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Measuring Prehistoric Mounds: Problems and Approaches

Also in this Issue:

Measuring Prehistoric Mounds: Problems and Approaches

Bill Whittaker

Recently I compared old mound measurements with modern measurements to try to detect gradual changes in mounds over the past century, and show how these mounds change. Using a set of 98 mounds in and near Effigy Mounds National Monument which were measured at least twice between 1901 and 2014, these measurements reveal more about the limitations of mound measurements than they do about changes in the size of mounds. There are many variables that can cause mounds to change shape, including natural and anthropogenic modifications.

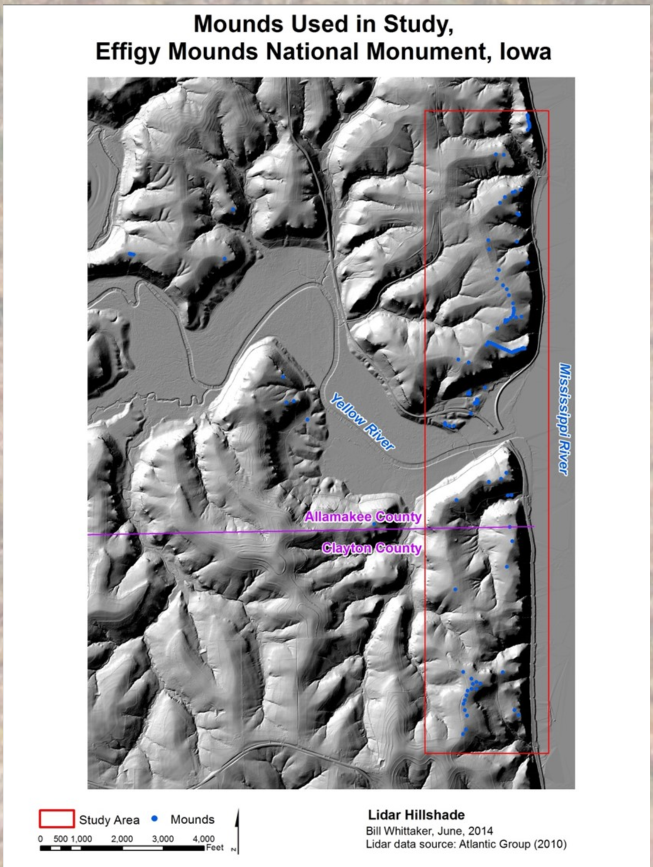
Effigy Mounds National Monument

Established in 1949, Effigy Mounds National Monument (EFMO) in northeast Iowa contains numerous prehistoric Indian burial mounds, many of them animal-shaped effigies. There are two main areas, the Yellow River area, which includes mounds north and south of the Yellow River mouth, and Sny Magill, an area of dense mounds on a Mississippi River terrace several miles south. Both areas contain approximately 100 mounds each. The exact number of mounds cannot be determined precisely because there are several low rises in both areas which may or may not be cultural in origin (Lenzendorf, 2000).

The first recorded investigations of EFMO were made by Theodore H. Lewis in 1885, and the vast majority of the mound groups at Effigy Mounds National Monument were systematically surveyed by Ellison and Harry Orr beginning in 1902, and over the next 40 years they mapped most of the mounds in what is now the monument.

Mound Construction

Prehistoric mounds are not typically piles of soil dropped on top of human remains, but often consist of complex layers of soil placed with what appears to be a great deal of planning. Archaeologically, the internal structure of mounds appears to vary with the shape of the mound. Conical mounds have a simpler shape, but tend to be much more complex and varied internally, an inclusion of specially-colored or textured soil in layers or patterns is not uncommon. Robert Hall noted the inclusion of dark mud or muck in mounds in Wisconsin and Iowa, and described their likely symbolic significance to Native Americans as representations of the "lowerworld" a supernatural spirit realm. Layers of bright red hematite are common in the mounds previously excavated at Effigy Mounds National Monument and there are often discrete soil layers within mounds. A general lack of interior soil structure, other than intaglios or shallow pit features, appears to be a common feature in effigy (animal-shaped) mounds. Linear mounds are traditionally not included with effigy mound forms, but share some general traits with effigies. Both linear and effigy mounds typically lack the complex layering often seen in conical mounds, both often lack burials, and linear mounds are frequently found in association with effigy mounds. Some researchers lump linear mounds with effigy mounds, considering them to be variations of lowerworld forms, such as water spirit tails or as snakes. Linear earthworks also defy simple classification because they are a longer-lasting form than effigy mounds, occurring from the Early Woodland period to the Protohistoric period, creating the possibility that some linears were created as effigies while others were not.



