ISSN 1538-2834

# JOURNAL OF NORTHWEST ANTHROPOLOGY



**Fall 2013** **Vol. 47, No. 2**

# *JOURNAL OF NORTHWEST ANTHROPOLOGY*

FORMERLY NORTHWEST ANTHROPOLOGICAL RESEARCH NOTES



Composed by Northwest Anthropology LLC, Richland, WA ; Printed by Copy Court, Moscow; Bound by Arts & Crafts, Oakesdale. Missing issue claim limit 18 months. For back issues and catalogue of prices contact Coyote Press, P O Box 3377, Salinas, CA 93912. <http://www.californiaprehistory.com>.

## POLICY

***Journal of Northwest Anthropology***, published semiannually by NARN, Inc. a non-profit organization in Richland, Washington, is a refereed journal and welcomes contributions of professional quality dealing with anthropological research in northwestern North America. Regular issues are published semiannually with additional memoirs issued as funds are available. Theoretical and interpretive studies and bibliographic works are preferred, although highly descriptive studies will be considered if they are theoretically significant. The primary criterion guiding selection of papers will be how much new research they can be expected to stimulate or facilitate.

## SUBSCRIPTIONS

The subscription price is $40.00 U.S. per annum for individuals and small firms, payable in advance, $60.00 for institutional subscriptions, and $30.00 for students with proof of student status. Remittance should be made payable to ***Northwest Anthropology LLC***. Subscriptions, manuscripts, change of address, and all other correspondence should be addressed to:

Darby C. Stapp
***JONA***
P.O. Box 1721
Richland, WA 99352-1721

telephone (509) 554-0441
e-mail dstapp@pocketinet.com
website www.northwestanthropology.com

## MANUSCRIPTS

Manuscripts can be submitted in an electronic file in Microsoft Word sent via e-mail or on a CD to the Richland, WA, office. An abstract must accompany each manuscript. Footnotes will be avoided and if used at all will be assembled at the end of the text. Questions of reference and style can be answered by referring to the style guide found on the website or to ***Journal of Northwest Anthropology***, 47(1):109–118. Other problems of style can be normally solved through reference to *The Manual of Style,* University of Chicago Press. All illustrative materials (drawings, maps, diagrams, charts, and plates) will be designated "Figures" in a single, numbered series and will not exceed 6 x 9 inches. All tabular material will be part of a separately numbered series of "Tables." Authors will receive one free reprint of articles, memoirs, or full-issue monographs. Additional reprints may be produced by the author; however, they must be exact duplicates of the original and are not to be sold for profit.

# JOURNAL OF NORTHWEST ANTHROPOLOGY

VOLUME 47

DARBY C. STAPP and DEWARD E. WALKER, JR.

EDITORS

## Number 1 Spring 2013



## Number 2 Fall 2013

JOURNAL OF NORTHWEST ANTHROPOLOGY

VOLUME 47 | FALL 2013 | NUMBER 2

# EXPLORING ANCIENT WOOD AND FIBER TECHNOLOGIES ALONG THE NORTHWEST COAST OF NORTH AMERICA

**Dale R. Croes and Kathleen L. Hawes**

**Abstract**

Well-preserved waterlogged/wet archaeological site explorations have revealed a focused use of wood and fiber technologies spanning more than 10,500 years along the Northwest Coast of North America. Major artifact categories represented include those for subsistence (e.g., wooden shank fishhooks and nets), manufacture (e.g., wooden wedges, wood chip debitage, and basketry element debitage), containers (e.g., basketry and wooden boxes/bowls), and tying elements (e.g., cordage and binding elements). The kinds of plants used for tools at different sites are explored. Also, technologies and styles used often reflect long-term cultural continuities in different regions—with focus here on wet sites in the recently renamed Salish Sea shared between British Columbia and Washington state.

## Introduction

Aquifer wet sites are commonly found along the entire Northwest Coast of North America, from southeast Alaska to southwest Oregon, with dates ranging from 10,700 cal C14 years B.P. through contact periods (Fig. 1). Aquifer wet sites are characterized by waters actively running through the archaeological deposits. This process results in a loss of oxygen content, creating an environment that preserves wood and fiber (but rarely leather, hide, hair or softer animal matter).

Several factors have combined to produce a large number of wet sites along approximately 10,000 miles (16,000 kilometers) of shoreline from all time periods of human occupation. The region is marked by abundant precipitation, caused by the North Pacific Drift, prevailing westerly winds, and the steep topography of the mountain barriers; these conditions have led to saturated landforms along the coastal waterways, where Northwest Coast peoples have subsisted throughout their past. Probably every sizable shell-midden site along the Northwest Coast, if explored with the intent to find a waterlogged area, would exhibit a wet site area with preserved wood and fiber artifacts. Unfortunately, wet site techniques and procedures have not been fully integrated into the learning traditions of archaeology programs in our region, so wet sites are rarely sought out by practicing archaeologists. This methodological weakness, however, is changing, as the potential of Northwest Coast wet sites to contain wood and fiber artifacts has caught the attention of native peoples of the region. Increasingly, native groups are working with archaeologists to explore wet sites to recover the wood and fiber materials that once made up over 90% of the Native material culture of the Northwest Coast (Croes 2012b).

The best known wet site is the Ozette Village wet site, located near Cape Alava in northwestern Washington state, where an entire section of an occupied Indian village was covered and encased by a successive series of massive clay mudslides. This situation provided a Pompeii-like complete artifact assemblage. Most Northwest Coast wet sites, however, are the result of various other environmental contexts and typically contain perishable artifacts that were broken and discarded at these locations. These sites, for the most part, have been discovered as a result of naturally occurring erosion (often a critical problem in itself). Other sites have been found below the water table level during the course of non-wet shell-midden excavations (Croes 2012b).

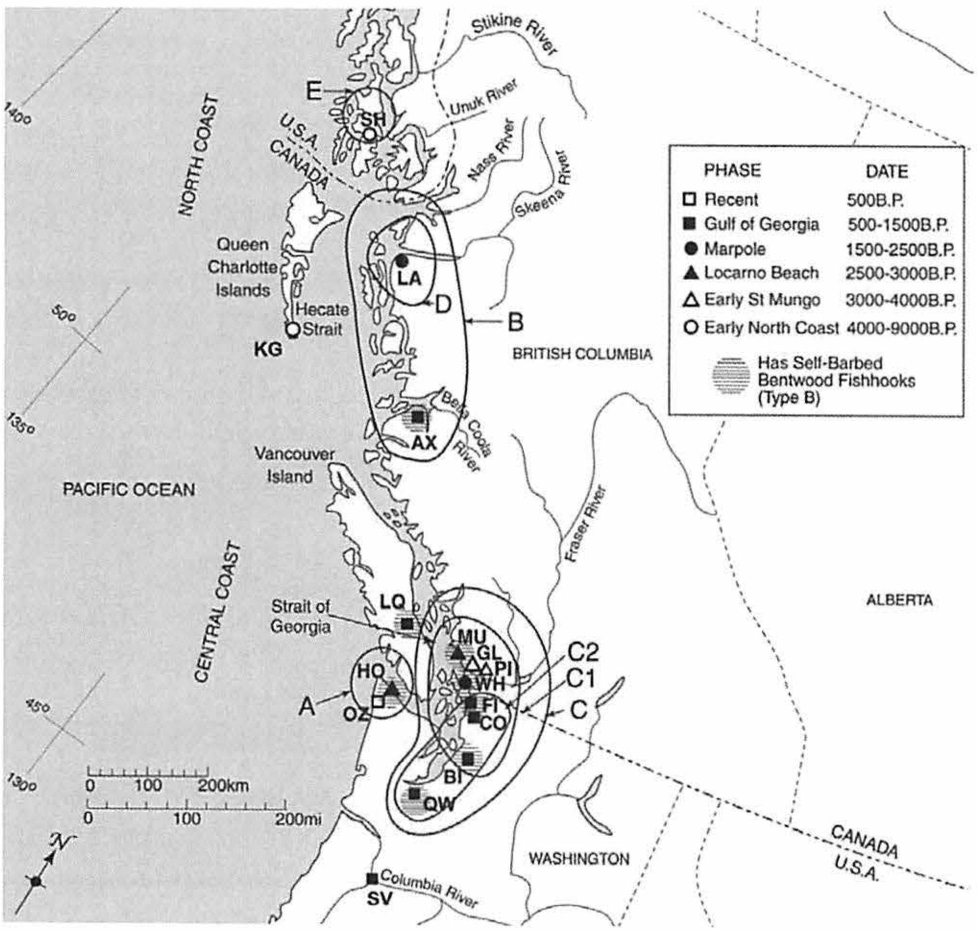



Fig. 1. Locations and general phases/time periods of major explored wet sites on the Northwest Coast of North America. This map denotes regions of ancient basketry style continuity on the Northwest Coast and locations where self-barbed bentwood fishhooks have been reported (see Croes 2001). Site abbreviations: SH: Silver Hole, KG: Kilgii Gwaay, LA: Lachane, AX: Axeti, LQ: Little Qualicum River, MU: Musqueam NE, GL: Glenrose, PI: Pitt Polder, WH: Water Hazard, FI: Fishtown, CO: Conway, BI: Biederbost, Qw: Qwu?gwes, HO: Hoko River, OZ: Ozette; SV: Sunken Village (Matson, Coupland and Mackie 2003).

The purpose of this article is to first review the methods used to identify the types of materials often recovered at wet sites, and describe the plant preferences that native peoples had for making various items such as wedges, fishooks, basketry, cordage, and nets. Second we use wet sites from the recently named Salish Sea region to explore a different pattern for distribution of wet site basketry artifacts when compared to stone, bone-antler, and shell artifacts. Our hope is that our work will stimulate more native peoples and archaeologists to work together to recover and understand the rich assemblages of wood and fiber materials recovered from coastal wet sites.

## Identification of Ancient Wood/Fiber Artifacts used at Northwest Coast Wet Sites

For over 10,500 years, we see similar plants used in making wood and fiber artifacts on the Northwest Coast. Native experts have developed a complex understanding of the plant properties and how different parts of the same plant (limbs/boughs, heartwood, inner bark, roots, etc.) can best be used to construct native material culture. Often, we find a specific plant was used widely, such as *Thuja plicata* (western red cedar), though different parts of the plant may have been emphasized in different regions at different times in making their basketry and/or cordage. For example, the ancient outside West Coast peoples emphasized inner cedar bark basketry construction, whereas the ancient inside Gulf of Georgia/Puget Sound peoples emphasize splint cedar bough basketry construction—a cultural preference for using different parts of the same plant through time.

To identify the ancient plant species and part of the plant that was used to fashion the items found archaeologically in a wet site, a cellular analysis is conducted. The cellular identification of ancient wood and fiber artifacts was pioneered in the 1970s by Janet Friedman at the Ozette Village wet site (Friedman 1975, 1978, 2005). Expansion of this work continues, as shown by a case study from the Qwu?gwes wet site. This case study, described below, illustrates the basic importance of distinguishing the use of hardwoods and softwoods, especially for the construction of fiber basketry and cordage artifact; hardwood barks appear to be have been used at Qwu?gwes more than at any other Northwest Coast wet site to date. Results revealed an emphasis on big leaf maple bark (*Acer macrophyllum*) for woven basketry, cordage (especially braids) and nets.

Cellular analysis of archaeological wood involves taking samples with a sharp razor blade from three sections of a piece of wood: tangential, radial and cross-section (Fig. 2). Samples are then placed onto glass slides, and viewed with a compound microscope. Differences between deciduous hardwoods and coniferous softwoods can be quickly identified by this method, and unique characteristics between softwoods can be observed in the rays, tracheids, and pit features.

### *Softwoods*

Softwoods (gymnosperms), also called conifers, when microscopically viewed, have tracheids, which are long thin cells that conduct water vertically along the length of the tree. In cross-section, the tracheids appear as small holes (Fig. 3, left). The long thin tracheids can be seen running vertically in the tangential section view, the area of wood that begins just under the bark (Fig. 3, center).

Ray cells, composed of parenchyma and tracheid tissue, also appear in the cross-section view similar to spokes of a wheel radiating out from the center of the stem. The ray cells can be a few or many cells in height but in softwoods is generally only one cell in width (uniseriate); the ends of several rays are visible in the tangential section view. Fig. 4 illustrates the various cell elements described above in a modern sample of western red cedar (*Thuja plicata*).

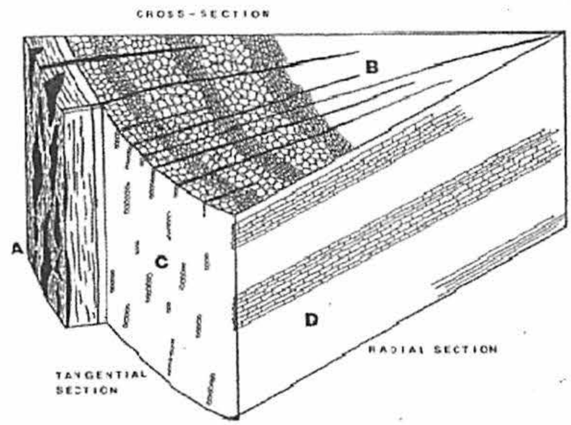



Fig. 2. Stylized piece of wood, with the orientations used for sampling and identification labeled. Samples are taken from these orientations with a sharp razor blade, and then viewed microscopically (Friedman 1978:3).

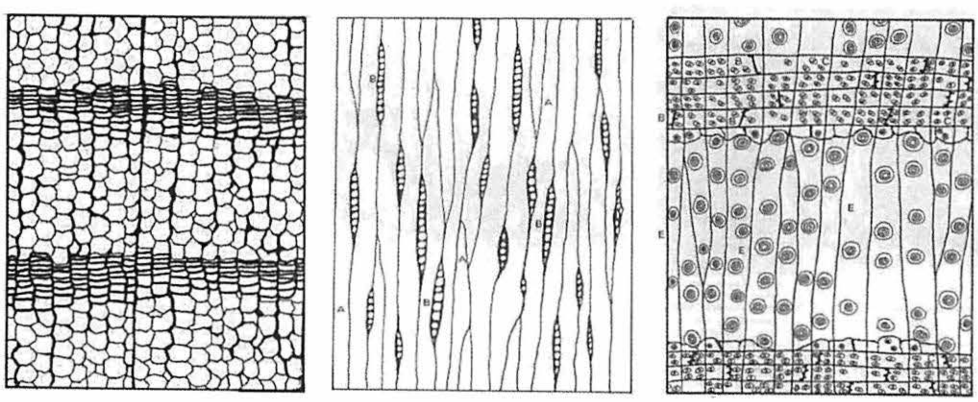


Fig. 3. Stylized drawings of (from left) cross-section, tangential section, and radial section views of a typical softwood (Friedman 1978).

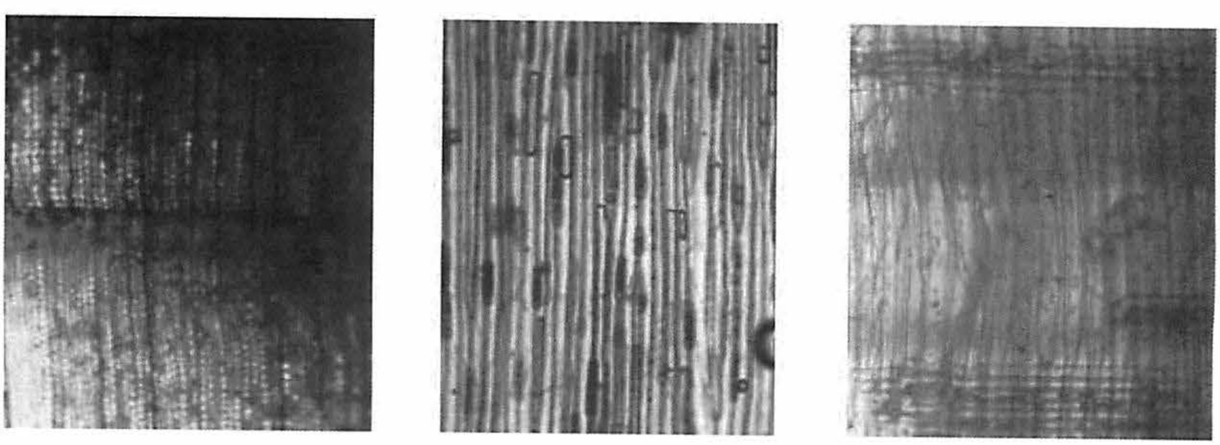


Fig. 4. Samples of western red cedar (Thuja plicata) wood (left to right): cross-section, tangential section, and radial section views (100x magnification).

*Hardwoods*

Hardwoods (angiosperms) are flowering plants and trees that have broad leaves that usually change color and die every autumn. Bigleaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*), and bitter cherry (*Prunus emarginata*) are examples. The most reliable way to distinguish between a softwood and hardwood microscopically is to examine the cross-section view. Hardwoods, in addition to tracheids, contain thick-walled fibers and large vessel elements. Vessels are specialized cells in hardwood for conducting water and dissolved salts (Pearsall 1989:157). In the cross-section view, vessels are seen as large pores contrasting with the smaller fibers (Fig. 5, left).

The arrangement of the pores in cross-section can be used to identify different hardwoods, as each genus, and frequently species, has unique patterns of these pores, as seen in Fig. 6. Red alder is a diffuse-porous hardwood, with medium-sized pores distributed fairly evenly across both early and latewood. Bitter cherry is also a diffuse-porous hardwood but has a row of pores following the growth ring. Garry oak (also known as Oregon white oak) is a ring-porous hardwood, with a larger row of pores in the earlywood along the edge of the growth ring and smaller pores in the latewood. The vessels in Garry oak also have spidery inclusions called tyloses (Pearsall 1989:158).

Hardwood rays as seen in cross-section can be uniseriate or two or more cells in width (multiseriate), and some species such as Garry oak (*Quercus garryana*) have very wide rays that are diagnostically important in identification (Fig. 6, right).

In the tangential section view, the ends of the rays are visible, as well as the vessels seen running vertically (Fig. 5, center). The individual vessel elements are arranged end to end and are connected by perforation plates; these can be simple holes as in bitter cherry and Garry oak or scalariform, appearing as a ladder-like pattern across the end of the vessel element, as found in red alder. Several hardwood species include spiral thickening in tracheids and vessels, aiding in identification.

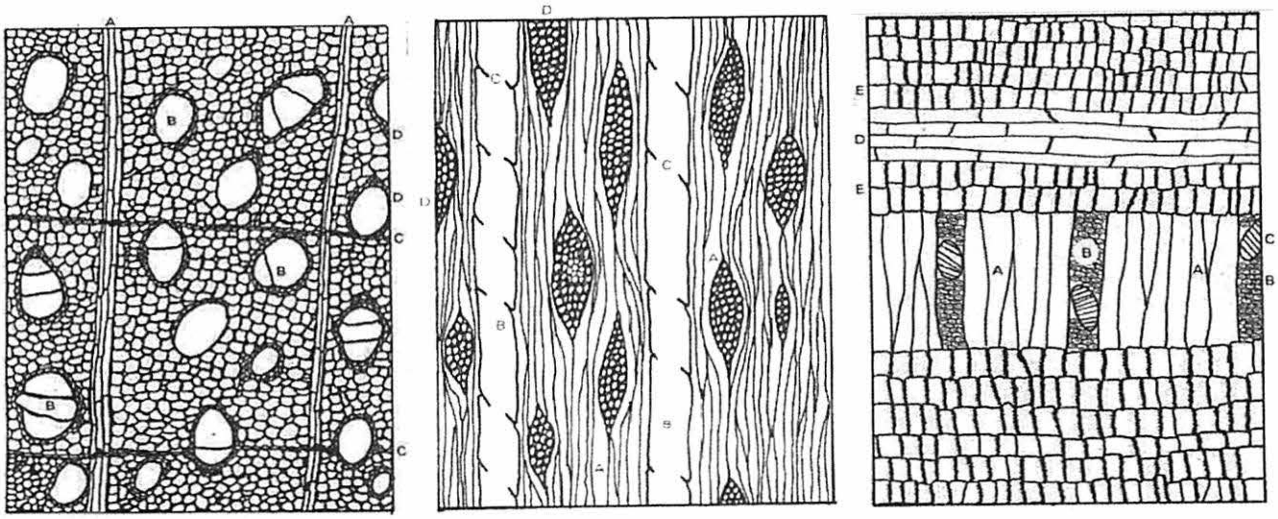



Fig. 5. Stylized drawings of (from left) cross-section, tangential section, and radial section views of a typical hardwood (Friedman 1978).

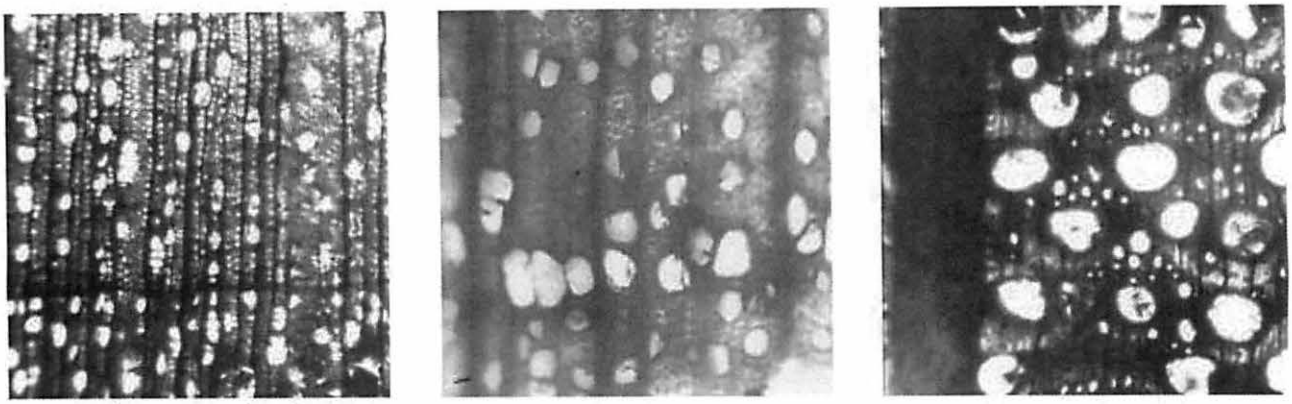


Fig. 6. (From left to right) Cross section views of red alder (Alnus rubra), bitter cherry (Prunus emarginata), and Garry oak (Quercus garryana) showing differing pore arrangements (100x magnification).

*Characteristics of Softwood Bough and Root Fibers*

The process of identifying plant materials and fibers used in basketry and cordage is similar to that of wood; however, not all orientations may be visible. Materials used in basketry such as western red cedar roots and boughs, usually have the cross-section and radial section views available, and occasionally the tangential section can be obtained. In these woody elements, tracheids and rays can be viewed for identification. Differences between bough and root are identifiable microscopically; the wood of boughs has central pith, and the growth rings are similar to trunk wood, with thicker-walled tracheids several cells wide forming the latewood. In root material, the cells are larger and more thin-walled compared with bough material, with a vascular stele in the center, and although growth rings can be found, they consist of fewer cells (Fig. 7).

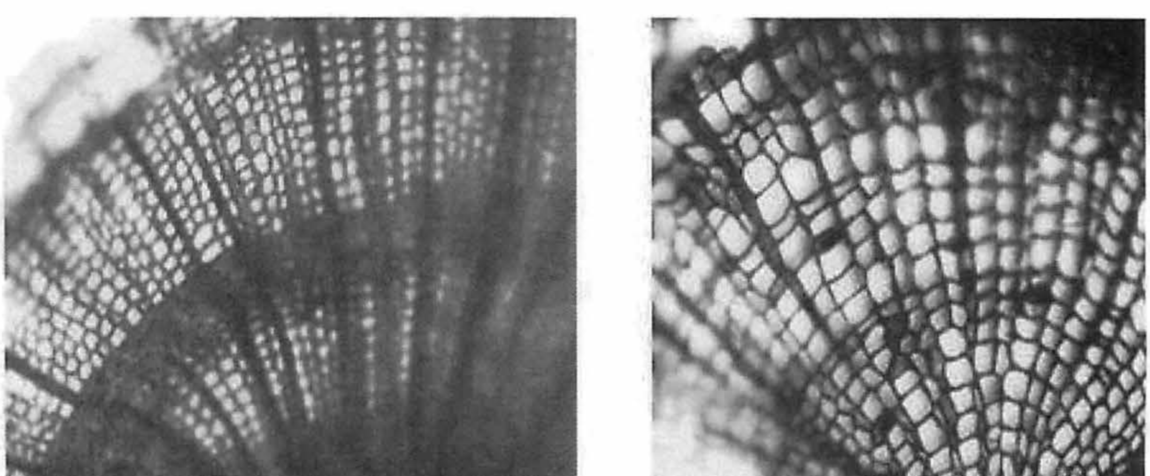


Fig. 7. Cross-section views of western red cedar bough (left) and root (right). Photos courtesy of Vernon Veysey and Daniel Rowley, 2009.

*Flat Inner Bark Elements*

For flat inner bark elements found in checker and twill weaves and braids, the cross-section and/or radial views may not be obtainable. In this case, identification is based primarily upon the tangential section view. Tangential section views can also be obtained from twisted cordage and knots. The secondary phloem tissue of western red cedar (commonly referred to as "bark," although not a true outer bark) is commonly used for these artifacts and often can be identified visually by a characteristic appearance with "fraying" of the fibers, especially after use. This characteristic can also be seen microscopically (Fig. 8).

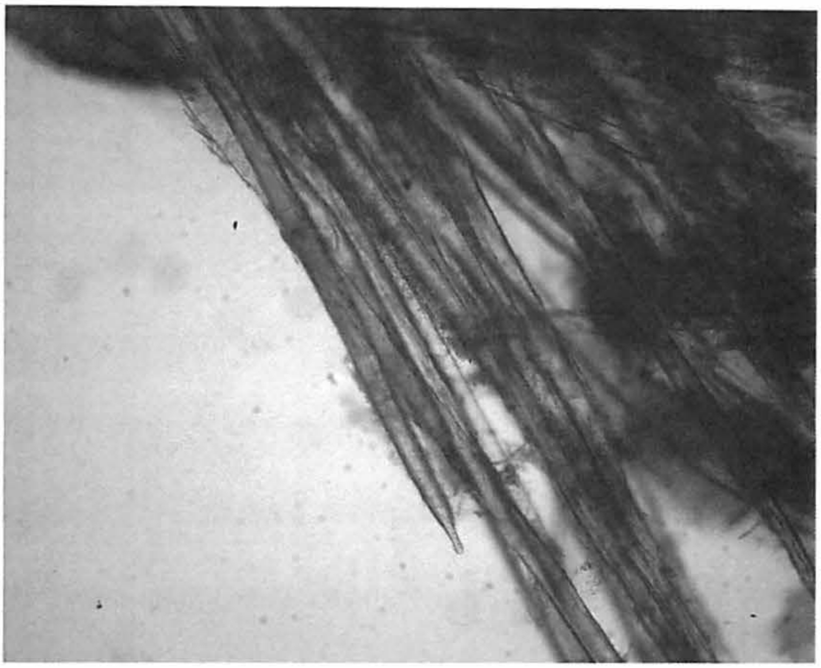


Fig. 8. Western red cedar bark showing "frayed" qualities.

The use of cedar bark for basketry, cordage and clothing has been well-documented among tribes along the Northwest Coast (Stewart 1984:113–153). This indispensable fiber, the inner phloem tissue below the outer layer of western red cedar bark, was traditionally gathered in spring when the sap began to run and the inner bark separated more easily from the tree wood. It was dried in large bundles, to be later softened by soaking in water when needed. Strips of varying widths were split and thinned from the lengths of bark and woven into mats and baskets of various sizes. Cedar bark was also shredded for use in clothing, twisted into string and cordage and pounded into a soft fiber used in infants' bedding and diapers. Yellow cedar (*Chaemocyparis nootkensis)*, less commonly found growing in lowland areas than western red cedar (Pojar & McKinnon 2004:43), was also used in similar ways.

An example of a case study of plant material identification at the Qwu?gwes wet site provides an examples of basketry originally thought to be western red cedar bark, but had a thinner, layered single-element bark-like appearance and lacked the characteristic frayed attribute of cedar bark (Fig. 9). The construction materials of these artifacts, often tumpline straps, strongly resembled the inner phloem fibers of big leaf maple bark (*Acer macrophyllum*), which separates easily into thin sheets when deteriorated or dry (Florian 2002:70; Fig. 10). Microscopically, the fibers also lacked softwood tracheids and included characteristic hardwood multiseriate rays (Fig. 11). Among the basketry identified as woven from big leaf maple bark is a checker weave folded bag/mat. This distinct basketry piece revealed an overlay grass-like white element that presented a pattern across the surface (Fig. 12).

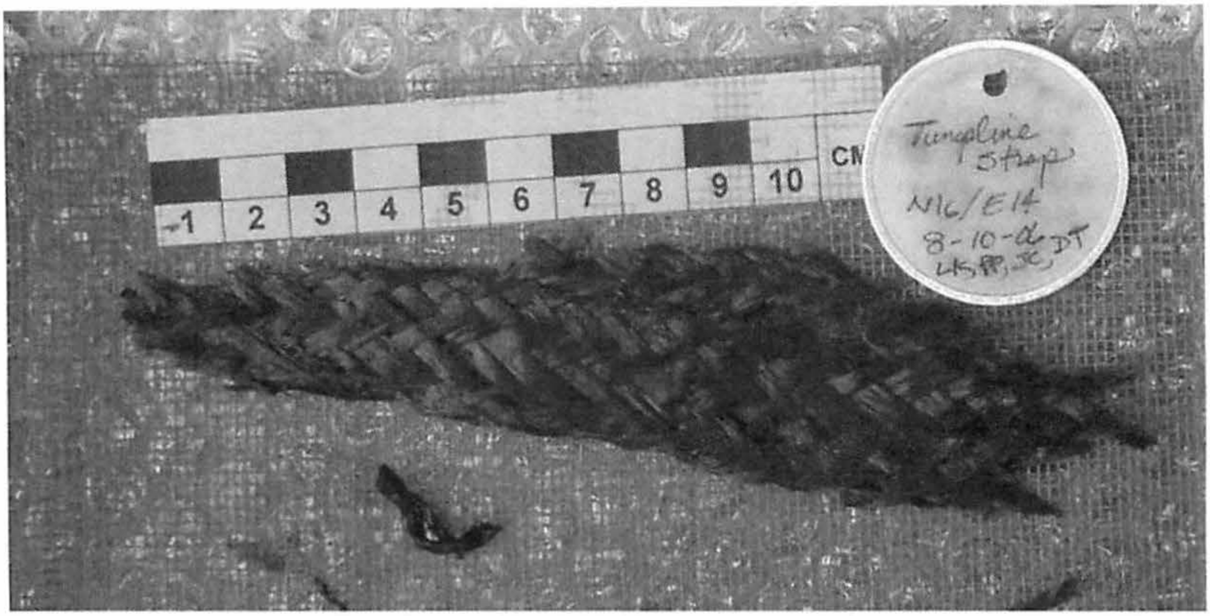



Fig. 9. Twill-on-bias tumpline fragment with layered single- element appearance (N16E14, 45-50, 2006).

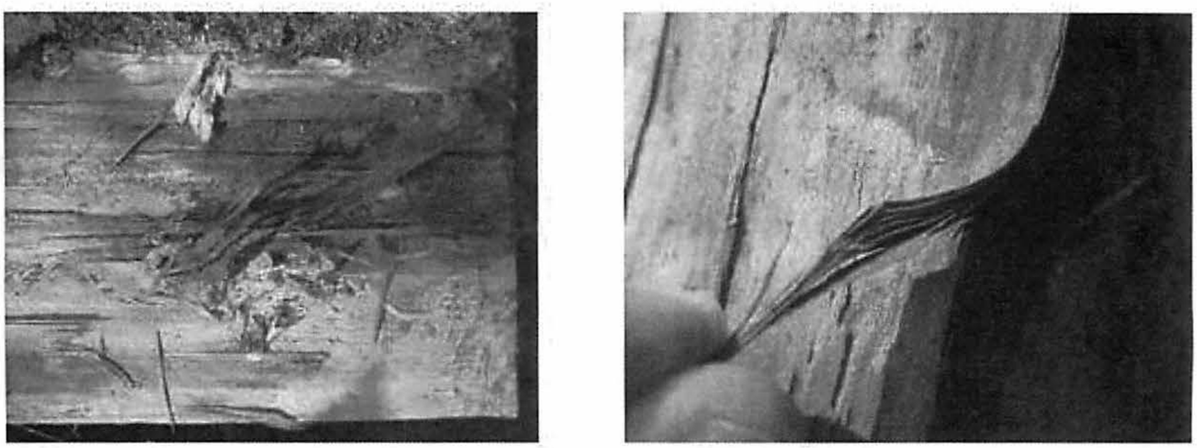


Fig. 10. (Left) Modern big leaf maple (Acer macrophyllum) bark from a mature downed log; (Right) close-up of maple secondary phloem fiber—note the characteristic separation into numerous thin sheets.

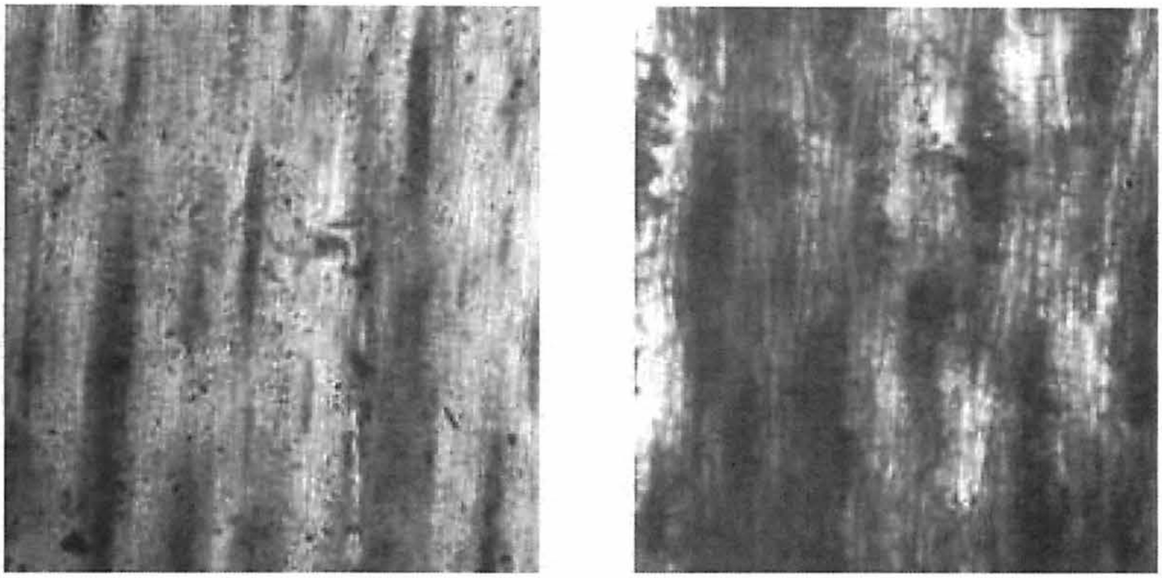


Fig. 11. (Left) microscopic image of sample from ancient tumpline or braid; (Right) microscopic image of modern secondary phloem fibers of big leaf maple (100x magnification).

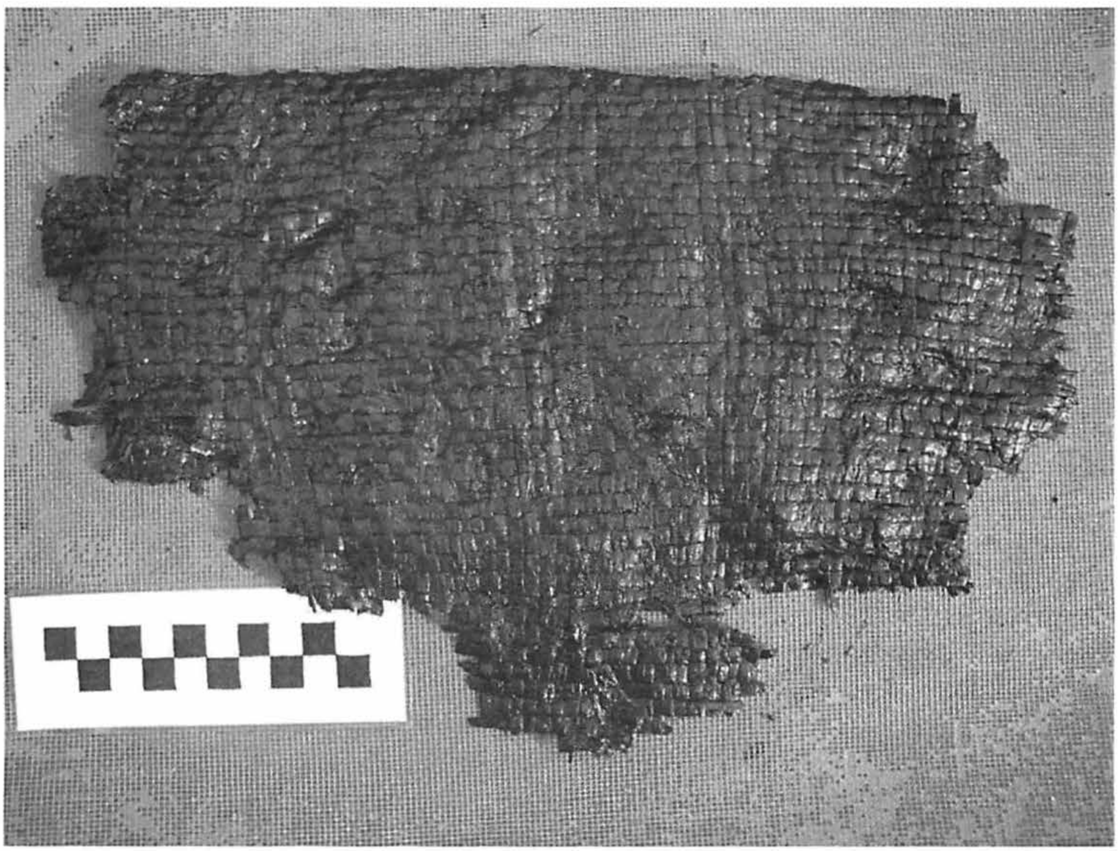


Fig. 12. Example of fine gauge checker weave "matting" identified as big leaf maple (Acer macrophyllum) (N21E14, 55–60, 2004).

Following this discovery, it became clear that the majority of the Qwu?gwes twisted two-strand and braid cordage also was big leaf maple bark (Fig. 13). In the first year of excavation at Qwu?gwes in 1999, a net was recovered from the waterlogged shell midden area, and fragments of net were also discovered in all future years. Although the net fragments appeared to be cedar bark, cellular analysis identified the net and net fragments to be maple bark. This difference is an unusual find, as no recorded ethnographic or archaeological evidence has been found for the use of big leaf maple bark in construction of nets.

