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A Case Study of Cache Pit Construction, Use, and Abandonment from the Upper Great Lakes, USA

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ABSTRACT
Archaeological investigations on sandy, well-drained terraces of the Grand River in southwestern Michigan revealed a large number of shallow surface depressions, marking the locations of former cache pits, i.e., subterranean storage features. Our paper documents these pits, one of the largest arrays of cache pits reported for the Upper Great Lakes. Excavations into 29 cache pits revealed that they had been backfilled with generally artifact-poor sands. Prior to backfilling, the cache pits had been burned, leaving behind a black, charcoal-rich, charred horizon at their base, below the fill. This type of intentional burning has not previously been reported. Intentional re-use of cache pits was rare, if it occurred at all. Subsequently, pedogenesis has formed tongue-like soil horizons below the surface depressions. Radiocarbon dates from the cache pits, along with diagnostic artifacts, place the use of these features to the Late Precontact period, particularly the mid- to late 15th century A.D.

KEYWORDS
subterranean features; hunter-gatherers; Late Prehistory; residential mobility; pre-agricultural economy; anthropogenic soil formation; risk management; pit taphonomy

Introduction

We report on a large-scale archaeological investigation at a Precontact Native American archaeological site in southwestern Lower Michigan, USA. The investigations focused on a large number (346) of surface depressions in the native forest soils which are associated with the remnants of deep subsurface storage facilities, i.e., cache pits. Data for 29 excavated cache pits is reported—perhaps the largest collection of cache pits ever studied in the Upper Great Lakes region (Dunham 2000; Howey and Parker 2008; Howey and Frederick 2016). We provide typical morphologies, soil properties, ages, and cultural components associated with these pits and discuss when this site was being regularly utilized. By synthesizing the various aspects of cache pit morphology and soil characteristics, we provide baseline characterization data for typical cache pit morphologies for the region and place our findings within the broader cultural context of other Late Precontact (ca. A.D. 1200–1600) cache pit locales.

Background

Consideration of food storage as an adaptive strategy employed by mobile hunter-gatherers and low level horticulturalists has recently undergone significant changes. Simpler explanations, often tied to the role of food storage as a mechanism for coping with environmental variability, have been replaced with a perspective of food storage as a dynamic, multidimensional component of these cultural systems (Ingold 1983; Brenton 1988; DeBoer 1988; Halperin 1994; Howey and Parker 2008; Morgan 2012; Howey and Frederick 2016; Frederick 2019). Four general options for food storage are recognized: 1) biological storage through fat and protein stored in the body, 2) social storage through exchange, redistribution, and markets, 3) environmental storage through the use of tended animals and wild resources, and 4) technological storage through the use of built facilities (Brenton 1988, 46). These options are not mutually exclusive; indeed, they typically function in concert. Of the four, however, the use of immovable storage facilities by mobile hunter-gatherers has garnered the most recent attention.

The use of immovable food storage facilities by mobile hunter-gatherers who rely on a seasonally abundant and often geographically dispersed resource base is an effective strategy to ameliorate intra- and inter-annual fluctuations in resource availability and abundance. Although an effective coping strategy, it is does come with a degree of risk. As pointed out by Howey and Frederick (2016, 38–39), immovable food storage facilities might not only fail technologically, but they must also be placed in appropriate locations in order to be successful. Technological failure entails not only failure of the storage structure itself but also failure to maintain an internal environment conducive to food preservation. The choice of where to locate such storage facilities must balance being proximate to the resources being exploited with locations that have environmental parameters conducive to food preservation and which are effective at concealment.

Construction and use of food storage facilities, along with decisions regarding 1) location, 2) the foodstuffs to be placed in them, and 3) the manner in which the resources are processed for storage, all require specialized knowledge sets (Howey and Frederick 2016; Dunham 2019). The construction of, in this case, subterranean pits, requires knowledge of the optimal pit size and depth, as well as internal features including pit lining, wall supports, and insulating material(s).

Similarly, the choice of where to place food storage facilities requires knowledge of 1) the environment, 2) the distribution of resources within the bounds of the territory within which a social group moves, and 3) when those resources are available. Environmental and ecological knowledge of the

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area also factors into this decision; users must factor into their decisions the locations of 1) well-drained soils, 2) transportation routes, and 3) resource patches and/or the nature of game animal movements (Howey 2015; Howey and Frederick 2016; Howey et al. 2016; Dunham 2019; Howey et al. 2020). The use of cache pits as part of an economic strategy then becomes part of the long-term linkages between people and places (Dunham 2019).

Processing and storage of foodstuffs for future use has been documented in a wide array of cultures, ranging from the Mesolithic of northern Europe (Hoist 2010; Valdeyron 2014) and the Upper Paleolithic of eastern Europe (Soffer et al. 1997; Svoboda, Péan, and Wojtal 2005) to Middle Holocene Archaic cultures of the American Midwest (Brown and Vierra 1983). The use of subterranean food storage facilities as part of an economic strategy was also a key cultural adaptation of Late Woodland societies (ca. A.D. 600–1600) in the Great Lakes region, particularly during the period ca. A.D. 1200–1600, referred to as the Late Precontact period (Hambacher and Holman 1995; Dunham 2000; Holman and Krist 2001; Howey and Frederick 2016; Dunham 2019). Subsurface storage features are, in this context, commonly called cache pits. A distinguishing aspect of cache pit use in this context is their frequent placement away from residential base camps and/or in proximity to locations where economic resources were seasonally abundant (Dunham 2000; Holman and Krist 2001). The importance of cache pits as an adaptive strategy is underscored by the fact that they represent one of the most common Late Prehistoric site types in the region (Hinsdale 1925, 1931).

Although subsurface storage has a long history in the region, cache pit locales per se appear in the archaeological landscape of the Great Lakes region only after ca. A.D. 1000 (Dunham 2000; Howey and Parker 2008; Howey and Frederick 2016). Nonetheless, Native American communities, particularly the Ojibway (Chippewa) and Odawa (Ottawa), continued to utilize them up through the historic period (Densmore 1929; Hilger 1951; Dunham 2000). Intensified use of cache pits after ca. A.D. 1200 also may have been in response to the increased unpredictability in resource distribution and abundance associated with the onset of cooler climatic conditions known as the Little Ice Age (Grove 1988; Kapp 1999; Mann 2002).

Easily excavated into the well-drained, sandy soils commonly found in Michigan, cache pits provided a means of exploiting seasonally abundant resources and extending their availability after processing by providing for over-winter storage. These practices increased the communal capacity for survival, success, and regeneration in the difficult environment of the region. Storing foodstuffs at economically strategic locales during times of abundance, rather than transporting them during residential moves, not only facilitated seasonal mobility (Dunham 2000) but also served as a risk management strategy (Holman and Krist 2001; Howey and Parker 2008; Frederick 2019). Food storage also served to anchor groups to the landscape, imbuing it with cultural meaning (Dunham 2019).

Cache pits commonly occur along former trails and hunting routes, and in areas that held overlapping seasonal resources in both time and space. Thus, they provided options for efficient resource extraction and mobility (Holman and Krist 2001). Although little data exist on the actual contents of cache pits in the Great Lakes region, a range of plant resources and possibly dried meat products have been documented (Densmore 1929; Dunham 2000; Holman and Krist 2001; Howey and Parker 2008; Hambacher et al. 2016; Howey and Frederick 2016).

Archaeological data on cache pit locales in Michigan are extremely limited. Early accounts of cache pit excavations provided little information beyond general dimensions and emphasized the paucity of artifactual remains within (Hinsdale 1925, 1931; Greenman 1927; Dustin 1936). Modern reports of cache pit excavations in Michigan are limited in number, broadly scattered, and typically include only a small number of pits (O'Shea 1989; Branstner 1991; Hambacher 1992; Dunham, Hambacher, and Branstner 1999; Dunham 2000; Howey and Parker 2008; Howey and Frederick 2016). These studies often do little more than confirm the general outlines of these features, as documented in ethnographic and ethnohistoric sources. Except for a report of decayed pieces of birch bark in some pits (Dunham 2000), information on the internal structure of cache pits has also been sparse, again relying heavily on ethnographic data. These reports indicated that pits were typically lined with bark, insulated with dry grass, and covered with logs and a small mound of earth (Densmore 1929; Bendremer, Kellog, and Largy 1991; Mrozowski 1994; Dunham 2000; Howey and Parker 2008; Howey and Frederick 2016; McLeester 2018). In our study, we provide a rich suite of data on the morphology, contents, age, and function of a suite of cache pits from a site in the lower Grand River Valley of southwestern Michigan.

