Freshwater Mussel Shells from Three Late Prehistoric Glenwood Locality Earthlodge Sites in Western Iowa: Analysis of Species Composition and an Assessment of Shell Modification

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ABSTRACT

Freshwater mussel shells were analyzed from three Late Prehistoric Glenwood culture sites (A.D. 1250 – 1400) in western Iowa. Shells were identified to the species level and all modified shells were segregated for additional analysis and description. Shells of specific shape and texture were selected for some tool types. A newly described tool, referred to as pigment applicators, are described and were successfully replicated through experimental application. The current analysis of shell assemblages is compared to the nearby Wall Ridge site.

INTRODUCTION

Native Americans have a long history of utilizing freshwater mussels, including those peoples who lived on the Great Plains. Freshwater mussels were first gathered from aquatic habitats on the Great Plain more than 10,000 years ago (Warren 2000:79). Mussels have been an important riverine resource and their shells are found archaeologically throughout the Midwest and Great Plains regions. They have commonly been used as a food source, their shells shaped into tools, ornaments, and crushed for use as temper in pottery. Mussel shell utilization and unique modifications can sometimes be attributed to certain cultures and can provide information regarding the daily life of ancient native peoples. Though the shells can provide important facets of information, their study is often overlooked and little is known about how exactly they were used as tools and what functions they performed.

Following the species identification, this study focuses on shell artifacts from the Glenwood culture sites located in southwestern Iowa. Freshwater mussels were harvested by Glenwood people in modest numbers for dietary purposes, and shells were sometimes kept as “tool stock” to be modified into tools or ornaments. The Glenwood culture in Iowa is one of the nine localities occupied by Nebraska phase people, and is the only one east of the Missouri River (Alex 2000:171).

Some shells have been recently recognized to have been utilized as tools but without intentional modification. Many shells from one Glenwood site, Wall Ridge (13ML176), exhibit a wear pattern on the back of shells combined with traces of what appears to be black charcoal paste, red pigments, or both. These shells seem to be “pigment applicators”, a tool never before recognized in the archaeological record of the Great Plains and Midwest. James L. Theler, who analyzed the shells from the Wall Ridge site in 2010, believes these may have been used to apply color (black or red) to hides or skin clothing (Theler and Tiffany 2011:9). The application of pigment to clothing was a common practice historically among Native American peoples; however, shells as applicators have not been identified before (James Theler, personal communication 2010).

As a result of the work done at the Glenwood locality in the 1960s, more than 60,000 archaeological artifacts are curated at The Office of the State Archaeologist at The University of Iowa in Iowa City (Hotopp 1978:22). This collection is an essential component of the database for the study of Central Plains archaeology, but has never been fully analyzed. The present investigation seeks to continue previous studies of freshwater mussel shells and to expand these studies to new sites with more in-depth research. This includes identifying the species of mussels from Glenwood sites to find what habitats were being exploited (Hirst 2000; Theler 1990), as well as observing the modification/wear patterns on the shells to determine for what purpose the Native peoples of the Glenwood locality were using the mussel shells; as tools, a food resource, or both. More specifically, this study focuses on the categorization of tools and an attempt to learn more about the new applicator type tool. These applicator tools have specific wear patterns that were recreated through experimental application along with the chemical analysis of the black and red substance on the backs of the shells.

BACKGROUND

Glenwood Locality

The archeological remains of late prehistoric populations living along the Missouri River in eastern Nebraska and southwestern Iowa represent localities of the Nebraska phase of the Central Plains tradition (Figure 1). The Nebraska phase represents one of the most intensively studied prehistoric cultures among the Central Plains manifestations. This distinctive pattern of culture is recognized in the archaeological record as early as A.D. 900**;** although recent evaluation of radiocarbon dates suggests the Nebraska phase formed after A.D. 1200 (Alex 1980:140; Perry 2004; Tiffany and Lensink 2010).

The Glenwood culture has a complex of traits, which include a variety of pottery types, and bone and stone tools shared with other Nebraska phase sites. They built square houses with rounded corners of varying size but that average about 30 feet on the side. They were constructed with four main roof supports near the middle of the house around a central fire pit. The walls were made of closely set vertical poles and a narrow covered entrance that usually extended from the south wall of the lodge. These structures most likely had sod-covered roofs. Storage pits were dug into the floor of the house that range in shape from shallow depressions to deep, straight walled or bell-shaped pits. These pits were used to store food as well as valuables (Alex 1980:140, Anderson 1975:43). These houses were generally isolated along valleys or bluffs overlooking rivers and streams in the Glenwood locality. Other sites contained small clusters of lodges, suggesting a community of perhaps 40 to 60 people. The members of a number of households in a particular valley or cluster may have linked together in larger kin groups (Anderson 1975:44).

Glenwood locality economy was based on ubiquitous crops such as corn and squash. Several artifacts were found that were used in farming, such as bison and elk scapula hoes and shell hoes made from freshwater mussels. The scapula hoes were often notched which made them easier to haft to a wooden shaft. Archaeologists believe that deer and elk were available locally while bison was only a minor part of their diet, the bison scapula hoes being the result of trade (Alex 1980:141, 2005; Pope and Whittaker 2010:11-25**)**.

The most common hunting weapon was the bow and arrow, which used small multiple notched points or larger unnotched triangular points. Several different tools were used to process meat and hides. These included stone knives that were oval or triangular in shape as well as scrapers, bone awls, and bone needles. Hide end scrapers were also found and were generally long and oval shaped. Some were handheld while others were tied to handles made from large ribs or antler tips. Glenwood people also used antler knapping tools, hammerstones, anvils, whetstones for sharpening blades, and shaft straighteners (Alex 1980:140-142; Anderson 1975:45).

The Glenwood people conducted very little trade though they did “borrow” some generally shared pottery decoration and vessel forms such as loop handles from Mississippian groups. They produced several kinds of pots comprising several different ceramic types that have been distinguished based on rim formation and decoration. These include McVey, Beckman, Swoboda, and Debilka wares. In general, vessels were globular shaped with a constricted neck, varied rim form, rounded shoulder, and round bottom. Vessel walls were formed by modeling the clay into the desired shape and thinning it by beating with a cord-wrapped paddle. Cord marks were often smoothed over before the pot was fired. Clay pipes, often zoomorphic forms, and clay figurines are also distinctive of the Glenwood peoples and are not seen in other western Iowa cultures. It is likely that the pipes were used for ritualistic purposes (Alex 1980:140, 2005; Anderson 1975:46).

Along with limited evidence for trade there is no evidence for warfare. The lodge site clusters are not fortified and so it is assumed that the Glenwood people coexisted peacefully with their neighbors. Resources, including nearby cropland, may have been sufficiently distributed to prevent intergroup hostilities. The wide spacing of lodges across the landscape probably helped reduce competition for land and wild food resources. The rugged topography of the Loess Hills with narrow valley drainages also limited house clustering. Virtually nothing is known about the Glenwood peoples burial patterns. Mounds have been recorded in the vicinity of Nebraska phase sites, although, those whose affiliation is known are Woodland (Alex 2000:173-174).

Glenwood Nebraska phase sites have shell tempered pottery associated with the Steed-Kisker complex near Kansas City. Through time Glenwood peoples experienced increasing contact with the Oneota tradition which can be seen with the appearance of locally-made shell tempered and grit tempered pottery in the Oneota style. The Glenwood peoples and the Nebraska phase disappear from the archaeological record around A.D. 1400. This could be due to changing climatic, environmental, and cultural factors as well as crop failure that may have put new pressures on the Glenwood people that forced them to move away or regroup in later Plains Village culture manifestations (Alex 1980:141; Ritterbush 2007:183-189).

History of Excavations

The first excavations of sites assigned to the Nebraska phase were done in the late nineteenth century (Alex 2000:171). Since that time many Glenwood house sites have been excavated by professional archaeologists.