Methods

A total of 16 mound sites with 98 mounds were analyzed, these sites were chosen because they contained mounds visible on a 2010 National Park Service-funded lidar survey and were previously measured by Harry Orr or Ellison Orr between 1901 and 1934 or by Robert Petersen in 1983. Of the 98 mounds in the 16 sites, 57 were conical and 41 were nonconical, including effigy, linear, and compound shapes.

The Orr brothers' mound diameters were presumably obtained by survey chain, since bearing and distance is often specified in maps, however, there is evidence the Orrs estimated some mound diameters. For example 16 of their 41 conical mounds were noted as 30 ft (9.1 m) in diameter, suggesting they frequently rounded off measurements. Petersen (1983) measured the diameter of mounds using surveyor's tape; Petersen did not specify how he defined the edge of mounds, presumably he used visual estimation.

My measurements were based on the 2010 lidar survey using a bare-earth digital elevation model (DEM). If a mound was constructed on a fairly flat area, the raster point where elevation increased was used as an edge, if the mound was built on a slope, the raster grid where the difference between surrounding grids was indicative of a slope change was used. This determination was often subjective. My full dataset is on file at the Office of the State Archaeologist.

Data were compared between the three survey periods to determine mound changes, and separate comparisons was made of excavated and unexcavated mounds, under the assumption that mounds excavated after the Orr surveys and before the Petersen surveys would change at different rates than unexcavated mounds.

Results

Results were disappointing. It was anticipated that mounds would remain relatively constant in size, or change in a predictable manner, such as shrinking or growing at a consistent rate, with excavated mounds growing larger because of added soil. None of the expectations came true. Mounds shrank in size between Orr's surveys and 1983, and then grew substantially afterwards. Excavated mounds actually shrank between Orr's surveys and 1983 and then grew at a faster rate than unexcavated between 1983 and 2014.

Some observations about measuring mounds:

- Change in height of mounds could not be determined because mounds are never built on a perfectly level surface and researchers do not specify how the off-mound comparison location was derived. For example, Mound 18 (13AM207) is well defined, and had a maximum elevation of 273.82 m above mean sea level (amsl). Nearby off-mound comparisons were 272.73 (north), 270.89 (east), 271.35 (south), and 273.50 m amsl (west), meaning the mound's height could be anywhere from 1.09 to 1.94 m, combined with the potential error of up to 16 cm on lidar-derived elevations even these elevations are suspect. In 1902, Harry Orr measured Mound 18 height at 7.5 ft (2.29 m), and in 1983 Petersen estimated the height at between 1 and 1.1 m.
- Methods for measuring maximum length of mounds is usually not specified, and the boundary of mounds is subjective. Mound edges are not abrupt, they gradually curve into the surrounding landscape and each surveyor is likely to determine a different edge point.
- Linear, compound, and effigy mound measurements were so variable that they had to be excluded from the sample. Peterson measured bear-shaped effigy mounds from the center of the head to the tail, which is usually not the greatest length, typically the tip of the nose to the tail is the greatest length. A great example of the variation in measurements of linear mounds is the compound mound at 13CT55. In 1915, Orr noted seven conical mounds, each 30 feet in diameter, connected by six linear segments of 75 feet each, for a total length of 660 feet (201 m). The general shape of this compound mound has not changed, but the total length is far smaller in subsequent measurements. In 1983 Peterson measured the total length at 141.8 m and in in recent lidar it measured 146 m. It was for these reasons that only conical mounds were included in analysis.
- Excavated and reconstructed mounds change at different rates than unexcavated mounds, but not in any comprehensible way. Excavated mounds shrank more than unexcavated between the 1930s and 1983, but grew more than unexcavated between 1983 and 2011.
- Lidar DEM maps probably produce larger mound diameters because they have higher precision, and show very subtle elevation changes at the edge of mounds. Also, DEM maps easily allow for multiple measurements of mounds to determine their greatest diameter, compared to in-the-field measurements, which are typically done at only one or two cross-sections.

