination of Botanical Materials from Mashantucket Pequot Site 72-58

Submitted by:

Heather Trigg and Jessica Bowes

Fiske Center for Archaeological Research
University of Massachusetts Boston

Cultural Resources Management Study No. 24b

INTRODUCTION

This analysis reports on plants remains recovered from site 72-58. As part of the larger goal of understanding the impact of the reservation system on the Pequots and their relationship to the environment, we examined floated botanical materials from this 18th-century homestead on the Mashantucket Pequot reservation. Samples from 11 features (2, 3, 4, 6, 7 8, 9, 10, 11, 12, and 13) from this site have been analyzed. These 79 samples comprised nearly 1000 liters of original sediment. During our analysis, we attempted to identify all types of botanical materials recovered including hard and soft tissues, and a sample of the charred wood.

In this report, we identify the types of botanical remains recovered, their possible uses, and implications for Pequot society. To aid in the interpretation of these results, we compare the botanical materials recovered in this analysis with plant materials found at other sites on the Mashantucket Pequot reservation and in the Northeast. The aim of this analysis is ultimately to examine the Pequots' response to the landscape changes as well as their maintenance of and changes in subsistence practices. As an example of a site during the reservation period, it allows us to understand the response to the territorial constriction that accompanied colonialism.

METHODS AND PROTOCOLS

All botanical samples were submitted to UMass Boston's Paleoethnobotany Lab previously floated. We scanned the light fractions of all samples and a small number of the heavy fractions. For these few heavy fractions, we removed cultural material as well as plant parts. The majority of heavy fractions were sorted at the Mashantucket Pequot Tribal Museum. At UMass Boston, light fractions were sifted through geological sieves with 2 mm, 1 mm, and .5 mm openings and were then scanned using Zeiss dissecting microscopes at magnifications of 10-

40x. All charred seeds, nutmeats, nutshells, and non-woody tissues were removed from all fractions.

A subsample of charred wood fragments was selected for identification. While some recommend sampling a larger number of pieces, Asch, Ford, and Asch (1972) found that a selection of 20 specimens gives a representative picture of the types of wood in a sample. We followed this protocol, analyzing between 20 and 30 pieces per sample. Wood fragments at least 2mm in size were examined first using a dissecting microscope at 10-40x and then if necessary a Nikon metallurgical microscope at magnifications of 100-600x. Such magnifications were needed to positively identify such taxa as maple, cherry, dogwood, and willow.

Special attention was paid to retrieving non-seed, non-wood plant materials, including those that might be parenchymous tissues. Hather (2000) recommends identifying only fragments larger than 2mm in size. Others suggest attempting identifications on specimens that are not less than a majority of the tuber or bulb and where the epidermis remains (Andrea Weiser, Sonia Zarrillo personal communications). In addition to the common small starchy fragments, we recovered several larger plant parts that were clearly not wood or nutshells. We attempted to identify them by analyzing their morphological structures and comparing them to charred modern specimens. When we were unable to make taxonomic identifications, we attempted to examine the quantities and types of non-seed, non-wood tissues in hopes of obtaining some information about them. All identifications were made by comparison with the comparative collection housed in the Paleoethnobotany Lab at UMass Boston and published sources (Hoadley 1990; Martin and Barkley 1973; Montgomery 1977). Plant remains were removed from the samples, sorted by taxon and plant part and stored in microcentrifuge tubes.

Given the age and exposed nature of the archaeological sediments, any uncharred seeds found in the samples are probably modern contaminants. In samples scanned and sorted at UMass Boston, these seeds were noted but not counted or removed from the samples. These included such taxa as wild grape, pokeweed, and copperleaf. There are several uncharred seeds with catalogue numbers; these specimens were recovered from heavy fractions sorted at Mashantucket. All pokeweed (*Phytolacca americana*) and a few of the grape (*Vitis* sp.) seeds were uncharred. I would suggest deleting them from Mashantucket's database of archaeological plant specimens. These are noted in the database constructed at UMass Boston.

RESULTS

Our goal during the laboratory analysis phase was to identify as many macrobotanical remains as possible, regardless of their nature. The results of our analysis are divided into groups based roughly on anatomical part: wood, nutshells/nutmeat, seeds (domesticates, fruit seeds, wetland plants, other seeds), and other plant parts.

Wood

Charred wood fragments were recovered from all features. We attempted to identify all samples to family or generic levels. At the most gross level of identification, charred wood pieces were classified as either hardwood or softwood; while we looked for monocot stems (for example maize, grass, or sedge) we did not find any. Hardwoods that we could not identify taxonomically were grouped into categories that are based on the micromorphological characteristics of wood structure: ring porous, semi-diffuse porous and diffuse porous woods. In New England, ring porous woods include such trees as oak, hickory, ash, chestnut, and sumac.

Semi-diffuse woods are walnut and butternut. Diffuse porous woods include maple, willow, dogwood, cherry, birch, apple, sycamore, and beech. In some instances, particularly with very small or highly degraded pieces, we were unable to determine the morphological category; these we merely identified as hardwood.

Hardwoods

We identified a broad spectrum of wood types including both hardwoods and softwoods, although the vast majority of wood fragments were hardwood (Tables 1 and 2, Figure 1). The most commonly identified hardwood remains were members of the Fagaceae and Juglandaceae families: oak (*Quercus*), chestnut (*Castanea*) and hickory (*Carya*), and to a lesser extent walnut or butternut (*Juglans*). There is clearly an abundance of oak and chestnut, which comprise 37% of identified wood fragments. Small pieces of oak and chestnut can be difficult to distinguish, so we grouped such pieces as oak/chestnut, and it is likely that many of the specimens in the ring porous category are also oak or chestnut. Hickory was also a taxon commonly recovered comprising 5% of the assemblage. There were smaller amounts of other hardwood taxa: maple (*Acer*), willow (*Salix*), dogwood (*Cornus*), and ash (*Fraxinus*).

The majority of the wood assemblage came from large trees, and only smaller quantities were from smaller trees such as sumac, dogwood, and willow. This may be not only an indication of the Pequots' preference for larger pieces of wood, but also the result of taphonomic processes which select for larger, more durable pieces of wood. Given the introduction and importance of domestic fruit trees to historic Pequot society (Campisi 1990; Den Ouden 2005), particular attention was paid to the possibility of wood from fruit trees (in particular apple and cherry) that might have become available when the trees were pruned. Neither cherry nor apple were identified although they may be included in the diffuse porous category where we lumped specimens we were unable to identify more specifically.

Conifers

Conifers, including pines, comprised only 10% of the wood fragments. We found at least two types of softwoods, pine and at least one specimen of a softwood that was not pine (Table 2). This may be hemlock or cedar, but was too small to identify further.

