The Wenas Creek Mammoth Project:  
2007 Interim Report on Excavations at 45YA1083

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Introduction

The Wenas Creek Mammoth Project is an interdisciplinary investigation of paleontological remains and possibly associated artifacts at Site 45YA1083 on private property near Selah, Washington. Fieldwork at the site was undertaken in a series of three summer university field schools, sponsored by Central Washington University, in 2005, 2006, and 2007. In the 2005 season and initial part of the 2006 field season, the site was purely a paleontological excavation of mammoth remains, requiring no excavation permit. In July, 2006, a single artifact was discovered in the excavations, providing the site archaeological isolate status for the first time. Given this find, a permit was requested and granted for the 2007 field season, providing the requirement for this report.

This interim report is prepared to fulfill obligations of Archaeological Excavation Permit No. 07-09 granted by State of Washington Department of Archaeology and Historic Preservation (DAHP) on May 30, 2007. It represents a work in progress on the overall project rather than a final report. Given the long-term research nature of the project, its primarily paleontological rather than archaeological focus, and the academic pressures of the major research staff, reporting will be completed on an irregular basis, some as peer-review publications. The first of these is a Current Research in the Pleistocene article (Lubinski et al. 2007).

Investigations through summer 2007 have yielded mammoth and other paleontological bones, but very limited cultural material. The total of cultural materials from the site thus far is two pieces of chipped stone debitage, both found apparently stratigraphically above the mammoth bones. Given the debitage find locations, the archaeology and the mammoth bones are presumed unrelated, although they are in fairly close proximity (ca. 15 cm) and this requires further evaluation. Based on chronometric dating thus far, the mammoth bones are from about 16,000 calendar years ago (CALYBP) or 13,000-14,000 uncalibrated radiocarbon years ago (RCYBP). The artifacts presumably are later, but how much later is unknown. Details of findings to date are given in a later section.

Environmental Context

The Wenas Creek Mammoth Site is located at about 1400 feet elevation (427 m) on a bench on the south valley wall of the Wenas Creek valley, about 800 feet (244 m) from the current creek channel and 70 feet (21 m) above the valley floor. At the time of bone deposition
at the site (ca. 16,000 CALYBP), Wenas Creek would likely have been higher and closer to the site. The site is drained by two deep ephemeral channels which pass to the west and east of the excavation, and flow into the South Wenas Road ditch north of the site. Prior to construction of the road ditch, the ephemerals would have passed into Wenas Creek, a small tributary of the Yakima River. The site lies on the side of a broad interfluval ridge between Wenas Creek and the Naches River. The mammoth site occupies the upper edge of a ~300 m long x ~100 m wide bench dissected by several gullies, about 170 m below the crest of the ridge. Although this bench is mapped as “Quaternary landslide deposits” by Walsh (1986), its origin is not certain. It could be a landslide deposit, an alluvial fan remnant, or even a terrace.

The Wenas Creek Valley lies within the northwestern portion of the Yakima Fold and Thrust Belt, with a tectonically folded ridge of basalt (Umtanum Ridge) forming the north valley wall. However, the southern wall upon which the site sits is an erosional remnant cored with volcanioclastic Ellensburg Formation gravels (Waters 1955; Smith 1988). The Ellensburg formation gravels observable uphill of the site and within the excavations include a large number of volcanogenic rocks like tuff and small amounts of cryptocrystalline materials such as a translucent yellow or orange chert. Surface sediment on the slope in the site vicinity appears to be dominated by loess.

The site lies within the Columbia River hydrographic basin, and near the western edge of Columbia Basin physiographic unit, not far from its intersection with the Cascade Range. The area is within the rain shadow of the Cascade Range, which results in a dry, continental climate with marked seasonality. In the historic period, the nearby Yakima Valley had average temperatures of 28°F in January and 73°F in July, with about 8" (20 cm) of annual precipitation (Miller and Highsmith 1949). Most regional precipitation falls as winter rain and snow.

Current native vegetation in the general study area is sagebrush steppe, part of the *Artemisia tridentata/Agrropyron* Association defined by Daubenmire (1970). Dominant vegetation in this association is big sagebrush (*Artemisia tridentata*) and bluebunch wheatgrass (*Agropyron spicatum*). Native vegetation observed onsite includes shrubs (mostly big sagebrush, but also some gray rabbitbrush, purple sage, and an unidentified slender bush), forbs (yarrow, lupine, Mariposa lily, unidentified phlox and daisy), and bunchgrasses (needle and thread, wheatgrass, unidentified). There are also introduced plants such as cheat grass, Russian thistle, tumble mustard, and Western salsify.
The Columbia Basin is well-known for Late Pleistocene glacial outburst floods that formed the channeled scablands in eastern Washington (Bretz 1969; Waitt 1980; Clague et al. 2003), now dated 15,700-13,500 RCYBP (Booth et al. 2004). The study site is in an area above the highest-known levels of these outburst flood events, and beyond the limits of Late Wisconsin continental and montane glaciers (Waitt and Thorson 1983; Booth et al. 2004). The Late Wisconsin glaciation, known regionally as the Fraser Glaciation, extended from ca. 25,000-10,000 RCYBP, with the Last Glacial Maximum (LGM) ~18,000 RCYBP or 21,000 CALYBP. Paleoenvironmental proxy data indicate that the Late Glacial period from 18,000 to 10,000 RCYBP generally had cool, moist conditions (Whitlock et al. 2000; Blinnikov et al. 2002). This is somewhat mismatched with general circulation models, which predict colder, drier Late Glacial conditions (Bartlein et al. 1998). Vegetation near the study site was an *Artemisia* shrub steppe at LGM, with a subsequent shift to grassland and a modeled downward movement of shrub steppe to lower elevations in Late Glacial times, based on pollen and phytolith records from nearby Carp Lake and KP-1 sites (Blinnikov et al. 2002). The Wenas Creek Mammoth site is elevationally near the Late Glacial steppe/grassland ecotone proposed by Blinnikov et al. (2002), and the mammoth bone dates are temporally near the onset of Late Glacial conditions.

**Cultural Context**

The site is located within the lands ceded by the Confederated Tribes and Bands of the Yakama Nation in the Treaty of 1855. In the mid 1800s, Wenas Creek was the approximate territorial boundary of the Upper Yakama bands (e.g., Kittitas) and the Lower Yakama bands (Yakama proper), each composed of a number of smaller independent bands or villages (Schuster 1998:327). These groups all are speakers of dialects of the Sahaptin language (Schuster 1998).

The nineteenth century economy of Yakama bands was typical of hunter-fisher-gatherers, with settled winter villages along the major watercourses and more scattered temporary camps placed to exploit seasonal resources like spawning fish, root crops, and ripening berries (Hunn 1990; Schuster 1998). The principal foods were fish (particularly salmon, steelhead trout, suckers, and "eels" or lampreys), wild roots (particularly bitterroot, camas, cous and desert parsleys) and meat, particularly deer meat (Hunn 1990; Schuster 1998). The typical Yakama annual round would begin with breakup of the winter village for fishing camps during the first
salmon run about March, then movement in May to root-digging grounds for gathering and hunting, followed by a return to fishing camps for the June salmon run, and subsequent movement over the summer to higher elevation mountains and/or root-digging grounds for hunting, trout fishing, root collecting, and berry picking (Schuster 1998:331). In the fall, people revisited the valleys for fish runs, hunting, and visiting, returning to the winter villages in about November (Schuster 1998:331).

