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AN APPROACH TO EXCAVATING AND ANALYSING LARGE QUANTITIES OF ARCHAEOLOGICAL DATA

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Abstract

This paper investigates particular aspects of the excavation and analysis of copious quantities of material from prehistoric sites. By way of example, the practicability of initially processing faunal data in the field is examined. Work study techniques are used to calculate the time required to undertake all phases of the processing and analysis of midden material from sites with moderate shell densities. Using the results of this study as a guide, estimates are made of the numbers of staff that would be required to sort and record faunal material in the field for both moderately concentrated and concentrated middens. It is shown that the total pre-analysis of all faunal material from concentrated shell midden deposits is practical when a field staff of not less than 37 is available.

The time taken to perform various calculations on the faunal data with the aid of a hand calculator has been estimated and shown to be significantly high, suggesting that such calculations might be performed with a computer with considerable time saving. The several advantages in using the computer to carry out this part of the analysis are emphasised. These include greater efficiency and reliability of calculations, and sophisticated, compact data storage facilities. The concept of time and motion study in archaeology is projected as a tool worthy of further consideration.

INTRODUCTION

It is widely recognised that when an archaeologist selects a site for excavation he is, in general, focusing attention on a small segment of the culture under scrutiny. He is in effect sampling a culture or universe about which he may know little. The data collected from such an excavation are used to make inferences about the culture, the value of these varying according to the quality of the data and the level of integration and synthesis utilised. As a rule few archaeologists excavate entire sites - they sample the sample - and further, because of the differential survival of archaeological material and the limitations of present excavation techniques, the samples (sites) and the sub-samples (portions of sites) of the universe represent varying proportions of the original populations anyway. In these circumstances it would seem important to ensure that the data which are recovered from both partial and total excavations are of the highest quality, and should be limited only by our present knowledge of excavation techniques. Having made these general remarks about sampling, attention will now be given to the excavation and analysis of midden deposits.

As is well known, this type of site has its own sampling problems. In most cases field workers are reluctant to removal all faunal material which they excavate from a site because of the sheer enormity of the task. As a compromise they fall back on some sampling technique, i.e., sampling a sample (Cf. Cook 1946; Cook and Treganza 1947; Treganza and Cook 1948; Ascher 1959; Greenwood 1961). However, a careful study of the literature available on midden sampling indicates that, to date, no satisfactory sampling technique is available (cf Glassow 1967; Ambrose 1967). Most of the methods advocated are dependent on unjustified assumptions and questionable approximations. One principal drawback of most of the available techniques is the failure to make meaningful estimates of sampling error.

In consideration of the initial remarks in this paper, one is faced with the prospect of either devising some new and more reliable sampling technique, or analysing all the excavated midden material. It is one of the purposes of the present paper to explore the practicability and economics of total analysis.

MATERIALS AND METHODS

Faunal data obtained from two excavations of coastal middens at Wilson's Promontory, Australia, have been employed to illustrate the arguments. These middens were composed of shell lenses of thickness ranging from three to about 20 centimetres. There was no skeletal component present. All the excavated faunal material was retained and taken back to the laboratory for analysis.

The faunal material passed through three stages - excavation, processing and conversion to a form suitable for numerical analysis, and finally analysis. In order to assess the time and labour involved in excavating this type of material, work studies were initiated for each stage. Thus at the analytical stage of the project, the approximate time to perform each calculation was measured and the total time taken to perform the full suite of calculations on data for each excavation was worked out. The final time is dependent on the objectives of the analysis and in this case the calculations were very detailed and exhaustive (Coutts 1970). Similar studies were made at the processing and conversion stages of the project.

RESULTS OF ANALYSIS

The results of the work study analysis are set out in Table 1.

In practice the time taken to perform the last stage of the project would take more than the estimated time because all the results have to be checked, corrections made, and tables compiled. It is notable that a considerable amount of time was required to perform the calculations. Moreover, the huge number of computations involved (over 150,000) increased the probability that mistakes would be made in the course of the analysis. Finally, the constant reading and transfer of data from various tables increased the chances of misrecording and misreading.

CONCLUSIONS

Processing Data in the field

If one assumes an eight-hour working day, it is clear that all this material could have been processed easily in the field by including two extra persons on the staff.

Number of men employed Processing Mollusc Material	Time taken to complete job in days
1	37.8
2	18.9
3	12.5

Although the shell density in these excavations varied, few spits could be described as "concentrated shell deposits". The Wilson's Promontory shell densities ranged from 0-6000 shells per cubic yard, with average values of around 750-1500 shells per cubic yard. For three-foot squares, assuming firstly an average spit depth of 0.4 feet, and secondly that a concentrated midden would have at least one shell/cubic inch, the total number of shells in the volume

1 x 1 x 0.03 cubic yards would be approximately 6000, corresponding to a shell density of 185,000 shells/cubic yard. Thus a volume of shell deposit which comprised concentrated shell would contain about 60 times more shells than a similar volume comprising a moderately concentrated deposit.

Using the results obtained to date, and supposing that the time for analysis is directly proportional to the shell density, one deduces that between nine and 18 man-hours would be needed to analyse a spit of concentrated shell deposit. In practice one must be prepared to devote one day to the analysis of each spit, especially when other classes of fauna, such as fishbone, are present. The skeletal data can be separated from the mollusc data and removed to the laboratory for further processing.