Discussion of Wood

While oak and chestnut dominated the site assemblage, the distribution of wood types was not even across the site. Feature 11 was striking in that all wood identified was softwood, predominantly pine, and Features 7 and 13 contained a substantial proportion of pine. Maple comprised a significant proportion of the wood in Feature 8 (where there were a small number of pieces) and Feature 9.

The Pequots would have selected tree products for a variety of purposes including building materials, tools, and basketry and perhaps even as medicines. The choice of woods depended not only on availability, but also the use to which it would be put. The wood recovered at the site comes from a diverse array of species, but as much of it is charred and recovered from features, it probably represents the remains primarily of fuelwood rather than other utilitarian uses, field clearance, or accidental burning. Some bud fragments found suggesting that small twigs were also burned, perhaps as tinder. Firewood recovered from archaeological sites reflects the intersection of several factors, those intrinsic to the wood and cultural choices. Factors intrinsic to the wood such as fragmentation and completion of combustion affect recovery and identification. Choices made by site inhabitants reflect both cultural factors and physical properties (Smart and Hoffman 1988). Some types of wood burn slowly and have high heat values (for example, oak and hickory) while others such as pine burn quickly or pop or smoke, but cultural attitudes towards specific tree taxa also influence their selection and usage (Kahn and Coil 2006). We may be seeing the importance of these factors in the dominance of hardwoods and small numbers of softwoods in the assemblage at 72-58. These patterns make the wood assemblage in Feature 11 where pine dominates all the more interesting. From the botanical evidence alone, it is difficult to interpret this choice of wood. It is possible that the predominance of pine was less the Pequots' deliberate choice than the easy availability of this wood when Feature 11 was used, but we can also entertain the idea that the pine in Feature 11 represents a considered choice that related to the feature's function.

Hardwoods, in general, are preferred to softwoods for fuel, and specifically in New England, oak and hickory were prized (Cronon 1983). In addition to their use as firewood, hickory and oak were used for building materials. During colonial times, the pressure on hickory stands in New England was intense, so much so that by 1800 few large stands remained (ibid). With pressure on selected tree taxa, we might see differences in fuels recovered from the 17th- to 18th-century sites. Moreover, documented complaints from the Pequots suggest that fuel wood was becoming scarce due to colonists' depredations (Campisi 1990; Den Ouden 2005). As prime fuel woods diminished, we might expect the Pequots to become less selective in their choice of fuel woods; this might be reflected in a shift from preferred woods to less desired wood or alternatively, the utilization of a broader range of fuel types. In the specific case of the peoples of New England, this might be seen in the archaeological record as a shift from oak and hickory wood to shrubby trees or those with lower heat values such as softwoods.

To examine the range of species utilized at 72-58, we analyzed the fuel woods using diversity and species richness indices. Species richness of wood (the number of taxa represented) at this site was 11, a bit higher than at 72-92 where the species richness was only 7. This could relate to abilities of the analysts because much of the increase in richness occurs in more obscure taxa (such as dogwood) with only a few specimens recovered from the site. Ubiquity indices were calculated for several of the more common wood taxa. Here we used ubiquity as the percent of sampled features in which a taxon occurs. Despite the numerical dominance of hardwoods in the assemblage, hardwoods and softwoods are equally ubiquitous in features across the site (Table 3).

Of more interest are the relative proportions of the different taxa and the emphasis of different woods in different features. The recovery of sumac wood is interesting. Wood from this taxon was identified in only Feature 3. It is not a typical fuelwood, and is not often recovered from archaeological sites in the region. Sumac is a shrubby tree common on forest margins and in disturbed habitats. Recovering this wood suggests that the inhabitants of 72-58 were accessing open, disturbed areas, perhaps shifting to less useful fuels. Charred sumac seeds were also recovered from Feature 3. Sumac fruits are used for food, but since the fruit is only slightly larger than the seed itself, it is generally not considered a significant source of food (Asch, Ford, and Asch 1972). The seeds found in this feature may have been charred because they were burnt in association with the wood, because they had gathered the wood, cleared it, or as because they had gathered the fruits.

A small but significant amount of maple was found in the assemblage. The various species of maple tolerate different environments, some preferring deep shade, others an open canopy. We were unable to determine species for this genus and thus understand possible ecological implications of this fuelwood choice. Negligible amounts of taxa preferring very moist environments, willow or birch, were found; neither of these woods provides much heat value when burned.   Softwoods, which occur in small amounts in many features, dominate only in one feature. We might assume from this that the feature had a specific, single use purpose, or even that the pieces we recovered came from a single piece of wood. The broader distribution of small numbers of softwoods across the site might reflect more of the typical selections made, suggesting a constant but limited use of softwoods. Cronon (1983) notes that pines, in high demands for the ship-building industry, were the first to go, but the Pequots were able to get sufficient quantities to burn. The high proportion of oak and hickory in the archaeological record at 72-58 suggests that the Pequots continued to be able to obtain high quality fuel wood. These taxa respond well to light disturbance, but not clear cutting, and both hickory and oak are adapted to periodic fire burns (Wagner 2003). Despite the destruction of forests associated with colonization, agriculture, timber production, the data suggests that the Pequots obtained these types of wood perhaps because they were able to access more remote areas where stands of the trees remained.

Nutshell and Nutmeat

Nutshells were among the most common plant parts identified. Due to the small size of many nutshell fragments, some pieces could not be identified, but those that were include hazelnut, acorn, oak/chestnut, hickory, and thick-walled nutshells which are either hickory or *Juglans* (walnut or butternut). Most identifiable nutshell fragments belong to the oak/chestnut and hazelnut categories (Table 4, Figure 2). Of the thick-walled nutshells, those that could be identified were exclusively hickory nut.

While we cannot distinguish between them, oaks are typically grouped as white oaks and red oaks, both of which produce acorns of varying nutritional values (Scarry 2003:65). Available in the fall, acorns from the Eastern woodland area were a staple food in Native American diets (Scarry 2003:65). One difference between these two types is that the white oak acorns are sweet, take about a year to mature, and need only limited processing before being able to be consumed. Red oak acorns are bitter, mature over two years, and require more processing due to the higher levels of tannic acid (Scarry 2003:65-66).