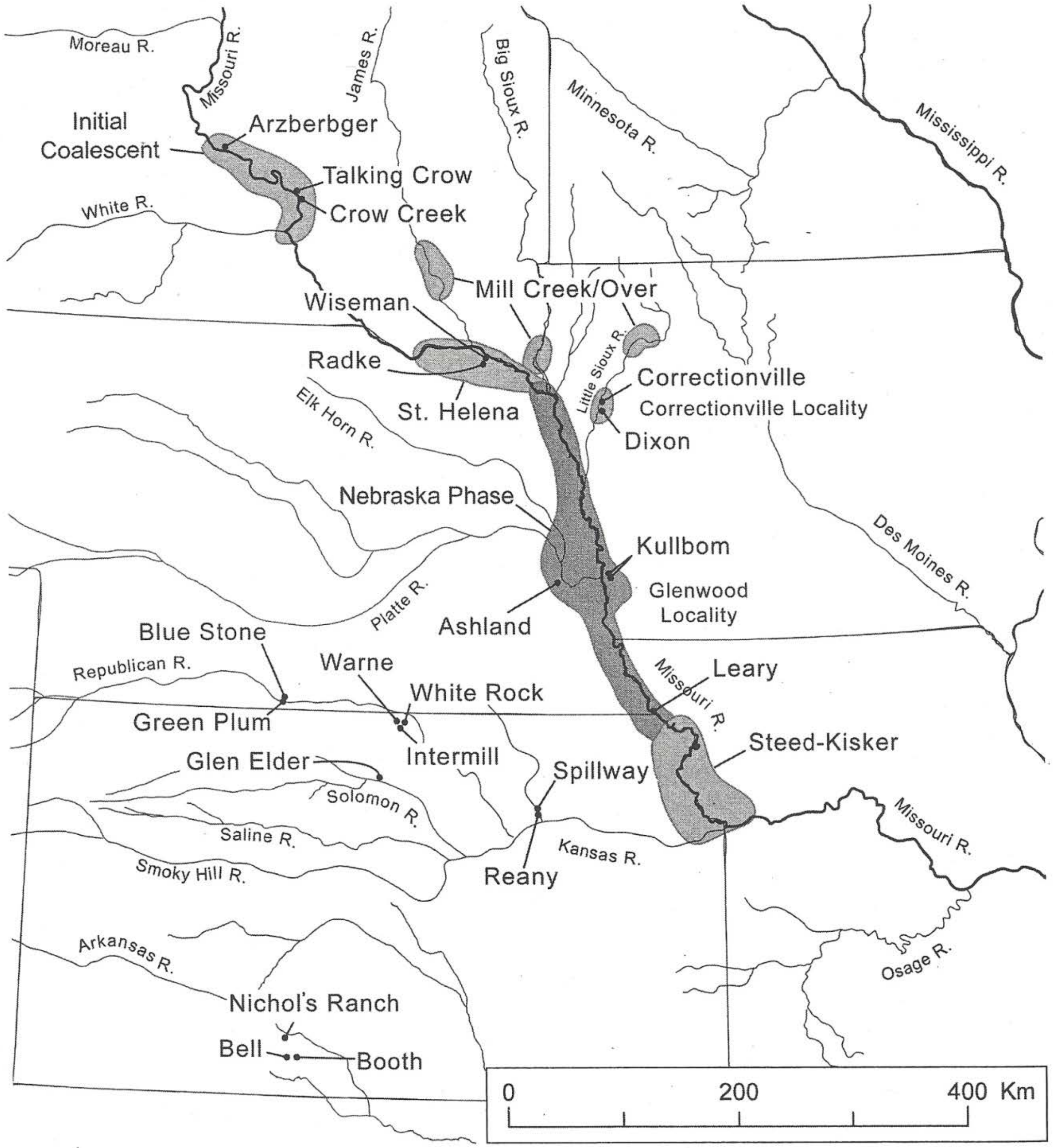


Figure 1. The Central Plains Tradition. *Source*: Ritterbush (2007:figure 14.1)

Avocational archaeologist Paul Rowe searched for Glenwood earthlodge sites from the early 1920s through the early 1960s. His work and that of Ellison Orr, who led Works Progress Administration (WPA) sponsored research through the Iowa Archaeology Survey in the 1930's, identified over 200 earthlodge sites (Perry 2004). Their efforts as well as the Smithsonian Institution River Basin Surveys led to the accumulation of a major collection of Nebraska phase materials and several published excavation reports. The Rowe Collection is now housed in the Mills County

Historical Museum and in Iowa City at the Office of the State Archaeologist of The University of Iowa (OSA). Work sponsored by the WPA and primarily the Iowa DOT is also housed at OSA.

The Wall Ridge site (13ML176) was the first Glenwood earthlodge carefully excavated with stratigraphic control, fine screening, and soil sampling from the present ground surface to the floor and sub-floor pits, providing the data base needed for an integrated paleoecological study (Schermer 2010). The site was found in 1984 on a reconnaissance survey for prospective borrow pits for a local roads project in Mills County, Iowa. It was excavated by the Iowa Archeological Society field school under the direction of Shirley Schermer. This excavation was sponsored by the Office of the State Archaeologist and the Mills County Engineer’s Office. The project was under the general supervision of the Principal Investigator, Joseph A. Tiffany.

The Wall Ridge excavation gives a comprehensive look at the household economy of a homestead of the Nebraska phase. When completely excavated, a typical Central Plains earthlodge with a 9 meter square floor area was exposed as well as a central hearth and nine subsurface storage pits, four of which were bell-shaped. Only the entryway was not found. From 1984 to the present, work on Wall Ridge has focused on processing, inventorying, cataloging, identifying, and describing the material culture and floral and faunal remains from the site (Schermer 2010). Analysis of Wall Ridge Glenwood culture fauna has been completed by James L. Theler (Theler 2010:11-2—11-27). And the analysis of bone tools has been completed by Joseph A. Tiffany and James L. Theler (Tiffany and Theler 2011:1-8).

Glenwood Archaeological Sites

The shell artifacts in this study are from three Glenwood sites; 13ML133, 13ML136, and 13ML139 (Figure 2). These are three of the 18 earthlodges excavated as part of the U.S. 34 highway project undertaken by the OSA for the Iowa Department of Transportation (DOT) in the late 1960s and early 1970s.

Site 13ML133 is located on the western side of a ridgetop overlooking Horse Creek. No plan view is available for this site. After this area was disturbed by construction, only a trace of the lodge floor and part of a cache pit were observed. The artifact catalog lists two proveniences, a lodge wall and a refuse pit. The artifact collection is small, there were no historic artifacts found which indicates that there was no recent disturbance, and ten ceramic rims and 141 bodysherds were found. There was one shell hoe found and several bone tools, such as a scapula hoe, awl, and needle (Billeck 1993:108-109).

Site 13ML136 is located on a west-facing footslope at the entrance of Pony Creek into the Missouri Valley. This lodge was found during construction and part of the north wall was removed (Figure 3); prior erosion had destroyed the west wall. Excavations in 1972 detected seven refuse pits, four central posts, and 35 wall and interior posts. The lodge is 7.3m by 7.7m and the entrance extended downslope to the south or west, where it was destroyed by road construction or erosion. Several burned wood beams indicate that the lodge was burned. The shell artifacts found at this site include one triangular pendant and seven shells that showed a modified edge (Billeck 1993:120).

Site 13ML139 is also located on the west-facing footslope of a hill at the entrance of Pony Creek. The lodge was found during construction and during excavations in 1971-1972. Six internal refuse pits, one external refuse pit, a central hearth, four central support posts, and 40 wall and interior posts were found (Figure 4). The lodge is 6.5m by 6.9m, with a southwest-facing entrance. This lodge was also burned; this is indicated by the presence of burned earth and wood. The artifact collection from this site is distinctive in the high occurrence of cores. This lodge contains four times more cores than any other lodge in the sample. There is also a shell pendant which depicts a turkey head with a weeping eye motif. Human remains from two individuals are present. Other shell artifacts found at this site includes one hoe and one sub-triangular pendant (Billeck 1993:137).

