2018

3D Scan Data for Selected Artifacts from Blackwater Draw National Historic Landmark

Robert Z. Selden Jr.
Center for Regional Heritage Research, Stephen F. Austin State University, zselden@sfasu.edu

George T. Crawford
Blackwater Draw National Historic Landmark, Eastern New Mexico University

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Abstract
Between February 8-11, 2016, selected artifacts from the Blackwater Draw National Historic Landmark (LA3324) were scanned in advance of a grant proposal to digitally aggregate the Clovis-era artifacts from the Clovis type site. These data were collected using a NextEngineHD running ScanStudioHD Pro, and post-processed in Geomagic Design X 2016.0.1. All data associated with this project are publicly available (open access) and accessible in Zenodo under a Creative Commons license, where they can be downloaded for use in additional projects and learning activities. These data have the capacity to augment a variety of research designs spanning the digital humanities, applications of geometric morphometrics, and many others. Additionally, these scans will augment a wide range of comparative research topics throughout the Americas and beyond. Reuse potential for these data is significant.

Keywords
First Americans — Clovis — 3D

1 Center for Regional Heritage Research, Stephen F. Austin State University
2 Virtual Curation Laboratory, Virginia Commonwealth University
3 Blackwater Draw National Historic Landmark, Eastern New Mexico University
*Corresponding author: zselden@sfasu.edu

1. Overview

Research from the Blackwater Draw National Historic Landmark (LA3324) has served as the foundation for much of Clovis archaeology, and it is one of the more well-studied Clovis sites in the Americas. Influential studies from this site come from a variety of analytical domains to include lithics, mega-fauna, and plant remains. The site is located in southeast New Mexico (Figure 1), and is the type site for Clovis technology.

The addition of analytical approaches that employ 3D meshes (Figure 2) helps, in this case, to advance discussions of shape variations that occur among these artifacts; many of which are regularly used in studies of shape using 2D data [1, 2, 3, 4, 5]. Many components of shape are difficult—if not impossible—to characterize using traditional linear and orthogonal approaches [6, 7], and are more accurately captured using their native 3D format [8, 9]. These attributes can be couched within a variety of theoretical frameworks [10, 11, 12]; however, evolutionary archaeology remains the theory of choice for geometric morphometric studies of lithic artifacts. While the production of 3D data are labor and time-intensive (although see [13]), the benefits can be seen in their contribution to conservation [14], participatory digital archaeology [15], and dynamic illustrations [16, 17].

1.1 Context
While the detailed context of these artifacts is discussed elsewhere [18, 19, 20, 21, 22, 23], an abbreviated listing is included in Table 1, and in each of the Zenodo entries. Those artifacts from Area C include 24136, 24143, 24152, 24156, 24157, 24158 and 24161. The two artifacts from Area D are...
24122 (Mammoth II) and 32095, while the large biface is from Area E. Artifacts 6183/6188 (a refit of 6183 and 6188), 6185 and 6186 are from the Dickenson Cache. Clovis points 25313, 25316 and 25317 were found in context with Agogino’s Mammoth IV, and Clovis point 25314 with Agogino’s Mammoth I.

1.2 Temporal Coverage
A representative sample of 11 radiocarbon dates were selected from those areas of the Blackwater Draw NHL that correspond to the known provenience for artifacts reported herein [18, 21, 22, 23] (Figure 3). The Blackwater Draw NHL is the Clovis type site, and most regularly articulates with the Paleoindian period.

2. Methods
Selected artifacts were scanned using a NextEngineHD running ScanStudioHD Pro. Two scans were collected at the highest HD setting using eight divisions, then trimmed, aligned, fused and polished in ScanStudioHD Pro, before each was exported as ASCII.stl and ASCII.ply files prior to post-processing [26, 27]. Those data were then imported to Geomagic Design X, where the final meshes were aligned and processed.

2.1 Steps
To align each scan, a reference vector was inserted, followed by a reference point at the confluence of the vector and the mesh (using a projection) at the central base. A plane was then inserted using the pick point and normal axis function, utilizing the vector as the normal axis, and the projected point as the pick point. Both elements (reference vector and reference point) of reference geometry were utilized in an interactive alignment, with the the reference vector as the moving vector, and the reference point as the moving point (Figure 2). Alignment has proven to be an important factor in downstream analyses, particularly when making the transition from Design X and Control X to SolidWorks or other CAD-based platform [28] (Figure 5).

Post-processing of each 3D mesh began with the healing wizard function in Design X, which corrects problematic issues with non-manifold poly-vertices, folded poly-faces, dangling poly-faces, small clusters, small poly-faces, non-manifold poly-faces, crossing poly-faces, and small tunnels. Following correction, the rewrap function was used to render the final mesh. Upon completion of post-processing, each mesh was decimated to decrease file size prior to export as an ASCII.ply.