Production in any single grove is variable with a mast averaging every 5 years. Because of the large number of oak species, their varying tolerance for differing weather conditions, and the steady rotation of nuts they produce, there is usually a regular acorn crop (Scarry 2003:66). Acorns are quickly utilized by wildlife soon after they drop, the white oak's sweet nuts being the first to go (Scarry 2003:66). It is possible that Native Americans, to some degree, managed oak groves as a way of controlling access to ripened acorns, before squirrels could remove the nut mast. One way of managing the groves is by "girdling undesirable trees to thin the canopy and burning undergrowth to kill saplings" (Scarry 2003:76). Oaks, as fire-tolerant species are thought to have been influenced by fire management practices (Wagner 2003:135). "Given that in eastern North America oak and hazel are capable of vegetatively sprouting and that both are adapted to regular fire regimes, it is possible that some oak and hazel populations were managed by fire-induced coppicing or sprouting" (Wagner 2003:157).

The nutritional value of acorns, especially their caloric content, and the regular crop may be reasons for their prolonged use as a staple (Gremillion 2003:24). Acorns must be parched before being stored to prevent mold and worms. Once a white oak acorn is parched it can be consumed, but red oak acorns must further be processed to leach out the tannic acid. This can be achieved through several techniques including, boiling the acorns, boiling them with ash, or soaking them in fresh water. The acorns were then ground, as meal for bread, paste for broth, or meal for gruel (Scarry 2003:66-67). The use of fire to process the nuts for storage is one reason these plant materials survived.

Chestnut nutshells were also found at 72-58. Chestnut is a common nut producing tree whose sweet nuts are available in the fall (Scarry 2003:58). The chestnut is part of the beech family along with acorns, but seems to be less important than acorns to Native Americans (Scarry 2003:65). Although there is little archaeological evidence for the use of chestnuts, there is ethnohistorical evidence (Scarry 2003:67). The lack of macrobotanical remains identified from archaeological contexts may relate to the expansion of the tree's range in historic times or possibly analysts' lack of recognition or misidentification of the remains. As a food source, chestnuts are a good source for carbohydrates, with about 3.9 grams of carbohydrates per chestnut (Scarry 2003:62), the highest level of all Eastern nuts (Scarry 2003:67). Each fall the chestnuts ripen, drop from the tree, and are quickly gathered by wildlife (Scarry 2003:67). In order to obtain chestnuts before the local animals, Native Americans would need to be prepared to collect them once ripe (Scarry 2003:74). Once gathered, Native Americans pounded or boiled chestnuts, ate them raw, or ground them into a meal to be used in bread (Scarry 2003:67).

Chestnuts can withstand fire and chestnut forests in the southern Appalachians increased through fire management after 1000 B.C. (Delcourt et al. 1998; Wagner 2003). From the palynological record, some suggest possible management of chestnut stands by Native peoples in the Northeast (Jacobucci 2006). However, over exploitation of trees resulted in the reduction and division of forest stands; such loss of forest cohesion led to a drop in oak and chestnuts (Wagner 2003:150-151).

A substantial proportion (25%) of the nutshell assemblage was composed of hazelnuts (Figure 2). While hazelnuts were found in several features, they were primarily recovered from

Feature 3. This shrub colonizes disturbed habitats, grows well in sun and partial shade, but also tolerates deep shade. Its adaptation to a broad range of ecological zones and rapid colonizing abilities suggests that the environmental disturbances that accompanied colonization may have encouraged the spread of the plant. Cleared forests, old field margins, and abandoned settlements would have provided excellent habitats and promoted hazelnut growth.

These shrubs were all the more valuable because they produce a regular mast, and the nuts have a high fat and calorie content (Asch, Ford, and Asch 1972; Scarry 2003). Unlike hickory nuts and walnuts, once collected they are easy to process. The nutmeats can easily be separated from the nutshells, roasted, or stored. One disadvantage is that they are difficult to retrieve because when they are just mature, the nutmeats are tightly covered in a husk. When fully mature the nuts are released and fall to the ground where they are difficult to retrieve (Scarry 2003).

Hickory nutshells are among the most common plant parts recovered from archaeological sites in the prehistoric eastern woodlands; in some instances their numbers are rivaled only by charred wood (Asch, Ford, and Asch 1972). They are an excellent source of fat, vitamins, and calories which perhaps explains their popularity. At 72-58, hickory nutshells were common, occurring in 5 of 11 features and comprising up to 25% of the assemblage. Hickory nutmeats tend to cling tightly to the shells, thus obtaining the meat requires some effort. In contrast to acorns and hazelnuts, the nutmeat itself is not typically consumed. Instead the shells are pounded, cracked, roasted in the shell, and the meat and shell boiled together. The oil floats to the top, is skimmed off, and stored for later use. The method of processing these nuts may have encouraged charring and thus their preservation. The parching of the nuts with the shells would definitely increase the chances of the nuts becoming charred. In contrast to acorns, hickory trees' production of nuts is regular and therefore provides a predictable source of food.

Hundreds of nutmeat fragment were recovered from Feature 13. Since this feature contained chestnut nutshell, these nutmeat fragments were probably also chestnut. In other instances it is difficult to determine which type of nut they were from.

Discussion of Nuts

The nutshell assemblage provides interesting contrasts with other sites in the region. In many cases, hickory nuts are the predominant nut type in the assemblage. Here, though, they appear to comprise a lower proportion of the botanical assemblage. When compared with assemblage recovered from the 17th-century Monhantic Fort, the difference is striking (Figures 2 and 3). It appears that there was a shift from hickory to thin-walled nutshells such as acorns or chestnuts. Nutritional changes that accompany this change suggest a shift from higher fat hickory nuts to low fat, but high carbohydrate acorns. Acorns provide less than half the calories and protein of hickory nuts, but hazelnuts are nutritionally similar providing about as many calories as hickory nuts (Asch, Ford, and Asch 1972). Whether this shift to acorns and hazelnuts mirrors changes in local vegetation or instead reflects differences in the Pequots' selection of foods cannot be determined, but the continued availability of hickory wood for fuel, argues for changes in choice.

Seeds

Cultigens

We recovered a substantial number of maize fragments (Table 5). These include kernel fragments and a few cupules, the part of the cob that holds the kernels. These were recovered from features 3, 6, and 12, yielding a ubiquity of 30%. Within the stratified layers of Feature 12, maize fragments were found in all strata (1-5). The cupule fragments, very common at archaeological sites in the Midwest, South, and Southwest, are relatively rare in samples from the coastal Northeast (but see Largy et al. 1999; Cassady and Webb 1999). Largy (Largy et al. 1999) suggests that maize use in the region may be greater than the remains suggest, and we agree. At sites in other regions of the country where maize is commonly recovered, cupule fragments tend to dominate the assemblage except in atypically preserved contexts (such as intact storage spaces). The dearth of cupules reported from the Northeast may relate to a variety of issues that have little to do with the importance of maize. These may be the result of differential use and disposal of maize cobs as well as archaeologists' sampling and analysts' familiarity with these plant parts.

