Introduction

The analysis and interpretation of wood charcoal macro-remains from archaeological sites has been extensively used by archaeobotanists and paleoecologists in Europe as a means for reconstructing past vegetation, and by inference, climate patterns. Defined as the charred remains of a plant’s woody structures, predominately from trees and shrubs, wood charcoal is the most common plant material recovered archaeologically, due to the fact that it preserves in most conditions. This paper will examine the technique of cellular analysis in identifying archaeological charcoal to genus and often to species, and how it can be applied to two archaeological sites from the Pacific Northwest Coast to reconstruct past vegetation and possible climate patterns.

Method of Charcoal Cellular Analysis and Identification

Wood charcoal is identified by microscopic cellular analysis using similar methods to identify archaeological wood. In wood identification, samples are taken from wood with a sharp razor blade from three sections of a piece of wood (tangential, radial, and cross-section; Figure 1), placing them onto glass slides, and viewing with a compound microscope. A digital camera can be mounted on the microscope to record images for future comparisons. The same methods are used to cellularly identify charcoal as for wood analysis, using the same planes of orientation; however, due to its brittle nature charcoal is broken into the proper orientations rather than cut. Charcoal has reflective surfaces, which means a standard microscope using direct light sources generally creates too much contrast to view cells. A metallurgical microscope is used to produce imaging of cellular structure. This type of microscope has a light source that is transmitted directly down onto the sample through the objectives, and then retransmitted from the sample back through the objectives, eliminating reflection.
Figure 1. Stylized piece of wood, with the orientations used for sampling and identification labeled. Samples are taken from these orientations with a sharp razor blade, and then viewed microscopically (Friedman 1978:3).

Aside from differences in preparation of samples and the types of microscopes used, identification is accomplished using comparisons between modern wood species and samples from archaeological wood and charcoal. Each species of tree has unique cellular characteristics, with arrangements of different types of cells aiding in identification. With practice and an extensive comparative collection, identification can be frequently made to species. The following images are microphotographs of modern coniferous wood (Figure 2) and deciduous woods (Figure 3) at 100x magnification.
Figure 2. Microphotographs of Western red cedar (Thuja plicata), a coniferous wood (softwood). From left: cross-section; tangential section; radial section views.

In the sample of Western red cedar shown above, wood tracheid cells ("tracheids"), which appear microscopially as small tubes that run along the grain of a tree, are visible. In the cross-section view (left image), the tracheids are seen as small holes becoming darker and thicker-walled at the growth ring. Wood rays, extending from the center pith outward to the bark like spokes appear as thin lines intersecting the growth ring. The tangential section view (center), reveal the tracheids running vertically, with wood rays seen end-on. Tracheids are also visible in the radial section view (right), with a cross-section view of the rays running at right angles to the tracheids. The cross field where the rays intersect the tracheids are one of the most diagnostic characteristics of conifer wood, as the arrangement of small intervessel pits within the cross fields and shape of the end walls of the rays differ between conifer species.
Deciduous hardwood species have wood fibers that run along the grain, rather than tracheids. Larger vessel elements are interspersed among the fibers, with each hardwood species having a different arrangement of vessels seen as pores in the cross-section images (Figure 3). These pore arrangements are the quickest way to distinguish between hardwoods, with views of the vessel elements seen in tangential and radial sections also revealing identifying characteristics.

The same characteristics that aid in identifying wood samples are also visible in wood charcoal. The images in Figure 4 (100x magnification) are of wood charcoal samples taken with a digital camera mounted on a metallurgical microscope.

Figure 3. Microphotographs of deciduous wood (hardwood) cross-sections views, showing pore arrangement differences between species. From left: Red alder (Alnus rubra); bitter cherry (Prunus emarginata); Garry oak (Quercus garryana).

