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Spatial Analysis and Archaeological Resources in the FingerLakes National Forest

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The Finger Lakes National Forest is an archaeological resource with a unique and compelling history, encompassing the tribulations of rural farm families to the implementation of high-level federal policy. The agrarian settlement of the Hector Backbone, like the settlement patterns of similar rural areas, shifted dramatically as the agrarian mode of production in the United States became increasingly industrialized. As the previous articles of this volume have demonstrated, the archaeological and historical research completed on the Finger Lakes National Forest has spoken to many social and economic processes at work in the region. As the goals of the Finger Lakes National Forest project included both the collection and integration of data into a GIS database, as well as the analysis of that data, the objective of this article is to test how some of the more sophisticated analytical capabilities of GIS can be applied to our data set. It should be noted that the analyses reported on here should be seen as examples of what can be done with GIS. In so doing, I demonstrate how GIS can be used to model the spatial characteristics of our data. As a series of tests, the results presented in this article should not be considered as final products, but as demonstrations of the kind of analyses historical archaeologists can conduct with GIS.

Spatial Analysis and the Display of Database Information

As discussed in preceding articles, the actual archaeological data collected during the Finger Lakes National Forest project consisted of site maps of extant architectural features and diagnostic artifacts including materials collected from the surface of sheet middens and the interiors of cellar holes as well as from limited test excavations. The database constructed for the artifact assemblage can be analyzed for evidence of settlement and economic process using GIS by establishing associations between visually displayed objects on a map and the characteristics of tabular data linked to them. Each artifact recovered during the project was associated with coordinate data (i.e. "georeferenced") by using the UTM coordinates for the site. In ArcView, it was possible to create a theme layer using these coordinates. The "add event theme" command of the program asks the user for a tabular data source; once identified, these tabular data are used by the program to plot the locations of the georeferenced data. This procedure allows information from the tabular database to be represented on the digital map, and thus compared with other georeferenced data. The process creates a pin-map according to the tabular data, with each point representing the artifacts collected from that location.

This process of mapping artifact locations on a regional scale allows the archaeological assemblage to be represented and investigated relative to other features in a spatial display. The icon depicts information pertinent to the pinpoints, such as size, color, or other assigned qualities. Added to the regional view this way, however, artifact information was only represented in the project by point location and iconic symbol. In order to distinguish differences between the farmsteads it was necessary to quantify the data. GIS software can plot the data in a number of ways, e.g. distance between the artifacts and other assigned variables, or density of specific types of artifacts by site. In order to quantify the presence of specific kinds of artifacts in relation to other features, a surface density map was created plotting the location of artifacts by both distance and density. Figure 1 shows the results of this procedure, specifically the density of artifact distribution in the Burnt Hill Study Area.

This process of calculating surface density is called "neighborhood interpolation." The calculation of artifact density was made using the Inverse Distance Weighted (IDW) method of nearest neighbor analysis, in which artifacts occupied the z value field. This is an automatic function in ArcView and requires only a few mouse clicks to calculate. Surface interpolation used the 12 nearest neighbors and a power of 2 as the exponent of distance in the calculation. The calculation generated the spatial patterning seen in the density map (FIG. 1). Modeling data by this process has numerous applications for exploring the significance of an artifact assemblage and evaluating its meaning. First, the calculations allow easy identifications of areas with high concentrations of artifact debris. Secondly, the density plot can then be used to evaluate other factors in the project. The process created a visually effective representation of artifact density across space, but also transformed the data set. The initial procedure plotted the artifact data in intervals of occurrence. The neighborhood interpolation process transforms the interval data into a continuous variable whose frequency across space can be analyzed in relation to other features. Such a transformation of the data increases their value for statistical analysis and allows the information to be used in ArcView interactively with other types of data.

It is clear from an examination of the surface density that there are two distinct zones of high concentration in the Burnt Hill Study Area. On the western side of the forest artifacts

Figure 1. Density plot of the total artifact assemblage recovered from the Burnt Hill Study Area. The two dark areas represent the areas of highest artifact concentration.

concentrate highly in compartment 60, corresponding to the high density of artifacts recovered from site 60-1 (see Six et al., this volume). A second area is also apparent on the eastern portion of the study area in compartment 53. Material debris generally represents processes of production and consumption by a population. To further test how GIS could be used to analyze disparate kinds of data, the artifact assemblage was compared to other data to see if any correlations could be established.

