



The ACKMA Journal

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FRONT COVER: Blue Stalactite, Murder Cave, Cliefden Caves, New South Wales.

Photo: Garry K Smith

BACK COVER: Cliefden Caves

Top left Rare aqua coloured speleothems in Taplow Maze Cave

Top right. Speleothems in Murder Cave

Bottom. Boxwork on ceiling in Main Cave

Photos: Garry K Smith

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FROM THE EDITOR

Somehow journal number 96 has been completed and you are now enjoying a rich mix of articles. Thank you to those who have hit the keyboards and contributed to this edition.

I imagine the first thing most of you asked when you saw the cover was “where is that stalactite?” I was ignorant to the fact that such speleothems occur in Australia until I received Garry K Smith’s article of Cliefden Caves, with his usual excellent images. These caves and important fossil site are in danger of being lost to development. Read Garry’s article, and President Dan Cove’s comments, and help out where to you can to ensure we don’t lose these caves.

The first circular for the 2015 ACKMA Conference, to be held in Naracoorte, South Australia, is included. It provides some important information on how to get to Naracoorte, and a brief outline of the program. Full details will be available in the December journal and hopefully on line prior to this. I hope to reciprocate to those who have kindly taken me caving at ACKMA conferences and on other occasions either prior to, or after the main event.

Rolan Eberhard provides an update on happenings in Tasmania. We have been trying to get something published for several editions on this, but there has been much political discussion and has been held over until now. I was personally very pleased to see the Australian Government’s application to the World Heritage Committee to remove 74,000 hectares from the Tasmanian World Heritage Area rejected. This outstanding landscape, both above and below ground, deserves to be protected.

Armstrong Osborn’s article covers his work in Sri Lanka, and it appears there are a lots of opportunities for the keen caver in this country with some unusual caves to explore.

On a light note, Phil McGuinn provides a quaint story about a cave, a ring and a dog. I didn’t know quite what to expect when I saw the title, but really enjoyed this contribution.

A few years ago, there was a blaze of publicity around a *Diprotodon* Fossil found at Jenolan Caves, New South Wales. Anne Musser provides a comprehensive analysis of the specimen, that is now confirmed to be *Zygomaturus trilobus*.

The value of a sincere welcome is the topic of Sasa Kennedy’s contribution. I think this is a good reminder to everyone involved in hospitality. I have also included an address by David Summers, President of the International Show Caves Association, which

includes reference to ACMKA Life Member Andy Spate, with some of his thoughts on the role of show caves.

The most travelled couple in ACKMA, John Brush and Marjorie Coggan, provide a report on the Pillaga Sandstone Caves in New South Wales, an important archaeological site.

Members who attended the conference in Ulverstone, Tasmania in 2009, will remember the Governor of Tasmania, His Excellency Peter Underwood, who opened the conference and visited Gunns Plains caves afterwards with Geoff and Trish Deer. Peter passed away in July and Geoff reflects on his short time with him at his caves.

Andy Spate gives high praise to the Sixteen Legs exhibition on the Tasmanian Cave Spider, *Hickmania troglodites*, that was recently opened in Hobart. Andy is working to bring this to the ACKMA Conference at Naracoorte next May. I hope he is successful.

Research, trip reports, management, art exhibition, an obituary, opinions and a plea to help save some caves. A rich selection of articles for your enjoyment.

Ross Anderson kindly sent me a calendar of his outstanding cave images. I contacted Ross to see if he was selling these, but alas, no. I have one of a very small print run - many thanks Ross! Have a look at some of the cave panoramas Ross has put together on his website www.lightsspeed.com.au.

Many will know that Brian Clark and his family have returned to Australia after 10 years managing the Gunung Mulu World Heritage Area. Alison Pritchard, ex Yanchep Caves, Western Australia has taken over from Brian.



The Naracoorte town entrance feature
Photo: Steve Bourne

The International Show Caves Association (ISCA) conference is fast approaching and I know a number of ACKMA members, myself included, have joined ISCA and will be attending this conference. A report on this will be provided in the next journal. The conference proceedings from ISCA will be electronic only, however I have permission from ISCA to publish papers in the journal with the permission of the author. I hope to be able to present a number of papers in coming editions.

Enjoy this edition, and I look forward to your copy by mid November for the December edition.



Speleo 2017 field excursions

Cathie Plowman

The 17th International Congress of Speleology will be held in Sydney in July 2017. I have accepted the role of chairing the field excursions committee and am now looking for support from others who would like to be part of organising and/or supporting field excursions for the Congress.

Field Excursions will include:

- caving excursions during the congress;
- pre and post congress trips; and
- caving weekends and day trips before and after the congress.

July brings a range of weather conditions: 20–25° in the Chillagoe area, snow at Jenolan Caves and minus temperatures and heavy rain at Mole Creek. Weather conditions will need to be carefully considered for field excursions. If you're wondering 'why have the Congress in winter', that's something that is out of the hands of the organisers; it needs to be held in the European summer. Besides weather, practicalities such as cost, access, transport and accommodation will need to be considered.

International caving colleagues will be travelling a long way, wanting to see Australia's caves and to experience wildlife, culture, locations such as Uluru and the Great Barrier Reef and much more.

I invite cave and karst managers to consider how they may be able to support the Congress in ways such as reduced or complimentary access cave fees and reductions in camping and accommodation fees.

If you're interested in helping to showcase Australia and its caves and karst, I would love to hear from you to discuss any ideas and options. Thank you, I can be reached at: Speleo2017-excursions@caves.org.au

Coming Events

2014: 2-8 November	International Show Caves Association, Jenolan Caves, Australia www.jenolan2014.com
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: 21-26 June	30th Australian Speleological Conference, Exmouth, Western Australia
2016: May	ACKMA Annual General Meeting and Cave Guides Workshop, Rockhampton, Queensland
2017: 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

PRESIDENT'S REPORT

Dan Cove



It is often observed that time has a funny habit of seeming to accelerate when a deadline is looming, and never has a year seemed to rush so quickly towards Spring as this year has. In my case, this is largely due to the looming presence of the ISCA Congress, now mere weeks away. I am very pleased to note that

preparations are well in hand for this Congress with my tireless committee members Scott Melton and Dom Cove working hard on the myriad of organisational details. We are still expecting a good turnout with bookings accelerating in the last few weeks. It is very pleasing also that Australia and New Zealand will be strongly represented at the Congress, and that the number of 'home grown' members of ISCA has increased in advance of the Congress. Given the importance of certain issues to be debated during the Congress itself, including the ISCA Management Guidelines, I believe that it is of high importance that we are in a position to make a positive contribution to the shaping of these guidelines.

Meanwhile there are many cave related issues unfolding currently. Some ACKMA members may have heard of the saga currently unfolding at Cango Caves in South Africa. In brief, this saga centres on the appropriation of \$R16 Million from the Cango Caves sovereign fund – monies accumulated by the caves over many years as a source of funding for future improvement and infrastructure projects. Manager Hein Gerstner, ACKMA

member and ISCA Director, has been fighting against the removal of this vital funding in a struggle that has become a front page news story in South Africa carrying significant political implications. I have, at Hein's request, written a letter of support on behalf of ACKMA to the Provincial Government of the Western Cape. I sincerely hope that reason prevails, and that the natural and cultural heritage of this fine cave system can continue to enjoy prudent and forward thinking management.

A little closer to home (and a lot closer for me) is the new threat to the Cliefden Caves, New South Wales (NSW) being posed by the proposed Needles Gap Dam. The recent NSW state budget has allocated funds for a feasibility study into the dam which would inevitably flood the caves as well as other significant sites including the Fossil Hill site. In addition to there being genuine doubts as to the suitability of the site at all, it need not be elaborated to ACKMA members what a tragedy this would be for one of the most significant karst areas of NSW. A strong local campaign has been launched against the dam project with good coverage in local and state media. It is certain that ACKMA will throw strong support behind this campaign.

In the face of issues such as these, I am again reminded of the importance of organisations such as ACKMA that can provide a strong and relevant voice to the debate, and am grateful to all ACKMA members who are active in ensuring that the long term protection of cave and karst areas always remains on the political agenda.

I look forward to catching up with several members very soon at Jenolan for the 7th Congress of ISCA!



Top. He is not so new now, into his second year as president. A nice image of Dan from a Jenolan caves newsletter.

Left. Visiting palaeontologists Dr Lorna Steele and Dr Julian Hume and ACKMA member Cath Sellars in Starburst Chamber, Naracoorte on a recent visit.

Read more about Cliefden Caves at <http://bookproduction.org/savecliefdencaves/facts.html>.

On the website there are also links to on-line petitions and suggested ways people can help save Cliefden Caves.

CAVE SCIENCE AND SUSTAINABLE CAVE TOURISM IN SRI LANKA 2008-2014

Armstrong Osborn
University of Sydney, New South Wales

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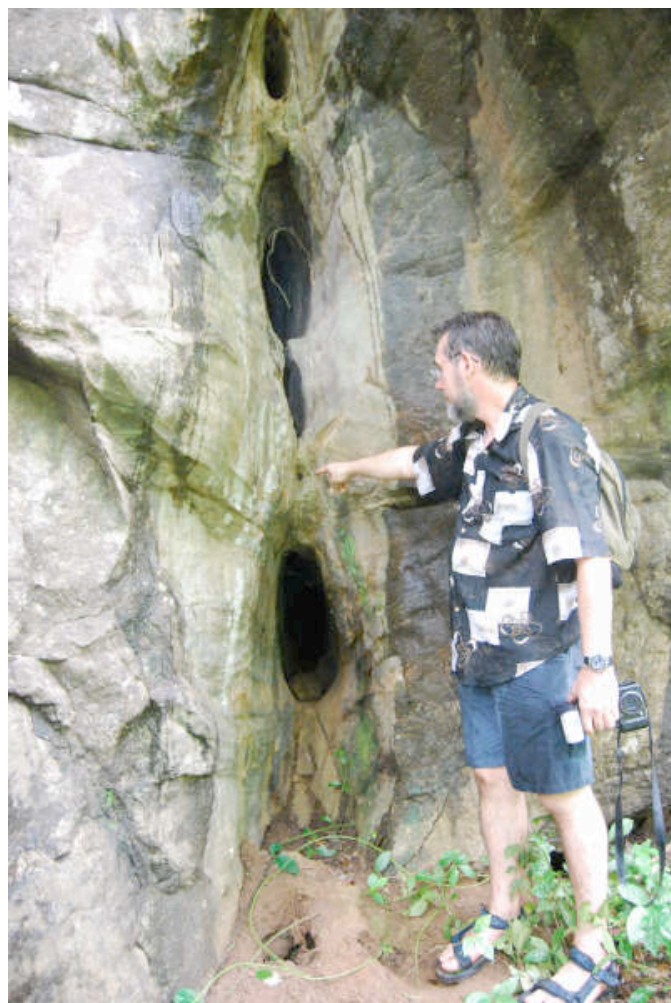
Sri Lanka is a tiny tear-shaped blob of Gondwana hanging from the southeast corner of the Indian sub-continent. It is an island of tea, spices, gems, ancient civilizations, Palaeolithic archaeological sites and legends. It is still recovering from a thirty-year civil war and the 2004 tsunami.

Nothing was further from my mind than Sri Lanka when in October 2008 I received a forwarded email from Dr Weliange (Weli) of the Postgraduate Institute for Archaeological Research (PGIAR) in Colombo asking for assistance in establishing cave science research in Sri Lanka. I thought Gondwana fragment, Proterozoic rocks, could be a good place to look for very old caves so I put my hand up. After a few emails it became clear that there was not just no cave science in Sri Lanka, there were also no cavers to explore and map the caves and cave locations were poorly known.

The available literature consisted of references to nitre caves in an 1820's English colonial book, an extensive data base produced entirely from library research by a German scholar which lists caves alphabetically by name and which has never been field checked and a very few reports from visiting European cavers. So locating caves was going to be difficult and as our German friend had discovered, many caves had the same name (usually bat cave or women's cave referring to a local legend) and some caves had twenty or more names. Locating and determining the name of a cave when found remains a problem.

There was a need to develop cave science training for archaeologists as many of their important sites were in caves. All available literature suggested that the caves were developed in Proterozoic marble so it should not be too hard to apply existing ideas about karst caves to Sri Lanka.

In June 2009 I made a four-day reconnaissance trip to Sri Lanka on my way home from a hypogene cave conference in the Ukraine, this set the stage for all that has ensued since. All but one of the caves seen appeared to be entirely developed in highly-deformed gneiss of granitic composition, while the presence of what looked like carbonate stalagmites suggested something else was going on. The best-known cave in Sri Lanka, Vavulpane Bat Cave (also called "oldest cave") turned out to be developed in a tufa mound, with the tufa deposition continuing from a spring rising out of a joint in entirely siliceous gneiss. Whatever was



Many international karst experts have been fooled by this image. No, its not a solution tube in limestone, the bedrock is gneiss!

Photo: Wasantha Weliange

happening in Sri Lanka it was clearly not conventional karst cave formation in marble.

The lack of local cavers was solved by Dr Weliange. He collected a team of young people including architects, archaeologists, a geo-archaeologist and a geography teacher who were willing to give caving and cave mapping a go. Their caving ability and mapping has improved greatly over the last five years and they are now foundation members of the just incorporated Lanka



*No, north is this way, cave mapping training,
Sthreepura Cave, August 2010
Photo: Wasantha Weliange*

Institute for Cave Science (limited by guarantee) (LICAS), which will apply for membership of the International Speleological Union as its conference in western Sydney, New South Wales (Penrith Panthers) in 2017.