3. Data Description

3.1 Collection Name
3D Scans from Blackwater Draw National Historic Site

3.2 Data Type
Decimated meshes

3.3 Format Names and Versions
ASCII.ply (mesh)
Table 1. Context of Scanned Artifacts

<table>
<thead>
<tr>
<th>Artifact No.</th>
<th>Description</th>
<th>Provenience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biface</td>
<td>Lg Biface</td>
<td>S. Bank Locality</td>
</tr>
<tr>
<td>EL-2-120</td>
<td>Agate Basin Pt</td>
<td>N. Bank Spring</td>
</tr>
<tr>
<td>6183/6188</td>
<td>Blade</td>
<td>W. Arroyo</td>
</tr>
<tr>
<td>6185</td>
<td>Blade</td>
<td>W. Arroyo</td>
</tr>
<tr>
<td>6186</td>
<td>Blade</td>
<td>W. Arroyo</td>
</tr>
<tr>
<td>24122</td>
<td>Clovis Pt</td>
<td>N. Bank Mam. Kill</td>
</tr>
<tr>
<td>24136</td>
<td>Clovis Pt</td>
<td>N. Bank Mam. Kill</td>
</tr>
<tr>
<td>24143</td>
<td>Clovis Pt</td>
<td>N. Bank Mam. Kill</td>
</tr>
<tr>
<td>24152</td>
<td>Clovis Pt</td>
<td>N. Bank Mam. Kill</td>
</tr>
<tr>
<td>24156</td>
<td>Clovis Pt</td>
<td>N. Bank Mam. Kill</td>
</tr>
<tr>
<td>24157</td>
<td>Clovis Pt</td>
<td>N. Bank Mam. Kill</td>
</tr>
<tr>
<td>24158</td>
<td>Clovis Pt</td>
<td>N. Bank Mam. Kill</td>
</tr>
<tr>
<td>24161</td>
<td>Clovis Pt</td>
<td>N. Bank Mam. Kill</td>
</tr>
<tr>
<td>25313</td>
<td>Clovis Pt</td>
<td>N. Bank Mam. Kill</td>
</tr>
<tr>
<td>25314</td>
<td>Clovis Pt</td>
<td>N. Bank Mam. Kill</td>
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<td>25316</td>
<td>Clovis Pt</td>
<td>N. Bank Mam. Kill</td>
</tr>
<tr>
<td>25317</td>
<td>Clovis Pt</td>
<td>N. Bank Mam. Kill</td>
</tr>
<tr>
<td>25330</td>
<td>Clovis Pt</td>
<td>W. Wall</td>
</tr>
<tr>
<td>32095</td>
<td>Agate Basin Pt</td>
<td>S. Bank</td>
</tr>
</tbody>
</table>

3.4 Creation Dates
Feb 8-11, 2016

3.5 Dataset Creators
Robert Z. Selden, Jr.

3.6 Language
English

3.7 License
Creative Commons Attribution

3.8 Repository Location
3D Scans from Blackwater Draw National Historic Site

- ENMU LA3324 Biface [29]
  (http://dx.doi.org/10.5281/zenodo.47134)
- ENMU LA3324 EL-2-120 [30]
  (http://dx.doi.org/10.5281/zenodo.47132)
- ENMU LA3324 6183/6188 [31]
  (http://dx.doi.org/10.5281/zenodo.46910)
- ENMU LA3324 6185 [32]
  (http://dx.doi.org/10.5281/zenodo.46911)
- ENMU LA3324 6186 [33]
  (http://dx.doi.org/10.5281/zenodo.46914)
- ENMU LA3324 24122 [34]
  (http://dx.doi.org/10.5281/zenodo.46918)
- ENMU LA3324 24136 [35]
  (http://dx.doi.org/10.5281/zenodo.47131)
- ENMU LA3324 24143 [36]
  (http://dx.doi.org/10.5281/zenodo.46919)
- ENMU LA3324 24152 [37]
  (http://dx.doi.org/10.5281/zenodo.46920)

3.9 Data Publication Date
March 3, 2016

4. Reuse Potential

Data from this project have long-term and wide-ranging reuse potential, of which many applications may (likely) not yet have been contemplated. While the primary purpose of this endeavor was to document these resources for use in additional analytical and outreach efforts, one of the projectile
Figure 4. Aligned 3D mesh for ENMU LA3324 25313 illustrating the reference geometry (reference vector, point and plane—in green) used to align the mesh.

points has since been modeled as a 3D puzzle that can be cut out using materials that are easily acquired by most (i.e., a cardboard box).

These data have significant reuse potential in the digital humanities where they can augment both qualitative and quantitative studies. They also hold promise for clarifying questions of shape, form, size and asymmetry, which can be addressed in analyses of geometric morphometrics.

4.1 3D Puzzles

In addition to the 3D meshes, one 3D cardboard puzzle was created (for ENMU LA3324 25313 [48]) to augment the onsite efforts of the interpretive staff by providing a physical model through which visitors can interact with the digital proxy. These cardboard puzzles were generated using Autodesk 123D Make [49], and plans for the cardboard puzzles (Figure 5) accompanied the uploads to Zenodo. Those plans can be downloaded, glued to cardboard, then cut out to create a tangible model of a Clovis point. These files were uploaded to Zenodo in .pdf format, and are also compatible with most laser cutters.

Figure 5. Modeled 3D puzzle of ENMU LA3324-25313 created with Autodesk 123D Make.

Acknowledgments

We extend our gratitude to the Blackwater Draw NHL and to Eastern New Mexico University for providing the requisite permissions and access needed to scan this selection of artifacts. We also thank Dr. Michael J. Shott, Dr. Briggs Buchanan, and the anonymous reviewers for their comments on an earlier draft.

References


