POSTER AND INTERACTIVE WORKSHOP

IS IT A CAVE AND HOW LONG IS IT?

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REVIEW OF THE WORKSHOP

The purpose of this presentation was NOT to present dogmatic or erudite definitions of the subject, nor to exhaustively review and discuss the subject. Instead, enlarged poster copies of Sheets 1 and 2 were displayed prior to the Workshop, participants were invited to apply their experience and perceptions to a variety of actual cave maps, and key concepts and issues were then discussed in workshop.

Many speleologists have little familiarity with caves in tropical Australia, so differences between caves in temperate and tropical environments were highlighted, with particular attention given to caves in the tropics, many of which are characterised by roof holes, collapses, grikes and multiple entrances to a far greater extent than is encountered in temperate latitudes. Discussion then proceeded on segmentation of cave passages, roof holes and collapses, large chambers, dolines and shafts, drip lines etc. The definitions presented at the conclusion were those employed in surveying Bullita Cave in the Northern Territory.

Workshop discussion raised some interesting points relating to recent advances in the technology of cave surveying whereby cave passages visible to the surveyor can be measured without human entry. Thus in Lechuguilla Cave (New Mexico) electronic distance measuring devices (DISTO) are now measuring the length of some passages large enough to traverse, but considered too fragile to enter. The even more recent development of the spinning IR laser (Anon. 2004) similarly raises the prospect of rapid electronic surveys of cave passages with quite limited human entry, indeed of decisions about lengths being determined only after a 3D map is automatically generated post-survey.

Consistent application of the principles covered in the Workshop will very likely increase the length of any one cave even without discovery of significant new passage, and certainly as more accurate surveys are undertaken.

IS IT A CAVE?

From time to time debate takes place about exactly what *is* a cave and how to measure its length, and efforts are made to provide more rigorous definitions. So, the first question in our exercise is, is it a cave? (See Sheet 1). The ASF definition of "A natural cavity in rock, large enough to be entered by man" is probably the most useful general wording. Some definitions are enshrined in legislation. For example, in the USA the *Federal Cave Resources Protection Act 1988* defines a cave as "any naturally occurring void, cavity, recess, or system of interconnected passages which occurs beneath the surface of the earth or within a cliff or ledge (including any cave resource therein, but not including any vug, mine, tunnel, aqueduct, or other manmade excavation) and which is large enough to permit an individual to enter, whether or not the entrance is naturally formed or manmade. Such term shall include any natural pit, sinkhole, or other feature which is an extension of the entrance".

This is a start but leaves open debate about how long the "naturally occurring void" has to be in order to qualify, and it is here that perceptual differences arise. Refined definitions usually attempt a distinction between caves and overhangs or rock shelters, and/or set precise minimum lengths, but in reality there is a continuum involving ratios of height, width and depth, and total length and/or depth. At an ASF Conference over 20 years ago Ken Grimes gave an informal but enlightening presentation on the definition of a (primarily horizontal) cave. The consensus among participants then was that if the maximum entrance diameter is greater than the length of the hole, then it is a 'rock shelter' and not a cave. A similar approach could be used to separate dolines from shafts i.e. an open depression or shaft has to be deeper than it is wide to qualify. When it comes to minimum qualifying length Savage River CC, for example, sets a criterion of either 10m deep or 10m long. At Jenolan Sydney University Speleological Society appears to have used the criterion of whether a human body would fit into the hole.

So, to a large degree we all have our own subjective idea of what a cave is. We know one when we see it, but we should still observe the accepted criteria.

ONE CAVE OR MULTIPLE CAVES?

