PROBLEMS OF SURVEYING THE BULLITA CAVE SYSTEM
– THE LONGEST CAVE IN AUSTRALIA

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INTRODUCTION

This presentation is to examine the problems of surveying this very extensive cave over the last fifteen years, to encourage discussion with other cave surveyors and to improve the management of surveying extensive cave systems. This annual survey project has required a great deal of planning and preparation because expedition members, survey techniques and computer programs are continually changing.

Surveyors of Bullita Cave are always working under difficult conditions because of the area's remoteness and the nature of its climate. Intending expedition participants are made aware in advance of what to expect during two weeks of working in such a location.

Waddington (1998) says that a large cave surveying project is "*essentially any cave survey where a surveyor cannot find or identify a previously used survey station from recent memory. This may be because personnel has changed and the surveyor has not been in the cave before, or because the station to be found was last used a long time ago and (its location) has been forgotten, or because the cave is so extensive that it exceeds what one person can remember'.*

Which cave has 268 separate surveys, more than 10,000 survey legs, 9,100 survey stations located in an area of 4 x 1 kms, 1,400 survey loops, more than 40 entrances and more than 100 kms of surveyed passage? The answer is the Bullita Cave System in northern Australia. Figure 1 shows the length of Bullita Cave compared with thirty-nine other well-known "long" caves in Australia (ASF Karst Index). Many speleologists who have taken part in the survey have also been on major expeditions elsewhere in Australia and overseas but the surveying of Bullita Cave poses problems quite different from those encountered in smaller and less complex caves.

ENVIRONMENTAL AND BACKGROUND PLANNING PROBLEMS

Weather

The weather conditions have to be suitable. The best time of year to visit the cave is during late June and early July. From December to March the onshore northwest monsoon winds of northern Australia bring torrential rain and very high temperatures. In contrast the number of rain days in June/July is very small and there is plenty of sunshine and low humidity. This helps to evaporate any water remaining in the cave. The temperatures are still high during the day but nights can be quite cool (Figures 2 and 3).

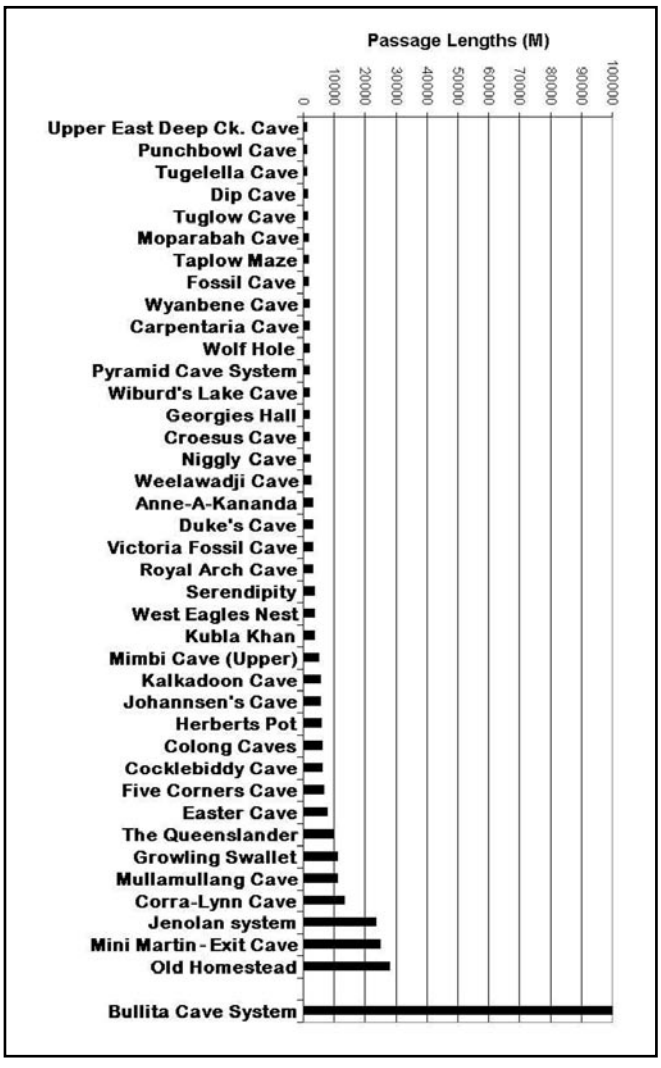

Figure 1: Comparison of passage lengths of Australia's longest caves.