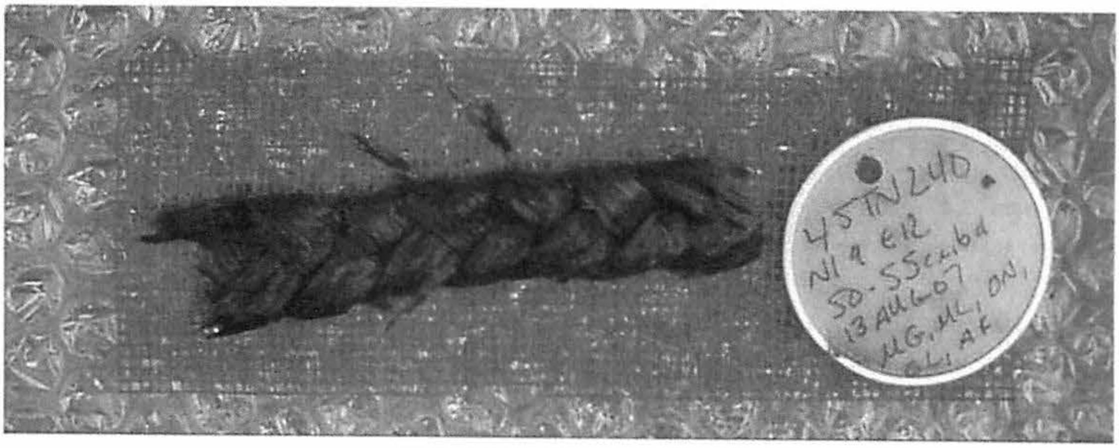


Fig. 13. Braid fragment (N19E12, 50–55, 2007) used to confirm cellular identification of material as big leaf maple bark by Mary-Lou Florian, Research Associate, Royal British Columbia Museum, Victoria, B.C., Canada.

Recent examination and cellular analysis of a braid fragment recovered from the Sunken Village wet site (35-MU-4) in 2007 from Transect III Pit E revealed that the material used in this artifact was also a hardwood, and comparisons with the braid and cordage artifacts from the Qwu?gwes wet site and modern samples of big leaf maple bark identify this braid fragment as woven from big leaf maple. All other cordage and checker weave artifacts examined from Sunken Village were constructed from western red cedar bark. It is possible that the use of this material is more widespread than previously thought and further examination of archaeological cordage and basketry from this area, as well as from other sites in the Northwest, may reveal more examples of the use of big leaf maple's inner phloem fibers.

There is also ethnographic documentation of the use of maple bark on the Northwest Coast. Erna Gunther mentions the use of maple bark for rope and tumplines (1973:39); and carrying straps braided of maple bark and overlaid with beargrass by Puget Sound Tribes (Haeberlin and Gunther 1975 [1930]:33). Maple bark was interwoven with cedar bark strips for use as bowls by the Cowlitz (Gunther 1973:20), and baskets were made from young maple bark for storing acorns in mud by the Chehalis (Gunther 1973:28). The Burke Museum at the University of Washington in Seattle houses baskets in their collections that have maple bark used in their construction, including a vertically twined soft bag with attached tumpline of maple bark and beargrass (Catalog ID:118) collected from Skokomish by Myron Eells around 1892–1893.

An image taken in 1910 shows a young Muckleshoot girl wearing a skirt and cape of shredded cedar bark, with a tumpline woven of maple bark overlaid with beargrass and attached to a basket on her back (Fig. 14; Suttles and Lane 1990: 494).

The use of maple bark has also been documented in other areas of the Northwest Coast. In the north, the Nisga'a of the Nass River and the Gitxsan of the Skeena River in northwestern British Columbia traditionally use both cedar and maple bark in basketry (Laforet 1993:218–231). To the south, the Siletz of the central Oregon Coast traditionally use maple bark for skirts (Robert Kentta, personal communication, 2008); and, at a traditional Renewal Ceremony in 2008, Hawes observed dancers wearing maple bark skirts.

Other archaeological evidence for the ancient use of maple bark by native people is also recorded. At the Glenrose Cannery Archaeological Site (DgRr-6) wet component in British Columbia, which dates to between approximately 4590 and 3970 years B.P., six open wrapped basketry fragments were recovered; four were constructed of true fir (*Abies sp*) with maple bark wrapping and two were entirely constructed from maple bark (Eldridge 1991:30, 37).

Fig. 14. 'Muckleshoot girl, granddaughter of Anne Jack, wearing skirt and cape of cedar bark, which were effective in shedding rain. The tumpline is made of maple bark imbricated with bear grass' (Suttles and Lane 1990:494).

## Wood/Fiber Preferences for Key Ancient Artifact Categories from Northwest Coast Wet Sites

With a growing understanding of plant cellular identification, we can begin looking at the plants and plant parts (wood, bark, boughs and roots) that were preferred for over 10,500 years along the Northwest Coast. Ancient ethnobotanical cultural knowledge transmission often reflects a preference for certain plant or plant parts in making artifacts. As mentioned, some Northwest Coast peoples used the inner bark of the western red cedar (*Thuja plicata*) for basketry and cordage, while others emphasized the use of cedar boughs (splint or twisted).

To illustrate further, we summarize current knowledge of ancient flora construction materials and plant preferences for making ancient (1) wooden wedges, (2) wooden fishhooks, (3) basketry, (4) cordage (including binding straps) and (5) nets.

### *Wooden Splitting Wedges*

The use of wood-splitting wedges, often with a cordage collar on the poll or proximal end, is recorded along the entire Northwest Coast for over 10,500 years, showing the incredible success of this wood splitting technology for at least that period (Table 1). These tools are used to split planks and split out dugout canoes, and also as a primary tool in splitting firewood. The wood used in the production of wedges tended to differ among sites and possibly through time (Table 1). Salish Sea sites of Hoko River, Little Qualicum River, Water Hazard and Musqueam Northeast mostly had wedges made with Pacific yew (*Taxus brevifolia*), while Ozette wedges generally are Sitka spruce (*Picea sitchensis*). Ethnographically, yew wood has been cited as the preferred wood for wedges because of its structural (compression) strength (J. Friedman 1975:115–121). Although Lachane and Ozette wedges were most often made of western fir (*Abies grandis*) and Sitka spruce (*Picea sitchensis*), in both cases the wood used exhibits a condition called compression—or reaction wood (Inglis 1976:166, J. Friedman 1975:121). This kind of wood typically is found on the underside of leaning coniferous trees and is noted for its structural strength (J. Friedman 1975:122). Even though Lachane and Ozette wedge makers did not use yew as the main wedge material, they demonstrated knowledge of wood properties by using the strongest portion of the wood types chosen for the purpose.

### *Wooden Fishhooks*

Over 1,300 wooden shanked fishhooks of three types have been recovered from Northwest Coast wet sites, of which 240 are the self-barbed bentwood fishhooks (called Type B; Fig. 15; Croes 1997, 2001, 2003). The Type B fishhook has the widest distribution in wet sites on the Northwest Coast (see distribution in map, Fig. 1) with at least seven sites recording them, and dating from 500–3000 years ago (Croes 1997, 2001, 2003).

The c. 3,000–2,600 B.P. Hoko River wet site (45-CA-213) has the most Type B hooks recorded (n = 109, with 35 preforms). The fishhooks are believed, through experimental archaeology, to have been used for cod in the off-shore fishing grounds (Croes 1995). Hoko bentwood hooks were shaped from Sitka spruce (*Picea sitchensis*) and true fir (*Abies* sp) (n = 109, Croes 1995:84). The Water Hazard DgRs 30 site in British Columbia yielded seven bentwood hooks, dating to c. 1,980–1,580 B.P. and made from Douglas-fir (*Pseudotsuga menziesii*, Bernick 1989:37). One bentwood hook recovered from the Little Qualicum River Site DiSc 1, British Columbia (Fig. 1), was constructed of fir wood (*Abies spp*) and dated between c. 1,030 and 730 B.P. (Bernick 1983:325). A possible Type B hook was found at the Qwu?gwes wet site (45-TN-240), southern Puget Sound, and is made of western hemlock (*Tsuga heterophylla*) (Hawes 2013).

This type of fishhook does not appear to have been used any longer at contact on the Central Northwest Coast; however, it continued to be used at contact by the Haida and other North Coast groups, who continued using it into the historic period (Croes 1995:104; 1997:607; 2003:54) and typically were used for cod fishing.

TABLE 1. WOODEN WEDGES FROM NORTHWEST COAST WET SITES

| Site | Time Period | No. of Wooden Wedges | Dominant Material Type | Reference |
|---|---|---|---|---|
| **Ozette Village (House 1)** | 300 BP | over 1,000 | Sitka spruce | J. Friedman 1975, 1978; Gleeson 1980, 2005 |
| **Conway** | 500-1000 BP | none recorded | | Munsell 1976:106 |
| **Fishtown** | 500-1000 BP | 5 | ? | Onat 1976:131 |
| **Qwu?gwes** | 500-1000 BP | possibly 1 | western hemlock (Tsuga heterophylla) | Hawes 2013 |
| **Little Qualicum River** | 500-1500 BP | 4 | yew | Simonsen 1976:71; Bernick 1983:326-328 |
| **Axeti** | 500-1500 BP | 21 | ? | Hobler 1970:91 |
| **Lachane** | 1500-2000 BP | 75 | western fir | Inglis 1976:170 |
| **Biederbost** | 1500-2000 BP | present | ? | Croes 1980 |
| **Water Hazard** | 1500-2000 BP | 44 | yew (4) | Bernick 1989:32-37 |
| **Hoko River** | 2500-3000 BP | 47 | yew | Croes 1976:213–214, 1980:268–273, 1995:156–161 |
| **Musqueam Northeast** | 2500-3000 BP | 18 | yew | J. Friedman 1975; Archer and Bernick 1990:27 |
| **Glenross Cannery** | 3500-4500 BP | possibly 1 | ? | Eldridge 1991:51 |
| **Kilgii Gwaay** | 9500-10,500 BP | 5 | western hemlock (Tsuga heterophylla) (1), Sitka spruce (1) | Fedje, A. Mackie, Wigen, Q. Mackie and Lake 2005:187-203; A. Mackie personal communications 2012 |

*Basketry*

Ozette basketry materials are defined in Table 2 and shows how an example of different parts of the same plant (e.g., western red cedar *Thuja plicata*) is used. Under the category "modification," an idealized cross-section through the designated plant part is drawn to illustrate the general method of splitting, thinning, or sectioning. Of the major Northwest Coast wet sites, Ozette has the largest basketry sample (446 examples, not including basketry fragments, from House I alone; Croes 1977). Basketry from other sites varied from 12 to 130 specimens.

Sample size is carefully noted in the comparisons. It should be pointed out that the Ozette Village basketry sample consisted of relatively complete specimens, rather than the generally fragmentary specimens found at most other wet sites. Controlled excavations and labeling techniques at most of the sites being compared indicate which fragments belong to a single specimen.

Most Northwest Coast wet sites have basketry artifacts constructed from similar materials as used at the Ozette Village site. However, the frequency of these basketry materials varies markedly among the different sites. If one compares the frequency graph (Fig. 16) some important patterns can be observed. The two northernmost sites, Lachane and Axeti, have a strong stress on the use of cedar bark basketry materials (100% and 96% respectively) (Fig. 16). The Puget Sound/Gulf of Georgia sites have a 3,000 year duration with a strong stress on cedar splints basketry materials (from 60–98%; Fig. 16). The three earlier sites (2000–3000 years ago: Musqueam NE, Water Hazard, and Biederbost) show the strongest emphasis on splints (90–98%) while the later sites (within the last 1,000 years: Fishtown, Conway and Qwu?gwes) continue to show a strong use of cedar bough splints for approximately 60% of their basketry) (Fig. 16). The Hoko River site on the other hand has a strong emphasis on cedar bark followed by cedar splints, splints/cedar bark, and root basketry materials (Fig. 16). Thus, of the Puget Sound/Gulf of Georgia sites show a positive correlation, whereas the Hoko River site is most similar to the Ozette Village site to which it is spatially very close (Map, Fig. 1), but temporally separated by about 2,500 years. The Little Qualicum River wet site is more diverse in its material selections, and possibly can be considered transitional between major cultural area. These trends were recognized in earlier studies of basketry and statistically correlated (Croes 1977:25–31).

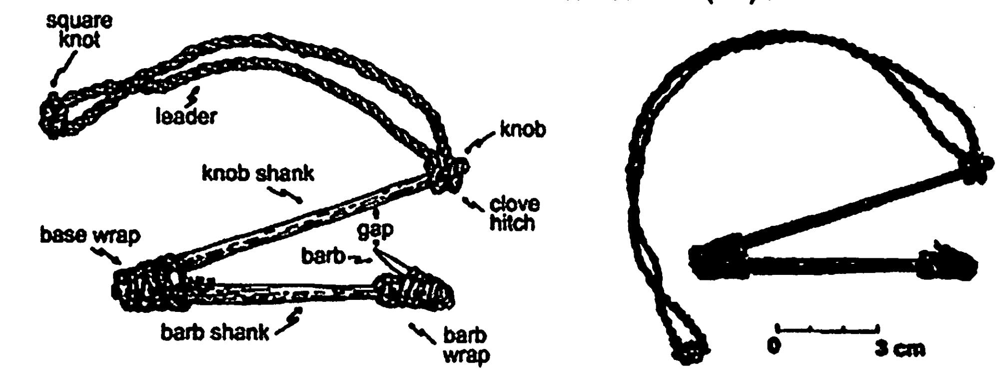
*Cordage*

Northwest Coast wet site cordage is made from different plant parts that are often twisted, braided, or used as flat strip elements (Table 3).

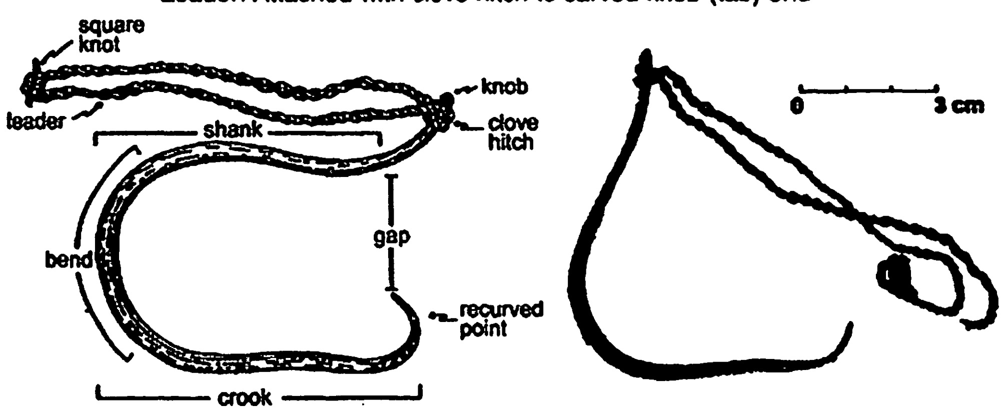
In comparing Northwest Coast wet sites with over 500 examples of cordage (Fig. 17), Hoko River is distinctive because it has revealed such a high percentage of string-gauge, Sitka spruce-rootlet cordage (Croes 1980; Bernick 1983, 1989). The high frequency of spruce-root strings probably reflects, in part, their use as the sewing element in tule mats (HO-M1, Croes 1995:136–138), which were common at Hoko River. Most likely, the mats were used as wall coverings for temporary fishing camp shelters. Thus, the high occurrence of spruce-root strings in the archaeological record appears to be due to the fact that worn-out and fragmented mats were discarded in the offbank area (Croes 1995:136–138, 144).

At Ozette, on the other hand, the most emphasis was given to the use of cedar-bough cordage. This, in part, may reflect the fact that large numbers of single-strand cords were used to hold, in a sling-fashion, the wall boards tied between the double house wall poles (Croes 1980:71–75; Mauger 1978:96–101, 1991:103–107).

**TYPE A** Construction: Composite; two wooden shanks in V shape
Barb: Attached bone bipoint
Leader: Attached with clove hitch to carved knob (tab) end




**TYPE B** Construction: Bentwood
Barb: Recurved self-barbed
Leader: Attached with clove hitch to carved knob (tab) end




**TYPE C** Construction: Bentwood
Barb: Attached bone bipoint
Leader: Attached with clove hitch to centre of top recurve

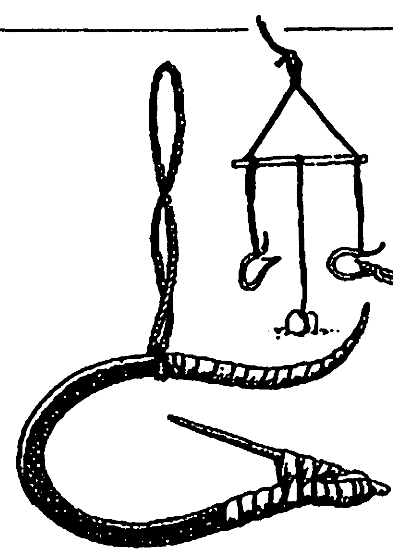
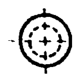
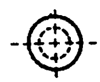
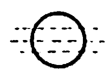
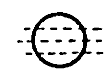
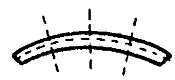
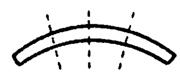
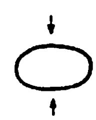
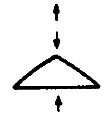


Fig. 15. Definition and illustrations of the three major Northwest Coast wet site fishhook types recovered to date. Type A and B illustrated by Ricky Hoff (1980:163, 166); Type C, Hillary Stewart (1987:89). Photo profiles are examples from the Hoko River site (Croes 1995).

TABLE 2. BASKETRY MATERIALS DEFINED

| Plant | Plant Part | Modification; X-Sec. | | | Name |
|---|---|---|---|---|---|
| 1. *Thuja plicata* | + root | + curvilinear split splints |  | → | Cedar Root Splints |
| 2. *Picea sitchensis* | + root | + curvilinear split splints |  | → | Spruce Root Splints |
| 3. *Thuja plicata* | + boughs (limbs) | + flat split splints |  | → | Cedar Bough Splints |
| 4. *Acer circinatum* | + boughs (limbs) | + flat split splints |  | → | Vine Maple Bough Splints |
| 5. *Thuja plicata* | + inner cortex of bark | + split ribbon strips |  | → | Cedar bark Strips |
| 6. *Prunus emarginata* | + bark (?) | + cut ribbon strips |  | → | Cherry Bark Strips |
| 7. *Xerophyllum tenax* | + leaves | + edges scraped |  | → | Bear Grass |
| 8. *Carex sitchensis* | + leaves (blades) | + split sedge blades |  | → | Split Beach Grass |
| 9. *Scirpus acutus* | + stems | + flattened |  | → | Tule (Bulrush) Stems |
| 10. *Typha latifolia* | + leaves | + flattened |  | → | Cattail Leaves |

At Axeti, the most emphasis was placed on the use of cedar-bark multi-strand cordage of several types (Croes 1980). Water Hazard and Musqueam Northeast appear to have had similar ratios of emphasis on cedar bark and cedar bough cordage (see Fig. 17). However, considerable caution must be taken regarding this pattern, because (1) the Water Hazard artifacts were affected by a dredging operation; therefore, it is difficult to say how fragmented the cordage became when redeposited (Bernick 1989), and (2) the Musqueam Northeast cedar-bark cordage statistics are the result of a high count of net fragments, which actually appears to represent four clusters, or possibly four nets (Archer and Bernick 1990:164). Therefore, these statistics should only be considered a reflection of general trends.

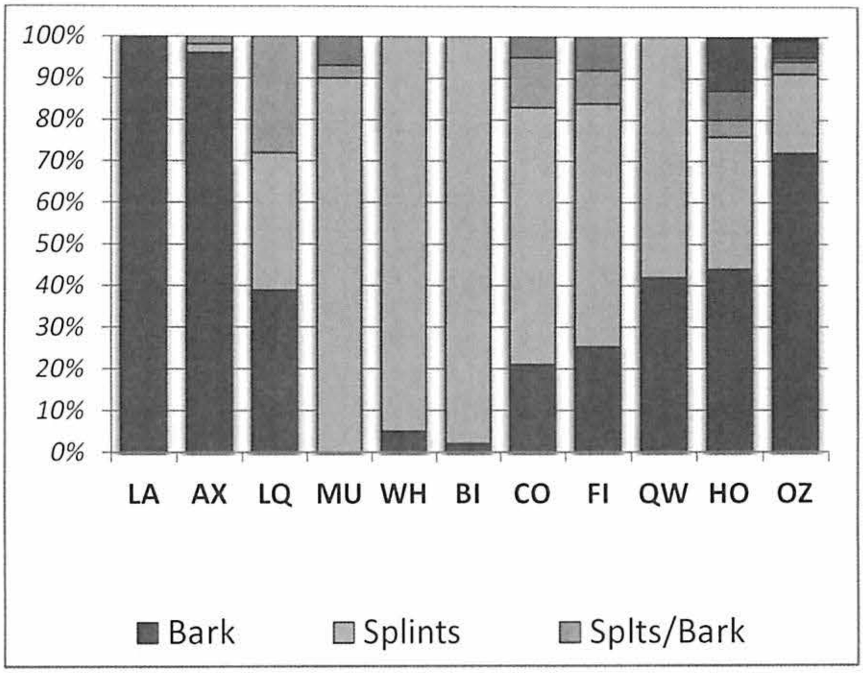



Fig. 16. Northwest Coast wet site basketry construction material emphases: LA=Lachane (N=27), AX=Aexti (N=46), LQ=Little Qualicum River (N=18), MU=Musqueam NE (N=130), WH=Water Hazard (N=102), BI=Biederbost (N=41), CO=Conway (N=42), FI=Fishtown (N=12), QW=Qwu?gwes (N=26), HO=Hoko River (N=202), and OZ=Ozette Village (N=446) (see map, Fig. 1, above).

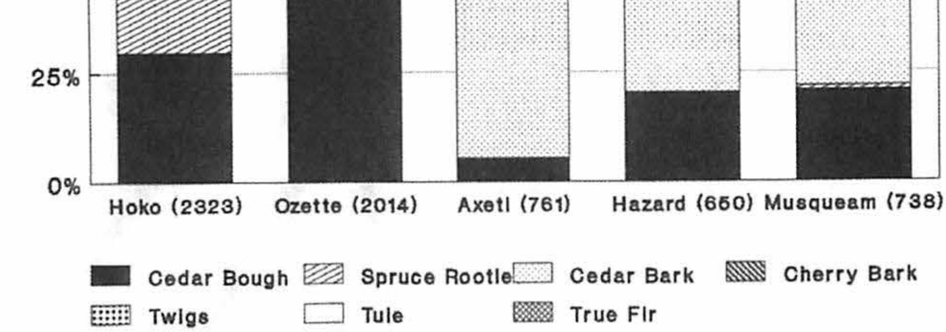
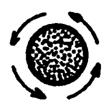
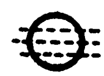



Fig. 17. Percentages of cordage construction material identified at five Northwest Coast wet sites. Based on over 500 examples.

TABLE 3. COMMON NORTHWEST COAST WET SITE CORDAGE MATERIALS

| Plant | Plant Part | Modification; X-Sec. | | Name |
|---|---|---|---|---|
| 1. *Thuja plicata* | + Bough | Twisted |  | Cedar bough withe |
| 2. *Thuja plicata* | + Inner cortex of bark | + Split ribbon strips |  | Cedar bark strips |
| 3. *Picea sitchensis* | + Root | + Twisted |  | Spruce root withe |
| 4. *Thuja plicata* | + Twigs | + Split in half |  | Cedar twigs |
| 5. *Prunus emarginata* | + Bark | + Cut ribbon strips |  | Cherry bark strips |
| 6. *Thuja plicata* | + Bark | + Shredded and twisted fibers |  | Twisted cedar bark fibers |
| 7. *Thuja plicata* | + Root (?) | + Split through center |  | Splint strip |
| 8. ***Acer macrophyllum*** | + Inner cortex of bark | + Split ribbon strips |  | Maple bark strips |

As a form of cordage, coiled strips of cherry bark binding have been found in all extensively excavated Northwest Coast wet sites (Fig. 18). At Qwu?gwes, and other Northwest Coast wet sites, these curls often occur independently, probably examples of discarded surplus from the ends of strips, unwound from artifacts, or stored for later use. Qwu?gwes has more cherry bark curls than all other Northwest coast wet sites combined, even the extensively excavated Ozette Village Wet Site (Fig. 18). However, few cherry bark curls were used to bind the artifacts found at Qwu?gwes. Therefore, it is believed that this site may have been a source for this raw material, similar to a quarry, where it was harvested for later use or traded elsewhere (Croes et al. 2013).

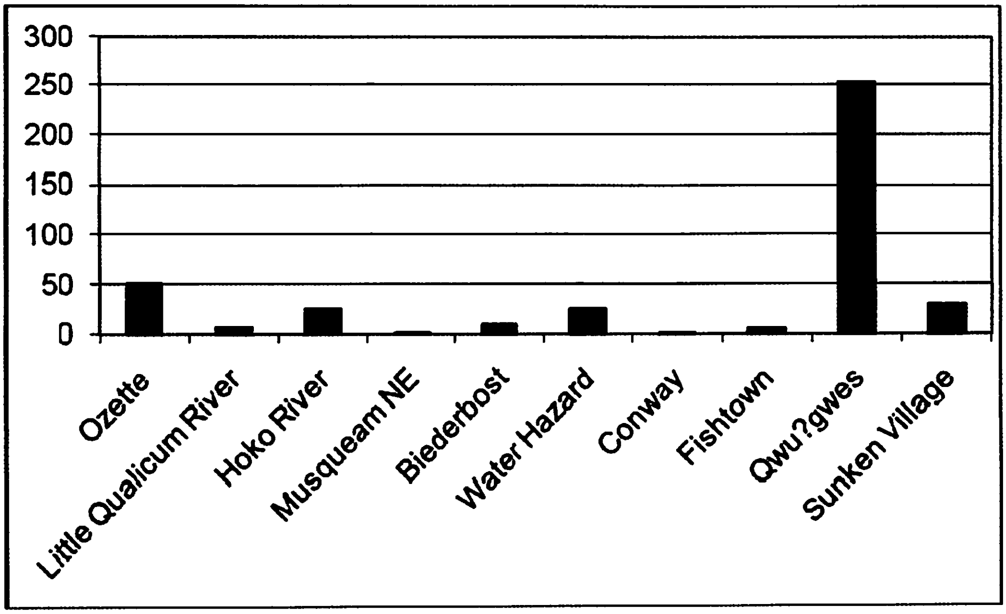



Fig. 18. Number of examples of *Prunus emarginata* strips from reported Northwest Coast wet sites. Qwu?gwes has a noticeable large occurrence – possibly collected for later use or trade.

Biederbost, Conway, Hoko River, Ozette Village, and Qwu?gwes wet sites have examples of cherry bark in a functional context. Therefore, a description of their uses at those sites may help suggest other uses at sites such as Qwu?gwes. Ancient cherry bark strips have been found binding fishhook shanks at Hoko River (Croes 1995:88) and otherwise unmodified anchor stones at Conway (Munsell 1976:121), Hoko River (Croes 1995:177–180) and Biederbost (Nordquist 1961:3–4, 1976:200). The most common use at Ozette Village was in the construction of the whale harpoon equipment (Croes 1980:149).

Other uses observed at Ozette Village include bindings for projectile or spear points, bindings for anchor stones, wrappings in lattice work, imbrications on coil basketry, and weft wrappings in open wrapped west coast burden baskets (Croes 1980:147–150).

A small toy war club, less than 5 cm long was found at Qwu?gwes. The club was constructed using a pebble wrapped onto the end of a cedar stick using cherry bark for binding (Fig. 19). If this artifact were not in a wet site, the pebble would be all that is preserved, and would never be recognized as an artifact (Croes et al. 2013).

The importance of cherry bark as a raw fiber material has not been adequately recognized in Northwest Coast archaeology. Hopefully this overview of cherry bark sheds some light on the importance of this raw material through, no doubt, a vast time period.

*Nets*

This important fishing equipment has been found from many Northwest Coast wet sites. The oldest net so far dates to approximately 5,000 years old (C14 dating) from the Lanaak wet site (49-XPA-78) on southern Baranof Island, southeastern Alaska (Table 4, Bernick 1999) supporting the fact that netting is a very ancient technology along the Northwest Coast. The uses also vary from smaller mesh dip nets to larger web gill nets (Table 4). Qwu?gwes is the only site where big leaf maple bark is extensively used to make nets (Hawes 2013).

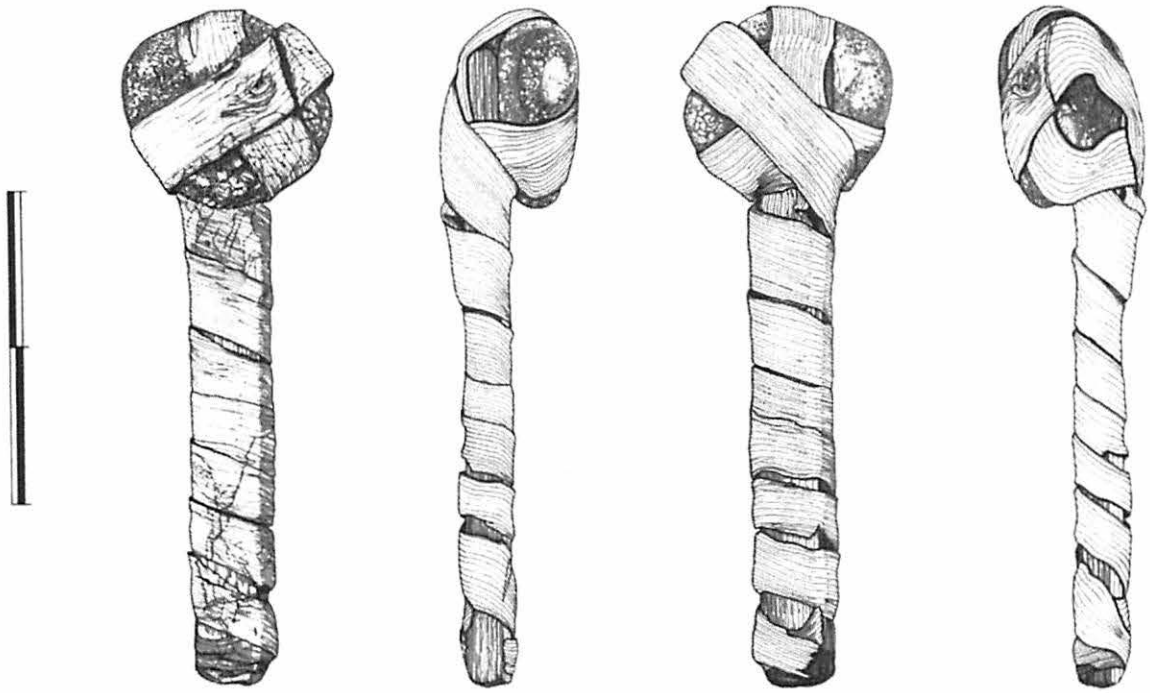


Fig.19. Example of a miniature toy war club from Qwu?gwes wet site (scale=cm; N19E12, 40-45, 2007); the handle is split cedar wood, the wrapping is a cherry bark strip and the head is a green sedimentary pebble (Illustration by Candra Zhang, 2009).

TABLE 4. CURRENTLY RECORDED NORTHWEST COAST WET SITE NET SUMMARY, OLDEST TO YOUNGEST

| ***Wet Site*** | **Date** | **Construction Material** | **Ply Direction** | **Mesh Size** | **Proposed Use** |
|---|---|---|---|---|---|
| Lanaak, Baranof Island, SE Alaska (49XPA78) | 5,000 B.P. | *Picea sitchensis:* Sitka Spruce Root | None-Single Filament | 3.5-5.0 cm | Dip Net |
| Hoko River (45CA213) NW Olympic Peninsula | 3,000 B.P. | *Picea sitchensis:* Sitka Spruce Splint Limbs | None- Single Filament | 10 cm | Gill Net |
| Musqueam Northeast (DhRt4) Fraser Delta | 3,000 B.P. | *Thuja plicata:* Western Red Cedar Inner Bark | Z-ply | 15 cm | Gill Net |
| Water Hazard (DgRs30) Fraser Delta | 2,000 B.P. | *Thuja plicata:* Western Red Cedar Inner Bark | S-ply | 8.9 cm | Gill Net |
| Qwu?gwes (45TN240) Southern Puget Sound | 500 B.P. | *Acer macrophyllum:* Bigleaf (or Broadleaf) Maple Inner Bark | S & Z-ply | 8.4 cm | Gill Net and Dip Net |
| Ozette Village (45CA24) NW Olympic Peninsula | 300 B.P. | *Picea sitchensis:* Sitka Spruce Root | Z-ply | 3.8 cm | Dip Net |

## Northwest Coast Archaeological Plant Technology—Case Study of Salish Sea Wet Site Perishable Artifact Comparisons

In 2009, the name ***Salish Sea*** for the inland marine waters of British Columbia, Canada and Washington state, USA was officially adopted. The Salish Sea forms a *single functioning estuarine ecosystem* (previously referred to as the *Georgia Basin–Puget Sound* watershed; Fig. 20). The northern Salish Sea has been the region for developing this region's archaeological phases, largely through the stone, bone-antler, and shell (SB-AS) artifacts from common shell midden sites (Table 5). We have chosen this region for a case study comparing wood and fiber artifacts from wet sites in this overall region to show how these abundant perishable artifacts have shifted perspectives on cultural evolution in this region.

With the expanding excavation of Northwest Coast wet sites, we can now examine the technically most sensitive artifact of all—ancient basketry. In contrast to stone, bone-antler and shell (SB-AS) artifacts, basketry construction involves fundamental technical complexities that "objectify themselves in the product and are not lost in the process of making" (Weltfish 1932:108); basketry is an additive technology not unlike ancient pottery in other parts of the world. As Adovasio in his North America-wide examinations of ancient basketry, mostly from dry cave sites, points out:

> . . . few classes of artifacts available to the archaeologist for analysis possess more culturally determined and still visible attributes than basketry. . . . It appears to be an established fact that no two populations ever manufactured their basketry in precisely the same fashion. Not only is this ethnographically demonstrable, it also seems to be archaeologically valid as well (Adovasio 1974:102).

In a study of over 2,800 Northwest Coast ethnographic museum baskets, Joan Megan Jones statistically verified the correlation of basketry types and "tribal" groupings (1976:173). As with these museum and contemporary Northwest Coast basketry traditions, these cultural distinctive techniques and styles no doubt have considerable time depth and can be used to identify the distinctive cultural styles of ancient Northwest Coast groups. For the Salish Sea itself, the data reflects an outside Wakashan style versus an inside (inland sea) Coast Salish styles through at least 3,000 years of time.

Ancient basketry in the Salish Sea and surrounding areas have revealed a pattern that regionally cross-cuts the Phases or Culture Types established well by SB-AS artifacts: Locarno Beach, Marpole and Gulf/Late Phases (Fig. 21; Table 5). Possibly this is the result of different kinds of cultural transmission, affecting different categories of artifacts differently. We argue that SB-AS artifacts tend to be *subsistence* and *manufacturing* related artifacts, as are those made of wood and fiber, as discussed above, including fishhooks and nets (*subsistence*) and wooden splitting wedges (*manufacturing*). These categories of subsistence/manufacturing artifacts are probably rapidly dispersed through diffusion, or a process called blending/ethnogenesis (Croes 2005:231–232).

A good example of a wooden *subsistence* artifact is the self-barbed bentwood fishhooks with a knob leader attachment (Type B; Fig. 15). This artifact appears to cross-cut basketry style areas (C and A in Fig. 1) as do the SB-AS artifacts that define phase designations (see map of Type B bentwood fishhook distribution in Fig. 1, above; Croes 1997). Therefore, not unlike SB-AS subsistence artifacts, this Type B wooden fishhook blends through diffusion across the region and through time. In fact, this fishhook type, no longer seen into the historic period in the Salish Sea region, appears to continue in use on the historic North Coast Tlingit-Haida areas as the main cod-fishing hook (Stewart 1982; Croes 1997).

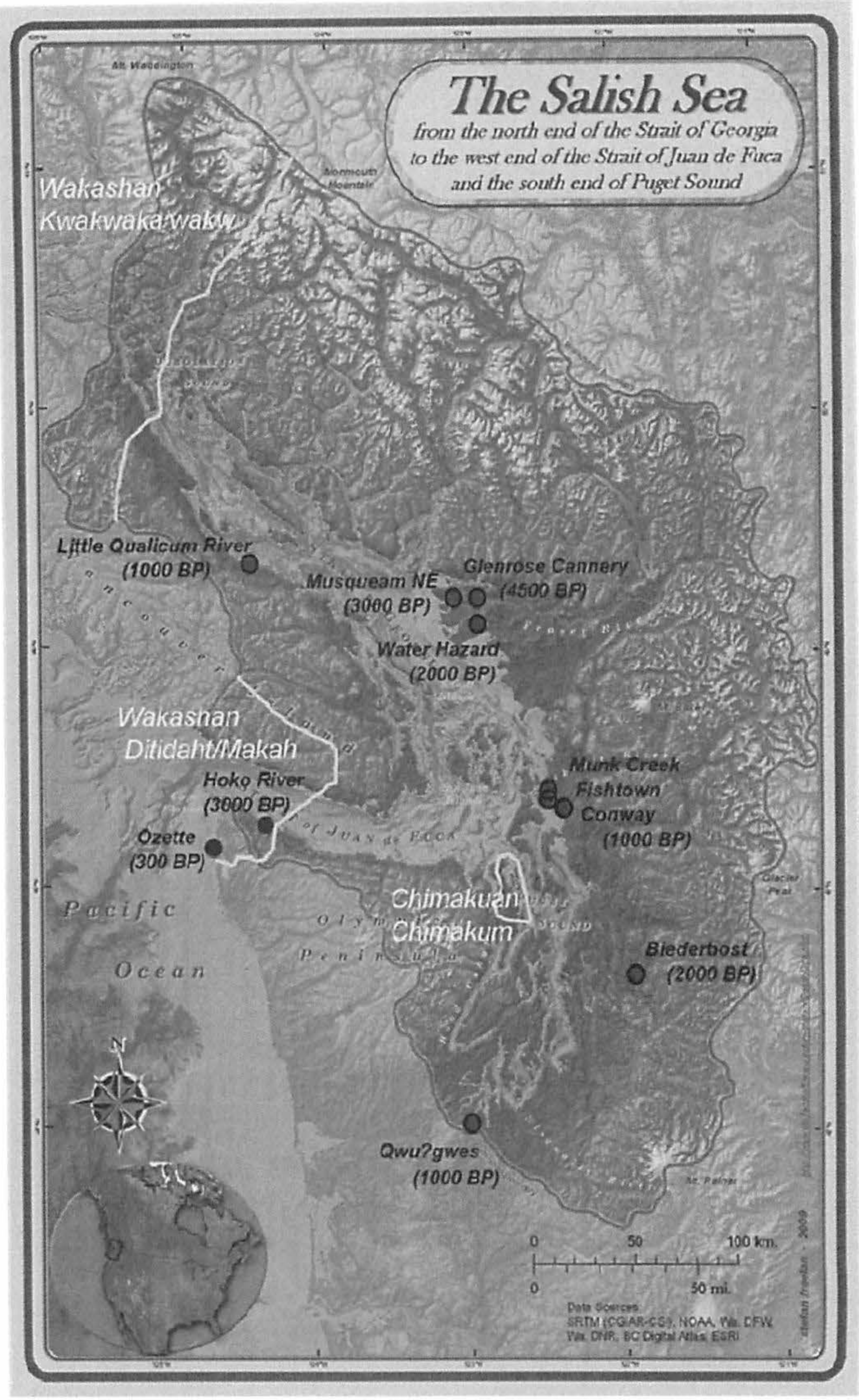



Fig. 20. Map of the Salish Sea, showing locations of different contact-period ethnographic groups in this largely Coast Salish region (outlined in white), and the locations of wet/waterlogged sites artifacts (base map courtesy Stefan Freelan, 2009).

