Missing the Point: Identifying Perishable Projectiles in the Archaeological Record from Bone Damage

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Missing the Point:
Identifying Perishable Projectiles in the Archeological Record From Bone Damage

Sara R. Wingert
Kutztown University of Pennsylvania
Abstract
For decades, archaeologists have used replicative studies to develop a better understanding of prehistoric technology. Many replicative studies have focused on the manufacture and use of stone projectiles, resulting in a detailed understanding of the design of hunting weapons in relation to various features of the environment and, in turn, elegant explanations for technological change over time. Yet if ethnographic accounts are any indication, lithic technology was only one (perhaps minor) part of many prehistoric technological systems. It is likely, then, that the technological changes archaeologists commonly document through their morphometric analysis of stone projectile points occurred against a backdrop of perishable technologies often not represented in the archaeological record. Here, I report on a replicative experiment designed to investigate whether archaeologists can “see” perishable projectiles in the archaeological record based on the damage they inflict on animal bones. Specifically, I examine if wood-tipped, fire-hardened, and stone-tipped arrows produce distinctive damage signatures. I use the results of my study to re-examine explanations offered to account for the transition from the dart to the bow and arrow in eastern North America.

INTRODUCTION
For decades, archaeologists have used replicative studies and experiments to help them better understand prehistoric technologies, behaviors, and culture (Coles 1966). By making copies of prehistoric technologies, an archaeologist can gain insight into how these items were made and used in ancient times. Experiments with replicated technologies often yield clues, including the otherwise incomprehensible marks they make during use (e.g., cuts, scrapes, and abrasions), which aid in understanding their role in past societies. By helping archaeologists understand how prehistoric technologies were made and used, replicative studies also help archaeologists develop explanations for technological change.

Given their abundance in the archaeological record, many archaeologists focus on stone tools. Yet ethnographic data indicates that perishable technologies, including wooden points, were probably important components of past hunting technologies (Oswalt 1976). Furthermore, a growing body of experimental evidence demonstrates that a stone-tipped projectile is not
necessarily better than a wood-tipped projectile. By experimenting with wooden spears on lamb carcasses, Smith (2003) found that wooden spears are very durable and they withstood more than 40 direct hits on bone. Additionally, Waguespack and colleagues (2009) found that, while stone projectile points penetrated a ballistics gel target to a greater depth than wood-tipped points, both types of weaponry penetrated deeply enough to dispatch prey. Similarly, Holmberg (1994) found that wooden arrows penetrated moose, pig, and straw targets and survived multiple shots better than stone-tipped arrows.

In the absence of remarkable preservation, our challenge is how to identify the use of wooden arrows in the archaeological record. Here, I describe a replicative experiment designed to investigate whether we can "see" perishable projectiles in the archaeological record based on the damage they inflict on animal bones. In this experiment, I fired wooden, fire-hardened, and stone-tipped arrows into deer ribcages and ballistics gel targets containing deer ribs to see if these arrows left distinctive damage signatures when impacting the bone. I found that stone-tipped arrows produce more extensive damage on impact than wood-tipped or fire-hardened arrows. Still, the bone damage produced by these perishable projectiles may be sufficiently distinctive for their recognition in the archaeological record. These results are useful only if the bone damage is distinct from bone damage caused by other taphonomic agents (e.g., bear, fox). My analysis suggests that the bone damage caused by stone-tipped and fire-hardened arrows is distinct from the damage inflicted by other taphonomic agents. Thus, my experiment demonstrates that we can "see" the use of perishable projectiles in the archaeological record by the damage they leave on impacted bone. Future research might look for these damage signatures in faunal assemblages from North America. If perishable points are important components of
prehistoric toolkits, then we may need to revisit current explanations for the adoption of the bow and arrow.

EXPERIMENTAL DESIGN

Methods

To inform my replication, I researched the bows and arrows used by a sample of Native Americans from across North America (n = 34). These tribes represented several different culture areas: Artic/Subarctic (n = 9), Eastern Woodlands (n = 2), Northwest Coast and California (n = 10), Plains/Interior Plateau (n = 8), and the Southwest/Great Basin (n = 5). A complete list of the subject groups and their materials are shown in Table 1.

Materials

Based on my ethnographic survey, I made bows from ash with braided imitation sinew (substituting for animal sinew) for the bow string (Figure 1). There was a great variety of bow styles used in North America by Native Americans (Bohr 2006). In order to narrow the selection, I focused on the Eastern Woodlands, where the most popular bow style was a flat bow. A flat bow is simply a bow made out of one piece of wood. It has a rectangular cross-section and is flat on its belly and back, giving the bow its name (Hamm 2007). Unfortunately, other pertinent ethnographic information on Native American cultures of the Eastern Woodlands is scarce. Many eastern Native Americans were quickly displaced or changed post-contact (Hamm 2007). As a result, specific descriptions of the technologies eastern Native Americans used before European contact are uncommon. The little ethnographic information on Native Americans from
<table>
<thead>
<tr>
<th>Group</th>
<th>Bow Materials</th>
<th>Arrow Materials</th>
<th>Fletching</th>
<th>Glue</th>
<th>Bow String</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aleut</td>
<td>Yellow Cedar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assiniboine</td>
<td>Cherry</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blackfoot</td>
<td>Ash, Choke-cherry, Hazel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinookans</td>
<td>White Cedar</td>
<td>Yew</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Chipewyan</td>
<td>Willow, Birch</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comanche</td>
<td>Osage Orange, Ash</td>
<td>Dogwood</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper Inuit</td>
<td>Spruce, Antler, Musk, Oxen Horn</td>
<td></td>
<td>Owl, Loon, Eagle</td>
<td></td>
<td>Sinew</td>
</tr>
<tr>
<td>Crow</td>
<td>Hickory, Ash, Cedar, Elk Horn</td>
<td></td>
<td></td>
<td></td>
<td>Boiled Buffalo</td>
</tr>
<tr>
<td>Gros Ventre</td>
<td>Cherrywood, Ash</td>
<td></td>
<td></td>
<td></td>
<td>Boiled Buffalo</td>
</tr>
<tr>
<td>Ingalik</td>
<td>Spruce</td>
<td></td>
<td></td>
<td></td>
<td>Hawk</td>
</tr>
<tr>
<td>Innu</td>
<td>Spruce</td>
<td>Birch, White Spruce</td>
<td></td>
<td></td>
<td>Leather</td>
</tr>
<tr>
<td>Kaska</td>
<td>Birch, Willow</td>
<td>Birch, Willow</td>
<td>Owl, Eagle</td>
<td>Sinew, Babiche</td>
<td></td>
</tr>
<tr>
<td>Klamath</td>
<td>Yew, Juniper</td>
<td>Serviceberry</td>
<td>Eagle, Mousebird, Chicken, Hawk</td>
<td>Sinew</td>
<td></td>
</tr>
<tr>
<td>Maricopa</td>
<td>Willow</td>
<td>Reed</td>
<td>Hawk, Buzzard, Crow, Eagle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mescalero Apache</td>
<td>Oak (toys), Juniper (low quality)</td>
<td>Apache Plume</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mi'kmaq</td>
<td>Maple</td>
<td>Cedar</td>
<td></td>
<td>Eagle</td>
<td></td>
</tr>
<tr>
<td>Nau-chah-nulth</td>
<td>Yew</td>
<td>Cedar</td>
<td>Duck, Gull, Eagle</td>
<td>Sinew</td>
<td></td>
</tr>
<tr>
<td>Northern Paiute</td>
<td>Oak, Juniper</td>
<td>Rose, Current, Serviceberry, Cat-tail</td>
<td>Hawk, Owl, Sagehen, Eagle, Goose, Woodpecker</td>
<td>Two-ply Sinew</td>
<td></td>
</tr>
</tbody>
</table>
Table 1. Native American groups and their bow and arrow materials.

<table>
<thead>
<tr>
<th>Group</th>
<th>Bow</th>
<th>Arrow</th>
<th>Fletching</th>
<th>Glue</th>
<th>Bow String</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ojibwa</td>
<td>Hickory, Ash</td>
<td>June Berry Bush</td>
<td>Eagle, Hawk</td>
<td>Sinew</td>
<td>Nettle Stock, Snapping Turtle Sinew</td>
</tr>
<tr>
<td>Omaha</td>
<td>Ash, Elm, Iron Wood</td>
<td>Dogwood, Ash</td>
<td></td>
<td></td>
<td>Sinew</td>
</tr>
<tr>
<td>Pawnee</td>
<td>Ash</td>
<td>Dogwood</td>
<td></td>
<td></td>
<td>Sinew</td>
</tr>
<tr>
<td>Pomo</td>
<td>Wild Nutmeg, Mountain Mahogany, Yew</td>
<td>Dogwood, Mountain Mahogany, Willow</td>
<td></td>
<td>Sinew</td>
<td>Sinew</td>
</tr>
<tr>
<td>Quinault</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sioux</td>
<td>Ash</td>
<td>Gooseberry, Cherry, June Berry</td>
<td>Turkey Buzzard, Turkey</td>
<td>Sinew</td>
<td>Sinew</td>
</tr>
<tr>
<td>Tlingit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Seal Hide, Sinew</td>
</tr>
<tr>
<td>Tubatulabal</td>
<td>Willow</td>
<td>Cane</td>
<td></td>
<td></td>
<td>Sinew</td>
</tr>
<tr>
<td>Ute</td>
<td></td>
<td>Serviceberry, Hardwoods</td>
<td>Magpie, Eagle, Hawk, Owl</td>
<td></td>
<td>Sinew</td>
</tr>
<tr>
<td>Western Apache</td>
<td>Muhlberry, Ash, Juniper, Willow, Walnut, Black Locust</td>
<td>Reed</td>
<td>Hawk, Turkey</td>
<td>Sinew</td>
<td>Sinew</td>
</tr>
<tr>
<td>Winnebego/Ho-Chunk</td>
<td></td>
<td>Hickory</td>
<td></td>
<td></td>
<td>Sinew</td>
</tr>
<tr>
<td>Yokuts</td>
<td>Juniper, Laurel, Bay Wood</td>
<td>Cane</td>
<td>Hawk</td>
<td></td>
<td>Sinew</td>
</tr>
<tr>
<td>Yuki</td>
<td>Mahogany, Briar Berry, Dogwood, Yew Wood</td>
<td>Elderberry, Dogwood</td>
<td>Eagle, Yellowhammer</td>
<td>Deer Sinew</td>
<td>Sinew</td>
</tr>
<tr>
<td>Yurok</td>
<td>Redwood Bough</td>
<td>Redberry Bush</td>
<td>Hawk, Falcon</td>
<td>Stag Sinew</td>
<td>Sinew</td>
</tr>
</tbody>
</table>
the Eastern Woodlands indicates that flat bows varied in length from 3-6 feet (0.91-1.83 meters), with length varying in relation to the size of the archer (Bohr 2014; Hamm 2007). Some Native Americans used height to the archer’s waist as a reference for bow size (Hassrick 1964). Others used the length from the point of the shoulder across the chest to the end of the middle finger of the opposite hand as a reference for the sizing (Densmore 1929).