The mouth of Wenas Creek where it empties into the Yakima River, about three miles downstream of the site, was a noted fishing location (Schuster 1998:Figure 1). Given its lowland valley location not far from the Yakima River, the Wenas Creek valley could have been used for winter villages, fish camps, and a variety of activities such as root digging, hunting of game, berry picking, and placement of burials. One plant, Mariposa lily (*Calochortus macrocarpus*), known to be used by local native peoples (Hunn 1990; Hunn et al. 1998), was observed on the site in June, 2006. The valley below may have formerly supported camas (*Camassia quamash*), while the foothills upstream probably supported huckleberry (*Vaccinium* sp.) and chokecherry (*Prunus virginiana*). Burials were sometimes placed in talus slopes such as found several places at the margins of the Wenas Creek valley; several burials were formerly located at the mouth of the creek (Warren 1968).

Given the project focus on Pleistocene bones and nearby artifacts, the relevant prehistoric cultural context is principally Pleistocene and early Holocene archaeology, although the artifacts found to date could be considerably later in time.

At present, the earliest well-established archaeological sites in North America date 11,500 RCYBP and later, most associated with distinctive Clovis artifacts (Anderson and Faught 2000; Holliday 2000; Meltzer 2004). Recent reanalysis of radiocarbon dates indicates that these sites may all date 11,050 RCYBP and later (Waters and Stafford 2007). Many sites with purported human activity dating earlier than 11,500 RCYBP are not well accepted, due to perceived problems with dating, unconvincing evidence of human activity (e.g., artifacts or human remains), and/or association of artifacts and dates (Haynes 1969; Dincauze 1984; Meltzer 2004). The best accepted pre-Clovis age site in the Americas is Monte Verde in Chile, which has a 12,500 RCYBP component with abundant organic artifacts plus stone tools and bone (Dillehay 1989, 1997; Meltzer et al. 1997). Other pre-Clovis sites are controversial, either for the reasons noted above or because they are not yet published in sufficient detail for convincing
peer review (Meltzer 2004). While many archaeologists no longer doubt that humans arrived in the Americas prior to Clovis, the nature of pre-Clovis archaeology is anything but clear (Haynes 2002; Roosevelt 2002; cf. Kelly 2003).

There is strong evidence for human hunting of mammoths at about a dozen sites in North America, but none in the Pacific Northwest (Grayson and Meltzer 2003; Fiedel and Haynes 2004). This evidence consists of intimate associations of artifacts and mammoth remains, convincing evidence of cutmarks or human-caused bone breakage, and/or unambiguous human-caused spatial movement of bones (Grayson and Meltzer 2002). In the Pacific Northwest, there are three sites with purported evidence for human hunting of proboscideans (mammoths and/or mastodons): Ledgerwood, Washington (Gustafson et al. 1991); Manis, Washington (Gustafson et al. 1979), and Owl Cave/Wasden, Idaho (Miller 1989), but all lack compelling evidence. In the case of Ledgerwood and Owl Cave, there is insufficient stratigraphic correlation of human artifacts and mammoth remains, and at Manis there is insufficient evidence for artifacts and butchery marks (Carlson 1990; Gustafson et al. 1991; Grayson and Meltzer 2002). Thus, all three sites should be considered paleontological but not archaeological based on the currently published record.

Although the connection of mammoths with Clovis artifacts is well established, there is still considerable uncertainty about the nature of human subsistence strategies in the period. Examinations of the existing faunal record indicate that Clovis hunters took ungulates (e.g., bison, equids, camelids), lagomorphs, and other prey as well as proboscideans (Haynes 2002:Tables 5.1-5.2; Waguespack and Surovell 2003). However, current evidence is insufficient to distinguish between a range of possible human foraging strategies from generalized foragers to specialized big-game hunters, based on possible geographic variation and diverse interpretations in the literature (e.g., Waguespack and Surovell 2003; Cannon and Meltzer 2004; Byers and Ugan 2005).

Overall, there is very little published scientific evidence for humans in the Pacific Northwest prior to 11,000 RCYBP. While a number of Clovis or Clovis-like artifacts have been found (Ames et al. 1998), only one Clovis site has stratigraphic control and chronometric age estimates: the Richey-Roberts (East Wenatchee) site in Washington. This site has yielded a number of unusually large Clovis bifaces in what appears to be a cache (Gramly 1993) atop Glacier Peak G tephra dating ca. 11,200 RCYBP (Mehringer et al. 1984). A handful of other
controversial regional sites are being evaluated that may pre-date Clovis (Jenkins et al. 2004) or be contemporary with it but exhibit distinct technology (Davis and Schweger 2004). In the period ~11,000-10,000 RCYBP, there are a number of well-accepted sites such as Lind Coulee (Craven 2004; Daugherty 1956), Marmes (Hicks 2004), and Sentinel Gap (Galm and Gough 2000) in Washington.

Local Archaeological Investigations

Previous archaeological investigations in the immediate site vicinity are limited. No previously recorded sites are noted within two miles of 45YA1083. Few recorded sites or projects have been located in the general area, mostly due to a lack of Section 106-mandated investigation, as the vicinity is almost entirely privately owned and used for farming, ranching, and housing. However, there are two other excavated sites within six miles of the Wenas Creek Mammoth site: the Wenas Creek site (45YA18) and the Rosa Rockshelter (45YA301).

The Wenas Creek site is located about 3.5 miles east-southeast of the study site at the mouth of Wenas Creek. It was recorded in an archaeological survey for a natural gas pipeline, and salvage excavated along its right-of-way in the summer of 1956 under the direction of University of Washington graduate student Claude Warren (Warren 1968). At that time, the site had already been extensively damaged by informal digging, and the focus was made on apparently undisturbed portions of the 50-foot wide right-of-way. Hand excavation of about 750 square feet to bedrock (up to 8.5' deep) revealed housepits, hearths, postholes, and talus burials, and yielded about 1300 artifacts (Warren 1968:2). Artifacts were dominated by chipped stone, including nearly 200 projectile points, mostly stemmed and corner-notched varieties (Warren 1968:Table 1). Other recovered artifacts included hammerstones, pestles, bone and antler tools, Olivella and Dentalium shell, and a copper kettle. There are no chronometric dates for this site.

The Rosa Rockshelter site is located along the Yakima River in Yakima Canyon about 5.5 miles east-northeast of the study site. It was explored and mapped in Fall 1969, and partially excavated in the summer of 1970 under the direction of William Smith of Central Washington State College (Smith 1971), now Central Washington University. Twelve 1x1 m squares were excavated to bedrock in the small rockshelter (6.3 x 5.5 x 1.8 m high), recovering perishable materials including one piece of tule matting, three fragments of basketry material, three fragments of leather, and 155 pieces of cordage (Smith 1971). Also recovered but not analyzed
were straw and stick fragments, animal bones, and some lithic debitage. The age of the site is unknown.

**History of Site Investigation**

The Wenas Creek Mammoth Site (45YA1083) is located on lands owned by Mayo Ranches, Inc. in Township 14N, Range 18E, in Yakima County, Washington (exact location suppressed in this document). The site is where construction workers discovered a large bone during construction of a private road on Mayo Ranches property near Selah in February, 2005. The find was made near the south edge of the road while smoothing the grade on that side with a backhoe. Subsequent to the find, the landowner contacted Central Washington University (CWU), provided the bone to the university, and covered the location with backdirt, obscuring the exact location of the find. The bone was later determined to be the left humerus of an unidentified mammoth (*Mammuthus sp.*). A Memorandum of Understanding (MOU) was signed April 27, 2005 between Mayo Ranches and CWU to allow for investigation of the mammoth find location. Since the find was strictly animal bone with no evidence of human artifacts, it was considered a fossil locality not subject to state archaeological law.