TABLE 5. EXAMPLES OF PROPOSED SUBSISTENCE, MANUFACTURE, AND CONTAINER/ LINES ARTIFACTS FOUND IN ASSOCIATION WITH SALISH SEA PHASES DEFINED MOSTLY IN THE GULF OF GEORGIA REGION[1]

| Phase/Culture Type | Artifacts Represented |
|---|---|
| **Locarno Beach** | |
| *Subsistence* | medium-sized flaked points; quartz crystal microblades & microcores; flaked slate/schist; microflakes made with bipolar flaking technique **[Wet (H): hafted in split cedar handles as fish fillet knives]**; large faceted ground slate points; ground slate knives; many quartz crystal microblades **[Wet (H): end hafted on split cedar handle]**; grooved and notched sinkers; **[Wet (H,M): cherry bark wrapped stone sinkers]**; handstone and grinding slabs; unilaterally and bilaterally barbed antler antler points; **[Wet (H): unilaterally barbed wooden points with line guards]**; antler toggling harpoon heads; antler harpoon foreshafts; **[Wet (H, M): Fiber gill nets], [Wet (H): wooden shanked fishhooks, Types A and B, Fig. 15]** |
| *Manufacturing* | small, well-made ground stone celts; **[Wet (H, M): wooden splitting wedges]**; heavy bone wedges; antler wedges; mussel celts; sandstone abraders; **[Wet (H): wooden tule mat creaser]** |
| *Fiber Containers/Lines* | **[Wet (H, M): baskets (numerous types), cedar and tule mats, tumpline straps, hats; ropes, cords and strings]** |
| *Other* | ground stone and coal labrets; **[Wet (H): decorated wooden blanket or hair pin]** |
| **Marpole** | |
| *Subsistence* | flaked stone points in a number of forms; microblades and microcores; large leaf-shapped and smaller triangular ground slate points; thin ground slate knives; handstones and grinding slabs; barbed, nontoggling antler harpoon points with a tang, lineguard or line hole, most unilaterally barbed; **[Wet (W, B): wooden shanked fishhooks, Type B, Fig. 15] [Wet (B): cherry bark wrapped stone sinkers]; [Wet (W): Fiber gill nets]** |
| *Manufacturing* | ground stone celts; **[Wet (W, B): wooden splitting wedges]**; antler wedges; antler sleeve hafts; stone hand mauls, with nipple or decorated top; sandstone abraders; sectioned and split bone awls |
| *Fiber Containers/Lines* | **[Wet (W, B): baskets (numerous types), cedar mats, tumpline straps; ropes, cords and strings]** |
| *Other* | disk beads of shale or clamshell; ground stone labrets; stone sculptures, including decorated bowls, seated human figures |
| **Gulf/Late Phase** | |
| *Subsistence* | small, triangular flaked basalt points; thin triangular ground slate points; thin ground slate knives; unilaterally barbed bone points; bone single-points and bipoints; **[Wet (O): bone bipoints in wood shanked fishhooks]**; antler composite toggling harpoon valves; ground sea mussel shell points; **[Wet (O, Q): Fiber dip and gill nets], [Wet (O, Q): wooden shanked fishhooks]; [Wet (C, O): cherry bark wrapped stone sinkers]** |
| *Manufacturing* | large ground stone celts, sandstone abraders; flat-topped stone hand mauls; split and sectioned bone awls; **[Wet (O, C, F, Q): wooden splitting wedges]**; antler wedges |
| *Fiber Containers/Lines* | **[Wet (O, C, F, Q): baskets (numerous types), cradles, cedar and tule mats, tumpline straps, hats; ropes, cords and strings],** |
| *Other* | decorated antler combs; decorated bone blanket or hair pins |

[1] Source for stone, bone-antler, shell (sb-as) artifact types: Mitchell (1990:340-348). Wet site abbreviations: h: Hoko; m: Musqueam ne; w: Water hazard; b: Biederbost; c: Conway; f: Fishtown; q: Qwu?gwes; o: Ozette.

A second example of broad diffusion/blending distribution is the wooden splitting wedge with rope collar, a *manufacturing* artifact. This type of collared wooden splitting wedge tool is found in all Northwest Coast wet sites for at least 10,700 years, as seen at the oldest known aquifer wet site, Kilgii Gwaay on southern Queen Charlotte Island, B.C. (Fedje and Mathewes 2005:198–203). This manufacturing artifact certainly demonstrates the success and longevity of this woodworking technology and how it was shared through time and space on the ancient Northwest Coast.

Basketry is often considered a *container* category of artifact, and, as with ceramics in the Southwest, can be made with a wide variety of techniques that can reflect emblemic styles—reflecting culturally who the makers represent (Wiessner 1983). Technically basketry is so diverse, through both weaving and sewing techniques, that in manufacturing techniques can be used for family and community cultural identity. The methods are often guarded in ther cultural transmission through a process called branching/phylogenesis (Croes 2005:232–233). In this branching/phylogenesis process:

> the similarities and differences among cultures are the result of a combination of predominately within-group information transmission and population fissioning. The strong version of the hypothesis suggests that 'Transmission Isolating Mechanisms' (TRIMS) (Durham 1992) impedes the transmission of cultural elements [considered basketry elements/styles here] among contemporaneous communities. (Collard, Shennan and Tehrani 2006)

A graphical representation of the way we perceive the processes of blending/ethnogensis and branching/phylogenesis is provided in Fig. 21. The newly analyzed ancient basketry tends to be guarded by communities/families and branches between regions through time as a form of emblemic styles or identity (Croes 2012a). Blending/ethnogenesis processes are proposed to define ancient Salish Sea Phases—Locarno Beach, Marpole, Gulf/Late—through rapid diffusion of good ideas for *subsistence* and *manufacturing* artifacts, whether wood/fiber or SB-AS varieties. Also these Salish Sea archaeological phases have been characterized as economic stages and/or plateaus that all Salish Sea area groups went through, reflected in the subsistence and manufacturing artifacts shared across the region (Croes and Hackenberger 1988).

To demonstrate statistically how these ancient Northwest Coast basketry technologies have shown these branching patterns in the Salish Sea region, we have carefully defined and compared their (a) modes or attributes, (b) types or classes, and (c) functional categories to show how they reflect potential emblemic sensitivity (Croes 1975, 1977, 1989, 1992a, 1992b, 1995, 2005). Eighty four distinct basketry modes or attributes systematically derived from the character dimensions of *basketry construction materials, shapes, construction techniques, selvages, gauge of weave, size and surface ornamentation* were compared individually among the twelve major Northwest Coast wet sites, nine or 75% of which are within the core Salish Sea region (Figs. 1 and 20).

Initial studies focused on using cluster analyses to measure degrees of similarity. Recent studies have used cladistic analyses, which more specifically define phylogenetic relationship in terms of relative recency of common ancestry. Ultimately, cladistic analysis seeks to find a special similarity rather than overall similarities.

The earlier resulting site average linkage clusters are regional, even though spatial and/or temporal considerations are not introduced as factors in the testing (Croes 2005; Fig. 22). The similarity coefficient between the regionally close Hoko River and Ozette (A cluster) is not as strong as between the temporally closer Musqueam Northeast, Water Hazard and Biederbost (3–2000 B.P., C1 cluster), or Qwu?gwes, Conway, and Fishtown (1000 B.P., C2 cluster) sites, but the A cluster similarity distance can be explained by (a) 2,500-year temporal distance and (b) the fact that the Ozette collection represents a *primary deposition*, containing an entire winter village house assemblage preserved under a massive mudslide, whereas the Hoko deposits are secondary, being discarded, typically broken examples from along a fishing camp beach. Therefore, as expected, Ozette has a much wider variety of available "household" basketry, making this clustering worthy of note.

The same presence/absence data was used to conduct the cladistic statistical analyses. However, these tests explore exclusive common ancestry as indicated by evolutionarily novel or derived character states. The resulting unrooted cladogram shows a similar and complimentary pattern to the average linkage cluster analyses, additionally supporting the cultural connections of basketry styles through time and space of these Northwest Coast sites (Fig. 23).

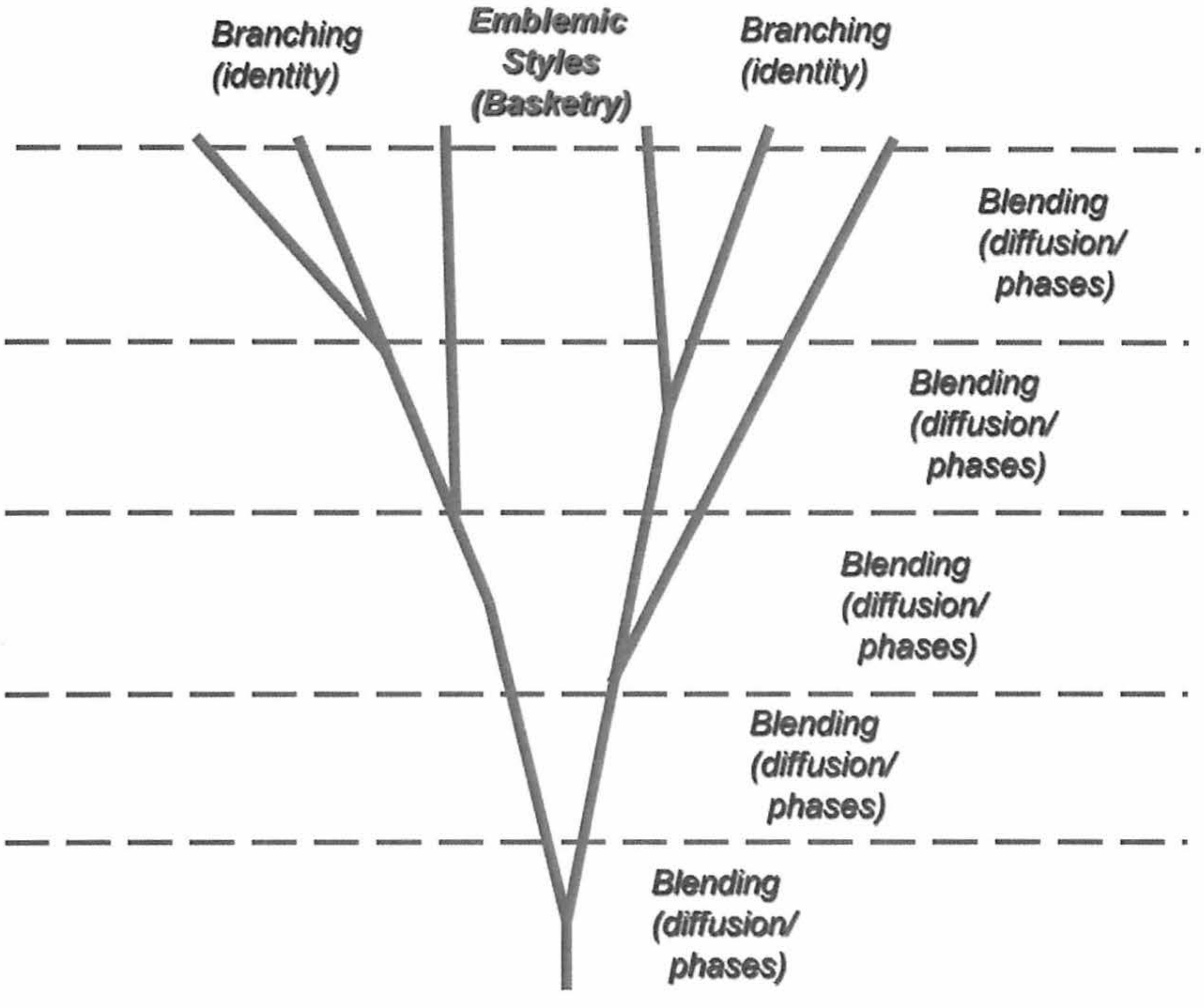



Fig. 21. Idealized example of how artifact categories (especially subsistence and manufacturing) may be shared across the region through blending/ethnogenesis, largely through rapid diffusion during economic shifts (or stages; also see Croes and Hackenberger 1988), and how proposed emblemic basketry artifacts branch through the region through guarding of techniques that reflect cultural identity through branching/phylogenesis.

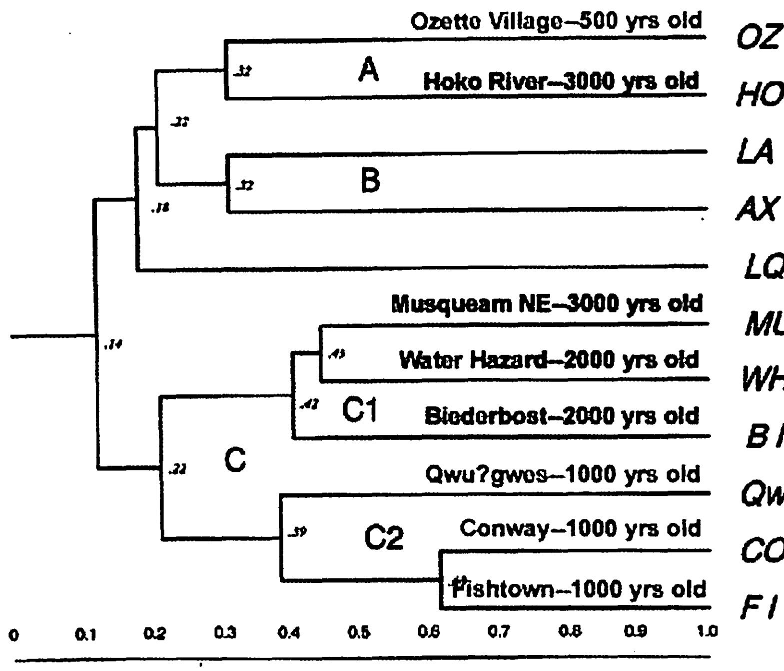



Fig. 22. Dendrogram representing an average linkage cluster analysis of Northwest Coast wet site basketry attributes (modes) on a matrix of Jaccard's Coefficient (degrees of similarity: 1=complete similarity, 0=no similarity). Data as of 2012, using current Hoko River and Qwu?gwes data and Bernick (1983, 1989); see Fig. 1 for site locations.

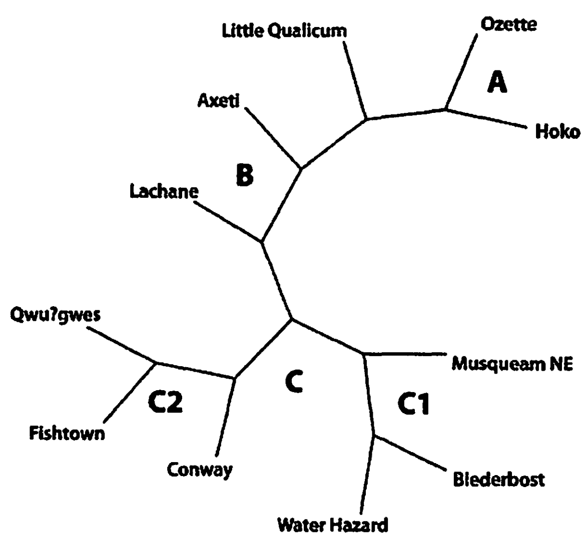



Fig. 23. Unrooted tree diagram based on PAUP software—Phylogenetic Analysis Using Parsimony—statistical test of Northwest Coast wet site basketry attributes (modes). Data as of 2012 using current Hoko River and Qwu?gwes data and Bernick 1983, 1989; see Fig. 1 for site locations). From this data and results we would propose that ancient Coast Salish basketry is represented for 3,000 years from sites in Area C (C1 sites: 2000–3000 years ago, C2 sites: 500–1000 years ago) and propose the top end branch is representing Wakashan basketry sites for 3,000 years in Area A. For additional details and discussion of all the sites and analysis, see Croes, Kelly, and Collard (2005:137–149).

The association of sites in both statistical tests of Musqueam Northeast—Water Hazard—Biederbost (C1 cluster; a spatial spread of 125 miles as the crow flies, and further spatial spread than between Musqueam and Hoko (about 100 miles)), and the Conway—Fishtown—Qwu?gwes (C2 cluster; with a 125 mile spread) basketry modes is particularly tight and is proposed to represent a Gulf of Georgia/Puget Sound (main reach of Salish Sea) inland sea Coast Salishan stylistic region (Fig. 24, cluster C) (Croes 1977:195–199).

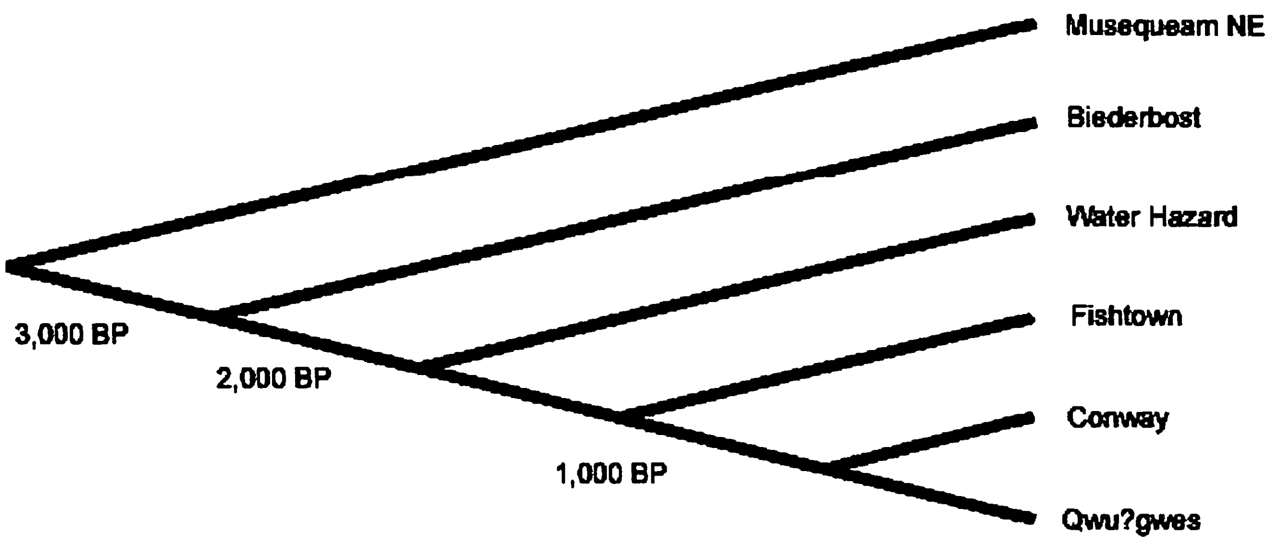



Fig. 24. Slanted cladistic analysis cladogram derived from Gulf of Georgia-Puget Sound wet site basketry attributes (modes) creating a phylogenesis tree of Coast Salish basketry style and proposed ethnic linguistic inter-connections in the heart of the inside Salish Sea for 3,000 years (based on PAUP software). See this as Area C in Fig. 23.

The pattern of branching basketry style continuity on the Northwest Coast, and especially the Salish Sea case study, can be graphically depicted through time and space and reflects how these artifact styles cross-cut through for at least 3,000 years the phases defined by SB-AS artifact types, mostly associated with *subsistence* and *manufacturing* tasks (Fig. 25).

A good example of likely embleic style differences at contemporary, 3,000 year B.P., Musqueam Northeast and Hoko River wet sites are the common pack baskets at each fishing camp. The carrying or burden basket comprise of over 50% of all baskets at each site (Croes 2005:239); however, the weave on the bottom and body, and the handle and tumpline attachments on these baskets were distinctly different at each site (Fig. 26). Although the burden basket is quite common at each of the 3,000 year old wet sites, they are very different in technology and style—but no doubt equally efficient as carrying or burden baskets. At this 3,000 year old time period we would suggest that someone seeing one of these baskets, and possibly a person carrying one, would identify the basket and carrier as an outside West Coast or inside Salish Sea person. Alternatively, if one saw a basket load of some product in one of these baskets, they would know its origin. Because of the continuity of styles through time on the outside West Coast and inside Salish Sea, one potentially may also be able to recognize that the person was ancestral Makah or Coast Salish too.

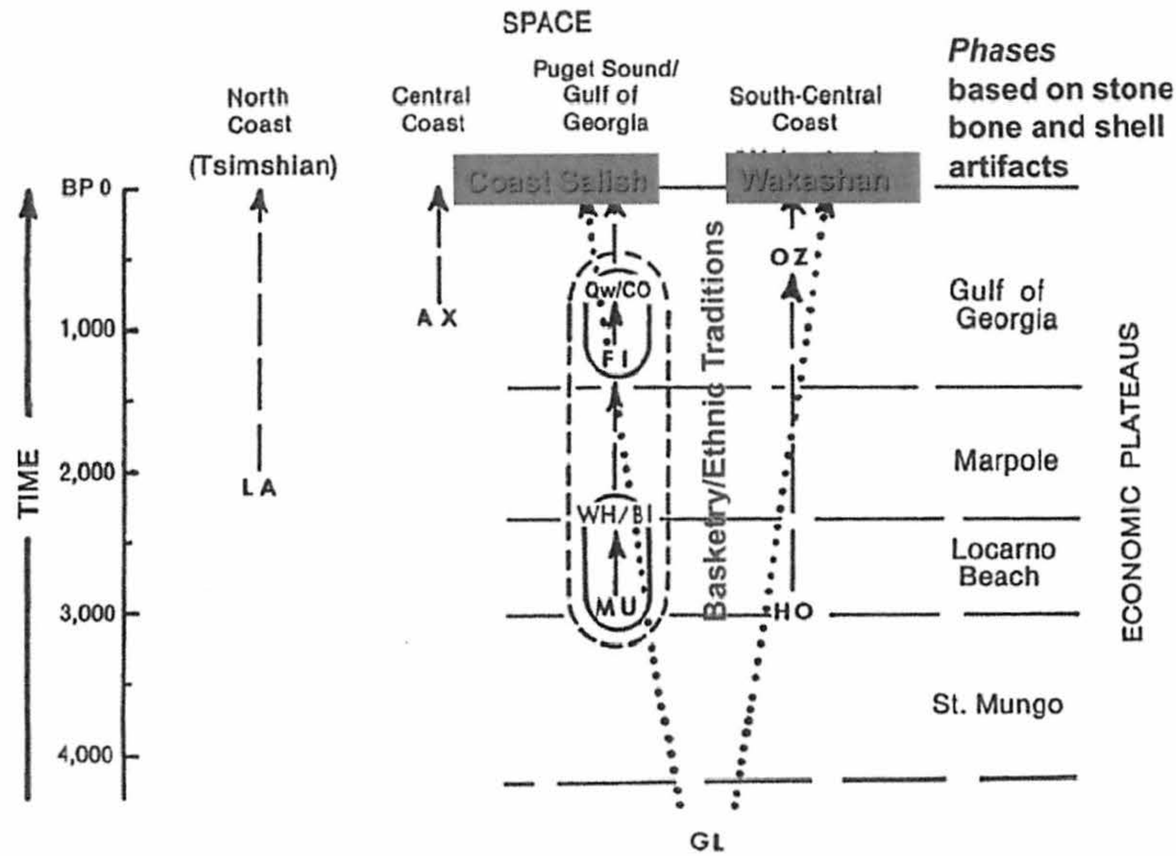



Fig. 25. Hypothetical branching stylistic/ethnic phylogenetic continuity patterns, based on basketry artifact analyses which cross-cut ethnogenetic phase designations based on Central Coast SB-AS artifacts (for site abbreviations, see Fig. 1; also, for a different rendition of the Coast Salish continuity see Fig. 24). Note: when looking at only SB-AS artifacts from Ozette, it reflects the Gulf of Georgia Phase, though clearly Makah in perishable artifacts from the wet site (see Croes, Kelly and Collard 2005:141–154).

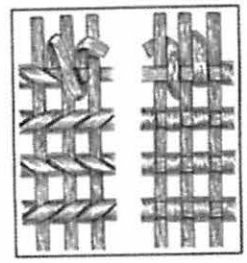
## Conclusion

Wet site paleoethnobotanical research has broad potential for learning about the wood and fiber technologies used by ancient- and contact-period people on the Northwest Coast. Using preliminary case studies that focused on micro- and macro-floral identifications and technological comparisons through time and space, a framework has been developed for use of these materials throughout the Salish Sea. Major artifact categories used to develop this framework include subsistence (e.g., wooden shank fishhooks and nets), manufacture (e.g., wooden wedges, wood chip debitage and basketry element debitage), containers (e.g., basketry and wooden boxes/bowls), and tying (e.g., cordage and binding elements). Given that wood and fiber materials comprised perhaps as much as 90% of the material culture in a pre-contact community, evidence from wet sites reveals technological complexity that can be used to better explain defined archaeological phases as economic stages that are cross-cut through time by the branching basketry styles that better reflect cultural identity. Together non-perishable and wet site perishable artifacts have great potential for developing holistic views of the overall ancient cultural dynamics from this distinct Northwest Coast region.

**Definition** | **Illustrated Reconstruction and Frequency of Occurrence**

HOKO BASKET (N=82)

HO-B1 MATERIAL: splints
SHAPE: inverted, sub-rectangular, truncated cone or ?
BASE CONSTRUCTION: wrap twining over expanding weft base or ?
BODY CONSTRUCTION: open wrapping
EXTENSIONS: none or double tumpline loops



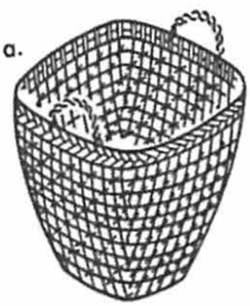
(n=61, 74%)

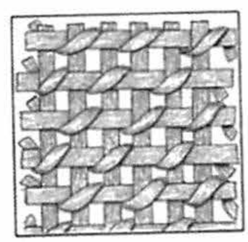
**Definition** | **Illustrated Reconstruction and Frequency of Occurrence**

MUSQUEAM NORTHEAST BASKET (N=114)

MU-Bl. MATERIAL: splints (cedar)
SHAPE: inverted, sub-rectangular, truncated cone or ?
BASE CONSTRUCTION: twill 2/2 or twill 3/3 or ?
BODY CONSTRUCTION: wrap around plaiting
EXTENSIONS: single opposing looped handles, series of looped handles or ?

a.





or

b.

(n=57, 50%)

Fig. 26. Definitions of the common pack basket types from the contemporary 3,000 year old Hoko River and Musqueam Northeast sites (Croes 1977, 1995).

## ACKNOWLEDGMENTS

JONA Editor Darby C. Stapp worked his magic on this manuscript, always showing patience and providing encouragement during this paper's final production. An anonymous outside reviewer gave excellent suggestions, which we hope we followed successfully. We would like to thank the Native partnerships we have had in our wet site work, including the Makah Nation, Squaxin Island Tribe, Confederated Tribes of Siletz Indians, Confederated Tribes of Grand Ronde, Quinault Indian Nation, Chehalis Tribe, Nisqually Indian Tribe, and Haida Nation. Our case study on the Qwu?gwes wet site was assisted especially in research and experimentation by Rhonda Foster, Director, and staff, Cultural Resources Department, and Charlene Krise, Director, and staff, Museum Library and Research Center, Squaxin Island Tribe. We need to admit that the original manuscript of this paper was developed for a different journal, a special issue of *BC Studies*. Our paper got to be too long, so the editors decided to reduce it into a Case Study and suggested JONA for the original manuscript. We would like to thank those editors and recommend their detailed special issue coverage of ethnobotany and paleoethnobotany in our region: *Ethnobotany in British Columbia: Plants and People in a Changing World,* Nancy J. Turner and Dana Lepofsky, editors, 2013, Special Issue, *BC Studies* 179. To these people this paper owes its existence. The final conclusions, however, remain solely the responsibility of the authors.

## REFERENCES CITED

Adovasio, James M.

1974 Prehistoric North American Basketry. In Collected Papers on Aboriginal Basketry, edited by D. R. Tuohy and D.L. Rendall, pp. 98–148. *Nevada State Museum, Anthropological Papers,* No. 16. Carson City, Nevada.

Archer, David and Kathryn Bernick

1990 Perishable Artefacts from the Musqueam Northeast Site. MS on file, [British Columbia] Archaeology Branch, Victoria B.C.

Bernick, Kathryn

1983 A Site Catchment Analysis of the Little Qualicum River Site, DiSc 1: A Wet Site on the East Coast of Vancouver Island, B.C. *Canada. National Museum of Man. Mercury Series, Archaeological Survey Papers*, 118. Ottawa.

1989 Water Hazard (DgRs 30) Artifact Recovery Project Report Permit 1988-55. University of British Columbia.

1999 Lanaak (49XPA78), a Wet Site on Baranof Island, Southeastern Alaska. Report of June. Archaeological Investigations, State of Alaska Field Archaeology Permit 99-10. Alaska Office of History and Archaeology, Division of Parks and Outdoor Recreation, Anchorage

2003 Serendipitous Discoveries: The Water Hazard Wet Site in Southwestern British Columbia. In *Enduring Records: The Environmental and Cultural Heritage of Wetlands*, edited by Barbara Purdy. Oxbow Books, Oxford, U.K.

Collard, Mark, Stephen Shennan, and Jamshid J. Tehrani
2006 Branching, Blending and the Evolution of Cultural Similarities and Differences among Human Populations. *Evolution and Human Behavior*, 27:169–184.

Croes, Dale R. (editor)
1976 The Excavation of Water Saturated Archaeological Sites (Wet Sites) on the Northwest Coast of North America. *Canada. National Museum of Man. Mercury Series, Archaeological Survey Papers*, 50. Ottawa.

Croes, Dale R. (editor) with Rhonda Foster and Larry Ross
2013 *The Qwu?gwes Archaeological Site and Fish Trap (45TN240), and Tested Homestead (45TN396), Eleven-Year South Puget Sound Community College Summer Field School Investigations with the Squaxin Island Tribe.* Manuscript in possession of the editor.

Croes, Dale R.
1977 *Basketry from the Ozette Village Archaeological Site: A Technological, Functional and Comparative Study.* Ph.D. Dissertation, Washington State University. University Microfilms, Ann Arbor MI. Available as PDF on the international blog site NewsWARP at: http://newswarp.info/2013/02/ozette-village-basketry-dissertation-digitized/.

1980 Cordage From The Ozette Village Archaeological Site: A Technological, Functional, And Comparative Study. *Washington State University, Laboratory of Archaeology and History, Project Reports*, 9. Pullman.

1989 Lachane Basketry and Cordage: A Technological, Functional and Comparative Study. *Canadian Journal of Archaeology*, 13:165–205.

1992a Exploring Prehistoric Subsistence Change on the Northwest Coast. *Research in Economic Anthropology*, Supplement 6, pp. 337–366. Jai Press.

1992b An Evolving Revolution in Wet Site Research on the Northwest Coast of North America. In The Wetland Revolution in Prehistory, edited by B. Coles, *WARP Occasional Paper*, 6:99–111. Department of History and Archaeology, University of Exeter, Exeter, England.

1995 *The Hoko River Archaeological Site Complex, the Wet/dry Site (45CA213), 3,000–2,600 BP.* Washington State University Press, Pullman, WA.

1997 The North-central Cultural Dichotomy on the Northwest Coast of North America: Its Evolution as Suggested by Wet-site Basketry and Wooden Fish-hooks. *Antiquity*, 71:594–615, Cambridge, England.

2001 North Coast Prehistory—Reflections from Northwest Coast Wet Site Research. In Perspectives on Northern Northwest Coast Prehistory, edited by Jerome S. Cybulski. *Canadian Museum of Civilization, Hull, Quebec. Mercury Series. Paper*, 60.

2003 Northwest Coast Wet-site Artifacts: A Key to Understanding Resources Procurement, Storage, Management, and Exchange. In *Emerging From the Mist, Studies in Northwest Coast Culture History,* edited by R.G. Matson, G. Coupland and Q. Mackie, pp. 51–75. UBC Press, Vancouver, B.C.

2005 *The Hoko River Archaeological Site Complex, The Rockshelter (45CA21), 1,000–100 B.P.* Washington State University Press, Pullman, WA.

2012a Ancient Basketry of the Olympic Peninsula. In *From the Hands of a Weaver: Olympic Peninsula Basketry through Time,* edited by Jacilee Wray and the Olympic Peninsula Intertribal Cultural Advisory Committee, pp. 142–155. University of Oklahoma Press, Norman.

2012b Wet Site Archaeology on the Northwest Coast of North America and the Native Communities' involvement in Managing their Wetland Heritage Sites. In *The Oxford Handbook of Wetland Archaeology*, edited by Francesco Menotti and Aidan O'Sullivan, Chapter 41, Oxford Press, Exeter.

Croes, Dale R., Katherine Kelly and Mark Collard
2005 Cultural Historical Context of Qwu?gwes (Puget Sound, USA): A Preliminary Investigation. *Journal of Wetland Archaeology*, 5:137–149.

Croes, Dale R. and Steven Hackenberger
1988 Hoko River Archaeological Complex: Modeling Prehistoric Northwest Coast Economic Evolution. *Research in Economic Anthropology*, Supplement 3:19–85. JAI Press.

Durham, W.H.
1992 Applications of Evolutionary Culture Theory. *Annual Review of Anthropology,* 21:331–55.

Eldridge, Morley
1991 *Glenrose Cannery Wet Component: a Significance Assessment*. Millennia Research. Report prepared for the BC Archaeology Branch, Victoria, B.C.

Fedje, Daryl W., Alexander P. Mackie, Rebecca J. Wigen, Quentin Mackie, and Cynthia Lake
2005 Kilgii Gwaay: An Early Maritime Site in the South of Haida Gwaii. In *Haida Gwaii, Human History and Environment from the Time of Loon to the Time of the Iron People,* edited *by* D.W. Fedje and R.W. Mathewes, pp. 187–203. UBC Press, Vancouver-Toronto.

Fedje, Daryl W. and Rolf W. Mathewes (editors).
2005 *Haida Gwaii, Human History and Environment from Time of Loon to the Time of the Iron People*. U.B.C. Press, Vancouver, B.C.

Florian, Mary-Lou E., Dale Paul Kronkright and Ruth E. Norton.
2002 *The Conservation of Artifacts Made from Plant Materials*. J. Paul Getty Trust.

Friedman, Janet.
1975 The Prehistoric Uses of Wood at the Ozette Archaeological Site. Ph.D. Dissertation, Washington State University, Pullman.

1978 *Wood Identification by Microscopic Examination: A Guide for the Archaeologist on the Northwest Coast of North America*. British Columbia Provincial Museum, Canada.

2005 The Prehistoric Uses of Wood at the Ozette Archaeological Site. In Ozette Archaeological Project Research Reports, Volume III: Ethnobotany and Wood Technology, edited by David L. Whelchel, pp. 97-218. *WSU Department of Anthropology, Reports of Investigations* 68, National Parks Service, Northwest Regional Office. Pullman.

Gleeson, Paul F.
1980 Ozette Woodworking Technology. Ph.D. Dissertation, Washington State University, Pullman.

2005 Ozette Woodworking Technology, In Ozette Archaeological Project Research Reports, Volume III: Ethnobotany and Wood Technology, edited by David L. Whelchel, pp. 219–333. *WSU Department of Anthropology, Reports of Investigations*, 68. Washington State University, Pullman.

Gunther, Erna.

1973 [1945] *Ethnobotany of Western Washington: The Knowledge and Use of Indigenous Plants by Native Americans*. University of Washington Press, Seattle.

Haeberlin, Hermann and Erna Gunther.

1975 [1930] *The Indians of Puget Sound.* University of Washington Press, Seattle.

Hawes, Kathleen L. and Daniel Rowley

2013 Cellular Identification of Wood/Fiber Artifacts and Fuelwoods. In *The Qwu?gwes Archaeological Site and Fish Trap (45TN240), and Tested Homestead (45TN396), Eleven-Year South Puget Sound Community College Summer Field School Investigations with the Squaxin Island Tribe,* edited by Dale R. Croes, with Rhonda Foster and Larry Ross. On file with the Washington Department of Archaeology and Historic Preservation and available as PDF on the international blog NewsWARP at: *http://newswarp.info/2013/06/qwugwes-archaeological-wet-site-final-report/.*

Hobler, Philip M.

1970 Survey and Excavation in the Vicinity of Bella Coola. *B.C. Studies,* 6-7:77–94.

Hoff, Ricky

1980 Fishhooks. In *Hoko River: a 2,500 Year Old Fishing Camp on the Northwest Coast of North America*, edited by D.R. Croes and E. Blinman. Laboratory of Anthropology, Washington State University. *Reports of Investigations,* 58:160-188. Pullman.

Inglis, Richard

1976 'Wet' Site Distribution - the northern case, GbTo 33 - the Lachane site. In The Excavation of Water-saturated Archaeological Sites (Wet Sites) on the Northwest Coast of North America, edited by D.R. Croes, pp. 158-185. *Canada. National Museum of Man. Mercury Series. Archaeological Survey Papers*, 50. Ottawa.

Jones, Joan M.

1976 Northwest Coast Indian Basketry, a Stylistic Analysis. Unpublished Doctoral Dissertation, University of Washington, Seattle.

Laforet, Andrea.

1993 Tsimshian Basketry. In *The Tsimshian: Images of the Past; Views for the Present,* edited by Margaret Seguin, pp. 215–280. UBC Press, Vancouver, B.C.

Mauger, Jeffrey E.

1978 Shed Roof Houses at the Ozette Archaeological Site: A Protohistoric Architectural System. Ph.D. Dissertation, Washington State University.

1991 Shed-roof Houses at Ozette and in a Regional Perspective. In *Ozette Archaeological Project Research Reports, Vol. 1: House Structure and Floor Midden, edited by* S.R. Samuels, pp. 29–173. *Washington State University, Department of Anthropology Reports of Investigations*, 63. Pullman.

Matson, R.G. and G. Coupland and Q. Mackie
2003 *Emerging from the Mist: Studies in Northwest Coast Culture History.* UBC Press, Vancouver, B.C.