A total of 3 bean (*Phaseolus vulgaris*) cotyledons were recovered from Features 3 and 12. Within Feature 12, beans were found in strata 3 and 4. We were fortunate to retrieve them, as beans are less commonly recovered in archaeological contexts.

One kernel of wheat (*Triticum aestivum*) was found. The morphology of the grain suggests bread or club wheat rather than other possible wheat species. A few other pieces, which look like grain fragments, were also recovered. No plant parts indicative of cultivation such as rachis, stem, or chaff fragments were recovered but these are sometimes rare. As a consequence of this lack of data, we cannot determine if the Pequots at 72-58 cultivated wheat or merely purchased the wheat from others. What we can ascertain is that they had access to wheat.

The only other evidence for the use of introduced cultigens is the presence of one *Malus* sp. (apple or pear) seed. While the planting and tending of apple orchards by the Pequots are well-documented in written sources (Campisi 1990; Den Ouden 2005), this plant's remains confirms the use of apples at the site.

Fruit Seeds

Fruit seeds, while often few in number, were fairly common. These were typically represented by taxa, with durable seeds from small fruits containing many seeds (Table 6). There were 150 fruit seeds found including blueberry/cranberry (*Vaccinium* sp.), huckleberry (*Gaylussacia* sp.), raspberry/blackberry (*Rubus* sp.), viburnum (*Viburnum* sp.), dogwood (*Cornus* sp.) and grape (*Vitis* sp.). Fruit seeds, especially blueberries, raspberries, and huckleberries are among the most common food remains found at sites in the eastern woodlands (Crawford and Smith 2003; Scarry 2003; Wagner 2003), and they have been frequently found at sites on the Mashantucket reservation. Most of these plants are stimulated by fire and inhabit areas in the early stages of succession or forest margins. Their fruits are typically available in mid- to late- summer.

A substantial number of charred sumac (*Rhus* sp.) seeds were found primarily in Feature 3, but also in Features 4, 6 and 12. Sumac fruits can be steeped as lemonade which is high in vitamin C. Remnants may have then been discarded into the fire. This may be how the seeds we found were used. However, we also found small amounts of charred sumac wood in Feature 3, and it is possible that the seeds inadvertently charred when the branches were burned as firewood or kindling.

One sweet fern (*Comptonia peregrina*) seed was recovered. Sweet fern grows especially well in open, sterile, sandy soils of woodlands, clearings, and pastures, but does not tolerate shading (http://plants.usda.gov). The nutlets, which mature in August and become available in September and October, were eaten as a snack or famine food. The leaves are frequently used for medicines and aromatics, but such plant parts are not typically preserved in archaeological deposits (Moerman 1999). The small number of sweet fern seeds at 72-58 contrasts with other sites particularly 72-91 where substantial numbers of such seeds were found. The small number of seeds recovered may indicate only incidental use of seeds or charring only as an accessory to use of the leaves. While it is possible that the lack of seeds at this site is the result of different sampling, preservation, or disposal patterns, the decline in their recovery is dramatic. It may be that the fruits of this shrub continued to be eaten into the 18th century and that they were merely not preserved. It is also possible that we are seeing changes in the availability of this food, although the clearance of land for agriculture and forests for timber should have provided the open, disturbed habitats that encouraged sweet fern growth. What is perhaps more likely, is the lack of sweet fern indicates changes in the Pequots' subsistence choices or medicinal plant use.

Wetland Plants

We recovered a small number of a diverse set of wetland taxa (Table 7). These were predominantly Cyperaceae (sedge family) plants. While the shoots of these plants were often used as early spring food, the leaves of these plants are widely used for matting and various other purposes. One seed of an aquatic plant (*Naias*) may merely be an accidental introduction that found its way to the site through drinking or cooking water. The substantial variety of wetland plants may be accounted for by both the proximity of the site to the Great Cedar Swamp and by the large number of uses of Cyperaceae plants, particularly their leaves. Buttercups have been interpreted as medicinal uses (Largy et al. 1999), but the seed of this wetland plant, like the naiad seed, may have been introduced in water.

Other Seeds

We found small numbers of other seeds. These included seeds such as goosefoot, bedstraw, and spurge which are associated with agricultural fields, gardens, and disturbed areas around homes or villages. Other plants associated with open areas include the mint family, buckwheat family (*Polygonum*), composite, wild lettuce, borage family and grass. The very small numbers of these plants makes it difficult to assess their significance. Many of these seeds are quite small, less the 1 mm in size, and may reflect historic seed rain rather than deliberate use. This may be especially true of the grasses and spurge, which is not used for food, but does have medicinal uses (Moerman 1999). We found large numbers of bayberry seeds; this is similar to that found at earlier sites.

Other Plant Parts

We recovered several additional types of botanical materials. We attempted the identification of any tissues that appeared to have at least a portion of exterior, surface tissue and some internal differentiation. These were few and far between. The majority of these tissues recovered appear to be nutmeats, and these were primarily recovered from Feature 13 (Table 4).

We found large numbers of plant tissues that we labeled starchy fragments. These were found in the majority of features sampled (7 of 11) and most numerous in Features 12 and 13. These fragments ranged in size but many were less than 2 mm. Clearly these fragments are botanical in origin, but they are lacking cellular differentiation that would allow for identification. They are typically highly vitrified and amorphous, with no detectable differentiation of cell type or morphology. They were very common in the samples and may be the remains of ground starchy grains (maize or European cereals), nutmeats, or tubers. We compared these materials to ground barley, maize, and nutmeats, but none were identical perhaps because the vagaries of charring conditions, moisture content of the plant part, temperature and duration of heating, all affect the visible characteristics. We believe these small fragments will remain unidentifiable using visible characters alone as little morphological differentiation is evident and cellular structures were destroyed.

We were, however, able to tentatively identify other non-seed, non-wood plant tissues. These include the previously labeled honeycomb-type material. These appear to be small fragments of the fruit receptacles heads of an aggregate or multiple fruit such as *Rubus* or sunflower (*Helianthus annuus*) or Jerusalem artichoke (*Helianthus tuberosa*). They appear similar to but not exactly like sunflower head remains reported by Bonzani (Bonzani et al. 2007). Features 12 and 3 yielded more than 160 of small these fragments. Larger fragments, which had a similar morphology, were also recovered from these two features, but it is difficult to quantify these remains since they are fragmentary.