The four days in June destroyed all my plans; there would be no course development until a completely new science of Sri Lankan caves had been developed from scratch. So with no funding, lots of local encouragement and Weli's old Nissan Patrol, the local team set out to locate explore and map caves that looked interesting, while I scratched up odd money and used my own pocket to make nine trips to Sri Lanka from June 2009 to May 2014 to help with training, give lectures to local archaeologists, geology academics and students and drive the science.



*Above left. Looking out from Fa-Hien Lena, an arch cave
Above right. Phantom rock filling a cave-shaped "cavity" in unaltered bedrock at Kukuluwa Kanda Rajamaha Viharaya.
Photos: Armstrong Osborn*

There appeared to be a number of types of caves in the gneiss, large arch caves often converted into temples, elongate tunnel caves with an elliptical cross-section, block breakdown caves with a striking resemblance to breakdown chambers in limestone caves, mass movement caves, and boulder caves, some with quite large dimensions. But what processes were excavating the arch and tunnel caves and what was being removed to drive the breakdown?

One clue to emerge in the first visit was a strange feature at Kukuluwa Kanda Rajamaha Viharaya rock temple, an elliptical mass of altered gneiss surrounded by unaltered gneiss. It became of greater interest when the local monk informed us that he was planning to dig out the altered material to make a new meditation cave so his temple was not filled up with American "spiritual" tourists. Perhaps the legends about a caste of tunnellers who made caves was true, but it did direct our thinking towards rock phantomization and removal as one likely mechanism for cave formation. The site retains intact today because, unfortunately for the monk, the phantom rock has developed a strong secondary ferruginous cement, making excavation very difficult.

While caves developed entirely in marble have been found to be uncommon, many caves are developed mostly in gneiss and partly in marble. This has confused previous investigators. Some caves really are the spaces left behind after the marble has been dissolved away, but most are more complex with indications of direct solution of gneiss and phantom rock processes as well.

If the caves themselves are unusual, the cave sediment and some of the speleothems are very strange indeed. The floors of many caves are covered with organic silt from guano, not at all unusual until you look at your trouser legs and see they are sparkling from mica plates



*Is it alive? Dr Weliangge with black spongy flowstone
Photo: Armstrong Osborn*

that apparently fall from the cave ceiling. In addition to apparently normal carbonate speleothems, small silica stalactites and large silica flowstones, there is strange soggy black flowstone with calcite sheets covering that looks distinctly alive.

By April 2012 we were in the position to start assembling out thoughts in an introductory paper with help from Ross Pogson (Australian Museum) on the cave minerals (that is on the samples I was prepared to take on a plane and attempt to get through quarantine in Sydney). After some financial misadventures in Europe our paper came out in 2013: *Osborne, R.A.L., Weliangge, W.S., Jayasingha P., Dandeniya A.S., Algiriya, A.K.P.P. & Pogson, R.E., 2013. Caves and karst-like features in Proterozoic gneiss and Cambrian granite, southern and central Sri Lanka: an introduction. Acta carsologica 42(1): 25-48.*

Since 2012 a phantom rock maze cave, two very large chamber caves, an unusual cave in dolomitic marble and stream-sink cave taking water into gneiss, have been investigated. In 2013 we made our first trip to the “security zone” near Jaffna to rediscover the karst features in the Miocene limestone, described by Czech scientists in the 1970s, which had not been accessible for thirty years due to the civil war and the tsunami.

Apart from still active minefields, the main threat to this extensive karst area is rapid clearing of scrub and destruction of the case hardened zone on the top of the limestone to create agricultural land. Our most recent visit (April 2014) revealed why it was so difficult to find caves in this very large karst area. The cave entrances open after heavy rainfall. These are 6m deep and about 1m in diameter. The local community quickly fills them to prevent small children from falling in. If caves are to be conserved than a non-destructive means of quickly making these shafts safe needs to be developed.

During 2013 local interest extended to the development of an organized, environmentally and socially sustainable cave tourism industry in Sri Lanka. Leading this is the Director General of the Central Cultural Fund, responsible for managing Sri Lanka’s World Heritage archaeological sites. So far seven sites suitable for a range of tourism development have been identified. These range from installation of protective hardware in a small cave shown by a local guide, through various levels of self-guided caves, to one very large block breakdown cave with a lake and stalactites which is suitable for full-scale show cave development. Our caving architects have prepared draft plans for one self-guided cave, so Welis was right in recruiting architects to caving.

The science is continuing with action being taken to recruit three Sri Lankan PhD students to work on gneiss caves, marble caves and cave sediments. LICAS is negotiating to establish a special cave and karst collection in the PGIAR library so Sri Lankan cavers, students and researchers will have access to the difficult to obtain literature of caves and karst. I will be donating my duplicate material and donations of suitable material are very welcome. In 2015 for the first time a major archaeological research project from PGIAR will investigate the caves in which the sites are located as a standard part of its program.

Similar Proterozoic rocks to those in Sri Lanka with caves are found in southern India, so Sri Lankan cave science may soon become international. With the very large amount of cavernous limestone in Southeast Asia, environmental aspects of karst are certain to become major issues in the areas to our north. Sri Lankan cave scientists will be well placed to meet this demand. While thinking about capacity in geological aspects of cave science it is worth pointing out that among Gondwana fragments (excluding the Bohemian Massif in the Czech Republic) the greatest strength in cave and karst science is in Brazil, which also has some of the world’s strictest cave conservation laws. With the state of cave and karst science in Australia, don’t be surprised if the next generation of researchers at Jenolan Caves come from Sri Lanka or Brazil or are Sri Lankan or Brazilian trained.

CLIEFDEN CAVES, NEW SOUTH WALES, AUSTRALIA: UNDER REAL DAM THREAT

Garry K. Smith

President - Newcastle and Hunter Valley Speleological Society

Brief Overview

The Cliefden Caves are located on the Belubula River, New South Wales, between the towns of Carcoar and Canowindra. There are in excess of 60 caves and over 50 additional karst features at Cliefden and evidence suggests that they are hypogene caves (formed by rising ground water). A permanent thermal spring is situated immediately downstream of the limestone outcropping and may have played a part in this process. (Osborne, R.A.L., 2001 & 2009) The caves consist of extensive underground caverns and networks of passages up to three kilometres in length.

The Cliefden limestone was the first discovered in Australia, by surveyor George Evans on 24 May 1815. (Evans, G.W., 1815) Surveyor, John Oxley in 1817, set out from Bathurst on an expedition to solve 'The Mystery of the Western Rivers'. On the first leg of his exploration he travelled down the Belubula River and camped in the vicinity of Cliefden downstream from Limestone Creek. (Oxley, J., 1820)

The early European history of the area also includes the Rothery family (property owners of Cliefden since 1831) being held up by the notorious bushrangers Ben Hall's gang in 1863. (White C. 1903)

Geologists from around the world regard the Fossil Hill site as one of the most important Ordovician fossil sites in Australia. This extremely significant fossil site has been extensively studied by researchers and may still hold secrets of untold new discoveries. The book 'Australia's Fossil Heritage, A Catalogue of Important Australian Fossil Sites', (2012), states that "The Cliefden Caves - Belubula River Valley sites contain the best exposures of Late Ordovician island marine invertebrate fossil assemblages in Australia. The well documented faunas and biostratigraphy serve as the reference sections of the Late Ordovician in Australia and as a window to the Late Ordovician island arc biota. The sites include the type localities for over 100 species." (The Australian Heritage Council, 2012)

There have been more than a hundred scientific papers published relating to the Cliefden karst area, documenting the fossil sites, caves, rare speleothems, cave fauna etc. However there is still potential for lots of new discoveries in the area.

Several caves contain rare blue speleothems. Analysis of the speleothems indicates that the sky blue and aqua colours are due to the presence of copper, chrome and nickel, which has leached through the limestone and deposited in conjunction with the calcite. (Turner, K., 2002)

There are many reasons why these caves and fossil sites must be preserved. They include; natural and cultural



Just a small portion of the outstanding helictite display in Main Cave - Cliefden.

Photo: Garry K Smith

heritage, scientific value, cave fauna (including threatened bat species), fossils, geology, geomorphology and paleontology to name a few. The Belubula River also supports a population of platypus and native fish species including the threatened Murray Cod.

Much of the karst area, fossil sites and caves would be inundated if the proposed dam is constructed at the Needles Gap site on the Belubula River. Hence the flooding and ingress of silt into the caves would destroy their potential for future research, aesthetic value and the habitat of many fauna species.

At present there is no statutory protection of any form to protect the karst area, nor caves. The present landowners are well aware of the scientific value of the caves and fossil sites and restrict access to the caves and karst. Property owners would also lose out with loss of highly productive land and resumption of additional catchment land around the foreshore, thus, downscaling their enterprise and reducing their livelihood on properties passed down through several generations.

The Dam Threat

Between 1941 and 1946, six dam sites around the Needles Gap and Cranky Rock area on the Belubula River were investigated by Government geologists. They determined that the rock strata were unsuitable for construction of a large dam at several of the proposed sites including the Needles Gap site. (Kenny, E. J, 1941 & Harper, L. J, 1946) A dam was again proposed in the

1960s through 1970s but again abandoned. Thankfully the original proposals faded away after these unfavourable geological reports.

In July 2012, the proposition of a dam at The Needles was again raised at a Local Government Water Conference when an officer of State Water NSW, in his address to the conference, stated that State Water had identified three locations in NSW that were suitable for new water storages. One of which was on the Belubula River at the location called The Needles. The NSW Dept. of Infrastructure released a report on 3rd October 2012 titled "State infrastructure Strategy 2012-2032" which recommended a "New Carcoar dam in the Lachlan Catchment". Then in August 2013, Central Tablelands Water (CTW) called on the Federal and State politicians to back this new dam. The Federal member for Calare, John Cobb in a press release on 21st January 2014, announced the proposal for the construction of a 90,000ML dam at Needles Gap and called on State and Federal Governments to back the plan. Mr Cobb followed this up the same day, with an onsite meeting of local town Mayors, GMs of local water authorities and media at the Needles Gap site overlooking the Belubula River. On 17 June 2014 the NSW Minister for Natural Resources, Land and Water, Kevin Humphries announced that \$1 million had been allocated in the NSW 2014 budget for a scoping study into the Needles

Gap Dam. On 12th July 2014 Mr Humphries further announced that the NSW government would also add another \$3.5 million to facilitate a full feasibility study over the next 2 years.

The proposed dam at the Needles and several of the Cranky Rock sites would flood many of the Cliefden caves and partially submerge the fossil beds. By July 2014, growing opposition to the dam proposal amongst the Speleological community saw the formation of the 'Save Cliefden Caves' committee and a web site developed. The inaugural meeting held at Bankstown, was attended by 27 representatives from twelve NSW caving clubs and several likeminded societies.



Speleothems known as the 'Donkey Tails' – stalactites encrusted in spar crystals in Malongulli Cave Cliefden

Photo: Garry K Smith

The rock strata at the proposed Needles Gap site was originally found to be unsuitable for dam construction in the 1930s and 1940s, however technology and construction methods may have progressed since then. What was not viable in the past may now be achievable, so this threat is a VERY real threat for the destruction of such unique caves and fossil sites. It is believed that this dam proposal is directed more at providing a water supply for gold, copper and

other precious metal mining operations in the region – not for agriculture or human consumption.

Any support which ACKMA members can provide to oppose any dam which will flood the Cliefden Caves and karst area would be very worthwhile.

Read more about Cliefden Caves at <http://bookproduction.org/savecliefdencaves/facts.html>.

On the website there are also links to on-line petitions and suggested ways people can help save Cliefden Caves.

References

- Evans, G.W., (1815). Evans's second journal: Discovery of the Lachlan River (Enclosure of Dispatch 9/1815). Published in Two Journals of early Exploration in New South Wales. Sourced from Commonwealth of Australia. Historical Records of Australia. Series I. Governors' dispatches to and from England. Volume VIII. July, 1813 – December, 1815. Published by: The Library Committee of the Commonwealth Parliament 1916. Sydney: William Applegate Gullick, Government Printers 1916.
- Kenny, E. J, (1941) & Harper, L. J, (1946). Dam Sites on the Belubula River, Near Canowindra. "Geological Survey Report (GS1941/057)". Report undertaken for the 'Water Conservation and Irrigation Commission'
- Klimchouk & D.C. Ford Eds: Hypogene Speleogenesis and Karst Hydrogeology of Artesian Basins. Ukrainian Institute of Speleology and Karstology, Special Paper 1. Simferopol. pp 33-43.
- Osborne, R.A.L., 2001. Halls and narrows: Network caves in dipping limestone, examples from eastern Australia Cave and karst science 28(1): 3-14.
- Osborne, R.A.L., 2009. Hypogene caves in deformed (fold belt) strata: observations from eastern Australia and central Europe. In A.B. Oxley, J., (1820). Journals of two expeditions into the interior of New South Wales, undertaken by order of the British Government in the years 1817–18. John Murray, London. [facsimile edition, Libraries Board of South Australia, Adelaide, 1964]
- The Australian Heritage Council, (2012). "Australian Fossil Heritage, A Catalogue of Important Australian Fossil Sites". Published by Commonwealth Scientific and Industrial Research Organisation (CSIRO) Publishing. 150 Oxford St. (PO Box 1139) Collingwood, VIC 3066, Australia. ISBN 9780643102309
- Turner, K., (2002). Chromophores Producing Blue Speleothems at Cliefden, NSW. Published in "Helictite" Journal of Australasian Speleological Research Council. Vol. 38(1): pp. 3-6
- White C. (1903). History of Australian Bush Ranging. Volume II, 1863-1880, Ben Hall to the Kelly Gang. Sydney Angus and Robertson, Melbourne: Angus, Robertson & Shenstone, 1903.

