Readings in Site Discovery and Site Evaluation

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ARCHEOLOGICAL RECORD


uses artifact density in a practical sense, doesn't 'define' it as such.


**CHEMICAL**


74. Overstreet, D. F. 1974. A Rapid Chemical Test for Archaeological Surveying: An Application and


The theory underlying the use of soil phosphate analysis in archaeology is discussed. After describing the field and laboratory methods used at Stavanger Museum, the method is illustrated by several examples. In all cases the results showed good agreement with the archaeological evidence, and generally provided useful supplementary information. The method may be used as a guide to the functions carried out in the different parts of a site and to the intensity of occupation. Although no hidden sites were found in a reconnaissance survey, the results indicate that the method has considerable scope in locating sites in areas destined for town development, etc. (From author's abstract).


**GENERAL**


This article provides guidelines to help determine site discovery techniques, taking into account environmental restraints, project goals and budget. McManamon discusses two characteristics of site obtrusiveness. The first is the ease with which site contents are detectable. The second is the types of techniques necessary to discover a site. Site discovery techniques are dependent on the frequency and spatial distribution of intrasite constituents such as artifacts, features, and anthropic soil horizons. McManamon evaluates a variety of archaeological techniques for their effectiveness in site discovery such as, subsurface probe techniques, chemical tests, magnetometry, subsurface radar and remote sensing. He found shovel tests to be the most effective overall means for site discovery, although this is dependent on the abundance and distribution of artifacts, and the placement of the shovel tests. Given the constraints archaeologists usually face in site discovery, McManamon suggests examining a portion of a study area and using the sample data to estimate characteristics of the entire area. Study areas can be stratified to use a combination of probability and judgement sampling methods.


Plog et.al. outline the steps integral to the design of an archaeological survey. They suggest that the probability for finding a site depends on the ratio between site area and the area of the sampling unit. The
first step is to define the survey boundaries. These are either natural, arbitrary, or cultural. The next step is to establish guidelines to define and determine what constitutes a site. Typically, artifact density is a factor in determining this criteria. The third step is survey intensity, which is the proportion of sampled land to 'unseen' or not sampled area. Plog et.al. found transects to be the most effective sampling units because they cover the most spatial area. Using archaeological sites in the Southwestern United States as their primary examples, Plog et.al. argue that smaller units are more efficient than larger sample units since only a part of a site needs to be located in order to establish its presence. Since larger sites are easier to find, Plog et.al. suggest there is a bias in site discovery techniques towards finding large sites. Plog et.al. determined that there is a linear relationship between survey intensity and site density. To test this hypothesis they examined the correlation between person-days per square mile and site density; the more sites that are found the more time the crew will spend on recording. The conclusions drawn in this article assume perfect visibility due to the nature of the Southwest terrain. Unit size and shape, surface collections, and time and labor costs are also considered in this article.


Schiffer et.al. outline the procedures and issues involved with archaeological survey including the regional archaeological record and parameters, discovery probability, and survey design. Abundance is the prevalence of an artifact type and clustering refers to the way these materials are spatially aggregated. Probability sampling methods can be used effectively when visibility and accessibility are known, and estimates on abundance, clustering and obtrusiveness are available. Schiffer et. al. compare the benefits and draw backs involved with sampling unit size, number and shape. Intensity, the amount of effort devoted to inspecting surveyed areas, has the most profound effect on site discovery probability. Schiffer et.al. outline three stages useful for survey design, beginning with Stage I, background studies; Stage 2, reconnaissance and Stage 3, intensive survey.

MANUAL TECHNIQUES


Sampling design in excavation calls for previous estimates of site dimensions, artifact variability, and density. Sites covered by forest cannot be surface collected to gain such data. Transect interval sampling provides the data at an early stage of research, and at low cost. Chartkoff suggests the collection and processing of standard-volume soil samples. These would be taken at regular intervals from a series of transects extending outward from the known area of the site. The screening of these soil samples provides a measure of artifact density across space, and empirical density values can be plotted to create an artifact density contour interval display. An adopted value of artifact density can be used to define site limits for sampling purposes (for example, 0.04 artifacts/liter). Use of such a measure would add to the precision and validity of sampling designs that frequently use more casual ways of estimating site dimensions. Chartkoff draws on examples from three excavations to illustrate his argument, the Root site and Clark-Stringham site in Michigan and the site of Petriolo II in central Italy.


