Primary Mapping and Stratigraphic Data and Field Methods for the Snowmastodon Project

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Primary Mapping and Stratigraphic Data and Field Methods for the Snowmastodon Project

Carol Lucking, Kirk R. Johnson, Jeff Pigati, and Ian Miller

During the Snowmastodon Project, many different people collected data for a wide array of purposes under a variety of conditions. Early in the process and in an attempt to provide project-wide consistency, Kirk Johnson appointed Carol Lucking as the project’s data manager both in the field and the lab. She was responsible for using GIS to create maps on an ongoing basis throughout the project. Jeff Pigati agreed to measure stratigraphic sections and coordinate the collection of various nonvertebrate samples to make sure that all resulting data could be plotted on common diagrams. Kirk Johnson was onsite for the entire project and measured the basin margin stratigraphy on a daily basis as it was destroyed by the digging teams. In the fall of 2010, we treated the upper part of the site (which included discrete excavations for the mammoth, deer, and bison skeletons) as an archaeological excavation and the lower part of the site (which contained isolated mastodon, ground sloth, and bison bones) as a construction salvage site.

In the spring of 2011, we treated the entire site as a constrained paleontological site within a measured and mapped stratigraphic framework. We anchored this framework with a series of trackhoe-excavated trenches and pits (also known as localities or stations). These localities were used by Jeff Pigati to measure sections and by Kirk Johnson to correlate with Pigati’s sections. The complex stratigraphy of the site complicated data collection as our understanding evolved in the course of excavations. This resulted in evolving field terminology. In addition, the fine-grained sediments in the middle of the lake have different stratigraphic units than the eastern edge of the lake, where we dug through interbedded and alternating conglomeratic and silty debris flows to retrieve laterally transported bones.

Our overall strategy in 2011 was to use total station surveying equipment calibrated to the engineering survey of the reservoir to precisely locate stratigraphic sections, numbered locality stakes, stratigraphic horizons, and discrete bone occurrences. Individual bones were measured to the stakes, providing overall x-y-z control with approximately 10-30 cm precision. In the museum, we are transforming the field data to the museum’s cataloguing system as we curate the fossils.

With all of these factors complicating data collection, we have attempted to synthesize the data sets, to clarify who collected the data, how the data were collected, how terminology and names evolved throughout the project, how maps were produced, and where to find the resulting data sets. Our goal is to produce maps and stratigraphic diagrams that integrate all of the various data sets produced by the science team, allowing for integrated analyses of the Snowmastodon site.
I. Introduction

During the Snowmastodon Project, many people collected data during different phases of the dig. The goal of this report is to summarize and synthesize the data collected, outline the collection techniques, explain inconsistencies, and enable people to find the original data. The site changed considerably over the course of the dig, further complicating data collection. The rapid pace of construction meant that landmarks moved and disappeared frequently in the ten weeks of digging. Please refer to Figures 1-10 for photographs and maps of Ziegler Reservoir that document the changes and provide locality information.

Many of the project leaders and team captains kept field notes that helped track and clarify the progress of the dig at Ziegler Reservoir (Table 1). Copies of all field notes are available in the Denver Museum of Nature and Science (DMNS) Archives.

Table 1. Field notes by scientist and year.

<table>
<thead>
<tr>
<th>Name</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kirk Johnson</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Ian Miller</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Joe Sertich</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Richard Stucky</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Carol Lucking</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Steve Holen</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Cody Newton</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Brendon Asher</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Heather Finlayson</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Dena Meade-Hunter</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Steve Nash</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

In 2010, scientists focused on collecting data from the articulated partial skeletons in the upper layers of the lake while the lower levels were treated as construction salvage. Carol Lucking recorded most of the data at SWSD while the bones and associated material were being washed.

In 2011, the Team Captains collected data on a daily basis. Dane Miller, Joe Sertich, Heather Finlayson, and Bryan Small recorded information about all specimens collected. Other floating captains also recorded data. The original data sheets are stored in the Big Bone Room at DMNS in a green binder titled "2011 Snowmastodon Field Data Sheets." Carol Lucking entered the original data into a master spreadsheet. This spreadsheet is regularly updated to include information about specimen loans and to reflect changes in specimen numbers, such as fixing double numbers. These data will be entered and maintained in the KE EMu\(^1\) collections database once it is live.

Conservator Meghan McFarlane photographed each specimen before it was washed and noted its condition. She recorded interesting features, concerning cracks, distinct coloration, and

\(^1\) Any use of trade, product, or firm names in this publication is for descriptive purposes only and do not imply endorsement by the U.S. Government.
any other unique features. Meghan also took photos of the bones after they were cleaned and dried. Lesley Petrie took over this task in September 2011. All of the bones have at least two photographs, one before any treatment and one after treatment. Many bones have multiple photographs showing the condition from multiple angles. The photographs are currently stored on DMNS servers, organized by field number. The photos will be stored with all other information in the catalog records in the KE EMu database.

