## Historical GIS as a Platform for Public Memory at Mammoth Cave National Park

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### ABSTRACT

The Mammoth Cave Historical GIS (MCHGIS) fosters new understandings of a national park landscape as a historic farming community and offers a web-based platform for public memory of pre-park inhabitants. It maps the 1920 manuscript census at the household level over a streaming topographic map and georeferences Civilian Conservation Corps photographs of dwellings for visualization and analysis of the area's population on the eve of creation of Mammoth Cave National Park. A web interface to the MCHGIS permits broader dissemination of archival holdings. Public participation GIS techniques are adapted to initiate a virtual site of public memory to supplement the history presented by institutionally-held materials with those donated from private holdings.

*Keywords:* Historical GIS, public memory, public participation GIS, virtual community building, national parks, Mammoth Cave, Kentucky

### INTRODUCTION

Figure 0. Mammoth Cave National Park is located in the karst region of central Kentucky and is easily accessible from Interstate 65, a modern roadway that roughly follows the route of the old Dixie Highway of the 1920s.

GIS has proven a valuable tool for historical geographers in facilitating integration of data from diverse sources, permitting visualization and analysis of past places, and allowing dissemination via the Internet of both digital databases and the tools to explore them (Gregory and Healey, 2007). This article describes a historical GIS created to document and enhance understanding of the history of the pre-park inhabitants of Mammoth Cave National Park (Figure 0). The national park was authorized by U.S. Congress in 1926, the same year as Great Smoky Mountains and Shenandoah National Parks, part of a wave of park-creation intended to meet the recreational and psychological needs for wilderness among the core of U.S. population located east of the Mississippi River (Ise, 1961). All three new parks had resident populations, variables mixes of EuroAmericans, African Americans and Native Americans. The Mammoth Cave region had, by far, the highest population density of the three new parks, yet it has received the least scholarly treatment of its displaced population.<sup>1</sup> As a first step in addressing this lacuna, the Mammoth Cave Historical GIS (MCHGIS) provides a snapshot of the region's habitation on the eve of the national park's creation. It combines 1920 manuscript census data for individual households with photographs of the dwellings where families lived, geolocating both to known house sites. It thus provides not only the basis for quantitative analysis of the pre-park population, but a framework for qualitative understanding of landscape and living conditions in the region.

A number of GIS map populations at the household level for small cities or portions of larger urban areas (see, for example, DeBats, 2008; Schlichting & Tuckel, 2006). Historical GIS at the individual or household level for rural areas in the U.S. are rare because rural street addressing was not standardized until recently, and many rural areas lack alternative data sets, such as city directories, tax lists, or utility records, that help locate urban populations. DeBat's (2009) GIS for rural Washington County, Oregon, used federal plat maps created under the aegis of the

Donation Land Claim Act, a data set unique to the Oregon Territory. Thomas and Ayers' (2003) Valley of the Shadow project, investigating the impacts of slavery at the time of the Civil War, created a detailed GIS of one Northern and one Southern county from census and military service records, letters, and newspaper articles. The web site for this project, however, presents only static maps.

The MCHGIS is methodologically innovative in its use of qualitative techniques to map census data for an entire rural community at the household level and for its creation of an interactive web interface that allows users to explore the GIS. A detailed topographic map prepared in 1930 as part of the land acquisition process in the Mammoth Cave region showed house locations, but the Park retained no information on who lived in each house. The authors developed a three-prong approach to matching census households with known house sites, comparing head-of-household house ownership data from the census with national park parcel purchase records, relying on local knowledge of key informants, and interpolating between existing matches based on the presumed path of the census taker.

The MCHGIS is also innovative in its adoption of techniques from web-based public participation GIS (PPGIS) to foster a collaborative site of public memory for the pre-park population of the Mammoth Cave region. Users may interact with the MCHGIS through an easy-to-use web GIS interface, viewing house and parcel layers overlaid on a hill shaded topographic map. Clicking on a house site brings up the 1920 census data for that household where a match is known, as well as any photographs of family members, the dwelling or farm outbuildings in the GIS. Layers are fully searchable to assist in the location of family names. Members of the public are encouraged to submit additional photographs and other historic information for inclusion in the MCHGIS.

The goals of this paper are to demonstrate the utility of historical GIS in achieving new understandings of a national park landscape, document the progress to date of the MCHGIS in creating a geospatial database of the pre-park population and a platform for dissemination of prepark history, and describe the creation of a geospatial framework for public memory through a participatory collaboration with former park residents and their descendents.

#### TOWARDS A NEW UNDERSTANDING OF A NATIONAL PARK LANDSCAPE

Individual U.S. national parks have varied in the policies applied to resident populations at the time of park creation and in their subsequent approaches to interpretation of cultural landscapes within their borders. Yellowstone National Park, created in 1872 as the first U.S. National Park, established the model of national park as uninhabited wilderness, yet the delineation of its boundaries antecedent to European American settlement was the exception rather than the rule (Dilsaver and Wyckoff, 2005). When Glacier National Park was created in 1910, sixteen years before the Eastern trio of Great Smokies, Shenandoah, and Mammoth, private inholdings amounting to 10,000 acres were allowed to remain inside Glacier's boundaries. Moreover, homesteaders and private land claimants were guaranteed both rights to their land and access corridors to use it (Dilsaver and Wyckoff, 2005). In contrast, residents inside the boundaries of the eastern trio of parks authorized in 1926 faced displacement, through condemnation, if necessary.