A CWU field school investigated the fossil locality in the summer of 2005 (June 27 - August 5), with two principal goals: (1) placing the bone found in construction in geological context, and (2) searching for additional mammoth bone. To begin, a ground-penetrating radar (GPR) survey was conducted under contract by Brian Whiting of Earth Imaging Associates. The purpose of this work was to seek geophysical evidence of additional mammoth bones and thus avoid damaging them in a subsequent backhoe trench. Two GPR grids were investigated at 50 cm intervals: Grid 1, a 26m N-S x 19 m E-W unit north of the gravel road, and Grid 2, a 10m N-S x 14.8m E-W unit south of the road, as near as practical to the estimated find location. Both grids yielded a number of GPR anomalies, but none appeared to be mammoth remains. A mechanical trench was then excavated near the presumed find location with a trackhoe to provide geological cross sections for the find. The trench was 37m long and L-shaped to provide a long downslope section and shorter cross-slope section. No bone or artifacts were discovered in the trench. Hand excavated units were dug in 2x2m units or smaller at 5 or 10 cm levels with horizontal bases. A map of all excavations to date is given in **Figure 1**. Hand excavation of 25.75 m² of deposits yielded hundreds of bone fragments, but no cultural materials nor human
bones were found. All of the mammoth-sized bone was fragmentary and unidentified except for a near-complete right humerus found in place. Sediment samples were obtained for luminescence dating and analyses of sediment particle-size, pollen grains, and opal phytoliths.

Figure 1. GIS map of investigations to date. The "Edge of Disturbance" indicates the southern margin of construction disturbance, while "Backhoe cut" indicates the northern margin of intact stratigraphy. Map produced by Christie Weitzel.

In summer 2006, CWU began a second season of field school excavations, with fieldwork extending from June 26 to August 18, 2006. Work focused on hand excavations adjacent to bone-bearing units from 2005, and in areas of GPR anomalies from 2005. These exposed additional mammoth bones and bovid (probably bison) bones. On July 7, a student exposed the first artifact, a chert flake fragment, near mammoth bones in XU 12. Assistant State Archaeologist Stephenie Kramer was consulted, and provided permission to proceed without a
permit so long as the flake was documented as an isolate and no additional materials were found. The Yakama Nation Cultural Resource Program was also consulted, and their representatives visited the site July 10. No additional artifacts and no human bones were recovered for the remainder of the season. The context of the flake find in relation to the mammoth bone has not yet been resolved, but it appears to lie stratigraphically above the mammoth bones. An isolate form was submitted August 25, 2006, and assigned number 45YA1083.

In summer 2007, CWU held a third season of excavation from July 2 through August 25, following protocols set forth in the DAHP Archaeological Permit application. Work focused on hand excavations adjacent to bone-bearing units from 2005 and 2006. In addition to numerous non-human bones, a single definite artifact was discovered in fieldwork. This chert flake was recovered from the screen in XU 20, apparently above the mammoth bone-bearing level. No other definitive human artifacts were recovered.

Results of the project to date are provided below under "Summary of Current Findings."

**Project Personnel**

The Wenas Creek Mammoth Project is a multidisciplinary project with a research team of professionals, students, and volunteers. Dr. Patrick Lubinski, an archaeologist and zooarchaeologist, is the overall project director. He is an Associate Professor in the Department of Anthropology at CWU. Other research team leaders are: Bax Barton, M.Sc., paleontologist (Curator, Quaternary Research Center, University of Washington); Karl Lillquist, Ph.D., geomorphologist (Professor, Department of Geography, CWU); and Morris Uebelacker, Ph.D., archaeologist and geographer (Professor, Department of Geography, CWU). These four faculty have overseen all phases of work on the project. Jake Shapley, a CWU Graduate Student in Resource Management, has played a significant role throughout the project, including a role as the principal Teaching Assistant in the field and laboratory since the inception of the project.

In the initial 2005 season, nine students were enrolled in the six-week CWU summer field school investigating the mammoth: Lorin Davidson, Ben Hanson, Ryan Murphy, Miles Muscato, Andrew Pruitt, Angela Reese, Mark Steinkraus, Jayne-Leigh Thomas, and James White. Jake Shapley, a CWU Anthropology undergraduate, was the field school Teaching Assistant. After the field school was completed, a number of people volunteered for up to another three days to finish: Bax Barton, Pat Lubinski, Miles Muscato, Joan Para, Andrew Pruitt,
Jake Shapley, Jayne-Leigh Thomas, and Morris Uebelacker. Student Laboratory Assistants for the 2005-06 academic year included Jennifer Eakins, Heather Hull, Amanda Messett, Minori Muramoto, and Emily Stamm.

In summer 2006, 15 students were enrolled in the eight-week field school: Nikki Boneham, Agnes Castronuevo, Stacie Cearley, Sarah Davis, Serena Ford, Beth Gilmore, Adam Gordon, Ian Gould, Tim Held, Melissa Hogrefe, Dayne Kinder, Lynne McCreight, Minori Muramoto, Hannah Spool, and Stacy Stanley. Jake Shapley (CWU Anthropology undergraduate) and Jayne-Leigh Thomas (CWU Resource Management graduate student), were field school Teaching Assistants. Summer field school volunteers included Becky Arnold, Frank Arnold, Sean Bruso, Meghan Caves, Traci Caves, Patricia Clark, David Cordoner, Jaclyn Davis, Jessica Griffith, Jay Held, Kathy Lind, Benjamin Losh, Sandy David Martinez, McKenzie, Zack McKenzie, Lorraine McKiristy, Cooper Scott, Diana Shapley, Olivia Shapley, Preston Shapley, Thomas Shapley, Sarah Silverman, Tony Simon, Mark Steinkraus, Rich Villacres, the six teachers from a CWU mammoth-related summer teaching institute (April Ashworth, Jerry Bushnell, Noreen Clark, Jennifer Coleman, Paul Olsufka, Jill Simmons), and visiting member of two archaeological field schools (CWU Saddle Mountains, and South Puget Sound Community College). After the field school was completed, a number of people volunteered for up to another five days to finish: Bax Barton, Nikki Boneham, Stacey Cearley, Sarah Davis, Serena Ford, Tim Held, Melissa Hogrefe, Ian Gould, Pat Lubinski, Minori Muramoto, Joan Para, Hannah Spool, and Morris Uebelacker. Student Laboratory Assistants for the 2006-07 academic year included Matt Bangeman, Carrie Barrett, Stacie Cearley, Robert Eikenbary, Anthony Ellering, Ian Gould, Kristen Gregg, Tim Held, Dayne Kinder, Jeremy Murray, and Lindsay Rosen.

