



Earthwatch Participants 2008:

I want to thank you for your efforts, and your individual contributions to a successful field season. We are still processing the materials removed from the bone bed during your field session. I suppose the most impressive accomplishment is the addition of two more individuals to the minimum number of individual (MNI) of mammoths, to 58. You also discovered many small (some yet to be identified) bird/rodent bones in addition to mammoth remains. Last, but not least, there were three wolf-size coprolites (fossilized scat) recovered.

My best estimates are that together (Team I & II) you removed approximately 14 tons of matrix (sinkhole sediments), plus at least two tons of screen wash material. In addition, one tusk has been prepared for casting and removal from the bone bed in the 2009 season. You discovered a minimum of 55 mammoth bones, plus fragments.

In addition, you helped educate, fascinate, and interest thousands of the public, the interns, guides, and staff. Thank you, again, for your participation in an excellent, productive, field season.

Best wishes,

Larry D. Agenbroad, Ph. D.

Director, Mammoth Site.



EARTHWATCH INSTITUTE ANNUAL FIELD REPORT

Project title: Mammoth Graveyard

Date completed: September 5, 2008

Completed by: Dr. Larry Agenbroad

Period covered by this report: August 2007 to September 2008

Reporting on research objectives

Objective 1: Excavation, preservation and exhibit of areas of the site, in both lateral and vertical dimensions.

This objective was well met during the 4 week field excavation. A total of approximately 14 tons of matrix (sinkhole sediments) was removed, plus at least 2 tons of screen wash. At least 55 new bones were discovered, including 4 new tusks, which increased the minimum number of individuals (MNI) of mammoths to 58.

Excavation took place in all portions of the site but concentrated on the western and eastern areas of high bone concentration. Several small bones were cast and taken to the laboratory. One tusk has been prepared for casting, but awaits increased laboratory space.

Two teams of Earthwatch participants were active from June 29 through July 27, 2008. Laboratory and mapping efforts will continue during the fall and winter months.

Objective 2: Taphonomic (history of faunal remains from post-death to post-burial) analyses of the yearly bone bed maps and selected skeletal elements via the computer mapping program.

This objective is on-going due to the 2007 acquisition of a new robotic transit. This instrument replaces our previous transit. It is a one-person instrument and combined with a more sophisticated software program, plus digital photography via the overhead crane, we are achieving unprecedented maps. The total bonebed is in process of remapping with the new equipment, and when completed, it will allow taphonomic analyses of exceptional sophistication.

The final map is approximately 50 % complete and will allow analyses to begin this fall and winter.

Objective 3: Continued mapping using the electronic (EDM) transit, of all bones encountered on-site.

As indicated in Objective 2 (above), we have upgraded our transit, to state-of-the-art capability and are in the process of remapping the entire bone bed. The new transit also cuts

the number of personnel needed, by 50 %, as it is a one-person robotic instrument. The remapping is approximately 50 % complete and will be continued this fall and winter.

Objective 4: Continued numbering of all *in situ* (in their original position) bones and those in storage.

We have continued our on-site numbering process, by year and by sequential number for that year, i.e. 08 HS 45, signifying 2008 as the year and 45 as the sequence number of bone discovered for that year. All bones are numbered and mapped prior to their removal and transfer to the laboratory.

Bones in storage and in the laboratory are assigned detailed records, both paper and electronic, once they are removed from the excavation. They are cleaned, stabilized, and preserved in the laboratory and then transferred to permanent storage in climate controlled conditions. These activities are on-going.

Objective 5: Water screening of 10% of the back dirt generated by the excavations, and 100% near bone.

At least 2 tons of material was water screened in the 2008 field season. Screen concentrates are air dried, labelled in bags, awaiting analyses, usually during the winter months. This objective is on-going.

Objective 6: Continued metric comparisons with *Mammuthus exilis* (pygmy mammoth) specimens.

The bones are being reanalyzed this fall and winter, to extend the published information from the 1994 and 2003 published manuscripts.

Objective 7: Collaborative research with other professionals.

Manuscripts are currently in press. Abstracts of papers presented are listed later in section 5 of this report.

Objective 8: Continued research in associated fauna, on-site and in the Black Hills Province.