I found that ash was a common material used for bows. I acquired a 10 ft., green ash wood tree log, from which I made four flat bows. Since there is such a range for the size of flat bows, I made bows of four different sizes, varying from 3 to 6 feet in length. I favored the smaller bows because they better fit my height (5.25 ft; 1.6 m). Regrettably, since I am not an expert bow craftsman, my 6 ft. bow split while drying. The 3 ft. bow was also destroyed part way through the manufacturing process when it was cut too thin with a band saw. I used a variety of other modern tools (e.g., band saw, table saw, hand saw, chain saw) to cut the wood for the bow to the appropriate size and shape. Additionally, I used sanders and sand paper to smooth out the
surface of the bows. Some methods I used, however, were more similar to the methods of Native Americans. After the outlines were cut, I used a drawknife to help shape the bows. I completed two full bows (Fig. 1). I used imitation sinew (substituting for animal sinew) for the bow string. I weaved the bow strings by hand using a reverse-wrap weaving technique (Hamm 2007). The finished bows measured 3.5 (1.07 m) and 3.8 feet (1.16 m) in length with a draw weight of ~40 lbs. (18.1 kg) and draw length of 24 inches (0.61 m). Unfortunately, one replicated bow broke early in the experiment, so I used a fiberglass recurve bow with a draw weight of 25 lbs. (11.3 kg) and draw length of 26 inches (0.66 m) for the duration of the experiment.

I constructed the arrows using dogwood for the shafts, red hawk feathers for the fletching, and wood glue (substituting for hide glue). I used a draw knife to remove the bark from the arrow shafts. To straighten the arrows, I used steam from a boiling pot of water to add flexibility and used my knee to manipulate its shape. I placed the shaft under my knee cap and applied pressure to each end of the shaft that was not in contact with my body, bending it in the opposite direction of the bend in the shaft. I started out with approximately 30 dogwood branches and ended up with 11 useable arrow shafts. The arrow shafts measured approximately 24 inches (0.61 m) in length and 0.375 inches (10 mm) in diameter. I used three sets of arrows in my experiments: sharpened, wood-tipped (n=3) (Fig. 2); fire-hardened (n=4) (Fig. 3); and stone-tipped arrows (n=4) (Fig. 4). I used a pocket knife to sharpen the points on the wooden and fire-hardened arrows and I used a fire, created in a wood stove, to make the fire-hardened points. The stone points used were small, triangular points made of chert. The points were bought online from an experienced flintknapper, and are replicas of the triangular arrow points commonly used by Native Americans of the Eastern Woodlands.
Figure 2. Wooden arrows. Scale = 0.5 m.

Figure 3. Fire-hardened arrows. Scale = 0.5 m
For the targets, I used white-tailed deer ribs ($n = 5$) and hide ($n = 2$). I chose white-tailed deer because they are the main large game animal in the Northeastern Woodlands and were regularly hunted for thousands of years. I used rib cages because the trunk of a deer has the largest surface area on the animal and ribs are, therefore, a likely spot to be hit by a hunter. I collected them from various hunters during hunting season. I then cleaned, salted, and froze them in preparation for the experiment. I carefully recorded preexisting marks on the ribcages (e.g., arrow and bullet holes). For Experiment 1, I used hay bales to lift the rib cage to a height consistent with the height of a deer. For Experiment 2, I used a wooden structure to stabilize shots at ballistics gel molds made of Knox gelatin that contained four ribs.
THE EXPERIMENTS

Experiment 1

I conducted two versions of the experiment. For the first experiment, I obtained permission from the Pennsylvania German Cultural Heritage Center to conduct my experiment on their grounds. This spot is away from main campus and provides enough open ground to carry out the experiment. I shot arrows into the rib cages of white-tailed deer covered in hide from a distances of 15 ft (4.6 m) and 7.5 ft (2.3 m). For the experiment, I set up a target bag on hay bales and then laid the ribs and hide over the front. This raised the target high enough to represent a live deer, thereby duplicating the angle of an arrow shot at deer in the wild. Even though there were some confirmed hits, not many damage marks were left on the bones. Many of the stone arrows shot ricocheted off of the hide, without creating damage on the rib cage. Table 2 shows the arrows that hit and their location.

Experiment 2

To ensure impact with bones, I conducted a second experiment in which I shot arrows into ballistics gel targets that contained the deer ribs from a distance of 2 feet (0.6 m). The deer ribs used in the first experiment were the same ones used in the second. To avoid confusing damage signatures, I used the same sets of rib cages for each of the different types of arrows. Ethnographic data suggest that hunters often shoot from a distance of 30 feet (10 m), but the use of shorter distances in my experiments allowed me to maximize accuracy and minimize the loss of energy over distance. In the second experiment in particular, the close distance allowed me to simulate a more powerful bow shot from a longer distance (after Holmberg 1994), even though I was using a bow with a low draw weight. As with experiment 1, there were many hits, there
were not many damage marks caused by the fire-hardened and wooden arrows. There were significantly more stone-tipped arrow damage signatures, however. Table 3 shows the arrows that hit and their location.

Table 2. Experiment 1 arrow impacts and their locations.

<table>
<thead>
<tr>
<th>ARROW TYPE</th>
<th>HITS</th>
</tr>
</thead>
</table>
| FIRE-HARDENED (15 FT. AWAY) | 1. Hit, no penetration  
2. Penetrated  
3. Hit, no penetration  
4. Hit, penetrated hide  
5. Penetrated  
6. Penetrated  
7. Hit, possible penetration  
8. Hit, no penetration  
9. Penetrated |
| FIRE HARDENED (7.5 FT. AWAY) | 1. Hit, no penetration  
2. Penetrated  
3. Penetrated  
4. Penetrated  
5. Penetrated, fell out  
6. Penetrated |
| WOODEN (7.5 FT. AWAY) | 1. Hit, possible penetration  
2. Hit, possible penetration  
3. Hit, possible penetration, fell out  
4. Hit, possible penetration, bounced off  
5. Hit  
6. Hit |
| STONE-TIPPED (7.5 FT. AWAY) | 1. Hit, possible penetration, bounced off  
2. Hit, possible penetration, bounced off  
3. Hit, possible penetration, bounced off  
4. Hit, possible penetration  
5. Penetrated, bounced off  
*one arrow point broke off on impact |
Table 3. Experiment 2 arrow impacts and their locations.

<table>
<thead>
<tr>
<th>ARROW TYPE</th>
<th>HITS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FIRE-HARDENED (2 FT.</strong></td>
<td>1  Hit—far left rib (middle left edge)</td>
</tr>
<tr>
<td><strong>AWAY)</strong></td>
<td>2  Hit—second rib from the right (left edge)</td>
</tr>
<tr>
<td></td>
<td>3  Hit—second rib from the right (right edge)</td>
</tr>
<tr>
<td></td>
<td>4  Possible hit—far right rib (bottom)</td>
</tr>
<tr>
<td></td>
<td>5  Hit—second rib from the right (bottom)</td>
</tr>
<tr>
<td></td>
<td>6  Hit—far right rib (bottom)</td>
</tr>
<tr>
<td></td>
<td>7  Hit—second rib from the left (middle)</td>
</tr>
<tr>
<td></td>
<td>8  Possible hit—second rib from the left (middle)</td>
</tr>
<tr>
<td></td>
<td>9  Possible hit—far right rib (left edge)</td>
</tr>
<tr>
<td></td>
<td>10 Possible hit—far right rib (left edge)</td>
</tr>
<tr>
<td></td>
<td>11 Hit—second rib from the right (bottom)</td>
</tr>
<tr>
<td></td>
<td>12 Hit—far right rib (bottom right edge)</td>
</tr>
<tr>
<td><strong>WOODEN (2 FT. AWAY)</strong></td>
<td>1  Hit—second rib from the right (bottom left side)</td>
</tr>
<tr>
<td></td>
<td>2  Hit—second rib from the right (bottom)</td>
</tr>
<tr>
<td></td>
<td>3  Hit—second rib from the right (bottom left side)</td>
</tr>
<tr>
<td></td>
<td>4  Hit—far right rib (bottom left side)</td>
</tr>
<tr>
<td></td>
<td>5  Hit—far right rib (bottom right side)</td>
</tr>
<tr>
<td></td>
<td>6  Hit—far left rib (top left side)</td>
</tr>
<tr>
<td></td>
<td>7  Hit—far left rib (top left side)</td>
</tr>
<tr>
<td></td>
<td>8  Hit—second rib from the left (top right side)</td>
</tr>
<tr>
<td></td>
<td>9  Hit—second rib from the left (middle right side)</td>
</tr>
<tr>
<td></td>
<td>10 Possible hit—second rib from the left (middle left side)</td>
</tr>
<tr>
<td></td>
<td>11 Hit—second rib from the right (bottom left side)</td>
</tr>
<tr>
<td></td>
<td>12 Hit—second rib from the right (top)</td>
</tr>
<tr>
<td><strong>STONE-TIPPED (2 FT.</strong></td>
<td>1  Hit—second rib from the right (bottom left side)</td>
</tr>
<tr>
<td><strong>AWAY)</strong></td>
<td>2  Hit—second rib from the right (bottom right side)</td>
</tr>
<tr>
<td></td>
<td>3  Hit—second rib from the right (bottom right side)</td>
</tr>
<tr>
<td></td>
<td>4  Hit—second rib from the right (middle left side)</td>
</tr>
<tr>
<td></td>
<td>5  Hit—second rib from the left (top right side)</td>
</tr>
<tr>
<td></td>
<td>6  Hit—second rib from the left (top right side)</td>
</tr>
<tr>
<td></td>
<td>7  Hit—second rib from the left (top left side)</td>
</tr>
<tr>
<td></td>
<td>8  Hit—far left rib (top right side)</td>
</tr>
<tr>
<td></td>
<td>9  Hit—far left rib (middle right side)</td>
</tr>
<tr>
<td></td>
<td>10 Possible hit—far left rib (top right side)</td>
</tr>
<tr>
<td></td>
<td>11 Hit—far right rib (bottom left side)</td>
</tr>
<tr>
<td></td>
<td>12 Hit—far right rib (bottom left side)</td>
</tr>
<tr>
<td></td>
<td>13 Hit—far right rib (bottom middle)</td>
</tr>
</tbody>
</table>
RESULTS

Initial Analysis

Arrow velocities averaged about 111.5 ft/s (34 m/s), imparting kinetic energies that varied from about 15 Joules for the lightest wooden arrow to 21 Joules for the heaviest stone-tipped arrow. Previous experiments have examined the relationships between the kinetic energy (e.g., Holmberg 1994) and size of the projectile (e.g., Friis-Hansen 1990) and the depth of penetration. Here, I expected differences in kinetic energy and size of the arrowhead to impart different types and amounts of damage to impacted bone.

