Administrative Rc'd Exh. 133

ASPPN I-14
September 1989

Archeological Sites Protection and Preservation Notebook
Technical Notes

PROBLEMS IDENTIFIED BY THE GENERAL ACCOUNTING OFFICE IN THE PROTECTION AND PRESERVATION OF FEDERAL ARCHEOLOGICAL RESOURCES

PURPOSE: This technical note is one of a series published as a means of disseminating information on the nature of impacts to archeological sites and strategies and technologies which have been employed in attempts to preserve such resources in situ. The series has been developed under the work unit "Field Preservation of Cultural Sites" of the Environmental Impact Research Program (EIRP). This note provides a summary of the General Accounting Office (GAO) review of federal agency protection of archeological resources in the Four Corners States of Arizona, Colorado, New Mexico, and Utah where a wealth of archeological resources are found on federally managed lands.

BACKGROUND: Concerned about the federal agencies' ability to protect and ensure the preservation of archeological resources, in 1985 the subcommittee on Public Lands, National Parks, and Forests of the Senate Committee on Energy and Natural Resources asked GAO to determine: (1) to what extent the resources are being looted; (2) what the federal agencies are doing to protect the resources; and (3) what the agencies are doing to ensure that the artifacts being legally removed from these lands are properly preserved.

Archeological resources located on lands owned/controlled by the federal government have been protected by law since enactment of the Antiquities Act (Public Law 59-209) in 1906. The legal basis for site protection and preservation was further strengthened by the Archeological Resources Protection Act (Public Law 96-95) in 1979. A requirement that federal agencies locate and inventory all significant archeological sites located on their lands was first initiated in Executive Order 11593, dated May 13, 1971.

ADDITIONAL INFORMATION: Contact the editor, Dr. Paul R. Nickens, (601) 634-2380, or the EIRP Program Manager, Dr. Roger T. Saucier, (601) 634-3233, US Army Engineer Waterways Station, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199.

341

US Army Engineer Waterways Experiment Station
3909 Halls Ferry Road, Vicksburg, MS 39180-6199

Introduction

The Department of the Interior's Bureau of Land Management (BLM) and National Park Service (NPS) and the Department of Agriculture's Forest Service (FS) are responsible for managing 37 percent of all land in the Four Corners states. The agencies seek to protect their identified archeological resources in two basic ways: (1) attempting to prevent looting and vandalism and (2) when looting occurs, attempting to apprehend and prosecute persons responsible.

NPS parks generally curate their own artifacts, whereas most artifacts from BLM and FS lands are curated by facilities operated by universities, colleges, and private museums.

Results in Brief

GAO found that the archeological resources of the Four Corners states continue to be lost and destroyed as a result of looting and that inadequate curation is being provided to some of the artifacts removed from federal lands. Although the federal agencies reviewed have identified only a small portion (about 7 percent) of the archeological sites they estimate are located on their lands, they have been unable to curb the looting and destruction of even the identified resources.

The federal agencies do not have complete and accurate records on what artifacts have been removed from their lands or where these artifacts are located. Moreover, they have not been assessing the adequacy of the facilities caring for the artifacts. Officials at some facilities told GAO that they have deficiencies related to the management, storage, and care of artifacts.

Looting: a Serious Problem

Agency records do not accurately reflect the extent of looting. However, knowledgeable persons contacted during GAO's review generally agreed that looters are destroying valuable scientific information at archeological sites (Figure 1).

Federal officials generally believe that enforcement efforts have deterred casual looting (looting to obtain artifacts for personal collections) but not commercial looting (looting to obtain artifacts for sale to others). When an

5-942

Figure 1. Looted archeological site on BLM land in Arizona

agency steps up its enforcement efforts, commercial looters shift their activities to other agencies' lands. BLM and FS lands have experienced high levels of commercial looting; whereas the NPS has experienced little commercial looting.

Limited Knowledge and Protection of Archeological Resources

Funding and staffing constraints, together with the vastness of the area's federal lands, limit physical protection to only a small portion of the known sites (Figure 2). In fiscal year 1985, the three agencies had only three staff members whose primary duty was protecting sites on over 104 million acres. The agencies had another 603 staff members whose duties included site surveillance, but who generally had other duties as their primary responsibility--e.g., visitor protection or fire patrol. BLM had the fewest staff (63), the most land (57 million acres), and the most recorded sites (76,000).

