The Ringler Dugout Revisited

N'omi B. Greber, Katherine C. Ruhl, and Isaac Greber

Abstract

In late November 1976, the Ringler Dugout was accidently discovered during commercial dredging excavations in Mud Lake, part of Savannah Lakes, Ashland County, Ohio. The significance of the find was recognized by the excavator and the land owner and reported to the Cleveland Museum of Natural History. The craft was quickly moved to the Museum for preservation and study. A summary of the two phases of the seven and half year preservation process is given. The results of dynamic stability experiments carried out on a scale model at the Department of Mechanical and Aerospace Engineering at Case Western Reserve University demonstrate that the craft responds slowly and stably to rolling disturbances. It is a sturdy and heavy boat likely useful in shallow swampy waters. Three radiocarbon dates differ from the date reported in 1982. These place the making and use of the Dugout in the mid-seventeenth century.

The largest single object in the archaeology collections of the Cleveland Museum of Natural History is the Ringler Dugout. It was discovered by accident during dredging in Savannah Lake, Ashland County, Ohio. Freezing weather protected it immediately and fast actions initiated by David Brose, then Curator of Archaeology, got the Dugout to the Museum within a week. The preservation process was successfully completed seven and one half years later. Before this completion, the cast, seen in Figure 1, was made and became a focal point of the Ohio Pre-history Gallery. It is an excellent replica. Visitors can see for themselves the marks and features left from the construction of the Dugout and from its use. These are noted by the small white signs seen in Figure 1. The cast has well served important aspects of the Museum's mission: to interest and enlighten visitors and to research objects in our collections to obtain new information to be shared with both general and professional audiences.

As noted below in the section by Katharine Ruhl, a water-logged wooden craft is a challenge for museum conservators. Not only does the conservation process takes years, a successful outcome is not guaranteed. After problems arose in the first conservation phase, the fiberglass cast was made for exhibit and study. The staff of the Exhibits Division, then headed by Ellen Walters, produced the cast from a latex mold of the Dugout itself. The preservation process was successful. The Dugout is now on limited display and ready for future permanent exhibit. Details of its conservation follow below. In the second section,

Figure 1. Cast of the Dugout on exhibit in the Ohio Prehistory Gallery, Cleveland Museum of Natural History. The text on the white cards points out tool marks and burned or burnished areas on the floor of the craft.

N'omi B. Greber, Curator of Archaeology, Cleveland Museum of Natural History (ngreber@cmnh.org)
Katherine C. Ruhl, Research Associate, Dept. of Archaeology, CMNH (kcruhl@sbcglobal.net)
Isaac Greber, Professor Emeritus, Dept. of Mechanical and Aerospace Engineering, Case Western Reserve University (issac.greber@case.edu)

Journal of Ohio Archaeology 2:16-29, 2012
An electronic publication of the Ohio Archaeological Council
http://www.ohioarchaeology.org/joomla/index.php?option=com_content&task=section&id=10&Itemid=54

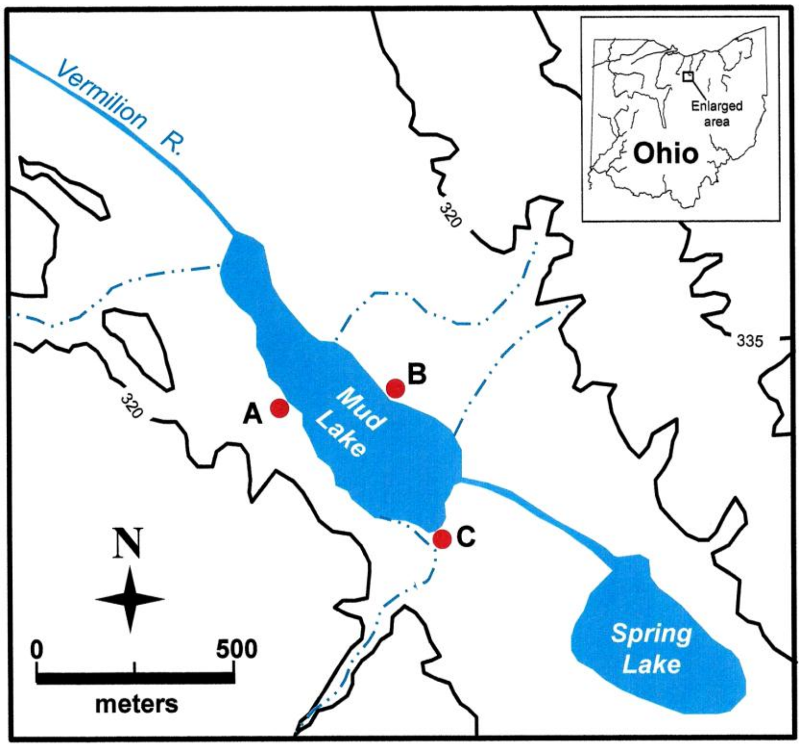


Figure 2. Map of Savannah Lakes, Ashland County, Ohio. A, location of Ringler Dugout (33AS80); B, location of 1957 dugout; C, location of 1962 dugout (contour interval in meters above mean sea level).

technical studies of the handling characteristics of the water craft conducted at Case Western Reserve University are described by Isaac Greber. Determination of the era when the Dugout was made and used concludes the paper.

Discovery and Preservation of the Ringler Dugout Canoe

Savannah Lake lies at the headwaters of the Vermillion River in Ashland County, Ohio, near the divide between the drainage systems of the Great Lakes to the north and the Ohio River to the south (Figure 2). On November 30, 1976, as Harold Slessman was dredging in the lake, removing peat with a clam-bucket scoop, he brought a large wooden object to the surface. Fortunately, he realized that he had found a dugout canoe, rather than simply an old log. He informed the Ringler family, who owned the property, and they in turn contacted Dr. David Brose at the Cleveland Museum of Natural History. Luckily a cold snap froze the Dugout and protected it from drying out on the shore of the lake (Figure 3). Within a week the Dugout had been moved to the Museum (Brose 1978; Brose and Greber 1982).

The Dugout was shaped from a large white oak log. The overall length is 690 cm, width 110 cm, and depth 60 cm. The interior depth was approximately 36 cm when the sides were intact. Both tool marks and scorched areas are preserved in the interior (Figures 4 and 5), showing that the Dugout was hollowed out by alternately burning and scraping, a prehistoric technique that has been described by early European observers. A flat platform was retained on either rounded end. Other features still visible are worn areas in the interior bottom, presumably where people sat or kneeled to propel the craft. On the edge of the highest part of the gunwale still preserved, a small semi-circular notch might have served as an oarlock. More problematic is a deep notch lower down in the opposite exterior side (Figure 6), perhaps also used to assist in paddling or poling the craft. The hull is elegantly shaped, with tapered bow and stern (Figure 7).

