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EDITOR: Steve Bourne

SUB EDITORS: Tony Culberg, Andy Spate,

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FRONT COVER: *Thylacoleo carnifex* skeleton in Victoria Fossil Cave, Naracoorte, South Australia. Photo: Steve Bourne

BACK COVER: Scott Melton and Jay Anderson in Lucas cave, Jenolan Caves, New South Wales. Photo: Ross Anderson

IN THIS ISSUE

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FROM THE EDITOR

Your editor having some fun on the Plug Hole tour at Jenolan Caves during ISCA.
Photo: John Brush

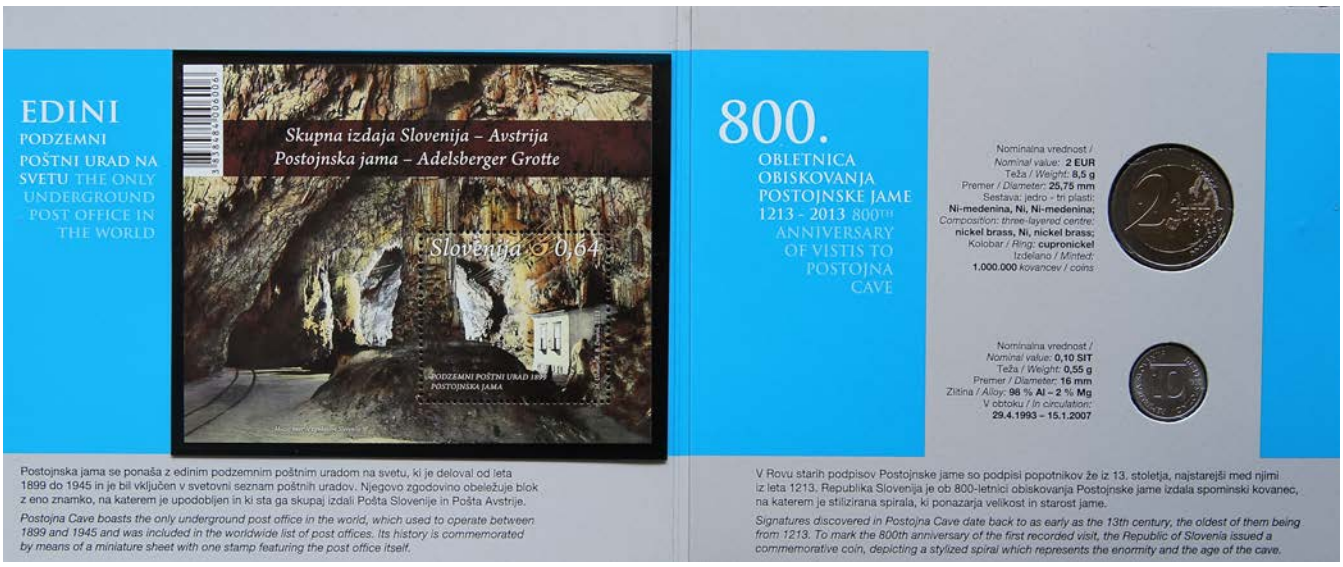
Time flies when you are producing the ACKMA journal. As one journal hits your mailboxes, the next one starts – always trying to source good material for ACKMA members. If I earned a dollar for every time I heard, "When is the deadline"?, I would be very well off. I do like to have all material by the middle of the month preceding the issue, i.e. November for the December issue, but these deadlines seem to fly past. Your assistance in writing articles and sending them to me anytime will ensure we always have a quality journal. And a reminder, if would like to continue receiving the journal, please ensure your membership fees have been paid.

The journal is a great read thanks to the contributions provided by members (and others at times) and is really a great forum for sharing information. I recently attended the International Show Caves Association (ISCA) Congress at Jenolan Caves and took a box full of back issues to try and attract some new members and increase available storage space at home. The copies were snapped up very quickly and the feedback was that the ACKMA journal is one of the best cave journals in the world. It may be hard work, but comments like that give me a boost.

A report on ISCA will appear in the next journal. Dan Cove and his team put on a great week that I will long remember for the food, fun and hospitality. When I paid the registration I will admit that I thought it was a high fee for a conference, but after a few days I wondered how Dan and his team managed to put on such a great event for the price. Although there were quite a few Australian representatives (plus Peter and Libby Chandler from New Zealand) who I knew, there was an excellent spread of delegates from across the world. I made lots of new friends and hope one day to be able to travel and see some of the caves that I heard about.

It was great to catch up with Hein Gerstner from Cango Caves in South Africa, although the struggles he is having are quite disturbing. I won't write anything further in this column, but invite members to type "Cango Caves corruption" into your search engine for media on the issue.

Three delegates attended ISCA from Postojna Cave, Slovenia. They had seen and heard about the "Stampgate" issue (see page 37, this issue) and were amazed to come to Australia and meet the person who had taken the image in question. They gave me a small souvenir (pictured below) from Postojna, coincidentally another stamp. This one commemorates the world's only underground post office that was used inside Postojna Cave until 1942. Also part of the souvenir are two coins, one celebrating 800 years of visitors to Postojna Cave. The anniversary is based on the earliest known signature in the cave from 1213 – astounding!



Nicholas White posted a media article titled *"SA Farmer has a big restaurant idea to sink your teeth into"* on the ACKMA mailing list. The image (see below) included the farmer Graham Kilsby, and chef Kirby Shearing, who I happen to know. I called Kirby to find out more detail on what was proposed. Kirby's wife Biddie is the Regional Tourism Manager. I worked alongside her for many years when I was chair of the Limestone Coast Tourism Board. Biddie is an innovative thinker and always exploring new ways to attract media, and the concept of a restaurant inside one of the great natural features of the region is a good way to get publicity, even if it's highly unlikely to ever happen. It just makes good media! Kirby and Biddie have been discussing ideas for an innovative eating place, and the cave fitted the bill. So rest easy cave conservationists – this was little more than a tourism publicity stunt for the region, although Kirby is still looking to create a unique dining experience in the Limestone Coast region.

THE AUSTRALIAN

SA farmer has a big restaurant idea to sink your teeth into

VERITY EDWARDS THE AUSTRALIAN NOVEMBER 15, 2014 12:00AM

Mount Gambier chef Kirby Shearing and Graham Kilsby at the sinkhole in South Australia where he wants to open a restaurant. Picture: Kelly Barnes Source: News Corp Australia

Arthur Clarke posted a story on the list relating to the proposed development of a cable car in Son Doong Cave in Vietnam. An online petition against the proposal http://www.thepetitionsite.com/takeaction/956/103/062/ had reached 68,000 at the time of writing. The following is an excerpt from a website outlining this outrageous proposal.

> *A Vietnamese resort company has been granted approval to begin surveys to build a 10.6 kilometre long cable car in the world's largest cave, the UNESCO-listed Son Doong in north-central Quang Binh province in Vietnam. If completed it would make it the longest cable car ride in the world, ahead of Tianmen Shan in China.*
>
> *Vietnam has a fondness for cable cars. They pop up in many tourist spots, from the Ba Na hills in the centre of the country to provincial spots popular with domestic tourists such as Nui Ba Den (Black Lady Mountain), south of Saigon. However, the prospect of this cable car, to be built by the large Sun Group (which owns the InterContinental Hotel in Danang and built the Ba Na hills cable car system), has upset environmentalists, the cave's original discoverers and inspired an online petition.*
>
> *The proposed $212 million cable car system would travel through Tien Son and Phong Nha caves (the latter was formerly believed to be the largest cave in Vietnam) and then Son Doong cave, with three of its seven stations in the 9 kilometre long Son Doong.*
> *Son Doong was discovered by local Ho Khanh in 1991 and explored by a group from the British Cave Research Association in 2009, led by Howard and Deb Limbert. The UNESCO-listed cave receives under 250 visitors a year who all trek with the one travel company licensed to offer tours, Oxacis Tours. Those doing so have to trek and camp, with porters carrying baggage and food.*
> *Whilst Son Doong still hosts few visitors the other caves, such as Phong Nha, within the Phong Nha-Ke Bang national park are far more touristed. The area has received 2.5 million visitors this year so far and this may rise to three million in 2015, according to Vietnamese news sources. The impacts of mass tourism are already being felt and experts worry that extending that to the pristine Son Doong, which is so large it contains a jungle and could fit skyscrapers within it, would be reckless at best.*
>
> *Dang Minh Truong, Sun's CEO, told Saigon-based Tuoi Tre News that the project will involve foreign experts and satisfy UNESCO's criteria for sustainable development. He also noted that 80 UNESCO-listed sites already have cable car systems (though it should be noted that none of those are in remote cave systems within national parks).*
>
> *Howard Limbert, who first explored the cave in 2009, has explored hundreds of caves in the area, is one of those staunchly against the idea of a cable car system. "The damage to Son Doong cave would be irreversible, and the cable cars would rob the cave of its pristine charms and the adventure thrills it has to offer," he told Tuoi Tre News. "The construction would also take its toll on the cave's surrounding areas."*
>
> *An online petition has been organized against the venture. It states, "This project is suicidal and have an infinite damaging impact on the Son Doong Cave and the ecosystem of the entire region at Phong Nha - Ke Bang National Park.*

In ACKMA journal 95, I published short article on the Aboriginal body found in Blanche Cave in the middle of the 19th Century. Mary Trayes and Deborah Carden reminded me of a story they had previously raised with me about an Aboriginal body mentioned in New

Zealand media. Mary kindly searched for information on this and provided me with a series of newspaper articles dated from 1903 to 1920. The New Zealand story related to a female body rather than a male, although there are similarities with an injury to one leg mentioned. Most media claimed the body was "of great antiquity", which conflicts with the bullet injury of the male body. Local Naracoorte historian Judy Murdoch has heard of this second body, but no evidence other than these media articles is yet to surface. Clearly there was something on display, but is the same individual, a second body or a fake? Perhaps even more tantalising is two separate visitors to Naracoorte Caves mentioning the remains they had see in a museum in Utah. There is an exhibition currently travelling the United States called "Mummies of the World", so it seems probable this is where these visitors saw a petrified body and made the link.

Journal 95 featured Cliefden Caves on the cover and an article by Garry K Smith, alerting members to the threat of flooding from a proposal to build a new dam on the Belubula River at Needles Gap in the Central West of NSW. This dam will flood many of the highly significant caves. Orange Speleological Society and the NSW Speleological Council, in conjunction with the ASF Karst Conservation Gift Fund, have launched an appeal to raise funds to support the campaign to save Cliefden Caves and foster further scientific research on the caves. The Help Save Cliefden Caves information flyer can be downloaded from http://www.caves.org.au/resources/internal-resources/finish/9/180. This has details on how to donate to the ASF Karst Conservation Gift Fund. All donations over $2 are tax deductible. Further information on Cliefden Caves is available at http://savecliefdencaves.caves.org.au

I have had a few weeks of media exposure over an issue where one of my in flight bat images was used without permission on a stamp in Slovenia. It was fun, and I used the media to highlight what I think is a real issue, the illegal use of images so easily downloaded from the Internet. I think we have all done it and used an image or two for a presentation and we try to attribute the image correctly, but using an image for profit is an entirely different matter. Annoying for amateur photographers but far worse for those who try to make a living from their photography.

Ross and Jay Anderson promoted their "*Caves of the World"* website and business at the ISCA Congress. Ross's photography is top shelf and he is offering an excellent service for cave operations. More information on this service is provided inside back cover.

Naracoorte Caves was inscribed on the World Heritage List at the December 1994 meeting of the World Heritage Committee. Naracoorte Lucindale Council hosted an event to celebrate the 20 year anniversary attracting 250 school children, along with the key players who took the site to World Heritage. Presentations at the 2015 conference will include 20 years of Naracoorte World Heritage.

This journal has a strong Naracoorte flavour as we head towards the 2015 conference. Michael Curry is about to start his PhD studies on the Marsupial Lion *Thylacoleo carnifex*. Michael spent two weeks with Liz Reed and myself looking over material that we had excavated from Komatsu Cave in Henschkes Quarry at Naracoorte. As part of his preparation for his studies, Michael reviewed the history of *Thylacoleo* at Naracoorte and we have traced the discovery of fossils, how knowledge of the animal has grown, the iconic nature of the species and its role in the marketing of Naracoorte and megafauna in general.

As part of your conference information, I suggested each of the Naracoorte guiding staff write a short piece on themselves, a Naracoorte tour and a personal highlight, similar to what the Waitomo organisers provided for the 2013 conference. This is presented along with booking details. I look forward to seeing you all at Naracoorte in May 2015.

Coming Events	
2015: 2-9 March	**Karstology in Arid Regions, Abu Dabi** http://abudhabi.zrc-sazu.si/.
2015: 10-15 May	**ACKMA Conference, Naracoorte Caves, South Australia**
2015: 15-20 June	International Karstological School and 50th anniversary of the International Union of Speleology, Postojna, Slovenia
2015: 21-26 June	30th Australian Speleological Conference, Exmouth, Western Australia
2016: May	**ACKMA Annual General Meeting and Cave Guides Workshop, Rockhampton, Queensland**
2017: 23-30 July	International Union of Speleology Congress, Penrith, NSW, Australia
	Do you know of an event that may interest ACKMA members? Please send to publications@ackma.org

CATCHING the MARSUPIAL 'LION' by the TAIL: *THYLACOLEO CARNIFEX* and the NARACOORTE CAVES

Michael Curry, Liz Reed[1,2] and Steve Bourne[3]

[1]School of Physical Sciences, The University of Adelaide, Adelaide, SA, Australia; [2]School of Physical Sciences, Flinders University, Bedford Park, SA, Australia; [3]Naracoorte Lucindale Council, Naracoorte, SA, Australia.