These three Eastern parks have adopted different approaches through the course of the twentieth century to interpretation of their cultural landscapes and displaced communities, differences that affect the visitor experience in the parks today as well as public understandings of their history. Great Smoky Mountains National Park was the first of the three to embrace

interpretation of its displaced community, through the (re-)construction of Cades Cove, owing largely to the interest and initiative of one of the park's rangers (Young 2006). While initial approaches to interpretation created a romanticized vision of an Appalachian community in harmony with nature and embodying a mythological primordial society, subsequent refinements in interpretation were more culturally sensitive and environmentally sustainable (Young 2006). What is significant is that, from the 1940s, this park embraced its settlement history as part of the story told to visitors. Shenandoah National Park has also seen contestation about interpretive materials concerning its displaced population and responded by altering displays most offensive to descendents (Horning, 2001). Archaeological surveys begun during the 1990s have furthered interpretation of its pre-park communities, some of which results are included on the park's official web site in a section titled "The Displaced" that explores cultural and economic differences between various former communities within the park and addresses the history of cultural resource interpretation (Horning, 2001). In contrast to these efforts at interpretation, similar efforts at Mammoth Cave National Park are notably lacking. A brand new visitor center opened in 2010, featuring displays on the physical environment and the development of tourism, but virtually nothing on the pre-park population. The "History and Culture" section of the park's official web site contains a database of individuals buried in over 80 cemeteries located throughout the park, a section on black history at Mammoth Cave that recognizes the contributions of the many African American cave guides, and a link to a selection of digitized photographs taken by a Civilian Conservation Corps photographer documenting the early years of park administration. The "Brief History of Mammoth Cave" that makes up the remainder of this section discusses the national park idea, the legislation behind the park's creation, the cost of land purchases, and the work of the CCC in transforming the landscape, but the communities and people who were displaced are not mentioned at all. Thus, the official approach to interpretation of pre-park communities at Mammoth Cave has been resounding silence.

Scholars have begun to probe such silences in park histories. As William O'Brien (2007) points out in his work on segregation in Southern state park systems, silences may initially occur because these aspects of social history are painful or disturbing to recall, but lack of discussion leads to a loss of institutional memory that perpetuates the silences. This is a historical trajectory that seems to be operating at Mammoth Cave. Oral histories by the Mammoth Cave's first rangers document a high level of bitterness among some of the displaced, leading, in one instance, to a ranger being shot (Lally 1987). Such incidents might understandably lead to avoidance of dealing with the issue of displacement in park interpretation. As might be expected, however, the passing of time has greatly tempered bitter feelings. The former residents who are still alive were children when they left the park and, in discussions with the authors, stress that they had a child's view of the situation. They and their descendents, while retaining feelings of attachment to former homesteads, do not express ill will towards the park, but an interest in preserving memories of their ancestors and their communities. This seems an appropriate time, then, to open a dialog about appropriate and effective means of interpreting the pre-park communities at Mammoth Cave and foster a new understanding of this national park landscape. The MCHGIS, an academic initiative launched by the authors, contributes to this effort by recovering and making accessible primary materials that document the history of the people and communities that were removed to make the national park.

Most visitors to Mammoth Cave National Park come to see a portion of the world's longest known cave system, the *raison d'etre* for the park, but many also enjoy camping, hiking a forest trail, or boating on the Green River. In the visitor's center or on a cave tour, they may learn about

the region's distinctive karst geology, the delicate cave ecosystem, or the history of cave exploration. In short, the visitor's experience is primarily an encounter with nature writ large. While several cemeteries along roadways are well preserved, there are few other reminders of the population that used to live here and little interpretation of the park's human history. It is safe to say that the typical visitor remains unaware that the iconic national park landscape that they encounter, one dominated by forest and devoid of human habitation, is a recent creation. Less than a century ago the area was occupied by rural hamlets and scattered farmsteads, with much of the land in open pasture and cropland. Mammoth Cave was a private tourism attraction with absentee owners run by a local community of guides, hotel workers, and other tourism support staff (Algeo, 2004).

Figure 1. The Mammoth Cave Historical GIS with parcel and house layers shown over a modern variable-resolution streaming topographic map. The MCHGIS reveals an extensive pre-park settlement pattern.

