

# Susquehanna Chapter Wooden Canoe Heritage Association



## The Pennsylvania Dugout Canoe Project



Native Americans living in Pennsylvania did not have access to the long sheets of bark found on birch trees farther to the north that the natives of that area used to make canoes. Instead, they had to use the trunks of large trees to make dugout canoes. Following is a description of a project to make a dugout canoe using the techniques and tools that would have been available to the early Native Americans.

The Pennsylvania Dugout Canoe Project

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Pennsylvania Historical and Museum Commission

Bureau for Historic Preservation

Society for Pennsylvania Archaeology Meeting

5/6/06

Abstract

The Commonwealth's Archaeology Program (CAP) of the Pennsylvania Historical and Museum Commission has carved three dugout canoes over the past decade. These have been done as public programs using historic and or prehistoric replicated tools. The sight of men sometimes dressed in loin cloths, wood chips flying, and fire attracts a lot of attention, and these programs have been very popular with the public. The resulting dugouts have been included in a variety of presentations. While the children are sitting in the canoe, we get to talk to the parents about archaeology and preserving sites. We are in the process of building our fourth dugout and we would like to document the experience. It will be generally patterned after the Mud Pond dugout which is prehistoric in age (AD 1250) and on exhibit at the Pennsylvania State Museum. This presentation will provide background on dugouts in Pennsylvania and it will describe the carving process, including an analysis of the wear patterns on the stone tools.

The Commonwealth's Archaeology Program (CAP) of the Pennsylvania Historical and Museum Commission has carved three dugout canoes over the past decade. These have been done as public programs using replicated historic and/or prehistoric tools. The sight of people sometimes dressed in loin cloths, wood chips flying and fire attracts a lot of attention and these programs have been very popular with the public. The resulting dugouts have been included in a variety of presentations. While the children are sitting in the canoe, we get to talk to the parents about archaeology and preserving the archaeological record.

The purpose of the following is to present the results of CAP's fourth dugout canoe building experiment. This project was part of the PHMC's Pennsylvania Archaeology Month celebration, in a partnership with Fort Hunter Park, the Allegheny National Forest and Michaux State Forest. The event was held on the grounds of Fort Hunter Park as a public demonstration illustrating the use of stone tools and the recreation of prehistoric technology.

There are three main goals in this presentation: to provide some background on dugout canoes found in the East, to describe our methodology; and to illustrate the results, especially the wear patterns on the stone tools. In addition, the project has caused us to begin to examine the role of stone adzes in the prehistoric tool kit.

As a simple definition, a dugout canoe or, simply, a "dugout" is a hollowed-out log used as a watercraft. It is typically made in a cycle of burning and cutting that includes repeatedly burning the log with a controlled fire and then scraping and chopping out the char and softened wood out with a variety of tools that can be as diverse as shells, wooden tools and stone adzes.

The dugout is likely the earliest form of constructed watercraft in the world, and specimens in Europe have been dated to over 9,000 years old. Considering that humans voyaged to Australia at least 50,000 years ago, dugouts are probably at least that old. In North and South America, dugouts have been the main form of

water travel since Native Americans arrived from Siberia over 16,000 years ago. In addition, there has been recent speculation that these early people first arrived by boat. The Northwest Coast seems to have the greatest variety of dugouts with some of these being very large and elaborately designed. In Eastern North America, dugouts are preserved in the lakes and bogs of Florida, Louisiana, North Carolina, Kentucky, Ohio and Pennsylvania. The oldest of these date to over 6,000 years before the present.

For example, in 1985, in Lake Phelps, North Carolina, 30 dugouts were discovered when the lake was lowered along a stretch less than 2 miles long. Nineteen canoes were carbon dated to between 4400 BP and 500 BP (three dated to the Late Archaic, 2 were Early Woodland, 11 were Middle Woodland and three were Late Woodland). Amazingly, one was found with a broken Early Woodland pot, half of which was found inside the dugout, with half lying outside of it.

The largest dugout was 37 feet long, and all were made from the wood of bald cypress trees. Unfortunately, measurements for the individual dugouts are not yet available.