Additional information on the actual number, location, and significance of archeological sites could assist the agencies in making better use of existing

Figure 2. Fenced prehistoric cave site on BLM land in Arizona

staff. However, the three agencies had surveyed less than 6 percent of their lands to identify sites and had located only about 136,000 (estimated to be 7 percent) of the 2 million sites thought to be located on their lands. Furthermore, most recent archeological surveys have been performed to obtain clearances for development projects and were not necessarily directed at those areas having the greatest archeological potential.

Inadequate Efforts to Ensure Proper Preservation of Curated Artifacts

Archeological artifacts removed from federal lands remain the property of the US Government. Therefore, the federal agencies are responsible for ensuring that the artifacts are properly curated. However, GAO found that the agencies were doing little to ensure that the artifacts removed from their lands and sent to curatorial facilities were accounted for and being properly preserved. BLM and FS lacked information on many artifacts excavated prior to the mid-to-late 1970s. NPS estimates that it has 15.5 million uncataloged artifacts located in both federal and nonfederal facilities. None of the agencies has required nonfederal facilities to notify them when artifacts are received or transferred to other facilities.

Artifacts removed from federal lands are to be preserved by suitable scientific or educational institutions possessing adequate curatorial capabilities. However, GAO found that the agencies lacked procedures for determining the adequacy of a facility's ability to curate archeological artifacts. The agencies also seldom systematically inspected a facility. The need for such inspections is evidenced by the facilities' problems in artifact collections management, storage, and care. For example, 9 of 37 respondents to a questionnaire GAO sent to nonfederal facilities curating federal collections said that artifacts had deteriorated or had been identified as destroyed, missing, or stolen.

NPS has drafted a regulation addressing both the curation facilities' responsibilities for management and care of federal collections and federal agencies' responsibility for inspecting the curation facilities. NPS officials also told GAO that they would add a provision addressing the need for agency internal control records.

Recommendations

GAO recommends that the Secretaries of the Interior and Agriculture direct the heads of the respective agencies to improve documentation of looting incidents and cumulative damage to archeological sites. Agencies should develop guidelines that (1) instruct field offices on when to prepare looting incident reports and (2) require field offices to periodically revisit recorded sites to update records as to the condition of the sites; improve the protection and management of their archeological resources by developing plans for surveying those areas not scheduled for project development and consistent with priorities for available funds and staff, insuring that a reasonable number of these surveys are carried out each year; jointly develop an agreement for funding and staffing an office that would compile and analyze looting incident information submitted by the individual agencies and conduct undercover investigations using its own staff or the agencies' law enforcement staffs.

S-945

Primary Source

US General Accounting Office. 1987. "Cultural Resources: Problems Protecting and Preserving Federal Archeological Resources." Report to Congressional Requesters, GAO/RCED-88-3.

5-946

Archeological Sites Protection and Preservation Notebook
Technical Notes

SITE BURIAL AS A MEANS OF PRESERVING ARCHEOLOGICAL SITES

PURPOSE: This technical note is one of a series published as a means of disseminating information on strategies and technologies which have been employed in attempts to preserve archeological resources in situ. The series has been developed under the work unit "Field Preservation of Cultural Sites" of the Environmental Impact Research Program. The concept of site burial as a means of preserving an archeological site is developed. The basic scientific information needed to develop a quantitative site decay model is not available, but a qualitative site decay model may be described and applied to site preservation needs.

BACKGROUND: The US Army Corps of Engineers and other federal and state engineering organizations are responsible for protecting the Nation's archeological resources impacted by public projects. Numerous options are available to the engineer, ranging from a complete archeological excavation to site protection through burial. In many cases, excavating the site is not desirable, since this effectively destroys the total archeological resource by removing artifacts from their environment. The concept of site protection through burial maintains the total archeological resource in place. There are many human-caused factors which may impact sites, such as vandalism, land leveling, collecting, construction and land development, brush chaining, logging, and many others. Natural impacts include erosion, groundwater leaching, frost action, forest fire, subsidence, earthquake-induced surface processes, and numerous others. This note discusses how these processes, which are part of the overall site decay process, may be affected, either positively or negatively, by site burial.

ADDITIONAL INFORMATION: Contact the editor, Dr. Paul R. Nickens, (601) 634-2380, or the EIRP Program Manager, Dr. Roger T. Saucier, (601) 634-3233, US Army Engineer Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199.