The MCHGIS reveals the extent to which the national park landscape has been socially constructed by mapping the pre-park population, revealing a lightly, but extensively settled landscape (Figure 1). Unlike the Great Smoky Mountains, where vast tracts of unpopulated land were held by timber companies (Campbell, 1960), the Mammoth Cave region was thoroughly settled and farmed. Photographs taken during the early 1930s by a Civilian Conservation Corps photographer reveal extensive open pastures and fields. Early park administrators followed a dual policy of removing signs of human habitation and re-creating a "natural" landscape via a massive tree planting campaign to compose a landscape that accorded with the institutional vision of what a national park should be. Subsequent visitors encountering the re-natured landscape, now devoid of farm fields, pastures, and houses, have reinforced for them the concept of a national park as a wilderness devoid of human imprint. Thus, the social construction of the Mammoth Cave National Park landscape was both material and ideational (Demeritt, 2002). Since interpretive material presented at the park favors a discourse of nature, science, and cave exploration, with human elements being most prominent in the latter, intersubjective encounters between visitors and park guides discursively reinforce notions of the park as nature over the park as historic human habitat (Berger and Luckmann, 1966). By contributing to a greater understanding of the area's settlement history and highlighting the social as well as environmental changes wrought by the national park, the MCHGIS creates "new insights into the geographies of the past," thus fulfilling Gregory and Healey's (2007) criterion for "the real test for historical GIS as a discipline" (p. 644).

Figure 2. The Mammoth Cave Historical GIS combines census, house site, and parcel data with CCC photographs of dwellings that were razed to make way for the national park. Although the streaming topographic map has resolution limitations at extremely large scales, it is useful for identifying landscape features such as the African American cemetery on Jennie Mansfield's land.

Specific outcomes of the MCHGIS include data integration, visualization, and analysis, which Gregory et al. (2001) identify as the three advantages of using GIS in historical research. Public records and archival photographs are correlated, using location as an organizing framework (Figure 2). Linking the manuscript census record for a household to the same location as a photograph of a farmstead or the structure in which the family lived adds a qualitative understanding of living conditions that cannot be discerned from census data alone, making possible new understandings based on associations among data sets. Superimposing house locations on a topographic map rendered with hill shading permits visualization of settlement patterns and a better understanding of how homesteads were situated in the landscape. As more records and photographs are added to the MCHGIS, it will become a data-rich exploratory environment that will assist genealogists and family historians, as well as more academically-oriented analysis (Ruvane and Dobbs 2008).

Preliminary demographic analysis of information assembled in the MCHGIS suggests that a new interpretation of forces behind the park's creation may be in order. Brunt (2009)<sup>2</sup> paints a portrait of a relatively stable agrarian society in the Mammoth Cave region of 1920. Farming was overwhelmingly the most common occupation among the slightly more than 2100 individuals living within what would become the park boundary. Nearly two-thirds of families owned the homes where they lived, in contrast to much higher tenancy rates in other parts of the South. Thus, the removal of the Mammoth Cave population should not be confused with 1930s-era rural resettlement programs in which struggling farm communities were relocated to model settlements. Such analysis helps frame the creation of Mammoth Cave National Park as a political approach to state-wide economic development rather than a humanitarian response to a failing agricultural sector.

The example of Brunt (2009) places the MCHGIS within the emerging field of digital humanities, establishing it as more than a digital archive, but also a tool, study object, exploratory laboratory and activist venue for engaging with and better understanding our world (Svensson, 2010). While early phases of the project focus on assembling a digital library of materials and making them publically accessible through innovative and experimental geospatial techniques, their potential as an object of study and analysis is exemplified by Brunt (2009). The activist element of the project is embodied in the preservation and dissemination of public memory about Mammoth Cave's displaced communities in the face of institutional silences. The authors' continued engagement with National Park personnel to encourage interpretation of this aspect of the park's cultural history may likewise be considered an activist endeavor.

#### MAPPING RURAL HOUSEHOLDS FROM THE CENSUS

Mapping entire communities at the household level rather than using aggregated data or sample populations not only allows more precise measurement and visualization, but also permits analysis of within-group variation and individual-group relationships to better reveal social dynamics (DeBats, 2008). "In the historical world, however, the scarcity of places fully mapped at the individual level remains a limiting feature for the spatial analysis of past communities," in large part because the kind of spatial data about individuals that we take for granted in contemporary society is lacking (DeBats, 2008, pp. 17-18). Historical GIS that have mapped individuals or households are almost exclusively for urban areas. Urban households are often possible to locate precisely thanks to Sanborn fire insurance maps or plat maps created for utility or tax purposes. Attempts to create historical databases on individuals in rural areas of the U.S. are few because of the greater difficulty of attributing location to rural households. Household census records in many U.S. cities included street addresses as early as 1880, but rural areas lagged in systematic use of street names and numbers (DeBats, 2008). As part of a series of four case studies creating individual-level GIS for different settlements in North America, DeBats (2009) mapped 71% of inhabitants of rural Washington County, Oregon, to a place of residence for the 1850s. This was the only rural U.S. case study among the four, and the high level of mapping was made possible by a set of federal land plats unique to the Oregon Territory.