Figure 4. Microphotographs of wood charcoal samples. From left: bitter cherry (Prunus emarginata), cross-section view; Douglas-fir (Pseudotsuga menziesii), tangential section view; Garry oak (Quercus garryana), cross-section view.
Usefulness of Wood Charcoal for Environmental Reconstruction

Environmental reconstruction of archaeological settings can be accomplished through several methods. Palynology (pollen analysis) is frequently used, but subject to limitations. Pollen is not always preserved, particularly in arid sites. Most pollen that is recovered is from tree and shrubs that are wind pollinated, and those plants that are pollinated by insect and birds are not represented. Another method is to examine plant material such as leaves and seeds, but again the right conditions need to be available to preserve these materials. Waterlogged or wet-sites, of which there are several on the Pacific Northwest Coast, are ideal for such preservation. These sites have underground aquifers that pump water through the site, and the movement of the water underground causes oxygen to drop out of the water, creating anaerobic conditions. Bacteria and fungi need oxygen to decay plant materials, and the lack of these organisms leads to preservation of plant materials.

Wood charcoal on the other hand preserves in most conditions, is rarely affected by water and heat (although can be crushed by subsequent human activity) and is frequently collected from archaeological sites particularly for radiocarbon dating. During archaeological excavations, depth measurements of excavated levels and associated stratigraphic profiles are carefully recorded, and artifacts that have been located are measured and mapped in with exact provenience. Where wood charcoal has been collected and used for radiocarbon dating, the time frame from the levels where it was recovered has therefore been fairly well established, and can assist in framing the time sequences for environmental reconstruction.
Environmental Reconstruction from Wood Charcoal

An example of environmental reconstruction is the detailed paleoenvironmental sequences built for the western Mediterranean basin by archaeobotanists trained at the University of Montpellier II, France (Asouti & Austin 2005). In this study, archaeologists have identified three criteria that most representative of charcoal assemblages to qualify for the purpose of paleoecological reconstruction:

1. The assemblage needs to represent charcoal deposits accumulated over a prolonged period of time, (secondary refuse, such as scattered charcoal or midden deposits), not short-term or episodic events (primary refuse, e.g. hearth deposits). Secondary deposits are more likely to produce a high diversity of woody taxa thus maximizing the potential for vegetation reconstruction. Such deposits are more likely to represent the accumulated remains not only of wood collected as fuel, but as “secondary” fuels, such as the by-products of fodder and food consumption, woodworking, defunct timber and wooden artifacts (Asouti & Hather 2001:25). They can also be expected to have been subject to broadly the same range of post-depositional alterations. By contrast, even if substantial quantities of charcoal are retrieved from short-term deposits and a high degree of taxonomic diversity is established, the probability that these are related to the specific circumstances of the last firing event, and do not represent a lasting trend, cannot be eliminated. Furthermore, with regard to preservation conditions, short-term deposits may have been subject to diverse post-depositional transformations.

2. To be primarily the result of fuel-burning activities. Depending on the predicted frequency of the disposal events (day-to-day or at longer intervals), they are more likely to characterize lasting patterns of fuel-related activities.
3. To contain sufficient quantities of wood charcoal to allow statistically meaningful
analysis.

The number of charcoal fragments needed for this purpose has been debated, however a figure of
at least 150 fragments is agreed upon; with 200 or more fragments the ideal (Smart & Hoffman
1988).

Archaeological case studies using the information and criteria outlined in this report, and
from which data were collected and past environments reconstructed include two sites located in
the Central Anatolian Region of what is now Turkey: the Neolithic tell site of Çatalhöyük, and a
complex of seasonally occupied Neolithic campsites in Pinarbasi (Figure 5). An advantage for
selecting these two sites was that they occupy broadly the same environmental setting (open
woodland/steppe/wetlands ecotone of the south-central Anatolian plateau) thus offering an
opportunity for a meaningful comparison of their results (Asouti & Austin 2005: 12). The
following is a summary of wood charcoal identification and environmental reconstructions from
these two sites.

Figure 5. Locations of Çatalhöyük (black circle) and Pinarbasi (white circle) within Turkey.
Çatalhöyük

The Neolithic tell site of Çatalhöyük is located overlooking wheat fields in the Konya Plain, southeast of the present-day city of Konya (ancient Iconium) in Turkey, and was occupied during the Neolithic period from approximately 7500 BC to 5700 BC. Analysis of wood charcoal macro-remains were conducted using samples collected from a sequence of midden/refuse layers representing secondary deposits, from the South area of the site spanning a 1000-year period.