The largest collection of dugouts from a single site in North America was uncovered from Newnan Lake in Florida where over 100 "log boats" were found (Wheeler *et. al.* 2003). This is a very significant collection as they represent a range of variation in sizes and shapes from Archaic through the Woodland periods. The collection was extensively carbon dated and 41 were placed between 2300 and 5000 BP. Charring was evident on the interiors and two were charred on the ends, suggesting that fire was also used to shape the outside. Moreover, using fire to shape the outside is supported by ethnographic descriptions. Tool marks were not observed on any of the vessels.

The Newnan Lake dugouts ranged from 4.57 to 8.6 meters long and averaged 7.06 meters. Average widths were 0.58 meters. Some were blunt on both ends, some had a slightly beveled bow and stern, and some had a distinctive overhanging platform at both ends. Wheeler *et. al.* felt that the variety of bow and stern shapes, all from the Archaic period, were not temporally diagnostic as previously suggested by Newsom and Purdy (1990). According to Wheeler *et. al.* (2003), the most distinguishing characteristic was a low partition or thwart in the middle or at the end on 19 of the dugouts. Although these elements may have been foot holds or as structural supports, their true purpose is problematical. Of those dugouts where the wood type could be identified, 31 were made from white pine and one was cypress. In the analysis of this collection, Wheeler *et. al.* (2000) used the shallow depths and narrow beams as evidence that these dugouts would have not carried heavy cargos. They were likely best used with poles rather than paddles and in a standing position in relatively shallow water.

Other notable finds in the East include an oak dugout reported by Brose and Greber (1982) from Ohio. This example was dated to 3550 BP, and measured 6.1 meters long by 1.1 meters wide. This dugout is notable for being made from oak and for its size, especially its width and depth. Brose and Gerber believe this dugout functioned best when hauling large cargos. Worn and polished areas on the boat's interior were interpreted as the result of the paddlers constantly kneeling, indicating that this dugout was probably paddled rather than poled. In addition, compared to the Newnan Lake specimens, which were rarely more than 20 cm deep, this example was 36 cm deep which is probably more conducive to paddling

than poling.

The discovery of all of these canoes reinforces the fact that dugouts were very common in prehistory and significant in the movement of goods, people and ideas. This idea has been detailed in three recent *American Antiquity* articles on dugouts and the impact of water travel.

Based on historic accounts and documents, most dugouts are less than 6 meters long but some are over 15 meters or larger. In the Southeastern United States, the 16<sup>th</sup> century Spanish explorer De Soto encountered dugouts on the Mississippi River containing 75 to 80 warriors with 25 paddlers on each side. These vessels may have approached 100 feet in length. Kandare (1984) reports that some of these were painted and some were carved with designs of snakes and fishes. Dugouts from the Mississippi Valley sometimes contain decks, seats or awnings. Being made from a single log, they were obviously very heavy; however, there are several reports that they were fast and navigable. According to Kandare (2000), they were used in local and distant trading, for fishing, hunting or gathering expeditions, and in warfare.

In Pennsylvania, less than 20 dugouts have been documented in bogs and lakes, primarily in the Pocono region of Northeastern Pennsylvania. Based on tool marks and narrow side walls, the majority of these are historic in age and were made with metal tools. According to Baker (1998), the larger number of historic dugouts compared to prehistoric ones may represent an intensification of the fur trade into northern Pennsylvania by Native Americans during the 17<sup>th</sup> century. It is believed that, in pre-contact times, many of these lakes would have had at least one resident dugout for hunting, fishing and gathering. Since dugouts are not very portable over land, they were probably not moved between lakes; they were probably stored year-round at the lake where they were built. As we have learned, once they are taken out of the water, they can crack and deteriorate. There is some evidence that, in the winter, they may have been sunk with rocks below the freeze line to avoid being crushed by the ice and to keep them from otherwise being damaged by the freeze-thaw cycle and other weathering processes.

Although, the more portable birch bark canoe may be more recognizable to the public as a Native American watercraft, these were probably rarely used in Pennsylvania. These could only be made in regions to the north where birch trees grew to a sufficient size to allow for their construction from this material.

Based on early descriptions of Native American vessels, including the well known 16<sup>th</sup> century descriptions by John White and Arthur Barlowe, we have some idea of construction methods and additional variations in size and shape. Both White and Barlowe describe a process of burning and scraping with shells to fashion dugouts. Other than for cutting down the tree, they do not reference the use of stone axes or adzes in dugout construction.