When excavated, the Dugout was entirely waterlogged. The acidic peat bog had protected it from air and destructive organisms during the years it had been submerged. Although the upper surfaces of both ends and some upper parts of the sides had decayed somewhat, most of the interior surface and the overall exterior shape of the hull were remarkably well preserved. Waterlogged wood may appear sound, even if the cell walls have become degraded, because the water fills and supports the cell structure. However, after excavation, drying out would naturally begin. When water evaporates during drying, a weakened cell structure can collapse unless appropriate conservation treatment is applied beforehand. Previously, two other dugouts had been recovered from Savannah Lake but, left on the bank to dry out, they had deteriorated rapidly (Brose 1978: Figure 3).

At the time of the discovery of the Ringler Dugout, the preservation of waterlogged wood and other organic materials was a topic of considerable interest and effort. Various treatments were developed for use on a range of objects (Gratten 1982; McCrawley 1977). Heroic efforts were required to preserve large, complex archaeological finds, such as the Vasa in

Figure 3. Dugout in the field, 1976.

Figure 4. Tool marks in the interior of the Dugout (CMNH Archaeology Archive Slide AT3270).

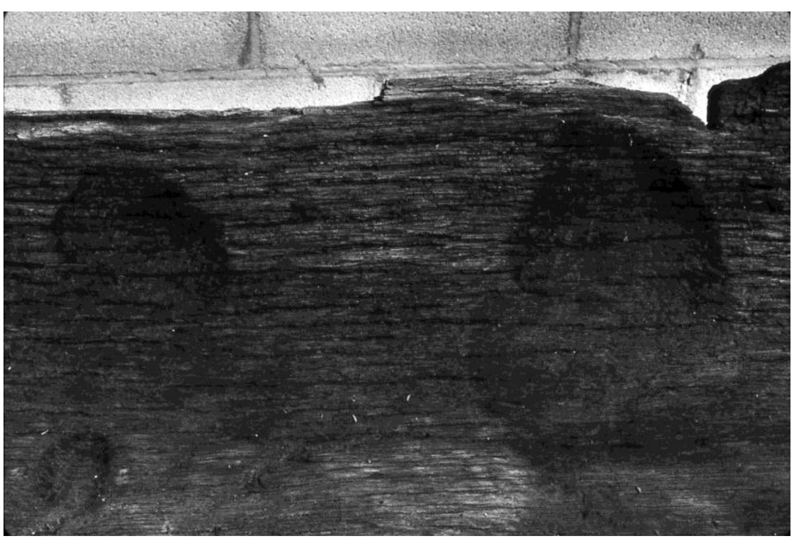


Figure 5. Burned areas in the interior of the Dugout (CMNH Archaeology Archive Slide AT3271).

Figure 6. Deep notch in the exterior of the Dugout (CMNH Archaeology Archive Slide AT3269).

Sweden and the Mary Rose in Britain. The time and expense involved were enormous. More recently, these considerations lead archaeologists to study many larger waterlogged artifacts *in situ* rather than attempt preservation (Wheeler et al. 2003).

Initially, an immersion technique was planned for the Dugout in order to replace the water in the cell walls of the wood with Polyethylene Glycol (PEG 540 blend). This water soluble wax prevents cell collapse upon drying. However, after a series of problems arose, Museum staff, in consultation with the Canadian Conservation Institute (David Gratten, personal communication, April 30, 1981), began a program of spraying the entire artifact with a solution of the PEG. Daily spraying was continued for eight months, using a gradually increasing concentration of the wax, until a buildup of wax on the surface showed that the wood could accept no more. Then, slow controlled drying proceeded over nearly two years. The humidity levels within the space enclosing the Dugout were gradually reduced until it approximated normal indoor conditions. Finally, excess surface wax was cleaned off and a final coating of higher molecular weight PEG (20M) was melted into the surface for dust protection. The long preservation treatment was completed in 1984.

Without the PEG treatment and slow drying period, the cell structure of the waterlogged wood might well have collapsed completely, destroying the Dugout. With the conservation completed, the streamlined hull shape and surface details of tool marks and wear patterns are well preserved. A storage case provides protection from any dangerous humidity fluctuations and the dugout remains in a stable condition. The Slessman and Ringler families still remain interested in the amazing artifact they helped to save.

Ringler Dugout Dynamic Stability Experiments

Not long after the Ringler Dugout was brought to the Museum, David Brose, then Curator of Archeology at the Museum, made preliminary measurements and cross-sectional sketches that provided estimates of the vessel's geometry. Based on these measurements and sketches Isaac Greber, Professor in the Department of Mechanical and Aerospace Engineering at Case Western Reserve University, performed a static stability analysis of the vessel. This analysis determined the load conditions under which the Dugout would tend to remain upright after a disturbance that would cause it to roll, and therefore they give some insight into the Dugout's ability to carry a crew and a load. The results of this analysis were reported in Brose and Greber (1982). [1]

A static stability analysis can only examine tendencies; it can provide no information about the behavior of the vessel in motion. Furthermore, it says nothing about how rapidly the boat would oscillate and the manner in which a rolling motion would subside. To examine the behavior of the Dugout in motion, a set of experiments was carried out by undergraduate students in I. Greber's Department as part of an engineering laboratory course that he taught. The experiments were carried out in two projects, one to make more detailed measurements than the ones made by Brose and to construct a wooden scale model suitable for tests in a small pool. A second project followed to perform dynamic stability experiments and analyze the behavior of the vessel. The detailed