Carol Lucking used survey data and the field data to create weekly maps of the site. These maps are on the DMNS servers and will be migrated to the KE EMu database so that the evolution of the Snowmastodon site can be seen.

We standardized data collection as much as possible, but with so many different types of materials, including large bones, articulated partial skeletons, micro-vertebrates, sediment, and logs, there were inconsistencies in data collection. The timing of the dig - split between two seasons - allowed us to refine techniques and knowledge acquired in the first season to streamline data collection for the second season. Refer to the timeline below for details of the different phases of the project.

**A. Snowmastodon Project Timeline**

The dig period spanning October 29, 2010 - November 16, 2010 is referred to as Fall 2010 or simply 2010 throughout this report and other Snowmastodon materials. May 14, 2011 - July 6, 2011 is referred to as Spring 2011 or 2011.

**October 14, 2010** - Bulldozer operator Jesse Steele discovers a partial mammoth while excavating Ziegler Reservoir.


**October 16, 2010** - Bryan Small, Tony DiCroce, and Mel Grantham of DMNS go to Snowmass to visit the site.

**October 19, 2010** - Ian Miller visits the site.

**October 27, 2010** - Kirk Johnson, Ian Miller, and Steve Holen visit Snowmass to work out an agreement with SWSD and are on site when additional animals are discovered by the bulldozer drivers. The high level of media and local interest is clear.

**October 29, 2010** - Steve Holen, Eric Parrish, Jude Southward, Samantha Richards arrive at the site to start the excavation of the mammoths and mastodons.

**November 1, 2010** - Ian Miller, Dane Miller, and Liz Miller arrive in Snowmass with food and supplies.

**November 3, 2010** - Kirk Johnson, George Sparks, and Carol Lucking arrive on site. The science team begins to grow as we realize the size and potential importance of the site. DMNS volunteers and staff steadily head to the site.
November 4, 2010 - Dan Fisher arrives, and we find the first sloth humerus. Ian finds the deer in the peat.

November 5, 2010 - Russ Graham and Greg McDonald arrive.

November 6, 2010 - Ian and Dane find the *Bison latifrons* skull.

November 7, 2010 - Steve Jackson and students arrive and find the first vertebrate microfossils by splitting the Yellow Brick Road.

November 8, 2010 - Dane finds the Clay Mammoth. Jeff Pigati, Tom Ager, and Paul Carrara arrive.

November 11, 2010 - Radiocarbon dates are returned for the peat around Snowy, showing that the peat is radiocarbon dead.

November 15, 2010 - Digging is done, site is packed.

November 16, 2010 - Load cars with bones and head back to the museum.

November 17, 2010 - May 13, 2011 - The team prepares to return to the site.

May 14, 2011 - Core Team and Team Captains arrive on site and start setting up.

May 20, 2011 - Carol Lucking and Cody Newton get the Total Station going and begin surveying the site.

May 31, 2011 - Numerous scientists arrive onsite.

June 13, 2011 - Chris Faison finds the skull of Ziggy the Sloth. Extra diggers arrive onsite to supplement the staff and volunteer crew.

June 20, 2011 - Many scientists arrive onsite. Dan Fisher discovers rocks intimately associated with the Clay Mammoth skeleton

June 22, 2011 - USGS personnel arrive and conduct LIDAR surveys of the Clay Mammoth and the Beach.


July 2, 2011 - Start to pack up site and operations. People and bones trickle down to the museum.

July 7, 2011 - Clay Mammoth is hoisted onto a truck and taken back to Denver.
July 9, 2011 - July 12, 2011 - Ian Miller, Dane Miller, Joe Sertich, and Gussie McCracken monitor the site for more bones.

Figure 1: Looking southeast over Ziegler Reservoir on November 5, 2010.

Figure 2: Looking north over Ziegler Reservoir on July 1, 2011.
Figure 3: Looking north over Ziegler Reservoir on July 1, 2011.

Figure 4: Looking south over Ziegler Reservoir on July 15, 2011.
Figure 5: Looking south over Ziegler Reservoir on June 8, 2012.

Figure 6: Looking southwest over Ziegler Reservoir on June 8, 2012.
Figure 7: Aerial photograph of Ziegler Reservoir looking down and toward the west.
Figure 8: Locality map of Ziegler Reservoir showing 2010 finds. The outcrop of Yellow Brick Road (Unit 10) is included for reference.
Figure 9: Map of Ziegler Reservoir 2010 localities with toe of dam and crest of dam. 
Created by SurvCo Inc.  
DMNS Technical Report 2012-4, Page 12
Figure 10: Locality map showing bones from 2010 and 2011 as well as localities, stratigraphic sections, and drillings.
Figure 11: Locality map showing surveyed localities and major finds.