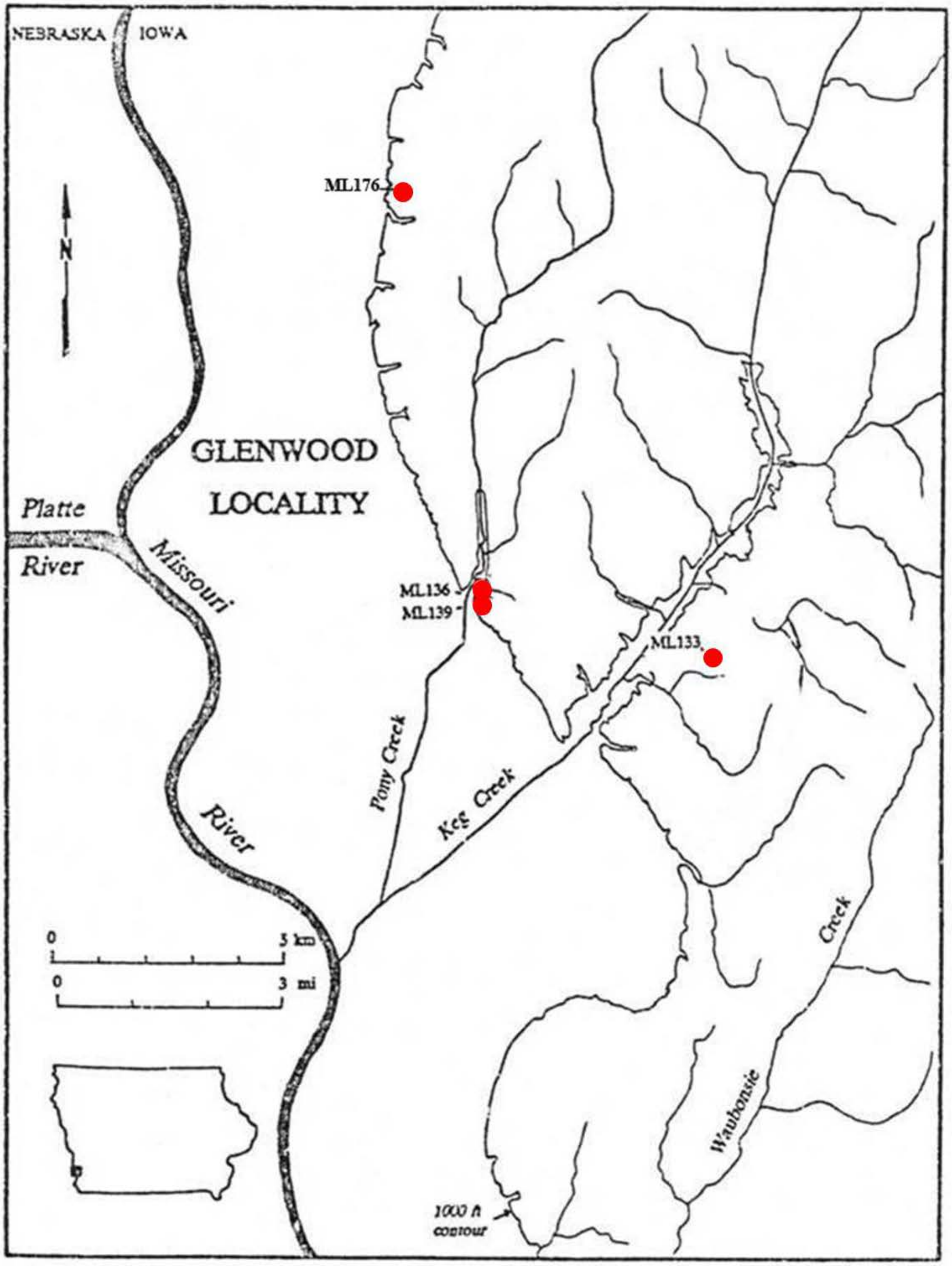


Figure 2. Site Locations. *Source:* Redrawn from Billeck (1993:figure 1.2)

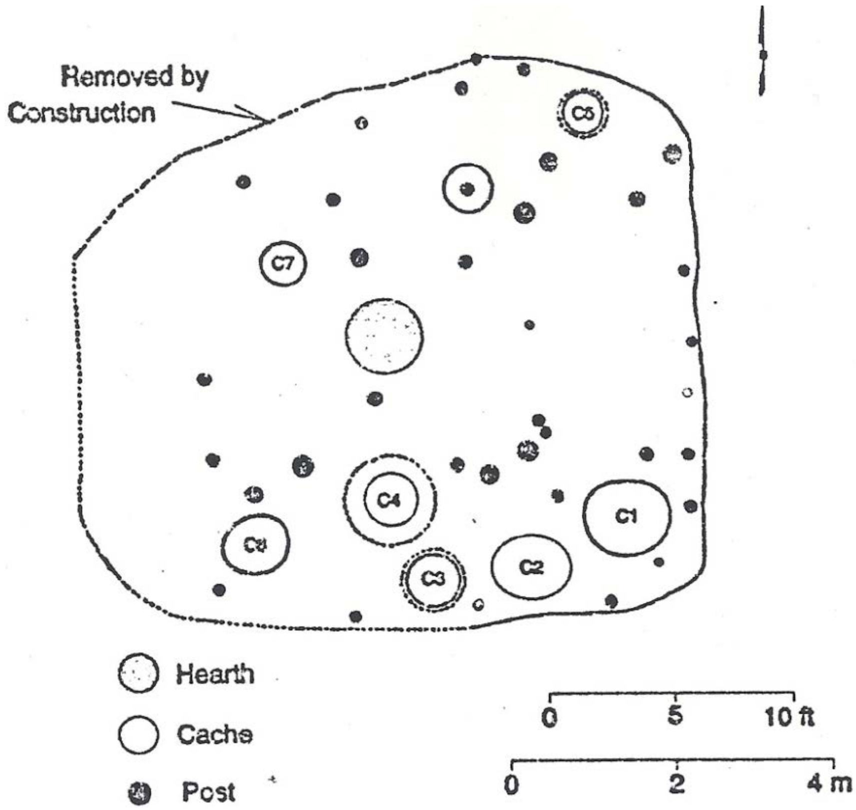


Figure 3. Plan view of site 13ML136. *Source:* Billeck (1993:figure 4.20)

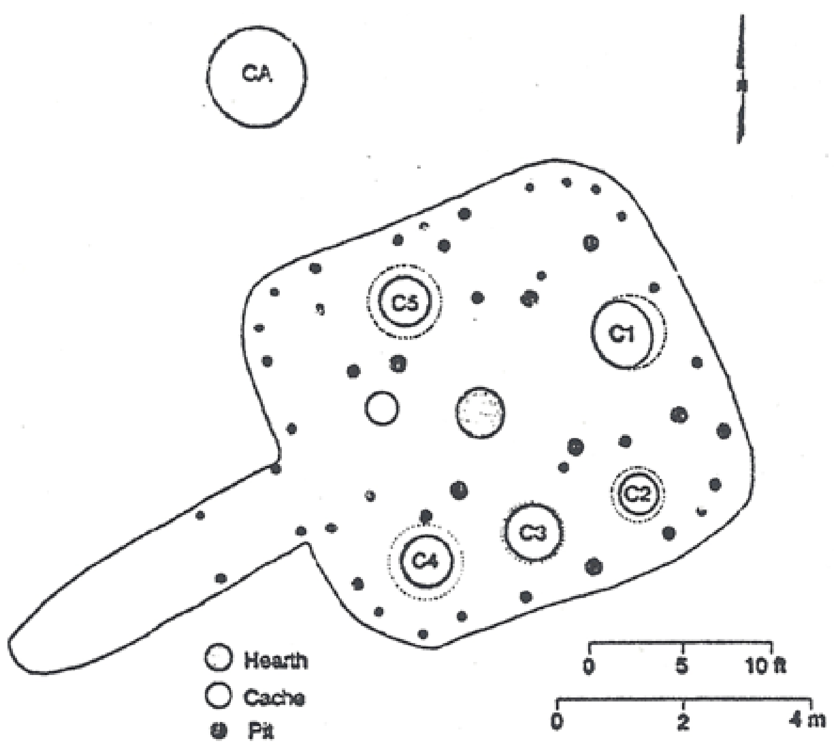


Figure 4. Plan view of site 13ML139. *Source:* Billeck (1993:figure 4.25)

ARCHAEOLOGICAL DATA ANALYSIS

Methods

The first step in the analysis was to identify the freshwater mussel species represented in the assemblages. MVAC (Mississippi Valley Archaeology Center) houses a comparative collection of modern freshwater mussels which was used to help identify the archaeological specimens. Reference books on freshwater mussels were also utilized during the identification effort and included the *Field Guide to Freshwater Mussels of the Midwest* (Cummings and Mayer 1992), *The Fresh-water Mussels of Illinois* (Parmalee 1967), and *Missouri Naiads: A Guide to the Mussels of Missouri* (Oesch 1984).

The catalogued shells were separated first by site and then by species. After a mussel species was identified, the next step was to determine if the shell was modified. To facilitate the recording of data pertinent to each shell, a standardized data form was created. The information recorded on this form included the catalogue number, species, side, percentage of completeness, types of wear/modification that were visible, and any other details that may have been important, such as recent or fresh damage or if distinct deposits of calcium carbonate was present. Each valve was then analyzed with the aid of a magnifying lens and in some cases a microscope to determine the presence/absence of use wear patterns on the shell. The collected data was then entered into a computerized spreadsheet using Microsoft Excel to facilitate analysis of the data.

The process of species identification was guided by Dr. James L. Theler, Professor Emeritus at the University of Wisconsin-La Crosse. Following an initial species identification by the author, each specimen's identification was verified by Dr. Theler.

Following this process the shells were put into specific tool categories based on type of wear, shell shaping, and modification observed. Some tools were put into more than one category. The tool descriptions and categories used in this analysis are from *Analysis of Bone and Shell Tools from the Wall Ridge Site, 1ML176, Southwest Iowa* (Theler and Tiffany 2011). The tool type identification was subsequently verified following the analysis by Dr. Joseph A. Tiffany, Professor of Archaeology at the University of Wisconsin-La Crosse.

Results

There are a combined total of 165 shell tools and tool fragments made from freshwater mussels from sites 13ML139, 13ML136, and 13ML133. These valves show both intentional and unintentional modification. Several of the shell tools may also have served more than one function.

Before the categories of tools are described it is important to understand the anatomy of the freshwater mussel shell. The parts that I will discuss throughout this paper include the umbo and umbo margins, ventral margins, pustules, anterior and posterior margins, the exterior and interior of the shell, and the pseudocardinal teeth (Figure 5).

Scrapers. Scrapers are valves that have smoothing, polish, or grinding along the ventral margin that leads to visible disruption of the growth ring patterns. There are a total of 34 scrapers and scraper fragments from 13ML139 and 13ML136; 13ML133 did not have any scrapers. The most common species on which the scrapers were made was the black sandshell (*Ligumia recta)*. An example of a scraper made from a black sandshell from 13ML139 (Figure 6) shows the ventral margin (marked by arrows) where the valve was clearly worked. An ethnographic and experimental study of scraper tools indicates that they were probably used for shelling parboiled corn off the cobs (Gradwohl 1982).

Shell Hoes. Two shell hoes were represented in the assemblages, one each, from 13ML139 and 13ML133. These tools have a perforation that appears to be pecked into the valve near the umbo; this is believed to be for hafting to a handle. The posterior shell margin shows evidence of grinding/use striations and smoothing, and the exterior and interior of the valves have grinding striations. Both specimens are made from the same species, the pink heelsplitter (*Potamilus alatus*). The shell hoe from 13ML133 (Figure 7) also includes notching along the anterior margin near the umbo. The edges of the pecked perforation have clear indications of smoothing and grinding. The shell hoe from 13ML139 (Figure 8) shows modified posterior margins, possibly from use.

