EXPERIMENTS IN HIDE BRAIN-TANNING WITH A COMPARATIVE ANALYSIS OF STONE AND BONE TOOLS

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ABSTRACT

White-tailed deer were a primary resource for native populations of the Midwest, serving as the principle source of protein and providing a great majority of the material goods used, such as hides for clothing. Processing the deer skins into usable hides, known as brain-tanning, was a highly evolved process. Tanning is defined as the process of making buckskin or leather from raw or green hides. The exact steps Native peoples used of this procedure are still debated today. In this study, we recreate the brain-tanning process as it was done by Midwest native populations at the time of European arrival. The focus of the study is on the use of stone tools and their effectiveness throughout the tanning process versus the use of bone tools and their effectiveness. This study reveals the most efficient and most likely used tool and material for specific aspects of the tanning process.

INTRODUCTION

Odocoileus virgianus, or white-tailed deer, are members of the Cervidae taxonomic family. They are ungulates, hoofed quadrupeds, that evolved 15-20 million years ago during the Miocene. White-tailed deer have successfully adapted to continue the species to the present day (Rue 1978). The range of the white-tailed deer covers the middle and eastern United States, and extends into southwest Canada and northeastern portions of Mexico. The habitat of white-tailed deer is mostly timber areas that include smaller woodlots, forests, lowlands, and timbered areas bordering major streams and associated tributaries (Gilbert 1980). In Wisconsin, prior to 1800, the northern half of the state was covered in hardwood evergreen forests, while the southern half of the state was dominated by oak and maple forests, interrupted by prairie openings. The frequency of deer in the northern half of Wisconsin was estimated at 10-15 per square mile, while the southern half was estimated at 20-50 per square mile. The southern half of Wisconsin was a prime habitat for white-tailed deer, with plentiful low-growing woody vegetation. The northern portion, while not ideal, contained a fairly adequate-sized deer population (Dahlberg and Guettinger 1956).

Figure 1: Deer distribution across Wisconsin prior to 1800 (after Dahlberg and Guettingen 1956)

Deer not only provided a major source of protein, but also skins, which could be tanned to create a finished hide of buckskin. Buckskin was the principal material used for clothing and footwear. It also was useful for making quivers (for arrows), pouches, blankets, possibly even shelters, as well as straps for fastening tools (Richards 1997). (A discussion of the importance of deer hides to native populations and several patterns or methods of making clothing from buckskin is given in Appendix B.) Throughout the state of Wisconsin, and throughout the Midwest, ancient native populations depended heavily on white-tailed deer. Stevenson, et al. (1997) comments on the importance of deer to the Woodland Tradition native populations existing in southwest Wisconsin

> "This environment [Southwestern Wisconsin] was a prime habitat for elk, and especially for white-tail deer, estimated at about 50 per square mile in prehistoric times. Deer were particularly important to Woodland peoples during fall and winter, providing not only meat and fat, but also hides for winter clothing."

Modifying raw skins into usable leather or buckskin through a process known as brain-tanning was a highly evolved procedure. Tanning is defined as a process of making leather or buckskin from raw or green hides. Buckskin itself is a soft porous material that can be made by tanning nearly any animal skin with use of lubricants to soften the hide, and smoke to finish the hide and make it more durable and somewhat water-repellant. The exact steps of the tanning procedure used by the ancient people of the Midwest are still debated today. In this study, we recreate the brain-tanning process as done by the Midwest native populations at the time of European arrival. The focus is on the use of stone tools and their effectiveness throughout the tanning process versus the use of bone tools and their effectiveness. This study reveals the most efficient and most likely used tool material for specific aspects of the tanning process.

METHODOLOGY

Several sources were used to determine which hide-tanning process would be employed. Two main ways to brain-tan hides were encountered, wet-scraping and dry-scraping. The sources used indicated the dry-scrape method to be the simplest, requiring less time and fewer materials, with the result being the same type of buckskin. This method seemed to be most likely used by prehistoric peoples, and will be used here.

The first step of the tanning process is to acquire or make the tools to be used. The majority of the tools are scrapers used to remove the hair, epidermis layer, and fat or flesh from the hide. Similar assemblages for each material, bone and stone, were made. The assemblages are comparable to a similar assemblage from an archaeological site in the Midwest with a known hide-tanning activity area. The bone tools were made from the leg bones of a white-tailed deer. The stone tools used were made by flintknapping. Flintknapping is the process of making stone tools by hitting a rock with an object. Because this process requires experience, the stone tools were flintknapped by another student here, Jon Baker.

Also, before the tanning process can actually begin, deer brains must be obtained. A hide needs to have some sort of oil-based substance rubbed into it to lubricate the fibrous structure of the skin. If this is not done, the hide will turn into stiff rawhide, like modern chew toys for dogs. Deer brain is used because it is likely to have been one of the most common substances used by prehistoric people. The brains, along with the hides, were obtained during the November deer-hunting season of 2000.

Once the tools are made and the brains are acquired, the dry-scrape process can begin. First, the hides are strung onto a rack by cutting holes along the edges of the hide and lacing it with a rope to a large wooden frame. The next step is to remove the flesh and fat from the inner, hairless side of the hide, using bone or stone scraping implements. Once this step is completed, the hide will be left to dry overnight. After it has completely dried, the hair and epidermis must be removed, again using bone or stone scraping implements. The goal of scraping both sides of the hide is to remove all tissue layers on either side of the dermis, the actual skin layer of the hide, so that the brains can penetrate the skin to soften it.

