1998 NORTHEASTERN NATURALIST 5(3): 249-276

PALEOETHNOBOTANICAL INQUIRY OF EARLY EURO-AMERICAN AND OJIBWA GARDENS ON GRAND ISLAND, MICHIGAN

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ABSTRACT - Exploratory archaeobotanical analysis was conducted on Grand Island, Michigan, in concert with current botanical inventories and historic document research. Our goal was to synthesize these three forms of data in the study of early cultural-plant use. We describe indigenous and Euro-American plant relationships on Grand Island, and the patterning of plant remains between individual sites. Botanical materials in four of five samples showed greater correspondence to current flora than to historic accounts of plant representation. Still, from most samples we recovered a good depiction of historic food plants. A well-defined feature sample yielded the greatest quantity and diversity of culturally important botanical material. The results support integration of documentary with archaeological sources to identify plant remains with cultural meaning.

INTRODUCTION

Vegetation history interests many people for different reasons: as an indicator of climate change and past flora/fauna distributions, a template for restoration, or for information about past cultures (Popper and Hastorf 1988). But must we rely on pollen stratigraphies drawn from isolated peat bogs and lakes to reconstruct past environments, or to examine how cultural groups provided for their basic needs? What other means do we have to pursue these types of historical ecology questions? Archaeological sites are often targeted for cultural-plant history clues by their strategic locations vis-a-vis anthropogenic environments and fortuitous preservation of environmental data (Forney 1992, unpub.; Popper and Hastorf 1988). Accompanying plant remains from archaeological contexts, historic documents can furnish leads to the vegetation of recent past and its cultural interplay via paleoethnobotany (Crumley 1994, Popper and Hastorf 1988).

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We were drawn to Grand Island, Michigan, U.S.A., for investigation of its cultural plant communities. The island lies in a southern bay of Lake Superior (Fig. 1) with dramatic geology and microclimate, uncommon plant communities, and a rich cultural history many centuries old. Grand Island was designated as a National Recreation Area in 1990, and is expected to receive substantial public interest and recreation use (USDA 1994). We undertook research on the island's cultural landscape to contribute to the evaluation, restoration, protection, and interpretation of its diverse heritage. By combining archaeobotanical remains with documentary sources and current field recovery, we have set the stage for continued exploration of Grand Island's vegetation history and greater understanding of its culture-plant relationships. Meanwhile, we have uncovered the patterning of Grand Island's plant remains and peeled back the overlay that current flora deposit on archaeobotanical assemblages.

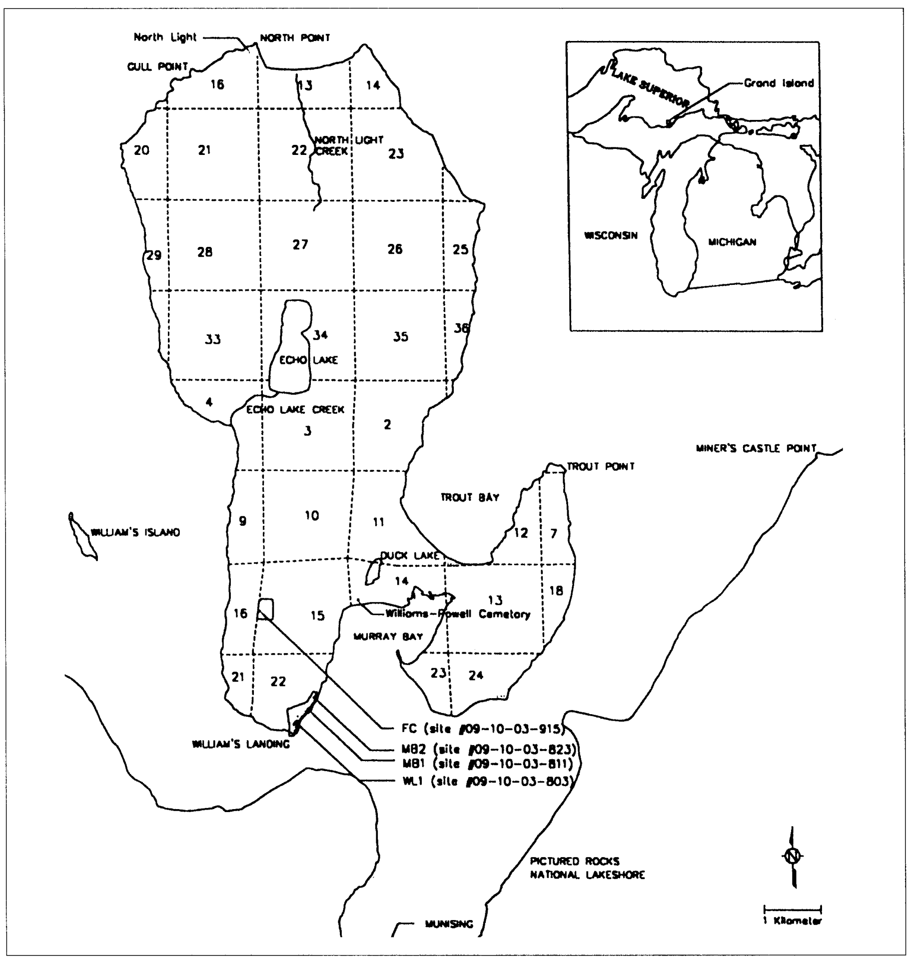

Figure 1. Sediment sample site locations on Grand Island, Michigan with catalogue numbers and abbreviated codes. Dashed lines indicate section boundaries. Inset: Location of Grand Island within Michigan, U.S.A., and Lake Superior vicinity.

Our objective was to describe cultural-plant relationships of early historic Ojibwa and Euro-American groups on Grand Island, and assess site differences in plant remains. This was accomplished by synthesizing ethnohistoric (documentary) reports and current flora with archaeobotanical remains, including pollen, phytoliths, and plant macroremains. This approach is based on two assumptions. First, current species composition influences assemblage patterns. With knowledge of current flora contribution, interpretations about past cultures based on plant remains may be more accurate (Smart and Hoffman 1988). Second, neither documentary sources nor archaeobotanical remains are fully accurate or complete, but used together, provide a clearer picture of past cultural-plant uses. For this study we have assumed that the historic record is an accurate baseline for plant use against which we compare archaeological plant remains and current floristic surveys.

FIELD SITE DESCRIPTION

Grand Island sits less than one kilometer north of Munising, Alger County, Michigan (Fig. 1, inset). It is approximately 55 square km (5500 ha), 13 km long and six km wide, with roughly 43 km of shoreline. Aside from one private parcel, the island is primarily under the management of the Hiawatha National Forest. Three areas on the island with documented historic settlements or gardens were selected for evaluation (Benchley et al. 1988, Roberts 1991). These areas included: Williams Landing,

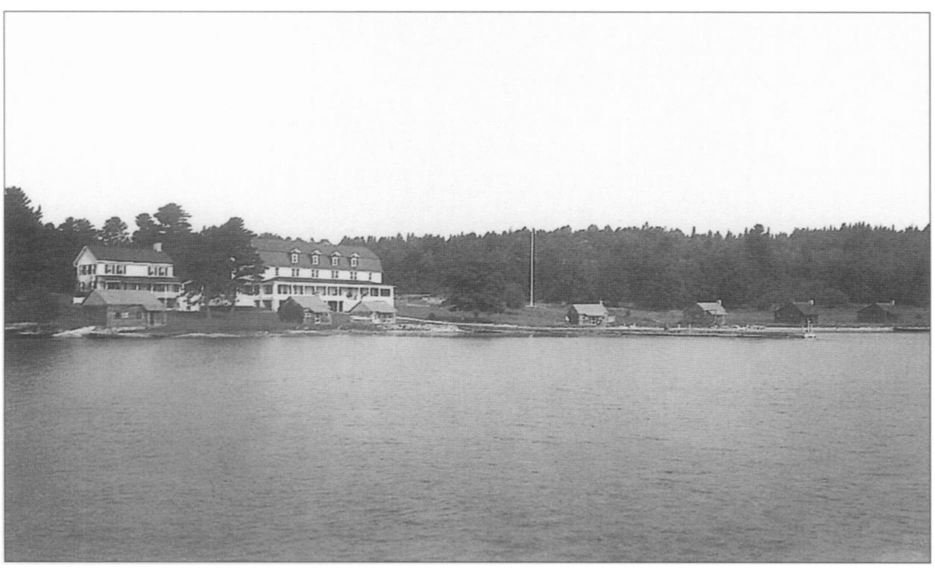

Figure 2. Murray Bay Shoreline, Grand Island, Michigan, ca. early 1900s. Photo courtesy of Hiawatha National Forest. Photographer unknown.

