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FRONT COVER:. Water streaming off shawls in River Cave, Jenolan Caves. Photo: Anne Musser

INSIDE BACK COVER: All Jenolan Caves. Top left. Devils Coach House. Photo: Dan Cove. Centre left. Island in Blue Lake. Photo: Sasa Kennedy. Bottom left. Binoomea Cut. Photo: Dan Cove. Top right. New Jenolan Caves app. Middle right. Cleaning after the flood. Photo: Sasa Kennedy. Bottom right. Anne Musser with rockfall, Carlotta car park. Photo: Sasa Kennedy.

BACK COVER: Jenolan Caves. Top. Crystal City, Imperial Cave. Photo: Sasa Kennedy. Bottom. Gravel deposit in Blue Lake. Photo: Anne Musser.

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FROM THE EDITOR

Not long after ACKMA members read this, we will meet in Waitomo. Our Conference Convener Libby Chandlers reports there are 70 or so registrations to date and I encourage any late comers to get their registrations in quickly. I will be staying on after the conference to do some promotional work with the South Australian Tourism Commission on behalf of the Limestone Coast region. It was very convenient that the conference and this 9 day trade show aligned so well, except I will need to leave Waitomo on Friday afternoon and will miss the final dinner. Dave Smith informed me the penalty for missing the diner was the same fee as the dinner itself!

While at the Buchan Caves Caves Guides Conference, I spent some time speaking with Dennis Rebbechi. Dennis informed me he has every copy of the ACKMA Newsletter and Journal published (as I am sure a number of members do) and offered to provide me with copies of issues I don't have, mainly the early newsletters. It is interesting to look back at the early days as ACKMA established itself, the support ACKMA gave to protect important karst areas in Tasmania, news from each cave site reported in most editions, and how it grew from a newsletter to a journal, initially published twice each year. In June 1994, then President Andy Spate reported, "*it was decided at the recent Executive Meeting to continue, for the moment, with two major issues and two minor issues per year. The major issues will be retitled as the ACKMA Journal and will contain the Newsletter as pullout pages in the centre. We further decided that one, and only one article in each journal will be treated as a peer-refereed scientific paper. This creates extra work for authors and editors but will lift the acceptability of the Journal as a quality serial.*"

That first journal was 40 pages long and this has largely remained the standard length since then, with some larger issues of up to 60 pages. As Publications Officer, I have been seeking to keep it to 40-44 pages, but with a lack of material forthcoming this may need to be reviewed. We can print colour covers each edition for minimal extra cost and the quality keeps improving with advances in printing technology. Full colour PDFs of the Journal are made available on line to members along with PDFs of individual articles. The electronic versions are very useful but I must admit to liking the bookshelf with an almost complete collection of ACKMA Journals. Should the Journal be available only on line or as a printed copy? I wonder how many read it on line prior to the arrival of the hard copy, which then just sits on the shelf.

In the Journal 89, *Mulu Mystery* sought responses to what might have created the unusual features in a Lagangs Cave in Gunung Mulu National Park. The photo unfortunately did not have a scale, due to access issues. Two responses were received.

The unusual features in Lagangs Cave.
Photo: Brian Clark

From **Jill Rowling:**

In an attempt to answer Brian Clark's challenging question, "How do swifts find enough dry limestone to make their saliva stick to the wall", I was interested to read on the Internet that since the Asian financial crisis apparently there has been a great increase in the numbers of disused farmhouses being converted to bird houses. People are raising swifts in these buildings in the hope that they can become rich by farming birds nests. This may well be a positive turning point in the preservation of the swift species.

Nevertheless there is Brian's question. I read about the complex substances which are produced by the male swift's saliva, and it occurred to me that, like our own saliva, it may very well stick underwater. I remember once stepping on a slug in bare feet and was amazed at how difficult it was to remove the sticky strands even with soap and water. Much easier to remove it once dried.

So I would suggest that the swifts do not need to look for a dry spot, just a spot with the right sort of roughness, and add a blob of saliva glue to start the nest. Once the structure is exposed to air, it should harden. The part attached to the cave wall probably remains fairly flexible yet strongly adherent.

This brings me to the other point Brian raised, which is "what processes could lead to dissolution like this" (depicted). The photo seems to be lit from below, meaning that the old nest positions are proud of the surface. Perhaps the nest saliva was protecting the limestone surface for a while, and all around was the normal process of tropical microorganisms eating away at the limestone.

And a couple of creative suggestions from **Van Watson:**

It is a well known supposition that the only real advantage of the ice age to Neolithic people was the abundance of ice cream. As a result, many 'cones' were mined from the relatively 'soft rock' of the Mulu Limestone. Due to high demand a 'Fast Lane' was established in Lagangs (Ice cream) Cave. To access the perfect cone rock, a four metre trestle was built of out of not yet endangered rain forest. This has since decayed but the circular marks, where the cones were finally chipped away from the parent rock, remain, and to a trained observer, are self explanatory.

Swifts and Swiflets vary slightly in their salivary glands. Swifts have the resin and Swiftlets the hardener. In the courtship ritual and nest building, components A & B are mixed like any 2 pot epoxy. People who remove the nests for study and elucidation are called 'crackpots' or Chinese Restauranteurs. Some people find all of this a bit hard to Swallow.

One item that has been missed in the past couple of journals is a list of upcoming events. I will endeavour to reinstate this and would be most appreciative of notification of relevant conferences, seminars and workshops.

One very large cave conference this year (aside from ACKMA in Waitomo!), is the International Congress of Speleology to be held in Brno, Czech Republic in July. The very impressive website for the conference shows 795 registrations from 51 countries, including 23 registrations from Australia and 3 from New Zealand. As much as I would love to attend, I won't get there, but look forward to receiving reports from the large Australian contingent. I was lucky enough to visit Brno and Moravian karst a couple of years ago and thoroughly enjoyed the experience. One site well worth seeking out is the Capuchin Crypt, where mummies of Capuchin monks are laid out. Maybe not what everyone wants to see, but fascinating nonetheless.

In this edition we have some remarkable images of Jenolan Caves in flood, along with a description of the deluge from Sasa Kennedy. At the same time as this was happening in New South Wales, South Australia's long run of hot dry weather was, and still is, continuing. We have had virtually no rain at Naracoorte for 5 months, although a few nearby places have scored some summer storms. While looking at the Jenolan images and the damage caused to infrastructure, it occurred to me that extreme weather events and their impacts on caves and karst would make an interesting little feature for the ACKMA Journal. Some are well known, such as the Cocklebiddy Cave collapse when cavers were in the cave, but I am sure there are some more obscure historical events that could be published. I look forward in anticipation to receiving some images; before and after or the normal conditions versus extreme conditions would be appreciated.

The events in Florida in early March when a bedroom in a house disappeared into a sinkhole illustrated the dangers of living on karst in some areas. It was desperately unlucky for the man who lost his life when the bedroom floor opened up. I watched the reporting of this by the media on line with great interest, especially the headlines generated and language used. "Man swallowed by giant sinkhole", "Man-eating sinkhole" and "Sinkhole devours man" are a small selection of headlines reporting the unfortunate incident. Not long after this, a golfer disappeared down a small sinkhole as well, but was luckier and survived. A google search of Florida sinkhole brings up many images of fabulous karst features. I am glad our south east of South Australia is somewhat more stable than Florida.

Tim Moulds, and Jay and Ross Anderson provide the first part of their two part report on their biological survey of the caves of Gunung Mulu World Heritage Area. This introduction to their survey will be followed by a results report after this has been presented to park management. This paper includes spectacular images by Ross Anderson.

In ACKMA Journal 86, Liz Reed's paper *Of mice and megafauna: new insights into Naracoorte's fossil deposits* reported on her work in Blanche Cave, Naracoorte. Liz and I have followed this up with a comprehensive look at the early days of Blanche Cave and the interpretation of the cave's fossils and compare this to what we know now with the benefit of more research and modern technology. This led us on a worldwide hunt via the internet of historical material and a trip to the Mary McKillop Centre to access their library. Much has previously been written about Father Julian Tenison Woods and we spent many hours searching to find when his interpretation of the caves and their deposits moved from a literal biblical interpretation to an acceptance of Deep Time, and what and who influenced these changes in his thinking. Our paper examines the interpretation of Blanche Cave in the early days and how this has changed in light of recent research.

A few weeks ago, Andy Spate posted a request on the ACKMA email list to vote for Claire Preece, hospitality manager at Kents Cavern in the UK, for a Tourism Superstar award. In another win for cave tourism, Claire was voted the Mirror Travel's Tourism Superstar 2013. The website made special mention of the votes Claire received from Australia; well done to all who took the time to vote.

Congratulations to Claire Preece, who is the winner of Visit England and Mirror Travel's Tourism Superstar 2013 competition. Claire, 39, is hospitality manager at the Kents Cavern prehistoric cave attraction in Torquay and came top in a public vote run by the national tourist board in partnership with the Daily Mirror. The

award – inaugurated last year – recognises the unsung holiday heroes who ensure visitors in England have an unforgettable experience. Ten shortlisted candidates were featured in a video on the Mirror Travel website, with readers voting for the one they thought deserved to be crowned Tourism Superstar 2013. Claire, from Paignton, is responsible for organising and hosting anything from concerts to guided tours at the family-run site. "I am absolutely delighted to win this prestigious award," said Claire, who is expecting her first child in May. "I'd like to thank all the people who voted for me. I love my job here and I've got a dedicated team at the caves delivering an outstanding experience, including, of course, our friend Cavog the Caveman! Kents Cavern is an innovative and exciting attraction and so important to the vitality of this region. I am really chuffed that this award is as much about giving a boost to the English Riviera and Devon as it is about me."

She was nominated by Laura Holt, of the Devon Tourism Partnership, and even received votes from staff at tourist caves in Australia. VisitEngland chairman Lady Cobham said: "Warmest congratulations to Claire – a very worthy winner! As VisitEngland's Tourism Superstar 2013, Claire embodies the passion and dedication that abounds in England's tourism industry. She is an example to others striving to achieve excellence in customer service and a credit to Kents Cavern."

Claire Preece with Cavog the Caveman.

Cathie Plowman has provided some notes on Tasmanian happenings in caves and karst.

- Southern Tasmanian Caverneers are continuing their survey of the 23 km long Exit Cave. Currently there is a one week survey expedition in the cave which is being coordinated by Tony Veness (STC).
- Trees planted a couple of years ago on the former grazing paddock adjacent to Baldocks Cave are progressing well. This project was funded with monies obtained by the volunteer group KarstCare.
- The Parks and Wildlife Service have obtained funds for rubbish clearing, tree planting and fencing off the creek on a former farm paddock that is now part of the Gunns Plains State Reserve. The result will be cattle grazing away from the creek, and the creek protected and rehabilitated. Local cavers are assisting with this project.
- Interpretive signs were recently installed at the Vale of Belvoir karst near Cradle Mountain. This karst has been acquired by the Tasmanian Land Conservancy.
- And besides nursing, I'm working on an interpretive book on glowworms that's been in my head for several years and is on track for being published later this year.Southern Tasmanian Caverneers are continuing their survey of the 23 km long Exit Cave. Currently there is a one week survey expedition in the cave which is being coordinated by Tony Veness (STC).

David Butler and friends at Mersey Hill.
Photo: Cathie Plowman

Anne Wood reported vandalism that has occurred at Giants Cave, Margaret River in Western Australia.

Some unknown person(s) broke into Giants Cave in the Leeuwin-Naturaliste National Park during the night on 2 March. They threw large logs into the long drop toilets, and also threw logs down into the cave entrance. These logs bounced on the way down and caused damage to the handrails and stairs and the abseil landing platform. Further into the cave there was some damage to stalactites. Several newly broken pieces were found on the cave floor. So although it is very disappointing I guess we should be thankful that there was not more damage.

I look forward to seeing many ACKMA members in Waitomo in May.

SO WHAT LIVES at MULU?
PRELIMINARY SURVEY of CAVE FAUNA in the GUNUNG MULU WORLD HERITAGE AREA, SARAWAK, MALAYSIA

Dr Timothy Moulds, Jay Anderson and Ross Anderson

The Gunung Mulu World Heritage Area (Mulu) is situated in the north eastern corner of Sarawak, Malaysia on the Island of Borneo, adjacent to the South China Sea. The area was prescribed as a National Park in 1974 and is the largest national park in Sarawak covering an area of 528 km^2. Mulu contains the second highest peak in Borneo, Gunung Mulu, a sandstone mountain situated to the east of the Melinau Limestone that contains the extensive caves that are the subject of the current study (Figure 1).

Many ACKMA members will be familiar with this site as a number of members were privileged to be able to visit MULU when ACKMA held its AGM and associated field trips at Mulu in May 2010. We all remember that was such a fantastic trip and we had been so overwhelmed with the size of the caves, and the active cave life. As our key speleological interest is biospeleology, we had wondered what study had occurred in relation to the biology of the Mulu Caves. So we began some discussions with Brian Clark and started to put together a plan...

From late April to mid May 2012, 12 Speleologists from Australia visited Mulu to undertake a preliminary subterranean biology survey in selected caves. The project was led by Mrs Jay Anderson and Dr Tim Moulds and included experienced speleologists from several states of Australia. A special permit had been obtained from the Malaysian Government, which would allow the team to undertake the research on the cave life at Gunung Mulu.

The current preliminary survey aimed to provide an overview of the invertebrate fauna in the cave systems near the Park Headquarters and predominately in those used as tourist caves and adventure caves. The survey will assist to provide a basis for future biological surveys in Mulu whilst building upon the only other biospeleological surveys undertaken in the area by Philip Chapman in the early 1980s as part of the British expeditions to the area.

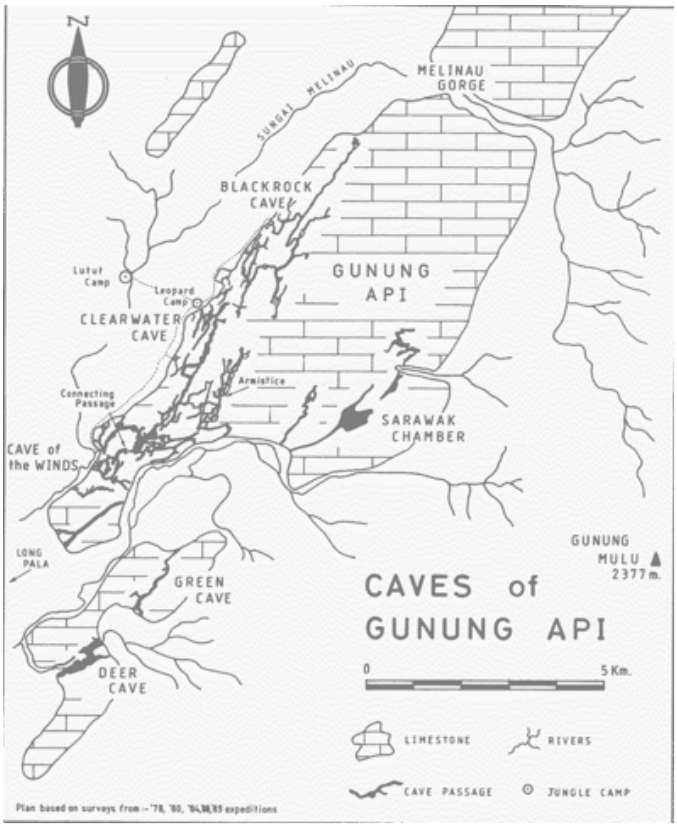

Figure 1. Cave locations within Gunung Mulu World Heritage Area

Right. Clearwater Cave. Photo: Ross Anderson.

