A QUANTITATIVE APPROACH TO CAVE CONSERVATION

by

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If we are to consider conservation as an attempt to minimise damage to a particular resource so as to preserve the resource for posterity then a way of recording the damage that is occurring to the resource becomes necessary. I will attempt to discuss four different methods of recording the amount of damage that has occurred in caves.

The first and most graphic method is a pictorial description of the cave. This would involve a series of pictures taken of various parts of the cave. Each picture would have to have a map reference and bearing and elevation figures supplied so that a similar picture may be taken at a later date for comparison. It would also be desirable to have the picture taken in colour and produced on a ten by eight format. The desire for colour can be explained by the tendency for a black and white photo to give a false impression of the cave. This method is purely qualitative and would be ideal for public relation purposes but has cost as the major objection to its extensive use.

The second system involves a verbal description of the cave taking note of several areas in which damage can be seen. These areas are:

(1) Markings on the walls;
(2) Amount of floor that has been turned into tracks;
(3) Damage to delicate formations;
(4) Damage to massive formations;
(5) Amount of rubbish left in the cave.

The description can also include any other damage of note in the cave. This system is probably the most versatile as it requires the least amount of effort to give a reasonable idea of the state of the cave. Unfortunately the system is still highly qualitative and very subjective.

A higher degree of objectivity can be obtained by using a grading similar to that used by rockclimbers.

DG0 – A cave that has not been entered, i.e. unexplored.

DG1 – This is a cave that has been entered by only a few people. It has virtually no markings on the walls. A track through only the obvious passages. Delicate formation that obstructs the track is the only formation that has been damaged and, of course, there would be no rubbish left in the cave.

DG2 – The cave is fully explored (excluding any undiscovered areas) with the damage associated with such exploration having occurred. Tracks are still well kept to and not much damage has occurred to formation off the tracks. Some of the flowstone is becoming soiled and any delicate formation placed so that some care would be required to avoid damaging it has been broken. Arrows are beginning to appear on the walls along with some other very occasional markings. An occasional flashbulb or carbide dump may be seen but would be unlikely.

DG3 – This would be a recently discovered but popular cave or a long known but much less popular cave. Arrows become frequent and initials become more common. Tracks are wide and more diffuse. A large percentage of the accessible delicate formation has been broken. Flowstone has become soiled while tracks crossing flowstone have become stained by people who have not taken the precaution of removing their boots and overalls before crossing it. You can expect to find some rubbish somewhere in the cave.

DG4 – This is a badly damaged cave with writing on the walls becoming common. All of the floor has been walked over, the delicate formations have been extensively damaged and a large percentage of the massive formations have been stained. Some of the massive formation has been broken. Rubbish has become common and one could expect to find flashbulbs, paper, carbide and similar litter in the cave.

DG5 – This is an extensively damaged cave with large amounts of writing on the wall. The floor has become extensively trampled. All the delicate formations have been broken and most of the massive formation has been damaged. There is evidence of extensive deliberate vandalism. Large amounts of rubbish are to be found in the cave.

DG6 – This cave has been removed by mining.

This system is more objective than the second method and also introduces a quantitative element into the description. A single cave could have several ratings for different parts. This method could also be coupled with the second method as a shorthand way of describing a particular part of the cave.

Unfortunately this method is not as quantitative as is desired: there are only five effective groups, and there is no definite mathematical relationship between any of them.

A way to overcome these problems is to obtain an index for each of the indicated areas (i.e. walls, formation etc.) and to combine them with appropriate weighting factors so as to average or coefficient.

(1) By taking a series of ten inch squares at random at shoulder height as one moves through the cave one can obtain an approximation of the area of marking on the wall. For each square, take the total length of marking and multiply by its width to obtain a percentage. These percentages are then averaged out over the number of squares used.

(2) The amount of track space can be estimated as a percentage of the floor area.

(3) The number of delicate formations broken can be obtained as a percentage of the total number of delicate formations (delicate formations to include helictites, small stalactites, small stalagmites and crystal formations).

(4) Massive formation can be taken as the area stained or broken as a percentage of the total area (massive formation to include flowstone, columns and non-fragile stalactites, stalagmites and also large shawls).

(5) Damage to the previous four categories occurs geometrically where as the amount of rubbish that accumulates in a cave appears to follow a more linear progression. If we therefore take a logarithmic function of the number of pieces of rubbish left in a particular area the figure should conform to the other four indices.

If these indices are taken from a number of areas in the cave spaced at intervals of say 20 minutes travelling time throughout the cave, then by combining the indices from a particular area in this form:

$$D_{dI} = \frac{aA + bB + cC + dD + e \log fR}{n}$$

where A = index from wall markings
B = index from track space
C = index from delicate formation
D = index from massive formation
R = number of items of rubbish

a, b, c, d, e, f, are weighting factors for their appropriate index and n = the number of indices used in that particular region.

It is necessary to introduce weighting factors for each of the indices so that the absence of any of them should not affect the result, e.g. there may be no formation in the particular region, or the floor may not give a definite track area. The weighting factors can be obtained by taking the average of a large number of values for a particular index from many caves, the average for each index is then adjusted by the weighting factor so that the weighted average for one index is equal to the average of the unweighted averages of the other indices.

To obtain the final coefficient for the cave it only remains to average the various coefficients for the various regions:

$$C_d = \frac{\sum_{1}^{m} C_{dI}}{m}$$

where m = the number of regions
C_d = coefficient of destruction.

This method is truly quantitative and may be used in statistical analysis. As an example of one of its applications C_d could be plotted against: entrance size, distance from campsite, length of time known, distance from road, distance from nearest large city.

If there is some doubt as to a particular cave's rate of damage a series of readings at regular time intervals could be taken to see just how much damage is occurring. Similarly a standard could be set whereby if a cave approaches it those concerned with the conservation of the particular cave should start thinking of taking positive steps towards further protection, e.g. a gate, asking the local landholder to restrict access, or getting the government to take legislative steps towards protection.

In many cases the above four systems can be used for only part of a cave as well as for individual caves or possibly for a whole area.