Murray Bay shoreline (Fig. 2), and the Farm Complex. Native American and Euro-Americans have inhabitated and gardened in the Williams Landing and Murray Bay areas, which lie along the Lake Superior shoreline, for centuries (Fig. 3). The Farm Complex lies upslope from the lakeshore and was developed in more recent history (1900-1950). It contained a maple sugar bush, orchard, and cultivated fields.

CLIMATE

Climatic data for the city of Marquette, approximately 64 km west of Grand Island, illustrate the dramatic influence of Lake Superior. High summer temperatures experienced in nearby inland communities are rare, and winters are moderated by lake air. Relatively moist air above the lake contributes to higher levels of cloudiness and snowfall. The frost-free season for Marquette averages 159 days. The number of frost-free days on Grand Island may be greater than in Marquette, particularly in the south-facing and protected Murray Bay area, due to lake-moderated temperatures (Ruffner and Bair 1977).

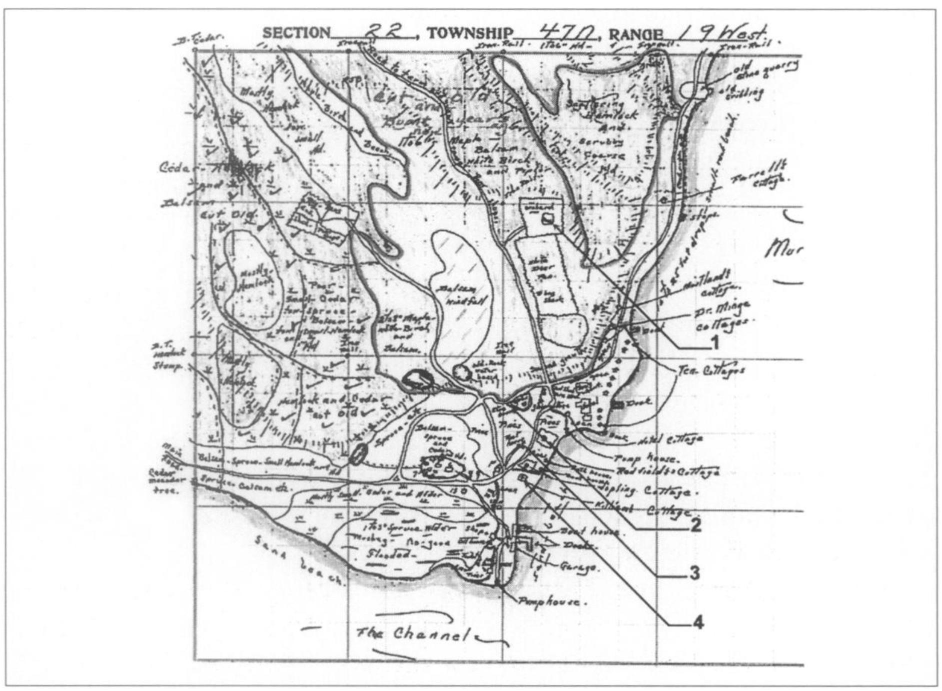

Figure 3. Timber cruise map of William's Landing area, Grand Island, Michigan, Township 47 north, Range 19 west, section 22. 1928. Cleveland-Cliffs Iron Co. Each square represents one quarter section, or approximately 1/4 mile by 1/4 mile. Sites noted on the drawing are: 1) orchard, 2) vicinity of old fields and gardens, 3) root house and 4) William's cottage. The farm complex would be slightly north and west of the upper left corner of this drawing.

GEOMORPHOLOGY AND SOIL

The Grand Island area experienced a series of continental glacial advances and retreats during the past 100,000 years. The most recent advance, the Marquette, was a sub-stage of the Wisconsin stage and left substantial marks on Grand Island sandstone formations, largely erasing evidence left by previous glaciers. Geomorphic features such as wave-cut bluffs and scarps, terraces, beaches, etc. are largely attributed to post-glacial lake activity (Dorr and Eschman 1971, Saarnisto 1974).

Today much of Grand Island has only a thin layer of soil over sandstone bedrock (0.6 m to 1.5 m). In some places the bedrock is exposed. Sands, sandy loams, loamy sands, and few areas of sandy clay loams and muck soils occur on the island. In an early soil survey of the Munising area, Rice and Geib (1905) mapped three soil types on Grand Island: dune sand, Miami sand, and muck. Their notes also provided some clues to early cultivation: "... only a small proportion of the vast area of the Miami sand has been cleared and farmed, but enough has been done to demonstrate that the type is surprisingly fertile for so sandy a soil. The grains and grasses grow to a perfection usually expected only on soils of heavy texture ... Potatoes come to maturity very quickly and large yields are secured."

VEGETATION HISTORY

The ice retreat left barren terrain and newly deposited till subject to colonization by pioneer plants. The early Holocene vegetational history of Grand Island can best be surmised from pollen stratigraphies taken around the Lake Superior area (Davis 1978, 1983, Webb et al. 1983, Wright 1976). Pollen maps show the times of arrival for tree species in the eastern United States (Davis 1983, Webb et al. 1983), from which estimates of the date of arrival to the Munising area were made ranging from *Larix laricina* (Duroi) K. Koch (larch) and *Pinus banksiana* Lamb. (jack pine) as early as 10,000 BP to *Fagus grandifolia* Ehrh. (American beech) as late as 500 to 3,000 BP. Any vegetation that was established on Grand Island by 10,000 BP would have had to re-colonize the area following the Marquette Advance ca. 9500 BP.

General Land Office (GLO) survey notes provided information on pre-European settlement (1850s) species composition (General Land Office 1840, 1855). Analysis of the survey notes recorded *F. grandifolia* as the major forest species, comprising 41% of the trees listed by the surveyors. *Acer saccharum* Marsh. (sugar maple) was less abundant (14%) on Grand Island, even though on nearby mainland sites it was more prevalent (29%) (Silbernagel and Padley, unpub. data; USDA 1994).

Current ecological types at William's Landing and Murray Bay are typified by sandy outwash with coarse sand and gravel in the substrata, supporting *Pinus* spp. (pine), *Acer rubrum* L. (red maple), *Betula papyrifera* Marsh. (paper birch), and *Quercus borealis* Michx. (northern red oak) in the overstory, and *Pteridium aquilinum* (bracken fern), *Gaultheria procumbens* L. (wintergreen), *Vaccinium* spp. (blueberry), and *Trientalis borealis* Raf. (starflower) in the ground flora. The Farm Complex is a different ecological type: mesic upland with loamy and deep soils on high plateus, with *A. saccharum* and *F. grandifolia* forests, few *A. rubrum* or *B. alleghaniensis* Britt. (yellow birch), and a species-rich ground flora (Ball 1993, USDA 1994). However, most of the Farm Complex area (several hectares) is now in abandoned fields with weedy herbaceous vegetation.