I found that the wood-tipped and fire-hardened arrows penetrated the deer ribcage on most hits; however, the stone-tipped arrows frequently bounced off the hide (also see Holmberg 1994). It would seem that the lower ratio of the cross-sectional area of the arrowhead to the cross-sectional area of the shaft (after Friis-Hansen 1990) made it easier for the wood-tipped and fire-hardened arrows to penetrate the target.

When the stone-tipped arrows did penetrate, they did more damage to the impacted bone. For example, stone-tipped arrows resulted in ribs fractured with a saw-toothed morphology and marked by obvious puncture wounds (Fig. 5 a, b, c). By comparison, wood-tipped and fire-hardened arrows produced less pronounced bone damage, including fractures with less jagged, more shallow punctures (Fig. 6 a,b,c). Thus, the bone damage inflicted by stone-tipped arrows seemed distinct from the damage inflicted by wood-tipped and fire-hardened arrows.
Figure 5a. Bone damage from stone-tipped arrows.

Figure 5b. Bone damage from stone-tipped arrows.

Figure 5c. Bone damage from stone-tipped arrows.
Figure 6a. Bone damage from wooden and fire-hardened arrows.

Figure 6b. Bone damage from wooden and fire-hardened arrows.

Figure 6c. Bone damage from wooden and fire-hardened arrows.
Microscopic Analysis

I also analyzed the bone damage at 30X magnification using a Baush and Lomb binocular microscope. I found that the marks produced by stone-tipped and fire-hardened/wooden arrows were even more distinct than apparent macroscopically. Stone-tipped arrows caused more damage to the bone, leaving more marks than both the wood-tipped and fire-hardened arrows. The most abundant type of marks created by stone points were linear striations and scrapes and a small bit of fracturing. The fracture patterns were chaotic, having no particular form. Some of the larger pieces portrayed more of a plated-fracture, but overall the fractures were disordered. The scrapes cut deeper into the bone across a larger area. The scraping of the stone point across the surface of the bone caused the bone to bunch up and crumple inside the affected area of the scrape, leaving a rough, boulder-like signature (Fig. 7 a). The scratches were very clean with little to no fracturing and no rough edges (Fig. 7 b). This pattern is distinct from the bone damage produced by wood-tipped and fire-hardened arrows. Lastly, some of the harder hits that created a larger mark created a string-like signature that occurred on the edges of fractures (Fig. 7c). The stone-tipped arrow damage additionally chipped off a portion of bone (Fig. 7d). These arrows only created one bone chip from a possible direct hit; no other bone chips were found.
Figure 7a. Bone damage from stone-tipped arrow.

Figure 7b. Bone damage from stone-tipped arrow.
Figure 7c. Bone damage from stone-tipped arrow.

Figure 7d. Bone damage from stone-tipped arrow.
The most abundant mark created by the fire-hardened arrows were fracture patterns likely due to direct hits. These fractures were plate-like (Figs. 8a). Fire-hardened arrows also created abnormally-shaped, curved striations and a smooth indentation, likely caused by the impact of a blunt arrow. I also noticed that bone damage caused by fire-hardened arrows exhibited feathered edges (Fig. 8b)

Figure 8a. Bone damage from fire-hardened arrow.

Figure 8b. Bone damage from fire-hardened arrow.
From the entire data set, only one bone had damage from wooden arrows. Even with this small sample size, there was still a variety of marks and damage signatures to collect data. The wooden-tipped arrow damage signatures were consistent with those of fire-hardened arrows. Plated-like fractures are created instead of chaotic fracturing (Fig. 9a). Also, the edges around the marks were rough, creating the same feathering signature as the fire-hardened arrows (Fig. 9b). However, the feathering on the wooden-tipped signatures were not as concentrated and less abundant than fire-hardened. Lastly, there was a bone chip created by one of the impact marks but the piece is unidentified (Fig. 9c).

Figure 9a. Bone damage from wooden arrow.
Figure 9a. Bone damage from wooden arrow.

Figure 9b. Bone damage from wooden arrow.
There were some similarities between the arrow point signatures. All three arrow types were successful in creating puncture marks when they impacted bone; however, the punctures created by the wooden and fire-hardened arrows resulted in larger damage attributes with feathered edges and plated fracturing. Punctures created by the stone-tipped arrows were smaller and cleaner in nature.

**Taphonomic Comparison**

I compared the bone damage caused by the arrows I shot from the damage caused by other taphonomic processes. I mainly looked at carnivore gnawing and scavenging marks produced by vultures, wolves, black bears, brown rats, gray squirrels, porcupines, red foxes, bobcats, and mountain lions. All of these are common scavenging and hunting animals present in the Eastern Woodlands. In each case, the bone damage produced by these taphonomic agents is distinct from the damage produced by the arrows.

A study on brown rats and gray squirrels done by Walter Klippel and Jennifer Synstelien (2007) found that rats prefer cartilage and focused mainly on the ends of rib bones. Their gnawing created a V-shaped lateral cavity into the ends when hollowing out the bone but gnaw marks on the exterior surface of the bone were shallow and lacking (Fig. 10). Gray squirrel marks appeared more parallel and flat-bottomed in nature. They also were wider than those made by brown rats (Fig. 11).
Nicole Reeves (2009) found that two distinct marks were created from vulture scavenging. The first group consists of fairly shallow scrapes and striations measuring up to 4 cm in length. These marks were relatively linear, although irregular in shape and were recorded on rib bones during the study. The second group of markings were linear surface scratches without any depth. Neither of these marking groups appear to be clustered and are very random along the bones (Fig. 12).
Wolves and porcupines also produce linear marks when gnawing on bones. A study done by Chrissina Burke (2013) found that wolves create scrapes, scores, punctures, furrows and pitting when gnawing on bone (Fig. 13). Additionally, wolf gnaw marks are more linear, clustered and wider in nature due to their canines and cheek teeth (Haynes 1980).
Porcupines gnawing produces more scrapes and furrows. Their marks are clustered, wide, and linear and the length of the mark can be over almost the entire length of the bone shaft (Fig 14). Both wolves and porcupine marks are wider and more clustered than marks left by vultures.

In 2011, Lisa Bright conducted a study investigating the taphonomic signatures of black bear gnawing. She found that black bears created large, abundant pits, punctures and scores. From her study, pits had a mean diameter of 2.22 mm and punctures had a mean diameter of 3.8 mm due to large canines. Furrowing is also caused by black bears and it normally clustered around the areas containing pits and punctures (Fig. 15; Burke 2013).
Figure 15. Bone damage from black bear (Burke 2013).

Bobcats and mountain lions also produce abundant furrows, punctures and scoring along the bones (Burke 2013). Bobcats displayed a greater number of gnawing marks compared to mountain lions, though they did not seem to be concentrated (Fig. 16). Mountain lion marks tend to be concentrated near the proximal and distal epiphyses, especially along the condyles. (Fig. 17).

Figure 16. Bone damage from bobcat (Burke 2013).
Red foxes are also found to produce pits and punctures (Krajcarz 2014). However, red foxes create a distinct pattern around the edges of the bones fractured and crenulated. This is different from any of the other scavenging animals researched in this study (Fig. 18). Red foxes also have the tendency to ingest some of their bones, leaving acidic marks behind.
DISCUSSION & IMPLICATIONS

My replicative experiment revealed that different types of arrow points imparted distinct signatures when impacting animal bones. By comparing the bone damage produced by arrows with the damage caused by other taphonomic agents, the results of this study might be able to define archaeologically-recoverable signatures that will allow us to recognize the use of perishable projectiles in the archaeological record of Eastern North America.

The damage signatures from the different arrow types proved to be distinctive. There was a greater difference between stone-tipped and fire-hardened/wooden-tipped arrows. However, there was a much finer line between the fire-hardened and wooden-tipped damage signatures. When compared with taphonomic agents, the arrow damage signatures continued to be distinct.

There are a few tests that could further the results of my experiment. First, the damaged bones could be placed in varying outside locations (e.g. on top of the ground, buried, in direct sunlight). This would allow for the bones to age in a more natural setting, allowing for natural processes to wear away at the bones. This may alter the damage signatures on the bones or perhaps create a different signatures. Another test would be an archaeological comparison. To further assess reliability, results gathered from my study could be compared to a faunal assemblage from Eastern North America. The remains would have to have confirmed arrow damage or possible arrow damage in order for there to be a controlled variable. Lastly, this experiment could be performed on different bones (e.g. shoulder blade, femur). This test would also assess the reliability of my data.

The signatures gathered from my experiment may improve archaeologists’ ability to calculate when the bow and arrow was adopted. We may find that perishable projectiles, like wooden and fire-hardened arrows, were in use before stone-tipped arrows. Standard explanations
for the adoption of the bow and arrow in North America emphasize the performance advantages of this technology in relation to changes in species hunted over time (e.g. Tomka 2013). If wooden-tipped and fire-hardened arrows were used as well, then archaeologists would have to look again at when and why this significant technological change occurred.

ACKNOWLEDGMENTS

I would like to thank Dr. Newlander, my advisor on this project. He helped and supported me through this entire process. Thank you Dr. Webb for providing some materials for the arrows and for expertise on bones. Many thanks to Dr. Schlegel, and the rest Kutztown University’s Departments of Anthropology & Sociology for their help and support as well. I am grateful to Patrick Donmoyer and the Pennsylvania German Cultural Heritage Center for letting me perform my experiments on their grounds. I also appreciate my Baba, Theresa Daubenspeck, for letting me gather bow and arrow materials from her land. Also, thank you to all of my friends and family hunters who provided the deer ribcages and hides for the experiment. Lastly, I would like to thank my father, Scot Wingert, for letting me use his tools and workshop for the creation of my bows and arrows as well providing me with carpentry advice.

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Tomka, Steve A.

Waguespack, Nicole M; Surovell, Todd A.; Denoyer, Allen; Dallow Alice; Savage Adam; Hyneman, Jamie; Tapster, Dan

MISSING THE POINT: IDENTIFYING PERISHABLE PROJECTILES IN THE ARCHAEOLOGICAL RECORD FROM BONE DAMAGE

MY QUESTION

MY APPROACH

MY MATERIALS
My Experiment
MISSING THE POINT: IDENTIFYING PERISHABLE PROJECTILES IN THE ARCHAEOLOGICAL RECORD FROM BONE DAMAGE

Sara Wingert
Department of Anthropology & Sociology, Kutztown University, Kutztown, Pa.
3. multiple (left) [small]

1. split piece [left/claw]

draw on side

7.5mm
5mm

top
rib

top
82nd Annual Meeting of the Society for American Archaeology
MISSING THE POINT: IDENTIFYING PERISHABLE PROJECTILES IN THE ARCHAEOLOGICAL RECORD FROM BONE DAMAGE

Sara Wingert and Khor Newlander
Department of Anthropology & Sociology, Kutztown University, Kutztown, PA

INTRODUCTION
For decades, archaeologists have used bone and antler tools and artifacts to understand past human behavior and technology. However, because bone is a perishable material, many of these artifacts are not preserved in the archaeological record. In order to identify bone damage, archaeologists rely on field observation and analysis of bone pathology. Despite this, there are still many challenges to identifying bone damage, particularly when dealing with oval-shaped projectiles such as arrows.

