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ANALYSIS OF ARCHAEOLOGICAL MATERIAL FROM ERODING MIDDEN SITES

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INTRODUCTION

This paper describes the results of several studies intended to investigate the mechanisms of shell midden erosion. The data for these studies was obtained from a series of experiments conducted at a coastal site, YW9A, Wilson's Promontory, Victoria, Australia, where a large area of soil was littered with eroded midden. Such sites are a common feature of many coastal areas throughout the world. The problem at the Wilson's Promontory site, as with all similar sites, is to devise some method of usefully analysing the eroded material. Before deciding on a particular analytical approach, it is desirable to try and determine what happens to the midden components before, during, and after erosion. Once some understanding of the erosion processes is reached one will be in a stronger position to devise analytical techniques to process the eroded material.

The experiments described in this paper were of necessity limited in scope and exploratory in nature. The preliminary results cited here should be regarded cautiously until the methods used to obtain the results have been tested more thoroughly. A number of techniques have been described below which gave inconclusive results; in most cases the fault was insufficient data. In these instances, the methodology and results have been outlined to illustrate that there are several different ways of viewing this problem.

FIELD STUDIES OF SITE YW9A

1. The site was divided into six foot squares. The numbers of shells of each species and the numbers of artefacts in each square were then counted.

2. Four areas were selected (in conjunction with other projects) for excavation. The main excavation YW9A/6 (18' x 15' in area) and two adjacent test pits YW9A/3 and 5 (approximately 6' x 3' in area) were conducted in uneroded areas of the soil. A further test pit YW9A/1 (3' x 18' in area) was sunk in an eroded area of the soil on the far side of the site, some 160' to the S.W. of the main excavation.

CUMULATIVE SHELL TOTALS FOR THE HYPOTHETICAL EROSION OF 'A' SERIES SOILS

Figure 2

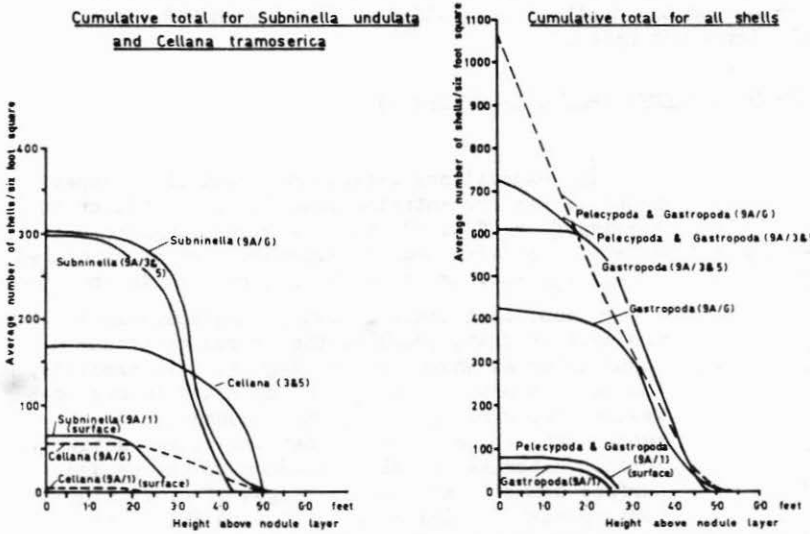
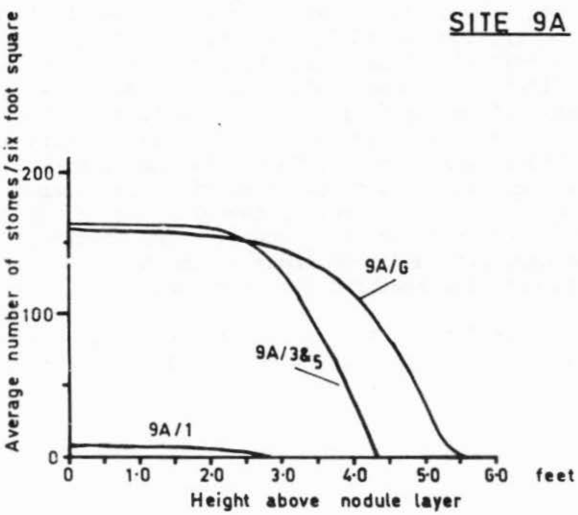


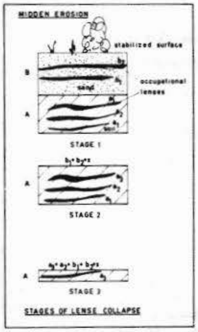
Figure 3

Cumulative lithic density for hypothetical erosion of 'A' series soil



3. The main site was augered at 10' intervals along predetermined traverses and the depth of occupation soil above an underlying nodule layer was noted.