"Thylacoleo exemplifies the simplest and most effective dental machinery for predatory life and carnivorous diet known in the Mammalian class. It is the extreme modification, to this end, of the Diprotodont type of Marsupialia."

Owen (1866)

Introduction

Of all the extinct Australian Pleistocene megafauna species, *Thylacoleo carnifex* (the marsupial 'lion') has captured the imagination and interest of people more than any other. Perhaps it is the allure of its predatory habits, (Australia's Pleistocene answer to *T. rex*); or the intriguing notion that it used caves as dens (Lundelius, 1966). It is certainly an enigma and, as Owen (1866) suggested, an extreme and meat-eating version of the otherwise herbivorous diprotodont marsupials. Spectacular fossil finds over the past few decades have put to rest much of the speculation regarding its habits and morphology. Fossil remains found in caves at Naracoorte in South Australia have played a central role in solving the puzzle of *Thylacoleo*. Likewise, this iconic marsupial has been integral to the history, science, tourism and interpretation of the Naracoorte Caves. The aim of this paper is to explore the discovery of *Thylacoleo carnifex* at Naracoorte Caves and how this has influenced the scientific and social history of the park.

Discovery

The first recorded fossil material of *Thylacoleo carnifex* was recovered by Major Thomas Mitchell at Wellington Caves in New South Wales in the 1830s (Figure 1). It consisted of only a few isolated teeth and was not immediately identified (Gill, 1954). Lake Colongulac, near Camperdown, in Western Victoria, some 150km east of Naracoorte, bore the first remains to be formally described by science. The eminent palaeontologist, Sir Richard Owen, received the fossils in 1855 and described the bones (parts of the cranium), in 1859. He interpreted the remains as those of a great marsupial carnivore and was sufficiently impressed by its carnassial-like premolars to assert that *"...it was one of the fellest and most destructive of predatory beasts*." (Owen 1859). Almost at once, controversy ensued.

William Sharp Macleay, an entomologist with a keen interest in Australian Natural History, lashed out in the Sydney Morning Herald convinced of Owen's folly, defending *Thylacoleo* as "A very gentle beast, and of good conscience" (Macleay 1859). Macleay based his argument on *Thylacoleo's* relationship with other Diprotodont marsupials, most of which are herbivores. Gerard Krefft, Curator of the Australian Museum, was almost equally as unimpressed with *Thylacoleo's* carnivory, opining that it *"...was not much more carnivorous than the Phalangers (possums) of present time."* (Krefft, 1866). Owen, meanwhile, had received an almost complete skull from the Darling Downs, in Queensland and published a more detailed paper, further describing the skull and teeth of *Thylacoleo*, acknowledging its diprotodont affiliation but more convinced than ever of its carnivorous habits (Owen, 1866). The debate raged back and forth in both the popular media and scientific literature for some years (for example see Broom 1898). While there was not enough evidence to settle the debate, *Thylacoleo* had captured the imagination of the public and scientific community.

The controversy did not end with *Thylacoleo's* diet. Krefft further proposed that an unusually large, clawed distal phalanx found at Wellington Caves belonged to an Australian Megatherium (giant sloth), and proposed the name *Mylodon australis* (Krefft 1870 - republished in Mahoney and Ride, 1975 page 198). Owen, who received photographs of the ungual from Krefft, referred the claw to *Thylacoleo*, almost purely by the deduction that it belonged to a carnivore, stating there was "No evidence of a Megatheroid...in Australia" and that "there is no other associated Carnivore corresponding in size...save the *Thylacoleo*" (Owen 1871; Figure 2)). Owen later received and described (again from Wellington Caves), a mandible, radius, ulna and a similar distal phalanx (Owen, 1883a) as well as a partial pelvis (Owen, 1883b), which he attributed to *Thylacoleo*. However, as an articulated skeleton was yet to be found, there was still a question whether these elements were from *Thylacoleo* at all. In 1888, Owen presented to the Royal Society a new Genus in the Thylacoleonidae, although the paper was never published (Anderson, 1929). He had received a skull (much smaller than those recovered earlier), from a newly found cave near Wellington. He named the species *Thylacopardus australis*, an allusion to the animal's size being more leopard-like, than lion-like.

Figure 1 - Thylacoleo incisors collected by Mitchell and sent to Owen at the Natural History Museum, London Photo: Steve Bourne

Early Discoveries at Naracoorte

Father Julian Tenison-Woods was the first person to describe any fossil material from Naracoorte Caves; however, he did not report any material attributable to megafauna species (Woods, 1858; Reed, 2012; Reed & Bourne, 2013). There can be little doubt he yearned to find megafauna animals, as he devoted an appendix in his 1862 book to the fossil discoveries of Wellington Caves (Woods, 1862). While, he had some success in finding isolated specimens in other sites around the southeast of South Australia, he never found them at Naracoorte. What Woods couldn't know was that the remains he sought lay as little as one metre below his feet as he explored Blanche Cave (Reed and Bourne, 2013).

William Reddan (caretaker of Naracoorte Caves from 1886 to 1919) was the first to discover Thylacoleo fossil remains at the caves. In Specimen Cave, he found skull and jaw bones of an unusual animal with "large tusks protruding" (Anonymous 1908a,b). He forwarded the bones to his department and they were subsequently presented to Dr Edward Stirling, Director of the South Australian Museum (SAM). Stirling identified the remains as belonging to *Thylacoleo* and was keen to visit

Figure 2 - The type of "Thylacoleo oweni" in the Natural History Museum, London. Photo: Steve Bourne

the site to determine if bones of the post-cranial skeleton were present in the cave. Fifty years after Owen's papers, very few bones of the skeleton were yet known to science, so the opportunity to expand knowledge of the species was too good for Stirling to pass up. He decided to do a systematic search for fossils and arrived at the caves on Monday 14th of December 1908, accompanied by his assistant, Fritz Zietz. They began their search the next day and found numerous bones, which were taken back to the museum for further study (Figures 3 and 4). Stirling later reported on the finds in reports to the museum board (Stirling, 1908, 1912). Reddan made some further finds in the newly discovered Alexandra Cave and these bones were also forwarded to the museum. Unfortunately Stirling never published the material.

Renewed interest in the science of Naracoorte Caves came in the 1950s, with the formation of the Cave Exploration Group of South Australia (CEGSA). Members of the group continued systematically exploring, mapping and surveying the caves. During these surveys, fossil material (including *Thylacoleo*) was discovered scattered throughout the system, adding numerous specimens to Naracoorte's collection; but in 1956, an amazing cave deposit was about to come to light in a somewhat unconventional way.

The James' Quarry *Thylacoleo*

During quarrying operations, Mr Amos James, the proprietor of Naracoorte Quarry, opened up a previously unknown cave (5U29) during blasting operations. Within a small cave he discovered an unusual skeleton and reported the find to staff at the SAM, who dispatched Norman Tindale (Curator of Anthropology) and fossil preparator, Paul Lawson, to investigate. Tindale, an

Top. Figure 3 - Specimens collected by Reddan and Zietz in the South Australian Museum; Photo: Liz Reed.
Below. Figure 4 - Newspaper article recording the Museum visit to Naracoorte Caves to collect Thylacoleo specimens. The Register, Saturday December 12th 1908 pp. 4.

SEARCHING FOR FOSSIL BONES.

NARRACOORTE, December 10.—Professor Stirling (Director of the Adelaide Museum), accompanied by Mr. F. R Zietz (one of the assistants) came down to Naracoorte on Monday afternoon to make a systematic search for the fossil bones of an unknown anmial called the marsupial lion, some mones of the head parts of which had been found in the Specimen Cave by the caretaker (Mr. W. Reddan). None of the bones of the lower part of the body of this animal has been found yet, although several of the jaw and skull portions have been picked up. Professor Stirling and Mr. Zietz visited the caves on Tuesday, and had a day searching for fossil bones. They found a number, but do not think they got any of the lower part of the body of the animal. Mr. Zietz is still searching, and will not return till Friday evening. Professor Stirling went back to the city on Wednesday morning.

accomplished anthropologist and entomologist, had previously published papers on the nearby Tantanoola Caves (Tindale, 1933) and excavated megafauna fossils at Rocky River on Kangaroo Island (Hall et al, 1935); a site that was later to bear *Thylacoleo* fossils of its own. Lawson was also experienced with Pleistocene megafauna, having recently accompanied the American palaeontologist Ruben Stirton to Lake Callabonna in the state's northeast, where they famously excavated large numbers of Diprotodon fossils embedded on the lake's shore (Anonymous, 1953).

Unfortunately, Tindale and Lawson arrived a little too late. With the best intentions, Mr James had covered the well preserved skull of the animal with a hessian bag to protect it from the weather. They arrived to find the skull in pieces, crushed under the weight of the rain soaked bag, scattered amongst the talus at the base of the quarry face (Daily, 1960). What remained in the cave was the well-preserved post-cranial skeleton of *Thylacoleo carnifex*, which Lawson painstakingly retrieved from the sandy sediment of the alcove while balanced on a wooden ladder some 4 metres above the quarry floor.

The post-cranial skeleton of *Thylacoleo*, which had remained elusive since description of the skull by Owen almost a century before, had finally been discovered. Previous attribution of post-cranial material to *Thylacoleo* by Owen was now confirmed. It was the start of a rewarding few years for palaeontologists. CEGSA members found the skull of a juvenile *Thylacoleo*, along with some skeletal elements (SAM P12902, P12911), in Cathedral Cave (5U12), which is now part of the Naracoorte World Heritage area. Ruben Stirton and Richard Tedford found another partial skeleton near Lake Menindee in NSW (Daily, 1960). In 1959, blasting at James' Quarry opened a second cave, in close proximity to 5U29. Another partial skeleton, comprising most of the front half of the animal and including a complete – albeit disarticulated - left manus, and complete forelimb, was added to the museum's collection (SAM P2910, Figure 5). Stirton and Tedford took the material back to UC Berkeley with the intention of describing the post-cranial skeleton. Unfortunately this did not eventuate and Gill (1973) suggests that the task was passed on.

Curiously, despite the excitement of the long awaited finds, research on the post-cranial skeleton was not to be published for almost two decades. The material and inspiration for this research was to come not from the James' Quarry specimens but from another Naracoorte cave, Victoria Cave 5U1. Two scientists, who were also avid cavers, were to make a remarkable discovery that would highlight the scientific importance of the Naracoorte Caves to the world.

Victoria Fossil Cave

Discovered by Reddan in 1894 and opened to the public in 1897 (Anonymous 1897), Victoria Cave (now Victoria Fossil Cave) is one of the main Naracoorte tourist caves.

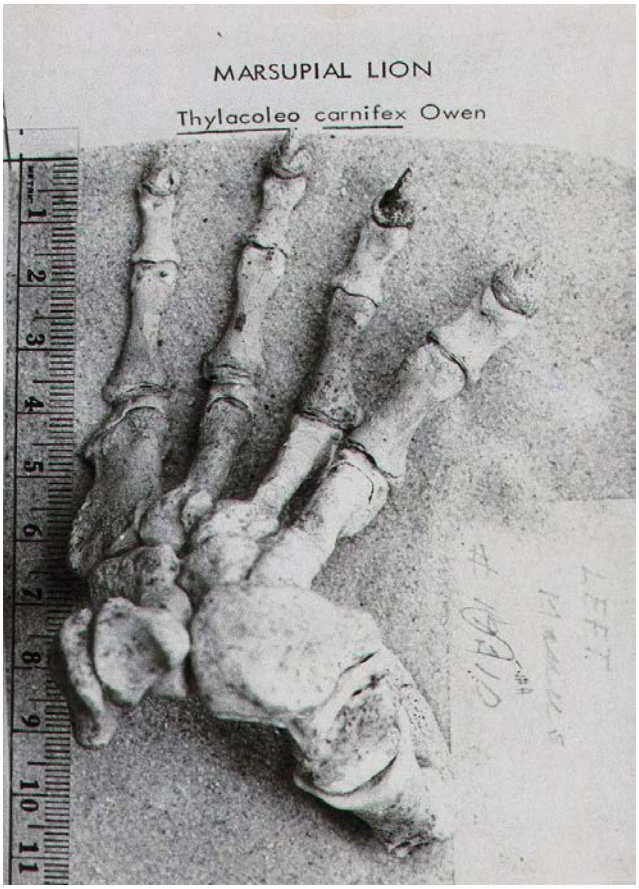


Figure 5 - James Quarry Thylacoleo manus specimen. Photo of image held in the South Australian Museum collection - Photo: Liz Reed

During explorations in 1969, Grant Gartrell and Rod Wells (members of CEGSA) pushed through a 10 m long, low rocky passage located about halfway through the known cave and found a chamber filled with countless fossils. Limb bones, skulls and other elements could be seen lying on the surface and poking through the sediment (Wells, 1975). As Gartrell explored the cavern, Wells scanned the sediment from a ledge at the front of the deposit where he found an encrusted *Thylacoleo* skull lying at his feet (Figure 6). Gartrell found another skull lying on a rock pile about halfway along the chamber (Wells, pers. comm. 2014). Over the next few years, the remains of at least 18 individual *Thylacoleo* were collected from the deposit (Wells et al., 1984). The chamber contains a sediment cone, which was deposited through an entrance hole located above the northeast end of the chamber. That entrance is now blocked, but once acted as a "pitfall" trap, collecting and preserving large numbers of animals over a period of more than 200,000 years (Wells, 1984; Reed, 2008).