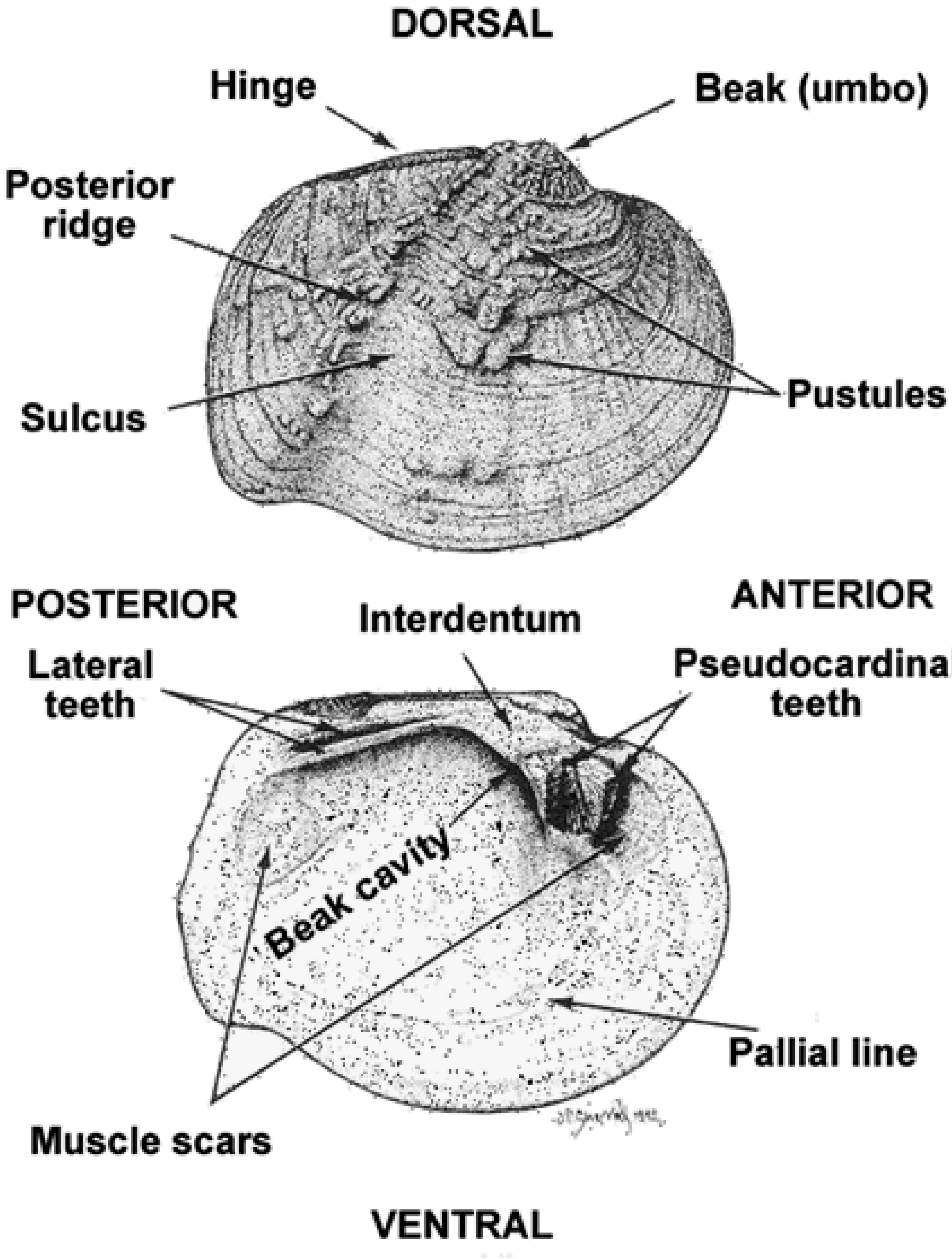


Figure 5. Anatomy of a freshwater mussel shell – *Source:* www.fws.gov

Figure 6. Black sandshell scraper tool

Notched Shell Margins. There are 11 valves from 13ML139 and 13ML136 that have worked margins with rough notching along the edge of varying sizes. All 11 of the specimens fall into one of three other categories; applicators, possible applicators, or scrapers. Two of these specimens were specifically unidentifiable fragments. One example of a notched shell margin is made of a pistolgrip (*Quadrula verrucosa)* (Figure 9) and also has a smoothed ventral margin.

Figure 7. Pink heelsplitter shell hoe from site 13ML133

Figure 8. Pink heel splitter shell hoe from site 13ML139

Figure 9. Pistolgrip mussel with notched shell margins

Spoons. There is one shell spoon from site 13ML139; it is made from a fatmucket (*Lampsilis siliquoidea)*. Spoons have a short handle, which is made by notching on the anterior margin of the shell. The specimen has polish on the umbo, smoothing on the posterior margin, striations on the umbo below the beak, and a small amount of red-brown pigment on the umbo. The most defining characteristic is the notching located on the anterior margin next to the umbo (Figure 10); this would be the handle, though it is not entirely finished.

Shell Beads. Four freshwater shell beads were found at 13ML139; they each have a perforation, which goes through the middle of the bead (Figure 11). They are all slightly different widths with different sized perforation holes. Bead A has a diameter of 6.3 mm and the central suspension hole is 2.7 mm. Bead B has a diameter of 6.9 mm and the central suspension hole is 2.9 mm, Bead C has a diameter of 6.1 mm and the central suspension hole is 2.5 mm. And finally, the central suspension hole of bead D is 2.0 mm and the diameter is 6.0 mm.

Figure 10. Shell spoon made from a fatmucket

Pendants. There are six pendants and one pendant preform made from freshwater mussel shell from 13ML139 and 13ML136. Three are sub-triangular pendants with a hole drilled near the top of each (Figure 12). These pendants have a square top with a pointed tip. Pendant No. 339-S-14 is 34.3 mm long and 11.0 mm wide and 4.3 mm in thickness. The diameter of the suspension hole is 2.5 mm. Pendant No. 339-8-20 is 3.8 mm long and 10.0 mm wide and 3.8 mm in thickness. The diameter of the suspension hole is 2.4 mm. One of these pendants has some different characteristics, it has been heat damaged and is broken in half, and the drilled hole has also been broken off (Figure 13). This pendant is 3.2 mm long and 8.7 mm wide and 3.9 mm in thickness.

Two other types of pendants are each made of entire valves; one is from the right side of a Wabash pigtoe (*Fusconaia flava)* and the other is the left side of a pimpleback. These two pendants have slits that were ground into the shell, perforating the umbo (Figure 14). Both pendants also have grinding striations all over the exterior of the shell, from the top of the umbo reaching down to the margin on all sides. This makes the shells exterior smooth. The pendant preform is the left valve of a pimpleback. This artifact, like the pendants just mentioned, has grinding striations covering the exterior of the shell as well as intentional smoothing (Figure 15). It does not have a slit in the umbo.

The last pendant is circular and has a weeping turkey motif incised into it (Figure 16) with a hole drilled into it near the top. The edges of the pendant have notches and are also smoothed off and on the back of the pendant you can see where drilling of another hole had been started (Figure 16). It is 34.2 mm long and 11 mm wide and 4.3 mm thick. The suspension hole has a diameter of 2.5 mm. Shell pendants with this type of motif are part of the Southeastern Ceremonial Complex and are dated to A.D. 1200-1400 (Tiffany and Lensink 2010).