PILLIGA SANDSTONE CAVES, NEW SOUTH WALES

John Brush
Canberra Speleological Society Inc



*High level caves in cliff of cross-bedded Pilliga Sandstone
Photo: Marjorie Coggan*

Hidden away in the mixed eucalypt and callitris forest of the Pilliga Nature Reserve in north-western New South Wales are some remarkable sandstone caves. They are located just a short distance off the Newell Highway about 35 km north of Coonabarabran and are well worth a short detour for anyone travelling through the area.

The caves occur in an outcrop of Pilliga Sandstone – a Jurassic Age Formation (approximately 150 million year old) which extends across much of north-western NSW and which underlies virtually all of the Nature Reserve.

The entrances are in cliffs 10-15 metres high on both sides of a north-south trending ridge but the most extensive cave development is on the western side. Some of the caves are more than just simple overhangs and are surprisingly spacious and extensive. Much of



*Kangaroo and emu track carvings
Photo: John Brush*



*The sandstone is quite friable on surfaces not directly exposed to the elements
Photo: John Brush*



*Above. Sharpening grooves
Below. Protective gate for cave with sharpening grooves
Photos: John Brush*

the passage development is parallel to the cliffs beyond a narrow zone of case-hardened sandstone. Behind the case-hardened veneer along the cliff faces, the sandstone is quite soft and friable and appears to be quite readily eroded once the surface layer has been breached.

Several caves are readily accessible from a 1.7 km walking track that starts from a car park and loops around the cliff line. The caves are an important site for the local Gamilaraay (Gamilaroi) people and in view of their cultural significance, the two most sensitive caves have restricted access and have been gated to protect

axe sharpening grooves and rock art (engravings of kangaroo and emu tracks).

The caves are well worth a visit and are easy to find once you know where to look. At the request of the Gamilaraay Elders, the turnoff from the Newell Highway is not signposted. However, there is a well-signposted car park with an interpretative sign on a gravel road about 1 km from the highway. Directions on how to get to the caves can be obtained from the NSW National Parks Service and from the Coonabarabran Visitors Centre.



**ADDRESS GIVEN BY DAVID SUMMERS,
PRESIDENT of the INTERNATIONAL SHOW CAVES ASSOCIATION to
the INTERNATIONAL CONFERENCE DEVOTED to the 100TH
ANNIVERSARY of KUNGUR ICE CAVE, PERM REGION, RUSSIA
27th MAY 2014**

When the average person thinks of a show cave they would rarely see it as a series of obligations and responsibilities, but rather as an attraction, or better still as a place of education. The successful show cave operator on the other hand, whether they want to admit it or not, is faced with a huge fundamental obligation, and an even greater fundamental responsibility.

The fundamental obligation is relatively simple. It is the obligation to preserve and conserve the cave or caves. An obligation is often thought of as being something that must be done because of a law. But laws are generally limited to the national boundaries of the country that they are enacted within. Many, in fact the majority, of the countries in the world do not have laws that adequately protect caves.

It is a very nice thought that all caves, all over the world, would be protected by well thought out laws. This, in reality, is not going to happen. The reality is that show cave operators will simply have to rely on best practice in order to fulfil their obligation to preserve and conserve their cave or caves.

Fortunately, thanks to organizations such as the Union Internationalé Spéléologie and the International Show Caves Association, assistance is available to help show cave owners and operators to know how best to preserve and conserve their cave or caves. This process, however, should never be thought of as being a process cast in concrete, but rather one of continuous education. This is particularly the case with new space age products, now available, that can be used in a show cave. Some of these products, such as light-emitting diode lighting, better known today as LED, has proven to have great success in show caves, whereas some composite lumber has proven to be nothing short of disastrous.

It is quite probable that we have gained more knowledge about the conservation and preservation of caves in the past fifty years than we did since the beginning of the era since caves began to be used as show caves. We know more about lampenflora and its causes. We know a great deal more about what materials can be used in a cave and what should be used. Stainless steel within itself is not the panacea to all material needs in a cave, as there are grades of stainless steel. Only the higher grades of stainless steel should be used in a cave.

The conservation and preservation of a cave is generally considered to involve a lot of science and technology, and in deed it does. But the services of scientists and

technologists rarely come free. They usually need to be paid with money.

It does not matter what currency you trade or deal in. It is all encapsulated in one word - money, which in turn can be described as capital, meaning an excess of assets over liabilities.

While being in this great country I am reminded of an appropriate quotation by Heinrietta Marx, the mother of the famed philosopher and economist Karl Marx said:

"If Karl, instead of writing a lot about Capital, made a lot of Capital, it would have been much better."

The need for capital to undertake the fundamental obligation to preserve and conserve the cave or caves is very clear, and it is for this reason that I referred to an even greater fundamental responsibility at the need for a show cave to be operated as a sustainable successful business.

Not only must a show cave run as a business, but it must be operated successfully, year after year. That is the reason that the word sustainable was just used. This fundamental responsibility must be complied with year after year. A show cave can barely afford to be unsuccessful for one year. It cannot afford to be unsuccessful for two years in a row otherwise, total economic failure may occur.

When a major construction project runs into financial difficulties, invariably the budgets for landscaping and planting are among the first items to be reduced. When a show cave runs into financial difficulties, invariably the budgets for conservation and preservation are among the first to be reduced or even eliminated.

It is often said that the worst thing that can happen to a cave is for it to be discovered by mankind. I offer you the thought that the worst thing that can happen to a show cave is for it to fail as a business venture and be closed down.

When a show cave fails as a business venture, the best that can usually happen is for the entrance or entrances to be locked with gates. Over a relatively short period of time the metal forming these locked gates will fail and will no longer be capable of securing the entrance. This provides those intent on vandalism ready access to the closed down cave in the form of built pathways and trails.

A show cave has all of the requirements that any other business has, including payroll costs, payment of taxes,

development costs, cost of supplies, payment of utilities, maintenance and repairs, vehicle costs, accounting services, advertising as well as scientific and environmental costs, to mention only some of the items that need to be considered.

Compared to many businesses, show caves have a great disadvantage in that they cannot relocate to a more favourable location. The vast majority of businesses have the luxury of selecting the place that they do their business in. Caves are rarely located in highly desirable locations.

A show cave operator needs to have all of the business knowledge and acumen that any successful business must have in order for it to be operated successfully, year after year. This is the great fundamental responsibility that every show cave in the world has. Without this financial security the show cave will not be able to fulfil its obligation to conserve and preserve the cave.

Achieving, and maintaining, a successful business model is of such fundamental importance to a show cave that it ranks as its most important element. The conservation and preservation of the physical cave may be considered the most important aspect in a show cave operation to the purist, but if there is no capital generated by a successful business operation, there will be no ability to fund these critical components of the operation.

While this address has focused on the most important obligation, and the even greater responsibility faced by a

show cave operator, there are many other obligations and responsibilities to be taken into account by a successful show cave operator. These other obligations and responsibilities are, however, subservient to the two primary considerations. It is imperative that operators of Government owned caves also be conscious that these fundamental obligations and responsibilities are applicable to them, as well as operators of private caves. Government owned caves are susceptible to the wishes and whims of politicians, who are apt to reset, without notices, when they realize that public funds are being lost.

It is important that I stress the need for show cave owners and operators, and those interested in show caves to, collaborate to a greater degree. The previous language barriers need no longer act as reasons not to collaborate.

Andy Spate, the noted Australian scientist, recently speculated in a paper on world-wide show cave visitation, that there may be about 1,500 show caves around the world. Each one of these show caves would benefit greatly if they were members of national or international organizations, where they could learn by the experience of other show caves.

If the vast majority of these approximately 1,500 show caves would come together, the information that could be shared would be tremendous. We all need to reach out to each other more. There is no place for complacency in the world of show caves.

VALE PETER GEORGE UNDERWOOD AC (10 October 1937 – 7 July 2014)

Geoff Deer
Gunns Plains Caves

Peter Underwood served as 27th Governor of Tasmania from 2008 until his untimely death in July 2014 after a short illness. A State Funeral was held on 21 July 2014 with proceedings also being broadcast on ABC radio. He had previously been Chief Justice of the Supreme Court of Tasmania in a distinguished law career. He was appointed an officer of the Order of Australia in 2002 and was made a Companion of the Order of Australia in 2009.

In May 2011 ACKMA held its conference at Ulverstone. Peter Underwood was invited to open the conference.

Then President of ACKMA, Steve Bourne welcomed him and in his welcome told us all about the first South Australian Governor to enter a cave. Apparently this was done by being lowered in on a chair. This caused a little consternation among some, including the Governor. After the conference opening, the Vice-Regal party travelled to Gunns Plains to visit the Gunns Plains Cave with Trish and Geoff Deer.

On arrival at the waiting area, Richard, the Governor's Aide-de-camp noticed a rope from the wall of the waiting

area through the cave entrance door. Enquiries about the rope got the reply from Geoff that "that has the chair attached." The journey down the steps was therefore a little subdued but once inside the cave proper and learning the history of the cave, the Governor soon became more confident. The normal hour long tour took over 90 minutes as all took in their surrounds and enjoyed the beauty of the cave while having a lot of fun.

Protocol has its ways of addressing the Governor but in true cave guide fashion Trish got away with a "mate" and Geoff a "bloke" during the visit. Peter Underwood held the highest office in Tasmania but he was still one of the people.

Tasmania and Australia not only lost a great jurist and Governor with the passing of Peter Underwood AC but also a bloody good bloke. He will be sadly missed by his family, friends and all Tasmanians. He is survived by his wife Frances, his four children, three stepchildren and 12 grandchildren. Our condolences go out to all of them.

REFLECTIONS ON A SINCERE WELCOME

Sasa Kennedy

On a recent trip to the snowfields I had a few experiences that caused me to reflect on what it is that makes a visitor feel welcome to a tourist attraction, natural site or even a restaurant. The first experience, at Thredbo, was extremely negative, when I had to search for the ticket windows, (while laden with heavy ski gear) then waited in a queue that didn't move at all for some time, was moved to another by staff where we were told we were on the wrong queue and then had to wait while a couple of groups discussed the ins and outs of various types of ski lesson before finally getting to the top of the queue and purchasing two single return lift tickets for the exorbitant price of \$32 each. The price, however, wasn't the issue. The issue was that I had lost a rare and precious hour on the snow while waiting, and had been made to feel like a nuisance merely for trying to hand over some money. Nor was I the only unhappy camper in the queue. If the establishment did not think it worth paying another staff member to provide decent service, a well signposted ticket vending machine would have been better than the lacklustre service that was grudgingly supplied.

Contrast this with the scene the following morning. We arrive at Perisher to catch the oversnow vehicle to Charlottes Pass, knowing only that it departs from the Skitube Terminal. Finding it is not a problem, as it is well signposted. We are welcomed and receive an apology for the short wait while the staff assist some other passengers. As we are early we are offered some vacant seats on an earlier departure, which means we will have more time on the snow. The driver chats to us about mutual interests as we drive to the resort. On arrival another staff member greets us and points out where all the facilities are located, then informs us of the special BBQ lunch (with vegetarian options) which is included in our lift ticket. Breakfast is freshly made and good value for money, as is the full day lift ticket (including lunch and oversnow transport) for \$99. Staff smile warmly and are swift to help at all times.

Which resort do you think I'll be visiting next time I have a weekend off and the snow report is looking good? Which one will I recommend to friends and fellow travelers?

So, what is it that makes our visitors feel welcome, how can we best deliver a sincere welcome at our cave sites and how does this affect our sustainability?

Clear signage – to the car park, toilets, ticket office, café and caves - is an excellent start. Visitors do not feel relaxed and welcome if no-one has bothered to consider their likely lack of familiarity with the site. Signs need to be easily read and clearly visible. Faded, chipped or peeling signs are not welcoming. Internationally



*At peak times, extra activities keep visitors gainfully occupied and feeling welcome
Photo: Sasa Kennedy*

recognizable symbols should be included to assist non-English speaking visitors. Signs will be easily missed if they compete with visual distractions such as a stunning vista, so placement should be carefully considered.

Having adequate staff to meet visitor needs is also crucial to ensuring a guest feels welcome. Keep people waiting too long in a queue without attention, or for a cave tour with nothing to occupy their time, and they will sense they are not your priority. In peak periods such as public holidays, queues and delays can be unavoidable; at these times having a staff member chat to people in the queue to assist in their decision making before they get to the ticket seller can show that you are concerned about their wait (and can shorten it considerably). At a smaller site eye contact and a smile from the ticket seller to those in the queue shows that they are aware of the situation and doing their best. Either way the visitor will sense that their welfare is important to you.

Self-guided walking tracks or cave tours, interpretive signage, a souvenir guide book, an interpretation centre, or a well provisioned café all provide time fillers for those waiting for tours. Most can also be excellent ways of filling in the gaps in the fascinating, but maybe more specialized or peripheral, information that cannot be included in every cave tour. It is important to remember that we each have different ways of learning, so to complement a guided tour, which is largely aural and visual, our supporting interpretation should also be visual and kinetic. Diagrams can go a long way towards clarifying scientific concepts.

Many years ago, when I delivered my first classroom presentation as a guiding student, I spent much time



*At peak times, extra activities keep visitors gainfully occupied and feeling welcome
Photo: Sasa Kennedy*

preparing it carefully to make sure my information was accurate and (hopefully) interesting. The feedback from my wise teacher was that the information was fine, but I really needed to smile occasionally. She was, of course, quite right. When concentrating and working hard we can unintentionally look quite severe. This can be quite off-putting for visitors and does not convey the welcome we may presume is implied by delivering a well researched and informative tour. To overcome this I had to actually practise, as I felt quite silly smiling at total strangers for no particular reason. Over time it felt more natural. It is crucial that the smile reaches the eyes and not just the mouth. Not only does this look more sincere, but it actually has a physiological effect, increasing our happiness, thus helping to ensure a welcoming demeanour.