These charcoal fragments were identified as primarily wood used as fuel by the inhabitants of Çatalhöyük; fulfilling the first two criteria listed previously. In addition, 7,197 fragments of charcoal were examined, fulfilling the third criteria as well. The results were used in conjunction with pollen evidence, geomorphological data and ecological analogues in order to reconstruct ancient woodland vegetation in the Konya Basin and its surroundings during the Neolithic.

Examination and identification of wood charcoal from Çatalhöyük recovered from the deeper (older) levels shows charcoal assemblages dominated by mesic riverine-wetland taxa, primarily willow/poplar (Salicaceae) and elm (Ulmus), followed by hackberry (Celtis). A substantial part of the assemblage was identified as undifferentiated Ulmaceae (hackberry/elm), where an identification to species was not able to be made. Almond (Amygdalus), terebinth (Pistacia) and pear/hawthorn (Maloideae) are ubiquitous. On the other hand, oak (Quercus) and juniper (Juniperus), species which are more drought-tolerant and representative of dryer steppe vegetation, were very minimally represented (Asouti, in press).

In the more recent levels, there is some reduction in the overall diversity of the charcoal samples, while oak frequencies rise substantially compared to the older levels of the site. There is also a gradual rise in the frequencies and abundance of juniper. Wetland taxa such as ash (Fraxinus), alder (Alnus) and tamarisk (Tamarix), although present, account for a much smaller
proportion of sample composition in contrast to the older levels. Higher proportions of wild plum (*Prunus*) and shrubs were also identified, indicators of steppic climate.

Paleoenvironmental sequences available from several locations in the Konya basin have indicated that climate conditions were moister at the time of the founding of Çatalhöyük, allowing for woodland expansion and the proliferation of mesic taxa that lasted until around 7000 BC. Oak woodlands were also identified, but apparently not frequently utilized for fuel in favor of the mesic taxa described previously. Although further analytical work is necessary, spanning a wider array of habitation sites from different time periods, this study and previous analyses from Pinarbasi (discussed in the next section) and other sites in the area have enabled tracing some general patterns in vegetation change through time, which broadly agree with the data through paleoecological investigations. The gradual rise in the presence and abundance values of juniper in the charcoal samples of the recent time periods of Çatalhöyük could be considered as an indication for the gradual development of drier conditions that favored the expansion of juniper stands from 7000 BC onwards. It could also signify the invasion of oak woodlands by juniper due to the selective logging of oak stands for timber and firewood, and also explain the rise in frequencies of shrubs. However, preliminary observations of wood charcoal collected from recent excavations from the West area of Çatalhöyük indicate the nearly complete substitution of oak by juniper as the dominant taxon. Although still at a preliminary stage, it seems likely that such changes reflect a major shift in species availability caused by climatic factors, rather than a culturally-derived reorientation of wood gathering activities (Asouti in press).
**Pinarbasi**

Pinarbasi is located near the center of the Konya basin, occupying the base of a cliff at the foothills of the volcanic massif of Karadağ some 30 kilometers southeast of Çatalhöyük. It was the location of a mobile hunting/pastoralist campsite used from approximately 7100 BC to 3725 BC. Presently, the climate is semi-arid with distinctly dry and hot summers and cool winters. Arboreal cover is restricted on the slopes of Karadağ, mainly in the form of open deciduous oak forests. On the plain itself, wetland environments are rapidly diminishing due to global environmental change coupled with continuously expanding irrigation works (Asouti 2003: 1185).

Analysis of charcoal was conducted from one of the excavation areas designated as PN-B, with samples collected from three different areas of the site. Enormous quantities of charcoal were recovered from PN-B, with 5,739 charcoal fragments examined and identified. It was discovered the majority of taxa represented included terebinth (*Pistacia*), almond (*Amygdalus*) and *Rosa*, species which grow in more arid steppe environments. The assemblage remained remarkably unchanged from the older to the most recent levels of occupation, and the conclusion drawn by Asouti indicated the woodland-steppe environment was already present in the region of Pinarbasi. The paleoenvironmental sequences used in the environmental reconstruction of Çatalhöyük tend to support this conclusion, as these sequences had indicated that the transformation to a dryer climate began around 7000 BC, very close to the same time period that human occupation of Pinarbasi began.
Analysis of Wood Charcoal from Pacific Northwest Coast Wet-Sites

Although frequently utilized by European archaeologists for environmental reconstruction, the technique of using wood charcoal macro-remains for this purpose is not apparently commonly used in the United States. To understand how this process can be used for North American sites, it was decided to apply these techniques to sites on the Northwest Coast. Wood charcoal had been collected during 11 years of excavation at the Native American site of Qwu?gwes on Mud Bay in Washington State at the southern end of the Salish Sea. Charcoal was also collected during testing of the Sunken Village Historic Landmark wet site, a Native American site located on Sauvie Island near Portland, Oregon. The following describes the process and results from wood charcoal analysis of these two sites.