Several non-mammoth elements were discovered in the 2008 field season. Those will be analyzed in the fall and winter months. Three juvenile ribs have been located; they are not mammoth. Research will be initiated to determine their identification. The fragmentary distal humerus (lower part of the front leg) of the American lion/ short faced bear will be analyzed using new measurement techniques of the distal articulation which should provide conclusive evidence as to which species it represents. Currently, of 7 comparable measurements, 4 indicate lion; 3 indicate bear. Terminal Pleistocene Bison remains and their accumulation from a regional site are also being assessed.

Project development

What logistical or scientific challenges have you encountered in the past season and how will you address these during the next field season?

Challenges resulting from *in situ* display of faunal remains in a cylindrical shaped sinkhole are:

- 1) Decreased working 'floor space' as depth of excavation is increased. It is analogous to descending in a funnel, i.e. the original width decreases, downward, as specimens are left *in situ*. Solution: I have already initiated removal of selected large, high elevation specimens to gain access to specimens and those exposed beneath them.

Non-technical summary of results

1. The four week excavation session was conducted by Earthwatch, from June 29 through July 27, 2008. Each team was comprised of twelve Earthwatch participants, including several returning veterans of the prior season, plus new members. After initial training in excavation on-site, the teams were dispersed throughout the deposit, concentrating on the eastern and western ends of the sinkhole. A total of approximately 14 tons of matrix (sinkhole sediments) were excavated, plus at least two tons of screen wash material. All screen wash material was processed and air dried by the end of the field season. A Minimum of 55 new mammoth bones were exposed and are being mapped. In addition, two non-mammoth bones were recovered; one is apparently a fragmentary bird bone, and the second is a fragment of a larger animal, but non-mammoth. Three wolf-size coprolites (fossilized scat) were also exhumed.

Perhaps the most exciting discovery of the season was the location of four new tusks, in separate sections of the bone deposit. The total number of individual mammoths (MNI) by tusk count has risen to 58, an increase of 2 since the 2007 season. Many of these tusks are still buried beneath other bones and considerable sinkhole fill, so it will be future excavation seasons before their full exposure is accomplished. One tusk, known from a former season, was prepared for casting and removal, but has been postponed until 2009 due to lack of current laboratory space.

The new discovery tally for the 2008 season includes 25 ribs, 9 vertebra, 3 hyoids, 3 phalanges, 3 inter-vertebral discs, 2 teeth, 2 pelvis, 1 fibula, 1 patella, and the 4 tusks previously mentioned, plus 2 specimens which are as yet unidentified, awaiting further exposure.

2. This entire project has been conservation oriented, since initiation. We are preserving fossil material where it was deposited in death, or was disarticulated and deposited within the sinkhole fill. Our initial methodology revolved around *in situ* exposure and preservation, allowing the public, as well as the scientific community the opportunity to observe a natural death assemblage. Specimens removed are transferred immediately to the laboratory where they are cleaned, stabilized, repaired (if necessary), and transferred to on-site permanent repository with climate control. Detailed information is kept on each specimen, its treatment, location, photographs, etc. in both electronic and hard copy formats.

3. What is/ are the significance/ benefits of your research at the following levels?

- Local (to the area of the research site)
The local economy is influenced by the volume of visitors, who stay in the local area's lodging, camp facilities, and dine in local restaurant, plus service their transportation needs, such as tour companies, fuel and similar services.
- National / Regional
The site is one of the regional tourist destinations within the Black Hills of South Dakota. It has become one of the locations for tour busses of foreign

travellers, school groups, field trips, etc. National conferences/symposia have been hosted on-site. Educational materials are distributed nation-wide via 'Mammoth in a Trunk' activities in age/grade levels from K-12. It is a focal point for television news programs, as well as documentaries.

- International

International conferences have been hosted on-site; educational workshops have been hosted on-site; a visiting scientist program has brought specialists from many countries; segments for international television documentaries have been produced here. Our staff participates regularly in international symposia.

Communication of results

Printed: peer reviewed scientific publications; books / book sections; reports, management plans or policies; fact sheets, brochures, leaflets, pamphlets, posters, academic dissertations, annual reports, proceedings of conferences or workshops; letters; newsletters.

1) Newsletter:

Mammoth Site Newsletter

2) Publications:

Shoshani, J., M. P. Ferretti, A. M. Lister, L. D. Agenbroad, H. Saegusa, D. Mol, K. Takahashi. 2007. *In* L. Agenbroad, G. Haynes, E. Johnson, and M. R. Palombo (eds.) World of Elephants 2: Selected Papers from the 2nd Congress, Mammoth Site of Hot Springs. Quaternary International 169-170: 174-185.