Making our tours more personal for visitors also makes them feel more welcome. There are many ways to do this. I like to ask the group, at the start of the tour, whether they have been to any other cave sites; if I have some knowledge of the sites they mention I then use this information to point out similarities and differences between my caves and the sites they have mentioned. If

not, I ask them about the sites as we chat between platforms. The interest this displays in the visitor and the information they have provided encourages them to more freely ask questions and comment on aspects of the information delivered, ensuring a more interactive and personal tour experience.

Scott Melton's excellent paper at the Waitomo conference on the impact of digital photography encouraged me to rethink my attitude to cameras on cave tours. Realising how important photos are to most people these days to validate their experiences, but as a guide also needing to avoid injuries to clients, nuisance to other visitors and delays to tours I now deal with the issue in a way that has proven to be quite effective for me and also more welcoming to visitors. I explain the reasons for limitations, such as not taking pix while moving so as to avoid injury; intersperse the rules with photographic tips, to show I understand their needs and wish to oblige, and invite them to take photos while I am talking, as the most photogenic cave features are usually where we stop to talk. I assure them this is not rude as we all multi-task nowadays. This not only gets a smile back from the group, but it saves a lot of time, as visitors no



*Japanese language tour supervised by a Jenolan Caves guide, Orient Cave
Photo: Sasa Kennedy*

longer feel rude taking pix while I speak and are usually ready to move on when I am. In addition I offer, whenever possible (nearly always), to take photos of them with a pretty background at some stage of the tour. I can get them a nice photo while waiting for groups to move on at bottlenecks, so it does not take much time and they generally seem pleased with the results. As I've helped them, they are often more compliant with the request to avoid blocking tracks when taking pix and I can more easily finish the tour on time. Everybody is happy.

When this tactic proved to be so successful I decided to try extending it. I now tell my groups that not only is it okay to take pictures while I'm talking, but if they aren't interested in the commentary that is fine – enjoy the tour in their own way; I won't be offended. It is, after all, their tour and I am there to help them enjoy it, not the other way around. This doesn't mean I don't care whether they pay attention to my information. The truth is that it is up to me to make it relevant and interesting to them and if I don't why should they listen? The reaction from visitors when I give them control of their own tour is, at first, a sense of disbelief, followed swiftly by genuine smiles, sometimes laughter and a palpable feeling of relaxation settling over the group. They love it and so do

I. The majority of the group members still listen intently to the interpretation and those that don't (often non-English speakers) would not really have been absorbing much anyway.

Overcoming the language barrier, to ensure visitors with little or no English feel welcome takes a bit more effort. En route to the ACKMA AGM in Mulu I visited the Sarawak Cultural Village to learn a little bit about local lifestyles before heading into the wilds of Borneo. I was utterly charmed by their avenue of entry banners. Each silk banner pictured one of the staff members with their hand over their heart, in the Malaysian symbol of a genuine welcome, and each had the simple message "welcome" written in a different language. It may sound a little corny, but it felt sincere. Banners like these are very expensive, and would not be appropriate on the entry to all sites; a simpler, less visually intrusive, idea for a natural site would be a single sign, carefully placed and including the "welcome" message in the languages spoken by all your major visitor groups. Including images of smiling staff sends a strong visual message.

A simple way to welcome non-English speakers is to have multi-language information sheets or audio-guides available. This seems expensive, but can be a one-off translation expense if sheets are designed to be



*Memories to share, Orient Cave
Photo: Sasa Kennedy*

photocopied. Backing this up with interpretation signs that are visually explicit will make the information more accessible to all. Being able to speak a word or two of greeting in a range of languages is another simple way to be inclusive of non-English speakers. Perhaps cave sites could compile a list of such greetings for new guides and ticket sellers, along with all the procedural and interpretative information, to be handed out at induction sessions.

How we react to tour members who may make our job more challenging is a real mark of how welcoming a site is to their visitors – parents with fractious children, people with disabilities and less mobile or elderly visitors often feel unwelcome or a burden. We must do everything possible to accommodate their varying needs in order for them to feel as welcome as every other member of the tour. Empathy is crucial. The guide will set the tone that the rest of the tour group will follow.

Be understanding of the parents with the fractious child; there is no law that says they must stay at home and not annoy other people until their child grows up. The truth is that every child has its less co-operative moments and

it is not a sign of bad parenting or lack of consideration for others when this occurs. Empathize with the parents and acknowledge that we were all young once; if the parents feel less stressed about disturbing the group it may even help settle the child. Parents who do not control their children are less easy to empathize with, but still deserve respectful treatment.

Be patient with the elderly or less mobile; give them easier options where possible, such as perhaps not climbing stairs to a high section of the cave, but make sure they know they are not holding the group up if they wish to be there. Likewise with phobic people; create space around claustrophobic visitors by keeping them near the front or back of the group, check how they are going occasionally and give them fair warning of what to expect. Remember that nearly all of us have some phobia, and be supportive rather than superior.

Be respectful of those with disabilities and be aware that those with intellectual disabilities may understand far more than is apparent. Your visitor may have very high emotional intelligence and will feel any slight just as you would. If unsure about the level of delivery that is appropriate, ask if they understand and, if not, rethink your delivery. Be inclusive.

Remember not to underestimate the abilities of those who have a disability. We recently had an adventure caving participant who had only one arm, so we had a chat and asked him to let us know if he needed assistance at any time so that we could demonstrate different ways of getting through if necessary. At the end of the tour, which he completed with no issues at all, he thanked us sincerely; he had previously booked a tour with Bridgeclimb (Sydney Harbour Bridge) and been refused entry as he could not hold on with both hands! He had explained that he had adapted to having one arm, having been born that way, but they still refused him permission.

Offering visitors the opportunity to comment on your site, via feedback surveys, in a visitor book or on TripAdvisor will indicate that you value their opinions and are always keen to improve your service. This is an excellent departing reminder that when they return the welcome will be just as sincere.

When visitors are made to feel welcome they will be more likely to return, and more likely to recommend your site to others. The counter is also true – if they do not feel welcome they will recommend that friends, relatives and fellow travellers avoid your site. Return visitors and recommended visitors cost a lot less to entice to your site, something which should not be underestimated in these days of so many competing attractions and activities. It is also probable that they will be more likely to assist you in protecting your site if they feel like welcomed guests, rather than cash cows. It all comes back to the triple bottom line; if you wish to have sustainable profits you need to tend to the needs of the environment and of the people, including the visitors. Make sure the welcome you are extending is not only a sincere one but is seen to be a sincere one.



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 significance - 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 Taillem 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 three taxi services in Naracoorte township; Naracoorte Taxis 131 008 and South East Taxi Service Ph: (08) 8762 0689 or (08) 8762 0798.

Accommodation in Naracoorte township

See - <http://naracoorte-sa.street-map.net.au>

Kincraig Hotel – 158 Smith Street, Naracoorte

Ph: (08) 8762 2200

Email: kinccraig@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

Located adjacent to the Naracoorte Caves National Park in a natural bushland setting. 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
<http://www.naracoortecottages.com.au/>

Naracoorte Holiday Park *** - Caravans, cabins.
Ph: (08) 8762 2128 or 1800 999 899
<http://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 between 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

More information

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

Meals and services in Naracoorte township

Naracoorte township has a population of around 5,500 people and serves a large extended rural community. The conference venue is the Naracoorte Town Hall. This is located in the main street of the town, allowing attendees and partners easy access to accommodation and shops. There are supermarkets and other retail shops available in the town centre. Other services include: five service stations for fuel and essentials including a 24 hour facility, medical facilities, post office and pharmacists. There are branches of the Commonwealth bank, National bank, ANZ bank, BankSA, Westpac bank and Savings and Loans credit union. Automatic teller machines dispensing cash are available at these locations. There is a Woolworths supermarket which is open 7 days (until 9pm on weekdays and 7pm on weekends) and a Foodland supermarket also open 7 days.

Please note – delegates (and partners) staying at Wirreanda Bunkhouse or Campground at the NCNP will need to bring their own groceries for breakfast and for any other meals where they don't join in with what is provided by the conference. There are excellent kitchen facilities including ovens and fridges. The Caves Cafe is open from 10am to 3pm daily.

Touring Australia?

If you're taking a bit more time to visit more of Australia feel free to get in touch with local ACKMA members for advice. Naracoorte also has an information centre that can help you with advice and bookings.

Email: naracoortevic@nlc.sa.gov.au
Ph: (08) 8762 3199



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, Ewens Ponds Pick Swamp, SE 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	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		

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 AFMSs 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 AFMSs 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.



Ramsar Sites

Bool Lagoon Game Reserve and the Piccaninnie Ponds are recognised under the Ramsar Convention as being Wetlands of International Significance. Both will be visited on the field excursions. Bool Lagoon, approximately 20 minutes drive south of Naracoorte, is considered one of the most valuable wetland conservation areas in Australia. It is also protected under the Japan/Australia and China/Australia Migratory Bird Agreements because of the importance of the area as a summer refuge for migratory waders. While the summer visits are especially spectacular in a good rain-year, bird life is viable throughout the year. The beautiful ponds are a prime example of the region's fresh water aquifers and it's a renowned cave diving site.

Fire and Water

The field excursions will pass through a variety of landforms comprising volcanoes, karst and other features. A highlight of one excursion will be to see a superb geological extravaganza showing in Mt Gambier at the city's new Main Corner. Feel free to google that but don't spoil the fun for those who don't!



*Above. Umpherston's Cave, Mount Gambier
Photo: Steve Bourne*

Below. Locality for Naracoorte



*Above. Town Cave, Mount Gambier
Below. Display at Main Corner, Mount Gambier
Photos: Steve Bourne*

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THE DOG, the RING and the CAVE

Phil McGuinn
Buchan Caves

One afternoon in late summer 2012, Caz was walking her dog Archie along the banks of the Buchan River. This was her regular walk, however today Archie's curiosity would get him into trouble. He crossed the river and suddenly a smell attracted him and he ran off. Caz spotted him disappearing along the base of the limestone escarpment known as 'The Bluff'. As he regularly chased rabbits and sought out other smells along this route, she simply called for him to come back and at first wasn't too worried, thinking that he'd be back out shortly. However, time moved on and she became more and more concerned when he did not reappear.

After 30 minutes, she called her friend Caroline (my wife) in tears as she couldn't find him anywhere. Caroline joined her and they repeatedly walked the base of the escarpment calling for Archie and listening for any sound of him. They even called in the services of the local farmer whose land adjoins the Bluff and he checked known rabbit holes further along the cliff face on his property. However, there was no sign. By this stage they believed that Archie had either entered a rabbit hole or in the worst case, gone 'inside' the Bluff.

As 2 hours passed with still no sign of Archie, their thoughts went to believing that he may have been bitten by a snake or encountered a wombat. Caz was due to work at the local pub that afternoon, however called to tell them that she would not make it. It was a well-known fact within the town that Archie was Caz's 'baby', and knowing how devastated she would be, the landlord (her friend and also the local plumber) called regularly for updates and other friends came and went offering support.

Having sat waiting (with regular walks along the base calling his name), a faint, muffled bark was heard which sounded as if it came from the inside of the Bluff (about 10 metres up). However, when it was not repeated, they could not decide if it was from within the Bluff or an echo of a dog barking in town. The frustration at the unknown was the worst part.

However suddenly, after 3 hours, Caz and Caroline heard a clear, repeated barking from within the Bluff – this was definitely Archie. They crossed the river and while calling, narrowed in on the area. Hidden behind a blackberry bush was a small opening through which Archie could clearly be heard. The opening was about 40cms in diameter and Caroline could just see the tip of Archie's nose – getting to him was not going to be easy. By lying on her back, putting her head and shoulder into the hole and reaching her arm into the cave, Caroline could just reach Archie's nose through a narrow phreatic tube about 10cm across and he could lick the tip of her fingers, but the hole was too small

and there was no way Caroline could grab enough of Archie to lift him out.

Archie had definitely not entered the cave that way and he gave much credence to the local theories that the Bluff is honeycomb like on the inside, as Archie had likely been moving through tunnels in there for 3 hours trying to find his way back out!

Despite the discomfort, Caroline remained in position while Caz called for help as Archie would only remain calm when he was being touched. What Caroline didn't tell Caz at that time (as she was upset enough) was that she had also just felt her wedding ring slip off her finger as she had to hyperextend her hand each time she wanted to touch Archie.

As it was now night time and the children were in bed, I was waiting at home receiving regular phone updates when Caz arrived – she wanted to swap places as she was too upset to help and, as a caver, she thought that I would be of more help in the rescue attempt! When I reached the Bluff, I discovered that it was a whole village effort – the local plumber and policeman and various friends were all there discussing what to do. Caroline showed me the hole and I saw her predicament as there was no way Archie could be retrieved from the hole as it was, so we had to make the decision to dig.

I have to admit that rescue looked unlikely; the area was essentially all solid rock except for one small area of clay underneath the small opening where Archie could be seen. Anyway, with nothing to lose I started digging and removing any loose soil and rocks I could. With the help of the local plumber and some of his tools we extended the tunnel by another metre straight down but it still seemed unlikely that we would join to where the dog was. Then, all of a sudden the crow bar broke through, and the dog squirmed out of the small hole. Archie must have dropped down from his original position and was ready to exit as soon as we made an opening. He would have been very close to being pierced by the crowbar, which broke through suddenly and carried a considerable distance into the void behind. I remember being very glad that I had not "skewered" Caz's dog! Archie, despite being MIA for 3 hours and trapped for a further 2, showed no ill effects from his ordeal and just sat up happily in the front seat as Caroline returned home with him to an ecstatic Caz. Archie was one VERY lucky dog!!

However, the story does not end there as I still had one very upset wife whose wedding ring was now missing – a ring of huge sentimental value as it is made from parts of her mother's and grandmother's wedding rings.