The MCHGIS attempts to map all households from the 1920 manuscript census for the area that would become Mammoth Cave National Park. U.S. Census Bureau policy mandates that data for recent censuses be aggregated because of privacy concerns, but individual data is released after 72 years. Thus, images of the original forms filled out by census takers as they

went from house to house are available for both the 1920 and 1930 censuses. Of the two, the 1920 census provides the better snapshot of the pre-park population for Mammoth Cave. Although most land purchases for the national park were made during the 1930s, land speculators became active after Congress authorized the park in 1926, and some families relocated during the late 1920s in anticipation of the park's creation. The manuscript census contains a wealth of socio-economic data about individuals, including age, occupation, homeownership, and household composition. Mapping the population at the household level rather than aggregated by census tract or other administrative unit both permits fine-grained demographic analysis and allows the household to serve as a container for other types of data as the GIS expands.

A significant challenge in using the 1920 census for rural Kentucky is that no location information below the level of the census district is available. Street names and house numbers were not then in use in the rural portions of the counties (Barren, Edmonson, and Hart) from which Mammoth Cave National Park was carved. While manuscript census forms for towns such as Brownsville, the Edmonson County seat, have marginal notations naming the street on which a house lies, forms for rural areas simply number houses sequentially, with no notation when the census worker left one road for another or of which side of the road a house occupied. Moreover, other forms of spatial residential information, such as city directories, fire insurance maps, plat maps, and utility records are lacking for this area.

Two other data sets were useful for placing households on the landscape – known house sites and parcels. House sites were digitized by Park Service personnel from a topographic map created by a 1930 U.S. Department of the Interior survey as part of the land acquisition process for the park. This resulted in a point data layer identifying 664 former residences, but with no information about who lived in the houses. These structures were dismantled during the 1930s by the Civilian Conservation Corps, which supplied manpower for most of the landscape alterations needed to ready the park for opening, including removing fences, filling stock ponds, and a massive tree-planting campaign. The challenge for the MCHGIS was to match these former house sites with the families who occupied them in 1920. The temporal offset between the 1920 census and 1930 survey of house sites must be kept in mind. A few houses extant in 1920 may not appear in the 1930 data set because of their destruction, e.g. by fire, and any houses constructed after 1920 will not have a matching census household. The latter are likely to be few, however, particularly after the 1926 authorization of the national park when it was known that the area was to be cleared of inhabitants.

Park Service personnel also digitized parcel boundaries of the 532 tracts purchased from private landholders to form the park. This layer includes the name of the former land owner as an attribute. Thirteen tracts were church or school properties, and thus, were not residential. When overlaid with the house site layer, 152 tracts were found to contain no houses, leaving 377 residential tracts. Over a third of the residential parcels (142) contained multiple dwellings. In this region, the level of absentee ownership was relatively low, but because extended family members or tenants typically occupied additional houses on a family farmstead, knowing a parcel's owner was in many cases not sufficient to pinpoint the house occupied.

A three-prong methodology was developed to match households listed in the 1920 manuscript census to house sites: 1) probable residency based on the owner of a tract with a single house on it being listed in the census as a head-of-household and a home-owner; 2) local historical knowledge of a key informant; and 3) interpolation of household records along a road between two existing matches. It is recognized that error may be introduced during each phase of

the methodology and that error propagation may occur when interpolating during the third phase from presumed matches made during the first two phases. As Gregory and Healy (2007) note, "Historical GIS databases are rarely a simple digital facsimile of a single source. Instead they take data from multiple sources, integrate them in a manner that is sympathetic to the sources' limitations, and create metadata and documentation to record the sources and standards used" (p. 639). In order to track uncertainty, an attribute was added to the MCHGIS house site layer indicating the basis on which a match was made with a census household and the level of certainty of that match. This is what Gregory and Healy (2007) term the "documentary" approach to handling error in historical GIS databases (p. 641). As new sources of data are uncovered or additional informants provide more information, we will be able to reevaluate and revise matches based on the best available information.

The first phase of the methodology compared land tract owners with census heads-ofhouseholds. Of the 235 tracts containing a single house site, 67 owners were located in the census as heads-of-households who owned their own homes. A simplifying assumption was made that these homeowners likely lived on the tract they owned and the census household was matched with the house site. The second phase of the methodology involved interviews with a key informant, Norman Warnell, who has extensive local knowledge of the Mammoth Cave region and of the families who used to live there. Mr. Warnell taught science for many years in the Edmonson County School System, authored a folk history of the Mammoth Cave region (Warnell, 2006), served as an officer of the Edmonson County Historical Society, and spends much of his free time hiking off-trail through the park, lending him an intimate familiarity with the remnant roads and traces of old homesteads. Mr. Warnell verified many of the householdhouse site matches made during the first phase of the project, and was able to supply, based on his knowledge of the region, the names of residents for a number of additional house sites. Some of his matches were subsequently verified with former residents and their descendants during a public exhibition of the MCHGIS at a Homecoming event held at the national park, giving the authors a high level of confidence in the matches Mr. Warnell made.