In summer 2007, nine students were enrolled in the eight-week field school: Becky Arnold, Jenny Eakins, Ian Gould, Brittney Gregory, Sarah Huntington, Stephanie Kirpach, Kim McDaniels, Minori Muramoto, and Kayla Snider. Jake Shapley and Christie Weitzel, both CWU Resource Management graduate students, were field school Teaching Assistants. Student Laboratory Assistants for the 2007-08 academic year included Rita Bennett, Jenna Brooks, Nathan Day, Laura Dice, Robert Eikenbary, Alfred Keller, Jonathan Mathes, Kim McDaniels, Lindsay Rosen, Lori Stacy, and Emily Wolden. Volunteer RSVP laboratory assistants (through
Fall Quarter 2007) were Jim Briggs, Jim Morgan, Nancy Morgan, Margaret Smith, Sue von Jentzen, and Sylvia Wheeler.

2007 Research Questions and Design

This investigation is multidisciplinary, with research questions in paleontology and paleoecology, geomorphology, and archaeology. For archaeology, the overriding research concern is whether or not the paleontological remains are associated with human activity. This is an especially important question given the presence of bones from an extinct mammoth and the likely age of about 13,000-14,000 RCYBP. If an association is found between the dated bones and cultural activity, the site will clearly be of international importance and eligible to the National Register of Historic Places. Our approach and methods are conservative, and no such association is expected. On the other hand, we want to be sure to employ an approach that will find any evidence that may exist.

Since so little is known prior to Clovis in North America, any information about human activity at the site would be highly significant. Even an association of a mammoth and human activity at a later date would be significant, since there are presently no compelling kill sites in the Pacific Northwest. If no cultural materials are found associated with the mammoth bones, the site will still yield significant paleoenvironmental information pertinent to arguments for human arrival and/or use of the region in the Pleistocene. These data will include information on mammoths and contemporary animals, as well as vegetation and climatic conditions if we can obtain sufficient funding for analyses of pollen, phytoliths, and chemical isotopes.

Given these research domains, the principal goals of the 2007 field investigation were threefold: (1) to determine the relationship (if any) of the cultural material to the mammoth bone, (2) to place both cultural material and bone in geological context including age and depositional history, and (3) to search for additional cultural material and faunal remains. To address goals (1) and (2) in the excavations, methods were designed to ensure sufficiently precise locational control to demonstrate any potential relationships between artifacts, bones, and matrix, and to collect excavated materials and sediment samples in a way conducive to future analyses. To address goal (3), prior excavations were expanded and units were systematically sampled for fauna/artifacts and microfauna/microartifacts.
2007 Field Methods

Field investigations in 2007 began on July 2 and continued weekdays through August 17 for the Mammoth Creek Field School sponsored by Central Washington University, and under the supervision of Dr. Patrick Lubinski of CWU. Other archaeology supervisory staff included Dr. Morris Uebelacker (CWU Department of Geography), Bax Barton (Burke Museum and Quaternary Research Center at the University of Washington), and CWU Resource Management graduate students Jake Shapley and Christie Weitzel. After the field school was completed, fieldwork continued on a volunteer basis under the direction of Dr. Lubinski through August 25.

Formal hand excavation units for the project (2005-2007) were placed either in areas of GPR anomaly or adjacent to units with previously exposed bone (see Figure 1). Units 1, 15, and 16 were placed over GPR anomalies. The overall goal for the GPR units is to test at least one positive and one negative anomaly from each of the two GPR grids, one grid north of the road (XU15, XU16) and one grid south of the road (XU1, and another to be initiated in 2008 or later). One unit (XU13) was placed adjacent to XU1, which yielded bone in 2005. The remaining units were grouped into a main excavation block expanding from the original bone find from road construction. Baulks (50cm wide) have been left between key units in the main block to preserve stratigraphy and provide locations for future sampling. Units excavated in 2007 were all continuations from the 2006 season or new units placed adjacent to bone-bearing units in the main block. This included continuation of work in XU 1, 13, 14, and 16, and initiation of excavation in XU 18, 19, 20, 21, and 22.

Excavation units and adjacent vertical control datums were laid out to correspond with the existing grid system with a Topcon CTS-223W total station theodolite and a prism pole (a SECO 25 mm prism with as few 30 cm pole extensions as practical, to minimize leveling error). The grid system uses a grid north set to 0° North with a magnetic declination of 20°, and a coordinate system with the southeast corner of XU 2 set to North 500 m, East 100 m, Elevation 100 m. The vertical datum nails were used for approximate depth control, but all elevation control was verified with total station shots. Excavation was in units of 2x2 m (less if a 50cm wide baulk wall is adjacent, or if the unit is a portion of baulk wall itself) in levels of 5 or 10cm with horizontal floors. An excavation level form was completed for every unit level. All excavated matrix was dry screened through 1/8" hardware cloth, except for the fine screen sample. The fine screen sample will be taken from a 45 x 45 cm column of sediment reserved in
each unit to approximate 5% of the total excavated volume. The fine screen sample will be water screened with doubled-over window screen to provide an effective mesh size of 1mm. The fine screen residuum will be dried and taken to the lab for sorting under controlled conditions. (Processing of 2005 and 2006 fine screen samples was undertaken during the 2007 field season, but no new fine screen samples were taken or screened this season.)

All encountered cultural materials and bone was left in place (as possible) and pedestalled until spatial relationships in the unit were clearly established. Fragile materials (most bones) were consolidated as needed with Butvar B-76 (polyvinyl butyral resin dissolved with acetone), except for those intended for radiocarbon dating or chemical analyses. Bone radiocarbon/chemical sample cores were removed from select larger bones with an electric hand drill equipped with a 1" diameter hole saw, which allowed the remainder of these bones to be consolidated with B-76. After fully exposed, all finds were recorded with 3-D coordinates (e.g., high point, low point, horizontal outline) with the total station as possible. As a data backup, hand-drawn plan maps were completed to indicate finds in each unit. For all in situ finds, upside, dip (slope) and strike (compass orientation) were taken with a Brunton compass. Once these data were obtained, the materials were removed, placed in Ziploc bags with their assigned field specimen number, and returned to the laboratory. Larger specimens not conducive to safe removal in this way were encased in plaster jackets and underlying sediment for transport and final excavation in the laboratory. Excavation progress was photo-documented at the base of each level with a Nikon D-70 digital SLR camera.

Because the potential for cultural association with the paleontological remains was a central goal of the project, particular care was taken in the evaluation of possible culturally modified stone. A sample of angular chert pieces and other stones was collected to provide comparative context for evaluating human vs. naturally-occurring "flakes." Other rocks with fracture morphologies similar to heat crazing were tabulated as "similar to fire-cracked rock" or "pseudo-FCR." Although all but one of these collected in 2007 was dismissed in the field as non-cultural, all will be re-examined in the laboratory.

All collected materials were tracked through a system starting with assignment of Field Specimen (FS) numbers for each unique collection, be it a single specimen with point provenience or screened material from a unit/level (lot). Provenience information for all assigned Field Specimen numbers will be entered into a computerized relational database.
Catalog numbers will be assigned in the laboratory to each lot and individual specimen of interest and tied to provenience in the database.

Excavation proceeded in each unit until the entire floor was well within the alluvium (geological Unit III) underlying the bones, or the unit was too deep for student safety. At the completion of excavation of each unit, the project geomorphologist examined and mapped the stratigraphy. All walls were mapped with the total station. Representative walls were photographed and mapped on graph paper by the students.

At the conclusion of the field season, all active units were covered for the winter. (Some completed units were backfilled in prior seasons.) Covering involved lining unit floors and walls with geotextile, shoveling a thin layer of fine sediment onto the floor, and placing a constructed plywood and 2 x 4 stud cap over the open hole. The cap was anchored upslope with steel reinforcing bar and/or attachment to an uphill cap, and the resulting structure was sandbagged and bermmed to prevent water from running into the unit.