Caroline knew exactly where she had lost it, but the unknown was where it had landed! Thoughts were

expressed that maybe Archie had swallowed it? Although Caroline didn't think that this was likely as she hadn't heard any noises at the time to indicate him swallowing anything, Caz still volunteered to check Archie's toilet offerings! Caroline, however, returned to the cave the next day as she was convinced it was in there 'somewhere'!

Having dug Archie out, the main tunnel now extended diagonally down for approximately 3 metres, but only the top meter or so was 'human-sized', with the small fissure where Archie was trapped half way up to the right. There was a possibility that the ring had fallen through Archie's hole into the now larger adjoining chamber, however, overall the chances of finding the ring seemed quite remote because if the dog hadn't swallowed it, it had probably kicked it deep underground in its struggle to get free.

The next day a small team from the Buchan Caves tackled the problem with an industrial strength vacuum cleaner. After removing about ½ a cubic metre of dirt, but still never actually being able to see clearly down the hole, we gave up. We had looked for 2 hours; most of the loose soil had been removed and then scanned with a metal detector. The ring was lost. I told my wife the bad news.

Fortunately, she decided to have one last look just to satisfy herself. She carefully lowered herself as far down the tunnel as she could and slowly scanned the entire

area with a torch. She saw a glint of gold so she found some fencing wire and gradually removed more dirt around the area. Unbelievably, it was the ring which was then retrieved with much trepidation as if it had slipped off the hooked wire, there was no saying how far it could have rolled into the cave interior.

Anyway, thus ends happily the story of the dog (and the wedding ring) in the cave.



Above. The Bluff at Buchan
Photos: Phil McGuinn

REDISCOVERING ZYGOMATURUS

Sasa Kennedy

We rediscovered the "*Diprotodon*" on 12 May 2007. Stephen Kennedy was there (on work experience at the time), as was Allie Fenton, Jeff Keith and myself. The skull is located just near where Jeremiah Wilson would have been exploring for new caves, and was forgotten about for over a century as that part of the system was never developed for tourists and was rarely visited due to a reputedly unstable section en route.

We were crawling through, checking things out, hoping to find a connection we had heard went through to Katie's Bower (non-existent it seems). Jeff Keith noticed the bones first and asked me to see if I could work out what they were. I had a good look and was very puzzled – they seemed to be knobby bones, but stuck in something. I couldn't work it out, but figured that knobby bones that big must be vertebrae. You have to remember we were not aware we had any megafauna at Jenolan at that time.

It was obviously worth further investigation, so I took a photo and showed Ted Matthews the next morning. We returned soon after with Ted, who took one, somewhat more educated, look and stated it must be teeth, as there was still enamel on them. Obviously what they were stuck in was the jaw!

We called the Australian Museum in Sydney, who sent

out Robert Jones, the Collection Manager in Palaeontology, to have a look. He thought it looked like a *Diprotodon*, the furthest east ever found. This was a bit of a puzzle, as they are usually found in more arid areas. Being located in a rock fall the bones could not be removed for precise study, but were surrounded by many other smaller bones and fragments.

Anyway this discovery was considered very significant, so much so that it got reported worldwide – we even featured in the China Daily News (delivered by our inbound coach drivers). It was reported that a guide on his "evening rounds" made the discovery, and Jeff became a celebrity for a while.

It could be true that some of us felt quite sheepish when some of Jeremiah's old reports were found from the 1890s, in which he reports the original discovery, also mis-identifying the remains as those of a *Diprotodon*. I found it quite astonishing that he got so close to being correct. He must also have called on the museum experts. They certainly collected many bone remains from Jenolan at around that time.

The bones lay undisturbed for a further century and more because they were in such a remote, unvisited section of the tourist cave system.

A SKULL of the MARSUPIAL 'RHINO' *ZYGOMATURUS*: MEGAFUNA from JENOLAN CAVES, NEW SOUTH WALES

Anne Musser, Sasa Kennedy and Robert Jones

Introduction

Caves are prime sites for discoveries of the bones of extinct animals, particularly those that are not of great geological age (e.g., animals from the Pleistocene or later). Preservation of these sub-fossil remains can be excellent and, since caves act as natural traps, bone accumulations can be substantial.

The animals most often associated with the Pleistocene Epoch are the extinct megafauna, defined as those animals with body weights greater than 44kg. Northern hemisphere Pleistocene mammals like mammoths, giant sloths and sabre-tooth cats are well known. In Australia, extinct megafauna include the megaherbivore *Diprotodon*, its smaller relative *Zygomaturus*, the fearsome predator *Thylacoleo* (the marsupial 'lion'), *Procoptodon* (the Giant Short-faced Kangaroo), and the giant goanna *Megalania*.

Aboriginal people have been in Australia for perhaps 50,000 years or more, and interacted with the last surviving megafauna. What caused the megafauna to become extinct has long been a matter of great debate, with the chief contenders being human causation, climate change or a combination of both.

Many species of megafauna are known from caves. In Australia, megafauna known from cave deposits include *Thylacoleo*, *Procoptodon*, *Megalania* and *Zygomaturus*. The massive *Diprotodon*, the largest marsupial known, was first discovered at Wellington Caves in New South Wales, and was the first Australian megafaunal species to be scientifically described. Australian caves noted for Pleistocene megafauna include Wellington Caves, Naracoorte Caves in South Australia, Nullarbor Plain caves, and the Western Australian Margaret River caves.

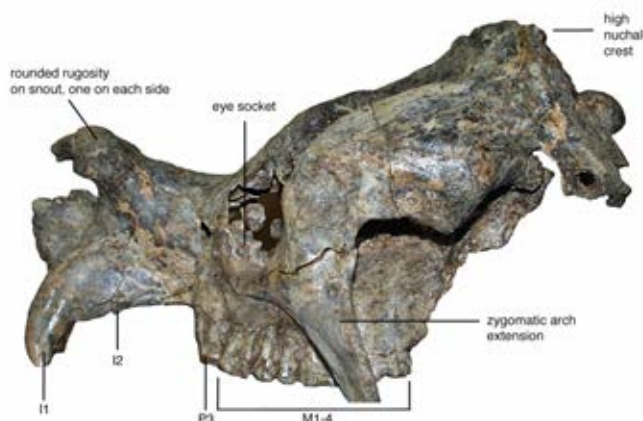
In this paper, we report megafaunal remains from Jenolan Caves in south-eastern New South Wales, a partail skull of the megaherbivore *Zygomaturus* (almost certainly *Z. trilobus*). The following account provides a brief description of the *Zygomaturus* skull from Jenolan, lodged in a rockpile in Wilkinson's Branch of the Chifley Cave in the north side of the Jenolan cave system, along with a history of *Zygomaturus* elsewhere in Australia. This account revises the identification of a skull found in the late 1800s first described as that of *Diprotodon* rather than *Zygomaturus*, and subsequently identified again as *Diprotodon* in an informal assessment in 2007 (for an account of its re-discovery, see Sasa Kennedy's article page 24).

Zygomaturus: the Marsupial 'Rhino' or 'Hippo'

Zygomaturus was a diprotodontid, a member of the extinct herbivorous marsupial family Diprotodontidae, which also includes the larger *Diprotodon* along with several other species of diprotodontids. There are two subfamilies in Diprotodontidae - *Zygomaturinae* and *Diprotodontidae*. *Zygomaturinae* includes several very old genera and species in addition to *Zygomaturus*, including the sheep-sized *Silvabestius* from the late Oligocene of north Queensland, around 25 million years old; the mid-sized *Kolopsis*, from the late Miocene of central Australia, about eight million years old; and dwarf *Zygomaturinae* from the Late Pleistocene of New Guinea (*Hulitherium* and *Maokapia*). Early *Zygomaturinae* were much smaller and less specialised than *Zygomaturus*, with the lineage increasing in size over time. *Diprotodontinae*, a smaller subfamily, includes the massive *Diprotodon*.

The oldest fossils attributed to the genus *Zygomaturus* date from the late Miocene and are around six million years of age. There are several named species of *Zygomaturus*, and quite a degree of variability between specimens assigned to *Z. trilobus*, so whether or not these are separate species is still a question. Named *Zygomaturus* species include *Z. gilli* (late Miocene, Victoria, known from just a single premolar); *Z. keanei* (early Pliocene, South Australia); *Z. macleayi* (Pleistocene, Queensland); and '*Z. nimborensis*' from New Guinea (also called '*Kolopsis watutense*' or '*Nototherium watutense*'; although all New Guinea diprotodontids are probably *Zygomaturinae*, it now appears that *Zygomaturus* did not live this far north).

Zygomaturus was first discovered in the Darling Downs area of southeast Queensland. A well-preserved skull, now held by the Australian Museum, was named and described by William Macleay in 1857. The same skull



Holotype skull of *Zygomaturus*
Photo: Anne Musser



A reconstruction of Zygomaturus by Anne Musser

was later described by the famed Victorian era anatomist and palaeontologist Sir Richard Owen, who thought it should probably belong to the genus *Diprotodon* rather than to the new genus *Zygomaturus*, or perhaps a third Pleistocene diprotodontid, *Nototherium*. A complete *Zygomaturus* skeleton (now held by the Tasmanian Museum) was discovered by E. C. Lovell in Tasmania in 1920, at Mowbray Swamp.

Zygomaturus was a stout, quadrupedal marsupial – amongst marsupials, second in size only to the hippo-sized *Diprotodon* – with a body form roughly similar to that of a pygmy hippo (*Choeropsis liberiensis*) but slightly larger in size. *Zygomaturus* weighed 500kg or more, was about 2m long, and around 1m at the shoulder. The name ‘*Zygomaturus*’ refers to its unusually broad cheekbones (zygoma), and ‘trilobus’ refers to the three prominent bumps on its snout. *Zygomaturus* has been dubbed the ‘marsupial rhino’ because some palaeontologists believe it may have had facial horns like those of a rhinoceros. Other nicknames include ‘Swamp Cow’, since its bones are often found associated with swamp deposits, and ‘marsupial hippo’ for its possible semi-aquatic lifestyle. Living as it did near rivers, lakes and swamps, *Zygomaturus* might have fallen prey to large crocodiles like the inland *Pallimnarchus*.

The skull of *Zygomaturus* is outsized (disproportionately large for its body size, as in many marsupials), but made up of surprisingly thin skull bones that helped to lighten its weight. Numerous air sinuses in the skull would have also reduced the weight of its skull (one reason that diprotodontid skulls are seldom preserved). The skull is unusually wide and ‘boxy’, but with a short, narrow snout. The snout is distinctly upturned and flared on each side, with rounded protuberances that may or may

not have supported horns in life. There are large areas for muscle attachment at the back of the skull, which would have given *Zygomaturus* a ‘bull neck.’

Zygomaturus had two large divergent, tusk-like first incisors on both upper and lower jaws. It might have used these ‘tools’ to rip plants up by their roots. Its five-cusped third upper premolar, like those of many diprotodontoids, is highly distinctive, and identification of P3 is the easiest way to confirm an identification. The molar teeth of *Zygomaturus* are broad and low-crowned and were probably used to grind coarse, woody vegetation. *Zygomaturus* had well-developed lips for manipulating vegetation, perhaps stripping leaves from trees and digging up tubers and roots with its tusk-like incisors. Like many marsupials, *Zygomaturus* had syndactylous (joined) toes. Its posture was low and sprawling, so it would have been somewhat lumbering, although it had mobile forelimbs, unlike large placental herbivores like bison.

The Jenolan *Zygomaturus*: A case of mistaken identity

The Jenolan *Zygomaturus* skull was initially found by the first Keeper of the Caves, Jeremiah Wilson, in Wilkinson’s Branch off what is now the Chifley Cave (originally called the Left Imperial Cave). An account of the discovery, written by the surveyor Oliver Trickett, reads as follows: ‘In October [1899] he [Jeremiah Wilson] found portions of the jaw and molar teeth of the *Diprotodon australis* in the Left Imperial Cave.’ Signatures of both Jeremiah and Fred Wilson can be found further into this section of Wilkinson’s Branch, not far from the skull.

The discovery of the skull was forgotten, and nothing was known of it for over a hundred years. It was re-discovered in 2007 by Jenolan staff during an after-hours caving trip. Puzzled by the large bones embedded in calcite and sediment, one of the authors along on the trip that night (SK) photographed them and brought them to the attention of Ted Matthews, a long-time Jenolan guide with extensive knowledge of cave science. Ted identified the bones as the teeth and jaws of a very large animal, and the Australian Museum was called in to help with the identification. Another of the authors (Robert Jones, Collection Manager, Australian Museum Palaeontology) confirmed Ted's initial identification, believing it to be the teeth and skull of the massive *Diprotodon*, although the obscuring matrix of calcified sediment made proper identification difficult.

Global media interest followed, with reports from as far away as China. The discovery of *Diprotodon* so close to Sydney, found in the famed Jenolan Caves, was of great interest. Likewise, the assumption that *Diprotodon* fossils were not usually found in a hilly, mountainous environment like that of Jenolan made waves in scientific circles. Jeremiah's original reports were later found, as was surveyor Oliver Trickett's report naming the species as *Diprotodon australis*.

Subsequently, one of us (AM) conducted a more complete investigation, removing as much of the matrix as needed to identify specific dental features that would help with identification. The skull is now confirmed as that of *Zygomaturus*, probably *Z. trilobus*, given its location and the size and shape of its teeth, almost identical in size and form to the dentition of *Z. trilobus* specimens at the Australian Museum used for comparison.

Description of the site

The skull is lodged between limestone rocks in the left hand section of Wilkinson's Branch off the Madonna Chamber, Chifley Cave, in the north side cave system. This partial skull is in an upright position, with the muzzle facing into the wall and the preserved parts of the back of the skull facing outwards. The fragile, lightweight skull has been fragmented, with much of it most likely further embedded in calcified sediments, and it's difficult to determine how much of the skull might actually be preserved. What remains of the left side of the skull is partially exposed, including dentition (the roots of the second and third upper left incisors and the left upper cheek tooth row) and sections of the sides and back of the skull.