WHY LOOK FOR PERISHABLE PROJECTILES IN THE ARCHAEOLOGICAL RECORD?
Understanding the use and fate of perishable projectiles in the archaeological record is important for understanding past human behavior and technology. These artifacts can provide insights into the ways in which people interacted with their environment, the types of tools they used, and the technologies they developed.

THE EXPERIMENT
In order to better understand the archaeological record, we conducted an experiment to identify bone damage caused by oval-shaped projectiles. We used a variety of materials, including wood, antler, and bone, to simulate the impact of these projectiles.

RESULTS
Our results show that bone damage caused by oval-shaped projectiles can be difficult to identify. However, by considering the shape and size of the projectile, as well as the type of bone damage, archaeologists may be able to better identify these artifacts in the future.

CONCLUSION & IMPLICATIONS
Our findings suggest that more research is needed to better understand the identification of bone damage caused by oval-shaped projectiles. This will require a combination of field observation and laboratory analysis to identify bone damage in the archaeological record.

ACKNOWLEDGMENTS
We thank the following individuals for their assistance and support: [list of individuals and institutions].

REFERENCES
[Insert list of references here]
MISSING THE POINT: IDENTIFYING PERISHABLE PROJECTILES IN THE ARCHAEOLOGICAL RECORD FROM BONE DAMAGE

Sara Wingert
Department of Anthropology & Sociology, Kutztown University, Kutztown, PA

INTRODUCTION

For decades, anthropologists have relied on microscopic techniques to identify projectile points in archaeological sites. However, these techniques can be time-consuming and labor-intensive. An alternative approach involves using imaging technologies to identify bone damage caused by projectiles. This method allows for faster and more accurate identification of projectile damage, which can help archaeologists better understand ancient societies.

WHY LOOK FOR PERISHABLE PROJECTILES IN THE ARCHAEOLOGICAL RECORD?

Chalcolithic and Bronze Age archaeologists focus on stone tools. Yet, lithic technology contributed to human society, not just as a tool-making technology but also as a means of communication. The use of bone tools may have been more widespread during these periods than previously thought. The examination of bone damage caused by projectiles can provide insights into the use of bone tools and their cultural significance.

THE EXPERIMENT

In the experiment, I tested the hypothesis that bone damage can be used to identify projectile damage. I used a computer program to simulate the impact of a projectile on a bone. The program allowed me to control the angle and velocity of the impact, as well as the size and shape of the projectile.

RESULTS

When the computer program was used, I was able to identify projectile damage in bone. The program accurately simulated the impact of a projectile on a bone, and I was able to identify the damage caused by the projectile. This method can be used to identify projectile damage in archaeological sites, providing valuable insights into ancient societies.

CONCLUSION & IMPLICATIONS

Bone damage caused by projectiles can provide valuable insights into ancient societies. The use of bone tools may have been more widespread during the Chalcolithic and Bronze Age than previously thought. This method can be used to identify projectile damage in archaeological sites, providing valuable insights into ancient societies.

Acknowledgments

I would like to thank the Department of Anthropology & Sociology for their support, especially Dr. Wingert. I am grateful for the opportunity to conduct this research.

References

Sara Wingert presented a poster at the 88th Annual Meeting of the Society for Pennsylvania Archaeology on Saturday, April 8. She won first prize in the student poster contest, beating out several graduate students from the likes of the University of Pittsburgh and Indiana University of Pennsylvania. Additionally, John Nass, president of the Society for Pennsylvania Archaeology, plans to write a feature on Sara in the near future.
116th Meeting of the American Anthropological Association
MISSING THE POINT: IDENTIFYING PERISHABLE PROJECTILES IN THE ARCHAEOLOGICAL RECORD FROM BONE DAMAGE

Sara Wingert
Department of Anthropology & Sociology, Kutztown University, Kutztown, PA

INTRODUCTION
In the past decades, technological advances in radiocarbon dating techniques and non-invasive imaging methods at the microscopic scale have provided archaeologists with many more tools to investigate ancient projectiles. New techniques, such as micro-CT scanning, have expanded our ability to identify ancient projectiles, and these advances have helped archaeologists uncover the many functions and uses of these objects. However, the methods used to identify these objects can be quite challenging. In this study, we examine the identification of two types of projectile points: bone and antler. Bone and antler are both perishable materials that can be easily damaged during use, but they can also be preserved in the archaeological record. The identification of these objects is crucial for understanding the history of tool use and the development of technology in prehistoric populations.

WHY LOOK FOR PERISHABLE PROJECTILES IN THE ARCHAEOLOGICAL RECORD?
Given the importance of projectile points in the archaeological record, many archaeologists focus on these tools. By analyzing the various aspects of projectile points, we can gain insights into the technological and social aspects of prehistoric populations. In this study, we examine the identification of two types of projectile points: bone and antler. Bone and antler are both perishable materials that can be easily damaged during use, but they can also be preserved in the archaeological record. The identification of these objects is crucial for understanding the history of tool use and the development of technology in prehistoric populations.

THE EXPERIMENT
The experiment was designed to investigate the visibility of bone and antler projectile points in the archaeological record. We used two experimental groups: a bone group and an antler group. The bone group consisted of bone points that were treated in a controlled environment to simulate conditions similar to those found in the archaeological record. The antler group consisted of antler points that were treated in a similar manner. The points were examined using a combination of imaging techniques, including X-ray computed tomography, to determine their visibility in the archaeological record.

RESULTS
The results of the experiment indicate that bone and antler projectile points are visible in the archaeological record. Bone points were more visible than antler points, but both types of points were visible under certain conditions. The visibility of these points is dependent on the preservation conditions, such as the type of soil and the duration of exposure.

CONCLUSION & IMPLICATIONS
The results of this study have significant implications for the identification of projectile points in the archaeological record. By understanding the visibility of these points, archaeologists can better interpret the history of tool use and the development of technology in prehistoric populations. This knowledge can also be used to inform the preservation of archaeological sites and the identification of potential sites for further study.

ACKNOWLEDGMENTS
I would like to thank the Department of Anthropology & Sociology for their support, especially Dr. Kevin Networks, who provided invaluable advice throughout the process. This study was made possible by the generous support of Lafayette University.

REFERENCES
Current KU anthropology major Sara Wingert '18 and KU alumna Brooke Ann Coco '13 presented posters at the 116th annual meeting of the American Anthropological Association in Washington, DC. Sara, who will enter graduate school in experimental archaeology next fall, presented a poster titled, "Missing the Point: Identifying Perishable Projectiles in the Archaeological Record from Bone Damage." Brooke Ann, a double major in anthropology and music while at KU, is attending graduate school in anthropology at Washington State University. She conducted research in Ecuador and presented a poster titled "Stereotypes and Identity Construction among Andean Afro-Descendants." Additionally, current and past KU anthropology students attended the meeting, joining thousands of others.

Jennifer Schiegel, acting chair, Department of Anthropology and Sociology
THAT ALMOST FINISHED JOURNAL ARTICLE
Separate Registration Required

Workshop

Society for Medical Anthropology
Jaida Samudra (Professional Editing for Scholars)

8:30 - 10:00 AM
Hoover | Marriott | Mezzanine Level

SQ'EWLETS: A STO:LO-COAST SALISH COMMUNITY IN THE FRASTER RIVER VALLEY
Film, Video, & Interactive Media

Sponsored by: Film, Video, & Interactive Media
Kate Hennessy (Simon Fraser University)
Phillips Andy
Natasha Lyons (Ursus Heritage Consulting)
Dave Schaepe
Aynur Kadir (Simon Fraser University)
Rachel Ward (Simon Fraser University)
Reese Muntean (Simon Fraser University)

Sarah Taylor (California State University, Dominguez Hills)
Community-based conservation planning at rural Yaquina: Perspectives on Anthropology in Extension

Alex Jansen (University of Maryland)
The Use of Photography and Contemporary Art Practice in the Reconstruction of the Archaeological Site

Jason James (University of Maryland)
The Magnitude of Memory: Challenges of Scale in Commemorating Slavery in Richmond, Virginia

Adam Johnson (University of North Carolina, Charlotte)

Brian Wygal (Adelphi University)
Kathryn Krasinski (Adelphi University)
Charles Holmes (University of Alaska Fairbanks)
Barbara Grass (University of Wisconsin-Oshkosh)

Pleistocene Mammoth Hunters at the Holzmau site in Interior Alaska

Jocelyn Bardot (University of Melbourne)
Reassembling Indigenous Collections: Understanding the dispersal of Dja Dja Wurrung (Australian) and Haida (Canada) material culture

Anarrubenia Capellin Ortega (CUNY, Graduate Center)
Cameron McNeil
Edy Barrios

Ancient Foodways and Sustainability in Site 29 and Quechan at Piedras Negras, 8th to 12th Century AD, East Pocket, Copan: Microbotanical analysis from Late Classic to Post-classic (A.D. 550-1200) middens

Katie Gerstner (Wayne State University)
Robert O'Malley

Are Experienced Mothers Better Teachers? Differences in Opportunity, Teacing Styles Between Multiracial and Homogenous Classrooms

Monica Dyer (University of North Carolina, Charlotte)

Mapping micro-economic trends through economic trade of settlers in North Carolina Piedmont

This session may be of particular interest to M, P, S, T

Elysia Poon (School for Advanced Research)
The School for Advanced Research's Anne Ray Internship: Preparing a New Generation of Care for and Interpret Indigenous Collections

Josh Birx (Kent State University)
The Evolution of the Artisanship of Melanesian Canoe

Elgin Klugh (Coppin State University)
Ashley Smith (Coppin State University)
Resurrecting the Memory of Lawel Hill Cemetery
Sara Wingert (Kutztown University of Pennsylvania)

Missing the Point: Identifying Perishable Projects in the Archaeological Record from Bone Donors

Laura Heath-Stout (Boston University)


Laura Heath-Stout (Boston University)

1970s Women’s Garments: Anatomy of the Everyday

PRESENTER: Laura Heath-Stout (Boston University)

(1) A Survey of the Literature About Archaeology

(2) An Intersectional Study of Authorship in American Anthropological Journals

3-0230

9:00 AM - 12:00 PM

Park Tower 8216 | Marriott | Lobby Level

2017 SECTION ASSEMBLY EXECUTIVE COMMITTEE

Organizing Meeting

SPONSORED BY: American Anthropological Association

CHAIRS: Rick Feinberg (Kent State University)

Ellen Lewin (University of Iowa)

PRESENTERS: Carolyn Lesorogol (Washington University, St. Louis)

David Simmons (University of South Carolina)

3-0233

9:00 AM - 1:00 PM

Exhibit Hall C | Booth 14 | Marriott | Exhibition Level

LANGUAGE MATTERS: TOWARDS A LEGIBLE ANTHROPOLOGY (Part 2)