In addition to the formal excavation units, there were three less formal pits excavated by the project geomorphology team at roughly 50 m intervals uphill and downhill from the excavations. These 2 x 1 m "geopits" were intended to investigate stratigraphy of the hillside to allow interpretation of site formation. Geopit "A" was approximately 100 m south and uphill of XU 1, Geopit "B" was about 50 m south, and Geopit "C" was about 50 m downhill and north of XU 15. Unit XU 15, which had been backfilled at the conclusion of the 2006 season, was partially re-excavated to serve as another geopit. These units were excavated by shovel and not screened. All were mapped and sampled by the project geomorphologist, and these hand maps were tied into the excavation with the total station.

**2007 Field Results**

Approximately 7.9 m$^3$ of sediment was excavated in nine formal units in the 2007 season, yielding one definite cultural flake, plus five large bones and a variety of bone and chert fragments (see Table 1). The single unambiguous artifact (FS 479, catalog number 327) is a complete tertiary flake from the screen in XU 20 Level 10 (a 10-cm horizontal level 65-100 cm below the present sloping ground surface). The flake is made of translucent tan chert or chalcedony and measures 8.5 mm long, 12.4 mm wide, and 2.3 mm thick. It has a simple platform with one planar surface, a well-developed bulb of percussion, an errailure scar, and a
feathered distal termination. Some sediment or soil salt remains adhering to its surface, and it has not been washed.

Table 1. Summary of 2007 Formal Excavations

<table>
<thead>
<tr>
<th>Unit</th>
<th>Size (m)</th>
<th>Excavated Levels</th>
<th>Volume (m³)</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>XU 01</td>
<td>2 x 2</td>
<td>only pedestals below bones</td>
<td>NA</td>
<td>Unit completed except fine screen sample block. Yield: 4 large bones (left from 2005-2006): FS 145/147, 219/502, 220, 270</td>
</tr>
<tr>
<td>XU 13</td>
<td>2 x 2⁹</td>
<td>L16-20 (101.70-101.40 m)</td>
<td>1.14</td>
<td>Unit completed except fine screen sample block. Yield: rodent bones; large mammal tooth enamel</td>
</tr>
<tr>
<td>XU 14</td>
<td>1.5 x 1.5</td>
<td>L16-17 (100.00-99.90m)</td>
<td>0.23</td>
<td>Unit completed. Yield: chert fragments in L16-17; removal of 2006 mammoth scapula in plaster jacket (FS 302)</td>
</tr>
<tr>
<td>XU 16</td>
<td>2 x 2⁹</td>
<td>L9-11 (97.40-97.10 m)</td>
<td>1.14</td>
<td>Unit in progress. Yield: chert fragments, rodent bone</td>
</tr>
<tr>
<td>XU 18</td>
<td>1.5 x 1.5</td>
<td>L1-13 (101.72-100.55 m)</td>
<td>1.59⁹</td>
<td>Unit in progress. Yield: chert fragment, a bison-size vertebra (FS 463), and 12 possible mammoth bones left in floor for 2008</td>
</tr>
<tr>
<td>XU 19 (baulk 10/14)</td>
<td>1.5 x 0.5⁴</td>
<td>L2-15 (100.82-99.90 m)</td>
<td>0.43⁵</td>
<td>Unit completed except fine screen sample block. Yield: chert fragments; 2 mammoth-sized foot bones (FS 150, 462), 2006 mammoth scapula in plaster jacket (FS 302)</td>
</tr>
<tr>
<td>XU 20</td>
<td>1.5 x 1.5</td>
<td>L1-12 (101.53-100.30 m)</td>
<td>1.70⁹</td>
<td>Unit in progress. Yield: chert fragments, rodent bones, bone fragments, one definite flake (FS 479)</td>
</tr>
<tr>
<td>XU 21</td>
<td>1.5 x 1.5</td>
<td>L1-6 (102.06-101.40 m)</td>
<td>0.88⁸</td>
<td>Unit in progress. Yield: Feature 1, plus chert fragments, bone fragments</td>
</tr>
<tr>
<td>XU 22 (baulk 1/13)</td>
<td>1.2 x 0.6</td>
<td>L1-14 (102.59-101.40 m)</td>
<td>0.83</td>
<td>Unit completed. Yield: 3 large bones (left from 2005-06): FS 145/147, 219/502, 220</td>
</tr>
</tbody>
</table>

a excluding a 45 x 45 cm sample block for fine screening in one corner

b includes estimate for partial upper levels (estimate used 1/4 of total potential unit volume for these levels, due to both south and east downslopes)

c includes estimate for partial upper levels (estimate used ½ of total potential unit volume for these levels, due to simple south downslope in this small unit)

One charcoal soil stain, referred to as Feature 1, was encountered in XU 21 Level 4, about 5 cm below present ground surface near the north wall of the unit. This gray stain was a small ellipse 15 cm long by 13.5 cm wide, with charcoal flecking and what appeared to be ash. It was sectioned across the long axis, revealing a very shallow, basin-shaped stain 10 cm wide and 2.5 cm deep. Given its ephemeral, irregular outline, shallow section, and occurrence very close to present ground surface, it is interpreted as a non-cultural sedimentary or depositional feature. Except for the presence of charcoal, it was not unlike the small pockets of 1980 Mount
Saint Helens ash noted near the top of several of the excavation units at the site, including the south margins of this unit in Level 1.

Eight significant bones were removed this season (see Table 2). By far the biggest and most important was a mammoth-size (mammoth or mastodon) scapula from XU 14 and 19. This specimen (FS302) was a complete left scapula approximately a meter long with a well-preserved glenoid end and a heavily fractured blade. The spine was fractured along most of its length, removing the dorsal surface, acromion, and mid-spinous process. The glenoid portion was sampled for radiocarbon dating and/or chemical analysis with a core (FS 500) made with a hole saw. The bone was removed in two pieces: the glenoid end was lifted out while the blade end was encased in a plaster jacket for removal. The jacket is now being excavated in the laboratory. Recovered near the FS302 scapula in XU 19 were two mammoth-size foot bones (FS 150 and 462). Excavation Unit 18 revealed a large number (12) of bison or mammoth-size bones, but time ran out before they could be fully exposed, so most were left until the 2008 season. Only one bone (FS 463) was recovered to date, a bison-size vertebra apparently above the mammoth bone layer. Four of the bones exposed in 2005 or 2006 in XU 1 were recovered this season: FS 145/147, 219/502, 220, and 270. Specimen FS 145/147 was removed in a small plaster jacket, while the others were lifted out "encased" in B-76. Two hole saw core samples (FS 520, 521) were removed from FS 219/502 to provide samples for future dating, since no radiocarbon dates have yet been obtained from this southern-most area of the excavation.