MODEL OF ERODING MIDDEN (Refer to Figure 1)



The excavations established that the occupation material was concentrated into lenses of thickness varying from 4" to 6" and of varying geographical extent. Several such superimposed lenses described as a_1, a_2, etc. are shown in Figure 1. In the event of erosion, each lense collapses successively on to the next so that, ideally, the eroded material accumulates as shown in the diagram. In practice, the exposed material would be subjected to chemical weathering, wind movement, and trampage, and subsequent damage through human and animal activity. Further material may also be added to the eroded surface deposits at various stages of erosion by contemporary Aborigines (factor x in Figure 1).

APPLICATIONS OF MODEL TO DATA

An 'ideal' or 'hypothetical' erosion concept was applied to the various excavations. The vertical profiles of the excavations were divided into consecutive six inch spits down to the limit of occupation defined by an underlying nodule layer. The hypothetical erosion of each spit with its occupation material was then considered in turn. Assuming no loss of occupation material, one would expect an increasing amount of refuse to accumulate at each new surface. For each excavation, graphs were drawn depicting the accumulation of individual shell species, total shells, and total stone per 6' square, as functions of 'height above the nodule layer' (Figures 2 and 3). The 6' square unit was chosen because the grid system on the surface site had been laid out in 6' squares, enabling a direct quantitative comparison to be made between the actual 'accumulated' shell and lithic material lying on the grid squares and that predicted from Figures 2 and 3. The predicted values for each grid square were obtained from these graphs by using the depth of occupation soil as had been measured with the auger.

Two graphs were drawn for the test pit YW9A/1 - one including the actual accumulated surface material, the other excluding it.

ASSUMPTIONS OF ANALYSIS

1. It has been shown elsewhere that the rate of accumulation of the soil above the nodule layers is relatively uniform (Coutts 1968, 1, Chapter 4).

2. The variation of shell density with depth is uniform over the whole area and volume of the site. This may be approximately true for a localized area and more particularly for shell refuse. However, it will be less valid for stone material which is much rarer and highly localized. However, in practice, the occupation material tends to be concentrated in irregular lenses of varying thickness and extent largely at random, so that this assumption requires further justification. Several other factors combine to reduce its uncertainty:

   (a) For each excavation, average values of the numbers of shells and stones per six foot square were calculated for each hypothetical spit. This helps to reduce the errors due to varying shell densities both in time and space.

   (b) The grid surface system was located adjacent to the major and minor excavations, and the comparisons between surface and excavated material are likely to be more valid when they are confined to those grid squares nearest to the excavations.

   (c) Shell concentrations on the various floors are frequently of similar size.

   (d) The results tend to become more reliable as the number of predictions (and therefore the number of comparisons) is increased.

3. Occupation extends to, and not beyond, the nodule layer. This assumption is based on the results of several excavations and on observations of eroded A series soil profiles elsewhere. Occupation may <u>not</u> necessarily extend down to the nodule layer, but it certainly <u>never</u> seems to go below it. The nodule layer is, therefore, a reasonable point from which to measure heights to the various spits.

4. Similar varieties of shell species tend to be found throughout the soil. This seems to be a valid assumption with some minor exceptions.

RESULTS OF THE ANALYSIS

Altogether, three sets of comparisons were made and tested statistically.

(a) A direct comparison between predicted accumulated shell and stone numbers and actual shell and stone numbers lying on the surface of the grid. Correlation analysis gave a result that was highly insignificant.

(b) A comparison between the predicted shell and stone numbers that should be in the eroding level and actual shell and stone numbers lying on the surface of the grid. Correlation analysis gave a higher correlation coefficient than in (a) above but it was still insignificant.

(c) A comparison between the predicted shell and stone numbers that would have derived from the levels immediately preceding the ones that remained uneroded and the actual shell and stone numbers lying on the surface of the grid. Correlation analysis gave a higher correlation coefficiency than in (a) above but it was still insignificant.

These results indicated that better agreement could be obtained from correlations of 'eroded level' and 'level above eroding' level. This aspect was investigated further.

Error ranges can be deduced from Figures 2 and 3, and these vary with depth below the surface. The curves which were derived from the accumulation of shell and stone material for excavation YW9A/6 were used as standards for predictions because this was the largest excavation. The other curves (for excavations YW9A/3 and 5, and for YW9A/1) were used to determine the error limits for predictions, e.g., from Figure 2 one would predict that at 3 ft above the nodule layer (hypothetical level 6) of YW9A/3 and 5, there should be an accumulation of 310 Gastropoda. In practice, the number would be 435 - an error of + (125/310) x 100, or 40 per cent. The approximate error ranges were tabulated as a function of height above the nodule layer for both shell and stones. The error ranges for the lower level can be further refined.

It is apparent from Figures 2 and 3 that there are notable differences between the curves for YW9A/1 and those of the other excavations. YW9A/1 is situated some distance from YW9A/3 and 5, and YW9A/6. The addition of the surface material to the excavated material makes little difference, and the figures for YW9A/1 are still very much less than their counterparts for YW9A/6 and YW9A/3 and 5.

It appeared that either the shell density for YW9A/1 was considerably less than for other parts of the site, or else much of the eroded faunal material had been lost. Thus, even when one allows the maximum errors calculated above, with the exception of Subninella, the curves cannot be made comparable. It seems likely, then, that much material has been lost from the surface.

Assuming this last hypothesis is correct, further attempts were made to refine the error ranges. Considering now the situation where all the upper levels of YW9A/6 and YW9A/3 and 5 have been eroded down to the present height of the soil of YW9A/1 above the nodule layer and where most of the occupation material from these upper levels had disappeared, one may then compare the accumulation of occupation material from the lower levels of YW9A/6 and YW9A/3 and 5 with those of YW9A/1 in order to deduce new error limits for the lower levels. Each of the comparisons listed on pp. 4-5 were then repeated, taking these new error ranges into account. The results of the analysis were inconclusive, since the error ranges tended to be too broad, making it possible to obtain correlations of widely divergent figures.

The data was rearranged in yet another way. The average actual accumulated values of stone and shell were calculated for the grid as a function of level number (in effect, the height above the nodule layer) and compared with the predicted values (see Table 1). The shell (and stone) numbers in the 'eroding' and 'level above eroding level' were added together for further comparisons.

Almost without exception, the predicted accumulated shell and stone densities are well above the actual numbers in the grid, while the predicted shell and stone densities for 'eroding level' and 'level above eroding level' are all below the actual numbers in the grid. The percentage number of (approximate) agreements between predicted and actual numbers increases from zero for accumulated shell densities, to about 20 per cent for 'eroding level', to about 25 per cent for 'level above eroding level', and to about 45 per cent for the addition of the 'eroded' and 'level above eroded levels'.

These results suggest that much of the shell and perhaps stone material formerly associated with the higher and eroded levels of the soil, has disappeared. The shells may have been blown about by the wind, broken and fragmented by weathering or by trampage and then blown away, they may have been picked up and taken away by man, or they may have been destroyed by chemical weathering. The disappearance of the stone material is harder to explain. Unlike shell, stones, in general, do not fragment and disappear. Even if stones were able to move about on the site, they would always remain in evidence. If one accepted a hypothesis of stone movement through wind action, then one should find considerable concentrations of stone material on the leeward side of the site. In practice, no such concentrations were found and, consequently, the hypothesis as applied to lithic material was rejected.

So far the study has indicated that shell destruction is likely. This conclusion is supported by the results of other studies.

RESULTS OF OTHER STUDIES

Further research projects carried out on midden shells in the same area produced documentation for shell movement, fragmentation and subsequent loss (Coutts 1968, 1, chapter 6). A series of experiments were set up to study the mechanisms by which shells were moved and destroyed on surface middens. The results of these experiments clearly suggested that shell material moves about on middens and is subsequently destroyed, and that the process of destruction can take place fairly quickly. Stone movement was not intensively investigated, but preliminary results suggested that lithic material tends to remain in situ.

The actual shell and stone densities of the in situ midden lenses in the A series excavations were compared with the corresponding overall densities on surface sites (see Table 2). The densities shown here for the various excavations represent the shell and stone densities of the actual occupation lenses within the A series soil. It is clear that the average shell densities for these lenses are reasonably comparable with the average shell densities on the A series sites. This indicates once again that the shell refuse found on the surface sites probably represents no more than the accumulation of shells from the so-called 'eroding' and 'level above eroding' levels.

The low stone densities for the lenses indicate that in the event of their erosion and subsequent accumulation on the grid surface, the total increase of lithic density would be very much smaller than is indicated in Figure 2. Thus, total erosion of a six foot square unit of YW9A/6 would yield a small stone density. The present averaging technique assumes that the seven lenses overlie one another successively. In reality, one finds fewer than seven overlying lenses appearing in any (limited) profile of the A series soil. Thus, the total accumulated stone density after a hypothetical erosion of the lenses in a restricted area is likely to be of the same order as the average stone density of the grid surface. One is therefore able to explain the conflicting results obtained previously.

When one applies the same argument to the shells contained in these lenses, it will be seen that the accumulated shell density for four or so successive lenses still greatly exceeds the real surface shell densities. These results, then, are in accord with previous conclusions - that shell has been lost.

CONCLUSIONS

In general, when one surveys midden sites, one cannot be sure, firstly, of how the exposed midden material is related to soil from which it is eroding; secondly, of how much or what material has been mixed together through erosion; and, thirdly, one cannot be certain of the age of the midden material. The results of these studies suggest that most of the exposed shell material belongs to the 'eroding' and the 'level above the eroding level', so that one is now able to place eroded shell material in an approximate stratigraphic context. If one can estimate the rate of build-up of the soil, it will also be possible to estimate the age of the shell material. The studies also indicate that stone material tends to accumulate on the surface as erosion proceeds. Inevitably, this means that one is dealing with a mixture of lithic material on the midden surface, and, although this presents severe problems for the analyst, one can at least start with the qualified assumption that the material is mixed.

REFERENCES

P. J. F. Coutts 1968. "The Archaeology of Wilson's Promontory". M.A. Thesis, A.N.U. (Unpublished).

ACKNOWLEDGMENT

This paper is based on work carried out for an M.A. degree. Copious data to support the observations and conclusions will be found in the author's thesis, "The Archaeology of Wilson's Promontory", housed in the School of General Studies Library, A.N.U., Australia.

TABLE 1

COMPARISON OF PREDICTED AND ACTUAL STONE AND SHELL NUMBERS

Level No.	Predicted No. of shells or stones	Average No. of stones or shells lying in grid square	Predicted No. of shells or stones in eroding level (A)	Predicted No. of shells or stones in level above eroding level (B)	A + B	
3	740	128	94	42	136	TOTAL SHELLS
4	550	104	42	67	109	
5	500	125	67	124	191	
6	390	98	124	180	304	
3	297	89	2	11	13	SUBNINELLA
4	290	76	11	18	29	
5	275	71	18	59	77	
6	265	55	59	129	188	
3	55	18	1	1	2	CELLANA
4	55	18	1	12	13	
5	53	25	12	6	18	
6	45	18	6	8	14	
3	157	35	2	1	3	STONES
4	155	34	1	2	3	
5	152	26	2	14	16	
6	150	30	14	44	58	

TABLE 2

COMPARISON OF STONE AND SHELL DENSITIES PER SIX FOOT SQUARE FOR SURFACE AND EXCAVATED A SERIES SITES

Site and/or Excavation No.	Occupational Level	Culture Sequence	Density/six foot square	
			Shell	Stone
9A/6 (Exc)	1	Yanakie A	265	
	3		83	3
	4		71	2
	5		282	39
	6		173	37
	7			9
11/1* (Exc)	1	Yanakie A		5
	2		530	25
	3		520	67
	4		527	13
	5			20
9A/3 & 5 (Exc. pits)	1	Yanakie A	42	
	2		140	94
	3		168	
	4			186
	5		500	
9A (Surface)		Yanakie A	128	30
10A* (Surface of limited extent)		Yanakie A	380	27

* These figures have been included for further comparisons.