PALYNOLOGICAL STUDY OF SEDIMENT SAMPLES FROM L-19, LA PLANTA, PUERTO RICO

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BACKGROUND

The eighteen sediment samples collected for pollen study at La Planta were received in Tempe 5 December 1987. Arrangements had been made for any pollen they contained to be extracted at the Palynology Laboratory of the Department of Anthropology at Arizona State University. Tentative agreement had been reached that after initial observation and evaluation of the pollen extracts was completed in Tempe, the extracts would be sent to Northland Research, Inc., in Flagstaff, Arizona. Observation, identification and counting of the pollen would be undertaken there, and a descriptive report would be prepared. I would then prepare an interpretive report for Archaeology & Museums, Caguas, based on Northland's descriptive report. Deadlines imposed by contractual obligations required that the interpretive report was to be completed before 30 Janunry.

This research plan was frustrated when Northland subsequently determined it was unable to guarantee completion of the descriptive report within the time limits required. Since committments had already been made to do the laboratory work involved in extracting pollen from the samples, I modified the plan of research as an

alternative to abandoning it altogether. My perception of the situation was that since the pollen work was an aspect of an archaeological data recovery program, any positive attempt to establish a body of information about the pollen of the sediment samples would be more productive than no attempt at all. The following report, then, represents a pollen study, but not a pollen analysis. An analysis would concern itself with the types and relative frequencies of the pollen of the samples, and with the archaeological significance of that information. This study concerns itself with the archaeological significance of a different body of information.

Since I am not familiar with the pollen flora of tropical regions in general, nor the Caribbean area, I am unable to identify most of the pollen types the samples would potentially contain. In such situations, the observed pollen can be described and subsequently identified through comparisons with published descriptions of pollen types and botanical reference materials. The necessity to complete the study within a short period of time, however, obviated this approach. In any case, such descriptions do not serve as more than a clue to the probable taxon identifications. Credible analysis would thus require re-observation of the samples by a pollen analyst with regional or local expertise at some future date. Even if time was allowed to undertake descriptive reportage of the morphology of the observed pollen, then, the result would not constitute recovery of any archaeologically significant data.

Microscopic examination of the polleniferous fraction of the sediment samples was undertaken at all solely because, to my knowledge, no prior potential value of study of the pollen of archaeological contexts of Puerto Rican sites. Though formal pollen analysis of the extracts was precluded, two or three relevant matters could be established by appropriate observation: (1) was pollen recoverable from sediments of such context at all; (2) was pollen equally preserved in all samples collected from this site; (3) if it were not equally preserved, were there evident patterns to the preservation potential of the deposits; and (4) was the amount of preserved pollen sufficient to meet normal analysis requirements. It was necessary to observe relatively few of the extracts to resolve these questions.

FIELD AND LABORATORY METHODS

Sediment samples averaging ca. 400 cc volume were collected from nine of the fourteen excavation units at La Planta, representing nine collection loci in Stratum II and nine in Stratum III. Field precautions were employed to reduce the possibility of cross-sample pollen contamination or contamination by modern airborne pollen. The samples from Stratum III contained a smaller fraction of organic materials, but the principle component of all samples was sand-size inorganic particles.

A 150 cc volume subsample waa removed from each sample for pollen study. The remainder of the original collections is now curated at the Department of Anthropology, Arizona State University. The

subsamples were processed to extract that portion of the original sample which contains organic particles having the size and weight of pollen grains, and chemical characteristics similar to pollen exines. When it is most successful, all of the pollen which was originally contained in 75-150 cc volume of sediment will be concentrated in an organic matrix of less than 0.5 cc volume. Laboratory equipment failures resulted in the loss of four subsamples at various steps of the procedure. Fresh subsamples of the original collections could have been subjected to the extraction method to compensate for these losses, but the limited objectives of this study did not require that additional effort.

Following extraction, 0.025 ml of the extract of five of the subsamples were transferred to a microscope slide, prepared for observation, and its pollen and spores viewed. Four samples were chosen at random from the fourteen available, two from each stratum. A fifth sample was selected when it was determined that one of the original four was unanalyzable. The other samples were not viewed because the objectives of this limited study were fully achieved with this smaller number, and investment of additional labor would not have been cost-effective.