METHODS

Ethnohistoric Research

When available, historic documents are useful sources on conditions that are no longer apparent on the site. Both primary sources (first hand accounts, maps, photos, or observations made at the time period they describe), and secondary sources (descriptions of an earlier time period not actually observed by the authors) were examined. Three ethnohistoric/ethnobotanic references provided a good background to aboriginal land and plant uses in the Upper Great Lakes region: Yarnell (1964), Densmore (1974), and Martin (1985). The history of Grand Island is captured by Castle (1987) and Roberts (1991), both of whom cited many of the early travelers' writings describing vegetation, cultivation, and food products.

Few detailed accounts of Ojibwa life on Grand Island exist. Early historic accounts were predominantly told by Euro-American travelers, reflecting their first-hand impression. Many of these documents were found at the J.M. Longyear Research Library, Marquette County Historical Society and Peter White Library, Marquette. Some of the early writers included Schoolcraft (1821, 1851, 1853), Gilman (1836), Copway (1890), Johnston (1890), Masson (1890) and Wheeler (1844). Longyear Research Library also holds historic photographs of Grand Island and mid-1800s census records for the study area. A list of culturally important taxa was generated from accounts of this sort, and served as the basis upon which we measured the degree to which archaeobotanical remains reflected ethnobotanical accounts.

Field Recovery and Analysis

In June 1993, meander searches were run within the study areas to assess current vascular plant taxa and their respective coverage. Many taxa were identified to genus in the field, then collected and pressed for later identification to species. Information from this inventory was used to supplement previous botanical inventories for the island (WWA 1991). Plants found during the inventory were checked against ethnohistoric, ethnobotanic, and historic documents to identify those with cultural associations.

Archaeobotanical Recovery and Analysis

In August 1992, five soil samples from four previously excavated test unit profiles were collected for archaeobotanical analysis. Archaeological inventory of portions of Grand Island was conducted by Commonwealth Cultural Resources Group (CCRG) in 1990 and by Leech Lake Tribal Council (Leech Lake) in 1991. CCRG and Leech Lake reports were examined to find sites with the greatest potential for prehistoric or historic botanical remains. Four units were selected from three sites along William's Landing (WL) and Murray Bay (MB) which contained evidence of Late Woodland and historic period Ojibwa, and of 19th century Euro-American habitation (site labels: WL1, WL1-F, MB1, and MB2) (Fig. 1). Late Woodland, in the Upper Great Lakes region, refers to a loosely related group of hunter-gatherer-fisher societies who inhabited the region from about AD 800-1650. The historic Ojibwa-fur trade era reflects the years from 1650-1840 AD, and the early Euro-American phase refers to the years 1840-1900 AD.

All four units had undergone Phase II test unit excavations (TEU) during the 1990 and 1991 field seasons in which one meter square pits were opened, soil profiles described, and artifacts identified (Appendix A). Phase II investigations are limited-area surface and below-surface excavations to assess the densities, ages, and distributions of preserved cultural remains such as tools, pottery, animal and plant remains. Of the four TEUs, one unit (WL1-F) had a distinct buried organic layer or feature context with datable cultural material. To minimize further cultural site disturbance, our approach was to reopen the test units and sample material from the walls of the units with a soil probe. We sampled the feature context in an attempt to collect material most closely associated with a particular occupation (Fig. 4) (Hastorf 1988, Pearsall 1988). In addition, we collected one sample from the farm complex (site FC), a non-site context, for comparison (Toll 1988).

Pollen analysis. Palynology, the study of pollen grains and their dispersal, has for many years been a key tool for paleoecologists. Pollen remains from bog and lake deposits have been used in establishing vegetational and climatic histories (Pearsall 1989, Trigger 1989). Palynology has also become an integral part of many archaeological investigations to reconstruct past environments (e.g., Davis 1986, Graumlich and Davis 1993).

Pollen analysis was conducted on samples from WL1-F and FC at the Archaeometry Laboratory of the University of Minnesota-Duluth (UM-D) (Huber 1993). Samples were treated with a modified Faegri and Iverson (1989) technique (addition of KOH, HCl, HF, and acetolysis), sieved through 7 micrometer Nitex screens (Cwynar et al. 1979), stained with safranin, and stored in silicone oil for counting. A minimum of 400 grains from trees, shrubs, and herbs was identified within the pollen sum. When the sum of 400 was reached, pollen counts were continued to the end of the transect, thus completing the count. The slide was then sealed and placed on a permanent file at the Archaeometry Laboratory, UM-D, along with original copies of pollen count sheets (Huber 1993).

Phytolith analysis. Phytolith analysis was conducted on all five sediment samples by the Archaeometry Laboratory at UM-D (Mulholland 1993). Phytoliths are mineral deposits (usually silica) that form in and between plant cells, creating microfossils that often provide information not available from other plant remains (Pearsall 1989). Phytolith classification is based on the type of cell that becomes silicified. However, most phytoliths cannot be assigned to a specific plant

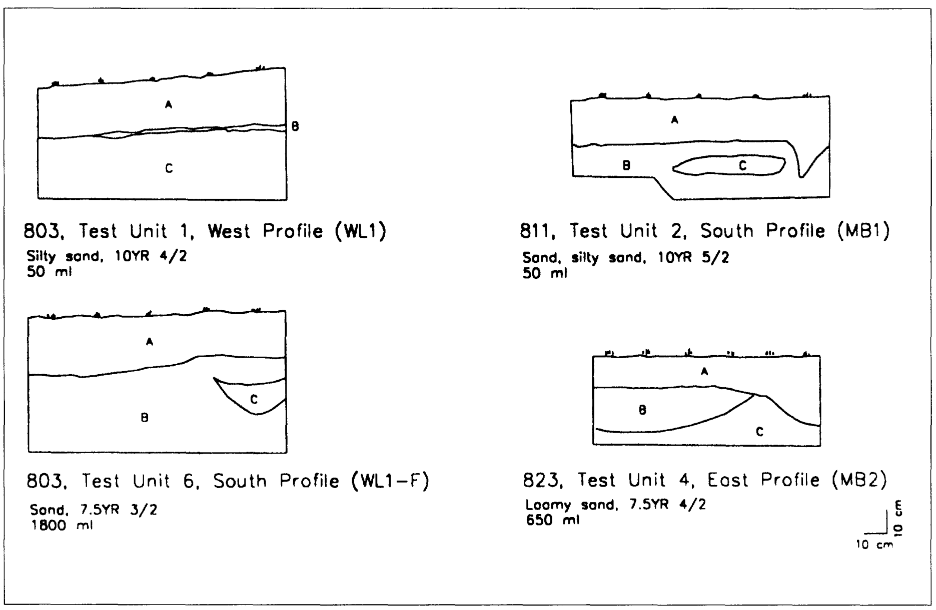

Figure 4. Test excavation profiles for the four samples taken from archaeological contexts. Both original permanent catalogue numbers and abbreviated codes used in this paper are shown. Soil horizons (A, B, C) are identified in CCRG (1990) using Munsell color system. Also see Appendix A for further sample descriptions.

taxon (Mulholland 1993). The phytolith type rather than plant taxon was used in classifying each sample. The Poaceae and Cyperaceae are known as phytolith-rich families and therefore have received more research and classification than other families. Because these families are not well represented by other types of paleobotanical evidence such as pollen or macroremains, phytolith analysis provides data not otherwise available (Mulholland 1993).

