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Northern Flint, Southern Roots: A Diachronic Analysis of Paleoethnobotanical Remains and Maize Race at the Aztalan Site (47-JE-0001)

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NORTHERN FLINT, SOUTHERN ROOTS:
A DIACHRONIC ANALYSIS OF PALEOETHNOBOTANICAL REMAINS AND
MAIZE RACE AT THE AZTALAN SITE (47-JE-0001)

by

Jennifer L. Picard

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December 2013

ABSTRACT
NORTHERN FLINT, SOUTHERN ROOTS:
A DIACHRONIC ANALYSIS OF PALEOETHNOBOTANICAL REMAINS AND
MAIZE RACE AT THE AZTALAN SITE (47-JE-0001)

by

Jennifer L. Picard

The University of Wisconsin-Milwaukee, 2013
Under the Supervision of John D. Richards, Ph.D.

Located in Southeast Wisconsin on the west bank of the Crawfish River, the Aztalan site was first settled by horticultural Late Woodland peoples. By the mid-eleventh century A.D., Middle Mississippian migrants arrived from the south. The site was eventually transformed into a fortified village with three platform mounds. During the later component, Middle Mississippian and Late Woodland peoples appear to have coexisted. This thesis consists of a diachronic comparison of floral subsistence remains and maize race at the site. The results of the analysis indicate that while the Late Woodland inhabitants grew maize, food production involving maize and native cultigens was intensified following the appearance of Mississippian traits. The transformation of the site into a fortified agricultural village may have related to intergroup hostility within the region and territorial circumscription. The analysis also identified a possible early Mississippian feasting context. Maize race data indicate both an Eastern Great Lakes connection tied to collared Late Woodland pottery, and a southern, likely American Bottom, connection. This thesis also explores environmental and social explanations for differences between the Aztalan floral assemblage and Late Woodland and Oneota subsistence within the region.

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In memory of Lucille Picard

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Chapter 1) Introduction and Background

Much of the data on plant use at Aztalan predates the use of flotation technology. More recent investigations have included flotation sampling; however, analyses of these samples is limited to a few feature contexts, and no diachronic analysis of the different cultural/temporal components at the site has been carried out. Furthermore, while floral analyses have been carried out for a number of Mississippian-influenced sites in southern Wisconsin, the dataset for collared ware Late Woodland archaeobotany is limited. As a multicomponent site representing a community in a state of transition, Aztalan has the potential to yield information on changing subsistence patterns in the late prehistoric Midwest. A study of maize race at Aztalan also provides an opportunity to explore the possibility of a southern (American Bottom) or Eastern Great Lakes connection for maize in the region, data which may provide insight into the origins of the collared ware phenomenon and information on the history of Aztalan itself.

Thesis Statement

An analysis of floral remains from the 1984 and 2011 field seasons was conducted in order to address the following research goals: **1)** What floral resources characterize the subsistence regime at Aztalan for all components? **2)** Do floral assemblages from Late Woodland contexts at Aztalan differ from Mississippian floral assemblages at the site, and in what ways? **3)** What affect does depositional context have on floral assemblages at the site? **4)** Do maize remains at Aztalan demonstrate affinity with Midwestern Twelve Row or Eastern Eight Row varieties? **5)** How do the floral

remains at Aztalan, and maize remains in particular, compare with sites within the region, and with sites in the American Bottom and Eastern Great Lakes? 6) What factors might explain differences in subsistence within the study area?

Results of the analysis indicate that Aztalan's inhabitants prioritized storable resources such as hickory nuts, maize and squash, as well as native cultigens such as *Chenopodium*. Between the Late Woodland and Mississippian components, reliance on agriculture increased. In particular, the significance of maize to the diet increased relative to nuts. A greater variety of native cultigens is employed during the Mississippian component, including oily seeds such as sunflower and sumpweed. Use of *Chenopodium* increases significantly. The observed differences between the two components likely relate to population growth. Additionally, territorial circumscription due to intergroup hostility may have led to a greater reliance on cultivated foods, as it is easier to intensify agriculture than it is to intensify foraging in a circumscribed territory.

Additionally, the floral analysis identified a possible feasting deposit related to the early Mississippian presence at the site. This feature, superimposed by later palisade construction, contained over 100 fragments of cut native sheet copper, copper artifacts, a high density of grit- and shell-tempered pottery, and a nearly intact groundstone celt. The diverse faunal assemblage included raptor, waterfowl, fish, deer, canids and fur-bearing mammals. The floral assemblage, discussed in depth in this thesis, included maize, nutshell, squash and native crops alongside more unusual taxa such as bottle gourd and tobacco. Based on density and variety of materials, this feature compares well with possible ritual deposits from below Aztalan's Northeast Mound, as well as with the

Lohmann phase Submound 51 assemblage at Cahokia (Arzigian 1985; Pauketat et al. 2002).

A review of the literature presented in Chapter 2 indicates that Eastern Eight Row maize is associated with collared pottery in the Eastern Great Lakes and in northeastern Illinois (Crawford et al. 2006; Hart and Lovis 2012; Jeske and Hart 1987; Simon 2000; Wagner 1987). Early maize in southern Wisconsin appears to have low row numbers (Arzigian 1993; Cutler and Blake 1969; Salkin 1993; Zalucha 1997). In contrast, maize in the American Bottom appears to have twelve rows until after ca. A.D. 1200 (Simon and Parker 2006). Aztalan's maize assemblage is reflective of influences from both regions, and may correspond with the presence of two cultural groups at the site. Maize from the Oneota Crescent Bay Hunt Club site shows affinity with Midwestern Twelve Row.

Residents of Aztalan appear to have relied on agriculture to a greater degree than residents of other collared ware Late Woodland sites. The Fred Edwards site, a Mississippian-influenced site in the Upper Mississippi Valley, has a floral assemblage similar to Aztalan's. However, residents of the Lundy site, a Mississippian-influenced site at the Apple River locality, were more reliant on maize than residents of either Aztalan or Fred Edwards. Some of the differences between Aztalan and Crescent Bay Hunt Club (CBHC), a nearby Oneota site, relate to environmental factors. These differences include a higher prevalence of wild rice at CBHC compared with higher reliance on maize at Aztalan. However, the environmental settings of these two sites are likely influenced by social factors such as intergroup hostility (Richards 1992; Richards and Jeske 2002; Rudolph 2009). Other trends, such as a greater presence of native cultigens and oily seeds in Aztalan's Mississippian component compared with the other

sites, may reflect social factors. Some researchers (e.g. Egan-Bruhy 2014; Jeske 1992) have suggested that collared ware Late Woodland groups were less reliant on Eastern Agricultural Complex taxa than Mississippian groups were.

The Late Prehistoric Cultural Landscape in Southeast Wisconsin

Late Woodland Complexity

Ceramic vessels have been used to delineate analytical units for the study of the Late Woodland period within the study area. The major categorical division for Late Woodland vessels in Southeast Wisconsin is between Madison ware and collared ware. Madison ware vessels are grit-tempered, cordmarked globular jars, often with cord-impressed decoration (Baerreis 1953; Rosebrough 2010:218). Collared ware is differentiated from Madison ware by the presence of a thickened collar around the vessel rim. Collared vessels at Aztalan include Aztalan Collared, Starved Rock Collared, and Point Sauble Collared types as well as Maples Mills cognates (Richards 1992, 2007a).

Archaeologists have attempted to use these ceramic categories to define cultural categories. For example, Madison ware pottery has been argued to represent Effigy Mound builders who practiced a seasonally mobile subsistence strategy. In contrast, collared ware was argued to represent a relatively sedentary horticultural population (Salkin 1987, 2000). However, the data suggest that divisions between the ceramic styles are not clear-cut. Collared ware almost always co-occurs with non-collared Late Woodland pottery, and many Effigy Mound sites have produced collared vessels (Kelly 2002; Rosebrough 2010). However, some real subsistence differences may be present – for example, collared ware Late Woodland sites tend to exhibit a higher maize density

than non-collared ware sites (e.g. Egan-Bruhy 2014). A more detailed account of what is known about Late Woodland subsistence will be presented in the next chapter. Clauter's (2012) recent analysis of non-collared Late Woodland pottery suggests a complex pattern of low-level territoriality and nested interactions for Late Woodland communities.

Creolization and the Concept of "Mississippianization"

This thesis focuses on dietary change at Aztalan during its transformation from a Late Woodland settlement to what David Overstreet termed "unquestionably the most flamboyant expression of Middle Mississippian presence in southern Wisconsin" (2000:413). The traits which inspire this characterization include the presence of pottery nearly identical to examples from the American Bottom, identification of exotic materials such as long-nosed god maskettes, and above all, the transformation of the site into a palisaded settlement with three rectangular platform mounds and a central plaza. Despite this dramatic change, Late Woodland traits appear at the site even after the Mississippian transformation, and hybrid pottery types and structures also exist at the site (Barrett 1933; Richards 1992, 2003, 2007; Zych 2013). Understanding of the transformation of Aztalan involves comparison with other Mississippian-influenced sites north of the American Bottom. For purposes of this study, "Mississippianization" is a process that involves the transformation of not just the artifact assemblage of a Late Woodland site, but also its structure. Zych's recent (2013) study of Northeast Mound materials suggests that at Aztalan at least, this process may not have involved coercion.

Recent discussions about the effect of Mississippian influence on peripheral sites have introduced the notion of "creolization," whereby new identities are formed out of an

amalgamation of different cultural traits. Millhouse (2012) argues that this process is primarily seen with regard to religious cults. In his explanation, people carry out “shifts and recombinations in religion and symbolic fields... develop syncretized spiritual rituals, cults and larger, hybridized religious organizations that seek to ameliorate differences and encourage unity through shared participation” (Millhouse 2012:324). Archaeologically, this process may help to explain the intrusion of Mississippian symbolism into areas far from the American Bottom. Furthermore, a process of creolization may help to explain why every “Mississippianized” site in the hinterlands demonstrates a different combination of local and Mississippian traits. Emerson (2012) have argued that this process of identity-creation may be observed at peripheral sites in the Illinois Valley.

Beginning in the eleventh century A.D., a suite of traits identified as the Mississippian begin to appear throughout Eastern North America. Many trait lists have been employed to define Mississippian. Deuel’s famous early trait list emphasized pyramidal mounds, rectangular houses, wattle-and-daub walls, and incised pottery in a variety of forms (1937). Although debate on the definition of Mississippian has continued, these traits are still widely accepted as evidence of Mississippian influence.

There has also been considerable debate as to the full extent of Mississippian influence over hinterland sites. Some arguments are highly Cahokia-centric. Gibbon (1974) proposed the “Ramey State” model, with the American Bottom at the center of an extractive exchange network. More recently, Pauketat and Emerson (2000) proposed a three-tiered settlement hierarchy for the American Bottom, with Cahokia, East St. Louis and the St. Louis site serving as a central administrative complex. More recent arguments

for Cahokia-centric hierarchy are focused on ideological as much as economic factors (e.g. Pauketat 2005). By contrast, minimalists (e.g. Milner 1991, 1998) argue that Cahokia represented one of many competing chiefdoms. In his assessment of the applicability of World Systems Theory to the Mississippian world, Jeske (1999) presents a more balanced perspective. While Cahokia may have exercised a large influence in the American Bottom, power distance decay would have limited the degree of political and economic control over hinterland sites. Again, Zych's (2013) study of evidence for community-building with regard to Aztalan's Northeast Mound suggests that Mississippian characteristics may have involved cooperation among various ethnic groups.

Support for the lack of complete domination includes the fact that outside the American Bottom, in areas like the Central Illinois River Valley and Apple River locality, sites with Mississippian traits retain many local Late Woodland characteristics, and hybrid ceramic styles and structures are often present (Clafin 1991; Conrad 1991; Emerson et al. 2007; Harn 1991; McConaughy 1991; Millhouse 2012). Recent researchers have interpreted these diverse combinations of traits as a process of creolization, especially given that no two hinterland sites demonstrate exactly the same combination of traits (Emerson 2012; Millhouse 2012). Thomas Zych (2013) has demonstrated this process in deposits within and below Aztalan's Northeast Mound. This process of creolization creates unique archaeological signatures in different locations. Even in the American Bottom, the appearance of Mississippian sites may reflect migration and the coming together of diverse Late Woodland communities (Alt 2012).

Many sites in the northern hinterlands, such as Aztalan, Trempealeau, the Lundy site, and Fred Edwards exhibit Mississippian architectural and structural characteristics, such as platform mounds, rectangular wall-trench houses, plazas and stockade walls alongside shell-tempered pottery similar to American Bottom types (Boszhardt et al. 2012; Emerson et al. 2007; Finney and Stoltman 1991; Richards 1992). A few sites in southern Wisconsin have produced Mississippian pottery, but no significant structural or architectural manifestations. This is the case at the Bethesda Lutheran Home site in Jefferson County (Hendrickson 1996). For purposes of this study, Mississippianized sites are those with Mississippian structural architectural traits. These traits are a better indicator of participation in the Mississippian phenomenon than mere artifacts, which may arrive at a site by means such as trade. In terms of diet, a Mississippian-influenced site is a sedentary village, likely with permanent agricultural fields (Peregrine 2003).

Many Middle Mississippian sites in the northern hinterlands have defensive palisade walls (Emerson et al. 2007; Finney and Stoltman 1991; Richards 1992). Skeletal remains from informal burials at Aztalan show a high degree of trauma consistent with violence (Rudolph 2009). Warwick's (2003) analysis of faunal remains from the riverbank midden noted an increase in the exploitation of fish during the Mississippian period; one possible explanation for this observation is increased territorial circumscription due to hostile neighbors. In any case, evidence suggests that the Mississippian presence in the northern hinterlands was not entirely peaceful.

Southeastern Wisconsin Oneota

The Oneota ceramic tradition represents the final ceramic tradition found in late prehistoric Southeast Wisconsin. Due to the association of this ware with the Upper Mississippi Valley, it has been given the designation Upper Mississippian (McKern 1931). Oneota pottery consists of shell-tempered jars with restricted orifices and outflaring rims. Trailed or punctate designs are found on vessel shoulders. Some of these designs resemble designs found on Middle Mississippian Ramey Incised vessels; in fact there is an overlap between the distribution of Ramey Incised and Oneota pottery (Hall 1962, 1991). Oneota subsistence appears to have followed a diversified pattern including both cultivated and wild resources (Brown 1982; Egan-Bruhy 2014).

Theories for Oneota origins fall into categories of in-situ and migration-based. Griffin's (1960) in-situ model argued for the devolution of Middle Mississippian groups due to pressures caused by climate change. In contrast, Gibbon (1972, 1982) argues that Oneota is present in the region prior to the appearance of Middle Mississippian populations at Aztalan, and suggests that Oneota developed in-situ from local Late Woodland Effigy Mound populations. The argument presented by Theler and Boszhardt (2006) focuses on in-situ development of the Oneota subsistence pattern due to sedentism and population growth. Overstreet (1995) by contrast argued that Oneota is the result of migration from the south.

Modern radiocarbon evidence does not support the notion that Oneota traits developed due to Mississippian influence on local populations. Radiocarbon evidence, including dates on ceramic residue from Grand River Trailed jars, suggest that Oneota populations were present at Lake Koshkonong prior to the appearance of Middle Mississippian traits at Aztalan (Edwards and Spott 2012; Richards and Jeske 2002).

Following from the discussion presented above regarding evidence for violence at Aztalan, Richards and Jeske (2002) have used environmental and artifact data to posit the existence of a closed frontier between Aztalan and Lake Koshkonong.

Maize Race in the Eastern United States

In the past, researchers have put forth the hypothesis that the introduction of a “better,” more productive eight row maize was at least in part responsible for the Mississippian emergence and an increased reliance on maize agriculture (Coe et al. 1986; Galinat and Gunnerson 1963; Fowler 1975). This hypothesis has effectively been refuted; however, a shift from high row number to lower row number in the American Bottom is apparent by Oneota times, ca. A.D. 1400 (Fritz 1992; Simon and Parker 2006). By contrast, early maize in the Eastern Great Lakes and Wisconsin appears to have had eight rows Arzigian 1993; Crawford et al. 2006; Cutler and Blake 1969; Egan and Monckton 1991; Hart and Lovis 2012; Parker 1996; Salkin 1993; Simon 2000; Wagner 1987; Zalucha 1997.

The question of maize race may still be useful in answering questions about temporal and cultural relationships between sites in the late prehistoric Midwest. In the case of Aztalan, maize row number data might provide information on geographic connections pertinent to research into the origins of maize agriculture and collared ceramics in the region. The question of maize race is treated more thoroughly in Chapter 2.

Archaeological Background: Aztalan (47-JE-0001)

Aztalan is situated in Jefferson County, Wisconsin, three miles east of the present-day city of Lake Mills and five miles north of the confluence of the Rock and Crawfish Rivers (Figure 1.1). The site is situated on the west bank of the Crawfish River. The vegetation zones surrounding the site consist of oak openings, oak forest, and the marsh and aquatic zones; these zones are discussed in greater detail below. Despite the presence of a fortified Middle Mississippian village at Aztalan, other Middle Mississippian-influenced sites are absent in Southeast Wisconsin. The Bethesda Lutheran Home site has Mississippian ceramics, but no other significant Mississippian characteristics (Hendrickson 1996).

Goldstein and Gaff (2002) report evidence for limited Middle Woodland presence at Aztalan in the form of pottery and a radiocarbon date. However, the bulk of radiocarbon dates from Aztalan fall between A.D. 1000-1200, corresponding with the rise of Middle Mississippian culture at Cahokia during the Lohmann phase, and with the Stirling phase (Richards 2007a ; Richards and Jeske 2002).

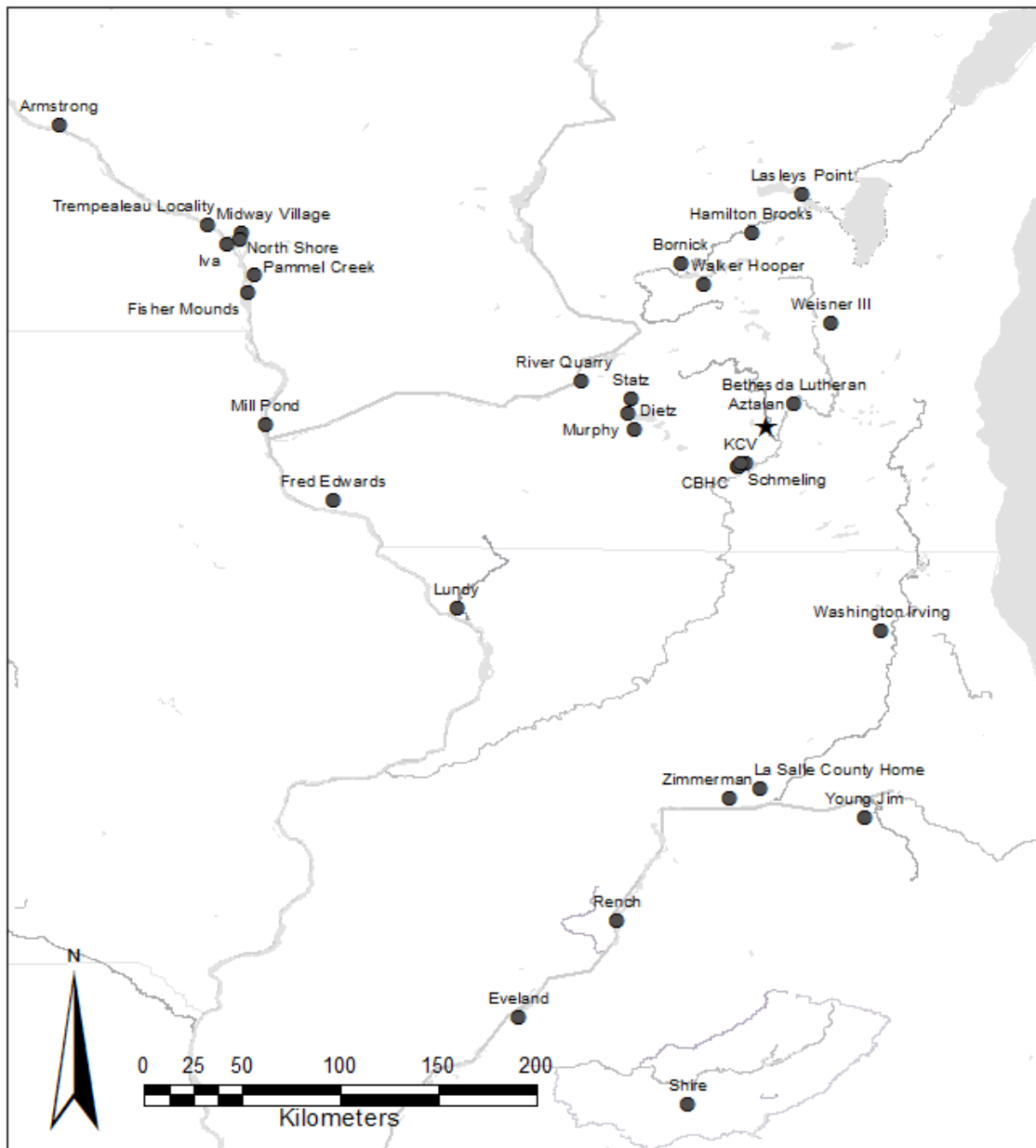


Figure 1.1: Location of Aztalan and selected horticultural sites in southern Wisconsin and northern Illinois

Late Woodland and Middle Mississippian at Aztalan

While there is evidence for use of the Aztalan location stretching into early prehistory, the bulk of radiocarbon and artifact evidence centers on the Late Woodland and Middle Mississippian periods, between ca. A.D. 1000-1200 (Richards and Jeske

1992:44). Ceramic evidence at the site includes both Late Woodland and Mississippian wares. Late Woodland ceramics include collared varieties such as Aztalan Collared, Starved Rock Collared and Point Sauble Collared. Madison ware vessels also have been recovered at the site, alongside vessels exhibiting hybrid Late Woodland and Middle Mississippian traits (Richards 1992, 2003). The 1984 excavations by the University of Wisconsin-Milwaukee (UWM) revealed a stratum containing only grit-tempered ceramics (Stratum 11), interpreted as evidence for a Late Woodland component predating the Mississippian occupation of the site (Richards 1985, 1992). Feature 6, a dumping episode situated within Stratum 11, produced a radiocarbon date of cal A.D. 780-1020 (Richards 1985, 1992; Richards and Jeske 2002:44).

Between the eleventh and twelfth centuries A.D, during the height of Cahokia's influence in the American Bottom, aspects of Middle Mississippian material culture began to travel north along the Mississippi trench into Wisconsin and east along the Rock River drainage to Aztalan. The bulk of radiocarbon dates for the site cluster between A.D. 1000-1200 (Richards and Jeske 2002:44). Middle Mississippian traits such as pyramidal platform mounds are highly visible, and have a tendency to obscure the earlier Late Woodland component. Ceramic evidence suggests both Lohmann and Stirling phase Mississippian influences (Richards 2003, 2007). In addition to artifacts and features similar to those seen in the American Bottom, hybrid Late Woodland and Middle Mississippian traits are seen in pottery and house forms (Barrett 1933; Richards 1992, 2003). Ceramic and skeletal data suggest the potential for migration from or fairly direct contact with Cahokia, or with the Apple River locality in Northwestern Illinois

(Goldstein and Richards 1991; Price et al. 2007; Richards 1992, 2007a; Richards and Schneider 2008).

It is worth noting that Late Woodland materials do not disappear from the site concomitant with the arrival of Middle Mississippian pottery. While some contexts, including Stratum 11 of the riverbank midden, produced only Late Woodland pottery, contexts with shell-tempered Mississippian pottery generally also contain Late Woodland types. The two wares appear to have been used simultaneously. Similarly, hybrids of Late Woodland and Mississippian vessels and structures are found at the site (Barrett 1933; Richards 1992, 2007a; Zych 2013). The archaeological evidence is suggestive of the process of creolization discussed previously (Figure 1.2).



Figure 1.2: Illustration of Late Woodland, hybrid and Mississippian pottery from Aztalan (a) Aztalan Collared, MPM collection (b) Hyer Plain, UWM collection (c) Ramey Incised, MPM collection (Modified from Richards 2003:Figure 5, Figure 8, Figure 9)

Layout of the Aztalan Site

Aztalan's stockade wall, dotted with square bastions, encircles an area of approximately nine hectares. This palisade presumably served a defensive purpose; skeletal evidence from informal burials at the site exhibited signs of violence (Rudolph 2009). The corners of the site are anchored by three mounds and a gravel knoll (Figure 1.3). The largest pyramidal mound sits in the southwest corner of the site and features two platform levels. Evidence for a structure atop this mound has been variously interpreted as a palisade bastion (Maher 1958) or an elite structure (Goldstein and Freeman 1997). The Northwest Mound, constructed in three stages, had a charnel structure atop the second stage. This subterranean burial feature contained 11 burials. A string bag of hickory nuts (*Carya* sp.) was among the limited grave goods (Rowe 1958; Rudolph 2009).

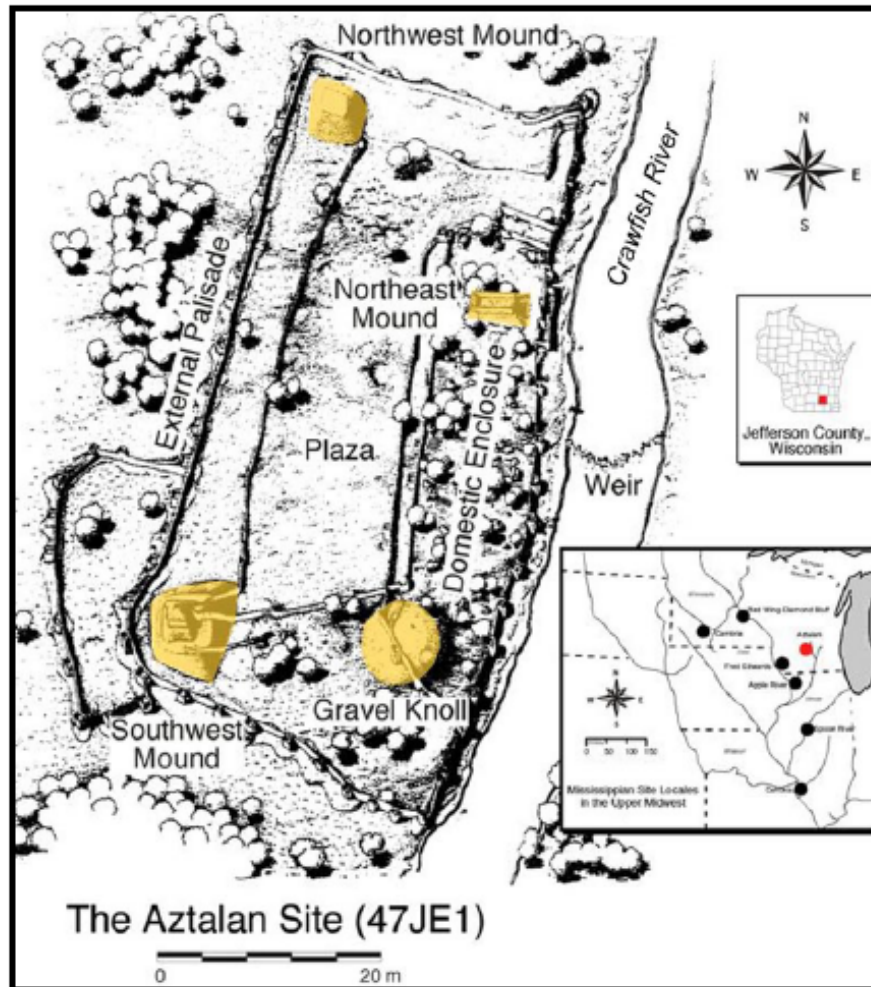


Figure 1.3: Layout of the Aztalan site (Richards 2007a:Figure 5, based on a drawing by E. Paulsen)

Damaged by plowing and as yet unreconstructed, the Northeast Mound is presently the least visible and was likely always the smallest of the three platform earthworks at the site. Recent reanalysis of the 1960s excavations by Thomas Zych (2013) suggests that the construction and destruction of a submound, Middle Mississippian-like wall trench structure and the subsequent construction of the mound indicate community-building activities early in the Mississippian occupation.

An open area in the center of the site, fenced by an interior palisade, has been interpreted as a plaza. While evidence for architectural features in this area is limited, 1984 excavations indicated that it may have been inhabited at some point in the site's history, likely during the Late Woodland period (Richards 1992).

Alongside the Crawfish River, separated from the plaza by an internal stockade, is a concentration of domestic structures. This area has been interpreted as the primary residential precinct of the site (Baerreis 1958; Barrett 1933; Goldstein and Freeman 1997). A midden deposit described by Barrett as containing ash and pottery along with faunal and human remains is present in a ravine eroding into the bank of the river (1933:83). The 1984 UWM excavations focused in part on this midden and its stratigraphy (Richards 1985, 1992). Excavations conducted by MSU in 2001 and 2002 indicate that habitation may have extended south of the palisade enclosure (Goldstein and Gaff 2002).

Brief History of Archaeological Investigations at Aztalan

The earliest investigations of Aztalan were nonscientific, and suffered from the unsystematic antiquarianism of the nineteenth and early twentieth centuries. The site was reportedly discovered in early 1836; the discovery is credited to Timothy Johnson (Richards 2007b). The earliest known written mention of the site appeared in the 17 December, 1836 edition of the *Chicago American*. The anonymously-penned article, titled "Ruins of the Ancient City of Aztalan," featured a written site description along with a wildly inaccurate sketch map (Richards 2007b:34-35).

Milwaukee's Judge Nathaniel Hyer visited Aztalan in 1836. His 25 February, 1837 "Letter to the Editor" in the *Milwaukee Advertiser* included a sketch of the site and the then-extant portions of the stockade. Nathaniel Hyer's account provides the only knowledge of raised garden beds at the site, situated almost 200 meters north of the northern palisade wall (Hyer 1837; Richards 1992:48). At a time of westward expansion and antiquarian romanticism, the discovery of Aztalan spurred visits to the site from far and wide. Henry Tatham, the son of a well-to-do Philadelphia family, completed a multi-stage journey to the site in 1837. He apparently missed Cahokia, East St. Louis and the St. Louis mounds during his return trip through the Mississippi Valley. Tatham describes an Aztalan not yet ravaged by the plow, with five-foot tall palisade embankments. Tatham's amateur excavations recovered human remains alongside the site's usual detritus of charcoal, pottery and burned daub, romantically referred to as Aztalan Brick (Richards 2007b).

Notable early researchers include Increase A. Lapham, who mapped and surveyed the site. Lapham also conducted limited excavations. These excavations recovered pottery, human remains and charcoal (Lapham 1855).

In 1919, 1920 and 1932, Samuel Barrett of the Milwaukee Public Museum conducted excavations at the site, the results of which are detailed in the volume *Aztalan*, published by the Milwaukee Public Museum (MPM) in 1933 (Barrett 1933; Richards 1992; Rudolph 2009). Barrett's vast excavations revealed evidence for the palisade, storage and refuse pits, and house basins of a variety of forms. The artifacts recovered in the early twentieth century resemble those that have come to typify Aztalan: a mixture of Late Woodland grit-tempered pottery and Middle Mississippian shell-

tempered vessels; lithic tools and tools made of shell and bone; and more stereotypically Mississippian items such as stone and clay earspools, copper ornaments and shell beads. A variety of faunal materials representing both terrestrial and aquatic resources were recovered. Unfortunately, floral remains are only briefly discussed in Barrett's text (1933). Barrett's research also provided the first insights into Aztalan's formal and "informal" burial programs, the latter consisting of "isolated, scattered and processed" human remains, often excavated from refuse contexts (Rudolph 2009:6).

Between 1949 and 1952, David Baerreis of the University of Wisconsin headed excavations for the Wisconsin Archaeological Survey. Investigations of the Northwest and Southwest Mounds were conducted in part to aid in restoration, and additional stockade lines were documented. As part of 1949 reconstruction efforts, excavations in the northwest platform mound under Chandler Rowe revealed a charnel structure on the second stage. This structure contained 11 individuals: nine extended burials, a partially flexed individual and a bundle burial. Grave goods were sparse but included a shell-tempered seed jar, bulrush mats and a woven bag of five hickory nuts, recovered from near burial four (Johnson 2003; Richards 2007a; Rowe 1958).

Excavations at the site continued in 1962, 1964, 1967 and 1968 under the direction of Joan Freeman of the Wisconsin Historical Society, with 1962 investigations of the palisade headed by William Hurley. Freeman's work included excavations of the Northeast Mound, conducted as a prelude to its unrealized reconstruction. A number of sub-mound features, including seven structures, were identified, as was a structure on top of the mound. These structures, in particular Structure 5, compare with large Mississippian structures at Cahokia and other sites (Zych 2013). Up until recently,

reporting and interpretation of these excavations was limited (Arzigian 1985; Bleed 1970; Freeman 1986; Goldstein and Freeman 1997; Hurley 1977; Jaehnig 1969, 1971; Schneider 1964).

Thomas Zych's recent thesis provides a summary of the 1960s excavations alongside new interpretations based on reanalysis of the maps and material culture (2013). Zych's reanalysis of the WAS excavations into the Northeast Mound suggests the possibility of sub-mounds laid down prior to construction of the primary mound. Zych interprets the large, burned sub-mound structure, along with the ceramic assemblage and mound construction itself, to be the remains of a process of community building (2013).

Limited investigations were conducted at the site in the 1970s and 1980s, primarily in the form of shovel-test and pedestrian survey, along with limited test excavations (Goldstein 1979, 1980, 1981, 1983; Goldstein and Patin 1979; Steube 1976; Woods 1972).

The next major excavations at the site were conducted under the direction of Lynne Goldstein for a University of Wisconsin-Milwaukee (UWM) field school in 1984. The bulk of the data for this thesis are taken from UWM's 1984 research. The field school consisted of detailed stratigraphic excavations in the riverbank midden, alongside test excavations in the plaza area (Richards 1985, 1992). Midden excavations revealed the presence of a stratum containing Late Woodland materials stratigraphically inferior to a stratum containing a mixture of Middle Mississippian and Late Woodland ceramics. This discovery paved the way for the current interpretation of the site's occupational history, beginning with a Late Woodland occupation by the ninth century A.D. followed by an occupation of both Late Woodland and Mississippian peoples beginning circa A.D.

1100 (Richards 1985, 1992). The stratigraphic deposits and plaza features included in this thesis are discussed in greater depth in Chapter 3.

In the 1990s, excavations were conducted by a UWM field school under the direction of Lynne Goldstein. Testing south of the Northwest Mound revealed a sculpted pit containing human remains which has been termed the “sculptuary” (Goldstein and Brinkman 1997; Goldstein and Gaff 2002: 102). Excavations units were placed north of the stockade in order to investigate evidence for agricultural fields mapped by Hyer (1837). Results were inconclusive (Goldstein and Gaff 2002).

In 2001 and 2002, investigations were conducted south of the palisade as part of a Michigan State University (MSU) field school under the direction of Lynne Goldstein and Donald Gaff. Testing was conducted south of the palisade along the river. These excavations revealed evidence of a habitation area, along with Late Woodland and Mississippian material culture (Goldstein and Gaff 2002).

Additional data for this thesis was recovered during a 2011 advanced UWM field school under the direction of John D. Richards. Several areas of the site were explored during the 2011 season. Removal of backfill from a 1949 Wisconsin Archaeological Survey trench in the bank of a ravine along the Crawfish River exposed a standing profile 3.7 meters long and 2.4 meters deep. The profile showed a large deposit of anthropogenic “buckshot” fill beneath a layer of colluvium; this fill apparently represents part of an attempt to construct a structure which would have enclosed a portion of the river within the stockade line (Richards et al. 2012:96). A 1-x-3 meter trench through an area presumed to represent the riverbank midden exposed Feature 8, a deposit of ash, fired earth, organic debris, and lithic and ceramic material. The feature also produced a

significant amount of cut sheet copper. 2013 excavations discussed below permitted reinterpretation of this area. Floral material from Feature 8 is included in the present study. Other excavations produced evidence of the site's archaeological history, including a rock pile intermixed with early twentieth century debris possibly dating to the time of the MPM excavations at Aztalan (Richards et al. 2012).

In 2013, two archaeological field schools performed work at Aztalan. A Michigan State University field school, under the direction of Lynne Goldstein, Jake Pfaffenroth, and Sissel Schroeder, focused attention on the gravel knoll located at the southeast corner of the site, as well as the small palisade enclosure west of the Southwest Mound (Gaff 2013; Goldstein 2013).

Later in the summer, UWM, under the direction of John D. Richards, returned to Aztalan. Backfill was removed from a 1968 excavation block on the Northeast Mound, permitting detailed re-mapping of the mound profile and sub-mound features. In addition, the trench containing Feature 8 was re-opened (Richards and Picard 2013). Identification of a series of postmolds led to the recognition that the trench encompassed part of a palisade bastion noted by Barrett (1933).

Previous Floral Research at Aztalan

Unfortunately, many of the early investigations conducted at Aztalan have suffered from a lack of systematic excavation and subsequent analysis and publication (Goldstein and Richards 1991). Many excavations at the site, notably Barrett's, were conducted prior to the so-called flotation revolution. As such, early identifications are limited to large, readily identifiable floral remains such as nutshell, squash rind

(*Cucurbita*), and maize (*Zea mays*) fragments. More recent investigations have involved flot sampling as part of the research design. The analyses produced as a result of these excavations will be discussed here. In general, these analyses are underreported and focus on a limited number of feature contexts. To date, no extensive, systematic comparative analysis of provenienced floral remains from 47-JE-0001 has been reported. This absence is particularly striking given the site's potential to yield information on changing subsistence patterns in the late prehistoric Midwest.

Understanding of the flora potentially available for exploitation by the site's inhabitants begins with historic accounts. For example, abundant wild rice was observed in the Crawfish River in 1838 (Hawkins 1940; Sterling 1920). When Porter, Irwin and Catlin conducted a casual excavation of the palisade in 1838, they noted that the clay of the "Aztalan brick" (daub) was mixed with marsh grass or wild rice (Sterling 1920).

Reports from pre-flotation investigations do contain accounts of floral remains. During the first large-scale excavation of the site, Samuel Barrett noted the presence of "charred fruits" and squash seeds, alongside evidence for maize cultivation (1933:356). Floral remains excavated under Barrett's direction are to this day curated at the MPM in "unanalyzed soil matrix;" however, these materials lack detailed provenience information (Richards 1992:9). In his analysis of burials in the Northwest Mound, Rowe discusses a string bag of hickory nuts, discovered in association with shell-tempered pottery (1958:106). Bulrush textiles from the burials provide evidence for the non-dietary use of plants (Johnson 2003). Limited maize race information is available from early research. Cutler and Blake examined a single maize cob from Aztalan, identifying it as 12 row flint with a mean cupule width of six millimeters (1969).

One trend that unifies previous analyses of floral remains collected through flotation is a pattern of high ubiquity and low abundance of maize. Yerkes' unpublished analysis of 20 features excavated in 1967 focused on fish scales and seasonality (1980). Seventeen of the 20 features contained maize, although not in large quantities.

Arzigian's unpublished conference paper also focuses on six features and "two levels of a house on the Northeast Mound" excavated during the 1967 field season (1985:2). This single-post structure, identified by Thomas Zych as Structure 1, is part of a submound structure assemblage related to the early occupation of the site (2013). Arzigian identified hickory, walnut, acorn, maize, cucurbit rind, *Chenopodium* sp., knotweed (*Polygonum* sp.), raspberry/blackberry (*Rubus*), nightshade family (*Solanaceae*), and an unidentified fungus. Once again, maize appears frequently but not in great quantity. The highest densities were recovered from the second house sample, identified on the tag of the flot bag as "NE Mound House 1 greyish brown soil" (Constance Arzigian, personal communication, 2013). The results of this analysis will be further explored in Chapter 4.

Only one flotation sample from the 1984 University of Wisconsin-Milwaukee field season had been analyzed prior to this study, and this analysis examined the light fraction only (King 1985). The results are detailed in an unpublished letter report. The analysis focuses on Feature 6 from Stratum 11 of unit N 0-2 E 14-16. This feature yielded only grit-tempered pottery and is argued to have a Late Woodland association. Samples of wood charcoal from this feature date to cal A.D. 780-1020 (Richards and Jeske 2002:44). Six fragments of squash rind and 5 fragments of maize were identified, though no weight is provided for the maize fragments. In addition, remains of grape (*Vitis*),

violet (*Viola*), Hickory (*Carya*) and bedstraw (*Gallium*) were identified. Chapter 4 presents a new direct radiocarbon date on maize from Feature 6, as well as a reanalysis of its contents.

Flotation samples from excavations conducted during the 1990s and early 2000s (Goldstein and Brinkmann 1997; Goldstein and Gaff 2002), along with material from the 1967 field season, have been analyzed by Kathryn Egan-Bruhy. Summary data for these assemblages are presented in a draft of an article for the *Midcontinental Journal of Archaeology* (Egan-Bruhy 2014).

A preliminary analysis of Feature 8, excavated during the 2011 field season, was presented as part of a poster session at the 77th Annual Meeting of the Society for American Archaeology in Memphis, Tennessee (Picard 2012). Data from this feature is reported in Chapter 4. Additional 2011 samples with unknown temporal association were analyzed and will be included as part of the Report of Investigations, though little additional information was gained as a result of these analyses. The data from these contexts are included in overall abundance measures for this thesis (Appendix A).

Other Sources of Subsistence Data

In addition to paleoethnobotanical studies, skeletal and faunal analyses have provided information on subsistence at the site. A study by Bender, Baerreis and Steventon (1981) examined C¹³ ratios and found that skeletal remains at Aztalan were consistent with the use of tropical cultigens, especially when compared with Effigy Mound sites. Interestingly, the study found that while C¹³ ratios were elevated for all human remains included in the study, levels from mound burials were less elevated than

levels in remains recovered from midden contexts (Bender et al. 1981:349). More recently, Rudolph noted porotic hyperstosis as the most common pathology found on Aztalan skeletal remains. Porotic hyperstosis is often associated with such factors as maize dependence, sedentism and high population density (Rudolph 2009).

A diachronic analysis of faunal material from Stratum 5 and Stratum 11 was conducted by Matthew Warwick (2002). Results indicate a similar faunal subsistence pattern for both components, with a dominance of mammals, particularly white-tail deer. While there was no statistically significant change between the two components, a trend toward increased exploitation of fish was observed. Possible interpretations include intensification with a minimal increase in labor costs to serve the needs of a larger population or alternatively, increased exploitation of resources in the immediate vicinity of the site due to defensive needs.

Lake Koshkonong Locality Oneota Sites

Maize specimens from the Crescent Bay Hunt Club site (CBHC, 47-JE-0904) are included in the maize row number analysis. In the environmental catchment analysis presented later in this chapter, the Lake Koshkonong site catchments are compared with Aztalan's catchment.

The area around Lake Koshkonong was a center of Oneota occupation during Late Prehistory. The environmental background section for this thesis includes comparative data from four Late Koshkonong Oneota sites: CBHC, Schmeling (47-JE-0833), Twin Knolls/Koshkonong Creek Village (KCV, 47-JE-0379) and Carcajou Point (47-JE-0002) (Figure 1.4). The presence of evidence for violence at Aztalan in the form

of defensive features and trauma on human remains (e.g. Richards 1992, Rudolph 2009) has been coupled with data on environmental circumscription, a lack of Oneota artifacts at Aztalan, and the absence of Middle Mississippian sherds at Lake Koshkonong, to argue for hostility between the two groups. The existence of a “closed, static frontier” in late prehistoric Jefferson County has been postulated (Richards and Jeske 2002).

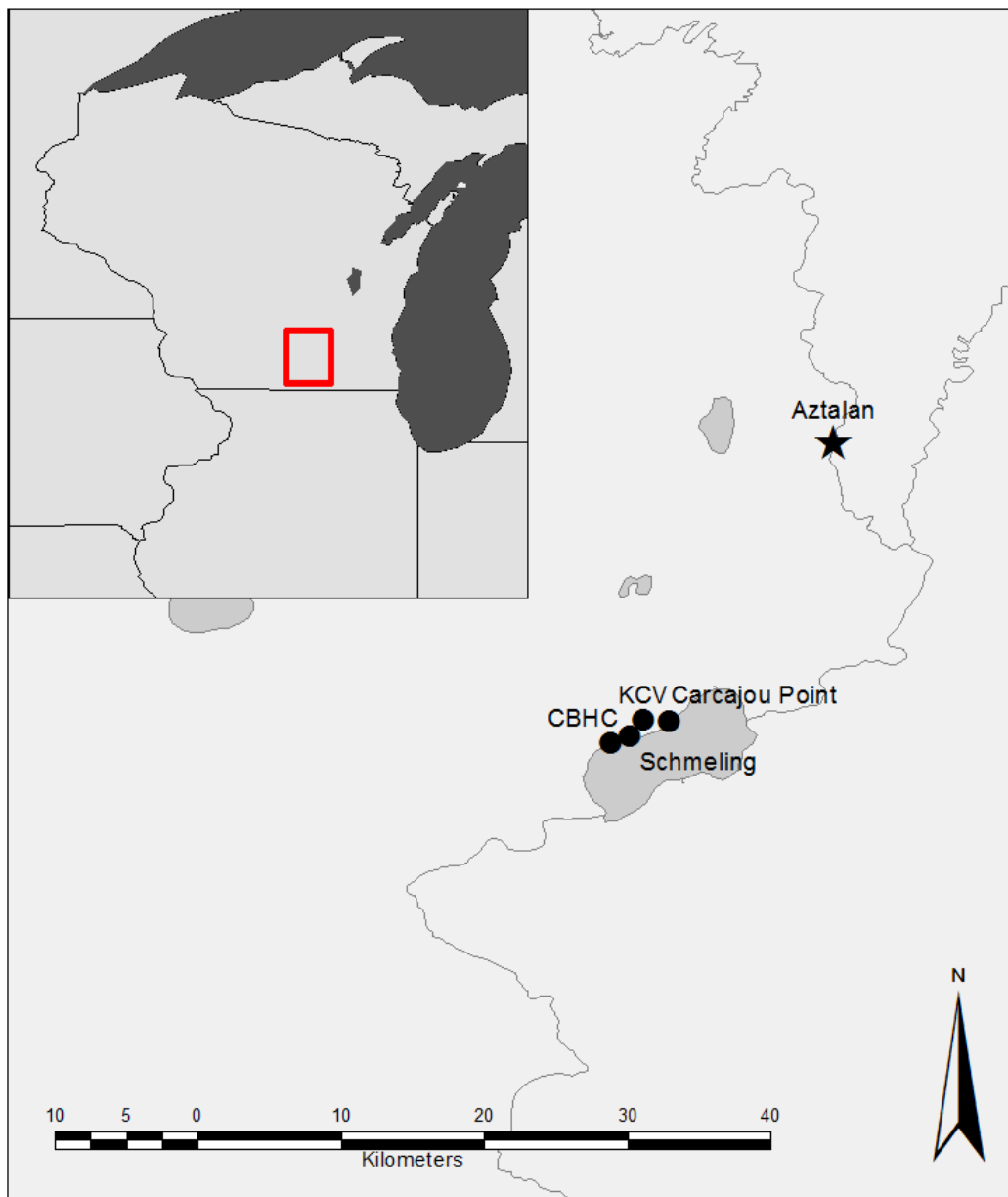


Figure 1.4: Map of Aztalan and Lake Koshkonong sites

Detailed comparisons between the CBHC floral assemblage and data from Aztalan are included in Chapter 4. CBHC is located on a ridge 300 meters west of the current shoreline of Lake Koshkonong (Figure 1.4). The Koshkonong locality served as an area of significant Oneota occupation (Edwards 2010; Hall 1962; Jeske et al. 2003). The first excavations at CBHC took place in 1968 by University of Wisconsin-Madison

under the direction of David Baerreis (Gibbon n.d.). The site has been the subject of biennial University of Wisconsin-Milwaukee field schools since 1998, under the direction of Robert J. Jeske. Food residues and diagnostic ceramics have securely dated the site to A.D. 1200-1400 (Jeske et al. 2003). Residues from three Grand River vessels have provided AMS dates that indicate occupation of the site at least by the twelfth century (Jeske 2001, 2003, 2010). Maize row number measurements from specimens recovered during the 2000 field season are included here. The floral assemblage from the 2000 season, as well as samples from the 2002-2006 seasons, have been previously analyzed (Egan-Bruhy 2001, 2010; Olsen 2003).

Carcajou Point was originally reported by GLO surveyors (Brink 1835). As described by Scout and Skavlem (1908), the site contains both historic materials and mounds. Well-known excavations conducted at the site by Robert Hall (1962) confirmed that Carcajou Point was the site of both historic and prehistoric occupations. Survey conducted by UWM during the 1980s determined that the majority of artifacts at the site related to an Oneota occupation, though some Woodland materials were identified (Rodell 1984). Salvage archaeology was conducted at the site in 1997 and 1998 after construction revealed the presence of human remains and a large amount of prehistoric material (Gaff 1998; Richards et al. 1998). Radiocarbon dates provide strong evidence that the site was occupied by the eleventh century (Richards and Jeske 2002).

Limited excavations conducted at the Schmeling site in 2006 and 2008 by UWM's archaeological field school under the direction of Robert Jeske revealed that while the site is multi-component, the most substantial occupation is Oneota (Foley-

Winkler 2008; Jeske and Winkler 2008). The single radiocarbon date from the site is calibrated to the early thirteenth century (Foley-Winkler 2008).

The Koshkonong Creek Village site (KCV) is located north of the other three sites and away from the lake (Edwards 2010; Edwards and Spott 2012). Recent research confirms that ceramics at the site compare well with the other Koshkonong locality sites, including Grand River, Carcajou and Busseyville Grooved Paddle vessels (Edwards and Spott 2012). A single radiocarbon date has been run on ceramic residue from a Grand River Trilled sherd; the residue dates between cal A.D. 989-1044 at the two sigma level, suggesting that producers of Oneota pottery may have been living at KCV prior to the appearance of Middle Mississippian traits at Aztalan (Edwards and Spott 2012:8).

Environmental Context

An understanding of the environmental context surrounding Aztalan can help to indicate which food sources would have been readily available to site inhabitants. When combined with data from the flotation analysis, this information will be useful in exploring dietary choices made by Aztalan residents. In this section, three different models for understanding the site's environmental context will be provided. The first is the traditional vegetation zone model. Vegetation zones near the site include oak openings, oak forests and the marsh and aquatic zones (Figure 1.5). The second model discussed is the forest communities model presented by Kotar and Burger (1996). Finally, an environmental catchment analysis, following a GIS methodology developed by Edwards (2010), is presented for a two-kilometer radius around Aztalan.

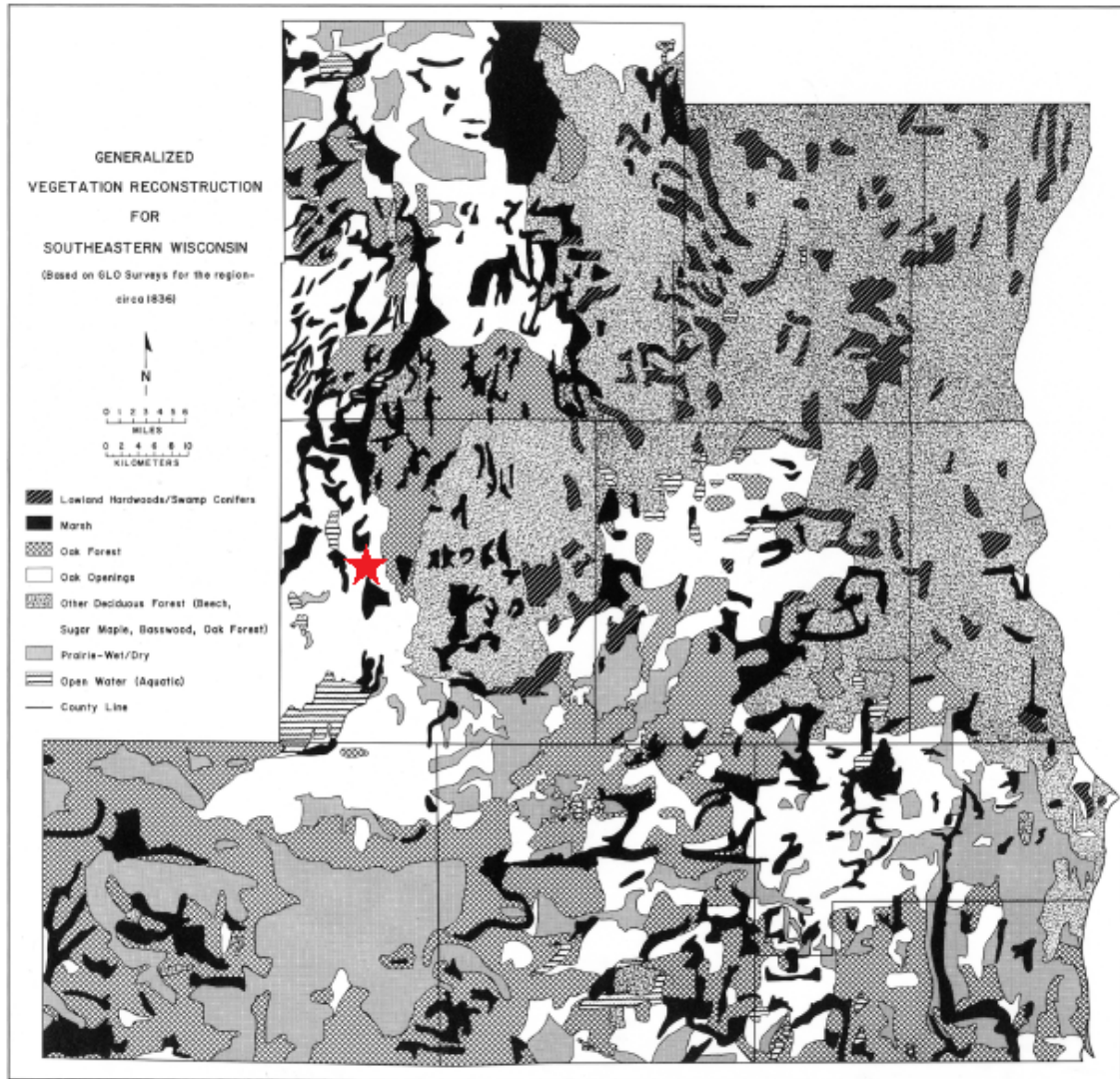


Figure 1.5: Presettlement vegetation of Southeast Wisconsin: Location of Aztalan indicated by star (modified from Richards and Jeske 2002:Figure 6, after Goldstein and Kind 1987)

The climate of Southeast Wisconsin also impacted the available dietary options for Aztalan residents. Of particular relevance given the focus on maize in this research, Jefferson County averages 160 frost-free days per annum (Finley 1976). Ethnographic data suggest that maize was grown at latitudes where the average number of frost-free days exceeded 120 (Yarnell 1964).

Vegetation Zones

Vegetation zones are included in the environmental catchment analysis, and described here to provide information on productivity and available taxa. Oak openings were more common in Southeast Wisconsin than suggested by published maps of pre-settlement vegetation (Auclair 1976; Curtis 1959; Dorney 1981; Finley 1976; Goldstein and Kind 1987; Richards and Jeske 2002). Oak savanna was prevalent in the area surrounding Aztalan (Goldstein and Kind 1987; Richards and Jeske 2002; Zicker 1955). The soils present in oak openings may have been particularly suitable for agriculture (Richards 1992). Fauna found in oak forest environments were likely also found in oak savanna zones, albeit at lower densities (Warwick 2002:76). These include deer, rabbits, and squirrel along with larger taxa such as white elk and bison (Goldstein and Kind 1987: 26). The open nature of these environments may have facilitated hunting. Fields may have attracted foraging animals, permitting “passive garden hunting” (Warwick 2002:76).

Oak forests, the most common vegetation community in Southeast Wisconsin, are also present near the site. This vegetation community covers 19 percent of the landscape in the vicinity of Aztalan (Goldstein and Kind 1987:26). Oaks are the dominant tree species, but other trees are present. These forests are probably maintained by episodic burning, though not as frequent as that required to maintain oak openings (Goldstein and Kind 1987:26). Oak forests offered a wide variety of floral resources including sugar maple, shagbark hickory, climbing bittersweet, hackberry, hazelnut, red ash, butternut, black walnut, black cherry, white oak, bur oak, black oak, Missouri gooseberry, basswood, aster, mayapple and merrybells. Many of these species occur only rarely, though acorns would have been abundant (Goldstein and Kind 1987: 26). Faunal

resources available in oak openings included small animals such as woodchuck, porcupine, fox, turkey and squirrel alongside small numbers of elk and bison and larger numbers of deer (Goldstein and Kind 1987: 26).