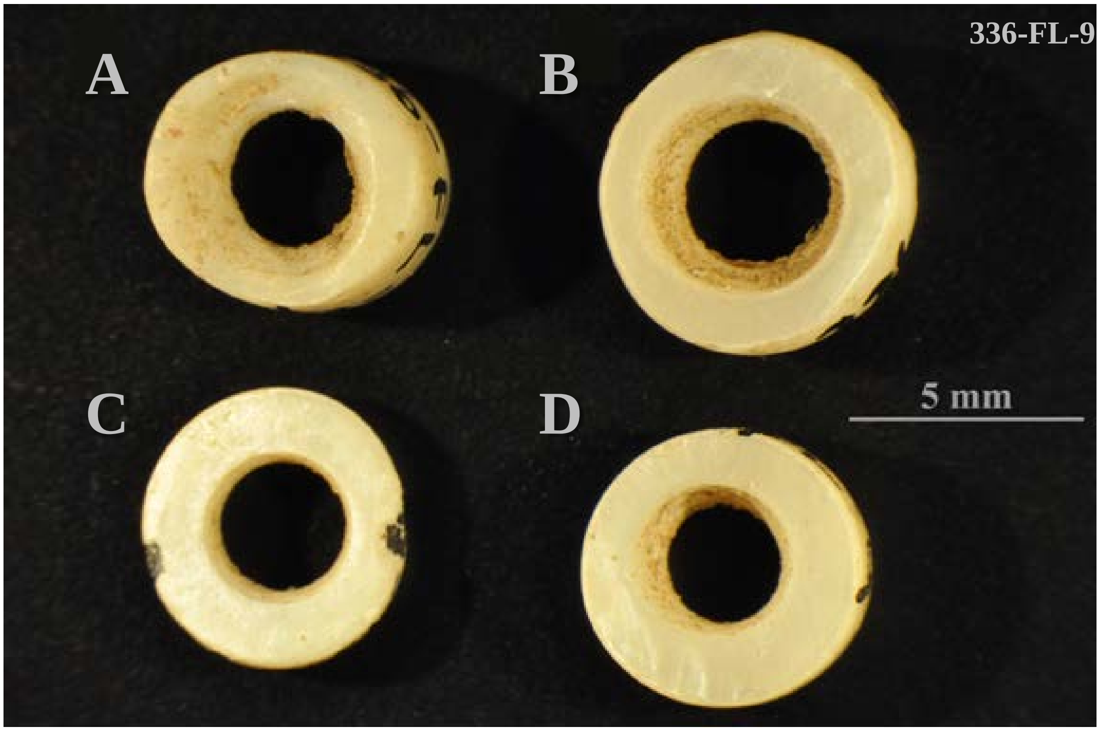


Figure 11. Four freshwater mussel shell beads; A, B, C, D

Figure 12. Sub-triangular pendant

Figure 13. Heat damaged sub-triangular pendant

Figure 14. Pendant made from the left valve of a pimpleback

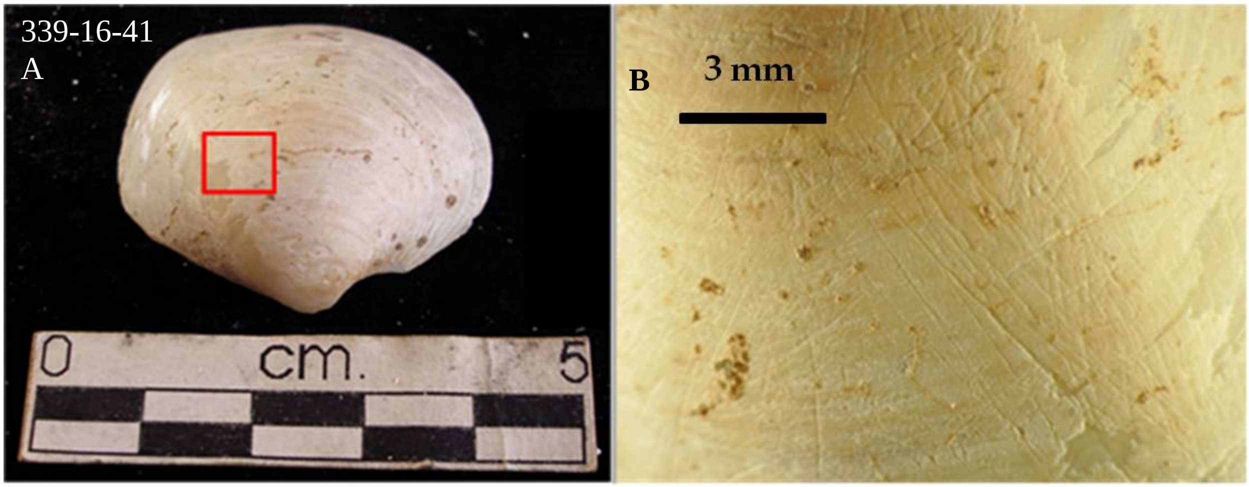


Figure 15. Pendant preform made from left valve of a Pimpleback: A (whole valve); B (close up of exterior) (26x)

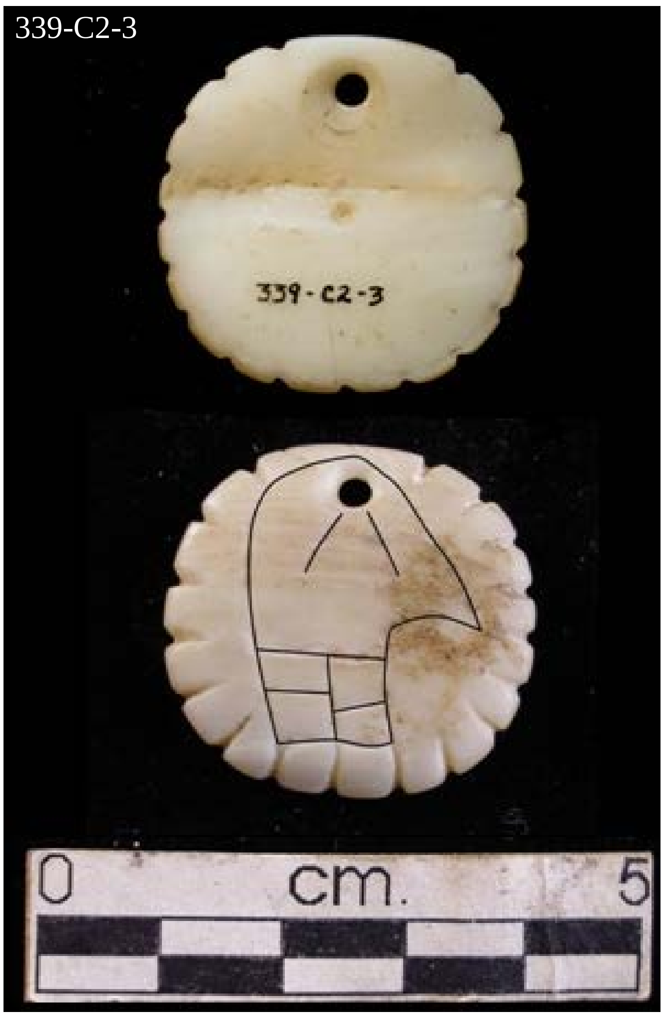


Figure 16. Shell pendant with turkey motif (outlined)

Shell Tool Production Material

There are two specimens in this category, one is an unidentifiable fragment and the other is a plain pocketbook (*Lampsilis cardium*). They have grooved lines that were sawed into the shell interior or exterior. This made it possible to snap off the part of part of the shell that would then be shaped into a tool. In the unidentified fragment (Figure 17) the grooved line is very deep. In the plain pocketbook (Figure 18) it is apparent where the grooved lines have been started but were not worked on for very long. In this shell it appears that the grooves were outlining a square that would have been punched out and used to make a tool.

Figure 17. Shell tool production scrap

Figure 18. Shell tool preform

Other Modified Shell

This category contains eight items. Seven of the specimens have grinding striations and smoothing on the exterior of the shell (Figure 19). Four of these specimens are unidentifiable fragments and the other three are made from a pinkheel splitter, black sandshell, and a plain pocketbook. The eighth specimen is made from a pinkheel splitter and presents grinding striations on the interior of the shell. The exterior of this shell is covered in calcium carbonate.

Applicators. This is a tool group that was first recognized in 2010 during a re-analysis of the Wall Ridge shell assemblage. "Applicators" have polish on the exterior of the shell, especially at the umbo and they often have a "pigment" represented by a dried, paste-like residue found near the umbo margins (James Theler personal communication 2010). This paste-like residue is not to be confused with the periostracum, the outer layer of the shell, as it can be seen over the top of the periostracum in several cases. These tools often share many characteristics with scrapers, including beveled ventral margins. These tools were previously processed in a lab, and therefore, some of the paste was probably inadvertently removed during the cleaning process. This paste was overlooked during the tools initial analysis.

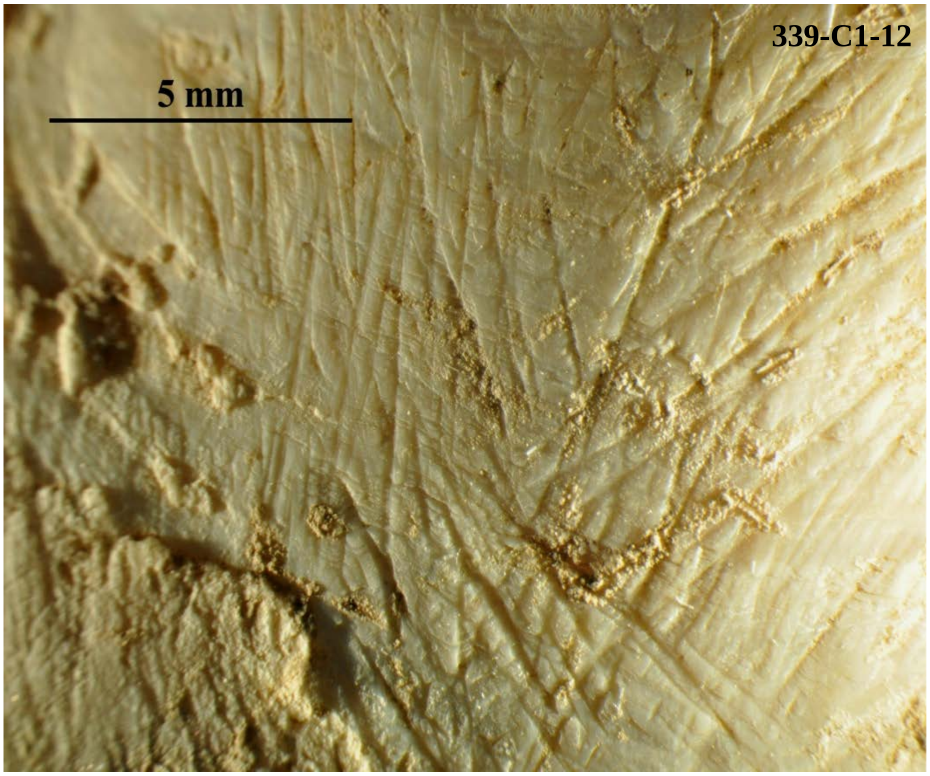


Figure 19. Close up of grinding striations on exterior of a plain pocketbook (26x)

These applicators are hypothesized to be hide-working tools by James L. Theler and Joseph A. Tiffany. They may have been used to hold the pigment mixture and then turned over and the external surface of the shell was used to apply the mixture to the hide. Because of the worked ventral margin on many of these tools, they may have also been used to scrape the hide during the processing stages (Theler and Tiffany 2011:9).