Phytolith separation was based on both particle size and specific gravity. Particles with a specific gravity between 2.3 and 1.5 gm/cm^3 were extracted with a heavy liquid solution of zinc bromide and water. Slides for light microscopic examination were examined with a Zeiss Universal petrographic microscope equipped with a Nomarski Differential Interference Contrast (DIC) Condenser system to increase contrast of transparent particles, including phytoliths, by introducing a shadow effect (Mulholland 1993). Identifiable phytoliths were counted and classified to one of seven categories: 1) trichomes, including cones, 2) stomata, 3) bulliform cells, 4) epidermal groundmass cells, including sheets, 5) rods, 6) rectangle/squares, and 7) grass silica bodies, including broken and tilted forms. Grass silica bodies were separated into four types, indicative of different subfamilies of grasses, that is, pooids, panicoids, chloridoid, and arundoid. Special phytolith types, which tend to be deposited by corn or other plant inflorescences, were also noted and counted (rootles, rondels, and crosses) (Mulholland 1993). Lastly, six other silica particle categories were assigned: tilted, unidentified, brown cell, algal sphere, diatom, and sponge spicule.

Analysis of plant macroremains. Macroremains are botanical materials visible to the naked eye and large enough to be identified under low magnification (Pearsall 1989). Prior to flotation, characteristics of the soil matrix of each macroremain sample were noted (Appendix A). Although machine-assisted flotation procedures, such as SMAP, are often recommended for recovering macroremains (Pearsall 1989), the manual flotation procedure was suitable for the small sample sizes (50-650 ml) of this study. The sediments were placed in a water bucket, agitated, and allowed to settle. The light fractions, which would float to the surface were poured onto a set of a #18 (1.0 mm) and #60 (0.25 mm) screens. The process was repeated until all sediments of the visible light fractions were recovered. The screens were then placed in a laboratory oven for several hours, allowing the light fraction to dry so that it could be transferred directly to storage vials. Five ml sub-samples of the heavy fraction were also dried and examined under 20x magnification to determine the amount of botanical material missed in flotation. Except for a few small pieces of wood charcoal, 100% recovery was obtained for samples WL1, WL1-F, MB1, and FC. In MB2, one carbonized plant part was found but no charcoal.

Data analysis

Counts from each plant fossil type were recorded to the highest level of identification possible. Basic data summaries such as total number of remains, total number of taxa, and frequency of a taxon to the total assemblage were calculated by sample. We then developed a ratio, CI:CP, of culturally important (CI) remains (based on our ethnohistoric research), to remains that reflected currently present (CP) taxa to compare pollen and macroremains data between sites. Ratios can be used to make comparisons between two parts of the same taxon, or between two groups of taxa. They are powerful and commonly used quantitative measures in paleoethnobotany (Miller 1988). The macroremain data also permitted calculation of richness and diversity indices to evaluate differences between samples. These indices were not calculated on the pollen or phytolith data because of the lack of consistent identification below the family level. Richness is defined here simply as the number of taxa. We used the Shannon-Weaver index to calculate diversity, which uses the relative abundance of each taxon to express the certainty of predicting the identity of a randomly selected plant remains (Ludwig and Reynolds 1988, Popper 1988). The Shannon-Weaver index is calculated as:

$$H= - \sum ((p(i)*\log p(i)),$$

where p(i) is the proportion of seeds of a given taxon to the total number of seeds. Here we replace "seeds" in the formula with "macroremains" to include nutshells and wood fragments, as we have in the previously described indices.

Phytolith data were summed by phytolith category and compared among samples. However, because this fossil form is difficult to classify to taxon, comparisons between sites were based on qualitative assessment of the counts and percentages of the seven phytolith forms, rather than calculation of a ratio or indices.

RESULTS

Field and Ethnohistoric Analysis

Over 190 different taxa were noted from the 1993 botanical inventory within the study areas (Ball 1993). We searched recorded descriptions by Voss (1972, 1985), Sturtevant (1972), Densmore (1974), Smith (1932), Yarnell (1964), and historic accounts of Grand Island for documentation of cultural plant use. From this search, 42 taxa (32 uncultivated, 10 cultivated) surfaced as culturally important (Table 1). These

Table 1. Culturally important plant list identified from historic documents. Season of use adapted from Yarnell (1964). Common names are according to Voss (1972, 1985) when possible.

SCIENTIFIC NAME	COMMON NAME
EARLY SPRING	
Acer saccharum Marsh.	sugar or hard maple
Betula alleghaniensis Britt.	yellow birch
Gaultheria procumbens L.	teaberry
Allium sp.	wild onion, leek
Scirpus validus Vahl.	softstem bulrush
SPRING	
Pteridium aquilinum	bracken fern
Pinus strobus L.	white pine
Dentaria sp.	toothwort
Arisaema triphyllum (L.) Schott	jack-in-the-pulpit
LATE SPRING	
Populus tremuloides Michx.	quaking aspen
Aster macrophyllus	large-leaved aster
Fragaria virginiana Duchesne.	wild strawberry
Sambucus pubens Michx.	red-berried elder
SUMMER	
Amelanchier laevis Wieg.	serviceberry, shadbush, juneberry
Gaylussacia baccata (Wang) K. Koch.	huckleberry
Ribes spp.	currant, gooseberry
Rubus spp.	bramble, raspberry, dewberry
Prunus virginiana L.	choke cherry
Prunus pensylvanica L.f.	pin or fire cherry
Vaccinium angustifolium Ait.	low sweet blueberry
Vaccinium myrtilloides Michx.	sour-top blueberry
LATE SUMMER	
Gaultheria hispidula (L.)	creeping snowberry
Arctostaphylos uva-ursi (L.) Sprengel	bearberry
Cornus canadensis L.	bunchberry, dwarf cornel
Smilacina racemosa (L.) Desf.	false spikenard
Viburnum spp.	nannyberry, highbush cranberry
Zizania aquatica L.	wild rice
EARLY AUTUMN	
Crataegus spp.	hawthorn, thornapple
Fagus grandifolia Ehrh.	beech
AUTUMN	
Chenopodium sp.	goosefoot
Quercus rubra L.	red oak
LATE WINTER/EARLY SPRING	
Cladonia rangiferina	reindeer moss
CULTIVATED OR HORTICULTURAL TAXA	
Brassica rapa L.	field mustard, turnip
Cucurbita maxima Duchesne	squash
Cucurbita pepo L.	pumpkin
Malus pumila Miller	apple
Pinus sylvestris L.	scots pine, scotch pine
Rosa spp.	rose
Solanum tuberosum L.	potato
Spiraea alba DuRoi.	spiraea, meadowsweet
Syringa vulgaris L.	lilac
Zea mays L.	Indian corn, maize

included food plants for both Ojibwa and Euro-american settlers on Grand Island, as well as popular horticultural or ornamental plants. The plants described as culturally important may have been planted, cultivated, or gathered for nuts, berries, leaves, roots, sap, etc. For example, Densmore (1974) explained that the Ojibwa cooked *Arctostaphylos uva-ursi* L. (bearberry) fruit with meat as seasoning for broth, and combined the leaves with tobacco or red willow for pipes. *Arisaema triphyllum* (L.) Schott (jack-in-the-pulpit) tubers were eaten by Ojibwa, and its shredded roots and berries were boiled with venison (Sturtevant 1972, Yarnell 1964). Ojibwa used *Fagus grandifolia* nuts, often collected from chipmunk and deermouse stores in winter (Smith 1932). In Schoolcraft's 1836 appraisal of Indian improvements he noted that the Grand Island band had 62 members who cultivated 28 acres in common and five acres individually. They had 110 acres of "old fields" and more "abandoned fields and villages of the most ancient class" (Roberts 1991). Reference was also found to the production of maple sugar by the Ojibwa (Holman 1984, Mason 1985, Wheeler 1844), and accounts in Castle (1987) mention their use of blueberries and raspberries. More direct accounts of food plants used by Euro-american settlers on Grand Island were found, such as one by Mrs. Powell, daughter of Abraham Williams, the first white settler, "... It was raspberry season, the bushes were loaded down with them. My! How we children enjoyed them." (Castle 1987). Williams and his family built several houses and outbuildings on the island, farmed the old Indian fields, caught and packed fish, and traded liquor and blacksmithing skills with the Indians (Roberts 1991). According to Pitezel (1882), Williams grew potatoes, squash, turnips, cabbage, and beets. After ten years on the island Williams had a farm of 40 acres.

