ESSAI

Volume 5 Article 35

1-1-2007

Invertebrate and Mammalian Remains of Badlands National Park from the Holocene Epoch Describe the Ancient Landscape and Community of the Time

Rutger W. Stache
College of DuPage, essai_stache@cod.edu

Invertebrate and Mammalian Remains of Badlands National Park from the Holocene Epoch Describe the Ancient Landscape and Community of the Time

by Rutger Wolfgang Stache

(Honors Biology 1152)

ABSTRACT

The study of invertebrate and mammalian remains recently found in South Dakota provided an opportunity to explore historical climates and communities. Employing carbon-14 dating indicated an archaeological age of 12000 years for the samples. A thorough investigation of the identified species yielded an understanding of the landscape and climate of the time as well as how they were interconnected. It was concluded that the animals lived during the Holocene epoch, as the last ice age was receding. The climate was warming, with a temperature similar to that of today and vast forests, prairies, and tundra were dominating the landscape. Of the invertebrates, many were arthropods common to the area and were found among parasites of the various species present. They also indicate the presence of a thriving rodent community in the area. Many of the invertebrates' diet included the organic material found, which happened to be found partially digested.

INTRODUCTION

Badlands National Park in South Dakota is home of one of the largest, protected mixed-grass prairies in the United States (Durant and Harwood 1988). Well known for containing the world's richest Oligocene epoch fossil beds, the area provides an ideal source for clues in determining the history of landscape and climate (Durant and Harwood 1988). Many animals' evolutionary stories have been depicted in the park's buttes, pinnacles, and spires through fossils and remains. This study focuses on the discoveries in and around a collapsed cave 7m high, 20m deep, and 10m high. Among the various species of invertebrates, there were a number of herbivorous grasshoppers and beetles. Parasitic invertebrates included nematodes, fleas, mosquitoes, and tapeworms discovered with the remains. Some of them are known parasites such as *Howardula benigna*, a nematode parasite of *Diabrotica undecimpunctata*, the cucumber beetle (Poinar 1983).

Bones were also discovered belonging to five unidentified species of mammoth. Mammoths have previously roamed the earth for millions of years: starting shortly after the demise of the dinosaurs and reigning up until approximately 10000 years ago (Lister and Bahn 1994). This most recent time period in history is referred to as the Holocene epoch. During this time period, major changes took place in climate and vegetation (Flint 1971).

The objectives of this study were to determine the ages of the biological material found in the cave, reconstruct the landscape and climate during the prehistoric time using the invertebrates as indicator species, and make connections among the animals both invertebrate and vertebrate.

METHODS

Carbon-14 dating was used to determine the archeological ages of the partially digested plant material, invertebrates and vertebrate skeletal remains. A study of all specimens allowed for a probable description of the surrounding landscape. An expected climate and landscape were established based on the age of the samples and the types of species found. The type of fauna found

in an area can be used to predict the local climate and landscape (Flint 1971). The presence of various mammoth fossils along with other mammal remains provided clues to the geological time period in which these specimens lived. Possible connections among various species were found through examining various species' eating habits, physical characteristics, and habitats based upon literature of how they lived today.

RESULTS

The results of carbon-14 dating indicated the biological materials found in the cave dated to 12510 $\pm$ 2.41 years standard deviation in to the past. Table 2 lists the invertebrates found in the cave along with notes on their ecology.

DISCUSSION

The age of the samples coincided with the end of the last ice age, providing a basis for the explanation and analysis of the climate, landscape, fauna, and relationships amongst the species. The climate of 12500 years ago was rapidly warming, being 3^{oC} - 5^{oC} warmer than the previous glacial period (Mackay and Battarbee 2003). As this increase in temperature would be maintained up until present day, new formations of monotonous landscape zones arose. The entire landscape fell into transition, as the glacial ice sheets retracted forests and tundra gained dominance, especially in the North American region.

The most prevalent relationship between the species consisted of a predator-prey or in some cases a parasite-host association. The presence of hydatid cysts in muscle tissues of dire wolves is characteristic of a parasitic tapeworm (Barnes 1980). The wolves would have been the intermediate host as the parasite can be acquired through ingestion of eggs. These wolves would have been possible predators of mammoths or scavengers. While they would most likely not have been able to take down a large mammoth in a group, a pack of wolves may have been successful in killing a smaller mammoth or a younger one that had strayed from the group (Lister and Bahn 1994). In North America, the Columbian species of mammoth was common. At maturity, they could reach heights of up to 4m and weigh as much as 10 tons, consistent with the fossil findings (Lister and Bahn 1994). Finding skeletal remains of rodents and prairie dogs in a cave suggests that the wolves may have been responsible for this and would have used the cave as shelter and a place to bring back recent killings.

Many of the arthropods identified such as *Diabrotica undecimpunctata* [western spotted cucumber beetle], *Callidium hesperum* [black-horned pine borer], and *Blissus leucopterus* [chinch bug], feed on plant shoots, roots, and other organic material (Arnett Jr. 1993). Moreover, it is common to find these arthropods and others such as *Hippiscus rugosus* [wrinkled grasshopper] in grassy and open wooded areas (Arnett Jr. 1993), also telling of the landscape.