Argument sometimes arises about whether a particular system should be regarded as one cave or many. For example, James et al. (1988) record debate about whether the caves on the two sides of the Grand Arch at Jenolan are part of the same system. In early lists (e.g. Ellis 1971) the two systems were listed separately and dissent from the consensus that there was really only one cave seemed to be based on daylight penetrating the entire arch, which in fact is more than 150m long between driplines. Minor collapses and daylight holes such as in Example 2 on Sheet 1 do not segment a cave and Example 8 is regarded as one cave because the openings are deeper than they are wide and it is possible to traverse the entire cave without passing outside the dripline. However example 7 is one cave only if the 3 larger collapses are deeper than they are wide. Crawford (1993) dealt with some of these conceptual aspects.

CAVE LENGTH

From here we move to the second question of how should we measure a cave's length and compare it with others (Sheet 2). Let's concede that because cave length is a simple number, people tend to grab hold of it and use it for comparative purposes, but it is a poor indicator of the true significance of a cave. From the point of view of a geologist or geomorphologist, the whole argument is fairly pointless. If a set of segmented passages is part of a genetic whole then it is one system, regardless of how many accidental collapses or discontinuities there are. For example, the main branch of the

genetically part of the same system. And, even more than a map of a single cave, karst area maps showing the relative position of a series of such disconnected caves can enlighten understanding of the geomorphological processes at work. Surveyors should aim to do this regardless of any perceptions about whether there is one cave or multiple caves.

Several measures of length are available:

The *map length* (also called the plan length, horizontal length, or sometimes – misleadingly – as true horizontal length) is the corrected horizontal length shown on a plan i.e. the measured distance corrected for elevation or depression. This is a projection and underestimates the true length, especially in caves with significant depth. If this measure were utilised, for example, a 100m deep pothole would have a length of only a metre or two.

The *survey length* is the total of everything surveyed, including surface surveys, resurveys, surveys around large chambers, and splay shots, and is, for example, readily available on cave survey programs such as COMPASS. This is a useful statistic but even within a cave it over-estimates by double-counting sections of passages or chambers. James et al. recorded that over 8km of traverse was measured to survey the Grand Arch at Jenolan, but noted that the length of such a feature is the traverse line from dripline to dripline with projections to the passages leading from it.

The *cave length* is the sum of all the surveyed distances between the survey stations. It is defined as the measured slope distance (not the horizontal or vertical distance), including minor zig-zags, short tie-in shots, vertical drops and maze passages, but excluding splay shots, radial shots, circumference shots around large chambers. It is a measure also readily available on COMPASS and other programs.

Cave length has been the accepted statistic internationally for nearly 40 years (Kermode 1968) and may be regarded as the accepted measure for comparative purposes, while Chabert & Watson (1981) have already canvassed many of the resulting practical applications, especially mazes. Much of the reasoning behind this is based on a utilitarian argument. As we observed, cave length is a measure used primarily by recreational cavers, not scientists. It gives a good estimate of the true distance a caver has to travel to actually move through the cave, up and down over large breakdown, through difficult rock piles, and up or down vertical drops. Even then it probably underestimates the distance a little, for circuitous routes are often necessary to avoid floor pits and to traverse large breakdown piles.

This utilitarian principle effectively places a lower limit of about 30cm diameter on any cave passage, obviating any argument premised on the existence of proto-caves of dimensions too small to admit human passage, however significant those may be to scientific enquiry. However, passages still must be surveyed, and on current criteria must also have been entered. So cave passages, rifts, vertical shafts, phreatic tubes etc. which have not been surveyed are not counted in cave length, whether or not they have been entered. Bullita Cave, for example, has numerous narrow shafts up to 20m high, often reaching the surface through small daylight holes. Only the very few which have been climbed or descended and surveyed would be counted in cave length. Similarly, the Gunbarrel Aven at Wyanbene (NSW) is part of the length of the cave to the extent that it has been climbed and measured, but not to the height reached only by hydrogen balloons. Nor should the height of a chamber higher than it is wide be counted unless it has been climbed or descended and surveyed.

I have consciously not dealt in detail with cave depth, defined as the vertical difference between the highest and lowest survey points within a cave (not the vertical distance between the entrance and the highest or lowest surveyed point, unless the entrance is one of the vertical extremities). This is a much more precise measure than cave length, but again, domes, pits, rising shafts and rifts which have not been surveyed should not be included in cave depth.