Pollen

Pollen taxa were recorded for sample WL1-F and FC by absolute count and percent of the total pollen count (Table 2). Several taxa were identified to genus while others could not be identified below the family level. We recovered 293 tree and shrub grains in 17 taxa and 39 herb grains in 5 taxa from sample WL1-F. From sample FC, 145 tree and shrub grains were found in 20 taxa and 239 herb grains in 9 taxa. In total, there were 332 pollen grains recovered in 22 taxa from WL1-F and 384 pollen grains in 29 taxa total from FC.

Samples from WL1-F were dominated by tree pollen (81.1%) compared to shrubs (7.2%) or herbs (11.7%) whereas the FC sample had predominantly herb pollen (62.2%), with less tree (30.8%) and shrub (7.0%) pollen. *Betula* and *Ostrya/Carpinus* were the most frequent pollen taxa of the 22 taxa represented in the pollen sum of WL1-F

Table 2: Pollen identification data from samples WL1-F and FC. Pollen analysis was conducted by the Archaeometry Laboratory, University of Minnesota-Duluth (Huber 1993).

Sample Label	WL1-F		FC	
Taxa	Count	%	Count	%
Trees and Shrubs				
Acer undiff.	1	0.2	1	0.3
Alnus undiff.	14	4.2	9	2.3
Betula	111	33.4	5	1.3
Carya	0	0.0	3	0.8
Castanea	0	0.0	1	0.3
Cornus	5	1.5	16	4.2
Corylus	5	1.5	2	0.5
Cupressaceae	1	0.3	2	0.5
Fraxinus nigra	6	1.8	10	2.6
Fraxinus pennsylvanica / F. americana	1	0.3	0	0.0
Ostrya / Carpinus	43	13.0	3	0.8
Picea undiff.	1	0.3	4	1.0
Pinus banksiana Lamb. / P. *resinosa* Aiton	5	1.5	16	4.2
Pinus half grains	36	10.8	9	2.3
Pinus strobus L.	0	0.0	1	0.3
Pinus undiff.	5	1.5	3	0.8
Populus undiff.	0	0.0	3	0.8
Quercus	35	10.5	26	6.8
Salix	8	2.4	29	7.6
Tilia	7	2.1	1	0.3
Ulmus	9	2.7	1	0.3
Totals: Trees and Shrubs	293	88.3	145	37.8
No. of Taxa	17		20	
Herbs				
Ambrosia - type	5	1.5	20	5.2
Artemisia	3	0.9	11	2.9
Chenopodiaceae / Amaranthaceae	2	0.6	7	1.8
Cyperaceae	12	3.6	10	2.6
Poaceae	17	5.1	171	44.5
Liguliflorae in Asteraceae	0	0.0	5	1.3
Tubuliflorae undiff.	0	0.0	12	3.1
Umbelliferae	0	0.0	1	0.3
Urtica - type	0	0.0	2	0.5
Totals: Herbs	39	11.7	239	62.2
No. of Taxa	5		9	
Totals: Trees, Shrubs, and Herbs	332	100.0	384	100.0
Total No. of Taxa	22		29	

(Valppu 1993, unpub.). This sample was also characterized by many degraded pollen grains. The pollen sum of FC was dominated by Poaceae (44.5%), with few degraded grains.

When family level taxa and unidentified grains or partial grains were removed from the pollen count, 264 tree, shrub, and herb pollen grains remained from sample WL1-F and 167 grains from sample FC. Of these, 152 grains from WL1-F and 52 from FC represented culturally important taxa. Compared to taxa currently on the site, 201 grains from WL1-F and 124 grains from FC represented taxa that were found during our recent field survey (Table 3). The proportions of culturally important (CI) to currently present (CP) taxa were 0.76 for WL1-F and 0.42 for FC (Fig. 5). If Poaceae grains are included the CI:CP ratios are 0.70 for WL1-F and 0.18 for FC.

Table 3: Pollen proportions used to calculate the amount current flora contributed to archaeobotanical assemblage. CI = no. of culturally important taxa, CP = no. of currently present taxa. Note: taxa identified to family level or above and unidentified or fragmented remains were removed from the dataset prior to these calculations.

Sample Label	WL1-F Count	WL1-F w/ Poaceae	FC Count	FC w/ Poaceae
Total Trees, Shrubs, and Herbs	264	281	167	338
No. of Culturally Important (CI) Remains	152	152	52	52
No. of Remains with Taxa Currently Present (CP)	201	218	124	295
CI / CP	0.76	0.70	0.42	0.18

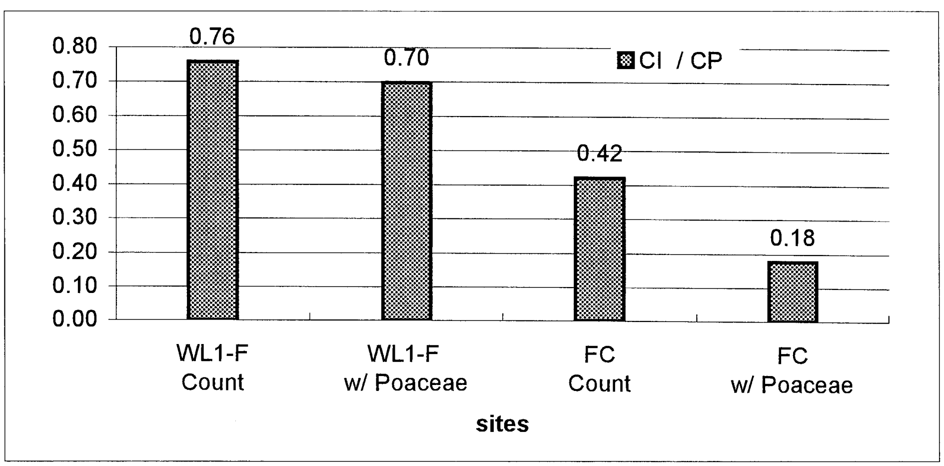

Figure 5. Pollen ratios used to calculate the amount current flora contributed to archaeobotanical assemblage. CI = no. of culturally important taxa, CP = no. of currently present taxa.

Phytolith Analysis

Phytolith remains were recorded into seven categories of phytolith forms (Table 4). Phytolith taxa (order) can be inferred from phytolith forms. Three samples (WL1, MB1, and MB2) produced similar phytolith assemblages which included high amounts of grass, dominantly Pooid types. WL1 contained relatively low amounts of phytoliths but the largest amount of unfamiliar brown cellular structures. Phytolith types from WL1 suggested Chloridoids and Pooids,

Table 4: Phytolith identification data by phytolith type from all five samples. Phytolith analysis was conducted by the Archaeometry Laboratory, University of Minnesota-Duluth (Mulholland 1993).