Our experiment in dugout construction took the form of a public exhibit and we had the opportunity to interact with over 6,000 visitors over a 17-day period.

One of our goals was to use tools of the type that would have been available to prehistoric peoples in Pennsylvania. Towards that goal, BHP archaeologists and Mr. Jack Cresson, a professional experimental archaeologist, constructed one metarhyolite and three greenstone meta-basalt adzes which were subsequently hafted to hardwood handles. The greenstone specimens were ground and polished and shaped to plano-convex cross sections. The rhyolite specimen was bifacially flaked and thus biconvex in cross section. Bit angles were between 30 and 45 degrees. Grinding each of the greenstone basalt tools required an estimated eight hours to complete. However, the most difficult aspect of making these tools was hafting them to their handles. In our first attempts, we attached the adze to the bottom of a forked branch. The handle broke quickly in this location and we changed the placement to the top of the fork. This position worked well but the tools became loose and required reattachment. With some experimentation, the most successful method consisted of sinew, covered with rawhide and glued with pine pitch. However, to expedite the experiment, at least one of the adzes was secured with commercial twine.

To construct the dugout, we began with a pine log 6.15 meters in length. The log was graciously donated and delivered by Michaux State Forest staff. The pine had blown down during a storm and then lain on the ground for approximately seven months. As a general model for the design, we used a ca. AD 1250 dugout from Mud Pond, Luzerne County, on display in The State Museum of Pennsylvania. Although much deteriorated, this vessel measures approximately 5.16 meters long, 0.43 meters wide and 0.27 meters deep. It appears to be blunt on each end and apparently it did not have decks or seats carved into its main body.

Our work lasted 17 days with at least three people working six to eight hours each day. In the beginning, the ends of the log were cut and charred to bevel the bow and the stern. Caution was needed during this procedure to avoid excessive thinning in these areas. The bow and stern were finally shaped with the adzes. The top of the dugout was dished out by alternating between burning and chopping/scraping the charred wood. The firing process facilitates the removal of wood but with the last firing, it also hardened and preserved the wood. By the day of burning, the side walls were sufficiently thinned so that the top of these areas (rails) were covered with clay prior to each burning to prevent additional charring. Each morning the clay insulation was applied to the top of the gunnels and a fire was started the length of the dugout and allowed to burn for two to four hours. The fire was allowed to burn down and the charred material was completely removed through scraping with beveled pieces of wood and finally with the stone adzes.

We found that a socketed piece of unmodified siltstone also worked to scrape the dugout walls. The worked progressed slowly and carefully so as not to overly thin the walls. We averaged less than 2 centimeters of wood being removed each day. In the end, the rough edges of the interior were rubbed with pieces of sandstone to reduce splinters and increase comfort. The final treatment involved applying a coat of pine tar mixed with hot wood ash as a sealer, after which it was smoothed by abrading with fine wood chips, followed by a hand-rubbing with medium-coarse sand.

Cutting with the adzes worked very well and the charred wood could be removed with a couple of blows. Knots were the hardest parts of the log to cross-

cut, followed by the heart wood. Initially the tools' edge angles were overly acute and chipped or broke quickly. Once the edge angles were increased, they did not incur any significant damage; however, within a few hours of use striations began to appear on the greenstone specimens. Under low power magnification, it was clear that the metarhyolite piece had developed a polish but no striations. The edges of the greenstone adzes did not require re-sharpening but, after 17 days, they were heavily striated. Considering the log was a soft wood, we were surprised at the amount and type of wear on the adze bits. The small hinge fractures were expected but not the striations. The knots and heart wood may have been the main cause, but what was the agent within the wood which actually produced the striations? Our only thought was that there may be something in the pine pitch which is sufficiently hard to create striations or maybe it is the silica-based phytoliths. According to some, pine contains more silica phytoliths than most trees.

In our experiment, we completed the scraping with a greenstone adze and beveled pieces of wood. But, having done the work, we now feel confident in saying that the vast majority of that labor could have been completed with shell and wooden scraping tools and the adzes were not necessary. Had such stone tools not been available, the dugout could have still been made.