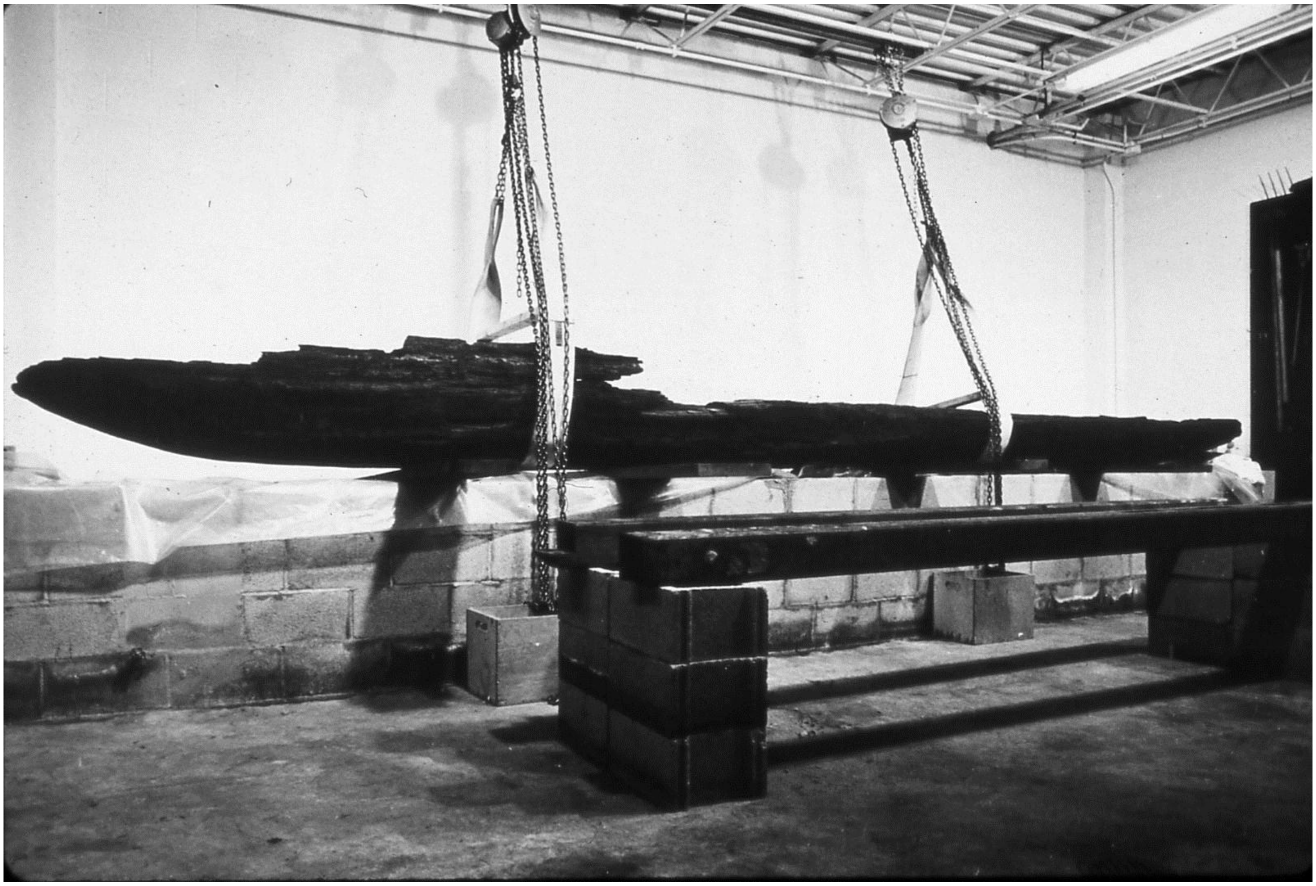


Figure 7. Dugout suspended over the immersion tank (CMNH Archaeology Archive Slide AT3275).

measurements were made on the cast, not on the dugout itself. The first group of students, Evan Harris and Joseph Mohner, designed and constructed a special measuring device for this purpose. They were assisted in their measurements by Katharine Ruhl, who had been instrumental in the preservation of the Dugout. A photograph of the students with Ms. Ruhl and with their measuring device is shown in Figure 8.

Based on their measurements the students constructed a 1/12 scale model of the vessel made of white oak, the same type of wood used to make the original Dugout. The model was constructed using the computer controlled milling machine in the Department's design laboratory for which they wrote a computer program in Pro/Engineer to control the carving process. The model was designed and constructed with gunwales raised to the level they would have had originally, not in the damaged state in which the Dugout was found in the bog.

The second project, the dynamic stability experiments, was carried out by Michael Szugye, Blake Williams, and William Wright. They first designed and constructed a small pool suitably sized for observing and measuring the rolling motion of the model dugout. A photograph of the pool with the model floating in it is shown in Figure 9. Preliminary experiments were performed on motion of water in the empty pool in order to ensure that waves reflecting from the walls of the pool would not influence the

Table 1. Dependence of oscillation period on loading.

Mode	Model Period (seconds)	Full Size Period (seconds)
Empty	0.470	1.63
3 persons	0.535	1.85
Full load	0.525	1.82
Front load	0.510	1.77
Back load	0.515	1.78

Figure 8. Katharine Ruhl, Evan Harris, Joseph Molner with measuring device and dugout cast in 2003.

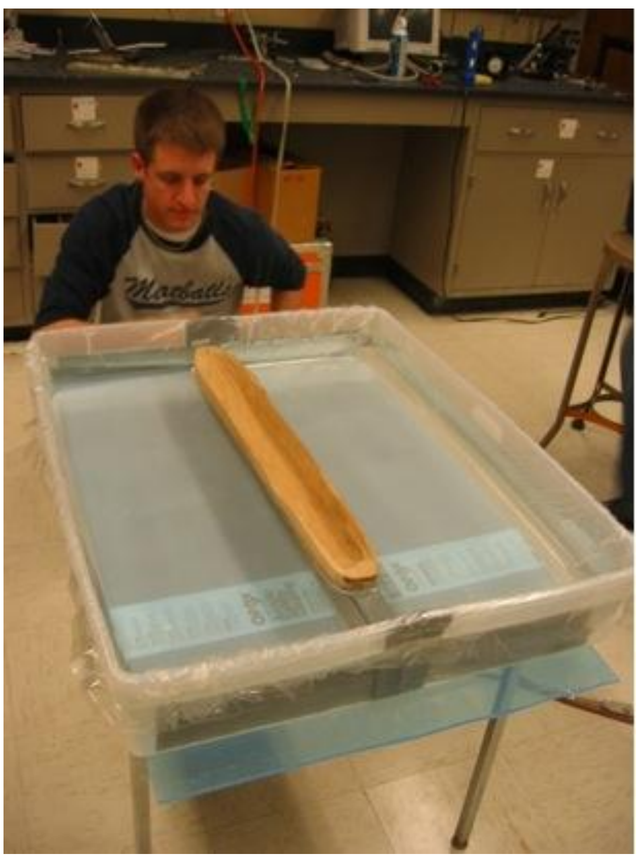


Figure 9. Model dugout in dynamic test tank at undergraduate laboratory, Dept. of Mechanical and Aerospace Engineering, Case Western Reserve University in 2004. Photo by William Wright.

stability measurements.