Marshes and aquatic zones are abundant in Southeast Wisconsin. Marshes make up 12 percent of the vegetation zones in the region, while six percent of the region is covered with rivers and lakes (Goldstein and Kind 1987:23). Large marshlands are found to the north, south and west of Aztalan. The Crawfish River would have provided residents of the site with access to the aquatic zone. Rock Lake, the nearest freshwater lake, is less than four kilometers from the site. The marsh and aquatic zones are combined for purposes of this discussion, as they would have provided many of the same floral taxa including wild rice, duck potato and bulrush. Despite the limited taxa present, marsh and aquatic zones would have been worthwhile to exploit for several reasons. These plants grow in stands, allowing for easy harvest. Second, marsh flora such as wild rice (*Zizania aquatica*) and duck potato are harvested in autumn and can produce large quantities of easily storable food for the winter (Goldstein and Kind 1987: 23; Yarnell 1964). Richards (1992) notes two likely seasons for the exploitation of marsh and aquatic zones. Bulrush tubers would have been available in early spring when other foods were scarce. On the other hand, as noted, storable resources such as rice and duck potato became available in fall.

Forest Communities

Kotar and Burger define vegetation communities somewhat differently (1996). In this model, Wisconsin is divided into 11 regions based on dominant forest communities

intended to correct for previous classifications which focused on dominant, generally successional species (Kotar and Burger 1996:1.3). In this classification, forest communities are defined by understory species as well as trees. The study area is located in Region 10, which has two main forest communities: ATiFrVb (*Acer saccharum*-*Tilia-Fraxinus*/*Viburnum* sp.) along with the associated ATiFrVb(Cr) (*Cornus racemosa* (Gray dogwood) phase, and ATiFrCa (*Acer saccharum*-*Tilia-Fraxinus*/*Caulophyllum*) (Sugar maple-Basswood-White ash/Blue cohosh) and the associated ATiFrCa(O) *Osmorhiza* (Sweet cicely) Phase (Kotar and Burger 1996:3.181-3.186).

The ATiFrVb community is characterized by shade-tolerant mesic hardwoods such as sugar maple, basswood and white ash; red and white oak also appear. Stands of the *Cornus* phase are dominated by white or red oak; other frequent species include black cherry, American or slippery elm and shagbark hickory (Kotar and Burger 1996:3.181). Frequent shrub layer taxa include choke cherry (most abundant), black cherry, elm, gooseberries, arrowwood, maple-leaf viburnum and prickly ash. Other shrub layer taxa may include blackberries/raspberries (*Rubus* sp.) and highbush cranberry (*Viburnum trilobum*) (Kotar and Burger 1996:3.181).

The ATiFrCa (*Acer saccharum*-*Tilia-Fraxinus*/*Caulophyllum*) (Sugar maple-Basswood-White ash/Blue cohosh) type is best represented in Fond du Lac and eastern Dodge, Jefferson and Waukesha counties. This community is generally associated with less fire disturbance than the *Osmorhiza* phase. Sugar maple, basswood and white ash with red oak share dominance, while bitternut and shagbark hickory are often present in small numbers (Kotar and Burger:3.185). The shrub and small tree layer generally is not well developed; only choke cherry is frequent. Wild currants and gooseberries may be

present but have low abundance. Ground flora include enchanter's nightshade, false solomon's seal, wild geranium, white avens, Virginia creeper, mayapple, Jack-in-the-pulpit, trillium, bloodroot, meadow rue, Virginia waterleaf and blue cohosh (Kotar and Burger 1996:3.185-3.186). The *Osmorhiza* phase is found primarily west of the ATiFrCa type, but can be found anywhere in Region 10. This phase is associated with a greater degree of fire disturbance and "may represent landscape positions that were historically more fire prone" (Kotar and Burker 1996:3.186). The *Osmorhiza* phase lacks mesic hardwoods; stands are mixtures of red oak, white oak, American and slippery elm, black cherry and shagbark hickory. Unlike ATiFrCa, this phase is often dominated by shrubs such as choke cherry, wild currant, gooseberry, blackberries, gray dogwood and prickly ash. Ground flora of the *Osmorhiza* phase include enchanter's nightshade, false solomon's seal, wild geranium, white avens, Virginia creeper and mayapple, also sweet cicely, riverbank grape, lopseed, tick trefoil and rattlesnake fern (Kotar and Burger:3.185).

Anthropogenic Habitats

Human activities create a distinct habitat type which may be advantageous for certain species. Smith (1987) argued that early sedentary communities were often riverine adaptations along floodplains; these communities may not have been occupied year-round, but only during the low-water growing season. This would have been sufficient to create the anthropogenic habitats which Smith terms "domestilocalities" (1987:28). These habitats may have provided the necessary conditions for what Smith sees as a co-evolutionary path to domestication. These conditions include increased sunlight due to

land clearing, increased soil fertility and disturbance, and the ongoing introduction of seeds (Smith 1987:28).

Oak openings may also be considered anthropogenic habitats. Oak savannas are transitional vegetation zones and must be maintained by regular fire, or they revert to oak forest within as little as two to four decades (Gleason 1922, Richards and Jeske 2002: 38). Richards and Jeske (2002) argue for the deliberate maintenance of such environments. Based on historical accounts of deliberate fire-setting by native groups and the observed frequency of lightning fires, it is likely that this was the case (Curtis 1959: 334-337). Forest soils present in oak openings may have been particularly suitable for agriculture (Richards and Jeske 2002).

Fauna found in oak forest environments were likely also found in oak savanna zones, albeit at lower densities (Warwick 2002: 76). These include deer, rabbits, and squirrel along with larger taxa such as white elk and bison (Goldstein and Kind 1987: 26). The open nature of these environments may have facilitated hunting. Horticultural fields are attractive environments for many animals, which may have permitted “passive garden hunting” (Warwick 2003:76). The more sparse vegetation of oak openings could have facilitated nut harvests. Oak savannah may be a suitable location for settlement due to a relative lack of vegetation to clear and available fuel for fires. The prairie soils associated within the palisade itself have deep A horizons and are generally not suited to cultivation. The forest soils located north of the palisade, coincident with Hyer’s mapped garden beds, would have been better suited for agriculture (Glocker 1979; Hyer 1837; Richards 1992).

Environmental Catchment Analysis

Methods

An environmental catchment analysis was performed for Aztalan in order to provide insight into the degree to which any apparent subsistence difference between Aztalan and CBHC might be accounted for by environmental differences. Edwards (2010) performed an environmental catchment analysis for four sites in the Koshkonong locality (CBHC, Schmeling, KCV, and Carcajou Point) using GIS modeling. For comparability, his methods are followed here. Analysis focused on vegetation zones as described by Goldstein and Kind (1987), soil arability, and the presence of ecotones. Ecotones are defined as a transitional area between two or more vegetational communities, in other words a “junction zone or tension belt” (Odum 1959, cited in Edwards 2010:41). Ecotones are argued to be economically efficient for two reasons. First, shores of lakes and rivers and forest edge environments attract a wide variety of species (Keene 1983; Winterhalder 1981, cited in Edwards 2010). Second, the presence of ecotones may permit exploitation of a greater range of resources within a limited area (Edwards 2010:41). While the ecotones in the area surrounding Lake Koshkonong are likely productive areas, it is worth noting that not all transition zones are highly productive. For example, in his discussion of the transition zone between the highly productive Carolinian biotic province and the less productive Canadian biotic province, Fitting (1966) notes that the tension zone is of only moderate productivity.

Edwards (2010) utilized a two kilometer catchment area around the Koshkonong locality sites. This decision was based on Vita-Finzi and Higgs’ (1970) analysis which demonstrated that resources within one kilometer would be 100 percent utilized, while

resources within two kilometers would be 50 percent utilized. As distance from the site increases, the percentage of resources exploited continues to decrease (Edwards 2010:43). For comparability with sites in the Koshkonong locality, a two kilometer buffer was created in ArcGIS around a point feature representing the approximate center of the Aztalan site.

Environmental zones were modeled based on survey notes from the General Land Office (GLO), argued by Edwards (2010) to be more detailed than Finley's (1976) Original Vegetation Cover map. Vegetation zones are described in more detail above (c.f. Goldstein and Kind 1987). Because the notes for sections around Aztalan were uniformly described as "second rate bur oak," previous vegetation reconstructions around Aztalan (Goldstein 1991; Kind 1979; Milfred and Hole 1970) were also employed, particularly to distinguish between oak forest and oak savanna. It is worth noting that GLO surveyors were often describing deciduous forests that had reverted from oak savanna in the absence of regular burning (Richards and Jeske 2002). In one case, the presence of wetland soils was used to refine the location of a wetland mapped by GLO surveyors. It is worth noting that given a sedentary and relatively large population at Aztalan, combined with timber needs for palisade reconstruction, the immediate site area was likely largely deforested during the site's occupational history. The resources likely to be encountered in each vegetation zone are discussed earlier in this chapter.

Soils data were downloaded from the USDA (Staff n. d.). Edwards (2010) chose soil characteristics based on previous studies of Oneota agriculture (Overstreet 1976; Sasso and Brown 1987). Categories which indicate that a soil type is arable for prehistoric farmers include whether or not it is tillable using prehistoric technology,

drainage, and whether the soil allows for water availability at plant roots (Edwards 2010:62). Edwards (2010) classed soils based on characteristics described in soil survey books for Jefferson and Dane Counties (Glocker 1979; Glocker and Patzer 1978). Soils were classed as good, fair or poor based on capacity to be tilled, drainage and slope. Detailed descriptions of these criteria may be found in Edwards (2010:62-63).

In order to model ecotones in ArcGIS, ecozone features were converted from polygons to lines. A polygon buffer of 250 meters was generated around each line. The clipping tool was employed to eliminate overlaps and ensure that the ecotone polygons did not extend past the limit of the catchment. Ecotones were classed based on the adjacent ecozones (wetland/savanna, forest/river, etc.).

Ecozone Comparison between Aztalan and Koshkonong Locality Sites

Figure 1.6 shows the ecological zones present within a two kilometer radius of Aztalan. The Aztalan catchment contains four vegetation zones: oak/hickory open, oak/hickory forest, wetland and open water. A small stream on the east side of the Crawfish River was mapped based on the GLO map and likely represents an intermittent stream.

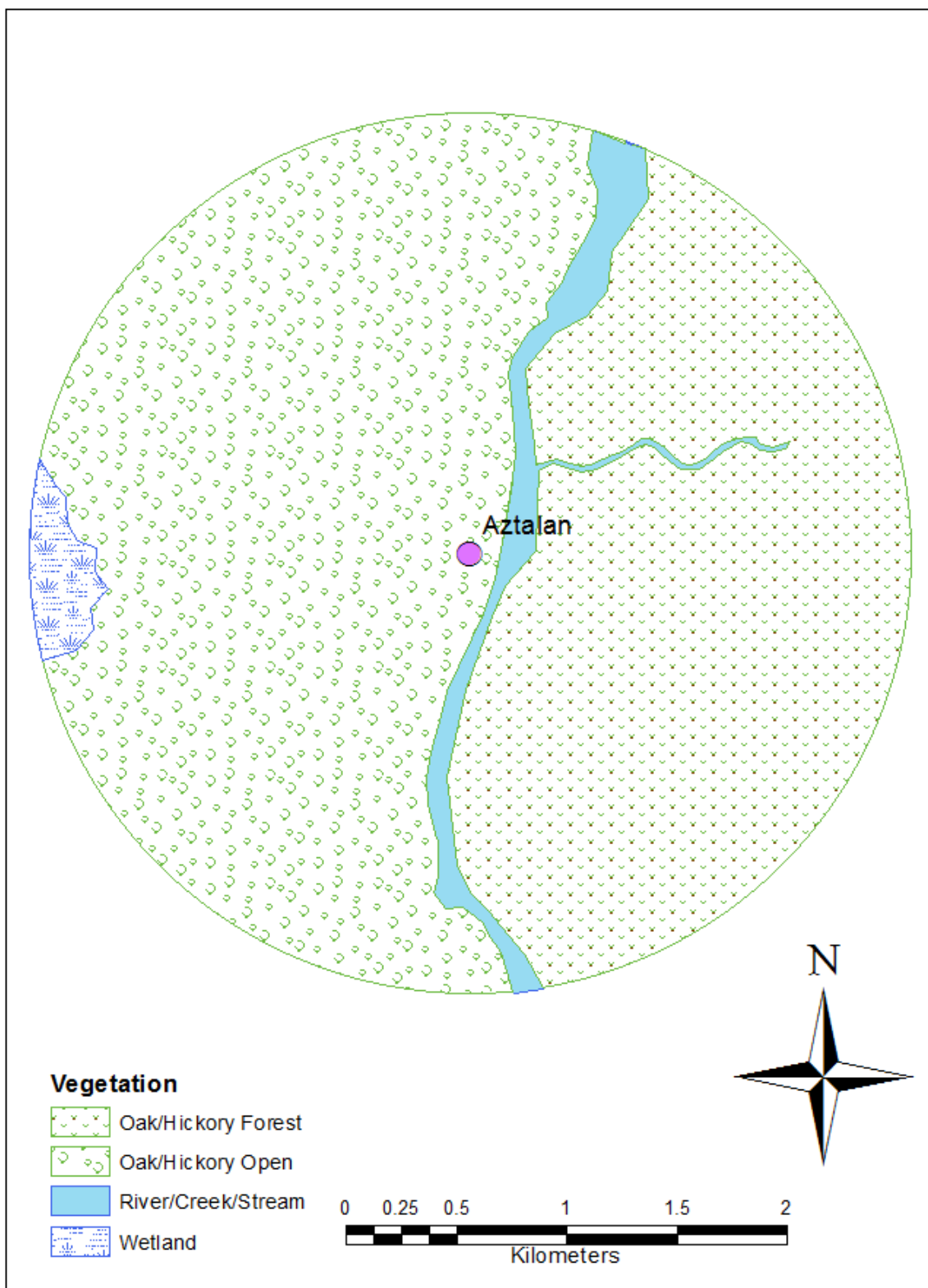


Figure 1.6: Map showing vegetation zones within a two kilometer catchment of Aztalan

Table 1.1 compares ecozone data for Aztalan and the Koshkonong locality sites. One striking difference between Aztalan and the Koshkonong Oneota sites is that Aztalan's environment is less diverse. Aztalan lacks both the prairie and the lake ecozones. The proportion of the Aztalan catchment defined as oak forest is 0.41, while the Koshkonong locality sites have no forest ecozones within their catchments. The proportion of the Aztalan catchment defined as wetland is low (0.02) compared with a high of 0.12 for KCV, 0.09 for Carcajou Point, and 0.05 for both CBHC and the Schmeling site. These numbers that subsistence patterns for Lake Koshkonong Oneota may involve more exploitation of wetland resources than is characteristic of Aztalan subsistence patterns.

Table 1.1: Comparison of Ecozones in the Aztalan Catchment with Koshkonong Locality Site Catchments (Adapted from Edwards 2010)

Site	Area	Savanna	Prairie	Forest	Wetland	Lake	River/Creek	Total
Aztalan (47-JE-0001)								
	2 km - Total Area (m²)	6,653,579	0	5,202,749	197,001	0	506,167	12,559,494
	2 km - Proportion	0.53	0.00	0.41	0.02	0.00	0.04	1.00
CBHC (47-JE-0904)								
	2 km - Total Area (m²)	7,583,785	1,428,812	0	654,975	2,797,518	92,899	12,557,989
	2 km - Proportion	0.60	0.11	0.00	0.05	0.22	0	1.00
Schmeling (47-JE-0833)								
	2 km - Total Area (m²)	8,168,570	1,426,957	0	666,248	2,192,631	105,982	12,560,389
	2 km - Proportion	0.65	0.11	0.00	0.05	0	0.01	1.00
KCV (47-JE-0379)								
	2 km - Total Area (m²)	10,488,508	310,649	0	1,469,804	0	290,070	12,559,033
	2 km - Proportion	0.84	0.02	0.00	0.12	0.00	0.02	1.00
Carcajou Point (47-JE-0002)								
	2 km - Total Area (m²)	5,224,370	48,940	0	1,071,648	6,111,744	103,868	12,560,570
	2 km - Proportion	0.42	0.00	0.00	0.09	0.49	0.01	1.00

Arable Soils Comparison between Aztalan and Koshkonong Locality Sites

Figure 1.7 is a map of the agricultural potential of soils in the Aztalan catchment. Only good and fair (arable) soils are shown. It is apparent that much of the two kilometer radius surrounding Aztalan consists of arable soils.

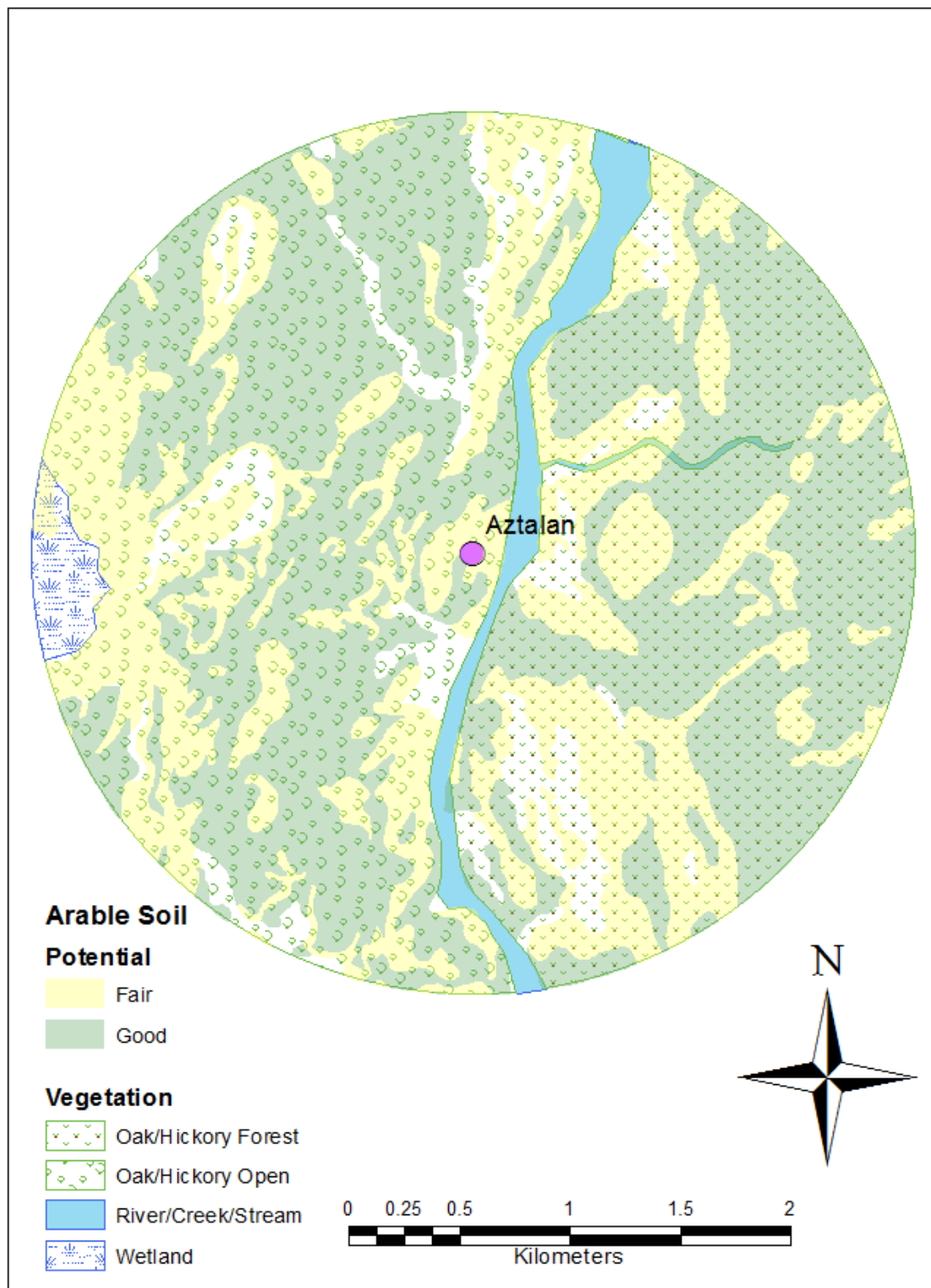


Figure 1.7: Map of arable soils in two kilometer Aztalan catchment

Table 1.2 consists of a comparison of the proportion of arable soils in the Aztalan site catchments and the Koshkonong locality site catchments. Aztalan has by far the highest proportion of arable soil (0.87) compared with CBHC (0.34), Schmeling (0.37), KCV (0.58) and Carcajou Point (0.26). Based on this data, Aztalan floral assemblages may be expected to have a higher prevalence of domesticates and cultigens than the Koshkonong locality sites.

Table 1.2: Comparison of Arable Soils within Aztalan and Koshkonong Locality Two Kilometer Site Catchments (Adapted from Edwards 2010)

Site	Area	Good	Fair	Total Arable	Poor
Aztalan (47-JE-0001)					
	2 km - Total Area (m²)	6,669,918	4,214,431	10,884,349	1,675,146
	2 km - Proportion	0.53	0.34	0.87	0.13
CBHC (47-JE-0904)					
	2 km - Total Area (m²)	1,860,435	2,398,753	4,259,189	8,301,285
	2 km - Proportion	0.15	0.19	0.34	0.66
Schmeling (47-JE-0833)					
	2 km - Total Area (m²)	2,118,656	2,552,143	4,670,798	7,889,683
	2 km - Proportion	0.17	0.20	0.37	0.63
KCV (47-JE-0379)					
	2 km - Total Area (m²)	3,406,921	3,926,079	7,333,000	5,227,530
	2 km - Proportion	0.27	0.31	0.58	0.42
Carcajou Point (47-JE-0002)					
	2 km - Total Area (m²)	1,627,666	1,601,126	3,228,792	9,332,148
	2 km - Proportion	0.13	0.13	0.26	0.74

Ecotone Comparison between Aztalan and Koshkonong Locality Sites

Figure 1.8 shows the ecotones present within the two kilometer Aztalan catchment. The catchment includes four ecotone types: savanna/river, forest/river, savanna/forest/river and wetland/savanna.

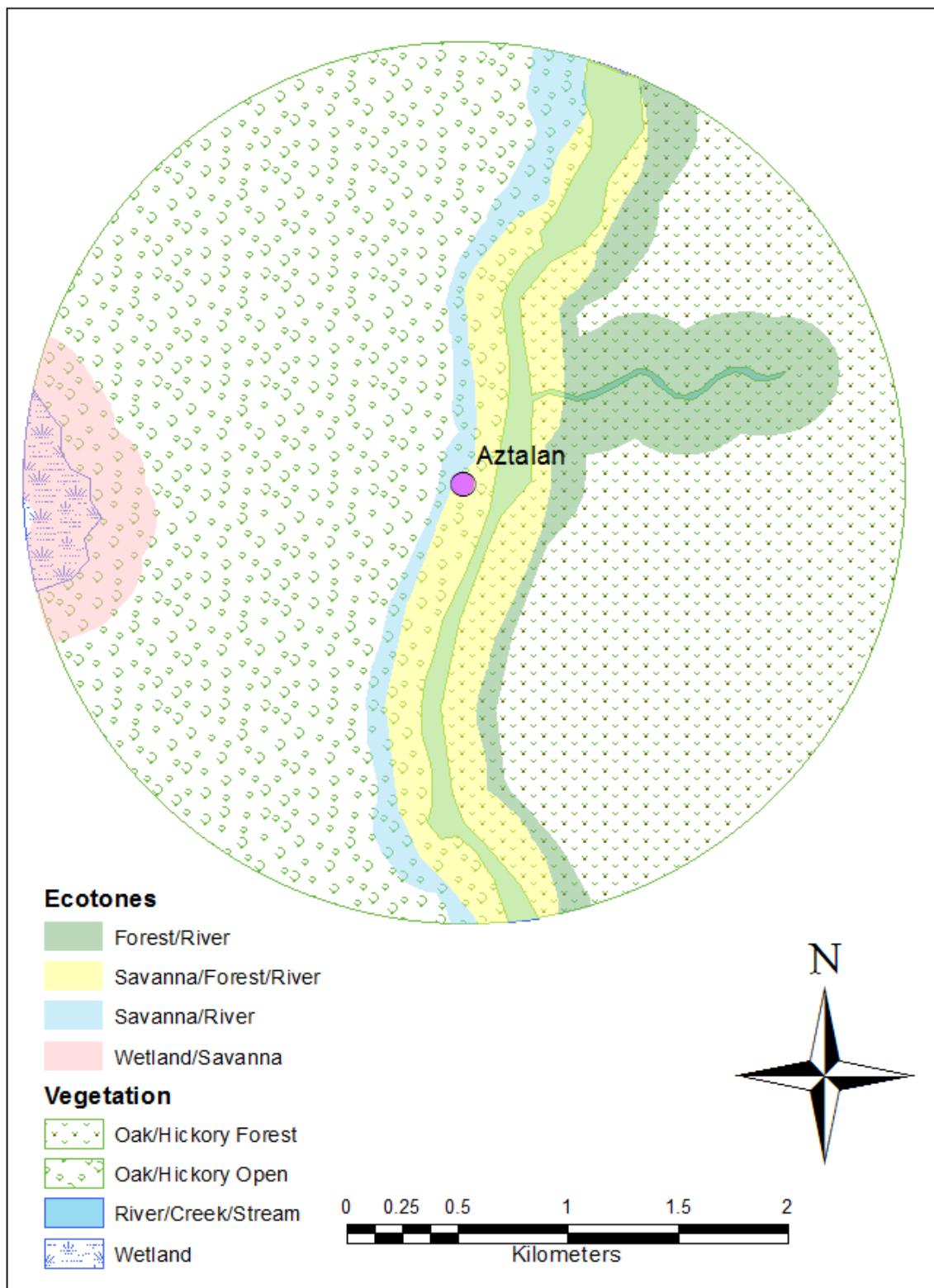


Figure 1.8: Map of ecotones within two kilometer Aztalan site catchment

Table 1.3 summarizes ecotone data for Aztalan and the four Koshkonong locality sites. Aztalan has a low proportion of ecotones within its two kilometer catchment (0.30) compared with CBHC (0.61), Schmeling (0.63), KCV (0.71) and Carcajou Point (0.44). Furthermore, the four ecotones identified around Aztalan (savanna/river, forest/river, savanna/forest/river and wetland/savanna) show less diversity compared with the 11 different ecotones identified around each of the Koshkonong locality sites (water/wetland, water/prairie, water/savanna, wetland/prairie, wetland/savanna, prairie/savanna, water/wetland/prairie, water/wetland/savanna, water/prairie/savanna, wetland/prairie/savanna, water/wetland/prairie/savanna). This data may predict a less diverse assemblage of wild resources for Aztalan compared with the Koshkonong Oneota sites.

Table 1.3: Ecotone Comparison between Aztalan and Koshkonong Oneota Site Catchments (Adapted from Edwards 2010)

Site	Area	Ecotones
Aztalan (47-JE-0001)	2 km - Total Area (m²)	3,776,750
	2 km - Proportion	0.30
	Ecotone Types	4
CBHC (47-JE-0904)	2 km - Total Area (m²)	7,688,288
	2 km - Proportion	0.61
	Ecotone Types	11
Schmeling (47-JE-0833)	2 km - Total Area (m²)	7,878,964
	2 km - Proportion	0.63
	Ecotone Types	11
KCV (47-JE-0379)	2 km - Total Area (m²)	8,874,423
	2 km - Proportion	0.71
	Ecotone Types	11
Carcajou Point (47-JE-0002)	2 km - Total Area (m²)	5,557,612
	2 km - Proportion	0.44
	Ecotone Types	11

Thesis Organization

In addition to defining the research goals, Chapter 1 presents the background of the Aztalan site, as well as a brief history of archaeological investigations at the site. Particular attention is paid to previous research regarding the use of floral resources by site inhabitants. The environmental setting is described in order to assess wild resources that would have been available to Aztalan's inhabitants. An environmental catchment analysis is presented for Aztalan in order to assess environmental differences between the site and sites in the Koshkonong locality.

Chapter 2 presents a review of literature regarding maize race in prehistoric Eastern North America, with regard to both morphological and genetic definitions for

maize lineage. Cultural subsistence histories are presented for the late prehistoric period in three regions: Southern Wisconsin/Northern Illinois, the American Bottom, and the Eastern Great Lakes (represented by Michigan, New York and Ontario). Particular emphasis is placed on the use of maize in each region. In addition, the utility of botanical data for refining culture histories is explored.

Chapter 3 includes a discussion of the contexts selected for analysis and their cultural affiliations. Chapter 3 also contains an outline of the methods employed in the analysis.

Chapter 4 presents the results of the flotation analysis of Aztalan materials as well as maize race data from Aztalan and the CBHC site. The chapter primarily consists of a diachronic analysis of Late Woodland and Middle Mississippian floral assemblages at Aztalan, as well as an analysis comparing Aztalan with five other late prehistoric sites in the region. Aztalan is also compared trends in the American Bottom and Eastern Great Lakes. A comparative analysis of maize row number at Aztalan and CBHC is also included.

Chapter 5 discusses the answers to the research questions set out in Chapter 1, based on the data produced in this analysis. Possible future research directions are also explored.

Chapter 2) Review of Maize Race and Floral Utilization in the Late Prehistoric Eastern United States

Introduction

The primary goal of this project lies in assessing any apparent shift in plant-based subsistence at the Aztalan site between the Late Woodland component and the Middle Mississippian-influenced occupation, both in terms of general plant use and in terms of maize race. This thesis also aims to place the maize at Aztalan within the general context of maize use and lineages in Eastern North America. The regional subsistence histories presented below place particular importance on maize.

This chapter begins with a brief discussion on the history of maize race research in North American archaeology, both in terms of morphologically and genetically based classification. This is followed by a summary of the available data on plant use in the American Bottom from the Patrick phase through the Oneota period. The American Bottom dataset is particularly useful as standardized flotation processing and analysis has been performed on well over 100 sites as part of archaeological mitigation work. This combined with the far-reaching spread of Mississippian influence radiating from the Cahokia site permits the American Bottom region to set expectations for other parts of the Midwest.

Unfortunately, the dataset for Late Woodland Wisconsin is neither as comprehensive nor as standardized as that of the American Bottom. Available information is summarized in this chapter, alongside data on sites in northern Illinois. The current debate on Late Woodland cultural taxa in Wisconsin is complicated by sparse subsistence data, especially on Effigy Mound sites. This further complicates analysis of the Aztalan assemblage, as understanding of what “Mississippianization” means in terms

of plant use in a particular region is predicated on an understanding of the Late Woodland diet.

The pre-Mississippian settlement at Aztalan is best characterized as a collared ware Late Woodland site. Some researchers have argued that collared ware has possible roots in the Upper Illinois River Valley (Hall 1991; Kelly 2002; Richards 1992:405). Others have noted a possible connection to the Eastern Great Lakes (Egan-Bruhy 2012; Salkin 1987, 1989, 1993). A brief summary of late prehistoric plant exploitation in Michigan, New York state and Ontario is provided in this chapter. In addition to the collared ware connection, this region provides very early dates on maize, and is probably the birthplace of Eastern Eight Row corn.

Finally, this chapter addresses the degree to which subsistence data – and at times subsistence speculation – have played a central role in the construction of regional culture histories. In recent years, new data have helped to alter and rewrite these histories, especially in terms of the American Bottom and Northern Iroquoia regions. These case studies illustrate the potential of an increased floral dataset for shedding light on the complex Late Prehistoric cultural landscape of Wisconsin. The literature presented in this chapter exhibits the need for continuing macro- and microbotanical archaeological research throughout Eastern North America.

Maize Race in the Eastern United States

The taxonomic utility of row number in determining relationships between lineages (races) of maize has long been recognized (Anderson 1943, 1946; Cutler 1946). In the past, a number of researchers proposed the hypothesis that the introduction of a

“better,” more productive eight row maize was at least in part responsible for the Mississippian emergence and an increased reliance on maize agriculture (Coe et al. 1986; Galinat and Gunnerson 1963; Fowler 1975). This hypothesis has effectively been refuted, as discussed below. However a shift from high row number to lower row number in the American Bottom is apparent by ca. A.D. 1400 (Fritz 1992; Simon and Parker 2006:243). The pattern for Wisconsin appears to show the reverse. For this reason, the question of maize race may still be useful in answering questions about temporal and cultural relationships between sites in the late prehistoric Midwest (Table 2.1).

Table 2.1: Row Number Measurements from Selected Late Prehistoric Sites in Wisconsin and Northern Illinois

Site Name	Site Number	County	Cultural Association	Method	Average Row Number	Estimated Row Number	Reference
Dietz	47-DA-0012	Dane	Late Woodland	Count, shape	12.0		Cutler and Blake 1969
Mill Pond	47-CR-0186	Crawford	Late Woodland	Shape		8-10 row	Arzigian 1993
Weisner III	47-DO-0399	Dodge	Late Woodland	Shape		8 row	Salkin 1993
Statz	47-DA-0642	Dane	Late Woodland	Shape		8-10 row	Zalucha 1997 (in Meinholz and Kolb 1997)
Bethesda Lutheran Home	47-JE-0201	Jefferson	Late Woodland/Middle Mississippian	Angle		Greater than 8-10 row; angles of 50-75 degrees	Hendrickson 1996
Aztalan	47-JE-0001	Jefferson	Late Woodland/Middle Mississippian	Count, shape	12.0		Cutler and Blake 1969
Fred Edwards	47-GT-0377	Grant	Late Woodland/Middle Mississippian	Shape		8-10 row	Arzigian 1987; Finney 1993; Finney and Stoltman 1991
Hamilton-Brooks	47-GL-0122	Green Lake	Late Woodland/Mississippian	Count, shape	10.7		Cutler and Blake 1969; Hall 1967
Lundy (Illinois)	11-JD-0140	Jo Daviess	Late Woodland/Middle Mississippian	Angle		8, 10 and 12-row	Emerson et al. 2007; Schroeder 1989

Site Name	Site Number	County	Cultural Association	Method	Average Row Number	Estimated Row Number	Reference
Zimmerman	11-LS-0013	La Salle	Langford	Angle		8-10	Jeske and Hart 1988
Armstrong	47-PE-0012	Pepin	Oneota	Angle		8-10 row	Hurley 1978
Carcajou Point	47-JE-0002	Jefferson	Oneota	Count, shape	10.7		Cutler and Blake 1969
Bornick	47-MQ-0065	Green Lake	Oneota	Count, shape		Grains from 8, 10 and 12 row ears	Cutler and Blake 1969; Gibbon 1970
Walker-Hooper	47-GL-0065	Green Lake	Oneota	Count, shape	9.9		Cutler and Blake 1969; Gibbon 1972
Lasley's Point	47-WN-0096	Winnebago	Oneota	Count, shape		Grains from 8, 10, 12 and one 14 row ear	Bullock 1940, 1942; Cutler and Blake 1969; Peske 1966
Midway	47-LC-0019	La Crosse	Oneota	Count, shape		Grains from 8 and 10 row ears	Cutler and Blake 1969
North Shore	47-LC-0185	La Crosse	Oneota	Angle		8 row	Zalucha 1988 (In Theler and Boszhardt 1988)

Site Name	Site Number	County	Cultural Association	Method	Average Row Number	Estimated Row Number	Reference
Pammel Creek	47-LC-0061	La Crosse	Oneota	Count, shape		8-10 row (1 full circumference), one possible 12 row	Arzigian 1989; Arzigian et al. 1990; Boszhardt et al. 1984

The Races of Maize

The first general maize race category in Eastern North America is defined as having 12-14 rows of narrow kernels. It is known as “Chapalote, Tropical Flint, Basketmaker-like, or North American Pop,” while an 8-10 rowed variety is “called Eastern Complex, Eastern Eight Row, *Maiz de Ocho*, or finally, Northern Flint, after its modern landrace” (Brown and Anderson 1947; Fritz 1992:19). Given that cobs with 10-12 rows are common at late prehistoric Midwestern sites, Fritz notes that this “Midwestern Twelve Row” has been viewed by some researchers as a “transitional” or “conservative” variety (Cutler and Blake 1976; Fritz 1992:19).

Midwestern Twelve Row is characterized by kernels that are longer than they are wide. Wagner argues that this type is “dominant in central southern archaeological sites” (1994:337). Wagner (1994) provides a succinct summary of early theories on the introduction of maize to North America. Carter and Anderson (1945) argued that high row numbered “Mexican Complex” corn was introduced to North America only after narrow-cob Basketmaker and Pima-Papago varieties were introduced to the southwest. Volney H. Jones contended that Mexican Complex maize arrived in the “Anasazi area” circa A.D. 600-700, spreading across the Prairie region and ultimately appearing in “dilute form” at later Mississippian sites in Illinois (Jones 1949:246; Wagner 1994:340). For Hugh C. Cutler and Leonard W. Blake, North American Pop is the earliest form of maize in the south and the east, and continues to dominate at south-central Mississippian

sites from Cahokia to the Caddoan region until late in prehistory (Cutler and Blake 1976; Wagner 1994:341).

Eastern Eight Row bears significant morphological resemblance to the historic landrace Northern Flint (Wagner 1994: 345). Northern Flint cobs demonstrate a fairly uniform morphology, leading some to suggest a single introduction of genetic material (Jones 1949; King 1987; Wagner 1987). Wagner describes Northern Flint as having long, thin, and tapered ears. Kernels are large, wide and thick but not as long as those of higher row number cobs (1994:336). Brown and Anderson argued that eight rowed flint corn was prominent in Eastern North America following about A.D. 1000. They also held that in many eastern areas, corn resembling Northern Flint was the only variety grown (Brown and Anderson 1947; Wagner 1994:339). According to V. H. Jones, Eastern Complex corn spread to the northeast from the Caddo region, arriving ca. A.D. 1200 (1949; Wagner 1994). Cutler and Blake advanced the idea of early Eastern Eight Row, suggesting that it arrived in Ontario by A.D. 800, and may have appeared in some Hopewell floral assemblages (Cutler and Blake 1976). Subsequent radiocarbon dating has of course refuted the notion that Hopewell communities relied on maize (Wagner 1994). The origins of the North American maize races remain a matter of debate, one which more recent genetic research may help to further.

Genetic Basis for Maize Race Distinctions

Northern Flint (and Eastern Eight Row) was defined as a type at a relatively early stage in the history of maize research (cf. Brown and Anderson 1947). More recent research suggests that there does appear to be a genetic divergence between so-called

Northern Flint and other maize races. Isozyme analysis conducted by Doebley et al. (1986) on 18 Northern Flint populations supported the conclusion that Northern Flint derives from the maize races of the southwestern United States and northwestern Mexico. During its relatively short evolutionary history, Northern Flint shows a degree of genetic divergence more typical of a separate species than a landrace of the same species. This divergence is likely caused by a combination of genetic drift, environmental selection and reproductive isolation (Doebley et al. 1986). Northern Flint shows reduced genetic diversity relative to Mexican maize races; this is likely the result of founder effect (Vigouroux et al. 2008).

Camus-Kulandaivelu et al. (2006) found the deletion of the *dwarf8* gene in 80 percent of Northern Flint inbreds and landraces. This gene is responsible for earlier flowering times and its deletion may represent a climate adaptation. Lusteck (2006, 2008) examined maize from Late Woodland, Mississippian, protohistoric, and early historic contexts and found that the phenotypic profile generated through phytolith analysis suggests at least two separate maize lineages entered the southeastern United States from at least two different sources. The location of those sources is yet to be determined (Lusteck 2006, 2008).

Cautions Regarding Maize Race Analysis

The same preservation problems that plague archaeobotanical assemblages in general also affect maize. In addition, maize may be even less likely to become accidentally charred and thus preserve in the archaeological record since maize is non-shattering, and kernels are large compared to other seeds (Lopinot 1992). Poor

preservation may in part explain the ubiquitous-but-not-abundant pattern observed for maize at Aztalan and many other sites.

Even if some evidence of maize is preserved, certain conditions must exist for form and measurable characteristics to be maintained. Goette (1990) observed that alternating periods of cooling and heating in a reducing environment at low temperature were necessary for experimentally carbonized maize to resemble archaeological specimens. King (1994) interpreted this to mean that the ideal carbonization environment for corn may be exceedingly rare. King (1994) found that either boiling or alkali treatment was necessary to prevent popping, splitting and extruded endosperm when charring maize.

Since the maize races of Eastern North America are defined primarily by row number, cupule angle becomes one of the most relevant measurements, due to its potential for predicting row number (Bird 1994; Cutler and Blake 1976). There is some methodological caution surrounding maize race analysis based on row number. A number of issues arise when relying on kernels for angle and row measurement (Goette 1990; Goette et al. 1994; King 1987). These concerns along with possible means for addressing them will be discussed in detail in Chapter 3. As Wagner (1994) indicates, shape may also be a predictor of row number/race. However, the shape of kernels can be dramatically altered by carbonization or treatment with alkali (Goette et al. 1994; Johannessen et al. 1990; King 1987, 1994:37).

An additional cause for caution revolves around the internal variability within races of maize. Samples may be non-representative, and according to Goodman, “most specialists familiar with the races of maize would not attempt to classify single ears by

race, even when the plants producing the ears were grown under uniform and nearly ideal field conditions” (Goodman 1994:89). Unfortunately the nature of archaeological collections leaves no choice but to rely on a limited and fragmentary sample.

There is additional criticism of the current maize typology and the methods used to determine maize race. Lusteck argues that the current macrobotanical morphological method for classifying archaeological maize remains in the southeastern United States is inadequate, as considerable morphological variation can occur even within the same harvest (Lusteck 2006, 2008). Lusteck criticizes classification of maize based on row number, and proposes using the phytolith-generated phenotypic profile to assign lineages that are closer to the actual genetic variation. Much work remains to be done on this before it is a viable option, mainly in terms of determining which phenotypic profiles correspond to particular lineages (2006; 2008).

At this juncture, a genetically-based classification of the Aztalan maize sample is not tenable. The phenotypic profiles of maize phytoliths are not sufficiently understood. Furthermore, there is no comparative data for phytolith analysis in the regions under consideration. Despite any potential shortcomings, maize row number will serve as a possible indicator of the real variation between maize lineages in the Eastern United States, an indicator which is readily measurable at low cost and for which there is considerable comparative data available.

Other Cultivated Foods

In addition to a study of the maize recovered from Aztalan, this thesis explores the degree to which residents engaged in the cultivation of native crops, compared with

residents of other late prehistoric sites in the region. By three to four thousand years ago, prehistoric peoples of the Eastern United States engaged in the cultivation of a suite of native starchy and oily seeds (Hart and Lovis 2012; Smith 2006; Smith and Yarnell 2009). Maize was adopted into this complex, and many techniques developed for native cultigens surrounding storage and processing were likely also useful for maize.

Cultivated starchy seeds included goosefoot (*Chenopodium berlandieri*, ssp. *jonesianum*), little barley (*Hordeum pusillum*), erect knotweed (*Polygonum erectum*) and maygrass (*Phalaris caroliniana*) (Simon 2000). Research has also identified barnyard grass (*Echinochloa*) as a possible inclusion in this agricultural complex (Arzigian 1989, 2000; Wolforth et al. 2000). Oily seeded plants such as sunflower (*Helianthus annuus*) and sumpweed (*Iva annua*) are also considered part of the native crop complex (Simon 2000). While sumpweed is native to southwestern Wisconsin, its native range does not appear to extend into southeastern Wisconsin (Hammett 1997:210). Its mere presence outside of its range might indicate cultivation. *Cucurbita pepo* squash is also among the native cultigens. Cucurbits were likely grown for their flesh, their seeds and for their usefulness as a container crop (Hart 2008).

Certain seeds exhibit external indications of human manipulation. For example, signs of domestication in sumpweed and sunflower include increased seed/achene size. Seeds of *Chenopodium* appear particularly affected by domestication, displaying thinner testa (seed coats), larger size and truncate margins (Gremillion 1997).

Many native crops are camp-following weeds and aggressive colonizers of disturbed habitats. According to the so-called “dump-heap” theory of domestication, the refuse piles generated by sedentary populations serve as ideal habitats for annual weeds

such as *Chenopodium* and sunflower (*Helianthus*). This permitted a form of coevolution: humans were able to obtain food close to home, while the plants gained the benefit of seed dispersal in fertile, disturbed ground (Fowler 1957; Kuznar 1992; Olsen 2003:18-19; Struever 1962; Watson 1988).

Regional Floral Subsistence Histories

The following sections will summarize what is known about the floral subsistence patterns for various regions which might have bearing on the Aztalan situation. While the overall subsistence pattern will be discussed, special attention will be paid to the use of maize and to potential information on maize race. In addition to data from late prehistoric Wisconsin, the American Bottom is discussed to provide an idea of the “typical” Mississippian subsistence pattern. This research was conducted under the expectation that the Mississippianized contexts at Aztalan might show greater affinity to the American Bottom pattern than does the Late Woodland context of Stratum 11. Data from Michigan, upper New York state and Ontario are included here due to the early presence of collared ceramics in these regions (Kelly 2002).

American Bottom

This section provides a brief overview of developments in the understanding of human-plant relationships in the American Bottom during the Late Woodland, Middle Mississippian and Oneota periods. An intensive research history with standardized flotation and analysis methods has enabled the production of an extensive dataset pertaining to floral subsistence in the region (Johannessen 1984; Lopinot 1992, 1994;

Simon 2012; Simon and Parker 2006; Wagner 1976). As a result, trends observed in the American Bottom create expectations for other regions, particularly for sites outside the American Bottom with Middle Mississippian traits. Figure 2.1 provides a comparison of the current American Bottom and Southeast Wisconsin culture histories.

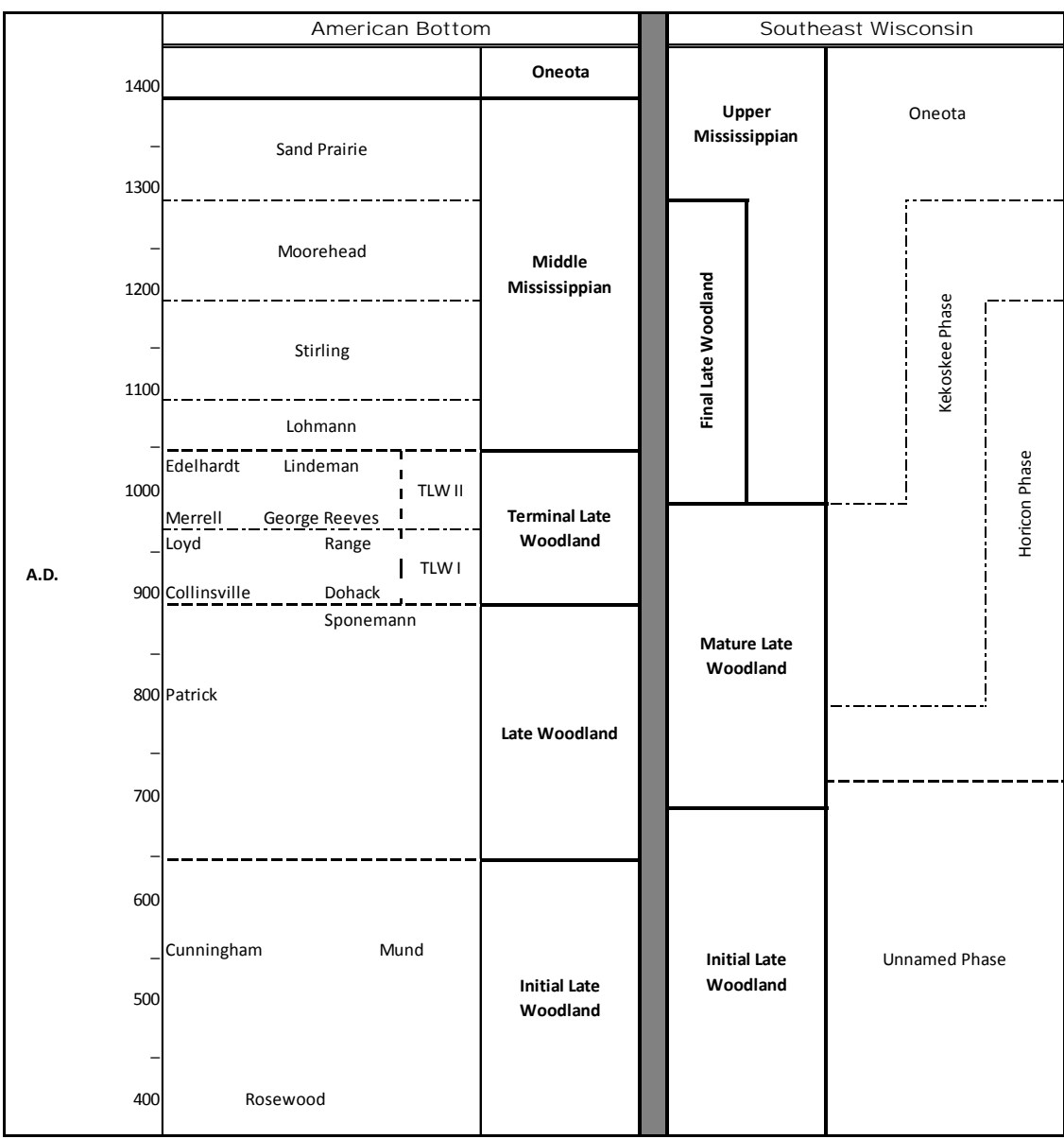


Figure 2.1: Culture history for American Bottom and Southeast Wisconsin (After Fortier et al. 2006; Rosebrough 2010)

Illinois sites provide early evidence for the use of native cultigens. For example, early gourd remains dated around 7000 B.P. originate in Illinois (Hart 2008). The region has also produced very early directly-dated maize macroremains, recovered from the Holding site and dating between 50 cal B.C. and cal A.D. 60 (Riley et al. 1994:493). The recovery of these remains is due to the intensive sampling of over 5000 liters of flotation, and thus is not readily comparable with other archaeological maize assemblages (Hart 2007).

The role of maize in Mississippianization. The intensification of maize agriculture from Late Woodland levels is considered a significant aspect of the Mississippian phenomenon (Peregrine 2003). One school of thought, though difficult to substantiate, contends that maize held a special ritual position in Mississippian society. One explanation for the adoption of maize involves its ceremonial use as related to the rapidly changing sociopolitical situation at the start of the Mississippian period (Hastdorf and Johannessen 1994). Scarry (1993) also argues that maize was chosen as the crop for intensification because of “cosmological reasons” (89-90). However, archaeological data from ceremonial contexts such as the Cahokia Submound 51 floral assemblage suggest that other crops may have been ceremonially important alongside maize (Pauketat et al. 2002; Simon and Parker 2006).

Much of the earlier research presented in this section centers around an “older” culture historical chronology created in the 1980s as a result of the FAI-270 project (Bareis and Porter 1984). At the time, archaeologists favored an in-situ evolutionary trajectory for the region, leading to the formulation of the “Emergent Mississippian” concept; included in the evidence for Emergent Mississippian was the apparent gradual adoption of maize (Bareis and Porter 1984; Kelly 1982). More recently, the recognition

of rapid population aggregation ca. A.D. 1050 has led to the notion of a Cahokian “Big Bang” (Pauketat 1994, 1997, 1998; Emerson 1997). A new, fully calibrated chronology has been presented (Fortier et al. 2006, Fortier and McElrath 2002). The neo-evolutionary “Emergent Mississippian” stage has been rechristened the “Terminal Late Woodland” in light of a historical-processual paradigm. Doubts surrounding the gradual increase in maize agriculture, along with doubts about the primacy of maize in the Mississippian food system, are among the motivations for this shift (Fortier and McElrath 2002). Recent AMS dates on Sponemann phase maize macroremains support this new chronology and a more rapid introduction of maize (Simon 2012).

The early hypothesis that better, more productive eight row maize adapted to short day lengths was a “prime mover” for Mississippianization has already been mentioned (Coe et al. 1986; Fowler 1975; Galinat and Gunnerson 1963). The critique of this argument presented by Fritz (1992) has also been mentioned but deserves further elaboration here. Reasons for rejecting the hypothesis include a reduced dataset for Middle Woodland maize, the fact that Late Woodland maize remains tend to be fragmentary and row numbers therefore speculative, and the fact that most early Mississippian maize appears to be 12 row. Fritz contends that low average row numbers are rare at pre-Oneota sites throughout the Midwest, and Mississippian assemblages in the American Bottom often have eight row cobs alongside those with higher row numbers (1992:26). Cutler and Blake characterized Middle Mississippian maize from Cahokia itself as “more conservative and more southern in its characters than corn from other sites in the region” (1969:134). A number of researchers have agreed with the characterization of American Bottom Mississippian maize assemblages as varied, but trending toward higher row

numbers (Blake 1986; Lopinot 1994; Parker 1992; Simon and Parker 2006; Wagner 1994).

Further caution regarding the “prime mover” argument is provided by Sissel Schroeder’s (2013) reassessment of the measures used to estimate maize productivity in prehistory. For example, archaeologists’ estimates for prehistoric maize yield appear to have doubled in the years following World War II. Schroeder theorizes that this is due to unconscious bias due to modern agricultural techniques, such as the application of inorganic fertilizers (2013).

Simon and Parker (2006) contend that Mississippians grew multiple types of maize. Midwestern Twelve Row is the most common until late in prehistory. Mississippian maize assemblages from the American Bottom also include a high row number variety, likely North American Pop, and some amount of Eastern Eight Row. Simon and Parker theorize that multiple varieties were grown in order to maximize yield under unpredictable growing conditions (2006: 245). Nonetheless, data presented by Simon and Parker do illustrate a conservatism in American Bottom maize assemblages.

Simon and Parker’s 2006 synthesis suggests that maize arrived in the American Bottom through a series of repeated, small-scale introductions for use as a specialty crop. These small scale introductions eventually allowed for the threshold of protection from inbreeding depression to be reached. By the Terminal Late Woodland (A.D. 900–1050), Simon and Parker contend that a relatively balanced agricultural strategy combining native cultigens with maize was practiced in the American Bottom; Mississippian period subsistence was not dramatically different. Earlier analyses suggested a similar pattern,

albeit on a somewhat earlier time scale with maize achieving importance circa A.D. 750-1000 (Hastdorf and Johannessen 1994; Johannessen 1993a, 1993b).

Simon and Parker (2006) note that early populations of maize were likely small and unsustainable. Furthermore, maize from Sponemann phase sites (circa A.D. 850-900) only occurs in multicomponent contexts and may be intrusive (Simon and Parker 2006). In a paper presented at the 58th Annual Meeting of the Midwest Archaeological Conference, Mary Simon (2012) provided new dates on one sample of early Late Woodland Mund phase maize and 7 samples from the Sponemann and Patrick phases. The dates on all of these samples suggested intrusion from Terminal Late Woodland, Mississippian or even historic contexts. Possible Late Woodland maize was recovered from the Illinois River Valley (2012). These results await publication, but indicate that the chronology of maize discussed below will continue to be refined. Interestingly, these results are somewhat in line with those observed by Johannessen (1984) prior to the analysis of the Sponemann site.

The following discussion will further elaborate data on maize use in the late prehistoric American Bottom, while also summarizing other plant-based subsistence trends. Figure 2.2 provides a map of specific American Bottom sites mentioned in the text.