Mitchell, Donald H.
1990 Prehistory of the Coasts of Southern British Columbia and Northern Washington. In *Northwest Coast,* edited by Wayne Suttles, pp. 340–358. Handbook of North American Indians, Vol. 7. Smithsonian Institution Press, Washington, D.C.

Munsell, David A.
1976 Excavation of the Conway Wet site 45SK59b, Conway, Washington. In The Excavation of Water-Saturated Archaeological Sites (Wet Sites) on the Northwest Coast of North America, edited by D.R. Croes, pp. 86–121. *Canada. National Museum of Man. Mercury Series. Archaeological Survey Paper*s, 50. Ottawa.

Nordquist, Delmar
1961 Bound Net Weights from 45SN100. *Washington Archaeologist,* 5(1):3–6.

Onat, Astrida R. Blukis
1976 A Fishtown Site, 45SK99. In The Excavation of Water-saturated Archaeological Sites (Wet Sites) on the Northwest Coast of North America, edited by D.R. Croes, pp. 122–145. *Canada. National Museum of Man. Mercury Series. Archaeological Survey Paper*s, 50. Ottawa.

Pearsall, Deborah M.
1989 *Paleoethnobotany: A Handbook of Procedures.* Academic Press, San Diego, CA.

Simonsen, Bjorn O.
1976 The Little Qualicum River Site (DiSc 1): An Attempt at Wet Site Conservation. In *The* Excavation of Water-Saturated Archaeological Sites (Wet Sites) on the Northwest Coast of North America, edited by D, R. Croes, pp. 58–77. *Canada. National Museum of Man. Mercury Series. Archaeological Survey Papers,* 50. Ottawa.

Suttles, Wayne and Barbara Lane
1990 Southern Coast Salish. In *Northwest Coast,* edited by Wayne Suttles, pp. 485–502. Handbook of North American Indians, Vol. 7, Smithsonian Institution Press, Washington, D.C.

Stewart, Hilary
1982 *Indian Fishing: Early Methods on the Northwest Coast.* Douglas & McIntyre, Vancouver.

1984 *Cedar: Tree of Life to the Northwest Coast Indians.* University of Washington Press, Seattle.

1987 *The Adventures and Sufferings of John R. Jewitt, Captive of Maquinna.* Douglas and McIntyre. Vancouver, B.C.

Weltfish, Gene
1932 Problems in the Study of Ancient and Modern Basketmakers. *American Anthropologist,* 34:108–117.

Wiessner P.
1983 Style and Social Information in Kalahari San Projectile Points. *American Antiquity,* 48:253–276.

Dales Croes, Adjunct Faculty, Anthropology, Washington State University and Director, Pacific Northwest Archaeological Services
Tumwater, WA

dcroes444@gmail.com

Kathleen L. Hawes
Assistant Director,
Pacific Northwest Archaeological Services
Tumwater, WA

aragalen@gmail.com

Dale R. Croes received his B.A. in anthropology from the University of Washington and his M.A. and Ph.D. in anthropology at Washington State University (WSU). He did his Ph.D. dissertation research on basketry and cordage artifacts from the Ozette Village wet site, conducted post-doctoral research with the Makah Tribal Nation at the 3,000 year old Hoko River wet site, directed first-ever archaeological excavations at the National Historic Landmark wet site of Sunken Village with the Confederated Tribes of Siletz Indians, Confederated Tribes of Grand Ronde and the Conferated Tribes of the Warm Springs Indians, and recently co-directed excavations of the Qwu?gwes wet site with the Squaxin Island Tribe. He is semi-retired from teaching, adjunct faculty with WSU, and president of a contracting company, Pacific Northwest Archaeological Services that specializes in wet site excavation and wood/fiber conservation and cellular ID.

Kathleen Hawes is currently the Assistant Director of Pacific Northwest Archaeological Services (PNWAS), and has seven years of archaeological experience, receiving her Bachelor's Degree in Archaeology and Paleoethnbotany from the Evergreen State College and Cultural Resource Certifications in Archaeology and Museum Studies from South Puget Sound Community College (SPSCC) in 2009. She has participated in several projects and surveys in the region in consultation with Tribes of the Quileute, Lower Elwha, Quinault, Skokomish, Chehalis and Nisqually. Her specialties include wet-site archaeology, conservation of wooden artifacts, and microscopic identification of wood/fiber and charcoal from archaeological sites.

*Journal of Northwest Anthropology*, 47(2):153–166 2013

# GROUND-PENETRATING RADAR STUDIES AT THE HAMMER TEST BED FACILITY, RICHLAND, WASHINGTON

**Lawrence B. Conyers**

## ABSTRACT

The HAMMER geophysical test bed in Richland, Washington provides a facility to compare ground-penetrating radar (GPR) reflection images to known archaeological features in the ground. The test bed provides simulated buried features, including stone cairns and rings, burials, trash middens, artifacts and other materials, that were buried at depths from 12–36 inches in sandy ground and then re-buried with the same material. In 2002, grids of GPR data were collected in dry and wet ground conditions, and the amplitude maps from each were compared to the known buried features using 900, 500 and 400 MHz frequency reflection maps and profiles. The stone and metal objects and features were visible in most images, with only the 900 MHz maps failing to identify the deepest buried features due to energy attenuation with depth. When the ground was wet the metal features were still visible, but water hampered delineation of some features due to differential water distribution in some areas of the grid that had been compacted by mechanized machinery. The wooden features were invisible when the ground was dry, but visible when wet, as they retained water and produced distinct radar energy reflection surfaces. These variations in feature definition during different ground conditions are very important for GPR exploration and mapping in sandy ground and can be readily applied to many field conditions. The differences in antenna frequency also played a role in feature definition, especially with regard to depth. Features with no difference in materials along their boundaries, such as burials and the un-fired earth oven, were invisible with GPR as there were no differences in materials from which to reflect radar energy.

## Introduction

Geophysical archaeology has long been used as a way to explore for and map buried archaeological features and associated geological units in the ground (Conyers 2013; Gaffney and Gater 2003). The most common methods used today are ground-penetrating radar (GPR) (Conyers 2013), magnetics (Aspinall et al. 2009), and earth-resistance (resistivity) (Schmidt 2013). In many cases data sets produced from these methods can go far beyond finding buried materials and be used to construct past landscapes (Campana and Piro 2009; Conyers 2009) and test hypotheses about cultural change and history (Conyers 2010).

Ground-penetrating radar is being increasingly employed by archaeologists and other scientists to explore for and to locate three-dimensional archaeological features, artifacts, and important cultural strata in the near-surface. The GPR method has been especially effective in certain sediments and soils within 1–5 meters of the ground surface, where the archaeological targets to be imaged have significant physical and chemical contrasts with the surrounding medium. Site conditions such as moisture, soil types, clay mineralogy, and matrix stratigraphy are factors affecting the success of a GPR survey (Conyers 2013). It is usually not known in advance if a GPR survey will be successful, and there have been many failures, few of which have entered the published record. As a result, there are common misconceptions about the utility of GPR in different environments, and often unsubstantiated "rules of thumb" are cited as reasons why GPR should or should not be used in any given area. Previous studies from many sites all over the world indicate that many of these preconceptions regarding GPR technology are incorrect, misleading, or uninformed (Conyers 2012). For this reason direct comparisons between known features in the ground, such as at the HAMMER site, and the produced GPR images can be especially valuable.

Before geophysics can be used as a primary database in attempting to understand the past (Kvamme 2003), datasets must be calibrated with and compared to known features in the ground. There are a number of ways to interpret often complex images produced from geophysics, the most straightforward being spatial analysis of the resulting maps (Conyers 2012: 20). Sometimes geophysical results produce maps or images that are exactly as would be expected if buried features were excavated and exposed to the human eye (Goodman and Piro 2013). Most often, some type of more complex interpretation is necessary in order to differentiate cultural "anomalies" from those that might have been produced from associated features or other origins, background "noise" or post-depositional disruptions of modifications. One very useful method, which is a type of "geophysical experimental archaeology," is to collect data over test beds where simulated archaeological features have been buried (Conyers 2004). The HAMMER Geophysical Test Bed provides one excellent resource for this type of comparison.

In 2002, a GPR research experiment was conducted at the Remote Target Test Bed component of the HAMMER facility, funded by the Strategic Environmental Research and Development Program (SERDP), a Department of Defense environmental research program.

## The HAMMER Test Site

The HAMMER Geophysical Test Bed, near Richland, Washington, dates to 1994 when the Hazardous Materials Management and Emergency Response Training Facility (HAMMER) responded to a request from Hanford Area Tribes to help develop non-destructive tools to assist in the location of human burials and other important resources. A 7-acre parcel was set aside for cultural resources research and training. Planning for a geophysical test bed commenced. Through consultation with the tribes, the idea for a surface component also emerged to assist in educating people, for example, law enforcement officers, in the identification of archaeological sites, artifacts, and looted sites.

The Cultural Resource Test Bed is described in detail on Confederated Tribes of the Umatilla Indian Reservation (CTUIR) website: http://www.umatilla.nsn.us/crpp/tr_hammer.htm). Briefly, the Test bed has two major components:

1. The "surface" component consists of approximately 12 sites, constructed by the Cultural Resource Protection Program, includes housepits, burials, lithic scatters, and historic

dumps. The surface component is used primarily for trainings where it provides opportunities for people to see artifacts (reproductions) in context.

2. The "subsurface" component, named the Remote Target Test Bed, contains 30 buried archaeological features buried in sandy ground, including simulated burials, prehistoric and historic trash dumps, a lithic cache, a brick well, and an earth oven (Woody and Stapp 2002). The subsurface component is used for geophysical experimentation with technologies such as ground penetrating radar, magnetometry, and electro-resistivity.

The Remote Target Test Bed was designed and constructed by scientists at Pacific Northwest National Laboratory (PNNL) in consultation with cultural resource professionals from the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and the Wanapum of Priest Rapids. The goal was to bury materials to simulate both pre-historic and historic archaeological deposits in a test bed 100x30 ft. in dimension. The ground was first excavated using heavy equipment and divided into three general areas with a shallow bed 12 in. below the surface, a moderate depth 24 in. deep and a deep area 36 in. below the ground surface (Fig. 1). The three floors of the trench were not modified and the materials were placed on or within the exposed sand sediment. The excavated surfaces of these units were treated as the original paleo-surfaces, on which artifacts were deposited and some caches and simulated burials were dug. Filling of the test bed by the same sediment originally in the trench would simulate the passage of time and the subsequent burial of the archaeological features. A variety of materials were then placed or constructed on the three surfaces to simulate a shell midden, rock cairn, rock rings and piles and a cairn, lithic scatters and caches, an historic dump, earth oven (un-fired), wooden railroad ties and a tree stump (Fig. 2). These, and other simulated features were then measured in space (depth being determined by the depth of the excavations within which the features were placed), and then re-buried by mechanized machinery (Fig. 3).

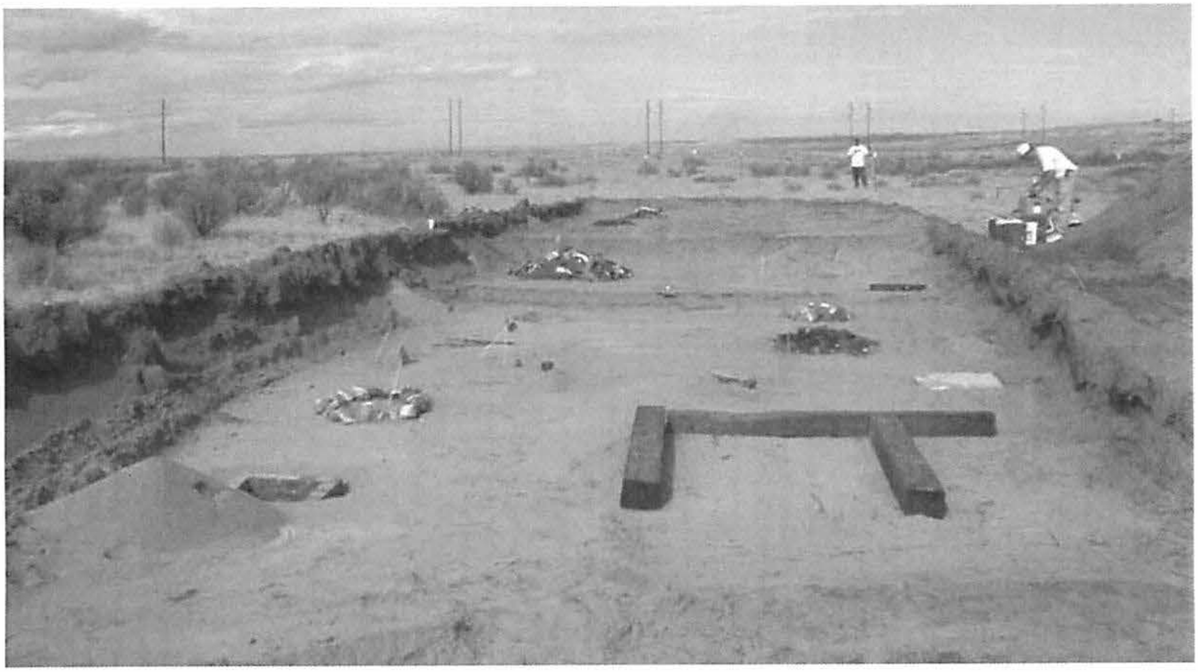


Fig. 1. The Remote Target Test Bed after trenching and placement of artifacts and features on the three excavation surface. The deeper zone (36 in.) is in the foreground, with the medium (24 in.) and shallow depth (12 in.) areas in the distance (looking north). September 2002.

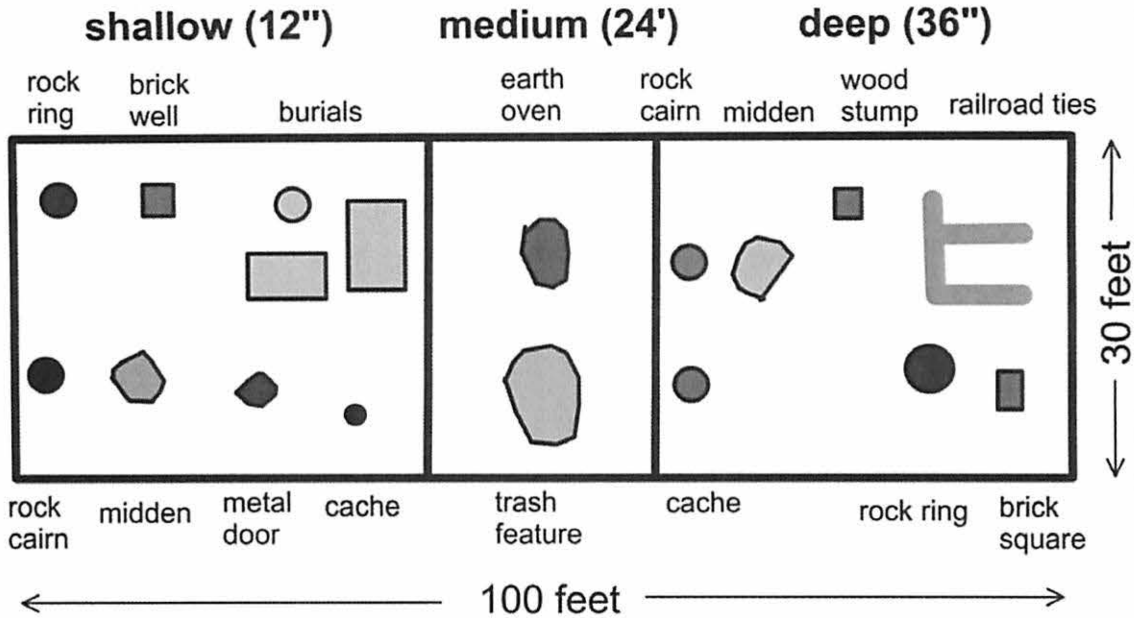



Fig. 2. The conceptual model of The Remote Target Test Bed, with the larger features of interest shown. North is to the left of the model.

Fig. 3. Photograph showing the burying of simulated archaeological features in the Remote Target Test Bed using heavy equipment to carefully refill the trench with the original sandy material. September 2002.

## Ground Penetrating Radar Data Collection

A total of six grids of GPR data were collected over the site using two different antennas for different depth penetration and resolution. A GSSI SIR–3000 control system, with 400 and 900 MHz antennas, was used with an attached survey wheel for distance measurement. In addition, a Sensors and Software control system with 450 MHz antenna was also used as a further comparison (Fig. 4). Data were collected in grids that had been surveyed into space (x and y dimensions) so direct comparisons could be made between buried materials and the resulting GPR maps. The GPR grids collected were larger than the test bed with about 1.5 meters overlap in all dimensions.

Data were first collected in September, 2002 when the ground was very dry. Comparable datasets were again collected in February 2003, after the ground had been flooded for three days from a fire-hose attached to an industrial-sized sprinkler. The two very different data sets (dry and wet) were then processed and compared to see how radar reflections and the resulting maps produced would vary depending on whether the sand matrix and the buried features retained or distributed water.

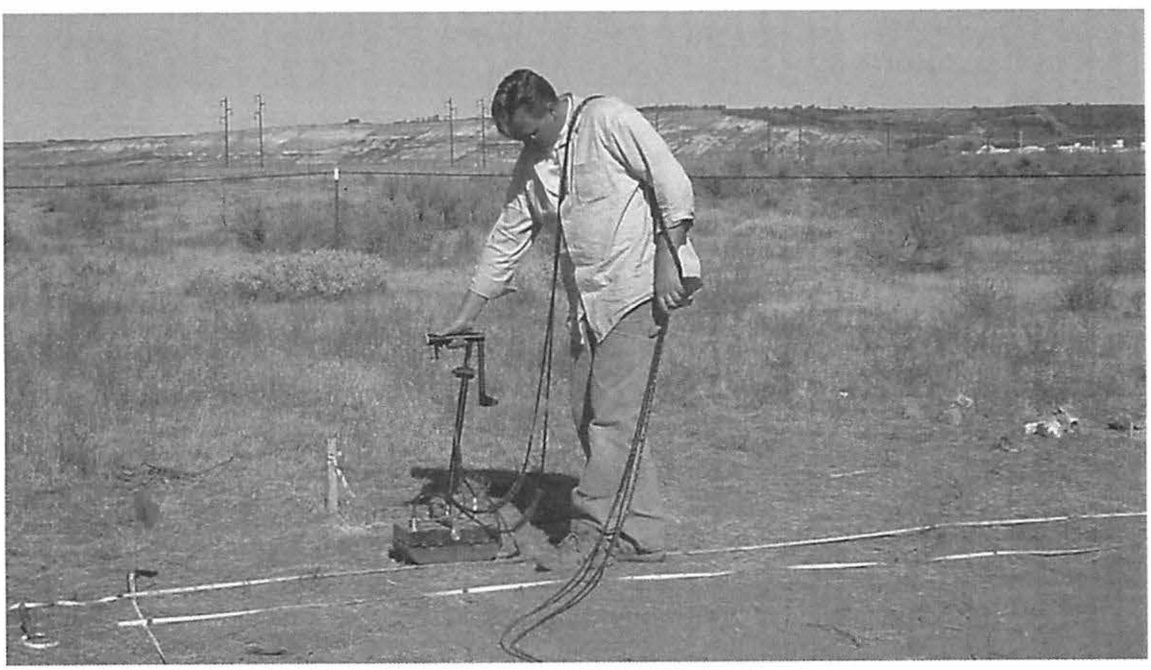


Fig. 4. Photograph of technician collecting GPR reflection data at the Remote Target Test Bed, using a Sensors and Software 450 MHz antenna.

## The Ground Penetrating Radar Method

Ground-penetrating radar data are acquired by reflecting pulses of radar energy on a surface antenna, which generates waves of various wavelengths that propagate outward. The waves spread into the ground in a cone as the waves propagate downward. As these waves move in the ground, they can be reflected back from buried objects, features or bedding surfaces (Fig. 5). The reflected waves then travel back to the ground surface and are detected and recorded at a receiving antenna that is paired with the transmiting antenna. The two-way travel times of the waves into the ground to the reflection surface and back to the receiving antenna are recorded in nanoseconds. As the radar waves propagate through various materials in the ground, their velocity will change depending on the physical and chemical properties of the material through which they are traveling (Conyers 2013). At contacts between different materials in the ground the waves' propagating velocity can change and when this occurs a reflected wave is generated. Some reflected waves will then travel back to the ground surface and recorded while the remaining energy continues to propagate deeper and can be reflected again from additional interfaces, until all the energy finally dissipates with depth. Only the reflected energy that travels back to the surface antenna is recorded and visible for interpretation. If buried surfaces that reflect energy are oriented in a way that waves move away from the surface antenna, that reflected energy will not be recorded, making those interfaces effectively invisible using the GPR method.

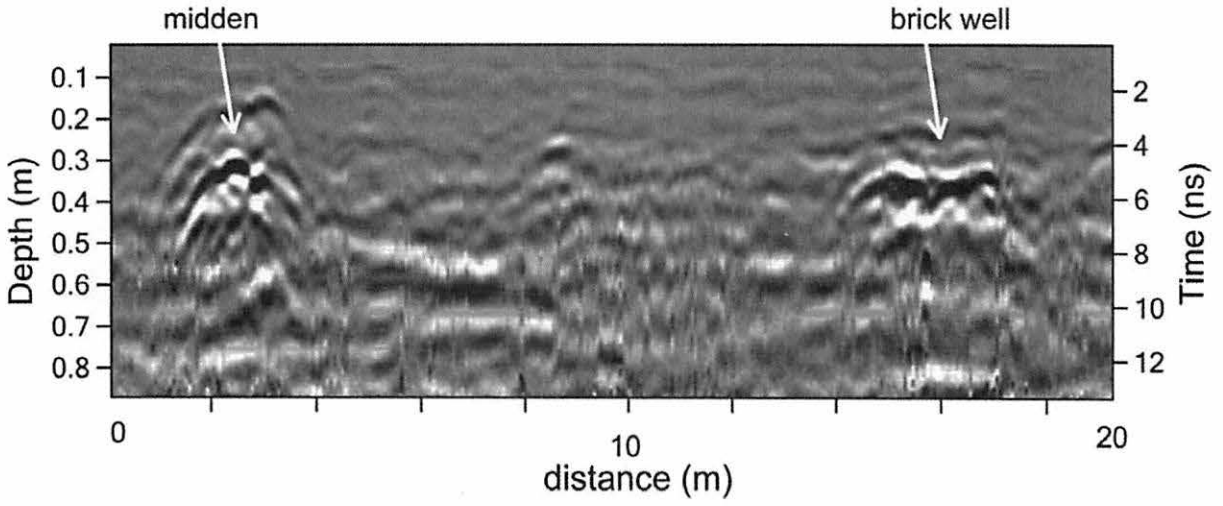



Fig. 5. Reflection profile showing the shallow midden and brick well as high amplitude reflections in the shallow portion of the test beds.

The velocity of radar energy in the ground can be calculated and reflected radar wave travel times converted to distance (or depth in the ground). It is this ability to determine depth that makes GPR capable of producing a three-dimensional data set. There are many ways to calculate velocity (Conyers 2013), all of which are estimates of wave propagation speed through packages of sediments and soils. Velocity of propagating waves can vary considerably with depth, usually decreasing as water saturation increases, and also vary laterally because of a variety of other changes in ground composition. At HAMMER, velocity was easily determined as the travel time of the radar waves was directly measured, and depth was simulated using the known depths from construction of the test site.

Various frequency antennas can be used for radar transmission into the ground. High frequency antennas will produce short wavelength radar waves, capable of high resolution, but only shallow penetration. The highest frequency antenna used at HAMMER was the 900 MHz antenna, which was capable of transmitting energy to about 3 feet (one meter) in the sandy ground. The 400 and 500 MHz antennas were also used, which transmitted energy to 12 feet (3 meters) in the ground, which was more than enough depth to resolve all the buried features at HAMMER, but with somewhat lesser resolution than the 900 MHz.

In most GPR datasets, radar antennas are moved along the ground in transects and two-dimensional profiles of a large number of reflections at various depths are created to produce reflection profiles (Fig. 5). When data are acquired in a closely-spaced series of antenna transects within a grid, reflections from adjoining profiles can be re-sampled, compared and then processed into amplitude maps (Fig. 6). These images produce an accurate three-dimensional picture of buried reflection surfaces (Conyers 2013) indicating the location of features spatially (in x and y dimension) and with good depth control (z). An interpretation of the reflections in the ground can then be accomplished using both reflection profiles and amplitude maps, which show the intensity of reflections across the grid in defined horizontal slices (Fig. 6). At HAMMER a 25 cm transect spacing was used.

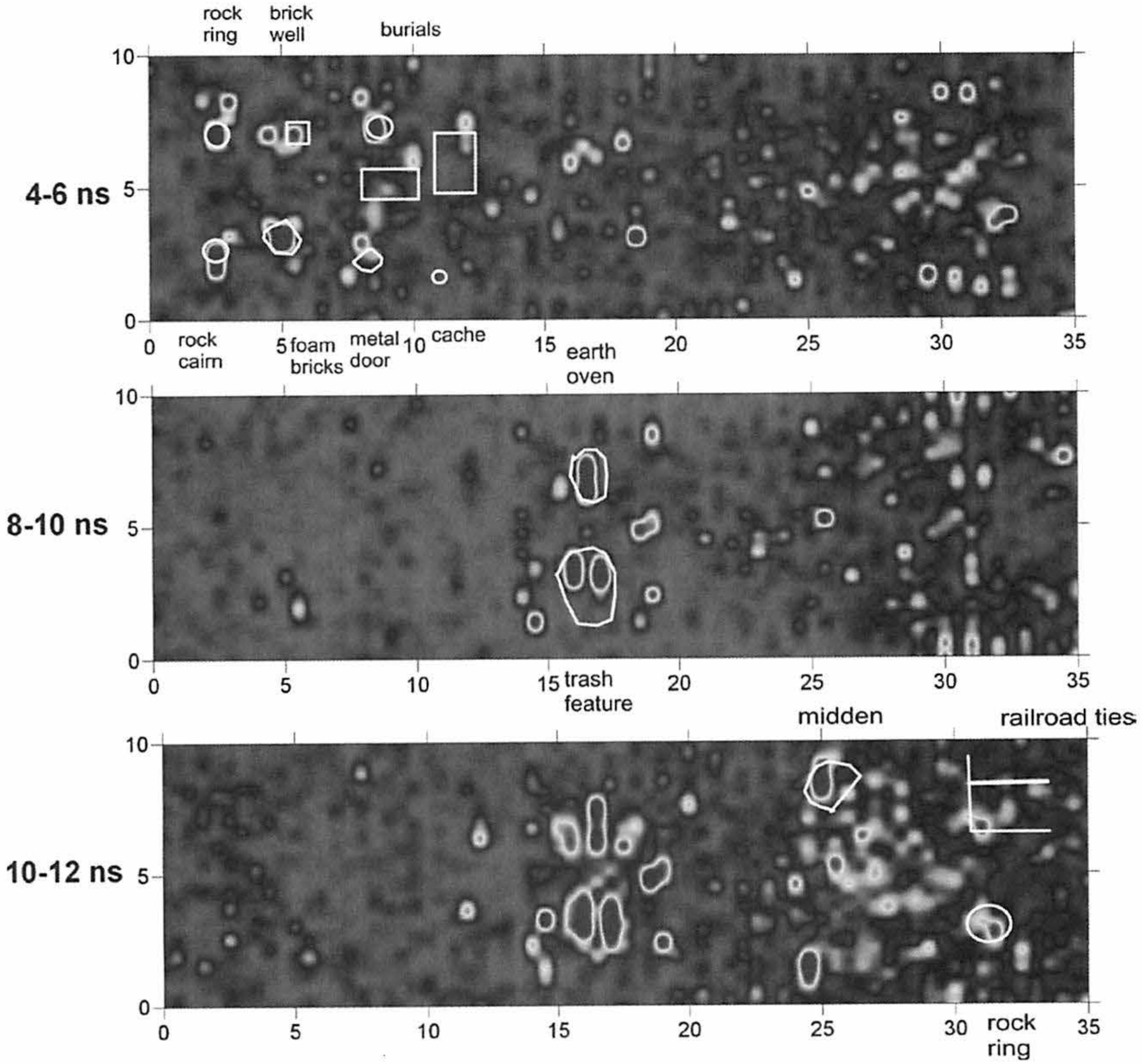



Figure 6. Amplitude map of the 400 MHz reflection data collected when the sandy ground was very dry in September 2002.

The buried discontinuities where reflections occur are usually created by changes in electrical properties of the sediment or soil, lithologic changes, and differences in bulk density at stratigraphic interfaces. Those measurable (and sometimes visible) differences in materials in the ground create water saturation variation within those buried units, which is what usually produces the velocity changes that generate wave reflections. Reflections can also be created by void spaces in the ground, which may be encountered with burials, tombs, tunnels. In theory, any variation in buried material that produces an abrupt radar wave velocity change will create reflections. Metal is a perfect radar reflection surface and almost always produces high amplitude features in both profiles and amplitude maps. Wood and other organic materials rarely reflect radar waves, except if they have retained water.

The most common GPR processing step is the production of amplitude slice-maps, which produce horizontal images of all reflection amplitudes in defined levels. These are similar to arbitrary excavation levels in standard archaeological excavations, with the depth thickness defined by the radar travel times (and then converted to approximate depth in the ground using velocity calculations). Every reflection in every profile is compared, contrasted, averaged and gridded spatially across the grid in each slice, and then the relative amplitudes of those waves are displayed in maps. Color or gray scales can be applied to the relative strength of the recorded waves as a way to display the reflection features. Those reflection features were then directly correlated to the known features in the ground at HAMMER.

## Analysis and Comparison of GPR Images to the Known Features

The high resolution 900 MHz antennas readily resolved all the features in the shallowest portion of the test bed including the rock ring, brick well, rock cairn and midden (Fig. 7). These features (Fig. 8) are mostly composed of reflective stones or metal trash, all of which was highly reflective especially at this shallow depth. The slice within which these features was sampled to produce the amplitude map was between 4 and 6 nanoseconds (two-way travel time), which corresponds to the 12 in. burial depths of these materials. In the 24 in. burial depth at HAMMER, the 8–10 nanosecond slice showed only the trash feature. The earth oven was effectively invisible with GPR (Fig. 7) as it had not been burned and was only an excavated pit in sand, filled with the same sand. As a result there is no discontinuity from which to reflect radar waves. Because reflections are only produced along interfaces of materials that have very distinct differences in composition (Conyers 2013), small features such as the lithic cache (Fig. 10) were too small to reflect energy from the 900, 500 or 400 MHz antennas and produced no distinct reflections. The burials (Fig. 7) were also invisible for the same reasons as the un-fired earth oven (Fig. 11).

There are interesting broad features in the shallowest slice (4–6 nanoseconds) within the 900 MHz maps (Fig. 7), which are compaction scars produced by the wheels of the earth mover that filled in the test bed (Fig. 3). These types of reflection features have been commonly seen elsewhere in areas that have been disturbed by heavy machinery (Conyers 2012: 91).

The 400 and 500 MHz radar energy was used primarily to map the deepest buried materials at HAMMER. These frequencies were suitable for the 36 in. depths where a number of features were buried (Fig. 2). The wooden railroad ties buried in the deepest area of the test bed (Fig. 12) were invisible in the 400 MHz amplitude maps (Fig. 6) when the ground was dry. Wood and dry sand are comparable in their porosity and therefore retain similar amounts of water when dry. As in most usual ground materials it is differences in the water saturation that accounts for much of the reflectivity at their interfaces (Conyers 2012: 38), and the wood and sand contacts produced no reflections that could be resolved.

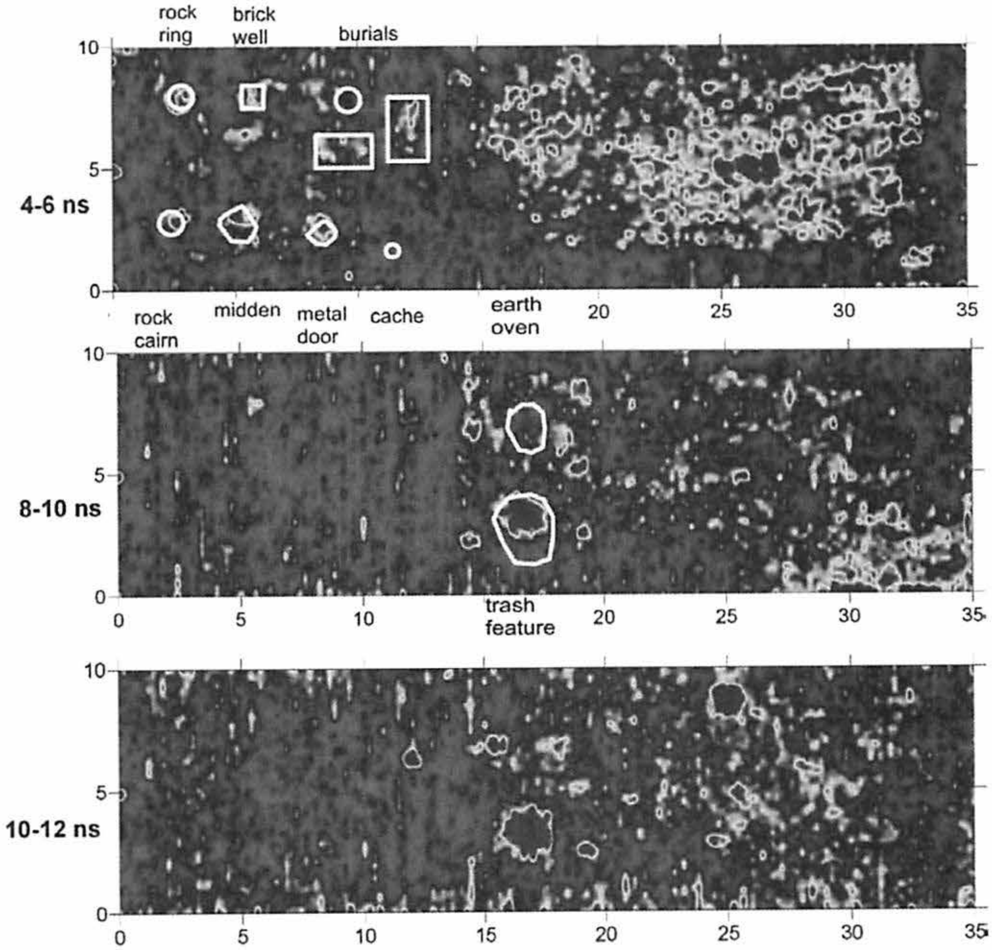



Fig. 7. Amplitude maps constructed from the 900 MHz reflection data showing high resolution features in the shallowest portion of the test bed (on the left). In the middle depth the trash feature is visible while the earth oven is invisible.

Fig. 8. Photograph showing the simulated shallow rock cairn, stone ring, brick well and trash midden, constructed at the 12–inch depth level of the Remote Target Test Bed. September 2002.

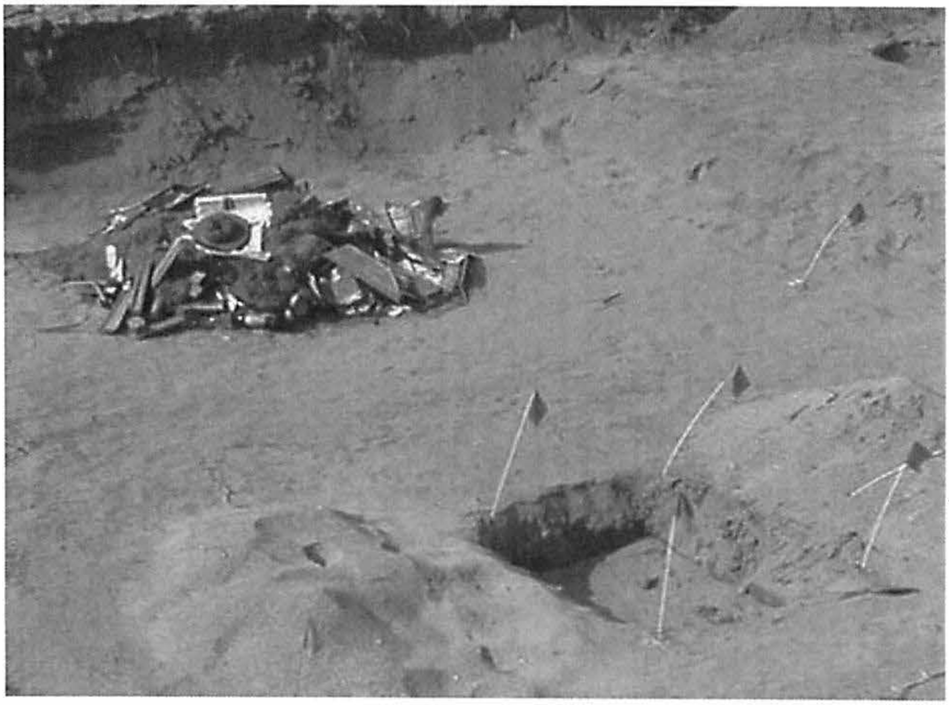


Fig. 9. Photograph showing the simulated trash pile and un-burned earth oven (in the foreground), constructed in the medium depth level of the Remote Target Test Bed. The trash pile contains many metal objects that reflect radar energy, but the earth oven was un-fired and therefore did not have a surface from which to reflect energy.

Fig. 10. Photograph showing the simulated cache of lithic materials, constructed at the 24 in. depth level of the Remote Target Test Bed. These small artifacts reflected no radar energy due to their small size.

Fig. 11. Photograph showing one of three simulated human burials, constructed in the shallow level of the Remote Target Test Bed using organic material. These features produced no reflections because there is not a distinct surface from which to reflect radar energy.

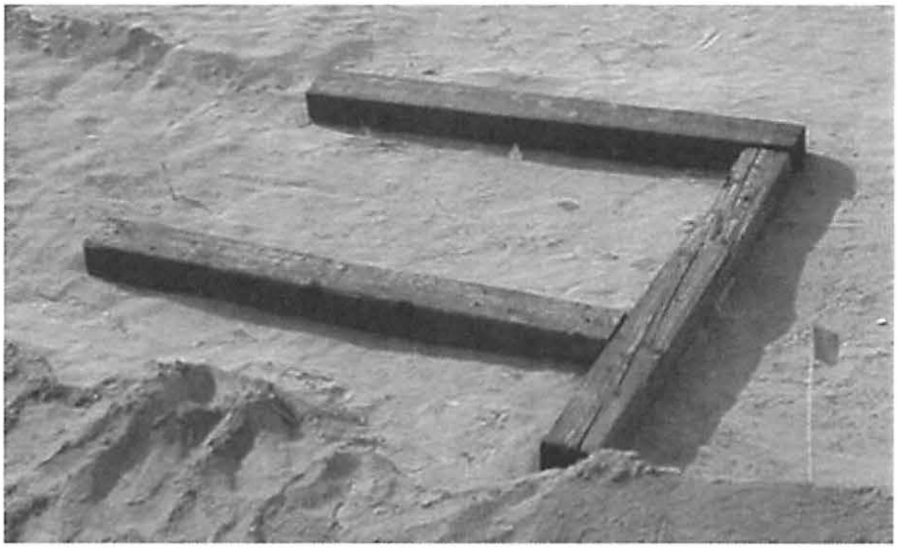


Fig. 12. Photograph showing the railroad ties placed at the deepest portion of the Remote Target Test Bed. The railroad tie feature produced no reflections when the ground was dry. When the ground had been saturated with water and then left to drain for 2 days, these ties retained water like a porous sponge, while the water drained readily from the surrounding sand. As expected, the saturated railroad ties reflected radar waves.