Remoteness

Caves in northern Australia are remote from major capital cities where most cavers live. Trips require a duration of one week or more. Participation in Bullita expeditions needs a great deal of preparation whether one drives or flies to Darwin and hires a vehicle. Because winter is the peak holiday season in the tropical North, most of the cheap air tickets are sold well in advance and vehicles may be difficult to hire.

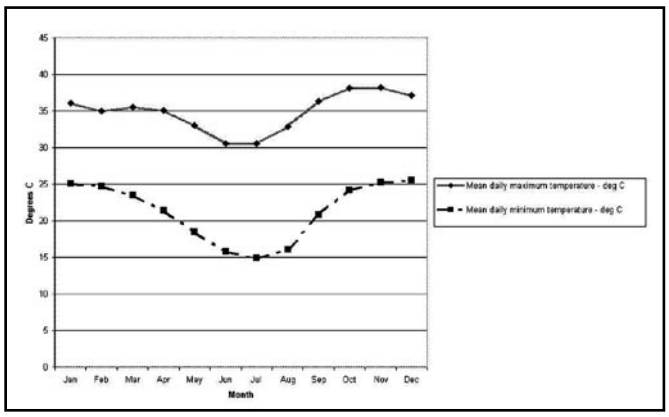

Figure 2: Variation in mean monthly temperatures in the Bullita area.

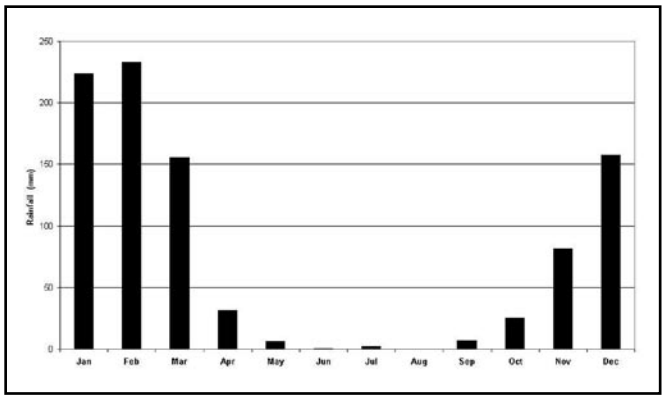

Figure 3: Variation in mean monthly rainfall in Bullita area.

Participation and Changing Personnel

Each year the group is made up of disparate cavers from all over Australia who quickly have to learn to work as a team and accept the control of the expedition organisers. During the past fifteen years 55 individuals and 17 rangers from the Northern Territory Parks and Wildlife Commission (PWC) have contributed a total of 1800 days to take part in surveying this very extensive cave system. Figure 4 shows the participation rate of those members who have taken part over the last fourteen years. The "corporate memory" of the original core members is fading and information about the area and the cave has to be passed on to more recent participants in the annual expeditions.

Team Work and Cost Sharing

Members of the expeditions have to agree to the conditions of the permit and must be willing to be part of a collective effort for two weeks. This involves camping and working together under a variety of conditions, cooking and cleaning communally, not having hot water for showers, doing your own laundry by hand and sharing all expenses. Expenses per person amount to some $500 and that does not include your travel expenses to reach the site which can also amount to several hundred dollars.

Hygiene

Food is frozen or refrigerated. The one available toilet stretches the ability of the septic system to cope. For this reason showers inside the Rangers "Donga" are banned. We either have cold showers outside or swim in the creek at the end of the day, often after the sun has set.

Risk Management

So far no major accidents have occurred. Every year we have several members with first aid qualifications and an ex-nurse is present at the camp. Minor injuries do happen and insect bites are a regular occurrence. A risk management strategy is in place and one expedition member carries a satellite telephone to the survey area each day. It is also a requirement for each member to leave in camp a personal form with emergency contact and medical history details. Each day a "daily whereabouts sheet" is left in camp for the information of the camp warden and rangers in case of a late return of the party. Prearranged return times are agreed to each day and if several parties are working in the same general area they wait for each other and return together. Parties do not leave from the swimming hole until everybody has returned unless by prior arrangement.