Study Area

Site 20OT283 is located on low terraces of the Grand River, near Lake Michigan (Figure 1). Here, two terraces rise ca. 5.5 m above the adjoining floodplain wetlands. The site borders an area of high terrain informally known as the Spoonville Peninsula (see Figure 1). Traveling upstream from the mouth of the Grand River, the Spoonville Peninsula is the first sizeable upland encountered. Here, the river changes from a wide, low-gradient stream with extensive back channels, swamps, and bayous, to a narrower, incised channel (see Figure 1). Thus, the peninsula occupies what would have been an environmentally strategic location for obtaining, processing, and storing resources from the area (see Figure 1). Previous work has documented Late Paleoindian through early Historic period sites on the peninsula, and survey work in the adjoining valleys has documented numerous small artifact scatters, predominantly dating to the Middle Woodland (150 B.C.–A.D. 500) and Late Woodland periods (A.D. 500–1600) (Flanders 1965; Flanders, Marek, and Szten 1979; Morrisey, Brashler, and Tucker 1995; Dunham et al. 1999; Hambacher et al. 1999, 2016).

Of particular importance to the interpretation of 20OT283 is the Little Ice Age, which began after ca. A.D. 1250 and lasted into the 19th century (Bernabo 1981; Kapp 1999). Although there is some disagreement as to its exact timing (Mann 2002), some of the coldest portions of that period occurred between about the 15th and late 18th centuries. Perhaps not coincidentally, this period also corresponds with an intensification in the use of subsurface storage and a continued increase in the role of horticulture within a still primarily hunting-gathering-based economy.

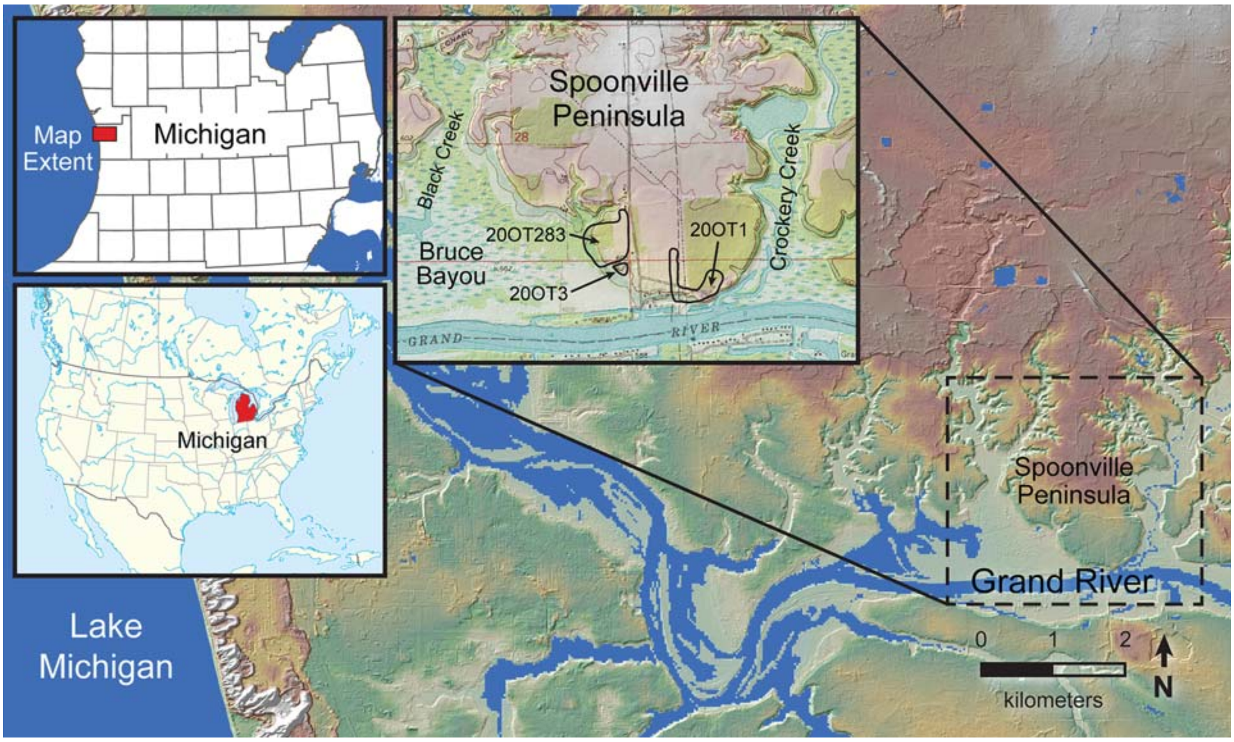

Figure 1. Study area map.

General Land Office (GLO) surveys in the region during the 1830s indicate that the Spoonville Peninsula was at the southwestern edge of a large expanse of beech-sugar maple forest (Albert and Comer 2008). As expected, lowland areas were dominated by shrub swamp, emergent marsh, and mixed hardwood swamp forest. Paleobotanical remains from the site, however, indicate that a stand of oak-hickory forest dominated the terraces during the occupation period. Contemporary forests in this area have been only selectively cut and remain as mature mixed beech-maple and oak-hickory forest.

Methods

Site 20OT283, within a proposed highway corridor, is a ca. 305 m long scatter of prehistoric debris and surface depressions encompassing approximately 10 ha and extending across portions of two terraces (see Figure 1). Reconnaissance surveys identified four contiguous artifact clusters and/or areas of low artifact frequencies (Stephenson 2010). Subsurface shovel testing provided preliminary data about the distribution, kinds, and ages of artifacts at the site. Subsequent excavations focused on understanding the vertical distribution of artifacts and cultural features, as well as their distribution, via hand excavations of 166 1 m^2 test units.

Most of the ca. 350 surface depressions identified and mapped at the site were found to be associated with subsurface storage facilities. Based on this discovery, investigations were expanded to include an intensive examination of a sample of these features. Ultimately, 29 cache pits were excavated, described, and sampled; of these, six were radiocarbon dated. At least one 10 L flotation sample was taken from each feature. At some pits, samples were taken from the different internal zones to better understand their construction, use, and abandonment. Specialized samples for organic residue (lipid) and phytolith/starch grain analysis were also collected from the base of the cache pits and other selected contexts.

Subsurface features were classified by morphology and inferred function based on size, plan, and profile shape, as well as comparisons with similar features at other Late Precontact sites in the region. The ethnohistoric literature helped estimate feature function, particularly regarding the two main types of features: 1) large, deep features and 2) shallower features of varying sizes. The latter were associated with food processing activities that preceded storage, e.g., shallow hearths with fire-cracked rock (FCR) concentrations; large, shallow roasting features; and, large, deep processing pits that probably served as earth ovens. Analyses of the artifacts recovered, mainly prehistoric ceramics, lithics, and FCR, helped establish their functional, temporal, and cultural affiliations. Artifact analyses provided baseline information pertaining to the age of the site, as well as the range and kinds of activities that took place there.

Samples of charred material were submitted to Beta Analytic, Inc., for Accelerator Mass Spectrometer (AMS) dating. Six of the radiocarbon dates, including one from a cache pit, were from charred annuals, including aquatic tuber fragments, butternut shell (*Juglans nigra*), squash rind, and an unidentified seed fragment. The remaining dates were obtained on the outer annual rings of charred wood fragments from within the pit bases.

Nine cache pits were selected for soils/sediment analysis. At each, the pit profile was described and sampled using standard soil horizon nomenclature. Lab analyses were performed on the complete suite (118) of horizon-based samples. Munsell color was determined in the lab on moist samples, using rewetted samples. pH was determined on 2:1 water:soil suspensions. Loss on ignition, a surrogate for organic matter content (Konen et al. 2002), was performed at 430°C for eight hours. For particle size analysis, air-dried samples were lightly ground to pass a 2 mm sieve and run on a Malvern Mastersizer 2000E™ laser particle size analyzer.

Results

Soils

The fine-sandy soils at 20OT283 formed in well-sorted alluvial/lacustrine deposits. On the terrace, well above the floodplain, the soils show little evidence of wetness or high water table. The soils at the site have mean values of 91.8% sand, 6.5% silt, and 1.7% clay, with the most common texture classes being sand, loamy sand, and loamy fine sand. The soils are acidic (pH values between 4.8 and 5.6) and low (< 2.4%) in organic matter. A horizons averaged 2.7% organic carbon and are more acidic (mean pH = 4.4) than the parent materials (mean pH = 5.4), mainly because of the acidic oak-hickory litter. Soils on the site have surprisingly little intra-site and inter-feature variability. Within the sand fraction, medium (42.1%) and fine (27.0%) sands dominate, with almost no gravel.

In southern Michigan, soil development proceeds fairly rapidly in sandy sediments. Organic matter accumulates on the forest floor and, as it decomposes, soluble organic materials are translocated into the mineral soil by infiltrating water. In this kind of environment, translocation of organic matter in association with Fe and Al compounds (i.e., podzolization), is a background pedogenic process (Schaetzl and Isard 1991), expressed morphologically as whitish-colored E horizons above reddish brown (7.5YR) B horizons.