Clearly there will always be an element of subjectivity about cave length. However, a caver consulted about this presentation observed that if there is a general consensus (either nationally or internationally) about acceptable ways to define a cave and measure its length, then different caves can be broadly compared using widely accepted criteria even if room remains for argument about precise definitions. That consensus does exist in the statistic of cave length.

In conclusion, I urge even experienced cave surveyors to consult the books now readily available on the subject, notably Ellis (1976) and Dasher (1994) to gain a wider understanding of conceptual and practical difficulties.

SOME WORKING DEFINITIONS (PRIMARILY FROM DASHER 1994)

The definition of a cave is not based on the existence of a dark zone, though that might be significant for biologists

"A cave is a continuous subterranean cavity; any discontinuity such as a collapse where one must leave and re-enter a cave, divides that cave into two caves"

"However, a daylight hole or collapse only segments a cave if it is not possible to travel between the two passages without crossing the drip line i.e. if the whole roof hole is not the full width of the passage."

"An open collapse pit is part of a cave (for purposes of adding to total length and/or depth, if and only if its greatest horizontal dimension (width, length or diagonal) is less than its depth"

ACKNOWLEDGMENTS

Ken Grimes, Chairman of the ASF Survey Standards Commission, offered useful advice about this presentation, along with Bob Kershaw, who has charge of protocols and standards for the survey of Bullita Cave, NT. The maps used to illustrate the presentation were from publications of Chillagoe Caving Club and from the Nullarbor Cave Atlas, CEGSA, 1986.

NOTE RE ACCOMPANYING WORKSHEETS

Note that in Sheet 1, the scale bars accompanying each map all represent a distance of 10m. ■

REFERENCES

Anon. 2004: Lasers scan caves for science. *http://www.prweb.com/releases/2004/9/prweb157673.htm*

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Ellis, B. 1976: *Surveying Caves.* British Cave Research Association, Bridgwater, Somerset, 88pp.

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James, J. M et al.1988: The Jenolan Cave System Surveying Project. Part 1 – History, Organisation and Assessment (pp. 25-30 in) *Proc. 17th Biennial Conf. Aust. Speleological Federation*, Lake Tinaroo.

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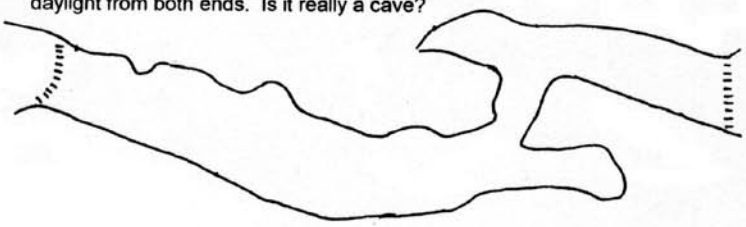
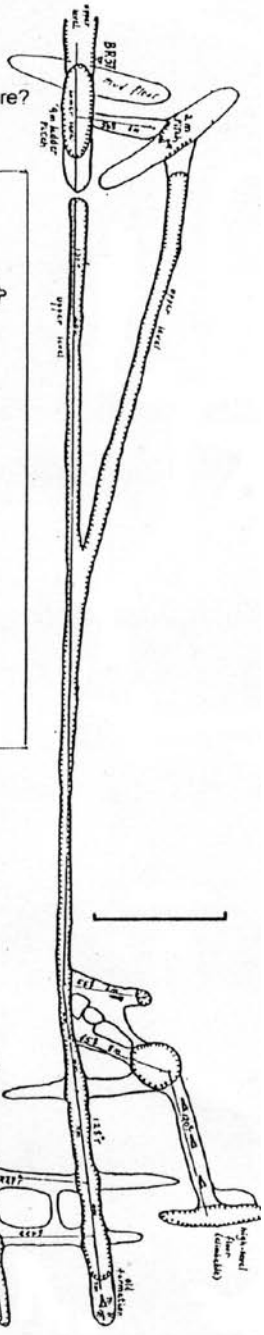
SHEET 1
Is it really a cave?
(examples mostly from tropical Queensland.
(vertical drop at grike or roofhole)