A concerted effort was made to recover soft tissues, even those we could not identify. The purpose of this was two-fold: recovery for eventual identification if possible and recovery to assess the quantity of parenchymous tissues. One reviewer of the previously submitted NSF grant proposal questioned how much parenchymous tissue was available and commented that the reviewer had found little in their samples. This comment raised the question of how much of this sort of tissue would be found in samples of this age. We might expect changes in subsistence patterns and technologies to influence how many soft tissues we recover. In an attempt to answer this question, we removed and counted all such materials, being particularly liberal in our placement of all possible fragments in this category. Included in this group were any plant parts that were clearly not wood, nutshell, or seeds. Thus, this grouping may contain starchy fragments, fleshy fruits, rinds, or nutmeats and is not necessarily limited to tubers or roots. We recovered nearly 400 fragments, many of which are less than 2 mm in size and are probably starchy fragments. On initial inspection, the vast majority of these fragments do not look promising for more specific identification. Two exceptions are samples 2600 in feature 3 and 2683 in Feature 13 where we found a number of larger pieces. These will be examined in more detail.

DISCUSSION

We might expect the reduction in territory size that accompanied the creation of the reservation and loss of coastal land to have affected the Pequots' ability to access some habitats, but plant remains recovered from 72-58 came from a variety of ecozones. Wood and nuts came from mature forest stands, nuts and fruits from bushes and shrubs along forest margins, seeds from wetland plants, and cultigens and weedy plants from active fields. Plants associated with gardens and fields are more than just the cultivars, maize, wheat, and beans, identified here. Other plants associated with both active and abandoned, successional fields include bedstraw, goosefoot, and among older fields raspberry bushes and sweet fern. Many of these are also well adapted to forest fires that may have been used to clear brush for agricultural fields. With the exception of the rare types of charred wood and the European-introduced cultigens (wheat and apple), all the plants found at this site were also found at earlier Pequot sites. Thus the impact of the reservation on Pequot subsistence patterns may be subtler than the mere presence or absence of specific taxa; rather, the effect might be evident in changing proportions of the various types of plants.

Pushed to poorer agricultural land and harried by colonists (Den Ouden 2005), we might expect to see the Pequots experiencing greater difficulty in obtaining crops. To examine this, we calculated the ubiquity of domesticates and other types of foods. We calculated the ubiquity of domesticates in features as 36%. This sort of analysis is better understood in comparison with other sites. At the 17th century Monhantic Fort, 72-91, the ubiquity of cultigens in all sampled features is 9% (3% of postholes and 16% of all other features) (Table 10). Likewise we calculated the ubiquity of nutshells as an indication of the use of traditional, gathered food. At 72-58, the ubiquity of hickory is 45%; hazelnut and oak/chestnut each had a ubiquity 36%, total nutshells had a ubiquity of 55% of features. At 72-91 the ubiquity of nutshell is 33%. Fleshy fruits had a ubiquity of 73% at 72-58 and 9% at 72-91. Food remains were more widely distributed at 72-58 than at the fort. Traditional interpretations of ubiquity indices would suggest that none of these food types was diminishing in importance from the fort to the 18th- century site. This pattern, no doubt, relates to the number of different types of contexts sampled at the fort. Moreover, it is not possible to determine the quantity of these plants in the Pequots' diet, so changes in nutritional adequacy cannot be determined from ubiquity measures alone, nor can we directly examine the nutritional stresses that might have resulted from the reduction in territory. These analytical measures do suggest that all of these types of traditional foods were available to the inhabitants of the site, and in some cases, we can determine that traditional methods of food processing were used.

We do, however, see some interesting changes. At 72-58, there is a reduction in the proportion of seeds coming from cultigens. While nuts appear to remain a relatively stable resource, a greater proportion of the seeds appear to be coming from gathered resources. In this instance, blueberries, raspberries, and the like appear to be making a greater contribution, relative to cultivated plants than they did at the earlier site. The paleoethnobotanical record suggests only a slight increase in the number of seeds from weedy plants such as goosefoot. This may reflect a slightly more intensive use of garden area, but this change is dwarfed by the increase in proportion of wild berries. Thus there appears to be a lower contribution of cultivated plants to the Pequots' suite of foods. This is interesting because Pequot women began to augment their incomes by gathering berries for sale to colonists (Campisi 1990). This shift to wild plant foods may indicate some type of nutritional stress, but the increase in fruit seeds may merely reflect the production of fruits for the wider colonial economy.

Additional changes in the types of nuts utilized provide interesting contrasts with the Mohantic Fort site. We see a definite change in the types of nuts found at the later site. While we continue to find hickory nuts, their importance appears to decrease. In their place, we see a substantial increase in the proportion of thin-walled nutshells. At earlier sites at Mashantucket and many places in the east, hickory dominates the nut assemblage, but at 72-58, there is a shift to thinner walled hazelnuts and acorns. Acorns have a different nutritional composition than hickory nuts, fewer calories and fat, and such a shift might have negatively affected the Pequots' diet, but hazelnuts provide similar nutrition and might have served as a substitute.

The shift in nut taxa may reflect a change in the Pequots' preferences or an increase in hazelnuts in the area or both. Many nut trees reflected in this archaeological record are stimulated by an open canopy which is often achieved by girdling or by fire. Oak and hazelnuts have the ability to sprout even after high intensity fires, but hickory, while more sensitive, will generate greater mast with an open canopy or low intensity fires (Wagner 2003). The growth of some fruit bearing plants, such as raspberries and sumac, is also stimulated by burning. With the laws suppressing Native peoples' fires as forest management tools (Den Ouden 2005), we might also expect to see a reduction in the mast of trees so adapted and an increase in those preferring denser underbrush or canopies. The fact that we do not see such a drop in the archaeological record of 72-58 suggests that sufficiently open landscapes were also achieved by clearing land for agriculture and homesteads.

In our examination of the practices of the inhabitants of 72-58, we questioned whether the reservation system and colonists' encroachment affected the inhabitants' ability to obtain fuelwood. The record of fuels used indicates a slight increase in the number of taxa used, perhaps suggesting some stress, but for the most part, the people inhabiting 72-58 were still able to obtain high quality fuelwood: oak, hickory, and chestnut. Either they continued to have access to plenty of preferred types of wood, or they purchased fuel. Documents of the time do describe the purchase of firewood, but the large proportion of high quality woods at 72-58 suggests continued availability.

We do see distinctive changes in the dietary practices at 72-58. In contrast to earlier sites, there is the near absence of the sweet fern although this plant would have been encouraged in cleared areas or successional fields that were common after colonization. There is also a reduction in the importance hickory and an increase in acorns and hazelnuts in the nut assemblage.

The plant remains recovered indicate transformations in the Pequots' subsistence strategies as well as maintenance of some aspects of historically significant practices. The food remains found at 72-58 indicate that the Pequots in the 18th century continued some pre-conquest dietary and food preparation practices, which include the utilization of many traditional foods, cultivated plants, nuts, and non-domestic fruits. The time-consuming and labor-intensive practices associated with traditional methods of processing hickory nuts were also maintained. Comparisons with earlier Pequot sites, however, reveal a diminished importance of these nuts.