It would be difficult to overstate the significance of the discoveries in Victoria Fossil Cave. The Main Fossil Chamber is massive, some 54 metres long, about 16 metres at its widest point and at least 3 metres deep (Reed, 2008). The accumulation dates from around 213,000 to as far back as 478,000 years ago (Reed and Bourne, 2009). The sediment deposit contains a diverse assemblage of fauna, with over 100 species of vertebrates

Figure 6 - Thylacoleo skull in situ, Fossil Chamber, Naracoorte Caves
Photo: Rod Wells

recorded (Reed and Bourne, 2000). Numerous important *Thylacoleo* specimens have been recovered from this rich deposit, including the articulated right and left manus and an almost complete pes; which were recovered by Wells soon after the chamber was discovered (Wells, 1975). Grant Hall, a chamber located just beyond the Fossil Chamber and discovered in 1975, covers a period from around 70,000 to 93,000 years ago (OSL chronology), providing an almost complete chronology of the late Pleistocene fauna (Macken et al., 2011). The Upper and Lower Ossuaries, located through low passages beyond the main Fossil Chamber, contain breathtaking fossils littering the sandy-clay floor of a chamber covering an area of around 450 m^2 (Reed, 2006). The Ossuaries are so remarkable, that David Attenborough filmed the cave for his "Life on Earth" series, which aired in 1979 (Nolan, 1977, Figure 7).

He also mentioned them in his book of the same name (Attenborough, 1979). As the chambers contain relatively pristine sediment floors, they are protected as a "Reference Area" for the Naracoorte Cave system – no excavation has taken place in the chamber and no research is allowed without special permission and strict conditions. Fossils of *Thylacoleo*, *Megalibgwilia*, *Zygomaturus* and *Thylacinus* are spread across the surface, but they are overwhelmed by the number of Sthenurine kangaroos – which account for almost 60% of the visible material (Reed, 2006). Butch and Lake Chamber, a small chamber adjacent to the Main Fossil Chamber has also provided *Thylacoleo* fossil material.

An underground museum

The scientific value of the Victoria Fossil Cave deposits was recognised at once by Rod Wells, who wrote in a special report to the Deputy Director of the South Australian Government Tourist Bureau strongly recommending the area be protected, as "*…it could yield a considerable amount of scientific information if studied by qualified zoologists and palaeontologists*". *Furthermore if properly developed it could also be of educational value to the general public*" (report by Wells September 1969 –

R. Wells pers. comm. 2014). Tours in Victoria Cave had occurred since its discovery and had focussed on the impressive speleothem formations in the cave; but the idea of the deposit being an underground museum for communicating the scientific value of the fossil deposit was novel, and one that would shape the future of tourism at Naracoorte. In 1970, Dr Richard Tedford,

Figure 7 - David Attenborough with Thylacoleo skull in the Ossuaries, Victoria Fossil Cave, Naracoorte Photo: Rod Wells

Curator of Vertebrate Palaeontology from the American Museum of Natural History in New York visited the site. He was quoted in the Canberra Times (July 18 1970 page 13) to have remarked - "*From these exceptionally rich deposits we may get some answer to the puzzle of why so many forms of large animal life became extinct*". Tedford also noted that ".. similar bone caves in the United States and Europe had provided excellent tourist attractions".

By the mid to late 1970s, the Tourist Bureau had installed electric lighting at the excavation area and was conducting tours to the site for the general public. Part of the ticket office at the caves was made available for Rod and his team to use as a field laboratory and by 1971 Rod was working together with Ern Maddock of the Tourist Bureau to develop displays for visitors. One of these was a silhouette image of *Thylacoleo*, that Rod had reconstructed based on the two known skeletons of the time. The focus of guided tours shifted to discussions of the significance of the deposit and on vertebrate palaeontology of the late Pleistocene in Australia. A workbench had been set up at the dig and fossils were used as props by cave guides. The Tourist Bureau improved facilities at the park in preparation for the increased numbers of visitors the new site had attracted.

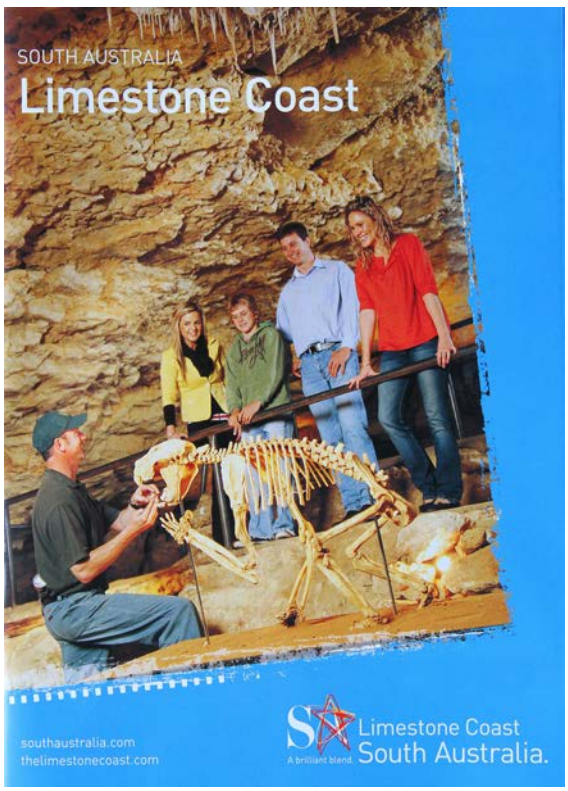
Currently a 60 minute tour runs at least twice daily through Victoria Fossil Cave. The tour includes a 30 minute talk held in the Fossil Chamber, just above the Excavation Site A (Wells et al., 1984), where a purpose built viewing and seating area supports up to 25 visitors. Immediately below the viewing platform, hundreds of exposed skeletal elements are visible in the pit, relieved out *in situ*. A full skeletal cast of *Thylacoleo carnifex*, as well as *Simosthenurus occidentalis*, is mounted on display at the front of the platform (Figure 8). The cast of *Thylacoleo* is a composite model, reconstructed from a number of individual specimens which have been excavated from the Fossil Chamber. The hands and forelimbs, pelvis and hind limbs of the model were cast from those used by Wells and Nichol (1977). The vertebrae were cast from individual bones found associated with a *Thylacoleo* skull in the Fossil Chamber (R. Wells, pers. comm. 2014). Casting of the manus and pes was done by Rod Wells, limbs and vertebral column by Ed Baily and the skull and dentaries by Peter Daenke at Flinders University. The cast is posed in a somewhat aggressive stance, and is striking and photogenic, appearing in numerous photos on popular photography websites, such as Flickr and is currently featured on the Wikipedia entry for the Naracoorte Caves (2014). *Thylacoleo* has also featured on various tourist websites, brochures and information boards for the region (Figure 9a,b).

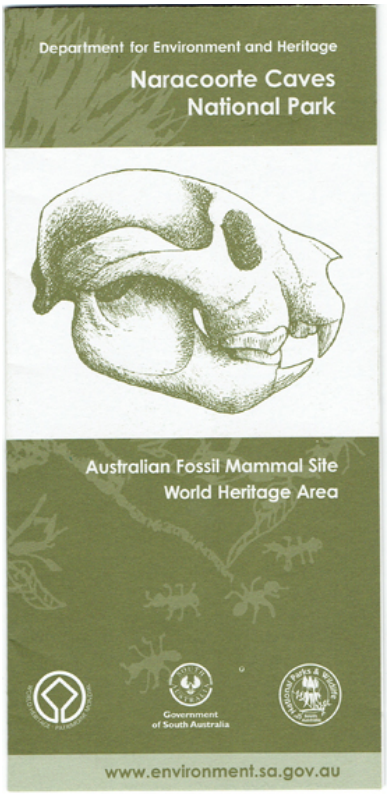
A second cast from the same material is on display at the caves visitor centre, the Wonambi Fossil Centre, where the reconstruction is "struggling" with the extinct madtsoiid snake, *Wonambi naracoortensis*. This reconstruction is the centre piece of the visitor centre foyer, and accompanies two other reconstructions of *Thylacoleo*; both animatronic, life models. The original robotic model is located in the diorama, along with a number of other life-sized Pleistocene reconstructions, such as *Diprotodon optatum*, *Zygomaturus trilobus* and *Palorchestes azael*. Artist Stephen Hayter made the robotic models in consultation with Rod Wells and they were constructed at Flinders University. The models were revealed to the public when the centre opened in 1998. The robot moves its head from side to side and growls. The second model, located in the foyer near the mounted cast, is a more recent addition, again made by Stephen Hayter and installed around 2005.

The cast and life models are popular with tourists, but lack the visual impact of the cast mounted in the Fossil Chamber. The location, pose and atmosphere of the reconstruction at the Fossil Chamber provide a depth and dimension to the science of palaeontology that it is not possible to recreate in a standard museum. The guide's talk, in front of the fossil bed, dwarfed by the shadow of the *Thylacoleo* skeleton on the cave walls, creates a powerful impression. The skeletons at the fossil bed also provide important props to assist the guides in conveying the process of palaeontology and how scientists work from bones to reconstruct extinct animals.

In 1994, Naracoorte Caves, along with the Riversleigh Fossil Sites in North West Queensland, received international recognition and protection under the UNESCO World Heritage program. UNESCO ranks the fossil sites as being "among the world's 10 greatest fossil sites" and singles out Victoria Fossil Cave (5U1) Naracoorte as being "... in terms of both volume and diversity, Australia's largest and best preserved and one of the richest deposits in the world" (UNESCO 2014).

Above. Figure 8 - Thylacoleo and a sthenurine kangaroo skeleton cast shadows on the wall in Victoria Fossil Cave
Below left. Figure 9a - Guide interacting with visitors using Thylacoleo skeleton. Cover of regional visitor guide Photo: Steve Bourne; Below right. Figure 9b - 2005 park brochure featuring a Thylacoleo skull. Photo: Steve Bourne





The fossil record of *Thylacoleo* at Naracoorte Caves

Victoria Fossil Cave is spectacular not just for the number and size of fossil deposits in its numerous chambers, but also for the excellent preservation of the specimens that have been recovered. The left and right manus of *Thylacoleo*, along with some of the forelimb bones, were recovered fully articulated and preserved in calcite (R. Wells pers. comm. 2014). These specimens finally provided the reference material needed to fully describe these aspects of the animal (Wells and Nichol, 1977). Analysis of the articulated manus showed *Thylacoleo* was capable of a wide range of motion of the first phalanx (tipped with a large recurved claw), including gripping by opposing the pisiform. The other phalanges were each tipped with ungual crests, homologous to those found in felids, which allow the animal to retract its claws. *Thylacoleo* also had a wide range of motion of its forearms, and was capable of using its hands for powerful grasping. Unfortunately, the pes was incomplete, preventing a deep understanding of *Thylacoleo's* locomotion and stance.

In 1969, at a quarry owned by the Henschke family, a cave was opened up during limestone quarrying. The cave, later named Henschke's Fossil Cave (5U91, 5U97) was a substantial cave, first surveyed at about 50m long with later extensions discovered adding an additional 60m of passages at two levels. Henschke Industries kindly changed their quarrying plans and left the cave in an accessible state until 1981, allowing palaeontologists from the SAM to excavate and document the fossils. Neville Pledge (Curator of Fossils), calculated there were at least 46 individuals of *Thylacoleo* from the deposit, making it more far more common that other carnivores such as *Thylacinus cynocephalus* (12 individuals) and *Sarcophilus* (6), and similar to the number of *Sthenurine* kangaroos (52) (Pledge, 1990). The large mammal component of the deposit was dominated by macropodine kangaroos; with *Macropus rufogriseus* and *Macropus giganteus* comprising 482 individuals. Pledge noted that most of the *Thylacoleo* material recovered from the cave system was from juveniles, mostly very young individuals with un-erupted, or recently erupted teeth. He attributed this to the pitfall nature of the cave entrance and the inexperience of younger animals, presumably hunting around the vicinity. The faunal composition of the deposit was similar to that of Victoria Fossil Cave; however, the stratigraphy and taphonomic properties of the Henschke's deposit were unclear. Given the salvage nature of the excavation; the site did not lend itself to a more thorough interpretation.

Table 1 – Fossil sites that have yielded remains of *Thylacoleo carnifex* - Naracoorte Caves World Heritage Area.