Three survey trips were made between 2011 and 2014 to assess the site and skull, prepare and clean the specimen and identify the skull. The survey team included Jenolan staffers Stephen Kennedy and Richard Kennedy as well as the three of authors.

We had a look at the area to determine how the skull might have reached its present position, minus its body, wedged between rocks and encased in calcified sediments (intriguingly, a report by Wilson dated 1891 mentions the long bones of a very large animal from

Wilkinson's Branch; were these removed, and were they the bones of our *Zygomaturus*?). The skull might have reached its present position as part of a slump deposit resulting from a collapse at a higher level. There is a mound of sediment chock-full of the bones of several species, to the side of the embedded skull, although the relationship of this deposit to the skull isn't yet known. Both the skull and sediment mound might represent an old pond that has slumped from above. *Zygomaturus* may have fallen into the pond, and the head may have become disarticulated from the body as it decomposed. Acidic water from rotting vegetation might have helped cause the collapse as carbonic and organic acid ate into the soluble limestone. The cave directly above Wilkinson's Branch, Michelmas Cave, is accessible from the surface, and the deposit may have originated in or passed through this cave before ending up below in Wilkinson's Branch.



Dr Anne Musser brushing away calcite that has been scraped from the tooth row of the Wilkinson Zygomaturus (using a toothbrush on the teeth, of course!).

Photo: Sasa Kennedy

Description of the skull and dentition

Anatomical information is limited because of the condition and position of the skull, and because preparation was carried out only as far as needed for identification. Matrix was carefully removed from around the dentition using dental tools and small brushes. Cleaning proceeded just to the point where the all-important premolar could be positively identified; further cleaning – with the possibility of damage to the specimen – was deemed unnecessary.

The lower left side of the skull is partly visible (the skull is missing above the tooth row). The partial skull is clearly crushed, and some elements have been displaced. Preserved skull material includes a section of the posterior zygomatic arch and part of the back of the

skull. Some parts of this section may have fallen to the floor of the cave before, during or after its arrival in its present position. The posterior of the skull measures around 20cm across; however, as described, it has been broken and displaced, so this is not a useful measurement of the skull. The cortical bone is very thin, as in all diprotodontoids. Part of the inner ear region is exposed at the posterior of the skull. There are two rather chunky, ventrally located bones behind the tooth row, but their identities have been obscured by sediment.

The dentition includes the displaced and broken roots of the second and third upper incisors, the third upper left premolar (broken through the centre), and the complete upper left molar row minus part of the fourth molar (which is broken posteriorly). The animal appears to have been a mature adult at time of death judging from the moderate degree of dental wear. The teeth have been partially covered in calcite, some of which is moderately thick flowstone and some of which was able to be removed.

The bases of the two incisor teeth are quite close together, anterior to the cheek tooth row, and displaced posteriorly from their original position in the skull. The anterior incisor root is roughly triangular in outline, while the posterior incisor base has a more oblong outline (its exact shape can't be determined because of breakage), resembling the incisor outlines of other *Zygomaturus*.

In *Zygomaturus* the third premolars are highly distinctive, with five cusps: two cusps on both the inner (lingual) and outer (labial) side, and an anterior cusp in the centre of the tooth (in contrast to the third upper premolar of *Diprotodon*, which has a 'horseshoe-like' circular crest). The premolar has retained the anterior cusp and remnants of the two innermost cusps, although because it is broken along the midline - probably an old break - the outermost cusps have been lost. The two inner cusps are partially visible: the second cusp appears to have been higher than the first, and it meets the first cusp via a slight crest.

The crowns of the second and third upper molars are obscured by calcite and sediment. However, the third upper molar could be cleaned, exposing its lateral side. This third upper molar has a notch or crest linking the anterior and posterior halves of the tooth, differing from the crest in the same tooth of a Queensland specimen (AMF.109960) in that it does not curve dorsally as it does in the Queensland *Zygomaturus*. The last molar (fourth upper molar) has been broken, and doesn't provide much in the way of information.

Measurements of the dentition are almost identical to those taken from an Australian Museum specimen with a complete cheektooth row (AMF.109960, which is a cast of *Z. trilobus*, Queensland Museum specimen QMF6560). In addition, the plaster cast of the Queensland *Zygomaturus* was taken into Wilkinson's Branch for a direct comparison with the Jenolan skull, which proved to be similar in length, measurements and other general features.

If this species is indeed *Z. trilobus*, as is almost certainly the case, the Jenolan skull would likely be Pleistocene in age since this species hasn't been recorded from either the Pliocene or Holocene. Dating of the skull or dentition hasn't yet been attempted, although it would be possible to remove very small samples of enamel from the *in situ* specimen for dating.

Palaeoecology and distribution of *Zygomaturus*

Zygomaturus is usually found in deposits interpreted as lakes, rivers or swamps, deposited during periods when the regions were well-watered and the climate temperate. Habitats are most often interpreted as areas of open woodland or forest, with rich vegetation, except for some drier areas in Western Australia, Kangaroo Island and Queensland. *Zygomaturus* has controversially been interpreted as possibly being semi-aquatic, wallowing in swampy areas close to waterways. As a megaherbivore, it may have feasted on roots and tubers, using its wide, splayed incisors to dig up buried vegetation. *Zygomaturus* fossils are rare, and it may have been a relatively solitary animal or an animal living in small herds.

Zygomaturus has been found in all Australian states, including Queensland, New South Wales, Victoria, South Australia, Western Australia and Tasmania, as well as from the Kimberley region in Western Australia. The geographical distribution of *Zygomaturus* appears to have been through coastal and montane Australia, with inland records along watercourses (for instance, the Lake Eyre region, where large herbivores like *Zygomaturus* and *Diprotodon* followed waterways through otherwise arid or semi-arid areas). Interestingly, the Kangaroo Island *Zygomaturus*, like many island forms, is dwarfed, and is much smaller than its mainland relatives.

In New South Wales, *Zygomaturus* has been recorded exclusively west of the Great Dividing Range until its appearance at Jenolan. Sites west of the Divide include Lake Mungo (where a single specimen has been found), Lake Victoria, Willandra Lakes, Bingara, and Cuddie Springs in the central west. Some evidence suggests that *Zygomaturus* co-existed with Aboriginal people at Willandra Lakes.

Extinction of *Zygomaturus*

Extinction dates for many species of Australian megafauna are hard to pin down, in part because many sites are poorly dated. Some megafaunal species seem to have disappeared well before the arrival of indigenous Australians (who may have entered Australia at least 50,000 years ago); some species disappeared soon after the arrival of people, at around 45,000 years ago; and some species survived until perhaps around 30,000 years ago, overlapping for a substantial amount of time with indigenous people (evidence from Cuddie Springs in New South Wales indicates at least 10,000 years of overlap between humans and megafauna).



Above Left. 'Original' discovery 2007.

Photo: Sasa Kennedy

Above middle. Close-up of the lingual (inside) half of the third upper premolar, with an old break running anteroposteriorly (fore and aft) through the centre of the tooth.

Above right. Dentition in situ.

*Below left. Ventral view (underside) of the holotype *Zygomaturus* skull from Kings Creek, Darling Downs, Queensland (Australian Museum specimen F.49671).*

Below right. A small hand mirror was held up to the third upper molar to determine the degree of tooth wear on this individual. Its partially worn teeth suggest that it was a mature (but not aged) adult at the time of its death.

Photos: Anne Musser



Megafaunal extinctions therefore appear to have been staggered across both time and space. Desertification during colder periods of the Pleistocene may have driven some species from now-arid habitats, isolating them in areas too small to sustain viable populations. Mounting evidence suggests that climate change was extensive during the 'extinction window' between 50,000 to 40,000 years ago, when large numbers of megafauna were lost. The role of early Australians in the extinction of the megafauna has been hotly debated; however, a consensus is building that megafaunal extinctions were caused by a combination of factors, including climate and human activity such as hunting and firestick farming.

Zygomaturus seems to have been one of the species that disappeared at around 45,000 years ago, soon after human arrival. At Tight Entrance Cave in southwest Western Australia, *Zygomaturus* is recorded in sediment layers dated between 143,000 - 48,000 years, after which it seems to have disappeared from the area. Over twenty *Zygomaturus* individuals were found in Mammoth Cave, also in southwest WA, dated between 55,200 and 44,400 years ago. *Zygomaturus* may therefore have become extinct in WA somewhere around 45,000 years ago. Because these Western Australian extinctions preceded a marked period of aridity, it is believed that human activity must have played a part in their extinction. Mammoth Caves and Tight Entrance caves both show evidence of human use of caves and possible interactions with megafauna.

Zygomaturus has been found in several sites in South Australia, including the Lake Eyre region, Naracoorte Caves and Kangaroo Island (a very young date of 20,000 years for the Kangaroo Island *Zygomaturus* has been questioned, and is probably no longer considered valid). Evidence from Lake Eyre suggests that animals migrated to more habitable areas during glacials (in Australia, 'glacials' were periods of cold, dry climate rather than ice, snow or glaciated landscapes although small areas of the mainland and more of Tasmania had ture glacial conditions), returning to the area when conditions improved. Large mammals, including *Zygomaturus* and *Diprotodon* – both known from Lake Eyre - would have used riverine corridors where water and food were available. When climate change caused these corridors to close, animals would have been vulnerable to local extinction, and populations would have gradually been reduced past the point of viability. One study shows that Lake Eyre was a deep lake at around 80,000 years ago, with well-vegetated habitat, before beginning a decline from which it has never recovered. All megafauna from Lake Eyre were gone by 30-35,000 years ago, in a staggered extinction of megafauna caused principally by climate.

The fossil record to date suggests that megafauna were most abundant and diverse in southeastern Australia (Victoria and New South Wales), followed by Lake Eyre. The latest dates for southeastern *Zygomaturus* are hard to come by. In Victoria, *Zygomaturus* has been found at Spring Creek, but dates are uncertain ('at least 35,000 years old'). Bingara deposits are thought to be Middle Pleistocene (780,000-126,000 years ago) rather than Late Pleistocene (126,000-10,000 years ago) and therefore can tell us little about the local extinction of *Zygomaturus*. At Cuddie Springs in the central west, *Zygomaturus* was found in the pre-archaeological sediments (although *Diprotodon* has been found in the higher archaeological layers, co-existing with humans). Getting a date for the Jenolan *Zygomaturus* would be quite a useful addition to the discussion.

Significance of *Zygomaturus* at Jenolan

The occurrence of *Zygomaturus* at Jenolan, just east of the Great Dividing Range in New South Wales and around three hours west of Sydney, is of interest for

several reasons. First, the Jenolan *Zygomaturus* is the easternmost record for this species in the state, and the closest megafauna species to either Sydney or the Blue Mountains. *Zygomaturus* is otherwise known only from west of the Dividing Range in more central-western parts of New South Wales (Lake Mungo, Lake Victoria, Willandra Lakes, Bingara and Cuddie Springs). At Bingara, *Zygomaturus* co-existed with its larger relative *Diprotodon*, along with the true giant wombat, *Phascolonus gigas*, *Thylacoleo carnifex* (the marsupial 'lion'), and several species of kangaroos, including *Procoptodon goliah*.

Of the Pleistocene diprotodontoids, *Zygomaturus* would have probably been the most 'at home' at Jenolan, based on studies from other sites where *Zygomaturus* has been found. At Jenolan, *Zygomaturus* would have lived in protected river valleys between wooded hillsides, with swamps, pools and waterfalls, still seen at Jenolan today. *Zygomaturus* was not a climber or hopper, and probably left the limestone bluffs to the rock-wallabies. Perhaps Jenolan acted as a cool, well-watered refuge from the vagaries of the Pleistocene climate, as it does today.

The discovery of *Zygomaturus* at Jenolan, rather than its larger relative *Diprotodon*, is of interest: significant ecological differences between *Zygomaturus* and *Diprotodon* include choice of food (browsing for *Zygomaturus*, and a combination of browsing/grazing for *Diprotodon*); possible adaptations to semi-arid or arid conditions (some palaeontologists think *Diprotodon* may have had arid-zone anatomical adaptations), and niches as either specialists (*Zygomaturus*) or generalists (*Diprotodon*). *Diprotodon* was a more adaptable animal, found in many areas that would have excluded *Zygomaturus*, and it's not surprising that *Diprotodon* lasted far longer than it appears *Zygomaturus* did (possibly surviving until around 27,000 years ago).

Note: This report on the Jenolan *Zygomaturus* is not being published in a peer-reviewed scientific journal because the specimen, lodged between rock and cemented in by calcite, cannot be removed from its present position within Wilkinson's Branch. It is a condition of scientific research papers that specimens described in the literature must be made available to subsequent researchers, housed in a public institutional such as the Australian Museum, which in the current situation is not possible.

Acknowledgements

Special thanks to Stephen and Richard Kennedy, key members of the survey team, whose good humour, patience and skill 'made it happen'.



SIXTEEN LEGS: ENTER the CAVE!

Andy Spate
Optimal Karst Management

Dr Niall Doran and colleagues have been researching the life and times of the Tasmanian Cave Spider, *Hickmania troglodytes*, for 23 years. Some ACKMA members may have seen this magnificent spider on earlier cave visits during ACKMA Conferences.

Niall and his colleagues have put together a truly magnificent exhibition on *H. troglodytes*! The Sixteen Legs name of the exhibition refers to the unusual mating relationships of the large lady spider and her smaller – and probably to be eaten – mate! The exhibition was staged by the Bookend Trust (www.bookendtrust.com) backed by a variety of sponsors.