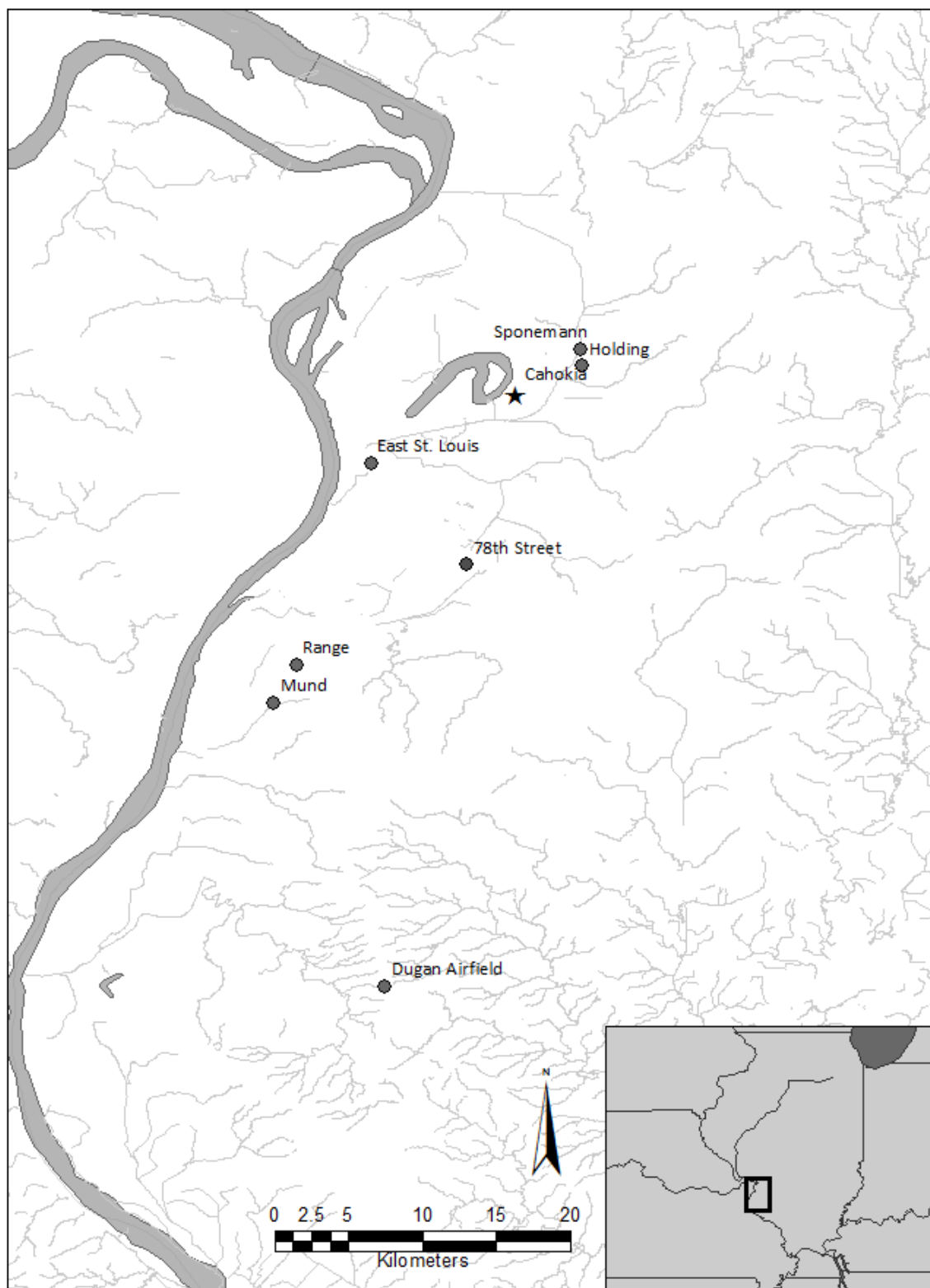


Figure 2.2: Map of American Bottom sites mentioned in text

Late Woodland. Johannessen (1984) summarized trends for the general Late Woodland period. She found that the remains of cultigens were generally more abundant than for the Middle Woodland, while the amount of nutshell relative to wood decreased slightly. Thick-shelled hickories (*Carya*) were the dominant nut taxon. Out of identified seeds, 76 percent were native cultigens from the “starchy seed complex” (1984:202). Squash rind fragments became relatively common, and tobacco (*Nicotiana*) was recovered from some features. According to Johannessen, the only pre-Emergent Mississippian maize from a Late Woodland component was one cupule at the Mund site (1984:203).

Patrick phase (A.D. 650-900) subsistence appears to focus on native cultigens. Lopinot (1992) argued that settlement nucleation associated with the Patrick phase Range site was not necessarily tied to subsistence change. Out of all seeds recovered from 26 components, about half are native cultigens. The full suite is present, but maygrass and chenopod predominate (Simon and Parker 2006). Simon and Parker (2006) also challenge Johannessen’s assertion that nut mast usage decreases alongside an increase in native crops. The phenomenon appears to be true regarding sites in the floodplain for this period, but not for the uplands. Corn is only rarely recovered and from insecure contexts; most specimens originate at sites with sizeable Mississippian components (i.e. Range, Dugan Airfield) (Simon and Parker 2006).

Traditionally, an increase in the frequency of maize recovery defines the Sponemann phase (A.D. 850-900). Maize remains occurred in one third of features from the Sponemann site itself (Parker 1991). Otherwise, subsistence remains are similar to the Patrick phase with regard to cultigens, particularly maygrass and *Chenopodium*.

Cultigens compose almost 90 percent of seeds from the Sponemann phase component of the type site; squash rind and tobacco were also recovered (Simon and Parker 2006).

Other Sponemann phase sites with maize also had significant Mississippian components; sites with only Sponemann phase assemblages yielded no maize (Simon and Parker 2006). In light of recent direct AMS dates, the evidence for Sponemann phase corn is currently being reconsidered (Simon 2012).

Terminal Late Woodland I&II/Emergent Mississippian (A.D. 900-1050). According to Johannessen's summary, maize occurs in 50 percent of Emergent Mississippian features. The nut-to-wood ratio continues its decline, with thick-shelled hickory retaining dominance. The prevalence of acorn increases slightly. Native cultigens increase in prevalence alongside maize (Johannessen 1984). Simon and Parker (2006) suggest a balanced strategy employing cultivated seed crops and maize, though maize ubiquity in the American Bottom varies for this period. Stable carbon isotope analysis of an individual from a burial at the Drda site (11-MS-0032) indicates $\delta^{13}\text{C}$ levels consistent with a diet consisting primarily of C_3 plants. This individual likely consumed maize, but tropical grass did not make up the bulk of the diet (Dong et al. 2010).

Mississippian Period. General trends for the Mississippian period discussed by Johannessen include an ever-decreasing amount of nutshell relative to other floral remains, with hickory and acorn the most substantial contributors. Starchy seeds (mainly maygrass, knotweed and chenopod) retain their importance, along with oily seeds such as sunflower. Maize was recovered from 78 percent of features, and cucurbit rind from 7 percent (Johannessen 1984). Lopinot (1992) cited sparse evidence for beans (*Phaseolus vulgaris*); more recent research has demonstrated that the common bean is not adopted in

Eastern North America until relatively late in prehistory (Hart 2008; Simon and Parker 2006).

Maize cupules and kernels are highly ubiquitous for the Lohmann phase (A.D. 1050-1100), appearing in almost all assemblages regardless of site function or size (Lopinot 1992; Simon and Parker 2006). Row number varies but is usually greater than 10. Little to no Eastern Eight Row is present. Despite the high ubiquity of maize during this period, the Lohmann phase Cahokia Submound 51 floral assemblage contained less maize than expected relative to large amounts of native crops and tobacco (Pauketat et al. 2002; Simon and Parker 2006). It is unclear whether this paucity of maize reflects use or differential deposition due to variation in processing method.

As is the case throughout Late Prehistoric American Bottom floral assemblages, native crops continue to take priority during the Stirling phase (A.D. 1100-1200). Chenopods and maygrass remain predominant. Maize was present at all 20 of the Stirling phase components examined by Simon and Parker, with ubiquities ranging from 50 to 100 percent (2006). The East St. Louis site contained basin features with maize burned in-situ. In these features, kernels outnumbered cupules 4:1 (Fortier 2005; Pauketat 2005; Simon 2003a, 2003b). This suggests the possibility that Mississippian farmers produced maize in surplus for storage; starchy seeds were not recovered from these contexts (Simon and Parker 2006). Cahokia ICT-II maize recovered from Lohmann/Stirling contexts appears to be mostly 10-14 row, alongside a possible 16-20 row type (Lopinot 1994:135).

High abundance and ubiquity for maize persist and even increase during the Moorehead phase (A.D. 1200-1300). Stable carbon isotope data from five Moorehead

phase sites in the American Bottom demonstrates that maize formed a significant component of the diet, though diversity in reliance on maize was also apparent (Hedman et al. 2002). Eight row maize appears at ICT-II for the first time during the Moorehead phase, prompting Lopinot (1994) to conclude that the most significant row number decrease occurred during this time. However, Simon and Parker note that a variety of maize types ranging from 8-18 row occur. These range in form from “narrowly pyramidal” to “broadly crescentic” (Simon and Parker 2006:240). An increase in Eastern Eight Row is observed but 10-12 row cobs remain most prevalent (Blake 1986; King 1987, 1994; Simon and Parker 2006). The later Moorehead phase sees a significant decrease in the frequency of native cultigens, particularly oily-seeded crops, in both floodplain and upland contexts. Floodplain sites exhibit higher nutshell densities than in preceding Mississippian phases (Simon and Parker 2006).

The floral dataset for the Sand Prairie phase (A.D. 1300-1375) is limited, in part due to population decline. Native crops continue to decrease in importance, while maize is abundant. Cob remains outnumber kernels, indicating local production, processing and consumption of maize and suggesting that cobs were utilized for fuel (Simon and Parker 2006).

Oneota period (A.D. 1400-1500). Just three sites are available to reconstruct Oneota floral subsistence in the American Bottom: the Range site, the Sponemann site and the 78th Street site. Abundant maize is accompanied by lower levels of Eastern Agricultural Complex plants. Maize measurements from the Sponemann site Oneota component suggest high row numbers, but maize remains at the Range site have lower average row numbers, indicating that Eastern Eight Row was present during this time.

Though *Chenopodium* continues to be the most prevalent starchy seed, weedy varieties become prevalent at the expense of domesticated *Chenopodium berlandieri* (Simon and Parker 2006). In marked contrast to arguments employing maize as a “prime mover” toward Mississippianization, the current data imply that maize-centric subsistence at the expense of native cultigens only takes root in the American Bottom after the Stirling Phase, post-A.D. 1200 (Simon and Parker 2006).

Wisconsin and Northern Illinois

Table 2.1 summarizes maize row number data for selected late prehistoric sites in Wisconsin and northern Illinois. The trend for Wisconsin appears to be opposite that seen for the American Bottom. For the most part, lower row numbers appear to be characteristic of early maize from Late Woodland sites. The exception to this is the Dietz site in Dane County, where Cutler and Blake identified 12 row maize (1969). Oneota sites exhibit a greater variety of maize row numbers, with some high row number examples. Still, 8-row maize is dominant. A single cob from Aztalan measured by Cutler and Blake had 12 rows of kernels, perhaps reflective of American Bottom influences at the site.

Bulk $\delta^{13}\text{C}$ values may provide an additional line of evidence for maize intensification in regions where maize is the only C_4 plant (Hart et al. 2012). Hart et al. (2012) found that bulk $\delta^{13}\text{C}$ values for encrusted ceramic residues on pottery from Northeast Illinois and Southeast Wisconsin showed a trend for enrichment up until ca. cal A.D. 800-900, after which trend lines flatten. Beginning ca. cal A.D. 700, there is a bifurcation in trends between enriched and depleted values. These trends may reflect

different C₃ plants prepared in ceramic vessels, or differences in processing method (Hart et al. 2012:321).

Early evidence for the utilization of non-maize cultigens by Wisconsin residents dates to the Middle Woodland. Squash and sumpweed remains were found at the Mill Coulee Shell Heap site in western Wisconsin. Squash rind was ubiquitous at the site (Arzigian 1987). Early evidence for exploitation of wild rice (*Zizania aquatica*), an important wild plant food in the late prehistoric Upper Midwest, also dates to this period (Arzigian 2000; Crawford and Smith 2003; Egan and Monckton 1991).

Late Woodland culture history. In an attempt to explain the immense variation seen in ceramic types and subsistence/settlement patterns among Late Woodland sites in Wisconsin, Late Woodland traits have previously been used to construct a number of phase divisions. As with the culture histories of other regions in the study area, these phases have been called into question in recent years (e.g. Clauter 2002, 2012; Rosebrough 2010). As these phases have been widely employed in the literature, they will be described briefly here, followed by a discussion of recent evidence for their inadequacy.

The Eastman phase was initially defined by Stoltman (1990) for Effigy Mound sites in the Driftless Area of southwestern Wisconsin. Stoltman and Christiansen (2000) proposed dates of A.D. 700-1030 for the phase. Based on the recovery of sunflower and maize kernels from rockshelter sites, Stoltman and Christiansen (2000) argued that the Eastman phase reflected a horticultural society.

In southeastern Wisconsin, the Effigy Mound Late Woodland has previously been assigned to the Horicon phase, associated with Madison ware ceramics and dating

between A.D. 700-1050. The Horicon phase has been argued to represent a foraging society with little to no reliance on native cultigens (Gartner 1999; Salkin 2000; Simon 2000). The Kekoskee phase of south-central Wisconsin, between A.D. 800-1300, is typically associated with horticulture involving both native and tropical cultigens, alongside the use of collared ware vessels. Kekoskee phase peoples were argued to have been more sedentary than Effigy Mound builders. Keyhole-shaped structures were also included within the Kekoskee phase definition (Salkin 2000; Stevenson et al. 1997).

More recent research has called into question the validity and utility of these phase distinctions (e.g. Clauter 2003). One of the main criteria for defining the Horicon and Kekoskee phases revolves around the association of Madison ware vessels with Effigy Mound ceremonialism, and collared ceramics with non-Effigy Mound sites. However, Effigy Mound sites, for example the Nitschke Mounds Complex, have produced collared pottery and vice-versa (Clauter 2003, 2012; Kelly 2002; McKern 1930; Rosebrough 2010). Recent research at the Regula Mounds group recovered only Aztalan Collared pottery from presumably sub-mound features, adding further support to the rejection of the Kekoskee/Horicon division. Flotation samples from sub-mound features produced only wood charcoal (Richards and Foley-Winkler et al. 2012)

Stoltman and Christiansen (2000) have proposed dividing the Late Woodland into Early, Mature and Final periods. The Mature Late Woodland, circa A.D. 700-1000, would correspond with the height of the Effigy Mound tradition. The final Late Woodland, dating from roughly A.D. 1000-1200, corresponds with the decline of Effigy Mound ceremonialism. Stoltman and Christiansen's (2000) chronology acknowledges an overlap of Effigy Mound building and collared ware production of at least a century.

Rosebrough (2010) proposes the retention of the Kekoskee phase terminology with significant alteration. According to her definitions, the Horicon phase would refer to Effigy Mound groups existing prior to the introduction of collared ware ceramics, while the Kekoskee phase would begin following their introduction. Rosebrough (2010) also suggests an “early” and “late” Kekoskee division, reflecting increases in sedentism due to Mississippian influence (524).

Other researchers reject any notion of distinct phases within Late Woodland Wisconsin. While not all sites with Madison ware pottery contain collared vessels, collared ware is virtually always found in association with non-collared Late Woodland vessels. Clauter’s (2012) analysis of non-collared Late Woodland pottery within the study area found that decorative traits were significantly clustered, while compositional data was less so. She interprets the data as indicating a pattern of low-level territoriality, with sufficient contact between groups to permit transport of vessels across the landscape. Socially, this may reflect “nested” levels of interaction, for example “families, groups, and regions” (Clauter 2012:172). Clauter (2012) also notes that decorative and compositional traits are more strongly clustered to the west along the upper Mississippi trench, suggesting a somewhat higher degree of territoriality than found in the eastern part of the study area. Overall, the picture of group interaction during the Late Woodland is significantly more complex than the notion of an egalitarian society would suggest.

This thesis avoids use of the Kekoskee phase terminology, instead referring to Late Woodland sites with collared pottery as collared ware Late Woodland, or merely Late Woodland. The Late Woodland sites chosen for comparative analysis with Aztalan all produced collared pottery alongside other Late Woodland types. The origins of

Wisconsin's collared ware technology remain a matter of debate. Some have argued for influence from the Woodfordian area of northern Illinois (Hall 1986, 1991; Kelly 2002; Richards 1992:405). Others have noted the similarity with collared vessels in the Eastern Great Lakes (Egan-Bruhy 2012; Salkin 1987, 1989, 1993).

Some collared ware sites show limited evidence for direct or indirect influence from the American Bottom. At Aztalan and the Bethesda Lutheran Home site, collared ceramics co-occur with shell-tempered Mississippian pottery (Hendrickson 1996; Richards 1992). Late Woodland sites with collared ceramics such as Statz and Weisner III exhibit the remnants of keyhole-shaped structures (Meinholz and Kolb 1997; Salkin 1993). These are similar to Patrick phase structures in the American Bottom, where they appear to predate Wisconsin examples (Rosebrough 2010; Zych 2013). However, Starved Rock Collared sites in northeastern Illinois lack these characteristics (e.g. Jeske 1992). Additions to the dataset on plant-based subsistence in late prehistoric Southeast Wisconsin will aid in understanding the cultural complexity of the period, and possibly provide insight into the origins of collared ceramics and other technologies.

Late Woodland subsistence. Unfortunately, the dataset for Late Woodland subsistence within the region is limited, particularly as regards the early Late Woodland period. At the early Late Woodland Mill Pond site in southwestern Wisconsin, flotation recovered nutshell and five fragments of squash rind (Arzigian 1993).

Beginning in the eighth century, rockshelter sites in the Driftless Area with only non-collared pottery provide some evidence for cultivation. For example, Hadfields Cave produced sunflower seeds. Hadfields Cave, Lawrence I, Brogley Rockshelter and Mill Pond have yielded evidence for the use of tropical cultigens in the form of *Zea mays*

kernels (Stoltman and Christiansen 2000). However, Simon (2000) notes that maize remains are sparse from these rockshelter sites, as are starchy and oily-seeded cultigens. Nutshell is abundant at these sites, and wild rice is present. Riverine sites from the same period show more evidence for food production than do the rockshelters. At the Mill Pond site, maize shows almost 60 percent ubiquity. Ubiquitous squash rind, *Chenopodium* and knotweed (*Polygonum*) were identified also (Arzigian 1993; Simon 2000). To the south, the Terminal Late Woodland Webster site (ca. A.D. 1050) at the mouth of the Apple River produced an abundance of apparently eight row maize (Benn 1997; Simon 2000).

Roughly contemporaneous with western sites showing evidence for low-level horticulture, Madison ware sites in southeastern Wisconsin show little evidence for cultivation. The Luedke site (47-DO-0393), investigated by Salkin, yielded very little in the way of subsistence remains; only nutshell and a few wild seeds were recovered (Salkin 1993:54). Limited data for non-collared ware Late Woodland sites shows evidence for maize, but in lower densities than observed for collared ware sites (Egan 1993, Egan-Bruhy 2003a, Egan-Bruhy and Nelson 2008, cited in Egan-Bruhy 2014).

Data are similarly limited for collared ware sites. The Weisner III site in the Kekoskee Archaeological District provided impetus for the suggestion that collared ware subsistence differed from that of Madison ware producers. Anthony Zalucha identified a small amount of eight row maize, as well as acorn, *Chenopodium* sp. and other seeds (Salkin 1993). The Statz site (A.D. 900-1000) in Dane County produced limited evidence for *Chenopodium* and eight row corn (Meinholz and Kolb 1997; Zalucha 1997). The Murphy and River Quarry sites in Dane County, Wisconsin produced evidence for maize,

nutshell, and squash. No native cultigens were found at River Quarry; the Murphy site had only two *Chenopodium* seeds and one *Polygonum* seed (Hawley et al. 2011). Egan-Bruhy (2014) notes a significant increase in maize density compared with Madison ware sites. The number of different Eastern Agricultural Complex plants present increases at collared ware sites, and includes *Chenopodium*, maygrass, knotweed, little barley, and barnyard grass. However, densities are very low, at less than one seed per 10 liters of soil (Egan-Bruhy 2014). Previous Late Woodland data from Aztalan indicate the presence of maize, squash and hickory nutshell (King 1985).

Mary Simon's (1998, cited in Egan-Bruhy 2014) analysis of northern Illinois collared ware sites in the Middle Rock River Valley indicates the presence of a wider variety of native cultigens, including sunflower, sumpweed and little barley. Densities are relatively low, but considerably higher than at Southeast Wisconsin collared ware sites with an average of six seeds per 10 liters of soil. Maize from this region was identified by Simon (1998) as 10 row or less.

Sites in Northeast Illinois with Starved Rock Collared pottery indicate a limited role for native cultigens. Archaeological testing conducted in the Illinois and Michigan National Heritage corridor in the 1980s provided information on Late Woodland subsistence in the Upper Illinois River Valley (Jeske and Hart 1988). Floral analysis for this study was conducted by Kathryn Egan. The Young Jim site (11-GR-0076) produced hickory nutshell and maize at a density of 1.8 fragments per 10 liters of soil. Significantly, Eastern Agricultural Complex taxa were absent from the assemblage. Similarly, a Late Woodland feature at the LaSalle County Home site (11-LS-0014) produced a small quantity of maize (0.5 ct/10 liters) and a single fragment of squash rind.

Once again, native cultigens are conspicuous in their absence (Jeske and Hart 1988). The historical implications of subsistence patterns at Starved Rock Collared Late Woodland sites will be discussed with Upper Mississippian subsistence below.

Mississippian-influenced sites in Wisconsin and the Northern Hinterlands. The spread of Middle Mississippian influence in areas north of Cahokia appears to have been sporadic both across the landscape and through time. In almost all cases, Middle Mississippian traits appear circa the eleventh century in localities that already had a substantial Late Woodland component; material culture and settlement practices often reflect hybridization of Late Woodland and Middle Mississippian styles.

A number of such cases are apparent in the Central Illinois River Valley (CIRV). The Rensch site, located near the present-day city of Peoria, is a case of early Mississippian contact. Powell Plain and red-slipped pottery were recovered alongside grit-tempered local copies (Conrad 1991; McConaughy 1991). Maize showed 90 percent ubiquity, while butternut, black walnut and hickory dominated the nutshell assemblage. Hazelnut appeared infrequently. Starchy seeds were also recovered, but these may have come from contaminated contexts (McConaughy 1991:108). The Eveland site, also located in the CIRV in Fulton County, Illinois, presents a somewhat later example of Middle Mississippian influences. These include Powell Plain and Ramey Incised pottery, as well as wall-trench structures and a pyramidal mound, appearing alongside Late Woodland traits (Conrad 1991; Harn 1991). The Shire site in the Sangamon River drainage is particularly interesting, as Middle Mississippian vessels and hybrid forms are found alongside a wide variety of Late Woodland types – many of which are either

uncommon or unknown in other parts of the Sangamon drainage. Clafin (1991) argues that this admixture may be a result of immigration.

The Apple River focus of northwestern Illinois is located at the far southern edge of the Driftless Area and includes the Mills Village, John Chapman, Savannah Proving Ground and Lundy sites (Emerson 1991). The primary occupation appears to have occurred what is locally termed the Bennett phase, beginning about A.D. 1100 (Emerson et al. 2007). The Mississippian ceramic assemblage for the Bennett phase is fairly typical of other early Mississippian assemblages, but jars feature traits such as lip notching and cordmarking below the shoulder that appear to reflect hybridization with Late Woodland ceramic technology. Maize from the Lundy site apparently included both low and high row number varieties, but high row numbers are slightly more common. The small seed concentration was relatively low (0.16 seeds/10 liters), but *Chenopodium* dominates. One sumpweed achene, one tobacco seed and three grains of wild rice were identified. Curiously, acorn predominates over hickory in the Lundy site nutshell assemblage (Emerson et al. 2007). The Lundy site botanical data are compared with Aztalan in Chapter 4.

Further to the north in Southwest Wisconsin, the Fred Edwards site in present-day Grant County provides evidence for Late Woodland/Middle Mississippian interaction. Stirling phase ceramics such as Powell Plain and Ramey Incised were recovered alongside grit-tempered collared ware, otherwise rare in western Wisconsin. The site also shows evidence for a palisade enclosure (Finney and Stoltman 1991). The floral assemblage from Fred Edwards will be compared with Aztalan in detail in the next chapter. Maize is ubiquitous, with 8-10 row cobs recovered from smudge pit features.

Squash rind appears in over 60 percent of samples. A number of native cultigens and tobacco are present also in the Fred Edwards assemblage alongside wild foods such as hickory nut (Arzigian 1987). A detailed comparison of floral data from Fred Edwards and Aztalan is presented in Chapter 4.

Recent research has generated data on early Mississippian interaction in the Upper Mississippi Valley. In Vernon County, Wisconsin, the Fisher Mounds site has evidence for Edelhardt and Lohmann phase contact, including wall trench houses (Benden et al. 2010). Similarly early Mississippian contact is evidenced at the Trempealeau Mounds locality, which consists of a series of platform mounds atop the Wisconsin Bluffs on the Mississippi River, with habitation sites in the nearby valley (Boszhardt et al. 2012). Preliminary floral analysis has yielded little in the way of food remains, with charred floral material consisting primarily of wood charcoal and corn (Kathryn Parker and Timothy Pauketat, personal communication, 2013). The recently excavated Iva site, also in southwestern Wisconsin near the present day city of La Crosse, produced sunflower, *Chenopodium*, tobacco and wild rice as well as maize out of a limited floral sample (Boszhardt 2004).

While the Bethesda Lutheran Home site, located in Jefferson County, is primarily a Late Woodland settlement, Late Woodland ceramics co-occur with Mississippian ceramics. Floral analysis by Kathryn Parker identified hickory, acorn, cucurbit, *Polygonum*, and *Chenopodium*. Maize, likely a higher row number variety, was recovered also (Hendrickson 1996).

As discussed in Chapter 1, previous floral data from Aztalan suggest that its inhabitants relied on corn, squash and hickory nuts alongside native crops, namely

Chenopodium (Arzigian 1985; Egan-Bruhy 2014). Detailed information regarding these previous analyses is provided in Chapter 4.

Upper Mississippian subsistence. Radiocarbon evidence suggests that Upper Mississippians were living in the study area by the time Mississippian influence is observed at Aztalan (Edwards and Spott 2012; Richards and Jeske 2002). In southern Wisconsin, the Upper Mississippian tradition is represented by the Oneota. Oneota subsistence has been characterized as maize horticulture combined with native cultigens and wild foods (Craig 1996; Jeske 1990; Simon 2000). This diverse subsistence economy may have been chosen in order to minimize risk (Brown 1982; Cleland 1966; Edwards 2010:16; Hart 1990; Olsen 2003:120). It appears that a variety of different types of maize were cultivated by Oneota groups in Wisconsin (Table 2.1). The possibility of risk-buffering must be considered in terms of maize as well (cf. Yarnell 1964).

The Crescent Bay Hunt Club site is an Oneota occupation on the northwest shore of Lake Koshkonong in Jefferson County. The earliest radiocarbon assays from Crescent Bay and the nearby Koshkonong Creek Village site indicate an overlap with dates from Aztalan (Edwards and Spott 2012; Richards and Jeske 2002). Given the site's proximity to Aztalan, it may serve as a focal point for understanding the differences between Mississippian and Oneota subsistence in the upper Midwest. Other Lake Koshkonong locality Oneota sites, such as Carcajou Point and the Koshkonong Creek Village site, have similarly early dates (Edwards and Spott 2012; Richards and Jeske 2002).

Analysis of floral remains from Crescent Bay found maize to be highly ubiquitous (65 percent of features) (Egan-Bruhy 2010). Nutshell density is 9.12 ct/10 liters, with hickory and acorn most prevalent. Oily seeds and were lacking, while wild rice was

ubiquitous, appearing in over half of all features at a density of 17.98 ct/10 liters, compared to 4.37 ct/10 liters for *Chenopodium* (Egan-Bruhy 2001, 2010; Olsen 2003). Only two squash rind fragments have been identified at the site, while 77 tobacco seeds were identified (Egan-Bruhy 2001, 2010; Olsen 2003). Corn and wild rice are common also at Oneota sites in western Wisconsin (Arzigian 1989, 2000).

Egan-Bruhy (2014) summarizes data for eastern Wisconsin Oneota as having a lower density of maize and native cultigens, and a significant decrease in the ubiquity of squash. Use of nuts (mainly acorn) increases. Barnyard grass, which appears in collared ware assemblages but not Mississippian assemblages, is found at eastern Oneota sites. The appearance of wild rice increases significantly. Subsistence at Oneota sites in the Mississippi trench is more similar to Middle Mississippian subsistence (Egan-Bruhy 2014).

Northeast Illinois provides additional data on Upper Mississippian subsistence. Between ca. A.D. 1100-1440, the Langford and Fisher ceramic styles are found at sites in Northeast Illinois (Jeske 2003). While Langford and Fisher vessels are more similar to each other than to Middle Mississippian pottery, important differences exist. Namely, Fisher pottery is shell-tempered like most other Upper Mississippian pottery; Langford jars are grit-tempered (Jeske 2003). The Jehalo site (11-GR-0096), tested during the 1980s Illinois and Michigan Canal survey, produced maize from a presumably Langford feature at a density of 3.41 ct/10 liters, along with one fragment of squash rind. No cultivated starchy or oily seeds were present (Jeske and Hart 1988). Similarly, the floral assemblage from the Langford occupation of the Zimmerman site (11-LS-0013) in the Upper Illinois River Valley produced maize (9.2 ct/10 liters), squash but no Eastern

Agricultural Complex taxa (Jeske and Hart 1988). Seven measurable maize cupules indicate that the maize was likely 8-10 row. The Langford component at the LaSalle County Home site (11-LS-0014), also in the Upper Illinois Valley, produced maize but no native cultigens (Jeske 1998). The Washington Irving site, a Langford occupation in the Fox River Valley of northern Illinois, dates between the thirteenth and fifteenth centuries. Maize is present in 47 percent of features, with squash in eighteen percent. Unsurprisingly, taxa from the Eastern Agricultural Complex are absent (Jeske 2000)

Jeske (1992) argues that Upper Mississippian culture in northern Illinois is characterized by a divergence from Middle Mississippian norms, especially in terms of diet. He argues that environmental factors do not entirely account for this divergence. Compared with large populations in the Lower Illinois and Mississippi River Valleys, smaller population sizes for Late Woodland communities in Northeast Illinois would have permitted less dependence on cultigens. Even by A.D. 1000, maize is not a dominant part of the diet, and Eastern Agricultural Complex plants do not appear to have played a significant role. Interactions with larger populations to the south likely influenced lifeways in this region, and may have paved the way for the transformation from Late Woodland to Upper Mississippian. Retention of a more-or-less Late Woodland diet may have served to maintain group identity in the face of a larger, more powerful population, and facilitated non-competition and boundary maintenance (Jeske 1992). These notions of historicity and continuity between Late Woodland and Mississippian groups may have implications for Southeast Wisconsin as well.

Eastern Great Lakes

Many researchers have suggested the possibility of an eastern connection for collared pottery (Egan-Bruhy 2012; Salkin 1987, 1989, 1993). Two of the earliest collared forms are associated with central New York and eastern Ontario during the Middle Woodland. These applied-collar vessels make up a small percentage of ceramic assemblages for the Kipp Island phase of the Point Peninsula tradition, dated from about A.D. 500-700 (Kelly 2002:10; Ritchie 1969). Figure 2.3 shows the location of eastern Great Lakes sites mentioned in the text.

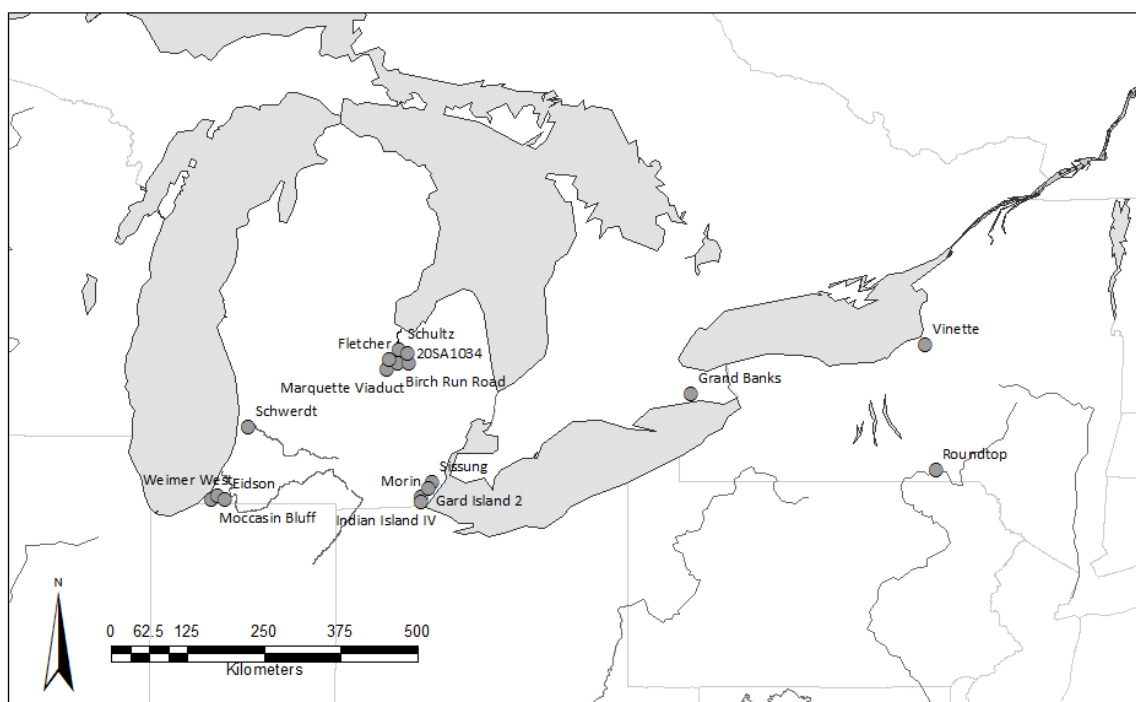


Figure 2.3: Map of key sites in the Eastern Great Lakes

Late Prehistoric Michigan. This section will provide a brief overview of subsistence trends during the Late Woodland in Michigan. Prior to A.D. 1000, there appears to be only limited evidence for cultivation. A Middle Woodland feature at the

Eidson site in the uplands of the St. Joseph River Valley yielded a single maize cupule with an indirect date of circa A.D. 240 (Crawford et al. 1997, Parker 1996; Simon 2000).

Southeast Michigan and the Saginaw Valley. Certain researchers have identified the Wayne Tradition as a separate, local tradition in southeast Michigan and the Saginaw River Valley, dated circa AD 500-1300 (Brashler 1981; Halsey 1968, 1976, 1980, 1981; Stothers 1999). Ceramic similarity has led others to suggest that the Wayne Tradition falls under the Western Basin Tradition of southeast Michigan, southwest Ontario, and upper New York state (Kelly 2002; Stothers 1975; 1978; 1994, 1995, 1999; Stothers and Bechtel 2000; Stothers et al. 1994).

Wild foods played a major role for Wayne/Western Basin Tradition peoples in Michigan. Even later occupations dating to A.D. 800-1000 at sites such as Cassasa, Bridgeport Township and Birch Run Road have evidence for the importance of wild plant foods (Egan 1990; Egan and Monkton 1991; Parker 1986; Simon 2000). Wetland resources were particularly prevalent. Wild rice (*Zizania aquatica*) remains were recovered from several Late Woodland components in the Saginaw Valley (Egan 1990; Egan and Monkton 1991; Simon 2000). Pre-A.D. 1000 components at the Fletcher and Bridgeport Township sites produced aquatic tuber remains (Egan 1990; Lovis et al. 1996). Increased exploitation of wetlands may have facilitated sedentism and ultimately horticulture (Brashler et al. 2000; Egan and Monkton 1991; Lovis et al. 1996; Parker 1996).

Evidence for maize and other domesticates is sparse at Western Basin Tradition sites in Michigan. Associated charcoal dates of A.D. 600 or earlier are available for contexts containing maize at the Gard Island 2 site, Indian Island 4 site, Sissung site, and

the Leimbach site, all located around western Lake Eerie (Crawford et al. 1997; Simon 2000:58). The Morin site, associated with the Western Basin Tradition, produced possible early maize dated to around A.D. 700 (Parker 1996; Prah 1974). In the Saginaw Valley, the Birch Run Road site yielded a single kernel of eight row maize with an associated date of A.D. 850 (Parker 1996; Simon 2000).

Also located in the Saginaw Valley, the SA1034 site, dated to circa A.D. 1150, provides important data on subsistence and cultivation in Late Woodland Michigan (Parker 1996). Floral remains from the site include tobacco, *Cucurbita pepo* squash, *Chenopodium*, sunflower and maize, with 85.7 percent maize ubiquity. Prominence of 8-row cobs was suggested by an average cupule angle of 82°. Within individual features, angles provided possible evidence for multiple different kinds of maize (Parker 1996). A high-ubiquity, low-abundance pattern for maize is seen also at the Marquette Viaduct and Schultz sites; this corn appears to be eight row (Egan and Monkton 1991; Simon 2000). Recent dates on starch and phytolith cooking residues suggest the presence of maize in the Saginaw Valley as early as the Middle Woodland, prior to A.D. 1000 (Raviele 2010). Bulk $\delta^{13}\text{C}$ residues for pottery from the Saginaw Valley, often used as an indicator for maize, did not show an increase through time, in marked contrast to the trend seen in New York and southeastern Wisconsin/northeastern Illinois (Hart et al. 2012).

Western and Southwestern Lower Peninsula. While evidence for horticulture is limited at Western Basin Tradition sites, it is even more so for sites in the western and southwestern Lower Peninsula. While Early Late Woodland subsistence practices are not fully understood in many parts of the Lower Peninsula, Holman and Brashler (1999) suggest that foraging involved seasonal movements along river drainages. Early Late

Woodland residents of Michigan apparently were not horticulturalists (Brashler et al. 2000).

In the St. Joseph and Kalamazoo River Valleys the time period from A.D. 600-1200 is associated with the Allegan Tradition. Allegan Tradition subsistence focused on a riverine strategy, including fishing, winter hunting and possibly maple sap collection (Brashler et al. 2000:12, Garland 1979; Holman and Brashler 1999; Kingsley 1979). Evidence for Early Late Woodland plant cultivation is absent in the Kalamazoo Valley and along the Portage River (Brashler et al. 2000).

Later Late Woodland components have produced only meager evidence for cultivation, some of which has come to be doubted in recent years. Maize remains were known from two sites in the St. Joseph Valley: the Wymer West Knoll site (Garland 1991) and the Moccasin Bluff site (Bettarel and Smith 1973). More recently, Adkins (2003, 2004) presented evidence against the presence of Late Woodland maize at Moccasin Bluff. The case of Moccasin Bluff is particularly compelling, as the site had been used to formulate an entire subsistence system and justify the absence of maize at other sites. The first excavations at Moccasin Bluff took place in 1948. When Fitting and Cleland (1969) developed their settlement/subsistence model for Michigan, they suggested that Moccasin Bluff might serve as a “type site” for agricultural villages in the Carolinian biotic province (Adkins 2004:1-2). Bettarel and Smith (1973) labeled Moccasin Bluff an agricultural village based on the presence of maize in just two smudge pits, despite over 90 other features at the site showing no evidence for maize. Increasing pit size was used to infer growing reliance on maize, beans and squash (Bettarel and Smith 1973; Adkins 2004). This meager evidence was used to explain the absence of

maize at contemporaneous sites. As noted by Adkins (2004:2) a number of researchers argued that Moccasin Bluff was a central summer agricultural village around which fishing camps were situated (Barr 1979; Brashler et al. 2000; Cremin 1980, 1983; Holman and Brashler 1999; Parachini 1981; Parker 2001; Waltz 1991).

When the corncobs from the smudge pits at Moccasin Bluff were submitted for direct dating, the result was a date of cal A.D. 1450-1640; a pollen core taken from a wetland at the southern end of the site did not produce maize pollen (Adkins 2003:76). The evidence for maize at Wymer West Knoll is limited also. Parker (2001) asserted that the quantity of maize remains recovered was not consistent with high-level processing of corn. Ahern and Kapp took pollen cores from two nearby bogs; these also did not yield corn pollen (Garland 1990). Prior to the data reported by Adkins (2003, 2004), Wymer West Knoll was argued to belong in the Moccasin Bluff-centered agricultural system (Parker 2001). The far-reaching nature of the Moccasin Bluff example highlights the pitfalls of using very limited data to generalize about subsistence patterns.

In the western Lower Peninsula, the Upper Mississippian period begins around A.D. 1050 and persists until the proto-historic period, circa A.D. 1600 (Bettarel and Smith 1973; Krakker 1999). Floral subsistence data for this period are relatively sparse. Both Moccasin Bluff and the Wymer West Knoll site exhibit a blending of Late Woodland and Upper Mississippian ceramic traits, complicating interpretation (Adkins 2004; Garland 1991; McAllister 1999). Some researchers have included Moccasin Bluff within the Fisher-Huber tradition (Faulkner 1972:157; McAllister 1999). The Berrien phase, dated between A.D. 1400-1600, was first identified at Moccasin Bluff. Bettarel and Smith (1973) describe the ceramics as similar to Huber ware.

Given the direct dates now available for the maize recovered from Moccasin Bluff (Adkins 2003, 2004), it is possible that the smudge pit cobs actually date to the Berrien phase. The charred corn recovered from the Wymer West Knoll site dates to the 11th or early 12th centuries (Garland 1991; Parker 2001). Located on the Kalamazoo River, the Schwerdt site is associated with the Berrien phase based on ceramic and radiocarbon evidence (McAllister 1980, 1999). Remains of nutshell, native weedy annuals and tropical cultigens are not found at the site. Instead, the aquatic and riparian environments appear to have been heavily exploited. Paleoethnobotanical research at the site identified an unusually high amount of aquatic tuber (*Nelumbo lutea*) remains (McAllister 1999). The Upper Mississippian Berrien phase component at The Preserve sites produced only a single maize fragment. The site dates to the seventeenth century (McAllister 1999). A quote from McAllister serves to summarize the picture of Upper Mississippian horticulture in the western Lower Peninsula: “Where are the villages from whence they came in the spring of the year to fish for sturgeon and harvest the tubers of the American lotus?” (1999:269-270). The available evidence does not suggest that food production was the primary subsistence activity for Late Prehistoric peoples in this area.

New York/Canada. Northeastern North America is a likely center of development for eight row Northern Flint. The known prehistoric maize macrofossils from this region are almost exclusively low row numbered (Crawford et al. 2006; Hart and Lovis 2012; Wagner 1987). This section will focus first on the traditional culture history for the area known as Northern Iroquoia (cf. Snow 1995), followed by an explication of recent archaeobotanical research by John P. Hart and others which complicates the traditional cultural historic taxa.

It is worth noting that the northern regions of the continent provide compelling recent evidence for early pre-contact maize. For example, accelerator mass spectrometry dates on maize fragments from the Grand Banks site in Ontario range from A.D. 540-1030. The maize is likely a form of Eastern Eight Row (Crawford et al. 1997: 113). Even earlier, maize microfossils from Canadian Laurel phase vessels suggest that maize was present in the Laurentian Plateau region by ca. A.D. 500 (Boyd and Surette 2010: 124).

The culture history of Northern Iroquoia. Historical analogy lends the name Northern Iroquoia to the area under consideration; this is the region which was inhabited by speakers of Northern Iroquoian languages. The designation is most accurate for the period following A.D. 900 (Snow 1995). The presence or absence of maize, along with the presumed geographical trajectory of its introduction, has played a role in the construction of this culture history. The region provides a case study for the potential of macrobotanical data to aid in the reassessment of culture histories.

Initially defined by Ritchie, the Point Peninsula culture was once conceived to cover a vast timeframe, from A.D. 100-1000 (Ritchie 1969). The dates for Point Peninsula have been refined a number of times, but there is an overall agreement that it begins earlier in Ontario than it does in New York, while ending at around the same time throughout its range (Snow 1995; Spence et al. 1990; Wright 1972, 1979, 1990). Recent accelerator mass spectrometry dates suggest that Point Peninsula may span the period from A.D. 500-1000 (Crawford et al. 1997). Early pottery traditionally classed as Point Peninsula, such as the Vinette 2 series from New York, features dentate and rocker stamping along with other decoration typical of Middle Woodland complexes throughout the Eastern United States (Ritchie and MacNeish 1949; Snow 1995). Some later Point

Peninsula pots possess what appear to be applied collars, but the technology is different than seen in later Iroquoian collared vessels (Ritchie 1969; Snow 1995).

Broadly defined, Point Peninsula subsistence is argued to consist of foraging, fishing and hunting. Some have suggested the development of an early horticultural economy based on native cultigens (Smith 1989; Snow 1995; Stoltman and Baerreis 1983).

In Ontario, the Princess Point culture is defined for the period beginning after A.D. 650 (Snow 1995; Stothers 1976; Wright 1966). Researchers once argued that Princess Point peoples originally brought maize to the region, allowing the in-situ development of later Iroquoian society (Snow 1984, 1995; Wright and Fecteau 1987). Later radiocarbon dates suggest that the macroremains associated with Princess Point are intrusive from later Iroquoian components (Fox 1990; Snow 1995; Williamson 1990). These data prompted Snow (1995) to argue that Northern Iroquoian culture was the result of migration by a group already practicing maize agriculture, such as the Clemson's Island culture of Pennsylvania. In this model, maize agriculturalists are presumed to have an adaptive advantage over other groups.

In a challenge to this hypothesis, Crawford and Smith (1996) provided new radiocarbon dates on maize from the Grand Banks site in the lower Grand River Valley, Ontario. These dates range from cal A.D. 540-780, on maize recovered from a soil stratum containing abundant Princess Point pottery. Crawford et al. (1997) contend that Princess Point peoples were engaging in horticulture by A.D. 800, rejecting the migration model put forth by Snow (1995). Given this subsistence pattern, Crawford and Smith (1996) conclude that Princess Point is not a Middle Woodland culture, but may be better framed as an early Late Woodland phenomenon.

In New York, the predecessor to Iroquoian lifeways has long been known as the Owasco Tradition (Ritchie 1969). The Owasco Tradition is generally held to begin circa A.D. 1000, although some chronologies delay the beginning of Owasco until A.D. 1150 (Ritchie and Funk 1973; Snow 1995; Stuiver and Reimer 1993; Williamson 1990).

New subsistence data, Owasco, and the problems of culture history. The work of John P. Hart, among others, has initiated a broad reconsideration of late prehistoric subsistence in the Northeast, along with the traditional culture history tied to presumed subsistence-settlement patterns. As originally defined, the Owasco Tradition was based around maize-beans-squash agriculture, matrilineal residence, and a nucleated village settlement system (Ritchie 1969; Ritchie and Funk 1973). Archaeologists generated these assumptions by projecting historic Iroquoian data back in time. Recent evidence has called into question the histories of all of these characteristics (Hart 1999, 2008, Hart et al. 2011). Hart and Brumbach state that “the search for the origin of New York Iroquoians within a culture-historic framework can no longer be considered a viable research agenda” (2003:68). Recent paleoethnobotanical research has in large part enabled this rejection, particularly the rewriting of the history of “three sisters” cropping (Hart 2007, 2008). A brief summary of the extensive recent research on maize and other crops in this area is presented below.

One factor motivating the rejection of the Owasco stage is the fact that the so-called “three sisters” crops (maize, beans and squash) actually have vastly different histories in this region. Squash (*Cucurbita pepo*) might be considered the oldest of the sisters, with a direct date on remains from the Marquette Viaduct site in Michigan of 3840±40 B.P. (Monaghan et al. 2006). For many years, the earliest dates on squash in

Northern Iroquoia were on remains from the Roundtop site in the Upper Susquehanna River valley, the source of supposed early dates for the maize-beans-squash complex. Associated dates for squash at Roundtop range from A.D. 1000-1100 (Ritchie 1969; Ritchie and Funk 1973). Direct AMS dates on the Roundtop cucurbit rind are considerably later, ca. A.D. 1350 (Hart 1999:56, 2000, Hart and Brumbach 2003). However, probable squash phytoliths were directly dated to the seventh and eighth centuries A.D. from pottery residues at the Kipp Island, Hunter's Home and Wickham sites (Hart et al. 2003; Hart and Brumbach 2003). Even earlier squash phytoliths were identified at the Scaccia site in western New York; these date to 2905 ± 35 B.P. (Hart et al. 2007:566).

Despite the limited macrobotanical record, there is evidence for very early, if limited, use of maize in this region. As previously discussed, AMS dates on likely Eastern Eight Row at the Grand Banks site in Ontario range from A.D. 540-1030 (Crawford et al. 1997). For many years, the earliest direct date on maize in New York was A.D. 1000 (Cassedy and Webb 1999). The associated radiocarbon date for eight row maize at the Roundtop site (the long-held evidence for early "three sisters" cropping) fell within the ninth century A.D., but direct dates from the maize were relatively late, circa A.D. 1300 (Hart 1999:56; Ritchie 1969, 1973; Winter 1971).

Microbotanical remains provide evidence for earlier maize. Phytoliths taken from residues at the Kipp Island and Hunter's Home sites in the northern Finger Lakes region date to the seventh century A.D. (Hart et al. 2003). These phytoliths were more similar to those Northern Flint landraces than to Southern Dent corn, suggesting that the Northern Flint lineage may have been present by an early date (Hart et al. 2003). Caries rates and

isotopic analysis at Kipp Island are consistent also with maize use (Hart et al. 2011). At the Vinette site in Oswego County, New York, phytoliths date to cal 399-208 B.C. (Hart et al. 2007; Thompson et al. 2004).

Despite these early dates, the bulk of dates on maize residues in the Northeast correspond with the range of directly dated macroremains, and maize remains are sparse prior to circa A.D. 900-1000 (Hart et al. 2007; Hart and Lovis 2012). The true relevance of very early maize dates remains to be interpreted. Hart and Lovis (2012) hold with the theory that at the time of its introduction to Eastern North America, maize was adopted as a simple addition to the starchy seed complex (cf. Fritz 1993), as opposed to a crop of special spiritual and social significance (cf. Scarry 1993). Bulk $\delta^{13}\text{C}$ values for central New York state show a general trend for more enriched values through time, with steeper slopes following ca. cal A.D. 400-500, suggesting a rapid increase in the C contribution made by maize (Hart et al. 2012:317). These data suggest that maize intensification may have begun earlier in central New York than in either Michigan or southeastern Wisconsin.

Among prehistoric crop plants in Eastern North America, the common bean has the shortest history. Despite supposed early remains at the Roundtop site, direct dates confirm that domesticated bean was not present at the site until after A.D. 1300 (Hart 1999, 2007, 2008; Ritchie 1969; Ritchie and Funk 1973). Dates from sites from the Illinois River Valley to the Connecticut River Valley indicate that a similar pattern was seen through the Midwest and Northeast (Hart et al. 2002; Hart and Brumbach 2003; Hart and Scarry 1999). Currently, calibrated 700-650 B. P. marks the earliest macro- and

microbotanical evidence for beans in northeastern North America (Hart 2007, 2008; Hart et al. 2002; Hart and Scarry 1999).

While not a cultivated plant, wild rice is a grain providing an abundant seasonal harvest. Wild rice appears in archaeological assemblages in New York long before the seventh century A.D., suggesting exploitation of this resource predated maize.

Consumption of wild rice alongside maize provides essential amino acids similar to the consumption of maize and beans together (Hart et al. 2003). The combination of nutritional and archaeological evidence led Hart and Lovis (2012) to propose that the early consumption of maize was facilitated by extant use of wild rice.

The starchy and oily seed crops of the Eastern Agricultural Complex were present in the Northeast prior to the arrival of maize, as is the case in the Midwest and Midsouth, where such crops are present by ca. 4000-3000 B.P. (Hart and Lovis 2012; Smith 2006). For example, the Hunter's Home site in the Finger Lakes region of New York produced phytoliths similar to those expected for little barley dating to 3530±30 B. P. (Hart et al. 2008). *Chenopodium* is present very early in the Northeast, but does not show evidence for cultivation until the fourteenth century (George and Dewar 1999; Hart and Lovis 2012). Like wild rice, these crops supplement the nutritional profile of maize (Hart and Lovis 2012).

Discussion

The foregoing discussion provides certain expectations for the floral dataset at Aztalan. Regarding maize row number, an affinity with early Wisconsin maize assemblages would predict low row numbers for the Late Woodland component, with a

possible increase in row number following the introduction of Mississippian influences. As explored above, the pattern for the American Bottom contrasts with that seen in Wisconsin, where eight row maize does not appear until quite late in prehistory. Prevalence of Eastern Eight Row at early maize-growing sites in Wisconsin may suggest an Eastern Great Lakes connection. The relevance of this connection to the collared ware phenomenon remains speculative. Bulk $\delta^{13}\text{C}$ levels from ceramic residue suggest varying trajectories of maize adoption for the three regions (Hart et al. 2012).

The different regional histories also set out different expectations for the subsistence pattern at Aztalan. In the American Bottom, the early Late Woodland period is characterized by a predominance of native cultigens. Hickory (*Carya*) is the dominant nut taxon. In fact, hickory continues to dominate nut assemblages through the Mississippian period. By the Terminal Late Woodland, American Bottom assemblages show increased maize ubiquity – in fact, recent research suggests maize may first appear during this time period. Maize utilization increases dramatically by the Lohmann phase, but native cultigens continue to be important. By the Moorehead phase, stable carbon isotope and macrobotanical data suggest that maize had become the dominant dietary staple (Hedman et al. 2002; Simon and Parker 2006).

In Southeast Wisconsin and Northeast Illinois, the appearance of collared pottery brings with it an increase in maize density, alongside the appearance of squash (Egan 1993, 2003a, Egan-Bruhy 2014; Egan-Bruhy and Nelson 2008; Jeske and Hart 1988; Hawley et al. 2011; Meinholz and Kolb 1997; Salkin 1993; Simon 1998; Zalucha 1997). However, these sites generally have a low representation of native cultigens. Middle Mississippian sites demonstrate an even higher density of maize and squash, alongside a

more diverse and abundant assemblage of native cultigens. Oily-seeded annuals appear for the first time in this region at Mississippian sites (Egan-Bruhy 2014). Oneota sites resemble Late Woodland sites in terms of maize density and sparseness of native cultigens, and demonstrate a higher diversity of wild foods than observed at Mississippian sites (Egan-Bruhy 2014; Jeske 1992, 2000, 2003; Jeske and Hart 1988). At the Lake Koshkonong locality, this includes an increased reliance on wild rice (Egan-Bruhy 2001, 2003a, 2010; Olsen 2003). Throughout the Late Prehistoric sequence, sites to the west along the upper Mississippi trench bear more resemblance to Middle Mississippian assemblages, particularly with regard to diversity of native cultigens, including oily seeds (Arzigian 1985, 1987; Egan-Bruhy 2014, Emerson et al. 2007).

Throughout Michigan, Late Woodland sites show little evidence for food production; evidence for maize-centric horticulture is particularly sparse, especially outside the Saginaw Valley. At Saginaw Valley sites with evidence for cultivation, maize is present but Eastern Agricultural Complex plants are limited (Egan-Bruhy 2014; Parker 1996). Egan-Bruhy (2014) also notes that sites in Pennsylvania have a low density of Eastern Agricultural Complex plants, similar to that observed at collared ware sites (King 1999, cited in Egan-Bruhy 2014). Some of the earliest evidence for maize and squash horticulture originates in western New York state and Ontario.

Also apparent is the degree to which new subsistence data can challenge long-standing culture histories. Culture historic taxa undoubtedly remain useful historic devices, necessary for dividing archaeological data into meaningful units. Culture histories constructed decades ago often relied upon assumptions about subsistence practices, projection of ethnohistoric accounts back in time, or limited data. Ongoing

macro- and microbotanical investigation necessitates looking beyond culture history and at times rewriting it. This is true in the case of the Emergent Mississippian/Terminal Late Woodland in the American Bottom and the Owasco phase in late prehistoric New York and Ontario. In the case of southern Wisconsin and northern Illinois, ceramic studies have already demonstrated the complexity of the late prehistoric period (e.g. Clauter 2012; Rosebrough 2010). This thesis aims to provide new botanical data for the multicomponent Aztalan site, in hopes of providing further insight into the complex group interactions occurring at this time.

Chapter 3) Sample Selection and Methods

This chapter describes the depositional contexts included in this analysis. Further interpretations of these contexts are explored in Chapter 5. An outline of the methods employed for this study is provided also in this chapter.

Samples Selected for Analysis

A complete list of all samples examined for this analysis may be seen in Appendix A (Table A.1). Samples were chosen from the 1984 and 2011 field seasons. Figure 3.1 shows the locations of the contexts included in this analysis. Several contexts from the 2011 field season lack a specific temporal affiliation; these are included in the overall abundance measure but not in the analysis. The same is true of the sample from Feature M84-22d. In addition, substrata S11₄ and S11₈ are likely non-cultural (Richards 1985, 1992). In the intrasite analysis tables, ubiquity measures are presented both with and without these substrata included.