The Qwu?gwes Cultural Site

The Qwu?gwes Cultural Site (45TN240) is located on Puget Sound at Mud Bay on the southern end of Eld Inlet near Olympia, Washington (Figure 4). The site was named Qwu?gwes, a term in the indigenous Lushootseed language meaning a place to come together, share, and gather by the Squaxin Island Tribe in 2000. It describes a place where Western scientists and the cultural experts from the Squaxin Island Tribe strive to work together to better describe and explain the ancient history of this location.

The site consists of an area above the beach where food resources were processed (food-processing area), an intertidal shell midden, and an area where People gathering and processing would have temporarily lived (habitation area). Also presented is a fishtrap system at the end of Orr Cove, northeast of the Qwu?gwes site and a homestead area to the southeast of Qwu?gwes that is associated with the original Donation Land Claim. The site was first occupied around 700
years ago, on an area that was formerly higher in elevation. Around 1000 years ago a large earthquake along the Legislative Fault dropped the area 9 meters almost instantly, submerging the former forest floor and allowing the waters of Puget Sound to rush in. Over a period of 300 years as the drowned forest decayed, an intertidal beach area developed and eventually established shellfish populations and salmon began to migrate and spawn up the small creek that runs into Orr Cove.

Figure 4. Location of Qwu?gwes in lower Puget Sound.

The Qwu?gwes shell midden area fulfills two of the three criteria established by Asouti and Austin:
1. The shell midden is distinct from the food-processing and living areas, which is most likely to represent a diversity of wood as charcoal would have been deposited here from cleaning out the food processing and habitation areas; 

2. The charcoal deposited in the shell midden is primarily the result of fuel wood burning activities.

The third criteria, to contain sufficient quantities of wood charcoal to allow statistically meaningful analysis, is possibly fulfilled in the samples collected from each excavation unit of charcoal from the intertidal shell midden, however only a small sub-sample has been identified at this point in time.

Over an 11-year period, a total of 55 units were excavated. Radiocarbon dates were found to correspond very closely with excavated levels; with each 10 centimeter level representing approximately an hundred-year period. Wood charcoal was collected from a quadrant of each 1 meter x 1 meter excavation unit from the intertidal shell midden. These samples represent 25% of each unit, as a large amount of charcoal was found in each unit. At the time of excavation, little use was seen for the charcoal remains, and storage space for excavated material was limited. A 25% sub-sample from unit N16E14 was then identified by microscopic cellular analysis for purposes of adding to the 11-year synthesis report (in publication). This sub-sample is very small, consisting of 114 fragments and therefore the third criteria for paleoenvironmental reconstruction is not fulfilled; however further research is planned to identify the 75% remaining charcoal. Excavation unit N16E14 was chosen for analysis, as this unit has been completely excavated. Table 1 (below) details the results of microscopic identification.
Table 1. Results of charcoal identification by cellular analysis of Unit N16E14

<table>
<thead>
<tr>
<th>Level</th>
<th>Thuja plicata</th>
<th>Pseudotsuga menziesii</th>
<th>Alnus rubra</th>
<th>Prunus emarginata</th>
<th>Taxus brevifolia</th>
<th>Pinus spp</th>
<th>Tsuga heterophylla</th>
<th>Acer macrophyllum</th>
<th>Pseudotsuga menziesii bark</th>
<th>Fraxinus latifolia</th>
<th>Quercus garryana</th>
<th>Acer circinatum</th>
<th>unidentified</th>
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<tr>
<td>0-10 cm</td>
<td>4</td>
<td>2</td>
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<td>30-35 cm</td>
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<td>40-45 cm</td>
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<tr>
<td>50-55 cm</td>
<td>11</td>
<td>10</td>
<td>2</td>
<td>4</td>
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<tr>
<td>55-60 cm</td>
<td>6</td>
<td>5</td>
<td>13</td>
<td>5</td>
<td>3</td>
<td>1</td>
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<td>60-65 cm</td>
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<td>totals</td>
<td>27</td>
<td>22</td>
<td>24</td>
<td>18</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>1</td>
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</table>