Sample Label	WL1		WL1-F		MB1		MB2		FC	
	Count	%	Count	%	Count	%	Count	%	Count	%
Phytolith Category										
Trichomes, including cones	7	6.9	13	4.1	10	4.9	9	4.4	16	8.9
Stomata	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Bulliform cells	2	2.0	5	1.6	0	0.0	0	0.0	1	0.6
Epidermal groundmass cells	11	10.9	6	1.9	12	5.9	21	10.3	16	8.9
Rods	7	6.9	51	16.1	12	5.9	15	7.4	33	18.3
Rectangle/squares	8	7.9	116	36.6	15	7.4	20	9.8	29	16.1
Silica-bodies	66	65.3	126	39.7	154	75.9	139	68.1	85	47.2
Total	101		317		203		204		180	

Table 5: Descriptive summary of phytolith remains from each sample (Mulholland 1993).

Sample Label	Indications of Plant Contributions
WL1	Low silica abundance = low contributions of silica rich families or poor preservation conditions. Abundant brown cellular pieces. 65% grass silica-cells = high indication of grasses. Pooid subfamily indicated.
WL1-F	Abundant rectangle / square types, many with thick ridges = unknown plant contributor. Few brown cellular pieces (contrasts with WL1). 40% grass silica cells = lower contribution of grasses. Chloridoid indicators high; Pooid indicators also. 13 unidentified.
MB1	75% grass silica cells = high contribution of grasses. Pooid indicators dominant.
MB2	68% grass silica cells = high contribution of grasses. Pooid indicators dominant.
FC	Abundant rods suggest inflorescences. 47% grass silica cells. Pooid indcators high. Trichomes at highest amount.

whereas only Pooids were indicated in MB1 and MB2 (Mulholland 1993). The feature sample (WL1-F) was quite different, producing fewer grass silica bodies, but containing many other types, including possible indicators of maize and non-grass species (Mulholland 1993). Sample FC from the abandoned field was also different, containing numerous phytolith types suggestive of grass inflorescence, and three possible indicators of maize (Mulholland 1993) (Table 5).

Table 6: Macroremains data from five samples. WL1-F and FC were analyzed by the Archaeometry Laboratory, University of Minnesota-Duluth (Valppu 1993). Remaining three samples were analyzed by the authors.

Sample Label	WL1	WL1-F	MB1	MB2	FC
Plant Remains					
Carbonized Wood					
Acer saccharum Marsh.	1				
unidentified	many	many	few	several	some
Carbonized Nutshell					
cf. *Fagus grandifolia* Ehrh.	1				
unidentified	1				
Uncarbonized Nutshell					
cf. *F. grandifolia* Ehrh. / *Ostrya virginiana* (Miller) K. Koch / *Carpinus caroliniana* Walter	1			2	
unidentified	2				
Carbonized Seeds					
Betula papyrifera Marshall		2			
Chenopodium spp.		2			
Diervilla lonicera Miller		1			
Prunus virginiana L.		3			
Rubus sp.		10			
Sambucus cf. *pubens* (Michx.)		3			
Scirpus sp. (flat)		4			
seed fragments	1		3	several	
unidentified silver seed			1		
Uncarbonized Seeds					
Chenopodium spp.					10
Diervilla lonicera Miller			1		
Medicago sp./*Trifolium* sp.	4				
Portulaca oleracea L.					373
Potentilla argentea/norvegica				3	1
Rubus sp.			1		3
Vaccinium sp.				1	
Fungal sclerotia					
cf. *Cenococcum* sp.	6	many	12	340	some

Macroremains

Macroremains samples yielded primarily carbonized wood fragments and mycorrhizal sclerotia with modern rootlets and seeds, although the relative proportions of each type varied by sample. Despite similar soil characteristics, each sample had distinctly different light fraction compositions. For example, many *Portulaca* cf. *oleracea* and Poaceae undiff. were recovered from FC, neither of which occurred in the shoreline samples (Table 6).

One piece of wood charcoal from WL1 was identified as *A. saccharum* (Barefoot and Hankins 1982, Brown and Panshin 1934). All other wood fragments were too small to identify. The larger carbonized nutshell fragment from sample WL1 was identified as *F. grandifolia*. Although the smaller fragments of both carbonized and uncarbonized nutshell appeared similar, they could also have been fragments of *Carpinus caroliniana* Walt. (hornbeam) or *Ostrya virginiana* (Mill.) K. Koch. (ironwood or hop-hornbeam) nutshells (Martin and Barkely 1961, Montgomery 1967, USDA 1974).

Seeds, both charred and uncharred, were the most abundant macroremain type. Uncarbonized seeds, except *Portulaca*, were all identified as species that currently occur on the island (Martin and Barkley 1961, Montgomery 1967, WWA 1991). Sample WL1 contained most of the carbonized wood and nutshells, with few seeds. All carbonized seeds came from WL1-F. Samples from MB1 and MB2 contained few macroremains, mostly uncharred, except that MB2 had a proliferation of *Cenococcum* sp. Sample FC had many uncarbonized seeds with a high proportion of *Portulaca oleracea* L. (purslane). Recovered species identified through historic documents as culturally important (Table 1) included *Prunus virginiana* L. (choke cherry), *Rubus*

Table 7: Macroremains proportions used to calculate the amount current flora contributed to archaeobotanical assemblage, and to compare differences between samples using richness and diversity indices. CI = no. of culturally important taxa, CP = no. of currently present taxa. Note: unidentified remains were removed from the dataset prior to these calculations.

Sample Label	WL1	WL1-F	MB1	MB2	FC	AVG	STDEV
Total Identified Remains	7	25	2	6	387	85.40	168.83
No. of Culturally Important (CI) Remains	3	24	1	3	13	8.80	9.71
No. of Remains with Taxa Currently Present (CP)	7	23	2	6	14	10.40	8.26
CI / CP	0.43	1.04	0.50	0.50	0.93	0.85	1.17
Richness Index	4	7	2	3	4	4.00	1.87
Diversity Index	0.50	0.74	0.30	0.44	0.08	0.41	0.24

spp. (raspberry or blackberry), *Sambucus* sf. *pubens* Michx. (red-berried elder), *Scirpus* spp. (bulrush), and *Vaccinium* spp. (blueberry or cranberry). All except *Vaccinium* spp. were charred. *Cenococcum* sp. sclerotia (mycorrhizal sclerotia) were identified in all samples (McWeeney 1989, Howlett and Jackson 1976, Mikola 1948), but have no known cultural significance.

After removing unidentified, fragmented, or uncounted remains, we recovered an average of 85.4 macroremains (charred and uncharred) from each sample ranging from two (sample MB1-F) to 387 (sample FC) macroremains (Table 7). The percentage of culturally important remains ranged from 3% (sample FC) to 96% (sample WL1-F), with an average of 48%. Taxa currently present represented in remains ranged from 4% (sample FC) and 100% (samples WL1, MB1, MB2). Again, a proportion of CI to CP was used to compare archaeobotanical to ethnohistorical correspondence. Sample WL1-F had the highest ratio (1.04) of culturally important to currently present remains. The FC sample also reflected a high CI:CP ratio (0.93), while the other samples had ratios of 0.50 or less (Table 7, Fig. 6).