From the beginning of our project, we had an assumption that adzes were an integral part of canoe-making and could be considered as a part of a canoe-making tool kit of sorts. We were impressed with the Dalton and Laurentian adzes and assumed that they reflected a proliferation of dugouts and water travel. Further, part of our assumption also rested on the discovery of a cache of nine adzes, axes, and preforms (specimens in progress), in a buried Late Archaic context on City Island in the 1990s. Based on that context, we had hypothesized that these objects were used in making dugouts that would have been paddled on the Susquehanna River. And another part of that assumption rested on the comparison with later metal counterparts used in various types of woodworking. But is this correlation of dugout canoes and adzes true? Or could it vary regionally depending on what resources are available?

While the historic accounts from Virginia and North Carolina only reference the use of bivalve shells, these accounts are of Coastal Algonkians living in an environment where the shell material was abundant and easily replaceable, and comparable sources of suitable stone for production of axes and adzes was generally absent. However, a perhaps compelling reason that adzes may have been used for this purpose in non-coastal areas is the reverse of this situation: the availability of the proper stone materials inland, and the associated lack of renewable sources of the suitable shell. Nonetheless, the canoes could have been made without using heavy stone tools.

The wear patterns on the greenstone basalt adzes were relatively distinctive. With the assistance of Janet Johnson and Steve Warfel of the State Museum, Section of Archaeology, for comparative purposes we examined a sample of adzes in the collections. Adzes are not systematically catalogued separately from other ground and polished tools and we ended up going through 4 boxes of approximately 200 celts to find less than 20 adzes. As expected, they are a relatively rare tool type. They were mainly made from quartzite, sandstone and greenstone basalt and are found in a variety of shapes. There were only two

specimens of beveled adzes and only two gouges in the entire collection. The wear patterns on our experimental pieces were regularly spaced and perpendicular to the bit edge. However, the depth and width of these striations are irregular. Many of the specimens in the collection exhibited edge damage, usually in the form of chipping and hinge fractures. Striations were also frequently evident but they were commonly parallel to the bit edge and very regular in size and spacing. We feel these were the result of sharpening rather than use wear. Only one specimen had similar striations, unfortunately, this was a quartzite piece and harder than our greenstone specimens so the comparison is not exactly equal.

We definitely need to look at a larger sample but the preliminary conclusions are that the adzes in our collections were not used to cut large amounts of pine and therefore adzes are not part of a dugout making tool kit.

To further investigate the role of adzes in dugout production we also examined the distribution of these tools in the archaeological site survey files. Adzes are recorded on 136 sites but only half of these sites are found on major streams or rivers. This suggests that they were frequently used in upland settings and not dugout construction. However, we must caution the quality of this data. When Janet Johnson attempted to find these specimens in our collections, she frequently found artifacts that were incorrectly identified as adzes so this data is questionable.

Looking back on this project, we regard it as a success in public outreach and education, as well as a learning experience for those of us who created it and participated. Public outreach becomes more and more important each day as federal and state funding for archaeological resource protection dwindles, and as agencies and archaeologists themselves recognize that, as a profession, we have to get the word out better to both the general public and to our legislators. In this case, we had good positive publicity through television and newspaper coverage, and those who visited the event (several thousand people, all told) became fascinated with the subject matter.

With regard to the value of the experimental archaeology here, we do recognize that our “experiments” are tempered by factors such as having grown up in a modern, non-native culture, and other real-world factors that we often forget about. But nonetheless, we do believe that this exercise has taught us some valuable insights into the craft that went into producing the dugouts and, perhaps more importantly, it caused us to re-examine some of the documentary evidence and archaeological data. And that part has been productive in that it made us think harder about some of our assumptions.

Archaeologists seek to find archaeological signatures for specific activities to recreate real behavior from artifacts and features and their associations. Here, for an example, we were starting to assume that adzes may signal canoe-making or that they are a needed component a tool kit used in canoe-making. However, it is now apparent that this does not necessarily have to be the case, and points out the sometimes frustrating reality that end products can be the same even though different methods are used to achieve those ends.

In closing, we would like to say that we hope to be able to continue similar

outreach programs that serve to better inform both the public and ourselves. And we invite you come to see us this year at the 2006 Pennsylvania Farm Show where we will be displaying our dugout and hoping to convert as many visitors as possible to become fans of archaeology.