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The effect of recovery techniques on faunal data at Klithi, North West Greece

Twigs Way, *Department of Archaeology, University of Cambridge, Downing St., Cambridge CB2 3DZ, U.K.*

Summary

The palaeolithic rock shelter of Klithi, North Greece, has been undergoing investigation by archaeologists and geologists since 1983. During this period excavation strategies and in particular recovery techniques have been occasionally revised as the condition, type and density of the artefactual material was realised and further information was gained about the deposits within which the artefacts were contained. This report outlines recovery techniques practised at the site, and also presents the results of a short series of experiments designed to establish the cause and extent of fresh fragmentation and other types of damage which occurred on some of the bone material during the 1988 season.

The results of the experiments suggest that the damage may be attributed to the weight of overlying sediment etc. during post-excavation transportation and the rapid wetting/drying to which the faunal material is subjected. However, the sample used was too small to produce conclusive results. Finally there is a brief discussion of the need for more experimental work and fuller publication of recovery and recording techniques on early prehistoric sites.

Introduction

The rock shelter of Klithi is situated within the lower part of the Vikos Gorge in the Epirus region of Northern Greece. It is one of several palaeolithic rock shelters in the Epirus region and the largest so far known. Excavation of the site has been carried out since 1983 and is an integral part of a programme of research on the palaeolithic of the Epirus region which includes geological and palaeobotanical studies both within the Vikos region and beyond (Bailey *et al.* 1983; 1984; 1986a; Bailey and Thomas 1987; Sturdy and Webley 1987). The dates so far obtained on excavated material from Klithi bracket the prehistoric occupation of the site between 17,000 ± 400bp and 10,420 ± 150bp (Bailey *et al.* 1986b).

Major factors which have influenced the excavation and recovery techniques used on the site have been the overall objectives of the excavation and research project, the size of the site, the richness of the artefacts (i.e. their density within the sediment) and also the general inaccessibility of the site and the 'primitiveness' of its immediate surroundings in terms of facilities available.

The overall objectives of the excavation and the research programme of which it forms a part are fully described by Bailey *et al.* (*ibid.*) and it is only necessary here to note that these objectives include the detailed investigation of the spatial distribution of the cultural materials within the shelter, the identification of features such as hearths, 'dump' areas and other special activity areas, and therefore necessitate the fullest possible recovery of the artefactual material accompanied by recording and understanding of the microstratigraphy within which the material lies.

As has been stated, the shelter itself is the largest of this period in Epirus; currently the shelter opening is 25 m wide and 10 m deep although this may well have varied in the past. Until recently the shelter was used by a modern goat herder and this has produced a flat topped layer of dung over the whole area of 450 m^2—extending slightly out of the overhang. Although the exact depths of archaeological deposit within the entire shelter have not yet been obtained these certainly reach a depth of over 1 m in places and may reach 2 m, whilst seemingly 'sterile' scree deposits have been recovered to a depth of more than 7 m (Bailey and Thomas 1987). The problems of devising strategies and techniques to cope with such a large volume of complex deposits are several, including those of storage and safety, but perhaps the one that dominates is that of time (Bailey in press).

Inaccessibility of the site also dictates to a certain extent the post-excavation techniques used. The site is approximately 25 minutes by goat track to the nearest point which is accessible to a car, and there is a further 20 minute drive to the project house in Aristi where the majority of finds are currently stored and where detailed analysis of the artefacts is carried out. Therefore, it is highly desirable to remove all sediment from the artefactual material at, or close to, the shelter (although a few bags of sediment are carried back each year for specialist analysis/examination).

The excavation is fortunate in having access to running water in the form of the Vikos river which runs directly past the site 30 m below, but it is necessary to walk approximately 500m over very steep terrain to arrive at a point where the river is accessible for sieving or for use in flotation. In 1988, as staffing was limited, it proved necessary to dry-sieve on-site to remove the majority of sediment (<3 mm) and large limestone fragments (>10 mm) before this journey was made. However, this has not always been the case (see below).