Second Analysis Using Slope to Define Edges

A second analysis was made to see if a different method would produce more consistent measurements. It was hoped that slope changes would be abrupt enough that a de-facto boundary could be obtained for a systematic way of measuring diameter. The line of conical mounds at site 13AM190 was used for this analysis.

The lidar DEM for this mound group was cropped, and a surface slope tool was used to calculate slope values for each map unit.

Again, these results were disappointing. There are two variables that prevent mound boundaries from being defined clearly with slope measurements. First, because mounds fade gradually into the surrounding landscape there is never a clean edge, and any designation of an edge will always be arbitrary, even if a specific change in slope is defined as the edge. Second, most mound groups are not built on perfectly level surfaces, so the apparent center of the mound is not necessarily level, and the sides (especially the uphill side) may actually have less of a slope than the apparent top of the mound.

Discussion

Mounds can change size over time for a number of reasons. Plowing, excavation, or looting likely reduces mound height and increases mound width. Reconstruction likely increases height, and might decrease width. Walking and driving on top of mounds likely reduces height, while walking and driving around the perimeter likely increases perceived height, decreases width, and encourages long-term erosion. Soil erosion will decrease height, and can decrease or increase width, depending on where the eroded soil ends up. Tree and plant root lifts can increase height, and tree falls can decrease height when the root ball lifts, or it can shift highest part of mound. It is possible that insect and rodent burrows increase mound height. Alluvium and eolian deposits around the base may decrease perceived height. Monitoring all the changes to the shape of a mound is a necessary component of maintaining the mounds, to identify changes early on so that corrective steps can be taken to protect the mounds.

It was hoped that this study would be able to identify gradual changes in the mounds at EFMO over approximately one century, and show how these mounds change. However, the results revealed more about the limitations of how humans define the edge of mounds and the lack of systematic measurement methods. There are too many hypothetical variables that could affect mound shape that it is not possible to make even broad statements about general change in size, we cannot assume that mounds on average are getting shorter or wider, for example.

This study reveals that it is very difficult to systematically measure mounds, and past measurements of mound size cannot be used for determination of changes in mound shape. Even high-accuracy lidar has differences in elevation as great as 16 cm, far greater than what a total station obtains. Determining height of a mound is subjective, since the off-mound comparison point is necessarily arbitrary. The edge of a mound is subjective, since it gradually tapers into the surrounding land, and there probably will never be a systematic way to measure the diameter of a mound.

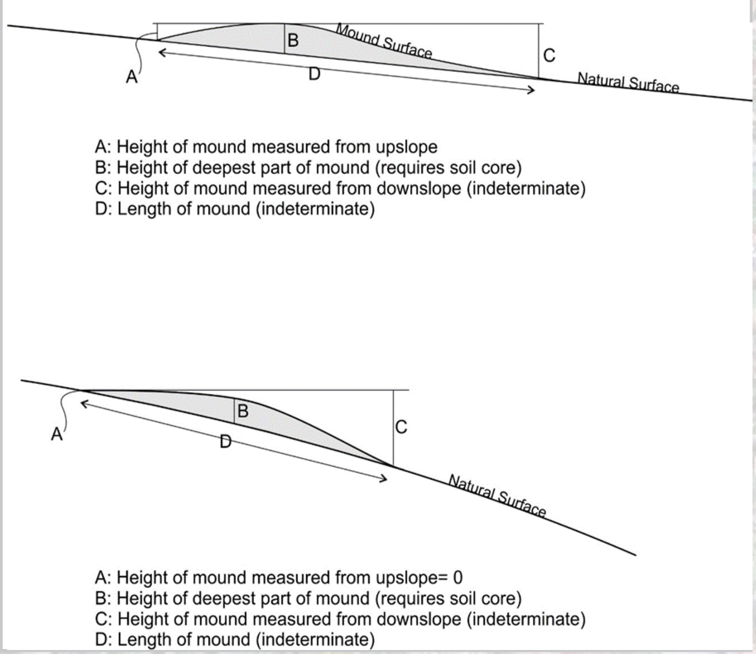
Mounds could be viewed as organic entities, that grow and shrink because of anthropological and natural causes. It is conceivable that mounds "breathe"- they might rise slightly in spring as roots expand, as insects and rodents burrow, as soil expands with moisture, and as soil bacteria emit carbon dioxide, and then shrink in winter as these processes stop or slow.