The survey aimed to:

1. Identify and photograph the majority of invertebrate fauna within each cave.

2. Provide a repeatable survey methodology to enable future comparison of relative species richness and abundance.

3. Identify key habitats used by the fauna.

4. Identify any potential threats to the survival of the fauna.

5. Provide management strategies to assist in retaining fauna.

6. Provide recommendations for future works to complement the findings of the current study.

The caves chosen were a mixture of tourist caves, adventure use caves and wild caves and included a range of habitats and use levels. The caves examined are shown in Table 1.

Caves were divided into several distinct biological zones to aid interpretation (Figure 2). These correspond to the amount of available light and varying environmental conditions (Humphreys 2000). The team would collect some specimens of cave fauna as part of the project.

The Entrance Zone is the area directly around the cave entrance; it is generally well lit, often supports photosynthetic plants, and undergoes daily temperature and humidity fluctuations.

The Twilight Zone is just beyond the entrance zone and is often dominated by lichen and algae that require low light conditions. The temperature and humidity are still variable but fluctuations are dampened compared with epigean variation.

Deeper into a cave, light is reduced to zero and the Dark Zone is entered, which is subdivided into three zones, the transition, deep cave and stale air zones.

The Transition Zone is perpetually dark, but still fluctuates in temperature and humidity determined by epigean conditions.

The Deep Cave Zone is almost constant in temperature and humidity conditions.

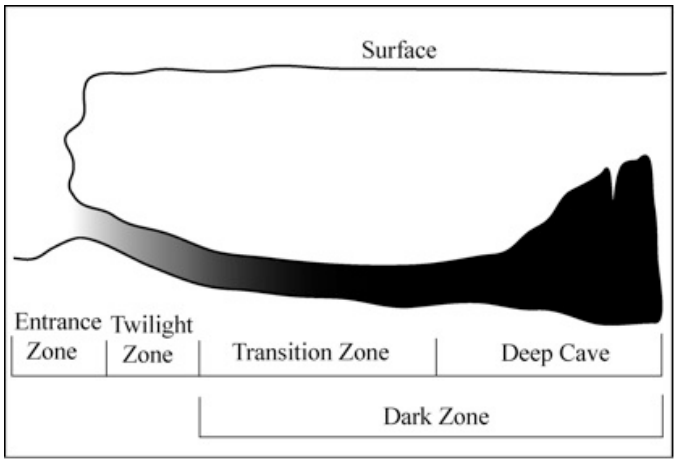

Figure 2. The environmental zones of a cave shown in cross section.

Stonehorse Cave. Photo: Ross Anderson.

Table 1. Cave usage and location within Mulu

Cave Name	Primary Use	Limestone Section	Visitation
Deer Cave	Tourism	Deer/Green Section	High
Green Cave	Wild	Deer/Green Section	Low
Stonehorse	Adventure	Deer/Green Section	Low
Fruit Bat Cave	Adventure	Kenyalang/Fruit Bat	Low
Kenyalang	Adventure	Kenyalang/Fruit Bat	Low
Lagang	Tourism/Adventure	Gunung Api	Moderate
Racer	Adventure	Gunung Api	Moderate
Goodluck Cave	Adventure	Gunung Api	Low

Cave Cricket Rhapidiphora sp.in Fruit Bat cave.
Below. Millipedes. Photos: Ross Anderson.

Cave invertebrates are generally classified according to their degree of cave dependence using the Schiner - Racovitza system (Schiner 1854, Racovitza 1907), despite numerous other systems and variations being proposed and adopted by various authors (see references in Boutin 2004).

The Schiner - Racovitza system classifies organisms according to their ecological association with subterranean environments, and relies upon detailed ecological knowledge of animals that is commonly lacking for most species. In order to circumvent this lack of knowledge, the concept of troglomorphy (Christiansen 1962), specific morphological adaptations to the subterranean environment, is used to define obligate subterranean species. The term troglomorphy, initially confined to morphology has since been used to describe both morphological or behavioural adaptations (Howarth 1973). This combination provides a practical system, easily applied in the field and with minimum of detailed ecological study required. The level of subterranean dependency for different ecological groupings is described below:

Above. Cave spider
Below. Bat. Photos: Ross Anderson

•Troglobionts are obligate animals that possess specific adaptations (troglomorphisms) such as loss or reduction of pigmentation and/or eyes, flightlessness, elongate appendages and specific sensory adaptations (Barr 1968, Poulson and White 1969). These species rely solely on the cave environment for food and reproduction. They are generally restricted to the deep cave zone where conditions are the most stable and are rarely found closer to entrances in the twilight zone.

•Troglophiles are animals that can complete their entire lifecycle within a cave but possess no specific adaptations to the cave environment. These species are capable of living outside caves in suitably dark and moist epigean habitats.

•Trogloxenes are animals that regularly use caves for part of their lifecycle or for shelter, but must leave the cave to feed. Common examples of these are bats and cave swiftlets.

•Accidentals are animals that do not use caves on a regular basis and cannot survive in hypogean environments.

Aquatic hypogean animals are classified using a similar system to terrestrial hypogean animals except the prefix 'stygo' is used instead of 'troglo' (Humphreys 2000a).

Due to the very limited amount of time available for the current preliminary survey it was decided to use active hand searching (hand foraging) to enable a wide variety of different habitats, and caves to be surveyed quickly and detect the majority of species present within. In order to undertake a more comprehensive survey of the subterranean fauna (vertebrate and invertebrate) a combination of multiple techniques in each cave over longer time periods would be required. This was beyond the scope of the current project.

Green cave entrance. Photo: Ross Anderson.

The research objectives included:

- Sample at least one site in each Zone (Entrance/ Twilight and Deeper Cave)
- Overall there will be two or three of the Sites in different light zones/location throughout the cave
- If there is more than one entrance, sample additional entrances separately
- Each site will comprise of one or more of the seven micro-habitat types
- Sample for 20 minutes in each micro-habitat type present
- Document and record each species seen and abundance
- Collect one representative of each morpho species if possible
- Photograph as many species as possible from each site
- Record proximity to track/Infrastructure in metres
- Ensure that each cave has a site sampled in close proximity to the track or under the track.

The team had two weeks at Mulu, and there was a lot to study and document. Each day the team members visited caves and examined what cave life was in particular zones. The results of the project will be report in another ACKMA Journal. We would like to thank Brian Clark and his team for their support of the project and assistance with accommodation and logistics.

From the Editor

This is the first part of a two part paper. The results of this survey will be published in a future journal once they have been presented to the management of Gunung Mulu World Heritage Area.

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'OLD' CAVE, NEW STORIES: THE INTERPRETATIVE EVOLUTION of BLANCHE CAVE, NARACOORTE, SOUTH AUSTRALIA.

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"What difference is there, do you think, between those in Plato's cave who can only marvel at the shadows and images of various objects, provided they are content and don't know what they miss, and the philosopher who has emerged from the cave and sees the real things?"

Desiderius Erasmus (Dutch Renaissance scholar 1436 to 1536)

Seeking answers in the dark

Plato's cave is a metaphor for freeing oneself from conventional thought or ignorance and looking beyond the bounds of accepted reality. In the modern vernacular the equivalent would be 'stepping out of your comfort zone' or 'broadening your horizons'. In his own erudite way Plato was espousing the values of philosophy and his theory of 'forms'. Interestingly, he was also proving that he was a masterful interpreter, using analogy, as many good interpreters do. What is intriguing is his use of a cave to symbolize being 'kept in the dark' and the outside world to represent freedom and enlightenment. Was he echoing the popular views of his time? Were caves seen as somewhat static and sinister, more suited to fantasy than serious endeavour?

Certainly the presence of fossil bones added to the mysterious allure of caves. In Ancient Greece, Quaternary aged mammal fossils from coastal caves were interpreted as the bones of mythological heroes and monsters (Mayor, 2000). Early European travellers to Crete were taken on guided tours of caves by monks and shown the bones of "giants from ages ago" (Mayor, 2000). Much later, bones were collected from caves for medicinal purposes, as they were believed to be the horns of unicorns (Gesner 1603 cited in Dawkins, 1874). In 17th Century Hungary the so-called "Dragon's Caves" were thought to contain the remains of dragons until these were later identified as bones of cave bears by Cuvier (Dawkins, 1874). It wasn't until the nineteenth century that fossils in caves were recognised as being bones of once-existing animals (eg. Buckland, 1823). Early interpretations of these were largely fettered by religious dogma; however, by the latter part of the nineteenth century cave deposits were receiving serious attention from scientists (Dawkins, 1874). Since then caves have formed the backbone of Quaternary palaeontological research.

Undoubtedly there are still people who view caves in a similar fashion to those in ancient times; their views influenced by portrayals of caves in popular media such as film. However, the modern cave visitor has the advantage of greater access to information and the opportunity to connect with a place via on-site interpretation. Caves are now accepted as an important resource for a multitude of disciplines and significant components of natural and cultural heritage. At Naracoorte in South Australia one old cave is showing how the tables have turned and that caves provide a unique opportunity to explore some of today's hottest topics. Even Plato may have struggled with the idea of people going into a cave to expand their knowledge and views on the world. On the other hand, he may have been intrigued by the notion that fossil deposits (far older than he could have imagined), can shed light on the past, present and future.

The aim of this paper is to review how Blanche Cave (Naracoorte Caves World Heritage Area) has been used and interpreted by people in the past. An overview of the historical background of the cave, its visitors, interpretation and fossil discoveries will be presented. The impact of new fossil research on the interpretation of Blanche Cave and of the larger World Heritage area is discussed.

A cave by any other name

Prior to its 'European' discovery, indigenous people living in the area would have known about Blanche Cave. Clark (2007) mentions a link to a cultural story relating to a cave near Naracoorte. There is anecdotal evidence that people may have used the cave in some way; however, no archaeological material has been formally recorded, leaving an unfortunate gap in the cave's history. In contrast, much is known of the history after European settlement.

In 1845, two pastoralists discovered a large cave in scrubland not far from the township of Narracoorte (known as Naracoorte since 1924). William Macintosh and Benjamin Sanders had been investigating the alleged theft of sheep from their flocks when they stumbled upon a cave (Hamilton-Smith, 2003). Soon, other caves were found in the vicinity and the "Mosquito Plains Caves", as they were collectively known, became popular places for people to visit and a source of great pride amongst locals (Hamilton-Smith, 1998).

Blanche Cave, the largest and most accessible of these caves, has been identified by several names over the years. It received the name Blanche in February 1856,

following a visit by the South Australian Governor Sir Richard Graves MacDonnell who named it in honour of his wife, Lady Blanche. Despite this, the cave was largely known as "Big Cave" until the name Blanche Cave was officially re-established in the 1980s. Other names include "Old Cave", "Mosquito Plains Cave" and even the "Mummy Cave" (Tenison-Woods, 1879c). At one time the whole group of caves became known as the "Blanche Caves" (eg. Tenison-Woods, 1879a). It is not unusual for a cave to have several names, each one reflecting how various people have related to it. In the case of Blanche Cave, it is interesting that these names mirror its key interpretative aspects and also elements of its social, spiritual, aesthetic, scientific and historical significance.

Blanche Cave gained early fame (or infamy) for the presence of human remains in the far reaches of the cave. An early article reported that two visitors had encountered a preserved body in 1851 (*"South Australia", Colonial times, Tuesday 17 June, page 2*). Later, Woods reported seeing the remains in 1857 (Woods, 1858). Thomas Craig stole the body in 1861 and a fair amount of drama ensued (see Hamilton-Smith, 2003 for the detailed story).

Ebenezer Ward wrote:

"…I saw the Strangwayian gridiron, intended to be an iron-barred gate, which failed to protect the petrified remains of the blackfellow, who years agone crept into those dark recesses, away from his Christian hunters, and finally laid down to die in the nook where the Showman found him."

Ward (1868).

Tragically, it was discovered the deceased man had been shot during an altercation over livestock in the late 1840s. It appears his remains were last seen in London, at an exhibition in 1869 (Anonymous, 1869).

Entertainment venue

In the absence of any formal monitoring on visitation, picnics, parties and specimen hunting were just a few of the activities that took place in Blanche Cave (Hamilton-Smith, 2003). William Milne (Commissioner of Public Works in the South Australian Cabinet) visited the cave with Mr. Seymour and party in 1863 and recorded his visit:

"After moving about from one part to another, in order to get specimens and to admire the variegated forms and lines which were to be seen, we were glad to return to the first cave to rest, being tired and for my part perspiring profusely. The first cave, as I have already stated, was well lighted, being open from above at both ends. Here we found that ample provision had been made for our refreshment. A bucket of pure crystal water had been taken from a neighbouring cave and bottles of claret, whisky, brandy, sherry, ale and porter were at our service. A fire was now lighted and the ladies vied with each other in assisting to get lunch ready."

William Milne (transcribed in Rymill, 2010).

Unfortunately, these activities took their toll on the cave as Ebenezer Ward (1868) vividly conveyed:

"Imagine an unfinished boring for a huge and lofty cellar, in a very slovenly condition of disorder and incompleteness, weeds here, and litter of all kinds there, but after all with a roof of rare but half obliterated beauty which you scarcely notice in the mess which prevails, and you will have some idea of the first of the caves, and perhaps agree with me in thinking that after all a pint of Bass won't be a bad thing before we go any further… There is one circumstance in connection with these caves that is very much to be deplored. All of the choicest stalactites have been chipped to virtual destruction for the sake of specimens to be taken away, and there is scarcely a perfect petrifaction to be found. But as the process of exudation and congealing is constantly going on, the present defects would be largely remedied in time if further spoliation were prohibited. By-and-bye, as population increases around Narracoorte, and the attractions of the caves become more widely known, it may be worth while to declare a reserve and appoint a keeper who might supplement his income by levying a small charge as a guide to visitors."

Ward (1868).

Guano mining commenced at Naracoorte in 1871 (Hamilton-Smith, 1998) and this was seen by many to be detrimental to the caves. A visitor in 1879, since identified as the Rev. W. R. Fletcher, (Hamilton-Smith pers. comm.) wrote:

"The floor of two of the caves has been rich in deposits of guano formed by the bats. But the guano is of a poor sort, and the Government has made a dear bargain in giving licenses to cart away this manure. The caves have been injured, and a valuable opportunity for scientific examination lost for the sake of a few pounds in license fees. We would urge that this mode of spoliation should be stopped were it not that the supply is nearly exhausted, when the caves will be once more left in peace."

Anonymous, (1879).