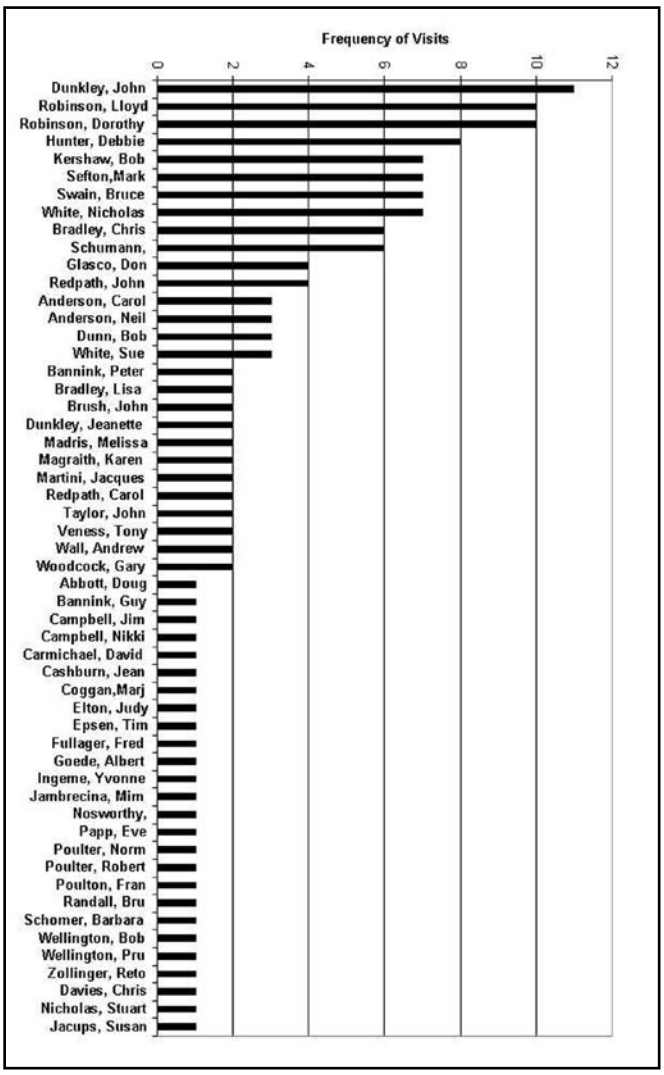

Figure 4: Participation frequency of Bullita expeditioners.

Biology

Some cave dwellers such as spiders and wetas regularly occur underground. We often come across dead kangaroos that have fallen down a vertical entrance from the surface. If the carcass is "fresh" it may be necessary to curtail surveying in the area until the following year. Snakes have been encountered underground. The Mulga Snake (formerly known as the King Brown) is common in the area.

Miscellaneous

Breakfast is eaten "on the run". There are no cooked breakfasts and lunches are prepared at breakfast time. We

have to depart by 0830 because later in the morning the 3-5 km walks to the cave become unbearable due to the high temperatures. We return to the creek at approximately 6 pm for a swim and return to camp at about 7 to 7.30 pm for a late dinner. We do this to avoid walking in the heat of the day. Most members are off to bed at 9 pm.

SURVEYING

The Bullita Cave survey is a project with five major data files saved in the Compass Survey program that incorporates 268 separate surveys with over 10,000 survey legs, 1,400 loops and involving more than 40 entrances. When printed in Arcview there are over forty A3 size map sheets each depicting an area of 250 x 250 metres. The problem is how to keep track of the survey data and maps as well as undertaking another 5 to 7 km of surveying on each expedition.

Survey Stations

In the early years of exploration, small pieces of flagging tape were used to identify survey stations and toilet paper was used one year when tape ran out. Unfortunately many of these early markers have disappeared. When we come across one we have to ascertain its number. Each station is now marked with a good sized piece of flagging tape tied to it. In the case of prominent survey stations aluminium garden tags are attached to cairns or walls with electrical cable ties. The tags are either stamped prior to the trip or in the cave.

We do not survey over or through areas of unique speleothems. We may pass a tape through to complete a loop or tie into another survey.