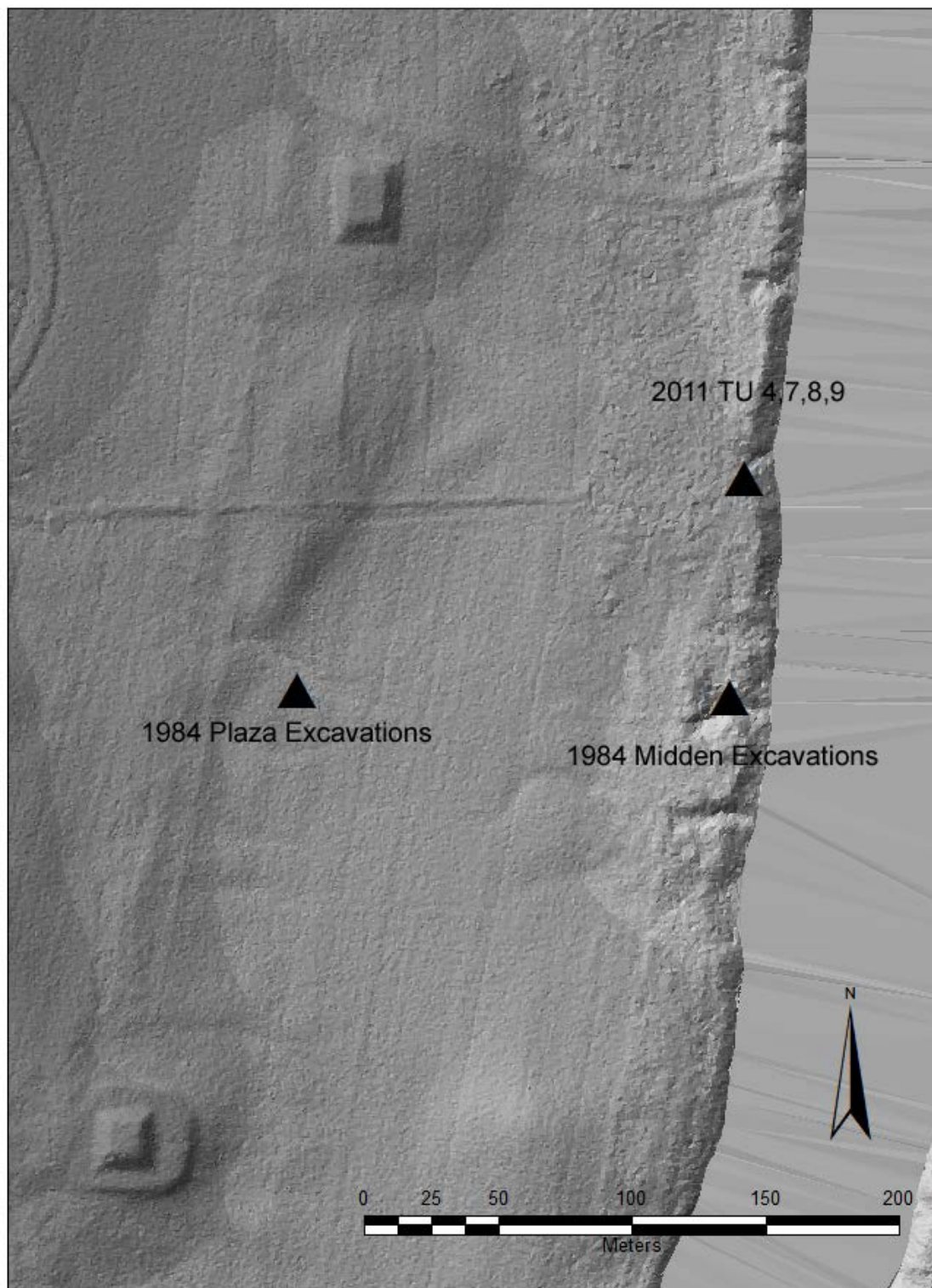


Figure 3.1: Bare earth LiDAR image showing location of excavations included in the analysis (adapted from Richards et al. 2012: Figure 15. Source for LiDAR data: Wisconsin Department of Natural Resources)

Contexts from 1984 excavations.

Three primary contexts from the 1984 season are included in this analysis. The first two consist of two strata of the riverbank midden; the third context consists of a group of features from the plaza area. The location of the midden excavations was selected due to Barrett's report of said deposits eroding out of a ravine. Excavations consisted of "slicing back" the north wall of the ravine in order to expose a profile of the midden (Richards 1992:137). The primary excavation unit in this area consists of a 2-x-2-m square block referred to as N 0-4 E 14-16. Additional 1-x-1-m units were excavated adjacent to the north, east and west limits of N 0-4 E 14-16. The stratigraphic sequence is described in terms of the entire 4 m long profile (N 4 E 13-17) (Figure 3.2; Richards 1992:138).

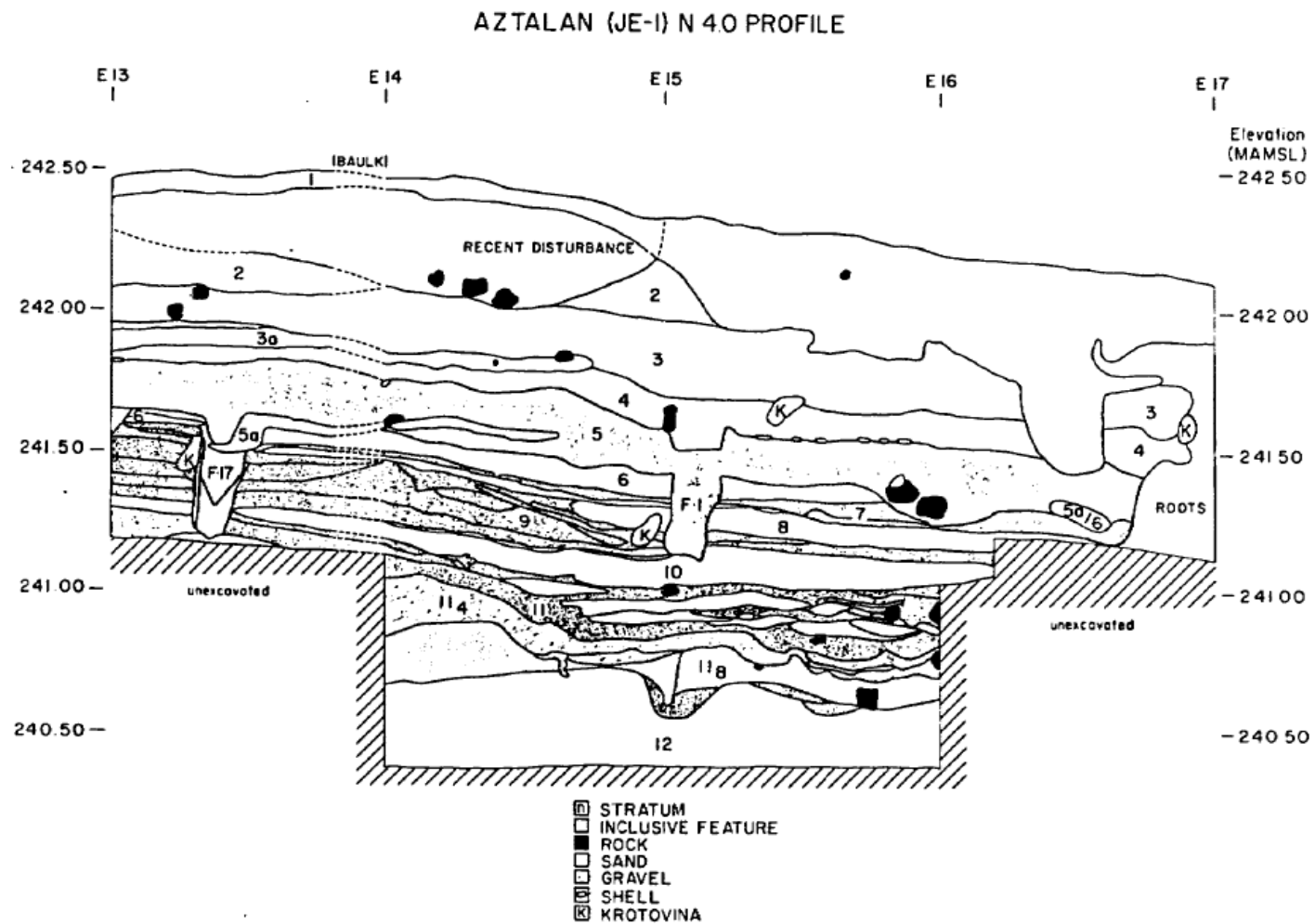


Figure 3.2: Profile of 1984 Unit N 4 E 13-17 showing Strata 5 and 11 (Richards 1992: Figure 4.11)

The midden profile revealed a total of 12 strata. Two of these strata are associated with distinct cultural occupations of the site. **Stratum 5** consists of a clay loam soil and represents an intact occupation zone (Richards 1992:144). The stratum contained shell-tempered Mississippian ceramics alongside grit-tempered Madison ware and collared ware sherds. This combination of Late Woodland and Mississippian materials is typical of Mississippian contexts at the site, and is consistent with the observation that northern sites with Mississippian characteristics typically retain Late Woodland traits. Richards (1992, 2007) interprets the commingling of Late Woodland and Mississippian materials to indicate that site inhabitants continued to use Late Woodland vessels even after the introduction of shell-tempered technology to the site. This supports the hypothesis that two separate groups inhabited the site simultaneously. For the sake of simplicity, this later component at the site will be referred to as “Mississippian” in the analysis. Feature 20, located in Stratum 5, yielded a radiocarbon date of cal A.D. 980-1220 (Richards and Jeske 2002:44). Stratum 5 is argued to represent the Middle Mississippian occupational surface horizon (Kolb et al. 1990; Richards 1992).

By contrast, **Stratum 11** produced only grit-tempered ceramics, including Aztalan Collared, Starved Rock Collared, Madison ware and Hyer Plain vessels, suggesting a Late Woodland affiliation (Richards 1992). Radiocarbon assays on charcoal recovered from **Feature 6** within Stratum 11 yielded dates of cal A.D. 780-1020 (Richards and Jeske 2002:44). For purposes of this study, maize kernels from this feature were dated to cal A.D. 1040-1155. These results are fully detailed in Chapter 4.

Stratum 11 contained 18 subvenience levels (S11₁-S11₁₈). One limitation of the data under consideration surrounds the comparison of a Middle Mississippian occupational surface with a Late Woodland refuse midden. Stratum 11₁₀ is described as consisting of “in situ ash beds and dumping episodes” (Richards 1992:148). Stratum 11 contained two substrata that are likely non-cultural. S11₄ represents culturally sterile, poorly-drained wetland soils located at the base of the cultural midden. S11₈ is also culturally sterile, and may be more closely related to the underlying glacial deposits of Stratum 12.

Feature M84-6, located in Stratum 11, is an in-situ dump. Contents included ash, charcoal, pottery and faunal materials. Two Aztalan Collared vessels and two Starved Rock Collared vessels are represented in the feature (Richards 1992). Floral analysis has previously been conducted on this feature (King 1985). King’s analysis included only the light fraction.

Three plaza area features from the 1984 season were selected to provide additional feature contexts. **Feature M84-5, Feature M84-11 and Feature M84-16** are included to provide further comparative data. As these features contained only grit-tempered sherds, they are presumed to have a Late Woodland affiliation.

Contexts from 2011 excavations

Feature 2011.20-8 provides the most securely defined context for the 2011 season. Located along the river in Test Units 4, 7, 8 and 9, Feature 8 consists of a deposit of ash and fired earth. Initially, only the northwest half of the feature was excavated in 2011, due to the fact that the feature was not uncovered until the end of the field season.

The entire northwest half matrix was recovered as a flotation sample. Artifacts recovered include abundant cut sheet copper, faunal material, lithic debitage and both grit and shell-tempered pottery (Richards et al. 2012). Maize from this feature was submitted to Beta Analytic for AMS dating, with a resulting date between cal A.D. 1030-1210. These results are discussed in more detail in Chapter 4. In combination with this date, the presence of red-slipped pottery and exclusion of Ramey Incised vessels suggests that this feature may be associated with the early appearance of Mississippian pottery at the site. The presence of both grit- and shell-tempered vessels is typical of the later component at the site.

During the 2013 UWM field season, the trench containing Feature 2011.20-8 was cleared of backfill, and the tarped-over remnant of the feature was exposed. At the same time, circular stains were identified east to west along the south wall of the trench, superimposed over Feature 8. Upon consultation of Barrett's plane table maps, these stains were interpreted as part of a palisade bastion located in Barrett's Section V-A (Figure 3.3; Figure 3.4) Figure 3.5 shows a map of the 2011 and 2013 UWM excavations superimposed over a portion of Barrett's site map, demonstrating the relationship between the palisade bastion and Feature 8.

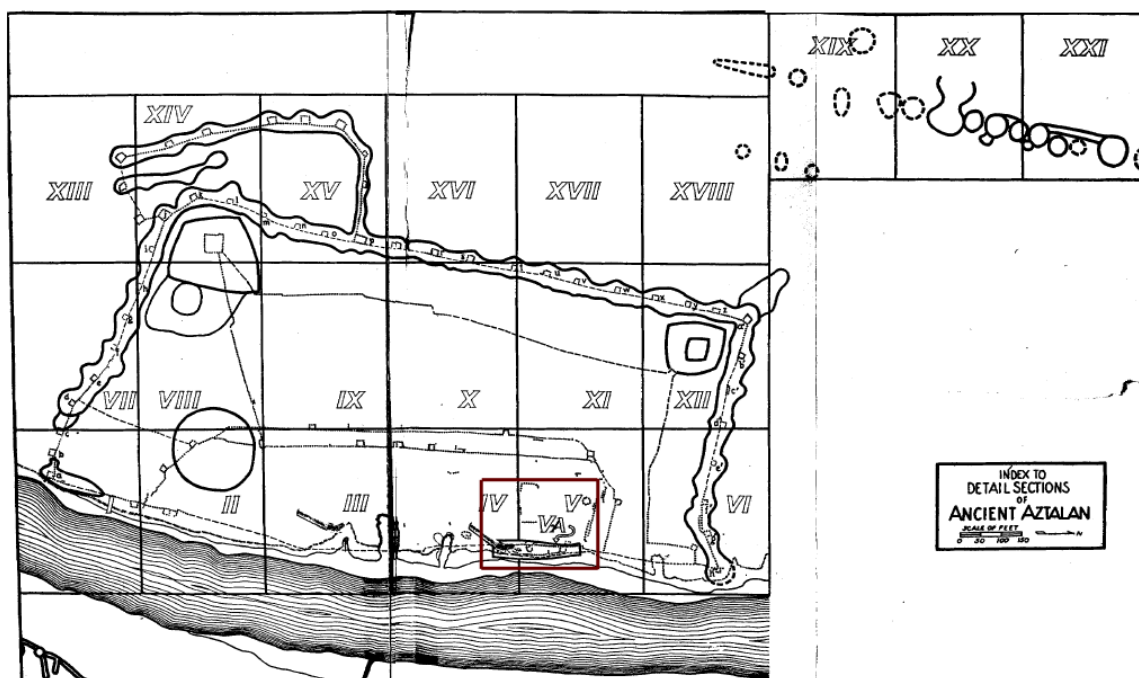


Figure 3.3: Barrett's map of Aztalan showing location of Section V-A (modified from Barrett 1933: Map 2)

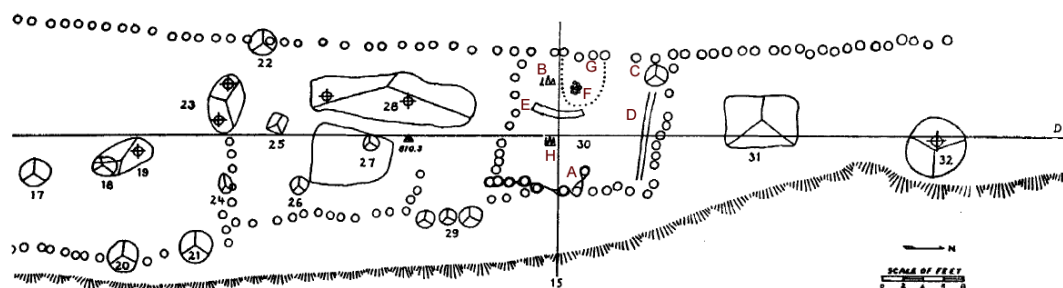
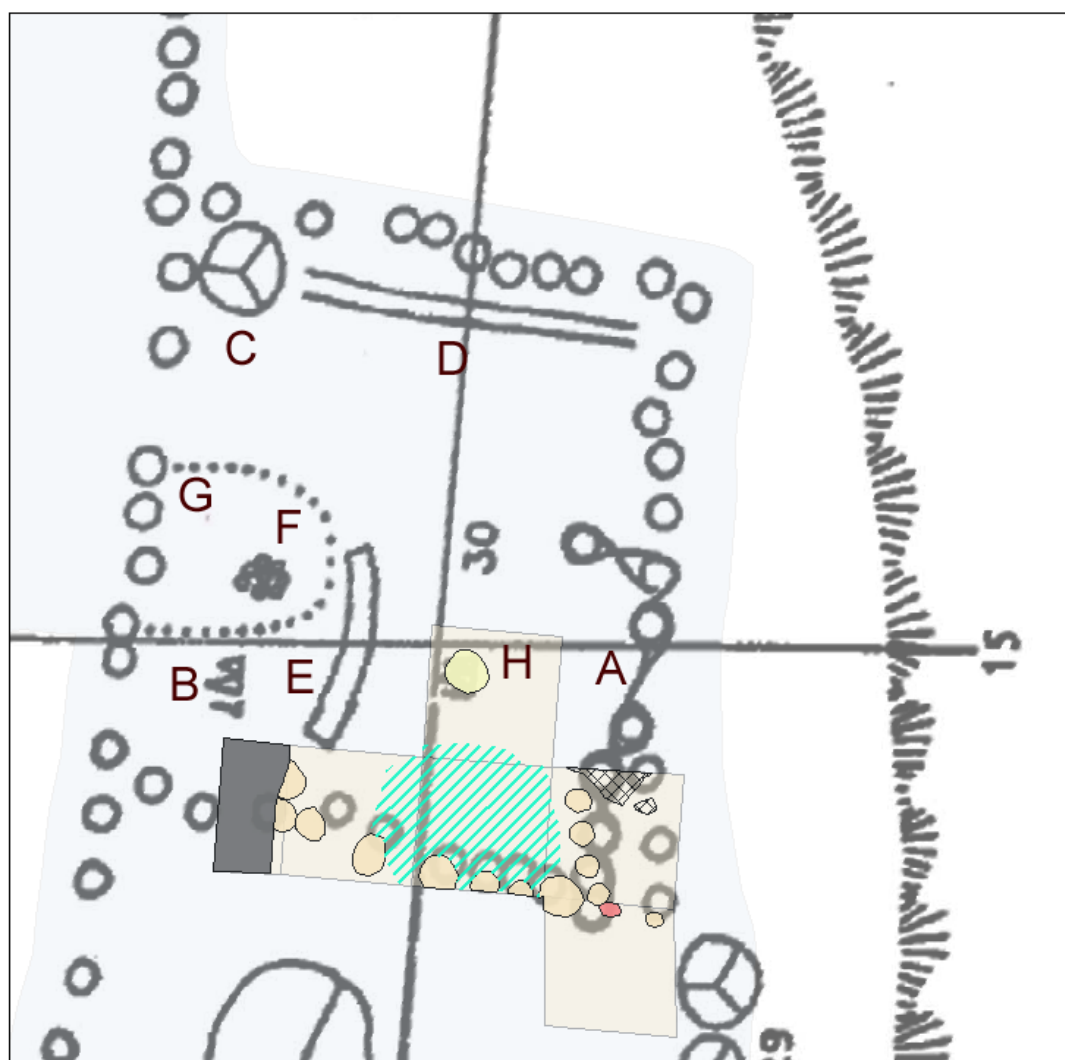


Figure 3.4: Close-up of Barrett's Section V-A showing Structure 30 and inclusive features (modified from Barrett 1933: Sec. Plat. V-A)

MPM Excavations (1919-1932) and UWM Excavations (2011-2013)



2011-2013 UWM Excavations

- Bastion postmolds
- Burned Post
- F14 post pit
- Feature 8
- WHS Excavation (1962)
- Krotovina

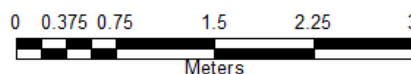


Figure 3.5: Map showing Feature 8 and 2013 palisade excavations over Barrett's map of Section V-A enclosure 30 (modified from Barrett 1933: Sec. Plat. V-A)

This bastion is identified by Barrett as Feature 30 in Section V-A (1933:199). Barrett describes several other unusual features within the enclosure or bastion. The features

described here may be seen in Figure 3.4. Barrett (1933) describes a “wall of wattling at the corner of the enclosure;” it is possible that the remnant of this wall is observed on the east edge of the south profile of the trench, visible as a concentration of burned sediment and charcoal (Figure 3.6). Barrett describes the wattling as “reduced...to the form of charcoal due to the smothering effect of the surrounding ground” (1933:199). Kathryn Egan-Bruhy of Commonwealth Cultural Resources Group, Inc. identified a sample of wood charcoal from this feature as red oak group (*Quercus*) (personal communication, 2013).

The MPM excavation trench, visible as a dark layer below the A horizon in Figure 3.6, does not appear to have extended to the depth where Feature 8 was defined. Based on Barrett’s descriptions, Feature 8 does not appear to have been the sole ash deposit, or indeed the sole copper concentration, in this area.



Figure 3.6: Photograph of south wall of 2011/2013 Test Units 7, 8 and 9 showing Feature 8, palisade bastion posts, intact surface and Barrett excavation trench. Note 1962 WAS trench visible in profile at far right of photo. Feature 8 is light gray ash deposit (UWM ARL Photo 08-16-4782C1.jpg)

As described by Barrett (1933), V-A 30 B is a “fireplace” which consisted of a two-inch thick layer of burned sediment covered in a layer of ash; Barrett describes pottery and shell in this feature. The structure of this feature is not dissimilar from what was observed for Feature 8 (Figure 3.7) (Barrett 1933:199). An additional fire pit, V-A 30 C, was located in the extreme northwestern corner of the bastion.



Figure 3.7: Photograph showing partially excavated profile of Feature 2011-20 Feature 8 from 2011 excavation, view to southeast (UWM ARL Photo 07071404.jpg)

Barrett (1933) described a “pair of poles” running the entire length of the enclosure along the north wall (200). Reduced to charcoal, these poles were only 2.5 inches in diameter and therefore too small to have been palisade posts. Feature E, located between fireplaces B and H, is described as a curved concentration or “wall” of Aztalan brick (1933:200). The enclosure also included two ash deposits containing evidence of copper, which based on Barrett’s map appear to be spatially distinct from Feature 8. The first, Feature V-A 30 G, was a green-colored area at the base of the enclosure (Figure 3.4). Feature H also exhibited green staining. Barrett’s description of Feature G is as follows:

Whether or not there had been a large sheet of copper or a number of small pieces of copper at this point, could not be determined in the excavation, but that copper had been present and was the cause of this discoloration, there can be no doubt. Resting upon the immediate bottom of the area at this point, there was a layer about an inch in thickness of mixed earth and ashes, and upon this a layer of charred fiber which had probably been originally a piece of matting. It was an interesting fact that this whole area was discolored with this greenish copper impregnation to a thickness of about two inches [Barrett 1933:200-201].

Superpositioning suggests that Feature 8 predates the palisade, further supporting an early Mississippian affiliation (Figure 3.6). Below Feature 8 is an intact surface, possibly representing a buried A horizon. The intact matrix above the feature appears to represent aboriginal fill. Feature 8 is located within the bastion but the ash visible in the south profile wall suggests that it may extend to the south past the wall of the enclosure.

As seen in Figure 3.5, there is a line of smaller posts extending north of the highly burned post. It is possible that these posts represent a structure which is superimposed by the palisade. At this time there is insufficient data to interpret whether Feature 8 would be inside or outside of this structure. Red oak from a burned palisade post in this area dates

to the mid-thirteenth century and provides further support for the theory that Feature 8 predates the palisade (Richards and Picard 2013). In fact, this burned post may date the abandonment of the site (Richards and Picard 2013). Some possible interpretations for Feature 8 will be presented in Chapter 5.

Other contexts from the 2011 season were examined also (Appendix A: Table A.1). Results from these excavations will be included in the field school Report of Investigations. While included in overall measures of abundance, these samples are excluded from other parts of the analysis as no specific cultural affiliation has been secured.

Methods

Flotation Processing

Flotation technology has evolved considerably in the past three decades. Differences in flotation method may produce some difference in the rate of recovery for floral materials. This should be kept in mind when comparing older samples to more recently recovered materials.

Samples collected during the 1984 season were processed using a “standard ‘Patty Jo Watson’ flotation barrel” (Richards 1985:75). Unfortunately, volume data is not available for all samples collected in 1984 (Appendix A: Table A.1). Volume data is completely lacking for Stratum 5 samples. Several Late Woodland samples also lack this data. For this reason, density is not used as a primary tool for the diachronic, intrasite analysis. Densities are presented for those contexts with volume data available.

Samples from the 2011 season were processed using a Flote-Tech Model A-1 flotation machine. Samples were processed five liters at a time, and volume data was recorded for all contexts. Soil was sprinkled slowly into the machine in an attempt to maximize recovery. All parts of the machine were thoroughly cleaned in between lot numbers in order to avoid contamination.

Floral Analysis

As there is currently no faculty member at the University of Wisconsin-Milwaukee (UWM) specializing in floral analysis, basic identification of floral remains was learned during a semester-long internship at Commonwealth Cultural Resources Group (CCRG) under the tutelage of Kathryn Egan-Bruhy. A significant portion of the samples included in this analysis were sorted and scanned using a dissecting microscope located at CCRG, while the remaining samples were processed at the UWM Archaeological Research Laboratory (ARL). The UWM ARL houses an AmScope SZM-3BZ microscope capable of 3.5X-90X magnification. Samples sorted at UWM were subsequently transported to CCRG for confirmation of identifications.

Comparative collections are the primary resource used in the identification of floral remains. At present, no regional comparative collection exists at UWM. Kathryn Egan-Bruhy maintains an extensive comparative collection at CCRG. This comparative collection formed the primary resource for identification of floral remains. This collection was supplemented through occasional use of previously-analyzed materials housed in the UWM ARL. When necessary, the comparative collection was supplemented with standard seed identification manuals (Martin and Barkley 1961; Montgomery 1977).

Size grading. Prior to sorting and scanning, both light and heavy fractions were split into a greater than 2.0 millimeter size grade and a less than two millimeter size grade. Floral remains from the greater than 2.0 millimeter split of both fractions were completely sorted. Charcoal, nutshell, maize, fungus and cucurbit remains were only removed from the greater than 2.0 millimeter split. Studies have shown that quantitative comparisons, such as the nut-to-wood ratio, are not significantly different whether wood charcoal is removed from the less than 2.0 millimeter grade or not (Asch and Asch 1975).

The light fractions were further split into a greater than 1.0 millimeter size grade and a greater than 0.5 millimeter size grade in order to facilitate scanning for seeds. The 0.5 mm screen is small enough to catch tobacco (*Nicotiana rustica*) seeds, the smallest seeds likely to be recovered from sites in the region (Kathryn Egan-Bruhy, personal communication). Seeds are rarely recovered from the heavy fraction. In this case, because the 1984 samples were processed prior to the introduction of machine flotation and may therefore have lower rates of seed recovery, the less than 2.0 millimeter split of the heavy fraction was briefly scanned to check for seeds.

Quantification. Because of the relatively sparse nature of the floral remains, all samples were analyzed in their entirety. All materials from the <2.0 mm split (wood charcoal, maize fragments, squash rind, etc.) were counted and weighed. Counts only were recorded for small seeds. Carbonized plant remains are assumed to be prehistoric; uncarbonized remains are not included in counts. In the case of cucurbit rind, a few partially carbonized examples were presumed to be cultural.

1/16" Water-Screened Samples.

For most contexts from the 1984 midden excavations, 1/16" water screened samples were taken alongside flotation samples. Because an insufficient number of measurable maize fragments were identified during the flotation analysis, 1/16" water screen samples were sorted in an attempt to identify additional measurable specimens (Appendix D: Table D.1). To maintain comparability with specimens recovered from flotation samples, water-screened samples were size-graded through a 2.0 mm geological sieve before sorting. In the interest of time, only measurable maize fragments were removed from water screen samples.

Quantitative Comparisons

Botanical assemblages are subject to several different sources of bias. The first involves which plants and which parts of plants are used, stored, processed and disposed of. This has significant bearing on preservation. In most climates, only charred floral remains will preserve. Therefore, only those taxa and parts that are exposed to fire will appear in the archaeobotanical assemblage. Hard plant parts are more likely to preserve than fleshier ones. Furthermore, botanical assemblages are subject to the same post-depositional disturbances as other artifact classes (Pearsall 2010; Popper 1988: 54). In an effort to discover the most informative trends for Aztalan, and to deal with past inconsistencies in data reporting, a variety of quantitative comparisons are included in this analysis. These include absolute counts, abundance, density, ubiquity, diversity and ratios.

Absolute counts. Absolute counts are the most affected by preservation bias, and must be converted into ratios to be analytically useful (Popper 1988). Nonetheless, it is

important to include absolute count and weight data in paleoethnobotanical analyses (Pearsall 2010:194). In this study, summary counts and weights for all taxa are presented in the next chapter; Appendices B and C present results by individual sample.

Abundance. Abundance is expressed here as the percentage of a particular taxon relative to the entire assemblage (Pearsall 1988). Percentages allow for standardization independent of density, as differences in density may have an unknown cause. However, the fact that all specimens must add up to 100 percent, changes in occurrence observed in percentages may be deceiving (Pearsall 2010:196).

Density. Density measures involve the division of the amount of charred floral material by the liters of soil floated (Miller 1988). Standardized densities are often presented in terms of counts/weights per 10 liters. This standardization is especially useful in cases of low density. Density allows for an assessment of the amount of charred material present in a sample (Pearsall 2010:196). In the analysis of materials recovered from Aztalan, densities are only presented for those contexts where volume data are available. Changes of recovered floral materials at a site may be caused by factors such as increased population, and therefore are not always useful for assessing the relative importance of various resources.

Ubiquity. Ubiquity, or percentage presence, ignores absolute counts, instead measuring how frequently a taxon appears in a group of samples. Merely noting that a taxon is present at a site conveys a certain amount of information; if the taxon is ubiquitous this can provide further information. Pearsall (2010:213) cites increasing ubiquity of maize at Mississippian period sites in the American Bottom through time as an example of the utility of this measure. Pearsall (2010:213) also argues that measures

of ubiquity can indicate if a particular plant was accessible to the majority of residents at a site. Because ubiquity/presence minimizes the impact of absolute counts, the measure can help to control for differences in preservation and deposition (Pearsall 2010:214). However, care must be taken to ensure comparability of contexts used for ubiquity calculation. This is particularly true in the case of this analysis. Few features were identified during the 1984 midden excavations, so ubiquity is calculated using samples (taken from substrata within the midden) as a unit of analysis. Most of the sites examined in the regional comparative analysis present ubiquity on the basis of presence or absence in discrete features. The midden samples are likely more subject to disturbance than are discrete feature contexts, complicating the use of ubiquity in the analysis.

Measures of diversity. Diversity aims to describe the composition of a botanical assemblage by examining both the number of different taxa present and the relative abundance of each (Pearsall 2010: 209; Popper 1988:66). Such measures are used to assess diet breadth. A high diversity score is the result of a large number of species with even abundance. Two scenarios may cause a low diversity score. A low number of species may be represented in the assemblage, or a few species may be overrepresented (Pearsall 2010:210). The Shannon-Weaver index, used here to calculate the biodiversity of various assemblages, is used by both floral and faunal analysts. A higher score indicates higher diversity. The formula uses the natural log:

$$H = \text{Sum}(N_j/N) \ln (N_j/N)$$

where N = total number of seeds/fragments in the phase

N_j = total number of specimens of taxon j in the phase

(Pearsall 1983:137, cited in Popper 1988:67).

As with most quantification measures, differential preservation is the primary concern with the Shannon-Weaver index (Pearsall 2010).

Ratios. Ratios are designed to standardize data. Miller (1988) describes two different types of ratio. In the first type, which includes percentages and proportions, the taxon represented in the numerator is also included in the denominator (for example, percentage of nutshell represented by a specific genus). In the second, two mutually exclusive classes of botanical material are compared, for example nutshell and wood (Miller 1988: 72). Wood ratios are especially useful, and are based on the notion that the amount of wood charcoal produced by human activities is relatively constant across contexts, and can therefore be used as a denominator in a ratio to control for preservation bias (Miller 1988). In the case of Aztalan, the use of wood as a denominator might control for an increase in population through time at the site.

Nut-to-wood ratios are most commonly employed, although the ratio can also be useful for other taxa from the greater than 2.0 millimeter size grade, such as maize and squash remains. Wood ratios provide an important comparative metric for this study, especially given the lack of volume data for many samples. Using just counts or just weights for this ratio may be problematic. For example, hickory nutshell will be denser and heavier than an equivalent amount of acorn shell. Similarly, the thinner shells of acorns are more likely to fragment into many pieces.

Maize Row Number

The reproductive elements of the *Zea mays* plant are less affected by environmental factors than are other elements. For this reason, reproductive elements are

among the best characteristics to use in determination of maize race (Goodman and Paterniani 1969). Fortunately, kernels and cobs are the elements of maize most frequently recovered from archaeological contexts, for four main reasons. First, and most obviously, they represent the parts of the plants utilized for food. Second, they are more easily recognized by archaeologists than fragments of the stalk or leaves. Third, they are more durable than other elements. Finally, they represent the elements of the plant most likely to be exposed to fire, whether for cooking or as refuse (King 1987:121).

North American maize exhibits considerably less variation than Central and South American maize due to its descent from a small founding population; therefore there are fewer possible measures for identifying North American maize races. Even row number shows a relatively small range of variation among North American varieties (King 1994). Nonetheless, in her comparison of measures for differentiating maize race, King found cob measurements (such as row number) to be the most promising. This is due in large part to the poor preservation, loss or distortion of other measures, especially those taken from the kernel or alicole (1994).

Pitfalls of row number measurement. Due to the factors mentioned above, and to the fact that row number is the one racial characteristic for maize consistently provided in earlier floral analyses, maize row number is likely to be a useful tool for analysis. Nonetheless, there are a number of potential pitfalls surrounding the measurement of row number, in addition to the theoretical issues outlined in the previous chapter.

Kernels on a single ear often vary dramatically in size and shape. For example, kernels at the end of an ear or immature kernels may be smaller or misshapen (King 1987:127). King (1987) conducted experimental research which brought to light

complications with reliance on kernel measurement. Kernels carbonized off the cob would give incorrect row numbers 68 percent of the time (King 1987). An experimental study by Goette et al. (1994) had even less promising results, with charred kernels predicting the correct row number only 57 percent of the time. Cutler and Blake (1969) contended that kernels carbonized on the cob (which generally display flat, angled sides) are better for reconstructing row number, while those carbonized off the cob tend to be too distorted. King found that even kernels carbonized on the cob could provide misleading measurements 40 percent of the time (1987:139).

While arguing that calculation of row number based on kernel angle should be avoided where possible, King (1987) suggests that cupule measurements may be more accurate, particularly when more than one cupule is still attached to the rachis. Goette et al. (1994) also found that cupules provided more accurate measurements; estimates made using cupule angle were correct 64 percent of the time. Fritz (1992) cites personal communication with Cutler and Blake that even individual cupule angles can give accurate row numbers, provided the analyst exercises discretion and only selects those cupules that lack obvious distortion. Given the available data on row number calculation, the order of preference for row number calculation is as follows: cupules attached to sections of the rachis; loose, undistorted cupules; and intact, measurable kernels where no measurable cupules are present. Furthermore, while individual angle measurements often produce inaccurate results, the mean row number measurement of a given sample generally does provide an accurate estimation of the row number (Goette et al. 1994).

Many researchers have attempted to identify maize race based on kernel shape (see previous chapter). However, given the effect of charring and other processing on the

shape of archaeological maize kernels (Goette et al. 1994), such identifications are considered tentative at best, and this method is not employed in the present analysis.

Maize row number samples: Aztalan and CBHC. Maize row number measurements were taken from Aztalan samples and from flotation samples from the 2000 field season at the Crescent Bay Hunt Club (CBHC) site (47-JE-0904). Cupules from CBHC are included in part because of the small sample size for Aztalan maize, and also to provide a comparison for local Oneota maize. Appendix D (Table D.1) provides information on the specimens analyzed from both sites.

Row Number Measurement. Angles for undistorted kernels and cupules were measured using polar graphing paper marked in five degree increments. In the case of measurements of 70° , the measurement was recorded as 72° , as this is the likely angle measurement for 10 row cobs (Figure 3.8).

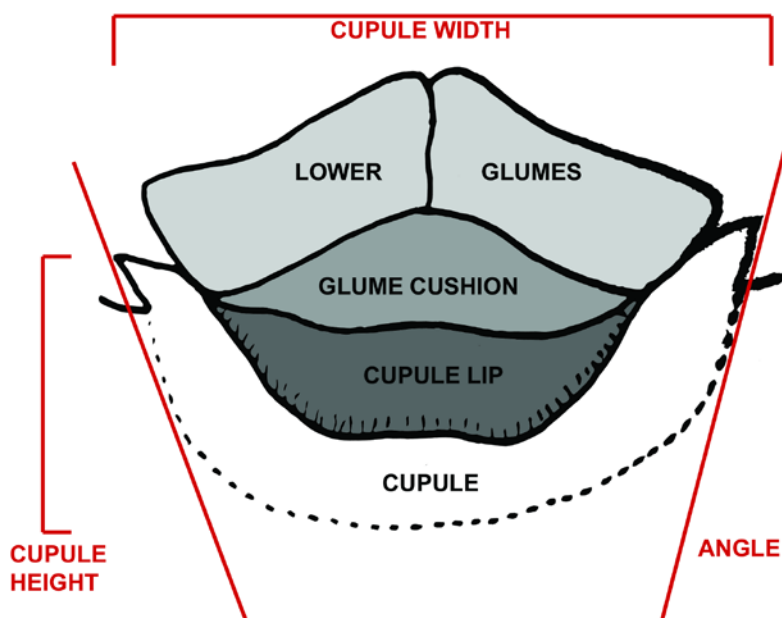


Figure 3.8: Cross-sectional diagram of maize cupule with measurements taken (modified from King 1994: Figure 3.1)

Chapter 4) The Aztalan Floral Assemblage: Results and Analysis

This chapter presents the results of the flotation analysis performed on 1984 and 2011 samples from Aztalan. Results of maize row number analyses carried out on Aztalan and Crescent Bay Hunt Club specimens are presented. The chapter contains a diachronic analysis of Late Woodland and Middle Mississippian contexts at Aztalan. A comparison of maize race data from two components at Aztalan and from Crescent Bay was conducted. A comparative analysis with four other late prehistoric sites in the region, and with broad trends elsewhere in Eastern North America, is also included.

Results of Aztalan Flotation Analysis

Table 4.1 shows the overall results of the flotation analysis by context. Volume data were not available for all contexts analyzed. A total of 1173 liters were floted from Stratum 11, with approximately one liter from Feature 6. The total volume of soil floted from Stratum 5 is unknown. A total of 105 liters of soil were floted from Feature 8.

Results of individual sample analyses may be seen in Appendix C. A total of 500.78 grams of carbonized plant material was recovered from these contexts; this mass excludes small seeds from the <2.0 mm split. Twenty-four different small seed taxa were identified; a total of 922 seeds were recovered.

Table 4.1: Results of Aztalan Flotation Analysis

Period	Late Woodland						Mississippian			
Provenience	M84 Stratum 11 (Includes Fea. 10)		Plaza Features 5, 11, 16		M84 Fea. 6		M84 Stratum 5		2011-20 Feature 8	
	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
Total flot soil volume (liters)	NA	NA	NA	NA	~1	NA	NA	NA	105.4	NA
Total wood charcoal	11036	172.24	430	4.81	2644	57.42	1218	15.05	5906	198.32
# of samples	23	NA	3	NA	1	NA	9	NA	5	NA
Total nutshell:	647	8.6	49	0.54	113	2.64	153	1.95	397	3.64
Juglandaceae:										
Unidentified nutshell	32	0.2	-	-	-	-	3	0.01	52	0.34
<i>Carya</i> sp [Hickory]	609	8.54	49	0.54	113	2.64	150	1.94	347	3.31
<i>Juglans nigra</i> [Black Walnut]	1	0.01	-	-	-	-	-	-	5	0.33
Other Nut Families:										
<i>Corylus</i> sp [Hazelnut]	2	0.02	-	-	-	-	-	-	-	-
<i>Quercus</i> sp [Oak]	3	0.03	-	-	-	-	-	-	1	0.01
Unidentified nutmeat	2	0.13	-	-	-	-	-	-	-	-
Poaceae:										
<i>Poaceae</i> [Unidentified]	5	-	-	-	-	-	-	-	14	-
Total <i>Zea mays</i>	248	1.96	34	0.35	45	0.37	71	0.47	511	4.15
<i>Zea mays</i> kernels	204	1.76	29	0.3	41	0.35	49	0.32	462	3.92
<i>Zea mays</i> cupules	44	0.2	5	0.05	4	0.02	22	0.15	49	0.23
<i>Hordeum pusillum</i> [Little Barley]	-	-	-	-	-	-	-	-	3	-
<i>Zizania aquatica</i> [Wild Rice]	10	-	-	-	-	-	-	-	3	-
cf <i>Zizania/Hordeum</i>	1	-	-	-	-	-	-	-	-	-
<i>Echinochloa</i> sp [Barnyard Grass]	1	-	-	-	-	-	-	-	-	-
Cucurbitaceae:										
<i>Cucurbita pepo</i> rind (incl. peduncle)	52	0.23	-	-	16	0.11	4	0.03	41	0.17

Period	Late Woodland						Mississippian			
Provenience	M84 Stratum 11 (Includes Fea. 10)		Plaza Features 5, 11, 16		M84 Fea. 6		M84 Stratum 5		2011-20 Feature 8	
	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
<i>Cucurbita pepo</i> seeds	1	-	-	-	-	-	-	-	-	-
<i>Lagenaria siceraria</i> [Bottle Gourd] rind	-	-	-	-	-	-	-	-	2	0.01
Asteraceae:										
<i>Asteraceae</i> [Unidentified]	1	-	-	-	-	-	-	-	4	-
<i>Helianthus annuus</i> [Sunflower]	-	-	-	-	-	-	-	-	1	-
<i>Iva annua</i> [Sumpweed]	-	-	-	-	-	-	-	-	1	-
<i>Ambrosia</i> sp [Ragweed]	-	-	-	-	-	-	-	-	-	-
Chenopods-Amaranths:										
<i>Chenopodium</i> sp	21	-	-	-	-	-	-	-	670	-
<i>Amaranthus</i> [Amaranth]	6	-	-	-	-	-	-	-	8	-
<i>Polygonum</i> sp	3	-	-	-	-	-	-	-	1	-
Rosaceae:										
<i>Rosaceae</i> [Unidentified]	-	-	-	-	-	-	-	-	2	-
<i>Prunus</i> sp [Cherry]	-	-	-	-	-	-	-	-	3	-
<i>Rubus</i> sp [Raspberry/Blackberry]	-	-	-	-	1	-	-	-	-	-
Solanaceae:										
<i>Solanum</i> [Nightshade]	29	-	-	-	-	-	-	-	3	-
<i>Nicotiana</i> [Tobacco]	-	-	-	-	-	-	-	-	2	-
Other Fruits/Seeds:										
<i>Vitaceae: Vitis</i> [Grape]	-	-	-	-	2	-	-	-	-	-
<i>Anacardiaceae: Rhus</i> sp [Sumac]	-	-	-	-	-	-	-	-	1	-
<i>Lamiaceae</i> [Mint family]	-	-	-	-	-	-	-	-	8	-
<i>Cyperaceae: Carex</i> [Sedge]	4	-	-	-	-	-	-	-	14	-
<i>Rubiaceae: Galium</i> [Bedstraw]	-	-	-	-	1	-	-	-	-	-
<i>Ericaceae: Epigaea</i> [Trailing Arbutus]	1	-	-	-	-	-	-	-	-	-
<i>Violaceae: Viola</i>	-	-	-	-	1	-	-	-	-	-

Period	Late Woodland						Mississippian			
Provenience	M84 Stratum 11 (Includes Fea. 10)		Plaza Features 5, 11, 16		M84 Fea. 6		M84 Stratum 5		2011-20 Feature 8	
	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
Unidentified Seeds	18	-	2	-	5	-	4	-	61	-
Other organic material:										
Tuber (aquatic)	3	0.11	-	-	-	-	-	-	-	-
Rhizome	7	0.06	3	0.03	1	0.01	3	0.03	2	0.02
Herbaceous stem	-	-	-	-	-	-	-	-	-	-
Fungus	-	-	-	-	98	0.59	-	-	43	0.23
Unidentified organic	78	0.62	13	0.09	12	0.11	15	0.08	43	0.39

Table 4.2 shows the relative abundance of all plant taxa identified during the flotation analysis. This table includes culturally and temporally unassigned contexts from the 2011 field season; these contexts (Test Unit 2 and Test Unit 12) are excluded from the remainder of the analysis. Wood charcoal is by far the most abundant category, followed by nutshell and then maize. Table 4.3 shows the density per liter for those contexts where volume information was available.

Table 4.2: Abundance for Aztalan Floral Remains

	Frequency (%) by weight	Weight (g)	Frequency (%) by fragment	Fragment Ct
Full Assemblage*				
Wood Charcoal	93.95%	522.67	86.29%	22120
<i>Zea mays</i>	1.55%	7.51	3.62%	936
Cucurbit/ <i>Lagenaria</i> rind	0.12%	0.57	0.46%	118
Nutshell/Nutmeat	3.86%	18.73	5.48%	1417
All Seeds	-	-	3.57%	922
Other floral remains	0.52%	2.54	1.30%	337
Mississippian Contexts				
Wood Charcoal	95.03%	213.37	77.33%	7124
<i>Zea mays</i>	2.06%	4.62	6.32%	582
Cucurbit/ <i>Lagenaria</i> rind	0.09%	0.21	0.51%	47
Nutshell/Nutmeat	2.49%	5.59	5.97%	550
All Seeds	-	-	8.72%	803
Other floral remains	0.33%	0.75	1.15%	106
Late Woodland Contexts				
Wood Charcoal	93.46%	234.57	90.19%	14110
<i>Zea mays</i>	1.07%	2.68	2.09%	327
Cucurbit/ <i>Lagenaria</i> rind	0.14%	0.34	0.43%	68
Nutshell/Nutmeat	4.69%	11.78	5.18%	811
All Seeds	-	-	0.73%	114
Other floral remains	0.65%	1.62	1.37%	215

*includes all samples (Appendix A)

Table 4.3: Density Table for Contexts with Volume Data

	2011-20 Feature 8	M84 Stratum 11*
Nutshell		
Fragments (ct)	397.00	91.00
Weight (g)	3.64	2.37
# of liters	105.40	1173.00
Density (ct/ 10 liters)	37.67	5.19
Density by wt (g/ 10 liters)	0.35	0.07
Zea mays		
Fragments (ct)	462.00	196.00
Weight (g)	3.92	1.71
# of liters	105.40	1173.00
Density (ct/ 10 liters)	43.83	1.67
Density by wt (g/ 10 liters)	0.37	0.01
Cucurbita (rind)		
Fragments (ct)	41.00	49.00
Weight (g)	0.17	0.22
# of liters	105.40	1173.00
Density (ct/ 10 liters)	3.89	0.42
Density (g/ 10 l)	0.00	0.00
Chenopodium (seeds)		
Seeds (ct)	670.00	21.00
# of liters	105.40	1173.00
Density (ct/ 10 liters)	63.57	0.18

*Does not include M84-1094, M84-1421, includes Feature 10

Accelerator Mass Spectrometry Dating

In order to provide further temporal data on maize use at Aztalan, two direct AMS dates were run on specimens identified during research for this project. The first date was run on two maize kernels from 2011-20 Feature 8. Both were too rounded to permit

accurate row number estimation. These kernels were submitted to Beta Analytic. The date for the Feature 8 maize is 910 ± 30 B.P. or cal A.D. 1030-1210 (Reimer et al. 2009). This date is consistent with the suggestion that the feature relates to the early part of the Mississippian occupation (Table 4.4).

Table 4.4: AMS Dates on Aztalan Maize

Context	Material	Lab	Conventional Radiocarbon Age	Cal 1σ Range	Cal 2σ Range
2011-20 Feature 8	Maize kernel	BETA	910 \pm 30 B.P.	Not provided	A.D. 1030-1210
				A.D. 1043-1054	
				A.D. 1077-1106	
M84 Feature 6	Maize kernel	ISGS	930 \pm 15 B.P.	A.D. 1118-1153	A.D. 1040-1155

The second date was run on 4 kernel fragments recovered from M84 Feature 6, submitted to the Illinois State Geological Survey (ISGS). Again, these specimens were too fragmentary to permit row number estimation. These produced a conventional radiocarbon age of 930 ± 15 B.P., or cal A.D. 1040-1155 (Reimer et al. 2009). This new date is later than the earlier date on wood charcoal for this feature, cal A.D. 780-1020 (Richards 1985; Richards and Jeske 2002:44). This difference is not surprising, since maize is an annual grass and provides much more accurate dates than wood charcoal.

Recent re-analysis of a suite of 23 radiocarbon assays from Aztalan (Richards and Picard 2013) demonstrates that these 23 dates, taken from both Late Woodland and Mississippian contexts at the site, are statistically identical at the 95 percent confidence level. This leads to the conclusion that events at Aztalan may have occurred during a short period of time, rendering stratigraphic information more reliable than radiocarbon dates in determining site chronology (Richards and Picard 2013).

Intrasite Analysis

The primary goal of this research consists of comparison of Late Woodland contexts and those contexts which contain both Mississippian and Late Woodland pottery. These contexts represent a later component at the site where residents utilized both Late Woodland and Mississippian vessels; this component will be referred to as “Mississippian” in the analysis for the sake of simplicity. The Late Woodland contexts studied include M84 Stratum 11 and M84 plaza Features 5, 11 and 16. The Mississippian contexts are represented by M84 Stratum 5 and 2011-20 Feature 8. While these contexts are assumed to represent different time periods, they may also represent different utilization patterns; these possibilities will be discussed in Chapter 5. Comparison of floral subsistence remains is presented by taxonomic category below.

Nutshell

Nutshell is the most frequently identified plant food recovered at Aztalan. Nutshell ubiquity is 95.24 percent for Late Woodland contexts (excluding noncultural strata S11₄ and S11₈) and 100.00 percent for mixed Mississippian contexts. However, the nut:wood ratio is higher for the Late Woodland contexts than for the mixed contexts (0.05 versus 0.03 by weight) (Table 4.5). Nutshell density (fragments per liter and grams per liter) is higher for 2011-20 Feature 8 than for M84 Stratum 11 (37.67 ct/10 liters versus 5.19 ct/10 liters) (Table 4.3). The dramatic difference observed in densities for the two contexts may be a reflection of the overall larger amount of charred material in Feature 8; the use of the nut:wood ratio is intended to correct for this.

Table 4.5: Aztalan Nutshell Comparison by Context

	Number of Fragments	Weight of fragments	# samples w/ nutshell (w/o S11(4) and S11(8))	Total samples (w/o S11(4) and S11(8))	Nut:Wood Ratio (g)	Ubiquity (including S11(8) and S11(4))	Ubiquity without S11(4) and S11(8)
Total Nutshell							
Stratum 11	647	8.46	19(16)	23(17)	0.05	82.61%	94.12%
Feature M84-6	113	2.64	1	1	0.05	100.00%	100.00%
Plaza Features	49	0.54	3	3	0.11	100.00%	100.00%
Total LW:	809	11.64	23(20)	27(21)	0.05	85.19%	95.24%
Stratum 5	153	1.95	9	9	0.13	100.00%	100.00%
Feature 2011-8	397	3.64	5	5	0.02	100.00%	100.00%
Total MM:	550	5.59	14	14	0.03	100.00%	100.00%
<i>Juglandaceae</i> (indeterminate)							
Stratum 11	32	0.20	4(4)	23(17)	0.00	17.39%	23.53%
Feature M84-6	0	0.00	0	1	0.00	0.00%	0.00%
Plaza Features	0	0.00	0	3	0.00	0.00%	0.00%
Total LW:	32	0.20	4(4)	27(21)	0.00	14.81%	19.05%
Stratum 5	3	0.01	1	9	0.00	11.11%	11.11%
Feature 2011-8	52	0.34	2	5	0.00	40.00%	40.00%
Total MM:	55	0.35	3	14	0.00	21.43%	21.43%
<i>Carya</i> sp							
Stratum 11	609	8.54	19(16)	23(17)	0.05	82.61%	94.12%
Feature M84-6	113	2.64	1	1	0.05	100.00%	100.00%
Plaza Features	49	0.54	3	3	0.11	100.00%	100.00%
Total LW:	771	11.72	23(20)	27(21)	0.05	85.19%	95.24%
Stratum 5	150	1.94	9	9	0.13	100.00%	100.00%
Feature 2011-8	347	3.31	4	5	0.02	0.80%	0.80%
Total MM:	497	5.25	13	14	0.02	92.86%	92.86%
<i>Juglans</i> sp							
Stratum 11	1	0.01	1(1)	23(17)	0.00	4.35%	5.88%
Feature M84-6	0	0.00	0	1	0.00	0.00%	0.00%
Plaza Features	0	0.00	0	3	0.00	0.00%	0.00%
Total LW:	1	0.01	1(1)	27(21)	0.00	3.70%	4.76%
Stratum 5	0	0.00	0	9	0.00	0.00%	0.00%

		Number of Fragments	Weight of fragments	# samples w/ nutshell (w/o S11(4) and S11(8))	Total samples (w/o S11(4) and S11(8))	Nut:Wood Ratio (g)	Ubiquity (including S11(8) and S11(4))	Ubiquity without S11(4) and S11(8)
<i>Quercus</i> sp	Feature 2011-8	5	0.33	1	5	0.00	20.00%	20.00%
	Total MM:	5	0.33	1	14	0	7.14%	7.14%
	Stratum 11	3	0.03	3(3)	23(17)	0.00	13.04%	17.65%
	Feature M84-6	0	0.00	0	1	0.00	0.00%	0.00%
<i>Corylus</i> sp	Plaza Features	0	0.00	0	3	0.00	0.00%	0.00%
	Total LW:	3	0.03	3(3)	27(21)	0.00	11.11%	14.29%
	Stratum 5	0	0.00	0	9	0.00	0.00%	0.00%
	Feature 2011-8	1	0.01	1	5	0.00	20.00%	20.00%
	Total MM:	1	0.01	1	14	0.00	7.14%	7.14%
	Stratum 11	2	0.02	2(2)	23(17)	0.00	8.70%	8.70%
	Feature M84-6	0	0.00	0	1	0.00	0.00%	0.00%
Plaza Features	0	0.00	0	3	0.00	0.00%	0.00%	
Total LW:	2	0.02	2(2)	27(21)	0.00	7.41%	7.41%	
Stratum 5	0	0.00	0	9	0.00	0.00%	0.00%	
Feature 2011-8	0	0.00	0	5	0.00	0.00%	0.00%	
Total MM:	0	0.00	0	14	0.00	0.00%	0.00%	

In a draft of an article prepared for the *Midcontinental Journal of Archaeology* (MCJA), Kathryn Egan-Bruhy (2014) cites data for three distinct components at Aztalan. These samples originate in samples recovered during excavations led by Goldstein and Gaff, and component identifications are based on ceramic data. For the Effigy Mound Late Woodland component, Egan-Bruhy cites nutshell as 1.1 percent of the floral assemblage, with 4.2 ct/10 liters of flot and a ubiquity of 66 percent. For what is identified as the Collared Ware Late Woodland component, Egan-Bruhy describes nutshell as 3.1 percent of the floral assemblage, with a density of 20.1 ct/10 liters and a

ubiquity of 87.5 percent. Egan-Bruhy's summary data for the Mississippian component at the site includes data presented in this thesis. For this component, Egan-Bruhy describes nutshell as 5.5 percent of the assemblage, with a density of 35.1 ct/10 liters and a ubiquity of 87.5 percent (Egan-Bruhy 2014:Tables 1-3). These data suggest an increase in the exploitation of nut masts through time at the site.

Hickory (*Carya* sp.) is by far the most common type of nut identified; hickory was identified in almost all samples containing nutshell. Walnut (*Juglans* sp.) was slightly more likely to be recovered from Mississippian samples than in Late Woodland contexts (7.14 percent ubiquity versus 3.70 percent ubiquity). By contrast, acorn (*Quercus* sp.) and hazelnut (*Corylus* sp.) are more likely to be found in Late Woodland contexts (11.11 percent ubiquity versus 7.14 percent ubiquity and 7.41 percent ubiquity versus 0.00 percent ubiquity, respectively) (Table 4.5).