The exhibition is presented in a beautifully restored ~1818 sandstone barn and the associated Rosny Park School. We start in the schoolhouse: five rooms containing backlit panels talking about caves with wonderful background cave images. The backgrounds are often overlaid with further images. Two additional panels are of art work depicting The Siren's Song - the imagined emotions of a female cave spider - are found in each room. All in all there are 64 beautiful panels. These are fabulous backlit displays.

Around the walls of the schoolrooms we find 30 artworks produced by school students – many of these are simply stunning – they will be judged and the winner gets a flight over Antarctica. In a late development one of the sponsors has appreciated the talent of all the students and is providing additional prizes! There are also two very evocative musical pieces based on the students' cave experiences.

A sign outside the schoolhouse reads:

This is not a standard exhibition with open space and clear lines. It has darkness intruding on light, unsettling shapes and unusual layouts.

This makes moving through the rooms a “cave-like” squeezing and manoeuvring experience.

Then off to the 1818 Rosny Barn – beautifully restored by the City of Clarence - it must have cost them heaps. Here we are in a much darker environment than in the school house. We have another 36 panels telling us more about this wonderful spider and the project itself. There are two more student's displays – a Tardis-type tent with stalacights [sic] – beautifully illuminated plastic stalactites. The other student project here is a DVD of a body being wrapped in gladwrap – a wonderful analogy to the creation of an *H. troglodytes* egg sac. And – at the stunning finale – in the ceiling are two huge spider models underneath their web in the roof. Underneath there are the remains of a caver eaten and



*Caver 'eaten' by the spiders
Photos: Andy Spate*

discarded by the Queen of the Night! And next to these two queens of the night is a stunning illuminated video of the about to hatch baby spiders in their egg sac.

Also here we have a great looped DVD describing the project – inducing the incidental involvement of Dr Who. Who? And a naked lady wearing spiders! Almost all of the more than sixty back-lit panels have wonderful photographs taken by the world-renowned American cave photographer, Dave Brunnell.

To quote from the Bookend Trust press release announcing the winners of the school students' art works:

[Twenty five] student works covering a variety of interpretations, styles and materials – including paint, graphite, plaster, preservation of webs, dreamcatchers, dioramas, living ecosystems, sculptures, photography, musical compositions, video installations, and constructions that could be viewed and even entered into! The standard of the entries in this competition was incredibly high, and the judges (Kirsha Kaechele from MONA and Professor Peter Davies from UTAS) spent several intense hours



ACKMA gets a mention on this panel
 Photo: Andy Spate

examining and discussing them in detail. The judges commented: "It's really inspiring to see all of the work. It's amazing how much great work there is, in quality and diversity. The competition is so serious - it's really tough."

... THE WINNER IS:

A tie.

Not just a tie between the judges, but both judges arrived at the same tie in their individual assessments. When questioned in detail by Bookend, it was clear that it was a genuine tie with both judges unable to decide between the two entries. Those entries and the judges' comments were:

- *Vocava Musica* - Julia Parker, Smithton High School (stunning work, showing really well-developed musicality and compositional sensibility).
- *The Howling Mute* - Sophie Ambler, Clarence High School (fabulous, sending shivers up the spine, and demanding to be re-watched).

The judges felt Julia's work was simply beautiful and sensitive, with an ability to evoke space in sound. They would love to hear her soundscape of Antarctica, but they felt she would also benefit from an edge of the radicality shown in Sophie's filmmaking. In contrast, Sophie's work was visually arresting, and conceptually deep. It had a strong emotional effect and was timed perfectly, but the judges felt her work would benefit from original musical components.

Both judges wanted to see more work from both students, and believed they should work together. They

felt both would gain something from this experience and that it would take them both to the next level.

On the basis of this, Bookend is prepared to offer both Julia and Sophie a place on the 4-day Antarctic Experience program in February, including the flight to see Antarctica - provided they are prepared to work together to deliver a combined short piece for public display after the trip.

All in all this was a stunning exhibition – Niall, his colleagues and helpers must be heavily congratulated. This – after three visits - I think is the best cave-related display that I have seen in my viewings around the world. The Grotte Orgnac in France would beat it – wonderful archaeological/anthropological material and beautifully presented – but go Sixteen Legs! For more information and to order the upcoming book *A Visit to the Queen of the Dark* showcasing Jodee Taylah's *The Siren's Song* art go to www.sixteenlegs.com. It is expected that there will be a further book of images and the science of the Tasmanian Cave Spider forthcoming as well as potentially a DVD – keep visiting the website. I am working with Niall to see if Sixteen Legs can get to museums and cave sites (including Naracoorte for next year's ACKMA Conference).



A student's 3D work of art of a cave in a hillside
 Photo: Andy Spate

TASMANIAN REPORT: FOCUS on WORLD HERITAGE

Rolan Eberhard

Each State Party to this Convention recognizes that the duty of ensuring the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage referred to in [Articles 1](#) [cultural heritage] and [2](#) [natural heritage] and situated on its territory, belongs primarily to that State. It will do all it can to this end, to the utmost of its own resources and, where appropriate, with any international assistance and co-operation, in particular, financial, artistic, scientific and technical, which it may be able to obtain.

Convention Concerning the Protection of the World Cultural and Natural Heritage (UNESCO 1972)

Australia currently has 19 World Heritage properties. Of these, the Tasmanian Wilderness World Heritage Area (TWWHA) is one of several properties with strong associations with caves and karst. This is reflected in multiple references to karst-related values in the Statement of Outstanding Universal Value of the property. The Statement is currently under revision but historically emphasised the diversity and natural integrity of the karstlands, their biota and the presence within them of Pleistocene cave occupation and art sites. This article has two purposes: first, it provides an update on the implications for karst of a recent amendment to the TWWHA boundary; second, it draws attention to an initiative directed at improving the management of key elements of those values, namely the 2014 Cave Access Policy.

2013 TWWHA Boundary Amendment

In July 2013 the Federal Minister for the Environment gazetted an amendment to the TWWHA, following acceptance of a recommendation from Australia to the UNESCO World Heritage Committee. The amendment involves areas which are contiguous with the existing TWWHA and extend it primarily on the northern and eastern margins [INSERT MAP?]. The additions include a mix of existing reserves, new reserves and areas of State forest. Mt Field National Park, Hastings Caves State Reserve and parts of Mole Creek Karst National Park are included. The net result has been to increase the area of the TWWHA by more than 170,000 ha. It now comprises in the order of 1.6 million hectares or about 25% of the land area of Tasmania.

Australia's submission to UNESCO made numerous references to caves and karst, which were cited as an outstanding universal value against world heritage criterion vii (contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance) and criterion viii (be outstanding examples representing major stages of the earth's history, including the record of life, significant ongoing geological processes in the development of landforms, or significant geomorphic or physiographic features). The submission included photographs of the forested karstlands in the upper Florentine Valley, anthodites in Shooting Star Cave and a spectacular image of the Forbidden City in Kubla Khan Cave by Ross Anderson.

Table 1 summarises the karst-related values of the extension areas and highlights some issues pertinent to their management.

The background to these events was the Tasmanian Forest Agreement (TFA), a three year negotiation between conservation groups, forestry industry bodies and the forestry workers union (CFMEU). This is the latest in a series of initiatives which have sought to resolve the debate between resources use and the environment which has dogged Tasmanian politics for decades. The TFA earmarked 504,000 ha of forest for formal protection in reserves and agreed that the TWWHA should be extended. A bill giving effect to the TFA was subsequently amended by Tasmania's upper house, delaying the enactment of some but not all of the new reserves until after October 2014 and making this contingent on accreditation of Forestry Tasmania by the Forest Stewardship Council.

The status of the TFA was further challenged by opposition to it from incoming State and Federal Liberal governments in early 2014. Both governments have been critical of the TFA. The Federal Abbott government attempted to reverse UNESCO's decision regarding the TWWHA by proposing that the areas in question should be excluded on the basis of prior disturbance. This proposal was rejected by the World Heritage Committee in early 2014. This has not deterred the State Liberal government from progressing plans to roll back aspects of the TFA with the stated aim of reinvigorating the Tasmanian forest industry. The cornerstone of its policy is a new forestry bill, which is currently being debated in the Tasmanian parliament. It is understood that the bill provides for the removal of 400,000 ha of native forest from reserves set up under the TFA.

Clearly, until the parliamentary process is completed it would be premature to draw firm conclusions regarding the land tenure status of the TWWHA boundary amendment areas and their future management arrangements.

2014 Cave Access Policy

A comprehensive approach to cave management requires consideration of environmental effects arising from both cave-based activities and catchment-based activities. Cave-based activities can be defined as all

Karst area	Karst values	Potential management issues	Present land classification
Nelson Valley/ Bubs Hill	Cavernous limestone karst mostly within the Franklin-Gordon Wild Rivers NP (existing TWWHA), addition of the Princess River CA brings entire karst catchment into TWWHA.	Very accessible karst area traversed by Lyell Highway; catchment recovering from extensive historic disturbance	Princess River Conservation Area
Mole Creek	Iconic limestone cave systems on State forest (e.g. Lynds Cave, Croesus Cave, Tailender Cave, Shooting Star Cave) and existing PWS reserves (e.g. King Solomons Cave, Kubla Khan Cave, Baldocks Cave, Herberts Pot).	Land uses on adjacent properties; transport and communications infrastructure; legacy of historic catchment disturbance; popular recreational and guided caving venue; show cave business enterprise	Mole Creek Karst National Park Great Western Tiers Conservation Area Mersey River Conservation Area Conservation Area (un-named) Permanent Timber Production Zone Land
Florentine Valley/Mt Field	Extensive limestone karst systems; notable additions to TWWHA include: Coles Creek system (caves and enigmatic karstic lakes); Junee Cave system (includes many individually deep and long caves); forested karst systems of the upper Florentine Valley	Former limestone and other quarries; former logging coupes; roads and other infrastructure; popular recreational caving venue	Florentine River Regional Reserve Humboldt Ridge Regional Reserve Franklin-Gordon Wild Rivers National Park Lady Binney Regional Reserve Mt Field National Park Junee Cave State Reserve
Kallista Creek	Dolomite karst (formerly State forest)	Roads and gravel pits	Styx River Regional Reserve
Styx River	Dolomite karst (formerly State forest)	Roads and gravel pits	Styx River Regional Reserve
Mt Weld	Dolomite karst (mostly already TWWHA within Southwest NP); additions bring entire karst catchment into TWWHA	Walking tracks; roads and gravel pits	Southwest National Park
Eddy Creek	Unusual marbled dolomite karst	Dolomite quarry proposed within non-TWWHA enclave	Weld River Regional Reserve
Hustling Creek (Riveaux)	Cavernous limestone karst with caves of Aboriginal cultural significance	Former forestry roads; culturally sensitive sites	Southwest National Park
Lake Picton	Near-pristine limestone karst system (discovered 2010)	Forest operations on karst in adjacent State forest	Picton River Conservation Area
Cook Creek	Probable limestone karst system (discovered 2010)	Former forestry roads	Picton River Conservation Area
Picton River	Riverine outcrops of spectacularly fossiliferous Ordovician limestone	Protection of fossils	Picton River Conservation Area

Table 1: List of karst areas included in the 2013 TWWHA extension, with notes on potential management considerations. NP: National Park; CA: Conservation Area; FR: Forest Reserve

CAVE CLASS	SHOW CAVES	WILD CAVES	RESTRICTED ACCESS CAVES
Overview/ Description	Caves designated for commercial use with areas developed specifically for guided tours utilising formed pathways, artificial lighting and other infrastructure. These caves are available for general public access in the context of formal tours supervised by guides. Show caves may contain undeveloped areas zoned for purposes other than tourism.	Caves suitable for visitation by caving parties across a spectrum of skills and experience levels, in general where no formal restrictions apply to access. These caves generally contain minimal infrastructure to support public access. Selected Wild Caves are available for supervised 'wild caving' activities; others are considered suitable only for trips by experienced Australian Speleological Federation cavers or equivalent (See Appendix 4 for clarification of equivalent). These caves may include highly sensitive passages that are designated as Limited Access or Special Management Zones.	Caves where access is restricted. Caves may be declared as a Restricted Area within the meaning of the National Parks and Reserves Management Act 2002 or as having Limited Access under Regulation 17 of the National Parks and Reserved Land Regulations 2009. They include highly sensitive caves that include frequent and or outstanding sensitive component features. Access to these caves requires advanced caving skills to navigate through highly sensitive areas without causing unacceptable environmental impacts. Where open for recreational access, restricted access caves are available for trips by experienced cavers who are full members of Australian Speleological Federation or equivalent, subject to site-specific conditions to protect cave environments.

ACCESS ZONES	Show Cave Zone	General Access Zone	Experienced Leader Access Zone	Self-reliant Zone	Limited Access Zone	Special Management Zone
Statement of intent	To protect cave values and showcase outstanding underground scenery in a safe and controlled setting	To protect cave values and provide opportunities for introductory caving experiences in largely natural settings by parties who may lack prior caving experience	To protect cave values and provide opportunities for more extended caving experiences in largely natural settings by parties supervised by experienced cave leaders	To protect cave values and provide opportunities for caving experiences requiring an advanced level of technical caving competence by all participants	To protect cave values and provide opportunities for caving experiences requiring an advanced level of technical caving competence by all participants	To protect cave values at sites which are considered too sensitive for recreational caving activities
Relevant cave classes	Show Caves	Wild Caves	Wild Caves Show Cave	Wild Caves	Show Caves Wild Caves Restricted Access Caves	Show Caves Wild Caves Restricted Access Caves
Principal user group	General public - inexperienced cavers	For general public with limited or no caving experience	General public seeking a guided 'wild caving' experience supervised by Experienced Leaders.	Experienced cavers who are full members of Australian Speleological Federation or equivalent	Experienced cavers who are full members of Australian Speleological Federation or equivalent	Restricted access for management or scientific purposes only.
Permit/ Authority requirements	Yes (Entry Fee)	No. Bookings to access some caves may be required	Bookings to access some caves may be required	Full ASF membership or equivalent (no authority required)	Standard Restricted Access Cave Authority required. Bookings to access some caves may be required	Authority may be issued for scientific or management purposes only.