The level of identification obtained on the macroremain data permitted calculation of richness and diversity indices. In our analysis, rich-

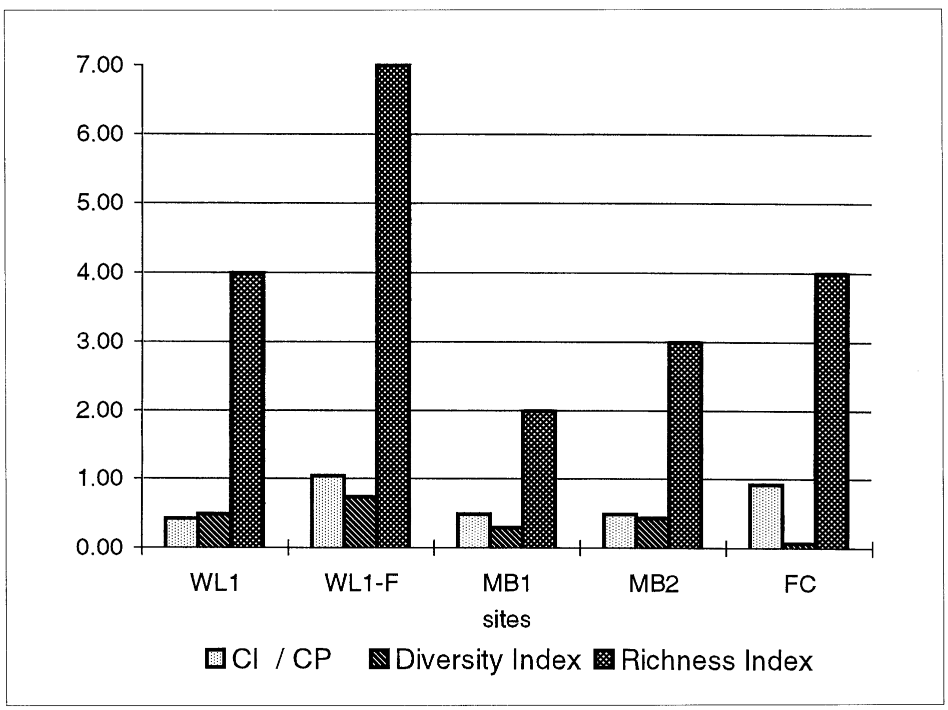

Figure 6. Macroremains ratios used to calculate the amount current flora contributed to archaeobotanical assemblage, and to compare differences between samples using richness and diversity indices. CI = no. of culturally important taxa, CP = no. of currently present taxa.

ness ranged from 7.0 (sample WL1-F) to 2.0 (sample MB1). Diversity was also highest from sample WL1-F (0.74) and lowest from FC (0.08), with the remaining three samples reflecting similar diversity measures around 0.40.

DISCUSSION

Our culturally important plant list included 32 uncultivated taxa, (most to the species level though several such as *Rubus* spp. were grouped), and ten cultivated species. The plants were listed by season of use (Yarnell 1964). Pollen and macroremains analysis recovered 16 of the 32 uncultivated taxa and none of the cultivated taxa. The largest group of unrecovered taxa were those typically used in late summer. These results indicated a fair correspondence of archaeobotanical remains to ethnohistoric accounts. The lack of taxa used in late summer supports written accounts claiming that historic Native Americans inhabited Grand Island seasonally. They allegedly arrived in spring to collect maple sap, fished the bays with nets and spears, cultivated corn, squash, and potatoes, traded with other villages or bands, and often left the island in the fall for their hunting grounds (Roberts 1991). Further analysis could assess whether different activities in late summer resulted in fewer plant remains, if late summer plants were used in equivalent amounts to plants in other seasons but they produced fewer remains (e.g. fewer but larger seeds), if the late summer plant remains were less durable, or if it reflects seasonal use patterns of the sites by Late Woodland and early historic Ojibwa.

Culturally important to currently present ratios (CI:CP) were less than onefrom both the pollen remain samples (0.42 and 0.76), indicating that pollen was more reflective of current species composition than it was of taxa in ethnobotanical accounts. On the other hand, the macroremain data resulted in an average CI:CP ratio of 0.68, ranging from 0.43 to 1.04. These indicated greater correspondence on some sites with ethnohistories (see following discussion on plant and fruit forms typically represented in pollen sums).

Archaeobotanical remains also reflected local site variation. Based on macroremain data, three samples (WL1, MB1, and MB2) had very similar CI:CP ratios (0.43, 0.50, 0.50 respectively). In contrast, the other two samples had much higher ratios (1.04 at WL1-F and 0.93 at FC). These two samples, then, seemed to reflect greater cultural use of plant materials. Sample WL1-F was taken from a well-defined feature within the test excavation unit which had a number of Late Woodland and early historic artifacts. Therefore, it is reasonable to expect a high proportion of cultural plant remains from this context. The FC sample, however, was a comparison sample taken from a contemporary field (Toll 1988). The high CI:CP ratio from this sample was largely due to the occurrence of *Portulaca* seeds, a taxon not found during the 1992 botanical survey, and therefore not in the current species list. As a result, the percentage of CP taxa was quite low (4%). A number of weedy plants (such as knapweed, yarrow, bugleweed, yellow rocket, oxe-eye daisy, orchard grass, fleabane, spurge, avens, hawkweed, St. John's wort, chickweed, goatsbeard, clover, dandelion, thistle, and others) were noted in and around the field, so it is possible that *Portulaca* was missed during field surveys. If so, the CI:CP ratio would have been 0.03, the lowest ratio of all samples, and closer to the expected since FC had less intensive documented cultural use and more recent site disturbance. Note: some authors have shown *Portulaca* as an "economic weed," (Toll 1988) but our documentary research did not uncover its economic significance on Grand Island. The lower FC pollen CI:CP ratio of 0.42 supports our suspicion.

In terms of both richness and diversity, WL1-F was substantially greater (Table 7). Our results show a different pattern of archaeobotanical remains for the feature sample (WL1-F) from other documented cultural sites (WL1, MB1, MB2), and for the farm field (FC) from the other sites. This presents some suggestions for future sampling. Clearly there appear to be more remains from the feature context, or at least more remains with cultural connotations. However, this observation may be a result of improved archaeobotanical preservation within the feature rather than greater site usage. Of all the samples used in this analysis, WL1-F provides the strongest correspondence to ethnohistoric accounts of Late Woodland and early historic plant usage. Yet, because it came from a multi-component feature, correlations can only be made to the general period of the Late Woodland to early historic transition.

Both the pollen and phytolith remains supplement macroremains but are less direct in their use for determining cultural-plant interactions for several reasons. Taxa identified to family level or above, and unidentified or fragmented pollen remains were removed from the data set to facilitate quantitative analysis. But in doing so, the size of the pollen data set was reduced. Many taxa represented by pollen remains were not culturally important. The number of CI remains from WL1-F was influenced by many *Betula* grains. This can be partly attributed to the plant and fruit forms typically represented by pollen remains compared to macroremains. We tend (as this research supports) to find more edible fruit and nut bearing plants represented by macroremains than by pollen. However, at least four taxa were found in the pollen sum that are potential food plants but were not found in the historical accounts: *Carya* (hickory/pecan), *Castanea* (chestnut), *Alnus* (alder), and *Corylus* (hazlenut).

Pollen results suggested a somewhat forested overstory around WL1-F, and an open, herbaceous vegetative community at FC (Table 2). The palynomorph taxa found were largely represented in the current flora except for the genera *Carya*, *Castanea*, and *Carpinus*. We found no pollen representation of *F. grandifolia* in the samples analyzed, a species now abundant on Grand Island. Beech is a relatively recent arrival to the area (500-3000 BP), and Grand Island is at the edge of its present northwest range (Davis 1978). The lack of *F. grandifolia* pollen in the sample may indicate the sample profiles predate the arrival of beech to Grand Island, or more likely, that beech pollen is not as durable or prevalent as pollen of other species (Pearsall 1989).