To provide suitable loading of the boat, scale models of humans and cargo were constructed, again after writing computer programs in Pro/Engineer to control the construction process. The models were constructed of non-drying art clay. This material was chosen both because of its non-drying property and because its density is relatively close to that of humans. Photographs of the model boat with loads of two or three humans and with cargo are shown in Figure 10. The locations of the people and the cargo correspond to the several loading conditions under which the vessel's performance was measured. As is illustrated, the measurements were made with the boat empty or loaded with three people and no cargo or with two or three people plus two cargo elements. Each cargo element had a mass equivalent to two-thirds that of a person. Thus the boat was loaded to about half its maximum capacity.

The experiments were conducted by displacing the boat a given angle, then releasing it and observing and recording its rolling motion. The motion was recorded using a digital video camera, and the information was transferred to a computer using the software program MGI Videowave III. Measurements were made at rolling angles of 10, 20 and 30 degrees at each of the loading conditions, and all measurements were made several times to ensure that the data were repeatable and accurate. A photograph of the observation view as seen on the computer screen is shown in Figure 11. In all of the experiments the humans were in a position that would correspond to kneeling or being seated low in the vessel.

Figure 12 shows a sample graph of the time history of the oscillation after the boat is released from its displaced angle. From graphs such as this one we can obtain the period of an oscillation (that is, the time for a side-to-side swing) and the time it takes for the oscillation to subside. Table 1 presents the oscillation period and corresponding loading condition. The periods are averages over the set of displacement angles. The variation with displacement angle is at most 3 percent.

One sees that the empty boat has a significantly shorter oscillation period than the loaded boat, and that the longest periods occur with the three persons or with three persons plus cargo. The spread of periods for the loaded conditions is 4.3 percent of the maximum period; the empty boat period is 11.9 percent smaller than the maximum value. These times can be translated to corresponding times for the full

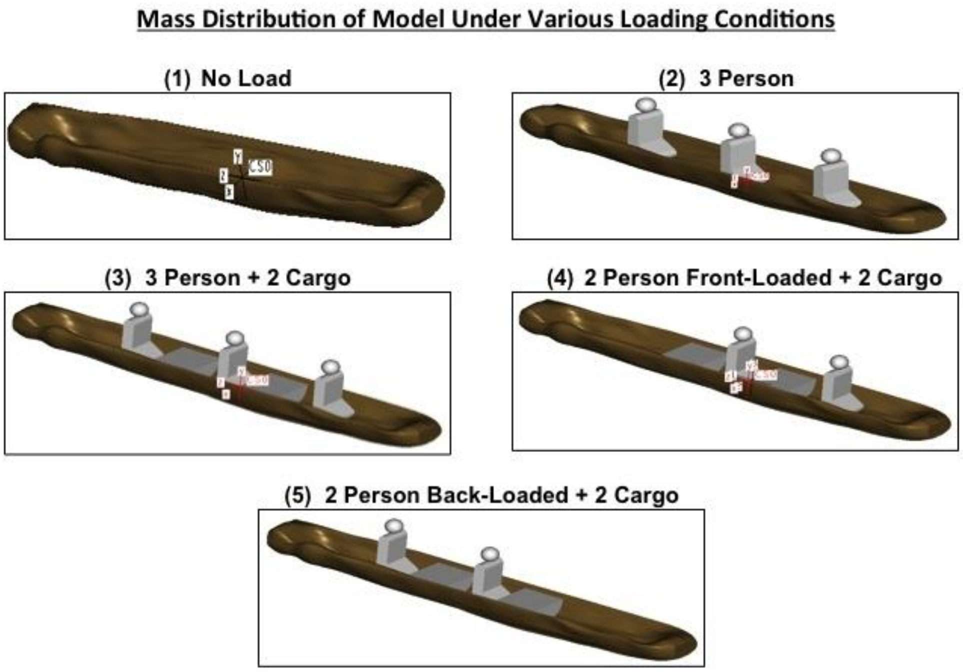


Figure 10. Model dugout with simulated loads.

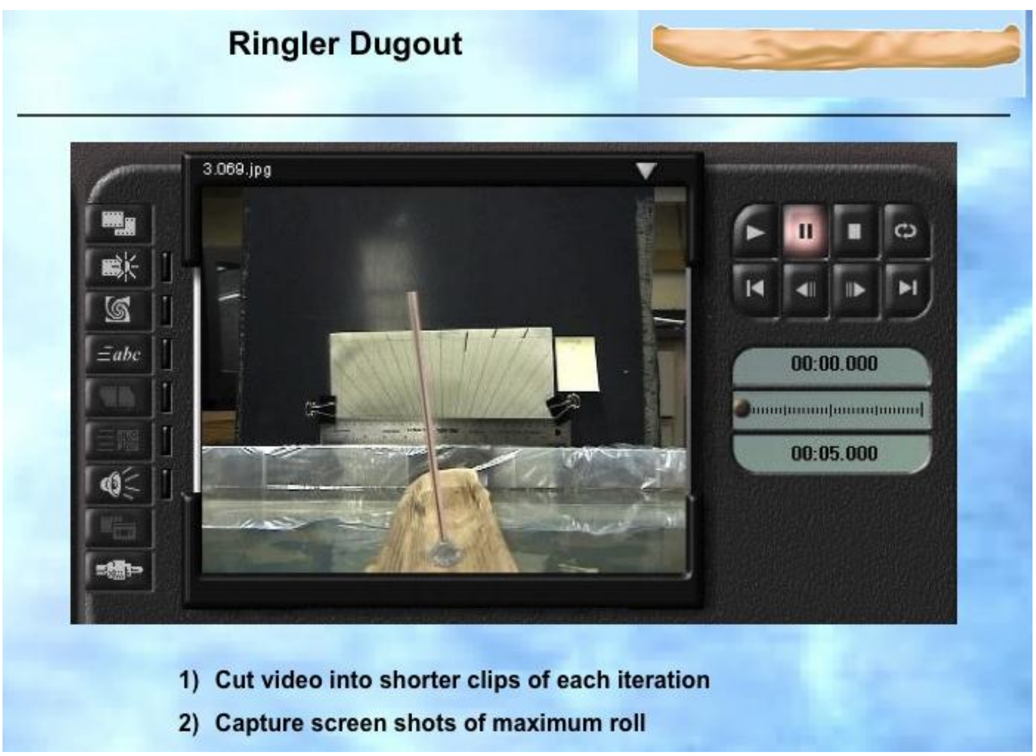


Figure 11. This photograph taken by William Wright shows the video equipment (on each side of the image) that was used to visually record changes in the rolling angle of the dugout under various loads. The center of the image is a still from the video showing the dugout and the needle arrangement for marking a roll angle. The entire video was played later and the angle readings recorded for use in calculating graphs such as the one in Figure 12.