Figure 3. Interpolation of census records between known matches allowed additional houses to be matched to census households. In this figure, the residents of houses labeled "2" and "5" were determined by key informants. The corresponding manuscript census records were located. Note that a generational transfer is evident in the Ritter match, reflecting the temporal disjunction between the 1920 census and 1936 parcel data. When a slight misalignment of layers is taken into account (the Carwell house should be on the Carwell parcel and the Hogan house on the Hogan parcel), it was possible to match three additional houses with census records based on an inferred linear route by the census taker.

The third phase of the methodology located households within the manuscript census that were already matched to house sites in close geographic proximity and sought to interpolate the gaps both in household records and house sites. That is, if the manuscript census shows three records between two census household records that are already matched to house sites A and B, and the house site layer shows three houses along the road between houses A and B, then we assumed the path of the census worker ran between houses A and B and matched the intervening houses to the intervening census records (Figure 3). Through the combination of the three methods, 230 of 664 house sites (35%) were matched to 1920 census household records (Brunt, 2009). Although this match rate seems low, we are hopeful of being able to make additional matches during the public participation phase of the project, which will make the MCHGIS accessible to many more potential local informants and potentially uncover new data sources.

#### **DISSEMINATING PRE-PARK HISTORY**

A web-based interface was developed for the MCHGIS to disseminate materials documenting the historic settlement history of the Mammoth Cave region. While the primary data used in the MCHGIS is publicly accessible, there are practical barriers to access by the general public. For instance, the 1920 manuscript census for Kentucky is available on microfilm in a number of federal depository libraries (or on subscription-based services such as Ancestry.com), but one has had to travel to the library to use the microfilm (or pay a subscription fee for online access) and then one simply has the raw census data. It is the integration of census data in geographic context with topographic maps and photographs that fosters a richer understanding of the prepark communities. Given the common availability of the internet, a web version of the MCHGIS seems the best way to reach the widest possible target audience. The visual orientation of GIS aligns well with that of the web; Map-based internet services, such as Mapquest, YahooMaps, and GoogleEarth, are ubiquitous, as are the concepts of zooming in and out to alter the scale of a map, layers of information that can be turned on and off, and keyword searches. Thus, the skills needed to operate a simple web-based GIS have become part of American popular culture. Moreover, the cost-of-entry for the internet has decreased dramatically, with cell phones as well as personal computers providing access, and most schools and public libraries providing computers with internet access.

## Figure 4. The parcel and house site layers are searchable by name, allowing users of the Mammoth Cave Historical GIS to locate properties occupied by ancestors.

The web interface was created with ESRI ArcGIS Server (version 9.3.1) and is hosted on a university computer at http://161.6.109.206/mammoth\_HGIS/. The internet mapping application displays MCHGIS data including house, parcel and roads layers on top of a streaming topographic map provided by the ESRI Resource Center. Two advantages of the streaming map are its seamlessness and its variable resolution, allowing the image to remain clear at any zoom level. A high quality topographic map facilitates user interpretation of the MCHGIS, as many former residents and their descendants associate their memories in reference to topographic features such as a streams, ridges, and sinkholes. Layers may be turned on and off, and standard map navigation tools allow the user to zoom and pan. An inset overview map shows the extent of the main frame as the user changes map scale. The "Search for Family Name" tool allows users to enter part or all of a family name and returns a sorted list of matching records from the parcel and house layers (Figure 4). Users can right click on a result and zoom to the matched feature. The search results include key attributes for matched parcels, such as acreage, and for houses that have been matched to a census household, including head-of-household name, age, and occupation. A help page explains all of these features.

Custom HTML code was added to the map application to allow hyperlinking of photographs. Fields in the parcel and house layers specify the physical file location of a high resolution .jpg and metadata documenting the photo's source. The hyperlink is displayed along with other attribute information for a parcel or house, and when a user follows the link, a new window displaying the photograph is opened. Captions written on the verso of the CCC photographs, presumably by the photographer or his assistant, in many cases identified the parcel number of a farm or the name of a house's owner or resident, allowing photographs to be matched to parcel and house features. The CCC photographs had been scanned as high resolution .jpgs and the captions entered into a database by Park Service personnel. Matching a photograph to a house or parcel sometimes required reconciling spelling variations. Since the authors used processed versions of the captions, they could not distinguish between data entry errors, cases when the photographer misrecorded a name, or the local use of variant spellings. In most cases, enough other information was present to make a match. For instance, a photo captioned "House to be razed on tract #281 T. M. Durham" clearly is the house of Tom M. Denham on parcel #281.

A pilot version of the MCHGIS was loaded onto a laptop equipped with ESRI ArcMap software and demonstrated at the 2009 Mammoth Cave Homecoming, held on the Fourth of July weekend. This is an annual event whose origins date back over a hundred years as a combination community celebration and tourism promotion during the era of private ownership of Mammoth Cave. It has been revived by the National Park Service in recent years for the same combination of purposes. Musical performances, guided hikes and other events of interest to the general public are complemented by activities organized by and for former residents of the park area and their descendants, such as a genealogy room where people gather to reminisce and share family history. Here people display extensive collections of photographs, records, and genealogy charts that document their family's history. Reflecting the diaspora of Mammoth Cave area residents, some participants came from as far as Kansas and Michigan. It was in this room that the MCHGIS was demonstrated.