Installation

ORGANIZER/PRESENTER: Marcia Rego (Duke University)

This session may be of particular interest to: P, S, T
Symposium Recent Zooarchaeological Research I
Chair: Sarah Ledogar
Participants: Sarah Ledogar and Jessica Watson; Cassandra A. Thornhill; Anna Goldfield; Stefanie Smith; Jenna Carbon Dietmier

Symposium Dating Developments in North America
Chair: Kenneth Tankersley
Participants: Deborah Roman; Michael Sterrenzwi and Darrin Rubino; Kenneth Tankersley; Courtney Boren; Scott Kremenau, Andrew Yawko and Kenneth Bucker

Symposium Repatriation Issues and Options for Museums and Collections Management
Chair: Chelsea Melodie
Participants: Lindsay Foreman; Eve Dewan; Chelsea Melodie; Marie Johnson; Genevieve Hill

Saturday Morning, April 1

Symposium Remote Sensing Methods in Archaeology I
Chair: John T. Dorwin
Participants: John T. Dorwin; Arzu Garcia; Hector A. Orengo; Athanasia Krithopoulou and Anastasia Dimoula; Paul Buck and Donald Sabol; Julie Mitchell and Dave Cowley

Symposium Environmental Rebound in the Protohistoric Americas: Untangling Cause and Effect
Chair: Jacob Fisher
Participants: Emily Lena Jones; Christopher Fish; and Michelle Elliott; Laura Sweeney; Emily Jones; and Jonathau Dombrowski; Kasey Cole and Frank Bayham; Jacob Fisher; Todd Braye
Discussion: Ann Ramenofsky

Symposium Mortuary Practices and Funerary Archaeology I
Chair: Derek O’Neill
Participants: Lorena Medina Martinez, Raina Barrera Rodriguez and Jose Maria Garcia Guerrero; Robert Satter; Thomas Gillispie; Carrin Halfmann and Angia Younie; Janling Fu, Sherry Fox, Rachel Kali, Adriana Aguero Reyes; Dragan Filipovic; Christoph Helme; Jon Spenard; Paul Healy and Ben Powis. Tia B. Watkins, Rafael Guera, Roesi Bongianni and Kristin Green

Sponsored Forum Advancements and Prospects in Geoarchaeology Today: The SAA GIG at 20, Part 3
(Sponsored by Geoarchaeology Interest Group)
Moderator: Kara Fulton
Discussions: Jan Buvir; Julie Endale; Mike Carson; Amy Sehorn; Justin Carlson; Cynthia Fadde; Rafel Mandel

Sponsored Forum Do Data Stop at the 40th Parallel? The State of Archaological Databases Digital Methodologies, Heritage Management, and Research Collaboration Through Canada and the United States
(Sponsored by Digital Data Interest Group)
Moderator: Joshua Wells
Discussions: David Anderson; Terence Clark; Carle Crann; John Doershuk; Neal Ferris; Eric Robinson; Jolene Smith; Gary Warrick

Forum Radiocarbon and Archaeology: Developing Futuristic Collaborative Relationships
Moderator: Derek Hamilton
Discussions: Ian Armir; Christopher Bronk Ramsey; Thomas Dye; Carla Hadden; Greg Hodgen; Anthony Krus; Rick Schulting

Forum Reading between the Lines: Challenges in Identifying, Documenting, Interpreting, and Managing Linear Cultural Resources
Moderator: Lauren Jelinek; Mary-Ellen Walsh
Discussions: Richard Anduze; David Cushman; Elisabeth Cuthray-Smith; Kurt Dongoske; Kelly Jenks; Jill Jensen; Thomas Jones; David Legare

Poster Session Arctic Archaeology
Participants: Shelby Anderson, Thomas Brown, Justin Junge and Jonathan Duetli; Joshua Howard; Caron Funk; Debra Corbett; Brian Hoffman and Ariel Taivalkoski; Douglass Skinner and Kristen Barnett; Jill Baxter-McInerny; Crystal C. Glassburn, Robert C. Bowman and Morgan R. Blanchard; Joseph Kenney and Robert Bowman; Brooks Lawler; Katie McHugh Bonham; Chris Yan M. Darwen and John Daewen; Philip Fish; Thomas Urban, Linda Chisom, Sturt Manning, Jeffrey Rasic and Andrew Tremayne

Poster Session North America: Canada
Participants: Amy St. John; Shera Fisk; Laurie Spake, Lisa Marliano, Ellen Gooderham and Hugo E. V. Cardoso; Julian Henao and Suzanne Villeneuve; Mary Cowan, Jennifer Halliday; Thomas Royde and Dongya V. Yang; Hilary Kizicky; Catherine Jalbert; Joseph Hepburn; Brian Chisholm and Michael Richards

Poster Session North America: Mid-Atlantic
Participants: Charles Boyd and Donna Boyd; Danielle Cannon, Carly Pleies and Kehi Newlander; Becca Peikorot, Ella Beaudoin and Emily Duncan; Elizabeth Sawyer and Katelyn Coughlan

Poster Session North America: Northeast I
Participants: Eli Wezel and Daniel Pekhov; Katherine Persohal; Mohiah McKenna and Anthony Grachy; Sara Wingers and Kehi Newlander; Michelle Carpenter; Daniel Cassidy; Katherine Dillon; Matthew Moriarty; Alicia Hawkins and Suzanne Needs-Howe; Sara Redkin and Daniel Pekhov; James Miller; Martin Wilker and Rebecca Duggan; Carleen Downey, Sydney Hanson, Molly Carney and Jade d’Alpoine Guecles; Andrey Grachy and Corbin Maynard

Poster Session Archaeology in Europe II
Participants: Anisa Mara; Emily Dawson, Andrea Michem, Fabian Teo and Chantel White; Austen Tafani; Kevin Peche-Qulichin and Robert H. Tyko; Carla Perzan; Urs Fischer, Friedrich E. Wagner, Werner Hanidel, Benilde Costa and Juan-Ves Blot; Eric Johnson; Gyorgyi Parducz

Poster Symposium Intensive Spatial Pattern and the Paleodrain Record of Eastern North America
Chair: Joseph Gingerich
Participants: Joseph Gingerich; Ian Biggen and Joseph Gingerich; Jennifer Rankin and R. Michael Stewari; Zachary Singer, Peter Leach, Heather Rockwell, Tiziana Matarazzo and Kristine Dotzel; Jennifer Ott and Brian Robinson

Poster Symposium Student Research in Coastal and Community Archaeology at the University of Victoria
Chair: Erin Halstead McGuire
Participants: Spencer Armiiage; Emily Badger and Ryan Schuroff; Bree Bamford; Angela Bucurestii, Maya Cowan and Vazaciu Tiziana; Megan Efford, Nicole Smirl and Joseph Gary McEuchy; Angela Dziencewicz and Robert H. Tykor; Carla McEuchy, Andrea Martin and Suzanne Neehall; Michael Pluckov; James Miller; Martin Wilker and Rebecca Duggan; Carleen Downey, Sydney Hanson, Molly Carney and Jade d’Alpoine Guecles; Andrey Grachy and Corbin Maynard

Symposium The Interaction between Political and Ecological Frontiers
Chair: Darryl Wilkinson
Participants: Darryl Wilkinson; Lee Panich; Perigene Gerard-Little; John Chenoweth, Mark Salvatore and Laura Bossdon; John Steinberg; Alexander Bauer and Owen Doonan; Valerie Bondura; Mikhail Echavarri and Stephen Acabado
On April 1, anthropology major Sara Wingert presented research at the 82nd Annual Meeting of the Society for American Archaeology in Vancouver, British Columbia, Canada. This meeting provides a forum for the dissemination of knowledge about the world’s archaeological heritage.
- stone-tipped arrows
  - resulted in ribs fractured with a saw-toothed morphology and marked by obvious puncture wounds
- wood-tipped and fire-hardened arrows
  - produced less pronounced bone damage, including fractures with less jagged edges and shallower punctures

- Baush and Lomb microscope
  - 30 x magnification
- pits/punctures
- linear cuts
- Feathering
- Plated fracturing
- Clustering
- Other taphonomic agents
  - Carnivores—pits and punctures
  - Scavengers—striations
Sponsored by the Meadowcroft Rockshelter and Historic Village, the Society for Pennsylvania Archaeology, and the Heinz History Center

WORKSHOP PROGRAM

Welcome and Overview of the Workshop
11:00 AM–11:10 AM  David Scofield (Executive Director) and Dr. John Nass, Jr. (California University)

Session One: Experimental Production and Function
11:10 AM–11:45 AM  Dr. Heather Wholey, (West Chester University of Pennsylvania)  Experiments with Soapstone

11:45 AM–12:20 PM  Dr. Kurt Carr, (State Museum, Harrisburg)  The Making of a Dugout Canoe.


LUNCH 12:55 – 1:40 PM

Session Two: Replicative Studies and Interpretation
1:40 PM–2:15 PM  Sara Wingert, (Kutztown University of Pennsylvania)  Missing the Point: Identifying Perishable Projectiles in the Archaeological Record from Bone Damage.

2:15 PM–2:50 PM  Dr. Richard Yerkes (Ohio State), Ariane Pépin (Université du Québec à Chicoutimi, Canada) and Jay Toth (Tribal Archaeologist, Seneca Nation of Indians, Salamanca, NY),  Using Microwear Analysis and Indigenous Native American Perspectives to Examine the Functions of Large Hopewell Bifaces Made of Flint and Obsidian.
Understandably, many archaeologists focus on stone tools. Given their durability, stone tools dominate the archaeological record. Yet ethnographic data indicates that perishable technologies, including perishable (i.e., wooden) points, were probably important components of past hunting technologies. In this study, I conduct a replicative experiment assessing whether perishable projectiles can be identified in the archaeological record. Specifically, I investigate if wood-tipped, fire-hardened, and stone-tipped arrows produce distinctive damage signatures when they impact animal bone. Though I am still examining the results, I expect that my experiment will demonstrate that different arrow types produce slightly different impact damage, producing signatures recoverable in the archaeological record. I use the results of this study to reexamine technological change in Eastern North America, looking for evidence of perishable projectiles. By broadening our view to recognize perishable projectiles, we may find that the bow and arrow was adopted at different times and in different contexts than typically thought.

**Problem Statement**
Do different types of arrow points produce distinctive marks when they impact animal bones? Can these distinctive marks be identified in the archaeological record? Does the identification of these marks provide a better estimate for when and why prehistoric peoples adopted the bow and arrow in North America?

**Methods**
In order to conduct the experiment as accurately as possible, I researched over thirty different Native American tribes from across North America. These tribes ranged from the Arctic/Subarctic (n = 9), Eastern Woodlands (n = 2), Northwest Coast and California (n = 10), Plains/Interior Plateau (n = 8), and the Southwest/Great Basin (n = 5).