OBSERVATION RESULTS

Two samples from Stratum II (collected at units 1 and 7) were sufficiently polleniferous to allow analysis. Pollen density is calculated at 628 and 546 pollen grains per cubic centimeter of

original sediment sample, respectively. A third sample from Stratum II (collected at unit 7) was not analyzable because the pollen it contained was obscured by finely divided organic detritus. One sample from Stratum III (collected at unit 12) was sufficiently polleniferous for analysis, while a second (collected at unit 18) was not. Pollen density is calculated at 462 and 74 pollen grains per cubic centimeter of original sediment sample, respectively. The observable pollen in the samples from Stratum II was sufficiently well preserved to allow description of exine sculpturing and aperture characteristics in roughly 80 percent of the pollen grains observed, though the grains were often so distorted by crushing or folding that identification to botanical taxon could only be reliably performed by an analyst familiar with a regional reference collection. The non-polleniferous background observed in these cases mostly consisted of plant cell and tissue fragments, with a large number of cryptogam, algal and fungal spores. The observable pollen in the samples from Stratum III was corroded, eroded, broken and otherwise poorly preserved in roughly 60 percent of the pollen grains observed. The non-polliniferous background observed in those cases was much sparser, with smaller, more eroded, cell fragments and more amorphous detritus, and few spores.

DISCUSSION AND CONCLUSIONS

Reports of the palynological study of archaeological site context deposits often identify samples as producing insufficient pollen for analysis. The statement is variously interpreted by different

readers, and in fact has different meanings in different situations. It only rarely, however, means that the amount of pollen trapped and preserved within the sediment does not allow observation to occur. Normally, the statement identifies the opinion of the analyst that observation of the pollen that does occur in the sample would not yield sufficient data to fulfill analytic objectives.

But there are a number of grounds upon which an analyst may support this opinion. One is statistical: the number of pollen grains which may be observed in the extract recovered from the original sample is sufficiently low that statistical evaluation of the character of the population of pollen grains contained in the sediment is not possible. The accepted minimum for statistical evaluation of a pollen record, or spectrum, is a pollen sum of 200 grains, though smaller pollen sums are valuable in certain cases, depending on the format of analysis or the sort of problems under investigation. Recovery of the pollen of a smaller volume of original sample, then, might have this result when recovery of the pollen of a larger volume would not.

The pollen analyst may also justifiahly identify a sample as containing insufficient pollen for analysis for a quite different reason: if the analysis demands comparison of the observations of a number of samples, some of them may contain a great deal of pollen and some may contain orders of magnitude less pollen. Though the latter contain sufficient pollen to meet the minimum statistical standard, the analyst may be concerned that they contain too little to allow legitimate comparison with those containing a great deal of pollen. S/He justifies excluding them from the analysis on those

grounds. In yet another situation, logistical constraints may be imposed upon the analysis by virtue of either the normal operating rules of the laboratory or the character of the research project. In my own case, for example, I impose a limit on the amount of time I will normally expend on the processes of extracting, observing, identifying and tabulating the pollen of a sample. More time would only be required if there was very little observable pollen per unit volume of extract. Such samples are excluded from study on the grounds that they contain too little pollen to allow completion of analysis within my logistical standard.

Of the five samples from the La Planta site, one contained no pollen grains at all in the fraction of the polleniferous extract observed (0.008%). Though it is likely that some pollen actually exists in the remainder of the extract, recovery would be arduous and study would be extremely time-consuming, relative to the other samples. Existence of such a sample from Stratum II, however, suggests that significant variability occurs in the pollen density of samples from this stratum at the site, and that the stratum does not represent the sort of deposit in which pollen preservation can be effectively characterized by the study of a small number of samples.

Samples which yield pollen density values larger than 400/cc original sediment sample are considered analyzable by some pollen analysts and unanalyzable by others. If the analyst is generally experienced in the study of pollen of archaeological context sediment samples, s/he recognizes that extraction procedures designed to concentrate the pollen of large volume sediment samples often produce yields of this sort, and that prior experience suggests their

analysis is fruitful. The analyst will tend to incorporate or reject such samples in an analysis depending upon the purposes of the research. Such samples would normally, however, not be considered analyzable by a palynologist whose standards are set by the yields of samples of marine, lacustrine or peaty deposits, or the samples of organic soil horizons. Normal yields in such cases are often one to three orders of magnitude larger than were observed here. The sample which contains pollen at a density less than 100 grains per cubic centimeter original deposit would rarely be considered analyzable.

The pollen density of the samples collected at La Planta, then, is sufficient to justify analysis in roughly half the observed cases -- providing the analyst is prepared to interpret data so distinct from that normally interpreted for purposes of paleoenvironmental reconstruction. It seems likely that pollen counts which meet minimal statistical standards could be recovered from eight or ten of the existing pollen extracts within logistically reasonable standards by someone familiar with the pollen types of the region. However, it would not be advisable to assume that the results of such pollen counts would be an adequate data base for conclusions regarding the paleoenvironmental context within which the behavioral patterns represented at the site occurred.

There are a number of reasons why this is so, and expression of them here is relevant as a guide to future archaeological pollen study in Puerto Rico. First, since pollen may occur at given point in a deposit as a result of soil formation and leaching processes, the pollen spectrum of an analysis may not represent the pollen rain trapped by the deposits of a site at the time the artifacts were

trapped. Paleoenvironmental reconstructions based on the pollen, then, may not date to the horizon of occupation despite the intimate association of the pollen studied and the artifacts recovered. Second, when the pollen density is lower than a few thousand grains per gram or per cubic centimeter of original deposit, it is not unlikely that this results from processes known to cause differential preservation (the situation in which certsin pollen types are preserved in the deposit while other types are selectively destroyed). The risk of differential preservation is particularly obvious in the samples from La Planta, because pollen density is generally lower in the samples from the stratum in which the preservation of background organic material in the extract is generally poorer. Third, and most significantly, all of these samples were collected from an archaeological context. The direct association of pollen with evidence of human behavior suggests, unless evidence exists to the contrary, that the customary ways in which the occupants of a site location were likely to have interacted with the plants and the ecosystem have affected either the types or the numbers of pollen grains observed, or both. Some of the samples were collected from the stratum containing a minimal artifactual record, and are less likely to evidence any behavioral influence. But those are also the samples that generally contain less pollen.

Generally, the positive results of this study are twofold. It has been demonstrated that if this site is taken to be representative, Puerto Rican site context deposits do contain preserved pollen. Pollen density is sufficiently low that cautions must be excercised in interpretation, and reconstruction of the

paleoenvironmental contexts of site occupations would be inadvisable. However, the pollen is there, and future mitigation programs oriented towards recovery of the data potential of archaeological sites should include collection and study of the pollen of site-context deposits as a matter of course. It has also been demonstrated that preservetion of both pollen and the organic materials of the polleniferous fraction of samples of site context deposits varies from sample to sample. This information suggests caution is required in interpretation, but it is quite possible that the variability may be pnttemed in wnys that are identifiable as indices of natural processes or behaviorul norms. In either case, further pollen study would be relevant to examination of transformation processes causing Puerto Rican sites to have the character we observe. Pollen study is thus not only suggested for Puerto Rican site-context deposits as a means of compliance with the legal requirement to recover data the site may contain which is important in prehistory, but is also suggested because it offers opportunity to approech a methodological question that has rarely been addressed in Puerto Rican archaeological research.

This research also, however, suggests some of the significant problems that a regular program of study of the pollen of Puerto Ricen site-context deposits would encounter. First, and most significantly, such a program would require the availability of one or more pollen analysts with expertise in regional and local pollen flora identifications. This expertise would, in turn, demand the establishment of adequate reference collections and plant geography/plant community analyses. It would be appropriate to

encourage the development of such expertise, collections and analyses as soon as possible and as systematically as possible.

Second, such a program would require identification of the principal sorts of archaeological problems the analysis of site-context deposit samples pollen analysis could most profitably address. Basically, methods of archaeological pollen analysis tend to apply to three sorts of archaeological problems: problems of paleoenvironmental reconstruction, problems of intra-site and site dating, and problems of behavioral reconstruction (particularly reconstructions of man-plant relationships). Identifying and prioritizing the sorts of archaeological problems it would be relevant for the analyst to deal with allows choice of the most effective existing methods of pollen study and rationalizes the design of new methods.

Third, such a program would require establishment of pollen sample collection strategies that would be adapted to the details of Puerto Rican archaeological site structure, as well as the objectives of local and regional archaeological research. By and large, archaeological pollen analysis is not effective when it is implemented in a discovery research mode. Normally, the conclusions of a pollen analysis are substentive only when the effort has been properly controlled and the research mode is one in which hypotheses are rigorously tested. Sample collection strategies adapted to these parameters, however, must also be sensitive to the realities of the sites to which the studies apply.