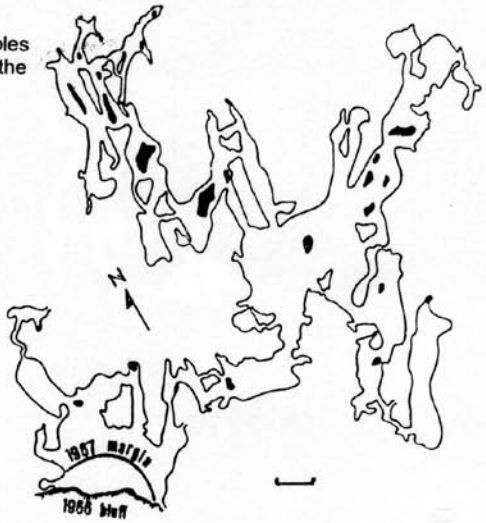
1) Is it a cave *only* if it has a dark zone? This karst feature is lit throughout by the sun and by daylight from both ends. Is it really a cave?



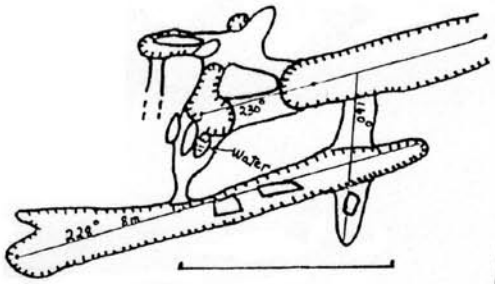
4) How many caves here? Pick a number!

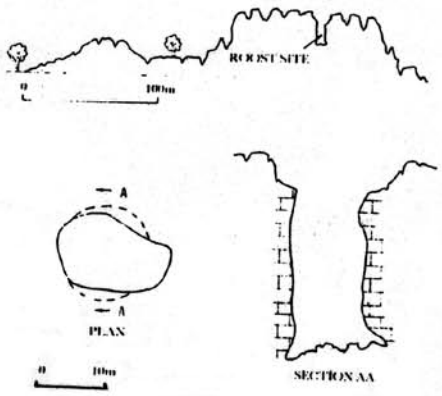


2) In this cave the shaded areas are roof holes that light up much of the cave. Can we call the whole feature a cave?



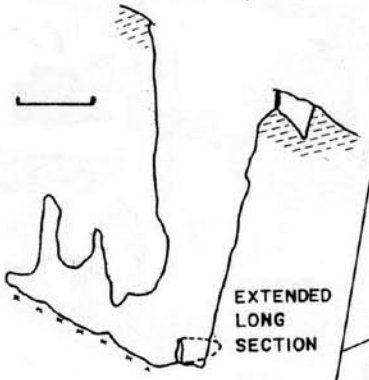
3) How many caves are there here? 1, 2, 3, 4 or 5 ?

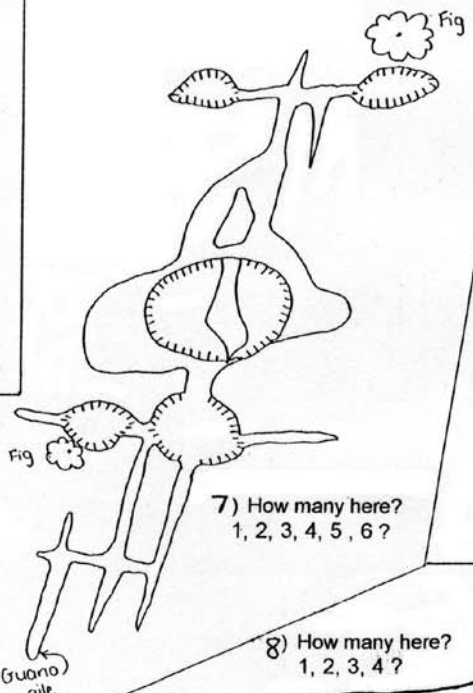




5) Is this a cave?