Agenbroad, L., and B. Huckell. 2007. The Hunting Camp at Murray Springs. *In* Murray Springs: a Clovis site with multiple activity areas in the San Pedro Valley, Arizona. C. V. Haynes, Jr. and B.B.\. Huckell (eds.) University of Arizona Press. p. 146-159.

3) Abstracts of presented papers:

Thompson, K., L. Agenbroad, O. Potapova, and S. Holte. 2007. (abstract) From salvage operation to in situ preservation; techniques used in conservation at the Mammoth Site of Hot Springs, South Dakota. 57th Annual Meeting of the Society of Vertebrate Paleontology. Austin, Texas. Programs and Abstracts 27:158A.

Falkingham, P., L. Agenbroad, K. Thompson, and P. Manning. 2007. (abstract) Vertebrate tracks and their significance at the Mammoth Site (Late Pleistocene) of Hot Springs, South Dakota. Geological Society of America. Denver, CO. Oct. 29.

Agenbroad, L. D. 2008. (abstract) Geologic age interpretations and inferences made from the metric analyses of selected skeletal elements of *Mammuthus exilis* from California Channel Islands. 7th California Islands Symposium. Oxnard, CA. February, 5-7.

Visual: artwork; visitor centre, poster or display, slides, photographs

New visitor center display of *Elephas falconeri* (Pygmy elephant) from Sicily

Digital: database; internet - websites, email group/ blog/forum; CD Rom, e-newsletter

Website <www.mammothsite.com>

Mass media: broadcast production; film; TV, radio, print (newspaper/ magazine coverage); Press releases; press conference; interview, article creation; press trip

National Television

History Channel "Evolve" series

Animal Planet: "Adventures with Jeff Corwin"

Local television

SD Public television

SD Kello Land television

Press releases

July 25, 2008

July 29, 2008

Meetings and conferences: presentations/ lectures; conferences; workshops; training sessions; discussions; local community meetings and events.

Paleoclimate Workshop:

by Dr. Reid Bryson, Univ. Wisconsin; September, 2007. Held at the Mammoth Site, Hot Springs, SD.

Lectures:

Agenbroad, L. 2007. Mammoths in the Mountain West. College of Southern Idaho. Twin Falls, ID. November.

Agenbroad, L. 2008. Mammoths, Men, and the Post-Pleistocene World. Department of Climatology. University of Wisconsin. April 21.

Educational Opportunities

1. Does your project directly or indirectly involve the following groups in your research topic?

- Students
 - a. The Mammoth Site has six college interns from May-September.
 - b. Project Exploration (inner city Chicago high school students) 4 days
- Early career scientists
 - a. There are 'Young Scientist Scholarships' available on a competitive basis.
- Other Groups
 - a. Elderhostel: One or two 4-day experiences

2. How does your research help these groups better understand and act towards the conservation of a sustainable environment?

It instructs them on the value of fossil resources and their importance to laypeople. It also lets them sample a possible career goal experience.

3. Has your project contributed to the completion of Masters' or PhD theses or degrees, or other educational research findings?

Project duration:

Theses:

- Pamela Kempton, M. S. Geology, Southern Methodist University 1980
- Barbara Dutrow, M. S. Geology, Southern Methodist University 1980
- Eric Straffin, M. S. Quaternary Studies, Northern Arizona University 1993
- C. Manganaro, M. S. Quaternary Studies, Northern Arizona University 1994

Publications and Presentations:

- a) Kempton, P. 1981. Quaternary terraces along the Fall River, Hot Springs area, South Dakota. *Geological Society of America Abstracts with Programs* 13:201.
- b) Jass, C., J. Mead, A. Morrison, and L. Agenbroad. 2002. Late Quaternary Mollusks from the southern Black Hills, South Dakota. *Western North American Naturalist* 62: 129-140.
- c) Mead, J. C. Manganaro, C. Reppening, and L. Agenbroad. 1996. Early Rancholabrean mammals from Salamander Cave, Black Hills of South Dakota. *In* K. Stewart and K. Seymore(eds.) *Palaeoecology and palaeoenvironments of late Cenozoic mammal: tribute to the career of C. S. Churcher*, University of Toronto Press, p. 458-482.

Acknowledgements

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