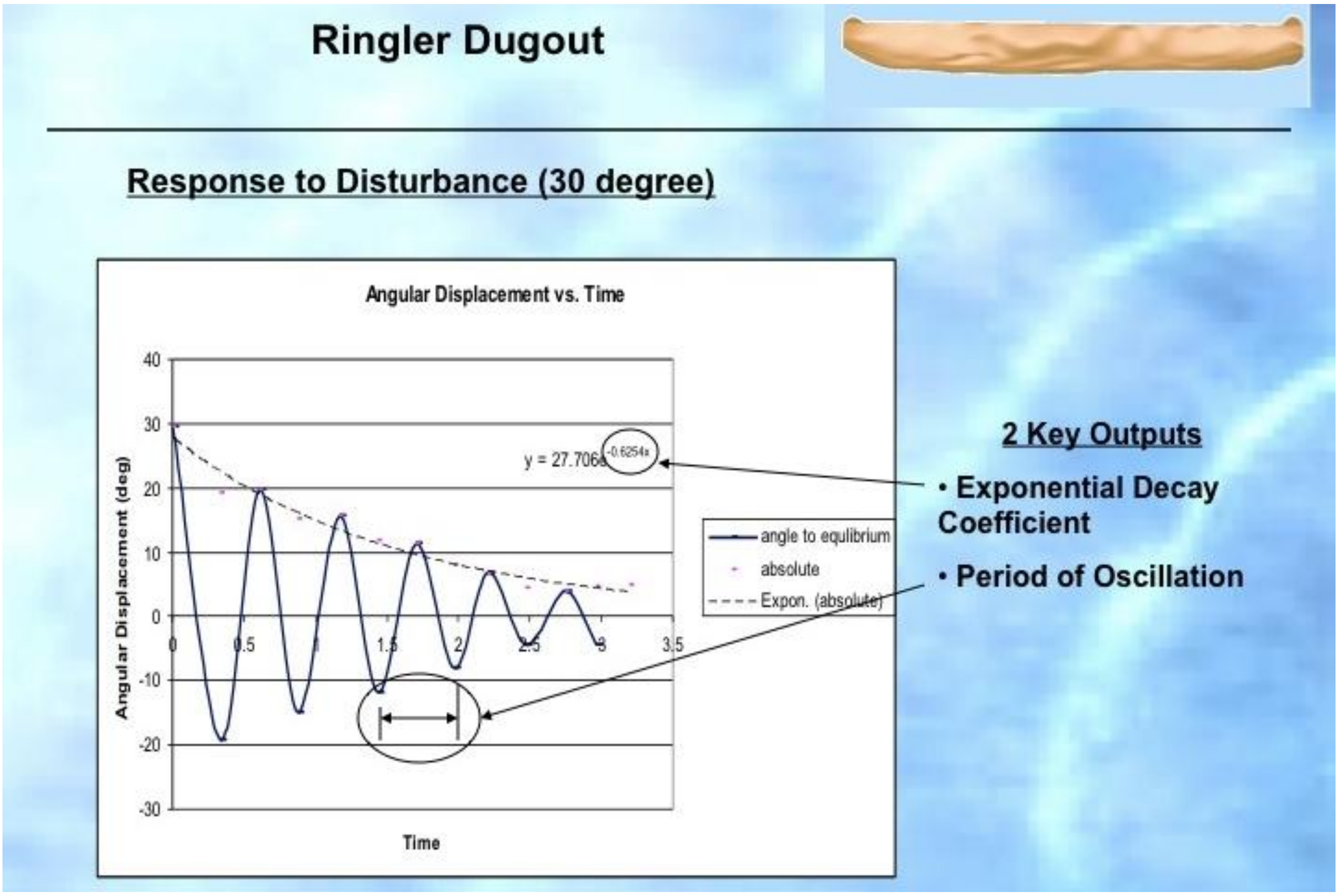


Figure 12. Time history of rolling motion.

size vessel. The period of oscillation increases as the square root of the size, similar to the behavior of a pendulum. The maximum period for the full size boat would be 1.85 seconds, and the shortest period, that of the empty boat, would be 1.63 seconds. Boaters would tend to regard these times as slow rocking. The rocking subsides rather quickly. As one sees in Figure 12, the rolling angle decreases to about half its displaced angle in about two oscillations, and to about a third in four oscillations. These values do not vary significantly with loading.

The boat behaves much more stably, and appears to be a much better load carrier, than the static stability analysis reported by Brose and Greber (1982) would suggest. That analysis indicated that the empty boat would be unstable, and that loading with three people would require high density cargo in order to keep the center of gravity low enough. It was pointed out in that reference, however, that further examination of the shape might cause one to alter the stability analysis. Thus, the fact that more detailed measurements and dynamic experiments modify the conclusions is not entirely surprising.

The boat responds slowly and stably to rolling disturbances. It is a heavy boat, and built sturdily. It is likely to be slow and not a good open water boat; with its weight, its probable slow turning, and its rounded and sturdy prow the boat is much more suitable for travel in shallow quiet waters. It would be able to push aside or skirt over vegetation and debris. It may lend itself to poling. One anticipates that a boat of this kind could be useful as a cargo carrier in shallow swampy waters.

Museum Storage and Dating of the Ringler Dugout

At the completion of the preservation process in 1984 the Dugout was removed from the drying tent, put into a custom made wooden case, and moved into the Museum proper. The case is fastened to a metal rolling base, a necessity for safely moving the largest object in the Archaeology Collections (CMNH 9127).

Figure 13. James Bowers, Archaeology Department, Cleveland Museum of Natural History installing the new clear plastic top in 2004.

Figure 14. The notch on the gunwale after completion of the preservation process, photograph taken February 2004. Compare to Figure 6.