This is the third article in a trilogy of debates in American Antiquity on the effectiveness of shovel-testing. In this article, Lightfoot responds to Shott, and agrees that alternative survey methods should be developed for surveying wooded environments. Unlike Shott, Lightfoot argues that shovel-test sampling is an effective discovery technique when the probability is high that material remains are buried less than 50 cm below the surface. Lightfoot addresses the issue of site definition by suggesting that discovery probability can be generated to estimate artifact population parameters across a study area. Lightfoot also recognizes the lack of a standardized form for defining sites, making cross comparisons of site densities difficult. Lightfoot also sites the shortcomings of surface collection as it only samples from a two dimensional plane, where as most artifacts are located three dimensionally. Lightfoot's major concern with the comments by Shott are the implications for cultural resource management. Given the cost and labor investment in subsurface testing some agencies and developers may try to use less intensive means to survey. Shott, in his 1989 American Antiquity article, suggests two alternative methods to shovel-test sampling which Lightfoot addresses. The first alternative is the surface survey of clear-cut forests, which Lightfoot dismisses as unrealistic since resources would need to be visible on the ground surface. Furthermore, many government agencies and developers are skeptical of clear-cutting forests. Shott's second recommendation was to monitor construction activities. Lightfoot contests this, suggesting that it does not provide adequate planning measures, nor does it provide any basis for estimating the population parameters. Lightfoot uses a survey on Brookhaven Township to illustrate the benefits of shovel-test sampling.

Problems involved in the application of probability sampling strategies to woodland environments are discussed and illustrated by example. Some directions for the development of specialized field tactics in woodland environments, including the reduction of transect intervals, the use of test-pitting, and the generation of explicit means for survey alteration, are suggested. Lovis tested several hypotheses during the 1974 field season at the Traverse Corridor, in northern Michigan. He found there is not a relationship between the presence and absence of ceramics at a site and the environmental zone in which it occurs. There was a relationship, however, between site location and its proximity to water. Lovis concluded that 1x1 foot test units worked better than using core tools for the discovery of low density sites in areas of low surface visibility. Smaller transect intervals, for example 25 yard intervals, are more reliable than larger intervals, and smaller test units (1x1 foot) are the most efficient. Lovis also argued that in woodland environments, efficiency can be increased by using cluster sampling because less time is used traveling from unit to unit.


This article is the second in a trilogy of commentaries in *American Antiquity* (1989) that examine the effectiveness of shovel-test sampling. Nance and Ball in response to a commentary by Shott (1989) reassert that among subsurface probes, shovel-test sampling is the most effective for site discovery. Nance and Ball recognize that shovel-test sampling does have its limitations, but propose that an understanding of these shortcomings can aid in the development of new techniques. They refute Shott's suggestion that the intersection probabilities that Nance and Ball used were 'absurdly high' (Nance and Ball:407 1989). They clarify their use of controlled samples and assert that their goal was to measure the effects of artifact density and aggregation on productivity probability. In this article, Nance and Ball graph the error that arises by assuming random (Poisson) artifact distributions when they are clustered spatially. They assert that to assume random artifact distributions when these distributions are actually spatially clustered results in error. Nance and Ball agree with Shott that aggregation is secondary in importance to density in determining detection probabilities, however, it is still a factor to be considered. Nance and Ball reassert that the effects of artifact aggregation are much more pronounced for low density sites than for those with high artifact density. Nance and Ball also propose that shovel-test sampling is less effective for low density sites and the spatial clustering of artifacts is not uniform over the density gradient. They advocate the use of small portable (approximately 40x60 cm) screens. They agree that although screening adds to the cost of test pit sampling, significant and valuable data is lost when screening is not done.


This commentary by Shott questions the effectiveness of shovel-test sampling as a survey method for site discovery. Using two articles from American Antiquity by Nance and Ball(1986) and Lightfoot(1986) as the basis for his argument, Shott suggests that shovel test sampling is not effective for site discovery because a shovel test must first intersect the boundaries of a site. Furthermore, he suggests that not all areas within a sites' boundaries contain artifacts. Shott also contests the validity of the site concept, suggesting that regional distribution of sites, rather than discrete sites more accurately model the archaeological record. He criticizes Nance and Ball (1986) for assuming high intersection probabilities in sampling the boundaries of known sites. Shott suggests that this skewed value exaggerates the effectiveness of shovel test sampling. Shott acknowledges that data on average site size is limited, but that the average intersection rate suggested by Nance and Ball (1986) is too high for discovering smaller sites which are more frequent in North America. Shott argues that sites would have to be very large (80x100m) in order to be discovered by a 30 unit intersection rate. He emphasizes that the significance of artifact density is far greater than that of artifact distribution particularly in North American sites. In contrast to Nance and Ball(1986), Shott also argues that screening is inefficient because it is more labor intensive, particularly in vegetated areas. Shott refutes the use of square rather than offset grids, in Lightfoot's 1986 article in American Antiquity. Shott criticizes Lightfoot for dividing the artifacts found by the area in which the units were distributed. Rather, he contends, the artifacts should have been divided by the area occupied by sample units. Shott implies that by subdividing larger archaeological sites into smaller sites, Lightfoot inflates the average site density. The last point that Lightfoot makes which is addressed by Shott in this article is the duality of shovel-testing in ground coverage by crews moving from site to site. Although Shott praises Lightfoot's thorough examination of shovel test methods, he contests the use of shovel-test methods for site discovery because they are labor intensive, destructive and yield inaccurate data.


**NEAR SURFACE**


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Electrical resistivity has been used to produce maps of subsurface features, and more recently, to determine the depth and geometry in vertical sections of earth. The authors identify two problems with using this technique; its high cost, and the lack of a computer data-processing program to convert field measurements into a meaningful image. Using Salmonsbury Fort and Rocester in Gloucestershire and Derbyshire, England, respectively, the authors illustrate the use of a system which controls the switching unit and the resistance meter, and stores the measurements in the memory for later processing. This method will greatly reduce measurement time, however, more sophisticated processing is required for superior image quality. The sharpest images are produced by a completely automatic computer inversion process developed by Barker (1992). The technique is illustrated with an image of true resistivity measured across a burnt mound in Birmingham.


In this article, Weymouth provides an overview with examples of several geophysical methods that can be used for intrasite archaeological surveying. Outlined in this article are five particular geophysical methods; seismic, electromagnetic, resistivity, magnetometry, and radar. Seismic methods detect the differences in soils and rock through the reflection and refraction of sound. Electromagnetic methods detect magnetic properties of objects and soils below the surface by transmitting an alternating current, or pulse, between two coils. Weymouth argues that seismic techniques are slow, difficult to interpret and produce somewhat ambiguous results. In contrast, he suggests that resistivity surveying is very useful and fairly inexpensive for site assessment. Resistivity surveying measures the electrical resistivity or conductivity of soil near the surface. Resistivity is particularly useful in detecting intrusive structural features like foundations, walls and cellars. Magnetometry detects rocks, soils and iron objects magnetized by the field of the earth which slightly distort the local magnetic field. Weymouth discusses three types of magnetometers that are used in archaeological surveys; fluxgate gradiometer, alkali metal magnetometer, and the proton free precession magnetometer. Ground penetrating radar is the most expensive method but generates the greatest amount of information. Radar directs a pulse of electromagnetic radiation into the earth. The return time from discontinuities of electrical properties of soils provides information on the depths of features. Radar operates best when soil resistivity is high and when attenuation is low. In this article, Weymouth also provides a clear chart including cost efficiency, favorable conditions, and restrictions to employing one site discovery technique over another.


**REMOTE SENSING**


The purpose of this handbook is to provide archaeologists with the basic principles of remote sensing. It presents some explanation of the application of imaged and digital remote sensing data which are more time efficient and less costly than traditional field methods. The book is divided into several sections reviewing issues, methods and techniques in aerial photography, photographic and mosaic mapping, imaging and nonimaging sensors, interpretation of remote sensing data and interpretation of human alteration of landscapes and vegetation, and lastly, photogrammetric mapping and use in cultural resource management. This article includes technical specifications on materials, equipment and procedure, such as, a chart listing the days suitable for aerial photography by state and month, film types (black and white, infrared etc.), and types of stereoscopes. Examples of maps and aerial photographs from Chaco Canyon, Yosemite National Park, and Pima and Coconino Counties, Arizona are provided. There is also a glossary of terms related to archaeology, photography and remote sensing provided by the editors.


This volume is one of a series of collected papers which serves to disseminated information on the results of the practical application of remote sensing techniques. Using examples from case studies in Teshekpuk Lake Area, Alaska, Chaco Canyon National Monument, New Mexico, and Big Cypress Swamp, Florida. Lyons and Mathien review the cost effectiveness, accuracy and general use of remote sensing techniques. This volume is divided into four parts. The first section on sampling and survey emphasizes methods developed to handle problems faced in large regions where mapping, surveying and projection of land use are important considerations. A sample strategy developed for the study of the National Petroleum Reserve in Alaska is examined in an article by D. Hsu. An article by Brown and Ebert on Teshekpuk Lake, on the Arctic Coastal Plain, describes sampling a limited portion of a larger area in order to assess which sampling strategy would be the most effective. The second section focuses on vegetation and environment. An article by J.Ehrenhard examines how size and dense vegetation at Big Cypress National Preserve generated special reconnaissance problems that were solved through the interpretation of high-level color infrared imagery. In contrast, the environment of the southwest deemed aerial photography necessary to discover and examine prehistoric roadways at Chaco Canyon. The third chapter, on ephemeral archaeological features, examines how remote sensing can be applied to discovery and recording processes. In a paper by Ebert and Hitchcock, discovery of the prehistoric Hohokam canals from Skylab III and Landsat imagery illustrate that despite urban alterations, past land use can be detected. This section also examines the use of remote sensing techniques in a non-arid climate with dense vegetation. Several chapters considering the impact of remote sensing on locating Greene's Encampment, Ninety Six National Historic Site in South Carolina are also included. The final section of this volume discusses photogrammetry, which is the technique for measuring photographs. Ehrenhard found this remote sensing method extremely efficient because it enabled archaeological teams to locate baselines and delineate survey areas before entering the field. Therefore teams were not spending time trying to locate landmarks and survey boundaries in the field. Klausner emphasizes the use of the bipod in recording objects as they are located on the site. Boyer examines problems in rectifying optical illusions that can occur when using the bipod. An article by Ireland discusses a mapping procedure that is not as accurate as photogrammetric maps, but does provide a quick and inexpensive method for creating maps of high quality.


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**SAMPLING**


Problems involved in the application of probability sampling strategies to woodland environments are discussed and illustrated by example. Some directions for the development of specialized field tactics in woodland environments, including the reduction of transect intervals, the use of test-pitting, and the generation of explicit means for survey alteration, are suggested. Lovis tested several hypotheses during the 1974 field season at the Traverse Corridor, in northern Michigan. He found there is not a relationship between the presence and absence of ceramics at a site and the environmental zone in which it occurs. There was a relationship, however, between site location and its proximity to water. Lovis concluded that 1x1 foot test units worked better than using core tools for the discovery of low density sites in areas of low surface visibility. Smaller transect intervals, for example 25 yard intervals, are more reliable than larger intervals, and smaller test units (1x1 foot) are the most efficient. Lovis also argued that in woodland environments, efficiency can be increased by using cluster sampling because less time is used traveling from unit to unit.


This article examines the potential of statistical survey, ranging from estimating the average density of cultural remains in a region to estimating the meaningful parameter of those remains. Nance defines discovery model sampling as the confidence of finding archaeological remains within given expenditure of energy, such as labor, budget, and time. Nance notes the difference between prospecting which is to predict the location of cultural remains given statistically definable spatial trends, and statistical estimation which is to infer something about the quantitative properties of an entire area from a small sample. Nance argues the importance of discovery model sampling and the relationship between the spatial clustering of cultural remains and the organization of site survey techniques, like test-pit sampling. A ratio of cost to accuracy can be used to determine which of these models is best suited for a particular project. Nance argues that the sample standard deviation is the most important variable in discovery model sampling because existing estimates of site density are positively biased through estimations of site 'size' and site 'edge'. Also examined in this article are cluster and element sampling designs, site intensity, and test-pit subsampling. Nance concludes by identifying a need for a sampling design aimed at locating obtrusive remains combined with a subsampling procedure that would estimate less obvious remains. Test pit subsampling of quadrants and transects appear to be the most effective method of testing in dense vegetation, however, Nance challenges this assumption on the basis that the number of sites that have not been discovered is unknown.


It is the purpose of this paper to examine some of the assumptions about the ability to recover certain classes of data through archaeological excavation. Using the Lower Cumberland Archaeological project in western Kentucky, Nance evaluates several methods involved in small site sampling. Nance cautions
that information in this article is specific to single component sites, that are small, shallow and lack surface features. Element sampling is when the elements, or members of a sample, are selected independently of each other from a statistical population. Grid units are an example of element sampling. A cluster sample is when elements are selected in groups (clusters), for example cultural material. In determining which discovery method to employ, one must take into account the perceived abundance of an item class. Some variables that determine abundance are size of the excavation unit, frequency of the item class in relation to the overall cultural population, and the degree of dispersal of the item within the site matrix. The purpose of the discovery model is to know the full range of classes of items, whereas the purpose of the statistical precision model is to define the parameters of the population of items in a site. Nance concludes that when using the statistical precision model, absolute sample size is more important than the proportion of the population appearing in the sample. On the other hand, in discovery model sampling, the sample fraction is critical. Nance argues that there are two means for controlling precision; the number and size of sample units.


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