The site was sprinkled with a high volume of water from a fire hydrant for 3 days and the ground was then let to dry for 2 days before GPR data were collected again. When the GPR grid was re-collected in these wet conditions the railroad ties were visible, as well as the heavy equipment scars in the shallower slices (Fig. 13). The compaction scars were visible because they had differentially retained the water. A similar condition was visible with the railroad ties, which also retained water in their pore spaces, while the surrounding sand readily drained water due to its permeability. In the deep slices, the wooden materials therefore produced high amplitude reflections as they had a high retained moisture content.

While many of the more reflective features, especially those that contained metal, reflected energy and were visible in the amplitude maps produced from data collected in "wet" conditions. The "wet" amplitude maps were much "noisier" due to the differentially retained water in the sandy ground (Fig. 13). This complexity of differential water retention in the ground has been documented elsewhere (Conyers 2012: 95).

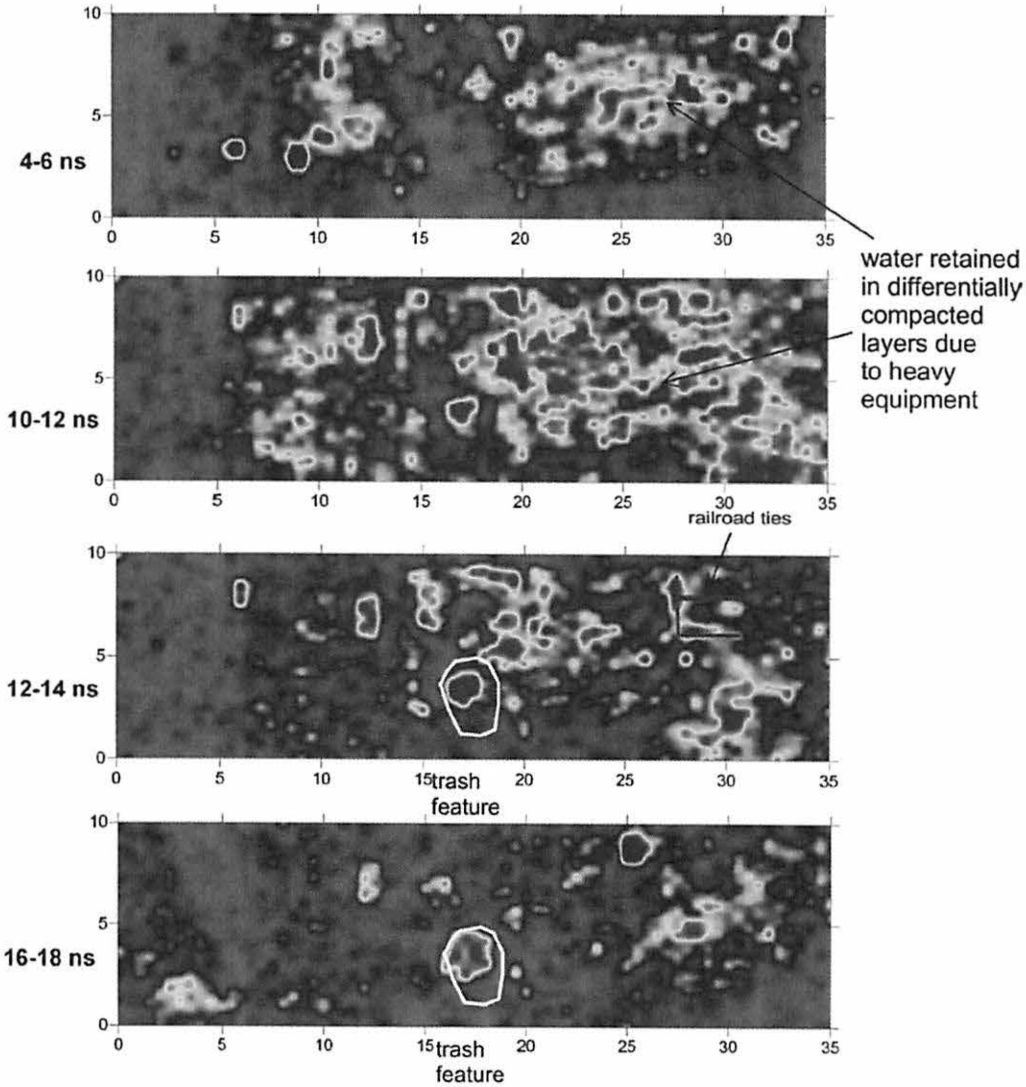



Fig. 13. 400 MHz slices from data collected after the ground was saturated with water. The shallow heavy equipment scars were visible and the railroad ties also produced reflection in the 12–14 nanosecond slice.

## Conclusions

At the HAMMER site, where the ground is sandy, features such as stone cairns, rock piles and buried metal readily generated reflections at depths between 12 and 36 in. in the ground. The only features that were invisible, no matter what the frequency of the antenna used, were the features that had no differences in composition from the matrix sand (earth oven and burials). The small lithic features were also invisible as they are too small to reflect the radar waves transmitted from the antennas used in these tests. The railroad ties produced no radar reflections when the ground was dry as they were not different enough in their reflective properties from the surrounding sand (Fig. 6). When water was applied then GPR data were re-collected, the wooden materials became one of the most prominent buried features visible in both reflection profiles and amplitude maps. The wood had retained water in its pore spaces like a sponge and the remaining water we had added to the ground percolated into the surrounding sand and moved downward. In this case the wood was visible with reflected waves because of its high water content and its contact with the quickly-draining sand, which created a large difference in velocity. In the processed amplitude maps collected during wet ground conditions the heavy equipment scars from site backfilling were also visible due to differential water retention due to differential sediment compaction.

The results of these studies demonstrate that GPR is a very effective tool for finding and mapping many buried features in sandy ground, such as is found at the HAMMER site. All stone, metal and brick features will readily produce reflections and are visible in amplitude maps. Subtle features with no distinct boundaries between the features and the matrix will be difficult to image with GPR. A comparison of the GPR maps with the model features at the HAMMER site have yielded a much more complete understanding of the effectiveness of GPR surveys in this type of ground. It also shows how moisture differences can play a large role in feature resolution depending on the water holding and distribution characteristics of the buried materials.

The difference between the resolution of the 400 and 900 MHz antennas was also significant, as many of the smaller features were much better resolved in the 900 MHz amplitude maps. Due to the limited depth of energy penetration of the 900 MHz energy, this was only possible in the upper 24 in. or so of the ground surface. The 400 and 500 MHz radar energy was capable of imaging all reflective features at all the depths in the test bed.

## ACKNOWLEDGMENTS

Fluor Hanford, Inc., and the Hanford Cultural and Historical Resources Program provided funding for design and construction. PNNL and the CTUIR constructed the test bed in 2001, with support from Fluor Hanford, Inc., and the Wanapum Tribe. SERDP provided the funding for the GPR testing and analysis. All photos of the HAMMER test site are courtesy of Darby Stapp. Many thanks to Michael Grealy, Tiffany Osburn, and Terry Ferguson for data collection and processing.

# REFERENCES CITED

Aspinall, Arnold, Gaffney, Chris and Armin Schmidt
2009 *Magnetometry for Archaeologists*. AltaMira Press, Latham, MD.

Campana, Stefano and Salvatore Piro.
2009 *Seeing the Unseen. Geophysics and Landscape Archaeology*. Taylor & Francis, London.

Conyers, Lawrence B.
2004 Moisture and Soil Differences as Related to the Spatial Accuracy of GPR Amplitude Maps at Two Archaeological Test Sites. In *Proceedings of the Tenth International Conference on Ground Penetrating Radar: June 21–24, Delft, The Netherlands*, edited by Evert Slob, Alex Yarovoy and Jan Rhebergen, pp. 435–438. Delft University of Technology, The Netherlands and the Institute of Electrical and Electronics Engineers, Inc., Piscataway, NJ.

2009 Ground-Penetrating Radar for Landscape Archaeology. In *Seeing the Unseen-Geophysics and Landscape Archaeology*, edited by Stefano Campana and Salvatore Piro, pp. 245–256. CRC Press/Balkema: Taylor and Francis Group, London.

2010 Ground-penetrating Radar for Anthropological Research. *Antiquity*, 84(323):175–184.

2012 *Interpreting Ground-penetrating Radar for Archaeology*. Left Coast Press, Walnut Creek, CA.

2013 *Ground-penetrating Radar for Archaeology, 3rd Edition*. AltaMira Press, Latham, MD.

Gaffney, Chris and John Gater
2003 *Revealing the Buried Past: Geophysics for Archaeologists*. Tempus Publishing, Stroud, Gloucestershire, England.

Goodman, Dean and Salvatore Piro
2013 *GPR Remote Sensing in Archaeology*, Geotechnologies and the Environment, Volume 9, Springer Science, NY.

Kvamme, Kenneth L.
2003 Geophysical Surveys as Landscape Archaeology. *American Antiquity*, 63(3):435–457.

Schmidt, Armin
2013 *Earth Resistance for Archaeologists*. AltaMira Press, Lanham, MD.

Woody, Dave and Darby Stapp.
2002 The HAMMER Geophysical Target Area Construction. Letter Report. Hanford Cultural Resources Laboratory. Pacific Northwest National Laboratory. Richland, WA.

Lawrence Conyers, Department of Anthropology, University of Denver, 2000 E. Asbury St., Denver, Colorado 802081 ; lconyers@du.edu; http://mysite.du.edu/~lconyer/

Lawrence Conyers is a professor of anthropology in the Anthropology Department at University of Denver. He was one of the first to apply the GPR technology to archaeological applications, beginning in the late 1980s. He and his students have developed many software programs and data analysis applications for GPR image processing.

# AN EXPERIMENTAL ARCHAEOLOGICAL STUDY OF THE EFFECTS OF OFF-ROAD VEHICLES ON LITHIC SCATTERS

**Carolyn R. Temple and Robert Lee Sappington**

ABSTRACT

The purpose of this study is to provide a basis for understanding the ways that cultural resources such as lithic scatters are being affected by the use of off-road vehicles. This project involved creating an artificial site by using lithic debitage and replicas of stone tools from modern flintknappers. Debitage and stone tools were placed on the surface of plots that were driven over by a four-wheeler at controlled speeds for a specified number of times. Afterwards, each artifact was located to record movement and breakage. It is the intention of this project to provide a foundation for resource managers and recreation planners to better understand how cultural resources are being affected by off-road vehicles and to enable them to make decisions to effectively manage those resources that are located within areas being considered and/or impacted by the use of off-road vehicles. As off-road vehicle usage increases, so will the impacts to cultural resources.

## Introduction

This experimental study examines the ways that off-road vehicle recreation can impact cultural resources, particularly lithic scatters (Temple 2012). The purpose of this study is to identify and record the movement and breakage patterns of lithic artifacts within areas of off-road vehicle use. Although it would appear that one pass by a vehicle over a site would have a negligible effect on artifact movement and breakage, previous studies done on ecosystems indicate that even a single pass by an off-road vehicle over a lithic scatter has the potential to have a negative effect on the artifacts (Webb 1983:51–79). It is anticipated that this preliminary study will provide a foundation for future studies as well as to offer land managers a strategy for balancing recreational use and cultural resources on public lands.

Several studies have documented the impact that recreational vehicles have on natural resources. Delicate ecosystems such as riparian areas and waterways are damaged as banks and riverbeds are disturbed. In areas where off-road vehicle trails cross streams or rivers, oil and gasoline can inadvertently be washed from engines and cause pollution (Havlick 2002:36–58). Furthermore, leakage of hydrocarbons, such as gas and oil, can have an impact on buried organic cultural materials, making radiocarbon dating difficult or even useless (Davis 1983:4).

Soils are often irreparably damaged when plants, which act as soil stabilizers, are destroyed. Off-road vehicles also contribute to the transportation of non-native species that often choke out native plant life. Wildlife habitat and breeding areas are destroyed by the use of off-road vehicles (Long et al. 1999:3; Sampson 2009:190–201; Taylor n.d.:4). Soil compaction and erosion are also greatly increased in areas of off-road vehicle use (Webb 1983:51–79). One study revealed that erosion in off-road vehicle use-areas increased by as much as 50 percent (Stull et al. 1979:9–21; Wilshire 1979:108). In some cases, the damage was so deep that even the bedrock was affected (U.S. Department of the Interior National Park Service 1999).

Although the above reports clearly indicate that natural resources are affected by off-road vehicles, there has been little research on the exact ways that cultural resources are impacted by the same processes. In some instances, such as the case of the Yuha intaglios in Yuha Wash, California, where motorcycles and off-road vehicles destroyed 70–75% of the ground figures, it is easy to see and understand the damage (Bureau of Land Management Memo 1975). A 1980 study of site reports lists off-road vehicle use as a major contributor to the deterioration of homesteads, early settlement towns, and historic trails through theft and vandalism (Lyneis et al. 1980:4–20). In a survey of vandalized sites in southwestern Colorado, Paul Nickens and others blame off-road vehicle use for an increase in illegal excavation and surface collecting (Nickens, Larralde, and Tucker 1981:108–110).

A 1976 study conducted by Brian and Teresa Zinck indicates that although established trails do affect archaeological sites through vegetation loss, increased erosion, artifact exposure to displacement and breakage, and loss of archaeological context, they also state that unestablished trails have little effect on sites (Zinck and Zinck 1976:23). This seems to conflict with Webb's findings that the greatest changes in soil properties occur within the first few passes, contributing to erosion and soil compaction (Webb 1983:51–79). As soil condition plays a large part in the preservation of artifacts as well as being a major contributor in understanding the context of the site, it is possible that even a one-time pass by an off-road vehicle could have a lasting effect.

Although it is generally agreed that off-road vehicle use contributes to site degradation when the impacts are clearly visible, such as in the case of the destroyed intaglios, little has been done to quantify this damage. A less considered aspect of off-road vehicle use is the inadvertent impacts. Inadvertent impacts are acts that modify any element of a cultural resource including site size, artifact number, artifact density, or condition (Sullivan et al. 2002:42–45). Sullivan et al. also go on to say that since inadvertent impacts occur on surface rather than on stratified sites, it is considered to be less important and given little thought (Sullivan et al. 2002). In addition, as off-road vehicles are often used as a mode of travel to project areas located at a distance from roads, it is important that archaeologists are aware of the potential impacts that can occur to the very resources that they are trying to protect. The purpose of this study is an attempt to understand the inadvertent damage caused by the use of off-road vehicles.

## Off-Road Vehicle Definition and Use

The term "off-road vehicle" is very broad. It can be confusing and is often used interchangeably with the terms Sports Utility Vehicle (SUV), All-Terrain Vehicle (ATV) and Off-Highway Vehicle (OHV). The definitions associated with each of these terms are ambiguous and it often falls to the discretion of the writer to define the intended use of the word within the document. This study employs the definition used by the Forest Service National OHV Implementation Team and defines the term "off-road vehicle" as referring to any vehicle that can "travel without roads or trails and such vehicles as four-wheel drive vehicles originally intended for highway use but capable of traveling off-road" (National OHV Implementation Team 2005:25).

Although the first motorcycle was invented in the early 1900s, it was not until after World War II that people began looking for new ways to recreate. The Army's introduction of the Jeep provided a lightweight vehicle that had the ability to navigate off the beaten path (Foster 2004:66–91). In the early 1960s, Honda began production of motorcycles that were capable of being ridden in areas without established roads or trails and unveiled the first all-terrain vehicle in 1970 (History of the ATV 2010; Total Motorcycle 2011). By the mid-to-late 1970s, there were approximately 1.8 million off-road vehicles in the United States (Adams and McCool 2009). According to a USDA study, in 2000 there were nearly 36 million off-road vehicle users in the United States (Cordell et al. 2000:1–9). According to a report published in 2003 in California, off-road vehicle registration has increased 108% between 1980 and 2001 while off-roading opportunities (areas open to legal recreation) has decreased 48% during the same timeframe (U.S. Department of the Interior Bureau of Land Management 2003:95).

Not only has off-road vehicle use increased while legal-use areas have decreased, but the size and abilities of off-road vehicles have changed. Very different from the limited capabilities of early off-road vehicles, today's vehicles, such as the Polaris Ranger Crew, are 48+ inches wide, can carry as many as six passengers, and have the capability to tow 2,000 pounds, as well as carry more than 1,500 pounds in the cargo area (Adams and McCool 2009:45–116). Prior to 1990, vehicles wider than 40 inches were banned from use on national forest trails. In 1990, the Forest Service eliminated this rule and allowed each region to determine appropriate vehicle-use (Forest Development Trails 1990). This has allowed the use of vehicles like the Polaris Ranger Crew, which is nearly the same size as a small car with the capacity of a much larger vehicle. This increase in size and ability of these vehicles has raised concerns with public lands managers (U.S. Department of the Interior Bureau of Land Management 2001).

A Forest Service survey that took place between July 1999 and July 2002 discovered that more than 88% of people in the United States who are 16 years and older participate in some type of outdoor recreation. Of those participating in outdoor activities, 17.4% (or 37.1 million people) listed Off-Road 4-Wheel Driving, ATV, or motorcycles as their choice of activity (U.S. Department of the Interior 2002).

## Lithic Scatters

Typically, lithic scatters are composed of debitage, or flakes, generated by the onsite production of projectile points and other flaked stone tools, and less frequently, by the tools themselves. Lithic scatters are one of the most abundant sites found on the landscape, especially within desert areas, such as the Great Basin. As the environment of these regions is not always conducive to long-term settlement, people did not stay long enough in any one area to leave much more than these subtle indicators of their passing. At first glance, lithic scatters often appear as little more than prehistoric waste scattered across the land. However, lithic scatters can provide a wealth of information if one looks a little deeper. Many archaeological undertakings begin with a pedestrian survey of an area and a lithic scatter is often the first indicator of a prehistoric site (Sullivan et al. 2002:42–45).

Joseph Chartkoff states that as lithic scatters figure so prominently into the cultural record, that this situation "gives significance to lithic scatters as a major expression of past cultural activity." He took this observation one step further by outlining five ways in which lithic scatters can provide information for cultural studies and land managers. The first is the "within-site context" that looks at the variation and patterning among the components of the scatter. Second, the "assemblage as a whole" focuses on the scatter as a whole rather than just the parts. Third, the "environmental context" sees the site in relation to environmental resources (such as tool material, water, or game). Fourth, is the "context of cultural systems," meaning that aspects within lithic scatters can indicate area use by more than one cultural group. Finally, "context at the regional level" indicates lithic scatters can provide information on multiethnic relationships (Chartkoff 1995:26). In other words, not only do lithic scatters provide information about occupation locally but also regionally.

Lithic scatters typically represent short-term occupations (Glassow 1985). As such, the information they can provide is likely to be centered on specific activities, such as day-use areas for resource acquisition or overnight hunting camps. The knowledge of artifact assemblage, environmental locality, approximate date of occupation, and spatial patterning of these small sites can then be applied toward understanding larger, more complex sites within the adjacent area as well as across the region. For example, hunting camps are characterized by tools associated with hunting and meat processing in the form of fire-cracked rock, projectile points, knives, and scrapers but usually lack the artifacts and features that are associated with long-term habitation (such as earth ovens, hearths, and plant-processing tools).

The material type, abundance, and flake size are also informative. For example, if there are no known sources of a particular material within the area, the presence of that material in the site could indicate trade. Distance from the material source could also indicate wealth as materials that are rare or difficult to acquire necessitate greater resources. Newman states that flake size decreases as distance from the source material increases (Newman 1994). In other words, larger debitage flakes are found if the source material is nearby while distance dictated reduction techniques that are more conservative. The condition of material can indicate site type; small internal flakes indicate onsite tool manufacturing or modification while sites with flakes containing cortex (the outer exposed part of a stone) may indicate early stage reduction to facilitate transportation. Even the distribution of a particular material type within the site itself could provide important information concerning where certain activities took place (West 1974:1–3). For example, each type of lithic reduction technique produces a unique flake-size distribution pattern (Patterson 1990).

Lithic scatters are also important because they are the starting point for many federal management decisions (Spoerl 1988:17–25). The National Register of Historic Places has certain criteria by which sites are evaluated and deemed significant (Little et al. 2000). Lithic scatters fall under Criterion D: sites that have yielded, or may be likely to yield, information important in prehistory or history. The key here is "may be likely to yield" as in the future. It is not enough to consider only what can be learned now but it is also necessary to consider what may be found in the future (Sharrock and Grayson 1979:327–328). Lithic scatters can also provide valuable information for understanding mobility and settlement patterns within local and regional areas; however, due to the ephemeral nature of these sites, archeologists often have a difficult time providing adequate protection for these sites (Cowan 1999; Tainter 1979).

Provenience, the context in which lithic scatters are found, is easily changed or lost by off-road vehicle use. Although surface lithic scatters are susceptible to impacts from the natural world such as weathering and erosion, these impacts are increased when off-road vehicle use is added to the mix. Erosion, artifact movement, and breakage affect the context of lithic sites; off-road vehicle use can contribute to these factors. Once this pattern is lost, it is lost forever.

## Impacts from Off-Road Vehicles

As evidenced by a quick search on Google, off-road vehicle use on public land has been hotly debated over the past 20 years and is only growing more intense (Howard 2012). As off-road vehicle ownership rises and access declines, land managers often find themselves caught in the middle as off-road vehicle users and environmental groups collide. Both sides of the opposition have filed lawsuits and the results have often left more problems than solutions. For example, in January 2011, five environmental groups filed a lawsuit against the Forest Service for approving an expansion of off-road vehicle trails in the Pike National Forest and the San Isabel National Forest claiming it was done in violation of National Environmental Policy Act (NEPA) and the

Endangered Species Act requirements (Boczkiewicz 2011:4). In response to this, the Colorado Off-Highway Vehicle Coalition (COHVCO) and the Trails Preservation Alliance plan to fund legal action to defend against any action taken to close trails in these areas (Potter 2011:1).

In 2002, the COHVCO filed a lawsuit against the Forest Service when it closed the Arapaho Ridge Trail (Abboud 2002). In 2009, three environmental groups filed a lawsuit against the Forest Service for NEPA violation when the Forest Service decided to allow Coos County to construct an off-road vehicle path through a section of the Oregon Dunes National Recreation Area (Oregon Wild 2009; Preusch 2009).

The public is becoming more aware of the growing conflict between off-road vehicle users, the federal government, and environmental groups as evidenced by the growing number of articles written by the public and published in local newspapers and magazines. In a blatant disregard of federal laws, a county commissioner in San Juan County, Utah, led a jeep safari through Arch Canyon after being denied a permit by the Bureau of Land Management (BLM) (Schiffman 2005). In early 2005, angry comments from locals forced the BLM's Monticello Field office to make last minute adjustments in a permit granted to Jeep Jamboree USA based in California (Binkly 2007). The issue of off-road vehicles also poses concern for Tribes. In 2004, the Paiute-Shoshone Tribe of Fallon, Nevada, proposed that the BLM take a harder look at the way it manages certain areas, which are important in their spiritual practices (McConnell 2004).

In Utah, a study conducted by Utah State University (2002) put some numbers to the issues faced by law enforcement and federal land managers. A survey of off-roaders showed that 49.4% preferred to riding off established trails and half of those who rode dirt bikes had avoided established trails during their last outing. On the other side of the issue, a survey conducted of federal law enforcement individuals reveal feelings of frustration and inadequacies in the law (Rangers For Responsible Recreation Memo 2007). Of the respondents, 65% felt that penalties (written warnings, citations, and fines) were insufficient for the violations citing that the loss of hunting and fishing privileges would be useful in deterring further violations. Only 33% of the law enforcement officers had the authority to seize the vehicles of offenders. Respondents cited a lack of resources and preparedness in dealing with violators.

Their response is in conflict with the insistence by agencies, such as the BLM, who believe they have the situation under control. In 2007, an Easter weekend gathering turned into a riot when nearly 1000 off-road vehicle devotees began sexually harassing women at the Little Sahara Recreation area in Utah (Clayton 2007). In Colorado, off-road vehicle registrations increased by more than 650% between 1990 and 2004 (Wilshire et al. 2008).

Government regulations have been ambiguous at best and worthless at the worst. Although agencies acknowledge that something needs to be done about the explosive growth of off-road vehicle use, management plans often take time to implement and then are often in revision for years (Beck 1979). In 2001, the BLM released a National OHV Management plan (U.S. DOI BLM 2001). The management plan states that "this strategy is an effort to manage ORV activities in compliance with Executive Orders 11644 (1972) and 11989 (1978), 43 CFR 8340 . . . and is a 'catch up' initiative aimed at meeting the challenges of the fast-growing West . . . and an effort to enhance the management and protection of all public lands administered by the BLM" (Bureau of Land Management 2001:5). Unfortunately, this plan did not set any new regulations, close or construct any new roads, provide additional funds and staffing for off-road vehicle management, increase fine or penalties for violations, nor provide any real guidance for agencies to effectively manage off-road vehicle use. Other agencies, such as the Forest Service, have also attempted to get a handle on this ever growing style of recreation and admit that it is nearly impossible to meet the goals of Executive Orders 11644 and 11989 (Cordell et al. 2008).

## The Experiment

The experiment was conducted in a natural setting at a private ranch near Burns, Oregon, Harney County. Four areas were selected and divided into five individual plots measuring 30x30 cm. Artifacts, including tools and debitage, were obtained, labeled, and placed within the plots. Each plot was then driven over by a 1997 Polaris Xplorer 300 four-wheeler, typical of four-wheelers used by recreationists. Following each drive-over, evidence of artifact breakage and movement was recorded in a field notebook.

### *Setting*

The study area was located in the northern reaches of the Great Basin, in the Harney Basin, within the Wright's Point geologic area (Fig. 1). Wright's Point is an inverted valley with soils from the Pliocene era being exposed by erosion (Niem 1974:33). The Point itself is a basalt cap that was formed when an ancient lava flow followed a streambed. This cap provided protection to underlying sediments when surrounding soils were swept away. Soils are shallow to moderately deep silt over basalt lava flows with outcrops of volcanic and tuffaceous sedimentary rock (Walker and Nolf 2006). These poorly drained, alkaline soils are typically used for livestock grazing, hay production, and wildlife habitat (USDA 2006:227–228).

Vegetation of the area is high desert sagebrush steppe—a treeless plain covered with low bushes, shrubs, and bunchgrasses. Commonly found vegetation includes basin big sagebrush (*Artemisia tridentata tridentata)*, Wyoming big sagebrush (*Artemisia tridentata tridentata* Nutt. ssp. *wyomingensis)*, greasewood (*Sarcobatus vermiculatus*), silver sagebrush (*Artemisia cana* Pursh ssp. *bolanderia*), basin wildrye (*Elymus cinereus)*, inland saltgrass (*Distichlis spicata*), beardless wildrye (*Elymus triticoides)*, Thurber's needlegrass (*Achnatherum thurberianum)*, needle and thread (*Hesperostipa comata*), and Sandberg bluegrass (*Poa secunda*) (USDA Online Plant Database 2012).

The Northern Great Basin has been occupied for thousands of years, with archaeological data providing evidence of human occupation for as long as ten thousand years (Fowler and Liljeblad 1986; Aikens 1993; Aikens and Couture 2007). In a view held common to Native peoples in Oregon, the Northern Paiute believe they have called this area home since time immemorial. Robert Stuart documented this belief held by Oregon Native Americans as far back as 1811 (Stuart 2006:44). Wright's Point is within the area indicated by Aikens as part of the seasonal round for the Harney County tribe of Northern Paiute, the *Wadatika,* which means "eaters of wada seed" (Aikens 1993:16).

### *The Experiment*

This experiment took place on 5 October 2011. The weather during this project was cold and cloudy with rain. On the previous day, 0.16 in. of rain had fallen and 0.64 in. fell on the day of the project. Winds were 8 mph with gusts up to 29 mph (Weather Underground 2011). As a result, the soil, although not muddy, was moist and easily compacted within the project area. No standing water was present within the site of the experiment.

As there is evidence for previous prehistoric occupation and the possibility that the area may contain artifacts or debitage, the location chosen for the project was surveyed with pedestrian transects spaced 5 m apart to ensure no cultural artifacts existed within the project area. Four test areas were chosen from a locale that had no known previous off-road vehicle impacts or any known archaeological sites. Each test area contained five 30x30 cm plots that were not contiguous (Fig. 2) but were separated by the distance of one meter.

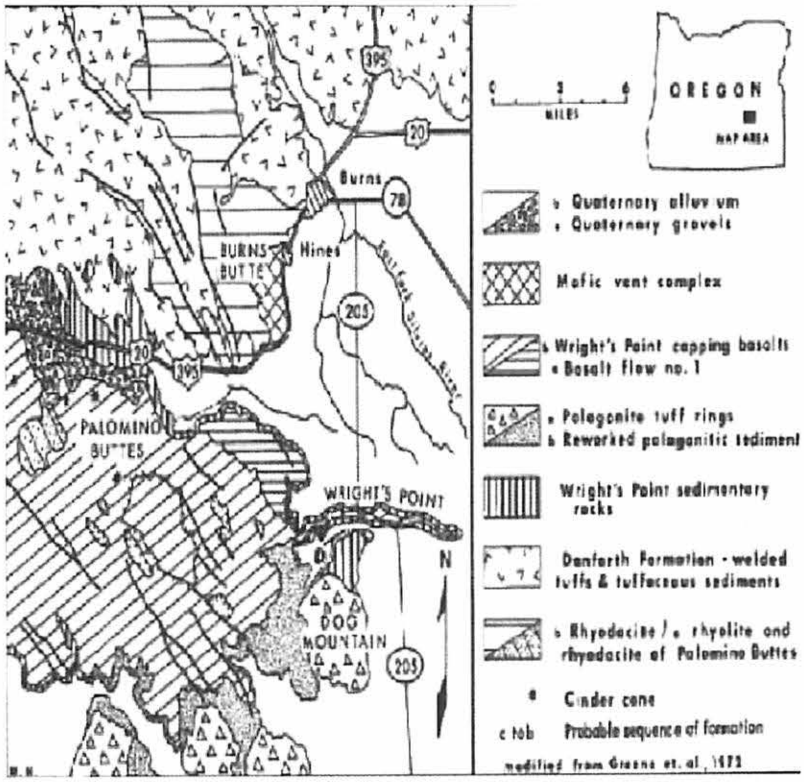



Fig. 1. Map of the project area. Adapted from State of Oregon Geologic Maps (*The Ore Bin* 1974:34).

The test areas were separated from one another by two meters. Test areas are identified as Test A, Test B, Test C, and Test D while the plots are identified Plot 1, Plot 2, and so on. A particular plot was identified first by test area then by plot. For example, the second plot located in Test Area B is noted as Test B Plot 2. Each plot was then outlined with white ground-marking paint in order to increase visibility (Fig. 3). This step was decided on after test passes indicated that the plots were difficult to see without some sort of indicator.

Each plot contained 16 pieces of debitage and 4 projectile points for a total of 20 artifacts per plot. The debitage was divided into four categories by size: 5 cm and larger, 4 cm, 3 cm, and 2 cm or smaller. Lithic scatters are made up of flakes in many sizes, shapes, and material types. For the purpose of this experiment, these size divisions were chosen in order to ensure the size groups remained consistent throughout the entire project. Since most lithic scatters contain few, if any, actual tools, it was decided to use a lower ratio of projectile points to flakes in each test area. Each plot contained four flakes from each category as well as four projectile points. The lithic debitage and tools were labeled with a unique identifier using a diamond-tipped scribe. Labeling provided a way to track each artifact. Artifacts were also photographed in order to record original condition in case of breakage.

The artifacts were placed on the surface because, as previously discussed, surface lithic scatters are typically the initial indicators of a site as well as the first thing to be impacted by off-road vehicle use. Artifacts were placed in rows across the plots (four across, five down) beginning with the smallest group of flakes and ending with a row of projectile points. Artifact location within the plot was recorded by using an established datum point that consisted of a 9-in. spike nail driven flush with the ground at the southeast corner of each plot.

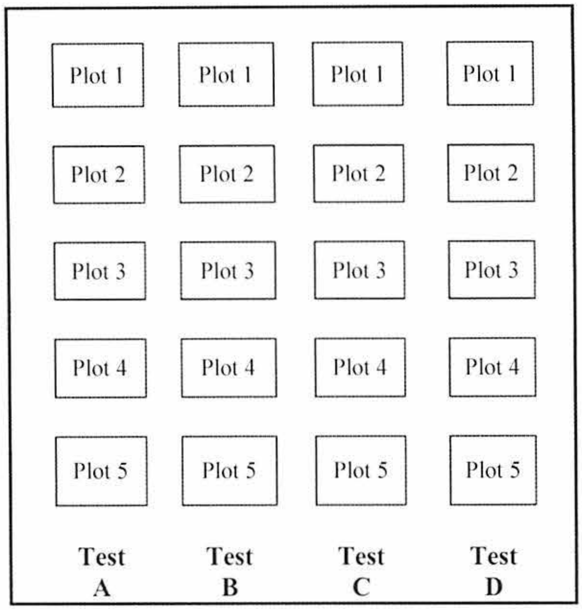



Fig. 2. Map showing the layout of the four test areas and the twenty 30x30 cm plots.

Fig. 3. Example of a typical test plot with the 20 artifacts in place. The 30x30 cm plot has been outlined in white paint.

The off-road vehicle used for the experiment, the 1997 Polaris Xplorer 300, has front tires measuring 7 in. wide (4 psi) and rear tires measuring 11 in. wide (3 psi) and can be driven in either 2- or 4-wheel mode. The Xplorer weighs approximately 560 lbs. with a carrying capacity of 90 lbs. on the front axle and 180 lbs. on the rear (London 1999). For this experiment, a driver weighing 180 lbs operated the Polaris in 4-wheel drive mode.

After the plots were set up, the Polaris was driven over the artifacts on a controlled basis. Vehicle movement was controlled concerning speed and number of passes. All off-road vehicle users ride at different experience levels and speeds based on terrain and surface conditions and these speeds were chosen after research was conducted on a study from the Motorcycle Industry Council and the Environmental Protection Agency (EPA) (Office of Transportation and Air Quality 2003). Most riders (average users) indicated that their speeds ranged between 5 and 10 mph with more advanced riders listing up to 35 mph on well-groomed established trails such as reclaimed railroad tracks. The speeds chosen for the passes in this project (5 mph and 25 mph) were taken from both ends of the survey. After a few preliminary passes, it was determined that the plots were difficult to spot at 35 mph and the top speed was reduced to ensure the driver could see the plot area. The speed of Test Areas A and B were 5 mph. Test Area A had one vehicle pass and Area B had five passes with a speed of 5 mph. This process was repeated for Test Areas C and D with a speed of 25 mph.

After the designated passes for each speed were completed, the artifacts were re-located and their locations were noted. This allowed the researcher to determine the way in which artifacts are displaced at a given speed. Each artifact was examined to determine the level of breakage, if any. The three missing artifacts were included within horizontal movement since none of them was located within the unit, indicating they were moved elsewhere in a horizontal fashion. When an artifact was not located, the unit was excavated to a depth of 5 cm and the dirt was screened using 1/8 in. screen. This depth was chosen as the surface was not disturbed beyond a depth of 5 cm with a maximum of five passes.

## The Data

This project involved 400 artifacts consisting of stone flakes and projectile points of chert, obsidian, and basalt. These materials were chosen because they are typical of the materials found in the Harney county region. Coons Lapidary of Burns, Oregon, donated the lithic debitage to this project. In an effort to prevent bias in material type, flakes from flint knapping waste piles were raked into a bucket for collection. Obsidian made up nearly half of the materials represented. This was not surprising as Glass Buttes, a known obsidian source, is located 50 miles west of the project location and easily accessible by Coons Lapidary. The breakdown of material types comprising the sample was as follows: 95 flakes of basalt (23.75%), 108 flakes of chert (27%), and 197 flakes of obsidian (49.25%). The projectile points used in this project were purchased online through Amazon.com.

Of the 400 artifacts placed in the placed into the plots, 200 artifacts (50%) experienced some sort of effect in the form of movement, compaction, breakage, or a combination of the three (Fig. 4; Table 1). More precisely, 175 artifacts (43.75%) experienced movement, 22 artifacts were broken (5.50%), and 3 artifacts were missing (0.75%). The three missing artifacts fell within the <2 cm category. The impacts experienced by each test plot are described in the tables below.

Movement was classified as vertical movement, horizontal movement, missing artifacts, and flipped artifacts. Artifacts were placed in the plots with the number side up (Fig. 5). Artifacts that were found in their original location but with the number facing down were placed within the

Fig. 4. Pie chart showing the effect of the experiment on the artifacts.