Table 2. Significant bone specimens recovered in 2007

<table>
<thead>
<tr>
<th>FS #</th>
<th>Prov.</th>
<th>Taxon</th>
<th>Element</th>
<th>Length</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>145/147</td>
<td>XU 1/22 bison or mammoth-size</td>
<td>unknown</td>
<td>45 cm</td>
<td>shaft fragment</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>XU 10/14 mammoth-size</td>
<td>metapodial or phalanx</td>
<td>13 cm</td>
<td>near complete</td>
<td></td>
</tr>
<tr>
<td>219/502</td>
<td>XU 1/22 bison or mammoth-size</td>
<td>unknown</td>
<td>49 cm</td>
<td>shaft &amp; epiphysis frag.</td>
<td></td>
</tr>
<tr>
<td>220</td>
<td>XU 1/22 bison or mammoth-size</td>
<td>rib?</td>
<td>16 cm</td>
<td>shaft fragment</td>
<td></td>
</tr>
<tr>
<td>270</td>
<td>XU 1   bison or mammoth-size</td>
<td>rib</td>
<td>~90 cm</td>
<td>medial fragment</td>
<td></td>
</tr>
<tr>
<td>302</td>
<td>XU 10/14 mammoth or mastodon</td>
<td>left scapula</td>
<td>~100 cm</td>
<td>near complete</td>
<td></td>
</tr>
<tr>
<td>462</td>
<td>XU 14  mammoth-size</td>
<td>metapodial or phalanx</td>
<td>11 cm</td>
<td>distal fragment</td>
<td></td>
</tr>
<tr>
<td>463</td>
<td>XU 18  bison or mammoth-size</td>
<td>vertebra</td>
<td>10 cm</td>
<td>fragment</td>
<td></td>
</tr>
</tbody>
</table>

Geological findings in 2007 continue to support the ongoing interpretation of site stratigraphy. The site has three principal strata: a basal unit (Unit III) of stratified gravels and sand, a middle Unit II of non-stratified fines with gravels, and an upper massive silt-dominated Unit I. Based on field characteristics these units have been tentatively interpreted as alluvium,

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colluvium, and loess, respectively. The bones and artifacts appear to derive primarily from Unit II, although it is as yet unclear if they are geologically contemporaneous or if Unit II can be subdivided into stratified microstrata.

**Laboratory Work**

The Wenas Creek Mammoth Project maintains a laboratory currently in Room 232 Farrell Hall at Central Washington University. The laboratory houses the recovered specimens from the project, the project computer data, selected field equipment, bone consolidation facilities, and work space. Laboratory work is in progress for all seasons of the project, with some portions near complete (e.g., 2005-2007 collection and photograph catalogue record) and others barely initiated (e.g., bone identifications). It is expected to take years to complete laboratory work for the project.

A number of laboratory assistants worked in the lab under supervision of Dr. Lubinski, Bax Barton, and/or Jake Shapley. Jake Shapley was a funded Graduate Assistant in 2006-07 and 2007-08 with some of his time assigned to the project for laboratory supervision. Assistants since the 2007 field season have included CWU students enrolled for Independent Study credit and volunteers from the Retired and Senior Volunteer Program (RSVP). Assistants worked on cataloguing finds, cleaning and consolidating bone, excavating sediment from plaster jackets, computer data entry, initial identifications, and sorting through fine screen matrix for bones and artifacts.

All collected materials were tracked through a system starting with assignment of Field Specimen (FS) numbers for each unique collection, be it a single specimen with point provenience or screened material from a unit/level (lot). Provenience information for all assigned Field Specimen numbers were entered into a computerized relational database. Catalog numbers were assigned in the laboratory to each lot and individual specimen of interest and tied to provenience in the database. Catalog number, along with material type, count, and provenience was written in pencil on a pre-printed acid-free label inserted into a Ziploc bag for each specimen or lot. Large specimens (e.g., complete mammoth bones) were labeled directly on the treated bone surface to facilitate refit attempts. All materials are stored by catalog number for researcher access. While provenience information is with each specimen or lot, it is
anticipated that researchers will use the database to find specimens of interest during our analysis and in the future.

Fragile bone was treated with Butvar B-76 (polyvinyl butyral resin) dissolved in acetone for consolidation, except when untreated portions were desired for future radiocarbon or chemical analyses. Bone treated in the field was cleaned in the laboratory with acetone for removal of adhering dirt, and fresh consolidant was applied. Other bone was dry brushed or cleaned with water prior to analysis. Future bone analysis will consist of recording, as possible, element, side, portion, taxon, and taphonomic attributes (e.g., size, weathering stage, carnivore modification, digestive corrosion, butchery cutmarks, etc.). We will attempt refits of all potentially identifiable mammoth-sized bone fragments.

Project records include excavation level forms, profile maps, supervisor's log book, Field Specimen record, catalog records, analysis notes, total station coordinates, and photographic files. During analysis, these will be located in the Department of Anthropology at Central Washington University. Subsequent to analysis, these will be curated at the same location, probably through the museum program.

2007 Visitation and Public Participation

The project is located on a private road on private land, but due to the interest of the landowners, it was open to the public. Public participation in 2007 included an on-site interpretive tent, guided site tours, limited volunteer opportunities, and visits by the press. The interpretive tent was a 20 x 10' portable garage with a series of tri-fold panel displays describing the site history and general information about mammoths and archaeology. Visitors were encouraged to start in this tent, sign in on the guest register, and also to use it as a shady resting station. We provided guided tours Monday through Friday from July 9 through August 8, every half hour from 9:00 AM through 2:00 PM. An additional open tour day was provided on Saturday August 4 from 9:00 AM through 3:00 PM. Tour guides were principally Public Education Coordinator Christie Weitzel, plus supervisors Dr. Lubinski, Bax Barton, Jake Shapley, and selected field school students. The original plan was to enlist public volunteer docents to assist with guiding tours, but few volunteers were comfortable in that role. Volunteer Nancy Kenmotsu, a professional archaeologist, was a notable exception. Over the course of the summer tour period, plus three private events on evenings and weekends, there were at least
1,300 guests. An unknown number of additional guests did not sign the guest book. Guests included schoolchildren (e.g., Union Gap School, Cub Scout Troop of Selah), university students (e.g., South Puget Sound Community College's archaeology field school, Washington State University's Fall Semester Geoarchaeology class), retiree groups, and members of the press.

Official visits were made by representatives of the Yakama Nation Cultural Resource Program on August 2. An official visit was made by DAHP Assistant State Archaeologist Stephenie Kramer on August 6. Press visits were made by the *Daily Record, KAPP-TV, KIMA-TV, KNDO-TV, Northern Kittitas County Tribune, Selah Independent,* and *Yakima Herald-Republic.* On July 25 and 26, excavations and interviews were filmed by Limulus Productions for inclusion in the History Channel program "Journey to 10,000 BC," which first aired March 9, 2008.

Volunteers helped lead tours, sort fine screen sediment, and screen for excavations under supervision. There were 53 volunteers throughout the summer: Scott Alstrom, Rebecca Bly, Larae Brigg, Warren Brigg, Rochel Burke, Gabe Cathcart, Stacey Cearley, Chloris Curnutt, Mary Espe, Ben Facio, Nick Groth, Nathan Groth, Nancy Kenmotsu, Diane Kirpach, Debra Lane, David Lang, Bronwyn Mayo, Doug Mayo, Nevonne McDaniels, Kayte Munson, Amber Nelson, Julie Nelson, Jack Parsons, Janna Parsons, Jennifer Segle, Mark Steinkraus, Jude Swales, Kathleen Trumbull, plus 19 visiting members of the South Puget Sound Community College archaeology field school and 6 exchange students from the CWU Cultural Resource Management field school (Ken Durham, Ashley Grimes, Mike Schantz, Alyssa Wallin, Lauren Walton, Elizabeth Witkowski). Six of the Mammoth field school participants volunteered the week after the field school was over to complete fieldwork: Bax Barton, Sarah Huntington, Karl Lillquist, Pat Lubinski, Minori Muramoto, and Morris Uebelacker.