Historical Perspective and Interpretation

Following our example, we have established two areas of high artifact density in the Burnt Hill Study area, the first corresponding to Site 60-1, and the second to the cluster of farmsteads located in compartment 53. To test how well ArcView could be used to establish correlations between disparate types of data, information on the settlement and economic history of these two locations was queried. The density plot of the artifact database was compared with the distribution of settlements. One line of inquiry was to compare artifact density with historic property boundaries as they existed c.1940 (FIG.1) The settlement layout at that late date reflects conditions just prior to the purchase of the properties by the federal government. The property boundaries established in the project date from the actual purchases, which began in 1936, but all are subsumed under the "circa 1940" heading. In considering the material record, artifacts from the sites most likely date to the time of abandonment, and will therefore best reflect the situation at that time.

Investigation of historical data was initiated using the artifact density plot showing the two areas of high density. A function of ArcView called "summarize by zones" was carried out on the "circa 1940 properties" data. This procedure compiled the historical data on properties according to the density of associated artifacts. Carrying out this procedure generated a table listing the property owners and associated information in the order of highest to lowest artifact density. This procedure is a sophisticated analytical process that evaluates the frequency of spatial data and ranks them by proportion. The discussion of density earlier mentioned that converting location data to a surface density map not only provides an effective visual display but also allows values to be calculated statistically. When the software summarized the property data by zones, it evaluated the spatial parameters of each property in the "circa 1940 properties" theme and tabulated which ones had the highest density. In effect, it was taking polygons from a drawn theme (property boundaries) and using those shapes to set the parameters of another theme (artifact density), then calculating the spatial area of the second theme that fell within the extent of the first, ranking the results, and displaying them in a table.

This advanced procedure identified two parcels of land on which to focus attention, and our test proved accurate, as the highest concentration of artifacts did fall into the 1940's boundaries of site 60-1, identified as the property of Pearl Egan. As test excavations had been completed at this site, it was our expectation that ArcView would identify 60-1 as the property with the highest density of artifacts. The second property was identified as the property of Jabez Chesley, a parcel of 100 acres sold to the government in 1936 for $1,036.

The nature of the GIS database allowed for further data from these two sites to be immediately compared. By bringing up the site plans for each, it was easily seen that the two parcels were architecturally different (FIG. 2). The Chesley property had two farmstead sites located upon it, identified by the survey as sites 53-3 and 53-8; this may in fact account for the higher density of artifacts detected by the database. The site plans for these two locations indicated that 53-3 contained the remains of both a house and a barn, as well as several visible outbuilding foundations, while 53-8 was comprised only of a house, privy, and well. It seems clear that the layout of site 53-3 was a typical farmstead. This inquiry has produced an interesting question: what went on at site 53-8? Was this the home of a tenant, rented out to supplement farm income, or did another family member live here and work with Jabez Chesley? In either event, the appearance of a second house site on a single property indicates some strategy by which the Jabez family was coping with economic hard times in the early-20th century.

In contrast, the Egan property had a single house upon it, the heretofore mentioned site

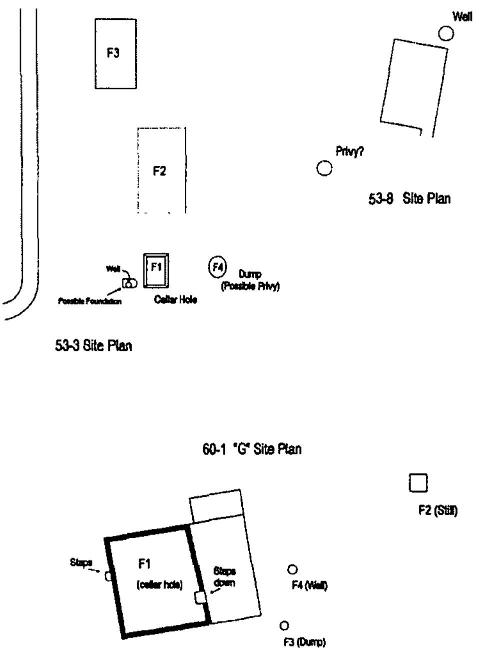

Figure 2. Site plans for sites 53-3, 53-8, and 60-1.

60-1 (FIG. 2). The archaeological site map indicated a large cellar hole, with numerous additions, in association with a few smaller outbuildings. Other notable features include a well and a large surface scatter of artifacts. A slight distance from the house was a feature interpreted as a still (see Six et al., this volume for more details about the artifacts recovered from site 60-1). Notably absent is any indication of a barn. The artifacts recovered from this site suggest that bootlegging may have been a strategy used to supplement income prior to the sites abandonment. Glass made up a large proportion of the assemblage, including many whole bottles.