Feedback for the pilot system was overwhelmingly positive from both Mammoth Cave area descendants and national park personnel. Although the system was in the early stages of development, participants were receptive, even excited, to use the interactive map and see family names on parcels and houses and to see photographs appear upon clicking hyperlinks. Several attendees offered historic photographs from their private collections for scanning and inclusion in the MCHGIS. Additional photographs were submitted via email the following week after an article describing the Homecoming and mentioning the MCHGIS appeared in the Bowling Green Daily News (Gaines, 2009).

### PARTICIPATORY GIS AS A FRAMEWORK FOR PUBLIC MEMORY

The final phase planned for the MCHGIS is a collaborative site of public memory for the prepark communities. Public or collective memory resides in consciously constructed representations of the past, such as monuments and museums, that both memorialize the past and, at the same time, contribute to its ongoing social construction (Foote, 1997). Public memory linked to places of social significance is a key means of fostering national or group identity (Hoelscher & Alderman, 2004; Leib *et al.*, 2000), although separate groups may not be in consensus about the meaning conveyed by a particular commemorative structure (Forest *et al.*, 2004; Linantud, 2008).

The most obvious examples of public memory are statues, museums and other elements of the built environment, but non-material culture, such as commemorative naming practices, can also be key components of public memory (Alderman, 2000). The evolution of the web has led to virtual forms of public memory, particularly web sites that pay tribute to people and events (Hess, 2007). Virtual sites of commemoration have several advantages over material ones. They are accessible to a much larger potential audience, and access is unconstrained by the exigencies of travel to a physical site. Web sites can be developed rapidly, while bricks-and-mortar monuments are often subject to design review and political contestation. For instance, while the official memorial to the victims of the September 11 terrorism attack at the site of the World Trade Towers languished over competing visions, dozens of web tributes appeared. Although created by individuals, these web sites opened "space for communal memorializing" (Hess, 2007, p. 813) through means such as digital guestbooks that allowed others to post tributes,

reflect and grieve online, resulting in "collections of vernacular voices, often with contradictory and controversial stances on the interpretations of public memory" (Hess 2007, p. 828). Such multivocality arguably fulfills the "public" dimension of public memory better than the elite visions of artists, government officials and other experts who design and approve the typical statue or museum. A memorial open to comment and annotation, essentially allowing the public to co-construct it, closes a notable gap in meaning between production and consumption of public memory, for a monument may be understood in ways very different from those intended by its designers, particularly when the passage of time has blurred other memories of the person or event (Johnston & Ripmeester, 2007).

These commemorative web sites are vernacular forms of public memory, as opposed to the elite forms embodied in monuments and museums designed by experts and approved by a political process. Traditionally, vernacular forms of public memory have been less visible than elite forms, by virtue of occupying less prominent positions in the landscape (e.g. roadside crosses marking the deaths of ordinary citizens versus generals memorialized with a statue in the town square) or because of use of ephemeral materials (e.g. flower tributes to Princess Diana placed outside the gates of Buckingham Palace), but the web, with its ability to draw a virtual flash mob of attention, through links and blogs, promises to be something of an equalizer in terms of the prominence of virtual real estate.

The methods of public participation GIS (PPGIS) will extend the MCHGIS web site to a virtual site of public memory for the former residents of Mammoth Cave National Park and their descendents (Epperson, 2010). PPGIS, also called participatory GIS (PGIS) and community-integrated GIS (Dunn, 2007), is well suited to fostering a digital form of collaborative public memory, although its use in this manner is rare to date. The plethora of names for this form of GIS signal a technology in its infancy for which standards, including a name, have yet to be settled, but they also indicate its perceived usefulness, as many researchers are pursuing related forms of development. What their efforts have in common is an intent to democratize GIS, making it more socially-inclusive by widening access to it among a variety of social groups and by cultivating those groups' participation in creation of geospatial data represented in GIS.

Participatory GIS has been most often used in the areas of urban and environmental planning, to solicit the perspectives and knowledge of residents of a place whose lives will be impacted by decisions being made about infrastructure and resources (e.g. Craig *et al.*, 2002; Elwood, 2002; Ghose, 2001). Web-based GIS enhances public participation in some of the same ways that web-based memorials do – by reaching a larger virtual audience than could attend a physical meeting, by offering asynchronous access, and by the possibility of anonymity, which reduces psychological barriers to participation (Wong and Chua, 2001). Although technological barriers to participatory GIS still exist in developing countries, among most of the United States' population, "GIS technologies are no longer elitist" (Wong & Chua, 2001, p. 65), a statement even more true a decade after Wong and Chua wrote it.