Starchy fragments provide tantalizing suggestions of foods consumed. Especially if ground without parching or purchased already ground, identifiable cereal grains be would be a challenge to find. Evidence for tuber use may be similarly obscure. Tubers were often consumed with little preparation or by roasting, steaming or boiling (Scarry 2003). Ethnographic descriptions of steaming or roasting tubers indicate these techniques often leave few charred plant remains except wood because the food items are wrapped in leaves and steamed over heated stones (Zarillo personal communication). In an alternative processing method, tubers are sliced, dried in the sun and then ground into a flour, which can then be stored (Roundtree 1998). In contrast, roasting of nuts, particularly hickory nuts, could potentially leave more evidence. Nuts are commonly roasted in shallow pits in direct contact with fire-heated stones, and under these conditions charring could easily occur (Scarry 2003).

There are a few indications for the use of European-introduced crops at this site. There is confirmation that the Pequots at 72-58 used both wheat and apples, although there is currently no evidence for the production of these crops. If we assume that the Pequots at the site grew apples and wheat that we found rather than purchased these items**,** changes to the Pequots' production strategies were required. These crops may have been conceptually easy for the Pequots to incorporate into their cuisine since they were familiar with field agriculture and perhaps arboriculture, but they did require changes in technology and scheduling. Wheat and other grains may have been easy to add to the cuisine since they can be processed and cooked in ways similar to maize, but the European-introduced grains required alternative technologies and livestock to plant and harvest, thus complicating their incorporation into indigenous subsistence production strategies. The Pequots' choices may have altered the nutritional balance of their diet. Apple orchards were extremely useful because they not only provided food but also tangible evidence of land tenure acknowledged by colonial authorities. But heavy investment in this fruit crop had the potential to alter the nutritional balance of the diet. While wheat and maize are nutritional equivalents (Trigg 2004), apples with their high sugar but lower protein content are not the nutritional equivalent of other plants such as nuts which might have been gathered at the same time. These data support other evidence of increasing adoption of European-style subsistence practices during the later 18th century (McBride1990).

The changes in diet cannot be explained by changes in the vegetation alone. We do not discount the veracity of the first hand accounts that describe lack of firewood and food. We do suggest that there may have been variation in individual Pequot families' experiences on the reservation. As noted elsewhere (Trigg, McBride, and Smith 2007), settlements located in more interior areas of the reservation may have been spared the heaviest depredations on crops and firewood resources. The location of 72-58 may have allowed the inhabitants to continue some traditional practices. More likely, we are seeing a shift in technology, practice, or choice of foods. Perhaps they chose plants that required less processing or different processing techniques. We see investment garden crops and forest margin and disturbed forest rather than deep forest resources. Most importantly, we see the adoption of European-introduced foods into the diet.

The adoption of European-introduced crops and livestock, may not have represented merely syncretic additions to the Pequots' subsistence regimes, but instead brought about significant modifications which had an impact on seasonal rounds, work scheduling, technology, and ultimately social organization (Snow 1995). In general terms, the incorporation of new plant foods into a subsistence regime has been known to stimulate large-scale transformations in subsistence practices as people modify their behavior to take advantage of new food sources. Adoption of agriculture is one striking example of transformation that had substantial social impacts. Even the shift from one type of agriculture to another may result in a series of non-trivial changes (Scarry personal communication). For example the move from small-seed agriculture (*Iva*/ *Chenopodium*/ *Phalaris*) to maize agriculture required a suite of modifications to technology and activity scheduling (ibid). We might expect the adoption of European-introduced crops and livestock, even those that were conceptually easy to accept, to have affected the Pequot in a similarly transformative way. Investment in one subsistence regime might have required the reduction of another. Plant foods that might have been widely used in past times may have lost favor or were necessarily abandoned as the Pequot moved to adopt new food production and land tenure practices.

ONGOING WORK

We are continuing sample analysis. We feel that examining additional samples from the site will be useful because of the low density of important plant materials such as seeds from cultivated plants. For example, the single specimens of wheat and apple were found only recently after the analysis of the majority of samples. We will continue to attempt to identify all plant materials recovered including soft tissues. However, we prefer to approach this analysis by first finding such materials and identifying probable analogues. We will also broaden our analysis to examine other colonial period sites. These will help us analyze the patterns we see at 72-58 and see if these trends correspond to other sites. Such analyses will help us test the hypotheses about the relationships between site locations and plant availability and uses as well as the larger scale nutritional and social consequences of the adoption of European subsistence practices.

Table 1

Charred Wood – Ring and Semi-Diffuse Porous

Feature	Oak	Oak alba-type	Chestnut	Oak/ Chestnut	Hickory	Ash	Sumac	Ring Porous	Walnut	Semi-Diffuse
2	5	2	0	3	2	0	0	11	0	0
3	113	5	29	47	31	0	1	195	12	1
4	24	1	26	9	11	0	0	44	3	0
6	20	0	17	16	2	0	0	39	0	0
7	5	0	5	5	7	0	0	8	0	0
8	1	0	1	0	0	0	0	5	0	0
9	66	18	7	41	13	0	0	67	0	0
10	4	0	0	2	0	0	0	11	0	0
11	0	0	0	0	0	0	0	0	0	0
12	136	0	29	61	31	1	0	78	6	0
13	0	0	0	0	0	0	0	19	0	0
Total	374	26	114	184	97	1	1	477	21	1

Table 2

Charred Wood – Diffuse Porous, Softwoods, and Unidentified

Feature	Maple	Dogwood	Willow	Willow Family	Diffuse Porous	Hardwood	Pine	Non-Pine Softwood	Softwood	Unidentified
2	0	0	0	0	1	12	0	0	0	0
3	7	4	0	0	11	42	1	0	9	10
4	0	0	0	0	0	7	1	0	0	2
6	4	0	0	0	5	8	3	0	7	2
7	0	0	1	0	0	4	6	8	8	1
8	1	0	0	0	0	10	0	0	1	6
9	32	0	0	0	11	69	0	0	18	44
10	0	0	0	0	0	2	0	0	1	0
11	0	0	0	0	0	0	43	0	6	2
12	0	0	0	0	3	12	0	0	4	2
13	0	0	0	1	12	49	20	0	64	27
Total	44	4	1	1	43	215	74	8	117	96

Table 3

Ubiquity of Wood Types

Taxon	Ubiquity
Oak	82%
Chestnut	64%
Oak/Chestnut	73%
Hickory	64%
Ring Porous	91%
Maple	36%
Diffuse Porous	55%
Softwood	91%
Pine	55%