Site	Description	Reference
Victoria Fossil Cave 5U1		
Main Fossil Chamber	Excavation by R. Wells, E. Reed and others	Wells *et al.* (1984); Reed and Bourne (2000, 2009).
Grant Hall	Excavation by R. Fraser and later A. Macken.	Fraser and Wells (2006); Macken *et al.* (2012); Reed and Bourne (2000, 2009).
Upper and Lower Ossuaries	Material collected from cave floor and documented *in situ*.	Reed (2006); Reed and Bourne (2000).
Butch and Lake Chamber	Material collected from cave floor and documented *in situ*.	Reed and Bourne (2000).
Bat Cave 5U2	Material collected from the entrance chamber	Tideman (1967); Maddock (1971); Reed and Bourne (2009).
Alexandra Cave 5U3	Material collected by caves caretaker W. Reddan.	Pledge (1977); Reed and Bourne (2000).
Blanche Cave 5U4,5,6	Incidental finds in cave tunnels; later formal excavation by T. Laslett and expanded by E. Reed.	Reed and Bourne (2000, 2009, 2013).
Stick-Tomato Cave (Wet Cave) 5U10, 11	Excavation in the entrance chamber of the cave.	Reed and Bourne (2000, 2009).
Cathedral Cave 5U12, 13	Incidental finds in cave tunnels; subsequent organized excavation in fossil chamber by S. Brown and G. Prideaux.	Daily (1960); Brown and Wells (2000); Prideaux *et al.* (2007).
Robertson Cave 5U17, 18, 19	Excavation in inner chamber of cave by M. McDowell and later S. Brown.	Reed & Bourne (2009).

Table 2 – Cave sites within the Naracoorte District* that have yielded *Thylacoleo* material.

Site	Description	Reference
James' Quarry Cave 5U29	Small cave uncovered during quarrying; fossils collected by N. Tindale and P. Lawson (SAM).	Daily (1960); Pledge (1977); Reed and Bourne (2000).
Henchke's Fossil Cave 5U91, 5U97	Cave uncovered during quarry activity. Excavated by SAM palaeontologists and later J. Barrie.	Pledge (1990); Barrie (1997); Reed and Bourne (2000).
Komatsu cave 5U240	Cave uncovered during quarry activity. Excavated by S. Bourne, E. Reed and others.	Reed and Bourne (2009).
Komatsu Cave 2	Cave uncovered during quarry activity. Excavated by S. Bourne, E. Reed and others.	Reed and Bourne (2009).
S102 Cave 5U47	Isolated pes elements found in cave tunnel by S. Bourne	Reed and Bourne (2009).
Haystall Cave 5U23	Fossil material collected from the sediment of a large cone.	Reed and Bourne (2000).
Specimen Cave 5U35 (also known as Zietz Cave)	Fossil material collected from sediments and cave tunnels by W. Reddan and E. Stirling.	Stirling (1908, 1912); Reed and Bourne (2000).
Cable Cave 5U125	Fossil material collected from cave floor.	Reed and Bourne (2000).
Buckridge Cave 5U169	Small cave uncovered and subsequently destroyed during vineyard preparation. Excavated by S. Bourne, E. Reed and M. McDowell.	Reed and Bourne (2000).
Crawford's Cornucopia Cave 5U171	Small cave uncovered during vineyard preparation. Excavated by S. Bourne and E. Reed	Reed and Bourne (2000).
Whale Bone Cave 5U250	Cave uncovered during vineyard preparation; sediment floored chamber with fossil material evident.	Reed and Bourne (2009).

*Other sites with *Thylacoleo* carnifex in South East Region - Comaum Forest Cave 5U118, Green Waterhole Cave 5L181, Wandilo Forest Cave 5L365, Gouldens Hole 5L8, Un-named Cave 5L441, Moorak, Kilsby's Hole 5L46, Un-named cave in Mount Gambier (site 45 in Reed & Bourne 2000).

In just a few years since these major discoveries, Naracoorte had provided enough *Thylacoleo* material to address some long standing taxonomic questions. Using material contributed from Naracoorte and Wellington Caves, Archer and Dawson (1982) began to revise the taxonomy of the Thylacoleonidae. They found that skulls varied greatly between individuals in the same geographic region and previous taxonomic distinctions actually fell within the normal range. Owen's *Thylacopardus australis* was also found to fall within the normal size range of *Thylacoleo carnifex*, as was Krefft's *Thylacoleo robustus* (Krefft 1872) and McCoy's *Thylacoleo oweni* (McCoy 1876). Krefft's *Mylodon australis* ungual (Krefft 1870) was also found to belong to *Thylacoleo*, as was Krefft's proposed genus *Plectodon* (Krefft 1870). The controversial nature of the taxonomy of the genus *Thylacoleo* had been neatly resolved to just one Pleistocene species, *Thylacoleo carnifex*; and the question of *Thylacoleo's* dietary and locomotory habits could now be addressed. Important biomechanical investigations of the post-cranial skeleton were made during the 1980s (Finch and Freedman, 1986 and 1988), setting the stage for later discoveries at Naracoorte and elsewhere. Wroe *et al.* (1999) used material from Naracoorte and elsewhere to determine body weight of *Thylacoleo.*

Wells et al. (1982) used material from Victoria Fossil Cave to resolve the century old question of *Thylacoleo's* dietary habits. Functional analysis of the jaw and tooth dynamics of *Thylacoleo* showed the animal's dentition was capable of exhibiting forces and shearing required to process large prey. Modelling of feeding behaviour also showed that micro-wear patterns on the teeth matched those generated by feeding on meat, rather than an herbivorous diet. Further supporting evidence came from another Naracoorte specimen from the Henschke's Quarry, where chemical analysis using Strontium (Sr) and Zinc (Zn) ratios was used to show that *Thylacoleo* was carnivorous (Nedin, 1991). The results of these studies have not been challenged and more recent work using finite element analysis techniques (Wroe *et al.*, 2005, 2008) have supported this finding, revealing that comparatively, *Thylacoleo* had a higher bite force than its eutherian namesake. Multivariate analysis of both cranial and post cranial features of *Thylacoleo* show that it clusters closely with other Pleistocene felid predators, such as *Smilodon* (Wroe, 2008). Owen's original hypothesis, that *Thylacoleo* was a well-adapted carnivore despite its ancestors being of a more herbivorous diet and "of good conscience", is now accepted theory.

In 2005 another cave was unearthed in the Henschke's quarry system, this time with a front-end loader, which gave the new cave its name. Komatsu Cave (U240) was opened around 11 metres below surface level and contained sediment cones with numerous fossils; again the Henschke family offered to change their plans to allow palaeontologists to collect and document the material. Two of the authors (LR and SB), assisted by Friends of Naracoorte Caves volunteers and students from Flinders University, conducted a salvage operation to excavate the site. The cave contained the remains of

both juvenile and adult *Thylacoleo* (Figure 10). For the first time, an articulated pes (complete with hind limb attached), was recovered (Figure 11). Using this fossil, Wells *et al.* (2009) were able to reconstruct the morphology of the pes, completing the story of *Thylacoleo's* limb morphology. *Thylacoleo* had morphological elements of both a scansorial quadruped, and adaptations consistent with a climber.

Based on their interpretation, *Thylacoleo* would have been able to grasp branches with its foot, and thrust its body weight upward in a manner of climbing similar to modern possums (Wells *et al.*, 2009). *Thylacoleo* has been found across Pleistocene fossil cave deposits in both the Naracoorte World Heritage Area (see Table 1) and the greater Naracoorte district (Table 2), spanning a time period of at least 300,000 years. It has now been found across fossil deposits in all states of Australia, and in many bioregions and environments (Prideaux, 2006). The regularity of its inclusion in these deposits is interesting, as large carnivores are usually underrepresented in fossil deposits when compared with other animals such as kangaroos. *Thylacoleo* may have been attracted to the caves to feed on trapped or injured animals, creating a similar accumulation bias to that seen in deposits such as the Le Brea Tar Pits in Northern America (eg. Spencer and Van Valkenburgh, 2003).

Megafauna icon

Large, carnivorous animals tend to capture the imagination and a 'marsupial lion' is unique and intriguing to scientists and the general public alike. Reconstructions of the animal have changed over time in light of new scientific evidence. Many of these discoveries have inspired popular articles, documentaries and memorabilia. In 2008, Australia Post published a series of stamps depicting Australian megafauna species. The stamps were designed by Peter Trusler, an accomplished palaeoartist, and featured *Thylacoleo carnifex* on the 55c stamp. In 2014, Perth mint released a 1oz silver coin depicting an adult *Thylacoleo* with a young on its back. This coin, part of a limited release, was also designed by Trusler. In 2011, for the Perth Mint coin release "Australian Fossil Mammal Sites" "World Heritage Area", *Thylacoleo* was chosen to represent Naracoorte Caves.

In recent years, *Thylacoleo* has been prominent in media appearances and scientific interpretation at the Naracoorte Caves. Many of these are filmed at the fossil pit under the shadow of *Thylacoleo*. In 2009, the cast skeleton at the fossil bed was used to discuss the habits of *Thylacoleo* for the Discovery Channel production *"Monsters Resurrected, Episode 6 – Megalania, Giant Ripper"* which aired in October 2009 and included one of the authors (LR). This is just one example from many. A photograph (taken by one of the authors SB) of a young girl posing with the *Thylacoleo* skeleton at the fossil bed, quickly became the 'face' of Geo-tourism in South Australia and was used in multiple tourism promotions,

Figure 10 - Cath Sellars excavating a Thylacoleo skull in Komatsu Cave 2, Naracoorte. Photo: Steve Bourne

Figure 11 - A reconstructed hind limb and pes of Thylacoleo from Komatsu Cave, Naracoorte. Photo: Steve Bourne

advertisements and tourism award nomination documents (Figure 12).

In 2010, an article in National Geographic Magazine ("Australia's Lost Giants"), included a life-like reconstruction of *Thylacoleo carnifex* created by the Kennis brothers. This was based on a skull from Komatsu Cave in Henschke's Quarry at Naracoorte. Many visiting palaeontologists have been photographed with the *Thylacoleo* skeleton at the fossil bed, including Dr Phil Currie and Dr Jackson Njau (Figure 13).

The End of the Tail

Naracoorte has played a pivotal role in both the scientific understanding and public profile of the extinct marsupial lion. *Thylacoleo* fossils have now been recovered from every state in Australia and from various biogeographic

regions and climates. In 2002 on the Nullarbor Plain, a team of cavers from the Victorian Speleological Association (VSA) were systematically surveying the Nullarbor Plain in Western Australia when they discovered a number of previously unknown cave entrances. During surveying of the new caves, they found the almost complete, articulated skeleton of Thylacoleo, exquisitely preserved, lying on the sediment in a chamber as if it had recently expired. The find was reported to the Western Australia Museum (WAM) and collected soon after by palaeontologists including Gavin Prideaux and John Long from Flinders University. The skeleton provided something that had eluded palaeontologists for 150 years – a tail.

Tails play an important part in the locomotion of marsupials; not just in climbers such as possums. Macropods use the tail as a 'fifth leg' in pentapedal locomotion. Tasmanian devils and other dasyurids use the tail to facilitate a 'tripod' stance, allowing these carnivores to stand on their hind legs. Current work by Professor Rod Wells and colleagues involves biomechanical analyses of the vertebral column of *Thylacoleo* skeletons from the Nullarbor Caves and Naracoorte. This will allow insight into the gait and stance of this enigmatic marsupial, putting in place the final pieces of the *Thylacoleo* puzzle.

Figure 12 - Young girl posing with the Thylacoleo skeleton in Victoria Fossil Cave. Photo: Steve Bourne

Figure 13 - Dr Phil Currie (above) and Dr Jackson Njau (below). Photo: Steve Bourne

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Welcome to Naracoorte

21st Australasian Conference on Cave and Karst Management
10 to 15 May 2015
Naracoorte, South Australia

Come to Naracoorte's 2015 Conference!

The 21st Conference on Caves and Karst Management (ACKMA) Conference will be convened in May 2015 at Naracoorte, South Australia under the auspices of the Department of Environment, Water and Natural Resources (DEWNR) with input from the South Australian (SA) Friends of Parks group, the Friends of Naracoorte Caves and local ACKMA members.

DEWNR manages a majority of the sites that the conference will visit on field excursions, including three that are internationally significant - Naracoorte Caves National Park World Heritage Area, and Bool Lagoon and Piccaninnie Ponds RAMSAR sites.

Conference excursions will visit many of the sites in the south-east of SA to which participants were introduced in 1999, when the ACKMA conference was based in Mt Gambier. The achievements of DEWNR and its partner agencies will be showcased in 2015 as will the investigations and findings of Flinders University palaeontologists in Naracoorte Caves National Park.

Conference theme: 'Caring for Country'

The conference theme acknowledges the association of Australia's first peoples to their land - to "country", allows insight into cultural relationships, reflection on early European settlement and insights into today's economic, social and conservation endeavours.

Getting to and from Naracoorte

Naracoorte is approximately 330 kilometres south east of Adelaide (capital of South Australia). By car it is approximately 3½ hours from Adelaide (via Tailem Bend, Keith and Padthaway; or around 4 hours via the coast). There are flights from all other capital cities into Adelaide daily. Adelaide airport has an international terminal with many direct flights available (check with airlines).

Regional Express (REX) (www.regionalexpress.com.au) flies into Mt Gambier (Mt Gambier is 100 km south of Naracoorte Caves) daily from Adelaide and Melbourne. Delegates could then travel via bus to Naracoorte. Alternatively (and a better option) is travel via coach from Adelaide. Premier Stateliner Coach Group travels to Naracoorte daily from Adelaide (see below for timetable). The required service is Adelaide to Mount Gambier (via inland) leaving from the Central Bus Station (Franklin St, Adelaide), with delegates getting off the bus in Naracoorte township (Battery Service, Smith St). It is then only a short walk or taxi ride to accommodation. Go to http://www.premierstateliner.com.au/ for more information on the bus service.