Zea mays

Overall, the maize:wood ratio by weight is slightly higher for Mississippian contexts (0.02) than for Late Woodland samples (0.01) (Table 4.6). When non-cultural substrata are excluded, maize ubiquity is higher for Late Woodland samples (90.48 percent versus 78.58 percent). This trend is true of both kernel and cupule/cob fragments. Densities for maize fragments are both greater for 2011-20 Feature 8 (43.83 ct/10 liters) than for M84 Stratum 11 (1.67 ct/10 liters) (Table 4.3).

Table 4.6: Aztalan Maize Comparisons by Context

	Number of Fragments	Weight of fragments	# samples w/ maize (w/o S11(4) and S11(8))	Total samples (w/o S11(4) and S11(8))	Maize:Wood Ratio (g)	Ubiquity including S11(4) and S11(8)	Ubiquity without S11(4) and S11(8)
Total Zea mays							
Stratum 11	248	1.96	17(15)	23(17)	0.01	73.91%	88.24%
Feature M84-6	45	0.37	1	1	0.01	100.00%	100.00%
Plaza Features	34	0.35	3	3	0.07	100.00%	100.00%
Total LW:	327	2.68	21(19)	27(21)	0.01	77.78%	90.48%
Stratum 5	71	0.47	7	9	0.03	77.78%	77.78%
Feature 2011-8	511	4.15	4	5	0.02	80.00%	80.00%
Total MM:	582	4.62	11	14	0.02	78.58%	78.58%
Kernel Fragments							
Stratum 11	204	1.76	17(15)	23(17)	0.01	73.91%	88.24%
Feature M84-6	41	0.50	1	1	0.01	100.00%	100.00%
Plaza Features	29	0.30	3	3	0.06	100.00%	100.00%
Total LW:	274	2.56	21(19)	27(21)	0.01	77.78%	90.48%
Stratum 5	49	0.32	7	9	0.02	77.78%	77.78%
Feature 2011-8	462	3.92	4	5	0.02	80.00%	80.00%
Total MM:	511	4.24	11	14	0.02	78.57%	78.57%
Cupule/Cob Fragments							
Stratum 11	44	0.20	9(9)	23(17)	0.00	39.13%	50.94%
Feature M84-6	4	0.02	1	1	0.00	100.00%	100.00%
Plaza Features	5	0.05	2	3	0.01	66.67%	66.67%
Total LW:	53	0.27	12(12)	27(21)	0.00	44.44%	57.14%
Stratum 5	22	0.15	5	9	0.01	55.55%	55.55%
Feature 2011-8	49	0.23	1	5	0.00	20.00%	20.00%
Total MM:	71	0.38	6	14	0.00	42.86%	42.86%

The ubiquity of maize in the Late Woodland samples indicates that this resource was available to the Late Woodland inhabitants of the site, however the higher ubiquity observed in Stratum 11 versus Stratum 5 may be an artifact of comparing a midden

deposit with an occupational surface. The maize:wood ratio and Feature 8 maize density suggest an increase in the use of maize between the two components.

Kathryn Egan-Bruhy's (2014) data for Effigy Mound Late Woodland at Aztalan show maize as 0.3 percent of the total floral assemblage, with 1.2 ct/10 liters and 66 percent ubiquity. For the Collared Ware Late Woodland component, maize is 5.5 percent of the total floral assemblage, with 15.4 ct/10 liters and 75 percent ubiquity. For the Mississippian component, which includes data from this thesis, Egan-Bruhy notes that maize is 3 percent of the total floral assemblage, with 23.6 ct/10 liters and 70.1 percent ubiquity. These data appear to indicate a slight increase in recovery of maize between Collared Ware Late Woodland contexts and Mississippian contexts (Egan-Bruhy 2014:Table 1-3).

Squash Rind

A number of fragments of squash rind, likely *Cucurbita pepo*, were identified in the Aztalan assemblage. One likely fragment of bottle gourd (*Lagenaria siceraria*) was identified from 2011-20 Feature 8. Ubiquity for squash rind is considerably higher in Late Woodland contexts (52.38 percent) than in Mississippian contexts (28.57 percent) (Table 4.7). This result supports the notion that Late Woodland residents of the site engaged in some degree of horticulture prior to the appearance of Mississippian traits at the site. Density for squash rinds (ct/10 liters) was higher for 2011-20 Feature 8 (3.89) than for M84 Stratum 11 (0.42) (Table 4.3). The rind:wood ratio by count is higher for Late Woodland/Mississippian contexts (0.01) than for Late Woodland contexts (0.00)

(Table 4.7). Both density and the rind:wood ratio suggest that squash use may have been intensified through time at the site.

Egan-Bruhy (2014) does not note any squash in Effigy Mound Late Woodland contexts from the site. For Collared Ware Late Woodland contexts, squash exhibits 38 percent ubiquity. Mississippian contexts, which include data from this thesis, show 24 percent squash ubiquity (Egan-Bruhy 2014: Table 1-3). These data are in line with results from this study which demonstrate squash to be an important resource for both Late Woodland and Mississippian residents at Aztalan.

Table 4.7: Aztalan Cucurbit Comparison by Context

	Number of Fragments	Weight of fragments	# samples w/ rind (w/o S11(4) and S11(8))	Total samples (w/o S11(4) and S11(8))	Rind:Wood Ratio (ct)	Ubiquity including S11(4) and S11(8)	Ubiquity without S11(4) and S11(8)
Total Cucurbit*							
Stratum 11	52	0.23	10(10)	23(17)	0.00	47.48%	58.82%
Feature M84-6	16	0.11	1	1	0.01	100.00%	100.00%
Plaza Features	0	0.00	0	3	0.00	0.00%	0.00%
Total LW:	68	0.34	11(11)	27(21)	0.00	40.74%	52.38%
Stratum 5	4	0.03	3	9	0.00	33.33%	33.33%
Feature 2011-8*	43	0.18	1	5	0.01	20.00%	20.00%
Total MM:	47	0.21	4	14	0.01	28.57%	28.57%

*Includes one fragment of *Lagenaria* rind from 2011-20 Feature 8

Small Seeds and Cultigens

Table 4.8 shows the seed diversity for all contexts included in the analysis. Overall, the Late Woodland and Middle Mississippian contexts have the same number of different seed types identified (16 each). 2011-20 Feature 8 has the greatest variety of seed types for any context.

Table 4.8: Aztalan Seed Diversity by Context

Context	Chenopod-Amaranths			Rosaceae			Poaceae					Cucurbitaceae	Solanaceae		Asteraceae			Other Fruits and Seeds							
	<i>Chenopodium</i>	<i>Amaranthus</i>	<i>Polygonum</i>	Unid. Rosaceae	<i>Prunus</i> (cherry)	<i>Rubus</i>	Unid. Poaceae	<i>Hordeum pusillum</i> (little barley)	<i>Zizania aquatica</i> (wild rice)	cf <i>Hordeum/Zizania</i>	<i>Echinochloa</i> (barnyard grass)	<i>Cucurbit</i> (seed)	<i>Nicotiana</i> (tobacco)	<i>Solanum</i> (nightshade)	Unid. Asteraceae	<i>Helianthus annuus</i> (sunflower)	<i>Iva annua</i> (sumpweed)	<i>Vitis</i> (grape)	<i>Viola</i> (violet)	<i>Rhus</i> (sumac)	<i>Galium</i> (bedstraw)	<i>Carex</i> (sedge)	<i>Epigaea</i>	<i>Lamiaceae</i> (mint family)	Unidentified Seeds
2011-20 Feature 8	*	*	*	*	*		*	*				*	*	*	*	*				*		*		*	*
M84 Stratum 5																									*
All Mississippian	*	*	*	*	*		*	*				*	*	*	*	*				*		*		*	*
M84 Feature 6						*											*				*				*
M84 Stratum 11	*	*	*				*		*	*	*		*	*				*	*		*	*	*		*
Plaza Fea. 5, 11, 16																									*
All Late Woodland	*	*	*			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

The types of seeds represented for the two time periods are different. The seeds found in both Late Woodland and Middle Mississippian deposits are *Chenopodium*, knotweed (*Polygonum*), amaranth (*Amaranthus*), wild rice (*Zizania aquatica*), nightshade (*Solanum*), aster family (*Asteraceae*), sedge (*Carex*), and grass (*Poaceae*). This suggests that certain starchy seeds (*Chenopodium*, knotweed and amaranth) and wild rice were utilized to a limited extent throughout the occupation of the site; the latter four taxa may be accidental non-cultural inclusions, perhaps from seed rain or fibers. Seeds identified in the Late Woodland component only include squash (*Cucurbita pepo* seed, rind was recovered from both components), barnyard grass (*Echinochloa*), raspberry/blackberry (*Rubus*), grape (*Vitis*), bedstraw (*Gallium*), *Epigea*, and violet (*Viola*). Seeds found in the Middle Mississippian component only include sunflower (*Helianthus annuus*), little barley (*Hordeum pusillum*), sumpweed (*Iva annua*), tobacco (*Nicotiana*), cherry (*Prunus*), sumac (*Rhus*), mint family (*Lamiaceae*), and rose family (*Rosaceae*).

Based on these results, the Mississippian component contains a greater variety of possible native cultigens. It also appears that tobacco was utilized or grown during the Mississippian occupation of the site, but there is no evidence for tobacco use during the Late Woodland occupation. Most of the seeds from the Mississippian component were identified from Feature 8, which may represent a very different depositional context compared with the midden strata.

In her article draft, Egan-Bruhy (2014) notes no starchy seeds for the Effigy Mound Late Woodland component. Contexts identified as Collared Ware Late Woodland contain *Chenopodium*, *Polygonum*, barnyard grass and maygrass. Contexts identified as

Mississippian, which include data from this thesis, contain *Chenopodium*, little barley, *Polygonum*, sunflower, sumpweed, maygrass, bottle gourd, tobacco and wild rice (Egan-Bruhy 2014: Table 3). This is consistent with the findings presented in this study, which recovered oily-seeded annuals from Mississippianized contexts.

Chenopodium. *Chenopodium* was the most frequently identified small seed. Table 4.9 illustrates the ubiquity of *Chenopodium* seeds. On the whole, ubiquities are similar between Late Woodland and Mississippian contexts (23.81 percent and 21.43 percent, respectively) 2011-20. In her *MCJA* article draft, Egan-Bruhy (2014:Table 3) also notes 28 percent *Chenopodium* ubiquity for Collared Ware Late Woodland contexts and 29 percent ubiquity for Mississippian contexts (which include data from this thesis). *Chenopodium* density for Feature 8 (63.57 ct/10 liters) is also high compared with Stratum 11 (0.18 ct/10 liters) (Table 4.3).

Table 4.9: Aztalan *Chenopodium* Comparison by Context

	Number of Seeds	# samples w/ seeds (w/o S11(4) and S11(8))	Total samples (w/o S11(4) and S11(8))	Ubiquity including S11(4) and S11(8)	Ubiquity without S11(4) and S11(8)
Total Chenopod					
Stratum 11	21	6(5)	23(17)	26.08%	29.41%
Feature M84-6	0	0	1	0.00%	0.00%
Plaza Features	0	0	3	0.00%	0.00%
Total LW:	21	6(5)	27(21)	22.22%	23.81%
Stratum 5	0	0	9	0.00%	0.00%
Feature 2011-8*	670	3	5	60.00%	60.00%
Total MM:	670	3	14	21.43%	21.43%

Assemblage Diversity

The Shannon-Weaver index (described in Chapter 3) was used to assess the relative diversity of the assemblages from each component. Results are presented in Table 4.10. For purposes of the Shannon-Weaver index, only counts for taxa likely to have been utilized as food are included.

Table 4.10: Shannon-Weaver Diversity Index for Aztalan Components

	Aztalan (LW)	Aztalan (LW/MM)	All Aztalan
Nutshell: Unidentified	32	55	87
Nutshell: Hickory [<i>Carya</i>]	771	497	1268
Nutshell: Walnut [<i>Juglans</i>]	1	5	6
Nutshell: Hazelnut [<i>Corylus</i>]	2	-	2
Nutshell: Oak (Acorn) [<i>Quercus</i>]	3	1	4
Maize [<i>Zea mays</i>]	327	582	909
Squash [<i>Cucurbita</i>]	69	45	114
Bottle gourd [<i>Lagenaria siceraria</i>]	-	1	1
Little barley [<i>Hordeum pusillum</i>]	-	3	3
Wild rice [<i>Zizania aquatica</i>]	10	3	13
cf <i>Zizania/Hordeum</i>	1	-	1
Barnyard grass [<i>Echinochloa</i> sp]	1	-	1
Maygrass [<i>Phalaris carolinianum</i>]	-	-	-
Panicoid [<i>Panicum</i>]	-	-	-
Sunflower [<i>Helianthus annuus</i>]	-	1	1
Sumpweed [<i>Iva annua</i>]	-	1	1
Chenopodium [<i>Chenopodium</i> sp]	21	670	691
Chenopod/Amaranth	-	-	-
Amaranth [<i>Amaranthus</i> sp]	6	8	14
Knotweed [<i>Polygonum</i> sp]	3	1	4
Unid. <i>Rosaceae</i>	-	2	2
Cherry [<i>Prunus</i> sp]	-	3	3
Raspberry/Blackberry [<i>Rubus</i> sp]	1	-	1
Strawberry [<i>Fragaria</i>]	-	-	-
Nightshade [<i>Solanum</i>]	29	3	32
Grape [<i>Vitis</i>]	2	-	2
Sumac [<i>Rhus</i> sp]	-	1	1
Blueberry [<i>Vaccinium</i>]	-	-	-
Bedstraw [<i>Galium</i>]	1	-	1
Cattail [<i>Stypha</i>]	-	-	-
Pea family [<i>Fabaceae</i>]	-	-	-
Wild bean [<i>Strophostyles helveola</i>]	-	-	-
Tuber [aquatic]	3	-	3
Fungus (incl fruiting structures)	98	43	141
Total (N)	1381	1925	3306
Diversity index (H) (natural log (ln))	1.38	1.46	1.56

The Shannon-Weaver index for Late Woodland contexts at the site is 1.38, while the index for Mississippian contexts is 1.46 (the diversity index for the assemblage as a whole is 1.56). This indicates a greater diet breadth for the site following Mississippian contact. While the Shannon-Weaver index does not specify which taxa are responsible for increased diet breadth, a perusal of the numeric data indicate a much higher number of *Chenopodium* seeds in the Mississippian contexts (670 versus 21 in the Late Woodland contexts) possibly indicating a greater balance between these seeds, maize and nutshell for the later time period. This, combined with the presence of oily-seeded annuals in later contexts and the high density of *Chenopodium* seeds in Feature 8, suggests an increase in the use of native cultigens through time.

Comparison with Northeast Mound Structure 1

In a 1985 paper presented at the Society for American Archaeology meeting in Denver, Colorado, Constance Arzigian presented data from preliminary analyses of Aztalan and Fred Edwards floral assemblages (Arzigian 1985). The Aztalan data were taken from 1967 Wisconsin Historical Society (WHS) excavations. Included among the contexts studied were two samples from a “house,” a sub-mound feature identified as “Structure 1” in Thomas Zych’s (2013) recent analysis of the Northeast Mound excavations (Figure 4.1). Ceramic debris associated with this structure includes Late Woodland vessels and a hybrid Hyer Plain vessel (2013:63-67). According to Constance Arzigian, the tags from samples HS-1 and HS-2 read “NE Mound House 1, Brown organic debris level” and “NE Mound House 1 greyish brown soil,” respectively (personal communication, 2013).

Charcoal weights were not recorded for the Aztalan samples analyzed by Arzigian (personal communication, 2013). Table 4.11 provides a comparison between 1984 Late Woodland contexts (those with available volume data), 2011-20 Feature 8, and Structure 1 from the 1967 excavations.

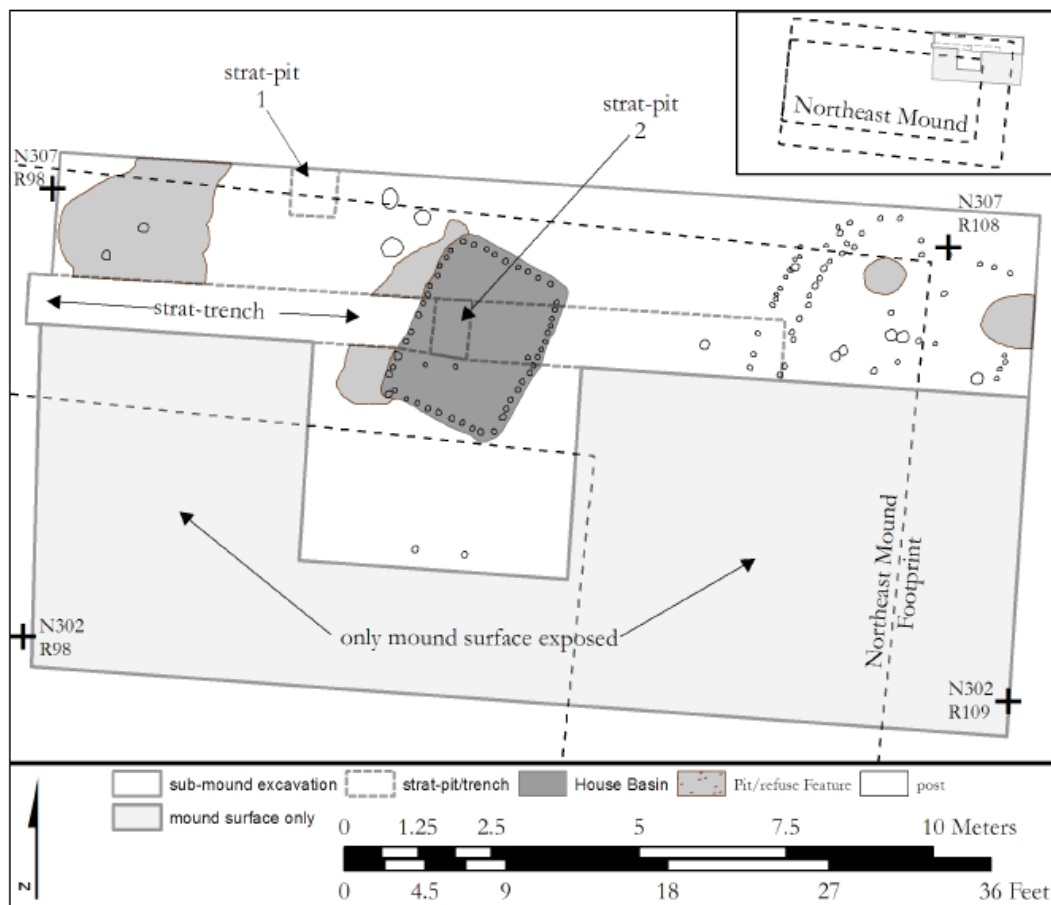


Figure 4.1: Map showing location of Structure 1 within Northeast Mound. Structure 1 is single-post structure along north edge of mound (WHS, Aztalan Map #26 & 41) (Zych 2013: Figure 4-2)

Table 4.11: Density Comparison between 1984 and 2011 Aztalan Contexts with Volume Data and 1967 Structure 1

Context	Aztalan Stratum 11 and LW Features		NE Mound HS-1, HS-2 (Arzigian 1985)
	Late Woodland	Mississippianized	Late Late Woodland/Early Mississippian
Total Flot Volume	1173.00*	105.40*	17.80
# Samples	27(21)	14	2
# Features	1	5	2
All Nutshell			
Density (g/10 liters)	0.07**	0.35**	0.97
Hickory (<i>Carya</i> sp)			
Density (g/10 liters)	0.07**	0.31**	0.71
Walnut (<i>Juglans</i> sp)			
Density (g/10 liters)	0.00**	0.03**	0.03
Acorn (<i>Quercus</i> sp)			
Density (g/10 liters)	0.00**	0.00**	0.00
Hazelnut (<i>Corylus</i> sp)			
Density (g/10 liters)	0.00**	0.00**	0.00

Context	Aztalan Stratum 11 and LW Features	2011-20 Feature 8	NE Mound HS-1, HS-2 (Arzigian 1985)
Association	Late Woodland	Mississippianized	Late Late Woodland/Early Mississippian
<i>Zea mays</i>			
Density (g/10 liters)	0.01**	0.37**	1.22
<i>Cucurbita pepo</i>			
Density (ct/10 liters)	0.42**	3.89**	129.78
<i>Chenopodium</i>			
Density (ct/10 liters)	0.18**	63.57**	176.40
<i>Zizania aquatica</i>			
Density (ct/10 liters)	0.09**	0.28**	0.00

* = S11 flot volume does not include M84-1094, M84-1421; flot volume for Mississippianized contexts includes only Feature 2011-8.

** = only includes those contexts with volume data

The immediately notable difference between the samples analyzed by Arzigian (1987) and the samples included in this analysis is that the Structure 1 samples contained a higher density of floral remains in general compared with samples from Aztalan with volume data (Feature 8 and Stratum 11). This is true in terms of nutshell (0.97 g/10 liters versus 0.35 g/10 liters for Mississippian Feature 8 and 0.07 g/10 liters for Late Woodland Stratum 11), but particularly striking with regard to domesticates and cultigens such as maize, squash rind and *Chenopodium* sp. seeds. The Northeast Mound structure exhibits a maize density of 1.22 g/10 liters, compared with 0.37 g/10 liters for Feature 8 and 0.01 g/10 liters for Late Woodland Stratum 11. *Chenopodium* density for Structure 1 is 176.4 ct/10 liters, versus 63.57 ct/10 liters for Feature 8 and 0.18 ct/10 liters for Stratum 11.

This Structure 1, located below the Northeast Mound, likely relates to the early appearance of Mississippian traits at Aztalan (Zych 2013). While increases in the densities of cultigens and domesticates compared to the Late Woodland component likely relate to intensification of farming at the site, temporal factors are probably not sufficient to explain the vast disparity between the floral assemblage from this structure and the assemblages from the contexts analyzed for this thesis. More likely, differential use leads to different floral signatures in different areas of the site. If this structure represents a house, then perhaps domestic contexts at Aztalan exhibit a greater concentration of floral remains relative to midden contexts; floral remains are small and may not be transported as far as other refuse. Alternatively, given the association of this structure with the Northeast Mound, the floral assemblage may be related to feasting residue. Non-temporal explanations for the different floral signatures seen across the site are discussed in Chapter 5.

The Effect of Depositional Context on the Aztalan Assemblage

Stratum 5 and Stratum 11. A complicating factor for the diachronic analysis is the issue of depositional context. Even within the riverbank midden excavated in 1984, Stratum 11 and Stratum 5 likely represent different kinds of depositional events. Stratum 11 probably consists of a refuse midden; substratum S11₁₀, for example, consists of “in-situ ash beds and dumping episodes” (Richards 1992:148). By contrast Stratum 5 is argued to represent the Middle Mississippian occupational surface horizon, based in part on the presence of postmolds and wall trenches (Kolb et al. 1990; Richards 1992). A midden deposit and a living surface will likely have very different depositional patterns. The midden will likely contain a greater density of all types of refuse, including floral remains. The occupational surface may have a lower density, and be more subject to disturbance during prehistory. Wood ratios are employed in this study as a means to control for differential deposition.

2011-20 Feature 8. Like Northeast Mound Structure 1, densities of floral material are higher for Feature 8 than for Stratum 5 and Stratum 11. The artifact assemblage is somewhat unusual for domestic refuse, as it contains over 100 fragments of cut sheet copper, copper artifacts, a high density of pottery and a nearly-intact groundstone celt. Barrett reports a high density of copper within Enclosure 30 (1933). As discussed above, the floral assemblage for this feature is more diverse than for other site areas, which may be reflective of increasing dietary breadth during the Mississippian occupation; however it may also reflect that this feature was deposited as a special event. The faunal assemblage includes raptor, waterfowl, deer, canid and fur-bearing mammals alongside a

wide variety of fish (Rachel McTavish, personal communication, 2013). Possible interpretations for this feature are discussed in the next chapter.

Maize Race Results and Analysis

Appendix D (Table D.1) shows the samples which yielded measurable cupules or kernels for row number analysis. Specimens from Aztalan and from previously sorted flotation samples from the Crescent Bay Hunt Club site (47-JE-0904) were measured. Due to the fragmentary nature of much of the floral assemblage, most maize specimens from Aztalan could not produce accurate measurements. The Crescent Bay Hunt Club site, an Oneota site which is also located in Jefferson County on the banks of Lake Koshkonong, is included also in the comparative analysis for general floral resource use discussed in the next section.

Appendix D (Table D.2) shows the angle measurement for each individual specimen, along with length and width measurements. While measurements from Mississippian contexts and strictly Late Woodland contexts at Aztalan are similar, mean estimated row number for Mississippian contexts does appear to be slightly higher, however the small sample size renders this observation insignificant (Table 4.11). The sole measureable sample from Feature 6 (a maize kernel) had an angle measurement consistent with 12 row cobs. Mean angle measurements for Crescent Bay Hunt Club samples were considerably smaller than those from all contexts at Aztalan, suggesting the prevalence of higher row number cobs.

Due to the previously cited inaccuracies surrounding row number measurement based on kernel angle, average angle measurements were also calculated based on cupule

measurements only. Mean angle measurements from the Aztalan contexts were similar, while Crescent Bay measurements were significantly smaller, indicating higher row number. Again, the Mississippian sample from Aztalan is not statistically significant. On the whole, the averages for both sites reflect 10-12 row cobs (Table 4.12).

Table 4.12: Mean Angle Measurement by Context for Aztalan and Crescent Bay (Cupules Only)

Site (Number)	Context	Mean Angle (°)	Estimated Row #
Aztalan (47JE0001)	M84 Stratum 5	69.75	10-12
	Feature 2011-20.0318	70.8	10-12
	Mean all Mississippian contexts	70.15	10-12
	Feature M84-06	No cupules	NA
	Stratum 11	69.27	10-12
	Mean all Late Woodland	69.27	10-12
Crescent Bay Hunt Club (47JE0904)	All Contexts	62.49	10-12

Comparing counts for specimens with varying row number assumes that angle measurements are accurate. Nonetheless, this type of comparison permits analysis of the potential variety of maize types present in a given assemblage. Table 4.13 shows raw counts for different angle measurements by context. Specimens have been divided into high and low row number types for analytical purposes.

Table 4.13: Row Number Counts for Aztalan and Crescent Bay by Component (Cupules Only)

Context	45-60° (12-16 row)	72-90° (8-10 row)
Crescent Bay Hunt Club	33	8
All Mississippian (Aztalan)	5	8
All Late Woodland (Aztalan)	10	11

As seen in Figure 4.2, 12 row cobs are common in Aztalan Late Woodland and Mississippian contexts, and they predominate in the sample taken from the Oneota

features at CBHC. Interestingly, CBHC site also had some specimens with angle measurements consistent with very high row numbered cobs (16 row). While eight row specimens do not dominate any context, they are more common in Late Woodland contexts from Aztalan than in Mississippianized and Oneota contexts.

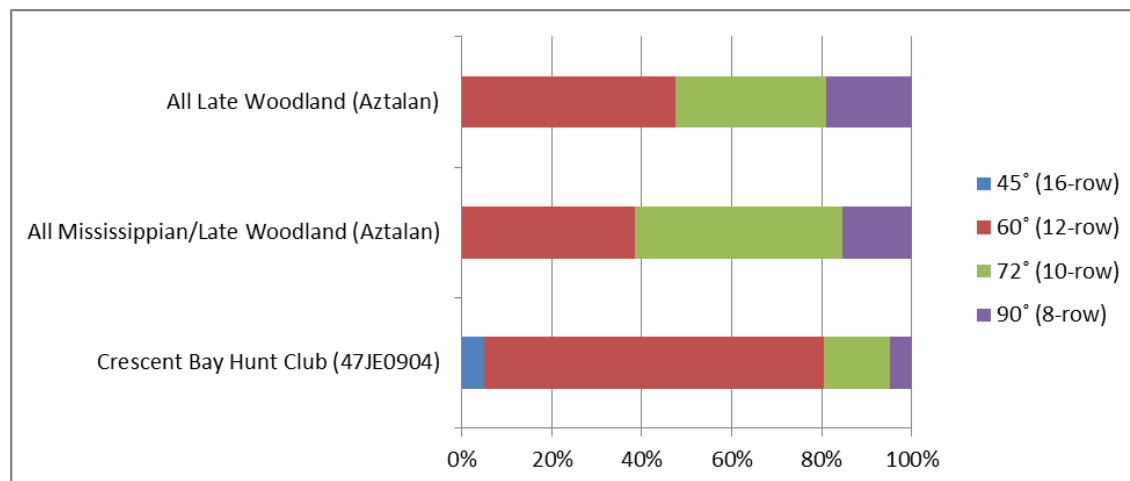


Figure 4.2: Row number percentages by context (cupules only)

Chi-Squared Test of Independence

For analytical purposes, to serve as a representation of Midwestern Twelve Row and Eastern Eight Row maize, measured cupules from Aztalan and CBHC were divided into high row number (12-16 row) and low row number (8-10 row) categories (Table 4.13). A chi-squared test of independence was performed to compare the two components at Aztalan. This test showed no significant difference between Late Woodland and Mississippian maize measurements at the site ($X^2=0.27$, $df=1$, $p=0.6012$). Following this result, a second test was performed to compare the entire Aztalan maize assemblage with the CBHC maize assemblage. The results of this test suggest that maize measurements at Aztalan are significantly different from those at CBHC ($X^2=9.15$, $df=1$, $p=.0025$). It is

worth noting that the mean maize measurement for all components is consistent with 10-12 row cobs (Table 4.12).

Regional Comparison of Floral Subsistence Data

Wisconsin and Northern Illinois

Sites selected for comparison. One of the goals of this analysis consists of assessing the floral assemblage at Aztalan in comparison with Late Prehistoric sites in southern Wisconsin and northwestern Illinois, as well as with the general late prehistoric plant use pattern for the region. Two Mississippian-influenced Late Woodland sites and one Oneota site were selected for comparative analysis. Three Late Woodland sites with collared pottery are also included to provide a benchmark for comparison.

The **Statz** site (47-DA-0642) is situated along Six Mile Creek and the associated wetlands of Waunakee Marsh in Dane County, Wisconsin (Figure 1.1). The site yielded evidence for both Woodland and Archaic occupations. Keyhole structures and collared pottery are present at the site. As no evidence for Mississippian pottery was recovered, the Statz site data is included as an example of a Late Woodland site. Though maize was recovered from just three contexts at Statz, one house structure containing maize produced a radiocarbon date of cal A.D. 1030-1245, roughly contemporaneous with Fred Edwards, Aztalan and CBHC (Zalucha 1997). Volume data was not presented for features from the Statz site. A percentage of the recovered wood charcoal was identified, however weights were not provided and counts included >1.0 mm specimens and therefore are not comparable. Only those features positively identified as Late Woodland are included here. Out of 44 features analyzed by Zalucha (1997), only 21 are classed as

Late Woodland (Meinholz and Kolb 1997: Appendix 4). Currently, the Statz site is interpreted as a winter occupation, which may affect the density of floral residues at the site (Egan-Bruhy, personal communication, 2012).

The **Murphy** site (47-DA-0736) is located in Dane County between the present-day City of Middleton and Town of Middleton (Figure 1.1). The site is situated on the northern edge of a now in-filled wetland. Archaeological evidence suggests intermittent occupation beginning in the Middle Archaic. The Late Woodland occupation of the site included features with both collared and non-collared vessels. Collared types present at the site include Aztalan Collared, Point Sauble Collared and Starved Rock Collared (Hawley et al. 2011). The bulk of dates for the Late Woodland occupation fall between cal A.D. 750-1000 (Hawley et al. 2011:16).

Similarly, the **River Quarry** site (47-DA-0768), also located in Dane County (Figure 1.1), shows evidence for occupation from the Middle Archaic onward. Both collared and non-collared Late Woodland vessels are present; collared varieties include Aztalan and Point Sauble Collared. The site is located near present-day Sauk City, at the base of steep bluffs on the west bank of the Crawfish River (Hawley et al. 2011). Dates for the River Quarry site are somewhat later than for the Murphy site, between ca. cal A.D. 1000-1200 (Hawley et al. 2011).

The **Fred Edwards** site (47-GT-0377) is a Mississippianized site located in far southwestern Wisconsin on a terrace above the Grant River (Figure 1.1). Ceramic evidence and radiocarbon dates support a Stirling phase affiliation for the Middle Mississippian influence at the site (Finney and Stoltman 1991). Site organization includes a plaza and probable palisade. Constance Arzigian (1987) analyzed floral remains from

15 features at Fred Edwards. Charcoal weights were not recorded for all features (personal communication, 2013). It is included here as an example of a northern hinterland site in the upper Mississippi trench.

The **Lundy** site (11-JD-0140) is part of the Apple River focus, located in the far southwestern part of the Driftless Area in Northwest Illinois (Figure 1.1). It appears likely that immigrants from Cahokia arrived in an area occupied by local Late Woodland peoples sometime around A.D. 1100. The hybridized artifact styles and settlement pattern seen at the Apple River sites may be interpreted as the forging of a new identity, possibly with a connection to later Upper Mississippian cultures in the area (Emerson et al. 2007; Millhouse 2012). The Lundy site is itself assigned to the Bennett phase (A.D. 1100-1250), correlating with the late Lohmann and Stirling phases at Cahokia. Wall-trench structures are present at the site; Mississippian pottery generally reflects Stirling phase vagues with some local influences such as lip-notching (Emerson et al. 2007). Marjorie Schroeder's floral analysis is included here as a comparative dataset (1989).

The **Crescent Bay Hunt Club** site (47-JE-0904) is located in Jefferson County, Wisconsin on the shores of Lake Koshkonong (Figure 1.1). The bulk of dates for this Oneota site fall between A.D. 1200-1400, but three dates on Grand River Trilled vessels date to cal A.D. 1025-1150 at one sigma (Jeske 2010), which overlaps with the dates for the Mississippian occupation of Aztalan. Dates on Grand River Trilled from the nearby Koshkonong Creek Village site also fall within this range (Edwards and Spott 2012).

Despite the apparent overlap in dates, Oneota artifacts are absent from Aztalan, and no Middle Mississippian artifacts have been identified at Crescent Bay or any other Oneota site in the Koshkonong locality. This and other factors have prompted some

researchers to posit the existence of a closed, static frontier between the Oneota and Middle Mississippian groups (Richards 1992; Richards and Jeske 2002). Crescent Bay floral data is presented for comparison in order to examine the degree of similarity or difference between Aztalan and Southeast Wisconsin Oneota subsistence (Egan-Bruhy 2001, 2010; Olsen 2003). As no previous floral analysis has attempted to assign row number to maize specimens from Crescent Bay, a small number of specimens recovered during the 2000 field season are included in the maize race analysis (Appendix D: Table D.1).

Comparison of Aztalan and Late Woodland collared ware sites. Three sites with collared pottery were selected to provide a Late Woodland comparison with the Aztalan assemblage. Table 4.14 shows a comparison of ratios, densities and ubiquities between Aztalan and the Late Woodland sites.

Table 4.14: Comparison of Aztalan and Late Woodland Sites

Site	Aztalan Stratum 11 and LW Features	Aztalan Stratum 5 Feature 8	Statz (Meinholz and Kolb 1997; Zalucha 1997)	Murphy (47-DA-0739/0965) (Egan-Bruhy 2003b)	River Quarry (47-DA-0760) (Egan-Bruhy 2003b)
Total Flot Volume (liters)	1173.00*	105.40*	UK	166.00	143.00
# Samples	27(21)	14	UK	20	16
# Features	1	5	21	9	2
All Nutshell					
Density (ct/10 liters)	5.19**	37.67**	UK	10.55	17.90
Density (g/10 liters)	0.07**	0.35**	UK	0.55	0.22
Nut:Wood ratio (wt)	0.05	0.03	UK	0.56	0.19
Nut:Wood ratio (ct)	0.06	0.08	UK	0.32	0.20
Ubiquity	95.24%***	100%***	42.86%*****	66.67%(60.00%)****	93.75%(100.00%)****
Hickory (<i>Carya</i> sp)					
Density (ct/10 liters)	5.19**	32.92**	UK	0.08	15.52
Density (g/10 liters)	0.07**	0.31**	UK	0.01	0.20
Nut:Wood ratio (wt)	0.05	0.02	UK	0.00	0.17
Nut:Wood ratio (ct)	0.05	0.07	UK	0.00	0.17
Ubiquity	95.24%***	92.86%***	33.33%*****	33.33%(15.00%)****	87.50%(100.00%)****
Walnut (<i>Juglans</i> sp)					
Density (ct/10 liters)	0.01**	0.47**	UK	0.00	0.07
Density (g/10 liters)	0.00**	0.03**	UK	0.00	0.00
Nut:Wood ratio (wt)	0.00	0.00	UK	0.00	0.00
Nut:Wood ratio (ct)	0.00	0.00	UK	0.00	0.00

Site	Aztalan Stratum 11 and LW Features	Aztalan Stratum 5 Feature 8	Statz (Meinholz and Kolb 1997; Zalucha 1997)	Murphy (47-DA-0739/0965) (Egan-Bruhy 2003b)	River Quarry (47-DA-0760) (Egan-Bruhy 2003b)
Ubiquity	4.76%***	7.14%***	4.76%*****	0.00%	6.25%(50.00%)****
Acorn (<i>Quercus sp</i>)					
Density (ct/10 liters)	0.03**	0.09**	UK	105.54	0.00
Density (g/10 liters)	0.00**	0.00**	UK	0.54	0.00
Nut:Wood ratio (wt)	0.00	0.00	UK	0.05	0.00
Nut:Wood ratio (ct)	0.00	0.00	UK	0.32	0.00
Ubiquity	9.52%***	7.14%***	0.00%*****	55.00%(66.67%)****	0.00%
Hazelnut (<i>Corylus spp</i>)					
Density (ct/10 liters)	0.02**	0.00**	UK	0.00	0.00
Density (g/10 liters)	0.00**	0.00**	UK	0.00	0.00
Nut:Wood ratio (wt)	0.00	0.00	UK	0.00	0.00
Nut:Wood ratio (ct)	0.00	0.00	UK	0.00	0.00
Ubiquity	9.52%***	0.00%***	0.00%*****	0.00%	0.00%
<i>Zea mays</i>					
Density (ct/10 liters)	1.67**	43.83**	UK	5.72	6.29
Density (g/10 liters)	0.01**	0.37**	UK	0.05	0.06
Maize:Wood ratio (wt)	0.01	0.02	UK	0.01	0.06
Maize:Wood ratio (ct)	0.02	0.08	UK	0.02	0.07
Ubiquity	90.48%***	78.58%***	14.29%*****	65.00%(77.78%)****	81.25%(100.00%)****
<i>Cucurbita pepo</i>					
Density (ct/10 liters)	0.42**	3.89**	UK	0.12	0.07

Site	Aztalan Stratum 11 and LW Features	Aztalan Stratum 5 Feature 8	Statz (Meinholz and Kolb 1997; Zaluca 1997)	Murphy (47-DA-0739/0965) (Egan-Bruhy 2003b)	River Quarry (47-DA-0760) (Egan-Bruhy 2003b)
Density (g/10 liters)	0.00**	0.02**	UK	0.00	0.00
Rind:Wood ratio (wt)	0.00	0.00	UK	0.00	0.00
Rind:Wood ratio (ct)	0.00	0.01	UK	0.00	0.00
Ubiquity	52.38%***	28.57%***	0.00%	10.00%(22.22%)****	6.25%(50.00%)****
<i>Chenopodium</i>					
Density (ct/10 liters)	0.18**	63.57**	UK	0.12	0.00
Ubiquity	23.81%***	21.43%***	19.05%*****	10.00%(22.22%)****	0.00%
<i>Zizania aquatica/palustris</i>					
Density (ct/10 liters)	0.09**	0.28**	UK	0.00	0.00
Ubiquity	29.00%***	7.14%***	0.00%	0.00%	0.00%

UK = Unknown (data not available)

* = S11 flot volume does not include M84-1094, M84-1421; flot volume for Mississippianized contexts includes only Feature 2011-8.

** = only includes those contexts with volume data

*** = excludes non-cultural S118 and S114; ubiquity by sample due to small number of features

**** = Ubiquity by sample (ubiquity by feature)

*****=only includes Late Woodland features

Nutshell densities for the Murphy site (10.55 ct/10 liters; 0.55 g/10 liters) and the River Quarry site (17.90 ct/10 liters; 0.22 g/10 liters) are higher than densities for Stratum 11 (5.19 ct/10 liters; 0.07 g/10 liters), but lower than densities for Feature 8 (37.67 ct/10 liters; 0.35 g/10 liters). The nut:wood ratios Murphy (0.56 by weight and 0.32 by count) and River Quarry (0.19 by weight and 0.20 by count) are higher than for Late Woodland (0.05 by weight and 0.06 by count) and Mississippian (0.03 by weight and 0.08 by count) contexts at Aztalan. The nut:wood ratio may control for the overall higher density of carbonized material in Aztalan Feature 8, suggesting that residents of the two Late Woodland sites exhibited an overall higher reliance on nutshell than did Aztalan residents for both components.

Because of the small number of features, ubiquities are first provided by sample for the Murphy and River Quarry sites. Statz site nutshell ubiquity by feature is 42.86 percent. By sample, nutshell ubiquity for the Murphy site is 66.67 percent and 93.75 percent for River Quarry. Ubiquity for nutshell in Late Woodland samples at Aztalan is 95.24 percent, while Mississippian samples show 100 percent nutshell ubiquity. The low ubiquity score at Statz is characteristic of the low presence of food remains at the site as a whole.

Like Aztalan, the River Quarry site nutshell assemblage is dominated by hickory. River Quarry exhibits a hickory nutshell density of 15.52 ct/10 liters compared to 0.08 ct/10 liters at the Murphy site. Nutshell densities at Aztalan are 5.19 ct/10 liters for Stratum 11 and 32.92 ct/10 liters for Feature 8. The 87.50 percent ubiquity by sample for

hickory nutshell at River Quarry compares favorably with Late Woodland ubiquity for hickory (95.24 percent) and ubiquity from Mississippian contexts (92.86 percent).

As at Aztalan, walnut exploitation at the other three Late Woodland sites is limited. Only the River Quarry site shows a significant density (0.07 ct/10 liters), compared with 0.01 ct/10 liters for Late Woodland Stratum 11 at Aztalan. The density for walnut in Feature 8 at Aztalan is 0.47 ct/10 liters, higher than for the Late Woodland components, but still quite low. All sites have a low ubiquity for walnut. No fragments of walnut shell were recovered from the Murphy site, while 6.25 percent of samples from River Quarry and 4.76 percent of Statz site features contained walnut. Ubiquity for walnut is higher for the Mississippian component at Aztalan (7.15 percent) than for the Late Woodland component (4.76 percent).

Acorn, which was not recovered from Statz or River Quarry, is overrepresented at the Murphy site at the expense of hickory. Acorn density at Murphy is 105.54 ct/10 liters. This is much higher than densities of 0.03 ct/10 liters in Stratum 11 and 0.09 ct/10 liters in Feature 8 at Aztalan. While the nut:wood ratio for acorn at Aztalan is negligible, a ratio of 0.32 (by fragment) is observed at the Murphy site.

Hazelnut remains were not recovered from the Statz, Murphy or River Quarry sites, or from the Mississippian component at Aztalan. A small amount of hazelnut shell appears in the Late Woodland component at Aztalan (0.02 g/10 liters).

The density for maize is greatest by far in Feature 8 (43.83 ct/10 liters). Notably, the Late Woodland component at Aztalan has a lower maize density (1.67 ct/10 liters) than observed at Murphy (5.72 ct/10 liters) or River Quarry (6.29 ct/10 liters). The maize:wood ratio, which may control for differences in overall density of charred floral

material, reveals an interesting pattern. By count, the River Quarry site has a maize:wood ratio (0.07) which compares with the Mississippian component at Aztalan (0.08). By contrast, the Murphy site has a maize:wood ratio by count of 0.02, identical to the maize:wood ratio observed for the Late Woodland component at Aztalan.

Squash rind appears frequently at Aztalan, and was identified at the Murphy and River Quarry sites, but not at Statz. Squash rind densities are higher for both components at Aztalan (0.42 ct/10 liters for Stratum 11 and 3.89 ct/10 liters for Feature 8) than observed at the Murphy site (0.12 ct/10 liters) or the River Quarry site (0.07 ct/10 liters). Ubiquities for squash are also higher at Aztalan (52.38 percent for the Late Woodland component and 28.57 percent for the Mississippian component) than at Murphy (10.00 percent) and River Quarry (6.25 percent).

Chenopodium is represented at Aztalan, Statz and the Murphy site, but is not found at River Quarry. The highest density is found in Aztalan Feature 8 (63.57 ct/10 liters). The density for Stratum 11 (0.18 ct/10 liters) is comparable to the density observed at the Murphy site (0.12 ct/ 10 liters). Ubiquities for the Mississippian component at Aztalan (23.81 percent) and the Late Woodland component at Aztalan (28.57 percent) are similar, and the Statz site also has a *Chenopodium* ubiquity of about one-fifth of features (19.05 percent). Ubiquity at Murphy is low (10.00 percent).

Small amounts of wild rice appear in the Aztalan assemblage (0.09 ct/10 liters for Stratum 11 and 0.28 ct/10 liters for Feature 8). Wild rice does not appear at the other three Late Woodland sites. This is somewhat surprising for the Murphy site, which was located adjacent to a wetland.

Table 4.15 presents the Shannon-Weaver diversity index for each Late Woodland site and for the two components at Aztalan; only taxa likely to have been consumed as food are included. The diversity scores for Aztalan (1.38 for the Late Woodland component and 1.46 for the Mississippian component) are higher than observed for the Late Woodland sites. The Statz site has a score of 1.13, while the River Quarry site has an index of 1.05. An examination of the numerical data suggests that an overrepresentation of nutshell and maize compared to other subsistence taxa accounts for the more restricted dietary breadth at these sites. The Murphy site's low diversity index (0.30) is likely explained by the extreme overrepresentation of acorn.

Table 4.15: Shannon-Weaver Diversity Indices for Aztalan and Late Woodland Sites

	Aztalan (LW)	Aztalan (LW/MM)	All Aztalan	Statz*	Murphy	River Quarry
Nutshell: Unidentified	32	55	87	2	6	33
Nutshell: Hickory [<i>Carya</i>]	771	497	1268	67	14	222
Nutshell: Walnut [<i>Juglans</i>]	1	5	6	1	-	1
Nutshell: Hazelnut [<i>Corylus</i>]	2	-	2	-	-	-
Nutshell: Oak (Acorn) [<i>Quercus</i>]	3	1	4	-	1752	-
Maize [<i>Zea mays</i>]	327	582	909	17	95	90
Squash [<i>Cucurbita</i>]	69	45	114	-	2	1
Bottle gourd [<i>Lagenaria siceraria</i>]	-	1	1	-	-	-
Little barley [<i>Hordeum pusillum</i>]	-	3	3	-	-	-
Wild rice [<i>Zizania aquatica</i>]	10	3	13	-	-	-
cf <i>Zizania/Hordeum</i>	1	-	1	-	-	-
Barnyard grass (<i>Echinochloa</i> sp)	1	-	1	-	-	-
Sunflower [<i>Helianthus annuus</i>]	-	1	1	-	-	-
Sumpweed [<i>Iva annua</i>]	-	1	1	-	-	-
Chenopodium [<i>Chenopodium</i> sp]	21	670	691	16	2	-
Amaranth [<i>Amaranthus</i> sp]	6	8	14	-	1	-
Knotweed [<i>Polygonum</i> sp]	3	1	4	-	1	-
Unid. <i>Rosaceae</i>	-	2	2	-	-	-
Cherry [<i>Prunus</i> sp]	-	3	3	-	-	-
Raspberry/Blackberry [<i>Rubus</i> sp]	1	-	1	-	-	-

	Aztalan (LW)	Aztalan (LW/MM)	All Aztalan	Statz*	Murphy	River Quarry
Nightshade [<i>Solanum</i>]	29	3	32	-	-	-
Grape [<i>Vitis</i>]	2	-	2	-	-	1
Sumac [<i>Rhus</i> sp]	-	1	1	3	-	-
Bedstraw [<i>Galium</i>]	1	-	1	-	-	-
Pea family [<i>Fabaceae</i>]	-	-	-	1	-	-
Tuber [aquatic]	3	-	3	-	-	2
Fungus (incl fruiting structures)	98	43	141	-	4	12
Total (N)	1381	1925	3306	107	1877	362
Diversity index (H) (natural log (ln))	1.38	1.46	1.56	1.13	0.30	1.05

*Nutshell counts estimated based on weights

Comparison with Mississippian-influenced sites. Two sites in the Upper Mississippi trench which exhibit a combination of Late Woodland and Mississippian ceramic and structural characteristics were selected to provide a comparison between Aztalan and other sites in the northern hinterlands of the American Bottom. Table 4.16 shows a comparison of ratios, densities and ubiquities between Aztalan, Fred Edwards and the Lundy site.

Table 4.16: Comparison of Aztalan Floral Assemblage with Mississippian-Influenced Sites in the Upper Mississippi Valley

Site	Aztalan Stratum 11 and LW Features	Aztalan Stratum 5 and Feature 8	Fred Edwards (Arzigian 1987, personal communication 2013)	Lundy (Emerson et al. 2007, Schroeder 1989, personal communication 2013)
Total Flot Volume (liters)	1173.00*	105.40*	1018.40	427.00
# Samples	27(21)	14	30	49
# Features	1	5	15	47
All Nutshell				
Density (ct/10 liters)	5.19**	37.67**	75.66****	515.31
Density (g/10 liters)	0.07**	0.35**	1.13	UK
Nut:Wood ratio (wt)	0.05	0.03	0.06†	UK
Nut:Wood ratio (ct)	0.06	0.08	UK	0.07
Ubiquity	95.24%***	100.00%***	100.00%††	81.00%††
Hickory (<i>Carya</i> sp)				
Density (ct/10 liters)	5.19**	32.92**	75.28****	38.24
Density (g/10 liters)	0.07**	0.31**	1.13	UK
Nut:Wood ratio (wt)	0.05	0.02	0.06†	UK
Nut:Wood ratio (ct)	0.05	0.07	UK	0.00
Ubiquity	95.24%***	92.86%***	100.00%††	43.00%††
Walnut (<i>Juglans</i> spp)				
Density (ct/10 liters)	0.01**	0.47**	0.07****	90.16
Density (g/10 liters)	0.00**	0.03**	0.00	UK
Nut:Wood ratio (wt)	0.00	0.00	0.00†	UK
Nut:Wood ratio (ct)	0.00	0.00	UK	0.01
Ubiquity	4.76%***	7.14%***	33.33%††	25.53%††
Acorn (<i>Quercus</i> sp)				

Site	Aztalan Stratum 11 and LW Features	Aztalan Stratum 5 and Feature 8	Fred Edwards (Arzigian 1987, personal communication 2013)	Lundy (Emerson et al. 2007, Schroeder 1989, personal communication 2013)
Density (ct/10 liters)	0.03**	0.09**	0.30****	331.51
Density (g/10 liters)	0.00**	0.00**	0.00	UK
Nut:Wood ratio (wt)	0.00	0.00	UK	UK
Nut:Wood ratio (ct)	0.00	0.00	UK	0.04
Ubiquity	9.52%***	7.14%***	33.33%††	60.00%††
Hazelnut (<i>Corylus</i> sp)				
Density (ct/10 liters)	0.02**	0.00**	0.00	3.90
Density (g/10 liters)	0.00**	0.00**	0.00	UK
Nut:Wood ratio (wt)	0.00	0.00	0.00	UK
Nut:Wood ratio (ct)	0.00	0.00	UK	0.00
Ubiquity	9.52%***	0.00%***	0.00%	13.00%††
<i>Zea mays</i>				
Density (ct/10 liters)	1.67**	43.83**	12.99****	3055.64
Density (g/10 liters)	0.01**	0.37**	1.04	4.13
Maize:Wood ratio (wt)	0.01	0.02	0.06†	UK
Maize:Wood ratio (ct)	0.02	0.08	UK	0.36
Ubiquity	90.48%***	78.58%***	100.00%††	98.00%††
<i>Cucurbita pepo</i>				
Density (ct/10 liters)	0.42**	3.89**	0.15	0.12
Density (g/10 liters)	0.00**	0.02**	UK	UK
Rind:Wood ratio (wt)	0.00	0.00	UK	UK
Rind:Wood ratio (ct)	0.00	0.01	UK	0.00
Ubiquity	52.38%***	28.57%***	73.33%††	2.00%††
<i>Chenopodium</i>				
Density (ct/10 liters)	0.18**	63.57**	15.59	0.49

Site	Aztalan Stratum 11 and LW Features	Aztalan Stratum 5 and Feature 8	Fred Edwards (Arzigian 1987, personal communication 2013)	Lundy (Emerson et al. 2007, Schroeder 1989, personal communication 2013)
Ubiquity	23.81%***	21.43%***	100.00%††	21.00%††
<i>Zizania aquatica/palustris</i>				
Density (ct/10 liters)	0.09**	0.28**	0.00	0.07
Ubiquity	29.00%***	7.14%***	0.00%	6.00%††

UK = Unknown (data not available)

* = S11 flot volume does not include M84-1094, M84-1421; flot volume for Mississippianized contexts includes only Feature 2011-8.

** = only includes those contexts with volume data

*** = excludes non-cultural S118 and S114; ubiquity by sample due to small number of features

****=counts estimated based on weight

† = includes only Fred Edwards Fea 7, 8, 9, 15, 47, 50, 73 as wood charcoal weight is only available for these features

†† = by feature

††† = does not include acorn as no weights provided

Nutshell densities are considerably higher for Fred Edwards (75.66 ct/10 liters) and the Lundy site (515.31 ct/10 liters) than for Aztalan Stratum 11 (5.19 ct/10 liters) and Feature 8 (37.67 ct/10 liters). Wood ratios are similar: 0.06 by weight for Fred Edwards compared with 0.05 for Late Woodland contexts at Aztalan and 0.03 for Mississippian contexts. The wood ratio by count for the Lundy site is 0.07, while Aztalan has a ratio of 0.06 for Late Woodland contexts and 0.08 for Mississippian contexts. Ubiquities for nutshell are similar across the sites: 95.24 percent for the Late Woodland component at Aztalan, 100.00 percent for Aztalan's Mississippian component; 100.00 percent for Fred Edwards and 81.00 percent for Lundy. The ubiquities and ratios suggest that the higher densities of nutshell observed at Fred Edwards and Lundy may merely reflect an overall greater density of charred plant remains from those sites.

As at Aztalan, hickory is the most commonly identified nut taxon at Fred Edwards (Arzigian 1987). Hickory nutshell is found at a density of 5.19 ct/10 liters in Stratum 11 at Aztalan, 32.92 ct/10 liters in Aztalan Feature 8, 75.28 ct/10 liters at Fred Edwards and 38.24 ct/10 liters at the Lundy site. By weight, the nut:wood ratio for hickory at Fred Edwards (0.06) is comparable to that observed for Late Woodland contexts at Aztalan (0.05) and not dramatically different from that of Mississippian contexts (0.02). By count, the Lundy site has a nut:wood ratio of 0.00 for hickory, while Late Woodland samples at Aztalan have a ratio of 0.05 and Mississippian samples have a ratio of 0.07 by count. The ubiquity of hickory in Aztalan's Late Woodland component (95.24 percent), Aztalan's Mississippian component (92.86 percent) and Fred Edwards (100.00 percent) are higher than the ubiquity observed for this taxon at Lundy (43.00 percent).

As previously discussed, walnut was not frequently recovered at Aztalan. Walnut density for Stratum 11 is 0.01 ct/10 liters; for Feature 8 it is 0.47 ct/10 liters. Neither component at Aztalan shows a significant nut:wood ratio for walnut. Fred Edwards has a walnut density of 0.07 ct/10 liters, but the nut:wood ratio is negligible. The density of walnut remains at Lundy is 90.16 ct/10 liters. Ubiquities for walnut are low in Aztalan's Late Woodland (4.76 percent) and Mississippian (7.14 percent) components. Walnut ubiquity for Fred Edwards is 33.33 percent, compared with 25.52 percent for the Lundy site.

Small amounts of acorn were recovered for both Aztalan components (0.03 ct/10 liters for Stratum 11 and 0.09 ct/10 liters for Feature 8). Nut:wood ratios for acorn at Aztalan are negligible. Fred Edwards exhibits an acorn density of 0.30 ct/10 liters, while the acorn density at Lundy is quite high (331.51 ct/10 liters). Acorn ubiquity at Lundy is 60.00 percent, compared with 33.33 percent for Fred Edwards, 7.14 percent for the Mississippian component at Aztalan and 9.52 percent for the Late Woodland component.