Saprovores, such as *Cynomyopsis dadaverina* [tachinid fly and blowflies] are very common at the first sign of decay of a dead animal (Arnett Jr. 1993), with the various rodents and prairie dogs present at the site being a source of food. Adding to the interrelated specimens were other parasites. The *Mermis* species of nematodes is a parasite of grasshoppers and deposits its eggs on vegetation that the grasshopper will eat. Mosquitoes are usually found in close proximity to decaying organic matter or flowers. Some are even adapted to feeding on tissue fluids from arthropods and vertebrates such as the wolves or mammoths. *Celatoria diabroticae*, one species identified, is a parasite of the cucumber beetle (Gillott 1995).

By the collection of specimen can provide a prediction of the climate and landscape some 12500 years ago. This scene took place at the start of the postglacial period. The greater warmth of this period encouraged the spread of forests and tundra and may have contributed to the demise of the

mammoth steppe and other fauna (Lister and Bahn 1994). The very stability of the postglacial climate may also have led to the formation of continuous landscape zones, in contrast to the almost unremitting variations through the last Ice Age (Mackay and Battarbee 2003). This perhaps helped to maintain mosaic vegetation by shifting and mixing plant distributions.

Future studies may want to compare this case with other invertebrate and plant remains found in the area for similarities and common characteristics. Looking at local and distant areas of continental environment during the post-glacial Holocene epoch may provide further insight. This study solely reflects the current understanding of earth's geological and faunal history, further studies may want to inquire into the latest developments and consider new climate hypotheses.

Works Cited

Arnett, R.H. 1993. *American Insects: A Handbook of the Insects of America North of Mexico.* The Sandhill Crane Press, Inc., Gainesville, FL.

Barnes, R.D. 1980. *Invertebrate Zoology*, 4th ed. Saunders College, Philadelphia, PA.

Durant, M. and M. Harwood. 1988. *This Curious Country: Badlands National Park*. Fenske Printing Inc., Rapid City, SD.

Flint, R.F. 1971. *Glacial and Quaternary Geology*. John Wiley and Sons, Inc., New York, NY.

Gillott, C. 1995. *Entomology*, 2nd ed. Plenum Press, New York, NY.

Lister, A. and P. Bahn. 1994. *Mammoths*. Macmillan, Inc., New York, NY.

Mackay, A.W. and R.W. Battarbee. 2003. *Global change in the Holocene.* Arnold Publishers, London.

Poinar, G.O. 1983. *The Natural History of Nematodes.* Prentice-Hall, Inc., Englewood Cliffs, NJ.

Table 1. Ratio of C^{14}:C^{12} for the partially digested plant material, invertebrates and vertebrate skeletal remains.

Sample	Ratio of C^{14}:C^{12} x 10^{-13}
1	2.8666
2	2.8701
3	2.8650
4	2.8667
5	2.8631
6	2.8634
7	2.8700
8	2.8649
9	2.8637
10	2.8632

Sample mean and sample standard deviation:

12510.61 $\pm$ 2.41 years

Table 2. List of organisms found at site and notes on their habitat.

Organism	Notes on ecology	Reference
Tapeworm	parasitic flatworm, live in digestive tract	Barnes 1980
Howardula benigna	parasitic nematode of cucumber beetle	Poinar 1983
Mermis species	parasite of grasshopper	Barnes 1980
Dissosteira carolina	grasshopper, herbivore, grasslands and fields	Arnett 1993
Hippiscus rugosus	grasshopper, herbivore, grassy area & woods	Arnett 1993
Melanoplus femurrubrum	grasshopper, herbivore, fields, meadows, in woods, and around irrigation ditches	Arnett 1993
Stenopelmatus fuscus	cricket, herbivore, found throughout the US	Arnett 1993
Blissus leucopterus	chinch bug, herbivore, pest of grains and plants	Arnett 1993
Diabrotica undecimpunctata	cucumber beetle, herbivore, in CA, WA	Arnett 1993
Callidium hesperum	pine borer, herbivore, found in western US	Arnett 1993
Platycholeus species	horn beetle, saprovore, carrion feeders scavenger	Arnett 1993
Aphodius fossor	dung beetle, saprovore, found in western US	Arnett 1993
Creophilus maxillosus	rove beetle, predator, found near dead animals	Arnett 1993
Aedes sticticus	mosquito, omnivore, found in wooded areas	Arnett 1993
Celatoria diabroticae	parasite of cucumber beetle	Barnes 1980
Cynomyopsis dadaverina	blowflies, saprovore, found near dead animals	Arnett 1993
Prionyx species	digger wasps, carnivore	Arnett 1993
Pogonomyrmex occidentalis	harvester ant, omnivore	Arnett 1993
Opisocrostis species	flea, parasite, live off blood of vertebrates	Arnett 1993