Table 4

Charred Nutshell and Nutmeat Counts

Feature	Oak	Oak-Chestnut	Hazelnut	Hickory	Hickory-Walnut	Nutmeat	Unidentified
2	0	0	0	0	0	0	3
3	12	9	62	5	15	0	20
4	0	0	0	0	0	0	2
6	0	0	1	0	0	0	0
9	0	32	0	7	9	0	0
10	0	0	0	7	4	0	7
12	1	0	2	3	3	3	10
13	0	38	1	14	0	619	0
Total	13	79	66	36	31	622	42

Table 5

Cultigen Seed Counts

Feature	Maize kernel	Maize germ	Maize cupule	Bean cotyledon	Wheat kernel	Apple/ Pear
3	11	0	1	1	0	0
6	1	1	0	0	0	0
9	0	0	0	0	0	1
12	71	0	12	2	1	0
Total	83	1	13	3	1	1

Table 6

Charred Fruit Seeds

Feature	Raspberry	Huckleberry	Blueberry/ Cranberry	Hawthorn	Grape	Dogwood	Sweet fern	Sumac	Viburnum
3	1	16	1	0	0	8	0	129	1
4	5	0	1	1	1	0	0	1	0
6	0	0	0	0	1	0	0	1	0
9	0	0	0	0	1	0	0	0	0
10	0	1	0	0	0	0	0	0	0
11	0	0	0	0	0	0	1	0	0
12	5	10	0	0	0	0	0	3	0
13	1	0	0	0	0	0	0	0	0
Total	12	27	2	1	3	7	1	134	1

Table 7

Seeds from Wetland Plants

Feature	Cyperaceae	Carex	Cyperus	Scirpus	Juncus	Naias	Buttercup Family
3	1	2	9	2	1	0	1
4	1	0	0	0	0	0	0
6	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	1	0	2	0	0	0	0
13	1	0	0	0	0	1	0
Total	4	2	11	2	1	1	1

Table 8

Seeds from Other Plants

Feature	Goosefoot	Bedstraw	Spurge	Mint Family	Buckwheat Family	Sunflower Family	Wild Lettuce	Grass	Borage Family	Bayberry
3	3	1	2	0	0	0	1	5	0	34
4	0	0	1	0	0	0	0	0	0	14
6	0	0	0	0	0	0	0	0	0	3
9	0	0	0	0	0	0	0	0	0	12
10	0	0	0	1	0	0	0	1	0	0
11	0	0	0	0	0	1	0	0	0	0
12	1	0	0	0	1	0	0	1	1	42
13	0	1	0	0	0	0	0	0	0	0
Total	4	2	2	1	1	1	1	7	1	105

Table 9

Other Plant Parts

Feature	Starchy fragments	Composite head small fragment	Composite head large fragment	Soft tissue
3	43	30	2	65
4	8	0	0	10
6	14	0	0	14
8	2	0	0	0
9	82	5	0	0
12	145	127	14	205
13	128	0	0	84
Total	422	162	14	398

Table 10

Ubiquity of Cultigens, Nuts, and Fleshy Fruits at 72-58 and 72-91

	72-91 (postholes - features)	72-58
Cultigens	9% (3-16%)	27%
Nuts	33% (19-52%)	55%
Fruits	9% (3-16%)	73%