The land surrounding the caves came under the control of the Forest Board in October 1876 and was declared the Caves Range Forest Reserve. Although this provided an official body to oversee the reserve, it did not provide any real control of activities at the caves, with the exception of guano mining (Hamilton-Smith, 1998). Damage to the caves continued and was noted at a meeting of the Forest Board in 1879:

"Considerable destruction on the stalactites has been done of late by visitors, and unless this be put a stop to

Figure 1. Stanley Leighton. (1868) Caves of Narracoorte, South Australia, watercolour, National Library of Australia http://nla.gov.au/nla.pic-an4623893.

at once the natural beauties of the place will soon be a thing of the past".
Border Watch, Wednesday 19 February 1879, page 4.

The condition of the cave and the damage that had been inflicted on it was by no means a reflection of disregard or contempt within the local community. Indeed, the link to community was strong and people were immensely proud of their caves, which were seen as a major asset and draw card for the district. During a visit by the Governor Sir William Jervois in 1880, local people expressed concern about the damage inflicted upon the caves (Hamilton-Smith, 1986), and there was increasing pressure to provide some sort of protection for them. In 1882 the Woods and Forests Department replaced the Forest Board, and in 1885/1886 50 acres surrounding the caves were set aside as a reserve to protect the caves. Daniel Battams was appointed as caretaker and commenced cleaning up Blanche Cave and others. William Reddan replaced him in 1887 and became a central figure in the development of the Naracoorte Caves as a tourist destination.

Art, photography and literature

One can never discount the purely aesthetic values of a cave, nor the sheer wonder that visiting such a place can bring to a visitor. Indeed this is an important part of the visitor experience. The massive limestone columns and colourful formations of Blanche Cave inspired Stanley Leighton to capture their beauty in a watercolour painting in 1868 (Figure 1). The work titled "Caves of Narracoorte" appeared in his journal *"Sketches in Australia with journal abstracts"*. In 1869, two wood engravings of Blanche Cave by Robert Bruce (Hamilton-Smith, 1997) were published in *The Illustrated Australian*

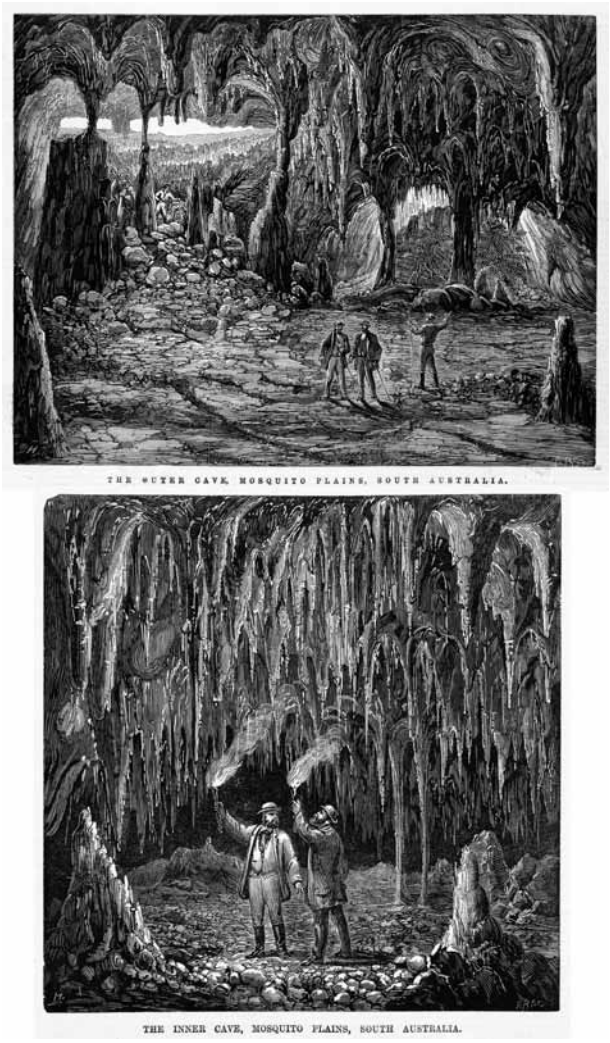
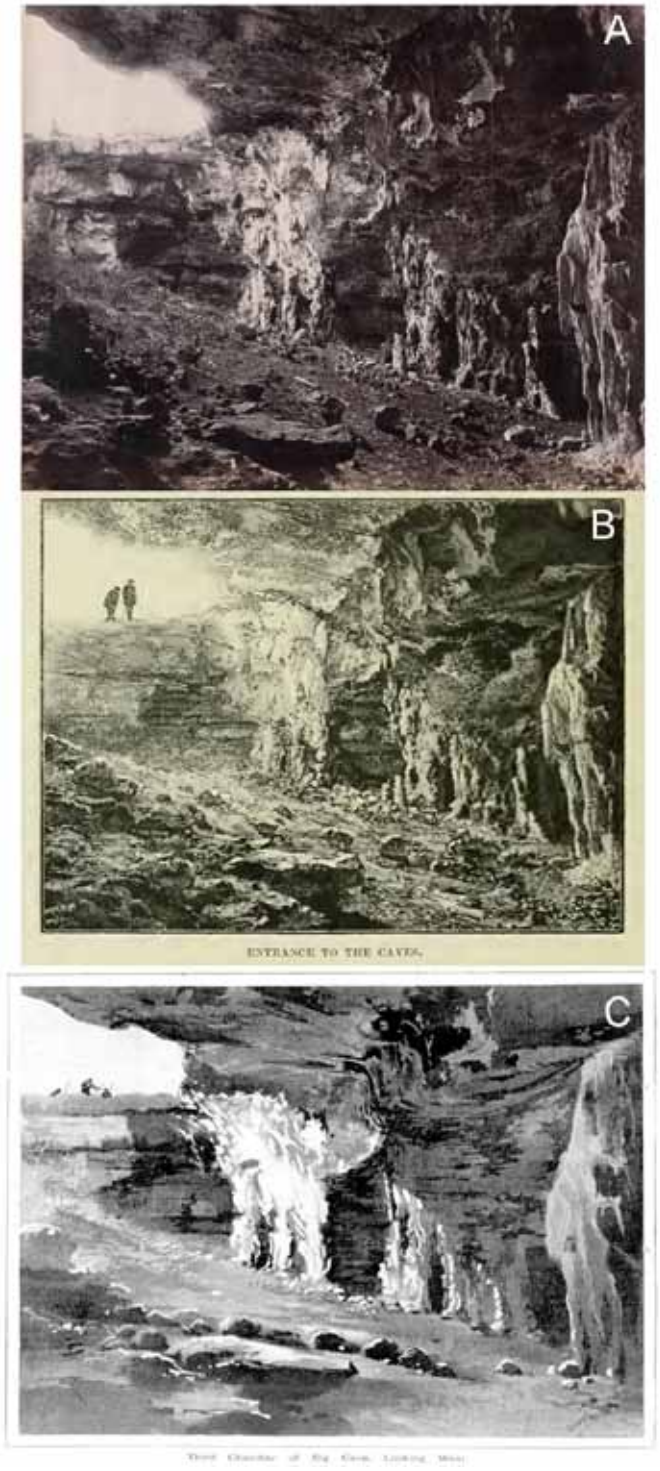
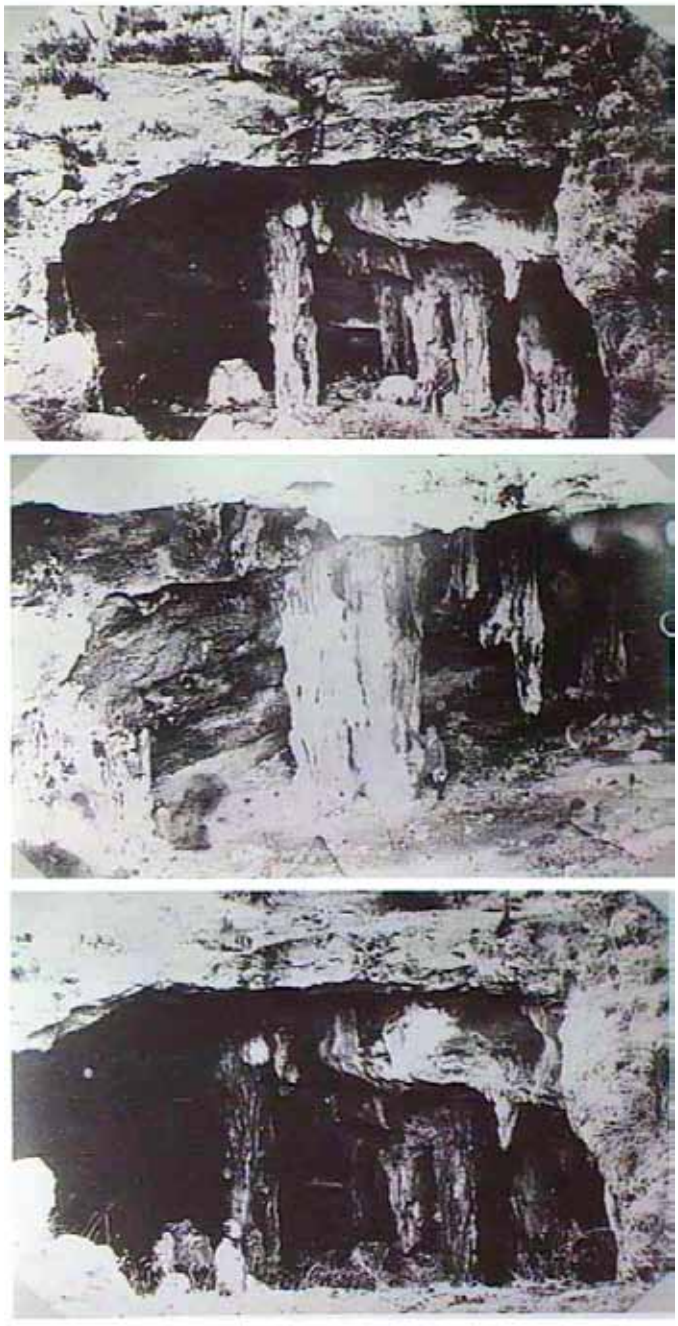


Figure 2. Caves on the Mosquito Plains (The Inner Cave and the Outer Cave), from The Illustrated Australian News for Home Readers, 10 July, 1869 page 140. Ebenezer and David Syme eds., print of wood engraving. Collection of the State Library of Victoria, accession number IAN17/07/69/140.

News for Home Readers and elsewhere (Figure 2). These images show two men carrying torches in the cave, which is thickly decorated with stalactites and stalagmites (perhaps somewhat exaggerated). Later, two illustrations based on photographs by Thomas Washbourne, were produced for articles in *Cassell's Picturesque Australasia* (Vol. IV, page 92, 1889) and *The Australian Town and Country Journal* (13 April, 1895) and reproduced in the *Narracoorte Herald* (21 May, 1895). Washbourne, a professional photographer from Melbourne, produced a series of five images of Blanche Cave in 1879. One of these is striking as it shows the natural shape of the sediment cone beneath the third roof window entrance (Figure 3). Another painting of the cave by Rev. Alfred Sells is held in the collection of the Millicent Art Gallery and there are others not mentioned here (see Hamilton-Smith, 1997 for a review).

Blanche Cave was a popular place for photographers, with the earliest photos taken in 1860, one of which featured Julian Tenison-Woods reclining above the third entrance (Figure 4).





Left. Figure 3. **A.** *Sediment cone beneath the third entrance in Blanche Cave. Photographer Thomas Washbourne, 1879. Collection of the State Library of Victoria, accession number H96.160/228;* **B.** *From. Cassell's Picturesque Australasia (Vol. IV, page 92, 1889);* **C.** *From The Australian Town and Country Journal (13 April, 1895).*
Above. Figure 4. Blanche Cave, 1860 (photographer unknown). Tenison-Woods is visible on the surface in the first photo (State Library of South Australia, B36858 top, B36859 middle, B36860 bottom).

Figure 5. Tenison-Woods at Blanche Cave. Woodcut by Alexander Burkitt (from Woods, 1862). Photographed from the original book: Steve Bourne

Woods (1862) included a woodcut by Alexander Burkitt based on this photograph (Figure 5). Adelaide-based photographer Captain Samuel White Sweet photographed various landscapes in South Australia. With his horse-drawn dark room in tow, he visited Naracoorte in 1880 and took photos of Blanche Cave (State Library of South Australia collection – album of South Australian Views). He was regarded highly as a photographer and was one of the first to use the dry-plate process (Sierp, 1976).

The most prolific photographer of Naracoorte Caves was William Augustus Francis, son of George William Francis, the first director of the Adelaide Botanic Gardens. Originally based in Adelaide, Francis later moved to Naracoorte and photographed Blanche Cave extensively (Figure 6). Local chemists sold his photographs as prints, stereoviews and postcards (Figure 7). The Tourist Bureau produced booklets of the photographs and some his images were reproduced on souvenirs (Figure 8). There were numerous other photographers over the years, with dozens of images of Blanche Cave to be found on postcards, brochures and booklets.

In 1901 Alfred Odgers published a novelette, "The squatter's story: an adventure in the Narracoorte Caves", telling the story of a young cattleman who was working near the caves in 1849 when he was tricked into descending into the 'Big Cave' to rescue someone who was trapped, only to find himself robbed and stranded in the darkness (Odgers, 1901). His friends, who encountered desiccated human remains in the cave, rescued the stockman before he succumbed to exhaustion and despair. The body mentioned in the story was no doubt a reference to the 'famous' remains noted previously. Odgers suggested that there was some truth to the tale. Regardless, it is an entertaining read!