Intuition suggests mounds naturally spread out slowly, becoming wider and lower over time, but this has not been confirmed, and the different rates at which mounds spread under different conditions is unknown- parent soil, vegetation cover, original shape, and topographic position, all probably affect the rate of mound spread.

Management requires some baseline data to determine how mounds are changing. If the long-term goal is to preserve the current shape of mounds for as long as possible, it is important to know how these changes occur.

Even if there is no systematic way to determine the precise height and diameter of mounds, it is possible to monitor its shape and size. Changes in shape could be determined with repeated measurements of the same spots on mounds over a period of decades. This type of measurement would require precision better than GPS margin of error in wooded area, and requires stable datum points and total station measurements.

Difficulties In Determining Mound Size



Possible approaches to the systematic measurements of mounds include terrestrial lidar, which could make hundreds of thousands of measurements of a mound, documenting it so thoroughly that even minor changes can be detected if the lidar survey is repeated a few years later. Another approach would be to use a Total Station EDM set up on a permanent datum and to shoot in the exact same profile points over a series of years.

It is important to establish if mounds are growing or shrinking over the long term, and how the mounds change in shape; current techniques are not useful for this mission.

Acknowledgments

Many thanks to the National Park Service and Effigy Mounds National Monument for allowing access to their lidar data. Versions of this article appeared as a paper produced for a GIS course at the University of North Dakota in 2014 and a paper presented at the Midwest Archaeological Conference in 2016.

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Table 1. Summary of Measured Change in Mound Size.

	Comparison Years	Number of Conical Mounds	Diameter Change (m)
All Conical	1901–1934 to 1983	41	-0.6
	1983 to 2014	45	+2
	1901–1934 to 2014	41	+1.4
Excavated Conical	1901–1934 to 1983	20	-0.9
	1983 to 2014	22	+2.4
	1901–1934 to 2014	20	+1.5
Unexcavated Conical	1901–1934 to 1983	21	-0.3
	1983 to 2014	22	+1.6
	1901–1934 to 2014	21	+1.3

Iowa Site Stewards

Lara K. Nolder

Bioarchaeology Director, Office of the State Archaeologist

Because the vast majority of Iowa lands are privately owned, we rely a great deal on the stewardship of Iowans to protect known burial sites, which include ancient and historic cemeteries and constructed mounds and other earthworks. On state-owned lands, we rely on the stewardship of Department of Natural Resources Staff.

On behalf of the Indian Advisory Council and the Office of the State Archaeologist, we would like to recognize the stewards that have worked with the Bioarchaeology Program from 2014-2017.

Thanks all, for your stewardship!

- Larry Roehl - Louisa Co. Engineer
- Dennis Miller - Pottawattamie Co
- Heidi Reams and Adam Sears - Floyd Co, Tosanak Recreation Area
- Bruce Mountain - Warren Co
- Andy Bartlett - Boone Co, Ledges State Park
- Sharon Brandert and Brian Ashurst - Hamilton Co
- John Tuthill - Clinton Co.
- Karen Kuntz - Polk Co
- Justin Pedretti - Van Buren Co.
- Scott and Linda Brimeyer - Clayton Co
- Gene Adkins - Poweshiek Co.
- Laurie Mohr - Clinton Co.
- Stephanie Black - Benton Co.
- Marlys and Bill Brown - Jackson Co
- Department of Natural Resources Staff – Benton, Boone, Cerro Gordo, Harrison, Linn, Monona, and Van Buren Counties

UPCOMING MEETING

The IAS Spring Meeting
(in conjunction with the Iowa Academy of Science)
April 20 and 21, 2018
Buena Vista University in Strom Lake.