Over-and under-representation of archaeological pollen must be considered in interpretation of results. Wind-pollinated taxa contribute differentially to the pollen rain of a region. Generally, in forested areas, the overstory is more represented in pollen rain than are understory plants (Pearsall 1989). Overstory trees with light, buoyant grains such as pine, which are transported great distances, are typically over-represented in the pollen sum. Our pollen data were dominated by a few taxa, especially among trees and shrubs. The potential for over-representation by these taxa (*Betula*, *Ostyra* or *Carpinus*, *Pinus*, *Quercus*, and *Salix*) should be considered when comparing the counts and percentages. Also because many pollen grains are wind-transported, micro-variation is likely to be less apparent than with macroremains.

We cannot tell how many pollen grains are ancient vs. contemporary. However, our intent was to sample from archaeological contexts (WL1, WL1-F, MB1, MB2), thereby uncovering plant remains consistent with the archaeological period. These findings were then compared via our CI:CP ratio to assess similarities with modern floral communities.

Phytolith data seem to complement data obtained from pollen and macroremains and strengthen interpretations of site variation. Because soil phytolith analysis is a relatively new paleobotanical technique, analytical procedures and classification have not attained the maturity of palynology. Application of phytolith analysis to identification of New World crops dates to the 1960s, with a dramatic increase in the 1970s and 1980s. A critical need in phytolith research is a database of plant phytolith types (Pearsall 1989). Like other botanical remains, plants are not equally represented in phytolith identifications. Many plants do not deposit silica, or very little. Not all phytoliths are preserved equally well in soil. Similar silica bodies may be produced by very different plant groups, reiterating the need for phytolith taxonomic research. Nevertheless, analysis of Grand Island phytoliths has revealed some interesting phytolith forms and assemblages. For instance, phytolith forms suggested forest cover with sparse Pooid grass on WL1 and greater Pooid presence, or more open sites for MB1 and MB2.

Samples WL1-F and FC contained less than 50% grass silica bodies but had two rondels, which have also been cited as indicators of Pooid grasses. Saddles occurred in WL1 and WL1-F and are generally indicative of Chloridoids. Rectangle / square forms, reflecting an unknown plant contributor, occurred in a much larger proportion in the WL1-F sample than any of the others. Sample FC, taken from a disturbed upland, demonstrated greater phytolith deposition from inflorescences than the other samples.

Chenopodium spp. found in macro samples WL1-F and FC, has frequently been connected with human activities, possibly as a food source. Several papers (Fritz 1984, Heiser and Nelson 1974, Smith 1932, Yarnell 1964) discussed the use of *Chenopodium* by the Ojibwa. Yarnell (1964) was interested by the finding of *C. album* L. (lamb's quarters, pigweed, goosefoot) and *C. hybridum L.* var. *gigantospermum* (Aellen) Rouleau. at the Juntunen site, a Late Woodland occupation site on Bois Blanc Island, Michigan, near the Straits of Mackinac. Some have suggested *Chenopodium* as a likely early cultigen candidate along with *Iva annua* L. (marshelder), and *Helianthus annuus* L. (sunflower), prior to new world crops (Yarnell 1964, Asch and Asch 1977). Further sampling and analysis of Grand Island deposits could explore potential for *Chenopodium* domestication by Late Woodland inhabitants.

Three archaeobotanical recovery and analysis methods granted surficial understanding of Grand Island's plant relics: 1) pollen, phytoliths and macroremains, 2) historic documents and 3) botanical surveys. The study provided knowledge about the nature of remains and their correspondence to historic accounts, as well as an estimate of current flora deposits that would need to be detached from paleo-deposits. Four of five samples showed greater correspondence to current flora than to historic accounts, although each produced some cultural plant deposits. Remains from one sample, taken from a subsurface feature context with Late Woodland and early historic artifacts, had higher correspondence to historic flora accounts than to current plant assemblages.

Plant relationships are difficult to separate between cultural groups because of overlap between cultures, i.e., sharing knowledge, plants and garden locations. Our findings indicated that much of Euro-American plant usage responded to early historic Ojibwa traditions. Many of the same plants were used, taking advantage of naturally available nuts, tubers, and berries.

Our data also suggest site usage differences, which could be extrapolated from variation in site deposits (Johannsen 1988). For instance, each sample differed in the relative abundance of remain types. More material of greater diversity was found from WL1-F than from WL1, MB1, or MB2. Sample FC contained seeds not found at any of the sites along the shoreline, reflecting its contemporary field nature. Although phytoliths could only be classified to type, differences in phytolith category assemblages between WL1-F and FC, and the other three units were evident. The differences apparent in WL1-F support attempts to sample from a well-defined feature associated with a particular occupation (Pearsall 1988).

These findings have several limitations that should be noted. First, sampling was intended to collect basic information about cultural plant stores, and to formulate future research designs. Obviously, these preliminary data alone cannot produce statistically significant results. Accordingly, more sites with good archaeological contexts are needed to draw conclusions about plant remains so that findings can be associated with particular cultures and time periods. Thirdly, richness and diversity indices are affected by the total number of remains and should be standardized to the total. Due to the above three points, our CI:CP ratio should be considered a descriptive or comparative model for assessing a site's archaeobotanical remains (Miller 1988).

Unearthing and studying archaeobotanical garden remains is like an unfolding mystery. We search for clues from written sources to combine with our ancient plant remains in a paleoethnobotanical endeavor. Our goal: to decipher human-plant interactions within an ecological and historical setting. By uncovering cultural plant remains of a place, we add chapters to both its natural history saga and its anthropological story, and more importantly, to the dialectics between the two.

ACKNOWLEDGMENTS

We would like to thank all those who assisted in this study, especially: Dr. Patrick E. Martin, Archaeologist, Michigan Technological University, Social Sciences Department; Susan Mulholland, James K. Huber, and Seppo H. Valppu, Archaeometry Laboratory, University of Minnesota-Duluth; and Dr. Steve Shetron, Forest Soil and Geomorphology, Michigan Technological University, School of Forestry.

Credit belongs to staff from the Hiawatha National Forest as well, especially: John Franzen, Forest Archaeologist; Janet L. Schultz, Forest Plant Ecologist; Dr. Eunice A. Padley, Landscape Ecologist, now in the Eastern Region Office of the USDA Forest Service, Milwaukee, WI; and Dr. John Anderton, Geographer/Archaeologist.

The Hiawatha National Forest supported this research by assisting with staff time and expenses. For their commitment to this research we would like to thank William F. Spinner, past Forest Supervisor; Teresa Chase, District Ranger, Munising; Don Howlett, Ecosystems Team Leader; and Art Easterbrook, retired Recreation Staff Officer.

Preliminary manuscript reviews were provided by Andrea Spencer, Washington State University.

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Appendix A. Characteristics of the soil matrix of each paleobotanical sample.

Sample Label	WL1	WL1-F	MB1	MB2
Sample Name	William's Landing 1	William's Landing 1 - Feature	Murray Bay 1	Murray Bay 2
Catalogue No.	09-10-03-803	09-10-03-803	09-10-03-811	09-10-03-823
Provenience	TEU1, horizon B	TEU6, horizon C	TEU2, horizon C	TEU4, bottom of A horizon
Context	West profile	South Profile	buried organic layer	East profile, 17 cm below surface
Date Collected	7/29/92	7/29/92	7/29/92	7/29/92
Texture	silty sand	sand	sand - silty sand	loamy sand
Munsell Color	10YR 4/2	7.5YR 3/2	10YR 5/2	7.5YR 4/2
Volume	50 ml	1800 ml	50 ml	650 ml
Inclusions	fine roots, small pieces of charcoal	charcoal, pottery sherds	fine roots, small pieces of charcoal	small pebbles, 1 large stone, fine roots