S-947

Site Decay and Preservation

Archeological sites are subject to multiple impacts resulting from both natural and human factors. The result is a cumulative degradation eventually resulting, if unchecked, in total site loss. Technological means are sought to retard or prevent such factors from impacting sites. However, prior to the implementation of prevention measures, the full range of site formational and decay processes must be assessed to understand how sites come to be as they are and how they continue to exist. At the heart of this is the question, "How does an archeological site respond to changes in the physical, chemical, and biological conditions at the site?" and "How, and at what rate, do changes in the site conditions cause changes in the archeological materials?" Only with this kind of specific information for individual site components, such as soil, charcoal, bone, pottery, lithics, and other materials, can the effects of protective efforts on the site be assessed.

The kinds of changes resulting from burial that need to be assessed include: compaction; fracturing; movement of components, both horizontally and vertically; changes in chemical and isotopic fractions; sorting of components; remnant magnetism, thermoluminescence; component loss; and many others. A further consideration is the degree of change that is acceptable as a result of interaction with the site. Since sites have been in place for hundreds or even thousands of years, it is often assumed that the site exists as a relatively constant entity. Whereas the excavator may choose to view a site as a fixed entity at the time of excavation, in fact, a site is located along a continuum of change over time. Therefore, preservation cannot be defined as nonchange, but instead should be defined as "any action which reduces or eliminates detrimental changes resulting from site impacts." The goal then is that preservation activities should reduce the rate of the ongoing detrimental processes on the site matrix and contents.

Concept of a Quantitative Site Decay Model

The general concept of the model envisioned can be patterned after a model of forest succession, except that the forest is renewable and an archeological site is not. The plant community that develops and changes through time is

S-348

responding to numerous external factors, such as climatic patterns, insects, soil conditions, slope, fire, and others. Each of these factors may act to either enhance or retard the rate of forest development in any number of ways. For example, climate is seasonal; bedrock is effectively constant; fire is a negative step function; and soil characteristics change gradually.

Schematic diagrams of the process-time relationship for forest succession and archeological site decay are shown in Figure 1. In the case of Figure 1A, the independent variables controlling the rate of forest development are uniform throughout time and a smooth succession curve is generated. Once the forest system reaches climax and is in equilibrium with the independent variables, a change in these variables must occur before forest conditions change. In Figure 1A, this is shown by the introduction of a new variable (fire) which causes a negative step function change to bare mineral soil conditions. In the