The advantages of processing the mollusc data in the field are fivefold. Firstly, there is a time-saving factor, in that precious laboratory time which might otherwise have been used to process the primary mollusc data can be utilised more beneficially on other projects. Secondly, if problems are encountered during the initial processing of the mollusc data which suggest that further field investigations have to be conducted, they can be carried out immediately. Thirdly, it is desirable to deal with both mollusc and skeletal material in the field because of its generally fragile nature. Transportation and packaging can damage it, and for the type of analysis being conducted at the Promontory this is undesirable. Fourthly, the huge volume of shell material often makes transport and storage impossible, so that it is again advantageous to deal with it in the field. And finally, a field analysis of mollusc and/or skeletal material is easily transferred to punch cards ready for computer analysis.

If both excavations had been concentrated shell middens, about 500 days would be required to analyse the mollusc material from 613 spits. If the archaeologist were to organise his field programme so that his faunal data could be processed in the field, within a reasonable time, and in unison with his rate of digging, it is clear that at Wilson's Promontory he would need to employ at least 20 extra staff to complete the task satisfactorily. If he processed the shell material in the laboratory using 20 men, and performed the calculations himself, it would take at least three months to complete the project. As he is unlikely to have more than half-a-dozen assistants in the laboratory, the time factor will be increased to such an extent that complete faunal analysis must certainly be rejected in favour of some sampling technique. Hence, there is a strong argument for processing the mollusc data in the field. For concentrated midden deposits the minimum field staff will be about 37 persons, and this number will reduce to about 20 for less concentrated middens. In these circumstances there seems no reason why a full mollusc analysis cannot be carried out, as a well organised expedition of 37 persons is quite practicable.

Processing of Mollusc Data by Computer

The processing of the mollusc data after initial processing and coding is particularly suitable for computer analysis. The primary data are recorded in the field on I.B.M. 80 column punch-card layout sheets. These are conveniently labelled with the species' names and have space for recording the numbers and weights of whole shells, the numbers of burnt shells and shell weights for each species. Appropriate fields are available for trench, square level and spit numbers. Once back from the field, the data sheets are handed in to the data processing unit where the data are transferred on to I.B.M. 80 column punch-cards. The mollusc data are then conveniently stored in card form to await analysis.

A conventional programme written in Fortran IV and with a storage capacity of not less than 32K, suitable for use on I.B.M. 360 computer, has been written to handle the mollusc analysis, carrying out all the appropriate calculations in less than an hour (compared with up to 64 days/man for manual calculations). The programme is versatile, and can be extended to analyse data from much larger excavations. The several advantages of using the computer for this type of analysis need hardly be emphasised (see Cowgill 1967):

1. It completes the analysis in a very short time; for example, for the Wilson's Promontory excavations the time-saving is highly significant: 32-64 days/man (manual) compared with one hour on the computer.

2. All primary data are compactly recorded on cards. There is no other handling or transferring of primary data.

3. No manual tabulations are required as this is all done by the computer. The tables can be photographed and reproduced in convenient form for publication or for storage in files. In this way a great saving in time is achieved.

4. Providing the programme logic has been thoroughly tested and the limitations of the programme are well defined, then there is much less chance of the computer making errors in the numerous calculations than there is when they are carried out manually. Further, there are several in-built sub-routines in the programme to check for the most likely errors while the compact nature of the computer output makes obvious errors easier to detect.

5. The programme is versatile. It can repeat the calculations many times; it can be used to calculate various parameters per stratum or/and per occupation level. Sub-routines can be built into the programme which will enable tedious statistical tests to be carried out as required. The disadvantage of using the computer is the cost, but this is more than offset by the saving in labour and time spent on the analysis.

SUMMARY

1. It is practical to excavate, process, and analyse complete archaeological deposits of shell fauna.

2. All excavated shell fauna can be initially processed in the field. The analysis would be carried out by a staff which will vary in size, depending on the method of excavations and on the shell concentration.

3. It is advantageous and economical to record the primary data on I.B.M. 80 column punch-card layout sheets in the field.

4. In cases where a quantity of data are involved, the most satisfactory method of processing the primary data is by means of a computer using appropriate programmes.

While the body of this paper has focussed on the problem of excavating and processing of mollusc data, the general principles outlined have relevance to any archaeological situation involving the excavation of large numbers of objects and where it is physically impossible to package and transport large quantities of archaeological material back to the laboratory. Thus sites yielding formidable quantities of sherds would qualify for this scheme. Both Newman (1970), working on Hawaiian sites and the present author working on New Zealand sites have experimented with coding while in the field, with good results.

It is strongly recommended that where large quantities of data are involved, archaeologists may well benefit by considering the efficiency of their excavation and analytical procedures in terms of work study methods. The logical time for the introduction of such procedures would be after the completion of initial site surveys and trial excavations.

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TABLE 1: RESULTS OF WORK STUDY FOR MOLLUSC DATA

	Man Hours	
Work Study Class	Excavation No. 1	Excavation No. 2
Time taken to excavate* Sites	3,240 (19 days)	1,020 (6 days)
Time taken to process and convert Mollusc Data	214	88
Time taken to analyse Mollusc Data	191.3	66.9

*Staff comprised an archaeologist, one supervisor, two surveyors/ draughtsmen, four excavators, four carriers, four sievers and one general assistant. Calculation based on 10-hour working day.