There are a total of 70 shell applicators representing 42% of the assemblages, and 27 possible applicators in the three site assemblages analyzed here. The applicator tools have the pigment residue on the exterior of the valve and polish that is located on or near the umbo. The possible applicators have polished umbos, but no trace of paste or the amount is so little it cannot be known for certain that it is paste residue. From all three sites the most common species that the applicators are made of is the threeridge mussel (*Amblema plicata)*. One example of a threeridge mussel applicator (Figure 20) has a pigment residue located at the umbo margin. A close up of the same shell shows the pigment and also the polish that is commonly seen on the applicators (Figure 21).

To understand better the applicators paste residue, five of the applicator tools from sites 13ML139 and 13ML136 were sent to the PaleoResearch Institute for Fourier Transform Infrared Spectroscopy. This method will identify the material composition of the paste/pigment residue if they do not have post-excavation contamination. Results are pending at the time of writing (April 2011).

Figure 20. Threeridge applicator tool

Figure 21. Close up of polish on threeridge applicator tool (26x)

Discussion

In the archaeological shell assemblages from 13ML139, 13ML136, and 13ML133 there are a total of 154 valves of 15 freshwater mussel species with an MNI (minimum number of individuals) of 93. The most common mussel species recovered is the plain pocketbook representing 42 valves or 27%. The second most abundant species is the threeridge; this represents 36 valves or 23%.

Of the 154 valves 125 are modified representing 81.2% of the assemblages. This suggests that the freshwater mussel shells were being frequently collected to be used primarily as tool stock, and perhaps as a minor food source. Specific species of shells are also being selected for certain tool types. This is seen in the applicator tools as well as the scrapers. The applicators are most commonly made from the shell of the threeridge. They may be selecting this specific type of shell because the ridges on the exterior of the shell make it easier to apply pigment to a hide then a shell with a smooth exterior. The scrapers are most often made on the black sandshell. This species may have been selected because it is long and narrow and the ventral margin is relatively straight and flat and this would make it easier to scrape a wider area. All identified black sandshell valves were placed in the scraper category.

There is also a selection for the left valve of the plain pocketbook. This is the second most common species on which the applicator tools are made. Of the 31 modified valves of the plain pocketbook from all three assemblages 23 are from the left side, or 74%.

COMPARISON WITH WALL RIDGE (13ML176)

Wall Ridge Tools

The Wall Ridge site assemblage has 112 shell tools and tool fragments made on freshwater mussel shells. Like the assemblage described above, modification are on the exterior and interior shell surfaces and along the margins, with many of the shells tools appearing to have served more than one function. These tools are made on locally available species. Several shell tool categories were encountered at this site, these include; applicators, possible applicators, scrapers, notched shell margins, spoons, a shell fish lure, a tubular shell bead, and pendants.

Applicators were first encountered at this site and theorized to be tools used to work hides. There are 50 applicators and 18 possible applicators with the threeridge being the most common species used (Figure 22A). There are also three shell spoons, two are on lefts valves of a plain pocketbook and the third specimen was probably made on the same species (Figure 22B) There are 11 scrapers and scraper fragments (Figure 22C). They share features with applicators and three of the specimens fall into the possible applicator category. There are three shells that fall into the notched shell margins category (figure 22D). They are believed to be scrapers or scraper fragments, but may have been cutting tools. (Theler and Tiffany 2011:9-11).

There are three pendants at Wall Ridge cut from freshwater mussel shell. Two are elongated and sub-triangular (Figure 23) and the third is on a fragment of a right valve. This third pendant has grinding along the dorsal margin and a suspension hole below the hinge. (Theler and Tiffany 2011:11-12).

There are two unique artifacts found in this assemblage, a shellfish lure and half of a tubular bead. The lure is cut from a freshwater mussel shell valve (Figure 23A). It is smoothed on the interior, exterior, and the margins. The artifact is detailed and looks like a species of chub minnow. The tubular bead is made from marine shell (Figure 23B) (Theler and Tiffany 2011:11).

In the “modified shell” category there are 19 specimens of unidentifiable fragments of worked ventral margins and worked interior and exterior surfaces. Some could be pieces of the working edge of shell hoes or fragments of applicators or scrapers. There are three specimens in the “other modified shell” category. One specimen is from a left valve and has been cut into a sub-rectangular shaped wafer (Figure 24A). It may be an adze-like woodworking or scraping tool. The next specimen is sub-triangular and is the ventral anterior corner of a fragment (Figure 24B). The working surface has three shallow V-shaped notches on the edge. The final artifact is a rectilinear fragment that has notched serrated edges (figure 24C) (Theler and Tiffany 2011:10-12).

Figure 22. Wall Ridge shell tools; A (threeridge applicator); B (spoon); C (scraper); D (notched shell margins)
Source: Theler and Tiffany 2011

Figure 23. Sub-triangular pendant from the Wall Ridge site – *Source:* Theler and Tiffany 2011

Figure 23. Wall Ridge shell tools; A (fish lure); B (marine shell bead) – *Source*: Theler and Tiffany 2011

Results

The three sites in this study share many similarities with the Wall Ridge shell assemblage. Applicators are present at Wall Ridge and the three Glenwood sites considered in this report and are the most common tool type of the shell assemblages. There is also a selection in tools for specific shell species at both sites. The applicators are most commonly made from the threeridge and the scrapers are made from the black sandshell. There are also several other tool categories shared among the sites including pendants, notched shell margins, and spoons.

The sub-triangular pendant found at the Wall Ridge site was also found at the three sites in this study. It could be that this specific type of pendant form is common among Glenwood sites.

While shell beads are uncommon at Glenwood sites they are seen in the assemblages from Wall Ridge and also from 13ML136. The shell bead from Wall Ridge is made from marine shell while the four beads from 13ML136 are made from freshwater mussel shells. This is a significant difference among the sites. To obtain the marine shell bead they would have had to travel or trade for it while the freshwater shell beads could have come from a source very close by.

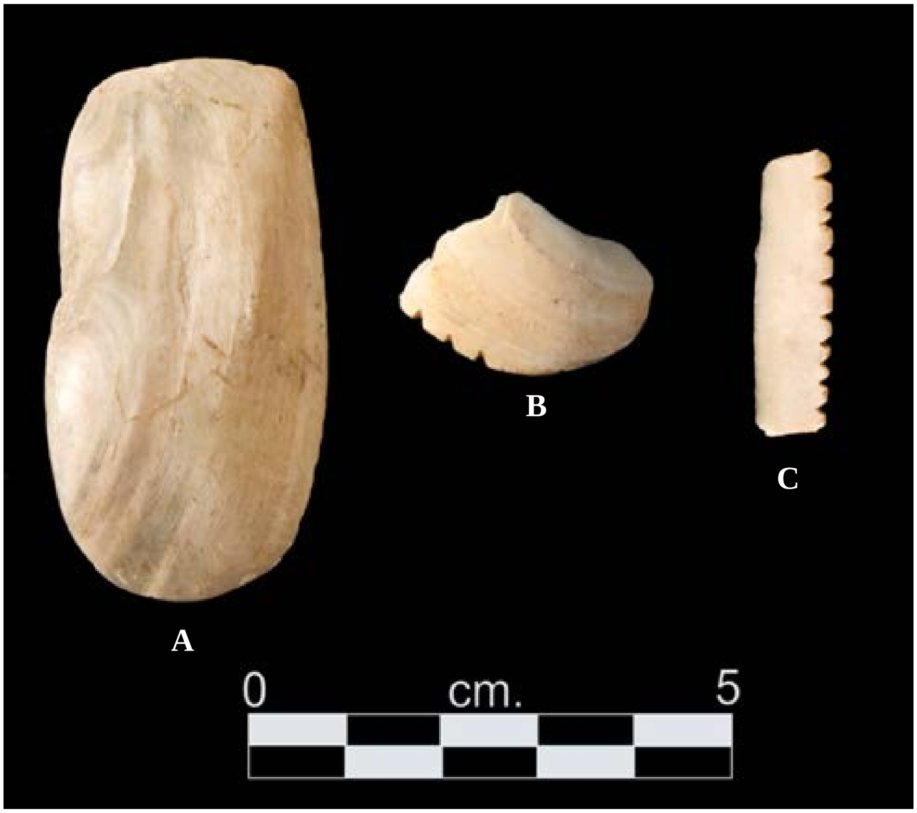


Figure 24. Wall Ridge shell tools; A (sub-rectangular wafer); B (sub-triangular fragment); C (rectilinear fragment)
Source: Theler and Tiffany 2011

APPLICATOR TOOL EXPERIMENT

Methods

Experimental research was conducted to provide possible functions of the applicator tools. Based on microscopic examination of archaeological applicators with "pigment" residue, an attempt was made to duplicate the pigments and wear patterns observed. To accomplish this deer fat was mixed with charcoal and with red ochre from hematite to produce black and red pigments. These pigments were then rubbed into a dry deer hide to see if the same wear patterns seen on the archaeological applicators could be reproduced.