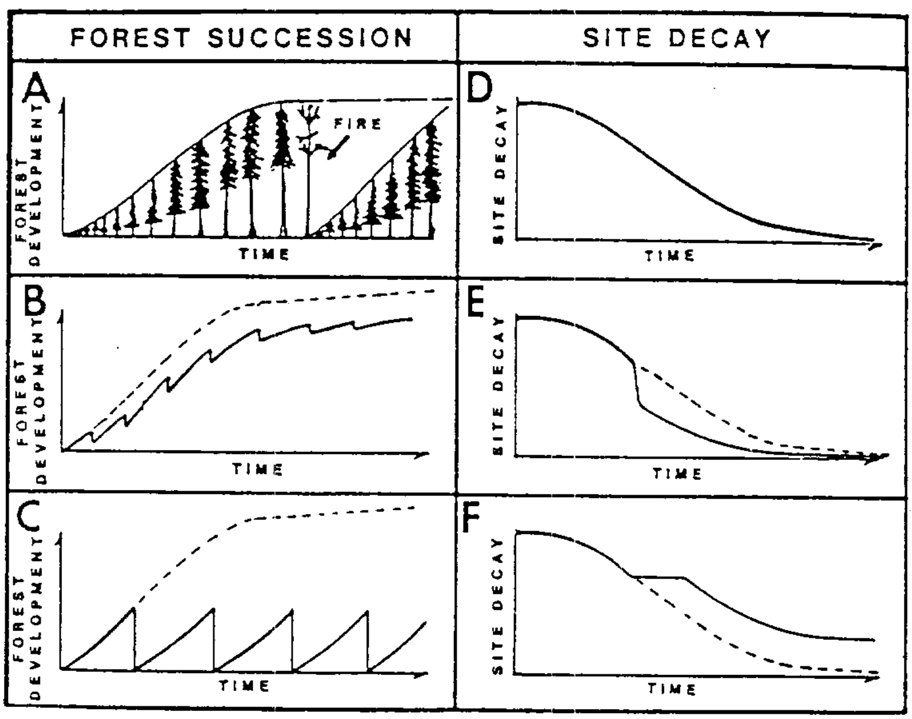

Figure 1. Schematic process-time relationships for forest succession and archeological site decay. In (A) and (D), the independent variables are uniform and the process-time relationship follows a smooth curve. A significant external, independent variable, fire in (A) causes an abrupt step function change in the process-time relationship. Nonuniform or cyclic changes in the value of the independent variables cause irregular process-time relationships. The influence of changes that increase decay (E) or that retard decay (F) are the primary objective

5-949

case of an archeological site, Figure 1D shows a uniform decay rate for a specific component of the site. If the independent variables are cyclic, they could produce the forest development-time relationship in Figure 1B, or prevent the forest from ever reaching equilibrium, as in Figure 1C. External impacts on an archeological site can either increase the rate of decay (Figure 1E) or retard the rate, as in Figure 1F.

The general decay-time relationship is expected to take the form of a "factorial equation," similar to the one below:

$$SD = f(Aa\alpha + Bb\beta + Cc\gamma) + g(Dd\delta + Ee\epsilon + Hh\mu) + \ldots\ldots\ldots$$

in which, SD = site decay rate; f and g are interaction functions; A, B, C, D, ... are constants; a, b, c, d, ... are independent variables derived from each of the interacting sciences; and α, β, γ, ... are exponents established by the time relationship of each independent variable.

Critical to the ultimate development of a quantitative site decay model is the identification of the interactions of the physical, biological, and chemical factors with the components that make up an archeological site. At present, these interactions have not been fully identified and analyzed. Sufficient information is available, however, to construct a qualitative site decay model as follows.

A Logic-Based Qualitative Site Decay Model

Development of a qualitative decay model used in the design of a preservation plan for a site must be carried out as a cooperative effort between the engineer, geologist, and archeologist. To ensure that the specific components or relationships at a site are protected, the archeologist must identify the critical cultural components and their relationships, and the engineer and geologist must then design the burial with conditions capable of enhancing the preservation of the site components.

The matrix shown in Figure 2 summarizes the effects of postburial change on the preservation or decay of the components of an archeological site. The influence of physical, biological, and chemical processes on the decay process are discussed in the following paragraphs.

S-950

SITE COMPONENTS

PROCESSES	ANIMAL BONES	SHELL	PLANTS	CHARCOAL	CRYSTALLINE LITHICS	GRANULAR LITHICS	CERAMICS	ARCHAEO FEATURES	SOIL ATTRIBUTES	METALS	CONTEXT	ISOTOPE CONTENT	TOPOGRAPHY
ACID ENVIRONMENT	A	A	E	N	N	A	N	N	A	A	N	A	N
BASIC ENVIRONMENT	E	E	A	N	N	E	N	N	A	A	N	N	N
DRY (CONT.)	E	E	E	E	N	E	N	N	N	E	N	E	N
WET ANAEROBIC(CONT.)	E	E	E	A	A	A	A	A	A	A	N	A	A
COMPRESSION	A	A	A	A	N	N	A	A	A	N	A	N	A
MOVEMENT	N	N	N	A	N	N	N	A	A	N	A	N	A
WET-DRY	A	A	A	A	A	A	A	A	A	A	N	A	A
MICOORGANISMS	A	N	A	A	N	N	N	N	N	A	A	A	N
MACROORGANISMS	A	A	A	A	N	A	N	A	A	N	A	N	N
WET AEROBIC	A	A	A	A	N	A	A	A	A	A	N	A	N
FREEZE-THAW	A	A	A	A	A	A	A	A	A	N	A	A	A
FREEZE	A	A	A	A	N	A	A	N	E	N	A	E	N
THAW	N	N	N	N	N	A	N	N	A	N	A	A	N

E - ENHANCES PRESERVATION
A - ACCELERATES DECAY
N - NEUTRAL OR NO EFFECT

Figure 2. Logic-based archeological component decay and preservation matrix, which relates physical-chemical-biological processes to post-formation changes of specified site components

Significant physical processes include: compaction/compression, freeze-thaw, movement, and ground-water conditions. Compaction and compression processes act to break brittle artifacts or displace components and destroy any geographic relationships. Freezing or freeze-thaw cycles act to break apart artifacts susceptible to freezing or disrupt geographic relationships through frost heaving. Movements within a site also break artifacts and disrupt associations. Large-scale movements, such as slope failures, are a major concern for sites to be buried, since these processes completely disrupt geographic relationships through the translocation of artifacts.