Hazelnut was not identified in the Mississippian component at Aztalan, or at Fred Edwards. The density of hazelnut in Stratum 11 is 0.02 ct/10 liters, compared with 3.90 ct/10 liters at Lundy. The ubiquity of hazelnut for Aztalan's Late Woodland component is 9.52 percent; Lundy exhibits a hazelnut ubiquity of 13.00 percent. Overall, Lundy shows a much greater diversity of nut taxa than found in the other components.

Maize appears to have been a significant dietary contributor at all of the Mississippian-influenced sites. At Aztalan, maize density for Stratum 11 is 1.67 ct/10 liters versus 43.83 ct/10 liters for Feature 8. The density of maize at Fred Edwards is 12.99 ct/10 liters, versus a dramatically higher 3055.64 ct/10 liters for the Lundy site. By

weight, the maize:wood ratio is higher for Fred Edwards (0.06) than for the Late Woodland (0.01) and Mississippian (0.02) components at Aztalan. While the maize:wood ratio by count is 0.02 for Late Woodland samples at Aztalan and 0.08 for Mississippian samples, the Lundy maize:wood ratio is 0.36, indicating that the higher density of charred botanical material at Lundy does not entirely account for the higher density of maize at the site. Maize ubiquity is high for all components: 90.48 percent for Late Woodland samples at Aztalan, 78.58 percent for Mississippian samples, 100.00 percent for Fred Edwards and 98.00 percent for Lundy.

Squash appears to have been a less significant component of the diet at Lundy than for the other three components. For Stratum 11 at Aztalan, squash density is 0.42 ct/10 liters; for Feature 8 it is 3.89 ct/10 liters. Densities of squash are similar at Fred Edwards (0.15 ct/10 liters) and at Lundy (0.12 ct/10 liters). The ubiquity of squash at Aztalan is 52.38 percent for Late Woodland contexts and 28.57 percent for Mississippian contexts. Ubiquity at Fred Edwards is higher, at 73.33 percent. Despite a relatively high density for squash, its ubiquity at Lundy is only 2.00 percent; squash may have been a less commonly utilized resource at Lundy than for the other three components.

Chenopodium densities are highest for Feature 8 (63.57 ct/10 liters) and for Fred Edwards (15.59 ct/10 liters). For Stratum 11, its density is 0.18 ct/10 liters, and *Chenopodium* density at Lundy is 0.49 ct/10 liters. Given the high density of floral remains at the Lundy site, this number suggests that Lundy site residents did not prioritize *Chenopodium* as a dietary resource. Ubiquity for *Chenopodium* is highest at Fred Edwards (100.00 percent). Ubiquities are comparable for Lundy (21.00 percent),

Late Woodland samples at Aztalan (23.81 percent) and Mississippian samples at Aztalan (21.43 percent).

Wild rice was not recovered from Fred Edwards. In the other three components, it appears to have played a relatively minor role. In Stratum 11, wild rice density is 0.09 ct/10 liters, compared with 0.28 ct/10 liters in Feature 8 and 0.07 ct/10 liters at Lundy. Ubiquity for wild rice is highest for the Late Woodland component at Aztalan (29.00 percent) followed by the Mississippian component (7.14 percent) and the Lundy site (6.00 percent).

Table 4.17 shows the Shannon-Weaver diversity index for Aztalan, Fred Edwards and the Lundy site. As mentioned above, the index for the Late Woodland component at Aztalan is 1.38 and the index for the Mississippian component is 1.46. The Fred Edwards index is 0.96, indicating a narrower dietary breadth. The cause of this appears to be an overrepresentation of hickory nutshell fragments (7667) followed by *Chenopodium* seeds (1587) and maize fragments (1323). The Lundy site has a much lower diversity score than the other three components (0.54). Maize appears very overrepresented in the Lundy assemblage (130476 fragments) followed distantly by acorn (14454 fragments) and walnut (3850 fragments). In other words, biodiversity is low in the Lundy site assemblage due to a high degree of reliance on maize.

Table 4.17: Shannon-Weaver Diversity Index for Aztalan, Fred Edwards and the Lundy Site

	Aztalan (LW)	Aztalan (LW/MM)	All Aztalan	Fred Edwards*	Lundy
Nutshell: Unidentified	32	55	87	-	1901
Nutshell: Hickory [<i>Carya</i>]	771	497	1268	7667	70
Nutshell: Walnut [<i>Juglans</i>]	1	5	6	7	3850
Nutshell: Hazelnut [<i>Corylus</i>]	2	-	2	-	166
Nutshell: Oak (Acorn) [<i>Quercus</i>]	3	1	4	31	14454
Maize [<i>Zea mays</i>]	327	582	909	1323	130476
Squash [<i>Cucurbita</i>]	69	45	114	15	5
Bottle gourd [<i>Lagenaria siceraria</i>]	-	1	1	-	-
Little barley [<i>Hordeum pusillum</i>]	-	3	3	28	5
Wild rice [<i>Zizania aquatica</i>]	10	3	13	-	3
cf <i>Zizania/Hordeum</i>	1	-	1	-	-
Barnyard grass (<i>Echinochloa</i> sp)	1	-	1	-	-
Maygrass [<i>Phalaris carolinianum</i>]	-	-	-	174	4
Panicoid [<i>Panicum</i>]	-	-	-	-	-
Sunflower [<i>Helianthus annuus</i>]	-	1	1	7	-
Sumpweed [<i>Iva annua</i>]	-	1	1	-	1
Chenopodium [<i>Chenopodium</i> sp]	21	670	691	1587	21
Chenopod/Amaranth	-	-	-	-	-
Amaranth [<i>Amaranthus</i> sp]	6	8	14	-	-
Knotweed [<i>Polygonum</i> sp]	3	1	4	10	4
Unid. <i>Rosaceae</i>	-	2	2	-	-
Cherry [<i>Prunus</i> sp]	-	3	3	-	-
Raspberry/Blackberry [<i>Rubus</i> sp]	1	-	1	9	2
Strawberry [<i>Fragaria</i>]	-	-	-	-	-
Nightshade [<i>Solanum</i>]	29	3	32	51	1
Grape [<i>Vitis</i>]	2	-	2	11	7
Sumac [<i>Rhus</i> sp]	-	1	1	51	15
Blueberry [<i>Vaccinium</i>]	-	-	-	-	-
Bedstraw [<i>Galium</i>]	1	-	1	-	10
Cattail [<i>Stypha</i>]	-	-	-	-	-
Pea family [<i>Fabaceae</i>]	-	-	-	-	2
Wild bean [<i>Strophostyles helveola</i>]	-	-	-	-	-
Tuber [aquatic]	3	-	3	-	626
Fungus (incl fruiting structures)	98	43	141	-	-
Total (N)	1381	1925	3306	10971	151623
Diversity index (H) (natural log (ln))	1.38	1.46	1.56	0.97	0.54

*Nutshell, maize counts are estimated based on weights, except *Quercus*

Comparison with Lake Koshkonong Oneota. Because CBHC is the only Oneota site at the Koshkonong locality with detailed floral assemblage data, it was chosen to compare the Aztalan assemblage with an Oneota assemblage in Southeast Wisconsin. Table 4.18 shows a comparison of ratios, densities and ubiquities between Aztalan and Crescent Bay.

Table 4.18: Comparison of Aztalan and Crescent Bay Hunt Club Floral Assemblages

Site	Aztalan Stratum 11 and LW Features	Aztalan Stratum 5 and Feature 8	Crescent Bay Hunt Club (47-JE-0904) (Egan-Bruhy 2001, 2010; Olsen 2003)
Association	Late Woodland	Mississippian	Oneota
Total Flot Volume (liters)	1173.00*	105.40*	3147
# Samples	27(21)	14	58
# Features	1	5	40
All Nutshell			
Density (ct/10 liters)	5.19**	37.67**	9.12
Density (g/10 liters)	0.07**	0.35**	0.08
Nut:Wood ratio (wt)	0.05	0.03	0.01
Nut:Wood ratio (ct)	0.06	0.08	0.02
Ubiquity	95.24%***	100%***	50.00%(51.72%)****
Hickory (<i>Carya</i> sp)			
Density (ct/10 liters)	5.19**	32.92**	1.11
Density (g/10 liters)	0.07**	0.31**	0.02
Nut:Wood ratio (wt)	0.05	0.02	0.00
Nut:Wood ratio (ct)	0.05	0.07	0.00
Ubiquity	95.24%***	92.86%***	50.00%(51.72%)****
Walnut (<i>Juglans</i> sp)			
Density (ct/10 liters)	0.01**	0.47**	0.24
Density (g/10 liters)	0.00**	0.03**	0.01
Nut:Wood ratio (wt)	0.00	0.00	0.00
Nut:Wood ratio (ct)	0.00	0.00	0.00
Ubiquity	4.76%***	7.14%***	7.50%(5.17%)****
Acorn (<i>Quercus</i> sp)			
Density (ct/10 liters)	0.03**	0.09**	6.07
Density (g/10 liters)	0.00**	0.00**	0.05
Nut:Wood ratio (wt)	0.00	0.00	0.01
Nut:Wood ratio (ct)	0.00	0.00	0.01
Ubiquity	9.52%***	7.14%***	42.50%(36.21%)****)
Hazelnut (<i>Corylus</i> sp)			
Density (ct/10 liters)	0.02**	0.00**	0.13
Density (g/10 liters)	0.00**	0.00**	0.00
Nut:Wood ratio (wt)	0.00	0.00	0.00
Nut:Wood ratio (ct)	0.00	0.00	0.00

Site	Aztalan Stratum 11 and LW Features	Aztalan Stratum 5 and Feature 8	Crescent Bay Hunt Club (47-JE-0904) (Egan-Bruhy 2001, 2010; Olsen 2003)
Association	Late Woodland	Mississippian	Oneota
Ubiquity	9.52%***	0.00%***	15.00%(12.07%)****
<i>Zea mays</i>			
Density (ct/10 liters)	1.67**	43.83**	15.41
Density (g/10 liters)	0.01**	0.37**	0.12
Maize:Wood ratio (wt)	0.01	0.02	0.02
Maize:Wood ratio (ct)	0.02	0.08	0.04
Ubiquity	90.48%***	78.58%***	65.00%(72.41%)****
<i>Cucurbita pepo</i>			
Density (ct/10 liters)	0.42**	3.89**	0.02
Density (g/10 liters)	0.00**	0.02**	0.00
Rind:Wood ratio (wt)	0.00	0.00	0.00
Rind:Wood ratio (ct)	0.00	0.01	0.00
Ubiquity	52.38%***	28.57%***	7.50%(5.17%)****
<i>Chenopodium</i>			
Density (ct/10 liters)	0.18**	63.57**	4.37
Ubiquity	23.81%***	21.43%***	57.50%(60.34%)****
<i>Zizania aquatica/palustris</i>			
Density (ct/10 liters)	0.09**	0.28**	17.98
Ubiquity	29.00%***	7.14%***	57.50%(56.90%)****

UK = Unknown (data not available)

* = S11 flot volume does not include M84-1094, M84-1421; flot volume for Mississippian contexts includes only Feature 2011-8.

** = only includes those contexts with volume data

*** = excludes non-cultural S118 and S114; ubiquity by sample due to small number of features

**** = Ubiquity by feature (ubiquity by sample)

Nutshell density regardless of taxon at CBHC is 9.12 ct/10 liters. Densities at Aztalan are 5.19 ct/10 liters for Stratum 11 and 37.67 ct/10 liters for Feature 8. Nut:wood ratios at CBHC (0.01 by weight; 0.02 by count) are considerably lower than observed for Late Woodland (0.05 by weight, 0.06 by count) and Mississippian (0.03 by weight, 0.08

by count) contexts at Aztalan. Furthermore, nutshell ubiquity at CBHC is much lower (50.00 percent) than for the Late Woodland (95.24 percent) or Mississippian (100.00 percent) components at Aztalan. Overall, the data suggest that nut masts were less significant to the diet of CBHC residents than to the inhabitants of Aztalan.

As previously discussed, hickory densities are high at Aztalan (5.19 ct/10 liters for Stratum 11; 32.92 ct/10 liters for Feature 8). Hickory density is much lower at CBHC (1.11 ct/10 liters). The nut:wood ratio for hickory at CBHC is negligible. For the Late Woodland component at Aztalan, the nut:wood ratio by count is 0.05, while for the Mississippian component it is 0.07. Ubiquities for hickory at Aztalan are 95.24 percent for the Late Woodland component and 92.86 percent for the Mississippian component. Hickory ubiquity at CBHC is 50.00 percent. The impression provided by these data is that CBHC residents relied on hickory nuts to a lesser degree than Aztalan residents.

A small amount of walnut shell appears in all three components. Density for walnut at CBHC is 0.24 ct/10 liters, compared with 0.01 ct/10 liters for Stratum 11 and 0.47 ct/10 liters for Feature 8. Nut:wood ratios for walnut are negligible for all components. Ubiquity for walnut at CBHC is 7.50 percent, compared with 4.76 percent for Late Woodland contexts at Aztalan and 7.14 percent for Mississippian contexts. Walnut does not appear to have been a substantial dietary component at Aztalan or CBHC.

Acorn appears to have been somewhat more important to CBHC residents than to Aztalan's inhabitants. While densities at Aztalan are only 0.03 ct/10 liters for Stratum 11 and 0.09 ct/10 liters for Feature 8, CBHC acorn density is 6.07 ct/10 liters. Furthermore, while nut:wood ratios at Aztalan for acorn are negligible, by both count and weight

CBHC demonstrates a nut:wood ratio of 0.01 for acorn. At 42.50 percent, acorn ubiquity is much higher at CBHC than in Late Woodland (9.52 percent) and Mississippian (7.14 percent) samples at Aztalan.

Hazelnut was not recovered from the Mississippian component at Aztalan, but miniscule amounts are present in the Late Woodland component and at CBHC. Density for the Aztalan Late Woodland component is 0.02 ct/10 liters, compared to 0.13 ct/10 liters for CBHC. Nut:wood ratios for all components are negligible. Ubiquity for Late Woodland samples at Aztalan is 9.52 percent, compared with 15.00 percent for CBHC. It does not appear that hazelnut was a significant dietary component at Aztalan or at CBHC.

Maize appears frequently at both sites. Density at CBHC is 15.41 ct/10 liters, compared with 43.83 ct/10 liters for Feature 8 at Aztalan and 1.67 ct/10 liters for Stratum 11. The maize:wood ratio by count, which may correct for varying densities of charred floral remains, is 0.08 for Mississippian samples at Aztalan, followed by 0.04 for CBHC and 0.02 for Aztalan's Late Woodland component. These numbers suggest that CBHC inhabitants may have utilized somewhat less maize than Aztalan's residents. Ubiquity for maize at CBHC is also lowest (65.00 percent) compared to 78.58 percent for Mississippian samples at Aztalan and 90.48 percent for Late Woodland samples.

Squash appears to have been considerably less important at CBHC than at Aztalan. Density for Stratum 11 at Aztalan is 0.42 ct/10 liters, and for Feature 8 density is 3.89 ct/10 liters. At CBHC, squash density is only 0.02 ct/10 liters. Wood ratios are negligible for the Late Woodland component at Aztalan and for CBHC; for Aztalan's Mississippian component the rind:wood ratio by count is 0.01. Ubiquity for squash at

CBHC (7.50 percent) is considerably lower than for Late Woodland (52.38 percent) and Mississippian (28.57 percent) samples at Aztalan.

Chenopodium appears frequently at CBHC, in 57.50 percent of samples compared with 23.81 percent for Aztalan's Late Woodland component and 21.43 percent for the Mississippian component. *Chenopodium* density at CBHC is 4.37 ct/10 liters compared with 0.18 ct/10 liters in Stratum 11 and 63.57 ct/10 liters in Feature 8.

Wild rice appears much more frequently at CBHC and in greater densities. Density for wild rice at CBHC is 17.98 ct/10 liters compared with 0.28 ct/10 liters in Feature 8 and just 0.09 ct/10 liters in Stratum 11. Wild rice ubiquity at CBHC is also much higher (57.50 percent) than for the Late Woodland (29.00 percent) or Mississippian (7.14 percent) components at Aztalan. Wild rice appears to have served as a more significant component of the diet at CBHC than at Aztalan.

Table 4.19 presents the Shannon-Weaver diversity index for both Aztalan components and for CBHC. The CBHC score (1.68) is the highest of any site included in this analysis, and higher than the Aztalan scores of 1.38 for the Late Woodland component and 1.46 for the Mississippian component. This index suggests that residents of CBHC had a greater diet breadth than Aztalan residents, a notion not out of line with concepts of risk-buffering in the Oneota diet (cf Brown 1982). An examination of the data suggests that part of this breadth may be the result of a balance between maize (4849 fragments) and wild rice (5657 seeds) followed by acorn (1909 fragments) and *Chenopodium* (1374 fragments).

Table 4.19: Shannon-Weaver Diversity Indices for Aztalan and the Crescent Bay Hunt Club Site

	Aztalan (LW)	Aztalan (LW/MM)	All Aztalan	CBHC (Oneota)
Nutshell: Unidentified	32	55	87	496
Nutshell: Hickory [<i>Carya</i>]	771	497	1268	349
Nutshell: Walnut [<i>Juglans</i>]	1	5	6	74
Nutshell: Hazelnut [<i>Corylus</i>]	2	-	2	42
Nutshell: Oak (Acorn) [<i>Quercus</i>]	3	1	4	1909
Maize [<i>Zea mays</i>]	327	582	909	4849
Squash [<i>Cucurbita</i>]	69	45	114	7
Bottle gourd [<i>Lagenaria siceraria</i>]	-	1	1	-
Little barley [<i>Hordeum pusillum</i>]	-	3	3	1
Wild rice [<i>Zizania aquatica</i>]	10	3	13	5657
cf <i>Zizania/Hordeum</i>	1	-	1	1
Barnyard grass (<i>Echinochloa</i> sp)	1	-	1	2
Maygrass [<i>Phalaris carolinianum</i>]	-	-	-	30
Panicoid [<i>Panicum</i>]	-	-	-	4
Sunflower [<i>Helianthus annuus</i>]	-	1	1	-
Sumpweed [<i>Iva annua</i>]	-	1	1	-
Chenopodium [<i>Chenopodium</i> sp]	21	670	691	1374
Chenopod/Amaranth	-	-	-	8
Amaranth [<i>Amaranthus</i> sp]	6	8	14	23
Knotweed [<i>Polygonum</i> sp]	3	1	4	35
Unid. <i>Rosaceae</i>	-	2	2	-
Cherry [<i>Prunus</i> sp]	-	3	3	2
Raspberry/Blackberry [<i>Rubus</i> sp]	1	-	1	4
Strawberry [<i>Fragaria</i>]	-	-	-	2
Nightshade [<i>Solanum</i>]	29	3	32	172
Grape [<i>Vitis</i>]	2	-	2	-
Sumac [<i>Rhus</i> sp]	-	1	1	1
Blueberry [<i>Vaccinium</i>]	-	-	-	1
Bedstraw [<i>Galium</i>]	1	-	1	4
Cattail [<i>Stypha</i>]	-	-	-	30
Pea family [<i>Fabaceae</i>]	-	-	-	47
Wild bean [<i>Strophostyles helveola</i>]	-	-	-	66
Tuber [aquatic]	3	-	3	19
Fungus (incl fruiting structures)	98	43	141	284
Total (N)	1381	1925	3306	15493
Diversity index (H) (natural log (ln))	1.38	1.46	1.56	1.68

Comparison between Aztalan and American Bottom Data

Table 4.20 presents taxa percentages for Aztalan in order to facilitate comparison with American Bottom floral data as summarized by Simon and Parker (2006).

Table 4.20: Seed and Nutshell Taxon Percentages for Aztalan

	Late Woodland	Mississippian
Total Nutshell (fragments)	809	550
Percentage <i>Juglandaceae</i>	3.96%	10.00%
Percentage hickory	95.30%	90.36%
Percentage walnut	0.12%	0.91%
Percentage hazelnut	0.24%	0.00%
Percentage acorn	0.37%	0.18%
Total identifiable seeds	89	738
Percentage starchy seeds	26.97%	92.41%
Total starchy seeds	24	682
Percentage <i>Chenopodium</i>	100.00%	98.24%
Percentage erect knotweed	0.00%	0.00%
Percentage maygrass	0.00%	0.00%
Percentage little barley	0.00%	0.00%

Late Terminal Late Woodland in the American Bottom. The Late Terminal Late Woodland (LTLW) dataset in the American Bottom consists of nine components: the Knoebel site, the J. Sprague site, Robinson's Lake, the Radic site, two components from the George Reeves site, the BBB Motor site, the Marge site and the Holdener site (Simon and Parker 2006:Table 10). Nutshell densities range from 0.2 ct/10 liters at the Radic site to 36.1 ct/10 liters at J. Sprague, with a median of 3.2 ct/10 liters. Nutshell density at Aztalan is 5.19 ct/10 liters for Stratum 11, higher than the median LTLW value for the American Bottom. Nutshell density for Feature 8 at Aztalan (37.67 ct/10 liters) is comparable to the Radic site.

At Aztalan, hickory makes up the highest percentage of nutshell (95.30 percent for the Late Woodland component, 90.36 percent for the Mississippian component). The Robinson's Lake site shows the highest percentage of hickory (90.9 percent) for American Bottom sites during this period. The Lindeman component of the George Reeves site has the lowest percentage of hickory (5.9 percent). The median percentage of hickory nut is 48.8 percent.

Acorn plays a small role at Aztalan (0.37 percent of Late Woodland nutshell and 0.18 percent of Mississippian nutshell). In the American Bottom, acorn ranges from a high of 83.7 percent at the BBB Motor site to a low of 0.00 percent at Robinson's Lake, Holdener and the Radic site. The median percentage for acorn at LTLW sites in the American Bottom is 4.3.

Percentages of walnut are limited in the Aztalan assemblage (0.12 percent for the Late Woodland assemblage and 0.91 percent for the Mississippian assemblage). Walnut is also of little significance in LTLW American Bottom assemblages. The only site where walnut shell makes up a measurable percentage of the assemblage is the Marge site (1.0 percent).

Only three LTLW components in the American Bottom have a significant percentage of hazelnut shell: Knoebel (2.0 percent), J. Sprauge (0.2 percent), and BBB Motor (0.5 percent). At Aztalan, hazelnut is 0.24 percent of the Late Woodland nutshell assemblage and 0.00 percent of the Mississippian assemblage. For American Bottom LTLW components, hickory and acorn were the most important nut taxa.

Maize densities for Late Terminal Late Woodland sites in the American Bottom range from 19.8 ct/10 liters in the George Reeves component of the George Reeves site to

0.1 ct/10 liters at the Holdener site. The median density of maize at LTLW American Bottom sites is 4.6 ct/10 liters. At Aztalan, maize density for Late Woodland Stratum 11 is 1.67 ct/10 liters, not vastly different from the densities observed at LTLW American Bottom sites. Maize ubiquities at LTLW American Bottom sites range from 0.0 percent in the Lindeman component of the George Reeves site and 92.4 percent at the BBB Motor site. The median ubiquity for LTLW maize is 66.7 percent. Maize ubiquity for Late Woodland samples at Aztalan is 90.48 percent, compared with 78.58 percent for Aztalan Mississippian samples.

Only three LTLW components have measurable squash ubiquities: Radic (9.1 percent), BBB Motor (3.1 percent) and Marge (17.7 percent). Squash ubiquities at Aztalan are 52.38 percent for Late Woodland samples and 28.57 percent for Mississippian samples, suggesting that this resource may have played a more important role at Aztalan than at LTLW sites in the American Bottom.

Chenopodium is the most commonly recovered starchy seed at Aztalan, making up 100.00 percent of the Late Woodland starchy seed assemblage and 98.24 percent of the Mississippian starchy seed assemblage. For LTLW sites in the American Bottom, percentages of *Chenopodium* range from a low of 4.1 percent at the Marge site to a high of 63.1 percent at the Lindemann component of the George Reeves site, with a median of 12.9 percent. The percentage of *Chenopodium* in the Late Woodland seed component at Aztalan is therefore comparable to LTLW American Bottom percentages.

Knotweed makes up 0.00 percent of the Late Woodland Aztalan seed assemblage and 0.00 percent of the Mississippian starchy seed assemblage. At LTLW sites, percentages of erect knotweed range from 0.0 percent at the J. Sprague site and 54.1

percent at the Marge site, with a median percentage of 9.1. The percentage of erect knotweed in the Late Woodland seed component at Aztalan is miniscule compared to LTLW sites in the American Bottom.

Maygrass was not identified in any of the Aztalan components examined for this study, however Egan-Bruhy (2014) notes its presence at the site. Maygrass appears to have been a significant resource at LTLW sites in the American Bottom. Maygrass range from 92.6 percent of the J. Sprague seed assemblage to 2.2 percent of the Lindemann phase George Reeves assemblage, with a median percentage of 64.4.

Comparison with Lohmann phase American Bottom Assemblages. Simon and Parker (2006) discuss summary data from 11 Lohmann phase components in the American Bottom: Lembke No. 1, ICT-II, Truck No. 4, Olzewski, Carbon Dioxide, Lohmann, George Reeves, Range, Walmart, East St. Louis and Esterlein (Simon and Parker 2006:Table 12).

Nutshell densities at Lohmann phase sites range from 1.0 ct/10 liters at the Esterlein site to 30.6 ct/10 liters, with a median density of 9.5 ct/10 liters. Nutshell density for Mississippian Feature 8 at Aztalan is 37.67 ct/10 liters, comparable to Lohmann phase densities in the American bottom. Nutshell density for Late Woodland Stratum 11 at Aztalan is 5.19 ct/10 liters.

Hickory composes 90.36 percent of nutshell from Aztalan's Mississippian component and 95.30 percent of Late Woodland nutshell. Hickory percentages at Lohmann phase sites components from 76.7 percent at the George Reeves site to 8.3 percent at the Lembke No. 1 site, with a median percentage of 37.2 percent at the

Olzewski site. These percentages suggest that hickory was less prevalent at Lohmann phase sites in the American Bottom than at Aztalan.

Acorn appears to have played a moderate role in Lohmann phase American Bottom subsistence. Percentages range from 36.0 at the Walmart site to 0.0 at Lembke No. 1, Truck No. 4, and East St. Louis, with a median percentage of 3.1. Acorn is less important at Aztalan (0.37 percent of Late Woodland nutshell and 0.18 percent of Mississippian nutshell).

Walnut appears to have been more important for the Lohmann phase than for the LTLW in the American Bottom. Percentages of the nutshell assemblage range from 18.2 at the Truck No. 4 site to 0.0 at Lembke No. 4, Lohmann and Esterlein, with a median percentage of 0.8. Aztalan walnut percentages are low (0.12 percent for the Late Woodland assemblage and 0.91 percent for the Mississippian assemblage).

Only four Lohmann phase components have a significant percentage of hazelnut: ICT-II (9.3), Range (0.3), Walmart (0.1) and East St. Louis (2.3). Hazelnut is 0.0 percent of the Aztalan Mississippian nutshell assemblage, and 0.24 percent of Late Woodland nutshell. As for the LTLW, hickory dominates nutshell assemblages for the Lohmann phase in the American Bottom, followed by acorn.

Lohmann phase maize densities are variable, ranging from 145.8 ct/10 liters at the Olzewski site to 0.0 ct/10 liters at the Truck No. 4 site, with a median density of 20.9 ct/10 liters, higher than the median density at LTLW sites. Maize density from the early Mississippian Feature 8 at Aztalan is 43.83 ct/10 liters, higher than the median density for American Bottom Lohmann phase sites (maize density for Late Woodland Stratum 11 is 1.67 ct/10 liters). Maize ubiquity at Lohmann phase American Bottom sites ranges from

100.00 percent (Lembke No. 1, Olzewski, Walmart, East St. Louis) to 6.6 percent (Truck No. 4), with a median ubiquity of 87.5 percent. At Aztalan, maize ubiquity for Mississippian samples is 78.58 percent, compared with 90.48 percent for Late Woodland samples.

Squash ubiquities for the Lohmann phase range from 50.0 percent (Olzewski) to 0.0 percent (Lembke No., Truck No. 4, Carbon Dioxide, Walmart, East St. Louis), with a median ubiquity of 7.2 percent. Aztalan's Mississippian component has a 28.57 percent ubiquity for squash, lower than for the Late Woodland component (52.38 percent) but higher than the median ubiquity for the Lohmann phase, possibly indicating that squash continues to be more important at Aztalan than at American Bottom sites.

Chenopodium accounts for 98.24 percent of the Mississippian starchy seed assemblage at Aztalan (100.00 percent of the Late Woodland starchy seed assemblage). Percentages of *Chenopodium* at Lohmann phase sites range from a high of 82.6 (Walmart site) to a low of 0.0 (Lembke No. 1 and Truck No. 4), with a median percentage of 19.1.

Knotweed composes 0.00 percent of the Mississippian starchy seed assemblage at Aztalan (also 0.00 percent of the Late Woodland assemblage). Percentages of knotweed for Lohmann phase sites range from 16.7 percent (Lohmann) to 0.0 percent (Lembke No. 1, Truck No. 4, Esterlein), with a median percentage of 5.8.

As previously noted, maygrass does not appear in the Aztalan samples used in this analysis, but a small quantity is present at the site (Egan-Bruhy 2014). In contrast, the percentage of maygrass at Lohmann phase sites ranges from 100.00 percent at Lembke No. 1 to 0.0 percent at Truck No. 4, with a median percentage of 62.5 percent. The dominance of maygrass (whether alongside *Chenopodium* or at its expense) is one of the

key factors separating subsistence at Aztalan from Lohmann phase American Bottom subsistence.

Little barley accounts for 0.00 percent of the Mississippian seed assemblage at Aztalan. Percentages at Lohmann phase sites range from 33.6 (ICT-II) to 0.0 (Lembke No. 1, Truck No. 4, Carbon Dioxide, George Reeves, Range and Esterlein), with a median percentage of 0.0. Little barley does not appear to have been a significant dietary staple at Aztalan or Lohmann phase sites.

Comparison with Stirling phase American Bottom Assemblages. Simon and Parker present data for 17 Stirling phase components in the American Bottom: Lembke No. 3, Lembke No. 2, Faust No. 1, Faust No. 2, Knoebel South, Range, Karol Rekas, Julien, Curtiss Steinberg, Turner, Sponemann, Olzewski, Fingers, BBB Motor, Vaughn Branch, ICT-II and East St. Louis (Simon and Parker 2006:Table 13).

Nutshell densities range from 971.2 ct/10 liters at Lembke No. 2 to 0.1 ct/10 liters at East St. Louis, with a median density of 10.9 ct/10 liters. Nutshell density for Feature 8 at Aztalan is higher than the median Stirling phase density (37.67 ct/10 liters, compared with 5.19 ct/10 liters for Late Woodland Stratum 11).

As at Aztalan, hickory accounts for the greatest percentage of nutshell assemblages at Stirling phase sites. Percentages range from 99.5 (Lembke No. 2) to 3.0 (Karol Rekas), with a median percentage of 58.1. This is higher than the median percentage of hickory for Lohmann phase sites (37.2), but lower than the percentages for Aztalan's Mississippian (90.36) and Late Woodland (95.30) components.

Percentages of acorn at Stirling phase sites range from a high of 41.6 percent (Sponemann) to a low of 0.00 at five sites, with a median percentage of 3.1, identical to

the median Lohmann phase percentage but still higher than the percentage for the Mississippian (0.18) and Late Woodland (0.37) occupations at Aztalan.

Stirling phase walnut percentages are low, ranging from 5.3 at East St. Louis to 0.0 at 8 sites, with a median of 0.2, lower than the median percentage for the Lohmann phase (0.8). Aztalan's Mississippian component has a higher percentage of walnut (0.91) than the median Stirling percentage (0.12 for the Late Woodland assemblage).

Hazelnut percentages for the Stirling phase range from 84.7 (Karol Rekas) to 0.00 at 9 sites; the median percentage is 0.0. Excepting one site, the low importance of hazelnut in Stirling phase assemblages is similar to the pattern to the Lohmann phase and to Aztalan, where hazelnut is not found in the Mississippian assemblage (hazelnut accounts for 0.24 percent of the Late Woodland assemblage).

As in the Lohmann phase, Stirling phase maize densities vary, ranging from a high of 361.8 ct/10 liters (Lembke No. 2) to a low of 0.2 ct/10 liters (Faust No. 2). The median Stirling phase maize density is 23.8 ct/10 liters, slightly higher than the median Lohmann phase density (20.9 ct/10 liters) but lower than the Aztalan Feature 8 density (43.83 ct/10 liters; maize density for Late Woodland Stratum 11 is 1.67 ct/10 liters). Aztalan's Mississippian component maize density appears to be within the range for Stirling phase sites. Maize ubiquity at Stirling phase sites ranges from 100.00 percent to 50.00 percent, with a median ubiquity of 88.1 percent. Aztalan's Mississippian component shows a maize ubiquity by sample of 78.58 percent, well within the range of Stirling phase ubiquities. Late Woodland samples at Aztalan have a maize ubiquity of 90.48 percent.

Stirling phase squash ubiquities range from 50.00 percent (Faust No. 2) to 0.0 percent at eight sites, with a median ubiquity of 1.8 percent. It appears that squash was a more important resource for Aztalan's Mississippian (28.57 percent ubiquity) and Late Woodland (52.38 percent ubiquity) components than for Stirling phase occupations in the American Bottom.

Chenopodium is the most important seed type at Aztalan, representing 98.24 percent of the Mississippian starchy seed assemblage (100.00 percent of the Late Woodland starchy seed assemblage). *Chenopodium* percentages for the Stirling phase range from 57.1 (Olzewski) to 0.0 (Curtis Steinberg) with a median percentage of 11.1, lower than the Lohmann phase median of 19.1

Knotweed is not a significant part of the diet at Aztalan, accounting for 0.00 percent of the Mississippian seed assemblage (0.00 percent of the Late Woodland assemblage). Stirling phase knotweed percentages range from 86.1 (Fingers) to 0.0 (Curtiss Steinberg, East St. Louis), with a median percentage of 9.5, slightly higher than the Lohmann phase median (5.8).

Maygrass appears rarely at Aztalan (Egan-Bruhy 2014) but is a significant resource at Stirling phase sites. Percentages in the American Bottom range from 97.3 (Knoebel South) to 0.0 (Curtiss Steinberg), with a median percentage of 57.6, slightly lower than the Lohmann phase median (62.5 percent) but likely indicating a fairly steady importance for this resource. Maygrass appears to dominate over *Chenopodium* for both the Lohmann and Stirling phases in the American Bottom.

Little barley percentages at Stirling phase sites range from 19.1 (Olzewski) to 0.0 at five sites, with a median percentage of 0.8, higher than the median for Lohmann phase

components (0.0). Little barley 0.00 percent of the Mississippian seed assemblage at Aztalan.

Comparison with Late Mississippian American Bottom sites. For purposes of analysis, Simon and Parker (2006) group Moorehead and Sand Prairie sites. Summary data from 12 sites is reported: Julien, Old Edwardsville Road, ICT-II, Radic, Florence Street, Faust No. 1, GCS 1, Lembke No. 2, Hawkins Hollow, Dave Lembke, Sponemann, and Julien (Simon and Parker 2006:Table 15).

Nutshell densities for Late Mississippian sites range from 9632.0 ct/10 liters (Dave Lembke) to 0.2 ct/10 liters (Radic), with a median density of 127.35 ct/10 liters, considerably higher than the median Stirling phase density (10.9 ct/10 liters), the Aztalan Feature 8 density (37.67 ct/10 liters) and the Aztalan Stratum 11 density (5.19 ct/10 liters). The dramatic increase in median nutshell density suggests that this resource increased in importance during the Late Mississippian period in the American Bottom.

Hickory as a percentage of the nutshell assemblage ranges from 100.00 (Sponemann) to 20.0 (Florence Street), with a median percentage of 87.7. This is much higher than the median percentage for Stirling phase sites (58.1) and closer to the percentages observed at Aztalan for the Mississippian (90.36) and Late Woodland (95.30) components.

Acorn as a percentage of Late Mississippian nutshell assemblages ranges from 10.5 (Hawkins Hollow) to a low of 0.0 at four sites, with a median of 0.6. This is lower than the Stirling phase median percentage (3.1) and may indicate that hickory comes to predominate over acorn during the Late Mississippian period in the American Bottom.

The Late Mississippian acorn percentage is still slightly higher than the percentage for the Mississippian (0.18) and Late Woodland (0.37) occupations at Aztalan.

As with the Stirling phase, walnut percentages for Late Mississippian American Bottom components are low, ranging from 33.3 (Florence Street) to 0.0 at five sites, with a median percentage of 0.4. Aztalan's Mississippian component has a higher percentage of walnut (0.91) than the median Late Mississippian American Bottom percentage (0.12 for the Late Woodland assemblage).

Hazelnut percentages are also low at Late Mississippian components in the American Bottom, ranging from 2.5 (ICT-II) to 0.0 at eight sites, with a median percentage of 0.0. Hazelnut is not found in the Mississippian assemblage at Aztalan, and it accounts for just 0.24 percent of Late Woodland nutshell.

Late Mississippian maize densities range from 38.8 ct/10 liters (Sponemann) to 1.8 ct/10 liters, with a median density of 12.5 ct/10 liters, lower than the Stirling phase median (23.8 ct/10 liters), and also lower than the Aztalan Feature 8 density (43.83 ct/10 liters; maize density for Late Woodland Stratum 11 is 1.67 ct/10 liters). Maize ubiquity at Late Mississippian American Bottom sites ranges from 100.00 percent at four sites to 21.1 percent (Radic), with a median ubiquity of 55.2 percent, lower than the Stirling phase median (88.1 percent).

Squash ubiquity for Late Mississippian sites in the American Bottom ranges from 8.3 percent (Lembke No. 2) to 0.0 percent at seven sites, with a median ubiquity of 0.0 percent. This indicates that squash is much less significant at Late Mississippian American Bottom sites than at Aztalan, where Mississippian samples show 28.57 percent ubiquity (52.38 percent for Late Woodland samples).

Chenopodium dominates the starchy seed assemblage at Aztalan (100.00 percent for the Late Woodland component and 98.24 percent for the Mississippian component). Percentages of *Chenopodium* at Late Mississippian sites range from 100.00 percent at Florence Street to 0.0 percent at two sites. The median percentage of *Chenopodium* in Late Mississippian starchy seed assemblages is 37.65. This is substantially higher than the median Stirling phase percentage (11.1).

Knotweed does not make up a significant percentage of the starchy seed assemblage for either component at Aztalan. Late Mississippian knotweed percentages range from 83.6 (Julien) to 0.0 at five sites, with a median percentage of 0.4, significantly lower than the Lohmann phase (5.8) and Stirling phase (9.5) medians.

Only a small amount of maygrass is present at Aztalan (Egan-Bruhy 2014) and none was identified in this study. Percentages of maygrass in the starchy seed assemblage at Late Mississippian American Bottom sites range from 90.7 at Old Edwardsville Road to 0.0 at three sites, with a median of 6.25 percent. This is lower than both the Lohmann phase median (62.5 percent) and the Stirling phase median (57.6 percent). This may indicate a decrease in the importance of maygrass during the Late Mississippian period in the American Bottom.

Little barley does not compose a significant percentage of the starchy seed assemblage for either component at Aztalan. Little barley percentages for Late Mississippian sites range from 50.0 (Faust No. 1) to 0.0 at five sites, with a median percentage of 0.8.

Comparison between Aztalan and Eastern Great Lakes

While 10-12 row maize appears to dominate both the Late Woodland and Mississippian components at Aztalan, the maize assemblage does contain some specimens with angle measurements consistent with eight row cobs, leaving open the possibility of Eastern Eight Row influence on the maize at Aztalan. The prevalence of maize and squash at Aztalan is certainly consistent with the early arrival of those crops in the Eastern Great Lakes region (Hart and Lovis 2012).

With regard to Michigan, Aztalan's floral assemblage appears more similar to sites in the Saginaw Valley than those in the western Lower Peninsula. The St. Joseph and Kalamazoo River Valleys show an emphasis on wild resources, particularly aquatic resources, through to the Upper Mississippian period (Simon 2000). The SA1034 site, located in the Saginaw Valley and dated ca. A.D. 1150, exhibited floral residues quite similar to those seen at Aztalan such as tobacco, squash, *Chenopodium*, sunflower and maize (Parker 1996). Maize density at SA1034 (2.7 ct/10 liters), is lower than observed for Mississippian Feature 8 at Aztalan (43.83 ct/10 liters) but only slightly higher than seen in Late Woodland Stratum 11 (1.67 ct/10 liters). Density of Eastern Agricultural plants is relatively low at SA1034 (0.04 ct/10 liters) (Parker 1996, cited in Egan-Bruhy 2014). The density for *Chenopodium* at Aztalan is higher for both the Late Woodland Stratum 11 (0.18 ct/10 liters) and Mississippian Feature 8 (63.57 ct/10 liters).

The 20SA367 site is also a late Late Woodland site in the Saginaw Valley, with "Ontario-related" collared pottery (Egan-Bruhy 2014:9). Maize density at 20SA367 is 3.58 ct/10 liters, more comparable to Late Woodland than Mississippian densities at Aztalan. The density of *Chenopodium* (0.1 ct/10 liters) is similarly low (Egan-Bruhy

2009). Even in the Saginaw Valley, Late Woodland sites appear to emphasize aquatic resources such as tubers and wild rice, a pattern not observed at Aztalan (Egan 1990).

Summary of the Analysis

Late Woodland versus Mississippian Subsistence at Aztalan

An assessment of any apparent shift in subsistence pattern between the Late Woodland and Mississippian occupations at Aztalan is the primary goal of this research. The Late Woodland component is reflected in contexts which contained only Late Woodland pottery. The Mississippian component reflects a period in which both shell-tempered and grit-tempered vessels are found at the site. It is referred to here as “Mississippian” for the sake of simplicity. In terms of the most ubiquitous taxa (hickory nutshell, maize and squash), the differences between the two components appear to be a matter of degree.

The majority of the nutshell recovered from both components was identifiable as hickory (95.30 percent of Late Woodland nutshell fragments and 90.36 percent of Mississippian nutshell; Table 4.20). Small amounts of walnut and acorn were identified in both components, accounting for less than one percent of each nutshell assemblage. A similarly small quantity of hazelnut shell was recovered from the Late Woodland component only. While density of nutshell is high (37.67 ct/10 liters) for Feature 8 compared with 5.19 ct/10 liters for Stratum 11, this likely relates to a greater density of charred plant remains in the feature than in the midden. The nut:wood ratio, intended to correct for this, is 0.05 for the Late Woodland component and 0.03 for the Mississippian component (by weight), which supports the argument that hickory nut was more

important during the Late Woodland occupation of the site than for the Mississippian occupation. The nut:maize ratio is also employed to provide insight into these trends. For the Late Woodland component, this ratio is 2.47, while it is 0.94 for the Mississippian component. Nuts were relatively more important than maize during the Late Woodland occupation as opposed to the Mississippian component.

Densities for maize are higher in Feature 8 (43.83 ct/10 liters) than for Stratum 11 (1.67 ct/10 liters). Controlling for differential deposition, Mississippian contexts at Aztalan have a maize:wood ratio of 0.02 by weight, compared with 0.01 for Late Woodland samples. This doubling of the ratio provides support for the argument that maize production and use were intensified during the Mississippian occupation. This trend may also be seen in the nut:maize ratio, which is 2.47 for the Late Woodland component and 0.94 for the Mississippian component. In Chapter 2, the potential for processing method to affect deposition and preservation in maize was explored. An alternative explanation for the higher maize ratio in the Mississippian component may relate to a shift in processing method or technology. The possibility that this shift is connected to a move toward alkali processing of maize (cf. Benchley 2003) is discussed in Chapter 5.

Squash rind ubiquity is higher for the Late Woodland component (52.38 percent) than for the Mississippian component (28.57 percent). While this supports use of squash during the Late Woodland component, the utility of ubiquity as a measure is limited due to the possibility of disturbance in the midden. Squash rind density is higher for Feature 8 (3.89 ct/10 liters) than for Stratum 11 (0.42 ct/10 liters). The rind:wood ratio (by count) for the Mississippian component is 0.01, compared with 0.00 for the Late Woodland

component. The data support the conclusion that utilization of squash increased through time at Aztalan.

The data also suggest that use of native cultigens and starchy seeds intensified through time at Aztalan. Starchy seeds make up 92.41 percent of all seeds recovered from the Mississippian component, and only 26.97 percent of Late Woodland seeds (Table 4.20). In both cases, *Chenopodium* accounts for the majority of starchy seeds (100.00 percent for the Late Woodland component; 98.24 percent for the Mississippian component). *Chenopodium* density for Feature 8 is 63.57 ct/10 liters, compared with 0.18 ct/10 liters for Stratum 11. As with maize and squash, it appears that *Chenopodium* use intensifies during the Mississippian component.

Three starchy seeds (*Chenopodium*, amaranth and knotweed) are found in both components. *Echinochloa* is found only in the Late Woodland assemblage. Little barley, sumpweed and sunflower are found only in the Mississippian component. The Shannon-Weaver diversity index for the Late Woodland component is 1.38, compared with 1.46 for the Mississippian component. Possible causes of greater dietary breadth during the Mississippian occupation of the site include an increased reliance on maize relative to nutshell, as well as an increase in the amount of native cultigens, especially *Chenopodium*.

Summary of Maize Race Data

Maize race data indicate that Aztalan residents grew two types of maize during both components. A slight majority of the maize at Aztalan is consistent with a low row number (8-10 rows, 55.88 percent), while 44.12 percent falls under a high row number

category. Over 80 percent of maize at CBHC falls into the high row number category.

Though these results must be viewed through the limitations of row number analysis, the difference between the two sites is statistically significant ($p=0.0028$).

Summary of Regional Comparative Data

Nutshell. Nut:wood ratios at the Murphy and River Quarry sites (0.56 and 0.19, respectively, by weight) are higher than observed at Aztalan for both the Late Woodland and Mississippian components (0.05 and 0.03 respectively, by weight). Collared ware Late Woodland sites appear to vary in terms of dominant nut taxon: like Aztalan, the River Quarry site nutshell assemblage is dominated by hickory (15.52 ct/10 liters). On the other hand, the Murphy site has a high density of acorn (105.54 ct/10 liters).

The nut:wood ratio by weight at Fred Edwards (0.06 by weight) is similar to the Late Woodland component at Aztalan, but much lower than the ratios for Murphy and River Quarry. By count, the wood ratio at Lundy is 0.07 (the ratios by count at Aztalan are 0.06 for the Late Woodland component and 0.08 for Mississippian contexts). This data provides support for the argument that levels of nut consumption at Aztalan were similar to levels at Lundy and Fred Edwards, but less than seen at other Late Woodland sites. As at Aztalan, Fred Edwards demonstrates a dominance of hickory (38.24 ct/10 liters). Unlike Aztalan and Fred Edwards, Lundy has a high density of walnut (90.16 ct/10 liters), hazelnut (3.90 ct/10 liters) and acorn (331.51 ct/10 liters). As for Late Woodland sites, nut exploitation strategies appear to vary among Mississippian-influenced sites in the northern hinterlands.

Nut exploitation at CBHC is also different from that observed at Aztalan. The nut:wood ratio at CBHC (0.02, by count) is considerably lower than for Aztalan's Late Woodland (0.06, by count) and Mississippian (0.08, by count) components, suggesting that nuts were a less important part of the Lake Koshkonong Oneota diet. Hickory density is low at CBHC (1.11 ct/10 liters), compared with 0.24 ct/10 liters for walnut, 6.07 ct/10 liters for acorn, and 0.13 ct/10 liters for hazelnut. The variety of nut types recovered at CBHC is reflective of the wider dietary breadth for the site as a whole, which will be discussed below.

Maize. Ratios reveal significant variation in the recovery of maize at Late Woodland sites. The maize:wood ratio for River Quarry (0.07, by count) is similar to the Mississippian component at Aztalan. On the other hand, the maize wood ratio at the Murphy site (0.02, by count) is identical to the Late Woodland component at Aztalan. This may relate to differences in levels of use or processing technique among Late Woodland communities in southern Wisconsin.

Maize ratios also reveal variability among Mississippian influenced sites. The maize:wood ratio at Fred Edwards (0.06, by weight) is higher than in Aztalan's Mississippian component (0.02, by weight). The Lundy site ratio (0.36, by count) is substantially higher than observed for Aztalan's Mississippian component (0.08, by count). Higher recovery of maize at Mississippian-influenced sites in the Upper Mississippi River Valley may indicate this domesticate was of greater dietary importance, or may reflect differences in processing.

The CBHC maize:wood ratio is 0.04 by count, compared with 0.08 for Mississippian samples at Aztalan and 0.02 for Aztalan's Late Woodland component.

Maize ubiquity at CBHC is 65.00 percent, compared with 78.58 percent for Aztalan's Mississippian component. The data provide support for the argument that maize was not as central to the diet of Lake Koshkonong Oneota as to the diet of Aztalan's later inhabitants. Again, the differences observed may also reflect differences in processing.

Squash. Squash appears to have been more important at Aztalan for both components than for other Late Woodland sites. Squash does not appear at all at the Statz site. The density of squash rind at Aztalan (0.42 ct/10 liters for Stratum 11 and 3.89 ct/10 liters for Feature 8) is higher than for River Quarry (0.07 ct/10 liters) or Murphy (0.12 ct/10 liters). Squash ubiquity is also higher at Aztalan.

Squash densities are lower at Fred Edwards (0.15 ct/10 liters) and Lundy (0.12 ct/10 liters) compared to Aztalan. The low density at Lundy is especially noteworthy, given the high density of floral remains in general. Squash may have been less important at Mississippian-influenced sites in the upper Mississippi trench than at Aztalan. At CBHC, the density of squash is only 0.02 ct/10 liters, suggesting that Oneota residents of the Lake Koshkonong locality placed little emphasis on this resource.

Cultigens and wild rice. Data for native cultigens, particularly *Chenopodium*, illustrate diversity amongst Late Woodland sites. *Chenopodium* was recovered from one-fifth of features at the Statz site, but is absent at River Quarry. Density is 0.12 ct/10 liters at the Murphy site, compared with 0.18 ct/10 liters for Late Woodland Stratum 11 at Aztalan and 63.57 ct/10 liters for Mississippian Feature 8. The Murphy site assemblage included single examples of amaranth and knotweed; otherwise starchy seeds apart from *Chenopodium* are absent from Late Woodland sites besides Aztalan. No wild rice was discovered from Late Woodland sites other than Aztalan, despite the fact that the Murphy

site is located on a wetland. Oily-seeded annuals are not found at the three Late Woodland sites.

Chenopodium density at Fred Edwards (15.56 ct/10 liters) is similar to Feature 8 at Aztalan, compared with just 0.49 ct/ 10 liters at Lundy. Given the high density of floral remains at Lundy, residents may not have prioritized *Chenopodium* as a resource. Little barley and maygrass are found at Lundy and Fred Edwards. Sunflower was identified at Fred Edwards, and sumpweed was found at Lundy. All of these taxa are present in the Mississippian component at Aztalan. No wild rice is present at Fred Edwards, but three grains were identified at Lundy, compared with 13 (10 for the Late Woodland component and three for the Mississippian component) at Aztalan.

Chenopodium is more ubiquitous at CBHC (57.50 percent) than at Aztalan; its density (4.37 ct/10 liters) is lower than Feature 8 (63.57 ct/10 liters) and higher than Stratum 11 (0.18 ct/10 liters). No oily-seeded annuals have been identified at CBHC. One little barley seed, two barnyard grass seeds, 23 amaranth seeds and 35 knotweed seeds have been identified at CBHC. Density for wild rice is much higher at CBHC (17.98 ct/10 liters) versus Aztalan Feature 8 (0.28 ct/10 liters) and Stratum 11 (0.09 ct/10 liters).

Dietary breadth. The Shannon-Weaver diversity index was used to provide a measure of diet breadth at the sites. The diversity scores for the Late Woodland component at Aztalan (1.38) and the Mississippian component (1.46) are discussed above. The other Late Woodland sites demonstrate lower diversity. The Statz site (H=1.13) and the River Quarry site (H=1.05) demonstrate overrepresentation of nutshell and maize. The Murphy site's very low index (H=0.30) is likely explained by an overrepresentation of acorn.

Mississippian-influenced sites in the Upper Mississippi River Valley have lower diversity scores than Aztalan. The Lundy site assemblage ($H=0.54$) shows less biodiversity due to a high reliance on maize. The low Fred Edwards index (0.96) appears to result from high reliance on hickory, *Chenopodium* and maize.

CBHC has the highest diversity index of any site included here ($H=1.68$). This breadth may be the result of a balance between maize (4849 fragments) and wild rice (5657 seeds) followed by acorn (1909 fragments) and *Chenopodium* (1374 fragments). CBHC dietary breadth is greater, in part because of higher utilization of wild resources.

Summary of American Bottom Comparison

Nutshell. Nutshell density at Aztalan for Late Woodland Stratum 11 is 5.19 ct/10 liters and 37.67 ct/10 liters for Mississippian Feature 8. These densities are higher than the median nutshell density for the Late Terminal Late Woodland (LTLW) in the American Bottom (3.2 ct/10 liters). Hickory makes up over 90 percent of nutshell for both components at Aztalan (Table 4.20), while the median percentage of hickory nutshell for LTLW components in the American Bottom is 48.8 percent. The median percentage for acorn at LTLW sites in the American Bottom is 4.3. As at Aztalan, walnut and hazelnut make up less than five percent of nutshell at American Bottom LTLW sites.

At Lohmann phase sites, the median nutshell density (9.5 ct/10 liters) is higher than the density for Late Woodland Stratum 11, but lower than the Mississippian Feature 8 density. Median percentages for various nut taxa at Lohmann phase site suggest a somewhat varied pattern of nut exploitation compared to Aztalan (37.2 percent for hickory, 3.1 for acorn, and 0.8 for walnut). Hazelnut, which appears in the Late

Woodland nutshell assemblage at Aztalan, is insignificant during the Lohmann phase in the American Bottom, appearing at just four sites.

Nutshell density from Feature 8 at Aztalan is higher than the median Stirling phase density in the American Bottom (10.9 ct/10 liters). The median percentage of hickory nut at Stirling phase sites is higher than that observed at Lohmann phase sites (58.1).

The median density for nutshell at Late Mississippian sites in the American Bottom is 10.9 ct/10 liters, lower than the Feature 8 density but higher than the Stratum 11 density at Aztalan. The median percentage of hickory nutshell at these sites (87.7) is more comparable to percentages at Aztalan – Late Mississippian nutshell assemblages in the American Bottom appear to show decreased diversity.

Maize. Maize density at Aztalan is 11.67 ct/10 liters for Late Woodland Stratum 11 and 43.83 ct/10 liters for Mississippian Feature 8. Median maize densities for the American Bottom are 4.6 ct/ 10 liters for the LTLW, 20.9 ct/10 liters for the Lohmann phase, 23.8 ct/10 liters for the Stirling phase, and 12.5 ct/10 liters for the Late Mississippian period. Median maize densities in the American Bottom appear to increase through the Stirling phase.

Maize ubiquities at Azalan are 90.48 percent for Late Woodland samples and 78.58 percent for Mississippian samples. Median maize ubiquities in the American Bottom are 66.7 percent for the LTLW, 87.5 percent for the Lohmann phase, 78.58 percent for the Stirling phase, and 55.2 percent for the Late Terminal Late Woodland. Based on ubiquities and median densities, recovery of maize at Aztalan is similar to Late Prehistoric sites in the American Bottom.

Squash. While squash is ubiquitous at Aztalan during the Late Woodland (52.38 percent) and Mississippian (28.57 percent) components, only three LTLW components had measurable ubiquities for squash. The median ubiquity for Lohmann phase assemblages is 7.2 percent, compared with 1.8 percent for the Stirling phase. Late Mississippian median squash ubiquity is 0.0 percent. Overall, the data suggest that squash was more important at Aztalan than in Late Prehistoric components in the American Bottom.

Chenopodium and maygrass. Major differences between the starchy seed assemblages at Aztalan and in the American Bottom revolve around the relative importance of *Chenopodium* and maygrass. *Chenopodium* is the most important starchy seed at Aztalan, composing 100 percent of the Late Woodland starchy seed assemblage and 98.24 percent of the Mississippian starchy seed assemblage (Table 4.20). Median *Chenopodium* percentages for American Bottom assemblages are 12.9 for LTLW sites, 19.1 for Lohmann phase sites, 11.1 for the Stirling phase, and 37.65 percent for Late Mississippian sites.