Web sites such as the Mark Twain's Mississippi Valley (Vandecreek, 2007) and the Civil War-era site, Valley of the Shadow (Thomas and Ayers, 2003), foster public memory by making available a huge variety of materials, text, images, and video, for the public to explore. They use a digital library model, presenting materials housed at academic and historical institutions that have been selected for preservation by experts and digitized. This is essentially a top-down approach to public memory. The MCHGIS mixes top-down and bottom-up approaches, allowing integration of institutional material selected by experts with information from private holdings deemed significant by members of the public. Most of the material currently available to the

public about the pre-park population is institutional in origin, e.g. the census and records collected by the nascent national park administration, yet a much greater volume of historical material remains in private hands among former residents of the park area and their descendants. Members of the public may submit material for addition to the MCGIS by identifying the relevant household and submitting a digital file (e.g. a photograph or scanned document) and a signed donation agreement. Ethical concerns require that potential contributors to the MCHGIS be aware that their digital donations will be freely accessible and downloadable over the internet and that they must be free of copyright. Donors will be asked to sign a contribution form stipulating these conditions. They will be given a choice of being noted as the donor or having their contribution listed as anonymous. The privacy insured by the latter choice may help encourage participation by individuals who would hesitate to be seen as critical of the National Park Service. It is typical for web GIS to employ a "gatekeeper" for new submissions (Dunn, 2007) in contrast to the wiki model of community-created data sets where anyone can write or edit a wiki page. Filtering public submissions is desirable for data quality control but also because the data structures behind the web GIS are not directly modifiable by the public. A GIS expert will need to add hyperlinks for new photographs and incorporate other data into existing structures.

Although participatory GIS is generally characterized as inclusive and democratizing, actual projects generally originate in technologically-informed settings, especially academia and government. One danger, then, is that because the projects are conceived by technocrats rather than by members of the target communities, "'a web-based PPGIS may run the risk of providing services that the public does not want" (Wong and Chua, 2001, p. 626). Since the MCHGIS was developed by an academic group, we should explain our perception of the need for it. First, the family history activities at the Mammoth Cave Fourth of July Homecomings demonstrate a significant constituency for public remembrance of the pre-park inhabitants. Second, interest in digital forms of public remembrance and a willingness to share privately-held historical materials are manifest in the section of the web site MyFamily.com devoted to Mammoth Cave. MyFamily is a social networking site run by Ancestry.com intended to allow sharing of photographs, videos, and other files, host discussions, and share an event calendar among members of a "family," with membership defined by the person who creates a particular family group. The Mammoth Cave "family" was created by a descendant of former residents of the park area who is active in genealogy, and as of June 2010, the Mammoth cave "family" had over 900 members. Members use the site both for sharing historical information and for keeping up with the current lives of friends and family. Wong and Chua (2001) note that web-based PPGIS present barriers to use by some community groups, but we anticipate that the Mammoth Cave MyFamily group, which currently shares an abundance of digital files, both image and text, and makes sophisticated use of online chat and blogging facilities, is a good target audience for a PPGIS application because a large number of interested individuals have demonstrated the kind of computer skills necessary to use a simplified web GIS interface. Hundreds of photographs have been uploaded to the MyFamily Mammoth Cave web site, but without a strong organizational framework, images of a particular family or place can be difficult to locate. The geospatial framework of the MCHGIS offers a distinct advantage by grouping materials related to a family, neighborhood, and community. Moreover, as a publicly accessible web site, anyone can use the MCHGIS, not just those who have been invited to join, as with MyFamily.com. In keeping with Dunn's (2007) view of community-integrated GIS, the MCHGIS "acknowledges the 'expert'

nature of GIS as a technology but enhances citizen access and participation and, hence, the democratic potential" (p. 620).

### REPRESENTATION AND REPRESENTATIVENESS

One hope of the MCHGIS developers is to reach former park area residents and descendants who do not currently participate in Mammoth Cave Homecomings or MyFamily.com and, thus, to broaden the pre-park population represented in the memory-making process. Alderman and Modlin (2008) point out that commemorative web sites can inadvertently create biased understandings by focusing on the lives of a small number of atypical individuals who might be taken as representative of a larger group. Their recommended strategy of documenting the wider community is at the heart of the MCHGIS methodology. There are substantial challenges to achieving this goal, however, that are historical and institutional in nature. Participants in the Mammoth Cave Homecomings, the MyFamily web site, and local historical societies are the easiest to reach and invite to become engaged with the MCHGIS project. Participation in these venues is self-selected, to a degree, but also influenced by existing social networks and residential proximity. For instance, although some Homecoming attendees traveled from distant states, most of those the authors met lived within a short drive of the park. As an example of non-representative participation, the authors did not observe any African Americans in the genealogy room during the 2009 or 2010 homecomings, despite the fact that most of the Mammoth Cave guides prior to park creation were African American and most lived with their families in the Flint Ridge area that is now part of the park. Jerry Bransford, a descendent of the storied Bransford family, many of whom were guides during the nineteenth and early twentieth centuries, continues his family's guiding tradition as a part-time ranger at the national park. Thus, the dearth of African American participants in the genealogy room activities does not stem from a disinterest in their Mammoth Cave heritage, but from other, unknown factors. No systematic study has been done of where the displaced population went after leaving the Mammoth Cave area. Anecdotal evidence is that some moved to nearby towns, including Cave City, Glasgow, and Louisville, and that some who had particularly strong ties to place and the financial wherewithal to do so purchased new homes just outside the park boundary. The authors suspect that differences in socioeconomic status, especially home and property ownership, and race may have influenced migration decisions following displacement. Testing of this hypothesis must await a future study, but if true, differential migration patterns are a historical factor that likely affects participation in Homecoming events and local historical societies.