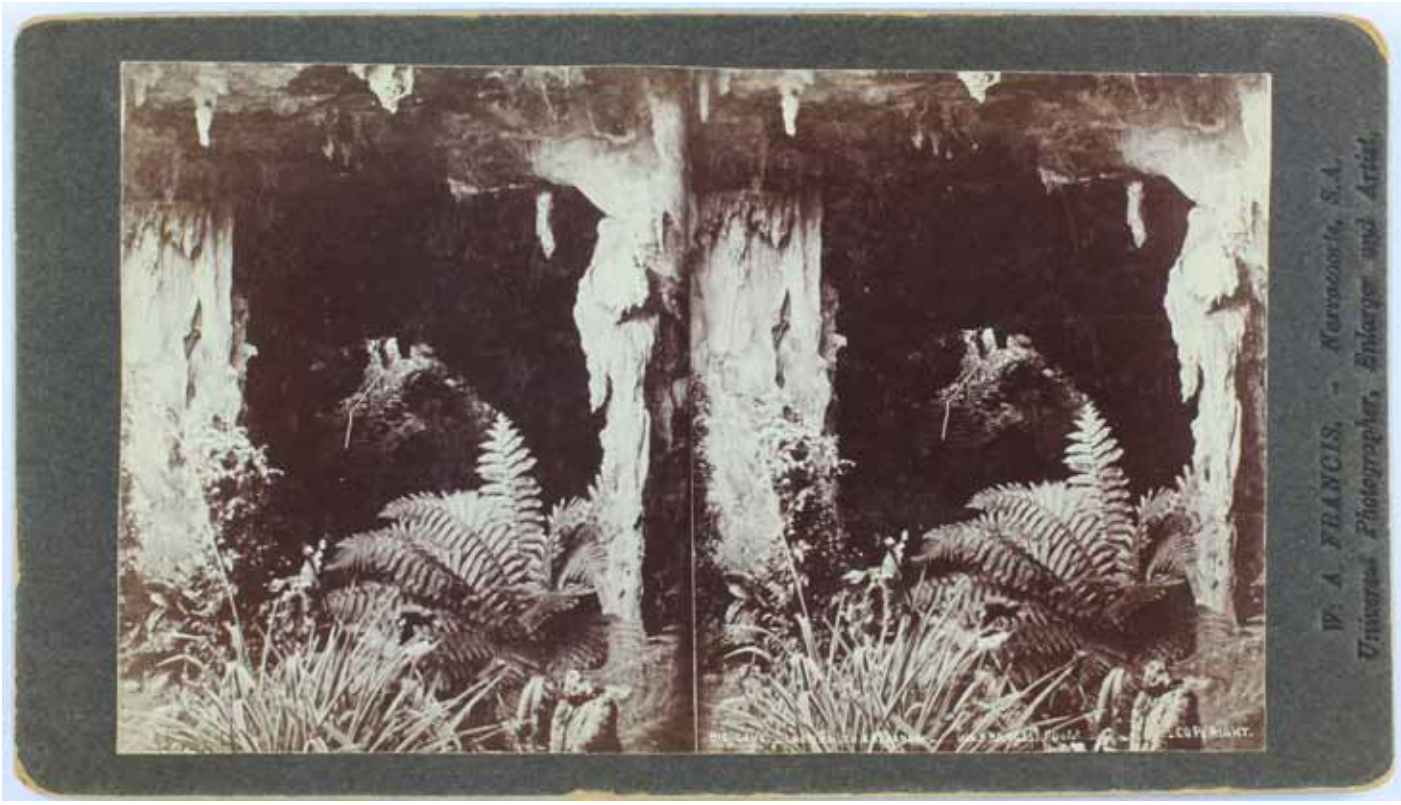


Figure 6. Stereoview of 'Big Cave', looking towards the entrance by William Augustus Francis (collection of the authors).

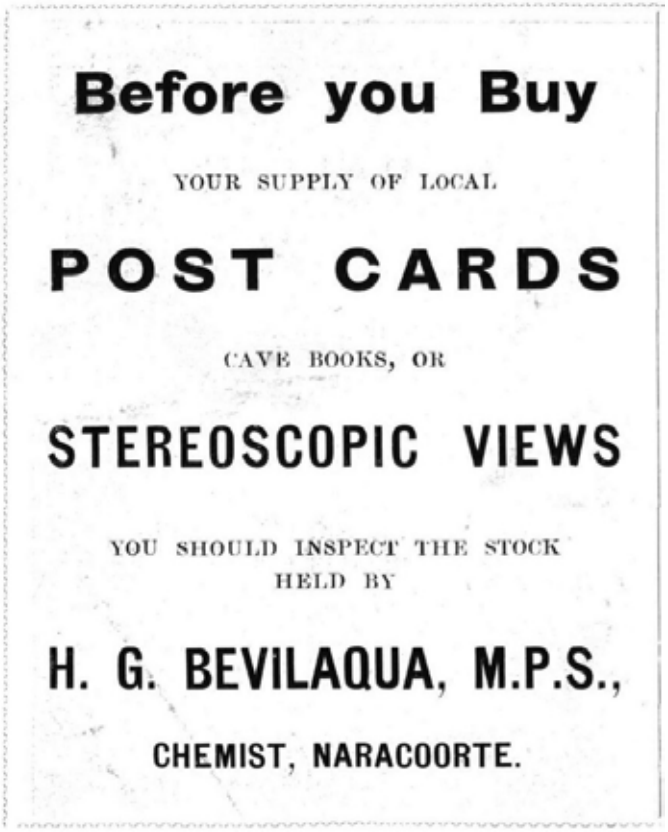


Figure 7. Advertisement from State Tourist Bureau booklet, 1909/1910, The Naracoorte Caves: "How to reach them". From page 30 (top) and 28 (bottom).

Figure 8. China plate with "fern grotto, Old Cave, Naracoorte" (collection of the authors).

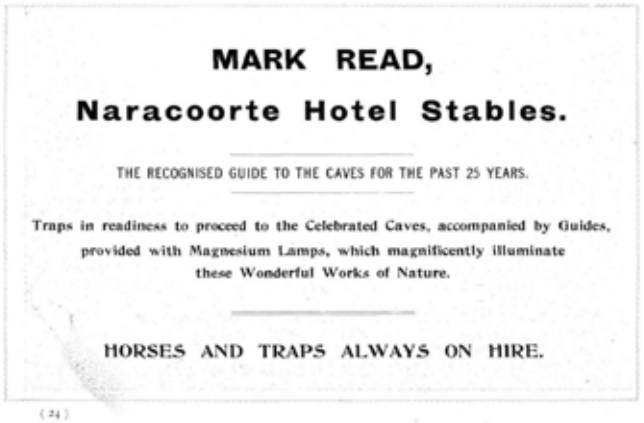


Figure 9. Advertisement from State Tourist Bureau booklet, 1909/1910, The Naracoorte Caves: "How to reach them". From page 24.

Tourist attraction

Several local entrepreneurs took advantage of the opportunity to escort visitors to the caves. The landlord of the Commercial Hotel had a wagonette specially built for taking people to the caves (Ward, 1868). Some people established themselves as guides, for example Mark Read (Figure 9), Charles Beauchamp and Charles Davies. These men operated from hotels or livery stables in the town until at least 1917 or 1918 (Hamilton-Smith, 2003). Tours to Blanche Cave usually included a picnic lunch and were popular with groups (Figure 10).

Consideration was given to improving the visual experience for visitors. Magnesium lights were used as early as 1866 (South Australian Adverstiser, Friday 1 June 1866, page 3). Fletcher wrote in 1879:

"In one deep recess, where the richness of ornamentation seemed to be at its best, our guide drew forth a ribbon of magnesium, and bidding us to go to the other end he flooded the place with mystic white light, which made the dark cavern like some hall of romance in the legends of the Arabian Nights."

Anonymous (1879).

A much-improved version of this form of lighting was trialed in 1883 (*The South Australian Advertiser, Tuesday 13 March 1883, page 6*), and presumably used from that time on until electric lighting was installed decades later. When choosing a local guide, visitors were encouraged to seek out the services of those offering magnesium lamps:

"Guides, who can be engaged in Narracoorte to show visitors through the caves, carry with them the magnesium lamp, and to visitors who wish to thoroughly explore the caves, and to see all the different spots of interest in them, it is recommended that the services of a guide with a magnesium lamp should be secured."

Anonymous (1895).

Figure 10. Group of visitors, Blanche Cave, Naracoorte c. 1890, photographer unknown (collection of the authors).

The first official tours began in 1886, following the appointment of a caretaker by the Forest Board. William Reddan (the second caretaker) became famous for his lively and entertaining tours of the caves, many of which featured stories of faeries and fanciful interpretations of cave decorations (Hamilton-Smith, 2003). He extended plantings in the gardens within Blanche Cave, introducing plants such as ivy and bridal creeper. From the photographic record it appears much of the sediment cone beneath the third roof window was relatively undisturbed prior to Reddan's redevelopment of it as a garden area (Figure 11).

During the latter part of the nineteenth century Reddan installed pathways, handrails, stairs and tables for visitors, making access far easier (Figure 12). Better promotion of the caves as a tourist destination was called for even as early as 1895:

> *"In conclusion it can only be said that want of proper publicity can be the only reason why the Narracoorte Caves are not to be found among the many sights (sic) of interest and curiosity to the tourist which are so widely written about and described in the hosts of periodicals of Australia"*
>
> Anonymous (1895).

In 1917, the reserve was gazetted as a Public Pleasure Resort and placed under the control of the Tourist Bureau. Reddan remained as caretaker until his retirement in 1919. W.A. Carthy was caretaker until 1923 and by that time package tours incorporating train travel from Adelaide were popular promotions for the Tourist Bureau. Blanche Cave was not lit or offered as a guided tour at that stage; but was available as a self-guided option and a place to eat lunch. Robert Leitch assumed the role of caretaker in 1923 and was known for maintaining the gardens, planting trees and installing a wisteria covered pergola over the entrance to Blanche Cave.

On special occasions, Blanche Cave was lit with candles to enhance the visitor experience. During the official opening ceremony for Alexandra Cave in 1909, the cave was lit with 600 candles, providing a spectacular site for Governor Bosenquet and party (Hamilton-Smith, 2003). In 1924 it was lit with nearly three times that number of candles for the "Back to Narracoorte" celebrations. This event included dancing, music and even a ping-pong tournament in the Robertson chamber of the cave, which was lit with hundreds of paper lanterns. The tradition of lighting up Blanche Cave continues today. In 2000, candles were lit to welcome the Olympic torch as it was carried though the cave.

Leitch retired in 1948 and the Tourist Bureau had difficulty maintaining a long-term caretaker after that. Blanche Cave remained an open access cave, even after the park was declared a Conservation Park in 1972 and placed in the charge of the National Parks and Wildlife service. The formation of CEGSA (Cave Exploration Group of South Australia) in 1955 was instrumental in renewing activity at the caves and providing the first organized and systematic surveying and scientific interest in Blanche Cave and others within the park. The first map of Blanche Cave was produced by CEGSA in 1956. It is unclear when guided tours first recommenced in the cave, but it was probably in the 1970s. A wonderful set of images published as postcards by CEGSA show the cave illuminated by garish coloured lights, with reference to the "Devil's pit" in the last chamber. Clearly, the fantasy tour was still popular at that stage.

During the 1980s and early 1990s, Blanche Cave was offered as a guided tour and there was little change in the way tours were presented during that time (Bourne, 2000). Educational offerings within Blanche Cave included 'learn by activity' sessions (Bauer, 1989). As part of this activity students were encouraged to sift through fossil bearing sediments to find bones. Unfortunately this practice was damaging to significant fossil deposits and it ceased in the late 1990s (Reed, 2012). However, the logic behind the activity was excellent as it provided an interactive exercise that helped children understand how scientists do their work. At some stage during the 1980s, a simulated fossil excavation display was created adjacent to the third roof window entrance. After 2000, the cave was used as part of the 'fossil kids' program during which children were guided through the cave in a mini adventure tour which included imitation digs outside the cave. Since the opening of the Bat Teleview Centre in 1995, the cave has been used as part of the Bat Tour due to its importance as a wintering site for the resident bats.

Heritage listing

Blanche Cave was registered as a State Heritage place in the SA Heritage Register on 12 January 1984 in a joint listing with Victoria Fossil Cave. The justification was given as:

Figure 11. Canna garden beneath third roof window entrance. From Narracoorte, Caves and Town. Back to Narracoorte Celebrations 1924. Photographer unknown (collection of the authors).

Figure 12. Blanche Cave entrance chamber c. 1923. Photographer unknown (collection of the State Library of South Australia, Accession number B28781/4).

"*Blanche Cave demonstrates the Victorian attitude of a recreational 'grotto', becoming a social venue complete with steps, tables and benches. In contrast, the rich fossil beds discovered in Victoria Cave illustrate later attitudes towards scientifically valuable sites of minimal disturbance, appreciation and education".*

Given the rapidity of scientific advances and the massive paradigm shift in thinking about natural science during the mid to late nineteenth century, it is not surprising the Victorians took comfort in a more retrospective view of nature as a curiosity.

Recognition for the outstanding fossil values of the caves came in December 1994 when they were inscribed on the World Heritage list as a serial nomination with Riversleigh to form the Australian Fossil Mammal Sites (Riversleigh/Naracoorte). The selection criteria met by the nomination were eight and nine from a list of ten (prior to 2004 site selection was based on six cultural and four natural criteria, now one list of ten is used):

- to be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;
- to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;

Despite the World Heritage nomination for Naracoorte being centred on Victoria Fossil Cave, the boundary of the property was set so that it encompassed the major caves, including Blanche Cave. It has only been in recent years that the full extent of the fossil resource at Naracoorte has been understood (Reed, 2012). In 2001 the park was made a National Park and in 2007 the Australian Fossil Mammal Sites were placed on the National Heritage list.

The vertebrate fossils of Blanche Cave

The Reverend Julian Edmond Tenison – Woods visited Blanche Cave in 1857 and first reported the presence of vertebrate fossils at Naracoorte Caves in 1858 (Woods, 1858). In his report he mentioned that he had been alerted to the presence of bone material in the cave long before he visited. He was not surprised by this fact, but was quick to assert his views, on cave fossils:

"In Germany, in Italy, and in many other places wherever bones were searched for, they were found more or less abundantly, in every case similar to animals at present existing, but of a much smaller size. This latter point is of much importance, and may be stated as having become almost a law in geology, as it is applicable to almost every instance known that the animals immediately preceding those at present existing on earth were identical in every particular with the present, only very much larger. Knowing these facts, and also knowing that our caverns were as ancient, according to appearance, as any mentioned above, there is nothing surprising in finding osseous deposits in them also."

Woods (1858).

The bone deposits he described in Blanche Cave were composed of an incredible number of small bones, concentrated together in a rather puzzling manner at the base of stalagmites and columns. He identified them as predominantly rodent bones, *"...perhaps, in the proportion of three to one of any other description"...* (Woods, 1858). He also concluded that these murids were larger than modern species reinforcing his previous assertion *"this little discovery, small as it is, makes another illustration of the truth of the law above stated, viz., that wherever bones are found in caves, they are*

always those of animals at present existing, but of a larger size" (Woods, 1858). He described remains that were likely bandicoots, dasyurids and bats, although his osteological skills were clearly limited which he admitted himself in the report.

Following this he presented his theory on how the bones had accumulated in the cave:

"Had the mouse bones been smaller and near some Phoenician colony, we might suppose them to be relics of pagan religious worship, for these people used to sacrifice mice in caves and make a tumulus of the bones. Such a theory would hardly do here.... Some others agree that the bones (referring to caves in general) *could only have collected during an extensive inundation, which would cause them to accumulate either by driving large numbers of animals into them by the restless agitation of the waters above. With this latter theory I agree, as the most consistent with the observed facts."*

Woods (1858).

Woods proposed that when the plains beneath the caves were inundated in the past, animals would have sought refuge on the hill, only to drown as the waters flooded the caves. He then went on to generalise that cave deposits worldwide were likely contemporaneous and reflected a "universal deluge", noting:

".... the bone deposits afford striking evidence in corroboration of the Mosaic record which has been overlooked by geologists, more especially as according to that record the creation of gigantic creatures appears to have died out then."

Woods (1858).

Later, he refined some of his views in a paper to the Geological Society of London in 1859 and his 1862 book:

"The bones in question are mostly of extinct species, closely allied to those of animals at present inhabiting the locality, but many times larger."

Woods (1859).

"There was a time when I very tenaciously held an opinion, at one time promulgated by the late lamented Dr. Buckland, in his 'Reliquiae Diluvianae', to the effect that the bones in caves were relics of the Deluge. That opinion I believe to be quite untenable."