Many early stations were placed in the middle of the passage, and unbeknown to the surveyors involved, were washed away after torrential rainfalls as they were in the middle of streamways. CSS members had problems with surveys done by TESS. They could not relocate survey stations because in line with conservation policies they were tiny pencil marks on a wall.

Mapping

Declinations were not taken in the early years of the survey as there were few if any computational programs that could deal with such data.

This was a mistake as very good survey programs are now available and declination data would have made the early maps more accurate. We have not yet returned to resurvey the many kilometres of passage that were surveyed in this way. Stations are in numerical order in the Bullita Cave system but similar numbers have been used in surveying other cave systems in the area. To avoid confusion we now use a unique station identifier: the year prefix followed by a 4, 5 or 6 figure station number. For example: 97703 (1997 station 703) or 04318 (2004 station 318). They are used only once in the whole area and cannot be confused with any other station unless an error is made in the central register.

We survey and sketch as we go to a scale of 1:1000 and these maps are often used to find our way out and back in again. This system has enabled the cave survey to progress successfully. We often have end of the day excursions into new passage for several metres to encourage us to return the next day to add to the survey.

This system should be used for any successful cave exploration. While it stifles the excitement of quickly exploring new passage, it insures that surveying is completed to a high standard.

A composite map of A3 sheets is often taken into the cave to assist in navigation if a long underground journey is planned. Occasionally we are able to use the PWC photocopier and are able to make a composite map of several sketches that have been drawn in the same new area over several days.

Each data sheet has an area prefix, year and survey number label. The survey sketch also has the same data and these details are recorded in a central register for each year. The central register is controlled by a single person who allocates numbers on a nightly basis and enters those numbers in the register with the team leader.

The date and location of the survey to be done the following day is pre-recorded. This is checked each night and the process continues for the duration of the expedition. If it were not for the register, there could be confusion when three to five surveys at different locations are carried out each day for a ten-day period.

The updated maps are drawn prior to next year's expedition and often a sheet is redrawn year after year so that minor reinterpretations can creep in. The updated maps carry the updated date so that we can identify the latest version of each map.

There can be minor problems in patching together different sketch maps done by different individuals. A master set of maps remains in Canberra and three sets are taken to Bullita each year. Two are used as field sets and the third copy remains in camp in case it is needed in order to locate a missing team. This has not yet happened! We have decided that we will only draw finished geo referenced maps when the cave survey is complete and we have transferred the data to GDA94.

Technology

In the first few years of surveying, data reduction was done using a CEGSA program. This system caused problems because it did not close loops and was notoriously slow to accept amendments and corrections. Now a computer is used to enter new data into the COMPASS survey program. This is sometimes done on site but usually after we return home. The COMPASS program allows us to check for errors and to compare the original sketch with the COMPASS plot line and correct any errors. The plot lines are then imported into ARCVIEW to relate them to geographic coordinates. GPS data of cave locations are entered into the GPSU utility program.

Recently data have been used to overlay plot lines on an aerial photo using ARCVIEW. Data in ARCVIEW are in GDA66 but that will soon change to GDA94. We soon found that computer use in the field reduced after dinner socialisation time so computer use after 5 pm has been banned.

Other Matters

Compasses are checked for errors due to magnetic intrusions such as metal frame glasses. If an error is found the relevant survey legs have to be resurveyed.

There is a great deal of terminology that participants soon become used to, such as "Neighbours Block", "Berks Backyard" and "SOGS". Acronyms such as SLOP and LOSP refer to "shit loads of passage" and "lots of shit passage" respectively. Nowadays we tend to target specific areas for surveying so that portions of the cave system can be completed and a final map drawn up.

PHOTO: BOB KERSHAW

Surface trogging, Bullita.

CONCLUSIONS

To achieve a trouble-free and productive expedition, it is just as important to take into account the background planning as the actual surveying. With the use of new technology and computer programs, we have been able to accurately locate the cave in relation to surface features. This has facilitated the location of new entrances that will enable us to conduct surveys in formerly remote parts of the cave system for many years to come.

ACKNOWLEDGMENTS

I would like to acknowledge the assistance of Mark Sefton of the Cave Exploration Group of South Australia, John Dunkley of Highland Caving Group and Albert Goede in producing this article.