The oldest and deepest level 60-65 cm bd (centimeters below datum) contained red alder (*Alnus rubra*), Douglas-fir (*Pseudotsuga menziesii*) and pine (*Pinus*), reflecting a period approximately 600-650 years BP (before present). The next level also contains red alder and Douglas-fir, with western red cedar (*Thuja plicata*), bitter cherry (*Prunus emarginata*), Pacific yew (*Taxus brevifolia*), pine, Garry oak (*Quercus garryana*) and vine maple (*Acer circinatum*) added to the assemblage. The 50-55 cm level (reflecting approximately 500-550 years BP) had the most amounts of wood charcoal, with western red cedar the most abundant, followed by Douglas-fir, bitter cherry, western hemlock (*Tsuga heterophylla*), pine, Oregon ash (*Fraxinus latifolia*), and Douglas-fir bark. The following levels from 40 cm-surface reveal considerably less wood charcoal recovered, mainly consisting of western red cedar, bitter cherry, Douglas-fir and red alder.

Interpretation of the results of this analysis considering the small amount of charcoal fragments identified is difficult. All the wood species identified still grow in the area at the
present time, despite a period of logging activity around Mud Bay near the end of the 19th
century and into the early 20th century. It is interesting to note however, that plant remains
collected from the shell midden also show a decrease in abundance in the more recent levels.
From about 45 cm level down to approximately 65-75 cm below the surface is where the
underground aquifer runs through the site, and preservation of fragile plant material that occurs
due to the anaerobic action of the pumping water may be compromised as the material is
collected above the capillary fringe action of the aquifer. This does not account for the decrease
in charcoal remains from N16E14 however, as they should remain preserved despite the presence
of oxygen. Other archaeological material recovered from the intertidal shell midden such as bird,
fish and mammal bones, Olympia oysters, littleneck clams and Pacific blue mussels also show a
decrease above this level.

A broader look at the total charcoal fragments collected from the shell midden however
reveals a bimodal distribution. Charcoal counts decline at the 35-45 cm level of the midden, then
increase in frequency; although not as abundant as in the deeper levels. This bimodal distribution
can also be seen in other identified shellfish species such as butter clams and horse clams; and
also in the presence of thermally altered rock which is produced by cooking and steaming in the
food processing area and the heat-cracked rocks subsequently discarded in the intertidal zone.
Research has indicated a another possible seismic subsidence event at the site around 300 years
ago, which may account for the bimodal distribution as the site may have been temporarily
compromised and possibly uninhabitable for a period of time. It also has been suggested
however that this seismic event was a slow subsidence (Brian Sherrod, personal correspondance,
2009), which would account for the continued presence of cultural archaeological materials
although much reduced in quantity.
The Sunken Village National Historic Landmark Wet Site

The Sunken Village site on Sauvie Island was occupied by Chinook People, and was observed by Lewis and Clark in 1805-1806 on their voyage of exploration along the Columbia River. Lewis and Clark called the island “Wappato Island” for the abundance of wapato (Sagittaria latifolia) growing in wetland areas. The edible tubers were gathered for food for personal use and trade by the Native People. Sunken Village is located on the southeastern portion of the Island, on the banks of the Multnomah Channel (Figure 5). The historical significance of this site, with archaeological artifacts collected over the years led to its designation as a National Historic Landmark site in 1989. Formal archaeological surveys were conducted at the site in the 1980’s, mostly consisting of shovel probe testing and auguring to determine the extant and richness of the site.