### **FUTURE WORK**

It is too early to know how successful a participatory MCHGIS will be, but it holds the potential for broadening representations of the history of the Mammoth Cave region, letting the residents and their descendants assert a presence that, in many ways, has been officially minimized (e.g. by the removal of most human artifacts from the landscape and from the lack of interpretive emphasis by park rangers). While it is no doubt true that some segments of the former resident population will benefit more from a historical GIS than others, owing to differences in internet use, interest in genealogy, and amount of family history preserved, the MCHGIS offers the potential for participation to all with a minimum set of technology resources which are now widely available through internet-connected computers in homes, public libraries, and schools.

To gauge who is using the web site and how they are using it, a survey enables users to provide anonymous feedback. The "Take a Survey" link opens a new window with a ten-

question survey created in the Qualtrics online survey software. The survey, which was approved by the authors' university Human Subjects Review Board, queries users about their background, prior experience with web mapping applications, ease in using the GIS application, and their perception of the site's usefulness. It also provides an opportunity to report problems with the web site and leave additional open-ended feedback. Analysis of survey results after the web site has been online for a while will allow the authors to assess their success in disseminating knowledge of the site and tweak its interface to resolve any usability issues.

The work of adding historical materials to the MCHGIS will be ongoing. User contributions will be incorporated as they are emailed to project staff. Based on a few initial contributions already received, we anticipate that a certain amount of email back-and-forth will be needed to best place contributed photographs on the landscape or to pinpoint which house or family a contribution belongs with. Future plans include expanding the multimedia capabilities of the MCHGIS to include audio clips selected from oral history interviews that have been recorded with former residents over the years and that reside in the Mammoth Cave National Park collection. Since GIS-produced maps have the power to prompt recollections, stories, and personal and family narratives (Bodenhamer, 2007), we also plan to explore using the MCHGIS as a prompt during future oral history interviews, essentially to talk with subjects about the materials available on the site in hopes of evoking thick ethnographic descriptions of communities and localities.

### CONCLUSION

The applied value of the MCHGIS stems from its preservation and dissemination of the human history of Mammoth Cave National Park. It will help the general public understand the landscape transformation required to create the iconic "wilderness" they encounter when they visit the park today, it will help rangers and other park personnel interpret the area's history, and it will help former residents of the Mammoth Cave region and their descendants retain a valued cultural identity, one that has been marginalized through neglect in official histories and interpretations. The MCHGIS integrates and makes accessible data from multiple archival sources, including the 1920 manuscript census and a collection of photographs of many of the pre-park dwellings taken by a CCC photographer. It also provides a platform for integrating in the same geospatial framework some of the vast privately-held stores of historical materials, thus increasing publicly accessible materials about the region's people and history.

We believe, with Bodenhamer (2007), that "a GIS-facilitated landscape of memory... is a vision worth pursuing" (p. 108) because of its potential for fostering a more inclusive construction of history. By welcoming multiple voices and privately-held memories, the MCHGIS can reveal a much richer past than can be read from institutional holdings alone, a past that will inform expert interpretations, offer alternative visions, and fill some of the silences surrounding a marginalized group. The web-based public participation GIS will integrate diverse forms of data in a geospatial framework, serve as a repository of local knowledge, provide persistent access to historical data, and serve as a model for collaborative public history.

### ACKNOWLEDGMENT

The authors would like to thank the generosity of Charles Silbereisen and the Silbereisen Fund in providing financial support that contributed to this research project. They gratefully acknowledge the efforts of Kevin Cary, GIS Lab Manager at Western Kentucky University, for his tireless

assistance in keeping the GIS servers running and his instruction in internet GIS. They appreciate the support and assistance of Mammoth Cave National Park personnel in locating archival material, including Bob Ward, Joy Lyons, Terry Langford, Chuck DeCroix, and Lillian Scoggins. And they are deeply indebted to all those who shared their memories, family histories, and photographs with us, but especially Normal Warnell for the hours he spent with us "talking Mammoth Cave."

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<sup>&</sup>lt;sup>1</sup> For scholarly treatments of the Great Smoky Mountains National Park and its displaced population see Brown 2000; Dunn 1988; Frome 1966; and Pierce 2000; for Shenandoah National Park, see Horning 2000; Lambert 1989; Powell 2007, and Reader & Reader 1978.

<sup>&</sup>lt;sup>2</sup> Brunt's (2009) analysis is for the portion of the national park that falls within Edmonson County, which comprises the bulk of the park. A very small portion of the national park lies within Barren and Hart Counties.