There are two taxi services in Naracoorte township; Naracoorte Taxis 131 008 and South East Taxi Service Ph: (08) 8762 0689 or (08) 8762 0798.

Papers guide

Please have abstracts to the Conference Convener (and cc the Journal Editor) by ***1 March 2015***. All papers will be 20 minutes with 10 minutes for questions.

With around 20 paper slots the conference organisers reserve the right to decline papers. We will try to advise speakers as soon as possible, and by 15 March at the latest.

Partner's Program

We have not designed a full week program for partners but are able to offer a hosted excursion to local sites of interest and along the way enjoy an interesting and entertaining mix of experiences – food, wine, tourism. This is proposed for Wednesday 13 May 2015 at a cost of approx $55.00 per head.

If there is not sufficient interest we could facilitate a rental vehicle and provide a range of ideas of things to see and do.

Conference clothing guide

You can buy t-shirts, polo shirts, long sleeved polar fleece jackets with full zip, two styles of vest – polar fleece and reversible. And as usual the colours are black or black – though if you really need a different colour ask the convener. The items are stock items in a local shop. We need to have the clothes orders by Monday 30 March 2015 so allow time for the embroidery to be done.

Conference program

May 2015	Morning	Afternoon	Evening
Friday 8 May Saturday 9 May	Pre-conference caving or field trips: to be confirmed		
Sunday 10 May	Registration opens 3pm, Naracoorte Town Hall		
Monday 11 May	Papers	Split groups and rotating tours: Victoria Fossil Cave, Bat Centre and Blanche Cave, Wonambi Fossil Centre, Fossil Laboratory	Key note address: Economic Development - a partnership approach
Tuesday 12 May	All day tour departing 9am to Ramsar site Piccaninnie Ponds Ramsar Site, Ewens Ponds Pick Swamp, South East water licensing, other wet places….		Key note address: Prof John Long
Wednesday 13 May	Papers	Site visits: Sand and Robertson Cave blocks and Ramsar site Bool Lagoon Game Reserve Ramsar Site	ACKMA Committee meets
Thursday 14 May	All day tour departing 9am to Mount Gambier. Aboriginal Centre, volcanoes. ACKMA AGM		Evening meal in Mount Gambier
Friday 15 May	Papers	Free time or organised trips to Coonawarra wineries	Final function
Saturday 16 May	Delegates depart for home or post conference trips		

Dr Jessica Bloise in Starburst Chamber, Victoria Fossil Cave, Naracoorte.
One of the adventure caves being offered as a pre conference trip.
Photo: Steve Bourne

Australasian Cave and Karst Management Association

Naracoorte 2015 11 -15 May

Conference booking form

Who are you?		
Name		
Affiliation/background Published in conference handbook. (or just say 'unchanged since Tasmania and/or Waitomo)		
Postal Address Include post code		
Email Address		
Preferred phone number/s		
What will you do?		
Paper ( ) Refer to paper guide Title:		
Poster ( ) Title:		
Where will you sleep? For Naracoorte accommodation - refer to the accommodation information in the Journal		
Arrival date ( )	No. of nights ( )	No. in party ( )
Accomm name, address		
ETA in Naracoorte?	Date and time:	
In Naracoorte		
Arrival date ( )	No. of nights ( )	No. in party ( )
Accomm name, address		
If sharing, with whom are you sharing?		For your records - your accomm costs: $
If you need information email the Conference Convener		
How will you get to/from Naracoorte?		
Bus Adelaide to Naracoorte	Tick one	Yes ( ) No ( )
Bus Melbourne to Naracoorte via Mt Gambier	Tick one	Yes ( ) No ( )
Fly to Adelaide	Tick one	Yes ( ) No ( )
Fly Adelaide to Mt Gambier REX Air	Tick one	Yes ( ) No ( )
Fly to Melbourne	Tick one	Yes ( ) No ( )
Fly Melbourne to Mt Gambier REX Air	Tick one	Yes ( ) No ( )
Own transport	Tick one	Yes ( ) No ( )
If you need information email the Conference Convener		

Pre- and post-conference trips
The Convener needs to know by *31 March 2015* the level of interest in activities to confirm trips/ tours.

1. Adelaide to Naracoorte via the Coorong RAMSAR listed area: 10 May 2015
If there is enough interest a pre-conference bus pick-up can be arranged from Adelaide / drive to Naracoorte. If enough demand a reverse trip can be arranged after the conference.
The drive takes the south western route from Adelaide, crosses the Murray River on the Wellington ferry and continues south along the Coorong coastal highway before turning inland at Kingston to arrive safely at Naracoorte in a 20-seater coach.

10 people	Expected cost per person	$150
15 people	Expected cost per person	$100
20 people	Expected cost per person	$ 75
Pick-up 8.30 city	**Festival Centre**	
Pick-up 9.00 sharp	**Domestic airport departures**	
Buy lunch en route	**Meningie**	Own cost
Drop off in Naracoorte	At your accommodation	

2. Pre- and post-conference caving
Locality: In Naracoorte Caves National Park World Heritage Area

Cave	**Leader**	**Best max party size**	**No. interested**
Sand Cave – vertical entry/exit – bring your gear	Steve Bourne	6	
Starburst	NCNP Guide/s	6 (can have two parties in cave at same time)	
Fox Cave	NCNP Guide/s	6 (can have two parties in cave at same time)	
Private property			
Beekeepers (adjacent NCNP WHA) short vertical	CEGSA or FUSSI cavers	8	

Once we have numbers we will confirm. Numbers are limited so first-in….

Conference Fees - Payment Information

Payment of Conference Fees can be made into the ACKMA account by direct credit; by cheque; or by credit card (VISA or MASTERCARD only).

Conference Fees				**Your cost**
Registration	Au $592. Includes lunch, dinner, morning and afternoon tea, in-conference transport, cruise, venues, publications and little extras. Includes Sunday pre-conference and Friday dinners			
Hotel breakfast Advise us so we can book you in	Continental $14.00 pp No. ( ) Cooked $20.00 pp No. ( )			
Own breakfast arrangements?	Are you making your own arrangements for breakfast Circle Yes			
Transport with us?	Enter your cost from above			
Day fee - members	$125/day – includes lunch & dinner. No of days ( )			
Day fee – others	$145/day – includes lunch & dinner. No. of days ( )			
Clothing	a) Tee shirt	size	$30 each	
	b) Polo shirt	size	$45 each	
	c) Vest polar	size	$55 each	
	d) Vest reversible	size	$75 each	
	e) Jacket	size	$85 each	
Sub-TOTAL	**AU $**			
Before 3 March '15	No additional fee charged			
After 1 April '15	Add late fee 10%			
Credit card	Add surcharge please 2.5%			
TOTAL	**AU $**			

How to pay – options		**Tick option**
A	Direct credit into the ACKMA Au account (our preference) 1/ Deposit into 'Aus Cave & Karst Mngt Assoc' account 2/ Deposit to BSB 065 156 Account 1025 7455 3/ Swift code is CTBAAU2S. Bank is 065, Branch is 156, Account is 1025 7455 5/ Use your_surname in the reference codes and also email these details to the Conference Convener. 6/ If grouping funds together to save transfer fees – please ensure the Conference Convener gets full details of ALL group members for a transfer	
B	Credit cards 1/ Add 2.5%. Visa and Mastercard only. Merchant name is 'Blueberry Patch'. 2/ Advise the Conference Convener the following: Type of card; Cardholder name; Amount authorized; 16 digit card number; 4 digit expiry date; 3 digit card security code from back of card. The record of payment will appear on your statement as debited to "Blueberry Patch".	
C	Cheques or bank drafts – contact the Convener to discuss.	

Registration receipts will be issued by the Convener after the Treasurer has confirmed payments have been received in the ACKMA bank account.

Accommodation in and around Naracoorte

See - http://naracoorte-sa.street-map.net.au
Email: naracoortevic@nlc.sa.gov.au
Ph: (08) 8762 3199

Kincraig Hotel – 158 Smith Street, Naracoorte
Ph: (08) 8762 2200 Email: kincraig@rbm.com.au

Bushmans Arms Hotel – 20 Robertson St, Naracoorte
Ph: (08) 8762 2100 Email: admin@bushmans.com.au

Naracoorte Hotel/Motel – 73 Ormerod St, Naracoorte
Ph: (08) 8762 2400 Email: info@naracoortehotel.com.au

Country Roads Motel ****- 20 Smith St, Naracoorte.
Ph: (08) 8762 3900 Email: countryroads@rbm.com.au

Greenline Motel ** ½ - Bordertown Road, Naracoorte. Ph: (08) 8762 2599
Email: greenlinemotel@bigpond.com

Cave Park Cabins *** ½ - self-contained cottages, Caves Rd Naracoorte
Ph: (08) 8762 0696 Email: robm@rbm.com.au

William MacIntosh Motel **** - Stewart Tce, Naracoorte
Ph: (08) 8762 1644 Email: info@william-macintosh.com.au

Naracoorte Cottages **** - five self-contained cottages.
Ph: 0408 810 645 www.naracoortecottages.com.au

Naracoorte Holiday Park *** - Caravans, cabins.
Ph: (08) 8762 2128 or 1800 999 899 www.naracoorteholidaypark.com.au/

Willowbrook Cottages **** **-** Jenkins Tce, Naracoorte
Ph: (08) 8762 0259

If you are phoning from overseas the prefix is 0011 61 or +61. The SA area code is 08 from within Australia and 8 from overseas; also delete the leading 0 from a mobile number.

Accommodation and camping at Naracoorte Caves National Park (NCNP).
Wirreanda Bunkhouse has four rooms with one and five bunks in each and H, I, J are three separate units with four bunks in each. The bunkhouse has a shower and toilet. A communal kitchen is only for accommodation users; communal showers and toilets are shared with campers. There are 13 powered sites and a tenting area. Wirreanda has been put aside for ACKMA attendees and will remain available until two weeks prior to the conference at a cost of $10 per person (shared) or $45 per room or unit (single or one couple). Bedding packs are available at $10 per person. Bring own towels.

Ph: (08) 8762 2340 Email: DEWNR.NaracoorteCaves@sa.gov.au

For more information about the Conference contact:

Deborah Carden
Email: conference.convenor@ackma.org
Email2: deborah.craven-carden@sa.gov.au
Ph: (08) 8762 3412 Mob: 0409 006 710

KEY SITES

Australian Fossil Mammal Site - Naracoorte

Naracoorte Caves was inscribed on the World Heritage list on 18 December 1994 as a serial nomination with Riversleigh in North Queensland. Together they form the Australian Fossil Mammal Sites (AFMS).

To become World Heritage listed, a property must meet at least one of ten criteria of Outstanding Universal Value (OUV) and the AFMS meet two. Criterion eight states that outstanding examples of major stages of earth's history must be represented and criterion nine requires representation of significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water and marine ecosystems and communities of plants and animals. The fossil record at Naracoorte Caves spans a major stage of earth's history (the Quaternary ice-ages) and the record provides examples of how ecological communities developed through the Pleistocene ice-ages. Dedicated research at both AFMS over the past forty years helps the sites meet obligations under the World Heritage Convention by furthering the understanding about the sites' OUVs, adding to existing knowledge and allowing transmission of that knowledge to the world-wide community. Recent work by Dr Liz Reed and colleagues shows that it's not only animal fossils that are preserved at AFMS Naracoorte.

2014 is the 20th anniversary of the World Heritage listing and while this will be celebrated in 2014, we will also celebrate it with ACKMA at Naracoorte in 2015.

Conference guests and keynote speakers

Conference guests will include representatives from the Department of Environment, Water and Natural Resources, the agency that administers the 'Australian Fossil Mammal Site – Naracoorte [(AFMS) the Naracoorte Caves National Park] and three RAMSAR sites.

DEWNR speakers will include Deborah Carden, Manager Naracoorte and Tantanoola; Dr Amy Macken, Executive Officer AFMS Naracoorte; and Ian Lewis, karst geomorphologist/hydrologist, caver and cave diver.

Prof Richard Mackay

Prof Mackay is a Partner of GML Heritage Pty Ltd and the immediate past Chair of the Australian World Heritage Advisory Committee. He was a member of the Commonwealth State of the Environment 2011 Committee with particular responsibility for heritage.

Prof Mackay teaches at La Trobe University and is a Research Associate at the University of Sydney. He is a former member of the NSW Heritage Council and Director of the National Trust, and a former Getty Conservation Institute Research Scholar. He has worked in heritage management throughout Australia and in Asia on sites including Kakadu National Park, Port Arthur, Sydney Harbour Bridge and the Royal Exhibition Building, Victoria. He is currently the Project Director for the Angkor Heritage Management Framework project in Cambodia.

Relevantly, in the context of this conference, Richard Mackay was an active speleologist and member of the Sydney University Speleological Society in the late 1970s and early 1980s. He was on the famous exploration trip that discovered the underground river in Spider Cave, Jenolan in 1979; and he subsequently served for more than a decade as a member of the Jenolan Caves Reserve Trust, including a period as Chair.

In 2003 Professor Mackay was made a Member of the Order of Australia for services to archaeology and cultural heritage and in 2013 he was the inaugural recipient of the Sharon Sullivan Award conferred by the Australian Heritage Council to an individual who has made an outstanding long term contribution to Australia's national heritage.

Prof John Long, Strategic Professor in Palaeontology at Flinders University.