ESRI Australia supports this project with sponsorship through their community assistance program.

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BULLITA CAVE SYSTEM AERIAL PHOTO

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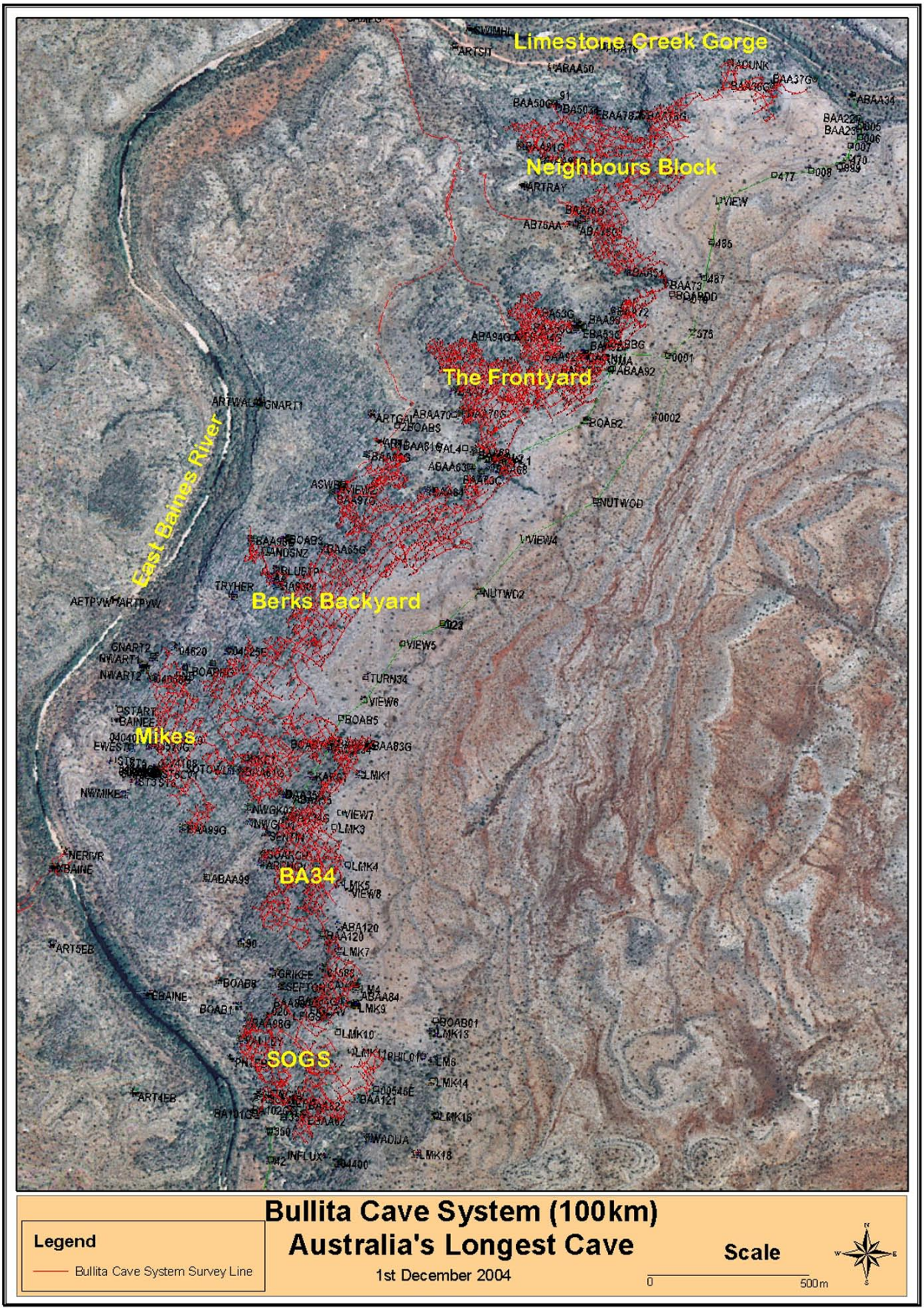

An aerial photo showing the approximate location of the Bullita Cave system in relation to the surrounding landscape.