Period and pattern of site occupancy

Our investigation presented an opportunity to document Late Precontact occupations within the lower Grand River Valley, a period which is only rudimentarily known from a small number of sites, most of which have not been systematically investigated. The site also represents the initial discovery of cache pits associated with a short-duration resource acquisition and processing site, located away from a main residential base camp or village in southern Lower Michigan. Investigations encompassed 1048 m^2, including five variably sized excavation blocks and isolated excavation units distributed across four intra-site artifact clusters, along with 90 cultural features. The excavations recovered a large artifact assemblage composed of diagnostic ceramics, chipped and groundstone tools, lithic debitage, FCR, preserved floral and faunal remains, and other miscellaneous artifacts. This data documents an extensive occupation that included plant and animal resource procurement, processing, and storage activities. The distribution of the different feature types and key artifacts associated with acquisition and processing activities such as projectile points, bifaces, end scrapers, and ceramics, indicated that there had been a broadly generalized differentiation of space at the site. Most of the resource processing activities occurred on the upper terrace, whereas the majority of the cache pits are on the lower terrace.

Radiocarbon dates and diagnostic artifacts indicate that the site use occurred over most of the Middle Archaic (6000–3000 B.C.) through Late Woodland periods. Likely, as indicated by small numbers of scattered projectile points, occupation during most of this extended period of time was neither constant nor consistent in intensity, but rather, sporadic and of low intensity. No features or activity areas have been associated with these early occupations. Use during the Early Woodland (800–150 B.C.) period appears to have increased, but nonetheless remained comparatively low; evidence occurs as scattered stemmed projectile points and characteristically thick, grit tempered ceramics. A small concentration of Early Woodland ceramics and several large processing pits suggestive of a periodic, small seasonal (mid-summer and fall) occupation was identified on the upper terrace.

Site use increased during the Middle Woodland (150 B.C.–A.D. 500) and early Late Woodland (A.D. 500–1100/1200) periods, when the focus of occupation was on the eastern side of the peninsula, at the Spoonville site (20OT1). Dense deposits and a range of tools, ceramics, and other artifacts, along with the presence of Middle Woodland burial mounds, document its importance within the regional settlement system (Flanders 1965; Dunham et al. 1999). In contrast, Middle Woodland use of 20OT283 on the upper terrace is represented by only a small number of scattered ceramics and projectile points. Early Late Woodland use here was more intense but still largely characterized by small, scattered clusters of diagnostic Spring Creek ware pottery. The scattered nature of these remains, coupled with the lack of features associated with them, suggests that 20OT283 most likely served in an ancillary and short-term/transient nature for task-specific groups traveling from the nearby Spoonville site.

The period of most frequent site use occurred during the Late Precontact period, specifically the mid- to late 15th century A.D., before decreasing and ultimately ceasing afterwards in the 17th century A.D. The proliferation of cache pit locales across the Upper Great Lakes region at this time represents a shift in socio-economic and socio-political strategies (Howey and Parker 2008; Howey and Frederick 2016; Frederick 2019) and the manner in which people were interfacing with their environment (Dunham 2019). During the Late Precontact period, 20OT283 became the focus of seasonally-based, short duration occupations, featuring focused episodes of resource acquisition, processing, and storage of a wide range of seasonally abundant resources (Hambacher et al. 2016). The dominance of a small number of different tool types closely associated with plant processing, namely projectile points, bifaces and bifacial preforms, end scrapers, and groundstone tools, indicates that occupations were narrowly focused, lacking the broad range of activities typically seen at residential base camps (Hambacher et al. 2016). Ceramics were indicative of a residential population within the Grand River Valley, although they do exhibit close stylistic ties with Upper Mississippian Berrien Phase groups to the south (Hambacher et al. 2016).

Cache pits: background and overview from the literature

Cache pits first entered the archaeological literature of the Upper Great Lakes region in the early 20th century. Some of the earliest references are to “provision caches” or “caches” in Wisconsin (Brown 1906, 336, 346, 353, 384, 407, 409; 1917, 12–14, 21–22, 31–32, 43, 53; Schumacher 1918, 130, 135, 142–143). Slightly later, Hinsdale (1925) and Dustin (1936) characterized them as one of the most numerous site types in Michigan.

Broadly, the use of subsurface storage by the inhabitants of the Upper Great Lakes region is well documented in the ethnohistoric and ethnographic literature (Blackbird 1887; Smith 1907; de Charlevoix 1923; Densmore 1929; Hilger 1951; Tanner 1956; Holman and Krist 2001). Recently, subsurface storage has been recognized as an important aspect of Late Precontact socio-economic adaptations, playing an important role in hunter-gatherer risk management strategies (Hambacher and Holman 1995; Holman and Krist 2001; Howey and Frederick 2016; Dunham 2019; Frederick 2019). Such features may occur in either residential habitation sites or at logistically organized, activity-specific sites, such as sugaring and wild ricing camps or garden plots and agricultural fields (Dunham 2000). Their association with agricultural fields has also been archaeologically verified in both the Upper Great Lakes and New England regions (Bendremer, Kellog, and Largy 1991; Mrozowski 1994; Overstreet 2000; Bruhy 2004–2006).

Cache pit clusters, typically manifesting as concentrations of shallow surface depressions, have been most commonly documented in northern Lower Michigan and northern Wisconsin, where sandy soils are widespread and the lack of agriculture has preserved them (Hambacher and Holman 1995; Dunham 2000; Overstreet 2000; Holman and Krist 2001; Howey et al. 2016). Identification of such features as cache pits is assisted by comparisons with ethnohistoric/ethnographic accounts, as well as assumptions about pit morphology as it relates to function. Summarizing ethnographic sources, Dunham (2000, 229–230) indicated that cache pits were often lined with elm or birch bark and that a variety of containers filled with foodstuffs were stored in them. Archaeological evidence for the use of grasses as a pit lining material has also been reported (Bendremer, Kellog, and Largy 1991; McLeester 2018). Clusters of cache pits range from only a few dozen or less to hundreds. Hambacher and Holman (1995) reported an average diameter of ca. 1.9 m for a suite of 109 cache pits at a site in central Lower Michigan, with surface depressions ranging from 10–59 cm deep (ca. 20 cm average). O'Shea (1989) noted typical widths of 1.0–1.5 m for cache pits, with surface depressions of ca. 20–30 cm, for 36 cache pits in northeastern Lower Michigan. Dunham (2000, 235) reported similar dimensions for 20 cache pits at the Ne-con-ne-pe-wah-se site in west-central Michigan. In general, cache pits can range from 40 cm to > 1 m in depth, although the limited data available for these features indicate a narrower range (85 cm to ca. 1 m) (Holman and Krist 2001). Thus, for the purposes of this study, we suggest that the typical cache pit morphology for this region is typically circular or ovoid in plan, 1–2 m (or slightly larger) in diameter, and roughly 80–100 cm deep.

The clustering of cache pits, particularly in moderate- to large-sized groups, underscores the importance of location as part of the overall food storage strategy. Whether this implies that pits were deliberately placed 1) along preferred travel routes, 2) at sites of strategic importance such as on ridges, near sources of food or resource habitats, or nearby more established camps, or 3) on sites with particular types of soils is not fully understood (Dustin 1936; Holman and Krist 2001). The complexity of the decision making involved in site location is highlighted by seemingly contradictory data that suggest concealment was also an important consideration (Dunham 2000). Nonetheless, other data suggest that concealment was less of a concern than was animal predation (Densmore 1929; Holman and Krist 2001).

The literature also is not consistent with respect to post-usage of cache pits; some pits appear to have been left open after the contents were removed, whereas others were deliberately backfilled (Dustin 1936; O'Shea 1989; Dunham 2000; Holman and Krist 2001; Howey and Parker 2008; Hambacher et al. 2016). Failure to deliberately fill the pits after use may explain why artifacts are so uncommon in cache pits, as this process would not have allowed for the incorporation of camp debris into the fill (Holman and Krist 2001). This stands in contrast to large, deep features interpreted as storage pits that do contain midden debris (Bettarel and Smith 1973; Parachini 1981; Branstner and Hambacher 1995; Beld 1996; Lovis 2002). Every excavated cache pit at 20OT283 had been deliberately infilled, often to the point that surface depressions were absent.

Cache pits: typical morphologies

At 20OT283, we identified both large, deep subsurface features and small to large, shallow, subsurface features. Deep features, which comprise slightly more than half of the total, include cache pits (n = 29), processing or roasting pits (n = 15), and deep basins (n = 2). Shallow basins (n = 17) and FCR concentrations (n = 9) represent the majority of the shallow features, although smaller numbers of small ash and charcoal stains (n = 6), large, shallow roasting pits (n = 4), hearths (n = 3), artifact concentrations (n = 4), and a possible sheet midden remnant were also documented. Cache pits differ from processing pits by their tendency to have straighter, more vertically oriented walls, forming a roughly conical or conoidal profile. Processing or roasting pits tend to be considerably wider and slightly shallower, with more gently excurved side walls and rounded bottoms, forming a basin-shaped profile. That said, cache pits are the focus of the discussion that follows.

Site 20OT283 is one of the largest known clusters of surface depressions and associated cache pits in the Midwest, and certainly the largest dataset in which the dimensions of such features have also been recorded (Figure 2). In all, 346 surface depressions across both the upper and lower terraces were mapped. Although the depressions were spatially clustered on each terrace and a number of the depressions occurred in close proximity, instances of overlap were not documented, suggesting that there was an active avoidance of previously used pits.