**Summary of Current Findings**

Thus far the archaeological findings are limited to recovery of two adiagnostic chipped stone flakes (FS 479, FS 261) somewhat above the mammoth bones. Additional, more ambiguous chert fragments are being evaluated. Artifact FS 479 (*Figure 2*), recovered in 2007, is a complete flake found in the screen for XU 20 Level 10. This location is North 498-499 m, East 90-91.5 m, Elevation 100.4-100.5 m in our grid system, and 65-100 cm below the present sloping ground surface. The flake is made of translucent tan chert and measures about 9 x 12 x 2
mm. Given the slope of the hill and incomplete nature of the excavation in that unit, a definitive evaluation of the relationship of the flake to mammoth bone will have to await additional excavation. Artifact FS 261 (Figure 3), recovered in 2006, was found in situ in XU 12, Level 5, at North 500.874 m, East 92.093 m, Elevation 100.147 m. The fragment is medial, about 13 x 16 x 3 mm in size, made of red translucent chert, with roughly parallel lateral edges and two prominent dorsal arisses. This find is about 23 cm below present ground surface and 15 cm above FS 279, a mammoth-size metapodial bone (see Figure 4). Although it was found above the bone (Figure 5), it lies within the same geological stratum (Unit II), which if a single mass-wasting event, could mean the flake and bone are contemporaneous. Additional research is anticipated to test this possibility, and will be discussed under "Future Research" below.

Figure 2. Artifact FS 479 (catalog# 327). This is a complete flake from the screen in XU 20, Level 10. The bars at base are 1 cm each.
Figure 3. **Artifact FS 261 (catalog# 176).** This is a flake fragment from in situ in XU 12, Level 5, about 15 cm above mammoth-size metapodial FS 279. The bars at base are 1 cm each.

Figure 4. **Location of flake FS 261 in relation to mammoth bone from XU 12 in 2006.** Exposed on the floor are four mammoth-size vertebrae, a mammoth-size metapodial, a mammoth-size phalanx, a bovid cannonbone, and an unidentified fragment. The flagging tape in the wall indicates the find location of the flake (mislabeled FS 259 on the photo board).
The two flakes constitute a "site" about 3 m North-South by 2 m East-West, with a maximum depth of 100 cm below surface. The chronological relationship of the two flakes is not clear. Although FS 261 was found 23 cm and FS 479 65-100 cm below surface, this does not necessarily mean one was deposited significantly earlier than the other. Both units had an unknown depth of sediment removed from the top during road construction, and the unit with FS 261 is downslope, where more sediment appears to have been removed. Their relationship with each other may become more clear when the geological strata are mapped in XU 20 next season. Given the ambiguity of the relationship between the two flakes, and between the flakes and bone, the findings of substance for the project thus far are more paleontological than archaeological.

Bones found in place are depicted in Figure 6. Bone analysis is underway, and many specimens currently lack element and taxonomic identifications. This analysis is complicated by the lack of adequate Pleistocene megafauna comparative material at CWU. Nonetheless, two elements are definitely mammoth (Mammuthus sp.), and a number of others are definitely mammoth-size and probably mammoth. Other elements are definitely cattle family (bovid), probably Bison antiquus, or bison-size. Key specimens collected to date are given in Table 3. Additional rodent-sized bone has not yet been examined.
Figure 6. Draft GIS map of bone and artifact discovered in situ to date. Note especially the flake in XU 12, humerus in XU 11, and scapula in XU 14. (Map produced by Christie Weitzel.)
Table 3. Significant bone specimens recovered 2005-2007

<table>
<thead>
<tr>
<th>FS #</th>
<th>Prov.</th>
<th>Taxon</th>
<th>Element</th>
<th>Length</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>unk.</td>
<td><em>Mammuthus</em> sp.</td>
<td>left humerus</td>
<td>98 cm</td>
<td>initial backhoe find; near-complete</td>
</tr>
<tr>
<td>1</td>
<td>unk.</td>
<td>mammoth-size</td>
<td>cuneiform carpal?</td>
<td>16 cm</td>
<td>with initial backhoe find; complete</td>
</tr>
<tr>
<td>12</td>
<td>unk.</td>
<td>bison-size</td>
<td>lumbar vertebra</td>
<td>12 cm</td>
<td>in construction backfill; near-complete</td>
</tr>
<tr>
<td>13</td>
<td>unk.</td>
<td>bison-size</td>
<td>articulated lumbar vertebra &amp; sacrum</td>
<td>&gt;17 cm</td>
<td>in construction backfill; near-complete</td>
</tr>
<tr>
<td>16</td>
<td>unk.</td>
<td>bison-size</td>
<td>lumbar vertebra</td>
<td>12 cm</td>
<td>in construction backfill; near-complete</td>
</tr>
<tr>
<td>54</td>
<td>XU</td>
<td><em>Mammuthus</em> sp</td>
<td>right humerus</td>
<td>99 cm</td>
<td>near-complete</td>
</tr>
<tr>
<td>145/147</td>
<td>XU 1/22</td>
<td>bison or mammoth -size</td>
<td>unknown</td>
<td>45 cm</td>
<td>shaft fragment</td>
</tr>
<tr>
<td>150</td>
<td>XU 10/14</td>
<td>mammoth-size</td>
<td>metapodial or phalanx</td>
<td>13 cm</td>
<td>near complete</td>
</tr>
<tr>
<td>219/502</td>
<td>XU 1/22</td>
<td>bison or mammoth -size</td>
<td>unknown</td>
<td>49 cm</td>
<td>shaft &amp; epiphysis frag.</td>
</tr>
<tr>
<td>220</td>
<td>XU 1/22</td>
<td>bison or mammoth -size</td>
<td>rib?</td>
<td>16 cm</td>
<td>shaft fragment</td>
</tr>
<tr>
<td>266</td>
<td>XU 12</td>
<td>mammoth-size</td>
<td>thoracic vertebra</td>
<td>~42 cm</td>
<td>near-complete</td>
</tr>
<tr>
<td>270</td>
<td>XU 1</td>
<td>bison or mammoth -size</td>
<td>rib</td>
<td>~90 cm</td>
<td>medial fragment</td>
</tr>
<tr>
<td>274</td>
<td>XU 12</td>
<td>mammoth-size</td>
<td>axis vertebra</td>
<td>25 cm</td>
<td>near-complete</td>
</tr>
<tr>
<td>275</td>
<td>XU 12</td>
<td>bovid</td>
<td>left metatarsal cannonbone</td>
<td>27 cm</td>
<td>complete; articulates with FS 417</td>
</tr>
<tr>
<td>278</td>
<td>XU 1</td>
<td>bison or mammoth-size</td>
<td>rib</td>
<td>41 cm</td>
<td>shaft fragment</td>
</tr>
<tr>
<td>279</td>
<td>XU 12</td>
<td>mammoth-size</td>
<td>metapodial</td>
<td>17 cm</td>
<td>complete</td>
</tr>
<tr>
<td>287</td>
<td>XU 12</td>
<td>mammoth-size</td>
<td>metapodial or phalanx</td>
<td>12 cm</td>
<td>complete</td>
</tr>
<tr>
<td>291</td>
<td>XU 12</td>
<td>mammoth-size</td>
<td>cervical vertebra</td>
<td>25 cm</td>
<td>near-complete</td>
</tr>
<tr>
<td>302</td>
<td>XU 10/14</td>
<td>mammoth or mastodon</td>
<td>left scapula</td>
<td>~100 cm</td>
<td>near complete</td>
</tr>
<tr>
<td>307</td>
<td>XU 12</td>
<td>bison or mammoth-size</td>
<td>unidentified</td>
<td>22 cm</td>
<td>fragment</td>
</tr>
<tr>
<td>323</td>
<td>XU 13</td>
<td>bison or mammoth-size</td>
<td>rib</td>
<td>32 cm</td>
<td>shaft fragment</td>
</tr>
<tr>
<td>417</td>
<td>XU 12</td>
<td>bovid</td>
<td>left cuneiform 2+3 tarsal</td>
<td>5 cm</td>
<td>complete; articulates with FS 275</td>
</tr>
<tr>
<td>462</td>
<td>XU 14</td>
<td>mammoth-size</td>
<td>metapodial or phalanx</td>
<td>11 cm</td>
<td>distal fragment</td>
</tr>
<tr>
<td>463</td>
<td>XU 18</td>
<td>bison or mammoth -size</td>
<td>vertebra</td>
<td>10 cm</td>
<td>fragment</td>
</tr>
</tbody>
</table>