Woods (1862)

Fletcher (Anonymous, 1879) praised the ingenuity of Woods' theories, but challenged his conclusions:

"The animals evidently did not live where they had been buried, for their remains are agglomerated together in utter confusion. A specimen fragment of this bone deposit which I possess contains fragments of jaws, tibia, and femurs, massed together in such away that it is impossible to disentangle them and to say which ought to be classed together to form one skeleton. Mr Woods has an ingenious theory about the rise of floods in the valley, which was formerly enclosed like a basin, sweeping these creatures into the caves through the openings in the surface, but I am afraid the theory will hardly account for all the facts of the case."

The bone deposits in Blanche Cave represented a long-term fascination for Woods. More than 20 years after his initial visit to the caves he was still publishing articles describing the caves and his fossil discoveries (Tenison-Woods, 1879a, b, c). The difference with these later articles was he had a broader context of Australian fossil discoveries within which to place the Naracoorte fossils and he had obviously been following the literature closely. In addition he was far more seasoned as a scientist. In one of these articles he discussed fossil finds of megafauna species around Australia and speculated what the continent would have been like in the past (Tenison-Woods, 1879b). He even went so far as to talk about the age of these animals and by that time he clearly had no problem with the concept of extinction in its true sense:

"The huge Diprotodon (it has no colonial title of domestic endearment) was as large as any elephant; the Nototherium was nearly as big, and twice as ugly..... There must have been a much greater variety in animal life in those days; in fact, it may be said that we only now see the remnant of what Australian zoology was formerly. The great mass of the species have died out.... But how long do these records extend back? Ah, that is what we have not the slightest clue about. Theory without some facts is simply a waste of thought and time. It was a very long time ago, we may say – only this, and nothing more."

Tenison – Woods(1879b).

In reference to the Naracoorte Caves, Woods wrote:

"The bones of the Mosquito Plains are not large – that is to say, those on the surface are not large. There may be larger ones deeper down... I think it would take years to exhaust all the natural history of these caves. A patient study of their remains will reveal a world of wonders, but that patient study they will hardly receive for years to come."

Tenison – Woods(1879b).

Following Woods' efforts there was surprisingly little attention paid to the Blanche Cave bones and Naracoorte fossil deposits in general (Reed and Gillieson, 2003). Stirling and Zietz re-examined some of the Blanche Cave material when they visited in 1908 (Hamilton-Smith, 2006), although Stirling only reported on material from Specimen and Alexandra Caves. It wasn't until sixty years later that fossil material was collected from the first chamber (apparently during lighting installation and digging of tunnels by cavers) and lodged in the South Australian Museum. This included bones from *Sarcophilus* (Tasmanian Devil – Figure 13) and a giant bird *Genyornis newtoni* (Rich, 1979). These finds were important as they recorded the presence of Pleistocene aged fauna in the cave (Reed and Bourne, 2000).

Figure 13. Sarcophilus dentary collected from Blanche Cave in the 1960s (P17321 – South Australian Museum).

Additional collection of material was made in 1984 in the third chamber. This yielded several 'megafauna' species including *Protemnodon* and *Thylacoleo*. Unfortunately these collections, although lodged with some sparse location details, were not collected in a systematic way with attention to excavation of the material according to stratigraphy.

A new era of fossil research in Blanche Cave

Woods was correct in thinking it would be a long time until the Blanche Cave fossil deposits received serious study (more than 120 years!). Flinders University MSc student Steve Brown excavated a small site in the first chamber in 2001. Preliminary dating suggested a terminal Pleistocene to Holocene age (11,000 to 13,000 years BP; Brown, 2006). Geochemistry and sedimentology of the cave sediments from the section were studied and revealed the presence of phosphate minerals derived from bat guano in the lower layers (Forbes and Bestland, 2006, 2007).

In 2004 one of the authors (LR) identified a potential site in the third chamber and later supervised Flinders University Honours student Tegan Laslett who conducted a preliminary investigation of the site in 2006 (Laslett, 2006; Reed, 2012). This study revealed a finely stratified sediment deposit containing a diverse and abundant vertebrate fauna (Laslett, 2006; Reed and Bourne, 2009). The excavation was expanded in 2007, with detailed sedimentological and chronological study conducted since then (Darrénougué *et. al*, 2009; St. Pierre *et. al*, 2009, 2012; Reed, 2012; Macken *et. al*, in press). A singular contribution of the site has been the first ancient pollen record for Naracoorte Caves (Darrénougué *et. al*, 2009; Reed, 2012). In 2012 the authors extended the pit to a depth of two metres (Figure 14) and investigation of the site is continuing with research by a multi-disciplinary scientific team (Reed, 2012).

Small mammal remains are the dominant group of fossils from the third chamber site. These are predominantly composed of rodent species, a fact also noted by Woods regarding the bone breccias that he found at the base of large columns (Woods, 1858). This is a reflection of the mode of accumulation, which was owl predation. Owls roosted in the cave in the past and pellets containing bones of prey items accumulated on the cave floor (Figure 15).

Owl pellet deposits can be recognised by several features including the sheer concentration of material, the dominance of species and size classes within the prey range of the owl, the presence (in varying degrees) of damage indicative of digestive modification of bone and the fossils of the owl itself (Andrews, 1990). The Blanche Cave deposit contains a number of fossils from the Masked Owl (*Tyto novaehollandiae*), which is well known to roost in caves. Boobook Owls (*Ninox novaeseelandiae*) still use the cave and are sometimes seen hunting bats, providing an entertaining sight for visitors. Other species within the deposit represent cave dwelling or frequenting species such as bats, quolls and possums. Larger species are present in low numbers relative to the small mammals and are attributable to pitfall entrapment. It is typical for large, roof window entrances at Naracoorte to facilitate multiple accumulating modes (Reed, 2012).

Given the enormous concentration of small mammal bones in the Blanche Cave deposits it is surprising that Woods and others never considered the activities of predators to be responsible. Woods' theory of animals trapped by rising flood waters does not hold up in light of the excavated evidence; however, smaller scale 'flooding' during storm events did lead to sediment movement

Figure 14. Excavating in Blanche Cave 2012. Photo: Steve Bourne.

down the cone and the burial of fossil remains in successive layers.

Presenting the past

> *"One of the things Ford Prefect had always found hardest to understand about humans was their habit of continually stating and repeating the very very obvious."*
>
> Douglas Adams, The Hitchhiker's Guide to the Galaxy (1979)

It is widely accepted that caves present particular challenges for guides (Austin and Chaney, 1977; Bourne, 2000; Dunkley, 2001). There can be a tendency for tours to become 'static' and unchanging, information to be out of date or incorrect and interactivity to be minimal. On a cave tour, interactivity is usually restricted to asking people questions and waiting until someone gives the 'right' answer or handing around various props. Austin and Chaney (1977) attribute a lot of this to inadequate staff training, stemming largely from priority being given to other things such as marketing and operational issues. If the tours are running on time and there aren't too many negative comments in the visitor book then everything must be fine. This form of quality 'benchmarking' sets up a cave attraction to aspire only to ever increasing levels of mediocrity. It is not a suitable environment for growth and innovation. These things come from challenging the norm and being willing to look 'outside the box'.

Today, there is a greater focus on the quality of interpretation at cave sites. Many sites have invested heavily in interpretative infrastructure and training activities for staff. Once these are in place, the temptation would be to rest on one's laurels and watch the visitors roll in. This would be analogous to sitting back in one's dressing gown and slippers, comfortable by the fire, accepting that all is well in the universe; heading straight back into Plato's cave. Dunkley (2001) rightly points out that the tradition has been to put more emphasis on what goes into the training process than what comes out of it. Often, training is too focused on injecting large amounts of information into guides. Interpretation should be continually monitored and evaluated to ensure it remains effective and dynamic. Fortunately, managers of Australian cave sites are generally aware of the importance of vitality in their interpretative offerings. A strong point for Naracoorte Caves has always been its diversity of product offerings, providing site interpreters with varied roles and opportunities.

Necessity is indeed the mother of invention and some of the most creative and innovative interpretation is done

Figure 15 (right). **A.** *Boobook owl roosting in Blanche Cave. Photo: Steve Bourne;* **B.** *Fossil bones from the third chamber dig. Photo: Liz Reed;* **C.** *Digestive corrosion damage to a femur Photo: Amy Macken.*

on a shoestring budget, relying on the skill and creativity of the person delivering it. After all, humans are interested in other humans and their whole impression of an experience can be shaped by the interactions they have had with the people involved. The masterful interpreter inspires visitors by opening the door to new possibilities, by challenging them to work things out for themselves and perhaps even step outside their comfort zone. The guide connects the dots between what is experienced in the cave and what is relevant to visitors once they leave. The visitor may leave a place with a new perspective and start to care about something, that prior to their visit, was only a passing interest or even completely foreign.

Visitors bring with them their own perceptions and expectations about what they will experience at a cave site. When the word fossil is mentioned, most people instantly think of dinosaurs or dusty old bones in a cabinet. Scientists are often perceived as people who wear white coats, hiding away in their lab staring down a microscope. Palaeontologists are often confused with archaeologists; but seen as somewhat more adventurous than the average scientist, thanks largely to Indiana Jones. Some years ago, one of us (LR) guided a three-hour World Heritage tour at Naracoorte Caves and after the tour one of the visitors remarked – *"We weren't quite sure when they said a scientist would take us through the caves, but you're just like a real person"*. The combination of science and fossils can be a 'hard sell' to a general audience, reinforcing the need for quality interpretation to tease out the stories.

Science and interpretation at Naracoorte Caves

The discovery of the Fossil Chamber in Victoria Cave in 1969, by Grant Gartrell and Rod Wells heralded in a new era for Naracoorte Caves and placed it firmly on the world stage (Reed and Bourne, 2000). Wells was instrumental in setting up the fossil bed area as an underground museum and was quick to recognise its tourism potential. (Wells *et. al*, 1980). Ern Maddock, Director of the National Pleasure Resorts, helped secure investment to develop the fossil story for tourism, which was innovative at the time (Wells *et.* al, 1980; Bourne, 2000, 2004). From 1971, visitors to the cave were able to view excavations in progress and receive explanations of the finds made by scientists and volunteers (Figure 16; Wells *et. al*, 1980). Collaboration between Flinders University, the South Australian Museum, CEGSA, the Tourist Bureau and National Parks and Wildlife led to further development of the Fossil Cave tour and the construction of an interpretative centre (Wells *et.al*, 1980).

Wells *et. al* (1980) wrote:

> *"An interpretation centre should foster a spirit of natural enquiry, a willingness to challenge explanations, when new evidence arises. We do not offer any final answers instead we attempt to lead the public through our interpretation of the history of the caves, from their formation to the accumulation of the fossils, to their discovery and the attempts to reconstruct these events".*

Consideration was given to how the static displays would complement the guided interpretation. Background information was provided to guides, who were encouraged to develop their own tours from this information. Wells *et. al* (1980) note:

> *"Unfortunately, this approach requires constant checking of the commentaries as they can, as time passes, gradually drift into greater and greater inaccuracies. Tape recorded commentaries at selected points within the cave were contemplated, but although they would give accuracy and consistency they were considered too impersonal and likely to lower the morale of the staff relegated to the role of usher".*

Science has remained central to the presentation of the Naracoorte Caves story, not just relating to fossils but also bats, geology and cave biology.

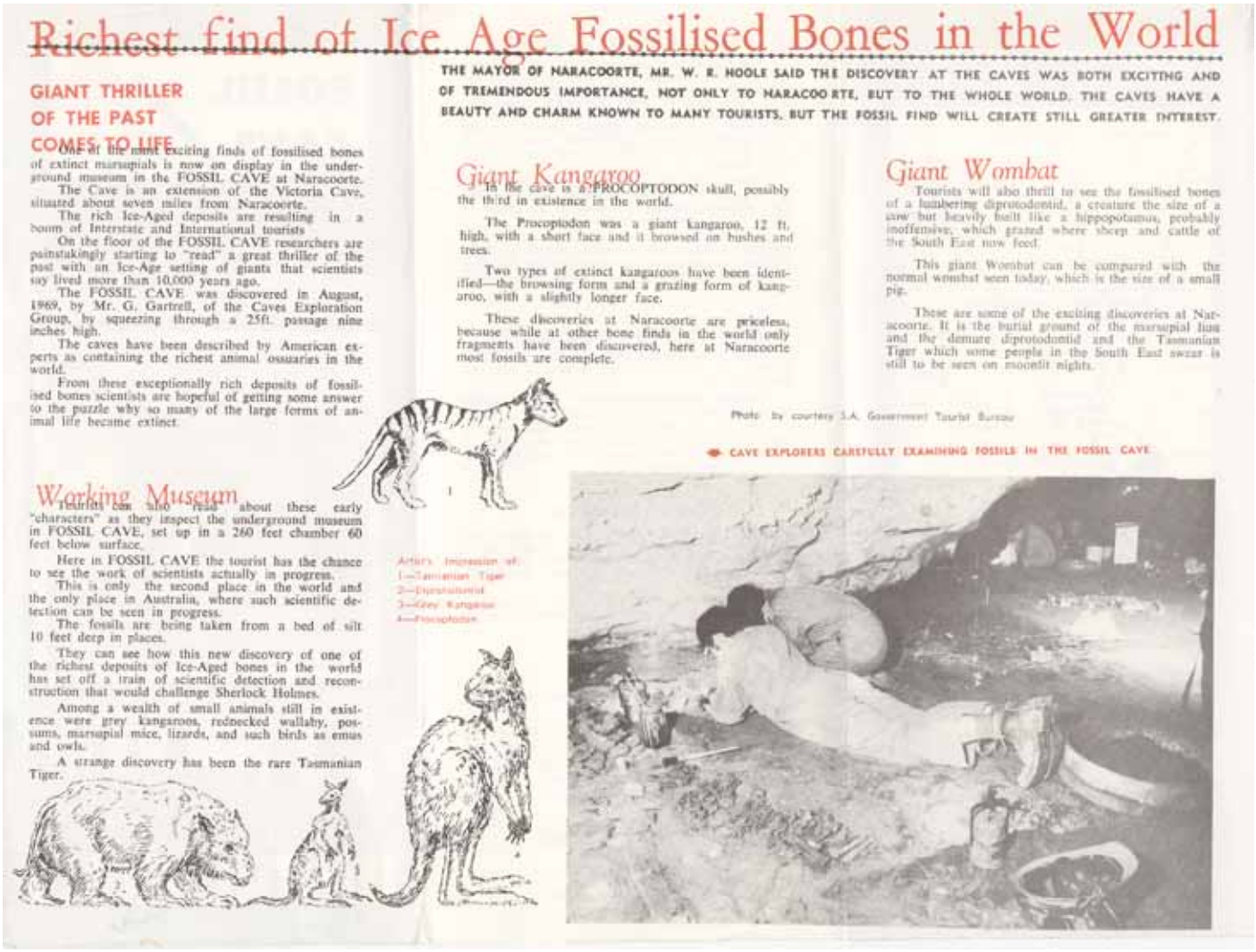
Douglas (2006) wrote:

> *"National Parks and Wildlife Services (NPWS) and scientists at the Naracoorte Caves World Heritage Fossil Site in south-eastern South Australia have worked fruitfully together to build ties with the South Australian Tourism Commission, better to integrate scientific and aesthetic values in marketing the site and to position the state as 'a unique and diverse tourist destination".*

The research undertaken at Naracoorte Caves has a wider function within the community as well. Cooperation with local landowners has led to research and protection of key fossils sites outside the World Heritage Area (Bourne, 2006). During the early years of the Victoria Fossil Cave dig, local people and school groups participated in activities to assist scientists in their work. This has continued into the present, with involvement of volunteer groups such as the Friends of Naracoorte Caves and countless interactive public science events. For the staff, an advantage of recent years has been more access to scientists (Bourne, 2000), with a palaeontologist being located at Naracoorte and visits from many others from a host of institutions and disciplines. This has enabled close interaction between site interpreters and those doing the research with the provision of training sessions, training materials and hands-on opportunities for participating in research activities.

