Three – Dimensional Paleo – Spur Throated Grasshoppers

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Introduction

To facilitate interdisciplinary analysis of the paleo-Melanoplinae, 3D scanning was performed. Three-dimensional volumes were created using a NextEngine 3D laser scanner with the intention of being able to enhance diagnostic features on specimens (i.e., prosternal spine) recovered from Terminal Pleistocene deposits within Crypt Cave, Western Nevada (Figures 1 & 2). Anticipated implications by posting 3D volumes online are that it will aid in interdisciplinary analysis among distant researchers. The process of scanning modern grasshoppers as a test and paleo-spur-throated grasshoppers for analysis will be reviewed.

Location of Crypt Cave, Pershing Co., Nevada (Figure 1).

Entrance to Crypt Cave (Figure 2).

Crypt Cave grasshopper specimens showing fragmentation (Figure 3).

Materials

Spur-throated grasshoppers (*Melanoplus spp.*) were recovered from a Terminal Pleistocene food cache (14,195 cal. B.P.) (Figure 3) in 1952 by archaeologist Phil Orr but remained unidentified and unanalyzed until 2016 (see Pellegrini et al. 2016). A comparative collection of grasshoppers (*Melanoplus sanguinipes*) (Figure 4) was then collected and used for scanning practice (Figure 5) so that the Crypt Cave specimens could have minimal handling.


Melanoplus sanguinipes (migratory grasshopper) comparative collection (Figure 4).

Process

Set up the NextEngine Scanner using a three panel scan on high density. Scan that view and then overlap the next over that by one scan panel, working your way around the object. Reset the object on its other axis and repeat. Once the scans are done, clean and trim the models, align, fuse and export.

Obstacles

These are the obstacles (in the Stoic sense) that we have run into while scanning grasshoppers: the small size of the grasshopper, getting the detail of the characteristics at the level needed for analysis (Figure 6), then not being overwhelmed by the detail, decimation or stripping of the points to get the model down to a workable size, not losing the characteristics while doing decimation (Figures 7 and 8), exporting the model to another file system without adding error, finding the right scanner to do the scanning on small pieces, conquering the open source programs, making the leap to 3D models from photos, getting returns off of broken pieces, transitioning to volumetric analysis.
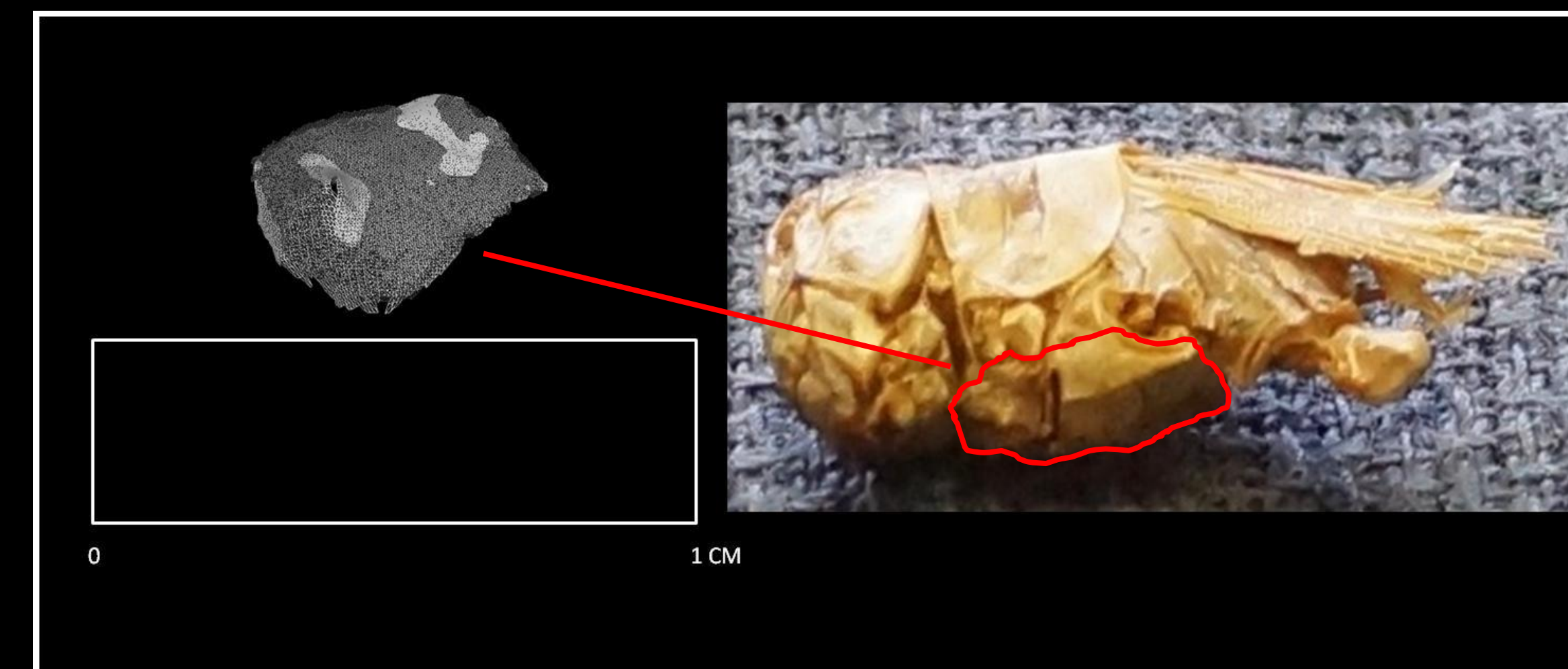