Before taking up his current appointment John served as Vice President at the Los Angeles County Museum (2009-2012) and prior to that was Curator of Vertebrate Palaeontology at the Western Australia Museum (1989-2004).

John is presently serving as the President of the Society of Vertebrate Palaeaontology; as Vice President of the Royal Society of South Australia; and Chair of the AFMS Naracoorte Interagency-Community Reference Group (IRG) and member of AFMS IRG Scientific Research Sub-Group. He is the author of 28 books, 150 peer-reviewed scientific papers (including seven in 'Nature' and Science' since 2006) and over 90 popular science articles and blogs.

Professor Long primarily investigates the origins of the vertebrate body plan through researching fossil fishes of the Palaeozoic Era. He has worked on expeditions collecting fossils in Australia, Antarctica, South Africa, Thailand, Vietnam, Iran and China. He has received the Eureka Prize for Promotion of Science (2001); the Australasian Science Prize (2008); the Royal Society of Victoria Research medal (2010) and the Verco Medal of the Royal Society of South Australia (2014).

Prof Rod Wells

Rod is Emeritus Professor in Biological Sciences at Flinders University. Although retired he is still actively involved in research. Growing up in Leura in the Blue Mountains west of Sydney he developed a love of natural history from an early age. On leaving school he studied engineering at the then University of Technology and the University of NSW. He became interested in cave exploration and palaeontology and took part in expeditions to the Nullabor Caves in the early 1960s. This lead to a career change and he returned to university to major in Zoology.

In 1973 he completed his PhD at Flinders University into the physiology and ecology of the Southern Hairy-nosed wombat, the first ever study of the biology of the species. He played a key role in establishing the Brookfield Wombat Reserve, South Australia, now Brookfield Conservation Park and its management/monitoring program.

With colleagues he has carried out extensive research into megafaunal fossil deposits at Flinders Chase on Kangaroo Island; at Redbanks Conservation Park at Burra; at Lake Callabonna and Lake Eyre Basin along Cooper's Creek and the Warburton. More recently, at Collinsville Station east of Mt Bryan, he has excavated *Diprotodon* skeletons with Flinders University Palaeontological Society.

With his good friend, ACKMA's Dr. Grant Gartrell, he discovered the fossil deposits in Victoria Cave in 1969. He spent the majority of his working life undertaking and directing extensive palaeontologic research at Naracoorte's fossil caves and played a key role in taking 'the Caves' to World Heritage status in 1994.

Dr Liz Reed

Liz is currently a Research Fellow, School of Physical Sciences at University of Adelaide. Dr Reed's interest in palaeontology began with a visit to Naracoorte Caves in 1995 as an undergraduate student. She completed her PhD thesis at Naracoorte investigating the taphonomy of the large mammal fossil deposits. She has led the research at Naracoorte Caves since 2005, taught the Vertebrate Palaeontology course until 2012 and supervised several Honours and PhD students. Recent and ongoing research investigates biodiversity response to climate change during the late Quaternary at Naracoorte.

Aside from research, Liz has been actively involved in promoting palaeontology and developed the concept of Palaeontology Week with Naracoorte Caves management and the SA Museum. She also prepared the Fossil Tourism Strategy for the South Australian Tourism Commission and has coordinated successful Science Week events.

Dr Helen Macdonald

Helen holds a PhD in Philosophy (Applied Ethics). She spent a number of years as a university academic, teaching philosophy and applied ethics before moving to the private sector. Initially she worked for the Australian gold mining company, Normandy Mining, on community and indigenous relations issues and policy development.

In 2002 Normandy merged with the Newmont Corporation and Franco Nevada and Helen was appointed as General Manager for Community Relations and Communications for the Australian region. In January 2003 she transferred to Denver, Colorado USA to take up the position of Director, Community Relations and Social Development for Newmont. In this position she developed policy, supported global exploration and mining activities and represented the company on a range of voluntary initiatives including the United Nations Global Compact, International Council for Mining and Metals, Global Reporting Initiative and the Voluntary Initiative for Security and Human Rights. In 2008 she was appointed General Manager, Environment & Social Responsibility for a 1 Billion USD new gold mine development project in Ghana and in early 2011 started working on Newmont's Conga project in Peru, a 5 Billion USD copper development project.

In October 2011she was appointed as the CEO of the Naracoorte Lucindale District Council and part of her responsibilities include identifying opportunities to enhance the economic prosperity of the Council as well as for the Limestone Coast Region.

AFMS Naracoorte is an important tourism draw-card and educative asset in the local and regional economy.

WELCOME FROM YOUR HOSTS

Alexandra Cave

Thomas Shortt 3 years

Background

I was born in Melbourne in 1988. My family and I moved to Naracoorte in 1999 to be closer to family. I completed Secondary School at Naracoorte High and was first exposed to Adventure Caving on Year 8 Camp. I attended the University of South Australia where I completed a BA majoring in International Studies. During my studies I had the opportunity to go on exchange overseas and ended up spending a semester in the US state of Minnesota. While it was a little chilly to start with (-45 degrees Celsius some nights) the experience was incredible.

After finishing university I returned to Naracoorte. I managed to land an amazing job at the Naracoorte Caves, which I still thoroughly enjoy doing today. I had visited the caves at least a dozen times whilst growing up, giving me a great appreciation for their beauty and the scientific value they offer. Now I have the opportunity to help protect the caves and allow others to experience and enjoy something that I think is very special.

Alexandra Cave

Alexandra Cave is one of the most beautiful caves on the park. The cave is one of our more highly decorated and is quite open and easy to traverse. It has a cluster of long straws, large columns and an amazing mirror pool. The latter never fails to impress (gets us plenty of ooos and ahhs!).

We focus on the geology of the caves, speleothems, and the recent scientific work done in the cave. We have even trialled photographic tours. The cave has an interesting history. Discovered in 1908 by William Redden, the cave was opened to great fanfare and celebration in 1909. A large gathering of people, including the governor of the state and quite a large band, was in attendance for the official opening. While the cave itself has not changed much since its discovery, the lighting and hand rails have. Things are set to change yet again with our current upgrade of the lights. People still enjoy the cave today, which is something that guides and others who have worked on the cave, both past and present, can be very proud of.

Highlights

Working at the caves has presented some very interesting opportunities but working with film crews has been one of the highlights. I have been filmed twice in Alexandra Cave for *Totally Wild* and *Scope*, both children's science shows based on science, nature and adventure. Was kind of nice to be recognised by some kids on a tour not long after it was on TV, even better was that they remember what I had said!

Stick Tomato Cave

Andrew Thompson 15 months

Background

Born Adelaide, South Australia, 1974. Graduated with a major in International and Regional Studies (University of South Australia) and a minor in German Language and Literature (University of Adelaide) 1998. Played viola for the Adelaide Uni Orchestra for two years. Taught English in China and South Korea 1998 – 2008. Moved to Naracoorte 2009 with partner Jinhwa and pet dog Snowy (a Jindo breed from Korea). Currently living on a hobby farm near the caves with our six dogs (!) and eight sheep. Haven't forgotten all my German, can speak and read everyday Korean, and basic Chinese.

Stick Tomato Cave

Adventure Caving in Stick Tomato Cave is perfect for introducing first-time cavers to this activity. The great thing about it is that all of the squeezes and challenges are optional. It is really interesting to see the group dynamics develop during the tour. People can be a bit nervous or excited at the start, some of them talking rapidly and joking loudly, some looking a bit stressed-out and quiet. As the tour progresses, they help each other, give encouragement, and often clap when someone completes a challenge that they thought was impossible. By the end of the tour, even though the group is often made up of complete strangers, they are socialising like old friends. Doing something that is challenging or a little out of your comfort zone can really make you feel great.

Highlights

You get to meet a huge variety of people in this job: tourists from all over the world and an interesting mix of personalities and backgrounds amongst the staff. I especially enjoy being able to say a few words to the occasional visitor in their native language – they absolutely love it.

My favourite tour would have to be Victoria Fossil Cave. Even if visitors have seen a myriad of caves before it, the cave has that huge and amazing fossil deposit and an interesting history. Each step of the tour whets the visitors' appetite for more, and by the time they reach the fossil chamber, I love seeing how keen everyone is to see the fossils from close-up and how amazed they are at what they are seeing. I enjoy this part of the tour, because everyone is so focused and inquisitive. It's great interacting with the group at the fossil bed, and there are usually lots of questions even as we exit the cave and walk back to our vehicles.

Fox Cave (Extended Adventure Tour)

Barb Lobban 12 Years

Background

I have three boys**.** My husband Scott and two sons, John and Will. I grew up in Adelaide and visited the caves quite often as a child as I had cousins in Naracoorte. I moved to Naracoorte in 1995 with my husband and John who was then 14 months old. When friends were down we often came to the caves, although I never imagined I would end up working in such an amazing office. After leaving school I worked in retail with BIG W Discount Stores.I started as a shop floor assistant, then worked as State Garden Buyer for the chain. Here I am now with what I believe to be one of the best jobs around!

Fox Cave

If you ever have the need to test your boundaries or experience a sense of adventure, then Fox Cave might be for you. Head off with your experienced guide for three hours of adventure and fun. Before entering the cave your guide will explain safety guidelines and cave conservation. As you enter, you begin your first challenge, shuffling between wall and rock then onto hands, knees and eventually belly. As the group passes through the gateway, it climbs down into a fairly open chamber. Then begins the journey through an amazing cave system. Names such as Tree Root and Madonna Chamber, beautiful speleothems, large rock piles and evidence of past cave entrances.

Highlights

Where do I start – there have been many highlights. My most memorable would have to be the first Palaeontology week we hosted with the SA Museum. The lawn area between the Wonambi Fossil Centre and visitor car park had between 700-800 school children. What an amazing Roadshow! Prof. Tim Flannery opened the event. As a fairly new guide I was pretty chuffed to be on a tour that Tim was to lead. I asked him to come up front and he said to me "You know more about this stuff than me". Wow, that was pretty cool.

Getaway, the holiday television program, visited a few years ago with Ben Dark the presenter. I guided the crew in to Starburst Chamber. What a funny bloke! He loved the cave experience and at one point said "I want your job".

Wet Cave and Wonambi Fossil Centre

Dannielle Thomas 3 years

Background

Born in Naracoorte and grew up on the family farm near Avenue Range which also has caves. CEGSA (Cave Exploration Group of South Australia) made numerous trips to our property to visit and map ours and others in the area. My sister and I used to assist them by crawling through the smaller passages. After finishing school I applied for a position at the Naracoorte Caves but was unsuccessful. I moved to Adelaide and obtained a job through The University of Adelaide. After a few years a position at the Naracoorte Caves came up again. With encouragement from my family I applied and was successful, making the big decision to move back home. I haven't looked back.

Wet Cave

It is frustrating to hear people say "I've seen one cave so I've seen them all." We all know that this isn't the case as each cave has its own personality. Wet Cave has large open entrances, high ceilings and huge chambers with speleothems to match. A new lighting system has recently been installed giving the cave a complete makeover.

Wonambi Fossil Centre

The Fossil Centre showcases the animals that once lived in the area, what they looked like and how they might have lived. Their story springs to life thanks to theatre, science and information gleaned from the evidence in the caves. Many young children don't get much further than the first door when the life size robotic *Thylacoleo* roars! I've often imagined stepping back in time….maybe humans would have been on the menu?

Highlights

The first time I experienced Opera in Blanche Cave. We set up and lit about 500 tea candles, transforming the cave into a beautiful, magical arena.

I was taking Adventure Caving into Stick-Tomato Cave and a couple of the kids were absolutely terrified. With a lot of encouragement I managed to get them through the challenges and by the end of the tour the tears had turned into large smiles. It was a very rewarding personal experience.

Bat Centre/Blanche Cave

Decima McTernan 21 years

Background

Born, Naracoorte. After completing my family I helped set up the Rural Access Centre in Naracoorte and eventually became co-ordinator there. I worked and trained in the areas of disability, employment and community education.

While still working at the Access Centre, I saw an ad in the local paper for a Cave Guide at the Naracoorte Caves. I envisaged it as a nice little "weekend job", a relaxing change from the all-consuming nature of the work I was doing! I have been the Senior Guide at Naracoorte for several years now. I work with a great team of people. It is rewarding, challenging at times but never, never dull!

Bat Tour

On a Bat Tour the first port of call is the Bat Centre itself. As a small child I played in Blanche Cave as most of the local children did. At that point in time man hadn't even walked on the moon! Would I ever have believed then, that in the future, infra-red technology would allow visitors insight into the otherwise rather secretive world of the Southern Bent-winged Bat? Could I have imagined then, that it would be possible to view the teeming insect life in the guano piles of Bat Cave in the same manner? This endangered Bat colony has been monitored for several years now, with night counts through a good portion of the year. The information gleaned from this research helps us to better understand their status and plan for their future protection.

Blanche Cave is majestic rather than delicate and a wintering site for bats. A tour of this cave usually encompasses the geology of the area, cave formation, speleothems and the palaeontological and palaeoecological significance of the cave. It is steeped in European and ancient history and was even used as a ballroom in the 1800s. If those walls could only talk!

Until more recently this cave tended to be overlooked by fossil researchers. In the past, practices such as unrestricted access and guano mining signalled the likelihood of too much human impact. It has since been proved that nothing could have been further from the truth and ground-breaking research has taken place here.