Most (22 of 29) cache pits at the site occur below subtle surface depressions, which ranged from 80 cm to > 2 m in diameter (most were between 1.0 m and 1.3 m in diameter) (see Figure 2). Although sometimes subtle, the depressions were typically 4–20 cm deep; only a very small number exceeded 10 cm in depth. Importantly, six surface depressions targeted for excavation turned out not to be associated with a cache pit or other cultural feature: they were either treefall remnants or another type of surface undulation, underscoring the importance of verifying the presence of an underlying cultural feature before assigning a surface depression to a cache pit. Unlike surface depressions formed by tree uprooting (Schaetzl et al. 1990; Šamonil et al. 2016), those associated with cache pits are more circular in plan view and are not associated with an adjacent mound. Although often nuanced, these attributes are critical in differentiating the two types of surface depressions.

The 29 cache pits we studied took three basic shapes in plan view: circular (n = 12), elliptical (n = 6), and ovoid

Figure 2. Collage of typical cache pits and one processing pit from 20OT283, illustrating the range of variation in the features across the site. A) Typical cache pit (Feature 7) with non-complex morphology. Vertical sides, slightly convex base, and charred basal horizon. No clear pedogenic overprinting due to the lack of a surface depression. B) Typical cache pit profile (Feature 58) with an overthickened A horizon underlain by a strongly developed E horizon and a well-developed, charred basal horizon. C) Non-complex cache pit morphology (Feature 67) with steeply sloping sides and a convex base. Note the overthickened A horizon due to a shallow, but distinct, surface depression. The basal charred horizon is weaker than at most cache pits at the site. D) Surface depression in this cache pit (Feature 96) has accelerated pedogenesis. In the depression is a thick Oi horizon above a strong E horizon, extending through the basal charred horizon, and a Bs horizon below that. E) Plan view of a well-developed cache pit (Feature 103) with prominent surface depression, leading to an overthickened A horizon and a strong E horizon below the native A horizon. F) Processing pit (Feature 120) with broad, deep, basin-shaped profile. It lacks a surface depression or an overthickened A horizon and has broadly sloping sidewalls. G) Oblique view of cache pit (Feature 82) with a second episode of infilling. Sediment below topmost A horizon shows minimal pedogenesis, but well-developed E and Bs horizons below the lower A horizon suggest that it was the surface horizon for a significant period of time, before the second infill event. The basal charred horizon is weakly developed and had very little charcoal, although burning is evident at base. Photos by R. Schaetzl and K. Hagenmaier.

(n = 11). Below about 20–30 cm, most became more circular, indicating that the initial plan shape is influenced by differential settling and slumping of the uppermost parts of the features. In profile, most pits appear as a truncated cone, or a cylinder with a flat to rounded bottom. Cache pit side walls were typically steep, generally at angles of 70° to ca. 90° and, although sometimes irregular, are generally straight and do not exhibit any significant curvature until near the bottom. Approximately half had rounded bottoms (see Figure 2). Even the pits with flat bottoms often exhibited slightly upturned edges. Most of the pits were 1.0–2.2 m in length, 0.8–1.9 m wide, and generally circular (Table 1).

Table 1. Summary of Cache Pit Dimensions at site 20OT283 (n = 29).

Dimension	Range	Mean ± St. Dev.
Length	102–215 cm	150.19 ± 28.5 cm
Width	75–185 cm	129.11 ± 24.4 cm
Depth	53–127 cm	85.93 ± 18.5 cm
Volume	0.31–1.52 m^3	0.89 ± 0.3 m^3

The largest two pits were 2.2 m long, 1.6 m wide, and 82 cm deep and 2.0 m long, 1.9 m wide, and 89 cm deep. The smallest was 110 cm long, 75 cm wide, and 53 cm deep. Six of the features were over 1.0 m deep; the deepest was 127 cm deep. Together, the average cache pit had a volume of 0.89 ± 0.3 m^3 (ca. 25 bushels).

The pits had a fairly simple internal structure: overthickened O and A horizons at the surface (often filling in a surface depression), crudely tongue-shaped E and B horizons formed in the central part of the backfilled sands, and a distinctive black, charred horizon at the base. The charred horizons frequently contained fragments of charcoal, along with charred wood and bark, generally concentrated around the outer margins (see Figure 2). In a number of instances, the placement and orientation of the wood and bark fragments were suggestive of remnants of internal framing structures or linings.

The pits had been filled with yellowish brown and pale brown (10YR 5/4 and 6/3) fine sands, similar to the native soils. Much of the internal variability within the pit sediment, i.e., the differently colored zones, is due to post-abandonment pedogenesis. Where present, the surface depressions preferentially accumulate forest litter to form an overthickened O horizon above a very dark gray (10YR 3/1), organic-rich A horizon. Thus, where a discernible surface depression occurs, A horizons are overthickened, sometimes up to 30–35 cm in thickness, in comparison to ca. 10 cm in the native soils. In plan, separation of cache pits from the surrounding native soil is often difficult. But upon deeper excavation, the base of the A horizon in cache pits takes on a clearly defined and slightly bowl-shaped morphology, overthickened within the surface depression. In most pits that had noticeable surface depressions, the overthickened A horizons were usually coupled with well-developed plumes, or tongues, of E horizon material below. These E horizons were darker than is typical, e.g., dark gray (10YR 4/1), because of their high (mean = 0.8%) organic matter contents. The tongues reflect pedogenesis, driven by increased percolation of water through the center of the surface depression; similar processes occur in treethrow pits (Schaetzl 1990; Šamonil et al. 2013). The E horizons are depleted in Fe and Al and occur next to or above dark brown (7.5YR 3/4) and strong brown (7.5YR 4/6) B horizons that are sometimes enriched in those elements, and hence reddened. These morphologies indicate that within cache pits, the degree of soil development is not correlated with age, but rather with the character (width and depth) of the surface depression, which drives infiltration.

Every cache pit at the site contained a charred lower horizon that marked the former base (see Figures 2, 3); above this horizon are generally sterile, infilled sands. Charred horizons have not been previously reported in other cache pits in Michigan (Dunham, Hambacher, and Branstner 1999; Dunham 2000; Howey and Parker 2008; Howey and Frederick 2016). Their occurrence in the cache pits here provides unique information about how they were managed. We attribute the existence of the charred horizon to deliberate burning of cache pit residues and any wood/bark linings or internal structural materials after removal of the stored foodstuffs but before backfilling. The horizon is typically 10–20 cm in thickness and 70–100 cm wide; most are concave upward, although some are nearly planar. Charcoal fragments, infilled worm burrows, and roots are common (see Figure 3). In 18 pits, large, intact pieces of charred wood and bark were identifiable in the charred horizon. At the edges of the charred horizon, the native sands are commonly overly reddened (strong brown; 7.5YR 4/6) from heating and slightly enriched in Fe and Al. This morphology indicates that the pits were backfilled while (at least some) embers remained, thereby heating the sands and forming the reddened areas, while also preserving some charcoal and partially burned wood. Oak and pine were the most common woods encountered in the charred horizons, both of which would have been locally available.

In most of the cache pits, the majority of the larger, charred wood fragments in the charred horizon were arranged along the outer margin, oriented parallel or nearly parallel with the walls. In at least several pits, these fragments were either stacked on top of one another or positioned at right angles, pointing to their function as internal framing, designed to create space between the bottom of the pit and the stored goods. The use of small poles to help support the bark lining of the pits is also a possibility; Hilger (1951, 150) reported the occasional use of bent saplings to hold the pit lining in place. In cases where the size of the wood pieces could be determined, most measured ca. 5 cm or less in diameter, typical for a branch or sapling. Only a few larger fragments were identified. We draw attention to Feature 104, in which three large pieces of wood were stacked on top of each other along the pit margin (Figure 4A–B). The intact section of this wood assemblage was less than one-quarter of the pit's circumference, but enough of the wood was present to confirm that it was part of an internal framework structure. Feature 104 also contained small fragments of probable conifer bark that appeared to have been remnants of a pit lining. In Feature 60, pieces of wood at the edge of the feature base abutted at a 90° angle, again suggestive of framing (Figure 4E). Charred fragments in at least five other pits were also oriented perpendicularly (or nearly so) to the circumference of the feature, often dipping down towards the base of the pit (Figure 4). At least two of these also had pieces of wood oriented parallel to the pit edge, underneath a jumble of other wood (Figure 4D–E).

Although the charred wood fragments may be remnants of wood added as fuel during post-use burning of the pits, their locations and orientation suggest deliberate internal framing. The only other option, and one that seems less likely, is that the large wood and bark fragments represent intact remnants of a pit lining or pieces that fell off the lined sides of the pit during burning.

Figure 3. Close-up of a charred (Ab) horizon at the base of a cache pit (Feature 28). Note the root proliferation within the horizon. Depth is 1 m; increments are 10 cm. Photo by R. Schaetzl.

Cache pits: typical contents and usage

Only two cache pits exhibited evidence for multiple episodes of use, as indicated by two distinct, well-developed charred horizons (Figure 5). Obviously, if a pit was used twice but the second instance of use involved deeper excavation, two charred horizons would not have been preserved. The rare occurrence of cache pit re-use was also noted at the Grapevine Point site in northern Lower Michigan (Howey and Parker 2008; Howey and Frederick 2016).