Figure 15. Air dried fragment (CMNH 9127C) next to canoe gunwale, photograph taken February 2004.

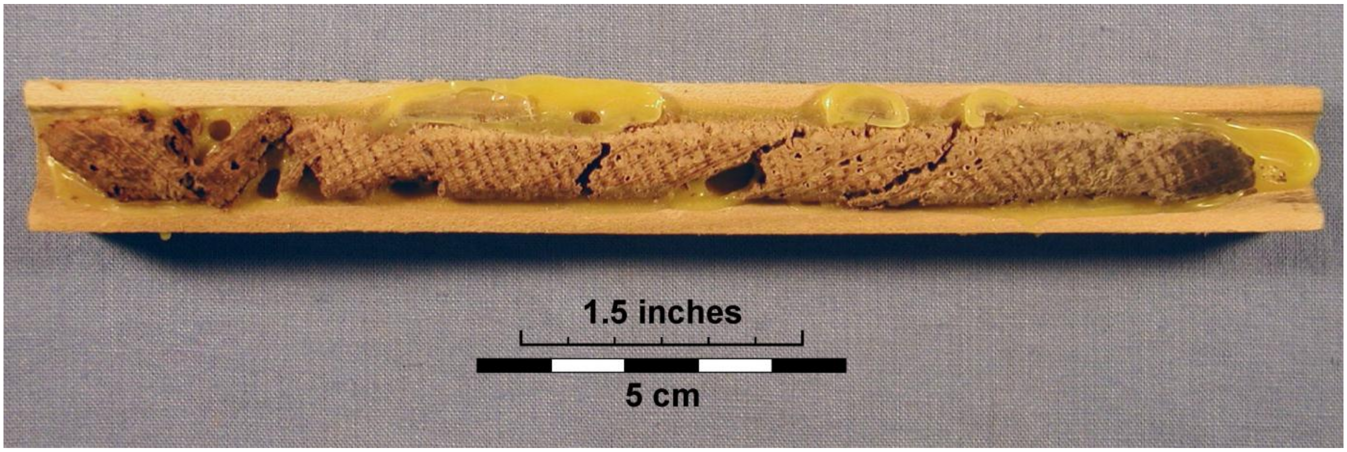


Figure 16. Core taken by Greg Wiles, Head, Wooster Tree Ring Laboratory, Wooster College on June 1, 2004 for comparison with Ohio dendrochronological records. The core is set in resin.

Within the case the Dugout rests on shaped supports padded with inert foam. The temperature and humidity inside the case are readily monitored by reading the gauge set into one side. The case was placed near the locked cage where the Museum stores the major portion of its archaeology collections that are not being actively studied in the departmental laboratory. The environment in this area is reasonably stable. The area functions as a passage way for school groups during scheduled class visits. Other visitors come into the area as part of scheduled "Behind the Scenes" tours that are popular special events.

In order to be able to show visitors the Dugout itself in its current case and location, in January 2004 the case was remodeled (Figure 13). Now the top of the sealed case is clear plastic that allows visitors to see the real Dugout. A folding wooden top covers and protects the plastic between viewings. While the case was open a close inspection showed that the preservation had gone well and the Dugout is stable. (Figure 14; compare to Figure 6). After all the wooden sides were removed in order to complete the remodeling, record photographs were taken for the archives and for future study.

Seven fragments, assumed to be from the Dugout, are also stored in the case. Some of these had been used to test conservation methods. One that had been air dried (CMNH 9127C) appeared to be a good fit as part of the original side of the boat (Figure 15). A small piece of this fragment was sent to Beta Analytic Radiocarbon Laboratory to obtain an additional radiocarbon assay of the Dugout's age. Two runs were reported: Beta-189203A, conventional radiocarbon age 100 +/- 50 BP and Beta-189203B, conventional radiocarbon age 200 +/- 40 BP. These significantly differ from the date obtained in 1976: DIC-612, conventional radiocarbon age 3550 +/- 70 BP (Brose and Greber 1982:247).

As part of re-checking the source of the fragment, James J. Heusinger, president of The Berea Hard Woods Company, Inc. visited the Museum on May 5, 2004. He determined that the fragment and the Dugout are composed of white oak. This agreed with the 1976 identification of the wood species used to make the Dugout. Although he did not match the fragment to a particular location on the Dugout, it was Mr. Heusinger's opinion that the fragment probably belonged to the Dugout since the wood species was identical and the degree of degradation was similar.

The difficulty in taking a sample now from the Dugout itself is that the organic chemicals that preserve it can interfere with the radiocarbon dating process. As an alternative dating method, in June, 2004 Dr. Greg Wiles, Professor and Chair Department of Geology, Ross K. Schoolroy Chair of Natural Resources, and Head of Wooster Tree-Ring Laboratory, Wooster College took a core sample from the dugout for comparison with Ohio dendrochronological records that come from a similar environment and extend some 400 years back (Figure 16). Unfortunately the length of intact rings in the core was not long enough to allow comparative studies. Largely due to the removal of sections of the tree trunk to shape the boat, there is no place left on the Dugout where there is an intact ring sequence long enough to determine a date.

A small piece of this core, apparently wood unaffected by decay or the conservation process, was removed by Beta Analytic staff to obtain an AMS (Accelerator Mass Spectrometry) radiocarbon date. As a precaution, the Beta staff carried out a series of sample pre-treatments to remove any residual chemicals in the wood that might interfere with the dating process. After these treatments the final sample was examined using a scanning electron microscope and no petroleum based resins were observed. The accuracy of the AMS dating process itself was checked by running a sample of known age of 4500 +/- 40 BP at the same time as the Ringler assay. "The result of the quality assurance run was 4560 +/- 50 BP, in good agreement with the expected age and indicating good accuracy in the dating" (Darden Hood, personal communication, 2005; Appendix A). The resulting conventional radiocarbon age for the Ringler sample 310 +/- 40 BP (Beta-198029) is slightly older than but statistically equivalent to the ages obtained from the air dried fragment. Perhaps the core sample contained rings from the center and older part of the tree while the fragment is likely from the side of the craft that was shaped from the outer and younger part of the tree trunk.