Mesosternum is very thin and delicate; left: 3D scan of mesosternum; right: Photograph showing mesosternum in relation to the grasshopper. The mesosternum has a "bump" on the proximal end (mesosternal process). Not all Melanoplinae have these and the size and shape varies from species to species of spur-throated grasshoppers that have them (Figure 6).

Goals

Goals for this project are twofold: first; use emergent technologies to scan 3D grasshoppers so that researchers can analyze them collaboratively. Second; share this data with other archaeologists, entomologists, and the public. This has potential to tease out taxonomical similarities and to fine tune geographical occurrences among taxa. A good example are the species *Melanoplus sanguinipes* (migratory grasshopper), *Melanoplus femurrubrum* (red-legged grasshopper), *Melanoplus bruneri* (Bruner's spur-throated grasshopper) and *Melanoplus spretus* (Rocky Mountain locust) (Figure 9), were until recently considered different phases of the same taxa, the latter two being the most closely related (Lockwood 2004:223).

## Potential of Emergent Technology

This work so far has raised new questions about grasshoppers and emergent technology used to scan them, such as:
1) Can we use a scan of the mesosternum and transform it into a "topographical map" that we can then potentially display and analyze in GIS?; 2) Will 3D scans aid in species identification based on the prosternal spine and mesosternal features of Melanoplinae species? This technology has potential to aid in lithic studies, zooarchaeological questions and entomological studies.
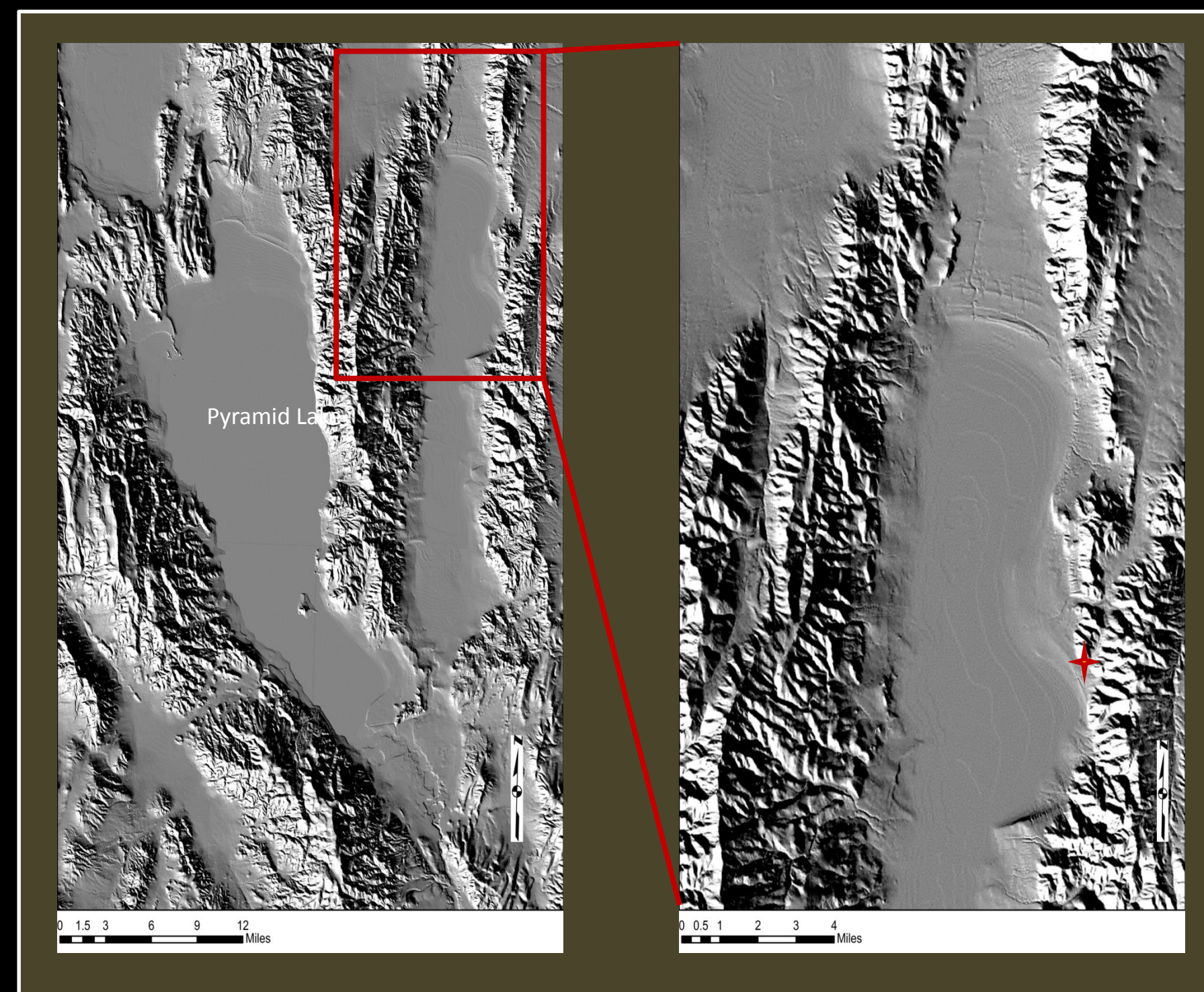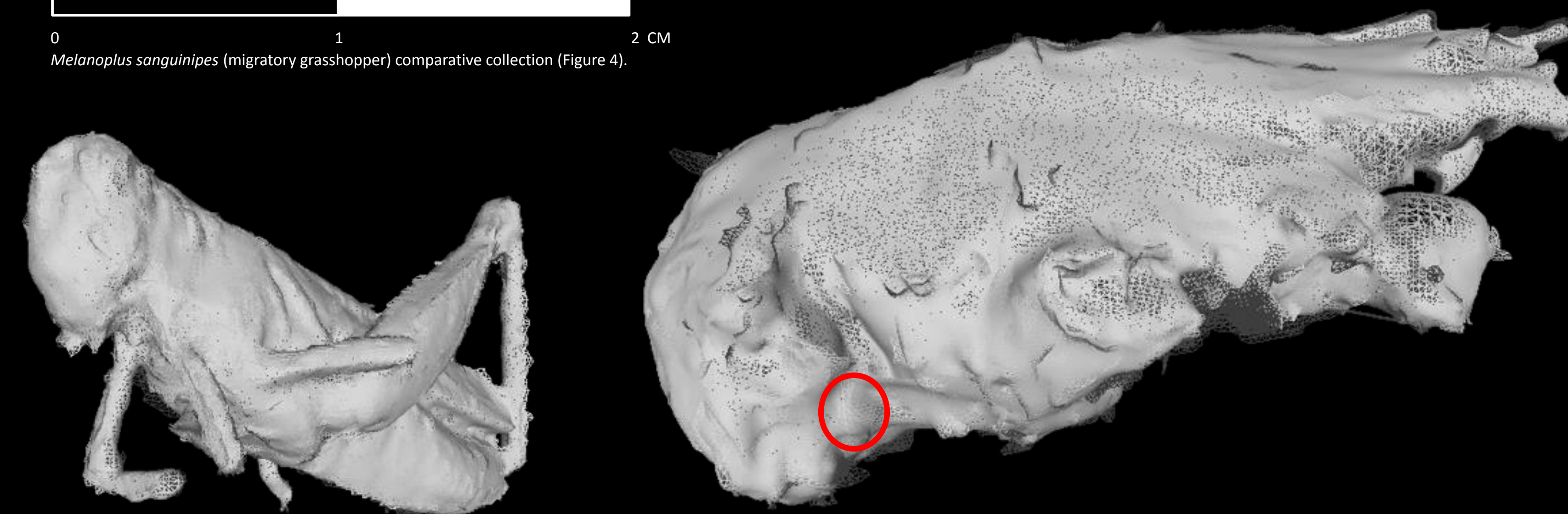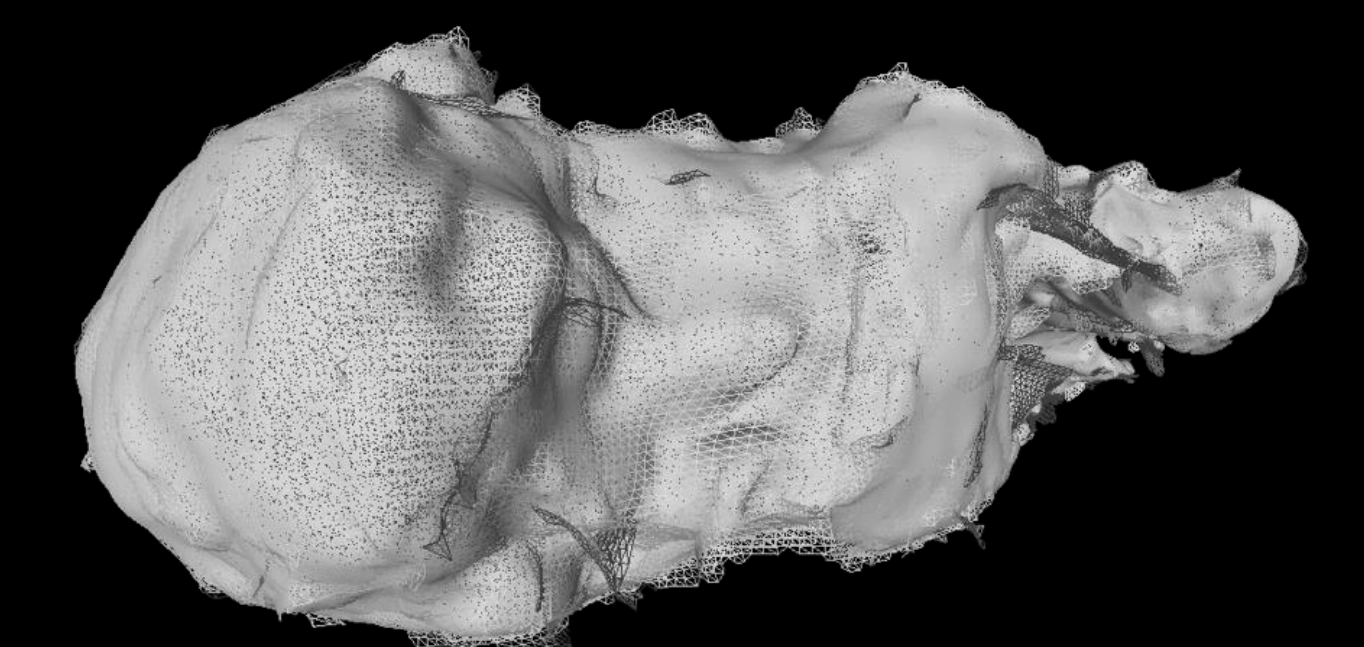

Three-Dimensional scan of *Melanoplus sanguinipes* from comparative collection (Figure 5).

Detail of 3D scanned spur-throated grasshopper from Crypt Cave showing prosternal spine (Figure 7).

Photograph of Crypt Cave spur-throated grasshopper showing prosternal spine (Figure 8).

3D scan of Melanoplus c.f. spretus from Crypt Cave. Specimen is on its back. Diagnostic features are lost in some rotations but present in others (Figure 9).

Citations

Lockwood, Jeffrey A.
    2004 *Locust: The Devastating Rise and Mysterious Disappearance of the Insect that Shaped the American Frontier.* Basic Books, New York, New York.

Pellegrini, Evan J., Eugene M. Hattori, and Larry V. Benson
    2016 A Paleoindian Grasshopper Cache from Winnemucca Lake, Pershing County, Nevada. Unpublished manuscript.