Egan-Bruhy (2014) observed a small amount of maygrass at Aztalan. Median maygrass percentages for the American Bottom are 64.4 for LTLW sites, 62.5 for Lohmann phase sites, 57.6 for the Stirling phase and 6.25 for Late Mississippian sites. For most of the Late Prehistoric sequence, the American Bottom differs from Aztalan in that maygrass appears to have been more important than *Chenopodium*; however, the trend reverses during the Late Mississippian period.

Chapter 5) Aztalan: An Agricultural Village in Eastern North America

This project focused primarily on a diachronic analysis of floral subsistence and maize race at Aztalan. Data from both the initial Late Woodland and later Middle Mississippian-influenced component were compared. Flotation samples collected from contexts recovered from the 1984 and 2011 field seasons were analyzed, and maize specimens from all contexts were measured in order to determine row number. Maize specimens from a nearby Oneota site, the Crescent Bay Hunt Club site, were also measured. The data from Aztalan were compared with Late Woodland, Mississippian-influenced and Oneota floral assemblages in the region. Data from Aztalan was also compared with late prehistoric floral subsistence trends in the American Bottom and Eastern Great Lakes.

The investigation into plant use at Aztalan focused on several research goals: **1)** What floral resources characterize the subsistence regime at Aztalan for all components? **2)** Do floral residues from Late Woodland contexts at Aztalan differ from those with evidence of Mississippian influence, and in what ways? **3)** What affect does depositional context have on floral assemblages at the site? **4)** Do maize remains at Aztalan show affinity with the Midwestern Twelve Row or Eastern Eight Row variety? How do maize row number measurements at Aztalan compare with measurements from the Crescent Bay Hunt Club site (CBHC)? **5)** How do the floral residues and maize remains at Aztalan compare with the immediate regional context and with sites in the American Bottom and Eastern Great Lakes? **6)** What factors might explain differences in subsistence within the study area?

1) What floral resources characterize the subsistence regime at Aztalan for all components?

The plants recovered during flotation analysis can be divided into five major categories: 1) wild foods; 2) domesticates; 3) potential native cultigens; 4) plants with possible non-dietary purposes, and 5) miscellaneous floral remains. Overall, the Aztalan floral assemblage appears to focus on storable wild resources (mainly nuts) and domesticates. The most prevalent plant foods are storable, nutrient and calorie-dense resources. Furthermore, it does not appear that all available resource zones were utilized equally by site inhabitants. In particular, wetland resources appear to have been neglected.

Wild Foods

The diversity of wild foods identified at Aztalan is lower than might be expected. Although some wild fruits and seeds are present, many of the wild foods anticipated for the site's environmental setting are absent from the assemblage (Goldstein and Kind 1987; Kotar and Burger 1996). Some fruit seeds were recovered, including cherry/plum (*Prunus*), raspberry/blackberry (*Rubus*), nightshade (*Solanum*) and grape (*Vitis*).

Thirteen grains of wild rice (*Zizania aquatica*) were identified within the assemblage. This small quantity is unexpected given historic accounts of wild rice in the Crawfish River and the prevalence of the resource at the nearby Crescent Bay Hunt Club site. While wild rice seeds produce large quantities of storable food, they mature in early autumn and must be harvested within a narrow window (Fernald et al. 1958:102; Goldstein and Kind 1987). Residents of Aztalan may have prioritized the harvest of other resources during this season. The Crawfish River may also have provided a different

habitat during the prehistoric occupation than at the time of the historic accounts. Wild rice requires a slow, steady movement of water and grows best at depths of between one and five feet of water. Fluctuations in water level during the growing season may affect productivity (Jenks 1977; Vennum 1988, cited in Arzigian 2000).

Despite the apparent lack of diversity for wild foods, one particular wild resource – nutshell – is the most ubiquitous and abundant plant food for the entire site across all components. Hickory (*Carya*) accounts for the vast majority of the nutshell identified in this analysis. The thick shells of hickory nuts are more likely to preserve than the shells of other nuts. Hickory is among the tree taxa present in both oak forest and oak opening habitats (Goldstein and Kind 1987). Hickory nuts are highly storable, but competition with other animals necessitates careful scheduling for the fall harvest (Scarry 2003). The presence of oak openings near the site may have facilitated the hickory harvest; maintenance of oak-hickory openings by fire is argued to have created an “unplanted orchard” (Asch 1994:32). Instead of painstakingly removing each individual nut from its shell, hickory nuts may be crushed and boiled, allowing the nutrient-dense oil to be skimmed off (Messner 2011:12-14; Swanton 1946.)

Other edible nuts such as black walnut (*Juglans nigra*), hazelnut (*Corylus*) and acorn (*Quercus*) were recovered at Aztalan, but in small quantities when compared to hickory nuts. Some authors have suggested that hazelnut (*Corylus*) should be more frequently recovered at horticultural village sites, since hazelnut flourishes in edge habitats created by agricultural land clearing (Simon and Parker 2006:222). Hazelnut remains were identified in just one sample from Aztalan, which may relate to preservation as hazelnuts have thin shells (Scarry 2003). Despite the fact that much of the

identified wood at Aztalan is oak (Barrett 1933; Egan-Bruhy 2014, personal communication), acorn remains are all but absent from the Aztalan assemblage. Acorns have thin shells, and are less likely to preserve than other nuts. Furthermore, acorns provide a source of carbohydrates but are generally lower in protein than other nuts (Scarry 2003). A population consuming significant quantities of maize may not have required the nutrients available from acorns. While some types of acorns require extensive processing, white oak (*Quercus alba*) is low in tannins and does not need leaching, so processing costs likely were not a primary factor (Messner 2011).

Domesticates

Maize is the most ubiquitous and abundant domesticated plant at Aztalan, found in over 85 percent of the samples included in the analysis. Maize represents a high-calorie resource that may be easily stored. Both cupules and kernels were recovered, although kernels generally outnumber cupules for all contexts. No large cob fragments are present. Details regarding maize measurement are discussed below.

Squash (likely *Cucurbita pepo*), identified primarily by rind fragment, represents the second most ubiquitous domesticate after maize. Found in approximately half of Late Woodland samples and one-third of samples from Mississippianized contexts, cucurbit remains are less likely to preserve than maize or nutshell. The seeds are large and edible, while rinds do not survive exposure to fire as readily as denser materials. *Pepo* squash is relatively high in calories, fat and protein; as such it represents an efficient source of nutrition (Scarry 2003). A single specimen of bottle gourd (*Lagenaria siceraria*) was also identified. Bottle gourd makes its first appearance in Illinois around 2,000 B.P. (Asch and

Asch 1985: 158). *Lagenaria* is rarely identified in the American Bottom region, but has been observed at some Terminal Late Woodland sites (Simon and Parker 2006: 230).

Potential Native Cultigens

For purposes of this discussion, a distinction is made between seeds of plants which may have been cultivated, and the seeds of those plants which were likely collected from the wild. In this case, “cultivated” simply refers to any activities that increase plant production. These activities include clearing fields and weeding to remove competitor plants, as well as deliberate sowing of seeds and transplanting (Scarry 1993: 6). An overview of the plants commonly considered to fall into the category of native cultigens is provided in Chapter 2.

Of the starchy and oily-seeded plants included in the native crop complex, *Chenopodium* is the only genus demonstrating abundance and ubiquity at Aztalan. Analysis employing a scanning electron microscope would be necessary to measure testa thickness in order to assess whether or not the chenopod remains at Aztalan represent domesticates. Specimens recovered at CBHC demonstrated that while the majority of *Chenopodium* at the site appeared to represent the wild variety, some specimens may have been domesticated (Olsen 2003). As will be discussed below, a prevalence of *Chenopodium* is consistent with late prehistoric assemblages in the American Bottom and the northern hinterlands.

Sparse remains of other starchy seeds are also included in the assemblage. Little barley (*Hordeum pusillum*), which ripens in the late spring and early summer, provides potential evidence for storage. Barnyard grass (*Echinochloa*), erect knotweed

(*Polygonum*) and *Amaranthus* remains are also weakly represented in the Aztalan assemblage.

Annuals with oily seeds are also rare at Aztalan. A single sunflower (*Helianthus annuus*) achene was recovered from Feature 8. This achene measures five millimeters in length. Heiser (1985) suggests a minimum length of seven millimeters for domesticated sunflower, corrected for shrinkage due to carbonization. Sumpweed (*Iva annua*), also an oily seed, is represented by a single achene from Feature 8. The achene measures four millimeters in length. This is considered the baseline length for domesticated sumpweed when corrected for shrinkage (Gremillion 1994: 94). The presence of sumpweed outside of its native range (Hammett 1997:210) is also evidence of cultivation.

Non-Dietary Plant Remains

Several seeds identified during this investigation may not have been used for food. These taxa may have served other functions for the residents of Aztalan. Two seeds identified with the genus *Nicotiana* were identified in the Feature 8 assemblage. The psychoactive properties of tobacco are widely known. When taken in small doses, nicotine behaves as a stimulant; in larger doses, hallucinogenic affects are possible (Rafferty 2006).

A single seed from genus *Rhus* (sumac) is contained within the assemblage. Ethnohistorically, sumac was used for a number of medicinal purposes, for the production of dye, and to make a “refreshing and cooling beverage” (Ericksen-Brown 1979: 117). Sumac berries are available from midsummer through fall (Duke 1992: 166). *Solanum* (nightshade) has psychoactive properties. At Mississippian sites in the

American Bottom, it is often found associated with tobacco (Emerson 2003; Simon and Parker 2006; Wagner 2000). Nightshade also may have been consumed as food alongside other fruits (Pauketat et al. 2002). Members of the family *Lamiaceae* (mint family) were known ethnohistorically to have medicinal uses (Densmore 1974). Other seeds identified include violet (*Viola*), bedstraw (*Galium*), sedge (*Carex*), and *Epigaea*.

Other Floral Remains

Fragments of aquatic tuber, rhizomes, herbaceous stems and fungus are found in the assemblage. It is unclear if these remains represent food waste.

Seasonality, Storage and Sedentism

The majority of the plants noted in the assemblage represent resources that are harvested in the late summer or autumn. Certain taxa, little barley in particular, are spring-ripening. Maygrass, noted by Egan-Bruhy (2014), is also a spring crop, which would have been a significant resource for a sedentary village at a time when winter stores ran low.

The presence of little barley in Feature 8 alongside fruits that ripen in the late summer strongly suggests that the little barley remains were stored. The two primary plant foods at the site, hickory masts and maize, also are highly storable; these resources would have been critical for a year-round village site like Aztalan. The three most common plant foods – hickory, maize and squash – are calorically dense. Hickory nuts and squash also are relatively high in fat relative to other available plant foods (Scarry 2003).

2) Do floral residues from Late Woodland contexts at Aztalan differ from those with evidence of Mississippian influence, and in what ways?

In some ways, the Late Woodland and Mississippian components at Aztalan are similar. For example, hickory nuts, maize and squash appear to have been significant resources throughout the site's occupation. This continuity is in line with findings based on faunal data (Warwick 2003). However, differences are present in terms of the quantities of these resources present at the site – food remains of all types make up a higher percentage of the Mississippian floral assemblage, possibly a result of population increase. Production of domesticates appears to have intensified. Furthermore, diet breadth increases for the Mississippian component, with more reliance on native cultigens.

Nutshell

Analyses of the Late Woodland to Mississippian transition in the American Bottom predict a slight decrease in the prevalence of nutshell. At Aztalan, the nut:wood ratio by weight is 0.05 for the Late Woodland component and 0.03 for the Mississippian component (Table 4.5), which indicates the possibility of declining nut use. However, the nut:wood ratio for the Late Woodland component by count (0.06) is actually lower than for the Mississippian component (0.08) (Table 4.14). Furthermore, density of nutshell is much higher in Mississippian Feature 8 (37.67 ct/10 liters) than in Late Woodland Stratum 11 (5.19 ct/10 liters, Table 4.3). The nut:maize ratio is employed to provide insight into these trends. For the Late Woodland component, this ratio is 2.47, while it is 0.94 for the Mississippian component. Nuts were relatively more important than maize

during the Late Woodland occupation as opposed to the Mississippian component. The increased density of nutshell through time is likely explained by an overall increased density of food remains. This increase in food consumption likely reflects an increase in population. Hickory makes up over 90 percent of the nutshell assemblage for both components (Table 4.20).

Egan-Bruhy (2014) notes that the percentage of the floral assemblage represented by nutshell increases from 3.1 to 5.5 percent between the collared ware and Mississippian components (Table 1). Mississippian data presented by Egan-Bruhy (2014) includes data from this study. Egan-Bruhy also reports an increase in nutshell density between the two components (from 20.1 ct/10 liters to 35.1 ct/10 liters, Egan-Bruhy 2014: Table 2).

Maize

Based on American Bottom data, an increase in maize recovery is expected between Stratum 11 and Stratum 5. The high ubiquity of maize for Late Woodland samples (90.48 percent) indicates that it was already an important resource to residents of Aztalan even before the appearance of shell-tempered pottery. Nonetheless, the importance of maize in the diet appears to have increased with time. The maize:wood ratio by weight is higher for the Mississippian versus the Late Woodland component (0.02 versus 0.01) (Table 4.6). The same trend may be observed in the maize:wood ratio by count (0.08 versus 0.02) (Table 4.14). Maize fragment density is much greater for Mississippian Feature 8 (43.83 ct/10 liters) than for Late Woodland Stratum 11 (1.67 ct/10 liters) (Table 4.3). Maize nearly doubles as a percentage of the total weight of floral remains (from 1.07 percent to 2.06 percent) (Table 4.2). While the overall amount of

maize appears to increase, we also see an increase of maize in relation to the entire floral assemblage, suggesting intensification. This trend may also be seen in the nut:maize ratio, which is 2.47 for the Late Woodland component and 0.94 for the Mississippian component. Egan-Bruhy's (2014) data show an increase in density from 15.4 ct/10 liters to 23.6 ct/10 liters between the collared ware and Mississippian occupations (Table 2).

In Chapter 2, the effect of processing method on maize preservation was briefly discussed. King (1994) found that alkali processing improved preservation of maize remains. Benchley (2003) argued that funnel forms of Mississippian pottery (sometimes referred to as juice presses) might have been used for alkali processing of maize. Such forms are found at Aztalan (Richards 2003). Alkali processing of maize may increase the availability of niacin (Benchley 2003:127). It is plausible that the increase in maize recovery following the appearance of Mississippian pottery at Aztalan is the result of a shift in maize processing. Additional research is needed to support this suggestion.

It is also likely that increased maize recovery is reflective of increased maize consumption. Egan-Bruhy (2014) found an increased prevalence of maize between collared ware and Mississippian floral assemblages in Southeast Wisconsin. Muller and Stephens (1991) have suggested a feedback loop between maize intensification and population growth. Of particular interest is the claim that it is easier to intensify agriculture than foraging in an environmentally circumscribed area. The arrival of Mississippian influence at Aztalan likely correlated with a population increase. The presence of a defensive palisade, alongside settlement and skeletal data, certainly suggests the possibility of territorial circumscription (e.g. Richards and Jeske 2002;

Rudolph 2009). Crops may have increased in importance as a larger population was constricted to a smaller area.

Squash

The ubiquity of squash is higher in Late Woodland samples (52.38 percent) than in Mississippian samples (28.57 percent, Table 4.7). This underscores the observation that Aztalan's Late Woodland residents were horticulturalists. Nonetheless, density for squash increases between the Late Woodland (0.42 ct/10 liters in Stratum 11) and Mississippian (3.89 ct/10 liters in Feature 8) components (Table 4.3). By count, Mississippian contexts have a higher rind:wood ratio (0.01 versus 0.00, Table 4.7). Both density and ratios suggest an intensification of squash use at the site. As with maize, population growth and territorial conscription may have played a role.

Native Cultigens

Differences between the two components appear with regard to potential native cultigens. Seeds from the native cultigen complex found in both components include knotweed, amaranth and *Chenopodium* (Table 4.8). The only starchy seed found in the Late Woodland component but not in the Mississippian component is barnyard grass. Sunflower, little barley and sumpweed are present in the Mississippian component only. Egan-Bruhy (2014: Table 3) identified maygrass in both Late Woodland and Mississippian contexts.

Based on density, use of *Chenopodium* appears to have intensified through time (63.57 seeds/10 liters in Feature 8 compared with 0.18 seeds/10 liters in Stratum 11,

Table 4.3). Starchy seeds, *Chenopodium* in particular, make up a much higher percentage of all seeds during the Mississippian component (92.41 percent versus 26.97 percent, Table 4.20).

The Shannon-Weaver diversity index is 1.38 for the Late Woodland component, compared with 1.46 for the Mississippian component (Table 4.10), indicating increased diet breadth through time as native cultigens are increasingly utilized.

The appearance of certain native cultigens, namely sunflower, sumpweed and little barley, may be tied to the appearance of Mississippian pottery. These seeds do not appear at other Late Woodland sites in Southeast Wisconsin (Egan-Bruhy 2014; Hawley et al. 2011; Meinholz and Kolb 1997; Salkin 1993). These taxa are also lacking from Late Woodland and Langford sites in Northeast Illinois (Jeske 1998, 2000; Jeske and Hart 1988). The appearance of oily seeds increases in the American Bottom during the Late Woodland to Mississippian transition. The increase in *Chenopodium* at Aztalan may also be tied to Mississippianization, as it is commonly recovered from American Bottom sites (Simon and Parker 2006).

3) What affect does depositional context have on floral assemblages at the site?

Stratum 5 and Stratum 11

When interpreting the diachronic differences in recovery of floral materials, the role of depositional context must be kept in mind. Even within the riverbank midden excavated in 1984, Stratum 11 and Stratum 5 likely represent different kinds of depositional events. Stratum 11 probably consists of a refuse midden; substratum S11₁₀, for example, consists of “in-situ ash beds and dumping episodes” (Richards 1992:148).

By contrast Stratum 5 is argued to represent the Middle Mississippian occupational surface horizon (Kolb et al. 1990; Richards 1992). These depositional differences likely affect both ubiquity and density measures; ratios have been employed in this analysis in an attempt to control for differential deposition of floral remains.

Potential for Disturbance in the Riverbank Midden

AMS dates cited in several cases in the literature review (for example the Sponemann site, Moccasin Bluff and Roundtop) suggest that disturbance in multicomponent sites can have a significant effect on the interpretation of floral residues for the various components (Adkins 2003, 2004; Hart 2008; Simon 2012; Simon and Parker 2006). As discussed in the previous section, Late Woodland and Mississippian contexts from the site share many of the same taxa. While these similarities may reflect real cultural phenomena, it is worth noting that the deeply-stratified midden at Aztalan shares this potential for disturbance.

A number of potential agents of disturbance can affect paleoethnobotanical assemblages. Pressures on sediments created by freeze/thaw and dry/humid cycles can lead to vertical and horizontal migrations of material (Théry-Parisot et al. 2010:148). Small rootlets were noted in all flotation samples analyzed from Aztalan; the potential effects of root disturbance are well documented (Darwin 1881; Carcaillet 2007; Stein 1983; Théry-Parisot et al. 2010). Fauna are particularly responsible for disturbance at archaeological sites. According to Wood and Johnson (1978), worms can shift archaeological features nearly 5 millimeters per year; small artifacts such as macrobotanical remains are most vulnerable (Stein 1983). Insects such as ants are

capable of moving materials several centimeters over periods of just a few months (Robins and Robins 2011). While samples were not taken from visible krotovinas, rodent and insect disturbance is highly evident throughout the riverbank deposits at Aztalan. A few samples included in this analysis contained small mammal feces (Appendix B: Table B.5).

Direct AMS dating of macrobotanical remains provides one means for assessing their contextual integrity (Adkins 2003, 2004; Hart 2008; Simon 2012). AMS dates were run on two samples of maize from contexts included in this analysis. The first, run on kernels from Feature 8, yielded a conventional radiocarbon age of 910 ± 30 B.P. or cal A.D. 1030-1210 (Table 4.4). This date does not conflict with the interpretation of the feature as being associated with the early Mississippian occupation of the site. Like most contexts with Mississippian ceramics at Aztalan, this feature also contains Late Woodland vessels, consistent with the interpretation that grit-tempered and shell-tempered vessels were in use alongside each other at the site.

The second sample was run on maize recovered from M84 Stratum 11 Feature 6. The date for this sample is cal A.D. 1040-1155 (Table 4.4). The early end of this date range is certainly within the range of possibility for the Late Woodland component; however Mississippian contexts such as Feature 8 have similar date ranges. Recent re-analysis of radiocarbon assays from Aztalan has confirmed that 23 dates from the site are statistically the same within a two sigma range of A.D. 1045-1120 (Richards and Picard 2013). This time range is not inconsistent with the emergence of Cahokia, but it suggests that events at Aztalan occurred within a short period of time. The maize dated from

Feature 6 may have migrated from a later context, or may simply have been deposited shortly before the appearance of shell-tempered pottery at the site.

Floral Remains from Outside the Midden

2011-20 Feature 8. The horizontal and vertical context of Feature 8 was treated in depth in Chapter 3. The feature is apparently superimposed by posts from a palisade bastion, suggesting that the feature predates bastion construction. This interpretation is complicated by the fact that Barrett cites evidence for re-building of the palisade wall. The complex feature assemblage located within the bastion (Structure V-A 30) is consistent with the possibility that the bastion superimposes an earlier structure. Recent radiocarbon evidence discussed in Chapter 3 supports the interpretation of Feature 8 as earlier than the palisade. Maps from previous excavations appear to show the palisade superimposed over house structures (Barrett 1933; Hurley 1977). The early part of the date range for Feature 8 is also consistent with early Mississippian “fire basin” features below the Northeast Mound.

The artifact and botanical assemblages from Feature 8 do not appear to reflect ordinary domestic refuse. A large number of worked copper fragments and two copper artifacts (a bead and an awl tip) were present in the feature. Barrett’s description of the area also makes mention of a high density of copper (1933). A nearly-intact groundstone celt was contained within the feature. The faunal assemblage contains remains from deer, canids and fur-bearing mammals. Both raptor and waterfowl are present, along with a variety of fish. Copper-stained specimens, butchering marks, tools and possible beads were also identified (Rachel McTavish, personal communication 2013).

The Feature 8 floral assemblage was unique among the contexts sampled. In addition to containing typical floral remains for the site such as maize, cucurbit rind and hickory nut, this feature also contained several taxa found in no other sampled context. Taxa unique to this feature include black walnut, acorn, bottle gourd, sunflower, little barley, sunflower and sumpweed. This feature also contains the majority of the taxa which may have served medicinal or ritual purposes such as tobacco, sumac, nightshade and seeds from the mint family. The kernel:cupule ratio for maize from this feature is over 9:1, suggesting the possibility of maize removed from the cob before consumption and deposition.

Previous analysis of the faunal assemblages from Stratum 5 and Stratum 11 yielded no significant evidence for feasting activities (Warwick 2002). Nonetheless, the presence of monumental architecture at the site in the form of platform mounds, combined with evidence for community-building ritual in deposits and structures associated with the construction of the Northeast Mound during the early Mississippian period at the site (Zych 2013) strongly suggests the possibility of ritualized food consumption at the site. To date, no obvious feasting deposits have been recovered.

One example of what Lohmann phase Mississippian feasting debris may look like originates in the Submound 51 borrow pit at Cahokia (Pauketat et al. 2002). The faunal assemblage for this context included more deer remains than typically found at American Bottom sites during the period, as well as a highly unusual amount of swan and prairie chicken remains. The floral assemblage contained over 50 species, including maize, bottle gourd, squash, sunflower, sumpweed, *Chenopodium*, maygrass and *Polygonum*. The deposit included over 3,000 squash seeds, while *Chenopodium* dominates the native

crop seed assemblage, much as in Aztalan's Feature 8. Given the amount of soil floted, corn was relatively sparse. In fact, native crop seeds outnumbered corn in Submound 51. Tobacco was also recovered from the filled-in borrow pit.

The Iva site, a Mississippianized Late Woodland site located near present-day La Crosse, illustrates a possible feasting context at a northern hinterland site. Feature 16 produced maize, sunflower, tobacco, *Chenopodium* and wild rice. The presence of dog remains prompts Boszhardt (2004) to suggest that this feature is indicative of a feasting context, perhaps distantly connected to the Ho-Chunk "Disease Giver" myth. The floral and faunal assemblages from Feature 16 at Iva are somewhat similar to those observed in Feature 8 at Aztalan.

As seen in the Submound 51 floral assemblage, *Chenopodium* seeds outnumber maize fragments in Feature 8 (670 *Chenopodium* seeds compared with 511 maize fragments, Table 4.1). This context also demonstrates the greatest variety of native crops seen in the assemblage. Only the Structure 1 assemblage from beneath the Northeast Mound exhibited a greater density of *Chenopodium* seeds (Table 4.10). Again, additional modern excavations are likely required in order to understand what the residues of ritual food consumption may look like at Aztalan.

Northeast Mound Structure 1. Structure 1 was located below the Northeast Mound at its northern edge, north of a large wall trench and post structure that was constructed and destroyed prior to mound construction. A Hyer Plain vessel was identified within this structure, indicating some degree of Mississippian influence (Zych 2013).

Like Feature 8, the samples analyzed from Structure 1 exhibit a high density of floral remains; in fact the density for these contexts is higher than that for any other Aztalan context included in this study (Arzigian 1985). Densities are exceptionally high for maize, squash, nutshell and *Chenopodium*. In contrast with Feature 8, few seeds were recovered – one knotweed (*Polygonum*) seed, one blackberry/raspberry (*Rubus*) seed and one nightshade (*Solanum*) seed. It is unclear whether this structure is representative of a domestic or a ceremonial context; certainly the large structure beneath the mound (Structure 5) appears to have had a ceremonial function (Zych 2013).

4) Do maize remains at Aztalan show affinity with the Midwestern Twelve Row or Eastern Eight Row variety? How do maize row number measurements at Aztalan compare with measurements from CBHC?

Regional Context for Aztalan Maize Data

A secondary goal of this project consisted of a diachronic analysis of maize race at Aztalan, alongside a comparison of the maize at Aztalan to specimens recovered from the nearby Crescent Bay Hunt Club site. In southern Wisconsin, Late Woodland maize was primarily 8-10 row (Arzigian 1993; Cutler and Blake 1969; Salkin 1993; Zalucha 1997; Table 2.1). Within this region Upper Mississippian maize is also primarily 8-10 row, however higher row numbers do appear at some Oneota sites (Arzigian 1989; Cutler and Blake 1969; Gibbon 1970, 1972; Hurley 1978; Zalucha 1988). Data from Northeast Illinois and the Middle Rock River Valley in northern Illinois are similarly biased in favor of low row number cobs (Hart and Jeske 1987; Simon 1998).

In Michigan, eight row maize is present at the SA1034 site in the Saginaw Valley, which also produced collared pottery (Parker 1996). A high-ubiquity, low-abundance

pattern is observed for maize at the Marquette Viaduct and Schultz sites; this maize appears to be eight row (Egan and Monckton 1991; Simon 2000). Similar data are found for the area of New York and Ontario referred to as Northern Iroquoia (c.f. Snow 1995). Known prehistoric maize macrofossils from this region are almost exclusively low row numbered (Crawford et al. 2006; Hart and Lovis 2012; Wagner 1987). The northern regions of the continent provide compelling recent evidence for very early precontact maize. Accelerator mass spectrometry dates from maize fragments at the Grand Banks site in Ontario range from A.D. 540-1030; this maize likely represents a form of Eastern Eight Row (Crawford et al. 1997:113).

American Bottom maize race data follow a different trend. Twelve row cobs dominate maize assemblages during the early Mississippian period. Eight row cobs do not make a significant appearance until the Moorehead phase, ca. A.D. 1200 (Fritz 1992; Simon and Parker 2006).

Summary of Maize Row Number Results at Aztalan and CBHC

For purposes of analysis, maize cupule angle measurements were divided into two categories: cupules measuring 45-60° (corresponding with 12-16 rows) and 72-90° (8-10 rows). At Aztalan, 52.38 percent of measurable cupules from the Late Woodland component fell into the 8-10 row category (Table 4.13), compared with 61.54 percent of cupules from the Mississippian component. However, a Chi-Squared test of independence found this difference to be insignificant ($X^2=0.27$, $df=1$, $p=0.6012$). By contrast, 80.49 percent of measured maize cupules at CBHC fell into the 12-16 row category. When a Chi-Squared test was performed on the CBHC assemblage compared to

the combined Aztalan assemblage, the result was significant ($\chi^2=9.15$, $df=1$, $p=.0028$). While the maize assemblage at Aztalan contains specimens similar to both Eastern Eight Row and Midwestern Twelve Row, the CBHC assemblage is biased toward Midwestern Twelve Row.

Maize Race, Collared Ware and Creolization

Archaeologists have suggested that collared ware may originate in the Eastern Great Lakes (Egan-Bruhy 2012, 2014; Salkin 1987, 1989, 1993) or from the Woodfordian area of northern Illinois (Hall 1986, 1991; Kelly 2002; Richards 1992:405). Maize race data presented above suggest that eight row cobs predominated in both of these areas. Perhaps these areas are not mutually exclusive as potential origins for the collared pottery found in southern Wisconsin – collared vessel technology could have traveled west along a route south of the Great Lakes along with maize. This theory is not inconsistent with Kelly's (2002) assertion that collared ware is part of a technological shift in pottery production coincident with increased maize use across the Great Lakes region.

The presence of eight row maize at Aztalan may correspond with the presence of Late Woodland collared ware, just as the presence of twelve row cobs likely corresponds to the presence of vessels similar to those seen in the American Bottom. The use of two maize types may reflect a process of creolization, much like the presence of two pottery wares in the later component. Alongside the ceramic data, the presence of two different types of maize supports the conclusion that two different groups of people were present at the site.

The presence of 12 row cupules in the Late Woodland stratum complicates this explanation. However, hybrid Late Woodland/Mississippian vessels (e.g. Hyer Plain) are found in otherwise Late Woodland contexts at the site (Richards 1992, 2007; Zych 2013). Zych's (2013) analysis of structures below the Northeast Mound also revealed the presence of hybrid architectural forms early in the site's history. The early presence of 12 row maize may similarly reflect direct or indirect contact with the American Bottom prior to the appearance of shell-tempered pottery and Mississippian architecture at the site.

No Middle Mississippian artifacts have been identified at CBHC (Richards and Jeske 2002), yet the maize assemblage resembles Stirling and Lohmann phase (A.D. 1050-1200) American Bottom maize. This may indicate some sort of direct or indirect contact between CBHC residents and the American Bottom. Speculation on the nature of this contact is beyond the scope of this research. The presence of 12 row maize is additionally problematic given the suggestion of a closed, static frontier between Aztalan and CBHC (Richards and Jeske 2002) and the absence of other Mississippian sites in the Crawfish/Rock River Valley. Some Oneota sites in southern Wisconsin maintain maize assemblages including eight to ten row cobs, while others appear to incorporate higher row numbers (Table 2.1). This indicates uneven Middle Mississippian influence on Upper Mississippian populations.

5) How do the floral residues and maize remains at Aztalan compare with the immediate regional context and with sites in the American Bottom and Eastern Great Lakes?

Wisconsin and Northern Illinois

Nutshell. The collared ware Late Woodland sites included in this study have high nut:wood ratios by weight (0.56 for the Murphy site and 0.19 for River Quarry) compared with both components at Aztalan (0.05 for the Late Woodland component and 0.03 for Mississippian samples, Table 4.14). Nuts appear to have been more important for Late Woodland inhabitants of Southeast Wisconsin than for inhabitants of the other sites included in the comparative analysis. This observation corresponds with the relative decrease in the importance of nuts relative to maize seen at Aztalan (nut:wood ratio of 2.47 for the Late Woodland component and 0.94 for the Mississippian component). Late Woodland nut preferences appear to have varied. For example, residents of the River Quarry site utilized hickory while Murphy site inhabitants appear to have preferred acorn (Egan-Bruhy 2003b).

At Fred Edwards, the nut:wood ratio by weight (0.06, Table 4.16) is similar to those observed at Aztalan (Arzigian 1987). The ratio for the Lundy site by count (0.07) is similar to the ratios by count for Aztalan's Late Woodland (0.06) and Mississippian (0.08) components (Emerson et al. 2007). This decrease in the importance of nuts is mirrored in the American Bottom during the Late Woodland to Mississippian transition (Johannessen 1984; Simon and Parker 2006) and may be related to an increase in the importance of maize. While hickory dominates American Bottom nutshell assemblages during the Lohmann and Stirling phases (Simon and Parker 2006), sites in the northern hinterlands show more variability. Fred Edwards and Aztalan share a predominance of hickory, while Lundy site inhabitants appear to have preferred acorn and walnut (Table 4.16).

At CBHC, the nut:wood ratio by count (0.02) is much lower than at Aztalan for either component. In addition, the nutshell assemblage is more evenly divided between hickory, acorn, walnut and hazelnut, with clear preference for acorn (6.07 ct/10 liters, Table 4.18). The variety of nut types recovered is a reflection of the wider dietary breadth for the site as a whole, which will be discussed below.

Maize. Collared ware Late Woodland sites demonstrate significant variability in maize recovery rates. The maize:wood ratio for River Quarry (0.07, by count) resembles that observed at Aztalan for the Mississippian component (0.08, by count). By contrast, the maize:wood ratio by count at the Murphy site (0.02) is identical to that observed in Late Woodland contexts at Aztalan (Table 4.14; Egan-Bruhy 2003b). This difference may relate to variability in levels of consumption or differences in processing method. The levels of maize identified at these Late Woodland sites is in line with the observation that collared pottery is associated with increasing recovery of maize (Egan 1993, Egan-Bruhy 2003a; Egan-Bruhy 2014; Egan-Bruhy and Nelson 2008; Hawley et al. 2011; Jeske and Hart 1988; Meinholz and Kolb 1997; Salkin 1993; Simon 1998; Zalucha 1997).

The importance of maize at Mississippian-influenced sites in the northern hinterlands also appears to vary. The maize:wood ratio by weight at Fred Edwards (0.06) exceeds that of Aztalan's Mississippian component (0.02; Arzigian 1987). By count, the ratio at Lundy (0.36) is substantially higher than Aztalan's Mississippian component (0.08, Table 4.16; Emerson et al. 2007). Maize appears to have been more central to the diet of Upper Mississippi Valley inhabitants than it was at Aztalan. The lower Shannon-Weaver indices for Fred Edwards (0.97) and Lundy (0.54) compared with Aztalan's

Mississippian component (1.46, Table 4.17) is reflective of the centrality of maize at these sites.

The maize:wood ratio at CBHC (0.04, by count) falls between the Late Woodland (0.02) and Mississippian (0.08) components at Aztalan (Egan-Bruhy 2010). Similarly, maize ubiquity at CBHC (65.00 percent) is lower than for Mississippian samples at Aztalan (78.58 percent, Table 4.18). The Shannon-Weaver index for CBHC (1.68) is indicative of high diversity and demonstrates that maize was less central to the Oneota diet at Lake Koshkonong than to Mississippian-influenced diets in the study area (Table 4.19).

Squash. Residents at Aztalan during both components appear to have placed greater emphasis on squash than residents of other Late Woodland sites. Squash was recovered from the Murphy site at a density of 0.12 ct/10 liters and from River Quarry at a density of 0.07 ct/10 liters, compared to 0.42 ct/10 liters for Stratum 11 at Aztalan (Table 4.14). Squash ubiquity is also higher at Aztalan, which may be evidence for the early importance of horticulture at the site.

Squash densities are also lower at Fred Edwards (0.15 ct/10 liters) and Lundy (0.12 ct/10 liters) compared to Feature 8 at Aztalan (3.89 ct/10 liters, Table 4.16). The low density at Lundy is especially noteworthy, given the high density of floral remains in general, and contributes to the site's overall lower diet breadth (Shannon-Weaver $H=0.54$, Table 4.17). Oneota residents of Lake Koshkonong appear to have placed even less of an emphasis on squash, with a density of just 0.02 ct/10 liters (Table 4.18; Egan-Bruhy 2010).

Cultigens and wild rice. Native cultigens are sparse at Late Woodland sites in the region. *Chenopodium* was not recovered at River Quarry. At the Murphy site, density for *Chenopodium* is 0.12 ct/10 liters (Table 4.14; Egan-Bruhy 2003b). This compares with 0.18 ct/10 liters for Stratum 11 at Aztalan and 63.57 ct/10 liters for Feature 8. Single amaranth and knotweed seeds were recovered at the Murphy site. No oily-seeded annuals were recovered from the Late Woodland sites included in this study. Wild rice was not recovered from these sites, despite the fact that the Murphy site was located on a wetland (Hawley et al. 2011).

The density of *Chenopodium* at Fred Edwards (15.56 ct/10 liters) resembles the density of Feature 8 at Aztalan (63.57 ct/10 liters, Table 4.16; Arzigian 1987). Density at the Lundy site is just 0.48 ct/10 liters; given the high density of floral remains at the site *Chenopodium* was apparently not an important resource (Emerson et al. 2007). Fred Edwards and Lundy both produced little barley and maygrass; sunflower was found at Fred Edwards and sumpweed is present at Lundy. All of these taxa are found in the Mississippian component at Aztalan. There is no wild rice at Fred Edwards, and just three grains are present at Lundy (Arzigian 1987; Emerson et al. 2007).

Chenopodium density is lower (4.37 ct/10 liters) than Aztalan's Feature 8 (63.57 ct/10 liters) but higher than Stratum 11 (0.18 ct/10 liters; Table 4.18, Egan-Bruhy 2010). Neither sunflower nor sumpweed has been identified at CBHC. Density of wild rice is much higher at CBHC (17.98 ct/10 liters) versus Aztalan Feature 8 (0.28 ct/10 liters) and Stratum 11 (0.09 ct/10 liters).

Diversity. Aztalan's Shannon-Weaver diversity indices for the Late Woodland (H=1.38) and Mississippian (H=1.46) components indicate a mid-range dietary breadth

compared with other sites included in the analysis. Low Shannon-Weaver diversity indices are assigned to the Lundy ($H=0.54$) and Fred Edwards ($H=0.96$) sites (Table 4.17). Diet breadth is low at these sites due to overrepresentation of maize. Indices for the Late Woodland sites are also lower than for Aztalan (Statz: $H=1.13$; River Quarry: $H=1.05$; Murphy: $H=0.30$; Table 4.15). These low scores are explained by a combined overrepresentation of maize and nutshell. CBHC has the highest index ($H=1.68$), indicating the widest dietary breadth.

Summary. Nuts were most important at Late Woodland sites within the study area. The Mississippian component at Aztalan, Fred Edwards and Lundy are similar in terms of nut exploitation. Oneota residents at Lake Koshkonong appear to have relied less on nuts than residents of the other sites, perhaps because of proximity to wetlands and availability of wild rice.

Given that white oak acorns would not have required significantly more processing time than hickory nuts (Messner 2011), variability in nutshell type among the sites may represent choice or preference, especially given that both acorn and hickory would have been available in oak-hickory forests. Acorn outranks hickory at the Murphy site, the Lundy site, and CBHC. Residents of River Quarry, Aztalan and Fred Edwards appear to have preferred hickory nuts. It is worth noting that hickory is the most prevalent nut type at American Bottom sites throughout the late prehistoric sequence (Simon and Parker 2006).

Maize is found at higher densities at sites with Middle Mississippian traits (Fred Edwards, Lundy and Aztalan) than at either the Late Woodland sites or CBHC. This may be tied to American Bottom influence, however it is worth noting that these three sites

also have evidence for fortification (Emerson et al. 2007; Finney and Stoltman 1991; Richards 1992), so territorial circumscription coupled with population growth may play a role. Muller and Stephens (1991) have argued that in such situations, agricultural intensification is more plausible than intensification of foraging.

Sites with Middle Mississippian traits also appear to have a greater density and diversity of native cultigens. This is especially true regarding oily-seeded annuals (sunflower and sumpweed). An increase in the use of oily seeds is concomitant with the Late Woodland to Mississippian transition in the American Bottom (Simon and Parker 2006).

The trends observed in the inter-site analysis are generally in-line with those noted in the literature. For Southeast Wisconsin and Northeast Illinois, the appearance of collared pottery is associated with an increase in maize density and the first appearance of squash. However, collared ware sites have a low representation of native cultigens (Egan 1993, 2003a; Egan-Bruhy 2014; Egan-Bruhy and Nelson 2008; Hawlet et al. 2011; Jeske and Hart 1988; Meinholz and Kolb 1997; Salkin 1993; Simon 1998; Zalucha 1997). Sites with Mississippian characteristics have a higher density of maize alongside a more diverse and abundant assemblage of native cultigens, including oily seeds (Egan-Bruhy 2014). Oneota sites are similar to Late Woodland sites in terms of maize density and sparseness of native cultigens, with a higher diversity of wild foods (Egan-Bruhy 2014; Jeske 1992, 2000, 2003; Jeske and Hart 1988). At the Lake Koshkonong locality, this takes the form of greater reliance on wild rice (Egan-Bruhy 2001, 2003a, 2010; Olsen 2003).

The Extra-Regional Context

American Bottom. Hickory dominates American Bottom nut assemblages throughout late prehistory (Simon and Parker 2006). Hickory is also the dominant nut taxon at Aztalan (Table 4.1). Nutshell density for Late Woodland Stratum 11 (5.19 ct/10 liters; Table 4.2) is higher than the median of 3.2 ct/10 liters for Late Terminal Late Woodland (LTLW) sites in the American Bottom (Simon and Parker 2006). Median nutshell densities for Lohmann phase (9.5 ct/10 liters) and Stirling phase (10.9 ct/10 liters) sites are lower than the density for nutshell in Aztalan's Feature 8 (37.67 ct/10 liters). The data suggest that nuts were a more important resource at Aztalan than at American Bottom sites.

For Aztalan's Late Woodland Stratum 11, the density of maize is 11.67 ct/10 liters, higher than the median maize density for LTLW sites in the American Bottom (4.6 ct/10 liters). Density for Aztalan's Mississippian Feature 8 is 43.83 ct/10 l, compared to a median of 20.9 ct/10 liters for Lohmann phase sites in the American Bottom and 23.8 ct/10 liters for Stirling phase sites (Simon and Parker 2006). Maize ubiquity for Mississippian component samples at Aztalan is 78.58 percent, compared with median ubiquities of 87.5 percent for Lohmann phase American Bottom sites and 78.58 percent for the Stirling phase. Based on these data, rates of maize consumption at Aztalan were comparable to sites in the American Bottom.

Squash is highly ubiquitous in Aztalan samples (52.38 percent for the Late Woodland component and 28.57 percent for the Mississippian component). The amount of squash found in LTLW assemblages in the American Bottom is miniscule. Lohmann phase median ubiquity is 7.2 percent, compared with 1.8 percent for the Stirling phase

(Simon and Parker 2006). Squash was more important for Aztalan during both the Late Woodland and Mississippian components than for sites in the American Bottom.

In terms of starchy seeds, the primary difference between Aztalan and American Bottom sites involves the relative importance of *Chenopodium* and maygrass (Table 4.20). Maygrass is most important during the LTLW (64.4 median percentage of starchy seeds), Lohmann phase (62.5 median percentage of starchy seeds) and Stirling phase (57.6 median percentage of starchy seeds) in the American Bottom (Simon and Parker 2006). In contrast, only a small amount of maygrass has been identified at Aztalan. It is present in both collared ware and Mississippian contexts (Egan-Bruhy 2014).

Chenopodium is the most important starchy seed at Aztalan, composing 100 percent of the Late Woodland starchy seed assemblage and 98.24 percent of the Mississippian starchy seed assemblage (Table 4.20). Median *Chenopodium* percentages for the American Bottom are 12.9 for LTLW sites, 19.1 for Lohmann phase sites, 11.1 for Stirling phase sites, and 37.65 for Late Mississippian sites (Simon and Parker 2006).

Eastern Great Lakes. The presence of eight row maize and squash at Aztalan correlates with the early arrival of these crops in the Eastern Great Lakes, and may reflect a connection between horticulture and the spread of collared pottery (Egan-Bruhy 2014; Hart and Lovis 2012). The SA1034 site is located in Michigan's Saginaw Valley and dated ca. A.D. 1150 (Parker 1996). Plant remains from the SA1034 site are similar to those at Aztalan and include tobacco, squash, sunflower and maize. However, density for native cultigens at SA1034 (0.04 ct/10 liters; Parker 1996) is much lower than for Stratum 11 (0.18 ct/10 liters) and Feature 8 (63.57 ct/10 liters). The 20SA367 site, also a late Late Woodland site in the Saginaw Valley with collared pottery, produced a

Chenopodium density of just 0.1 ct/10 liters (Egan-Bruhy 2009). Egan-Bruhy (2014) has argued that inhabitants of sites producing collared ware pottery placed less emphasis on native cultigens than inhabitants of sites with Mississippian pottery.

6) What factors might explain differences in subsistence within the study area?

The Interaction between Environmental and Social Factors

Certain differences in subsistence, especially between Aztalan and CBHC, appear connected to environmental factors. The CBHC diversity score is high, and use of maize and nuts is balanced by reliance on wetland resources, specifically wild rice. In contrast, residents of Aztalan were more focused on horticultural resources, especially during the Mississippian occupation.

These trends appear to correspond with significant differences in productivity within the two kilometer catchment of each site. At Aztalan, 87 percent of the soils within the catchment are arable. In contrast, only 34 percent of soils within the CBHC catchment are arable (Table 1.2). The area around Aztalan would have been more agriculturally productive. This may explain the greater reliance on maize, squash and *Chenopodium*.

By contrast, the CBHC catchment contains a greater variety of ecozones (seven as opposed to Aztalan's four, Table 1.1). Wetlands make up over twice as much of the CBHC catchment (five percent as opposed to two percent). In addition, the two kilometer area around CBHC has more ecotone types (eleven as opposed to four) and a greater percentage of the catchment consists of ecotones (61 percent at CBHC versus 30 percent at Aztalan, Table 1.3). This environment is well suited to the subsistence pattern observed

in the macrobotanical remains at CBHC, with high dietary breadth and significant reliance on wetland resources.

Researchers have argued that the locations of Aztalan and CBHC are based as much on social as environmental factors (e.g. Goldstein 1991; Richards and Jeske 2002). Goldstein (1991) has noted that any location along the Rock and Crawfish Rivers in Southeast Wisconsin would have been suitable for prehistoric habitation. Oneota communities in Southeast Wisconsin were spatially restricted to the northwest shore of Lake Koshkonong, an unusual observation given the distribution of Oneota sites elsewhere in the state. It has been argued that hostility with other late prehistoric groups might explain this restriction (Richards and Jeske 2002).

Edwards (2010) has shown that the area around CBHC and the other Lake Koshkonong Oneota sites is highly productive. Specifically, the density of ecotones would have allowed for productive foraging within a limited area. Environmental and social factors are not necessarily mutually exclusive – this environment would have been economically ideal for a group whose movements were restricted for political reasons. Late Woodland groups, including Effigy Mound builders, were present at Lake Koshkonong prior to the emergence of Oneota villages (e.g. Hall 1962; Richards and Jeske 2002). However, data from the Murphy site (Hawley et al. 2011) suggests that Late Woodland groups located near wetlands did not necessarily exploit wild rice. Perhaps territorial circumscription caused by political factors led the Oneota inhabitants of the Lake Koshkonong locality to intensify exploitation of wild rice, a resource that was close at hand.

Middle Mississippian pottery is even more spatially restricted than Oneota pottery within Southeast Wisconsin. The Crawfish River is atypical of the floodplain niche typically occupied by Middle Mississippian communities; in fact, it has been argued to be more suited to Late Woodland environmental considerations (e. g. Richards 1992). Explanations for the presence of Middle Mississippian traits at this location have prioritized social over environmental concerns. Richards and Jeske (2002) have suggested that Aztalan may represent Cahokia's response to an emerging Oneota presence at Lake Koshkonong, or possibly an out-of-the-way settlement of political refugees from the American Bottom (e.g. Emerson 1991).

The environmental catchment analysis presented in the Chapter 1 demonstrates that the two kilometer catchment around Aztalan has a high percentage of arable soils (87 percent, Table 1.2). Despite the lack of a floodplain, this area was suitable for prehistoric agriculture, especially as compared with Lake Koshkonong. Zych (2013) has argued that the initial transformation of Aztalan from a Late Woodland village to a site with Mississippian-style platform mounds was created through a process of cooperation rather than coercion. If Middle Mississippian migrants from the American Bottom or Illinois River Valley traveled up the Rock and Crawfish Rivers to Aztalan, they not only found a Late Woodland population amenable or persuadable to their political goals, but also a Late Woodland community already practicing a horticultural way of life in a location with high agricultural potential.

In terms of site selection, environmental and social factors appear to have been intertwined. Warwick (2003) has suggested intensification in exploitation of fish through time at the site, possibly due to territorial circumscription and hostility. Muller and

Stephens (1991) note the likelihood of agricultural intensification under such circumstances. The Aztalan catchment would have permitted such intensification.

Identity and Diet

Egan-Bruhy (2014) suggests ethnicity as a possible explanation for certain subsistence trends among Late Prehistoric sites in Southeast Wisconsin and Northeast Illinois. These include the presence of maize at collared ware, Mississippian and Oneota sites, the relative lack of Eastern Agricultural complex crops at collared ware sites, a higher density of wild rice at Southeast Wisconsin Oneota sites and a higher density of squash at Mississippian sites.

While wild rice exploitation may be connected to ethnic identity, Egan-Bruhy (2014) notes that its use is variable among Oneota groups, and that it is less important to Oneota residing in the Upper Mississippi Valley than to those at Lake Koshkonong. I have argued above that the high density of wild rice recovered at CBHC relates to environmental availability, possibly coupled with hostility-driven territorial circumscription.

Native cultigens do provide compelling evidence for an argument related to identity. Communities engaged in maize agriculture likely also could have grown starchy- and oily-seeded cultigens. Groups which grew maize almost certainly had the option of growing squash, and there is ample ethnohistoric evidence for the beneficial polycropping of these domesticates (Hart 2007, 2008). Choosing to focus on maize, but not on native cultigens, may have been a deliberate choice. Egan-Bruhy (2014) has suggested that a lack of native cultigens at collared ware sites in Southeast Wisconsin and

Northeast Illinois is tied to the origins of collared ware in the Eastern Great Lakes. While native cultigens (namely *Chenopodium*) appear at CBHC, density is lower than for the Mississippian component at Aztalan; it is also less than one-third that observed for wild rice at CBHC (Table 4.18). Oily seeds do not appear at collared ware or Oneota sites in the region. These observations are in line with those made by Jeske (1992) for collared ware and Langford sites in northeastern Illinois. Jeske (1992) suggests that late prehistoric groups in the Upper Illinois River Valley may have avoided use of these cultigens partly to maintain group identity in the face of the larger, more powerful Mississippian presence to the south. Perhaps a similar phenomenon is at play in Southeast Wisconsin. Still, in terms of maize density and the presence of native cultigens, CBHC is more similar to Middle Mississippian subsistence than are Late Woodland and Langford sites in northeastern Illinois (Egan-Bruhy 2014; Jeske 1992). This, alongside the maize race data, suggests at least some degree of Mississippian influence on subsistence at CBHC. It is also possible that residents of CBHC did not prioritize use of native cultigens because the high availability of wild rice near the site rendered it less necessary.

Egan-Bruhy (2014) notes an increase in maize for Mississippian sites within the region, alongside an increase in the diversity of native cultigens and the presence of oily-seeded annuals (sunflower and sumpweed). Within Southeast Wisconsin, sunflower, sumpweed and little barley are found only at Aztalan, and only in the Mississippian component. These taxa show an increase in prevalence during the Late Woodland to Mississippian transition in the American Bottom (Simon and Parker 2006). Within the study area, the presence of sunflower, sumpweed and little barley may serve as a marker of Middle Mississippian influence alongside more overt traits such as pottery and

platform mounds. Simon and Parker (2006) note that during the Lohmann and Stirling phases (A.D. 1050-1200), maize is ubiquitous in the American Bottom but its significance in the diet is balanced with starchy and oily seeds.

Maize row number shows significant potential as an archaeological marker of group identity. Early maize within the region is 8-10 row, correlating with maize from the Eastern Great Lakes (Arzigian 1993; Crawford et al. 2006; Cutler and Blake 1969; Egan and Monckton 1991; Hart and Lovis 2012; Parker 1996; Salkin 1993; Simon 2000; Wagner 1987; Zalucha 1997; Table 2.1). Data on maize from Northeast Illinois and the Middle Rock River Valley similarly suggest low row numbers (Hart and Jeske 1987; Simon 1998). By contrast, maize in the American Bottom is high row number until the Late Mississippian period (Simon and Parker 2006). The data imply that low row numbers are associated with the spread of collared ceramics, while Middle Mississippian pottery is expected to correlate with higher row number cobs.

At Aztalan, both components present a mixture of eight- to ten- and 12-16 row cobs. This could reflect the presence of two distinct groups at the site, just as the pottery assemblage represents two main ware types. The maintenance of eight row maize during the Mississippian occupation serves as a further example of the process of creolization suggested at Mississippian-influenced Late Woodland sites in the northern hinterlands (e.g. Emerson 2012; Millhouse 2012). In other words, various combinations of local Late Woodland traits continue to exist following the addition of Middle Mississippian traits. The presence of 12 row maize in the Late Woodland stratum is less expected. Like grit-tempered hybrid Late Woodland/Mississippian vessels found in Late Woodland contexts,

this maize may represent early direct or indirect contact with Mississippian or Mississippian-influenced groups.

The maize assemblage at CBHC (Table 4.13) is primarily twelve row. This suggests some degree of southern Mississippian influence, whether direct or indirect. This finding is interesting given the absence of Middle Mississippian artifacts at the Koshkonong locality (Richards and Jeske 2002). Speculation as to the nature of this influence is beyond the scope of this research.

As noted above, white oak acorns and hickory nuts would have had similar processing costs. Both taxa would have been available in the oak/hickory forests which were prevalent in the study area. Differences among sites in relative density of acorn and hickory may reflect dietary preference. Late Woodland sites included in this analysis vary in terms of nut preference (Hawley et al. 2011). The CBHC nut assemblage is biased toward acorns (Egan-Bruhy 2010). Aztalan and Fred Edwards show a bias toward hickory nuts, corresponding with American Bottom trends (Arzigian 1987; Simon and Parker 2006). However, the Lundy site nutshell assemblage is dominated by acorn (Emerson et al. 2007; Schroeder 1989). Variability in nut preference at late prehistoric sites within the study area may be a continuation of earlier variability.

Conclusions and Directions for Future Research

The residents of Aztalan focused on horticultural, and arguably agricultural, resources such as maize and squash, with heavy supplementation with hickory nuts. Native cultigens, namely *Chenopodium*, appear in both components but become a significant part of the diet following the appearance of shell-tempered pottery at the site.

Apart from nuts, wild foods such as fruits and wild rice are only sparsely represented. Plants with non-dietary purposes, such as tobacco, are also represented. The plant foods present at the site reflect resources that are easily stored, an observation confirmed by the presence spring-ripening taxa in Feature 8 alongside plants which ripen in late summer.

Differences between the Late Woodland and Mississippian occupations revolve around agricultural intensification. While the overall density of nutshell increases through time, this is likely related to population increase. Relative to maize, the importance of nutshell appears to decrease for the Mississippian component. There is an increase in the amount of maize recovered from Mississippian contexts. Though changes in processing may account for this difference, an actual increase in production is likely. Furthermore, the representation and variety of cultivated plants increases during the Mississippian component. Recovery of *Chenopodium* increases, and oily seeds, little barley and tobacco appear for the first time. Agricultural intensification may be tied to increased population and territorial conscription.

Some differences in the observed subsistence patterns may reflect depositional differences. Stratum 11 represents a Late Woodland refuse midden, while Stratum 5 represents a living surface associated with the Mississippian component. High densities of plant material found in Feature 8, associated with the early presence of Mississippian pottery at the site, may relate to ritual function. Structure 1, located beneath the Northeast Mound, exhibited similarly high densities of plant material (Arzigian 1985). Feature 8 also exhibited the most diverse floral assemblage of the sampled contexts, and contained taxa found in no other context such as tobacco, sumac, bottle gourd and mint family (*Lamiaceae*). The diversity of floral and faunal materials in the feature compares

favorably with early Mississippian feasting contexts such as the Submound 51 assemblage at Cahokia (Pauketat et al. 2002).

Maize row number analysis provides insight into Aztalan's connections with both the American Bottom and Eastern Great Lakes. Eight to ten row maize appears connected to the spread of collared pottery from the Eastern Great Lakes southwest into northeastern Illinois and then north into Wisconsin. Twelve row cobs are characteristic of pre-A.D. 1200 maize in the American Bottom. The presence of low and high row number maize at Aztalan may reflect the presence of two groups at the site. Twelve row cobs in Late Woodland contexts may reflect early southern influence at the site. Maize at the nearby Oneota Crescent Bay Hunt Club site is almost exclusively twelve row, suggesting a not yet understood southern connection.