Linking research and communication

Currently, the Blanche Cave fossil site is part of a larger project investigating biodiversity and climate change across three contemporaneous Naracoorte cave sites (Reed, 2012). The project is funded under the Australian Government's "Caring for our Country" (CfoC) initiative ("Investigating and Communicating Lessons of Past Climate Change" project OC11-00487, 2010-11 Business plan open call process). Research funding at Naracoorte



Richest find of Ice Age Fossilised Bones in the World

THE MAYOR OF NARACOORTE, MR. W. R. HOOLE SAID THE DISCOVERY AT THE CAVES WAS BOTH EXCITING AND OF TREMENDOUS IMPORTANCE, NOT ONLY TO NARACOORTE, BUT TO THE WHOLE WORLD. THE CAVES HAVE A BEAUTY AND CHARM KNOWN TO MANY TOURISTS, BUT THE FOSSIL FIND WILL CREATE STILL GREATER INTEREST.

GIANT THRILLER OF THE PAST COMES TO LIFE

One of the most exciting finds of fossilised bones of extinct marsupials is now on display in the underground museum in the FOSSIL CAVE at Naracoorte.

The Cave is an extension of the Victoria Cave, situated about seven miles from Naracoorte.

The rich Ice-Aged deposits are resulting in a boom of Interstate and International tourists.

On the floor of the FOSSIL CAVE researchers are painstakingly starting to "read" a great thriller of the past with an Ice-Age setting of giants that scientists say lived more than 10,000 years ago.

The FOSSIL CAVE was discovered in August, 1969, by Mr. G. Gartrell, of the Caves Exploration Group, by squeezing through a 25ft. passage nine inches high.

The caves have been described by American experts as containing the richest animal ossuaries in the world.

From these exceptionally rich deposits of fossilised bones scientists are hopeful of getting some answer to the puzzle why so many of the large forms of animal life became extinct.

Giant Kangaroo

In the cave is a PROCOPTODON skull, possibly the third in existence in the world.

The Procoptodon was a giant kangaroo, 12 ft. high, with a short face and it browsed on bushes and trees.

Two types of extinct kangaroos have been identified—the browsing form and a grazing form of kangaroo, with a slightly longer face.

These discoveries at Naracoorte are priceless, because while at other bone finds in the world only fragments have been discovered, here at Naracoorte most fossils are complete.

Giant Wombat

Tourists will also thrill to see the fossilised bones of a lumbering diprotodontid, a creature the size of a cow but heavily built like a hippopotamus, probably inoffensive, which grazed where sheep and cattle of the South East now feed.

This giant Wombat can be compared with the normal wombat seen today, which is the size of a small pig.

These are some of the exciting discoveries at Naracoorte. It is the burial ground of the marsupial lion and the demure diprotodontid and the Tasmanian Tiger which some people in the South East swear is still to be seen on moonlit nights.

Working Museum

Tourists can also read about these early "characters" as they inspect the underground museum in FOSSIL CAVE, set up in a 260 feet chamber 60 feet below surface.

Here in FOSSIL CAVE the tourist has the chance to see the work of scientists actually in progress.

This is only the second place in the world and the only place in Australia, where such scientific detection can be seen in progress.

The fossils are being taken from a bed of silt 10 feet deep in places.

They can see how this new discovery of one of the richest deposits of Ice-Aged bones in the world has set off a train of scientific detection and reconstruction that would challenge Sherlock Holmes.

Among a wealth of small animals still in existence were grey kangaroos, rednecked wallaby, possums, marsupial mice, lizards, and such birds as emus and owls.

A strange discovery has been the rare Tasmanian Tiger.

Photo by courtesy S.A. Government Tourist Bureau

CAVE EXPLORERS CAREFULLY EXAMINING FOSSILS IN THE FOSSIL CAVE

Artist's impression of
1—Tasmanian Tiger
2—Diprotodontid
3—Grey Kangaroo
4—Procoptodon

Figure 16. Tourist brochure from the 1970s (collection of the authors).

via the first two phases of National Heritage Trust grants (NHT) was relatively stable, with annual contributions enabling multi-year student PhD and Masters projects to be funded. The CfoC program is delivered under different guidelines, with the program threat-based, and outcome/output focused. MERI (monitoring, evaluation, reporting and improvement) plans became a requirement and while initially daunting, were relatively easy to develop for this project.

The Australian World Heritage Advisory Committee (AWHAC) was established in 2008 with one of us (SB) the South Australian representative on this committee. The committee presented several reports through to the Environment Protection and Heritage Committee (EPHC) with recommendations on how to address a number of issues within Australia's World Heritage properties. Included in these were reports on applied research (research directly addressing issues at a World Heritage site or contributing to the knowledge and understanding of the property) and on presentation, communication and tourism. The committee identified key issues and potential solutions for Word Heritage properties and many of these recommendations found their way into the annual Caring for our Country Business Plan as targets for Australia's World Heritage properties.

In the 2010-11 Business Plan, criteria were outlined guiding proposals from the various World Heritage Areas (in the section "Managing Australia's World Heritage"). These were site specific and the Naracoorte section of the Australian Fossil Mammal Sites could apply for funding related to the criterion "Investigate and communicate lessons of past climate change occurrences for current climate change." Although rather clumsily worded, the criterion opened up the opportunity to develop a project that involved research (which would not directly be funded under the Caring for our Country program) integrated with interpretative and management outcomes, and also contribute to modern ecological conservation initiatives. The project was developed around investigating three sites, feeding this information directly into training programs for guides and with the aim to contribute to conservation within the region; based on immediate pre-European flora and fauna found in the cave sites. This was the first time a research project had been written with specific interpretation and conservation goals included.

Stories in the strata

"My universe is my eyes and my ears. Anything else is hearsay."

Douglas Adams, The Restaurant at the End of the Universe (1980)

The Naracoorte 'story' is multi-faceted and includes Quaternary biodiversity and palaeontology, geology and palaeoclimate, karst science, cave biology, heritage and biodiversity conservation, intrinsic and aesthetic values of caves, history and human use, and the work of scientists. These stories have always been there, waiting to be unearthed, dependent on what things people value as important stories at any given time. This is illustrated well by the history of human activities in Blanche Cave, with attitudes to the cave evolving in light of prevailing paradigms.

The Blanche Cave fossil story (indeed much of the Naracoorte story) is as much about what can't be seen as it is about what can be. The work of scientists is largely 'behind the scenes' and there has always been confusion between the methods or processes of science (e.g. excavation) and the actual research (i.e. analysis, interpretation and publication of results). The latter is done in the lab, away from the cave. When excavation was in progress in Blanche Cave, visitors were able to clearly view the process and interact with those digging (Figure 17). This presented a wonderful opportunity for interactive interpretation. It would be easy to fall into the trap of assuming that if the scientists are not excavating every day, then nothing is happening. This is where the site interpreter steps in and conveys the 'other 90%' of the story.

There is also an important tale of heritage conservation to be told, where excavation for its own sake is not conducive to the long-term conservation of the resource (Reed, 2012). Scientific research projects must only be conducted if they have a strong plan and are well resourced to ensure successful completion. The World Heritage significance of the site demands that the benefits of activities on park be justified against potential impacts on the resource. An excellent addition to permitting requirements of recent years has been for researchers to complete a referral under the EBPC act (Environmental Protection and Biodiversity Conservation Act 1999).

Not only is much of the science 'hidden' from view, so too are many aspects of the deposits themselves. One thing recent research has highlighted is that there is a wealth of 'micro' evidence that yields important aspects of the story. Bones are one part of this and the multitude of small vertebrate remains, while not always immediately obvious at first glance, provide critical insight into Naracoorte's past ecology (Reed, 2012). Sediments in Blanche Cave contain microscopic pollen grains, phytoliths, diatoms and tiny terrestrial gastropods. Charcoal particles provide records of ancient bush fires and important material for dating. Fragments of cave formations can be dated and their chemistry sheds light on past climate. Each layer of sediment in the exposed section has a story to tell and one can literally "see" extinction in the strata (Figure 18). Visitors to Naracoorte have embraced the stories presented at the Blanche Cave excavation and it has challenged many of them to look at fossil deposits in a new way.

For many years Blanche Cave was 'pigeon-holed' as the historical tour and later the bat tour. There is nothing inherently wrong with this, unless interpretation becomes compartmentalised and each cave is treated as a separate entity rather than each conveying aspects of the broader Naracoorte story. There should be a persistent theme across all of the interpretative offerings, interconnecting the place as a unit. Musser (2012) provided a good example of how interpretative programs can be re-invented by interpreting a common theme across multiple features of a site.

As the new phase of interpretative planning unfolds at Naracoorte, consideration could be given to reinstating Blanche Cave as a standalone tour. The bat tour can be difficult to guide during winter when the bats are inactive or absent from Bat Cave. It would make an excellent seasonal offering from September to May. In many ways, Blanche Cave 'communicates' the whole Naracoorte story better than any other cave in the park. An opportunity exists to combine interpretation of the above and below ground features. Interpretative panels placed in key areas on the surface and in the cave would be useful props for the guided tours and provide interesting talking points for visitors enjoying the walking trails around the cave.

Complex stories require both knowledge and understanding. If understanding is the foundation rather than just the accumulation of factual information, then issues in cave guiding such as 'mis-information creep' and 'myth perpetuation' are reduced to virtually nothing. Training exercises embedded in the CfoC project delivery have provided up to date information and hands on fossil experiences for guides. These increase understanding of the science and build a strong foundation for interpreting how the science is done. If a guide has participated in the science activities it adds another dimension to their tour. Community involvement has extended beyond public events to training a small group of Friends group members in fossil sorting, screening and preparation of fossil material excavated during the project. This has enabled them to pass on their knowledge and pride of place to visitors (Figure 19).

Despite being largely 'unseen', ongoing research is critical to maintaining the vitality and integrity of the visitor experience, as it is the most effective way to 'inject' new stories into the interpretation. As Wells *et. al* (1980) note, *"Scientific research is dynamic, not static like a museum display"*. In this light, the site interpreter should be seen as the crucial link between the science and the public. Visitors are likely to be more critical of being shown an 'empty' dig site if there are no new stories, than if the guide can relate details of the latest research using the dig site as a interpretative aid.

Figure 17. Visitors viewing the excavation site during a tour in 2012. Photo: Steve Bourne.

The CfoC project has yielded multiple outcomes for Naracoorte Caves. There are the scientific aspects that continue to yield interesting results and help address the "so what, who cares?" aspect of interpretation by showcasing climate change and other topical issues of relevance to visitors. It has also reinforced the value of 'younger' fossil deposits in the large roof window caves and highlighted the need for stronger recognition of these in the management plan (Reed, 2012). Methodologies employed during the project have reiterated the need for site conservation to be an integral part of research planning. Importantly, the results of the project have allowed new perspectives on interpretation of the Naracoorte Caves site. Given this, it would be appropriate to conclude this paper with perspectives on the new research in Blanche Cave and how it has changed the perception of the cave and the way it is interpreted. Who better to express these perceptions than those at the front line of interpretation at Naracoorte, the site interpreters themselves?

In their own words (Comments unedited- Ed.)

Decima McTernan (Senior Guide):

"The current research and ensuing training in the same has allowed us as staff at the Naracoorte Caves to present a much more holistic view of the site. No longer is the focus on 'What killed the Megafauna" but more on how were they living and how does the fossil record give us a picture of the more recent past. Visitors find the small mammal story fascinating - how it presents an insight into biodiversity and climate change over time. They are always amazed that other evidence such as pollen, plant material, charcoal and scats is helping to put pieces of the jigsaw in place and may in fact help with our present conservation management. People love to know how a story may play a part in their future or the WIFM factor (what's in it for me!!)".

Gavin Kluske (Site Interpreter):

"The Blanche Cave fossil deposit is a popular part of the cave tours at Naracoorte Caves. Most visitors are impressed by the amount of detailed information sourced from the clearly visible layers within the deposit. I often describe each layer, its age, the fossil remains within the layer and what they infer about the climatic conditions at the time of accumulation. The training sessions with Dr. Liz Reed are a great source of information that I use daily on the tours. They have allowed me as a tour guide to answer any question from the visitors with up to date and relevant responses. I am able to tie together the multiple fossil

Figure 18. Stratigraphic section from the third chamber excavation, showing ages of various layers obtained from radiocarbon dates of charcoal (BP = before present) and topics for discussion of the section. The ages have been rounded for simplicity (see St. Pierre et. al, 2012 for complete dataset).

bed "stories" of many caves, into one complete history of the caves and the climatic and biological changes preserved within them. Most visitors then quite naturally draw their own conclusions as to how the past relates to the present in terms of climatic change and the environmental changes it will bring."

Jinhwa Lee (Site Interpreter):

"I normally give bit of information about fossils in VFC Site (213,000~ 500,000 years old) then talk about this site. What fossils Liz's been found: Thylacoleo, Thylacine and leaf eating Kangaroo. Ages of fossils around 47,000 years old which is more recent than the ones in VFC. Sediments: last ice age 18,000 to 20,000 years ago, vegetation, pollen. What we can find out about from sediments! Bat guano accumulation: try to guess when bats started using the cave and how many of them were here in the past. This year about 37,000 of bats, 200,000 only about 50 years ago, what about back in 1845 and even before that! Remind people our bats are endangered and what's causing the no.s to drop. I want Blanche cave tour to relate to the bats! it depends the group if they've done VFC tour or going to."

Yarrow Lee (Site Interpreter):

"I found the practical aspects of the training with the hands on approach, more insightful than I first thought it would be. It is strange how a pile of bones can be transformed into a pile of interesting bits, when you know a little of what you are looking at. Paleontologists certainly look at the world very differently. If anything this fact was highlighted with every exclamation of wow! Learning what was the wow bits, led to more exclamations of wow and the cycle continues. I'm still learning. Perhaps a highlight was not just the discovery side, but an overwhelming sense of how painstakingly time consuming sorting fossil material can be. I've mentioned this fact on tours, but it never really hit home how much time can easily be spent sorting fossils and identifying bones. You can't just quit either half way through. It is about being more than patient. It's also about being consistent and keeping to your main aim, though you can get easily sidetracked. Being able to use the knowledge I gained that day, to give other people a better sense of understanding fossil sorting has I hope helped them see the pile of treasure, as opposed to just a pile of bones."