Figure 1

Charred Wood from 72-58

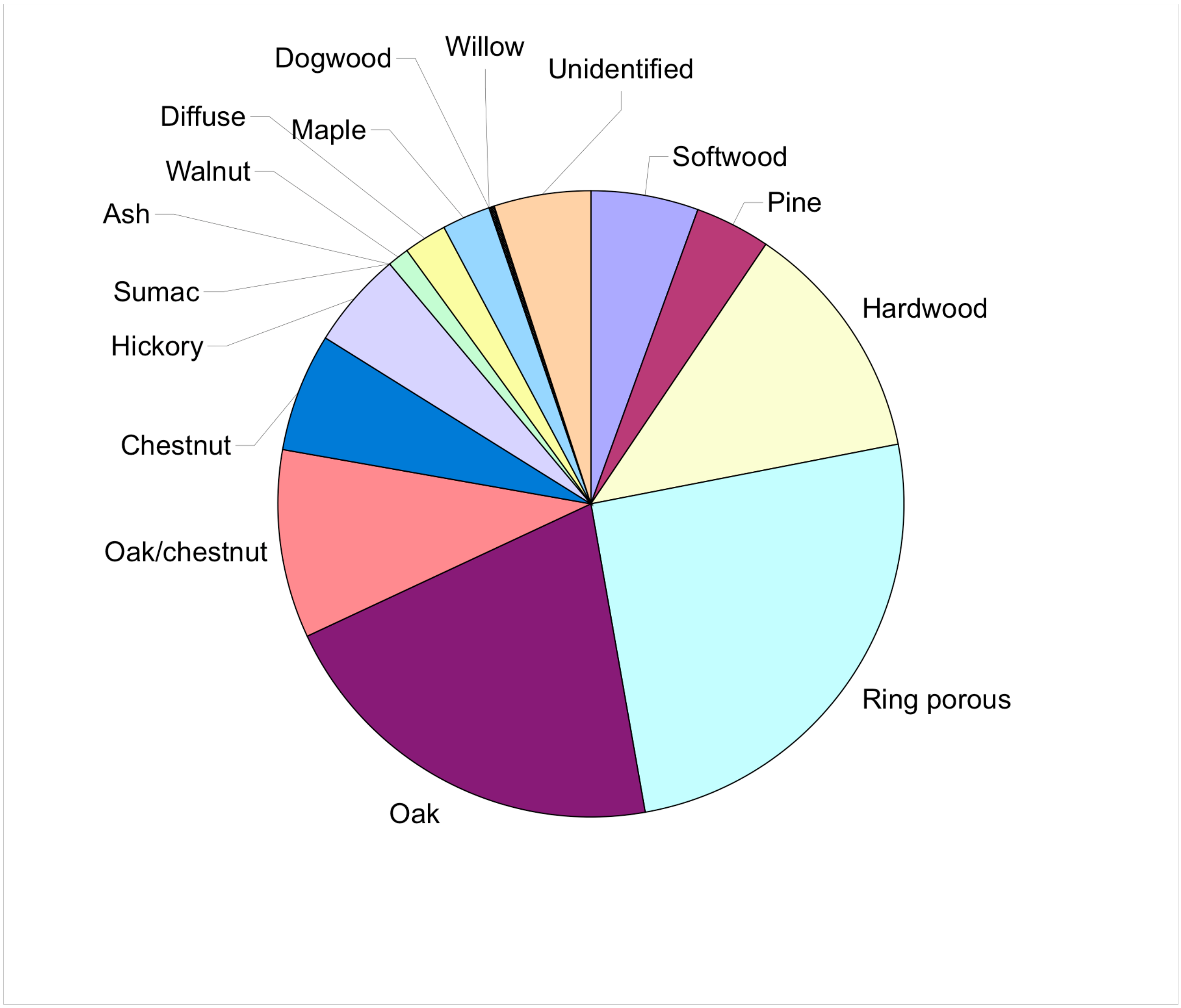


Figure 2

Charred Nutshell Proportions from 72-58

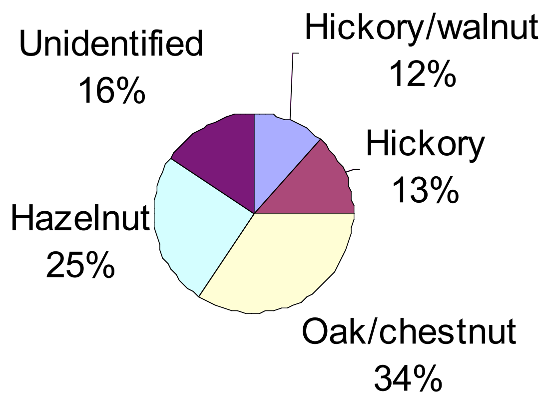


Figure 3

Charred Nutshell Proportions from 72-91

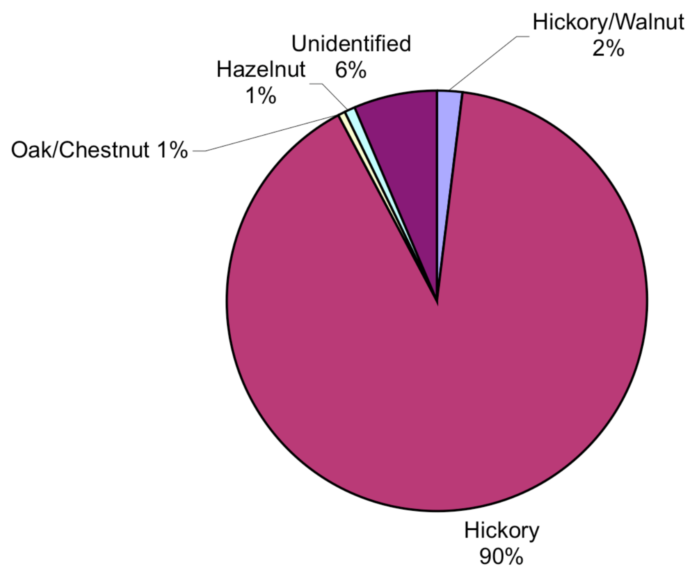
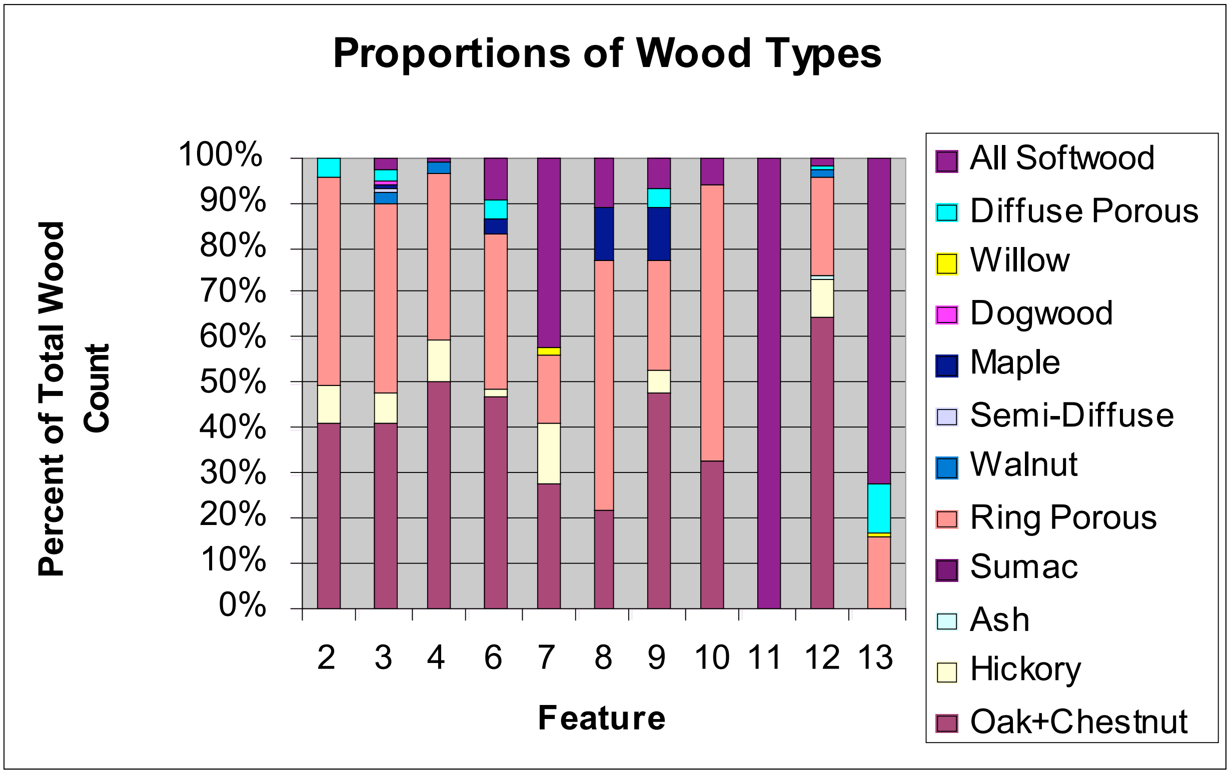


Figure 4



Proportions of Wood Types
Percent of Total Wood Count
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2
3
4
6
7
8
9
10
11
12
13
Feature
All Softwood
Diffuse Porous
Willow
Dogwood
Maple
Semi-Diffuse
Walnut
Ring Porous
Sumac
Ash
Hickory
Oak+Chestnut

Taxa Concordance

Acer - maple

Carya - hickory

Castanea - chestnut

Conifer – pine, spruce, fir, hemlock, cedar, or juniper

Chenopodium – goosefoot

Cornus – dogwood

Diffuse porous

Galium – bedstraw

Gaylussacia - huckleberry

Fagaceae – oak, chestnut

Fraxinus - ash

Juglans – walnut or butternut

Juglandaceae – walnut, butternut, or hickory

Malus – apple or pear

Quercus – oak

Rhus - sumac

Ring porous

Rubus – raspberry, blackberry

Salix - willow

Semi-diffuse porous – walnut or butternut

Triticum aestivum - wheat

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