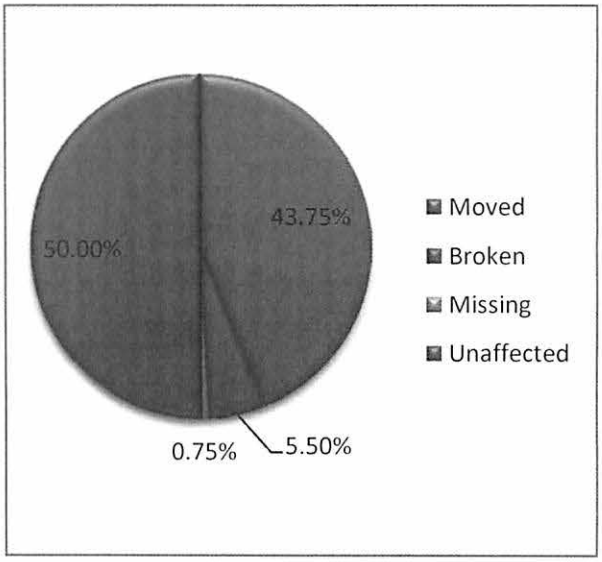



TABLE 1. RESULTS BY TEST AREA

Test A. Speed: 5 mph. Pass: 1

| | |
|---|---|
| Broken | 3 |
| Total Movement (14) | |
| Vertical | 9 |
| Horizontal | 3 |
| Flipped | 2 |
| Flipped on Edge | 0 |
| Missing | 0 |

Test B. Speed: 5 mph. Passes: 5

| | |
|---|---|
| Broken | 9 |
| Total Movement (49) | |
| Vertical Movement | 37 |
| Horizontal | 15 |
| Flipped | 10 |
| Flipped on Edge | 1 |
| Missing | 1 |

Test C. Speed: 25 mph. Pass: 1

| | |
|---|---|
| Broken | 3 |
| Total Movement (56) | |
| Vertical Movement | 16 |
| Horizontal | 43 |
| Flipped | 12 |
| Flipped on Edge | 1 |
| Missing | 0 |

Test D. Speed: 25 mph. Passes: 5

| | |
|---|---|
| Broken | 7 |
| Total Movement (59) | |
| Vertical Movement | 25 |
| Horizontal | 41 |
| Flipped | 7 |
| Flipped on Edge | 1 |
| Missing | 2 |

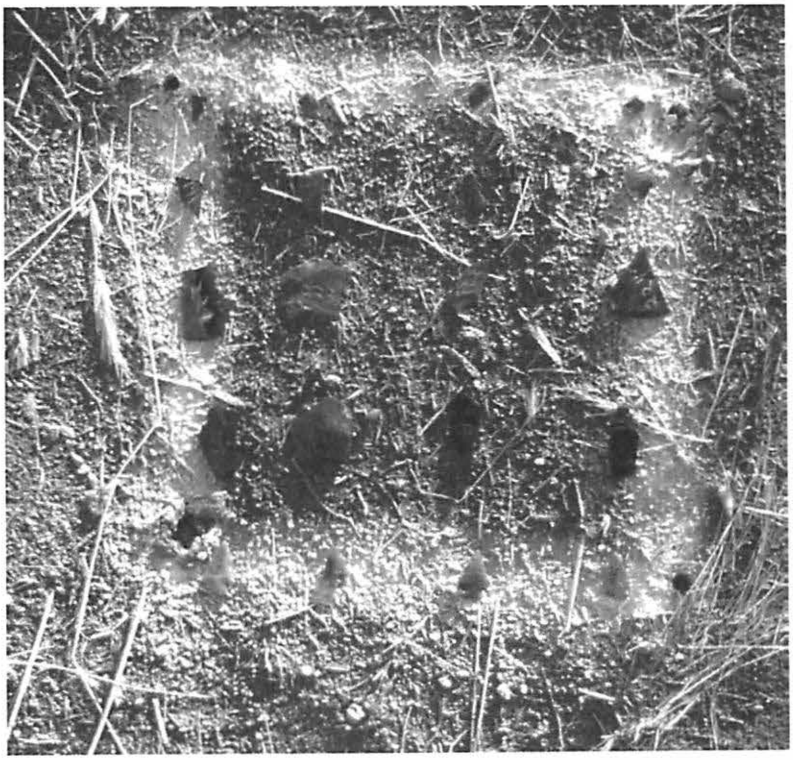


Fig. 5. Test Area D Plot 1 before passes by the Polaris Xplorer 300.

Fig. 6. Test Area D Plot 4 after five passes. Artifacts outside the plot area are circled.

flipped category. Three artifacts were found on edge and compacted into the soil and these were placed into their own category. Some artifacts experienced only one type of movement but most experienced both horizontal and vertical movement as well as breakage (Fig. 6).

The complete assessment of impacts to artifacts and results from each test area is found in the thesis (Temple 2012: Appendix A and B). The statistical analysis, which used the chi-square test to confirm that there was a significant would provide the needed information. The information for each variable was entered into an on-line statistical analysis table that performed the needed calculations (Temple 2012: Appendix C).

Three artifacts were not located after the experiment; these units was excavated to a depth of 5 cm. The excavations revealed that soil was not disturbed below 2 cm, compaction being the biggest factor. It is likely that the soil was damp enough due to the precipitation that fell during the previous 24 hours that the missing artifacts may have adhered to the wheels of the Xplorer and were deposited elsewhere. All three of these artifacts were smaller than 2 cm and their small size likely contributed to their transport outside the project area.

Of the 175 artifacts that were moved, 102 of them were moved horizontally. At 5 mph, movement was limited to 3 cm or less in direction. The number of passes by the Polaris appeared to have had no effect on the distance the artifacts moved. Artifact movement at 25 mph was somewhat similar, with most of the movement remaining at 5 cm and less, although twelve artifacts were displaced to distances up to 16 cm with one artifact traveling 24 cm beyond its original location.

There were 87 artifacts that experienced vertical movement. This was indicated by the artifact being compressed flush into the ground surface. Of those affected only two were found at 3 cm with the rest discovered 1–2 cm below the surface. The dampness of the soil likely had an effect on the compaction of the artifacts. Wet soil is softer than dry soil and this possibly prevented breakage by allowing the artifacts to be pressed into the ground instead of breaking beneath the weight of the Polaris.

Of the artifacts that were moved, 31 were inverted, or flipped, but still within their original position. In addition, three other artifacts were stood on edge and pushed into the soil. None of these artifacts were broken by this action and this can likely be contributed to the damp condition of the soil.

The 22 artifacts that were broken displayed varying degrees of damage (Table 2). The artifact pieces were found together except in two cases. The pieces of artifacts #187 and #198 were found 3 cm and 2 cm apart, respectively. These two artifacts fell within the 4-cm category. The category that experienced the most damage was the 5 cm and larger group. Of this group, 13 of the 80 (16.25%) were broken, and three of these experienced crushing. In this scenario, crushing involved pieces small enough to go through the screen and could not used to reconstruct the artifact. There were no broken artifacts in the category that contained the arrowheads. This is likely due to their size, which fell within the 3 cm category. The debitage that fell into this category is the one that experienced the least amount of damage.

Artifact breakage by material type was also considered and is listed in Table 3. Of the 22 broken artifacts, 7 were basalt (31.9%), 1 was chert (4.5%), and 14 were obsidian (63.6%). The higher percentage of broken obsidian artifacts was not unexpected given the higher percentage of obsidian within the assemblage.

As mentioned before, the plots were difficult to locate while driving at speeds higher than 25 mph. To counteract this problem, in addition to speed adjustment, the plots were outlined with white paint. Although both of these modifications allowed the four-wheeler operator to easily locate the plots in order to drive over them, it also had the effect of limiting freedom of movement.

TABLE 2. ARTIFACT BREAKAGE.

| Total | Damage Sustained |
|---|---|
| 8 | Broken into 2 pieces |
| 5 | Broken into 3 pieces |
| 2 | Broken into 4 pieces |
| 7 | Broken into 5+ pieces/crushing |

TABLE 3. DAMAGE BY MATERIAL TYPE.

| Material | Damaged |
|---|---|
| Basalt | 7 |
| Chert | 1 |
| Obsidian | 14 |


Fig. 7. Side-by-side comparison of artifact #229 before and after being broken.

The driver had a tendency to aim for the middle of the plot, which resulted in some parts of the plot experiencing no effects. One way to counteract this issue in further trials would be to set up plots on established trails and avoid visibly marking the plot areas. This would eliminate alerting the driver to specific areas and allow riders to operate with greater freedom in speed and direction.

## Results

To determine statistical significance of the plot patterning, the chi-square test was used (Freedman, Pisani, and Purves 2007). The information for each variable was entered into an on-line statistical analysis table that performed the needed calculations. The full analysis is found in the thesis (Temple 2012: Appendix C). The major questions developed concerned horizontal movement, vertical movement, and breakage. Factors considered included number of passes, speed, and artifact material type. Results from this experiment suggest the following:

1. One pass of a four-wheeler through a cultural site has the potential to cause as much damage to artifacts as many passes.
2. There was no difference in breakage rates for the three materials used (obsidian, chert, and basalt).
3. Larger artifacts are more likely to be broken.
4. Number of passes does not influence the distance the artifacts travel horizontally.
5. Speed does influence the distance the artifacts travel horizontally. This observation can be explained by Newtonian mechanics, which predicts that horizontal movement directly correlates to speed (McIlroy 2012).
6. Speed of the vehicle and number of passes has an effect on vertical movement.
7. Size of the artifact does not affect its movement.

## Discussion

This project was designed to determine the ways that speed and repetition of passes may affect lithic scatters. Tests would indicate that the speed and number of passes of the vehicle has little to do with the amount of damage sustained by artifacts. Although the null hypothesis was not rejected by the tests, it is important to keep in mind that there may be other variables that should be considered. Soil type may well play a part in breakage rates. For instance, loose soft soils such as sand may reduce or even prevent breakage while harder soils, like compacted clay, could cause higher rates of breakage.

As evidenced by the tests, the vertical and horizontal movement of artifacts is strongly influenced by the speed of the four-wheeler. Although horizontal movement does not appear to be affected by the number of passes, speed does determine the distance that the artifacts traveled. Both speed and number of passes affect vertical movement through the soil. Again, soil type likely plays a part in vertical movement. It is possible that hard compacted soils will cause artifacts to break rather than allow for vertical movement.

As mentioned earlier, soil moisture content may have played a part in artifact movement, particularly the loss of three artifacts. The rain of the previous 24 hours before the treatments were applied may have provided enough moisture for the artifacts to have been picked up in the tires of the four-wheeler and transported outside the project area. A more in-depth focus on the relationship between artifact movements and different soil types and conditions may show a connection between them. Additional circumstances that may have a bearing on further findings include vegetative cover, slope, terrain, vehicle and rider weight, flake morphology and weight, and seasonal variations among others. Considering other variables could provide more information for better understanding how off-road vehicles affect cultural areas.

As Ellis has pointed out, "experimental findings that have had broader applicability are those that are part of a long term program" (Ellis 2000:203). This project should not be seen as the final step in understanding the impacts of off-road vehicles but as a small beginning. More work can be done beyond simply looking at the mechanics of the impacts. Perhaps one of the first steps to negating the effects of off-road vehicles is public education. Raising awareness of the loss of cultural areas may facilitate a compromise between riders, archaeologists, and resource managers.

Archaeologists and resource managers often pass over lithic scatters in favor of larger, more complex sites. However, these sites are important in understanding settlement and land use patterns even when these areas have experience disturbance, especially if the archaeologist understands the way in which the site was damaged (Talmage and Chesler 1977:1–7). Caputo states that lithic scatters are "data points in the prehistoric continuum" and that they "contribute to a better understanding" of how prehistoric people interacted with the environmental (Caputo 1991:12). Recreational vehicles are not going away nor is it reasonable to expect that it is possible to prevent all illegal off-road vehicle use. However, if disturbance patterns are understood, it is possible that these areas will retain much of their information.

## ACKNOWLEDGMENTS

This article is adapted from a University of Idaho master's thesis in anthropology by the first author that was done under the direction of the second author. Other University of Idaho thesis committee members included Mark Warner and Stephen Bunting with additional help provided by University of Idaho faculty members Stacy Camp and David McIlroy.

Financial and other support for the research was provided by Renee Straub and Diane Pritchard of the Vale District Bureau of Land Management and by the Donald Crabtree Lithic Scholarship at the University of Idaho. Special thanks go to Vern and Tammy Freed of Burns, Oregon, for allowing the first author to conduct this project on their ranch, for donating the use of their four-wheeler, and for welcoming her into their home. Special thanks also go to Cecil Coons of Burns, Oregon, for providing the buckets and buckets of lithic debitage and for sharing his knowledge of lithic materials.

The first author would also like to extend her heartfelt gratitude to friends and supporters Don Rotell, Katherine Coddington, Ernest Boakye-Dankwa, Lisa Moody, and Tyler Woods and to her family members including her husband John Temple, her daughters Miranda and Nikkole, her stepson Allen Temple, and her parents, James and Julie Walls.

# REFERENCES CITED

Abboud, Jerry
2002 *Colorado Off-Highway Vehicle Coalition Files Federal Lawsuit on Routt National Forest.* COHVCO Land Use Issues and Litigation. <http://www.cohvco.org/landuse/index.php?item=2>

Adams, John C., and Stephen F. McCool
2009 Finite Recreation Opportunities: The Forest Service, the Bureau of Land Management, and Off-Road Vehicle Management. *Natural Resources Journal,* 49(1): 45–116.

Aikens, C. Melvin
1993 *Archaeology of Oregon.* Department of the Interior, Bureau of Land Management, Portland, OR.

Aikens, C. Melvin and Marilyn Couture
2007 The Great Basin. In *The First Oregonians*, 2nd edition, edited by L. Berg, pp. 275–282. Oregon Council for the Humanities, Portland, OR.

Beck, John L.
1979 *Interim Cultural Resource Management Plan for the Tangle Lakes Archaeological District with Recommendations for Off-Road Vehicle Designation.* U.S. Department of the Interior, Bureau of Land Management, Anchorage, AK.

Binkly, Gail
2007 *The battle over motorized recreation in San Juan County, Utah.* Four Corners Free Press. <http://fourcornersfreepress.com/news/2007/050701.htm > (Accessed 4 January 2013).

Boczkiewicz, Robert
2011 Forest Service asks judge to toss lawsuit. *The Mountain Mail.* August 15, 2011, pp. 4, Salida, CO.

Bureau of Land Management Memo
1975 Yuha Intaglio Destruction. *Memorandum to State Director from District Manager.* July 14, Riverside.

Caputo, Jane
1991 Something Out of Nothing: The Significance of Marginal Sites. *Society of California Archaeology Publications,* 4:11–21.

Chartkoff, Joseph L.
1995 A Nested Hierarchy of Contexts: An Approach to Defining Significance for Lithic Scatters. *Journal of California and Great Basin Anthropology*, 17(1):28–40.

Clayton, Mark
2007 Off-road vehicles rev up controversy in public lands. *Christian Science Monitor*, July 3. <http://www.csmonitor.com/2007/0703/p02s01-ussc.html?page=2> (Accessed 4 January 2013).

Cordell, H., J. Teasely, G. Super, J. Bergstrom, and B. McDonald
2000 *Outdoor Recreation in the United States: Results from the National Survey on Recreation and the Environment.* USDA Forest Service, Southeastern Research Station, Asheville, NC.

Cordell, H. Ken, Carter J. Betz, Gary T. Green, and Becky Stephens
2008 Off-Highway Vehicle Recreation in the United States and its Regions and States: A National Report from the National Survey on Recreation and the Environment (NSRE).

Cowan, Frank L.
1999 Make Sense of Flake Scatters: Lithic Technological Strategies and Mobility. *American Antiquity,* 64(4):593–607.

Davis, Craig W.
1983 *A Summary Assessment of the Effects of Off-Road Vehicle Uses on Cultural Resources.* National Park Service, Alaska.

Ellis, Linda
2000 *Archaeological Method and Theory: An Encyclopedia.* Taylor & Francis, Florence, KY.

Forest Development Trails
1990 Final Rule. 55 Fed. Reg. 25,831 June 25, 1990.

Foster, Patrick R.
2004 *The Story of Jeep.* Krause Publications, Iola, KS

Fowler, Catherine S., and Sven Liljeblad
1986 Northern Paiute. In *Handbook of North American Indians*, edited by W.C. Sturtevant and W. L. D'Azevedo, pp. 435–465. Smithsonian Institution, Washington, D.C.

Freedman, David, Robert Pisani, and Roger Purves
2007 *Statistics*, 4th Edition. W.W. Norton and Company, New York.

Glassow, Michael A.
1985 The Significance of Small Sites to California Archaeology. *Journal of California and Great Basin Anthropology,* 7(1):58–66.

Havlick, David. G.
2002 *No Place Distant: Roads and Motorized Recreation on America's Public Lands.* Island Press, Washington, D.C.

History of the ATV
2010 Specialty Vehicle Institute of America. <http://www.svia.org/About/History.aspx> (Accessed 4 January 2012).

Howard, Ted
2012 Written Testimony Provided to Oversight Hearing on the Impacts of Unmanaged Off-Road Vehicles on Federal Land. *Journal of Northwest Anthropology*, 46(2):203–207.

Little, Barbara, Erika Martin Seibert, Jan Townsend, and John H. Sprinkle
2000 *Guidelines for Evaluating and Registering Archeological Properties.* <http://www.nps.gov/nr/publications/bulletins/arch/> (Accessed 10 September 2011).

London, John
1999 *Polaris Xplorer 300 Specs.* eHow. <http://www.ehow.com/list_7349940_polaris-xplorer-300-specs.html> (Accessed 17 January 2012).

Long, Russel, Sean Smith, Shelia Gallagher, and Cindy Berning
1999 *Off-the-Track: America's National Parks under Siege.* Great Egg Harbor Watershed Association.

Lyneis, Margaret M., David L. Weide, and Elizabeth von Warren
1980 *Impacts: Damage to Cultural Resources in the California Desert*, edited by E.W. Ritter, pp 4–20. Bureau of Land Management, Riverside, CA.

McConnell, Cory
2004 *Fallon tribe seeks protection of cultural sites*. June 30: Lahontan Valley News. <http://www.lahontanvalleynews.com/apps/pbcs.dll/article?AID=/20040701/News/107010003> (Accessed 19 August 2011).

McIlroy, David
2012 Personal correspondence, February 24, 2012. (C. Temple, Interviewer).

National OHV Implementation Team
2005 *Off-Highway Vehicle Use and Collaboration: Lessons Learned From Project Implementation.* U.S. Institute for Environmental Conflict Resolution. USDA Forest Service.

Newman, Jay R.
1994 The Effects of Distance on Lithic Material Reduction Technology. *Journal of Field Archaeology,* 21(4):491–501.

Nickens, Paul R., Signa L. Larralde, and Gordon C. Tucker
1981 *A Survey of Vandalism to Archaeological Resources in Southwestern Colorado.* Bureau of Land Managegment, Denver, CO.

Niem, Alan R.
1974 Wright's Point, Harney County, Oregon An Example of Inverted Topography. *The Ore Bin,* 36(3):1–24.

Office of Transportation and Air Quality
2003 *Summary and Analysis of Comments: Control of Highway Motorcycles.* Environmentental Protection Agency, Washington, D.C.

Oregon Wild
2009 *Conservation Groups Bring Lawsuit to Protect Roadless Area from Off-Road Vehicles in the Oregon Dunes National Recreation Area.* Oregon Wild. <http://www.oregonwild.org/about/press-room/press-releases/conservation-groups-bring-lawsuit-to-protect-roadless-area-from-off-road-vehicles-in-the-oregon-dunes-national-recreation-area> (Accessed 12 December 2011).

Patterson, Leland W.
1990 Characteristics of Bifacial-Reduction Flake-Size Distribution. *American Antiquity,* 55(3):550–558.

Potter, Mike
2011 Lawsuit on Pike/San Isabel Forests Raises OHV Group Concerns. *The Flume*, pp. 4, 19 September. Baily, CO.

Preusch, Matthew
2009 *Groups sue to stop road building*. OregonLive.com. <http://www.oregonlive.com/environment/index.ssf/2009/12/groups_sue_to_stop_road_building.html> (Accessed 9 September 2011).

Rangers for Responsible Recreation
2007 *First-Ever Survey of Federal Rangers shows ORVs Out of Control, Need for Tougher Penalties.* <http://www.glorietamesa.org/RangersForResponsibleRecreation.pdf> (Accessed 18 April 2011).

Sampson, Michael P.
2009 The Effects of Off-Highway Vehicles on Archaeological Sites and Selected Natural Resources of Red Rock Canyon State Park. *Proceedings for the Society for California Archaeology,* 21:190–201.

Schiffman, Lisa
2005 Archaeology, Off-Road Vehicles, And the BLM. *Archaeology Online Feature,* 20 April. <http://www.archaeology.org/online/features/southwest/> (Accessed 19 September 2011).

Sharrock, Floyd W. and Donald K. Grayson
1979 "Significance" in Contract Archaeology. *American Antiquity,* 44(3):327–328.

Spoerl, Patricia M.
1988 Management Impacts on Cultural Resources: An Assessment of Forest Service Research Needs. In *Tools to Manage the Past: Research Priorities for Cultural Resource Management in the Southwest,* edited by J. A. Tainter, and R. H. Hamre. USDA Forest Service General Techinical Report RM-164, Grand Canyon, Arizona, Fort Collins, Colorado, Rocky Mountain Forest and Range Experiment Station.

Stuart, Robert
2006 They Possess Their Present Lands and Situation From Time Immemorial, 1811. In *Oregon Indians: Voices from Two Centuries,* edited by S.D. Beckham, pp. 43–51. Oregon State University, Corvalis.

Stull, R., S. Shipley, E. Hovanitz, S. Thompson, and K. Hovanitz
1979 Effects of Offroad Vehicles in Ballinger Canyon, California. *Geology,* 79–21.

Sullivan, Alan. P. III, Patrick M. Uphus, Christopher I. Roos, and Phillip B. Mink II
2002 Inadvertent Vandalism: The Hidden Challenge for Heritage Resource Management. *CRM,* 42–45.

Tainter, Joseph A.
1979 The Mountainair Lithic Scatters: Settlement Patterns and Significance Evaluation of Low Density Surface Sites. *Journal of Field Archaeology,* 6(4):463–469.

Talmage, Valerie, and Olga Chesler
1977 *The Importance of Small, Surface, and Disturbed Sites as Sources of Significant Archaeological Data.* Office of Archaeology and Historic Preservation, Cultural Resources Management Studies. National Parks Service, Washington, D.C.

Taylor, Richard B.
n.d. *The Effects of Off-Road Vehicles on Ecosystems.* Texas Parks and Wildlife. <http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_rp_t3200_1081.pdf> (Accessed 25 April 2011).

Temple, Carolyn R.
2012 *An Experimental Archaeological Study of the Effects of Off-Road Vehicles on Lithic Scatters.* Master's thesis, University of Idaho, Moscow.

Total Motorcycle
2011 *Total Motorcycle Website.* <http://www.totalmotorcycle.com/> (Accessed 16 September 2011).

Utah State University
2002 Off Highway Vehicle Uses and Owner Preferences in Utah (Revised). <http://extension.usu.edu/iort/files/uploads/pdfs/revisedOHVreport.pdf> (Accessed 17 April 2012).

U.S. Department of the Interior Bureau of Land Management
2001 *National Management Strategy for Motorized Off-Highway Vehicle Use on Public Lands.* Washington, D.C.

2003 *Final Environmental Impact Statement for the Imperial Sand Dunes Recreation Area Management Plan and Proposed Amendment to the California Desert Conservation Plan 1980. Revised 2003.* El Centro, California.

U.S. Department of the Interior National Park Service
1999 *Draft Recreational Off-Road Vehicle Management Plan: Supplemental Environmental Impact Statement.* Big Cypress National Preserve, Florida.

U.S. Department of the Interior Forest Service
2002 American's Participation in Outdoor Recreation: Results From NSRE (With weighted data) (Versions 1 to 13). Retrieved April 18, 2012 from http://www.srs.fs.usda.gov/trends/Nsre/Rnd1t13weightrpt.pdf.

USDA
2012 Online Plants Database. <http://plants.usda.gov/java/> (Accessed 4 January 2013).

2006 *Soil Survey of Harney County Area, Oregon.* Available online at: http://soildatamart.nrcs.usda.gov/manuscripts/OR628/0/Harney.pdf ed.United States Department of Agriculture.

Walker, George W., and Bruce Nolf
2006 *High Lava Plains, Brothers Fault Zone To Harney Basin, Oregon.* United States Geological Survey. <http://www.cr.nps.gov/history/online_books/geology/publications/circ/838/sec5.htm> (Accessed 24 September 2011).

*Weather Underground*
2011 History for Burns, Oregon. <www.wunderground.com/history/airport/KBNO/2011/10/5/DailyHistory.html> (Accessed 19 January 2012).

Webb, Robert H.
1983 Compaction of Desert Soils by Off-Road Vehicles. In *Environmental Effects of Off-Road Vehicles: Impacts and Management in Arid Regions*, edited by Robert. H. Webb and Howard. G. Wilshire, pp. 51–79. Springer-Verlag, New York.

West, Frederick Hadleigh
1974 *Report of Archaeological Research in the Tangle Lake Archaeological District.* University of Wisconsin, Madison.

Wilshire, Howard G.
1979 *Study of 9 Sites Used by Off-Road Vehicles That Illustrate Land Modifications*. U.S. Geologic Survey Open File Report.

Wilshire, Howard Gordon, Jane E. Nielson, and Richard W. Hazlett
2008 *Losing the West : a Source Book for Salvaging America's Western Lands*. Oxford University Press, New York.

Zinck, Brian, and Teresa Zinck
1976 *Survey of Archaeological Sites, Tangle Lakes Archeological District Near Paxson, Alaska*. Resources Development Internship Program, Western Interstate Commission for Higher Education, Boulder, CO.

Carolyn R. Temple
Burns BLM Fuels Archaeologist
28910 Highway 20 West
Hines, OR 97738

carolynr.temple@gmail.com

Robert Lee Sappington, Ph.D., RPA
Department of Sociology and Anthropology
University of Idaho
Moscow, ID 83844-1110

roberts@uidaho.edu

Carolyn R. Temple is a Fuels Archaeologist with the Burns District of the Bureau of Land Management in Hines, Oregon. She attended five colleges and universities before graduating from Eastern Oregon University in 2010. She completed her M.A. in anthropology at the University of Idaho in 2012. This article is based on her thesis research and her interest in the effects of off-road vehicles on archaeological sites is ongoing.

Robert Lee Sappington is an associate professor of anthropology and American Indian Studies at the University of Idaho, Moscow. He completed his M.A. in anthropology at the University of Idaho in 1981 and his Ph.D. in anthropology at Washington State University in 1994. He began working as an archaeologist in the Pacific Northwest in 1975 and has worked at numerous prehistoric and historic sites across Idaho, eastern Washington, and elsewhere. His research interests are focused on western North American prehistory and history.

*Journal of Northwest Anthropology*, 47(2):189–202 2013

# DIGGING FOR WEALTH: ARCHAEOLOGICAL AND HISTORICAL ANALYSIS OF AN EARLY TWENTIETH CENTURY ORE PROCESSING MILL SITE IN SHOSHONE COUNTY, IDAHO

**Ashley M. Morton and Robert Lee Sappington**

ABSTRACT

Between the late nineteenth and early twentieth centuries, mining operations were established throughout Shoshone County, Idaho. In compliance with Section 106 of the National Historic Preservation Act of 1966, data recovery was undertaken between 2010 and 2011 at the Idora Mill site, an early twentieth century ore processing mill. Material culture recovered revealed individuals not only working but living near the site. This article reports the findings of the archaeological investigations, the results of material culture analyses, and aims to shed light on the inhabitants and operations of the Idora Mill site through a cultural ecology lens.

## Introduction

Between the late nineteenth century and the first half of the twentieth century, mining operations were established throughout Shoshone County, Idaho. While well-known operations that processed precious metals like silver are well documented across Idaho, the documentation for small-scale producers of base metals such as lead and zinc are few and far between. The excavation of a lead/zinc mill site in the Beaver mining district of the Coeur d'Alenes is characteristic of a small scale operation associated with individual camps that include at least one household dating as early as the 1910s and as late as the 1950s. This article discusses the findings of the Idora Mill archaeological investigation, illustrates the material culture comprising small-scale mining refuse, and examines mining site types through a cultural ecology lens.

## Background

In the summers of 2010 and 2011, data recovery at the Idora Mill site was carried out by the second author, under contract with TerraGraphics Environmental Engineering, Inc., for the Idaho Department of Environmental Quality as part of the Coeur d'Alene Basin Superfund project, a program designed for remediating contaminated soils produced by abandoned hazardous mine sites (Sappington and Morton 2011). The Idora Mill site was recognized as a source of metals contamination by abandoned mine land surveys in 1993 (SAIC 1993).

Located north of Wallace in Shoshone County, the project area is situated west of Sunset Peak near the confluence of Carbon and Beaver creeks (Figs. 1–2). Containing nine features, the Idora Mill site is made up of the collapsed mill structure itself, a collapsed house/shop, a dugout, a shallow surface trash scatter, a concrete platform, a short adit, a collapsed unidentified structure, a collapsed bunkhouse, and a collapsed log bridge crossing Beaver Creek. The mill site is managed by the Forest Service (FS) while the associated mine claims and tramway are under Bureau of Land Management authority (BLM) (Fig. 3). The area between the mill structure and associated mine claims is private property and it contains the collapsed bunkhouse and log bridge. The project landscape and surrounding area has undergone post- abandonment processes. The mine area is outside the Area of Potential Effects and in October 2010, the portals to the associated mine entrances south of the mill site were barricaded by the BLM for public safety. Prior to the initiation of field work the mill itself and most associated features were slated for removal in order to eliminate them as a source of contamination to Beaver Creek. After recordation the features on private land were removed so that only those features on FS land were included in the data recovery plan.

Data recovery included surface collection, hand excavation, and monitoring during removal of contaminated tailings at the site. These methods were employed to provide a representative sample of artifacts from the mill, house site, and surface trash scatter features, as well as to probe the thickness and composition of the latter deposit. Probing was to confirm that that the trash scatter was surface only. The surface trash scatter was determined to be associated with the mill and house components. This article concentrates on the material culture recovered from these three features relating to both residential and milling activity (Figs. 3–4).

## Site History

Archival evidence suggests the Idora Mill was in operation between 1913 and 1939 (Salt Lake Mining Review 1913a, 1913b; Campbell 1939:271). The 1939 end date is inferred based on the company's last filing in the annual report by the Idaho Inspector of Mines. Idora Mill was established by the Idora Mining Co. of Tacoma, Washington. Between 1906 and 1917, Idora Mining Co., changed its company name as it acquired more claims to Idora Mine Co, Ltd. and then Idora Hill Mining Co., then back to Idora Mining Co., with limited (LTD) liability status.

According to the Salt Lake Mining Review, by July 1913, the mill was in full operation noting its design to "handle 50 tons daily, but is believed that the capacity will approach 100 tons, when the period of exercising is at an end." This source went on to describe the Idora Mining Company's mill had been leased to mine manager and accountant Gus Ehrenberg in 1915. It is worth mentioning that Ehrenberg owned a house in Spokane that was listed on the National Register of Historic Places (NRHP) in 2007 for its "excellent condition and is a hallmark example of the Craftsman Style" (Spokane Historic Preservation Office). The Mining and Engineering World Journal reported in 1916 (1916a) a continued sense of productivity citing "three new ore showings that are regarded as the best ever opened in the property."

Within the known twenty-six years of the mill's operation, Idora was managed by six mining companies (Fig. 5). Following this period of increased development, the property was noted as "idle with annual labor only being performed" (Tarabulski 1992). Consequently, a series of levies, leasing, and absorption into other mining companies occurred. Between the years 1918 and 1947, the Idora holdings were transferred from one company to the next as those companies either became absorbed themselves or were sold off. By 1928, the Idora group consisted of one patented claim (the Colwyn), one patented fraction (the Triangle), and five unpatented claims, (Idora 1, 2, 3, 4, and 5) (Tarabulski 1992). As previously mentioned, Idora was last listed in the 1939 Inspector of Mines report (Campbell 1939:271) with the note that: "The Idora Mining Co., Ltd. has sold all property of every kind and description to the Consolidated Mines Corp. and has no property of any kind except unpaid accounts and its charter; we are simply keeping the corporation alive for future use and to collect amounts due." The property holdings originally owned and managed by Idora Mining Co. and Idora Mining Co. Ltd., are last identified in the 1947 Monitor Mining Company records (Tarabulski and Essaim 1992).

Although no archival evidence was found during this investigation suggesting the construction of the bunkhouse, construction and household furnishing remnants indicate it was built sometime in the 1950s; the land owner indicated its abandonment in 1971 (Dennis O'Brien 2010, personal communication). The bunkhouse represents what appears to be the last episode of activity on the site.

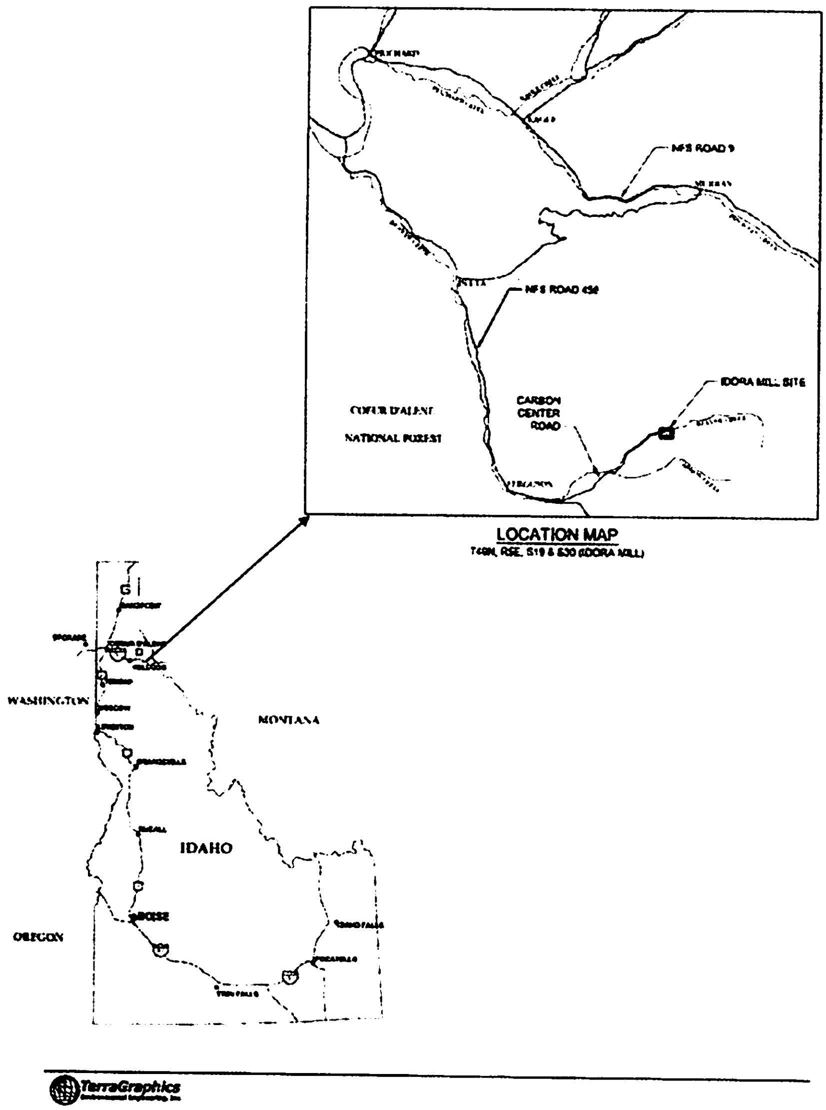



Fig. 1. Map showing the location of the Idora Mill site, Northern Idaho. Map courtesy of TerraGraphics Environmental Engineering, Inc.

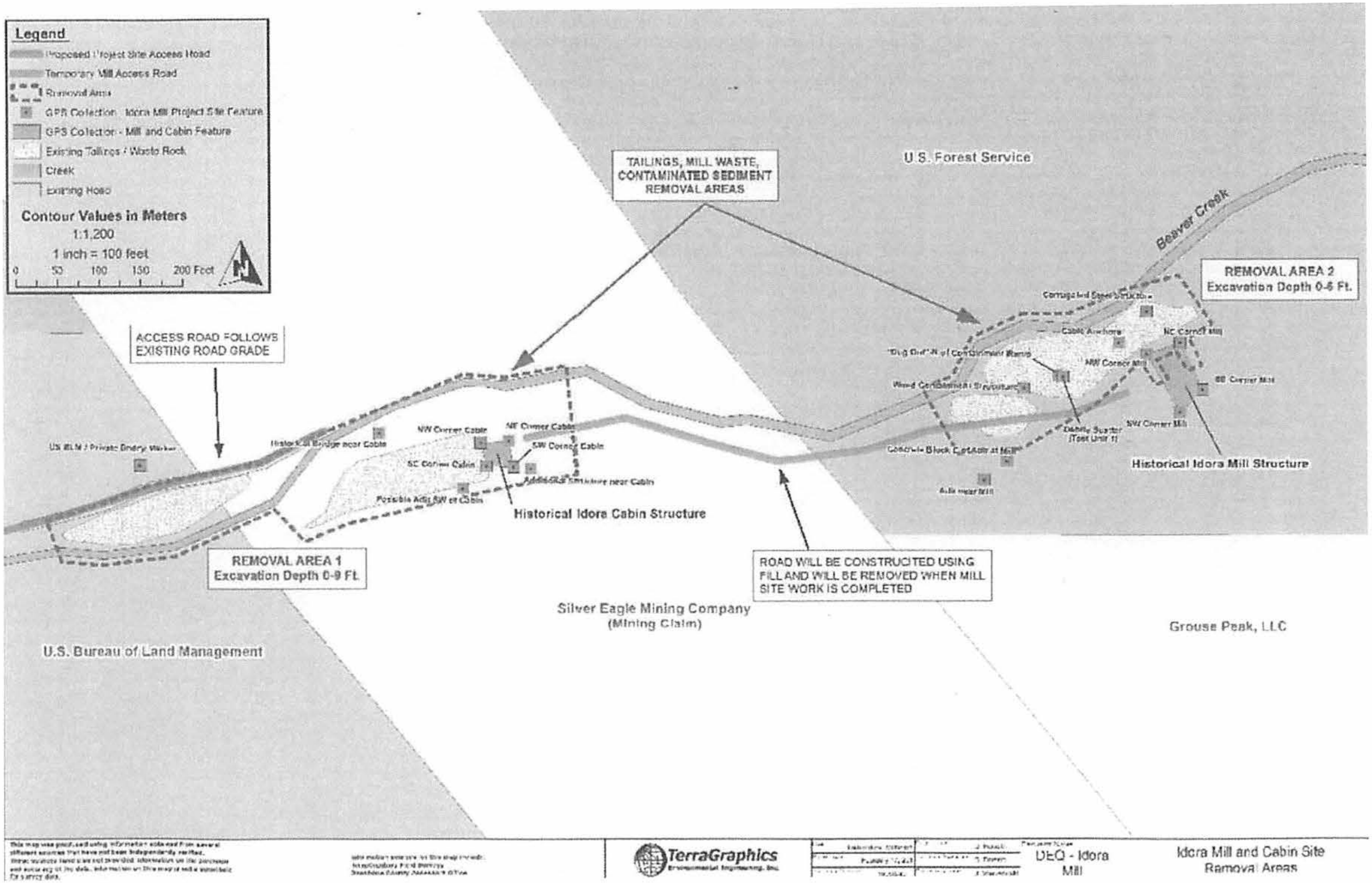



Fig. 2. Area Map of Idora Mill site. Map Courtesy of TerraGraphics Environmental Engineering, Inc.

Fig. 3. Idora Mill site, mill and tailing remnants in the background with an artifact scatter (flag pins) in the foreground.

Fig 4. The Idora Mill site prior to removal: construction build-up in the foreground.

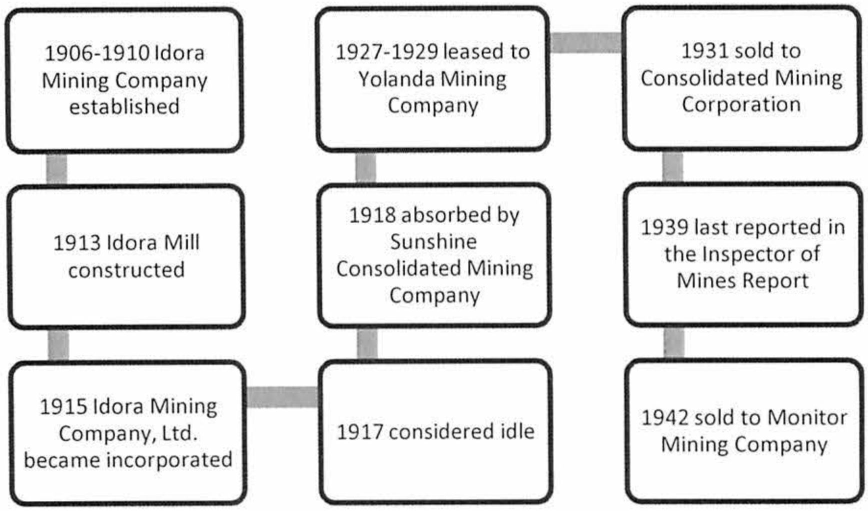



Fig. 5. Timeline of the Idora Mining Company (1906-1942), the original mining company to work the Idora Mill.