After the hair and epidermal layers are removed, the hide is ready to be brained. One deer brain contains enough oil to tan its own hide. The brain is put into a gallon of warm water and mashed to make a solution in which the hide is soaked. After the hide has been immersed in the solution several times, wringing the hide each time, it will be rung again and then stretched for several hours until the hide completely dries. The stretching can be done by hand with two people or by stretching the hide over something, such as a beam.

RESULTS

Review of Tools Used

The tools made for tanning the deer hides were similar in form and function to the tools found at archaeological sites in the Midwest where hide tanning was believed to have taken place. Both the stone and bone tool assemblages had the same types of tools; a blade or point to create holes along the hide and to cut the hide from the rack, and scrapers to remove the flesh, fat, and hair from the hides.

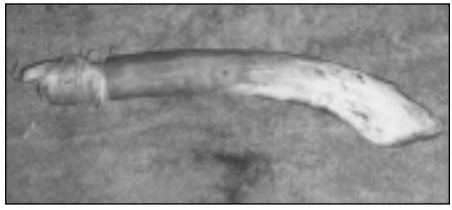

Figure 2: Hafted Hixton endscraper

Stone Tool Assemblage

The stone tool assemblage was made (by flintknapping) by a student from the archaeology department, Jon Baker. The endscrapers were flintknapped from chert and Hixton silicified sandstone. The scrapers were approximately 1-2 inches long and ?-1 inch wide. One of the scrapers, made of Hixton silicified sandstone, was fastened to a wood handle, approximately 7 inches long and ? inches in diameter, with sinew. Also, a modified flake knife was made from chert. It was used for making holes along the edges of the hide and also for cutting off the edges of the hide.

Bone Tool Assemblage

The bone tools were made from the leg and rib bones of adult white-tail deer, and were very similar to the stone tools used. The bone tool assemblage included a perforator made from the vertebral end of a right rib bone, for puncturing holes along the edges of the hide. The assemblage also included two bone scrapers, similar in size and shape to the stone scrapers, that were shaped using a grinder. One

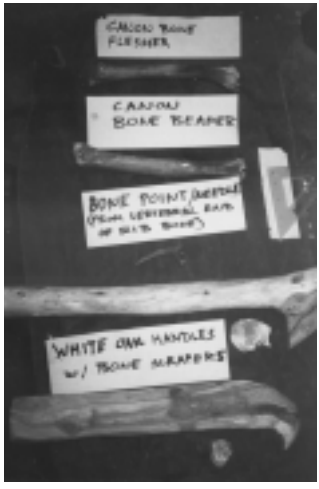

Figure 3: Bone tool assemblage

scraper was made from the distal end of the cannon bone, the other from the proximal (fatter) end of the ulna bone. Both scrapers were fastened to white oak wood handles with sinew (McPherson 1992, 1993). These tools are a common part of the archaeological record of the Midwest.

Two other bone tools were made that are not as common as the previously mentioned ones. A cannon bone beamer was made by hollowing out the shaft of the bone, creating two edges (Richards 1997). This tool was not used in the hide tanning experiments. The other tool was a cannon bone flesher, a tool more commonly found in the Plains, not in this portion of the Midwest. This tool was used during the hide tanning process, as it appeared to be a functional alternative to other scrapers as fleshing tools (Richards 1997, Riggs 1980).

THE TANNING PROCESS

The tanning process used here, suggested by McPherson (1992, 1993) and Riggs (1980), is known as the dry-scrape method. As opposed to the other primary way of brain tanning, the wet-scrape method, the dry-scrape method is very simple and less time consuming, with fewer materials needed. "Utilizing the methods we will be showing you here, it's really possible to shoot a deer first thing in the morning, and to wear that deer, a finished product of buckskin, that evening…"(McPherson 1992).

Major Differences between Wet-Scrape and Dry-Scrape

Both processes involve the removal of the fat, meat, hair, and epidermis from the hide, leaving only the dermis layer. The wet-scrape process can take up to three days to complete, with the extended periods of soaking the hide in water and wood ash solution (Ladd 1999, McPherson 1993). The dry-scrape method, as mentioned before, can be completed in one day, with the same end result, wearable, usable buckskin.

Ladd (1999) and Edholm and Wilder (2001) discuss the wet-scrape method in detail, and hypothesize that this method is much better for tanning thicker hides. When using this method, the resulting buckskin will be thicker and less breathable, better for winter clothing. In the dry-scrape method, some of the dermis layer can be lost from scraping too deep.

