# TEN YEARS OF MONITORING CAVE SITES AT FORT LEONARD WOOD, MISSOURI

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## Abstract

In 1997 Fort Leonard Wood was tasked with assessing, monitoring, and developing a management plan for nine clusters of sites deemed potentially eligible for the National Register of Historic Places. These clusters often represent site complexes with both a biological and cultural-resource component that by law had to be protected, monitored, and managed. The Fort's Directorate of Public Works and the Natural Resource Branch's Cultural Resource and Wildlife Management programs combined assets and developed a systematic approach to answer the questions: What are the impacts? Who was making the impacts? When are the impacts occurring? These site clusters contain significant archaeological records, human remains, and endangered bats. Specific guidelines included off-limits/no-entry restrictions during bat hibernation and maternity periods.

The crew did periodic spot checks of sites, utilizing mammal-monitoring protocols (in this case human footprints). All disturbances were recorded as to type of intrusion, what type of boot, time of year, and assessment of immediate and long-term effects. In the beginning of the survey it was assumed that most intrusions were military in nature; after two years of spot survey it was clear that the vast majority of incidents involving cultural resources and endangered species were nonmilitary. Data from the initial survey was used to establish additional monitoring protocols and protective measures, such as light monitors, cameras and cave gates.

Key words: cave monitoring, cave management, archaeology, biology, endangered species, Fort Leonard Wood, Missouri

## Introduction

The Maneuver Support Center (MANSCEN) and Fort Leonard Wood (FLW) military installation is 24,852 ha located in southwestern Pulaski County, Missouri, on the Salem Plateau of the Ozark Region. The Mark Twain National Forest borders the installation on three sides. Geologic features border narrow, flat, alluvial floodplains with rock outcrops, karst topography (caves and sinkholes), and sheer bluffs that commonly rise 60 m in elevation. Elevations range from 230 m to >396 m above sea level in the southern portion of the installation. Sixty-three known caves occur within Fort Leonard Wood boundaries. Currently the MANSCEN and FLW military primary missions are to train personnel in basic combat; combat engineering; military policing; and chemical, biological, radiological, and nuclear warfare. Other combined Department of Defense personnel (Army, Air Force, Navy, Marine, and Coast Guard) are trained in heavy equipment instruction and operation.

In 1996 MANSCEN and FLW was tasked in a Biological Opinion (BO) by the U.S. Fish and Wildlife Service (USFWS) and Missouri

*Figure 1* *Monitoring included raking fine dirt at the twilight area with a fire rake and checking the sites with footprints.*

Department of Conservation (MDC) to monitor and determine the number and types of entries in several caves with Federal and State Endangered Species. In addition, a negative Environmental Compliance Assessment System (ECAS) finding based on continued Archaeological Resource Protection Act (ARPA) and Native American Grave Protection and Repatriation Act (NAGPRA) violations encouraged the Cultural Resource Program to implement a monitoring program for sites eligible for the National Register of Historic Places (NHRP). The FLW Directorate of Public Works (DPW) Natural Resource Branch (NRB) was tasked to integrate a Biological and Cultural Resource Monitoring Plan. The monitoring plan was to determine who, why, and when caves on FLW were being entered. Since the installation was created in 1940 caves on FLW have had a history of frequent entry and disturbance. Bat caves are sensitive to specific, seasonal disturbances in hibernation and maternity periods. Archeological sites have been looted repeatedly during all seasons. The issues that faced the DPW NRB were to establish a monitoring protocol that would establish the following information: Who were the parties responsible for entering caves located on FLW, military or civilian? Why were the caves on FLW being entered, and what was the purpose of the cave entry? When were the caves being entered, and at what time of the year was the entry?

## Materials and Methods

To establish a monitoring protocol that could answer the Who? Why? When? questions, the NRB looked into established military and civilian regulations pertaining to cave entry. The FLW Installation Range and Training Area Reg. 210-14 Chapter 3-17 (e) clearly states "All caves and rock shelters are off limits to military activities." The regulations for civilians were less specific. If the cave did not have a Federal endangered species sign with specific time of year entry prohibition, the cave was subject to entry. The FLW hunting and fishing program as well as the FLW outdoor recreation center had no policy on cave entry. Therefore the NRB had to design a set of monitoring protocols which would track the "type" (military or civilian) of entry into the caves, month of entry and which type of cave restriction entry violation (biological or cultural) and if a violation occurred, which classification of the entry significance (minor or major) had occurred.

In 1997 a cheap, effective monitoring system had to be created in order to satisfy the parameters for the monitoring protocols. The initial site-monitoring protocols that were used to answer our questions were converting a modified Standard Mammal Track Station protocol to record human footprints at stations (Figure 1). This entailed raking fine dirt at the twilight area at the cave entrance with a stiff-tined (met-

al) fire rake, checking the sites bi-monthly and recording the footprints.

The 109 sites were divided into nine subgroups. The sites were grouped based on geographic proximity to each other, facilitating site survey and personnel resource time and travel. The sites in the initial survey period of two years were visited twice a month and information recorded. The month, type, and severity (temporal and special restriction) of cave access entry was recorded and initial determination, if possible, of Who (military/nonmilitary) was determined. We had worked with military police and installation game wardens to help us use military boot sole patterns to make determinations based on military boot issue. The U.S. military has a very limited boot sole pattern issue (four possible), so determination was relatively easy. Other data collected were frequency of entry since last visit. Evidence was collected for signs, type of disturbance, and the status of the area, whether the area was open or closed for civilian-use hunting or military training. The types of cave-access violations were divided into two categories: biological and cultural. Biological cave violations occurred when people entered posted cave sites (Figure 2) in disregard to the information signs located at the cave entrance point.

Cultural-resource cave violations occurred when people entered posted cave sites in disregard to the information signs located at the cave entrance, and dug for artifacts or disturbed the site looking for artifacts (Figure 3).

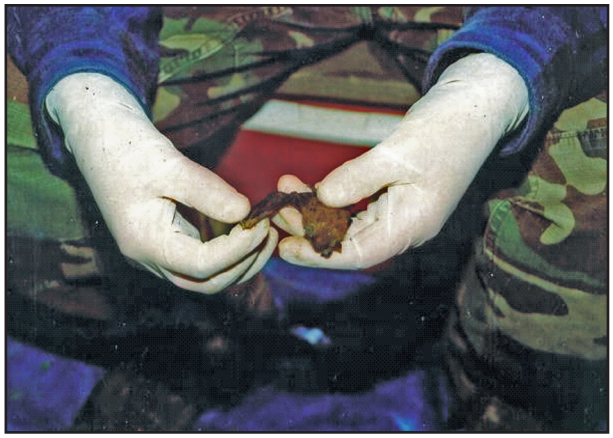

*Figure 2* *A possible biological disturbance included this dead, juvenile gray bat under a maternity roost.*

*Figure 3* *Evidence of a cultural resource disturbance left by looters at NAGPRA Site (bone, pottery and diagnostic points).*

## Results

The initial, two-year data summary shows that there were 43 entries, of which eight were major and 35 were minor violations. The violation categories were 37 biological and six cultural. The data analysis and interpretation showed the top months with the most frequent entries were April, November, and December. The top months with the most major entries were December and January. Most entries occurred when the hunting area status was scheduled for public use. Most of the minor violation entries coincide with both spring turkey and fall deer season. Most of the major violation entries coincide with the "Exodus" of personnel (Installation training holiday closure) in December and January. Most of the entry violations are minor and biological (casual, do not go beyond the twilight area). Most of the Cultural Resource violation entries are major and occur over Exodus and are organized (target sites at specific time of the year when military training is limited and post law-enforcement resources reduced). The data suggest that the most entries are civilian in nature, coincide with hunting seasons in the spring and fall when people are in the woods, and that through boredom or a sense of adventure they enter posted cave sites. The fact that most entries do not go beyond the twilight area reveals that the casual entry violations occur because most hunters carry a small flashlight or none at all and will not proceed into a dark zone unprepared. On the other hand the Cultural Resource violations occur at targeted times and sites,

and the people who are entering are knowingly violating the posted signs and committing a crime. They are highly organized, prepared to enter caves and do not wish detection. In order to attempt to limit the number of entries into endangered species caves at FLW, the NRB decided to use faux cameras on a trail bases and attempt to see if new signs with electronic camera warning would deter casual entries.


*Figure 4* *New electronic warning signs were attached to the bottoms of the existing signs.*

New electronic warning signs were attached to the bottoms of the existing signs (Figure 4) and faux cameras (similar to faux cameras used in convenience stores and homes) (Figure 5) were purchased and installed. The cameras cost approximately US $175.00 to $200.00 and were easy to install in the caves. The concept was to use faux cameras, with Hobo® H06-001-02 light sensors (Figure 6) deep in the cave and the track-count protocol to determine if electronic warning signs and faux cameras would stop the occasional minor entries into the twilight areas of posted, sensitive, endangered-species caves.

After two years of the use of the warning signs, Hobo light sensors, and the track counts, minor entries into the twilight areas of the endangered-

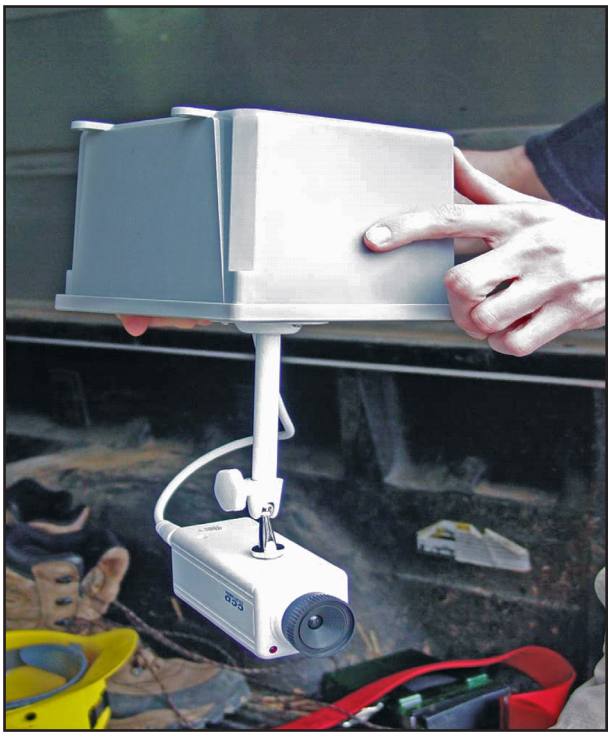

*Figure 5* *Faux cameras were installed along with light sensors.*

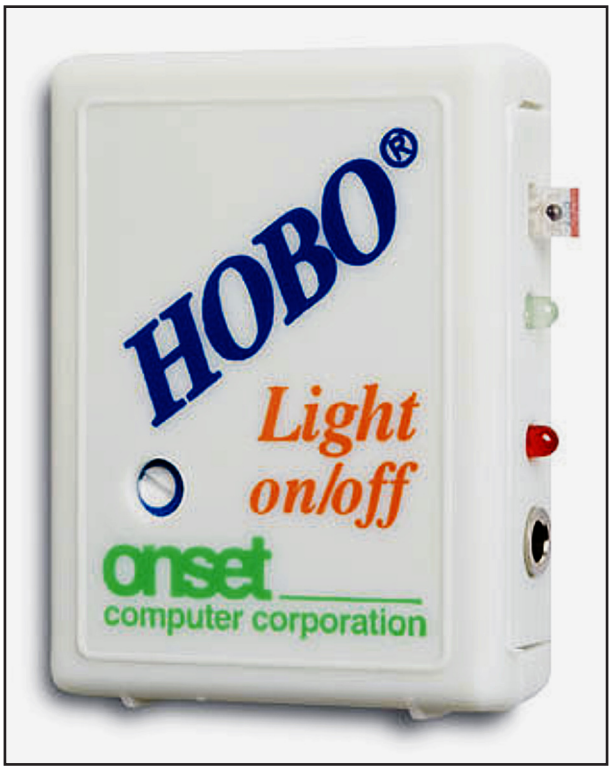


*Figure 6* *Hobo® H06-001-02 light sensor, courtesy of Onset Computer Corporation.*

species sites stopped. There were only two events recorded with Hobo light sensors; both were off-season and correspond to dates that cave survey teams were know to be in the caves doing surveys. The Hobo light sensors had worked and data backed up the fact that the electronic monitoring signs and faux cameras had been effective in deterring occasional cave entries into the twilight zone.

## Discussion and Conclusions

Cave with intact cultural-resource deposits (burials, rock art, and paleontology) are gated. These sites are still monitored to check status of the gate. Currently the monitoring protocol for the 109 monitoring sites is to make a visit at least once every six weeks. The only exception is the spring and fall hunting seasons; the sites are checked prior to the start of the season and the week after the season ends. Typically this time frame has been the period with the most public access and past violations. Future actions on FLW dealing with NAGRRA issues at cave sites are to continue cave gating and monitoring at NAGPRA sites, and ongoing consultation with tribal governments of the Dhegiha Council (Osage, Kaw, Omaha, Quapaw, and Ponca tribes) on cultural affiliation, repatriation of human remains, and visitation by Tribal Leaders to FLW sites.

The periodic monitoring of caves is an important tool to help protect cave resources, be they biological or cultural-resource sites. Once a routine protocol of site visits, monitoring, and protection measures is established for cave sites by an agency, the word goes out to the public that these areas are scrutinized. The entry violation decreases, damage is minimized and cave resources are conserved. The cost associated with preventive monitoring of sites in the long run will be effective. Taking action at a cave after major problem has occurred is usually expensive and in many cases the damage to the cave resource is not repairable. Therefore an inexpensive protocol of site visits and monitoring can help an agency determine which types of protection measures will be most cost-effective in the long term and best conserve cave resources.