Highlights

Seeing "Opera in the Cave" for the first time. Beautiful young voices, candles dancing to the music. Stunning! Watching the cave come to life with the new lighting system. Magic!

Blackberry Cave

Jinhwa Lee 4.5 years

Background

I was born in South Korea, and grew up in a big family where three generations lived together. They can't believe that I crawl though caves for a living, because they all know how much I hated bugs and snakes or getting my clothes dirty. Now they know I'm adventure caving, but they are still amazed. I majored in "English Language and Literature" and minored in "Tourism Management" at Uni. I had eight years teaching experience in Korea. My students ranged from seven to seventy years of age.

I came to Australia in 2009 with my husband Andrew and our puppy Snowy. She's a "Jindo", which is a famous Korean hunting and guarding breed.

Blackberry Cave

There are many caves with delicate crystals and great fossils, but Blackberry is one of my favourite Novice Adventure caving tours. You crawl most of the way in and out and have to stay with the group, doing everything together, as opposed to Stick Tomato where you can choose to do each challenge or not. There are two openings into the cave, and our groups use the western-most one. After entering the first chamber, there are two ways into the next part of the cave. We use one on the way in, and the other on the way out. One great challenge the cave offers is called "The Letterbox". It is at the furthest part of the tour. This challenge involves sliding yourself down into a small area, twisting yourself around, and then crawling and climbing out through a fairly tight tunnel.

Highlights

Being a guide at the Naracoorte Caves involves many different skills and provides many learning opportunities. We talk with geologists, learn about palaeontology, and also other things like snake behaviour, first-aid and four-wheel drive training. I really enjoy learning new things, so I look forward to these days of training and they're a real highlight for me. There are some very memorable people and experiences sometimes. Once I had a family who had lost their mother / partner to cancer. The father chose to take their children adventure caving as a way of bonding and helping them through the grieving process. They found it challenging, and even a little scary, but in the end completed everything successfully. I received a very touching letter afterwards. Adventure caving is not only physically challenging, but also mentally. I learned a lot from this family.

World Heritage Tour

Gavin Kluske 5 years

Background

In 1988 my father bought a house and subsequently discovered a large python living in the roof space, which I caught and kept as a pet. It rekindled a childhood interest in keeping and breeding reptiles and birds. I joined the South Australian Herpetology Group which is a group of reptile keepers that also conducts field research in association with the SA Museum. I worked with SAHG for over 20 years including 6 years as President. During the same period I began working with the Department for Environment as part of their Biological Survey Section, which was surveying the fauna and flora of South Australia. We travelled to remote areas, trapped and observed fauna, identified species and preserved specimens to become part of the collections at the SA Museum and State Herbarium. I also spent 2 years as an assistant collection manager at the SA museum. I first met the guys at the caves when I delivered a jar of 'pickled' reptiles from the museum, to be used in an education program at the caves.

World Heritage Tour

The World Heritage Tour is a tour catering for visitors with a deep interest in the Naracoorte Caves. Small groups of 2 to 4 people and a longer duration than regular tours, allows a freedom to explore the caves in great detail and visit some areas not accessible on regular tours. I usually include a visit to Victoria Fossil Cave, including a more comprehensive look at the fossil chamber deposit, a visit to the lab, a visit to Blanche Cave with its younger and more recently discovered fossils and the endangered southern bent-wing bats.

Highlights

It is a joy to watch visitors discover the secrets of the Naracoorte Caves and to come out of the cave at the end of a tour with a new appreciation of the fauna of Australia, both past and present. My personal highlight is sitting alone in Blanche cave after a night bat tour with thousands of Southern Bent-wing Bats flying past me in the dark.

Victoria Fossil Cave

Frank Bromley 14 years

Background

Born, UK. Worked as a Technician with Telstra for nearly thirty years until taking a redundancy package in 1998. Enrolled at Flinders University and undertook a Bachelor of Technology (Ecotourism) where I had the good fortune to study under Rod Wells. I had a four week “work experience” placement at Naracoorte Caves during my study. I enjoyed the experience so much that I applied for a vacancy that came available here just after I graduated. I enrolled in the Ecotourism degree with the hope that I would eventually gain employment showing people some of the things about our great country that I love and perhaps help them realise the importance of looking after our natural heritage. I didn’t realise at the time just how much the caves would come to match those criteria, and in particular the Victoria Fossil Cave.

Victoria Fossil Cave

A lovely cave with some great speleothems and interesting features. Compared to many caves elsewhere; probably not the most decorated or spectacular of caves. However the treasure within this cave is undoubtedly the fantastic fossil sites throughout its many convoluted phreatic passages and collapsed chambers.

On the public tour we cover a great range of topics, often starting with the bigger geological picture, the limestone/ karst, the Kanawinka fault, cave formation and speleothems. All of this is discussed within the context of the palaeontological significance of the site and the World Heritage listing of the Naracoorte Caves National Park. I always acknowledge Rod Wells’ contribution to Palaeontology at Naracoorte and his part in getting The Naracoorte Caves recognised as being worthy of World Heritage Listing, in conjunction with the Riversleigh fossil site.

I like to think that the history presented to us through the fossils gives us the opportunity to better understand our environment, how it works and how sometimes in some respects it has failed. We can take lessons from that history to help us understand the environment of today and perhaps better deal with the environmental challenges of the future.

Highlights

I had the opportunity, during a “Friends of Parks” Forum, to conduct a guided tour through this cave in the presence of Rod Wells. I conducted much of the usual tour with Rod then speaking to the group at the fossil bed. The fact that Rod was very complimentary after the tour was to me a complete and final justification that my choice of vocation had been a good one.

AURORA: A LARGE CAVE SYSTEM in the LAND of the TAKAHE FIORDLAND, NEW ZEALAND

John Brush
Canberra Speleological Society

The remote Murchison Mountains area of Fiordland in the South Island of New Zealand is home to the last remaining wild population of the Takahe, a critically endangered species of flightless bird. The mountains also contain a belt of cavernous limestone of which the major feature is the Aurora cave system, the longest and most complex system so far located in the southern half of the South Island.

Marjorie Coggan walking through Beech forest en route to the cave
Photo: John Brush

Aurora is the inflow end of an extensive (8 kilometre) network of passages carved by the Tunnel Burn. This stream starts as the outflow from Lake Orbell, plunges underground on reaching the limestone and ultimately emerges some 260 metres lower where it flows into Lake Te Anau through Te Anau-Au Cave (Cave of the Rushing Waters). This latter cave is a 200 metre stream passage that has been developed as a show cave by Real Journeys and which is now commonly called the Te Anau Glow Worm Cave. It is separated from the rest of the Aurora Cave system by a sump.

The Takahe (*Porphyrio hochstetteri*) had been sighted only rarely in the latter part of the 19th Century and during the first half of the 20th Century, it was generally considered to be extinct until being rediscovered in the Murchison Mountains in 1948 (Department of Conservation (DOC), 2014). A survey at the time indicated a population of about 250, which has since fluctuated between 80 and 200 adult birds, according to Wickes et al, 2009. Soon after the discovery, a 500km^2 Special Protection Area was set aside with stringent access provisions. This area, bounded to the west by rugged mountains and on the other 3 sides by Lake Te Anau, is like an island in some respects and this influences how the area is managed. The access

Top. Takahe
Photo: DOC/ Glen Greaves
Bottom.In the forest just above the main entrance to Aurora Cave
Photo: John Brush

Looking back to the main entrance of Aurora Cave
Photo: John Brush

restrictions remain in place to this day and also affect access to the cave – and probably afford a considerable measure of protection to it. A DOC permit is required to set foot in the area beyond the show cave facilities and special precautions are taken to help prevent the introduction of new organisms.

In August 2014, Marjorie Coggan and I were fortunate to have been invited to visit the cave. The trip (and the appropriate DOC permit) was organised by Neil Collinson, the current ACKMA Vice President – New Zealand, and Real Journeys' Operations Manager for Te Anau & Manapouri. The other members of the party were fellow ACKMA member Laura Dawson, Cave Operations Supervisor with Real Journeys and Loren Hrynkewycz, a former employee of the company.

Neil offered to provide us with helmets and lights and, as overalls are not really necessary, all we had to bring were boots, gloves, knee pads, thermals, spare headlights and food. Not to mention cameras and a couple of flashes.

What is around the corner? Marjorie Coggan contemplating a low, wet crawl
Photo: John Brush

Neil also arranged a water taxi for our early morning trip up the lake, but as the plan was to catch the Real Journeys cave tour boat back to Te Anau late that afternoon, our time to explore the extensive cave was limited. Nevertheless, Neil and Laura set out to show us as much of the cave as possible in the time available.

Aurora has several entrances on the slopes above the show cave. The main entrance is a one-hour walk from the show cave jetty. It is a pleasant up-hill walk through tall forest - mostly beech trees - on a spongy carpet moss and fallen leaves. Along the way we passed many wooden boxes that are used for trapping stoats. These introduced pests are the major predator of Takahe eggs, chicks and adults. Another major threat is Red Deer - also introduced – which browse on and trample the tussock grasses the Takahe eat and nest in. These are controlled by shooting.

The main entrance to Aurora is an imposing 40 metres wide and 5-10 metres high. It sits on one side of a leafy depression (a collapse doline?) which has a marked track leading across it and down into the cave. This is

Loren and Neil negotiating a stream canyon in The Sewers
Photo: John Brush

Laura Dawson at Twin Falls
Photo: John Brush

Laura, Loren and Neil resting up for the trip back to the entrance (Note the excellent head protection Neil is wearing - Ed.)
Photo: John Brush

intended to limit the area of visitor impacts and Neil was quite pleased with how the areas beyond the track are slowly revegetating. Even before we entered the cave, we could hear the roar of the underground stream, which sinks at a smaller entrance further up-slope. Most of the noise is generated by the Twin Falls, where the river plunges five metres or so, about 100m into the cave.

The walls and roof of the huge entrance passage are a cream-coloured, slabby Oligocene limestone approximately 30 million years old. The steeply inclined floor is a mix of breakdown slabs as well as silt, gravel and rounded igneous boulders that are remnant glacial deposits. Work by Paul Williams, the renowned karst researcher and ACKMA member, has revealed a complex history of passage development, ice and sediment blockages and subsequent partial removal of sediments in response to glacial and fluvial events on the surface. His studies suggest that during glacial periods the cave outlet was blocked by ice, and so the system was flooded by meltwater and became a sediment trap. Dating of speleothem material inter-bedded with sediments has enabled Paul to identify seven different glacial advances in the area over the last 230,000 years (Williams, 1996).

Not far beyond the Twin Falls area we left the main stream passage, climbed a sediment slope and then very quickly but quietly crawled under an evil-looking roof slab several metres across. A couple of years ago Neil noticed it had dropped several centimetres and informed DOC, which promptly closed off access to that part of the cave. As it appears the slab has stabilised in its current position, DOC is now permitting limited access, provided that visitors sign a liability waiver form and pass under the rock one-at-a-time. On the other side of the slab, the passage opens out into the Hall of Silence, where there are a few small patches of clean decoration. From there we wandered further down into the cave following small tributary streams through beautifully scalloped clean bedrock canyons, part of which is called the Sewer

Neil Collinson about to get wet feet
Photo: John Brush

System, and into a confusing area of abandoned stream passages called the Maze.

Although parts of the maze area were not depicted on one of the maps Neil carried – not that he needed to use one - he said it was easy to find the way out by remembering to turn right, left and left again at key passage intersections. The trick, it seemed, was to remember which were the key intersections. After a quick bite to eat we scrambled down to Juliet's Balcony where a side stream plunges into the main river passage. At that point, we were only about 200m horizontally and 50m vertically from the inner end of the show cave. However, as there is a sump separating the two caves, this snippet of information was purely of academic interest.

Sadly, there was insufficient time to drop down into the main stream passage for a closer look and any thoughts of returning upstream along the main river passage were set aside in view of the high water levels. So we simply retraced our route back to the entrance.

John Brush in The Sewers area of Aurora Cave
Photo: Neil Collinson

The elevated walkway in Te Anau Glow Worm Cave affords nice views to the cascading stream
Photo: John Brush

As we made good time on the way back down the hill, there was time to have a quick look at a couple of other cave entrances and take in more of the magnificent forest scenery. Unfortunately we did not spot any Takahe during our wanderings, but Neil assured us that they can be seen in the area. In winter Takahe tend move down from the alpine tussock country to the warmer forest areas.

There was also time for a quick look at the show cave. We had last visited Te Ana-Au Cave in 2003 and it was interesting to see the recent improvements. In place of the short boat trip along the outer stream passage there is now an elevated walkway of aluminium alloy and stainless steel. This has improved visitor management and enhanced safety. It has also enabled an artificial dam near the entrance to be removed, so that there are now good views from the walkway to the cascading stream where once there was a silent artificial lake. Lighting systems have also been upgraded and two independent emergency communication systems have been installed through the cave. In the Visitor Centre building, the new interpretation displays of local natural history are impressive and last, visitors are whisked back to Te Anau in the Luminosa, a large twin-hulled, 78-passenger vessel that completes the trip up Lake Te Anau in less than 30 minutes.

Just as well we were not late in returning from Aurora Cave as my GPS indicates the Luminosa left the cave jetty at 1600:00:01 hours, just one second after the scheduled departure time.