If you'd like to give a presentation at the Spring Meeting, contact Megan Stroh Messerole at
archaeologist@sanfordmuseum.org
Sanford Museum
117 East Willow Street
Cherokee, IA 51012
(712) 225-3922

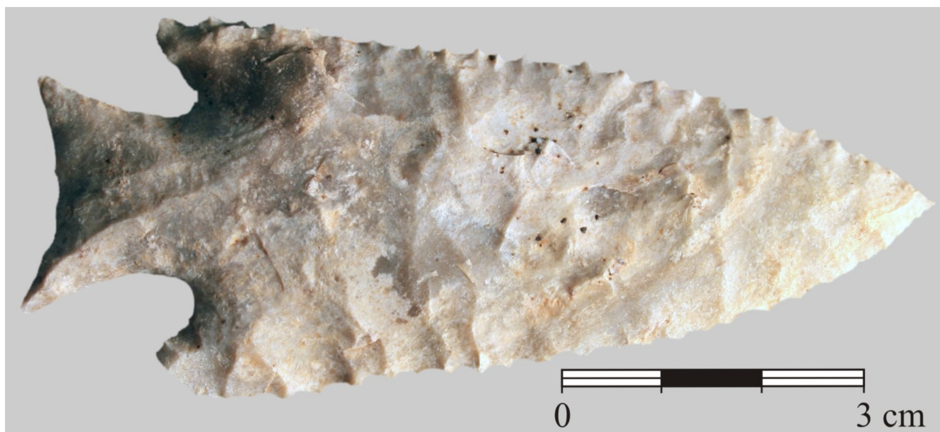
What's The Point?

Lowell Blikre
Bear Creek Archeology, Inc.
Cresco

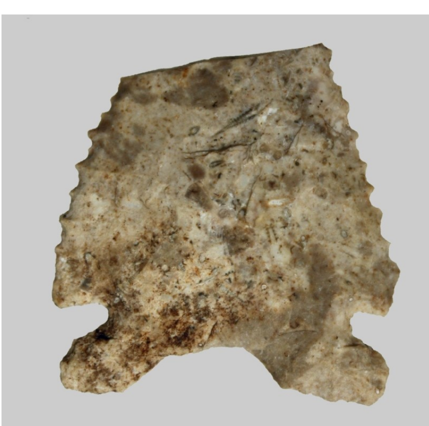
Discovered: The point featured in this issue (shown below) was recovered during excavations on a wooded, loess-mantled ridge in southeastern Iowa. This point was about 30 cm (12 inches) below the surface and was recovered near a hearth feature. Also present around this hearth were a few unfinished bifaces, flaking debris, two flake-tools, a grinding slab, and a mano. A small fragment of a similar point was also found nearby and about 5 cm deeper.

Description: This issue's point is 9 cm (3.5 in) long, 3.8 cm (1.5 in) wide at its widest (just above the shoulders), and only .9 cm (.4 in) thick at its thickest (at the base-blade junction). The blade edges are finely serrated and slightly beveled. The point comes to an exceptionally sharp tip.

Send your responses to me at Lowell@BearCreekArcheology.com. Answers will be listed in the next issue of the newsletter.



Late Issue's Point: We identified this as a Hardaway Side-Notched, an Early Archaic point more commonly found in the southeastern United States, but with a distribution range across much of the eastern part of the country. Points of similar age and morphology have been found in Iowa and the adjoining states and include the St. Johns variety of San Patrice. Not many guesses on this one, probably because I unfairly picked a broken point. The closest answer was provided by Dan Boddicker, who suggested it was a Pine Tree, another Early Archaic point found in the southeastern U.S. Also, Matt Kaufmann informed me that he has seen Hardaway points in northeast Iowa.



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Call For Articles And Pictures

The IAS Newsletter always needs articles. Do you have something you'd like to share with the membership? Did you take photos at any of the meetings or field trips? Do you have a collection, individual artifacts, or a site that you would like to highlight? Let the newsletter editor know.

Email: Lowell@BearCreekArcheology.com
US Mail: Lowell Blikre
Bear Creek Archeology
P.O. Box 347
Cresco, Iowa 52136

NOMINATIONS SOUGHT FOR THE CHARLES KEYES—ELLISON ORR AWARD

The Keyes-Orr Award is presented to individuals in recognition of outstanding service to the Iowa Archeological Society and in the research, reporting, and preservation of Iowa's prehistoric and historic heritage.

Nominations should be sent by mail or e-mail to:
Mike Christensen
1903 175th
Fort Dodge, IA 50501

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All materials for publication should be sent to the Newsletter Editor:

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