## A Brief History of Late-Nineteenth and Early-Twentieth Century Mining in Idaho

The historic development of Idaho is largely attributed to the feverish desire of mostly Euroamericans to gain wealth from its precious and base metal deposits. Following the California (1849) and Nevada (1859) rushes, investors and prospectors moved north along the coasts, and throughout the Inland Northwest. Rodman Wilson Paul (2001:138) noted, "Of all the new regions that opened to mining during the 1860s, Idaho and Montana came closest to making a reality of the prospector's dream of finding a new California. . . . Here were promising lodes of both gold and silver."

Idaho's best "diggings" in the period between 1860 and 1880 were hailed as coming from the Boise Basin. When placer production in southern Idaho exhausted gold deposits another boom arose; this time in the Coeur d'Alenes where silver, lead, and zinc were discovered. According to McKay and Cunningham (2011:47), northern Idaho and specifically the Coeur d'Alene region, has historically produced 80 percent of Idaho's overall metal production and forty-five percent of the nation's silver. This region is noteworthy for its lead and zinc output. In reviewing Annual Reports of the Mining Industry of Idaho, the region is well represented as a state leader in lead and zinc production consistently from 1906 to 1965. During this time the Coeur d'Alene mining district reportedly paid upwards of $300 million in dividends (Newell 1965:48).

The period from World War I through World War II contributed to heightened zinc production in this region. Lead and zinc were considered essential to the war effort as their use contributed not only to the production of brass shell casings but boxes protecting food and ammunition. Reasons for possible closure of the mill site in 1939 are unknown and while it cannot be said for certain if the mill was in operation during World War II as a base metal mill, Idora certainly participated in the changing market demands of lead and zinc occurring at least during the First World War. The Coeur d' Alene region is recognized as responding rapidly to demand created by both wars which made Idaho a leader of zinc output in the nation by the 1940s (McKay and Cunningham 2011:51). In any case, Idora undoubtedly contributed to the large role northern Idaho played in base metal production and consumption of the United States in the first half of the twentieth century.

## Artifact Analysis

A total of 1,926 artifacts were recovered and analyzed from surface and excavated units (Table 1). Artifacts include items made from ceramic, glass, metal, and other materials dating primarily between the 1920s and 1930s. Refuse disposal is reflective of Idora's operations under three different businesses—Sunshine Consolidated Mining Co., when absorbed in 1918; Yolanda Mining Co., when leased between 1927 and 1929; and Consolidated Mining Corp., when bought out by Sunshine in 1931.

Most artifacts identified were attributed to the functional categories of construction materials, storage and consumption of food and beverages, and tools and hardware. As the site consisted of collapsed structural features, it is not surprising that construction and tools/hardware related items including window glass, nails, bolts and the like are so heavily represented. Items in the food/beverage category include containers of commercially packaged food and beverage bottles, jars, and cans. No cooking vessels were recovered but at least one teacup or mug and a relief molded pitcher were identified. Small quantities of ceramic tablewares, personal objects, clothing (Fig. 6) and medical and health related items illustrate a collection suggestive of all-male occupants (cf. Spude 2005:89–106). Strong evidence representing male presence is not surprising—given the mill is a work camp—but one artifact, an aluminum toy crumb tray could indicate the presence of a family (Fig. 7). Of particular interest is a pink Depression glass juice dispenser advertising the brand Mission Beverages Co.

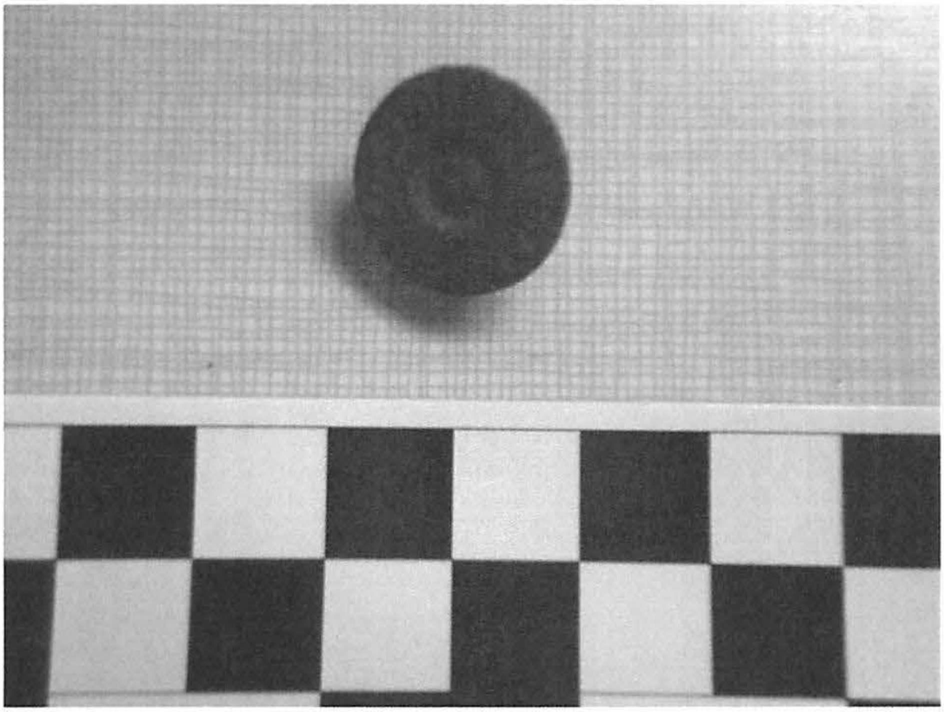


Fig. 6. Levi Jeans rivet ca. 1920s inscribed: "Boss of the Road." Catalog number 17, Feature 4. Photographed by Ashley M. Morton. Scale in cm.

TABLE 1. ARTIFACT COUNTS BY FUNCTION AND MATERIAL CLASS

| Function | Ceramics | Glass | Metal | Organics | Synthetics | Grand Total |
|---|---|---|---|---|---|---|
| Agriculture | - | - | 1 | - | - | **1** |
| Clothing/Clothing Maintenance | - | - | 26 | 69 | 5 | **100** |
| Communication | - | 15 | - | - | - | **15** |
| Construction | 20 | 672 | 2 | - | 25 | **719** |
| Food/Beverage | 15 | 311 | 45 | - | - | **371** |
| Food/Preparation Consumption | 3 | - | 18 | - | - | **21** |
| Heating and Energy | 16 | - | 2 | - | 1 | **19** |
| Household Furnishings | - | 1 | 2 | 4 | - | **7** |
| Household Maintenance | - | 4 | - | - | - | **4** |
| Leisure and Recreation | - | - | 1 | - | 2 | **3** |
| Machinery | - | - | 11 | - | - | **11** |
| Medical and Health | - | 9 | 2 | - | 3 | **14** |
| Other | - | - | - | 2 | - | **2** |
| Personal | - | 1 | 3 | - | 9 | **13** |
| Tools and Hardware | - | - | 366 | - | 2 | **368** |
| Transportation | - | - | 39 | 6 | 2 | **47** |
| Unknown | 18 | 73 | 62 | 10 | 16 | **179** |
| Weaponry | - | - | 32 | - | - | **32** |
| **Grand Total** | **72** | **1086** | **612** | **91** | **65** | **1926** |


Fig. 7. Aluminum toy crumb tray inscribed: "Little Miss Muffet Sat on a Tuffet." Catalog number 1, Feature 4. Photographed By Ashley M. Morton.

## Discussion

The profound importance of mining in anthropological and archaeological research has been thoroughly reported in both academic and professional literature. While recognition of mining sites research has only come about within the last twenty-five years, historical archaeology conducted at mining sites has allowed researchers to conceptualize and interpret a significant developmental period in American history, i.e., the expansion of the United States into the "West." But beyond that, scientific study of the industrial and archaeological remains of mining sites has provided a more realistic representation than the typical stereotype of "the western mining scenario as a cluster of false-fronted, clapboard saloons and general stores along a wide and dusty street" (Swope 1993:3).

Specific individuals who worked the Idora mill and associated holdings could not be identified. Nevertheless the archaeological investigations at the Idora Mill can answer questions regarding technology, household behaviors, late nineteenth and early twentieth-century ideologies, and the greater world system of which Idora was a part. For one, smaller, unheard-of mining districts are recognized "as representations of the type of mining most frequently conducted" during the nineteenth and early twentieth centuries (Swope 1993:16). Due to its small scale, the Idora Mill represents "one of the many little-known and inadequately documented" mining sites in the American West (Costello 1992:2).

Indeed, Idaho miners gained quite the reputation for short-term occupations. Likening local gold miners to quicksilver, the historian Hubert Howe Bancroft explained "A mass of them dropped in any locality, broke up into individual globules, and ran off after any atom of gold in their vicinity. They stayed nowhere longer than the gold attracted them" (Paul 2001:138). Historical archaeologists (Noble 1990:28; Wilke and Swope 1989:36; Swope 1993:16) have noted that the resulting small-scale mine sites with limited documentary records hold considerable significance because they portray a picture that is representative of short-term mining pursuits or operations and associated life ways. While large-scale well-documented mines like that of the Comstock in Virginia City, Nevada, or Idaho's own Bunker Hill have received greater attention by historians, those sites are in fact unique because of their success.

### *Technology, Transportation, and Victorian Consumerism*

Although structural integrity of the mill is considerably low, archival evidence was able to identify that Idora operated using the "Janney flotation process" (Fig. 8). Introduced to the Coeur d' Alene region between 1910 and 1920, flotation was used in separating sulfides such as lead and zinc from gangue, in this case, silver (McKay and Cunningham 2011:49). The Idora Mill likely used ball, tube, or rod technology to crush ore into the necessary particle sizes (Hardesty 1988:39). This technology was used in conjunction with flotation processes like that of Janney; Idora is representative of the latest technology of its time given the use of this type of technology and flotation and its installation coinciding with that of Bunker Hill's mill (McKay and Cunningham 2011:49).

Mining contributed greatly to developing the American West and in particular to transportation networks. Railroads have especially been instrumental in developing the Coeur d'Alene region and Idaho in general (McKay and Cunningham 2011:26–27). By the Idora mill's installation in 1913, wagon and railway systems had been well linked throughout the Coeur d'Alenes. The same year the mill began operation, The Salt Lake Mining Review reported "The ore is hauled from the Idora mill to Bunn station on the Northern Pacific railway, where it is loaded for shipment." By 1916 Mining and Engineering World (1916b) reported a new line with

Oregon and Washington Railway and Navigation Company (O.W.R & N) put in at the "Idora spur" connecting to the Murray branch . . ." and would bring "transportation within a mile of the Idora mill . . ." Placement of the Idora spur not only provided closer distribution access to the mill but larger mining companies in the vicinity—Ray-Jefferson and Interstate-Callahan— as well. Prior to the spur's installment, a 10,000-foot aerial tram had been relied upon for making shipments. Although the Idora connection is no longer in use the tracks are still evident today. Additional data regarding the distribution of Idora Mill shipments is available but was beyond the scope of this investigation.

Coined as the "material interaction sphere," Hardesty (1988:1–3) expands this concept as "a network for transporting materials between the frontier and the heartland, including supplies needed to support mining operations and the bullion from the mines." Transportation networks were sources for available material and informational commodities and these commodities were visible both archaeologically and in documentary research. The Janney Flotation machine for example, used at the Idora Mill was brought by the railroad and wagon networks established in the Coeur d'Alene and Beaver mining areas. The advertisement featured earlier indicated the flotation machine used at Idora was supplied by a Salt Lake City enterprise signifying the mill's participation in national supply networks of material commodities.

As evidenced by a largely mass-produced assemblage, Victorian ideology is represented at Idora. Mass produced products are a hallmark of Victorian society for their conspicuous value. Manufacturer marks present on artifacts found at the site indicated that regional (Tacoma, Washington) (Fig. 9), "western" (Pomona, California) and "eastern" products (Illinois and Indiana) were used.

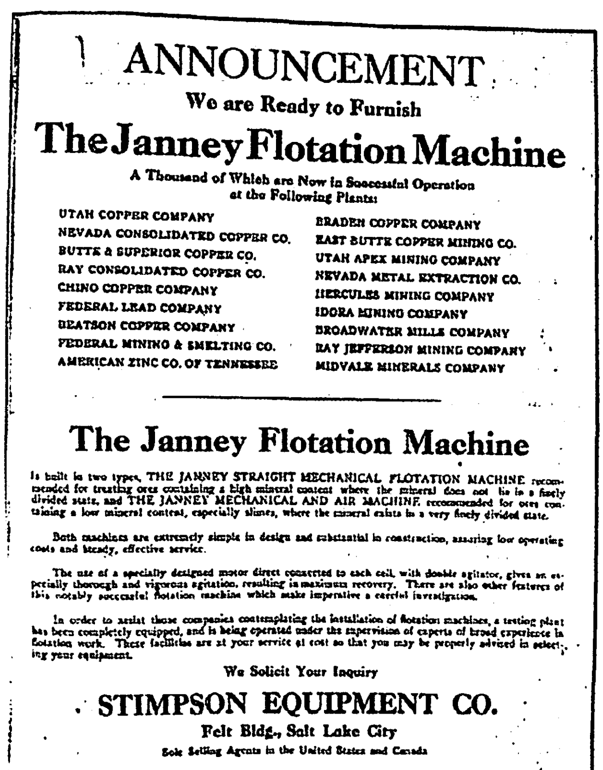



Fig. 8. Janney flotation advertisement in the *Salt Lake Mining Review*, 30 June 1916.


Fig. 9. Nalley's pickle bottle base inscribed: "If It's/Nalley's/It's Good." Catalog number 39, Feature 4. Photographed by Robert Lee Sappington.

*Cultural Ecology*

Many archaeological studies have applied models of cultural ecology to research at mining related sites. Examining sites where human activities impact the environment contribute to a built environment and in turn, further shape human behavior. Historical geographer Richard Francaviglia has expanded "Mining landscapes are a legacy of several processes. These may vary from place to place, but they explain the distinctive look of mining country" (1991:65). In so few words Francaviglia has expounded upon mining's contribution to settlement patterns, architecture, aesthetic appeal of a landscape, class, race, and gender interactions, use of space, natural resources, and labor history.

Because they are determined by the location of ore bodies and natural features, the placement of ore mills, shafts, adits, placers, open cuts, camps, and company towns is not random but intentionally driven. Successful mining required an accurate reading of the landscape and the potential wealth that could be extracted from beneath it. The placement of the Idora Mill took advantage of proximity to Beaver Creek, its associated mines—three quarters of a mile away and existing transportation networks to make a profit, however marginal. Its proximity to Wallace, just 11 miles away, was undoubtedly intentional. The Idora mill site seems to exemplify a typical aggregated camp, one that contained a small number of structures relatively close together. Francaviglia (1991:78–85) and Hardesty (2010:109–122) have noted this kind of grouping as nucleation. The nucleation effect is largely based on accessibility to resources necessary for the construction and operation of the mill, mine sites, and habitation i.e. wood, water, and ore. Given the small artifact assemblage however, this seemingly nucleated community may actually have been more dispersed.

Unlike the large assemblages recovered in most nucleated mining camps, Idora yielded a considerably small artifact collection representative of a brief habitation period, roughly a 10 year span. Coupled with what appears to be few domestic related structures, this small assemblage suggests most of the laborers lived outside of the site. It is thought that a "mill man" or foreman resided within the site and likely depositing the majority of the trash while the remaining laborers retired in Wallace. The dispersal of residents/workers may in fact be representative of Hardesty's (1988:9–17) distribution of feature systems in which "different parts of a feature systems may be dispersed over an extensive geographic area." In this interpretation, the mining town of Wallace itself may be included within the Idora feature system. This dispersed type of mining community has been observed by Gillespie and Farrell (2002:65–67) in southern Arizona where the Santa Rita Water and Mining Co.'s base camp, Kentucky Camp was located a mere two miles from the town of Greaterville. The installation of the O.W.R & N Idora spur likely confirms that Idora was more of a dispersed community considering the walking distance to the spur and its connection to the Murray branch in Wallace.

## Conclusion

The Idora Mill is representative of hundreds of such sites in north central Idaho and elsewhere in the American West. Historically, most mining and associated milling ventures were short term efforts producing little profit and leading to abandonment within a few years. The surviving sites will eventually disappear either through natural decay or by deliberate removal from being environmental liabilities. Given the removal of Idora Mill, the latter is particularly telling.

This article recognizes the significance mining has played in the physical development of Idaho's cultural and natural resources and has even contributed to them. The Idora Mill site marks the importance of small-scale operations across the American West and those contributing to Idaho's base metal production. Archaeological and historical analysis of such an operation shows the wider systems of technology, transportation, and consumerism that can be identified. Using a cultural ecology lens can illuminate human responses to the development of settlements associated with industrial landscapes. As environmental assessments and treatments of abandoned mine sites increase in Idaho it is imperative that these wider network systems are considered from a cultural resource perspective.

## ACKNOWLEDGMENTS

The authors wish to thank Karen K. Swope (Statistical Research, Inc.) and William G. White (Lake Roosevelt National Recreation Area, Washington) for their editing, guidance, and research support; Derek Forseth of TerraGraphics Environmental Engineering, Inc.; the Idaho Department of Environmental Quality; the Idaho Panhandle National Forests; and the Bureau of Land Management.

## REFERENCES CITED

Campbell, Arthur
1939 *Forty-first Annual Report of the Mining Industry of Idaho for 1939.* Boise, ID.

Costello, Julia G.
1992 *Prospects, Mill Towns, and Open Pits: The Changing Landscape of the Madam Felix Mining District.* Paper presented at the annual meeting of the Society for California Archaeology, Pasadena.

Francaviglia, Richard V.
1991 *Hard Places: Reading the Landscape of America's Historic Mining Districts*. University of Iowa Press, Iowa City.

Gillespie, William B. and Mary M. Farrell
2002 Work Camp Settlement Patterns: Landscape-Scale Comparisons of Two Mining Camps in Southeastern Arizona. *Historical Archaeology*, 36(3):59–68.

Hardesty, Donald L.
1988 The Archaeology of Mining and Miners: A View from the Silver State. *Special Publication Series* No. 6. The Society for Historical Archaeology, California, PA.

2010 *Mining Archaeology in the American West: A View from the Silver State*. University of Nebraska Press and Society for Historical Archaeology.

McKay, Katherine L. and Elisabeth J. Cunningham
2011 *Mining Idaho's History, Metal Mining in Idaho 1860–1960: A Mining Context for Idaho*. Idaho State Historical Society, Boise.

Mining and Engineering World
1916a Wallace, Idaho. 22 April:801. Chicago, Illinois.

1916b Wallace, Idaho. 9 September:470. Chicago, Illinois.

Newell, Merle
1965 *Idaho's Minerals Industry: A Flow of Product Analysis*. Unpublished Master's thesis, University of Idaho, Moscow.

Paul, Rodman Wilson
2001 *Mining Frontiers of the American West, 1848–1880*. Holt, Reinhart, Winston, NY.

Sappington, Robert Lee and Ashley M. Morton
2011 *Results of Archaeological Data Recovery and Monitoring Investigations at the Idora Mill Site, Shoshone County, Idaho*. Report Prepared for TerraGraphics Environmental Engineering, Inc., Moscow, ID.

Salt Lake Mining Review
1913a Idaho. 30 April: 24. Salt Lake City, UT.

1913b Notes from the Northwest. 30 July:19. Salt Lake City, UT.

1915 The Coeur d' Alene Mines. 15 May:18. Salt Lake City, UT.

1916 Announcement: The Janney Flotation Machine. 30 June:13. Salt Lake City, UT.

Science Applications International Corporation (SAIC)
1993 *Cleanup Alternatives for Coeur d' Alene Basin Mine Sites*. Report Prepared for I.S. Environmental Protection Agency, Seattle, WA.

Spokane Historic Preservation Office
2012 Ehrenberg House. Electronic document, <http://properties.historicspokane.org/property/?PropertyID=1789> (Accessed March 12, 2012).

Spude, Catherine Holder
2005 Brothels and Saloons: An Archaeology of Gender in the American West. *Historical Archaeology*, 39(1):89–106.

Swope, Karen K.
1993 *With Infinite Toil: Historic Archaeology in the Beveridge Mining District, Inyo County, California.* Unpublished doctoral dissertation, University of California, Riverside.

Tarabulski, Michael
1992 *Finding Guide To Idora Mining Company Records*, UI Special Collections, <http://www.lib.uidaho.edu/special-collections/Manuscripts/dmginv/mg263.htm> (Accessed March 12, 2012).

Tarabulski, Michael and Harriet Essaim
1992 *Finding Guide To Monitor Mining Company Records*, UI Special Collections, <http://www.lib.uidaho.edu/special-collections/Manuscripts/dmginv/mg259.htm> (Accessed March 12, 2012).

Wilke, Philip J., and Karen K. Swope
1989 *An Archaeological and Historical Documentation of the C & K Mine Site, Providence Mountains State Recreation Area, San Bernardino County, California.* MS on file at Archaeological Information Center, San Bernardino County Museum, Redlands, CA.

Ashley M. Morton
Fort Walla Walla Museum
755 NE Myra Road
Walla Walla, WA 99362

mort4230@vandals.uidaho.edu

Robert Lee Sappington, Ph.D., RPA
Department of Sociology and Anthropology
University of Idaho
Moscow, ID 83844-1110

roberts@uidaho.edu

Ms. Morton is an Historical Archaeologist and Archaeology Program Manager at the Fort Walla Walla Museum. She will receive her M.A. in anthropology from the University of Idaho in Fall 2013. For more information about Ms. Morton, please visit:
www.ashleymmorton.weebly.com

Robert Lee Sappington is an associate professor of anthropology and American Indian Studies at the University of Idaho, Moscow. He completed his M.A. in anthropology at the University of Idaho in 1981 and his Ph.D. in anthropology at Washington State University in 1994. He began working as an archaeologist in the Pacific Northwest in 1975 and has worked at numerous prehistoric and historic sites across Idaho, eastern Washington, and elsewhere. His research interests are focused on western North American prehistory and history.

*Journal of Northwest Anthropology*, 47(2):203–213 2013

# ADAPT AND ADOPT: *APSÁALOOKE* (CROW) BEADWORK AND REGALIA FROM THE NINETEENTH CENTURY TO TODAY[1]

First Prize Graduate Student Paper
66th Annual Meeting of the Northwest Anthropological Conference
Portland, Oregon, 27–30 March 2013

**Kiley E. Molinari**

ABSTRACT

For the Apsáalooke (Crow Tribe of Montana) traditional beading practices have continued with vitality and significance, adapting and adopting to reservation life. Beading can be understood as a form of cultural survival and resistance to European assimilation. While beading techniques and methods, along with many traditional designs and patterns, have remained virtually unchanged since pre-reservation times, other designs have been readily incorporated into ceremonial regalia by younger beaders in the tribe. This modernization of images, including pop and media culture designs, can be witnessed displayed as medallions and incorporated into other parts of ceremonial dress, for men, women, and children. Whether it is a superhero or a new type of bead, Apsáalooke beaders are able to display a little of their own personality, while still maintaining traditional beading techniques their ancestors have used for generations.

## Introduction

A crown representing the honor of Miss. Montana State University (MSU), Tiny Tot, sits almost finished on the kitchen table. The entire background of the crown is decorated with a new bead that is prevalent on the Crow Reservation today. Located in the exact middle of the crown is the Bobcat mascot of MSU, representing the powwow at which the title was won. Right alongside the Bobcat logo are three hourglass designs, beaded with six of the seven traditional colors the Crow use (Fig. 1). These traditional geometric designs have been incorporated into Crow beadwork since the first beads were introduced over 150 years ago, while the MSU mascot is a fairly recent addition. They sit side by side, representing a mix of cultures and images, neither taking attention away from the other. This article focuses on the adaption and adoption of one aspect of Crow, or Apsáalooke, culture through their expression of beadwork and powwow regalia.

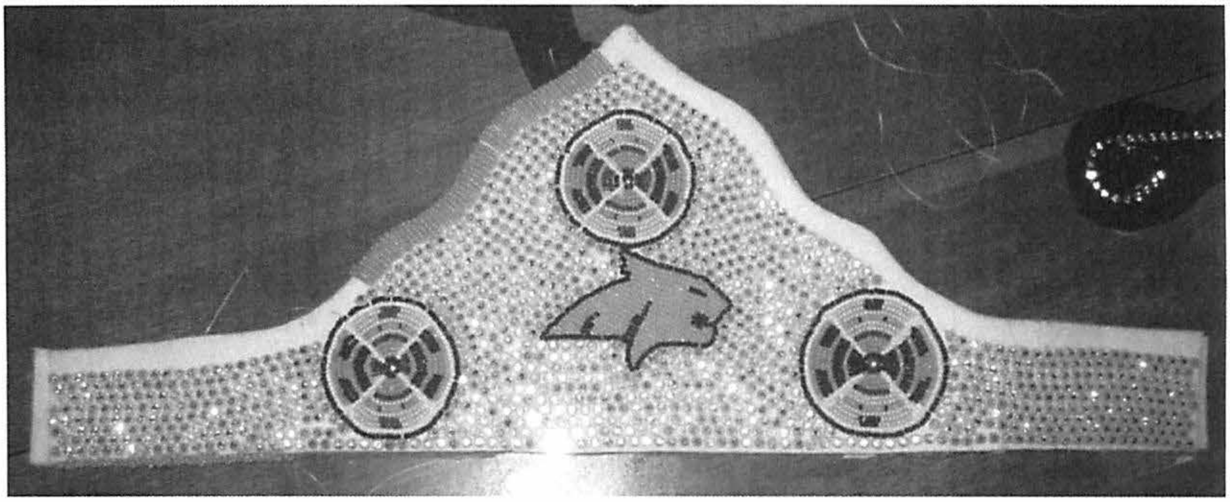


Fig. 1. Miss Montana State University (MSU) Tiny Tot Crown. Made by Winter Old Elk (Photograph taken by Kiley Molinari, June 2012, and used with permission.)

## History

The Crow, or Apsáalooke people, have roamed the Great Plains of what is now the United States and southern Canada for thousands of years. The word Apsáalooke literally translates to "children of the large beak bird," but European settlers and traders mistook this translation for "Crow" (Crow Tribal Website 2012). The present-day reservation is located in the southeastern corner of Montana and is the largest of the seven reservations in Montana, consisting of approximately 2.2 million acres of beautiful grasslands, rivers, and mountains.

In the nineteenth century, trade with European settlers, traders, and other tribes influenced the Crow Tribe's way of life. In an account from Prince Maximillian, a German trained scientist who traveled among Plains tribes, the Crow, after trade with surrounding tribes and Europeans, were "flooded with iron tools, glass beads, and cloth" (Lowie 1983:xv). Soon after trade between Europeans became more frequent, these glass beads were introduced more and more to members of the Crow Tribe. Glass beads were then incorporated into their clothing and other accessories, such as pipe bags, either along with porcupine quills, or replacing them altogether. Looking at the few sources that are in print, along with interviews conducted, it can be seen that the opinion on when exactly the Crow first came across glass beads differs from person to person. Some dates were as early as 1805, but the average was in the mid-1800s.

Joe Medicine Crow talked about a story of when someone in the Crow Tribe first came across glass beads. He recalled that

> Beadwork came into existence by about 1850, when a steamboat on its way up the Missouri River to the trading post in Montana exploded and sank. Some Crow Indians were camped near there, so the men swam out and brought back things. One of the men found a box-like container, opened it, and inside saw beads. European beads. Some looked big, some were small, there were all kinds. (Molloy Tribal Art Journal 2006:3)

Joe Medicine Crow continued, "the man didn't know what to do with the beads, so he put them aside. But then a woman came to look around and took some of the larger beads. She sewed, or maybe tied them onto her moccasins with sinew" (Molloy Tribal Art Journal 2006:3). This could have been the very first use of European beads incorporated onto ceremonial buckskin clothing. It was not long before "other women started adding beads to their moccasins too. They put sinew on the fringes of their dresses, put beads on men's buckskin and sheep shirts. Then later on as the traders brought in more beads, needles, and probably threads, then they started using that" (Molloy Tribal Art Journal 2006:3). This was a beginning of the change in using porcupine quills and sinew to beads, thread, and European manufactured needles.

In a presentation on Apsáalooke Beadwork, Birdie Real Bird discussed when she thought seed beads were first introduced to the Apsáalooke people. Birdie stated, "about 1850 were the first beads, I think. Then in the 1900s there were many more beads. As we went along the beads were changing, too" (Real Bird 2012). The size, design and colors of the beads changed over time. From the porcupine quills, to pony beads, to the variety of different sizes of seed beads, the beads have indeed changed, but the Apsáalooke people's skill and creativity working with them has remained the same after all of these years.

## Adapt and Adopt

Working closely with the Apsáalooke, it was stressed to me just how strong their desire as a people to maintain as much of their traditional culture as possible. The Crow are a very resourceful people. They learned to adapt and adopt different ways of doing things and importantly, what materials they used for their clothing and decorations. Author Steven Leuthold states, in the "twentieth century, as in earlier eras, native peoples have proven remarkably resilient, in part, because they have been able to adapt the tools and traditions of non-native cultures to their own purposes and needs" (Leuthold 1998: ix). An example of this would be the elk tooth dresses that the Crow women wear as part of their regalia. Birdie Real Bird stated that

> these dresses, the elk teeth dresses, belonged to women back in the day with husbands that were good hunters. Her husband would go out hunting and bring back the tooth and she would drill a hole through it. She would then put it on her dress and she keeps collecting them and putting them on her dress until she has about 300 teeth or so. (Birdie Real Bird Interview, 28 June 2012)

Since each dress can have anywhere from 300–700 teeth, when the two ivory elk teeth were being used, at least 150 elk were needed to make one dress. This shows how special these dresses were to the women who had one, and the hard work and patience it took to complete just one dress.

Birdie continued talking about a dress that she has had in her family for almost 40 years, explaining that the teeth on this particular dress were not real ivory, but rather imitation teeth (Fig. 2). Imitation teeth

> have been around quite a while since this dress is 37 years old. Before that they used bone. Some of them were made of all real teeth, but all of those real elk tooth dresses are in museums. Now, if you go to Crow Fair and see all these dresses, they are all imitation teeth; there are no dresses with all real teeth. There might be one or two [teeth] that are bone carved, though. (Birdie Real Bird: Interview, 28 June 2012)

If a dress does have a few real teeth on it, they are usually placed on the yoke portion of the dress. The yoke was made to simulate the hide of a buckskin dress and Carlene Old Elk told me

> I've read material that indicated that the wool, or the trade cloth, elk tooth's dress, by making the yoke was an attempt to make it similar to the buckskin dress. Because the yoke was supposed to be the tail of the animal...it does make sense when you look at the shape of the yoke on the wool dresses and the hide of a buckskin dress. (Carlene Old Elk Interview, 20 June 2012)

This is another way that the Crow were adapting to changing materials and adopting the ones that were now available to them in order to continue their style of traditional clothing.

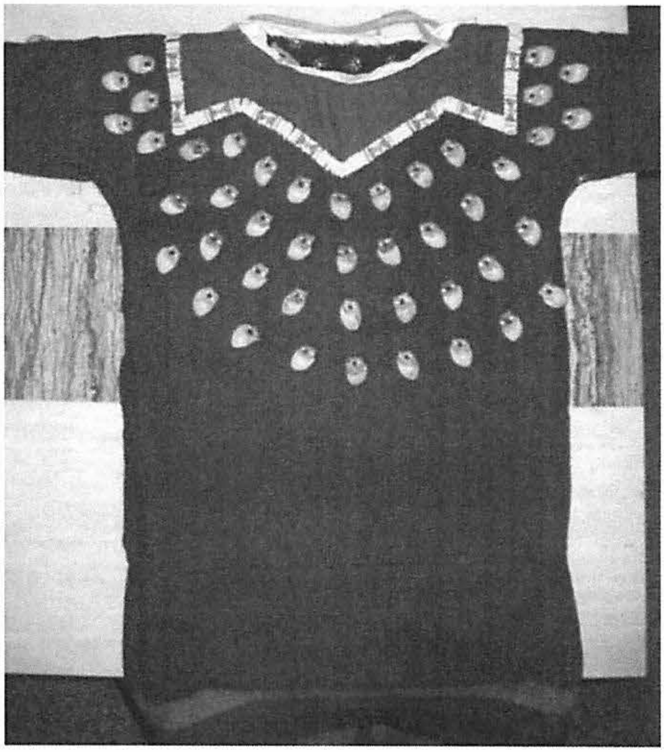


Fig. 2. An example of an elk tooth dress with a beaded yoke, made by Carlene Old Elk. (Photograph taken by Kiley Molinari, June 2012, and used with permission.)

Carlene Old Elk also talked about the significance of elk tooth dresses and adapting to the modifications of new and changing materials. She said that "elk tooth dresses when I first came here [in the 1960s] were really rare because the mold for the plastic teeth had not been introduced yet. People relied on the carved bone; which now those are really rare" (Carlene Old Elk Interview, 20 June 2012). She added "my mother-in-law would make elk tooth dresses with whatever they had as long as it fit the color, then [she would] use a material that they had [to make the dress]" (Carlene Old Elk Interview, 20 June 2012).

Not only were elk tooth dresses adapted over the years, but so were aspects of men's powwow regalia. When I asked Corky Old Horn when bells were incorporated into men's regalia he told me

> When the Europeans brought them. Before they didn't have the bells, but they would use dew claws of animals like elk and deer. They used what was here until Europeans brought beads and bells. They were really creative. They would say, 'I could use this for my finery.' They would incorporate many things they would find into their finery...It [brass] looked good so he added it to his finery. They found a way to make it work. (Corky Old Horn Interview, 19 June 2012)

Brass and bells are two things that are still incorporated into men's regalia today.

Carlene Old Elk also shared her knowledge of Crow history and how creative the Crow people were. She said

> I think it behooves me to say that the Crow's ability to use whatever materials that were available to continue their traditional dress is indicative of how and why they have survived. They have survived the whole world trying to annihilate them and forcing them onto a reservation, and they still have the basic way of life that has created this environment to survive.
>
> It makes sense to me. When they no longer could go out and kill enough animals to get hides for buckskin dresses they incorporated whatever they could to make dresses. Now they have all sorts of new things to incorporate into their dress. (Carlene Old Elk Interview 20 June 2012)

Looking at old beadwork from the mid- to late-nineteenth century, I noticed that there are still many hourglass designs and floral patterns that are almost identical, or very similar to those designs being made and worn on regalia today. In some instances just the colors have changed. For example the stems on the floral designs were, in some cases, made with yellow or brown stems instead of green. Victoria Bad Bear related about how her grandmother mentioned noticing the different colored stems:

> You know what my grandmother told me, when you look at old beadwork, when you look at the stems, they are brown. They think that they got that color from a tree, you know the branch. When you look at it you can tell. But today, you know flowers have green stems. (Victoria Bad Bear Interview, 10 July 2012)

One of the reasons that the stems are now green like flower stems in real life might be that today there are also an abundance of colored beads available for purchase and use in beadwork. Rainbows of beads line the wall at River Crow Trading Post in Crow Agency and an equally large number of colored glass beads lay in display cases at Lammers Trading Post in Hardin, which is the first town off the reservation.

Carlene Old Elk also mentioned to me about seeing older floral beadwork with yellow and brown stems on a dress made by a Crow woman at a museum in Browning, Montana:

> My mother in law use to say, 'we have to use what we have.' I kept looking at the flowers and the stems were brown and some were yellow. And I thought, 'why would they ever do that,' and my mother in law said that it was probably because it was the only beads they had. (Carlene Old Elk Interview, 20 June 2012)

## Modernity and Continuance

Along with still wearing elk tooth dresses, today, the younger generation of Apsáalooke are using new materials available to them to incorporate into their regalia, just as their ancestors did before them. Even with the new materials, they are still practicing their tribe's "traditional" technique of beading and making regalia. Parallel to that, younger beaders are also putting a "modern" spin on some of the things they make. The method and technique of tacking every three beads down is still used and for the most part so are the traditional Crow colors, but there are additions to the regalia which result in changes of the designs being produced. While powwow regalia is still traditional—e.g., the same hourglass or floral designs are used on moccasins, leggings, armbands, and cuffs—a newer addition to the regalia, a beaded medallion, has let the dancers express themselves in a personal sense, while still keeping their traditional dress, and therefore, still representing their culture. Art critic Margaret Dubin explained that this helps "to recognize areas of differences, as well as areas of merging social and cultural practices, as they coexist within and influence the nature of our shared modernity" (Cummings 2011:143). Some dancers wear beaded medallions around their necks, showing off a little bit more about themselves and their personalities. At powwows, I have seen representations of professional and college sports team logos, cartoon characters such as Hello Kitty (Fig. 3), superhero symbols such as Batman (Fig. 4), and initials in bright colors.

Beading designs such as these items I mentioned above allow the men and women creating the designs to convey an aspect of their tribe's past culture, while also expressing an aspect of their lives today. The artists are keeping the old style of beadwork alive, while incorporating a modern twist of today's pop and media culture. A blend of media and pop culture has merged with the traditional art form that the Apsáalooke express through their beadwork. Needless to say, all of the symbols were not found in Apsáalooke beadwork a hundred years ago, but they have worked their way into the art form today.

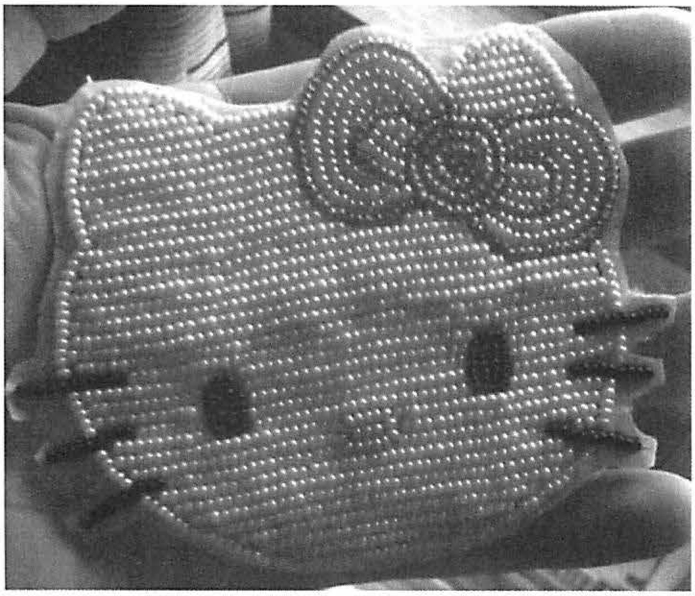


Fig. 3. Beaded Hello Kitty, made by Emily Pickett. (Photograph taken by Kiley Molinari, September 2012, and used with permission.)