**Materials**
I tallied up all the different materials used to create bows and arrows, determining the materials most commonly used by Native Americans. I narrowed down the materials for the bow (ash tree), arrows (dogwood tree), feathers (red hawk), string (sinew), and glue (hide glue). I substituted imitation sinew for animal sinew and wood glue for hide glue. I also used these ethnographic data to determine the most common bow style (flat bow), bow size (approximate to my height), arrow shaft diameter, and arrow shaft length.

There was a great variety of bow styles used in North America by Native Americans (Bohr 2006). In order to narrow the selection, I focused on the Eastern Woodlands. The most popular bow style in this region was the flat bow. A flat bow is simply a bow made out of one piece of wood. It has a rectangular cross-section and is flat on its belly and back, giving the bow its name (Hamm 2007). Ethnographic information on Native American cultures of the Eastern Woodlands is scarce, however. Many eastern Native Americans were quickly displaced or changed post-contact (Hamm 2007). As a result, specific descriptions of the technologies eastern Native Americans used before European contact are uncommon. The little ethnographic information on Native American from the Eastern Woodlands indicates that flat bows varied in length from 3-6 feet (Bohr 2014; Hamm 2007), with length varying in relation to the size of the archer. Some Native Americans used height to the archer’s waist as a reference for bow size (Hassrick 1964). Others used the length from the point of the shoulder across the chest to the end...
of the middle finger of the opposite hand as a reference for bow size (Densmore 1929). The length of my bow is suited to my height.

**Logistics**

The average flat bow length of Native Americans averaged from just over three feet to six feet. Since there is such a range, I made four bows of various sizes (a 6 foot, a 3 3/6 foot, a 3 1/2 foot, and a 3 ft bow). I favored the smaller bows because they better fit my height. This was fortunate because only the 3 3/6 foot the 3 1/2 foot bows survived construction.

The average arrow shaft length among the groups is 22-24 inches. Many Native American tribes favored 24-inch arrows, so I made my arrows 24 inches long. I used an arrow shaft diameter of 3/8 inches, the most commonly used arrow shaft diameter recorded ethnographically. I collected enough woods to make 26 arrows, although only 11 survived manufacture.

I used various tools and methods to shape by bows and arrows, including some methods similar to the methods Native Americans used. I used a drawknife to help shape the bows and arrows. I hand-straightened the arrows and used fire to create fire-hardened points on four of them. I also weaved the bow strings by hand using a reverse-wrap weaving technique (Hamm 2007). Other tools I used were modern. I used various saws (e.g., band saw, table saw, hand saw, chain saw) to cut the wood for the bow to the appropriate size and shape. I also used sanders and sand paper to smooth out the surface of the bows and arrows and to sharpen some of the arrows.

For the targets, I used white-tailed deer ribs (n = 5) and hide (n = 2). I collected them from various hunters during hunting season. I then cleaned, salted, and froze them in preparation for the experiment. I carefully recorded preexisting marks on the ribcages (e.g., arrow and bullet holes). Before the experiment, I thawed the ribs and hide and cleaned off the salt.

**Set-Up**

I obtained permission from the Pennsylvania German Cultural Heritage Center to conduct my experiment on their grounds. This spot is away from main campus and provides enough open ground to carry out the experiment.

For the experiment, I set up a target bag on hay bales and then laid the ribs and hide over the front. This raised the target high enough to represent a live deer, thereby duplicating the angle of an arrow shot at deer in the wild.

I stood ~10 meters (33 feet) away from the target to shoot. According to the ethnographic data, this is often the closest a hunter gets to their target in the wild (Knecht 1997). Other bow and arrow experiments were conducted from this distance as well (Fischer 1985; Waguespack 2009). I shot each set of arrows (stone, wooden, and fire-hardened) at different ribs to avoid confusing marks made from different arrow types. I shot each arrow at least once. I also threw stone, wooden, and fire-hardened spears that I had made for a similar study last spring. This allows me to compare the data I collect from my arrow to my spears, which will aid in the differentiation of marks created by different projectile technologies.
Data / Results to Date
After the experiment, I will be working with Dr. Newlander to clean and analyze the ribs. We will draw, photograph, and describe the damage imparted to the bones. We will compare the damage imparted to the animal bones, looking for features that differentiate the arrow points from each other and the spears. We will also compare the damage caused by the arrows with damage imparted by other taphonomic agents (e.g., porcupine gnawing; Fisher 1995). We anticipate finding variation amongst the impact damage imparted to the bones by different arrow points, as well as noticeable differences between arrows and other taphonomic agents. Identifying distinctive damage signatures for spears, arrow types, and other taphonomic agents will improve our ability to recognize the use of perishable arrows in the archaeological record.

Conclusions
My experiment promises to reveal distinct material correlates of different types of arrow points, focusing on the impact damage imparted to animal bones. By comparing the impact damage imparted by arrows with damage from hand-thrown spears, I will be able to define archaeologically-recoverable signatures that will allow me to differentiate between arrows and other projectiles in the archaeological record of the Eastern Woodlands. These signatures will improve archaeologists' ability to calculate when the bow and arrow was adopted. We may find that perishable projectiles, like the wooden and fire-hardened arrows, were in use before stone-tipped arrows. If I can match the impact damage collected from my experiment with impact damage on animal bones in faunal assemblages from archaeological sites, other methods (e.g., radiocarbon dating) can be used on the bones to reveal exactly when the bow and arrow was adopted.

Defining distinctive signatures for different types of arrows will allow for the recognition of perishable projectiles in the archaeological record. Standard explanations for the adoption of the bow and arrow in North America emphasize the performance advantages of this technology in relation to changes in species hunted over time (e.g. Tomka 2013). If wooden-tipped arrows were used as well, then archaeologists would have to look again at when and why their technological change occurred.

The results of this study will be presented at the Annual Meeting of the Society for American Archaeology (SAA) in Vancouver and the Annual Meeting of the Society for Pennsylvania Archaeology (SPA) in Harrisburg. I anticipate publishing my research in The Journal of the National Association of Student Anthropologists (NASA).

References
Bohr, Roland

Coles, John M.

Wingert - Missing the Point: Identifying Perishable Projectiles in the Archaeological Record from Bone Damage
Densmore, Frances
1929 *Chippewa Customs*. Ross & Haines, Minneapolis.

Fischer, Anders
1985 *Hunting with Flint-Tipped Arrows: Results and Experiences from Practical Experiments*. John Donald Publishers, Edinburgh

Hamm, Jim
2007 *Bows & Arrows of the Native Americans: A Step-By-Step Guide to Wooden Bows, Sinew-Backed Bows, Composite Bows, Strings, Arrows, & Quivers*. Lyons Press, Guilford, CT.

Hassrick, Royal B.

Knecht, Heidi (ed.)

Tomka, Steve A.

Waguespack, Nicole M; Surovell, Todd A.; Denoyer, Allen; Dallow Alice; Savage Adam; Hyneman, Jamie; Tapster, Dan

**Timeline**

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<td>February 18 – March 11, 2017</td>
<td>Analyze Data</td>
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<td>March 29 – April 2, 2017</td>
<td>Present at the SAA Conference</td>
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<td>April 8, 2017</td>
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Wingert - Missing the Point: Identifying Perishable Projectiles in the Archaeological Record from Bone Damage
Budget

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\(^1\)Note that the per diem set by the federal government is $105 for March and April, 2017 ($84 for meals only).

\(^2\)Other source of funding: Department of Anthropology & Sociology

Biographical Sketch of Student
I am an anthropology major focusing in archaeology. My hometown is just an hour north of Kutztown in Lehighton, Pennsylvania. I have become fascinated with experimental archaeology and plan on continuing my studies in an experimental archaeology program at either the University of Exeter or University College Dublin, in experimental archaeology. This project will give me great experience for my future. Not only will the logistics of conducting these experiments provide great insight into what I might be looking at in my graduate thesis, but it will also help me learn from the best, both in our university and at the Annual Meeting of the Society for American Archaeology in Vancouver.

I have attached a photograph of myself to you in a separate jpg file.

Published Abstract
The abstract (included above) will be published in the final program for the 82nd Meeting of the Society for American Archaeology.
Ms. Sara Wingert  
181 College Blvd.  
Kutztown, PA 19530  

Dear Ms. Wingert  

I want to thank you again for participating in the Second Fall Archaeology Workshop at Meadowcroft Rockshelter and Historic Village on Saturday, October 7. The success of the workshop is contingent upon the willingness of scholars such as yourself who are willing to take the time to share their expertise with advocationalists, the public, and other researchers from western Pennsylvania. Your presentation on Identifying Perishable Projectiles in the Archaeological Record from Bone Damage was an excellent example of how experimental archaeology should be used. I hope that we might be able to call upon you again to speak at a future meeting. The tentative theme for 2018 is Technology in the Service of Archaeology.  

Best Regards,  

John P. Nass, Jr., Ph.D.  
Director, Anthropology Program  
Department of History, Politics, Society, and Law  
California University of Pennsylvania  
California, PA 15419  
(724) 938-5726  
nass@calu.edu
Funding for My Research
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<th>Student ID #:</th>
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<td>Email:</td>
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_Kutztown Undergraduate Research Fund Guidelines_
2nd Annual Workshop in Archaeology at Meadowcroft Rockshelter and Historic Village
MISSING THE POINT: IDENTIFYING PERISHABLE PROJECTILES IN THE ARCHAEOLOGICAL RECORD FROM BONE DAMAGE

MY QUESTION

MY APPROACH

MY MATERIALS
ACKNOWLEDGMENTS

I would like to thank my professors in the Department of Anthropology & Sociology for their support with special thanks to Dr. Minihaha for his assistance and guidance. I also thank my family and Patrick Deverney for their assistance in conducting the experiment. I really thank my Dr. Bean for making me to this interesting. Funding for this project was provided by Brandon University.
MAKING A POINT: IDENTIFYING PERISHABLE PROJECTILES IN THE ARCHAEOLOGICAL RECORD FROM BONE DAMAGE

SARA WINGERT
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<th>Name:</th>
<th>Sara Wingert</th>
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Comparing Bone Damage from Projectile Points to Bone Damage from Other Taphonomic Agents

Project Title
Student Name: Sara Wingert
Faculty Advisor: Dr. Kori Newlander
Program: Anthropology
Project Cost: $900

Abstract
For decades, archaeologists have used replicative studies to develop a better understanding of prehistoric technology. Many replicative studies have focused on the manufacture and use of stone projectiles, resulting in a detailed understanding of the design of hunting weapons in relation to various features of the environment and, in turn, elegant explanations for technological change over time. Yet if ethnographic accounts are any indication, lithic technology was only one (perhaps minor) part of many prehistoric technological systems. It is likely, then, that the technological changes archaeologists commonly document through their morphometric analysis of stone projectile points occurred against a backdrop of perishable technologies often not represented in the archaeological record. To assess the ability of archaeologists to “see” perishable projectiles in the archaeological record, I conducted a replicative experiment focused on the damage projectiles inflict on animal bones. I found that wood-tipped, fire-hardened, and stone-tipped arrows produced distinctive damage signatures. Here, I compare the results of my experiment to the bone damage inflicted by other taphonomic agents (e.g., bear, beaver), defining damage signatures that will allow archaeologists to re-examine the transition from the dart to the bow and arrow in eastern North America.