Four bone samples from 2005-2006 investigations have been submitted to three laboratories for radiocarbon dating; three from the mammoth left humerus, and one from the bovid metatarsal. These have returned three plausible age estimates. When taken in conjunction with two infrared-stimulated luminescence (IRSL) dates on sediment adjacent to the right humerus, ages of ~13,000-14,000 RCYBP or 15,500-17,000 CALYBP are inferred for both the mammoth and bovid (Table 4), although corroborating age estimates are needed. The radiocarbon assays have also provided δ13C dietary values of -25.5 and -26.2‰ for mammoth, and -24.5‰ for bison, when corrected by -5‰ using Sullivan and Kreuger's (1981) model for the relationship of collagen and dietary value. These values fall within the range of expected values.
from northern grazers, such as those measured from early Holocene bison at the Hudson-Meng site in Nebraska (Jahren et al. 1998).

Table 4. Age estimates from Wenas Creek mammoth site

<table>
<thead>
<tr>
<th>Method</th>
<th>Lab #</th>
<th>Material</th>
<th>Raw Age, 1 sigma</th>
<th>Calibrated Age, 2 sigma</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMS</td>
<td>Wk-18064</td>
<td>bone (mammoth humerus)</td>
<td>13,398 ± 58 RCYBP</td>
<td>15,547-16,324 BP²</td>
</tr>
<tr>
<td>AMS</td>
<td>OxA-16755</td>
<td>bone (mammoth humerus)</td>
<td>14,010 ± 90 RCYBP</td>
<td>16,051-16,827 BP²</td>
</tr>
<tr>
<td>AMS</td>
<td>Wk-20117</td>
<td>bone (bovid metatarsal)</td>
<td>13,788 ± 70 RCYBP</td>
<td>16,051-16,324 BP²</td>
</tr>
<tr>
<td>IRSL</td>
<td>UIC 1688</td>
<td>sediment (Unit II base)</td>
<td>13,970 ± 1190 BP¹</td>
<td>11,540-16,300 BP¹</td>
</tr>
<tr>
<td>IRSL</td>
<td>UIC 1203</td>
<td>sediment (Unit III top)</td>
<td>18,280 ± 1580 BP¹</td>
<td>15,070-21,390 BP¹</td>
</tr>
</tbody>
</table>

1 for IRSL ages, present set to AD 2000
2 2-sigma age ranges (or maximum extent of multiple 2-sigma age ranges) calibrated with CALIB 5.0 using intcal04 data set, present= 1950
3 2-sigma age range, present adjusted to 1950 for comparison to radiocarbon dates
(Another AMS bone collagen C14 assay from the same mammoth humerus was rejected as anomalously young and internally inconsistent. The sample [Beta-207938] yielded two assays over 1,000 years apart at 9,730 ± 40 and 11,000 ± 40 RCYBP.)

Future Research

A number of major research questions direct overall work at the site, and all of these are under investigation. Some of these questions are archaeological, while others are paleontological or geomorphological. Most touch on several research domains. The speed with which and degree to which we can address these questions and goals depends on future time and funding. Given the employment of most of the research team in academic settings, we can and will continue to work on these regardless of our success with obtaining additional research funding. However, the scope of the research will be considerably diminished without significant additional resources.

Question 1: What is the human involvement with the site? This is the principal archaeological question, and we hope to continue to address it through several means. First, we are planning a taphonomic analysis of the bones themselves to see if any provide evidence of human butchery, disarticulation, or movement. Second, we plan a detailed analysis of spatial relationships going beyond the simple backplot in Figure 3 to better model the three-dimensional relationship of sediments, bones, and artifacts. This will likely involve computerized GIS or CAD. Third, we plan a detailed examination of all collected lithics (chert fragments and ambiguous "possible" flakes) to evaluate their potential to be humanly produced. Finally, we plan on additional excavations, which may yield less ambiguous results than those found to date. An application for a 2008 DAHP Archaeological Excavation Permit is being planned.
Question 2: What is the site's depositional history? This question connects archaeology and sedimentology or geomorphology, and will inform the first question by providing more details about the likelihood for contemporaneity of the flakes and bones. For the archaeology, it relates to and evaluation of bone and sediment movement and alteration. We plan an analysis of bone orientation and weathering which may intimate the mode of bone accumulation or reveal a stratigraphic subdivision based on a weathering front on the bones. Analysis of sediments is underway, including particle size analysis that may allow for more secure or finer stratigraphic divisions. If significant additional funding can be secured, we hope to obtain a suite of single-grain optically-stimulated luminescence dates on coarse sediment grains, as well as soil micromorphological analyses to evaluate the age and movement of sediment bearing the bones and artifacts, and thus the strength of their association.

Question 3: What is the origin of the landform on which the site lies? As noted earlier, the landform may be a landslide, alluvial fan, or terrace. These three landforms would have different implications for depositional history of the archaeological site, as well as its relationship to the surrounding landscape. This largely geomorphological question may be addressed by sediment analysis of the excavated "geopits" and a GIS-based map investigation of the hillside and surrounding landforms. If additional funding is obtained, we would also plan additional backhoe trenching.

Question 4: What animals are represented at the site? As noted above, the identification of bones from the site is currently in its early stages. We plan on more work in this area, which will have to involve visits to locations with comparative Pleistocene mammal materials, and will thus require some additional funding and time.

Question 5: What were environmental conditions at the time of the mammoth? To address this question, there are several potential sources of paleoenvironmental proxy data. We have recovered some microfauna (e.g., rodent remains) which may address this question, and we plan to identify these bones for this purpose. A small sample of pollen and opal phytoliths is being examined by a graduate student, and these indicate the potential for these data sources. We would like to obtain funding for professional analysis of pollen and phytolith samples. Another data source that would depend on funding is stable isotopic chemical analysis of the mammoth and bovid bones.
Acknowledgments

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References Cited


Appendices:

Appendix A: Artifact Catalog

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<th>Unit</th>
<th>Level</th>
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<td>XU 12</td>
<td>L 5</td>
<td>in situ</td>
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<td></td>
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<td>XU 20</td>
<td>L 10</td>
<td>in screen from N498-499, E90-91.5, Z100.4-100.5</td>
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</table>

Appendix B: DAHP Site Form
(provided separately)