As has been reported for other cache pits in Michigan (Dunham 2000; Howey and Parker 2008), pit fill materials at 20OT283 generally contained few artifacts. In most cases, they consisted of variable amounts of FCR, occasionally a few pieces of debitage and/or small ceramic fragments, and in some instances dumps of subsistence remains,

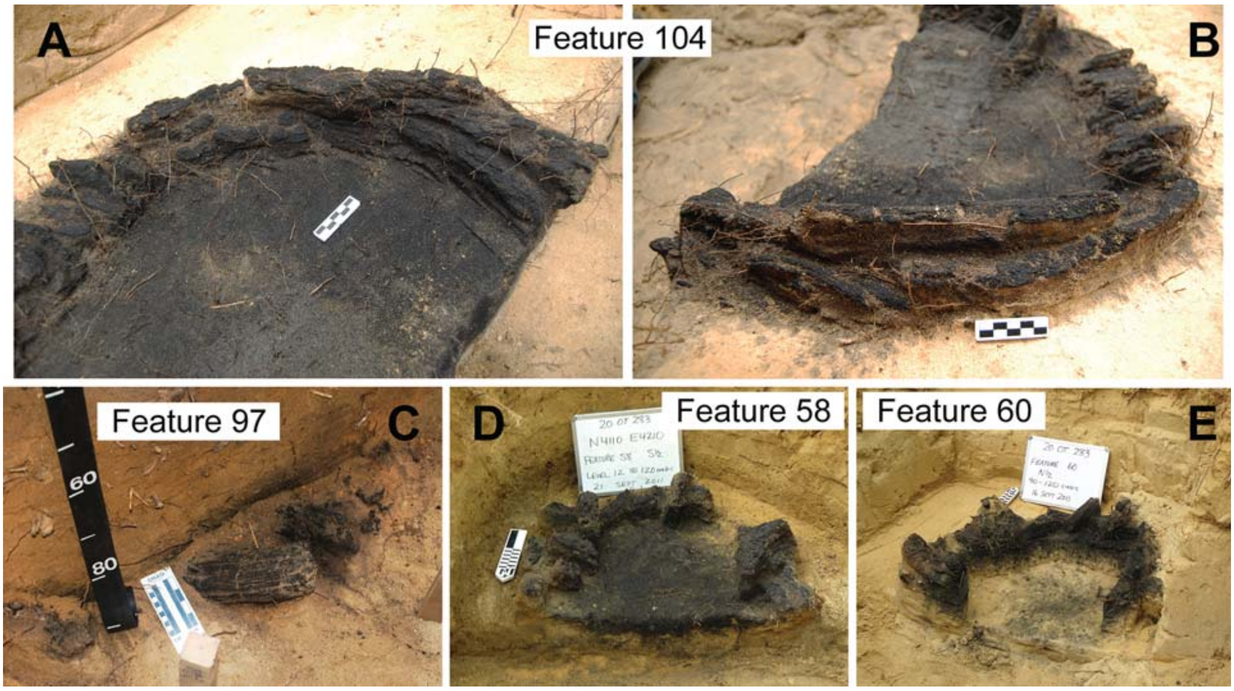

Figure 4. Charred, structural wood in the bases of excavated cache pits. Feature 104 was dated to CAL A.D. 1479 (Beta-350829). Photos by M. Hambacher, R. Schaetzl, and K. Hagenmaier.

principally freshwater mussel shell. The low densities of cultural material in the fill, as well as their distributions, suggest that, in most cases, artifacts in the cache pits simply represent incidental inclusions, added during backfilling. For example, a number of cache pits contained elevated amounts of FCR in the fill above the basal charred horizon. In these cases, the FCR typically occurred as a low density, but constant, presence in each of the excavation levels. We interpret this to mean that artifacts were already present in the soil when the pit was initially excavated and then were simply backfilled into the pit. Thus, we can only cautiously infer pit function or the range of foodstuffs stored in them based on materials recovered from the backfilled sediment. This finding places an emphasis on the careful consideration of specifically where within the pit artifacts, including subsistence remains, were recovered.

Figure 5. Cache pit (Feature 104) with two distinct charred horizons and basal wood structural materials in situ. This cache pit was dated to CAL A.D. 1479 (Beta-350829). Photo by K. Hagenmaier.

A few exceptions exist to the scenario described above. In a few pits, deliberate disposal of trash, in the form of distinct artifact concentrations, appears to have been associated with backfilling. In Feature 64, a large number of ceramic body sherds were concentrated in the middle of the pit, along with two broken triangular points and a broken early stage bifacial preform biface. In Feature 29, a concentration of freshwater mussel shells, identified as the three-ridge variety (*Amblema picata*), occurred in the middle of the feature matrix, most likely a dump of camp debris during backfilling. In Features 5 and 67, concentrations of freshwater mussel shell also occurred in the upper parts of the fill, but these are more likely due to debris dumps that utilized a low spot near an activity area and are unrelated to feature use and abandonment.

Given the typically low densities of interpretable materials in the pit fill and the fact that most, if not all, of the materials are incidental inclusions, the basal charred horizons became the focus of the paleobotanical, phytolith/starch, and organic residue analyses. Both the phytolith/starch and organic residue analyses were conducted on sediment derived from the heart of the charred horizons in a subsample of nine pits. Although interpreting these remains is difficult due to their exceedingly low densities, they generally point to a broad spectrum of nuts, seeds, and fleshy fruits, primarily blackberry/raspberry, in the fill. Nuts include acorn, black walnut, butternut, hazelnut, and other members of the walnut/hickory family (Juglandaceae). Seeds include flowering dogwood, western sunflower, pokeweed, tamarack, members of the Rosaceae family, and unidentified grass seeds. Phytolith analysis indicated the presence of wild rice (*Zizania* spp.) in three cache pits. Phytoliths from warm and cool season grasses suggested that these seeds were also being utilized as a starchy food source. The recovery of similar phytoliths from contemporaneous processing pits at nearby 20OT3 also support this conclusion (see Scott Cummings and Ladwig in Hambacher et al. 2016). Organic residue analyses of sediment from the bases of 10 cache pits also provided evidence for a variety of foodstuffs, primarily nuts, seed oils, and meat products, as well as specifically rendered fats and possibly fatty meats, although the organic residues were often degraded. In sum, a wide variety of foodstuffs were being stored in the cache pits.

With the exception of a single reference to the storage of fish in cache pits in Wisconsin (cited by Howey and Frederick 2016), ethnohistoric evidence does not indicate that cache pits were utilized for storage of meat products. Nonetheless, the possible co-occurrence of plant and animal products in the pits at 20OT283, as indicated by the organic residue analyses, may indicate that pemmican-like amalgams were being prepared and stored there.

Individual cache pit examples

Feature 32 is a prototypical cache pit at 20OT283, with relatively simple stratigraphy, sandy textures throughout, and a thick, well expressed, basal charred horizon (Figure 6). The outer rings of a piece of oak charcoal from the charred horizon, probably from structural members, dated to 410 ± 30 B.P., which calibrates to A.D. 1470 (2σ A.D. 1437–1520, 1588–1621; Beta-350827). This date places the pit within the period of most frequent site use and implies that post-burial pedogenesis in the pit infill material has occurred over only the last ca. 500 years. The basal charred horizon is 92 cm wide and (maximally) 32 cm thick, with distinctly upturned edges (see Figure 6). Below the shallow but well-formed surface depression, a 13 cm O horizon has formed. Below it is a distinct E horizon tongue, highlighting the importance of a central depression to promoting preferential percolation and, hence, soil development in the infilled sand. As is typical, reddened areas near the upturned edges of the charred horizon point to burning. Reddening of the area within the pit proper, mainly due to post-abandonment pedogenesis, makes the outline of the pit easily identifiable.

Feature 78 possesses very well expressed pit boundaries and a thick, upwardly concave, charred horizon (Figure 7). It is wider and shallower than Feature 32, with a surface depression of ca. 6 cm. Soil textures here are almost entirely uniform medium sands. As at Feature 32, the key morphological feature of this cache pit is its deep, wide, and well-expressed E horizon tongue, below the center of the surface depression. The tongue developed as water preferentially percolated through the thick litter in the surface depression, carrying with it organic acids capable of chelating the Fe and Al that exist as coatings on the sand grains and translocating these compounds downward. The tongue continues below the basal charred horizon as an illuvial feature. The AB horizon below the charred horizon (see Figure 7) provides additional evidence of the deep, focused percolation below the central depression, having gained organic matter by percolation through the charred horizon. A large (30 mm) charcoal fragment that ended abruptly at the left side of the lower charred horizon and the pit edge was uncovered, confirming that it had been placed in the pit prior to being burned. Although Feature 78 was not dated, the consistency of dates from other cache pits and the occurrence of probable Late Prehistoric artifacts in the general vicinity suggest that it is associated with the period of most frequent site use.