A number of technical problems arise in converting conventional radiocarbon ages to calendar years. Accounting for the Suess effect (changes in local and global variations through time in atmospheric carbon) is a common problem (e.g., Smith 2007). In addition, for the Ringler Dugout there are three separate but statistically overlapping conventional radiocarbon ages. Following the advice of Darden Hood, President, Beta Analytic Inc, we have chosen to use the calibration of the statistical weighted average of the three (216+/-24 BP) rather than perform separate calibrations (Figure 17). Accepting the results of the calibration, at a 95 percent probability the craft was made between AD 1650 and AD 1680.

Comments

This date is not unique for a dugout water craft in the Midwest. In 1990 the Wayland canoe, also dated to the mid-seventeenth century, was preserved at the Michigan Maritime Museum (Pott 1992). Two dates were obtained: conventional radiocarbon age 170 +/- 50 BP (Beta-38794) and conventional radiocarbon age 289 +/- 50 BP (Beta-39451). Fire-hollowed wooden water craft have been made in basically the same manner for many generations both before and after the seventeenth century. Numerous dugout canoes have been recorded in Florida (Newson and Purdy 1990). The oldest, from DeLeon Springs 2 (8VO30), dates to a conventional radiocarbon age of 6050 +/- 60 BP, Beta-42456 (Newson and Purdy 1990: Figure 2, Table 1; Wheeler et al. 2003: Table 2), while Seminole Indian Period dugouts date to the nineteenth century (Newson and Purdy 1990:164).

The finding of physical remains, such as the Ringler Dugout, is commonly a serendipitous event. A remarkable group of 101 dugouts made from fire-hollowed logs has been found in Newnans Lake, Florida (8AL4792) (Wheeler et al. 2003). These also illustrate the long history of the dugout. In 2000 a drought had lowered the water level and exposed decayed and water-logged dugout remains buried in the lake bottom. The remains were noted by Gainesville residents and reported to the Florida Bureau of Archaeological Research and Florida Museum of Natural History. Radiocarbon dates for 54 of the dugouts range from 500 to 5000 BP and illustrate that many generations used such canoes at the site (Wheeler et al. 2003:536).

At the time of the Newnan's Lake discovery there was local interest in removing some canoes for exhibit. Due to the highly degraded nature of the wood of virtually all the canoes, none of the 55 canoes identified during an extensive study in 2000 and 2001 "was targeted for removal and conservation" (Wheeler et al. 2003:538). In view of the amount of effort required in the conservation process and the uncertainty of success, this was a reasonable decision. Each craft was photographed, drawn to scale, located by GPS and a sample taken for wood identification and radiocarbon assays.

Many dugouts were made of pine, a commonly available wood in Florida. This was not a possible choice in the region of Savannah Lake, Ohio where the pre-dominate forest was oak-hickory. A large tree is needed and the choices available are dependent upon the local flora. Cyprus was used for some dugouts at Newnan. Some differences in design were noted in the crafts from Newnan's Lake. However, it is not yet known if there were changes through time in the particular tasks associated with these canoes that may have influenced the designs or the choice of wood. No spatial segregation of canoes by time period was seen (Wheeler et al. 2003:538).

Dugouts were and are used in many parts of North America (and beyond) on rivers and coastal areas. Examples from across the Western Hemisphere are shown in *Paddling Through the Americas,*

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25:lab. mult=1)

Laboratory number: **Beta-CanoeAvg**

Conventional radiocarbon age[1]: **216±24 BP**

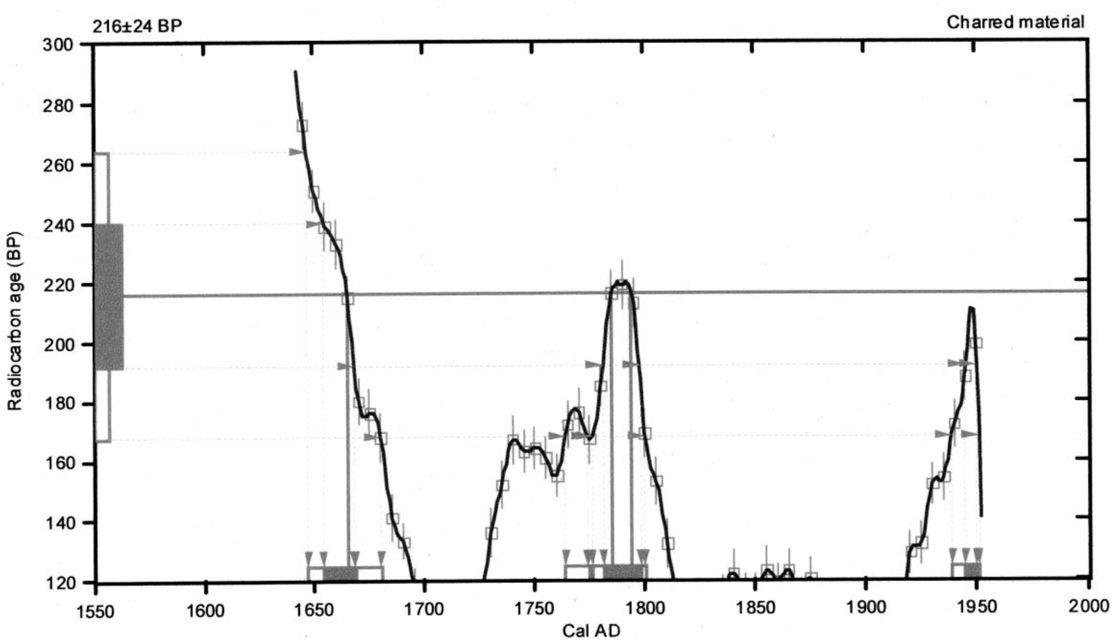
2 Sigma calibrated results: (95% probability)
Cal AD 1647 to 1680 (Cal BP 303 to 270) and
Cal AD 1764 to 1774 (Cal BP 186 to 176) and
Cal AD 1776 to 1800 (Cal BP 174 to 150) and
Cal AD 1939 to post 1950 (Cal BP 11 to post 1950)

[1] *C13/C12 ratio estimated*

Intercept data

Intercepts of radiocarbon age with calibration curve:
Cal AD 1665 (Cal BP 285) and
Cal AD 1785 (Cal BP 165) and
Cal AD 1794 (Cal BP 156)

1 Sigma calibrated results: (68% probability)
Cal AD 1654 to 1668 (Cal BP 296 to 282) and
Cal AD 1781 to 1798 (Cal BP 169 to 152) and
Cal AD 1945 to 1950 (Cal BP 5 to 0)



References:

Database used
INTCAL09

References to INTCAL09 database
Heaton,et.al.,2009, Radiocarbon 51(4):1151-1164, Reimer,et.al, 2009, Radiocarbon 51(4):1111-1150, Stuiver,et.al,1993, Radiocarbon 35(1):137-189, Oeschger,et.al.,1975,Tellus 27:168-192

Mathematics used for calibration scenario
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • E-Mail: beta@radiocarbon.com

Figure 17. Results of the calibration of the statistical average of three radiocarbon assays.

an exhibition produced by the Florida Museum of Natural History in Gainesville. The exhibit, that features dugouts from ancient times to the present, opened in November 2010 and continued until November 2012. The long term research on dugouts conducted by the staff of the Florida Museum and the associated University of Florida likely was useful in planning and producing this exhibit.