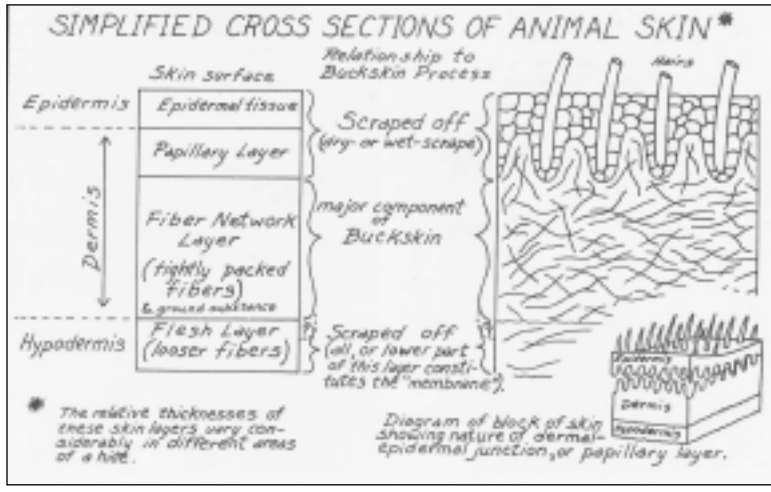

Figure 4: Cross-section of animal skin (Riggs 1980)

Because of this, the hides will be able to soak up brains easier and will soften easier. The result is more breathable, thinner buckskin, more suited for summer clothing. Also, the wet-scrape process can be done in virtually any weather, with the temperature above freezing. For the dry-scrape method to be accomplished in one day, relatively hot and dry weather is needed. However, even in less than ideal weather, the dry-scrape process will be less time consuming and require fewer materials than the wet-scrape method (Ladd 1999).

STEPS OF THE TANNING PROCESS

Both hides were from deer obtained during the 2000 hunting season, and were stored in a freezer for over a year. Freezing hides is one of many ways of storing fresh hides that will be tanned later. The hides, still frozen, were laid flesh side up on the ground in the center of a wooden rack, approximately 5 feet by 7 feet, made of two-by-fours screwed together. The frame could be made to varying sizes, not smaller than 2 feet by 4 feet for a standard hide.

After the hide has thawed somewhat and is soft and wet, it is ready to be laced to the wood frame. Beginning along the edges near the neck, puncture holes in the hide one inch from the edge and 3 to 5 inches apart, along the periphery of the hide. The perforator made of rib bone was used on one hide and the modified flake knife was used on the other. The rib perforator was much easier to puncture holes with because of the sharp point. A point is more easily obtainable when working bone rather than stone.

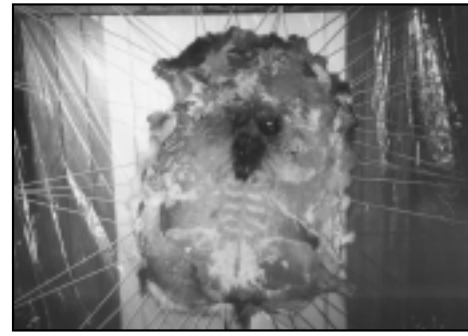

Figure 5: Green hide laced to rack

Next, the hide should be laced to the frame. Nylon rope, 1/8 inch thick, was used. Starting near the neck, the hide was laced to the frame, going through 2 to 3 holes each time before lacing the hide back to the frame. The hide was laced to the inside of the legs, as they will be cut off later. The lacing process does not take more than 10 to 20 minutes. It was faster and easier using the bone point.

Once the hide is laced fairly tightly to the frame, it is ready to be fleshed. This step is easier to accomplish while the hide is still wet or green.

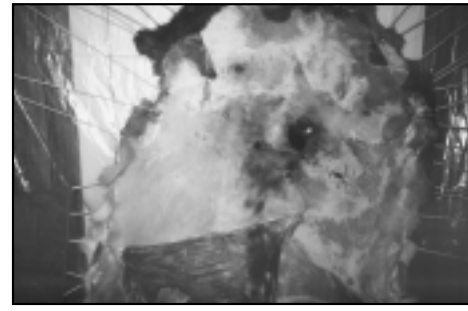

Figure 6: Hide partially fleshed.

Beginning at the top of the hide, near the neck area, the fat, flesh, and underlying membrane, or hypodermis, was removed with a downward scraping motion. For one hide, only the hafted bone scrapers and cannon bone flesher were used. The scraper made from the ulna bone was fairly effective in removing the flesh, as was the cannon bone flesher. When fleshing, a sharp edge is not needed; a dulled edge is actually more effective. For the other hide, only one scraper was used, the hafted Hixton sandstone scraper.

Both tool materials seemed equally as effective during the fleshing process, with the same investment of time. The bone tools did dull somewhat, but were still effective and did not require resharpening. Both hides, after fleshing, had the same appearance and texture, with no noticeable differences.

McPherson (1992) states that the fleshing stage should take no more than 1 hour. During this study, the fleshing stage took 2 to 3 hours for each hide, as a journal was kept and photos were taken of the process. However, this step easily could have been done in less than two hours.

After the hides were completely fleshed, they were allowed to dry overnight, still laced to the rack. After the hides completely dried, they were ready to be dehaired. The rack was flipped over to expose the hair side. As in fleshing, a scraping tool was used to scrape the hair and epidermis or grain layer from the hide. When using the wet-scrape method, the epidermis and dermis are more easily distinguishable, and thus the epidermis can be removed easier.

Figure 7: Completely fleshed hide

In the dry-scrape method, the color and texture difference between the epidermis and dermis is less distinguishable because the hides are dry. Therefore, more of the dermis was scraped away in trying to remove all of the epidermis. As in fleshing, the process was started in the upper neck area, just inside the laced edges of the hide. For the hide tanned with stone tools, the same hafted Hixton sandstone scraper was used for the entire dehairing process. Using this tool, the hide was completely dehaired with relative ease and in just a few hours. The stone scraper did not require resharpening at any point during the dehairing process.

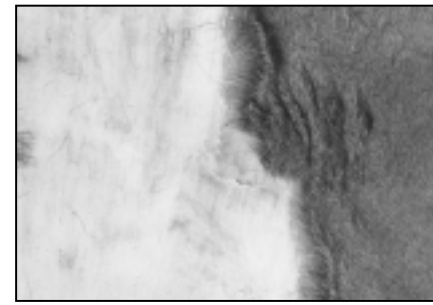

Figure 8: Close-up of epidermal layer (darker) and dermal layer (lighter)

The dehairing process using bone tools differed greatly. The hafted bone scrapers and cannon bone flesher were all used in dehairing the other hide. The cannon bone flesher, with a relatively dull edge, was ineffective. It dulled after only 3 or 4 strokes, and even after being resharpened, lasted only several strokes before dulling to the point of ineffectiveness. The hafted bone scrapers were more effective, as they had sharper working edges. These scrapers dulled quickly as well, however. Using the more effective scraper made from the ulna bone, it took approximately 45 minutes to remove the hair from a very small section, about 1/10th of the total hide area. After 45 minutes, the tool was very dull, with obvious loss of edge material. Constant resharpening is required when using bone scrapers for dehairing.

After attempting to dehair the hide completely using the hafted bone scraper made from the ulna, much of the epidermis remained on the hide. Even after several times resharpening the tool, the bone scraper still was not sharp enough to effectively remove the epidermis. In order to ready the hide for the next step in the tanning process, the epidermis had to be

removed. After having already noticed the obvious difference in the effectiveness of the tool materials for both hides, it was necessary to finish dehairing the hide with the hafted stone scraper.

The stone scraper was much sharper and held an edge much better. The small serrations on the working edge of the scraper created deep grooves in the hide. Many times the scraper removed epidermis and part of the dermal layer, thinning the hide. Also, it is easier to puncture holes in the hide by using too much force with the stone scraper, which is much less likely to happen with bone tools that are prone to rounding and dulling. Stone is still much more advantageous to bone in dehairing, however. The process takes at least 1/3 less time using stone scrapers. Also, the deep scores made allow oils from the brain to better penetrate the hide during the braining process (McPherson 1993).

McPherson (1992) states that the dehairing process should take between 1 to 2 hours. If only bone tools were used, the projected time would be closer to 5 or 6 hours. After the dehairing is complete, and as much of the grain or epidermis is removed as possible, both hides are cut off the rack, using the stone knife.

The next step in the tanning process is braining. As mentioned before, the purpose of braining is to let the oils of the brain soak into the hide to lubricate the fibers so that, when they dry, they do not stick together, but dry separated so that the hide is soft, pliable, and has elasticity. One deer brain is sufficient to tan its own hide the braining process for both hides was the same, with each hide being soaked in a brain and water solution for 15 to 20 minutes, then wrung and stretched for approximately 45 minutes to one hour. This process was repeated three times for each hide. At a minimum, a hide needs to soak in a brain solution for 15 to 20 minutes. A hide can never be over-brained, therefore, for this experiment, the hides were soaked longer to ensure that the oils penetrated the hides.

Figure 9: Brain in 1/2 gallon of warm water

Figure 10: Hide soaking in brain solution

During the braining process, as the hide is soaking in the solution, the colors of the hide change, making it easy to distinguish the dermal layer from any remaining epidermis. It was clear that on both hides, some epidermis still remained, specifically on the middle or back section of the hide.

Once the hide has been wrung the final time, it is ready to be stretched. The stretching was done by hand for both hides. The only difference between stretching the two hides was that one, tanned with bone tools, was stretched by two people pulling in opposite directions, while the other hide, tanned with stone tools, was stretched by just one person. When stretching, take hold of the hide by the edges and pull in opposite directions. Also, the edges need to be worked, as they are the first to dry and harden if the fibers are not kept moving. The

point of stretching is to keep the hide soft and stretched while it dries, otherwise it will dry hard and turn into rawhide instead of wearable buckskin (McPherson 1992, 1993).

Stretching must be done until the hide is completely dry. This may take several hours, depending on the relative humidity of the environment the hide is being tanned in. Here, the two hides were stretched for approximately 3 hours. Stretching can take as little as 45 minutes of work, if done in a drier, less humid environment (McPherson 1992). The hide is dry when there is elasticity to it. This step of the tanning process is the most physically demanding and the most time consuming, and is also very important.

RESULTING HIDES

The resulting hides differed greatly from one another in softness and texture. The flesh sides of both hides are very similar in appearance and texture. Both stone and bone tools were equally as effective in removing the fat, flesh, and hypodermis.

The hair side of both hides differed. The hide worked predominantly with stone tools still had much of the epidermal layer left on. This can be detected by the feel of the hide; it has a coarse, almost sandpaper texture. This is the grain layer. This texture is detectable throughout the hide, except on the sides or the belly, where the epidermal layer was thinner and easier to remove. The hide worked predominantly with bone tools also retained much of the epidermal layer, but only in the middle of the back, around the bottom rump area of the hide, and also around the upper neck area. Small ridges of epidermal layer can clearly be seen in these areas. The belly or sides of the hide are the softest areas. This difference can be attributed to the fact that the hide worked with bone tools was reworked again with the hafted stone scraper, in trying to prepare the hide effectively for braining.

From the beginning of the dehairing process, it was obvious that stone was a much better tool material than bone. Stone is harder, can hold an edge better, and does not round or dull as easily as bone when used for scraping. Because this hide was worked with both stone and bone tools, more epidermis was removed.

Another easily observable difference between the two resulting hides is the overall softness. The hide tanned with stone tools is much harder and more rigid. The other hide, tanned with bone tools, is much softer, flexible, and more elastic. Along the back, neck, and some of the bottom or rump area, it is relatively stiff. The rest of the hide is soft and cloth-like.

This difference in softness, and consequently in effectiveness as clothing, can be attributed to two factors. First, the stiffness seems to be restricted to those areas of the hide that still have epidermis. The hide tanned with stone tools appeared to have epidermis over the majority of the hide, except in small areas on the sides or belly. This hide was also predominantly stiff all over. The other hide, much less rigid, was stiff only in those areas with remaining epidermis as well. The presence of epidermis prohibits oil from fully penetrating the hide, therefor, those areas with epidermis do not soften as much while drying.

The second factor is the difference in how the two hides were stretched. Although both hides were stretched for approximately the same time, two people stretched the one tanned with bone tools, while only one person stretched the other. The efforts of two people can keep the fibers of the dermis moving much easier and more constant while the hide dries than one person can.

Another difference between the two hides is the presence or absence of holes. Holes were made on the hide tanned with bone tools, located on the thinner sides or belly of the hide, and along the very bottom. These were made by the hafted stone scraper, when the dehairing

process was being repeated to prepare the hide for braining. These areas of the hide are relatively the thinnest areas of the dermal and epidermal layers. In scraping away the epidermis, it is relatively easy to scrape through to the dermis and puncture holes. The holes were not created by any of the bone tools, as they were too soft to hold an edge sharp enough to create a hole.

EFFECTS ON THE TOOLS

The efficiency of the tool material can somewhat be detected by examining the use-wear patterns of the tools themselves. A comparison of such characteristics as overall loss of tool material and rounding or smoothing of the working edges or points can indicate which tool material is more appropriate for the hide tanning process.

Bone Tools

The bone tools, including the rib perforator, cannon bone flesher, and both hafted bone scrapers, were examined under a microscope. The larger hafted scraper, made form the proximal end of the ulna bone, showed severe rounding of the working edge, as well as a high degree of polish. There was also significant material loss of some areas of the working edge, indicated by pitting and also portions of broken edge where pieces were obviously missing. Some very small striations were also visible.

The smaller hafted scraper, made from the distal end of the cannon bone, showed very similar affects of use. There was significant rounding of the working edge as well as material loss. Because the working edge of this scraper had only a very thin layer of compact bone covering the inner, cancelous bone, there was much more material loss. The working edge was very weak. The working edge of the cannon bone flesher was very similar to the smaller scraper in that it was formed of mainly cancelous bone. Therefore, it showed the same wear pattern and extent of edge loss and rounding as the smaller scraper.

The rib perforator used in the hide tanning process of one of the hides was also examined under a microscope. First, the rib perforator was examined, followed by an unmodified white-tail deer rib bone to determine if the marks noticed on one were present on the other. The rib perforator exhibits numerous, fairly deep striations running parallel to the axis of the tool (towards the point), not shown on the unmodified rib. Also, rounding and smoothing of the surface and edges of the tool is observable. The polish of the tool is somewhat matted, but is still visible. This tool proved to be durable, with the point exhibiting almost no material loss or pitting.

Stone Tools

The stone tools were also examined under a microscope. The Hixton sandstone scraper, used for both the fleshing and dehairing stages on one of the hides, showed no material loss, with little polish observable. Some small striations and pits were noted. These traits are all characteristic of hide working (Hayden 1979).

The chert knife was also examined. It showed even less polish than the Hixton scraper. There was little rounding of the edges, restricted to around the point of the tool. There was no material loss, only slight smoothing and rounding.

The use-wear analysis here indicated the bone tools used for scraping were fairly inadequate when compared to the hafted stone end scraper. Significant loss of material, as well as severe rounding, indicate the bone scraping tools to be relatively ineffective. If used for an

entire hide, the bone tools would require constant remodification. The chert knife and rib perforator both proved to be durable tools; however, the rib perforator was a much more effective tool in puncturing holes in the hide (Bonnichsen and Sorg 1989, Semenov 1964).

CONCLUSIONS

Tool Material Efficiency in the Tanning Process

After tanning two hides with bone and stone, and comparing the resulting hides and use-wear of the tools involved, clear advantages and disadvantages to both materials can be seen. Certain tools were more effective for specific aspects of the tanning process.

Bone

The bone tools used here, aside from the rib perforator, were not effective when compared to the stone tools. The material for scraping tools needs to be relatively hard and durable, and must be able to hold an edge. The bone scrapers used here required constant resharpening to be effective. They showed significantly more edge rounding and material loss than the stone end scrapers.

The only bone tool that was effective was the rib perforator. Bone can be sharpened to a point much easier than stone can. Also, the bone point proved to be as durable as the chert knife, able to puncture numerous holes into a fresh hide without any significant material loss. This study shows that bone was the most likely used tool material for puncturing holes along the periphery of the hide, so it can be laced to a frame for fleshing and dehairing. Aside from this function of puncturing, however, bone serves little use as a tool material for hide brain-tanning.

Stone

The stone tools used here, one hafted Hixton sandstone endscraper and one modified chert flake knife, proved to be efficient in the hide tanning process. The hafted stone endscraper was used for both fleshing and dehairing one of the hides. Both steps of the tanning process took relatively little time and were fairly easy using the stone endscraper. Upon examination, the scraper appears to exhibit slight rounding of the working edge and some polish, with little material loss. Overall, the hafted stone endscraper was a very efficient tool for hide brain-tanning. It can be concluded that stone was the likely tool material for the fleshing and dehairing stages of hide brain tanning, using the dry-scrape method.

The modified chert flake knife, used for cutting hides from the frame and for puncturing holes along the edges of the hide, was not efficient as a perforator. It was much more difficult to puncture holes in a green hide with a flake knife with no point than with a pointed rib perforator.

TOOLS IN THE ARCHAEOLOGICAL RECORD

The conclusions drawn from this study on the most likely used tool material for specific aspects of the tanning process are supported by evidence form the archaeological record. Within the Midwest, artifacts believed to be associated with hide tanning support the conclusions drawn here; that the tools used for the scraping stages (fleshing and dehairing) were most likely made of stone and the tools used for puncturing holes in the hide (for lacing to a rack, sewing holes, sewing hides together for clothing,) were most likely made of bone.

From numerous prehistoric sites across the Midwest, many stone endscrapers have been found. Along with woodworking, hide tanning is believed to be one of the most common

activities associated with endscrapers. In contrast, very few scrapers made from bone have been found (aside from cannon bone beamers used in the wet-scrape method of hide brain-tanning). Few bone artifacts that do resemble scrapers exhibit indications of use in hide tanning.

Numerous bone points and awls believed to have been associated with hide working (through use-wear analysis) have been found at prehistoric sites throughout the Midwest. Few stone points (from a knife or projectile point) have been found with the characteristic markings of hide working.

Gottschall Rockshelter (47Ia80)

Very little has been done in use-wear analyses of bone, antler, and ivory artifacts. To better understand the micromorphological traits of a bone artifact characteristic of hide tanning, a brief use-wear analysis was done. Using a microscope, the rib perforator used in this study was examined, along with several bone awls and perforators from the bone tool assemblage from the Gottschall Rockshelter, located in southwestern Wisconsin, located near the lower Wisconsin River in Iowa County, Wisconsin. The site has occupational periods beginning around AD 300 and continuing to the 19th century.

There is an abundance of white-tail deer remains from the site, as well as numerous tools believed to be associated with hide tanning.

Nine awls/perforators were chosen from examination from over 40 bone awls and perforators found at the site. These nine awls/perforators were selected for closer examination from the assemblage because, they possessed certain qualities; some polish, a fairly sharp point, and a durable appearance and feel. Also, they were chosen because they could be held comfortably in the hand. A perforator used to make holes in a green hide must be able to withstand pressure that an individual must put on it to create the hole. Therefor, the tool must either be able to be held in a fist, or must have a solid non-working end opposite the point to put force behind. The remaining part of the assemblage from Gottschall either were not large enough to be held comfortably, thus resembling more a bone needle, or did not narrow to create an effective point capable of penetrating a green hide. A review of the use-wear analysis of the rib perforator and the nine bone awls/perforators from the site is given in Appendix A.

Overall, the rib perforator and bone awls/perforators from the site possessed very similar characteristics, all indicative of hide tanning. The tools had a similar degree of polish, more matted, which is characteristic of hide tanning. Also associated with hide working, found on these tools, were striations, longitudinal to the axis of the tool. The surfaces of all the tools were fairly smoothed and rounded, which is characteristic of use on a softer material, such as hides (Bonnichsen and Sorg 1989, Semenov 1964).

The use-wear analysis of the bone tools here presents a clearer picture of the morphological characteristics on artifacts that indicate hide tanning. The similarities existing between the tools supports the conclusion that the tool material used for specific aspects of the tanning process was the most likely tool material for this form of hide working in prehistoric Midwest.

HIDE BRAIN-TANNING: DRY-SCRAPE METHOD

This study also shows that the dry-scrape process of hide brain-tanning was a likely method of producing buckskin for native populations of the Midwest. If done by experienced individuals, this process requires few materials and can be done in a matter of hours, depending on the temperature and humidity (McPherson 1992, 1993). The most likely used tools for this process are found frequently throughout the Midwest.

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Appendix A

Use-wear Analysis: Gottschall Rockshelter

Little has been done on the use-wear analysis of bone, ivory, and antler material tools. In order to fully understand the micromorphological markers on culturally modified bone, Gilbert (1980) suggests experimental research in block design. In this way, the actions responsible for specific micromorphological features can be narrowed to specific input variables. Because this study focused on the effectiveness of tool material in hide tanning and not specific tool form and function, experimental research in block design was unnecessary and too time consuming, thus the use-wear analysis is presented here in this form.

Rib Perforator (Used here)

The rib perforator was examined under a microscope. Evidence of use-wear modification includes "…polish, rounding, smoothing, and microflaking of fracture edges and surfaces."(Lyman 1994). First, the rib perforator was examined, then an unmodified deer rib bone was examined to differentiate between natural marks and marks made from use.

The rib perforator exhibits numerous deep striations running parallel to the axis of the tool, not shown by the unmodified rib. The striations are rough at the bottom, some contain a lighter substance resembling deer remains. Deeper, longer striations are found at the point of the tool, also running parallel. Rounding and smoothing of the surface and edges of the tool is also observable. The surface around the striations is smoothed with a slight polish, which contrasts with the bottom of the striations. The polish of the tool is matted, but visible, and is mostly observable toward the point, but is still discernable at the handle of the tool.

Bone Awl/Perforator G2625 (S23W13)

This tool appears to be made from the splinter of a long bone (leg bone) of a deer. It exhibits a higher degree of polish and smoothing than the rib perforator, with a very smooth surface. The surface has many striations, with longer, deeper ones running perpendicular to the direction of the tool point, suggesting this tool may have been used in a twisting fashion. There are deeper cut marks or striations on the inner side of the shaft of the tool. The tool has retained a sharp point and is approximately the same width as the rib perforator. This artifact exhibits rounding on nearly every edge. The striations furthest from the point at the opposite end appear to be running parallel to the axis of the tool, as in the rib perforator.

Bone Awl/Perforator G2619 (S19W17)

This tool is an awl made form a deer ulna. It exhibits a higher amount of polish and signs of long-term use. It has a carefully refined point, and can be held onto or grasped by the flat-

ter, broad proximal end of the ulna, which has been modified at the top by cutting it flat, revealing the inner cancelous tissue, which is slightly smoothed. The tool is covered with marks and striations, yet it has no pits. None of the striations are deep, although the entire surface is varied. Severe rounding and smoothing of the surface is detectable, as even the bottom of the striations exhibit some polish. This could also be and indicator of long-term use. Near the tip or point, there are little to no striations or deep marks (the only are of the tool like this). The tip is whiter and more polished. The striations mostly run parallel to the axis of the tool.

Bone awl/perforator G2735 (S22W19)

This awl was made from the splinter of a long bone. It exhibits polish, more concentrated on the last one-inch of the tip or point. The tool is fairly straight and has a similar width to the rib perforator, a desired hole width. It has a fairly sharp point and is of durable bone. Much deeper, more consistent longitudinal striations exist on one side of the tool, which is most likely from tool shaping, since they are restricted to one side. Very small longitudinal striations are visible around the point. No edge of the tool is rounded except the last one-inch of the tip, where the striations, polish, and edge rounding occurs. The rest of the tool, the shaft, is much less rounded. These marks, similar to the rib perforator, could indicate use as a hole-punch. The very tip of the tool is broken, possible in trying to resharpen the tip.

Bone awl/perforator G2624 (S22W13)

This awl perforator was also made from a splinter of long bone. The tool includes an articular surface on the end opposite the point that appears to be a comfortable platform for gripping. Numerous striations are visible on the tool, all running longitudinal to the tool, and with varying depth. Polish and edge rounding are most visible the last one-inch of the tool point, which is very sharp. The tool width is approximately equal to the rib perforator. This tool exhibits much the same marks as the previous tool.

Bone awl/perforator G2621 (S24W16)

This tool is a very light, seemingly fragile, possible made from a rib bone or a bone of similar density. There is a very high degree of polish and edge rounding or smoothing throughout the tool. A sharp point is still in tact. Some longitudinal striations are visible, as are some perpendicular striations along one side of the tool, possible shaping or retouch marks. The high degree of polish may indicate long-term use. Also supporting this is the fact that there is a drill hole in the handle opposite the point, which indicates that the tool was valued.

Bone awl/perforator G2614 (S22W13)

This tool is one of the smaller perforators examined from Gottschall. Also made from lighter, more fragile bone, as the previous tool was, this tool also has a sharp point. Obvious shaping marks can be detected. Also, the edges have been rounded and the surface is smoothed. There is some more matted polish on the tool, but mostly around the tip, or last one-inch of the tool. Some small striations can be seen, running along the point of the tool only. Overall, this tool seems too brittle. It could have been used for buckskin repair, for sewing or some less stressful activity than working a green hide.

Bone awl/perforator G2626

This smaller perforator or awl was made from a more dense splinter of long bone. It has a durable, sharp tip that widens to slightly smaller width than the rib perforator. Polish, which can be seen all over the tool, is more visible on the tip, with a line between the more polished tip and less polished handle or shaft of the tool visible. The edges are more round and smooth throughout the polished tip area. Longitudinal striations are visible, and are concentrated around the tip.

Bone awl/perforator G2623

This tool could be an expedient awl/perforator made from a splinter of long bone. The very tip of the tool is broken off, with no sign of reworking or remodification. There is a very matted polish on the tool, and few striations were found, mostly around the point.

Appendix B

Buckskin: Finished Hides

The importance of tanned hides for clothing to ancient native populations was addressed in a paper by Richard Gramly entitled Deerskins and Hunting Territories: Competition for a Scarce Resource of the Northeastern Woodlands (1977). In it, Gramly discusses the apparent rise in conflict in the cultures of the Northeast Woodlands of the U.S. by the Late Woodland stage, around AD 1000. Numerous hypotheses have been formed in response to this.

One hypothesis, which Gramly supports in his paper, for the rise in conflict is the need for enough animals to provide adequate hides for clothing for the harsh winters. White-tailed deer were the only animal with sufficient population density and adequate hides in the Northeast Woodlands. Gramly argues that, through the competition for hunting territories, the availability of deer hides, as opposed to sufficient protein or land, indirectly affected the rate of population growth among the native cultures.

If a deerskin suit of clothing lasted on the average two years, an adult male would need two to three hides per year to be clothed, and one hide a year for moccasins. With this in mind, Gramly calculated that the entire Huron population of 18,000 individuals would require 62,000 hides each year to be completely clothed. This is a tremendous demand to satisfy, and could definitely lead to conflict over the better hunting territories (Gramly 1977).

Figure 11 (Riggs 1980)

Having established the importance of deer hides, several patterns or methods of making cloth-

ing from deer hides are given. The patterns given do not reflect a specific culture. The diagrams were taken from several sources used in this study that were more instructional in nature, not specific to a culture. However, these were the most detailed descriptions of making deerskin clothing, and therefore were included.

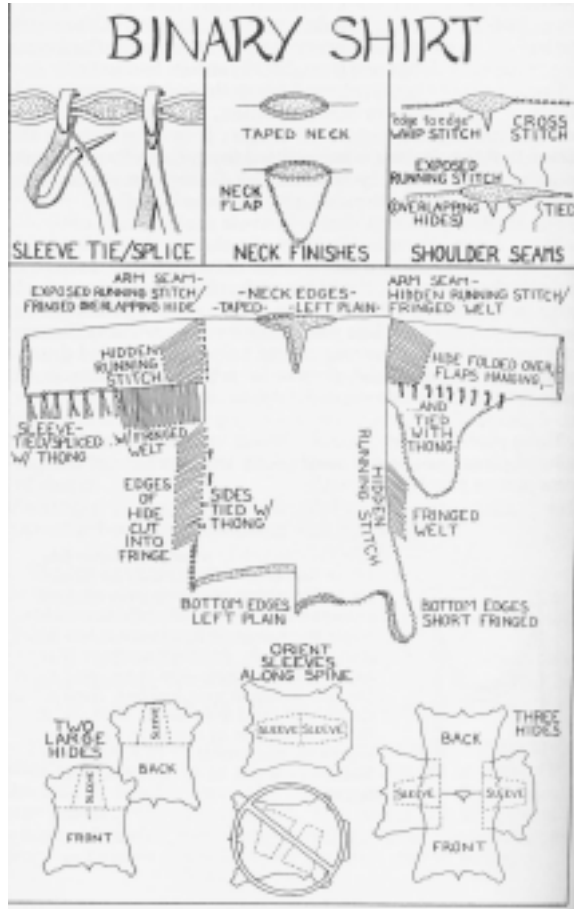

Figure 12 (Edholm and Wilder 2001)

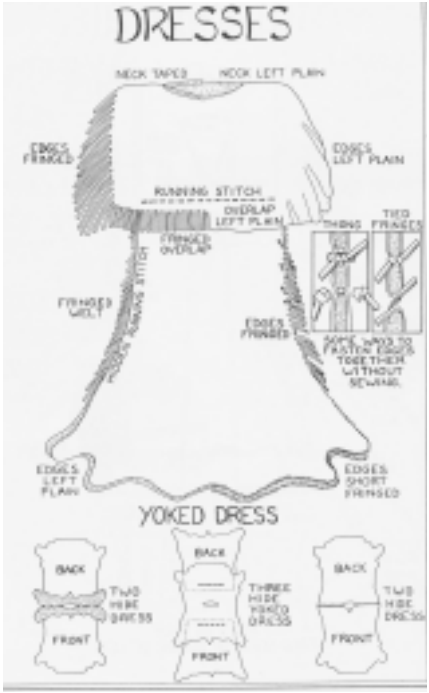

Figure 13 (Edholm and Wilder 2001)

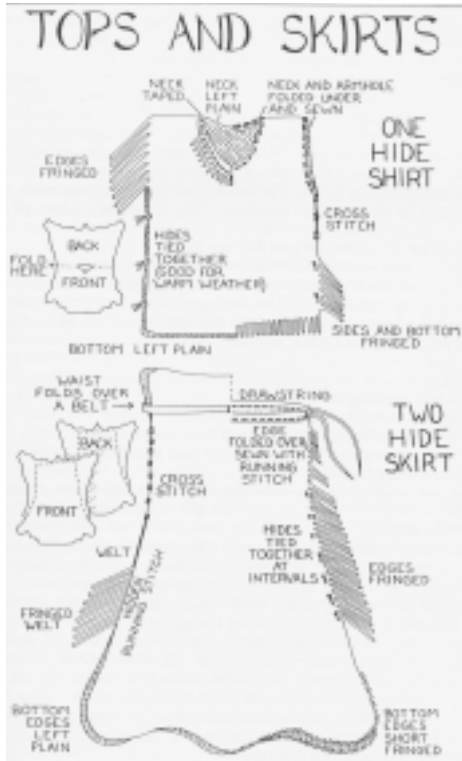

Figure 14 (Edholm and Wilder 2001)