While a good proportion of the artifacts recovered from 60-1 were beer bottles and other containers appropriate for storing liquids (like beer or moonshine), the artifacts recovered from 53-3 were nearly all identified as medicine bottles, a common turn-of-the-century artifact. Patent medicines were widely advertised in magazines and could be easily purchased either locally or through mail order (Parrington 1981). These concoctions were a reasonably priced alternative to doctors, and may indicate that patent medicines were the most available source of healthcare in the Burnt Hill Study Area. All of the bottles recovered from the site were of clear glass, and all have been dated (at least by manufacture if not use) between 1889 and 1926.

Given the preponderance of medicine bottles in the assemblage collected from 53-3, we decided to test the capabilities of the ArcView spatial analyst at yet another level of resolution. A second artifact calculation was made, this time the distribution of medicine bottles. The previous artifact density was calculated using the entire artifact database. Using the ArcView "query builder" function tabular data can be searched by specific criteria. Exploring the pattern of medicine bottle deposition began by opening the table containing the entire artifact database. The query builder tool was used to select medicine bottles for investigation. The query builder acts much like a calculator, allowing the researcher to create an expression, like a mathematical equation, of exactly what variables to examine from the data set. To create a density plot for medicine bottles, the equation "Form=medicine bottle" was entered. An additional benefit of the ArcView program is its preset ability to identify near matches in text strings; this allows the user to compensate for typographical errors or other anomalies in the database. In our case, for example, one data enterer used the abbreviation "med bottle" when identifying artifact forms in the database; likewise there were several misspellings, including "mediicine bottle." The query builder prompts the user as to whether such similar letter patterns should be included in the search. Once the expression was completed, including the abbreviations and misspellings, the user has the option of using the "New Set" command, which highlights all appropriate matches in the database, selecting them to be analyzed statistically or graphically by the software.

In our example, the database query had analytical potential, and thus was plotted as another thematic layer in the GIS. Specifically, the query builder was used to select the dataset of medicine bottles from all the artifacts recovered from the Finger Lakes National Forest; the selected artifact records were exported out of the database and into a separate table. This table was then entered as a GIS layer showing the locations where medicine bottles were recovered. The addition of the data as a layer or theme was accomplished using the "add event theme" function of ArcView. The medicine bottle data were added to the GIS in two forms, as a density plot (FIG. 3), and as blue cross icons proportionally weighted to show which sites produced the greater number of medicine bottle fragments.

This procedure has taken a quality of the database and mapped it as a feature with spatially defined characteristics. The simple process is invaluable to archaeologists because spatial characteristics of artifacts have meanings and implications for the study of social processes. For example, the presence of medicine bottles might be taken to indicate sickness in the community, or the beginning of the intrusion of for-profit capitalist production into the medical field. An alternative hypothesis might suggest that the bottles are indicators of substance abuse, as many patent medicines contained alcohol, opiates, and/or cocaine. By adding the locations of medicine bottles to the open view in the GIS, these locations can be compared to other features and their density calculated. In this case, the highest density of medicine bottles appears at the Chesley property, 53-3. In the context of the surface collection, several lines of research might be taken given the concentration of medicine bottles detected at the Chesley property. For example, it is possible that some member of the Chesley family was purchasing patent medicines during prohibition, when other forms of alcohol were much more difficult to obtain. A second hypothesis suggests