Frank Bromley (Site Interpreter):

"The Blanche Cave is an addition to the Bat Tour and as such, much of the interpretation is based on the Bat use of Blanche in winter and the points where Bats roost and drink.

The Fossil dig adds another dimension to the tour especially as many of the visitors have already done the Victoria Fossil Cave tour just prior to the Bats. The obvious stratigraphy and mineralised guano within the walls of the deposit enable us to discuss the sequential accumulation of sediment and the fossils within. The presence of pollen within the deposit can demonstrate vegetation change through time and prompt discussions about responses to climate changes. The story of the digs origins as Tegan's Honours studies and the further development by Liz are often brought up in discussions at the dig site.

We can also tell the story of how the area had been used in the past to examine the avens above the dig.

While the Bat/Blanche tour is not focussed on fossils particularly, the presence of the dig and its graphic stratigraphy have become an integral part of the tour and gives us another opportunity to discuss World Heritage and the opportunities that palaeontology presents to help us understand the present by examining the past."

Barb Lobban (Site Interpreter):

"The Blanche Cave deposit is an amazing interpretive tool to use when showing and explaining the changes in the environment over thousands of years but at a very recent time in the eyes of a scientist. The deposit shows definite changes in the sediment layers leading us to believe that there may have been many vegetation changes and maybe this impacted on the

Figure 19. Friends of Naracoorte Caves members instructing Friends of Parks forum delegates in fossil sorting in the lab at Naracoorte Caves. Photo: Steve Bourne.

fauna found in the layers. The most amazing part I think is the possibility of two events happening and being recorded in the same deposit with the third cave opening being a series of solution pipes and larger animals being the victims along with smaller animals then a larger cave opening developing as we see the cave today and allowing owls to prey outside then leaving their pellets behind that can be a very important part of a palaeontologists research."

Dannielle Thomas (Site Interpreter):

"The fossil site in Blanche Cave has an extra element we as Site Interpreters can use. The site shows us the recent climate change and tells us the history of the cave as well. It's this element that visitors find fascinating."

Thomas Shortt (Site Interpreter):

"The dig in Blanche cave has allowed us guides to interpret the cave in a different way. It has added another element to interpreting not only Blanche cave but also helping to explain what has happened in terms of the World Heritage area. The new research is also quite interesting as it covers a period that is quite recent compared to other deposits around the park and involves a wider range of fossil materials and has a greater relevance to a lot of current issues in the area. I have found people on the tour have a great appreciation of these issues as it is something that will have an impact on people in the area today. It certainly has changed our understanding of the cave, which is always helpful when talking to groups."

So it would appear you can teach an old cave new tricks!

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LED TECHNOLOGIES and LAMP FLORA: PROs & CONs

Alexander Chrapko and Gabor Salamon*

For eight years Cave Lighting project has been installing LED lighting equipment in show caves. Nowadays about 40 underground facilities successfully use 'Cave Lighting™' LED systems. For eight years we have been watching our systems: we have been assessing the reliability of their work and the influence on the ecosystem of caves. You can find some of our conclusions and recommendations for the use of LED lighting in show caves in this article.

Two and a half years ago the Cave Lighting Project™ team reconstructed the illumination system of the Cathedral Chamber in the Grotte de Remouchamps Cave (Belgium). An energy efficient controlled LED Cave Lighting™ system was installed.

Cave Lighting™ System Operation Summary:

- There has been no system or part failure within its working lifespan (2 years 9 months);
- Energy consumption was reduced 40-fold;
- There has been a significant reduction of lamp flora.

We would like to discuss the last point in more detail. When installing the equipment in May 2010, the walls of the Cathedral Chamber were 75% covered with green and brown biomass. This can be viewed on the interactive accompanying photos. At the end of February 2013 the amount of flora was reduced to 10%, which is demonstrated by the photos.

We must note that it is not the first case of lamp flora reduction in a cave after LED system installation. Since the Cave Lighting™ Project began, we have observed this same effect quite often in other caves. The Bad Segeberg show cave in Germany is a fine example.

What is the value of this effect? Is LED lighting the panacea?

Show caves have been turned into tourist attractions primarily to protect the caves from vandalism, to reduce anthropogenic impact and to control visitor flow. Equipping a cave with routing, constructing stairs, paths and railings harm a cave less, as a result, than disorganized and unauthorized tours.

Naturally, the main purpose of a show cave is to demonstrate the subterranean world and its mysteries and beauty in a delicate manner. It is also important to try to preserve its virgin nature. Lighting, its quality and quantity are of major importance.

Open sources of light (such as torches, kerosene lamps, etc) were used approximately till the end of the 19th Century. Those sources of light polluted the air and dripstones with a considerable amount of grime and ash. Electric light fixtures became an important step forward. They solved the problem of grime and ash. But eventually, a few years later, there appeared another side effect of electric lighting systems – lamp flora. Eventually lamp flora turned into an enemy which is hard to defeat. Algae, moss and ferns change the interior of a cave and also affect dripstone formation.

Cathedral Chamber in the Grotte de Remouchamps, 2010

Cathedral Chamber in the Grotte de Remouchamps, 2013

International public opinion, including cave managers' and visitors' opinions, is relatively accepting of lamp flora. However, it is undesirable and there have been plenty of attempts to stop and prevent its growth. This battle has been going on for decades but the results are contradictory. There are two methods of control:

1. Preventing flora growth,
2. Removing existing flora.

Long proven experience has shown that it is much more effective to prevent flora growth, rather than trying to remove it. It is the same with our health: preventing an illness is easier than treating it. But, unfortunately, neither of these methods guarantees 100% success. Combining those different methods brings the best results.

To prevent flora from thriving, it is necessary to eliminate conditions which promote its subterranean growth. In other words, it is important to create conditions which will make it impossible to grow. There are always inorganic compounds, such as nitrates and phosphates and water in caves, which promote growth.

Therefore, the first step, to eliminate this, is to change the light level. (This is the level of electromagnetic emanation with the waves of certain length.) In this way flora will have no chance to grow and spread.

This is theory. However, let us talk about practical aspects. There are three main trends in experiments.

1. Using yellow and green lighting

This is a very effective solution. But unfortunately, aesthetic outcome is quite pathetic. In some cases flora remains untouched though it is not so visible in the green or yellow light. Besides, it is important to remember that the main purpose of illuminating a cave is to demonstrate its beauty, rather than fight against lamp flora.

The other two methods concentrate on optimizing operation of an illumination system in a cave:

2. Shorter operation cycle of a lighting system. Light zoning of a cave space and the use of 'dynamic lighting'

Lighting in show caves must be zoned, controlled and dimmable. Lighting zones should be relatively small since only the zones occupied with visitors should be lit. Splitting the system into controlled electric circuits allows the dividing of a cave into smaller zones. In bigger parts (chambers) there should be dynamic lighting. A tour guide, or special software, controls dynamic light scenarios in these areas. In some areas of a chamber, light is turned on or off at certain intervals. Such dynamic illumination system draws the visitor's attention to certain parts and details of a cave. Lighting should be dimmed and minimized on route illumination, when visitors walk along the paths or go from one chamber to another.

3. Lower intensity of light

Human eyes easily adapt to certain conditions. Our irises adjust to low light if necessary. Therefore, lighting placed at one's eye level can be minimized. In other words, visitors' heads can be in shade and should not be affected by unnecessary or diffused light. But, there should be controlled lighting fixtures in a cave in order to meet this requirement. Excessive or unnecessary lights should be turned off or dimmed. However, paths and stairs must have separate lighting. As a result of this lighting, it becomes possible to achieve almost complete darkness on one's eye level and reduce overall illumination. At the same time it is important to point out that stairs and path illumination should meet all safety requirements.

High quality equipment in a show cave is a perfect method of fighting against lamp flora!

What makes LED equipment different from other kinds of lighting?

Perama Cave with yellow light

Perama Cave without yellow light

LED equipment allows the reduction of illumination levels in a show cave significantly. This was impossible with older equipment.

LED lighting fixtures can be dimmed or turned off. This in its turn means that the illumination level can be varied without changing the light temperature.

LED luminaries allow the use of different lenses, so that various and proper angles of lighting can be chosen when designing illumination of a cave. It also helps to avoid 'unnecessary light'.

LED lighting fixtures can be manufactured with different spectrums of light temperature. This allows the adapting of illumination to a cave environment. Light show colors can range from 'cold' to 'warm' lighting.

Frequent turning on and off doesn't affect LED fixtures. It makes them perfect for 'zoning a cave' or creating various light and dynamic shows.

The most frequently asked question concerning LED lighting system in caves is:

Can lamp flora growth be reduced if a cave is equipped with LED equipment?

The answer is:

Definitely!

In the case of a poorly designed and installed LED system and too long switching time, flora will continue to grow rapidly. Power consumption will be reduced significantly.

It is not out of the question that, even if a lighting system is properly designed and well balanced, there will still be few spots of vegetation caused by some sources of light. In such cases authorized eco-friendly measures should be used to remove the flora germs. Such preventive measures will reduce and gradually exterminate lamp flora completely. These measures must be taken on a regular basis.

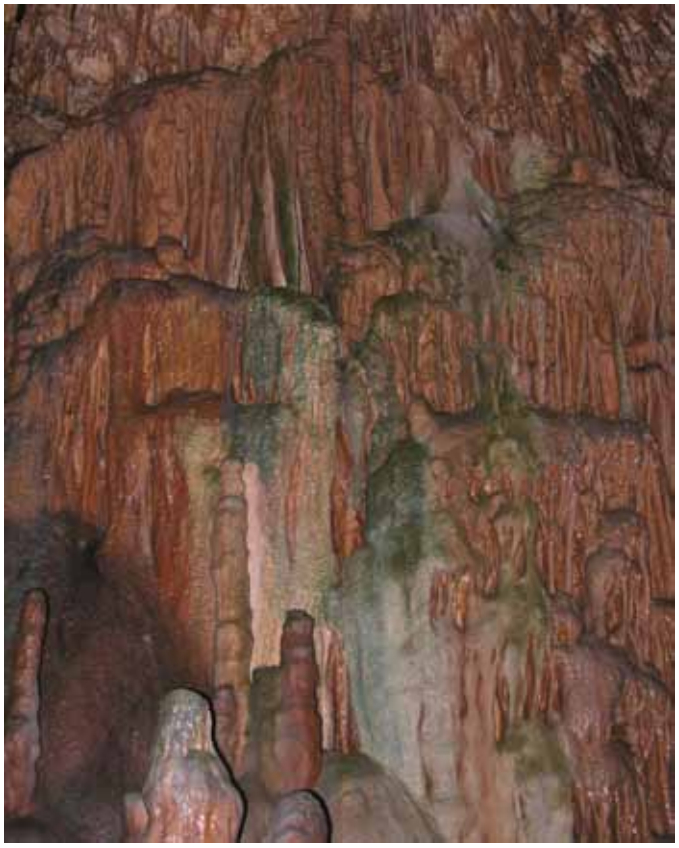
LED technology makes it possible to minimize possible harm and to preserve fragile eco-systems within a cave!

Conclusion:

Back to the question that we asked at the beginning of this article: "Can LED lighting be panacea for all woes"? We have to admit that LED technologies are neither panacea nor a magic wand as many mistakenly believe. Alongside LED technologies make it possible to bring eco-friendly and esthetically attractive lighting equipment into show caves. The key point is proper implementation and a new approach to cave lighting design.

In professional hands LED equipment can become a true panacea!

[*Editor's note: This article was taken, with permission, from the Cave Lighting Project website (http://www.cavelighting.com). The article has had minor editing.]



Lampenflora in Scocjan Cave, Slovenia 2005. Photos: Steve Bourne

JOHN DUNKLEY AM

Andy Spate

John Dunkley, known to many ACKMA members, has been a prominent figure in Australian speleology for more than five decades. He was a leading light in the first five cave tourism and management conferences hosted, or co-hosted, by the Australian Speleological Federation (ASF). He was granted the honour of a Member of the Order of Australia (AM) in the 2013 Australia Day list, for "Significant service to the exploration, science and conservation of caves".

He joins the late Don Matts (OAM) who gained his honour in 1993 for service to speleology and to the Cave Rescue group of the Volunteer Rescue Association of NSW and Elery Hamilton-Smith (AM, 2001) as Australian speleologists who have received Australian Honours. Elery's honour was for service to conservation and the environment, particularly in the areas of national park, wilderness, cave and karst management, to the development of leisure and recreation activities, and to the community as a contributor to social policy development and through programmes dealing with youth issues.

John was one of the driving forces behind the nomination by ASF and the Institute of Australian Geographers of Joe Jennings for an Australian honour. Unfortunately Joe died a few months before the decision process. As John has stated "It would have been fitting if he'd been the first speleologist to obtain that national recognition".

John has been the force behind many expeditions in Australia and Asia exploring and documenting caves, visiting over 500 caves in his career. He is the author, or co-author, of a number of books, expedition reports, conference papers and so on dating back to his seminal 1967 *Caves of the Nullarbor*.

Internationally, he was ASF's delegate to the International Union of Speleology (UIS) for four terms between 1969 and 1993. He has been president of ASF on two occasions (1983-1986 and 2002-2005); vice president in 1981, 2000-01 and subsequently from 2005 to the present. He was made a Life Member of ASF in 2007. He has been a director of the ASF Karst Conservation Fund since 2001 – this is a Registered Environmental Fund.

He has occupied presidential, vice presidential, secretary, treasurer and committee positions in ASF, Sydney University Speleological Society, Canberra Speleological Society and the Jenolan Caves Historical and Preservation Society amongst other cave-oriented bodies.

Like many of us of a 'certain age' his thirst for the subterranean world was fed by books such as Norbert Casteret's *Ten Years Under the Earth* (still beside my bed!), Jules Verne's *Journey to the Centre of the Earth* and Mark Twain's *Huckleberry Finn*.

I am sure that all ACKMA members will join with me in congratulating John for this well-deserved recognition which, after all, is also recognition that caves and karst are a part of the fabric of the Australian environment and society.

Above left. John Dunkley with Highland Caving Group President Ian Luthorborrow surveying a sandstone cave in Frenchs Forest/Sydney.
Above right. Cavemania 2005 conference convener Stephen Bunton introduces John Dunkley talking on "Early maps of Tuglow, The Bracewell Collection."

JENOLAN CAVES FLOOD DAMAGE

Sasa Kennedy

On Saturday night 23 February Jenolan Caves was hit by 124mm rain, causing flash flooding throughout the reserve. ACKMA members Dan Cove and Scott Melton agreed that, while they may not have been the highest floods in the last twenty years, they were certainly the most powerful.

A vast amount of sediment from McKeowns Valley has been deposited in the Blue Lake, creating a large gravel bar. Thankfully the resident platypuses do not seem to have been adversely affected.

However, there was large scale damage to the Devils Coach House infrastructure, with lights pulled out of the ground, taking sections of concrete path with them. Stainless steel handrails were also smashed by the power of the water and the debris it was carrying. The Coach House has many uprooted trees and other flood debris scattered across it. The Nettle Cave self-guided tour is suspended until repairs can be affected.