Feature 65 is unique in that the basal charred horizon is mainly planar, rather than concave (Figure 8). Most of the sediment here has sand and loamy sand textures, with fine sands dominating. The surface here had a shallow but noticeable depression, facilitating the formation of the deep A and E horizon tongues that also characterize the feature. Unlike many other cache pits, this feature has a deep tongue of dark, organic-rich A horizon material as well. Like Feature 78, the infilled sediment in Feature 65 has developed red (7.5YR) hues in areas below the surface depression, reflective of focused illuviation.

Cache pit ages

Generally stated, “storage” in the Upper Great Lakes has a long history, extending at least as far back as the Late Archaic (Lovis 1999, 2002) and possibly into the Middle Archaic period (Branstner 2004). Nonetheless, the relative importance of storage through time is not well understood. Research appears to suggest a significant increase in reliance on off-site storage developed during the Late Woodland period and that caching continued into Late Precontact times, as well as into the 19th century A.D. Usage may have intensified after ca. A.D. 1100/1200 (Howey and Parker 2008), as confirmed by data from 20OT283.

Ideally, cache pits would have contained diagnostic artifacts, particularly ceramics, so as to provide temporal control for the ceramic assemblage, but this was not the case at 20OT283. Because of the low densities of these types of materials, dates were constrained to materials within charred horizons; we have high confidence that materials in these horizons were associated with feature use. None of the ^{14}C dates at 20OT283 were taken solely on macrobotanical remains such as nutshell, aquatic tubers, seeds, or the outer rings from wood fragments.

The suite of 11 radiometric assays obtained from five cache pits, three processing pits, and one shallow basin (Table 2) allows for a refined assessment site usage. Statistical analyses of the dates were conducted in both Calib 8.1 and Calib 8.2 (Stuiver, Reimer, and Reimer 2021) as implemented with IntCal 2020 (Reimer et al. 2020). Initial assessments indicated that the earlier of two assays on Feature 64 (Beta 345158) was likely the result of older occupation material incorporated into the feature (Hambacher et al. 2016). Consequently, this date was deleted from the data set. Two assays on processing pit Feature 92 (Beta-345159 and Beta-363303) clearly suggested that it was associated with the Early Woodland component of the site rather than the Late Precontact component—the focus of this study. These ages were therefore also eliminated from subsequent analysis, leaving eight dates for additional consideration. These dates were approached in three ways.

We first attempted to understand the chronological relationships within the five cache pits (Features 13, 32, 64 [more recent assay Beta-350828], 65, and 104). Ward’s Test for Contemporaneity (Long and Rippeteau 1974) revealed that Features 13, 32, 65, and 104 are statistically the same age at $p = 0.95$ ($t = 0.8928$, $x^2 = 7.81[0.05]$, $df = 3$), whereas Feature 64 (Beta-350828) was statistically different, either from the group mean or from its closest chronological neighbor, Feature 32 (Beta-350827; $p = 0.95$, $t = 5.5556$, $x^2 = 3.84$ $[0.05]$, $df = 1$). Feature 64 is slightly more recent. Given that the four ages on the other cache pits were statistically similar, a pooled mean age was created: CAL A.D. 1441–

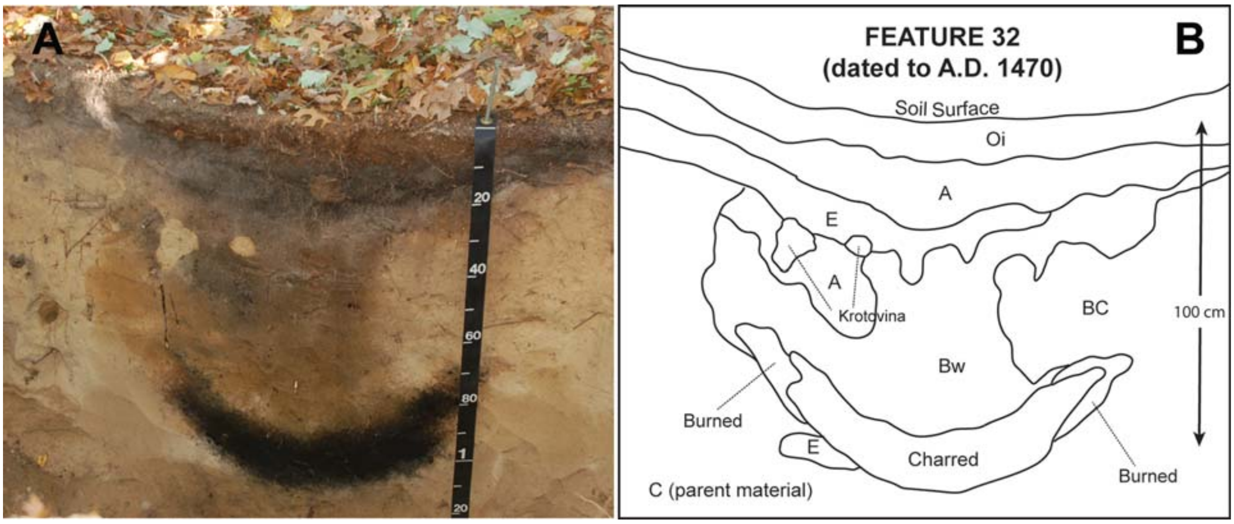

Figure 6. Photograph and graphical drawing of Feature 32, with a strongly expressed basal charred horizon. This cache pit was dated to CAL A.D. 1470 (Beta-350827). Photo by R. Schaetzl.

1478 (2σ). This timespan is our best estimate of intense caching at 20OT283.

We next attempted to understand whether processing was being conducted simultaneously with caching. To this end, the ages from two processing pits (Features 46 and 119) and a shallow basin (Feature 90) were examined, forming a pool of seven ages, i.e., the four cache pits that had been evaluated as contemporary, two processing pits, and the shallow basin. Ward's Test revealed that all seven of these features have statistically the same age at p = 0.95 (t = 11.8847, x^2 = 12.6[0.05], df = 6), suggesting that 20OT283 was being used simultaneously for multiple tasks, including processing, caching, and other activities.

Our final goal was to narrow down the most regular period of site use. Given their statistical contemporaneity, a mean pooled age was calculated for the seven assays, resulting in an age span of CAL A.D. 1445–1475 (2σ). Although there are both earlier ages (and one later) on pits from the site, this 30 year interval is our best estimate of peak site use at 20OT283.

Discussion

Research in the Upper Great Lakes region has demonstrated that Late Woodland sites were strategically located to maximize access to a diversity of plant and animal resources across multiple seasons (Holman and Brashler 1999; Brashler et al. 2000). The Spoonville Peninsula was utilized throughout much of the Precontact era, and 20OT283 was used most frequently by Late Prehistoric groups during the 15th century A.D. Site use was focused on regular, but seasonal, resource extraction, processing, and storage. A diverse forest cover on a sandy, well-drained terrace, close to mixed swamp and emergent marsh habitats along the Grand River, made this a strategically optimal site for these uses.

Subterranean storage facilities such as cache pits have a long and varied history in the region, extending back at least to the Middle Archaic. The use of cache pit locales, however, represents a particular strategy, one associated with seasonal mobility. Although storage facilities occur in association with residential camps of varying sizes (as well as at earthwork sites), their occurrence in isolation, or at seasonal extraction camps away from base camps, sets them apart. Most cache pit sites in northern Michigan were located near seasonal resources, often along transit routes between warm season encampments and winter hunting grounds (Holman and Krist 2001).

Although surface depressions at cache pit locales were described in early literature as among the most numerous and ubiquitous features of the Michigan archaeological landscape (Hinsdale 1925), use and morphology of the pits per se remain—even today—poorly understood. That said, recent

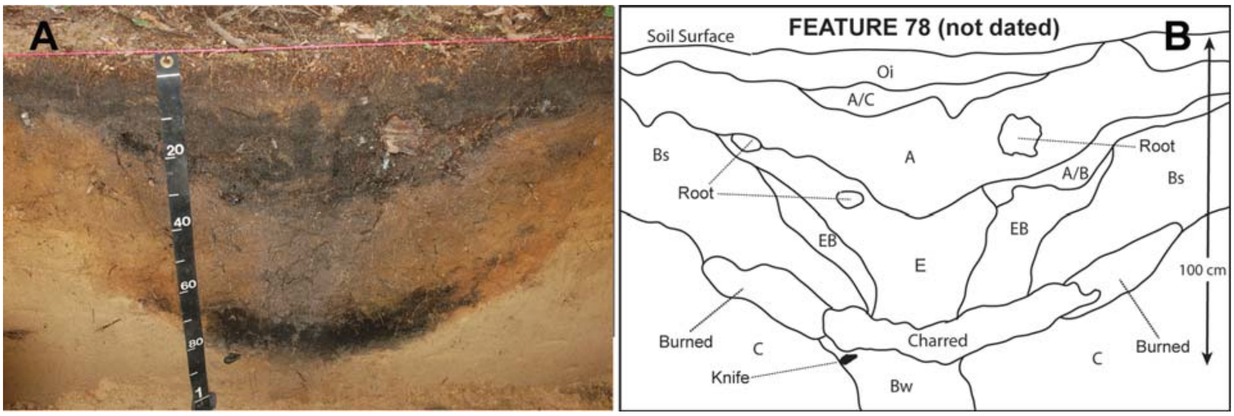

Figure 7. Graphical drawing and photograph of Feature 78, a cache pit with a well-expressed surface depression. Below it, an E horizon tongue has developed in the infilled sediment. This feature was not dated. Photo by R. Schaetzl.

