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3D Scan Data for Selected Artifacts from Blackwater Draw National Historic Landmark (LA3324), New Mexico, USA

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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 were post-processed in Geomagic Design X 2016.0.1. All data associated with this project have been made publicly available (open access) and are accessible in Zenodo under a Creative Commons Attribution 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. Overview

Research from the Blackwater Draw National Historic Landmark (LA3324) has served as the foundation for much of Clovis archeology, and represents one of the more well-studied Clovis sites in the Americas. Influential studies from this site come from a variety of analytical domains including 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 [Buchanan and Collard \(2010\)](#); [Buchanan et al. \(2011, 2007, 2012, 2013\)](#). There are many components of shape are difficult—if not

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impossible—to characterize using traditional orthogonal approaches [Shott and Trail \(2012\)](#); [Shott \(2011\)](#), and are more accurately captured using their native 3D format [Shott \(2014, 2015\)](#). These attributes can be couched within a variety of theoretical frameworks [Hosfield \(2009\)](#); [Costin \(2001, 2005\)](#); however, evolutionary archeology 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 [Ahmed et al. \(2014\)](#)), the benefits can be seen in their contribution to conservation [Kuzminsky and Gardiner \(2012\)](#), participatory digital archeology [Morgan and Eve \(2012\)](#), and dynamic illustrations [Magnani \(2014\)](#); [Carlson \(2014\)](#).

Figure 1: Map of NE 1/4 of the Blackwater Draw NHL (LA3324).

Figure 2: 3D scan of ENMU LA3324 25313. *This is a 3D figure that can be rotated, measured and otherwise quantified. To activate the figure, this article must be downloaded to your computer. Activate the figure by clicking on the image, then click/drag to rotate.*

1.1. Context

While the detailed context of these artifacts is discussed elsewhere (Haynes 1995; Bennett 2014; Hester 1972; Damon et al. 1964; Holliday 1997; Montgomery and Dickenson 1992), 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 Haynes (1995); Damon et al. (1964); Holliday (1997); Montgomery and Dickenson (1992)

Table 1: Context of Scanned Artifacts

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

(Figure 3). The Blackwater Draw NHL is the Clovis type site of the Paleoindian period.

2. Methods

Selected artifacts were scanned using a NextEngineHD running ScanStudioHD Pro. Scan data were collected at the highest HD setting using eight divisions, then trimmed, aligned, fused and polished in ScanStudioHD Pro, before being exported as ASCII.stl and ASCII.ply files prior to post-processing [Galeazzi et al. \(2014\)](#); [Weyrich et al. \(2004\)](#). Those data were then imported into 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 then utilized in an interactive alignment, with 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 to SolidWorks or other CAD-based platform [Selden Jr. \(2015\)](#) (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

Figure 3: Selected radiocarbon dates associated with scanned artifacts from Blackwater Draw NHL. All dates were recalibrated in OxCal (Bronk Ramsey 1995) using the IntCal13 (Reimer et al. 2013) calibration curve.

tunnels. After these issues were corrected, the rewrap function was used to render the final mesh. Upon completion of post-processing, each mesh was decimated by 50 percent prior to saving then export as an ASCII.ply. Decimation of the mesh decreases file size while increasing ease of use on standard computers.

2.2. 3D Puzzles

In addition to the 3D models, one 3D cardboard puzzle was created (for ENMU LA3324 25313 Selden Jr. (2016t)) to augment the on-site 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 Autodesk (2015), and the 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 4: Aligned 3D mesh for ENMU LA3324 25313 illustrating the reference geometry (reference vector, point and plane—in green) used to align the mesh.

3. Data Description

3.1. Collection Name

3D Scans from Blackwater Draw National Historic Site

3.2. Data Type

Decimated meshes

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

3.3. Format Names and Versions

ASCII.ply (mesh)

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** (Selden Jr. 2016r)
(<http://dx.doi.org/10.5281/zenodo.47134>)
- **ENMU LA3324 EL-2-120** (Selden Jr. 2016s)
(<http://dx.doi.org/10.5281/zenodo.47132>)
- **ENMU LA3324 6183/6188** (Selden Jr. 2016o)
(<http://dx.doi.org/10.5281/zenodo.46910>)
- **ENMU LA3324 6185** (Selden Jr. 2016p)
(<http://dx.doi.org/10.5281/zenodo.46911>)
- **ENMU LA3324 6186** (Selden Jr. 2016q)
(<http://dx.doi.org/10.5281/zenodo.46914>)
- **ENMU LA3324 24122** (Selden Jr. 2016a)
(<http://dx.doi.org/10.5281/zenodo.46918>)
- **ENMU LA3324 24136** (Selden Jr. 2016b)
(<http://dx.doi.org/10.5281/zenodo.47131>)
- **ENMU LA3324 24143** (Selden Jr. 2016c)
(<http://dx.doi.org/10.5281/zenodo.46919>)
- **ENMU LA3324 24152** (Selden Jr. 2016d)
(<http://dx.doi.org/10.5281/zenodo.46920>)
- **ENMU LA3324 24156** (Selden Jr. 2016e)
(<http://dx.doi.org/10.5281/zenodo.47116>)
- **ENMU LA3324 24157** (Selden Jr. 2016f)
(<http://dx.doi.org/10.5281/zenodo.47118>)
- **ENMU LA3324 24158** (Selden Jr. 2016g)
(<http://dx.doi.org/10.5281/zenodo.47120>)

- ENMU LA3324 24161 (Selden Jr. 2016h)
(<http://dx.doi.org/10.5281/zenodo.47121>)
- ENMU LA3324 25313 (Selden Jr. 2016i)
(<http://dx.doi.org/10.5281/zenodo.47122>)
- ENMU LA3324 25314 (Selden Jr. 2016j)
(<http://dx.doi.org/10.5281/zenodo.47124>)
- ENMU LA3324 25316 (Selden Jr. 2016k)
(<http://dx.doi.org/10.5281/zenodo.47125>)
- ENMU LA3324 25317 (Selden Jr. 2016l)
(<http://dx.doi.org/10.5281/zenodo.47126>)
- ENMU LA3324 25330 (Selden Jr. 2016m)
(<http://dx.doi.org/10.5281/zenodo.47127>)
- ENMU LA3324 32095 (Selden Jr. 2016n)
(<http://dx.doi.org/10.5281/zenodo.47128>)

3.9. Data Publication Date

March 3, 2016

4. Reuse Potential

Those 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 points has since been modeled as 3D puzzles 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 the shape, form, size and asymmetry of these artifacts, which can be addressed in analyses of asymmetry and geometric morphometrics.

Acknowledgments

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The 3D model used in Figure 2 was generated as a .ply in Design X and converted to a .u3d in MeshLab with the support of the 3D-CoForm project.

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