Carlotta Carpark had a major bank collapse following the rain, bringing mud and a rock of at least 3 tonnes down into car spaces (thankfully vacant at the time!).

In the caves themselves there was also plenty of action. The Imperial Streamway rose over the track and to the fourteenth stair, closing that section of the cave for four days. This was the highest water level recorded since 1998. Interestingly, the water level dropped back to the fourth step surprisingly swiftly. This raises the tantalizing question of whether the sumps between the Imperial Streamway and the Blue Lake may have been cleared of gravel by the force of the flow and whether they are now passable.

The track over the Pool of Reflections in the River Cave was also flooded for several days. It has been raining inside the caves also, notably at Wiburds Platform in the Temple of Baal, where umbrellas have been required at times to keep visitors dry!

Cave maintenance staff have been kept busy cleaning silt from the pathways in the Imperial Cave and Jubilee Cave. Also bailing water from paths in Jubilee and Bone Cave. On the positive side, staff have noted formations which are active for the first time in collective memory. Many sections of flowstone have been self-cleaning and the lovely sound of rippling and dripping water is a pleasure to us all.

On Thursday 28 February the rain began again, with 40.6mm falling overnight and continuing steadily at time of writing. The water is once again flowing through the Coach House and water levels are on the rise again in the Imperial Streamway and River Styx.

Left. Anne Musser with a dislodged boulder in Carlotta carpark.
Above. Debris in the Devils Coach House.
Photos: Sasa Kennedy

Above. Pool of Cerberus.
Photo: Sasa Kennedy

Left. Indian Canopy and Crystal Basin.
Photo: Anne Musser

Below. Crystal Basin from above.
Photo: Anne Musser.

UPCOMING SYMPOSIUM
THE SCIENCE of JENOLAN CAVES: WHAT DO WE KNOW?

Anne Musser

Caves and karst regions are unique natural laboratories and fertile areas for scientific research. Caves provide numerous case studies about the evolution of highly adapted species of animals and plants. Karst areas are also home to unusual suites of animals and plants, oftentimes serving as refugia for species that may be rare or extinct in less protected or more changeable environments. Cave minerals, interesting scientifically as well as aesthetically, may also be economically or medically important. Studies of cave morphology, hydrology and atmosphere are critical to such issues as subterranean water flow and climate change. Cave/ karst science, or karstology, is therefore an important and increasingly relevant field of research both regionally and globally.

Cave-related research is conducted in both wild caves and show caves as well as in surrounding karst. Show-cave research was the subject of the first International Congress on Scientific Research in Show Caves recently held in Park Skocjanske Jame, Slovenia (see ACKMA Journal No. 89, December 2012). This was a fitting venue, since karst was first described from this area between Slovenia and Italy and it has long been an area of active scientific research.

An upcoming symposium in May on current scientific research at Jenolan Caves aims to bring together researchers working on projects at the Jenolan Karst Conservation Reserve. This symposium also hopes to attract other interested scientists, cavers, guides and members of the public. The event, entitled The Science of Jenolan Caves: What do we know?, is co-sponsored by The Linnean Society of New South Wales and the Australian Speleological Federation.

Symposium goals include a summary of what is known to date about the science of Jenolan, drawing the threads together with talks from a range of experts. A wide range of topics will be covered, including recent scientific research on the caves and karst and the contribution of exploration, mapping and cave diving.

Above. Cave invertebrates such as this cave-adapted harvestman in the Orient show cave are of great scientific interest. Photos: Anne Musser.
Left. Measuring and recording vertebrate bones in the Northern Limestone, Jenolan. Pictured: Stephen and Richard Kennedy.

Why Jenolan? Impetus for the symposium came from the realisation that recent research results on Jenolan are scattered in many places and can be hard to find – probably to be expected given the many aspects of research conducted. Renewed interest in Jenolan Caves has also been generated by the recent publication of an estimated age for some of the oldest open caves (around 340 million years: Armstrong et al. 2006), opening a window into our deep past.

The symposium will run from Thursday, 23 May to Friday, 24 May 2013, with talks and presentations scheduled for Thursday from 10 am, and Friday from 9am to 5pm. Talks will be given in the Kanangra-Boyd Room in the heritage-listed Jenolan Caves House. The program will include talks from experts, posters, maps and displays, karst walks and specially scheduled cave excursions. The Keynote Speaker will be Prof. Richard Mackay AM, the former president of Sydney University Speleological Society (SUSS), veteran of the exploration of Spider Cave, former Chair of the Jenolan Caves Reserve Trust and now Chair of the Greater Blue Mountains World Heritage Area Advisory Committee.

Topics to be covered by a raft of speakers include geology, cave minerals, cave dynamics, environmental monitoring, vertebrate faunas and vertebrate palaeontology, stromatolitic stalagmites, spiders, mobile mapping, cave surveying, diving and recent exploration.

The Symposium registration cost will include several complementary cave tours. The cost will be $55 for the two days.

If you plan on staying in the area, Jenolan Caves House is offering excellent discounts on a range of accommodation options. To obtain these special rates, make reservations directly through Caves House reception (1300 763 311), not via their on-line booking engine or through an agent. You must also mention that you are attending the Science Symposium.

Those interested in attending in May should follow this link to The Linnean Society website: http://linneansocietynsw.org.au/.

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Top left. Geologist John Pickett searching a limestone outcrop for invertebrate fossils. Bottom left. Rare or endangered species that make the Jenolan karst home include this female Brush-tailed rock-wallaby (Petrogale penicillata) *and her joey. Grand Arch, Jenolan. Top right. Narawan Williams examining an Eastern bentwing-bat (*Miniopterus schreibersii oceanensis). *Bottom right. Many Reserve animals, such as this Eastern water-dragon (*Physignathus lesueurii)*, are accustomed to visitors and provide 'photo opportunities' for both domestic and overseas tourists. Photos: Anne Musser*

JENOLAN CAVES NEWS

Dan Cove

The start of the New Year has been busy at Jenolan. Visitors continue to come in increasing numbers, with the Christmas/New Year period setting a new 10 year record. Unfortunately the extreme heat and fire danger in January had a negative effect on visitation, particularly with the closure of NSW National Parks on several occasions. However, February has seen visitation rise to new record levels yet again. Meanwhile work is almost complete on the new interpretation of the surface trails with new signage and audio tour content available for free download. The audio tour of the Nettle Cave is now also available with the Gundungurra cultural version.

February also saw the Qantas Australian Tourism Awards presented at a gala ceremony in Hobart on Friday 15th. Jenolan was a finalist in three categories, and took out the Silver Award in each of these categories – Ecotourism, Cultural/Heritage Tourism and Adventure Tourism. This is a great tribute to the team at Jenolan, but also serves well to illustrate the breadth of experiences that are on offer at cave and karst areas when compared to other comparable tourist attractions.

In cave development news, a major electrical fault late last year forced the closure of the Pool of Cerberus cave, the only show cave in the Southern part of the Jenolan system to remain on the old 110v system. The nature of the fault was such that it was not cost effective to consider fixing the old system, the replacement of which has long been planned (funds permitting). Unfortunately, capital funds do not currently allow for the complete upgrade of the cave. However all old lighting infrastructure has now been decommissioned and completely removed from the cave. We continue to seek alternate sources of funds for a complete lighting upgrade and are hopeful that this will be a project to come off the drawing board in 2013.

The 2014 ISCA Congress is now starting to seem almost frighteningly close (November 2-8, 2014). International interest remains high. Any additional information (hopefully including the first draft of a program) will be provided at the ACKMA Conference at Waitomo in May.

There is nothing further to report on the ongoing process of evaluating future management options for Jenolan Caves. There has been a series of scoping studies and evaluations conducted over the past months. A decision on the next stage of the process is expected to be made over March/April 2013.

Proxy Forms

If you are unable to attend the ACKMA Conference in Waitomo and the AGM, you may appoint a proxy. A form was included in the previous journal and must reach the Executive Officer prior to the commencement of the AGM.

CHILLAGOE CAVES NEWS

Lana Little

A long-awaited lighting upgrade for the Donna show cave at Chillagoe-Mungana Caves National Park is now underway. Queensland Parks and Wildlife Service and private electrical contractors will be working together over coming months to deliver an improved cave experience for visitors to Chillagoe.

The cave was first lit in 1980, just 5 years after electricity was first supplied to the nearby township of Chillagoe, in north Queensland. The wet-dry monsoonal climate is not especially kind to wiring, and some of the light fittings are submerged during flood events.

ACKMA fellow Neil Kell drew up a lighting design for the cave in 2004. The plan at that time was to replace the old timber-and-pipe visitor infrastructure and the cave's lighting system simultaneously. The initial priority was the production of the lighting plan and plans for new stairs, handrails, platforms, catwalks and bridges. In 2007 the first of a series of funding allocations allowed for the infrastructure replacement program to begin. This was a project which would ultimately span four years – three of them 'flood event' years. During that time, the new stainless steel walkway sections were fabricated off-site and carried into the cave to be fitted, and old sections were removed. Gridded, gritted moulded fibreglass sections were used for step treads and platform decking. Most of the construction work was undertaken by local Queensland Parks and Wildlife Service Park Rangers, with periodic support from contractors, for example when the services of a certified demolitionist were needed. During these construction works, only intermittent cave closures were required.

During the development phase, Neil Kell re-visited the site armed with up-to-the-moment information on new low-voltage LED lights and associated technologies, and re-worked some of the design.

In 2013 we will see his vision come to fruition. Tenders have been called, the electrical contractor has been engaged, materials ordered, and work has now begun.

We're sure to have a detailed account of how it all went in a future edition.

We need your email address!!

ACKMA communicates to its members through the Journal, the website and via email. We don't have email addresses for a large number of members which means you are missing out on news posted on the email list and we cannot get information to you. Please forward your email address to webmaster Rauleigh Webb (address is inside front cover) or include on your membership form.

RAMSAR LISTING for PICCANINNIE PONDS, SOUTH AUSTRALIA

Ross Anderson* and Steve Bourne

The Piccaninnie Ponds Conservation Park was designated as a Ramsar site by Minister Tony Burke on 21December 2012. The Ramsar treaty was adopted in the Iranian city of Ramsar in 1971 at a convention of wetlands of international importance. It gives a framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

Ramsar Protection of the Piccaninnie Ponds wetlands ensures this diverse and beautiful wetland will be protected for future generations by an international treaty. The Ramsar Convention is the only global environmental treaty that deals with a particular ecosystem. A Ramsar Factsheet for Piccaninnie Ponds has been developed and can be downloaded from http://www.environment.gov.au

The Piccaninnie Ponds are one of Australia's best examples of rising limestone springs and collectively form the largest remnant of coastal fresh-water wetlands in the South East. Prior to European settlement it was part of a much larger wetland system extending form Green Point in the west, over 12 kilometres to the east discharging in the Glenelg River estuary. Over a period of time surrounding wetlands were drained such that by the 1970s a remnant of approximately 400 ha remained. This was gazetted a Conservation Park in 1974 to protect the unique wetland values. In the last ten years significant efforts have been undertaken to restore the wetland system including purchase and protection of land to more than double the area of Piccaninnie Ponds Conservation Park, and to restoration and revegetation of in excess of 100 hectares of wetlands. The Department of Environment, Water and Natural Resources (DEWNR) is planning works for improving and reinstating a further 175 ha of wetlands at the site.

The Piccaninnie Ponds are a valuable community asset and a unique visitor destination. Local groups have dedicated thousands of volunteer hours over many years to assist the site conservation and restoration program. These activities have been an exemplar for future natural resource management initiatives as far as community education, participation and awareness activities are concerned.

The wetlands are surface expressions of a much larger underground cave system of great beauty and interest, which has made the site one of Australia's premier cave-diving destinations. (See ACKMA Journal 85 for a report on cave diving at Piccaninnie Ponds. Ed.)

The wetlands at this site support 61 species of conservation significance including the critically endangered Orange-bellied Parrot; they also provide habitat for 20 migratory bird species. Over 30 vegetation associations including freshwater lakes and swamps, coastal dunes, silky tea tree thickets, and terrestrial grasslands and woodland are represented.

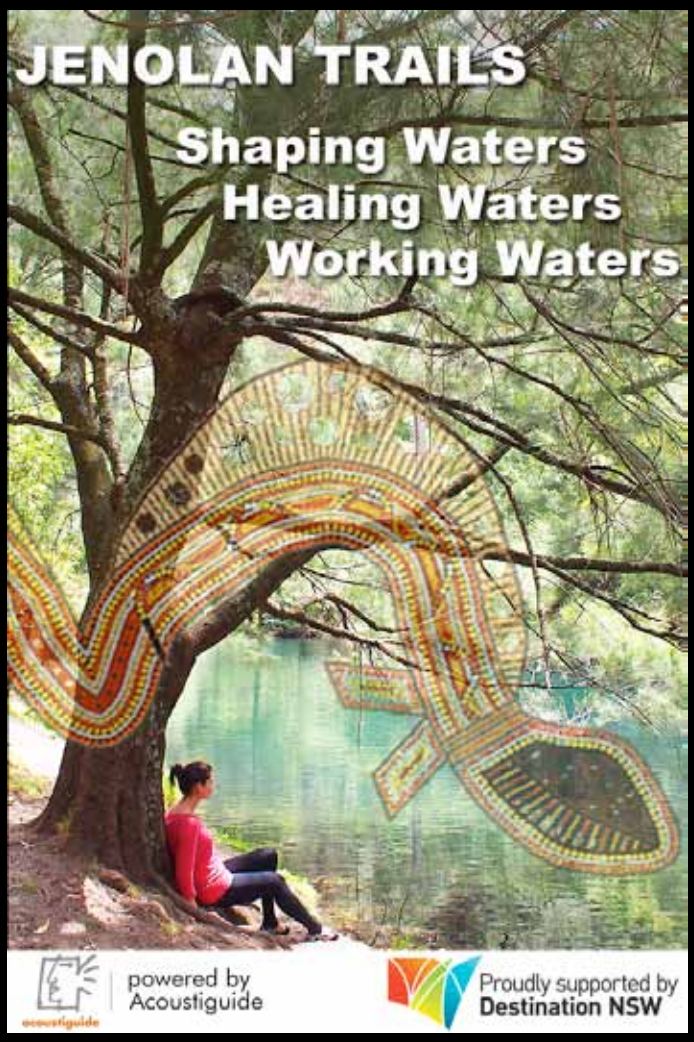
The 862 hectare Piccaninnie Ponds Karst Wetlands site is an outstanding example of rare fen and karst wetland types and has a range of conservation and cultural values. Local Boandik elders tell us that previous generations lived here permanently, in stone huts built close to the abundant food source the wetlands provided.

The site represents one of the few remaining permanent freshwater wetlands in the lower south-east of South Australia.

These wetlands are believed to be a drought refuge for many animals and to support native fish species that rely on freshwater to complete their lifecycle, such as the dwarf galaxias, Southern pygmy perch and Yarra pygmy perch.

Top. DEWNR Regional Manager Tim Collins addresses the crowd at the announcement of the Ramsar listing.
Bottom. Senator Don Farrell being interviewed.

** Ross Anderson is District Manager Lower South East for the Department of Environment, Water and Natural Resources*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