Ground-water conditions are important physical factors which have a direct impact on the chemical and biological environment within a site. A ground-water regime that seasonally varies from wet to dry increases the chemical decay within a site. A site within the shore zone of a reservoir is most severely impacted because the physical, biological, and chemical processes of decay are accelerated in the wet-dry conditions of this zone. It is recommended that sites within the shoreline zone should be excavated and documented rather than buried.

Changes in the local climate which increase the humidity generally accelerate the decay of any exposed site component. These changes, often brought about through the construction of an open body of water, should be recognized and incorporated into any site preservation project. Changes to a drier climate tend to enhance the preservation of exposed components.

The primary chemical processes identified are the oxidation/reduction and pH characteristics of the buried site. Chemical factors have the greatest impact on the components making up any site. Unfortunately for site preservation, the various components react differently to changes in the chemical environment.

Continuously wet and anaerobic environments enhance the preservation of bone, shell, and plant matter and accelerate the decay of all other site components and geographic relationships. A continuously wet, aerobic environment accelerates the decay of all site components except crystalline lithics. These conditions do not enhance the preservation of any component or geographic relationship within a site. A continuously dry environment enhances the preservation of all site components and relationships.

An acidic environment enhances the preservation of plant material and either accelerates the decay process or has no effect on other site components. Basic or alkaline environments enhance the preservation of bone, shell, and granular lithics, while accelerating the decay of plant material, soil attributes, and metals.

Significant biological processes identified include microorganisms, macroorganisms (burrowing animals), and plant roots. The creation of an environment that increases the number of microorganisms accelerates the decay of bone, plant material, charcoal, isotopic content, metals, and site context but has little effect on shell, lithics, ceramics, and site relationships.

Macroorganisms, especially burrowing animals, have a direct physical impact on a site through their burrowing activity. In addition these organisms tend to eat or chew on the site components, thereby accelerating the decay of a site.

Plants, especially large trees, have a physical impact on a site by mixing the site context with their roots. Significant mixing of the site context can occur whenever a tree is blown or pushed over. Special care should be exercised during preliminary clearing operations of a site where archeological remains may be present. In addition, trees can induce biochemical decay near plant rootlets where active chemical reactions take place.

The qualitative site decay model can be used as a planning and design tool to evaluate the potential of protecting an archeological site through burial. Much of the basic technology needed to evaluate the potential impact of burial is available within the US Army Corps of Engineers. Details of the actual impact of burial, however, have not been determined.

The initial step in the planning, design, and evaluation of a site burial project lies with the preliminary archeological investigation. The specific characteristics and components of the site to be protected must be defined. The decay matrix (Figure 2) is then consulted to select the desired environmental change to be induced through burial. If the site contains a complex mixture of components, environmental conditions that enhance preservation may be limited to a few alternatives. For example, a site containing both shell and plant remains must be maintained at a neutral pH and either continuously dry or continuously wet and anaerobic for preservation. Increases in either acidity or alkalinity will accelerate decay of both shell and plant material. If an environmental condition cannot be created to enhance the preservation of noncompatible components, it will be necessary to define those components to be protected and those components not to be protected. If this distinction cannot be made or if it is unacceptable, site burial is not the best preservation technique.

Once the site components have been defined and the desired environmental conditions for preservation identified, the engineers and scientists must evaluate the site to determine the existing physical, biological, and chemical conditions. Design concepts are then developed and evaluated to determine if the desired environmental change will occur. If the desired conditions can be generated, then the design concept is evaluated with respect to the cost of the proposed burial project. If the design is economically favorable and the environmental change will enhance site preservation, then the project can be implemented.

When possible, sites that have been buried for preservation should be monitored to determine that the desired environmental changes have taken place.

S-953

A monitoring program ensures against any unforseen or unpredicted conditions that may accelerate site component decay.

Primary Source

Mathewson, C. C., Editor. 1989. "Interdisciplinary Workshop on the Physical-Chemical-Biological Processes Affecting Archeological Sites," Contract Report EL-89-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

S- 954