The first step was to measure and mark four 625 cm^2 areas on the dry deer hide (Figure 25). These equal sized areas were the test areas for pigment application. The hematite was ground using a file to achieve a fine powder to mix with the deer fat. The charcoal was crushed and also sanded down with sand paper and then mixed with the deer fat. Both pigments were mixed in plastic containers using wooden dowels; these were also used to work the deer fat until it became paste-like, as this made it easier to apply.

Two different types of freshwater mussels were used to apply the pigment: the pimpleback and the threeridge. These two shell species were chosen based on the most common species of mussel used as the applicator tool from the archaeological assemblages. A total of two whole freshwater mussels were used, or four valves. Each mussel was a matched set with a left and right valve. The left valve of the threeridge was used to apply the hematite pigment and the right valve was used to apply the charcoal.

Figure 25. Test areas on deer hide

The opposite was done with the pimpleback, the left valve was used with the charcoal and the right valve was used for the hematite. The experiment was tried in two different ways; in the attempts with the valves of the threeridge the amount of time it took to fill the test square was recorded. In the other attempts with the valves of the pimpleback the amount of time was recorded as well as the amount of strokes it took to fill the test square.

The specimens and the hide were photographed at different times during the application process and also after each test was completed. After all four valves had been used they were each photographed under a microscope to view the wear patterns more closely. The archaeological specimens were also photographed this way so that they were able to be compared to the shells from the experiment.

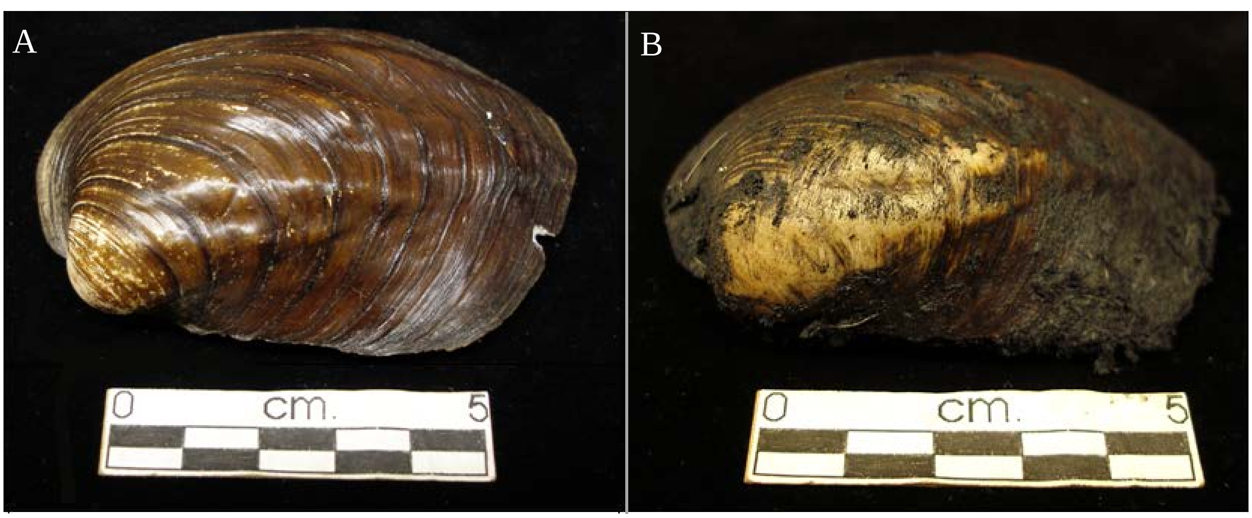
Results

The applicator experiment was done to test the hypothesized function of the applicator tools found in the freshwater mussel shell assemblages at the previously discussed sites (Theler and Tiffany 2010:8-9). This experiment provided evidence that these tools were in fact used to apply pigment.

In the experiment all four test areas were completely covered with pigment (Figure 26). The first valve used was the right side of a threeridge. This shell was used in combination with the charcoal pigment. It took 11 minutes and 30 seconds to fill the first test area of 625 cm^2. After the first minute and 30 seconds the periostracum was already wearing away and polish began to appear around the umbo of the shell (Figure 27). After the entire test area was filled with pigment the layer of shell under the periostracum had also started to rub off which made the polish more noticeable.

The second valve used was the left side of the threeridge. This shell was used with the hematite and took a total of three minutes and 30 seconds to completely fill the test area. The shorter time length had to do with the fact that the deer fat was considerably easier to mix with the hematite and also to apply to the hide. Another factor was that using the left side of the shell was significantly easier than using the right side. This valve showed some signs of polish on the umbo, but due to the short amount time it took, the periostracum did not wear off nearly as much. The umbo shows the polish beginning to appear (Figure 28). I had originally expected the hematite to be grittier then the charcoal and cause more wear, but it caused significantly less.

Figure 26. Completed test areas on deer hide



Figures 27. Right valve of threeridge experimental applicator; A (before); B (after)

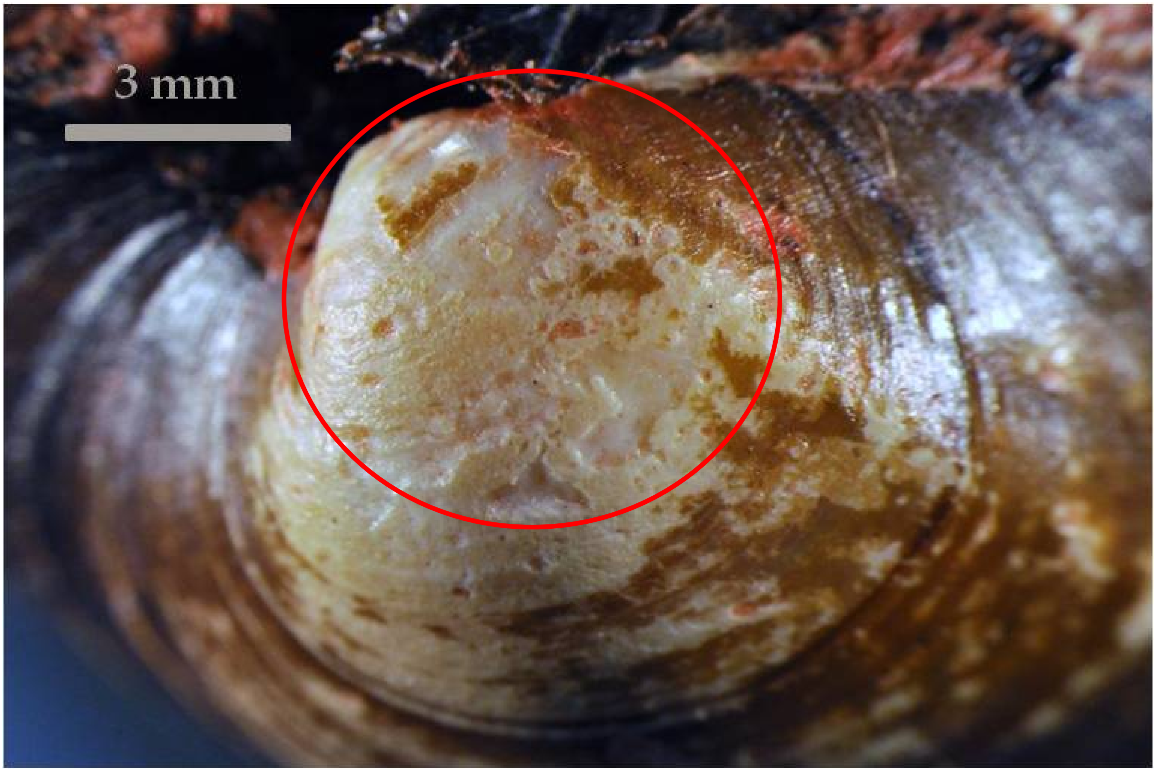


Figure 28. Close up of left valve of threeridge experimental applicator used with hematite (26x)

In the third test the left valve of the pimpleback was used. This time the left valve was used with charcoal to see if the left valve was actually easier to use or it was just the hematite. It took four minutes and 30 seconds and 640 strokes to cover the test area with pigment. I am right handed and found the left valve was easier to work with then the first right valve, even though both were used with charcoal. The periostracum on this shell also wore off and polish began to show, the pustules on the back of the shell showed signs of wear (Figure 29).

The final shell used was the right side of a pimpleback. It took two minutes and 30 seconds and 116 strokes to fill the square with hematite pigment. At this point the deer fat was very pasty; this made it very easy to apply to the hide which is why it did not take long to fill the area. This shell also began to show signs of wear, mostly on its pustules (Figure 30).The wear seen on the previous shells; this includes the polish on the umbo, on the pustules, and the location where the pigment ends up pooling, is identical to the archaeological specimens. Shells where the pustules have been worn down and polished include a pistolgrip (Figure 31) and a mapleleaf (Figure 32).