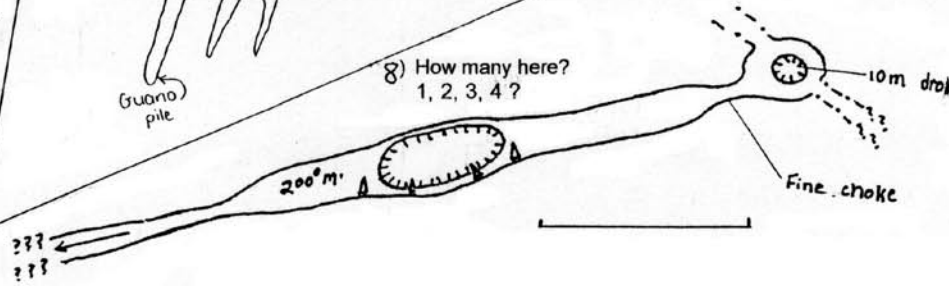
6) How about this one, then?





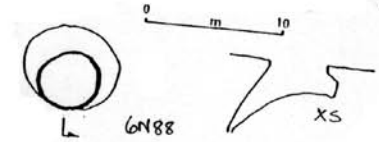
7) How many here? 1, 2, 3, 4, 5 , 6 ?

8) How many here? 1, 2, 3, 4 ?



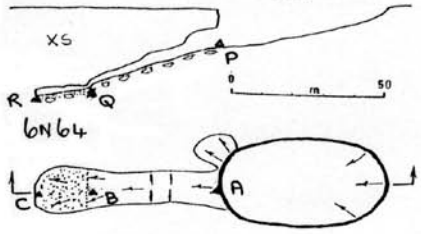
SHEET 2:
If it's a cave, how long is it?

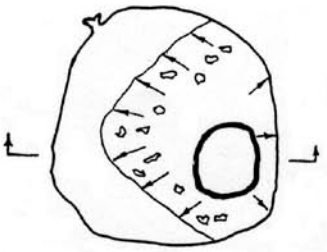
(small maps from Nullarbor Cave Atlas, CEGSA, 1986. Thin lines are cave walls, thick lines are edges of doline / blowhole)



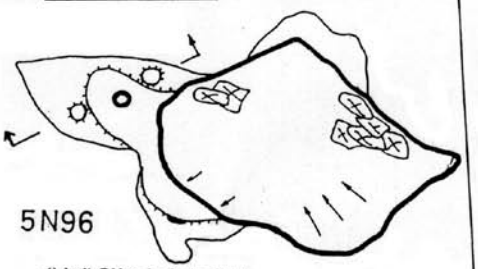
1) Is it a cave?

2) Is *this* a cave? Is its length the map length AB+BC, or the traverse (slant) length PQ+QR?