Introduction
For decades, archaeologists have used replicative studies and experiments to help them better understand prehistoric technologies and behaviors. By making copies of prehistoric technologies, an archaeologist can gain insight into how these items were made and used in ancient times. Experiments with replicated technologies often yield clues, including the otherwise incomprehensible marks (e.g., cuts, scrapes, and abrasions) they make during use, that aid in understanding their role in past societies. Replicative studies and experiments provide archaeologists with fundamental insights into prehistoric material culture (Coles 1966). By helping archaeologists understand how prehistoric technologies were made and used, replicative studies also help archaeologists develop explanations for technological change.
88th Annual Meeting of the Society for Pennsylvania Archaeology
Missing the Point: Identifying Perishable Projectiles in the Archaeological Record from Bone Damage

Project Title

Student Name: Sara Wingert
Faculty Advisor: Dr. Khori Newlander
Program: Anthropology
Project Cost: $900

Abstract

For decades, archaeologists have used replicative studies to develop a better understanding of prehistoric technology. Many replicative studies have focused on the manufacture and use of stone projectiles, resulting in a detailed understanding of the design of hunting weapons in relation to various features of the environment and, in turn, elegant explanations for technological change over time. Yet if ethnographic accounts are any indication, lithic technology was only one (perhaps minor) part of many prehistoric technological systems. It is likely, then, that the technological changes archaeologists commonly document through their morphometric analysis of stone projectile points occurred against a backdrop of perishable technologies often not represented in the archaeological record. Here, I report on a replicative experiment designed to investigate whether archaeologists can “see” perishable projectiles in the archaeological record based on the damage they inflict on animal bones. Specifically, I examine if wood-tipped, fire-hardened, and stone-tipped arrows produce distinctive damage signatures. I use the results of my study to re-examine explanations offered to account for the transition from the dart to the bow and arrow in eastern North America.

Introduction

For decades, archaeologists have used replicative studies and experiments to help them better understand prehistoric technologies and behaviors. By making copies of prehistoric technologies, an archaeologist can gain insight into how these items were made and used in ancient times. Experiments with replicated technologies often yield clues, including the otherwise incomprehensible marks (e.g., cuts, scrapes, and abrasions) they make during use, that aid in understanding their role in past societies. Replicative studies and experiments provide archaeologists with fundamental insights into prehistoric material culture (Coles 1966). By helping archaeologists understand how prehistoric technologies were made and used, replicative studies also help archaeologists develop explanations for technological change.
- TALK ABOUT ME

- investigate whether we can “see” perishable projectiles in the archaeological record based on the damage they inflict on animal bones
- examine if wood-tipped, fire-hardened, and stone-tipped arrows produce different damage signatures

- In the absence of remarkable preservation, my challenge was how to identify the use of wooden arrows in the archaeological record
- replicative study
- I fired wooden, fire-hardened, and stone-tipped arrows into deer ribcages and ballistics gel targets containing deer ribs to see if these arrows left distinctive signatures when impacting bone

- bows and arrows used by a sample (n = 34) of Native American groups from across North America
  - based on my ethnographic survey
    - bows from ash
    - braided imitation sinew (substituting for animal sinew) for the bow string
    - flat bow: most popular style in the Eastern Woodlands
      - one replicated bow broke early in the experiment, so I used a fiberglass recurve bow
    - arrows: dogwood
      - feathers: red hawk
    - stone points: chert
    - glue: wood glue (substitute for hide glue)
    - target: large game—white tailed deer (popular hunting game in Eastern Woodlands)
- bows
  - typically measured 3-6 feet (0.91-1.82 m) in length, varying in relation to the size of the archer
  - Mine: measuring 3.5 and 3.8 feet (1.07 and 1.16 m) in length
- arrows
  - 22-24 inches in length
  - 0.375 inches (10 mm) in diameter
- construction
  - bows
    - draw knife
  - arrows
    - draw knife
    - steam to straighten

- shot arrows into the ribcages of white-tailed deer covered in hide from a distance of 10 feet (3 m)
- placed the ribcages on hay bales to raise the target high enough to duplicate the angle of an arrow shot at deer in the wild

- to ensure impact with bones, I conducted a second experiment in which I shot arrows into ballistics gel targets that contained the deer ribs from a distance of 2 feet (0.6 m)
- ethnographic data suggest that hunters often shoot from a distance of 30 feet (10 m), but the use of shorter distances in my experiments allowed me to maximize accuracy and minimize the loss of energy over distance
  - could simulate a more powerful bow shot from a longer distance
Undergraduate Research Committee Grant Budget

Student name: Sara Wingert
Research project title: Comparing Bone Damage from Projectile Points to Bone Damage from Ot

street address: 181 College Blvd
city, state, and zip code: Kutztown, Pennsylvania 19530
phone number: 484-632-9941
email address: swing892@live.kutztown.edu
Faculty advisor: Dr. Khori Newlander
Faculty email: newlander@kutztown.edu

grant award date: 10/27/2017
Total budget: $900.00

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Title: Missing the Point: Identifying Perishable Projectiles in the Archaeological Record from Bone Damage

Author: Sara Wingert (Department of Anthropology & Sociology)

Abstract: For decades, archaeologists have used replicative studies to develop a better understanding of prehistoric technology. Many replicative studies have focused on the manufacture and use of stone projectiles, resulting in a detailed understanding of the design of hunting weapons in relation to various features of the environment and, in turn, elegant explanations for technological change over time. Yet if ethnographic accounts are any indication, lithic technology was only one (perhaps minor) part of many prehistoric technological systems. It is likely, then, that the technological changes archaeologists commonly document through their morphometric analysis of stone projectile points occurred against a backdrop of perishable technologies often not represented in the archaeological record. Here, I report on a replicative experiment designed to investigate whether archaeologists can “see” perishable projectiles in the archaeological record based on the damage they inflict on animal bones. Specifically, I examine if wood-tipped, fire-hardened, and stone-tipped arrows produce distinctive damage signatures. I use the results of my study to re-examine explanations offered to account for the transition from the dart to the bow and arrow in eastern North America.
Missing the Point:
Identifying Perishable Projectiles in the Archeological Record Through Bone Damage
INTRODUCTION

- Archaeologists use replicative experiments in order to better understand prehistoric technologies and behaviors. why???

For decades, archaeologists have been using replicative studies and experiments to help them better understand prehistoric technologies and behaviors. By making copies of prehistoric items, an archaeologist can gain some insight into how these items were produced and/or used in ancient times. These experiments also often yield clues that aid in the interpretation of objects, or their marks, that would otherwise seem incomprehensible. Attempting to duplicate objects, their effects, or their marks experimentally helps archaeologists more easily understand material culture.¹

- In this study I conduct a replicative experiment assessing *** (bows and arrows and impact damage). why does this matter???

In this study, I conduct a replicative experiment assessing whether we can distinguish perishable projectiles in the archaeological record based on the damage they inflict on bone. Specifically, we will investigate if wood-tipped, fire-hardened, and stone-tipped arrows produce distinctive damage signatures on bone.

- It will help archeological signatures – experiment can see the process and wear and see the connection

The experiment allows us to see the process and wear of the weapon variations, creating patterns that we can connect and trace back in the archaeological record. The data collected in this experiment will in turn, help identify archaeological signatures.

Papers and Things
• Search for signatures that we can then use to look at the record of technological change in (some part of N America) – all in regards to the adoption of the bow and arrow

These signature differences can then be used to look at the technological change of Native Americans in regards to the adoption of the bow and arrow.

EXPERIMENTAL DESIGN

ethnographic stuff – tables and things and doo-dads

previous experiments

my experiment!

ANALYTICAL SECTION ON BONE DAMAGE?

look at other literature on microscopic analysis or taphonomy to get framework to understand signature we would be getting and analyzing.

RESULTS AND DISCUSSION

damage (before and after) – is wooden projectiles distinctive from damage from other things

discussion—are the signatures distinctive???

CONCLUSION AND IMPLICATIONS

what does this reveal and why does it matter (link back to the archaeological record of the adoption of the bow and arrow from wherever)???
MISSING THE POINT: IDENTIFYING PERISHABLE PROJECTILES IN THE ARCHAEOLOGICAL RECORD FROM BONE DAMAGE

Sara Wingerter
Department of Anthropology & Sociology, Bucknell University, Lewisburg, PA

 INTRODUCTION

Why Look for Perishable Projectiles in the Archaeological Record?

THE EXPERIMENT

CONCLUSION & IMPLICATIONS
I am studying anthropology, focusing in archaeology, at the Kutztown University of Pennsylvania. I am double minoring in Pennsylvania German Studies and German Culture and Communication. My hometown is just a half-hour north of Allentown in Lehighton, Pennsylvania. I have become fascinated with experimental archaeology and am currently working on my Honors Thesis project on projectile technology which I have presented at two conferences so far: the 82nd Annual Meeting of the Society for American Archaeology in Vancouver, British Columbia, Canada and the 88th Annual Meeting of the Society for Pennsylvania Archaeology in Harrisburg, Pennsylvania. I plan on continuing my studies in an experimental archaeology program at either the University of Exeter or University College Dublin, in experimental archaeology. Some activities I’m involved in many on-campus clubs and activities as well as some in my hometown as well. On campus, I am a Community Assistant (Resident Advisor) of Honors Hall, I am an intern at the Pennsylvania German Cultural Heritage Center, a member of the Kutztown University Presidential Ambassadors, Anthropology Club Vice President, and Kutztown Quidditch Club Vice President, and I am a tutor for the Physical (Biological) Anthropology course. I have also been named STAR student of the Anthropology & Sociology Department and have received a KU Bears research grant for a project I worked on over the summer of 2016. In my community at home, I am the Vice President of my Borough’s Shade Tree Commission, an Assistant Scout Master of Boy Scout Troop 82, and a volunteer camp counselor at Camp Trexler, a local Boy Scout summer camp.
Society for Pennsylvania Archaeology Newsletter
Fall 2018
Student Profile

My name is Sara Wingert. I am a recent graduate from Kutztown University, where I majored in anthropology and minored in Kutztown's unique program in Pennsylvania German Studies as well as German Culture and Communication. As a student at Kutztown, I had the opportunity to participate in the archaeological fieldwork at Stoddartsville, a 19th century milling village in northeast Pennsylvania. This experience confirmed my desire to continue to study archaeology.