CONCLUSIONS

Analysis of the freshwater mussel shells from three prehistoric Glenwood sites clarifies the functions and uses of certain shell tools recovered at Nebraska phase sites. These shells were collected with their main purpose to be used as tools, their soft tissue may have been eaten, but they do not appear to have represented a significant food source.

The three sites in this study show commonalities with the more intensively studied Wall Ridge site. The tool categories and shape/modification of the tools is similar. The sub-triangular pendants and spoons are two types of tools that have identical modification and are a specific Glenwood trait. Selection for shells as specific tools is also a similarity among the sites. This is seen in the use of the threeridge for the majority of the applicator tools and the use of the black sandshell for the scrapers. This selection could be based on how useful the shape of each shell is for the task that will be performed, and is a common Glenwood trait. The single marine shell bead fragment found at Wall Ridge is the only difference between the sites. Marine shell beads are uncommon in Glenwood sites. This specimen was probably received through trade with other native groups; and probably was considered valuable.

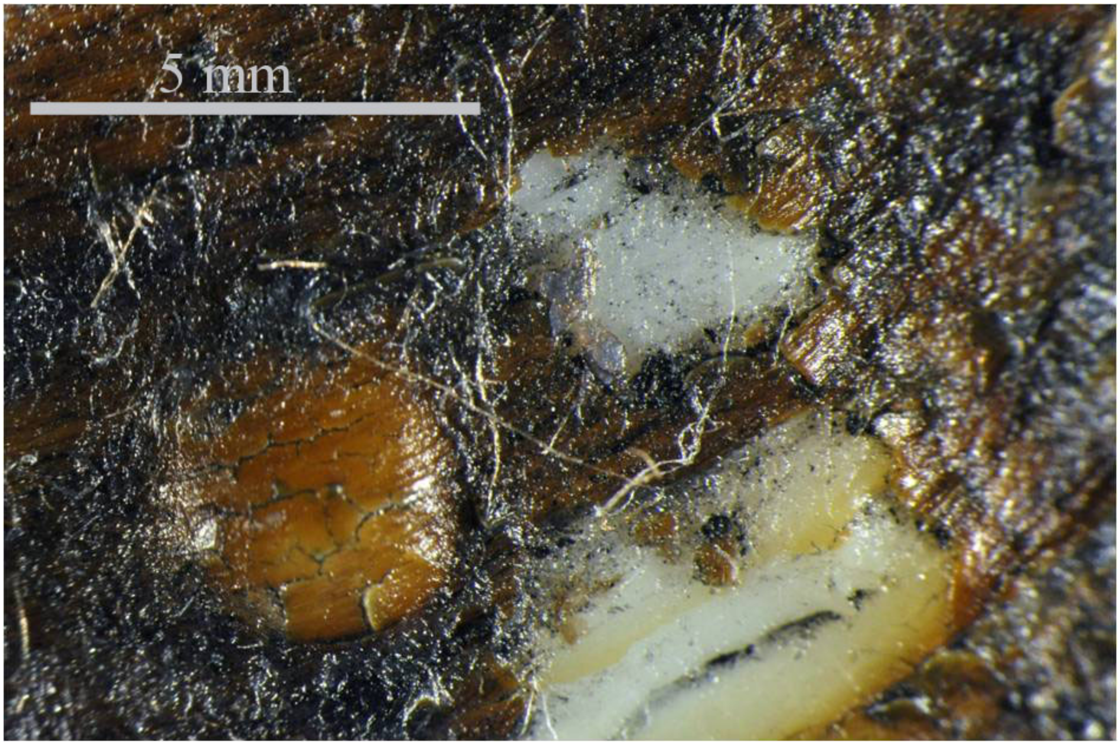


Figure 29. Close up of pustules on left valve of pimpleback experimental applicator (26x)

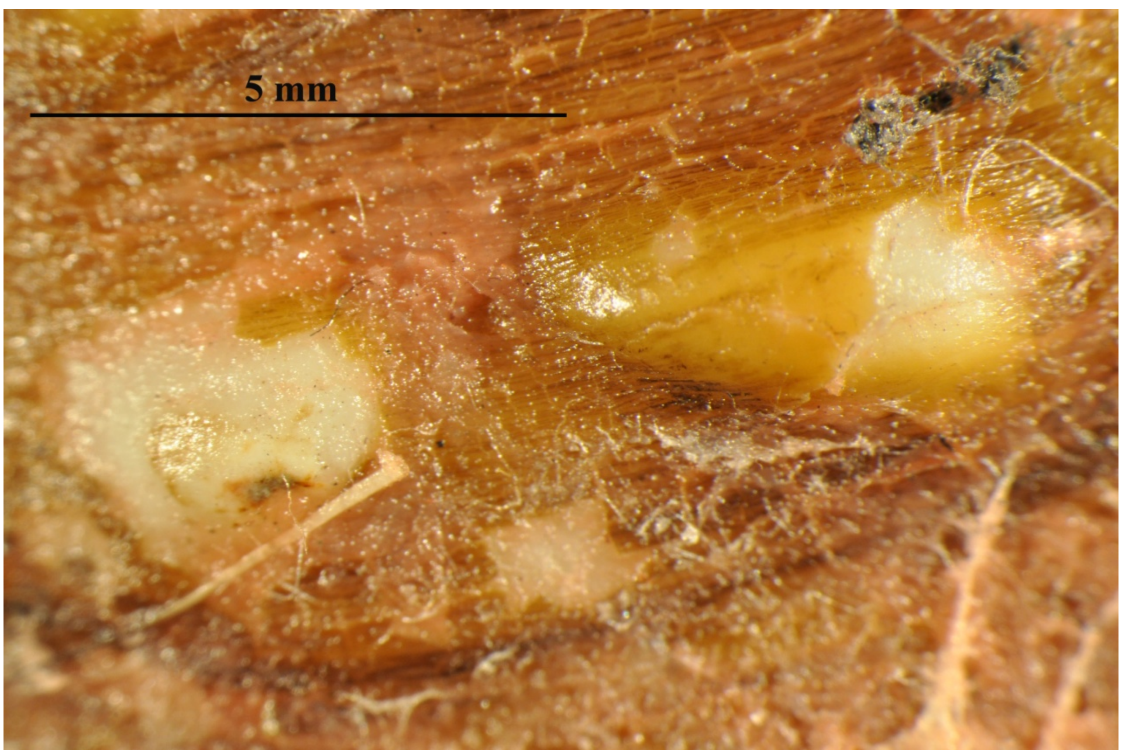


Figure 30. Close up of pustule wear on right valve of pimpleback experimental applicator (26x)

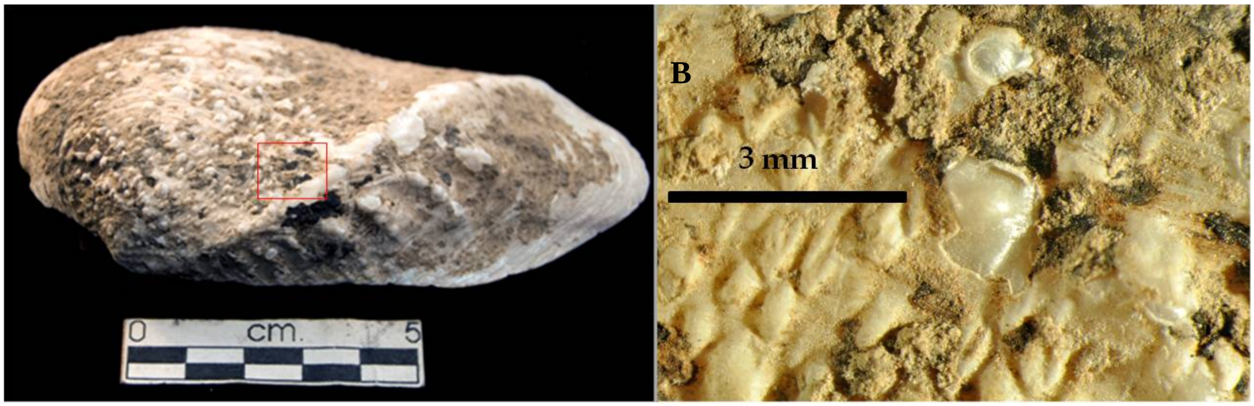


Figure 31. Archaeological applicator tool made from a pistolgrip; A (whole valve); B (close up of pustules) (26x)

Figure 32. Archaeological applicator tool made from a mapleleaf; A (whole valve); B (close up of pustules) (26x)

The recently recognized applicator tool was also successfully replicated. This hypothesis was tested by using four freshwater mussel valves to rub deer fat mixed with charcoal or hematite into a dry deer hide. The wear patterns produced from this experiment matched the archaeological applicators from the assemblages of the three sites. These patterns include high polish on the exterior that has worn through several layers of the shell, more specifically the umbo and the pustules (if present); pigment that has gathered at the umbo margins, and few striations near the umbo. The archaeological specimens also have an organic residue that has been ground onto the shell near the umbo. For this experiment it was also hypothesized that one side of the shell would be easier to use based on handedness. It was found that for a right-handed person the left valve was easier to hold and maneuver.

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