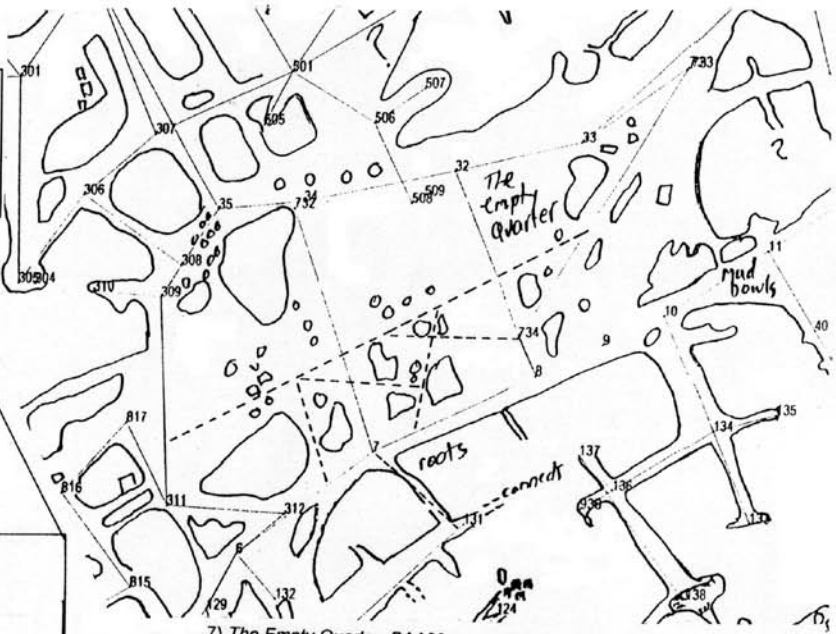




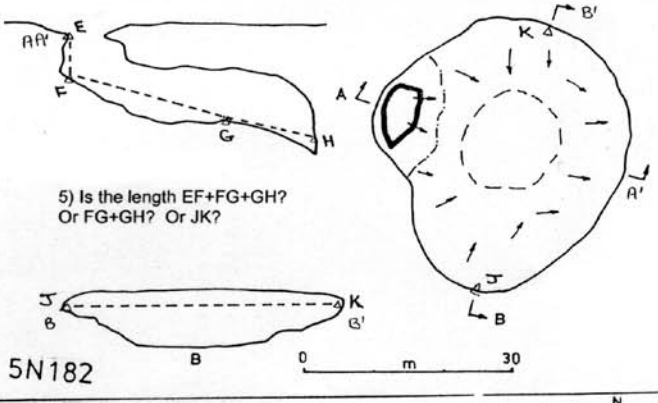
3) OK, what about this one?



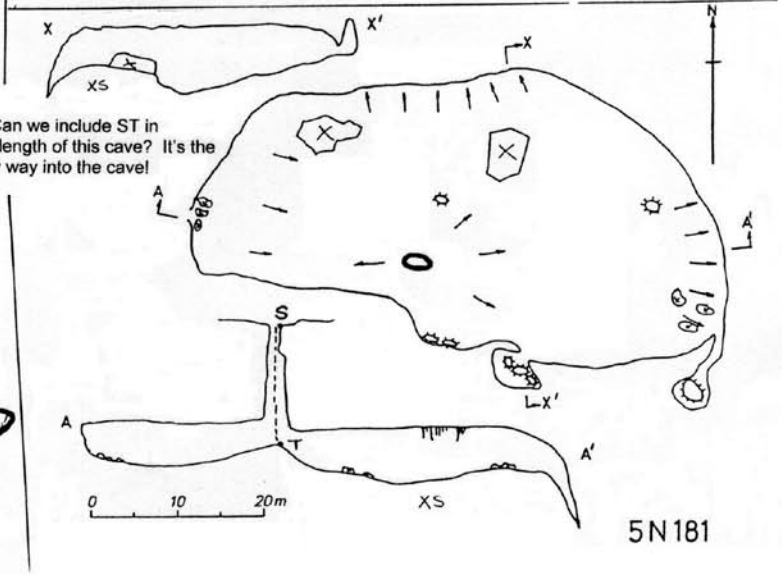
4) Is it OK to include GH in the length of this cave?



7) *The Empty Quarter, BAA29, part of the 5km long BAA29 Gregory National Park, NT. Closed lines are solid rock walls. Light, straight lines are survey traverses. Dashed straight lines are lines of sight that could have been surveyed (but weren't).* Ink in the ones you think could legitimately be counted as cave passage length.



5) Is the length EF+FG+GH? Or FG+GH? Or JK?



6) Can we include ST in the length of this cave? It's the only way into the cave!