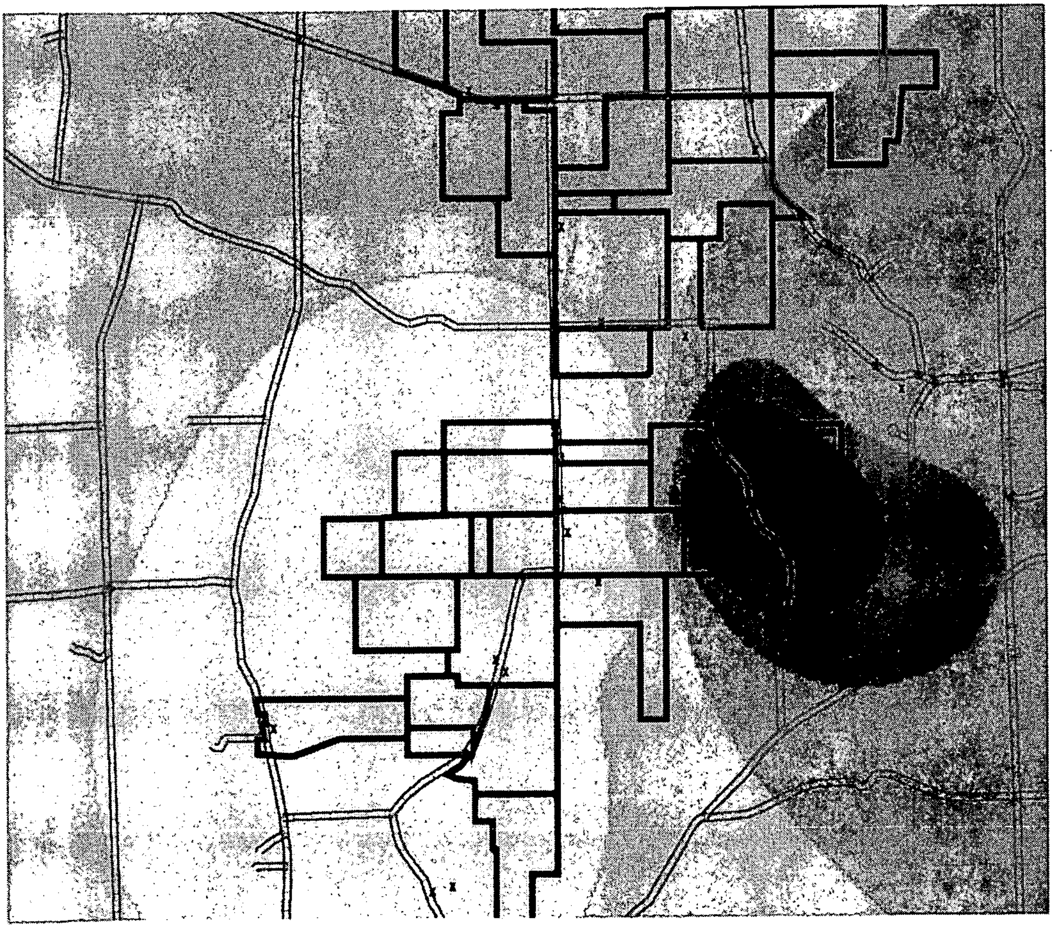

Figure 3. Density plot of medicine bottles recovered from the Burnt Hill Study Area. The darker areas represent areas of higher concentration.

that it is possible that the medicines were used for their intended purpose, indicating that the farmers living at site 53-3 may have suffered from chronic poor health. The queries made using the GIS have provided avenues for future research into the social history of the Burnt Hill Study Area.

Conclusion

This investigation, initiated as a test of one of the capacities of ArcView's Spatial Analyst extension, has resulted in the development of several research questions for future consideration. The two high concentrations of artifacts reflect dissimilar assemblages, and suggest something of the various elements of local culture on Burnt Hill in the late-19th and early-20th centuries, including the use of purchased medicines and the local production of alcoholic beverages. The artifact assemblages show potential contemporaneity between the sites, as both the beer bottles recovered from 60-1 and the medicine bottles from 53-3 were produced between the middle of the 19th century and the 1920s.

The wider data set collected and curated within the GIS database allows for immediate research into the history of the properties identified as having the highest density of artifacts. For example, an examination of the historic maps scanned and accessible through a hot link to the military compartment theme show that by 1944 no structures remained on the Chesley property. A further look at the tabular data linked to the circa 1940 property boundaries theme shows that the property was sold to the US government in 1936, at which time the four room framed house had an appraised value of $300. Looking back at evidence for earlier occupations of the site, the historic map data show that the property was occupied at least by 1874. The tabular data indicate that the property was sold by John Boynton to Oliver Hubble in 1887 for $1676 and the property remained in the Hubble family until it was sold by them to Jabez Chesley in 1914 for one dollar (indicating that Chesley was probably related to the Hubble family). The tabular data further indicate that the value of the property declined from its purchase value of $1676 to the price paid by the US government, $1000, in 1936. Such analyses are now immediately possible for any combination of farmsteads throughout the Finger Lakes National Forest.

This article provides only very preliminary tests of our GIS database. It is the hope of the Finger Lakes National Forest Archaeology Team that future researchers will be able to query the database we have constructed to attain a better understanding of the spatial processes behind the deposition of artifacts recovered from sites in the National Forest. In so doing, future research may shed more light on the material causes and effects of the intensification and eventual abandonment of agriculture on the Hector Backbone. On a larger scale, this research has the potential to help us better comprehend the complexity of social change that occurred as the nature of agricultural production changed in the 19th and 20th centuries.

References

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