Density of artefacts varies greatly across the site and according to context. However, it has been estimated that a single cubic metre of deposit within the shelter can yield as much as 160,000 recoverable specimens of flint and bone (Bailey in press) and during the 1984 season, when all bone material over 3 cm and all flint over 2 cm was individually plotted to the nearest centimetre, one area of the shelter contained approximately 800 plotted flints and bones in a deposit of 1 m^2 x 5 cm deep. This density is partly a function of the richness of the site (i.e. absolute numbers of artefactual debris) but it is also a relative product of the very slow sedimentation rate within the shelter's upper levels, estimated at an average of 0.4 mm per year (Bailey *ibid.*).

Although small mammal and bird bones are comparatively rare—the faunal assemblage is overwhelmingly dominated by ibex, *Capra ibex*, and chamois, *Rupicapra rupicapra* (Gamble, in Bailey unpublished)—recovery of the full size range of material has always been a recognised objective. Faunal material is analysed by quantity, weight and size of fragments (in addition to species, etc.; G. Bailey pers. comm.). In particular, with relevance to these experiments, it is felt that size can give a guide to both localisation of activity types and destruction patterns pre- and post-deposition (but importantly pre-excavation).

Recovery Techniques

1. Pre-1988 Recovery Techniques

Prior to the 1988 season recovery techniques had changed several times in response to results of on-going analysis of the recovered material and changing circumstances on site. Some discussion of this is contained in the interim reports for each field season and the major changes are briefly presented below.

Since 1984 actual tools used in excavation have always remained soft brushes and plastic scoops supplemented occasionally by small metal tools to loosen the more compacted sediments; these tools are felt to ensure that minimal damage is caused to fragile bones or the edges of the flint artefacts.

1983: This was the first season of excavation and the main objective was to evaluate the potential of the site. The team was fairly small and it was desirable to excavate one experimental trench to the base of the archaeological deposits. Spits of 5 cm and occasionally 10 cm were used for recording, with respect for layer changes, and there was no individual plotting of artefacts. The majority of the deposit was passed dry through 20 mm, 8 mm and 2 mm sieves and further samples were selected for water separation and flotation.

1984: Excavation in this year was concentrated in the parts of the shelter which it was believed were largely undisturbed since prehistoric occupation and which contained spatially distinct activity areas. Following the results of the previous year it was felt desirable to commence individual plotting of all bone material above 3 cm and all flint material above 2 cm. A combination of spits and layers was again used for recording and analysing artefacts under the size ranges above, with spit depth being restricted to 5 cm. In the report on the 1984 season it was stated that 'this method also ensures as complete a sample as possible of undamaged specimens, and has already in some cases altered our interpretations of the cultural material' (Bailey *et al.* 1986a). All material was dry-sieved through 10 mm and 2 mm sieves and again there was selective wet-sieving.

1985: Individual plotting was abandoned in this year as it had found to be extremely time-consuming given the density of artefacts and that examination of the deposit and sediment types suggested some vertical and possible horizontal movement may have taken place post-depositionally. Instead material was plotted to the quadrant (of size 50 x 50 x 5 cm, a quarter of an excavation area) and occasionally to mini-quadrants (25 x 25 x 5 cm)—again respecting layer changes. All deposits were now wet-sieved through 1 mm meshes on a flotation unit. This change in wet-sieving practice was made in the light of results gained by wet-sieving 1984 samples, which had been set aside for further analysis. Wet-sieving of these samples had shown that informative material in the 1–2 mm range was being lost by the practice of only dry-sieving. Dry-sieving was felt unnecessary prior to the wet-sieving stage.

1986: As much as possible was recovered at the excavation stage with all finds being provenanced to the mini-quadrant rather than the quadrant to simplify excavation procedures and subsequent statistical analysis. All sediment was again wet-sieved through 1 mm meshes.

1987: No excavation took place but work was commenced on a re-fitting programme for the lithic materials excavated in previous years and trampling experiments also took place to help assess horizontal and vertical movement within this type of loose deposit (Bailey in press; F. Wenban-Smith pers. comm.)

2. 1988 Recovery Techniques

The major changes in recovery techniques that were implemented in 1988 were the decision to bulk sample (within quadrants) rather than attempt to recover any material during excavation, and the re-introduction of dry-sieving through 10 mm and 3 mm meshes on-site prior to wet-sieving through 1mm meshes at the river. Flotation was not used—and had been abandoned since 1985 as results were so poor.

Individual plotting of material had also been discontinued since 1985 as the immense time consumed by this activity was not considered justified when balanced against the loss of overall information caused by restricting the time and therefore the area of the site that could be excavated. Since it had been noted (from analysis and experimentation) that certain areas of the site had also undergone a degree of mixing, this made exact plotting meaningless in some deposits, although it was obviously impossible to state prior to excavation which particular deposits had been disturbed. Results of lithic re-fitting carried out during the 1988 season by Wenban-Smith will shed further light on the integrity of the deposits and may again lead to modification of techniques in subsequent years. Bulk sampling by quadrants, followed by complete recovery through sieving was in a way a natural extension of the policy of not recording exact artefact placement. It had also been noted in 1986 that a two-tier system of some recovery within the trench and some at the sieving stage was time-consuming and generally decreased efficiency as artefacts recovered on-site had to be 'matched up' at a later date with material from the same quadrant (or mini-quadrants) recovered in the wet sieve.

Excavation techniques used in 1985 had been seen to be causing some damage to non-lithic material as it was recovered within the trench, in particular the fragile carbonised remains, and Bailey *et al.* (1986a, 18) stated that it was 'difficult to lift a bone without breaking it'. In 1988 the bulk sampling method was introduced mainly to speed up operations but also in the belief or hope that there would be no great damage to bones, and perhaps less damage than previously noted.

I produce below a brief resumé of the stages of 1988 post-excavation recovery procedure subsequent to removal by bulk excavation:

(a) Immediately after removal all sediment (and archaeological materials contained therein) were placed in a plastic bag ('soil sample' type); three of these bags were usually necessary for removal of a layer from a quadrant, and each bag was given an individual number which recorded the provenance of the material. Each bag contained up to 8 kg of sample.

(b) The contents of each bag were poured onto a standing stack of dry sieves in a shaker frame and agitated for approximately one minute. Sieves were 10 mm and 3 mm mesh (square holes) The bone material retained in the 10 mm sieve was extracted and placed back in the bag along with lithic material retained in this sieve (other than limestone fragments, which were discarded after brief examination). Faunal material and other residues caught in the 3 mm sieve were poured back into the bag. Towards the end of the excavation care was taken to place the >10 mm material back into the bag after the rest of the residue as it was feared that the pressure of the material from the 3 mm sieve might be damaging the bone already placed in the bag.

(c) The bags, now weighing 1–5 kg were placed in a sack with about four others and carried down to the wet-sieve—a journey of about 500 m over rough terrain.

(d) The sediment was poured onto plastic meshes (1 mm mesh size) and agitated in the river. The remaining bone and lithic materials were then laid out in the sun on the plastic meshes and left to dry in the sun for up to 3 hours (given the cold damp nights this was the only method of drying available; it was also necessary to lay out the meshes for as short a time as possible as in the afternoons the goat herder came through the valley and goats appear to regard plastic meshes as a legitimate part of their diet!).

(e) The dry material was poured back into the marked bags (now weighing 0.5–3 kg) loaded into sacks six at a time and carried back up to site.

(f) The contents of each bag were poured onto a table and sorted by hand.

Often there were extended periods of time between one post-excavation stage and the next and bags containing sediment were often moved around the site as on-site activities demanded.

It was at the hand-sorting stage during the 1988 season that fresh breaks were noticed on some of the faunal material. Material was often sorted by the person who excavated it originally and therefore not only were breaks visible by their clean whiteness, but particularly large or 'interesting' pieces might be remembered and so any damage to them commented on.

It is interesting that no fresh breaks were ever noted in the lithics, although they were not specifically examined at this stage for fresh chipping or edge damage.

Report on experiments carried out in 1988

Aims

Since observation of fresh breaks suggested the possibility of the 1988 bulk sampling technique causing damage to bone material, it was decided to carry out a short series of experiments to establish if bone fragmentation was occurring and, if so, to attempt to isolate the main causal factors and roughly to quantify the effects on individual bones, bone 'types', and ratios of bone fragment sizes. It was considered that if bone fragmentation was occurring this would have important consequences: reducing the numbers of pieces that were identifiable and also complicating the interpretation of variation in absolute bone numbers and sizes of fragments between archaeological contexts. It is possible that breakage had occurred in previous years and some idea of this should have emerged in the bone analysis when it was completed for each season, but this had not previously been specifically studied or quantified on site.

Method

To isolate and quantify the effects of the several post-excavation stages fully would have entailed several experiments being run, as each stage would, ideally, be undertaken on freshly excavated material of as near similar type as possible. However, as ever, the time available for this work was extremely limited. The following three experiments were therefore devised to be undertaken during the normal course of excavation on site.

Each experiment took place using the equivalent of a bag of archaeological deposit which was removed from the same quadrant and layer (removal of a quadrant usually necessitating filling three bags).

Experiment 1

This experiment was designed to assess the overall effects of post-excavation treatment on a sample of faunal material. The stages were as follows:

(a) excavation in usual manner of one-third of a quadrant with resulting sediment, etc., placed carefully in a large flat container rather than in a bag, thus minimising the weight placed on the bone material.

(b) measurement and recording of faunal material extracted—this produced the 'baseline' against which breakage was recorded, and also gave an indication of damage caused by excavation technique. All material was then placed in a bag and proceeded through post-excavation in the normal manner as described above.

(c) after sorting, the bone material was re-examined and measured and any breakage or other damage noted.

(d) comparisons were then made between results from stages (b) and (c).

Experiment 2

This was designed to assess the effect of dry-sieving (alone) and wet-sieving (combined with dry-sieving) on the bone material, but without the material being poured in and out of sacks, so minimising the weight factor throughout the whole recovery procedure.

(a) material was excavated into a large flat container and bone material extracted, measured and examined as in Experiment 1.

(b) the bone was placed gently back into the container and re-amalgamated.

(c) material was then put in the dry sieves and agitated, and then placed again into the flat container and the bones extracted and measured again.

(d) material was then placed again into the container, and taken to be wet-sieved as normal and left to dry.

(e) artefacts were then carried back up to site using a large container and sorted in the normal way, the bones being re-examined, measured, etc.

Comparison was made of results at stages (a), (c), and (e).

Experiment 3

This was designed to assess impact of wet-sieving (solely) on the bone material. It was carried out in the same way as Experiment 2, but omitting stage (c). Comparison was to be made before and after wet-sieving.

The information recorded at each examination stage was as follows:

(i) for all bone over 3 cm, and bone under 3 cm but identifiable to bone element, i.e. humerus, tibia, etc. (on brief examination):

maximum length
maximum width
maximum thickness
burnt or unburnt
signs of fresh breakage or other damage
articulations present
identifiable or not
comments

(ii) for all bone over 1 cm but less than 3 cm, not identifiable:

fragment count

(iii) bone under 1 cm was not examined unless it was identifiable to bone type (i.e. small mammal bones)

Each category was also weighed as a group, but sensitive scales were not available so it was felt that it would be misleading to weigh the <1 cm material as accuracy was only in the region of ±5 gm. The results of the experiments are shown in Table 6. Note that bone measurements are not reproduced here.

Discussion of experiments

The main conclusion from the experiments was that damage to the bone material was not as extensive as had been expected from the casual observations that had prompted the whole exercise.

There could be several reasons for this, but I would suggest two main factors. Experiment 1, despite being based on 'normal' post-excavation procedures did not mimic

Experiment 1 (all the bone was lightly burnt)

	Number	Weight (g)	No. Damaged	No. Articulated	No. Identified
1. *Results at stage (b)*					
Bone >3 cm and bone <3 cm identifiable to type	41	100	11	11	29
Bone >1 cm <3 cm	54	40	-	-	-
Teeth fragments	4	-	-	-	-
2. *Results at stage (c)*					
Bone >3 cm and bone <3 cm identifiable to type	36	90	23(+3)*	11	30
Bone >1 cm <3 cm	62	30	-	-	-
Teeth fragments	4	-	-	-	-

*Table 6 (above and opposite). Results of the experiments carried out in 1988. Notes: *—two bones showed signs of cracking and one of surface peeling; †—two bones showed signs of cracking, two of surface peeling, and four of 'edge nibbling'. Experiment 3 (in which all the bone was lightly burnt) was abandoned in view of the lack of damage in Experiment 2.*

either more resistant to damage or has already been as fragmented and damaged as it is likely to get.

As mentioned above, comparison of results from Experiments 1 and 2 suggests that more damage (particularly breakage) takes place when faunal material is subjected to an overlying burden of loose sediment and other artefactual material. Although it would be extremely difficult to replace the soil sample type bags with a receptacle that reduces this weight load (the large washing-up bowl used for the experiments would have been impossible to use during the normal course of recovery), perhaps it should now be considered whether the damage from this factor is great enough to outweigh the advantages of bulk sampling.

Cracking and peeling did occur as a direct result of the washing and drying of the bone. This is obviously a problem that should be considered and, if possible, within the restrictions imposed by the climate and situation, post-excavation procedures altered. Although at this stage it was not severe enough to affect identification it is not known whether further degradation will occur during storage.

The following additional points were also noted and emphasise the difficulty of such on-site experiments as much as giving any absolute results:

(a) More breaks were identified after wet-sieving—but this may well reflect the fact that breaks and damage are difficult to recognise whilst the bone is still covered in sediment and therefore may not necessarily mean that it is the wet-sieving that is causing the damage. This also makes it difficult to ascertain if the excavation techniques alone are causing damage. Further experiments on comparative damage by excavation techniques would be interesting particularly in view of the comments by Bailey *et al.* (1986a) about problems with lifting and my comments above.

Experiment 2 (all the bone was lightly burnt)

	Number	Weight (g)	No. Damaged	No. Articulated	No. Identified
1. *Results at stage (a)*					
Bone >3 cm and bone <3 cm identifiable to type	44	120	2	20	29
Bone >1 cm < 3cm	46	30	-	-	-
2. *Results at stage (c)*					
Bone >3 cm and bone <3 cm identifiable to type	45	110	3	20	29
Bone >1cm <3cm	69	50	-	-	-
3. *Results at stage (e)*					
Bone >3cm and bone <3 cm identifiable to type	45	110	3(+8)†	20	28
Bone >1 cm <3 cm	59	40	-	-	-

and therefore may not necessarily mean that it is the wet-sieving that is causing the damage. This also makes it difficult to ascertain if the excavation techniques alone are causing damage. Further experiments on comparative damage by excavation techniques would be interesting particularly in view of the comments by Bailey *et al.* (1986a) about problems with lifting and my comments above.

(b) More material was recovered at each stage in terms of numbers (and occasionally weight) especially in the 1–3 cm range. Again this might be caused by material becoming easier to recognise as it passed through each stage and sediment is removed. It may mean, however, that material was breaking down into this category.

(c) Loss of identifiability of fragments seemed minimal except in the categories of rib fragments and two vertebral epiphyses which were lost in Experiment 1 from the >3 cm category. *Fragmentation where it occurs appears to be selective, in that certain skeletal elements appear more susceptible to breakage; this may, of course, bias the final analysis in several ways.*

Obviously it would have been preferable to repeat the experiments several times to gain a larger sample and also to use unburnt material. However, further time on site was not available. It would also have been difficult to ensure, in advance, that the material about to be recovered would be unburnt.

Conclusions from the experiments

Despite the very small scale of the experiments, and the consequent problems of interpretation of results, they did prove useful in suggesting the main causes of the bone fragmentation that had been previously noted at the sorting stage, namely crushing by weight and the peeling/cracking caused by rapid wetting and drying. The fact that the damage was less than expected is particularly interesting—this may have been a factor of the experiment design as discussed above or it may be that the sorters had over-estimated the amounts of breakage, as the bones damaged tended to exhibit fresh 'white' areas that were easily visible.

When the detailed specialist analysis is completed on the 1988 faunal material as a whole (including quantification of breakage) then we should be able to compare this with previous seasons and detect any gross changes in patterns of 'fresh' damage although, obviously, comparability will be an even greater problem than was the case for the experimental material which was all specifically taken from the same quadrant and context.

Discussion

The original aim of this article was to present the results of the short experiment on bone fragmentation. The secondary aim which grew from the background reading for the original theme was to make available for discussion the methods of recovery used at Klithi with accompanying record of the changes that have occurred in these methods over the course of the five years of excavation and analysis, in the hope that this would encourage discussion of the techniques used, and subsequent problems and responses to them at other sites, particularly sites of the same period or type.

The very factors which have contributed to the enormous archaeological value of Klithi—namely the richness of the site and wealth of information potentially available, the type, condition and distribution of the artefactual material present, and also the relative inaccessibility of the area—have resulted in the recovery problems which I have outlined above. These are all factors which must have been tackled time and time again in archaeology and face directors at the start of many excavations when decisions on levels of recording and type of recovery practised have to be made. The techniques utilised on a site, subsequent changes and developments in response to pressures of time (and money) and results of on-going analysis are of interest to all who are attempting to formulate their own methods.

With reference, in particular, to early prehistoric sites the decision to bulk sample rather than recover material *in situ*, and not to record the position of each artefact to the centimetre, is one that merits discussion. The majority of palaeolithic and mesolithic sites undergoing excavation in Europe at present favour a system of three-dimensional recording, usually to the centimetre, occasionally to the millimetre and often with comments on angle of declination, axis, and so forth. The decision at Klithi not to continue this practice (following from the results of analysis of breakage, re-fitting, examination of matrix type and assessment of time and information loss at the meso-spatial scale) is one that may encourage wider discussion of reasons for continuing this practice and justifications for it.

There may be a reluctance to change recording or recovery systems part way through an excavation, even as a result of on-going analysis, but overcoming problems caused by changing techniques several seasons into the excavation may not be as time-consuming as the continuation of those techniques if they are more detailed than can be justified—for example, if the matrix was subjected to much post-depositional mixing. It will be realised that this approach puts emphasis on on-going analysis with results of previous season's excavation having to be available when decisions are being made as to techniques to be used in the following season.

On-site 'experiments' such as those of Sebastian Payne (1972; 1975) were of vital importance to the development of currently accepted standards and recovery techniques but, although this work on development of techniques is still carried out by various workers, there are few examples of on-site experimentation and assessment of recording and recovery techniques on 'artefacts' in general. If there appears to be a problem with fragmentation or edge damage, or indeed with the pace or scale of recovery, it is easier to quantify, analyse and successfully address these problems if experiments can take place *alongside* excavation with exact duplication of techniques in the particular circumstance of the site than if analysis and experimentation take place at the close of the season away from the site (often in laboratory conditions) or even after the completion of the excavation of the site entirely.

Perhaps the arena in which work of this kind could best be presented and discussed would