Figure 5. Location of the Sunken Village site on the Northwest Coast (left); project location on Sauvie Island (right).
In 2006 a request for an impact assessment was requested by the Sauvie Island Drainage Improvement Company (SIDIC) for proposed placement of rip rap boulders along a 320-meter length of the bank bordering the site to stabilize the bank from erosion. A contract for the assessment was proposed and awarded to Archaeological Investigations Northwest (AINW) of Portland Oregon and Dr. Dale Croes of South Puget Sound Community College (SPSCC) for joint investigations of the site. Evaluation of the site commenced in September of 2006, and the remains of nearly 100 circular pits dug into the shoreline lined with branches and containing thermally altered rock were mapped by SPSCC’s CAD program. These pits were discovered to be acorn leaching pits, with water flowing through them from an underground aquifer, lined with western hemlock (*Tsuga heterophylla*) boughs and containing acorn remnants. Four test units were also excavated, with only Test Unit 4 found to contain any substantial archaeological material. Among the material recovered from Test Unit 4 was a wooden splitting wedge, woodchips from carving activity, some preserved plant remains mainly consisting of seeds, and over 1,700 fragments of wood charcoal. Evidence of hearth features were not found, but it is believed the wood charcoal recovered was from cooking and heating activities by People guarding the acorn leaching pits. This would constitute a secondary deposit, with the charcoal primarily from wood collected for fuel; and with over 1,700 charcoal fragments recovered would fulfil the criteria set forth by Asouti and Austin. Some charcoal may have been deposited from the tides, but most of the site including the acorn leaching pits were capped by a thick deposit of silt and clay.

Radiocarbon dating indicates the site was occupied from 1560 AD to around 1830 AD, spanning a 270-year period. For purposes of publication in the *Journal of Wetland Archaeology*
Volume 9, a small 5% sub-sample (n=85) of the wood charcoal fragments were examined and identified (Table 2).

Table 2. Results of wood charcoal identification by cellular analysis of Test Unit 4

<table>
<thead>
<tr>
<th>LEVELS (cm)</th>
<th>Quercus garryana</th>
<th>Alnus rubra</th>
<th>Pseudotsuga menziesii</th>
<th>Thuja plicata</th>
<th>Prunus spp</th>
<th>Acer spp</th>
<th>Salix spp</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10 CM</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-20 CM</td>
<td>12</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>20-30 CM</td>
<td>19</td>
<td>8</td>
<td>6</td>
<td>5</td>
<td>2</td>
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<tr>
<td>30-40 CM</td>
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<td>5</td>
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<td>1</td>
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<tr>
<td>40-50 CM</td>
<td>3</td>
<td></td>
<td>3</td>
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<tr>
<td>TOTALS</td>
<td>39</td>
<td>15</td>
<td>18</td>
<td>1</td>
<td>8</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

The deepest (oldest) levels from 30-50 cm below surface reveal fewer charcoal fragments, consisting of Garry oak, Douglas-fir, red alder and one fragment of a willow (Salix) species. Wood charcoal became more abundant between 10-30 cm, and included Garry oak, Douglas-fir, cherry (Prunus) and maple (Acer) species; and then tapered off in frequency. The majority of charcoal identified was Garry oak (Quercus garryana), which grew in abundance on Sauvie Island. A few groves remain today on the island, and a sample for comparison with archaeological wood charcoal was taken from a tree estimated to be around 300-400 years old. The trees were most likely the source for the acorns leached in the pits at the Sunken Village site, and it is possible wood was collected during acorn gathering to use for fuel.

Again these results are inconclusive, and the relatively short period of time indicated by radiocarbon dating may be a negative factor in attempting an environmental reconstruction. Further analysis is planned for the remaining wood charcoal sample, as well as of charcoal collected during excavation of one of the acorn-leaching pits in 2006.
Summary and Conclusions

The combined analysis of pollen, plant remains and wood charcoal from archaeological settings are the ideal resources for environmental analysis, but in the absence of pollen and plant preservation, wood charcoal remains the most consistently recovered material from archaeological sites for this purpose. Although the results of wood charcoal analysis were inconclusive for the Northwest Coast archaeological sites, the technique of environmental reconstruction using charcoal macro-remains still has great potential for sites in the United States. Future research for the Qwu?gwes Cultural Site and the The Sunken Village National Historic Landmark Wet Site will include identification of a larger sample of the wood charcoal macro-remains, as well as a comparison of paleoecological materials including charcoal from nearby non-archaeological areas. Other archaeological sites on the Northwest Coast from which charcoal has been collected will also be examined and identified to see if environmental reconstruction can be successfully accomplished for this region of the United States.
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