

## The bioturbation of cave sediments by decomposers

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### Introduction

The investigation of animal remains in cave sediments is important to palaeontology and palaeoecology (Bramwell 1964; Campbell 1969; Gale, Hunt & Southgate 1984). However, the post-depositional processes, including decomposition and burial, are almost unknown. Recent work (Terrell-Nield unpubl.) suggests that these processes may result in misleading information when the remains are excavated.

The agencies responsible for the decomposition of animal remains underground are microbial and invertebrate. An investigation is currently under way to determine the degree of bioturbation caused by these decomposers.

### Methods

The investigation is being conducted in Robin Hood's Cave at Creswell Crags, Nottinghamshire (53°16'N 1°12'W). Rat carcasses have been deposited at three sites in the cave at increasing distances from the entrance. Results presented are based on experiments conducted in the middle chamber of the cave, approximately 35 m from the entrance.

Invertebrates in the cave are being monitored by pitfall trapping, and temperature and humidity constantly recorded. Carcasses have been regularly examined and photographed to assess post-depositional movement and overall appearance.

Since the remains will be excavated after two years, the carcasses were placed in tanks containing cave sediment of known depth and texture. Three sediment depths (5 cm, 10 cm and 15 cm) were obtained by partially filling the tanks with concrete.

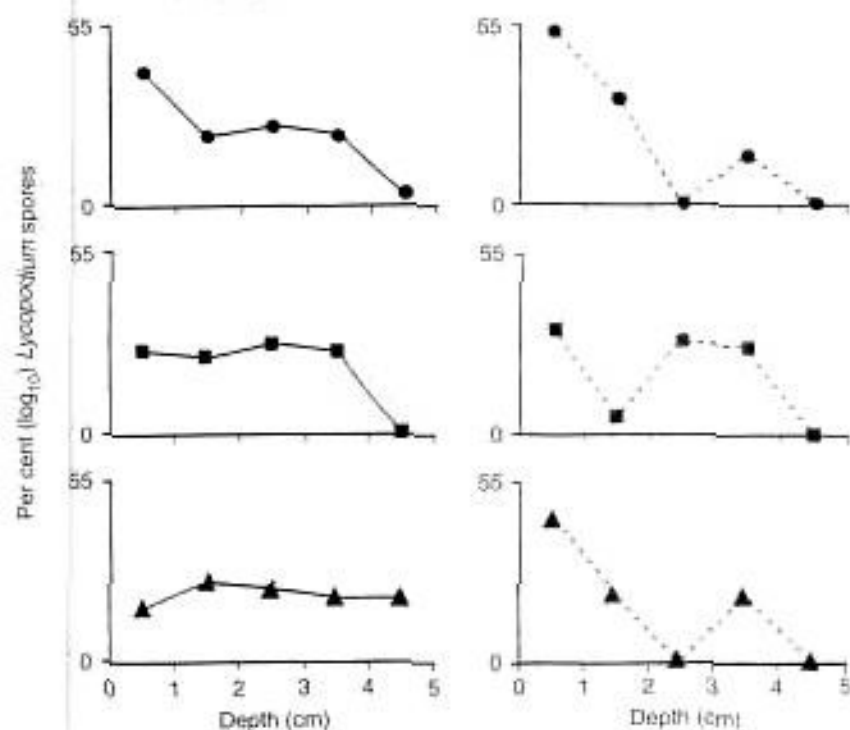


Fig. 1. Distribution (logarithmic) of *Lycopodium* spores in Tanks 10 (solid line) and 7 (hatched line) in relation to depth. Tanks 10 and 7 each contain carcasses on sediment to a depth of 5 cm. Circles indicate samples from cores taken from the sediment in the region of the head of the carcass, squares indicate samples from the tail region and triangles indicate samples from the edge of the tank.

- Campbell, J.D. (1969). Excavations at Creswell Crags. *Derbysh. archaeol. J.* 89: 47–58.
- Gale, S.J., Hunt, C.O. & Southgate, G.A. (1984). Kirkhead Cave: biostratigraphy and magnetostratigraphy. *Archaeometry* 26: 192–198.
- Terrell-Nield, C.E. (Unpublished). *Animal decomposition in caves*. [A video paper presented to a seminar on cave archaeology, at Creswell Crags, May 1988.]

To monitor bioturbation, the sediment was layered every 5 cm with a mixture of dried *Lycopodium* (Lycopodiaceae: Pteridophyta) spores, fresh pollen and polystyrene beads, plus talcum powder to make the marker layer more visible. The polystyrene beads were dyed different colours so that the layers were distinguishable.

Six tanks (two of each depth) were placed at each site. So that carcasses were accessible to flightless arthropods, the tanks were lowered into holes in plywood sheets over pits in the cave floor. A control tank, prepared in the same way as the experimental ones but with no carcass, was also placed at each site to determine how much bioturbation occurs without decomposing material.

After six months (when the 'active' stages of decomposition had passed), three cores were taken from each tank, one from the sediment in the region of the head of the rat, one from the tail region and one from the edge of the tank, approximately 20 cm from the centre of the carcass. Each core was separated in 1 cm samples.

To determine the degree of mixing, each sample was first examined for beads, bones, puparia etc. If these were present they were removed and recorded.

One gram of sample was boiled for 30 min with 20% KOH and filtered through 100 nm nylon bolting cloth, and the filtrate was centrifuged at 550 g for 3 min. The sample was resuspended in 2 ml distilled water and 0.8 ml 0.02% methylene blue was added. After centrifuging as before, 50 µl of the sample and 20 µl of glycerine albumen were transferred onto a microscope slide. The pollen grains and *Lycopodium* spores on the slide were then counted.

## Results and conclusions

Figure 1 demonstrates that during decomposition the underlying cave sediment is subjected to an appreciable amount of bioturbation.

Many more samples have been taken, down to 15 cm, and it is hoped that the degree of mixing at a specific depth and distance from a carcass can be predicted.

This is a new method by which the extent of bioturbation of cave sediments by insects can be assessed. It is hoped that it may be used to assist workers examining ancient remains in sediment and also, possibly, forensic scientists.

## References

- Bramwell, D. (1964). The excavations at Elder Bush Cave, Wetton, Staffordshire. *N. Staffordsh. J. Fld Stud.* 4: 46–59.