The age range of the many canoes found and yet to be found in Newnan Lake illustrates the usefulness of such craft in relatively shallow waters where the water level changes in yearly cycles (Wheeler et al. 2003:534), as occurs at Savannah Lake. Only three dugouts, including the Ringler, have been found to date in Mud Lake, part of the Savannah Lake system. The ages of the two other dugouts are unknown (Figure 2). They, like the Ringler Dugout and many Florida craft, were blanketed by beds of peat that formed an anaerobic environment. The technical qualities of the Ringler Dugout show that it is suitable for use in the marsh conditions that formed the peat (Dachnowski 1912). Its safe haven in our Museum makes it available for future studies that may add new knowledge about the lifeways of its makers as they poled or paddled near the watershed divide between the Great Lakes and the Ohio River in what is now Ashland County, Ohio.

Acknowledgments. The interest of Harold Slessman and the Ringler family in salvaging the Dugout and the assistance marshaled by David Brose enabled the Dugout to be transported to the Museum where the preservation process could begin. The Exhibits Department, under Ellen Walters produced the exhibit featuring the cast while continuing the preservation. In the next phase, centered in the Archaeology Department, Ann DuFresne provided major assistance for Katharine Ruhl. Jim Drake, Director of Design Laboratory, Department of Mechanical and Aerospace Engineering, CWRU assisted Evan Harris and Joseph Mohner in making the model dugout. Thasvesak Boonpongmane, Graduate Student in the Department assisted Driscoll Blake, Michael Szugue, and William Wright with their project.

Notes

1. The results reported by Brose and Greber (1982) were quoted incorrectly in the paper by Wheeler et al. (2003:547). They quote Brose and Greber as stating that the minimum load of the Dugout for stability would have been 680 kg. However, Brose and Greber state that 680kg is the maximum allowable load, assuming a minimum freeboard of 10cm (1982:253), and the minimum load for neutral stability is only 75 kg (1982:252).

References Cited

Brose, David S.
1978 Archaic Dugout Canoe Found in Northern Ohio. *The Explorer* 20(2):19-26.

Brose, David S., and Isaac Greber
1982 The Ringler Archaic Dugout From Savannah Lake, Ashland County, Ohio: With Speculations on Trade and Transmission in the Prehistory of the Eastern United States. *Midcontinental Journal of Archaeology* 7:245-282.

Dachnowski, Alfred
1912 Peat Deposits of Ohio: Their Origin, Formation and Uses. *Fourth Series Bulletin 16*, Geological Survey of Ohio.

Gratten, David W.
1982 Proceedings of the ICOM Waterlogged Wood Working Group Conference. Ottawa.

McCrawley, J. C.
1977 *Waterlogged Artifacts: The Challenge to Conservation*. Volume 2. Canadian Conservation Institute, Ottawa.

Newson, Lee Ann, and Barbara A. Purdy
1990 Florida Canoes: A Maritime History from the Past. *The Florida Anthropologist* 43(2): 164-180.

Pott, Kenneth
1992 The Dugout–Michigan's Early Maritime Traditions. *Michigan History, November/December*.

Smith, J. (editor)
2007 Featured Recent Meeting: Minoan Chronology Workshop Conference. *Geoarchaeology Interest Group Newsletter* 10(1).

Wheeler, Ryan J., James J. Miller, Ray M. McGee, Donna Ruhl, Brenda Swann, and Melissa Memory
2003 Archaic Period Canoes from Newnans Lake, Florida. *American Antiquity* 68:533-551.

Appendix A. Letter from Beta Analytic detailing sample treatment, etc. for radiocarbon dating.

FROM: Darden Hood, Director (mailto:mailto:dhood@radiocarbon.com)
(This is a copy of the letter being mailed. Invoices/receipts follow only by mail.)

January 17, 2005

Dr. Nomi Greber
Cleveland Museum of Natural History
1 Wade Oval Drive
University Circle
Cleveland, OH 44106
USA

RE: Radiocarbon Dating Result For Sample RINGLER-CORE

Dear Dr. Nomi:

Enclosed is the radiocarbon dating result for the wood sample recently sent to us. It provided plenty of carbon for an accurate measurement and the analysis went normally. As usual, the report sheet contains the method used, material type, applied pretreatments and, where applicable, the two sigma calendar calibration range.

The sample material analyzed was physically extracted as a sub-sample from within a section of wood embedded in resin. The sub-sample was subjected to both solvent extraction and cellulose extraction in an attempt to remove all resins. SEM (scanning electron microscopy) was performed on a small portion of the pretreated sample to identify any remaining resin. None was observed in the scanned sample. We subsequently proceeded with the dating. As an added cross check on the accuracy of the dating, a known age wood sample of 4500 +/- 40 BP was analyzed simultaneously with this sample. The result of the quality assurance run was 4560 +/- 50 BP, in good agreement with the expected age and indicating good accuracy in the dating.

The mean radiocarbon result for this analysis (310 +/- 40 BP) is consistent with previous wood analyzed from the same object (100 +/- 50 BP, 200 +/- 40 BP). It is slightly older, but statistically identical. Explanations beyond statistics for an older mean could lie in the possibilities that the rings represented in this sample were from an older part of the tree (i.e. rings closer to the center of the tree) or that the removal procedures were not 100% effective in removing a petroleum based resin. However, the result does confirm the previous young dates in comparison to a prior historical result on file for the wood of many years earlier obtained from another laboratory.

As always, we analyzed this sample on a sole priority basis. No students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analysis. We analyzed it with the combined attention of our entire professional staff.

The unused portion of the submittal material has been return mailed to you in a separate box.

Our invoice is enclosed. Please, forward it to the appropriate officer or send VISA charge authorization. Thank you. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood