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Abstract
In 2008, staff from the University of Kentucky Program for Archaeological Research (UK-PAR) and the Illinois State Museum Society (ISMS) conducted archaeological and paleontological investigations at Mammoth Cave National Park in advance of proposed rehabilitation of 40,499 linear feet of selected trail segments within Mammoth Cave. This presentation focuses on the results of archaeological investigations conducted within Mammoth Cave and is confined to discussion of the prehistoric materials. These materials were confined to the upper and lower passages of the Historic Tour, the Lantern Tour, and Gothic Avenue trails (Figure 1)

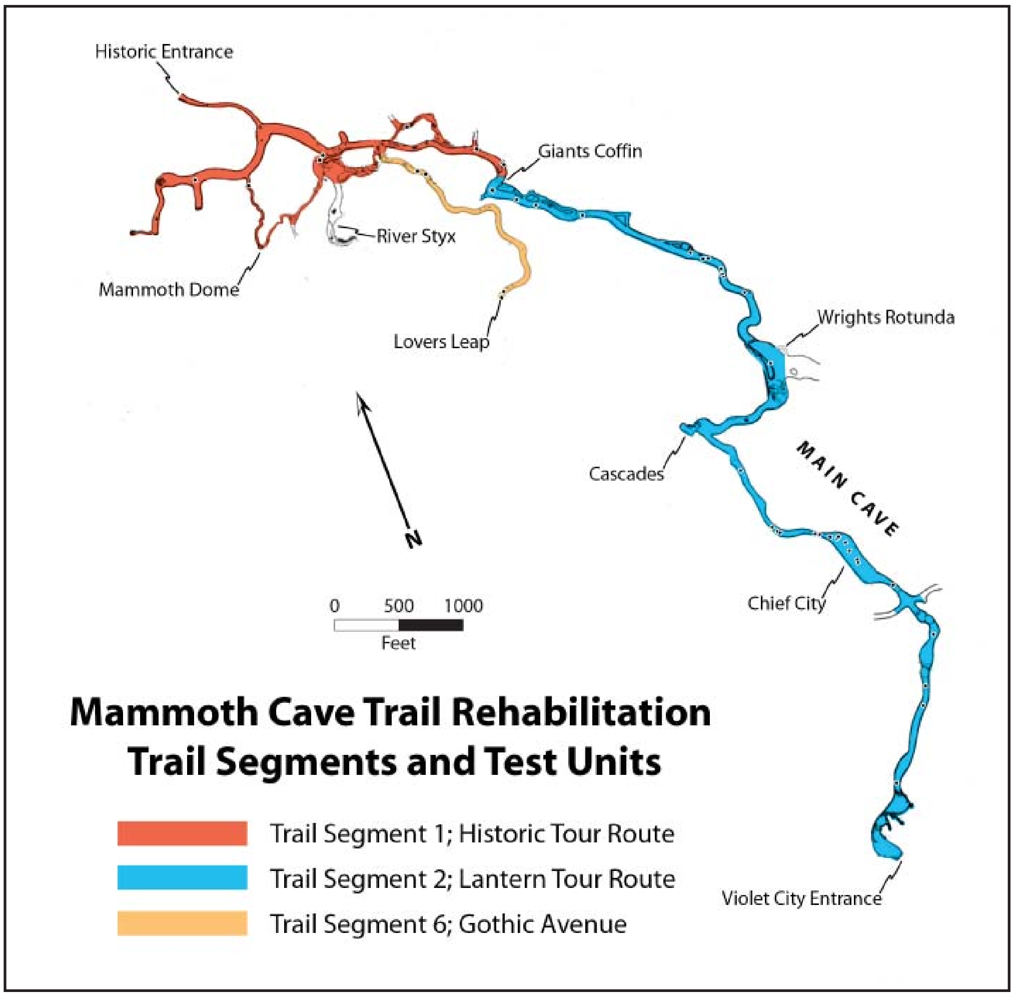

Figure 1: General Map of Upper Levels of Mammoth Cave System showing Selected Trail Segments Targeted for Rehabilitation. General test unit locations are shown as black squares with white borders. Small side passages are not shown.

Previous Research

Though the entrance rooms of many caves and rock shelters in the eastern United States show evidence of both short-term and long-term use beginning in the late Paleoindian period (ca. 9000 BC) and continuing through the prehistoric era, the earliest known evidence of cave dark zone exploration has been documented at sites in Tennessee (Simek et al. 1998; Watson et al. 2005), Indiana (Munson and Munson 1990), and Kentucky (Watson 1997a; Watson[editor] 1997). It appears that the purpose of these early activities was simply exploration, which left subtle traces in the form of torch charcoal, smudge marks, and human footprints. Jaguar Cave in Tennessee has produced the earliest dates for dark zone exploration, between 3520 and 3110 BC, in the Middle Archaic period. Although 3rd Unnamed Cave, Wyandotte Cave, and Mammoth Cave each also have a few early dates, the large majority of assays date to later periods.

Activities conducted in these caves include quarrying of high-quality chert, mining of aragonite, and in Mammoth Cave, mining of gypsum, selenite, mirabilite, and epsomite. These mining activities in Mammoth Cave primarily date to the Early Woodland period, 1000 to 200 BC (Crothers et al. 2002). Other temporal periods are apparently not represented, though cave use was also common in the midsouth between AD 1000 and 1550. Prehistoric gypsum mining is not limited to Mammoth Cave, but it is very well documented. Where gypsum has formed, it has been extensively pounded and scraped from the walls and ceiling where it is reachable, and the selenite form has been dug from remnant cave fill sediment. There is almost no portion of upper Mammoth Cave within several kilometers of the historic entrance that was not intensively mined. Gypsum was most likely ground and used as a white pigment. Mirabilite and epsomite are more localized in their occurrence within the cave system. Both minerals create soft frost-like coatings on cave wall surfaces and may accumulate on the floor. Both minerals are well-known as intestinal cathartics. The large number of desiccated human paleofeces found in Mammoth Cave suggests that this use was well understood by prehistoric cavers, and the salts were consumed in the cave for their effect.

Any activity conducted remote from the natural entrance of any cave requires artificial light. The most common evidence for prehistoric use of the dark zone is the torch debris left behind. The most common material for torches was river cane (*Arundinaria gigantea*), though a variety of other woody materials was used. Also commonly recovered are the plant fiber ties for torch bundles. Torch remains, both carbonized and uncarbonized, are ubiquitous through most of the upper-level passages that have not been disturbed by later activity. Any other material brought into the cave presumably had a specific purpose, as cavers would not want to be encumbered with unnecessary items. The mining activity in Mammoth Cave used simple expedient tools, such as digging sticks, mussel shell scrapers, hammerstones, gourd and wooden bowls and basketry for collecting minerals. Fragments of cordage and textile may be the remains of carrying bags or parts of clothing.

The single largest category of material exclusive of torch debris is human paleofeces. Hickory nut (*Carya* sp.), sunflower (*Helianthus annuus*), annual marshelder or sumpweed (*Iva annua*), pitseed goosefoot (*Chenopodium berlandieri*), maygrass (*Phalaris caroliniana*), and occasional squash (*Cucurbita pepo*) seeds apparently made up significant portions of the diet during the Early Woodland period. With the exception of hickory nutshell, all of these seed remains are components of the Eastern Agricultural Complex, a group of early plant domesticates used in eastern North America (Smith 1992). Aside from those found in paleofeces, subsistence remains are extremely rare in Mammoth cave. In the dark zone, no prehistoric ceramics have been found, and evidence for lithic reduction and toolmaking is very scant, in contrast to contemporary open sites. Systematic survey of the upper passage of Mammoth Cave showed that paleofeces were not randomly distributed, but instead were concentrated near abundant sources of mirabilite and epsomite (Crothers 2001), supporting the hypothesis that ingestion of medicinal salts in the cave was at least one of the reasons for the intense prehistoric utilization. Analysis of the steroids preserved in paleofeces has demonstrated that the prehistoric defecators were exclusively male. Combining these observations, Crothers (2012) hypothesized that caves like Mammoth and Salts may have functioned primarily as sites for performing rites of passage of young males into adulthood, with the cave environment and its mineral resources comprising important aspects of Early Woodland rituals.

Based on this previous research, specific research objectives were developed that included:

1) obtaining additional radiocarbon dates to verify primarily Early Woodland activities, or alternatively, to demonstrate that the cave was used during other time periods;
2) collecting materials from intact excavated contexts;
3) determining the types of activities conducted within the cave;
4) assessing the evidence for prehistoric activities besides mineral mining;
5) examining the spatial distribution of prehistoric materials to identify locations where specific activities took place; and
6) providing recommendations for minimizing impact to archaeological deposits with high research potential.

Methods

Field work began with a detailed walk-through and visual examination of the trails targeted for rehabilitation. Trail segments that contained thick trail construction fill, had been excavated to basal cave sediments, were severely disturbed by historic saltpeter mining, or were too moist to preserve uncarbonized plant remains were identified and excluded from further consideration. This initial triage excluded most of the Gothic Avenue trail and large segments of the upper level of the Historic Tour trail. Some of the upper Historic Tour had also been previously investigated in advance of installation of new electric lighting. Locations with high archaeological potential were identified based on previous survey, test excavation, and surface collection work. Archaeological test unit excavation was thus limited to the most productive, representative, previously uninvestigated, or potentially important locations.

All test units were confined to the existing trail and a 1.5-foot wide buffer on each side of the trail that will be directly impacted by trail rehabilitation activities. Previous excavation experience within Mammoth Cave led us to expect to encounter specific strata. Though there was considerable variation, especially in test units that encountered guano deposits, the typical stratigraphic sequence for archaeological deposits consisted of an upper Stratum I of historic trail sediments deposited when the trail was constructed by the CCC in the 1930s. This is underlain by Stratum II, an anthropogenic deposit of mixed carbonized and uncarbonized material distributed above, among, and below rock fall (Figure 2). Some units encountered basal cave fill

Figure 2: Example Test Unit Profile (Test Unit R4) showing Typical Sequence of Stratum I Trail Construction Sediments over Stratum II Intact Anthrpogenic Sediments. Stratum II is interspersed with rock fall. Note dark surfaces on rocks within Stratum II and lighter, fresh surfaces on smaller rocks that comprise the Stratum I trail fill.

sediment, but most often, excavation was halted because no additional rock fall could be removed. All units were excavated by natural strata when these could be identified, with sediment screened through ¼-inch mesh to collect artifacts and other prehistoric debris. After excavation halted, two adjacent profiles were documented, and test units were backfilled to original contour.

Five test units were placed on upper-level portions of the Historic Tour trail, four on the lower Historic Tour trail, four on Gothic Avenue, and 29 along the Lantern Tour (Figure 1). The units in Gothic Avenue produced very little archaeological material and are not discussed further. Units on the Historic Tour and Lantern Tour routes produced the bulk of material and provide the basis for the majority of the interpretations.

Findings

Principal findings from the project allow us to partially address the research questions outlined above. Eight additional radiocarbon assays derived from various test unit locations confirm that prehistoric use of Mammoth Cave is temporally restricted to the Terminal Archaic and Early Woodland periods, between about 2175 and 3400 years BP. Additional analysis suggests that age is positively correlated with distance from the historic entrance, which is somewhat counterintuitive. However, the correlation is relatively weak, and as usual, we would like more data.

Abundant archaeological remains were recovered, but they were not distributed evenly among the test units. The materials collected from prehistoric contexts were dominated by torch debris (n=1359), while prehistoric artifacts modified by human use were comparatively rare. Artifacts were limited to torch ties (n=236), cordage (n=30), expediently utilized sticks (n=20), lithic debitage (n=8), and a mussel shell. As expected, no prehistoric ceramics were found. This strongly supports the inference that the prehistoric activities carried out in the dark zone in Mammoth Cave were not typical of ordinary household activities, but are related primarily to mining minerals, likely for ritual purposes.

Subsistence remains (n=483) were relatively abundant, but were limited to botanical remains. This total includes chenopodium, maygrass, panic grass, sunflower, marshelder, and gourd seeds, plus nutshell and grape stems. Nutshell was most abundant (n=244), while sunflower and gourd seeds were also common. The subsistence remains identified from general recovery contexts is biased toward larger fruits, with the smaller chenopodium and maygrass seeds not as well represented. The high numbers of nutshell is surprising, but it may represent a high-energy food source utilized by prehistoric cavers. However, these fragments may also have been transported by woodrats outside their original contexts of use or storage. Finally, gourd fragments may be related to various storage or collection activities carried out by prehistoric cavers, including storage of food or water and collection of mined minerals. All examples are thin-fleshed, and likely served as containers rather than as food sources. Faunal subsistence remains recovered from prehistoric contexts were extremely rare, limited to only a few examples of feathers, fur, hair, and mussel shell. One of the mussel shell fragments appears to have been used as an expedient scraper.

Human paleofeces (n=255; 690 grams) were recovered from 14 of the test units. While detailed analyses of the contents and chemical residues was not attempted, qualitative observations indicated that they are highly fragmentary, and almost all contain chenopod and sunflower seed fragments. This suggests that the chenopod and sunflower seeds from general excavation samples may derive from fragments of human paleofeces rather than representing food caches or in situ use of food resources.

Density by volume of various material classes provided additional insights into differential spatial distribution of these materials and to potential identification of activity areas within the cave. The distribution of densities of torch debris and gypsum crystals (Figure 3) showed little overall correspondence. From this we infer that mining activity alone does not account for accumulation of torch debris in specific areas within the cave. Similar findings were derived from surface observations made by Hadley (2006) for the portion of the Main Cave passage in-cave from the Cataracts. Figure 3 also shows a general decrease in the density of both material classes with increasing distance from the entrance. However, distinct spikes in torch debris that do not correspond with spikes in gypsum density also suggest that specific portions of the cave were the focus of other prehistoric activities that required light and resulted in accumulation of torch debris.

Other activities that might be represented include subsistence storage and consumption, or consumption of cathartic salts. The distribution of subsistence remains among test units does not strongly correspond with the distribution of gourd remains (Figure 4), which suggests that the gourd was not used for food storage.

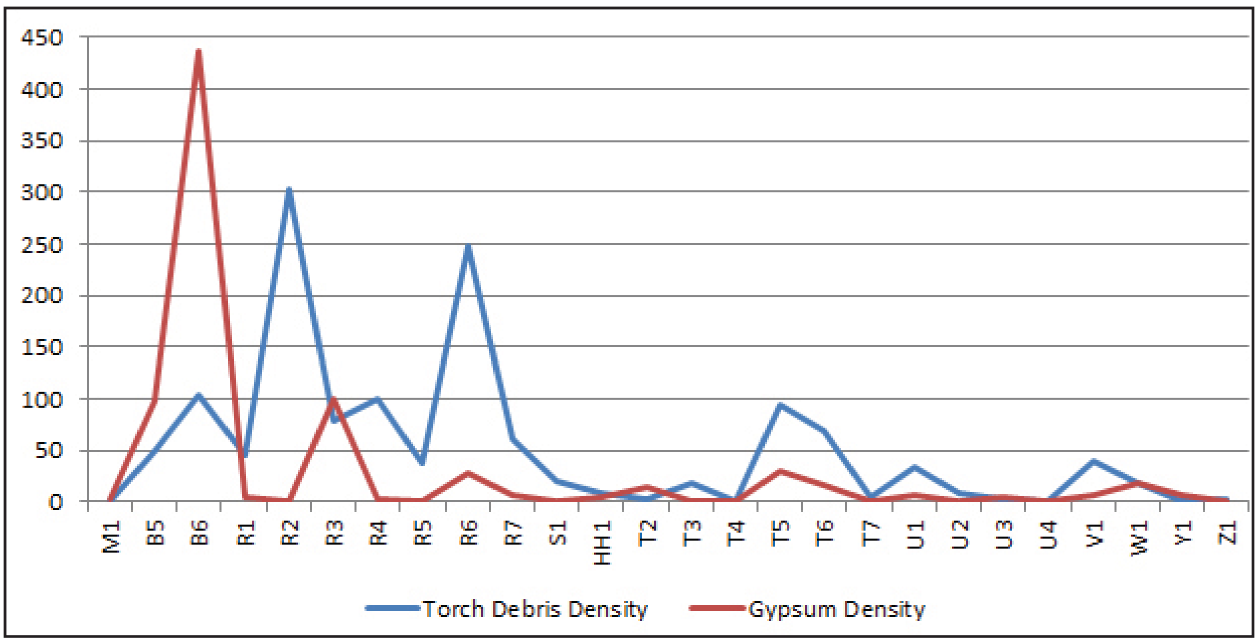

Figure 3: Density Data for Gypsum and Torch Debris from Stratum IIA Contexts for Selected Test Units in the Main Cave Section. Unit K1 has been omitted due to anomalously high gypsum density. Density values (y axis) are in grams per cubic foot, and test units are ordered in-cave from left to right.

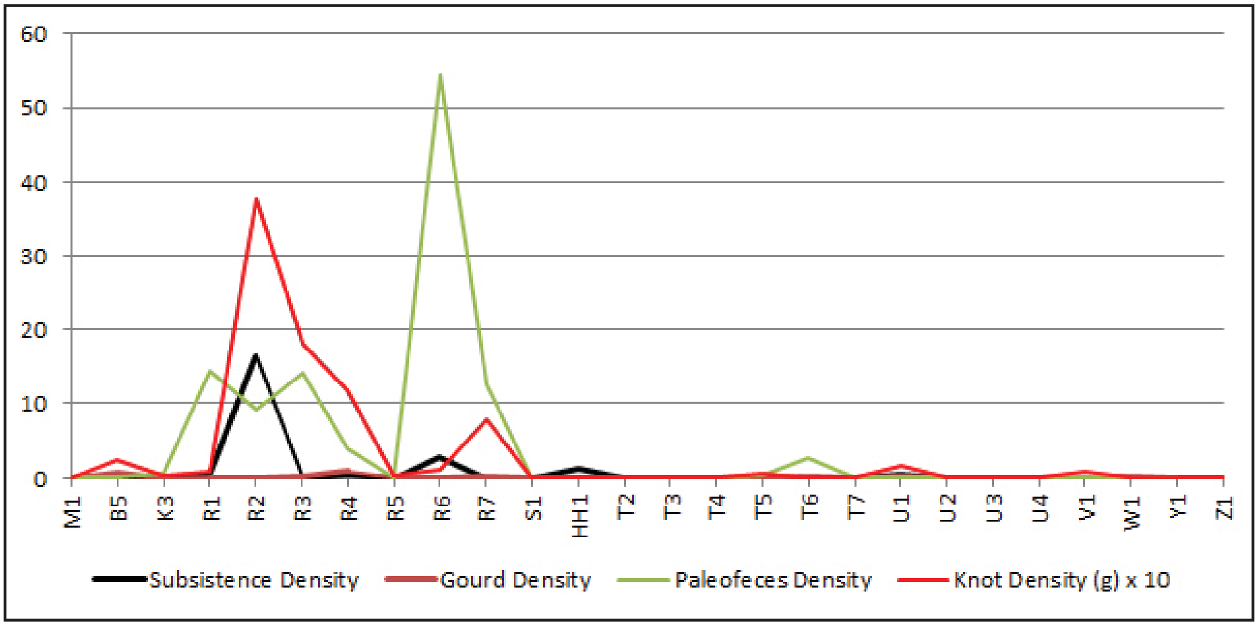

Figure 4: Density Data for Subsistence Remains, Gourd Fragments, Human Paleofeces, and Knots (x 10) from Stratum IIA Contexts for Test Units in the Main Cave Section. Density values (y axis) are in grams per cubic foot, and test units are ordered in-cave from left to right.

This figure also shows that paleofeces are most common in the R series of units, which were placed within and just in-cave from the Snow Room. This is a section of the cave where mirabilite and epsomite readily form on cave surfaces, and the high paleofeces densities suggest consumption of these salts took place in this area. Paleofeces are also generally in correspondence with the distribution of subsistence remains, which supports the earlier suggestion that some of the subsistence remains are derived from fragmented paleofecal material. However, there is no strong correspondence between the distribution of paleofeces and the density of torch debris. This lack of correspondence is understandable because consumption of these cathartic salts did not necessarily require illumination. Finally, though gourd density did not correspond strongly with density distribution of other subsistence remains, it is very strongly covariant with the density of gypsum crystals (not illustrated). This supports the interpretation that the thin-fleshed gourd fragments recovered from Mammoth Cave are primarily fragments of containers used for collection and storage of mined minerals.

These distributional data are not exhaustive and are not quantitatively rigorous, but they do indicate two broad patterns that are useful for making management recommendations for the proposed Trail Rehabilitation project. First, there is abundant evidence of prehistoric mineral mining along the Main Cave passage. This activity has resulted in accumulation of abundant prehistoric torch debris, gypsum crystals, torch ties, and gourd container fragments, all of which appear to be directly related to prehistoric mineral mining. The density of most of these material classes generally decreases with depth into the cave, but density of torch debris is also highly variable along the passage. Second, artifacts and material remains were recovered that indicate other activities were conducted besides mineral mining and simple illumination of passages. Subsistence remains, paleofecal remains, and knots/cordage all show highly variable distributions along the Main Cave passage, and also show strong concentrations in specific locations, including Giants Coffin (B Units) Snow Room (R units), Chief City (T and U units), and selected, localized concentrations at individual test units (such as V1). These locations therefore have great potential for contributing additional information about specific activities that were conducted within this cave system at particular locations.

Specific prehistoric activities were likely conducted in specific locations because particular cave resources were present in these areas or accessible nearby. This is obviously the case with the mining activities, which were conducted where minerals form on walls or in soft sediment deposits or precipitate on walls and ledges. Consumption of the cathartic salts also appears to have taken place near their source locations, such as the Snow Room.

However, locations where other activities were conducted may have little to do with mineral mining, or may correspond only partially to the mining activities. Access to water would be a necessity. Water is available in only limited locations in the upper-level passages, and is more abundant in the lower-level Historic Tour. One definitive finding of this project, is that these lower-level passages were used prehistorically, contemporaneously with the Early Woodland mineral mining activities carried out in the upper-level passages.

The architecture of the cave itself may have promoted more intensive use of some locations. Areas where multiple passages converge are junctions that provide access to other passages besides the Main Cave tour routes. The Giants Coffin area, for example, may have served as a staging area for sorties into smaller side passages, and this may account for a concentration of subsistence remains and other artifacts in the Giants Coffin area (B units). Wrights Rotunda is also a major passage junction, and surface inspection in other studies has shown abundant evidence of artifacts away from the current trail.

Recommendations

The density data, distributional data, and contextual information documented through these excavations form the basis for management recommendations for the Trail Rehabilitation project. A set of nine criteria was used to assess the contextual integrity, location, quantity and types of materials recovered at each test unit location. These data were combined with the initial walk-through observations to evaluated trail segments for their research potential. Maps were produced that showed cave reaches with nil, low, medium, and high research potential. Figure 5 shows the map produced for the southern half of the Lantern Tour Trail, with areas of archaeological research potential indicated by color codes. Similar maps were produced for the Historic Tour Trail and the northern half of the Lantern Tour Trail. These maps are the initial basis for recommendations regarding the type and intensity of additional archaeological work that may be required when rehabilitation construction is undertaken. No additional archaeological work is recommended in areas that have been evaluated as having nil archaeological research potential. Monitoring of construction activities is recommended for areas with low potential, and both monitoring and additional test unit excavations are recommended for areas with medium or high archaeological research potential. The specific level of work that will be required will depend on the type of construction activities that are undertaken, and the specific number and locations of additional excavations will depend on highly localized conditions, especially the integrity and depth of intact deposits below the existing trail. The work reported here will hopefully provide helpful guidance to the park personnel that manage resources and attempt to

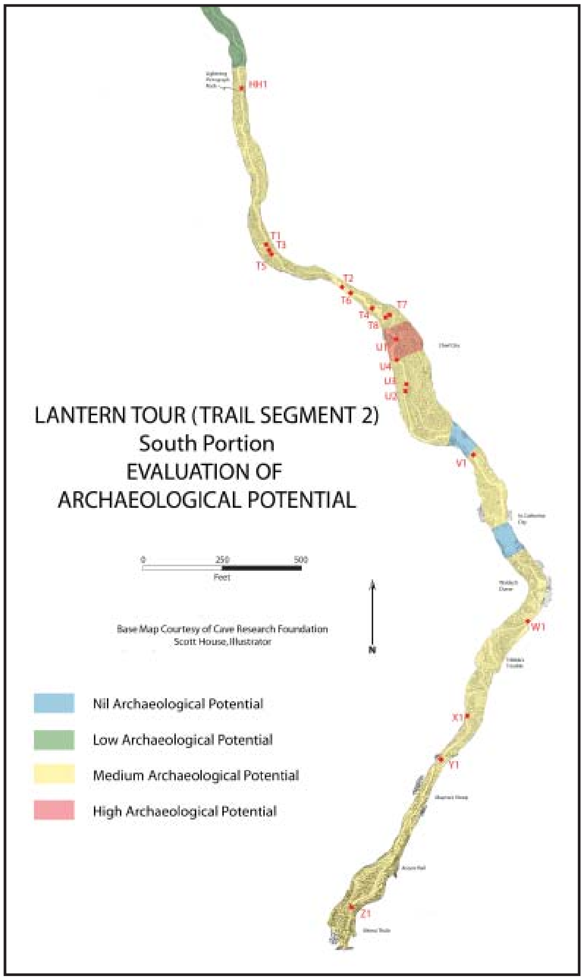

Figure 5: Archaeological Potential on the Southern Part of the Lantern Tour Route (Trail Segment 2)

balance the needs of the public, the goal of preserving scientifically significant cultural resources, and the mandate to preserve the natural resources of the park itself.

References Cited

Crothers, George M. 2001. Mineral Mining and Perishable Remains in Mammoth Cave: Examining Social Process in the Early Woodland Period. In Fleeting Identities: Perishable Material Culture in Archaeological Research, edited by P. B. Drooker, pp. 314-334. Occasional Paper No. 28, Center for Archaeological Investigations. Southern Illinois University, Carbondale.

Crothers, George M. 2012. Early Woodland Ritual Use of Caves in Eastern North America. American Antiquity 77: 524-541.

Crothers, George M., Charles H. Faulkner, Jan F. Simek, Patty Jo Watson, and P. Willey. 2002.

Woodland Cave Archaeology in Eastern North America. In The Woodland Southeast, edited by David G. Anderson and Robert C. Mainfort, Jr., pp. 502-524. University of Alabama Press, Tuscaloosa.

Hadley, Alison M. 2006. Early Woodland Gypsum Mining and Torch Debris in Mammoth Cave National Park, Kentucky. Unpublished Master's thesis, Department of Anthropology, University of Kentucky, Lexington.

Munson, Patrick J., and Cheryl Ann Munson. 1990. The Prehistoric and Early Historic Archaeology of Wyandotte Cave and Other Caves in Southern Indiana. Prehistory Research Series Vol. VII, No. 1, Indiana Historical Society, Indianapolis.

Simek, Jan F., J.D. Franklin, and S. C. Sherwood. 1998. The context of Early Southeastern Prehistoric Cave Art: A Report on the Archaeology of 3rd Unnamed Cave. American Antiquity 63: 663-677

Smith, Bruce D. (editor). 1992. Rivers of Change: Essays on Early Agriculture in Eastern North America. Smithsonian Institution Press, Washington, D.C.

Watson, Patty Jo. 1997. Lee Cave. In Archaeology of the Mammoth Cave Area, edited by P. J. Watson, pp. 215-220. Cave Books, St. Louis. Originally published 1974 by Academic Press, New York.

Watson, Patty Jo (editor). 1997. Archaeology of the Mammoth Cave Area. Cave Books, St. Louis. Originally published 1974 by Academic Press, New York.

Watson, Patty Jo, Mary C. Kennedy, P. Willey, Louise Robbins, and Ronald C. Wilson. 2005.