This analysis compared the floral assemblage at Aztalan with other late prehistoric sites in the region. Aztalan was found to be more reliant on agriculture than other collared ware Late Woodland sites. The Aztalan floral assemblage is most similar to that of Fred Edwards, a Middle Mississippian-influenced site in the Upper Mississippi Valley. However, residents of the Lundy site, a Mississippian-influenced site at the Apple River locality, were more reliant on maize than residents of either Aztalan or Fred Edwards. This variability among Mississippian-influenced Late Woodland sites is reflective of the concept of creolization discussed in Chapter 1.

Some of the differences between Aztalan and CBHC, a nearby Oneota site, relate to environmental differences. These differences include a higher prevalence of wild rice at CBHC compared with higher reliance on maize at Aztalan. However, the environmental settings of these two sites are likely influenced by social factors such as intergroup

hostility. Other trends, such as a greater presence of native cultigens and oily seeds in Aztalan's Mississippian component compared with the other sites, may reflect social factors. Some researchers (e.g. Egan-Bruhy 2014; Jeske 1992) have suggested that collared ware Late Woodland groups were less reliant on Eastern Agricultural Complex taxa than Mississippian groups were.

Overall, the floral assemblage at Aztalan is a reflection of the complex late prehistoric social landscape in which it is situated. Future research into the Aztalan floral assemblage should focus on feature contexts which have the potential to yield not just temporal data, but also insight into the variety of ways in which plants were used by site inhabitants. These data will likely come from curated collections as well as future excavations. The use of multiple lines of evidence, including starch grain and phytolith analyses on ceramic residue, along with macrobotanical data will aid in further understanding late prehistoric subsistence in southeast Wisconsin. Furthermore, future discussions of maize race should look to genetic methods, such as the phenotypic phytolith profiles proposed by Lusteck (2006, 2008).

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Appendix A: Contexts Selected for Analysis

Table A.1: List of Lot Numbers Selected for Analysis

Lot Number	Liters	Unit	Stratum	Level	Feature	Association	Comments
2011-20.0123	0.9				2011-8	Mississippian	Stratum subsequently identified as Feature 8
2011-20.0257	4.5				2011-8	Mississippian	Stratum subsequently identified as Feature 8
2011-20.0283	1				2011-8	Mississippian	Stratum subsequently identified as Feature 8
2011-20.0318	98	TU 8			2011-8	Mississippian	Main feature matrix
2011-20.0359	1				2011-8	Mississippian	Stratum subsequently identified as Feature 8
2011-20.0205	1	TU 12		2		Unknown	Included in overall abundance but not analysis
2011-20.0243	1	TU 12		3		Unknown	Included in overall abundance but not analysis
2011-20.0261	1	TU 12		4		Unknown	Included in overall abundance but not analysis
2011-20.0321	3	TU 12		6		Unknown	Included in overall abundance but not analysis
2011-20.0328	7	TU 12			Postmold	Unknown	Included in overall abundance but not analysis
2011-20.0370	1	TU 2	7			Unknown	Included in overall abundance but not

Lot Number	Liters	Unit	Stratum	Level	Feature	Association	Comments
							analysis
2011-20.0374	1	TU 2	6			Unknown	Included in overall abundance but not analysis
M84-1244	UK	N 2-4 E 13-14	5	6		Mississippian	
M84-1269	UK	N 4-5 E 14-16	5	6		Mississippian	
M84-1272	UK	N 2-4 E 13-14	5	7		Mississippian	
M84-1289	UK	N 4-5 E 14-16	5		20	Mississippian	
M84-1292	UK	N 3-5 E 16-17 (N 1/2)	5			Mississippian	
M84-1293	UK	N 3-5 E 16-17 (N 1/2)	5			Mississippian	
M84-1297	UK	N 3-5 E 16-17	5	7		Mississippian	
M84-1302	UK	N 4-5 E 14-16	5	7		Mississippian	
M84-1319	UK	N 4-5 E 14-16	5	8		Mississippian	
M84-1424	UK	N 3-5 E 16-17	11	10	22d	Late Woodland	Included in overall abundance but not analysis
M84-1104	~1*	N 0-4 E 14-16	11		6	Late Woodland	
M84-1028	15	N 0-4 E 14-16	S11			Late Woodland	

Lot Number	Liters	Unit	Stratum	Level	Feature	Association	Comments
M84-1031	90	N 2-4 E 14-16	11(1)			Late Woodland	
M84-1032	255	N 2-4 E 14-16	11(2)	1		Late Woodland	
M84-1033	75	N 2-4 E 14-16	11(3)	1		Late Woodland	
M84-1034	167.5	N 0-2 E 14-16	11(4)			Late Woodland	Probably non-cultural (Richards 1992)
M84-1069	30	N 0-2 E 14-16	11(4)	3		Late Woodland	Probably non-cultural (Richards 1992)
M84-1071	30	N 2-4 E 14-16	11(6)	1		Late Woodland	
M84-1074	15	N 2-4 E 14-16	S11(4)			Late Woodland	Probably non-cultural (Richards 1992)
M84-1078	255	N 2-4 E 14-16	11(8)	8		Late Woodland	Probably non-cultural (Richards 1992)
M84-1092	30	N 2-4 E 14-16	S11(9)			Late Woodland	
M84-1094	UK	N 0-4 E 14-16	S11(10)			Late Woodland	
M84-1112	15	N 2-4 E 14-16	11(11)			Late Woodland	
M84-1134	30	N 2-4 E 14-16	S11(10)	2		Late Woodland	
M84-1171	30	N 2-4 E 14-16	11(12)			Late Woodland	
M84-1177	15	N 2-4 E 14-16	11(13)			Late Woodland	

Lot Number	Liters	Unit	Stratum	Level	Feature	Association	Comments
M84-1182	15	N 2-4 E 14-16	11(4)	1		Late Woodland	Probably non-cultural (Richards 1992)
M84-1188	15	N 2-4 E 14-16	11(16)			Late Woodland	
M84-1191	15	N 2-4 E 14-16	11(17)			Late Woodland	
M84-1220	15	N 2-4 E 14-16	11(14)			Late Woodland	
M84-1223	30	N 2-4 E 14-16	11(15)			Late Woodland	
M84-1226	15	N 2-4 E 14-16	11(8)			Late Woodland	Probably non-cultural (Richards 1992)
M84-1228	15	N 2-4 E 14-16	11		10	Late Woodland	
M84-1421	UK	N 3-5 E 16-17	11	10		Late Woodland	
M84-2022	48+	L			5	Late Woodland	Information vandalized in the field (Richards 1992)
M84-2025	UK	K			11	Late Woodland	
M84-2045	UK	L			16	Late Woodland	
M84-1029	UK	N 2-4 E 14-16	S11, S10		1	Late Woodland	Included in overall abundance but not analysis

UK=unknown, NA=not applicable

Appendix B: Aztalan Flotation Analysis Results by Sample (>2.0 mm)

Table B.1: Results of 47-JE-0001 Flotation Analysis by Sample >2.00 mm Split (Part I)

Lot #	Context	Liters	Wood Charcoal		Bark Charcoal		Zea mays kernel		Zea mays cupule/glume	
			Ct	wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
2011-20.0318	Feature 8	98	5432	190.12	77	3.49	456	3.88	49	0.23
2011-20.0283	Feature 8	1	170	2.46	15	0.18	4	0.02	-	-
2011-20.0257	Feature 8	4.5	115	0.95	12	0.28	1	0.01	-	-
2011-20.0123	Feature 8	0.9	46	0.38	3	0.02	-	-	-	-
2011-20.0359	Feature 8	1	30	0.35	6	0.09	1	0.01	-	-
2011-20.0370	TU 2 Stratum 7	1	18	0.08	4	0.02	1	0.01	1	0.01
2011-20.0261	TU 12 Level 4	1	1	0.01	-	-	-	-	-	-
2011-20.0328	TU 12 Postmold	7	216	1.72	18	0.12	12	0.07	-	-
2011-20.0243	TU 12 Level 3	1	2	0.02	-	-	-	-	-	-
2011-20.0374	TU 2 Stratum 6	1	121	0.97	3	0.01	-	-	1	0.01
2011-20.0205	TU 12 Level 2	1	2	0.01	-	-	-	-	-	-
2011-20.0321	TU 12 Level 6	3	64	0.41	8	0.07	2	0.02	-	-
M84-1272	Stratum 5 Lvl 7	UK	95	1.1	2	0.06	1	0.01	-	-
M84-1244	Stratum 5 Lvl 6	UK	134	0.87	5	0.04	5	0.02	4	0.01
M84-1293	Stratum 5	UK	104	1.09	5	0.05	2	0.01	8	0.03
M84-1289	Feature 20	UK	125	4.19	5	0.18	6	0.05	3	0.02
M84-1292	Stratum 5	UK	56	0.55	5	0.04	-	-	-	-
M84-1297	Stratum 5 Lvl 7	UK	41	0.39	-	-	-	-	-	-
M84-1319	S5 Lvl 8	UK	112	1.34	23	0.26	3	0.02	-	-

Lot #	Context	Liters	Wood Charcoal		Bark Charcoal		<i>Zea mays</i> kernel		<i>Zea mays</i> cupule/glume	
			Ct	wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
M84-1302	S5 Lvl 7	UK	360	3.46	31	0.34	30	0.2	5	0.06
M84-1269	S5 Lvl 6	UK	110	1.05	5	0.04	2	0.01	2	0.03
M84-1104	Feature 6	~1	2523	54.95	121	2.47	41	0.35	4	0.02
M84-1424	S11 Lvl 10 Fea 22d	UK	208	2.22	9	0.24	3	0.04	-	-
M84-1228	Feature 10	15	521	5.96	18	0.51	17	0.15	-	-
M84-1033	S11 Lvl 3	75	1068	21.35	15	0.51	25	0.26	10	0.04
M84-1421	S11 Lvl 10	UK	65	0.63	1	0.03	1	0.01	1	0.01
M84-1034	S11 Lvl 4	167.5	3	0.09	-	-	-	-	-	-
M84-1031	S11 Level 1	90	806	17.24	24	0.52	36	0.24	8	0.03
M84-1188	S 11 Lvl 16	15	23	0.54	1	0.01	-	-	-	-
M84-1177	S11 Level 13	15	287	4.92	22	0.41	8	0.07	-	-
M84-1226	S11 Lvl 8	15	3	0.1	-	-	1	0.01	-	-
M84-1191	S11 Lvl 17	15	71	0.78	1	0.01	2	0.01	1	0.01
M84-1223	S11 Lvl 15	30	56	0.57	-	-	-	-	-	-
M84-1171	S11 Lvl 12	30	142	1.49	11	0.08	7	0.08	-	-
M84-1220	S11 Lvl 14	15	588	8.22	37	0.53	6	0.06	-	-
M84-1134	S11 10 Lvl 2	30	1205	20.36	66	1.29	10	0.05	3	0.01
M84-1028	Stratum 11	15	776	19.86	57	0.92	21	0.18	7	0.03
M84-1094	S11(10)	UK	786	10.22	95	1.12	7	0.04	-	-
M84-1092	S11(9)	30	1035	13.46	-	-	16	0.16	1	0.01
M84-1074	S11(4)	15	135	1.62	17	0.36	3	0.02	-	-
M84-1071	S11(6)	30	2223	26.68	-	-	17	0.11	7	0.04
M84-1032	S11(2)	255	523	6.28	47	0.56	14	0.13	-	0.01

Lot #	Context	Liters	Wood Charcoal		Bark Charcoal		Zea mays kernel		Zea mays cupule/glume	
			Ct	wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
M84-1078	S11(8)	255	7	0.93	-	-	-	-	-	-
M84-1182	S11(4)	15	15	0.11	-	-	-	-	-	-
M84-1069	S11(4)	30	2	0.02	-	-	-	-	-	-
M84-1112	S11(11)	15	264	3.43	20	0.52	13	0.18	1	0.01
M84-2022	Unit L Fea. 5	48+	108	1.19	9	0.1	5	0.03	-	-
M84-2025	Unit K Fea. 11	UK	70	0.64	2	0.03	3	0.03	1	0.01
M84-2045	Fea. 16	UK	232	2.71	9	0.14	21	0.24	4	0.04
M84-1029	S11, S10 Fea. 1	UK	196	2.2	16	0.18	6	0.04	1	0.01
Total	All Contexts	UK	21295	440.29	825	15.83	809	6.83	122	0.68

Table B.2: Results of 47-JE-0001 Flotation Analysis by Sample >2.00 mm Split (Part II)

Lot #	Context	Liters	<i>Cucurbita pepo</i> rind		<i>Lagenaria</i> rind		Peduncle (<i>Cucurbit</i>)		Nutshell (<i>Carya</i>)	
			Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
2011-20.0318	Feature 8	98	41	0.17	2	0.01	-	-	334	3.16
2011-20.0283	Feature 8	1	-	-	-	-	-	-	5	0.09
2011-20.0257	Feature 8	4.5	-	-	-	-	-	-	6	0.05
2011-20.0123	Feature 8	0.9	-	-	-	-	-	-	-	-
2011-20.0359	Feature 8	1	-	-	-	-	-	-	2	0.01
2011-20.0370	TU 2 Stratum 7	1	-	-	-	-	-	-	-	-
2011-20.0261	TU 12 Level 4	1	-	-	-	-	-	-	-	-
2011-20.0328	TU 12 Postmold	7	-	-	-	-	-	-	-	-
2011-20.0243	TU 12 Level 3	1	-	-	-	-	-	-	-	-
2011-20.0374	TU 2 Stratum 6	1	2	0.01	-	-	-	-	-	-
2011-20.0205	TU 12 Level 2	1	-	-	-	-	-	-	-	-
2011-20.0321	TU 12 Level 6	3	-	-	-	-	-	-	5	0.03
M84-1272	Stratum 5 Lvl 7	UK	2	0.01	-	-	-	-	2	0.02
M84-1244	Stratum 5 Lvl 6	UK	1	0.01	-	-	-	-	5	0.09
M84-1293	Stratum 5	UK	-	-	-	-	-	-	13	0.11
M84-1289	Feature 20	UK	-	-	-	-	-	-	15	0.2
M84-1292	Stratum 5	UK	1	0.01	-	-	-	-	2	0.04
M84-1297	Stratum 5 Lvl 7	UK	-	-	-	-	-	-	3	0.03
M84-1319	S5 Lvl 8	UK	-	-	-	-	-	-	8	0.07
M84-1302	S5 Lvl 7	UK	-	-	-	-	-	-	94	1.29
M84-1269	S5 Lvl 6	UK	-	-	-	-	-	-	8	0.09

Lot #	Context	Liters	<i>Cucurbita pepo</i> rind		<i>Lagenaria</i> rind		Peduncle (<i>Cucurbit</i>)		Nutshell (<i>Carya</i>)	
			Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
M84-1104	Feature 6	~1	15	0.04	-	-	1	0.07	113	2.64
M84-1424	S11 Lvl 10 Fea 22d	UK	1	0.01	-	-	-	-	11	0.1
M84-1228	Feature 10	15	17	0.1	-	-	-	-	-	-
M84-1033	S11 Lvl 3	75	10	0.02	-	-	-	-	41	0.43
M84-1421	S11 Lvl 10	UK	-	-	-	-	-	-	4	0.06
M84-1034	S11 Lvl 4	167.5	-	-	-	-	-	-	-	-
M84-1031	S11 Level 1	90	-	-	-	-	-	-	66	0.6
M84-1188	S 11 Lvl 16	15	-	-	-	-	-	-	4	0.21
M84-1177	S11 Level 13	15	6	0.02	-	-	-	-	9	0.13
M84-1226	S11 Lvl 8	15	-	-	-	-	-	-	-	-
M84-1191	S11 Lvl 17	15	-	-	-	-	-	-	32	0.6
M84-1223	S11 Lvl 15	30	-	-	-	-	-	-	38	0.91
M84-1171	S11 Lvl 12	30	-	-	-	-	-	-	12	0.24
M84-1220	S11 Lvl 14	15	5	0.02	-	-	-	-	6	0.07
M84-1134	S11 10 Lvl 2	30	2	0.01	-	-	-	-	55	0.6
M84-1028	Stratum 11	15	-	-	-	-	-	-	69	0.99
M84-1094	S11(10)	UK	3	0.01	-	-	-	-	17	0.2
M84-1092	S11(9)	30	1	0.02	-	-	-	-	54	0.6
M84-1074	S11(4)	15	-	-	-	-	-	-	9	0.07
M84-1071	S11(6)	30	4	0.01	-	-	-	-	47	0.59
M84-1032	S11(2)	255	2	0.01	-	-	-	-	67	1.12
M84-1078	S11(8)	255	-	-	-	-	-	-	-	-
M84-1182	S11(4)	15	-	-	-	-	-	-	2	0.01
M84-1069	S11(4)	30	-	-	-	-	-	-	2	0.01

Lot #	Context	Liters	<i>Cucurbita pepo</i> rind		<i>Lagenaria</i> rind		Peduncle (<i>Cucurbit</i>)		Nutshell (<i>Carya</i>)	
			Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
M84-1112	S11(11)	15	2	0.01	-	-	-	-	75	1.1
M84-2022	Unit L Fea. 5	48+	-	-	-	-	-	-	28	0.31
M84-2025	Unit K Fea. 11	UK	-	-	-	-	-	-	8	0.09
M84-2045	Fea. 16	UK	-	-	-	-	-	-	13	0.14
M84-1029	S11, S10 Fea. 1	UK	-	-	-	-	-	-	30	0.54
Total	All Contexts	UK	115	0.49	2	0.01	1	0.07	1314	17.64

Table B.3: Results of 47-JE-0001 Flotation Analysis by Sample >2.00 mm Split (Part III)

Lot #	Context	Liters	Nutshell (<i>Juglans</i>)		Nutshell (<i>Quercus</i>)		Nutshell (<i>Juglandaceae</i>)		Nutshell (<i>Corylus</i>)	
			Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
2011-20.0318	Feature 8	98	5	0.33	1	0.01	50	0.33	-	-
2011-20.0283	Feature 8	1	-	-	-	-	-	-	-	-
2011-20.0257	Feature 8	4.5	-	-	-	-	-	-	-	-
2011-20.0123	Feature 8	0.9	-	-	-	-	2	0.01	-	-
2011-20.0359	Feature 8	1	-	-	-	-	-	-	-	-
2011-20.0370	TU 2 Stratum 7	1	-	-	-	-	-	-	-	-
2011-20.0261	TU 12 Level 4	1	-	-	-	-	-	-	-	-
2011-20.0328	TU 12 Postmold	7	-	-	-	-	2	0.01	-	-
2011-20.0243	TU 12 Level 3	1	-	-	-	-	-	-	-	-
2011-20.0374	TU 2 Stratum 6	1	-	-	-	-	-	-	-	-
2011-20.0205	TU 12 Level 2	1	-	-	-	-	-	-	-	-
2011-20.0321	TU 12 Level 6	3	-	-	-	-	-	-	-	-
M84-1272	Stratum 5 Lvl 7	UK	-	-	-	-	-	-	-	-
M84-1244	Stratum 5 Lvl 6	UK	-	-	-	-	3	0.01	-	-
M84-1293	Stratum 5	UK	-	-	-	-	-	-	-	-
M84-1289	Feature 20	UK	-	-	-	-	-	-	-	-
M84-1292	Stratum 5	UK	-	-	-	-	-	-	-	-
M84-1297	Stratum 5 Lvl 7	UK	-	-	-	-	-	-	-	-
M84-1319	S5 Lvl 8	UK	-	-	-	-	-	-	-	-
M84-1302	S5 Lvl 7	UK	-	-	-	-	-	-	-	-
M84-1269	S5 Lvl 6	UK	-	-	-	-	-	-	-	-

Lot #	Context	Liters	Nutshell (<i>Juglans</i>)		Nutshell (<i>Quercus</i>)		Nutshell (<i>Juglandaceae</i>)		Nutshell (<i>Corylus</i>)	
			Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
M84-1104	Feature 6	~1	-	-	-	-	-	-	-	-
M84-1424	S11 Lvl 10 Fea 22d	UK	-	-	-	-	-	-	-	-
M84-1228	Feature 10	15	-	-	-	-	-	-	-	-
M84-1033	S11 Lvl 3	75	-	-	-	-	-	-	-	-
M84-1421	S11 Lvl 10	UK	-	-	-	-	-	-	-	-
M84-1034	S11 Lvl 4	167.5	-	-	-	-	-	-	-	-
M84-1031	S11 Level 1	90	-	-	-	-	-	-	-	-
M84-1188	S 11 Lvl 16	15	-	-	-	-	-	-	-	-
M84-1177	S11 Level 13	15	-	-	1	0.01	2	0.01	-	-
M84-1226	S11 Lvl 8	15	-	-	-	-	-	-	-	-
M84-1191	S11 Lvl 17	15	-	-	-	-	-	-	-	-
M84-1223	S11 Lvl 15	30	-	-	-	-	-	-	-	-
M84-1171	S11 Lvl 12	30	-	-	-	-	13	0.09	-	-
M84-1220	S11 Lvl 14	15	-	-	-	-	-	-	-	-
M84-1134	S11 10 Lvl 2	30	-	-	-	-	3	0.02	-	-
M84-1028	Stratum 11	15	-	-	-	-	14	0.08	1	0.01
M84-1094	S11(10)	UK	-	-	1	0.01	-	-	-	-
M84-1092	S11(9)	30	-	-	-	-	-	-	-	-
M84-1074	S11(4)	15	-	-	-	-	-	-	-	-
M84-1071	S11(6)	30	-	-	1	0.01	-	-	-	-
M84-1032	S11(2)	255	1	0.01	-	-	-	-	1	0.01
M84-1078	S11(8)	255	-	-	-	-	-	-	-	-
M84-1182	S11(4)	15	-	-	-	-	-	-	-	-

Lot #	Context	Liters	Nutshell (<i>Juglans</i>)		Nutshell (<i>Quercus</i>)		Nutshell (<i>Juglandaceae</i>)		Nutshell (<i>Corylus</i>)	
			Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
M84-1069	S11(4)	30	-	-	-	-	-	-	-	-
M84-1112	S11(11)	15	-	-	-	-	-	-	-	-
M84-2022	Unit L Fea. 5	48+	-	-	-	-	-	-	-	-
M84-2025	Unit K Fea. 11	UK	-	-	-	-	-	-	-	-
M84-2045	Fea. 16	UK	-	-	-	-	-	-	-	-
M84-1029	S11, S10 Fea. 1	UK	-	-	-	-	-	-	-	-
Total	All Contexts	UK	6	0.34	4	0.04	89	0.56	2	0.02

Table B.4: Results of 47-JE-0001 Flotation Analysis by Sample >2.00 mm Split (Part IV)

Lot #	Context	Liters	Nutmeats		Tuber (aquatic)		Rhizome		Fungus	
			Ct	Wt (g)	Ct	Wt (g)	Ct	Wt(g)	Ct	Wt (g)
2011-20.0318	Feature 8	98	-	-	-	-	2	0.02	42	0.22
2011-20.0283	Feature 8	1	-	-	-	-	-	-	-	-
2011-20.0257	Feature 8	4.5	-	-	-	-	-	-	1	0.01
2011-20.0123	Feature 8	0.9	-	-	-	-	-	-	-	-
2011-20.0359	Feature 8	1	-	-	-	-	-	-	-	-
2011-20.0370	TU 2 Stratum 7	1	-	-	-	-	-	-	-	-
2011-20.0261	TU 12 Level 4	1	-	-	-	-	-	-	-	-
2011-20.0328	TU 12 Postmold	7	-	-	8	0.09	-	-	-	-
2011-20.0243	TU 12 Level 3	1	-	-	-	-	-	-	-	-
2011-20.0374	TU 2 Stratum 6	1	-	-	-	-	-	-	-	-
2011-20.0205	TU 12 Level 2	1	-	-	-	-	-	-	-	-
2011-20.0321	TU 12 Level 6	3	-	-	-	-	-	-	-	-
M84-1272	Stratum 5 Lvl 7	UK	-	-	-	-	-	-	-	-
M84-1244	Stratum 5 Lvl 6	UK	-	-	-	-	-	-	-	-
M84-1293	Stratum 5	UK	-	-	-	-	3	0.03	-	-
M84-1289	Feature 20	UK	-	-	-	-	-	-	-	-
M84-1292	Stratum 5	UK	-	-	-	-	-	-	-	-
M84-1297	Stratum 5 Lvl 7	UK	-	-	-	-	-	-	-	-
M84-1319	S5 Lvl 8	UK	-	-	-	-	-	-	-	-
M84-1302	S5 Lvl 7	UK	-	-	-	-	-	-	-	-
M84-1269	S5 Lvl 6	UK	-	-	-	-	-	-	-	-

Lot #	Context	Liters	Nutmeats		Tuber (aquatic)		Rhizome		Fungus	
			Ct	Wt (g)	Ct	Wt (g)	Ct	Wt(g)	Ct	Wt (g)
M84-1104	Feature 6	~1	-	-	-	-	1	0.01	-	-
M84-1424	S11 Lvl 10 Fea 22d	UK	-	-	-	-	-	-	98	0.59
M84-1228	Feature 10	15	-	-	-	-	-	-	-	-
M84-1033	S11 Lvl 3	75	-	-	-	-	-	-	-	-
M84-1421	S11 Lvl 10	UK	-	-	-	-	-	-	-	-
M84-1034	S11 Lvl 4	167.5	-	-	-	-	-	-	-	-
M84-1031	S11 Level 1	90	-	-	2	0.05	-	-	-	-
M84-1188	S 11 Lvl 16	15	1	0.07	-	-	-	-	-	-
M84-1177	S11 Level 13	15	-	-	-	-	-	-	-	-
M84-1226	S11 Lvl 8	15	-	-	-	-	-	-	-	-
M84-1191	S11 Lvl 17	15	-	-	-	-	-	-	-	-
M84-1223	S11 Lvl 15	30	-	-	-	-	-	-	-	-
M84-1171	S11 Lvl 12	30	-	-	-	-	1	0.01	-	-
M84-1220	S11 Lvl 14	15	-	-	-	-	-	-	-	-
M84-1134	S11 10 Lvl 2	30	-	-	-	-	-	-	-	-
M84-1028	Stratum 11	15	-	-	1	0.06	-	-	-	-
M84-1094	S11(10)	UK	-	-	-	-	2	0.01	-	-
M84-1092	S11(9)	30	-	-	-	-	3	0.03	-	-
M84-1074	S11(4)	15	-	-	-	-	-	-	-	-
M84-1071	S11(6)	30	-	-	-	-	-	-	-	-
M84-1032	S11(2)	255	1	0.06	-	-	1	0.01	-	-
M84-1078	S11(8)	255	-	-	-	-	-	-	-	-
M84-1182	S11(4)	15	-	-	-	-	-	-	-	-
M84-1069	S11(4)	30	-	-	-	-	-	-	-	-

Lot #	Context	Liters	Nutmeats		Tuber (aquatic)		Rhizome		Fungus	
			Ct	Wt (g)	Ct	Wt (g)	Ct	Wt(g)	Ct	Wt (g)
M84-1112	S11(11)	15	-	-	-	-	-	-	-	-
M84-2022	Unit L Fea. 5	48+	-	-	-	-	3	0.03	-	-
M84-2025	Unit K Fea. 11	UK	-	-	-	-	-	-	-	-
M84-2045	Fea. 16	UK	-	-	-	-	-	-	-	-
M84-1029	S11, S10 Fea. 1	UK	-	-	-	-	-	-	-	-
Total	All Contexts	UK	2	0.13	11	0.2	16	0.15	141	0.82

Table B.5: Results of 47-JE-0001 Flotation Analysis by Sample >2.00 mm Split (Part V)

Lot #	Context	Liters	Herbaceous stem		Unid. Organic		Feces
			Ct	Wt (g)	Ct	Wt (g)	Ct
2011-20.0318	Feature 8	98	-	-	41	0.38	-
2011-20.0283	Feature 8	1	-	-	-	-	-
2011-20.0257	Feature 8	4.5	-	-	2	0.01	-
2011-20.0123	Feature 8	0.9	-	-	-	-	-
2011-20.0359	Feature 8	1	-	-	-	-	-
2011-20.0370	TU 2 Stratum 7	1	-	-	-	-	-
2011-20.0261	TU 12 Level 4	1	-	-	-	-	-
2011-20.0328	TU 12 Postmold	7	-	-	-	-	-
2011-20.0243	TU 12 Level 3	1	1	0.01	-	-	-
2011-20.0374	TU 2 Stratum 6	1	-	-	-	-	-
2011-20.0205	TU 12 Level 2	1	-	-	-	-	-
2011-20.0321	TU 12 Level 6	3	-	-	-	-	-
M84-1272	Stratum 5 Lvl 7	UK	-	-	-	-	-
M84-1244	Stratum 5 Lvl 6	UK	-	-	1	0.01	-
M84-1293	Stratum 5	UK	-	-	6	0.01	-
M84-1289	Feature 20	UK	-	-	-	-	-
M84-1292	Stratum 5	UK	-	-	-	-	-
M84-1297	Stratum 5 Lvl 7	UK	-	-	-	-	-
M84-1319	S5 Lvl 8	UK	-	-	-	-	-
M84-1302	S5 Lvl 7	UK	-	-	5	0.04	-
M84-1269	S5 Lvl 6	UK	-	-	3	0.02	-

Lot #	Context	Liters	Herbaceous stem		Unid. Organic		Feces
			Ct	Wt (g)	Ct	Wt (g)	Ct
M84-1104	Feature 6	~1	-	-	12	0.11	-
M84-1424	S11 Lvl 10 Fea 22d	UK	-	-	-	-	-
M84-1228	Feature 10	15	-	-	-	-	-
M84-1033	S11 Lvl 3	75	-	-	4	0.02	-
M84-1421	S11 Lvl 10	UK	-	-	-	-	-
M84-1034	S11 Lvl 4	167.5	-	-	-	-	-
M84-1031	S11 Level 1	90	-	-	10	0.05	-
M84-1188	S 11 Lvl 16	15	-	-	2	0.01	-
M84-1177	S11 Level 13	15	-	-	1	0.01	-
M84-1226	S11 Lvl 8	15	-	-	-	-	-
M84-1191	S11 Lvl 17	15	-	-	2	0.01	-
M84-1223	S11 Lvl 15	30	-	-	1	0.01	-
M84-1171	S11 Lvl 12	30	-	-	2	0.01	-
M84-1220	S11 Lvl 14	15	-	-	-	-	-
M84-1134	S11 10 Lvl 2	30	-	-	12	0.07	-
M84-1028	Stratum 11	15	-	-	9	0.06	-
M84-1094	S11(10)	UK	-	-	12	0.13	-
M84-1092	S11(9)	30	-	-	2	0.02	-
M84-1074	S11(4)	15	-	-	3	0.01	-
M84-1071	S11(6)	30	-	-	13	0.15	-
M84-1032	S11(2)	255	-	-	4	0.05	-
M84-1078	S11(8)	255	-	-	-	-	-
M84-1182	S11(4)	15	-	-	-	-	-
M84-1069	S11(4)	30	-	-	-	-	-

Lot #	Context	Liters	Herbaceous stem		Unid. Organic		Feces
			Ct	Wt (g)	Ct	Wt (g)	Ct
M84-1112	S11(11)	15	-	-	1	0.01	-
M84-2022	Unit L Fea. 5	48+	-	-	-	-	-
M84-2025	Unit K Fea. 11	UK	-	-	2	0.02	-
M84-2045	Fea. 16	UK	-	-	11	0.07	-
M84-1029	S11, S10 Fea. 1	UK	-	-	7	0.07	-
Total	All Contexts	UK	1	0.01	168	1.36	0

Appendix C: Aztalan Flotation Analysis Results by Sample (<2.0 mm Seeds)

Table C.1: Aztalan (47-JE-0001) Seed Counts by Sample

Lot #	Context	Liters	Chenopod-Amaranths			Rosaceae			Poaceae				Cucurbitaceae	Solanaceae	Asteraceae		Other Fruits and Seeds										
			<i>Chenopodium</i>	<i>Amaranthus</i>	<i>Polygonum</i>	Unid. Rosaceae	<i>Prunus</i> (cherry)	<i>Rubus</i>	Unid. Poaceae	<i>Hordeum pusillum</i> (little barley)	<i>Zizania aquatica</i> (wild rice)	cf <i>Hordeum/Zizania</i>	<i>Echinochloa</i> (barnyard grass)	<i>Cucurbit</i> (seed)	<i>Nicotiana</i> (tobacco)	<i>Solanum</i> (nightshade)	Unid. Asteraceae	<i>Helianthus annuus</i> (sunflower)	<i>Iva annua</i> (sumpweed)	<i>Vitis</i> (grape)	<i>Viola</i> (violet)	<i>Rhus</i> (sumac)	<i>Galium</i> (bedstraw)	<i>Carex</i> (sedge)	<i>Epigaea</i>	<i>Lamiaceae</i> (mint family)	Unidentified Seeds
2011-20.0318	Feature 8	98	660	8	1	2	1	-	14	3	3	-	-	-	2	3	4	1	1	-	-	1	-	14	-	8	61
2011-20.0283	Feature 8	1	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2011-20.0257	Feature 8	4.5	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2011-20.0123	Feature 8	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2011-	Feature	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Lot #	Context	Liters	Chenopod-Amaranths			Rosaceae			Poaceae					Cucurbitaceae	Solanaceae	Asteraceae			Other Fruits and Seeds								
			<i>Chenopodium</i>	<i>Amaranthus</i>	<i>Polygonum</i>	Unid. Rosaceae	<i>Prunus</i> (cherry)	<i>Rubus</i>	Unid. Poaceae	<i>Hordeum pusillum</i> (little barley)	<i>Zizania aquatica</i> (wild rice)	cf <i>Hordeum/Zizania</i>	<i>Echinochloa</i> (barnyard grass)	<i>Cucurbit</i> (seed)	<i>Nicotiana</i> (tobacco)	<i>Solanum</i> (nightshade)	Unid. Asteraceae	<i>Helianthus annuus</i> (sunflower)	<i>Iva annua</i> (sumpweed)	<i>Vitis</i> (grape)	<i>Viola</i> (violet)	<i>Rhus</i> (sumac)	<i>Galium</i> (bedstraw)	<i>Carex</i> (sedge)	<i>Epigaea</i>	<i>Lamiaceae</i> (mint family)	Unidentified Seeds
M84-1134	S11 10	30	2	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
M84-1028	Lvl 2		15	8	-	1	-	-	1	-	1	-	-	-	7	-	-	-	-	-	-	-	-	1	-	-	3
M84-1094	Stratum 11	UK	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	4	
M84-1092	S11(10)	30	-	-	-	-	-	-	-	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2	
M84-1074	S11(9)	15	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	
M84-1071	S11(4)	30	6	1	-	-	-	1	-	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	
M84-1032	S11(6)	255	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	
M84-1078	S11(2)	255	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
M84-1182	S11(8)	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
M84-1182	S11(4)	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
M84-1182	S11(4)	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Appendix D: Maize Row Number Analysis

Table D.1: Measureable Maize Specimens from Aztalan and Crescent Bay Hunt Club

Site Name (Number)	Lot Number	# Kernels	# Cupules	# Cob*	Sample Type	Unit	Stratum	Level	Feature	Association
Aztalan (47JE0001)										
	M84-1242	0	1	0	WS 1/16"	N 4-5 E 14-16	5	6		Mississippian
	M84-1269	0	1	0	Flot	N 4-5 E 14-16	5	6		Mississippian
	M84-1302	0	6	0	WS 1/16"	N 4-5 E 14-16	5	7		Mississippian
	2011-20.0318	3	5	0	Flot	TU 8		8	8	Mississippian
	M84-1104	1	0	0	Flot	N 0-4 E 14-16	11		6	Mississippian
	M84-1031	0	5	0	WS 1/16"	N 2-4 E 14-15	11(1)			Mississippian
	M84-1032	1	2	0	WS 1/16"	N 2-4 E 14-16	11(2)			Mississippian
	M84-1033	0	1	0	WS 1/16"	N 2-4 E 14-16	11(3)			Mississippian
	M84-1071	0	2	0	WS 1/16"	N 2-4 E 14-16	11(6)	1		Mississippian

Site Name (Number)	Lot Number	# Kernels	# Cupules	# Cob*	Sample Type	Unit	Stratum	Level	Feature	Association
	M84-1071	0	1	0	Flot	N 2-4 E 14-16	11(6)	1		Late Woodland
	M84-1093	2	6	0	WS 1/16"	N 2-4 E 14-16	11(10)			Late Woodland
	M84-1111	0	2	0	WS 1/16"	N 2-4 E 14-16	11(11)			Late Woodland
	M84-1120	1	1	0	WS 1/16"	N 2-4 E 14-16	11(10)			Late Woodland
	M84-1451	0	2	0	WS 1/16"	N 2-4 E 14-16	11(12)			Late Woodland
	M84-1453	1	0	0	WS 1/16"	N 3-5 E 16-17	11	11		Late Woodland
CBHC (47JE0904)										
	00-01C	0	3	1	Flot				00-01C	Oneota
	00-01B	0	3	0	Flot				00-01B	Oneota
	00-06B	0	1	0	Flot				00-06B	Oneota
	00-11	0	1	0	Flot				00-11	Oneota
	00-11B	0	8	0	Flot				00-11B	Oneota
	00-15	0	17	3	Flot				00-15	Oneota

Site Name (Number)	Lot Number	# Kernels	# Cupules	# Cob*	Sample Type	Unit	Stratum	Level	Feature	Association
	00-26	0	3	0	Flot				00-26	Oneota
	00-45	0	1	0	Flot				00-45	Oneota

*Cob is here defined as two attached cupules or larger

Table D.2: Maize Measurements by Specimen for Aztalan and Crescent Bay Hunt Club

Site	Lot #	Association	Part	Angle	Row # Estimation	Width (mm)	Height (mm)
Aztalan (47-JE-0001)	M84-1302	MM/LW	Cupule	60	12	6.00	2.00
	M84-1302	MM/LW	Cupule	60	12	6.00	3.00
	M84-1302	MM/LW	Cupule	90	8	5.00	2.50
	M84-1302	MM/LW	Cupule	60	12	5.00	2.50
	M84-1302	MM/LW	Cupule	72	10	5.00	2.00
	M84-1302	MM/LW	Cupule	72	10	6.00	3.00
	M84-1269	MM/LW	Cupule	72	10	8.00	2.00
	M84-1242	MM/LW	Cupule	72	10	5.00	2.50
	2011-20.0318	MM/LW	Cupule	60	12	6.00	3.00
	2011-20.0318	MM/LW	Cupule	60	12	6.00	3.00
	2011-20.0318	MM/LW	Cupule	72	10	7.00	2.50
	2011-20.0318	MM/LW	Cupule	90	8	6.00	2.00
	2011-20.0318	MM/LW	Cupule	72	10	5.00	2.50
	2011-20.0318	MM/LW	Kernel	36	10	7.00	5.00
	2011-20.0318	MM/LW	Kernel	30	12	5.00	6.00
	2011-20.0318	MM/LW	Kernel	36	10	4.00	5.00
	M84-1071	LW	Cupule	90	8	6.00	2.00
	M84-1071	LW	Cupule	72	10	4.00	2.00
	M84-1031	LW	Cupule	72	10	4.00	2.00
	M84-1031	LW	Cupule	60	12	5.00	2.00
	M84-1031	LW	Cupule	72	10	4.50	3.00
	M84-1031	LW	Cupule	90	8	3.50	1.50
	M84-1031	LW	Cupule	72	10	4.00	2.00
	M84-1071	LW	Cupule	60	12	5.00	3.00
	M84-1104	LW	Kernel	30	12	5.00	4.00
	M84-1120	LW	Kernel	30	12	6.50	4.00
	M84-1120	LW	Cupule	90	8	5.00	2.00
	M84-1111	LW	Cupule	60	12	5.00	3.00
	M84-1111	LW	Cupule	60	12	4.50	2.50
	M84-1093	LW	Cupule	60	12	4.00	3.00

Site	Lot #	Association	Part	Angle	Row # Estimation	Width (mm)	Height (mm)
	M84-1093	LW	Cupule	60	12	5.50	2.50
	M84-1093	LW	Cupule	90	8	4.50	2.00
	M84-1093	LW	Cupule	60	12	5.00	2.00
	M84-1093	LW	Cupule	60	12	4.00	2.00
	M84-1093	LW	Cupule	60	12	4.00	2.50
	M84-1093	LW	Kernel	45	8	7.00	5.00
	M84-1093	LW	Kernel	45	8	7.00	5.50
	M84-1451	LW	Cupule	72	10	4.00	2.00
	M84-1451	LW	Cupule	72	10	3.50	1.50
	M84-1033	LW	Cupule	72	10	4.00	2.00
	M84-1032	LW	Cupule	60	12	6.00	3.50
	M84-1032	LW	Cupule	60	12	5.00	2.00
	M84-1032	LW	Kernel	45	8	6.50	5.00
	M84-1453	LW	Kernel	45	8	7.50	5.00
	2011-20.0006	Unidentified	Cob	60	12	8.33	2.00
	2011-20.0086	Unidentified	Cob	60	12	8.67	3.00
	2011-20.0102	Unidentified	Cob	60	12	7.67	2.67
CBHC (47-JE-0904)	Feature	Association	Part	Angle	Row # Estimation	Width (mm)	Height (mm)
	00-26	Oneota	Cupule	60	12	7.00	3.00
	00-26	Oneota	Cupule	60	12	7.00	3.00
	00-26	Oneota	Cupule	72	10	7.00	2.50
	00-01C	Oneota	Cupule	72	10	8.00	4.00
	00-01C	Oneota	Double cupule	60	12	5.00	2.50
	00-01C	Oneota	Cupule	60	12	5.00	3.00
	00-01C	Oneota	Cupule	72	10	5.00	3.00
	00-01B	Oneota	Cupule	90	8	5.00	2.00
	00-01B	Oneota	Cupule	60	12	5.00	2.00
	00-01B	Oneota	Cupule	60	12	3.00	2.00
	00-11	Oneota	Cupule	90	8	5.00	2.00
	00-45	Oneota	Cupule	60	12	5.00	2.00

Site	Lot #	Association	Part	Angle	Row # Estimation	Width (mm)	Height (mm)
	00-11B	Oneota	Cupule/glume	72	10	5.50	3.00
	00-11B	Oneota	Cupule/glume	72	10	6.00	3.00
	00-11B	Oneota	Cupule/glume	60	12	7.00	3.00
	00-11B	Oneota	Cupule	60	12	6.00	3.00
	00-11B	Oneota	Cupule/glume	60	12	6.00	4.00
	00-11B	Oneota	Cupule	60	12	5.00	3.50
	00-11B	Oneota	Cupule	60	12	5.00	2.00
	00-11B	Oneota	Cupule	60	12	6.00	2.50
	00-06B	Oneota	Cupule	60	12	8.00	4.00
	00-15	Oneota	Cob fragment	60	12	5.33	2.00
	00-15	Oneota	Cupule/glume	45	16	5.00	3.50
	00-15	Oneota	Cupule	60	12	6.50	4.00
	00-15	Oneota	Cupule/glume	60	12	6.00	4.00
	00-15	Oneota	Cob fragment	60	12	6.33	2.67
	00-15	Oneota	Cupule/glume	60	12	5.00	3.00
	00-15	Oneota	Cupule/glume	60	12	5.00	4.00
	00-15	Oneota	Cupule	60	12	5.00	3.00
	00-15	Oneota	Cupule/glume	60	12	5.00	2.00
	00-15	Oneota	Cupule/glume	60	12	6.00	3.00
	00-15	Oneota	Cupule/glume	45	16	4.00	3.00
	00-15	Oneota	Cupule/glume	60	12	6.00	2.00
	00-15	Oneota	Cupule/glume	60	12	6.00	4.00
	00-15	Oneota	Cupule	72	10	7.00	3.00
	00-15	Oneota	Cupule/glume	60	12	7.00	2.00
	00-15	Oneota	Cupule/glume	60	12	5.00	3.00
	00-15	Oneota	Cupule/glume	60	12	5.00	3.00
	00-15	Oneota	Cupule/glume	60	12	6.00	3.00
	00-15	Oneota	Cob fragment	60	12	7.00	2.00
	00-15	Oneota	Cupule	60	12	5.00	3.00

Site	Aztalan				Late Woodland Sites					
	Aztalan Stratum 11 and LW Features		Aztalan Stratum 5 and Lohmann Phase Feature 8		Statz (Meinzholz and Kolb 1997; Zalucha 1997)		Murphy (47- DA- 0739/0965) (Egan-Bruhy 2003b)		River Quarry (47-DA-0760) (Egan-Bruhy 2003b)	
	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
<i>Lagenaria siceraria</i> [Bottle Gourd] rind	-	-	2	0.01	-	-	-	-	-	-
Asteraceae:										
<i>Asteraceae</i> [Unidentified]	1	-	4	-	-	-	-	-	-	-
<i>Helianthus annuus</i> [Sunflower]	-	-	1	-	-	-	-	-	-	-
<i>Iva annua</i> [Sumpweed]	-	-	1	-	-	-	-	-	-	-
Chenopods- Amaranth*:										
<i>Chenopodium</i> sp	21	-	670	-	16	-	2	-	-	-
<i>Amaranthus</i> [Amaranth]	6	-	8	-	-	-	1	-	-	-
<i>Polygonum</i> sp	3	-	1	-	-	-	1	-	-	-
Rosaceae:										
<i>Rosaceae</i> [Unidentified]	-	-	2	-	-	-	-	-	-	-
<i>Prunus</i> sp [Cherry]	-	-	3	-	-	-	-	-	-	-
<i>Rubus</i> sp [Raspberry/Blackberry]	1	-	-	-	-	-	-	-	-	-
Solanaceae:										
<i>Solanum</i> [Nightshade]	29	-	3	-	-	-	-	-	-	-
<i>Nicotiana</i> [Tobacco]	-	-	2	-	-	-	-	-	-	-
Other Fruits/Seeds:										
<i>Vitaceae: Vitis</i> [Grape]	2	-	-	-	-	-	-	-	1	-
<i>Anacardiaceae: Rhus</i> sp [Sumac]	-	-	1	-	3	-	-	-	-	-
<i>Lamiaceae</i> [Mint family]	-	-	8	-	-	-	-	-	-	-
<i>Cyperaceae: Carex</i> [Sedge]	4	-	14	-	5	-	-	-	-	-
<i>Rubiaceae:</i> <i>Galium</i> [Bedstraw]	1	-	-	-	-	-	-	-	-	-
<i>Ericaceae: Epigaea</i> [Trailing arbutus]	1	-	-	-	-	-	-	-	-	-
<i>Violaceae: Viola</i>	1	-	-	-	1	-	-	-	-	-
<i>Myricaceae: Myrica</i> <i>gale</i> [Sweet gale]	-	-	-	-	-	-	1	-	-	-
<i>Brassicaceae: Brassica</i> cf <i>nigra</i> [Black mustard]	-	-	-	-	-	-	1	-	-	-

Site	Aztalan				Late Woodland Sites					
	Aztalan Stratum 11 and LW Features		Aztalan Stratum 5 and Lohmann Phase Feature 8		Statz (Meinzholz and Kolb 1997; Zalucha 1997)		Murphy (47-DA-0739/0965) (Egan-Bruhy 2003b)		River Quarry (47-DA-0760) (Egan-Bruhy 2003b)	
	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
<i>Hypoxidaceae: Hypoxis hirsuta</i> [Yellow starflower]	-	-	-	-	1	-	-	-	-	-
<i>Cornaceae: Cornus</i> [Dogwood]	-	-	-	-	1	-	-	-	-	-
<i>Commelinaceae: Tradescantia</i> [Spiderwort]	-	-	-	-	1	-	-	-	-	-
<i>Fabaceae</i> [Pea family]	-	-	-	-	1	-	-	-	-	-
Unidentified Seeds	25	-	65	-	21	-	5	-	-	-
Other organic material:										
Tuber (aquatic)	3	0.11	-	-	-	-	-	-	2	0.07
Rhizome	11	0.1	5	0.05	-	-	36	0.54	8	0.10
Fungus	98	0.59	43	0.23	-	-	-	-	-	-
Fungal fruiting structures	-	-	-	-	-	-	4	0.02	12	0.09
Unidentified organic	103	0.82	58	0.47	-	-	183	1.11	73	0.79

UK=unknown

Site	Aztalan				Mississippian-Influenced Sites			
	Aztalan Stratum 11 and LW Features		Aztalan Stratum 5 and Lohmann Phase Feature 8		Fred Edwards (Arzigian 1987)		Lundy (Emerson et al. 2007)	
	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
<i>Violaceae: Viola</i>	1	-	-	-	-	-	-	-
<i>Polygonaceae: Rumex</i> [Dock]	-	-	-	-	128	-	-	-
<i>Hypoxidaceae: Hypoxis hirsuta</i> [Yellow starflower]	-	-	-	-	-	-	1	-
<i>Fabaceae</i> [Pea family]	-	-	-	-	-	-	2	-
Unidentified Seeds	25	-	65	-	-	-	22	-
Other organic material:								
Tuber (aquatic)	3	0.11	-	-	-	-	626.25**	UK
Rhizome	11	0.1	5	0.05	-	-	-	-
Herbaceous stem	-	-	-	-	-	-	12.3**	-
Fungus	98	0.59	43	0.23	-	-	-	-
Thorns	-	-	-	-	-	-	-	-
Buds	-	-	-	-	-	-	-	-
Galls	-	-	-	-	-	-	1055.55**	-
Unidentified organic	103	0.82	58	0.47	-	-	2996.11**	-

UK=unknown

*identified sample includes >1.00mm split

**calculated from counts/10L provided in Schroeder 1989, Emerson et al. 2007

Table E.3: Comparison of Aztalan Floral Data with the Crescent Bay Hunt Club Assemblage

Site	Aztalan				Crescent Bay Hunt Club (Egan-Bruhy 2010)	
	Aztalan Stratum 11 and LW Features		Aztalan Stratum 5 and Lohmann Phase Feature 8		All Contexts	
	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
Total flot soil volume (liters)	UK	-	UK	-	3147	-
Total wood charcoal	14110	234.57	7124	213.37	135381	1958.71
# of features	1	-	5	-	40	-
# of samples	27	-	14	-	58	-
Total nutshell:	809	11.78	550	5.59	2870	25.40
Juglandaceae:						
Unidentified nutshell	32	0.02	55	0.35	496	3.13
<i>Carya</i> sp [Hickory]	771	11.72	497	5.25	314	4.45
<i>Carya ovata</i> [Shagbark hickory]	-	-	-	-	35	0.51
<i>Juglans</i> sp	-	-	-	-	11	0.44
<i>Juglans nigra</i> [Black Walnut]	1	0.01	5	0.33	63	2.43
Other Nut Families:						
<i>Corylus</i> sp [Hazelnut]	2	0.02			42	0.14
<i>Quercus</i> sp [Oak]	3	0.03	1	0.01	1909	14.30
Unidentified nutmeat	2	0.13	-	-	5	0.11
Poaceae:						
<i>Poaceae</i> [Unidentified]	5	-	14	-	94	-
Total <i>Zea mays</i>	327	2.68	582	4.62	4849**	37.22**
<i>Zea mays</i> kernels	274	2.41	511	4.24	1824**	18.31**
<i>Zea mays</i> cupules/glumes	53	0.27	71	0.38	2841	17.46
<i>Zea mays</i> cob fragments	-	-	-	-	169	1.39
<i>Phalaris carolinianum</i> [Maygrass]	-	-	-	-	30	-
<i>Hordeum pusillum</i> [Little Barley]	-	-	3	-	1**	-
<i>Panicum</i> sp [panicoid]	-	-	-	-	4	-
<i>Zizania aquatica</i> [Wild Rice]	10	-	3	-	5657**	-
cf <i>Zizania/Hordeum</i>	1	-	-	-	1	-
<i>Echinochloa</i> sp [Barnyard Grass]	1	-	-	-	2	-
Cucurbitaceae:						
<i>Cucurbita pepo</i> rind	68	0.34	45	0.2	7	0.03
<i>Cucurbita pepo</i> seeds	1	-	-	-	-	-

Site	Aztalan				Crescent Bay Hunt Club (Egan-Bruhy 2010)	
	Aztalan Stratum 11 and LW Features		Aztalan Stratum 5 and Lohmann Phase Feature 8		All Contexts	
	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
<i>Lagenaria siceraria</i> [Bottle Gourd] rind	-	-	2	0.01	-	-
Asteraceae:						
<i>Asteraceae</i> [Unidentified]	1	-	4	-	84**	-
<i>Helianthus annuus</i> [Sunflower]	-	-	1	-	-	-
<i>Iva annua</i> [Sumpweed]	-	-	1	-	-	-
Chenopods- Amaranths*:						
<i>Chenopodium</i> sp	21	-	670	-	1374	-
Chenopod/Amaranth	-	-	-	-	8	-
<i>Amaranthus</i> sp [Amaranth]	6	-	8	-	23	-
<i>Polygonum</i> sp	3	-	1	-	35	-
Rosaceae:						
<i>Rosaceae</i> [Unidentified]	-	-	2	-	35**	-
<i>Prunus</i> sp [Cherry]	-	-	3	-	2	-
<i>Rubus</i> sp [Raspberry/Blackberry]	1	-	-	-	4	-
<i>Crataegus</i> sp [Hawthorn]	-	-	-	-	1	-
<i>Fragaria</i> sp [Strawberry]	-	-	-	-	2	-
<i>Potentilla</i> sp [Cinquefoil]	-	-	-	-	8	-
Solanaceae:						
<i>Solanum</i> [Nightshade]	29	-	3	-	172	-
<i>Nicotiana</i> [Tobacco]	-	-	2	-	77	-
Other Fruits/Seeds:						
<i>Vitaceae: Vitis</i> [Grape]	2	-	-	-	-	-
<i>Anacardiaceae: Rhus</i> sp [Sumac]	-	-	1	-	1	-
<i>Lamiaceae</i> [Mint family]	-	-	8	-	15	-
<i>Cyperaceae: Carex</i> [Sedge]	4	-	14	-	-	-
<i>Cyperaceae: Scirpus</i> [Bulrush]	-	-	-	-	-	-
<i>Rubiaceae:</i> <i>Galium</i> [Bedstraw]	1	-	-	-	4**	-

Site	Aztalan				Crescent Bay Hunt Club (Egan-Bruhy 2010)	
	Aztalan Stratum 11 and LW Features		Aztalan Stratum 5 and Lohmann Phase Feature 8		All Contexts	
	Ct	Wt (g)	Ct	Wt (g)	Ct	Wt (g)
<i>Ericaceae: Epigaea</i> [Trailing Arbutus]	1	-	-	-	3	-
<i>Ericaceae: Vaccinium</i> [Blueberry]	-	-	-	-	1	-
<i>Euphorbiaceae</i> [Spurge]	-	-	-	-	50	-
<i>Violaceae: Viola</i>	1	-	-	-	-	-
<i>Brassicaceae</i>	-	-	-	-	14	-
<i>Asclepidaceae</i> [Milkweed family]	-	-	-	-	1	-
<i>Najadaceae: Najas</i> sp	-	-	-	-	10	-
<i>Caprifoliaceae</i> [Honeysuckle]	-	-	-	-	4	-
<i>Cornaceae: Cornus</i> [Dogwood]	-	-	-	-	1	-
<i>Typhaceae: Typha</i> [Cattail]	-	-	-	-	30	-
<i>Verbenaceae: Verbena</i>	-	-	-	-	4	-
<i>Fabaceae</i> [Pea family]	-	-	-	-	47	-
<i>Fabaceae: Strophostyles helveola</i> [Wild bean]	-	-	-	-	66**	-
Unidentified Seeds	25	-	65	-	1777	-
Other organic material:						
Tuber (aquatic)	3	0.11	-	-	19	0.36
Rhizome	11	0.1	5	0.05	118	1.22
Herbaceous stem	-	-	-	-	52	0.45
Grass stem	-	-	-	-	33	0.11
Monocot stem	-	-	-	-	151	0.53
Fungus	98	0.59	43	0.23	284	0.82
Buds	-	-	-	-	5	0.00
Peduncle	-	-	-	-	1	0.01
cf Thorn	-	-	-	-	1	0.01
Unidentified organic	103	0.82	58	0.47	2394	14.11

UK=unknown

*Does not include partially carbonized specimens

**Includes cf

***includes estimated ct/wt(g) for partially sorted samples