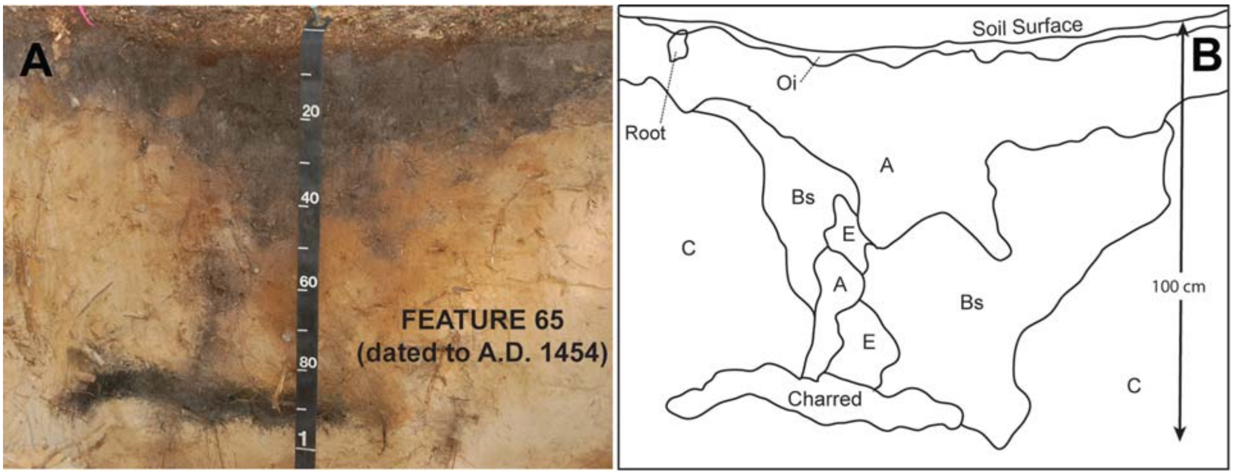

Figure 8. Photograph and graphical drawing of Feature 65, a cache pit with a generally planar charred horizon. This cache pit was dated to CAL A.D. 1454 (Beta-353223). Photo by R. Schaetzl.

work on mobility strategies and the role of storage among residentially mobile hunter-gatherers has refueled an interest in cache pits (Dunham 2000; Holman and Krist 2001; Howey and Parker 2008). Nonetheless, with the exception of excavations in eight pits at the Ne-con-ne-pe-wah-se site near Fremont, Michigan (Dunham and Branstner 1995; Dunham 2000), interpretations of cache pits are often based on only one or two excavations. Our study adds significantly to the literature by providing data for 29 cache pits.

Except for the charred horizons, which appear to be a distinctive feature of the cache pits at 20OT283, the pits here are structurally similar to those at the Ne-con-ne-pe-wah-se site (Dunham and Branstner 1995; Dunham 2000). Those pits had an internal stratigraphy that, like ours, appears to mainly reflect backfilling and subsequent pedogenesis, rather than pit usage. More complicated stratigraphy was reported for three cache pits at the Grapevine Point site near Douglas Lake in northern Michigan (Howey and Parker 2008; Howey and Frederick 2016). Even there, however, some of this complexity may have been related to the manner by which those pits were infilled, as well as post-abandonment pedogenesis, and not necessarily to cultural behavior. Fill sediments at Grapevine Point were distinctly darker than in the pits at 20OT283, some of the internal horizons in the pits were V- or U-shaped in profile, and they had deeper surface depressions. These data suggest that the Grapevine Point pits were either left open after they were emptied or were only partially backfilled. In contrast, the pits at 20OT283 appear to have been completely filled in with clean sands after their initial use and only rarely reused or refilled.

The charred basal horizons in the pits raise the question as to why fire was used in the construction and preparation of cache pits and/or during their post-use abandonment. Pits at the Allegan Dam site (Michigan) may have been burned to harden their walls, preventing them from slumping, or to harden a thin clay slurry applied to the walls (Spero 1979, 17–18); either strategy would have been moot for pits excavated in sands. Fire could have been used to initially dry out the pit in preparation for placement of a bark lining and/or to sterilize the adjacent soil, lessening the potential for microbial deterioration of the stored foodstuffs. Although our data cannot be used to conclusively determine the rationale for the burning of the cache pits, we are certain that most were fired at least *after* their use. This strategy would have had multiple advantages: 1) it sterilized the pit and killed any vermin, mold, or other organisms that could have potentially negatively affected stored foodstuffs, done in anticipation of reuse (of which we have little evidence), and/or 2) it was a means of conveniently disposing of rotted, molded, or otherwise spoiled and unused foodstuffs recovered from the pits.

Botanical remains recovered from the pits reveal an emphasis on exploitation of nuts, edible fleshy fruits, and berries, along with aquatic tubers. Gauging the relative importance of these resources, however, is difficult, because they vary in resistance to decay. Nonetheless, compared to other resources, nuts, represented by acorns, as well as those in the walnut/hickory family (Juglandaceae) and hazelnuts, were the most common foodstuff in the pit fill (Hambacher et al. 2016), even if their overall frequencies were expectably low (given that the contents were meant for consumption). Low nut densities within the pits may not necessarily imply that masts were underutilized but may instead suggest that processed and/or stored resources were removed and either consumed or transported elsewhere. Nuts were recovered from both cache and processing pits, indicating that roasting was one means by which they were prepared for storage (Frederick, Albert, and Lovis 2019).

Seeds were the next most common botanicals in the pits. Nearly 74% of the identified seeds were from fleshy fruits and berries, including, in descending order, blackberry/raspberry, huckleberry, hawthorn, cherry, sumac, elderberry, blueberry, grape, and plum. Illustrating that a variety of foodstuffs may have been stored together was the presence of 21 cherry seeds, along with acorn fragments and a dogwood seed recovered from the base of one pit. Other seeds recovered came from a variety of herbaceous taxa, including evening primrose, skullcap, western sunflower, bindweed, spurge family, St. John's wort, mint family, and pokeweed. Most of these have little subsistence value, but a number do have medicinal uses and illustrate the range of plant resources that were important to Native peoples.

A similar, but more expansive, macrobotanical assemblage, dominated by seeds from fleshy fruits and berries (along with some starchy seeds), was reported from the Ne-con-ne-pe-wah-se site—the only other site that reported

Table 2. Radiocarbon Data from site 20OT283 (Reimer et al. 2020).

Sample No.	Provenience	Conventional Radiocarbon Age	Calibrated Median Age	1σ Calibration	2σ Calibration
Beta-300388	Feature 13 (Cache Pit)	440 ± 40 B.P.	A.D. 1452 (498 B.P.)	A.D. 1427–1474 (478–476 B.P.)	A.D. 1409–1513, 1590–1620 (541–437, 360–330 B.P.)
Beta-350827	Feature 32 (Cache Pit)	410 ± 30 B.P.	A.D. 1470 (480 B.P.)	A.D. 1443–1490, 1604–1606 (507–460, 346–344 B.P.)	A.D. 1433–1520, 1588–1621 (517–430, 362–329 B.P.)
Beta-345157	Feature 46 (Processing Pit)	410 ± 30 B.P.	A.D. 1470 (480 B.P.)	A.D. 1443–1490, 1604–1606 (507–460, 346–344 B.P.)	A.D. 1433–1520, 1588–1621 (517–430, 362–329 B.P.)
Beta-350828	Feature 64 (Cache Pit)	310 ± 30 B.P.	A.D. 1561 (389 B.P.)	A.D. 1520–1587, 1621–1640 (430–363, 329–310 B.P.)	A.D. 1490–1604, 1606–1649 (460–436, 344–301 B.P.)
Beta-345158	Feature 64 (Cache Pit)	2330 ± 30 B.P.	B.C. 397 (2347 B.P.)	B.C. 408–384 (2358–2334 B.P.)	B.C. 479–358, 277–259, 245–233 (2429–2308, 2227–2209, 2195–2183 B.P.)
Beta-353223	Feature 65 (Cache Pit)	430 ± 30 B.P.	A.D. 1454 (496 B.P.)	A.D. 1438–1470 (512–480 B.P.)	A.D. 1424–1501, 1600–1616 (526–449, 350–334 B.P.)
Beta-363304	Feature 90 (Shallow Basin)	480 ± 30 B.P.	A.D. 1432 (518 B.P.)	A.D. 1422–1445 (528–505 B.P.)	A.D. 1408–1454 (542–496 B.P.)
Beta-345159	Feature 92 (Processing Pit)	2520 ± 30 B.P.	B.C. 641 (2591 B.P.)	B.C. 775–749, 686–666, 640–587, 583–569 (2725–2699, 2636–2616, 2590–2537, 2533–2519 B.P.)	B.C. 789–723, 707–662, 651–544 (2739–2673, 2657–2612, 2601–2494 B.P.)
Beta-363303	Feature 92 (Processing Pit)	2340 ± 30 B.P.	B.C. 402 (2352 B.P.)	B.C. 414–384 (2364–2334 B.P.)	B.C. 536–534, 516–496, 490–364, 239–238 (2486–2484, 2466–2446, 2440–2314, 2189–2188 B.P.)
Beta-350829	Feature 104 (Cache Pit)	400 ± 30 B.P.	A.D. 1479 (471 B.P.)	A.D. 1446–1496, 1601–1611 (504–454, 349–339 B.P.)	A.D. 1438–1522, 1575–1623 (512–428, 375–327 B.P.)
Beta-345160	Feature 119 (Processing Pit)	340 ± 30 B.P.	A.D. 1560 (390 B.P.)	A.D. 1494–1525, 1557–1602, 1609–1632 (456–425, 393–348 B.P.)	A.D. 1475–1638 (475–312 B.P.)