We are very grateful to our Kiwi friends, especially Neil and Laura, for organising the trip and for expertly and safely showing us through the cave.

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INTERPRETATION WORKSHOP: ISCA 2014 CONGRESS

Ann Augusteyn
Capricorn Caves

For many delegates, the Interpretation Workshop was one of the highlights of the International Show Caves Association (ISCA) Congress held at Jenolan Caves, New South Wales 2-9 November 2014. Facilitated by Maryanne Leigh from Acoustiguide of Australia and Cathie Plowman from the Australian Speleological Federation (ASF), topics ranged over a wide variety of interpretation experiences from around the world. The following is an overview of the ideas presented.

It was agreed that a cave is a living, dynamic museum, a precious resource that needs protection and interpretation. Visitors have different needs, expectations and cultural attitudes. Delivering responsible interpretation to satisfy visitor expectations and create memorable experience is therefore challenging. The cave tour route must be designed to facilitate the delivery of interpretation with platforms for groups to assemble and avoiding long narrow passages where interpretation is required.

SELF GUIDED TOUR via Handheld devices or Apps

For the preservation of the cave and the safety of the visitor, the cave must be carefully selected or purpose developed to accommodate a self-guided experience.

There was a variance in preference of experience depending upon cultural background; with one delegate reporting that English people preferred a "live" guide, whilst Dutch and Italians showed a preference for an audio guide.

Other delegates questioned whether audio guides were an option that visitors were requesting or was it the perception that self-guided meant "free". Therefore should the term self-guided be removed?

In caves with long narrow passages, delivery of interpretation can be challenging when it comes to large groups running in a line. The forerunners get up close to the guide and hear everything but those at the rear can find it difficult to hear. There are group guiding technologies available – however presently these radio frequency technologies can be really useful for whisper quiet nature walks above ground, but this technology can be challenging inside a cave. Development of these technologies including booster transmitters could see this challenge averted in the coming years offering all visitors a near one-to-one experience with the guide's voice straight into their ear.

There are many advantages to using other forms of standard MP3/MP4 multimedia guides in a cave including:

- Consistent delivery of accurate and quality information
- Catering for mass visitation or overflow during peak periods
- Catering for multilingual visitors – even when accompanied by a live guide.
- Provision of themed content options to cater for different levels of information: not one size fits all (e.g. kids' tours, indigenous focus tours, above ground geology, hydrology, flora and fauna trails)
- Inclusion of expert commentary
- Inclusion of music and sound effects
- Possible expansion of content to incorporate images, videos or animations to demonstrate past events or creatures such as fossils.
- Provision of a different experience that may extend a stay or cater for repeat visitation after experiencing a "live" guide.
- Opportunity to use pre-recorded tours as a resource for guide training.
- Development of smartphone apps to expand the reach of content to include use off site and practically around the world. Pre-visit learning is very popular, and armchair tourism is equally as popular.
- Way finding
    - in the caves using iBeacon
    - and outdoors using GPS
- Use of pre-recorded technologies minimised the need for signage which maintains the integrity of the site.

LIVE GUIDE INTERPRETATION

Many delegates believed that the best tour guides were irreplaceable; they are master story tellers delivering and editing a compelling story. The personal interaction between guide and guest was a valuable addition to the experience and provided a sense of place. It was also a refreshing contrast to a world connected to digital experiences.

Selection and training of quality guides is imperative to successful delivery of "live" interpretation. These were hot topics of debate with various methods adopted in different countries.

Various pre requisites for a guide were tabled. These included a drug test, working with children clearance and first aid.

Pre selection of applicants:

- Initial telephone conversation was used as part of the interview process.
- Candidate asked to do a screen test and present a scenario of a common object.
- Young people selected and employed for 2-4 year period.

Training programs are varied but it was agreed that no one can be taught passion or people skills; these come from the heart. Training methodologies tabled included

- Classroom setting to deliver geology, biology, history.
- Trainee guide shadowed other guides. This could result in an issue of consistency.
- Competency tests applied at end of training
- Guide tool kit developed as a resource
- Payment of trainee guides varied. An alternative suggestion was the trainee guide host a tour for his family/friends.

Sasa Kennedy introducing her group to Jenolan caves. Photo: Steve Bourne

GUIDING AS A CAREER

Dark Cave, Malaysia employed relevant science graduates, who combined research projects in the cave with tour guiding. A system of qualifying points was used to allocate time between research and guiding. This resulted in the cave being a desirable place to work with diversity of activities to keep the guides fresh and performance linked to productivity.

Guiding was perceived to be a life skill training that provided the development of skills in personal relationships and public speaking.

A system of staff hierarchy was advocated to encourage career advancement.

Different cultures placed different values on guiding as a profession. Remuneration varied between countries.

Professional development for guides included:

- Guide workshops on the strategies for delivering memorable experiences
- Road trips for guides to other attractions and caves
- Attendance at guide schools eg ACKMA gabfest, Savannah Guide school
- Organise guide meetings with regional guides
- Professional development is necessary to refresh and retain guides and avoid "boredom in paradise".
- Guest feedback important eg www.tripadviser.com.au
- Discussion of other interpretation methods.
- Cave websites.

Date claimer: ACKMA Guide School for Guides at Capricorn Caves, Queensland in 2016 will focus on interpretation and guide training. Everyone welcome.

CAPRICORN CAVES TOURISM WINNERS

Ann Augusteyn

Editor's Comment

I have had the opportunity to visit a few cave sites and meet others who have been to many more in recent times, and have participated in much discussion in the management of Australian caves. An unfortunate common theme through many of these discussions is the constant change, instability and restructuring of state agencies, that affect caves and the staff who work in them. One model and beacon of light is Capricorn Caves, somewhat immune to the vagaries of annual budget cycles of state governments. On the one hand, totally in control of their destiny and on the other, no safety net that is available for a state run cave system that "can't" fail. When Ann emailed me just as this journal was nearing the printers, I was delighted with her success for Capricorn caves and her hard working team. Ann takes her staff to each ACKMA conference and Gabfest, and attended ISCA as well, when other caves are not represented at these events. Well done Ann - Capricorn Caves is a shining light in Australian cave tourism.

In front of a crowd of elite operators of Queensland tourism industry, Capricorn Caves was announced the gold winner of the tourist attraction category at a gala ceremony of the Queensland Tourism Awards in Brisbane on Friday evening 28 November 2014.

"It was both an exhilarating and humbling experience to be named the best tourist attraction in our category. There are so many amazing quality attractions in the State," commented Ann Augusteyn, owner.

Writing a tourism award submissions provides an opportunity to benchmark your business, appraise your environmental programs, customer service, delivering the best guest experiences as well as business planning and marketing. A site inspection by a judge authenticates all claims made.

These were the 30th annual Queensland Tourism awards and a souvenir program commemorated the work of the late Ken Augusteyn in developing the infrastructure at Capricorn Caves.

It is always a great thrill to see a cave operation achieve recognition at a tourism award ceremony. Winners automatically go to the National Tourism awards to be held in April in Adelaide when Capricorn Caves will compete against the best tourist attractions from every state in Australia.

Capricorn Caves staff with their Queensland tourism awards trophy.
L-R Amanda Hinton, Helen Harmsworth, Ann Augusteyn, Kirsty White, Marnie Augusteyn

STAMPGATE: AN AUSTRALIAN BAT PHOTOGRAPH on a SLOVENIAN STAMP

Steve Bourne

Imagine my surprise when I received an email from a German stamp collector Wolf-Peter Friedrich asking for information on how and where I took the photo of a bent-winged bat *Miniopterus schriebersii* that was about to appear on a stamp in Slovenia! I had not given or sold the image for this purpose, and how did he know it was my photo? Wolf-Peter is an avid collector of stamps, specialising in stamps featuring bats. When a new bat stamp appears in any country, he likes to track down who took the image that the stamp is based on and source information on the photograph itself. He had received pre-release information on an upcoming series of stamps by Slovenian Post which featured four stamps including one with Miniopterus schreibersii. Wolf-Peter had managed to match my photo with the stamp, and track me down. I thought this was pretty amazing, but what happened next could hardly be believed.

I mentioned the story to an ABC freelance journalist Peter Little at a function the following Saturday night. On Monday, another journalist contacted me and we produced a web article with the stamp and the original image under the title "Hey, who nicked my photo". The next morning the ABC had an email from Slovenian graphic designer Edi Berk advising he had designed the

The stamp, first day cover, and images used to create them. Reversing the image for the first day cover was a nice touch.
Photos: Steve Bourne

Left. TV presenter and cameraman, Paul Makin with his soft toy bat that I had to photograph.
Right. L-R. Steve Bourne, Paul Makin and Naracoorte Caves Manager Deborah Carden in Blanche Cave after the filming.
Photos: Steve Bourne

stamps but had not stolen the image, but merely used it in the design of the stamp. He felt it wasn't a copyright issue because the image had been computer-altered and asked to be put in contact with the photographer. Another stamp collector in Slovenia has a Google search for "Slovenia bat stamp" and had picked up the story and advised Slovenian media and it was the lead story on Slovenian news that night, featuring one of their most regarded professional photographers, but not Edi, who refused to front the cameras.

The ABC thought this was once again news worthy, so a four way radio interview with designer who had suffered similar theft and a copyright lawyer was held with national radio on prime drive time radio. The advice was it doesn't matter if the image has been altered in anyway; copyright is still retained by the image's owner.

Then the Slovenian media really picked it up. Radio interviews, requests from newspapers and websites and a series of emails with Edi Berk and even a request from a copyright lawyer to act on my behalf. I came to an agreement with Edi Berk that he would provide me with copies of the stamps and first day covers as compensation. He offered to do some graphic design work for a brochure or website as compensation, but the distance seemed too far to achieve this. I was somewhat disappointed when 4 stamps, 4 first day covers and a book he had designed on Slovenian craft arrived in the post; I was expecting a sheet of stamps at least. Eight euros worth of stamps and a book that will make a great Christmas present for my sister hardly seemed adequate compensation.

Procounter, a website that provides news for professional photographers, ran a story as well. The key message through all of this media was that I am Ok with images being downloaded for school projects and similar, but using images for profit without approval or compensation is theft. Although these images have been sold several times previously, all funds have gone towards bat research, which just added more fuel to the story for the media.

Just when I thought it had died down, Paul Makin from Today Tonight, Channel Seven in Adelaide made contact, tipped off by Peter Little, the journalist I originally told the story. A story was filmed in Blanche Cave at Naracoorte Caves, complete with a fake hand puppet and me imitating taking photos of bats, which was nothing like how good bat photos are taken. I was attending the ISCA Congress at Jenolan Caves when this screened and missed it, but judging by the number of text messages and phone calls, plenty didn't. I have since seen the story and in a funny sort of way gave good publicity to Naracoorte Caves. The URL follows for your amusement. http://www.todaytonightadelaide.com.au/stories/bat-man

And then for a nice piece of symmetry to whole saga, I did a summary story for the ABC website on all the media that was generated by this issue. I think it's over.....I am quite sure Edi Berk will not be sending me a Christmas card.

Advertorial

CAVES of the WORLD

Ross Anderson

www.cavesoftheworld.com

Caves of the World has been established with the aim of bringing show caves around the world together onto one website and providing a joint promotional platform.

Utilising high quality imagery and virtual tours, the ***Caves of the World*** website will provide information on:

- tours, bookings, costs,
- how to get there,
- local service providers such as accommodation and activities
- special events such as local festivals

How will it work? Individual show caves will join ***Caves of the World*** as a member at the level of service and promotion that suits their operation or budget. Caves of the World will host the images and information and promote its members through online and traditional marketing techniques.

How is this any different from my own website? In the next three years we aim to host up to date information on more than 80% of show cave sites across the globe. Each of these sites will be able to update their information, provide news feeds and special offers onto the ***Caves of the World*** website. The power of this central hub of information and activity is that it raises the rankings of the Caves of the World website on searches for show caves, tourist activities or accommodation. Therefore we can promote your cave site to potential visitors and provide you with more visitors. Managers of show caves can utilise ***Caves of the World*** in two distinct ways;

1. Use the Caves of the World website and marketing services as an extension of their own website and marketing practices, and
2. Utilise Caves of the World to establish a fully functional website for their site and use the ***Caves of the World*** marketing services as an extension of their own marketing practices.

How will the public benefit from using the *Caves of the World* website? Members of the public can visit the Caves of the World website and access information on show caves in many locations around the world and plan their holidays based upon the information hosted by Caves of the World.

We aim to have 80% of the world's show caves listed on our website in three years. We have started out in Australia and Malaysia. We will be seeking listings in New Zealand early in January 2015, America in April 2015 and Europe not long after.

The ***Caves of the World*** website was established in October 2014. We have all of South Australia, Victoria and Tasmania's show caves photographed and are in the process of listing them. New South Wales and Western Australia are approximately 50% photographed and are due to be listed soon. We have lots of work to do on our website, it is far from complete and probably never will be due to the dynamic nature of the world wide web and the clients we are dealing with, but it is growing quickly.

The functionality that we will be implementing in the next 12 months includes: online tour and accommodation booking, a loyalty/ rewards program and various members lists. In addition we are beginning to offer client merchandising opportunities where the benefits of group buying will see you being able to purchase a wider range of goods at group buying rates.

What to do now:

1. Visit our website
2. Send us an email: info@cavesoftheworld.com expressing your interest in having a chat
3. We will call you and together we can determine the way forward.