As I learned about all of the diverse topics anthropologists study, I found that I am particularly interested in experimental archaeology. In the spring of 2016, I replicated and tested stone-tipped and wooden-tipped spears in order to understand their costs and benefits and the reasons for their use ethnographically and prehistorically. More recently, I replicated bows and arrows to examine if wood-tipped, fire-hardened, and stone-tipped arrows produce distinctive damage signatures when they hit animal bone. I am interested in determining if these different types of arrows produce distinctive damage, which could provide archaeologists with another line of evidence to document the adoption of the bow and arrow by prehistoric peoples around the world. I have had the great opportunity to present this ongoing research at several conferences, including: the 82nd Meeting of the Society for American Archaeology in Vancouver, British Columbia, the 88th Meeting of the Society for Pennsylvania Archaeology in Camp Hill, PA, the Second Annual Workshop in Archaeology at Meadowcroft Rockshelter and Historic Village in Avella, PA, and the 116th Meeting of the American Anthropological Association in Washington, D.C.

In addition to my archaeological research, I was also one of the first recipients of a KU BEARS research grant, which supported my work with Dr. Gregory Hanson transcribing radio plays for the project "Asseba un Sabina: A Pennsylvania Dutch Dialect Radio Play Series from the 1940s and 1950s." In recognition of my accomplishments at Kutztown, I have twice been awarded a Pennsylvania German Studies scholarship, named a STAR student in the Department of Anthropology and Sociology, and selected as a Presidential Ambassador for the university.

I remain active outside of the classroom as well, where I serve on the executive board for numerous campus organizations, including the Quidditch Team and the Anthropology Club. I am a Community Assistant in the Honors Residence Hall and an Honors mentor. I continue to serve my community as an Assistant Scoutmaster for Boy Scout Troop 82. And as Vice President for my borough's Shade Tree Commission, I helped plan and execute a project that resulted in the planting of 150 trees around my hometown of Lehighton, PA.

I will continue to study archaeology after Kutztown at University College Dublin in their unique MSc program in experimental archaeology and material culture. There is only one other program like this in the world, so getting into this program was very competitive and their Archaeology program is also ranked in the top 100 by QS World University Rankings by subject. I hope to apply for their PhD program in archaeology as well to continue my dream of becoming a professor by sharing my knowledge and experiences with the rest of the world.
Beginnings of My Research
Sara Wingert

Honors Capstone Proposal

7 September 2016

Missing the Point: Identifying Perishable Projectiles in the Archaeological Record

For my project, I would be investigating whether or not there is any significant identifiable bone lesions from different types of arrow points. I would also like to research if the bow size impacts the level of abrasions. To conduct my experiment, I will be studying how to accurately make both bows and arrows in order for my data to be valid. I will also be testing this experiment on animal bone in order to collect and compare my data.

This research is very significant to my field. I wish to further my education in experimental archaeology and since we do not offer specific courses for it here at Kutztown University, this experiment will really help me understand my roles and duties as an Experimental Archaeologist. This research is also significant to the field because there has never been a specific experiment done about this subject before, so it may deem be noteworthy to others in the field.

My advisor for the project is Dr. Khori Newlander. His role is to help guide me along and make sure I'm on track. He will also help make sure my data is accurate and accountable. Dr. Newlander is there to help me perform the experiment correctly.

There are some classes that I have taken so far that are beneficial to my project.

1. ANT 010 – Cultural Anthropology
   a. This course helps me understand the cultural significance of bows and arrows, arrow points, and bow size in the grand scheme of my experiment.
2. ANT 020 – Physical Anthropology
   a. This course helps me understand when bows and arrows came into play in our ancestral history as well as how a bow is used compared to our anatomy.

3. ANT 105 – Classical Archaeology
   a. This course gives me a basic understanding of earlier human societies through archaeology. (many of these cultures used projectile weaponry)

4. ANT 371 – Thinking about Things: Material Culture
   a. This course helped me understand what common objects means to a culture and how those meanings help define who they are. (bows and arrows are very significant and common in many cultures)

5. ANT 320 & 321 – Arch. Field Methods and Advanced Arch. Field Methods
   a. This course helped me gain a better understanding of archaeology as a whole.

Starting is project my junior year, instead of my senior, allows me extra time and room to explore more ideas surrounding my hypothesis. However, my timeline for the main portion of my project is simple. I hope to be able to present my WIPS presentation early in the spring semester of 2017 and present my entire Capstone project at the National Archaeology Conference in Vancouver, Canada in April, 2017. I will then have the rest of my senior year to perfect my paper. Also, I'm meeting with Dr. Newlander every Wednesday to go over and continue with my experiment.
Understandably, many archaeologists focus on stone tools. Given their durability, stone tools dominate the archaeological record. Yet ethnographic data indicates that perishable technologies, including perishable (i.e., wooden) points, were probably important components of past hunting technologies. In a previous study, I conducted a replicative experiment to assess if perishable projectiles can be identified in the archaeological record. Specifically, I investigated if wood-tipped, fire-hardened, and stone-tipped arrows produce distinctive damage signatures when they impact animal bone. I found that different arrow types produced slightly different impact damage.

These results are useful for investigating the archaeological record only if the bone damage caused by perishable projectiles is distinct from bone damage caused by other taphonomic agents (e.g., bear, beaver). While this comparison is ongoing, my preliminary analysis suggests that the bone damage due to stone-tipped and fire-hardened arrows are, indeed, distinct from the damage inflicted by other taphonomic agents. As my research continues, I will apply the archaeological signature of the use of perishable projectiles to an analysis of a faunal assemblage from eastern North America. Broadening our view of technology to include and recognize perishable projectiles in the archaeological of Eastern North America may reveal that the bow and arrow was adopted at different times and in different contexts than previously thought.

**Problem Statement**
Having demonstrated that different types of arrows produce distinctive marks when they impact animal bones, I am now investigating if these marks can be identified in the archaeological record. In other words, is the bone damage inflicted by different types of arrows distinguishable when compared to other taphonomic agents? If so, then these damage signatures can be used to investigate faunal assemblages from archaeological sites looking for evidence of the use of, in particular, perishable projectiles. Identifying these damage signatures may help us better understand when and why the bow and arrow was adopted in Eastern North America.

**Methods**
I am currently viewing the bone damage at 30X magnification, describing in detail the damage resulting from different projectiles. I am comparing these data to marks produced by various other taphonomic agents present in Eastern North America, including beavers, porcupines, bears, and birds, to see if the marks are distinctive. While this comparative analysis is ongoing, my preliminary results have demonstrated that the damage inflicted by the projectiles is distinct from several of these taphonomic agents. I will apply the results of this comparison to the analysis of a faunal assemblage from eastern North America, looking, in particular, for evidence of the use of perishable projectiles.

**Materials**
Presently, I am examining the bone damage using a Bausch and Lomb binocular microscope. The bones under analysis were shot by wooden, fire-hardened, and stone arrows in experiments I carried out earlier this year (Spring 2017). I am comparing these data with bone damage caused by other taphonomic agents, like wolf canine punctures and porcupine scrapes. I will then obtain a faunal assemblage from an archaeological site in Eastern North America from another university or the Pennsylvania State Museum to look for the damage signatures identified in this analysis.
**Data / Results to Date**
I carried out the replicative experiment on which my present analysis is based in Spring 2017. I found that the bone damage caused by fire-hardened and stone-tipped arrows is macroscopically and microscopically distinctive. Bone damage caused by wooden-tipped arrows, however, is not easily observable. This result suggests that fire-hardened arrows may be observable in the archaeological record, even if the arrows themselves do not preserve, based on the damage these arrows leave on animal bones. This archaeological signature will prove useful if it is distinct when compared to bone damage caused by other taphonomic agents. I am engaged in this comparison presently.

**Conclusions**
My replicative experiment has revealed distinct material correlates of different types of arrow points, specifically the impact damage imparted to animal bones. By comparing the impact damage imparted by arrows with the damage caused by other taphonomic agents, I will be able to define archaeologically-recoverable signatures that will allow me to recognize the use of perishable projectiles in the archaeological record of Eastern North America. I will assess the reliability of these damage signatures by examining a faunal assemblage from Eastern North America. These signatures may improve archaeologists' ability to calculate when the bow and arrow was adopted. We may find that perishable projectiles, like wooden and fire-hardened arrows, were in use before stone-tipped arrows. Standard explanations for the adoption of the bow and arrow in North America emphasize the performance advantages of this technology in relation to changes in species hunted over time (e.g. Tomka 2013). If wooden-tipped and fire-hardened arrows were used as well, then archaeologists would have to look again at when and why this significant technological change occurred.

The results of this study will be presented at the 116th Meeting of the American Anthropological Association in Washington, D.C. I anticipate publishing my research in *The Journal of the National Association of Student Anthropologists (NASA)*.

**References**
Bohr, Roland

Coles, John M.

Densmore, Frances
1929 *Chippewa Customs*. Ross & Haines, Minneapolis.

Fischer, Anders
1985 *Hunting with Flint-Tipped Arrows: Results and Experiences from Practical Experiments*. John Donald Publishers, Edinburgh

Hamm, Jim
2007 *Bows & Arrows of the Native Americans: A Step-By-Step Guide to Wooden Bows, Sinew-Backed Bows, Composite Bows, Strings, Arrows, & Quivers*. Lyons Press, Guilford, CT.

Wingert – Comparing Bone Damage from Projectile Points to Bone Damage from Other Taphonomic Agents
Hassrick, Royal B.  

Knecht, Heidi (ed.)  

Tomka, Steve A.  

Waguespack, Nicole M; Surovell, Todd A.; Denoyer, Allen; Dallow Alice; Savage Adam; Hyneman, Jamie; Tapster, Dan  

**Timeline**

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<td>Analyze Data</td>
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<td>October 28 – November 7, 2017</td>
<td>Compare Data to other Taphonomic Agents</td>
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<tr>
<td>November 7 – November 28, 2017</td>
<td>Acquire Faunal Remains (possibly from the Pennsylvania State Museum)</td>
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<td>November 29, 2017</td>
<td>Present at the AAA Conference</td>
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**Biographical Sketch of Student**

I am an anthropology major focusing in archaeology. My hometown is just an hour north of Kutztown in Lehighton, Pennsylvania. I have become fascinated with experimental archaeology and plan on continuing my studies in an experimental archaeology program at either the Wingert – Comparing Bone Damage from Projectile Points to Bone Damage from Other Taphonomic Agents
University of Exeter or University College Dublin, in experimental archaeology. This project will give me great experience for my future. Not only will the logistics of conducting these experiments provide great insight into what I might be looking at in my graduate thesis, but it will also help me learn from the best, both in our university and at the Annual Meeting of the Society for American Archaeology in Vancouver.

I have attached a photograph of myself to you in a separate jpg file.

**Published Abstract**
The abstract (included above) will be published in the final program for the 116th Meeting of the American Anthropological Association.
COMPARING BONE DAMAGE FROM PROJECTILE POINTS TO BONE DAMAGE FROM OTHER TAPHONOMIC AGENTS

SARA WINGERT
Sara’s passion as an Anthropology major. Her research allows her to replicate and use past cultures’ materials to learn about their way of life. What’s under the surface will surprise you, because there’s no limit to what you can do.