on substantial floral remains from cache pits (Dunham 2000, table 8.2). In that case, the majority of the seeds were from foodstuffs such as bunchberry, cherry, pin and black cherry, sumac, raspberry/blackberry, elderberry, grape, beechnut, and pokeweed. Although the floral remains reported from cache pits by Howey and Frederick (2016, table 3) were substantially fewer in number and lower in diversity, they nonetheless indicate the presence of both berries and fleshy fruits (raspberry/blackberry, elderberry, and sumac) and nut mast (hazelnuts and acorns).

Of particular importance among the subsistence-related botanical remains is the presence of small numbers of aquatic tubers, which would have been readily obtainable in the nearby marshes (see Figure 1). Although they do not preserve well, tubers are common in Late Precontact sites (Parachini 1981; Walz 1991; Beld 1996; Egan 1996). Data from both the archaeological and ethnohistoric literature indicate that aquatic tubers were commonly processed by roasting, usually in large, deep pits, but were also boiled and eaten raw, techniques that would have left little in the way of preserved botanical remains (Faulkner 1972).

Other subsistence evidence from the site points to usage of a variety of wild plants, most likely focusing on wild grasses, other starchy seeded annuals, and sedges, along with some musselling and collection of turtles; these data are consistent with late summer to early fall occupations. Limited botanical evidence, consisting of only a few pigweed seeds (*Amaranthus* sp.) from one pit, as well as phytolith data from a few others, indicates that a variety of starchy seeded grasses may have been processed, along with wild rice (*Zizania* spp.) and sedge seeds (*Cyperaceae*). In contrast to the pollen data from storage pits at the Oak Forest site in northeastern Illinois, which indicated the use of grasses for pit lining (McLeester 2018), the grass phytoliths and starches from 20OT283 are interpreted as evidence of seed processing and storage (see Scott Cummings and Ladwig in Hambacher et al. 2016). A burned phytolith from the squash/gourd/pumpkin family (Cucurbitaceae) may be the only evidence for potential cultigens at the site, although its derivation from a wild *Cucurbita* cannot be ruled out.

Of particular importance among the grasses represented by the phytolith data from both cache and processing pit contexts is the first documented occurrence of wild rice in this part of Michigan. Its use had only previously been identified from the Saginaw Valley (Lovis et al. 1996, 2001; Raviele 2010), northwestern Lower Michigan (Ford and Brose 1975; Hambacher 1992), and, more recently, from Middle and Late Woodland ceramic vessels at the Cloudman site in Michigan's Upper Peninsula (Kooiman 2018; Kooiman, Stephenson, and Dunham 2019). Wild rice phytoliths, even if at low frequencies, add to the list of foodstuffs that were collected and processed on the Spoonville Peninsula. The late summer/early fall utilization of 20OT283 for food storage coincides with the rice harvest season. Other starchy-seeded weedy annuals, such as pigweed, are also typically available in the fall, as are most nuts and some of the fleshy fruits (Munson 1984). The fairly frequent occurrence of groundstone plant processing tools also points to the processing of a diverse array of nut, fruit, and berry taxa during short-term, seasonally-based encampments.

In light of the good preservation of wood charcoal in the pits, the low densities of plant macrofossils appear to be a function of a number of factors (see extended discussion in Hambacher et al. 2016, 13:31–47). First, the dry, sandy soils probably led to high recovery rates of the stored foodstuffs (Morgan 2012). Second, the manner in which many of the resources would have been processed (drying, parching, and/or roasting) would have limited their introduction to firing environments conducive to preservation (Dunham 2000; Hambacher et al. 2016). Finally, firing the empty cache pits most likely biased the remains toward preservation of denser items such as hard, thick nut hulls and stones of various fruits. Thus, items such as tubers, berries, and fleshy fruits without stones or dense parts most likely would have been completely consumed, whereas moderately dense items such as grass seeds, wild rice grains, and thin nut hulls might have survived, but would have been charred.

Faunal remains from the cache pit fill sands are extremely limited, largely a result of the slightly acidic, coarse-textured soils and burning practices not conducive to bone preservation. Only some freshwater mussel shells and small amounts of animal bone occurred in the cache pits. With few exceptions, these remains appear to represent incidental inclusions from generalized midden debris introduced during backfilling. Five of the cache pits also contained freshwater mussel shell within the charred horizon. However, their position in the upper portions of the charred horizon makes it unclear whether they represent disposal of materials stored in the pit or a debris dump associated with site use at the time the pits were being opened, emptied, and backfilled. Freshwater shell concentrations in the middle portions of two pits clearly represent debris dumps that took place during backfilling.

The predominance of triangular projectile points, many of which were broken and exhibit impact fractures, along with bifaces, bifacial preforms, and end scrapers, indicate that hunting and trapping were also important activities at the site. With the exception of a single reference to the storage of fish in cache pits (Howey and Frederick 2016), recovery of meat products from subsurface storage facilities is conspicuously absent in the ethnohistoric literature. Additionally, because meat was typically removed from the bone before drying, bone (which preserves better) would not necessarily have been stored. Most of the recovered animal bone was from unidentified, medium-large mammals. White-tailed deer and beaver were the most common identifiable remains, along with elk, muskrat, eastern fox squirrel, red fox, raccoon, badger, and dog/coyote. Identifiable bird remains were primarily from ducks, whereas reptiles were mostly species of aquatic turtles. Fish were surprisingly underrepresented in light of the amount of freshwater mussel shell recovered, but the few identified remains consisted of spring-spawning lake sturgeon and sucker. In most respects, the range of faunal species represented at the site mirrors the opportunities provided by the local environment.

Conclusions

Site 20OT283 on the Spoonville Peninsula would have been a geographically and environmentally strategic locale for early peoples, providing easy access to a variety of aquatic, riparian, and upland terrestrial environments. Thus, it was used by cultures ranging in time from the Late Paleoindian through the Late Precontact period and into the modern era. Throughout most of this time span, episodes of occupation appear to have been comparatively brief and involved a limited range of tasks; resource extraction was likely one of the central tasks carried out there.

Middle Archaic through early Late Woodland occupations are largely represented by projectile points, a small number of other diagnostic tools, and a small number of different types of Woodland period ceramics. Most of the artifacts and features recovered at the site were associated with the Late Precontact period, making it the primary component at the site and most likely the period that saw the most frequent use. At this time, an important shift in the nature of site use appears to have occurred, as indicated by the many instances of deep features such as processing and cache pits. Their presence represents a significant investment of time and labor, particularly as it pertains to collection, processing, and preparation of foodstuffs for storage. The large number of surface depressions (346), coupled with the chronology established by the radiocarbon dates, indicate that the site was used intensively but for a relatively short period of time, with the main period of site use during the second half of the 15th century A.D. Analysis of the ^{14}C data from a subset of pits pointed to the most intense period of occupation from CAL A.D. 1445–1475 (2σ). During that time, site usage was represented by relatively short-term, task-specific occupations, occurring within the broader context of a highly mobile adaptive strategy.

After the foodstuffs were removed, the pits and their wooden structural members and any lining materials were intentionally burned. The empty pits were then backfilled with the native sands. For this reason, most of the cache pits here have a black, charred horizon at their base, below fairly clean, sandy fill material. Refilling was so complete that some pits lack a surface depression even today. The motivations for burning the pits are unclear, but the fires may have been set to destroy the bark linings and/or structural materials left behind, and/or to clean the pit of unwanted, spoiled foodstuffs. The incidence of pit re-use here was rare. Pits with depressions have accumulated thick litter layers, below which pedogenesis has been accelerated.

Although the use of subsurface storage features has a long intercontinental history, this survival strategy became particularly important after ca. A.D. 1200 in the Upper Great Lakes (Holman and Krist 2001; Howey and Parker 2008; Howey and Frederick 2016). Their use at resource acquisition locales not only provisioned resources across the landscape, but they are also embued with cultural meaning and served to tie groups to their territories in more than just a physical sense (Howey and Frederick 2016; Dunham 2019). Data from our site expands the understanding of these facilities and adds to the growing understanding of their life-cycle and role in hunter-gatherer economic and adaptive strategies.

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