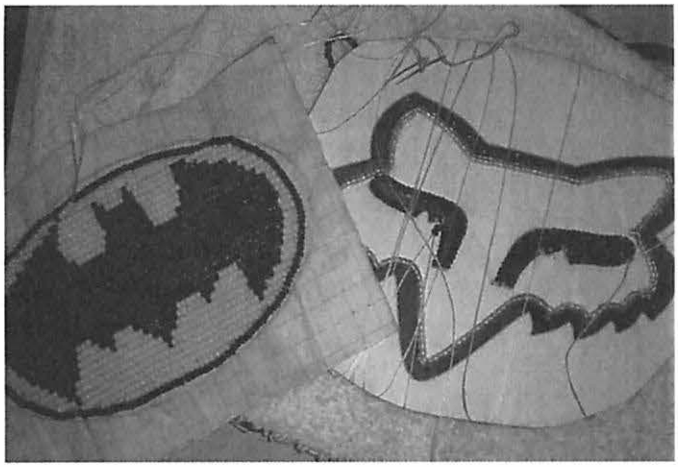


Fig. 4. Beaded pieces in progress. Batman and Fox Racing symbol, made by Emily Pickett (Photograph taken by Chelsey Pickett October 2012, and used with permission.)

Birdie Real Bird has also noticed a change in the items that are being beaded today. Earrings that the women now wear as part of their powwow regalia, for example, are different than they used to be a hundred years ago. Instead of wearing shell earrings, many of the girls wear big beaded earrings with gems in the middle. Today

> a lot of the younger people on the reservation are beading with real shiny things. There is this earring that is really popular back at home on the reservation; it has a big sequin in the middle, three rows of beads, and then a little shiny sequin going around it. The young people are beading and they are beading those kinds of items and that is good because we want to keep this beading alive and going on" (Birdie Real Bird Interview, 28 June 2012).

These earrings are not only popular among women dressed up in ceremonial regalia; they can be seen on women every day (Fig. 5).

Fig. 5. Pair of beaded earrings with the popular sequin around the outside. (Photograph taken by Kiley Molinari, January 2013, and used with permission.)

Another modern form of regalia is also taking on a traditional role with the addition of beads. From Head Start to college graduations, caps and gowns are now being beaded and representing a new, modern, form of regalia that the men, women, and children graduating can be proud wearing. Lorri Not Afraid talks about graduating from Little Big Horn College in 1998 and having her cap and gown beaded. There was

> about 20 something of us in that class and we all had our gown beaded and some [people] beaded around the cap. Nowadays they really go all out. When my oldest daughter graduated from high school a few years ago, my aunt beaded all around her cap and down the front of her gown. (Lorri Not Afraid Interview, 28 June 2012)

Victoria Bad Bear also talks about beading caps for members of her family; "My nieces that I raised, when they graduated high school, they wanted me to bead their caps and I did that for them. I beaded one for my nephew when he graduated from Lodge Grass" (Victoria Bad Bear Interview, 10 July 2012).

Two years ago when I attended Lodge Grass High School's graduation, almost everyone had either their cap or gown beaded and many had both. Whether the caps and gowns are beaded along the seams or whether other designs are incorporated, such as eagle feathers, the fact that they are beaded means a lot to the people wearing them. Winter Old Elk explained to me that it "displayed that I was proud to be Native American and that it was an honor to graduate from high school" (Personal Communication 30 Jan. 2013) (Fig. 6).

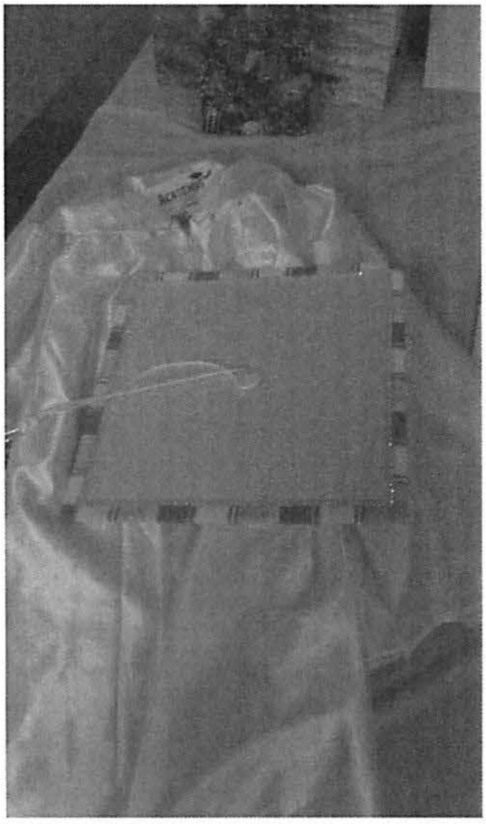


Fig. 6. Beaded cap and gown from a Head Start Graduation. Gown beaded by Frances Knowshisgun (Photograph taken by Kiley Molinari, May 2012, and used with permission.)

## The Significance of Colors

With the new images being incorporated into Crow regalia, it is important to discuss the significance of colors that are being used. There are seven colors that members of the Crow tribe use in their traditional beading: light blue, pink, red, green, yellow, white, and navy blue. Birdie Real Bird makes it clear that, "these are the seven colors that the Crow people use; that is it. They are not just these beads, but they are all different shades of these colors" (Interview on 28 June 2012). Sitting at a powwow in Crow Agency today, you can see dozens of different shades of these seven colors represented on men's, women's, and children's regalia. One of the most popular colors is powder blue. When Francois Larocque, a trader from Canada first met the Crow in 1805, he stated that they already possessed "small blue glass beads that they [got] from the Spaniards" (Wildschut and Ewers, 1985:2). Those blue beads are still as prominently used among the Crow today as they were over 200 years ago.

Victoria Bad Bear and I spoke about the use of the color black. "Crows don't use black... But way back in the old days when they were in mourning, they didn't have black clothes. They wore things that were light colored all the time until the settlers came and brought the cloth and they started using the black cloth when they were in mourning" (Victoria Bad Bear Interview, 10 July 2012). She goes on saying, "So, today, we are not allowed to use black, that even goes for beadwork" (Victoria Bad Bear Interview, 10 July 2012). Birdie Real Bird also talked about the use of black beads in her own beadwork. "Instead of using black we use navy blue; black beads are a representation, a sign of dying and the dead, the end... anything that has to do with that black, we want to stay away from it" (Birdie Real Bird Interview, 28 June 2012). Navy blue is a good substitution for designs that would otherwise have black.

Averyanna Pretty on Top commented on the use of black beads when we were talking about different logos and designs seen on medallions worn on regalia today. Averyanna, who is a dancer and a beader, talked about making her own outfits:

> For my regalia, I bead traditionally, but if I'm just beading for fun, I usually bead sport team emblems and super heroes. I usually use all the colors on my own time, but when I am beading my traditional stuff I don't use black at all. (Personal Communication, 16 Dec. 2012)

Since the color black is considered a color for mourning, it is never used in traditional beadwork, a tradition that Averyanna holds on to when she is beading her own regalia.

Today, with all of the different logos displayed in popular culture there are times that black is used, such as when beading the Batman symbol, but the black from those projects never gets mixed with beading traditional Crow designs on regalia. One of my informants told me that she has stayed away from using black beads her whole life, but she is thinking about maybe trying them in earrings that she makes. She said that there are more and more people using black beads for items that are worn every day, like earrings and hair clips. She thought that black cut beads would look good on earrings (Personal Communication 28 Dec. 2012). Her daughter, who just learned to bead last year, began using black beads for medallions of her favorite band and other symbols she was making; this might have been a factor in altering her mom's view on the use of black beads. This is yet another form of adapting to changing materials and resources, but in this case not mixing the black into geometric and floral designs is a way of maintaining the traditional style of beadwork, but still having the freedom to make whatever designs they choose.

## Conclusion

The beadwork and regalia made by members of the Crow Tribe are important to not only themselves, but their families as well. Beadwork and regalia is still handed down from generation to generation and given to family members as gifts for cultural expression. Few pieces are sold; rather, they given to family members or close friends. Some people outside of the tribe might not appreciate all of the hard work that goes into one piece of beadwork. Steven Leuthold states the "primary value of traditional art is that the art must establish continuity in the community. Souvenirs and other highly commercial forms, easily eviscerated of deep meaning for their producers, would be unlikely to sustain the cultural continuity that is the goal of the artists" (Leuthold 1998:35). Lorri Not Afraid also mentioned beading for only her family. "I am not one who really sells their beadwork. I am not sure if I am just not confident enough in my beadwork or what, but I like the idea of just beading for my family. I can't really get motivated to bead for money because I just want it for my family" (Lorri Not Afraid Interview, 28 June 2012). Keeping beadwork in the family is something these women cherish.

Art in all forms is an important part of Native American communities and cultures. While many traditional forms of art are still being practiced, the younger generations of artists are not only still beading with their tribe's traditional techniques, but are also making it more modernized with popular expressions today. As "a means of expressing identities, the aesthetic emerges as an important aspect of self-representation to the larger non-native public" (Leuthold 1998:1). Seeing Native American artwork not only in tribal communities, but in museums across the country helps show just how important beadwork has been to the Crow Tribe in the past and in contemporary times. Now sitting beside a beaded pipe bag from the nineteenth century, there may be a beaded graduation cap in the same museum display.

The practice of beadwork as an art form is still as alive as it was when the first beads were introduced to the tribe over 150 years ago. The "collective function of the aesthetic is so well recognized by 'outsiders' that non-native courts may look at aesthetic traditions as 'evidence' of the historical continuity of native peoples" (Leuthold 1998:1). Children are still being taught by their grandmothers, mothers, aunts, and cousins and with that, the tradition of beadwork continues to live on.

Hourglass and floral designs still continue to dominate the dancer's regalia as they move around the arbor in Crow Agency, and with that men, women, and children represent their tribe's culture expressed through these specific designs. Women dancing the traditional style of dance at a powwow still wear elk tooth dresses, along with women who are dressing up for a special occasion, such as a wedding, parade, or other ceremony. While these items have stayed the same over the last 150 years, the adaptation and adoption of other symbols have seemingly been welcomed into not only ceremonial occasions, but also everyday life.

## NOTE

[1] This article is based on preliminary research for my master's thesis and has been approved by the Cultural Resource Office in Crow Agency, Montana, who I have been working collaboratively with throughout the process. Informed consent forms were given to my informants before the interviews, and I was given permission to use all of the names below. Those who did not wish to have their names used in this project are listed as "informants" only, and their names are not connected to

their interviews in any way. This is not meant to be a comparative study of beadwork and regalia among other tribes, nor a focus on theories of resistance, but merely initial observations from fieldwork and time spent in Crow Country.

## REFERENCES CITED

Crow Tribal Website
2012 History of the Apsaalokee. http://www.crowtribe.com/, accessed September 22, 2012.

Cummings, Denise K., editor.
2011 Visualities: Perspectives on Contemporary American Indian Film and Art. Michigan State University Press, East Lansing, MI.

Leuthold, Steven.
1988 *Indigenous Aesthetics: Native Art, Media, and Identity*. University of Texas Press. Austin.

Lowie, Robert H.
1983 *The Crow Indians*. University of Nebraska Press, Lincoln.

Molloy Tribal Art
2006 *Apsaalooke Art and Tradition*. Molloy Tribal Art, New York.

Real Bird, Birdie
2012 Apsáalooke Beadwork. Presentation made in Big Horn, Wyoming, 28 June 2012.

Wildschut and Ewers
1985 *Crow Indian Beadwork: A Descriptive and Historical Study*. Eagle's View Publishing, Liberty, UT.

Kiley E. Molinari
Department of Anthropology
University of Oklahoma
Norman, OK 73069

Kmolinari@ou.edu

Kiley E. Molinari received an M.A. in Anthropology in 2013 from the University of Idaho. She is currently a Ph.D. student at the University of Oklahoma in Sociocultural Anthropology where she will continue to work with the Crow Tribe, among others, looking at both historical and contemporary beadwork.

# AN EXPLORATION OF INTENTIONS AND PERCEPTIONS OF CODE-SWITCHING AMONG BILINGUAL SPANISH-ENGLISH SPEAKERS IN THE INLAND NORTHWEST

First Prize Undergraduate Student Paper
66th Annual Meeting of the Northwest Anthropological Conference
Portland, Oregon, 27–30 March 2013

**Grace F. Cooper**

ABSTRACT

This study discusses the perceptions and understandings of code-switching of bilingual English-Spanish speakers from the Inland Northwest. Earlier studies reported that speakers generally hold a negative view of code-switching; however, results of this study questions whether these conclusions remain true. Results from ten, hour-long semi-structured interviews including four musical selections as examples of code-switching demonstrate a shift away from traditional views towards code-switching. Rendering, older studies problematic this study calls for the continuation of code-switching research as well as new and inventive approaches for researching code-switching in the future.

## Introduction

In the United States, economic and population changes have pressured many individuals to learn second or third languages and, in particular, Spanish. Linguists have dedicated much research to exploring this topic of bilingualism and how bilingual speakers use language. An essential component in bilingual communication is code-switching, or the shifting from one language to another within a conversation, a sentence, a phrase, or even a word.

This linguistic study in the Inland Northwest focuses on two specific questions related to Spanish-English code-switching. First, what are the intentions of Spanish-English speakers as they make their language choices and switch from English to Spanish and back again? Second, what perceptions do they have about the act of code-switching? Ten participants completed a semi-structured interview which encompassed these questions and several other specific questions about their individual language background and their experience with code-switching. Their responses lead to the conclusion that previous research on Spanish-English code-switching may not reflect the current language attitudes of bilingual Spanish-English speakers and demonstrates the need for continued research in this area.

## Literature Review

In the last century, researchers have developed a keen interest in the relationship between language and social interaction. The topic of multilingualism and the issues surrounding those individuals who communicate using more than one language offers researchers much to explore. Individuals who speak more than one language almost inherently live with more than one culture, identity, or nationality which creates intricacies in the human experience worthy of study and discussion. However, before addressing the questions of this study, it would be helpful to define two terms: the first, bilingualism and the second, code-switching.

Scholars debate how to define the term 'bilingualism.' Ronald Wardhaugh (2006) argues in his book, "An Introduction to Sociolinguistics," that to be qualified as a bilingual or multilingual speaker does not require a native-like command of more than one language. For bilingual or multilingual speakers, "The differences in competence in the various languages might range from command of a few lexical items, formulaic expressions such as greetings and rudimentary conversation skills all the way to excellent command of the grammar and vocabulary and specialized register and styles" (Wardhaugh 2006). Those who are considered multilingual or bilingual are not necessarily native speakers or entirely fluent, but at least semi-capable, familiar, or well-studied in a variety of situational uses for each language in question, in our case Spanish and English. This study has followed these guidelines in selecting participants.

Furthermore, Wardhaugh (2006) offers insight as to how to define "code-switching." He explains it to be the use of more than one language or code during a singular verbal exchange (Wardhaugh 2006). Generally utterances fall into one of two categories: intrasentential or intersentential. Intrasentential involves using two or more languages within on sentence. For example in this Spanish-English sentences, "Tu ojos pueden ser tu look más espectacular." or {Your eyes can make your look more spectacular.} Intersentential code-switching occurs when two or more languages are used between two separate sentences. Consider a short exchange between two speakers in which the first speaker asks the second speaker, "¿Habla usted ingles?" {Do you speak English?} To which, the second speaker responds, "Yes, I speak English." In short, code-switching involves the use of two or more languages during verbal and written communication that can be characterized a linguistic juggling act performed by those who speak more than one language or code. The current study examines the intentions or social motivations behind bilingual Spanish-English speakers' use of code-switching and their perceptions of this use of language.

"Language use in Multilingual Societies: Some Alternative Approaches" from the text Sociolinguistics Selected Readings, suggests that multilingual speakers follow particular decision paths in choosing their words (Pride, Holmes, Janet, and Sankoff 1972). Thus, choosing a certain code is not based on any inherent linguistic influences, but rather a result of the speaker's assessment of the social factors and potential outcomes of their language choice (Pride, Holmes, Janet, and Sankoff 1972). Wardhaugh (2006) has described this as "a controversial strategy used to establish, cross or destroy group boundaries; to create, evoke, or change interpersonal relations with their rights and obligations." Thus, when communicating bilingual speakers have a great deal more to think about than vocabulary and syntax, but also the setting and other participants in the conversation.

Carol Myers-Scotton (1993) furthers this point in her fundamental book, *Social Motivations for Code Switching Evidence from Africa*. Based on her markedness model, Meyers-Scotton (1993) categorizes the language choices multilingual speakers make as either "marked" or "unmarked." She describes how "the theory behind the markedness model proposes that speakers have a sense of markedness regarding available linguistic codes for any interaction, but choose their codes based on the persona and/or relation with others which they wish to have in place" (Meyers-Scotton 1993). However, Myers-Scotton (1993) explains that speakers typically make their choice without a conscious effort. Suggesting, that the ability to quickly determine which language will be used in any given situation is developed through social experiences and interactions (Meyers-Scotton 1993). Speakers use this sociolinguistic knowledge in reference to a particular speech event within a specific community and make their choice (Meyers-Scotton 1993). Meyer-Scotton's research leads to the conclusion that while the majority of the time speakers choose their language without much forethought given the naturalization that occurs within a speech community, speakers still retain the ability to make intentional choices with the language they use (1993).

In her work, "Code-Switching in Spanish/English Bilingual Speech: The Case of Two Recent Immigrants of Mexican Descent," Antonieta Cal Y Mayor Turnbull presents a unique reason for code-switching which, she calls the construction of an elite bilingual identity (2007). This term "elite bilingual" she uses to refer to individuals who acquire their second language in a formal educational setting and are not in fear of losing their primary or native language by the acquisition of a second language (Cal y Mayor Turnbull 2007). During one of the recorded conversations between the two participants of this study, Martha and Sara, Martha:

> comments on the negative characteristics of [a] man seated outside of [a Mexican restaurant]... Martha uses the expression 'tal como nuestra gente' {that's how our people are} to continue the gossip about the Mexicans in New York, but in this case Sara completely misaligns... [and] switches into English... 'our kind?' .... 'they are from our country but they are not our kind.'... it seems that by choosing English to state these words, she does not only misalign with Martha, but distances herself from that man seated outside the restaurant and from all immigrants alike... By replying in English she is thus showing she can speak English and she is an elite bilingual having fluent knowledge of English before her arrival in the US. (Cal y Mayor Turnbull 2007)

In her analysis of this short exchange between the two girls Turnbull has demonstrated very poignantly the intentionality of language choice as it aids in the creation of one's identity and social position. It has been the purpose of this study to gather information on such motivations for code-switching amongst Spanish-English speakers.

However, it has also been the purpose of this study to articulate some of the attitudes held by bilingual Spanish-English speakers about the practice of code-switching. In the study, *Perceptions of Spanish-English Code-Switching in Juarez, Mexico* conducted by Margarita Hidalgo (1988), participants characterized Spanish-English code-switching as a negative use of language. Cecilia Montes-Alcalá (2000) has found in a more recent study, *Attitudes Towards Oral and Written Codeswitching in Spanish English Bilingual Youths*, a more positive shift in speakers' opinions about code-switching.

Hidalgo asserts that when it comes to the general public, evaluations of language, "are social, not linguistic" (1988). These evaluations tend to be made on "aesthetic grounds" and the perceived value on the social market which can be determined by multiple factors and not an inherent linguistic characteristic (Hidalgo 1988). As for the participants in Hidalgo's study, English poses a direct attack on their national identity and impedes communication among Spanish-only speakers (1988). Hidalgo (1988) explains that, "On the Mexican side of the border, language loyalty appears to be a patent and unobstructed attitude that most border residents are willing to externalize at the slightest provocation." Using English in an otherwise Spanish-only conversation directly undermines, "their historical struggle for linguistic and cultural preservation" (Hidalgo 1988). Furthermore, Hidalgo (1988) found that, "about one-half of all subjects claimed not to understand Mexican-Americans when they switch continuously." While communication remains a relevant issue in bilingual speech communities for Hidalgo's participants it is not this that prompts such negative views of code-switching. Rather, it is the proposed threats English makes upon the Spanish language component of the Mexican identity that stimulate such negative views of the Mexican-American's tendency to use code-switching.

Montes-Alcalá's (2000) notes the existence of these negative views of code-switching as well. She explains how traditionally, bilingualism and code-switching in particular, has been seen as a "disease" tainting the purity of both languages (Montes-Alcalá's 2000). However, she reports, "The fact that we find more subjects who remain neutral on the subject than subjects who see code-switching as a cause of language loss might indicate a shift of attitude" (Montes-Alcalá's 2000). Montes-Alcalá (2000) also found that, "A significant majority (70%) agreed that they could relate better to the author in bilingual texts, as opposed to monolingual texts...It is becoming fashionable for bilingual/bicultural authors to express themselves more naturally in both languages..." So the issue of communication does not seem to be there as it was for those participants in Hidalgo's study. In fact it seems that not using code-switching would make understanding more difficult in this case. These results reflect a change or alteration in the traditional feelings about code-switching and are particularly relevant to our current study which has gathered strikingly similar results.

## Methodology

This research began with an application for exemption to the Institutional Review Board. Approval was received in July of 2012 and the interview process began directly after that. As part of this process every participant signed a consent form and was given complete confidentiality. Pseudonyms have been used for this publication. Each of the semi-structured interviews focused on use of Spanish-English code-switching and attitudes about this use of language. Each interview lasted approximately 45 to 75 minutes. Following transcription these interviews were analyzed for data related to the two original questions of the study.

## Participants

The participants were recruited through snowball sampling. This was necessary given the limited number of bilingual Spanish-English speakers in the area's population and their dispersed nature. Ten participants were included in this study, with ages ranging from 21 to 39. Six were students and four were professionals currently employed in the Spokane's healthcare and service industry. All participants were proficient at some level in both Spanish and English and thus, considered for this study to be bilingual Spanish-English speakers. Some were ultimately more proficient in English while others remained more comfortable speaking Spanish. For the sake of participant comfort and producing the most accurate and inclusive responses these interviews were conducted in either Spanish or English and occasionally a mixture of the two languages. The number of participants was relatively small, but due to the extensive interview and considering the depth and detail of responses the study was not lacking in results. It is impossible to generalize the patterns found in this study to the larger Spanish speaking, English speaking, or bilingual Spanish-English speaking communities and this study should be understood as an exploratory one. It has been designed not to expressly describe how one social group uses language, but to explore ideas of language usage within a particular speech community.

## Interview

The primary purpose of this interview was to evoke detailed responses on the issues presented in this study. However, a secondary purpose has also been to expand upon some of the traditional methodologies and approaches to studying code-switching. By using musical examples of code-switching to stimulate participant responses during interviews it was possible to create a more intriguing environment for questioning and prompt discussion about issues related to code-switching in ways previously unconsidered by researchers.

After each participant heard a portion from one song they were asked to identify reasons or motivations for artists to mix Spanish and English in their song lyrics, to articulate situations when they or others have used language in a similar way, speculate on the potential impacts of code-switching in popular music upon listeners, and share their perceptions and opinions of code-switching within music. Following these questions participants were asked to express their general attitudes, associations, opinions, and understanding of Spanish, English, and code-switching outside of the setting of music. Discussions were lively and extended; participants provided a healthy amount of qualitative data for analysis.

## Thematic Discussion

Four patterns emerged in participant responses to the primary questions of this study: what are the intentions of bilingual Spanish-English speakers when switching from Spanish to English and what perceptions of code-switching exist among these speakers? Results demonstrate that contrary to previous works Spanish has become, for some, a more appealing language choice than English. Participants also articulated that the use of code-switching in contemporary music reflects a new tolerance for code-switching and serves as a method for monetary gain with popular music artists. They gave positive and neutral reviews of Spanish-English code-switching indicating a shift away from the previously negative characterizations of this linguistic phenomenon. The participants in this study demonstrated a general shift in the attitudes of bilingual Spanish-English speakers in regards to Spanish-English code-switching. Excerpts from their responses best characterize this movement and highlight the general themes found within these interviews.

### *Challenges to Traditional Characterizations of Spanish and English Language*

Traditionally, studies of language attitudes and ideologies have found that English is often the more valued or appreciated language with Spanish falling second. However, this research says otherwise as participants often painted Spanish in a more attractive light than English. When prompted to describe their feelings for Spanish and English participants described how both Spanish and English were reserved for certain topics, settings, people, and often gave English a bad review. For most, Spanish was used for intimate relationships and English for more detached relationships. English was the langue used for work, school, or other professional settings while Spanish could be used at home or in other more casual environments. Repeatedly, Spanish was described as a more beautiful and expressive language while English was considered less than desirable. Specific examples help to illustrate this general point that Spanish is considered the more attractive language even among English dominant speakers.

Consider the case of Michael, a native Spanish speaker, who admitted to using more English during his day than Spanish and found he was unable to express certain words and ideas in Spanish. For example, he admitted he could not say the words "degree" or "major" in Spanish when attempting to share about his college experience with his parents. He found himself stuck as he tried to discuss a professional, academic topic in a familial setting. Michael however, did not seem disappointed from the limitation in his vocabulary, a sentiment shared by several other participants.

Michael helps to further this point when he shares another story about his relationship with his co-worker, Miguel. He and Miguel are both bilingual Spanish-English speakers and initially they engaged in Spanish-only conversations at work. However, before much timed had passed they both agreed this conduct was inappropriate and best left at home. Being new to their positions both felt it necessary to build healthy relationships with all the team members and to remain on a semi-impersonal level of intimacy at work. Using Spanish would counteract this goal so both follow an English-only policy while at work. Michael helps to demonstrate that English remains the language of choice for formal settings and work or school related topics, but Spanish for informal, intimate, and familial discussions. And while Michael admits to speaking English for a longer period of the day, he does say he "enjoys" speaking Spanish more than English.

This is felt by another participant, Jacob, an English dominant speaker who often utilizes Spanish-English code-switching when writing his poetry. He explained that code-switching should be used after or during an attempt to master the second language and is best used when being creative. He gave several examples of how he incorporates Spanish into his writing and said when using Spanish he felt "younger, more vital, and more human." When asked to elaborate on why he felt this way when communicating in Spanish he said "Because, it just… it feels like more of an intimate language in itself and the sounds and everything are a lot more human as opposed to, I guess, robotic." The more "robotic" language of course here being English as he continues to explain that "people who speak Spanish have more of a sense of their humanity." For him Spanish brought to mind "love", "making friends", and "sex appeal." Jacob demonstrates the positive characterizations of Spanish expressed throughout these interviews.

Other participants such as Maria express the more negative characterizations of English. She describes speaking English instead of Spanish as choosing to eat, "a plain bagel" instead of a, "cinnamon bagel." She explained that they are both "good", but ultimately English the "plain bagel" is less tasty. This general impression of English is held among other participants who described it as, "empty" and even, "cold."

It is clear from the participants' responses to the questions about feelings towards and associations with Spanish and English, that Spanish is thought of as the more desirable and high-quality language. It is used for family and loved ones, but English remains the langue for formal and professional relationships. Thus, we can conclude that language choices and attitudes are based on topic, setting, and situational variables as well as other factors. For these participants Spanish was the better choice.

*Contemporary Music Influences Language Choice*

After hearing all four songs each participant was asked to describe what influence Spanish-English code-switching in contemporary music has on listeners. Most articulated in one way or another that code-switching in contemporary music reflects a current practice of mixing among bilingual Spanish-English speakers. Some even stated that this music gives relief to some listeners who have traditionally felt ashamed or embarrassed by their use of Spanish and English mixing. Some participants testified that popular artists' use of code-switching seems to justify their own code-switching. They felt that highly publicized use of code-switching builds a new tolerance, acceptance, and even encouragement of language mixing that has been looked down upon in the past. What was once seen as proof of poor language skills or a lack of vocabulary is now seen as creative or clever. What is most interesting here is that participants articulated this change as stemming from contemporary music artists and their language use.

For example, Katie explained that at home with her father and mother it is preferred you speak Spanish and only Spanish and that mixing English with Spanish is not well tolerated. She confesses that she doesn't always follow this rule, but often mixes English with her Spanish. Katie explained that this is a common struggle for many of her friends who have been raised in a Spanish-only home, but have been educated and in the broader English-speaking community. When asked about the impact of contemporary music upon listeners she said, "it helps them (Katie and her friends) to relate to both cultures, especially the ones who are like… that are caught between the two cultures." For her, music that uses two languages (in this case Spanish and English) helps bridge a gap between the two groups someone may identify with and perhaps allow them to better cope with the balancing act they are asked to perform. In regards to code-switching specifically, she says this kind of music helps listeners who shift between the two languages to "view it as it's normal" and to realize "it's normal to mix the two languages, it's not as taboo as everybody says." Katie eventually states she feels restricted when put in a situation where she is limited to the use of just English or just Spanish, and confesses that she feels freer when able to express herself in both languages.

Maria, who grew up speaking Spanish in the home and English everywhere else also, articulates this idea of freedom when she is asked about the influence of contemporary artists' code-switching.

> "I feel like it makes it more okay to speak like that. Because you feel understood, even artists understand that, you know, society now speaks, you know, especially in the US, they speak two languages. You have to speak English at work at school with professionals and doctors, but then also you have that Spanish side to you. So it's just kind of to appeal to that audience that speak both languages not just one. So you wouldn't feel trapped of 'Oh should I only listen to Spanish music or only to English music.' You have like the mixture of you could listen to both at the same time and it's okay."

Maria explains here the idea that many other participants expressed about contemporary music as helping to view Spanish-English code-switching in a "better light."

*Financial and Social Motivations for Strategic Code-switching*

After each song was played for participants they were asked why they thought an artist would chose to mix Spanish and English for that lyric or phrase. Every participant eventually answered that code-switching in the selected songs and contemporary music as a whole is a marketing tool used by artists to expand their audiences and increase their profits. Their responses demonstrated that artists' use of code-switching in contemporary music is motivated by both financial and social reasons and can be helpful to both listeners and artists, but is ultimately more beneficial for the artist.

One participant, Ricko, was quite adamant about this point. He was asked why he believed the artist would mix languages after each clip and each time alluded to the issue of profits. Upon, the conclusion of the fourth song it was not necessary to even ask him his thoughts for he simply stated "Para ganar más dinero" {to earn more money}.

As it became clear that this would be the response of participants the use of a follow up question to explain how they believed code-switching allowed artist to accomplish these goals became pertinent in this part of the interview. The consensus was that artists could create sense of unity amongst listeners of varied language backgrounds by assuring that their lyrics allow everyone listening to understand at least some of the words.

Katie felt code-switching in popular music helps to unite people from different linguistic and culture backgrounds. She explained that by including multiple languages in music artists could bring together several different types of people in a common space and moment. Tony and Andrea shared that using both languages in a song helps listeners who are trying to learn a language or are simply unfamiliar with one of the languages being used. They specifically discussed how students or tourists traveling abroad to foreign countries where English was not the primary language would appreciate some English lyrics mixed in with Spanish. They felt this was also true for people immigrating to the United States from Spanish speaking countries who wished to learn English. It is fair to conclude that while participants viewed artists as having financial motivations for mixing language in their music they also recognized the socially based realities of this success. Participants identified that the artists' achievement was contingent on expanding audiences based on the potential unification of listeners through Spanish-English code-switching.

Following this discussion of how artists use language choice participants were asked to compare it to their own language use. They were asked to describe any occasions when they had used language to gain something and to appeal to a diverse group. None said they used language to get more listeners or more profits, but they did articulate instances when they switched languages to appeal to particular individuals in conversation. Max, an active Christian, reported using Spanish when possible to make church members or potential new members feel more comfortable. Max's story demonstrates a particular theme of using language for persuasion and accommodation evident in responses from all participants.

Whether it is one person attempting to appeal to a few friends or a famous artist attempting to create a larger fan base, code-switching has become an effective tool for speakers. This reminds us that all languages choices are not mindless, but can often be marked by specific social and monetary motivations.

*Code-switching Norms for Bilingual Spanish-English Speakers*

Previous studies have shown that code-switching has been frowned upon by many people including educators, language instructors, and even those who actively participate in this social phenomenon. Some have thought it to reflect poor language use and an incompetence or deficiency in language skills. Many have operated under the assumption that if someone is unable to communicate in only one language at one time that they do not have full mastery of that language. This stigmatization still remains as some participants expressed feeling, "ignorant" or, "embarrassed" and even, "ashamed" when they mixed English words into conversation with Spanish-only speakers. However, participants did articulate a shift in these perceptions and argued that these emotions were slightly irrational as they viewed code-switching to be strength. A shift in attitudes towards code-switching has accompanied this younger generation who acknowledge it as potentially more expressive than using just one language.

For example, Jacob, who we already know writes poetry, explained that he selects particular Spanish words when attempting to convey messages or ideas that he cannot translate to English for various stylistic and functional purposes. He felt knowing two languages and how to mix them properly is useful when being artistic. For Jacob, when mixing Spanish and English, "you have more at your disposal." This sentiment was shared by several other participants who touched on the artistic value of code-switching in literature, music, and other creative mediums.

This enjoyment of Spanish-English code-switching among participants is countered however, by the notion that certain occasions and settings call for a one language only policy. Consider the story of Andrea and Tony, both active professionals in the medical field who interact daily with patients. They agreed that hospital procedures should be conducted in one language and should follow the patient's needs.

Tony talks in detail about his understanding of professionalism in the examination room and how code-switching in his mind is not allowed. For Tony, work is not as "laid back" as home or spending time with friends and he needs to maintain a higher standard of language use and must follow the patient's lead. If nothing other than to simply "be courteous and for them to get the point." "If I am doing my job right I want to speak to them as fluently as I possibly can in Spanish." Of course he holds that same standard for English-only-speakers. He truly feels inserting Spanish words will make them uncomfortable and take away from his image as the expert in the room. "If there's a person on the other side that speaks just English, and I throw something Spanish I mean they'll make fun of me or think I'm an idiot... or I am inferior to them." Clearly some boundaries exist in the workplace when it comes to the use code-switching in the workplace for bilingual speakers, even though on the whole it is seen as a positive healthy use of language for bilinguals.

Another time that code-switching was expressed as improper among participants is when visiting a Spanish speaking country. There was a general understanding that if one needed to use English to understand something important, then of course do so, but refrain as much as possible from inserting seemingly "random" English words in your Spanish-only conversation. This was prompted by a fear some participants had of offending someone or exposing themselves as a "gringo/a" or American.

Maria touched on this explicitly during her interview when she was asked if she thought Spanish-English code-switching was a, "good" or a, "bad" thing. She explained that for herself and other descendants from Mexico speaking Spanish is an enormous and highly valued part of their culture and heritage. She admits that switching to English is seen as forgetting Spanish and therefore abandoning your past or, "forgetting your roots." Maria also explains that code-switching between Spanish and English while visiting in Mexico may, "sound stuck up" and make you look like a "white person" who does not appreciate their Spanish speaking background. Maria recommends that if possible stick to Spanish only and leave English for the U.S.

It is safe to conclude that while code-switching has become popular and acceptable for these participants there still lingers certain limitations and it is fair to say that a shift has been made for how people perceive code-switching, but not a complete conversion.

## Conclusion

This study took a closer look at code-switching within the Spanish-English bilingual speech community. The goal of this project has been to gain a better understanding of how Spanish-English bilingual speakers think about and participate in code-switching. Specifically, to articulate their perceptions of code-switching and if possible discover what switching between English and Spanish accomplishes for these speakers.

Ten participants completed interviews that consisted of several questions related to Spanish-English code-switching. Each interview also included four musical selections that used code-switching in their lyrics. These songs were used within the interview with the intention of encouraging participants to describe potential motivations or reasons for a person to use Spanish-English code-switching. This technique was a slight adjustment to the traditional interview process and has been an experiment in itself beyond the content of this research. The addition of musical selection as examples of code-switching has resulted in a more complete articulation of social motivations for code-switching.

Four major take-aways surfaced during this study.The first participants tended to characterize Spanish more positively than English which contradicts the often assumed inherent value of learning English. They also noted the process of legitimization that code-switching has undergone through the use of code-switching in contemporary music.Furthermore, they accredited code-switching in popular music as a potential money-making strategy for music artists. Finally, participants identified specific conventions as to when and where code-switching should be used. Combined these take-aways reveal a shift away from the traditional towards a more contemporary interpretation of code-switching among Spanish-English bilingual speakers.

Given these findings it is safe to say that much still needs to be explored in regards to bilingualism, code-switching, and in particular Spanish-English code-switching. It is up to contemporary scholars to continue this work and build upon that of others to capture the current trends of language use and further our understanding of the role bilingualism plays in the human experience.

## ACKNOWLEDGMENTS

Thanks go first to the ten participants who took the time to share their stories. Second, the Ronald E. McNair Post-Baccalaureate Achievement Program deserves recognition for support before, during, and after completion of the research. Finally, Dr. Julia Smith of the Department of Anthropology at Eastern Washington University must be acknowledged for her special contribution to this project. Her investment in this project and her commitment to my success has been exceptional.

## REFERENCES CITED

Cal y Mayor Turnbull, Antonieta
2007 Code-Switching in Spanish/English Bilingual Speech: The Case of Two Recent Immigrants of Mexican Descent. Master's thesis, Teachers College, Columbia University.

Hidalgo, Margarita
1988 Perception of Spanish-English Code-Switching in Juarez, Mexico. *Research Paper Series*, 20.

Meyers-Scotton, Carol
1993 *Social Motivations for Code Switching Evidence from Africa*. Oxford University Press Inc. New York, NY.

Montes-Alcalá, Cecilia
2000 Attitudes Towards Oral and Written Codeswitching in Spanish-English Bilingual Youths, *Research on Spanish in the U.S.*, 218.

Pride, J.B., Holmes, Janet, and Sankoff, G.
1972 Language use in Multilingual Societies: Some Alternative Approaches. In Sociolinguistics, Selected Readings, Vol. 565, edited by J.B. Pride and Janet Holmes, pp. 33–51. Penguin.

Wardhaugh, Ronald
2006 Codes. In, *An Introduction to Sociolinguistics*, 6th edition, edited by Ronald Wardhaugh, pp. 88–117. Blackwell Publishing.

Grace Cooper
Eastern Washington University
Department of Anthropology
Rondald E. McNair Post Baccalaureate Achievement Program
722 Cedar St. Cheney, WA 99004

gracefcooper@eagles.ewu.edu

Grace is a Ronald E. McNair Scholar at Eastern Washington University. She will graduate in June of 2014 with a double BA in Spanish and Anthropology as well as minors in Linguistics and Sociology. During her graduate studies Grace plans to work with Spanish and English speakers in the US and Latin America to better understand the roll of language in the human experience.