Table 2: Key elements of the Tasmanian Cave Access Zoning System (2014 Cave Access Policy).

activities involving people entering caves, including but not restricted to recreational caving, scientific research, commercial cave tours, search and rescue events, and so forth. These activities are distinct from catchment-based activities, which relate to land use in the broad sense and do not involve entry to caves. Both classes of activity entail potential to compromise the natural integrity of caves. However, in reserved areas, cave-based activities are typically the more immediate threat, because the level of disturbance from catchment-based activities is often constrained by the land tenure. This is not universally true but provides a useful generalisation for highlighting the critical role of access policy in managing caves on reserved land. This is especially pertinent in the TWWHA, where the catchment areas of the majority of caves are located inside the TWWHA and managed for conservation. Furthermore, although cave access policy is not itself a comprehensive basis for managing cave-based activities, it is the fundamental starting point without which all other initiatives are unlikely to be effective.

Historically, the Tasmanian Parks and Wildlife Service (PWS) has regulated access to relatively few wild caves. Most of those subject to access restrictions have been referred to as Limited Access Caves or Restricted Access Caves. Members of caving clubs affiliated with the Australian Speleological Federation (ASF) are allowed access to these caves, subject to certain conditions specified in a standard form of permit (Figure 1). While other members of the public are disallowed access to Restricted/Limited Access Caves, in theory they had open access to all other wild caves. In practice, cave-based activities by non-ASF cavers have devolved onto a relatively small pool of ‘unlimited access caves’.

The Restricted/Limited Access Caves system first came into effect in May 1983, when an initial pool of 12 caves was identified as needing management. Various forms of



Physical controls on cave access are a tool for promoting compliance with cave access policy, where this cannot be achieved by other measures. Unfortunately, cave gates do not always guarantee compliance. This stainless steel gate replaces a mild steel gate which was damaged during a break-in at Kubla Khan Cave, Mole Creek Karst National Park, in 2009.

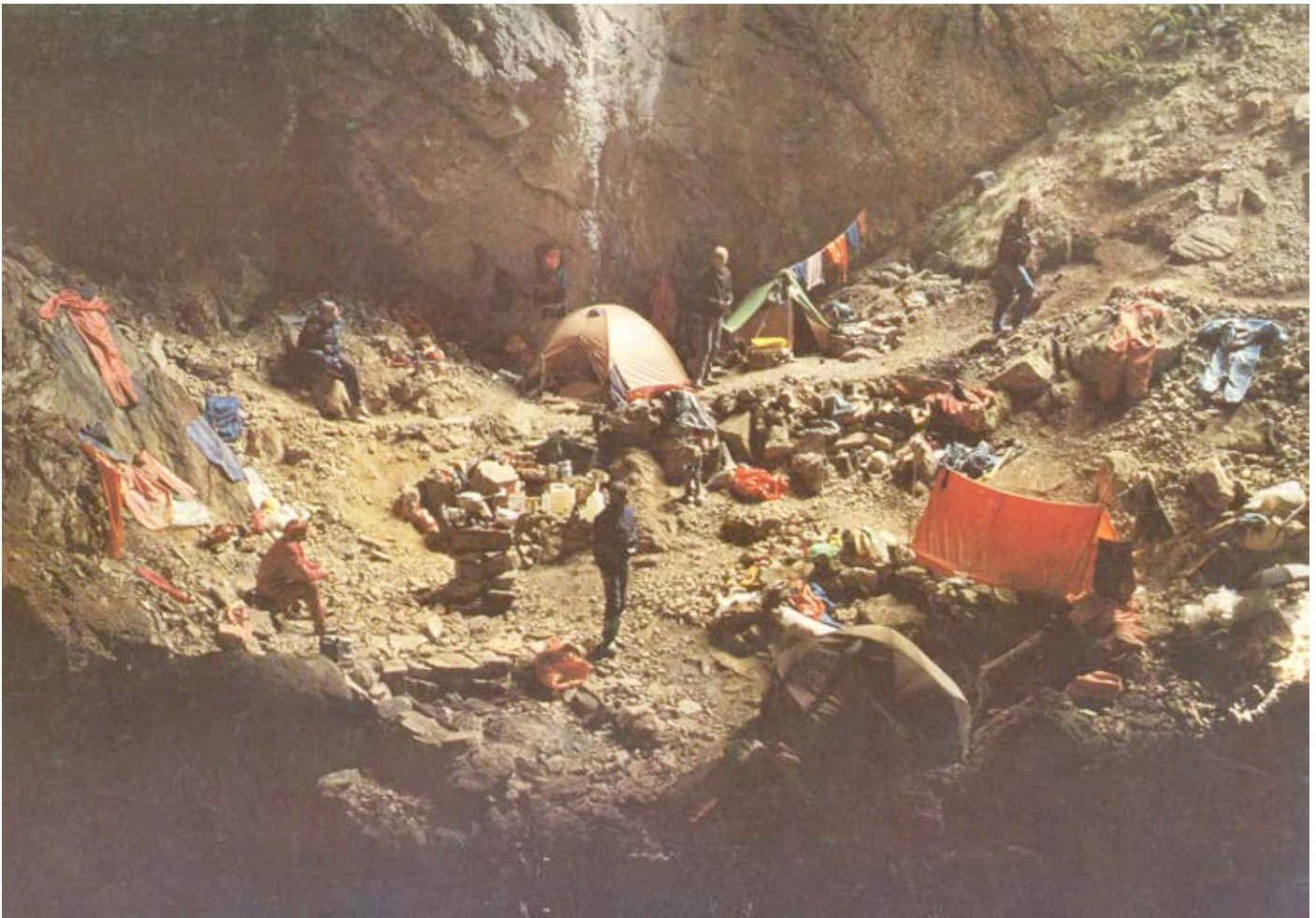
Photo: Rolan Eberhard

access restrictions have since been applied to an additional circa 12 caves. The approach is premised on an assumption that that ASF cavers are aware of and proficient in minimal impact caving practices, as embodied in the relevant ASF codes of practice. There are clear weaknesses in this approach. For example, it embodies no mechanism for assessing actual competence in minimal impact caving practices, allocating responsibility for this to caving clubs, which are almost certainly quite variable in the standards and procedures they adopt for inducting new members or



The Tasmanian Cave Access Policy proscribes use of carbide lighting; however, a number of caves contain a legacy of historic carbide use in the form of dumps of spent carbide. This example from Kubla Khan Cave, one of about 20 identified in this cave alone, was relatively easy to clean.

Photos: Rolan Eberhard



*Underground camping is a form of cave-based activity with potential for substantial impacts. This image shows the 1987 Czech Speleological Society expedition at Anne-A-Kananda. The expedition occupied the cave for 25 days.
Source: Tasler, R., 1989; Tasmania 87 Expedition Report, Czech Speleological Society, Prague.*

validating the responsible caving practices of existing members. This highlights the strongly self-regulatory basis of the approach. Alternative models involving more structured accreditation procedures may have merit but would require substantial changes to existing arrangements. The Tasmanian experience suggests that making access conditional on ASF membership has been instrumental in promoting conservation outcomes at all sites where it has been applied.

The need for a more sophisticated approach to managing access to wild caves has become increasingly obvious in recent years. First, the ASF caver/non-ASF caver dichotomy does not adequately describe the range of groups involved in cave-based activities or the relative scale of their impacts on the environment. Self-registration log books deployed at selected caves indicate that some of these are patronised by a diverse range of groups in numbers which are relatively large for Tasmanian caves. A few of these groups operate under the supervision of trained leaders and in accordance with documented procedures; others are less structured and quite informal. Catering for the diversity of groups

presently involved in cave-based activities is seen as consistent with community expectations and the 'presentation' objective of TWWHA management.

Second, and related to the above, evidence of substantial environmental impacts attributable to cave-based activities has emerged at a number of sites. Most of these sites are not classified as Limited Access Caves. In the majority of cases the impacts are due to the cumulative effect of numerous minor impacts accruing over time to produce more substantial impacts. Such impacts have progressed to an advanced stage in some cases. Evidence of substantial deliberate impacts, such as graffiti and vandalism of speleothems, is less common but not unknown. The caves in question are mostly not iconic sites, which in other circumstances, might be considered worthy of strongly restrictive access arrangements, as in the case of caves classified as Limited Access Caves. This suggested a need for an access policy incorporating options for promoting conservation objectives across a broader range of sites, including some of the most popular recreational caves in the State.

The 2014 Cave Access Policy was developed by a PWS working group advised by the Resource Management and Conservation Division (both are part of the Department of Primary Industries, Parks, Water and Environment). The form of the final 23 page document, which provides both contextual information and prescriptive content, incorporated the results of an external consultation process.

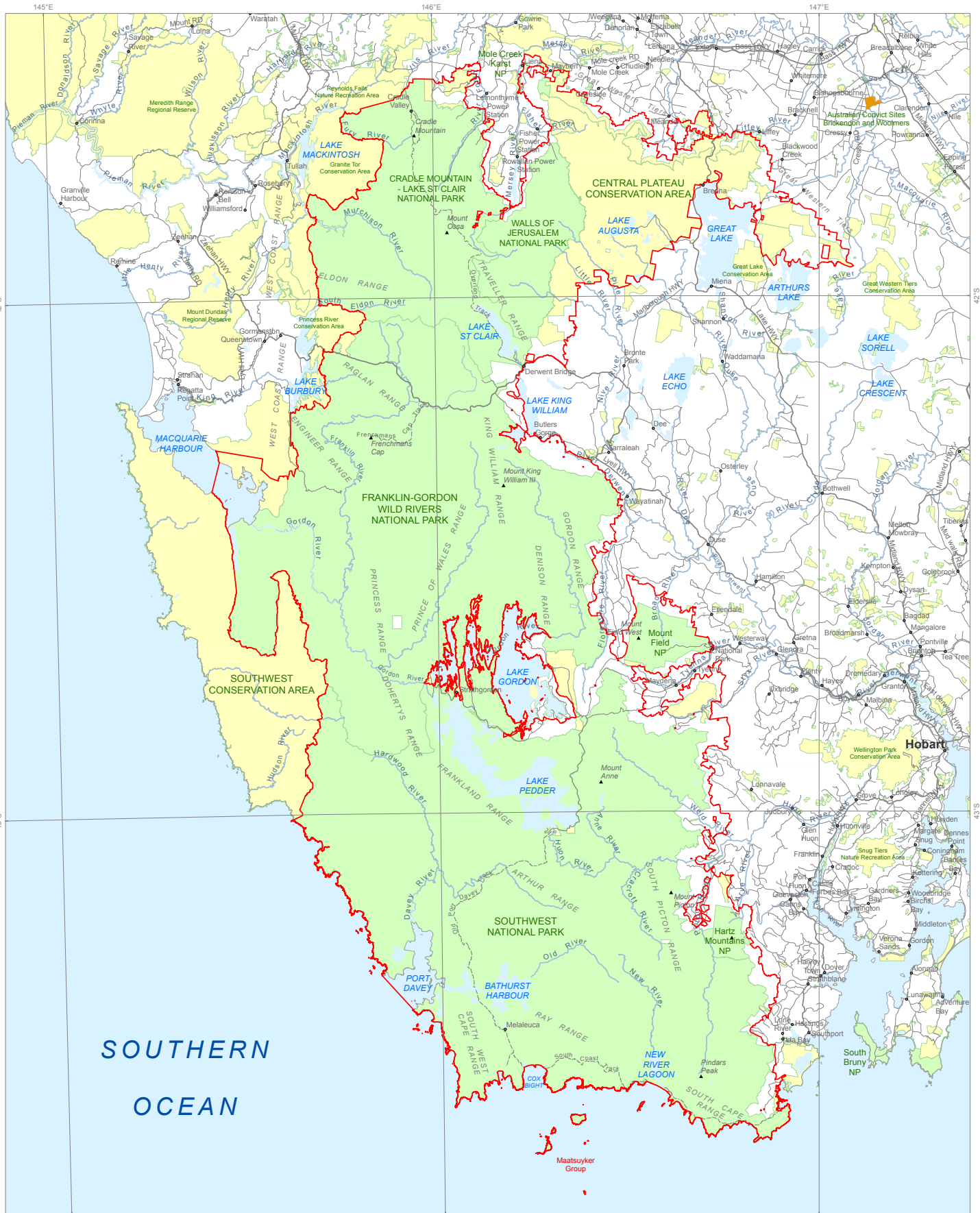
A key element of the Policy is the cave classification and zoning system. This component of the Policy is loosely based on an ASF cave classification model from the 1970s, cross-referenced to other elements of PWS management systems. The approach recognises three broad classes of cave – Show Caves, Wild Caves, Restricted Access Caves – these define the broad intent for managing whole caves (Table 2). Each class is further classified according to six access zones, some of which are applicable to certain cave classes. For example, a cave classified as a Show Cave may contain passage within any of the following access zones: Show Cave Zone, Experienced Leader Access Zone, Limited Access Zone, Special Management Zone. The zones provide a hierarchy of controls on access, ranging from open, facilitated access to more restrictive access regimes.

Appropriate user groups, entry protocol, maximum party sizes and daily limits and other protocol relevant to the respective zones are specified. ASF membership has been retained as a criterion for access to more sensitive zones; however, monopoly access for ASF members is avoided by establishing guidelines for assessing applications by non-ASF cavers.

It is anticipated that implementation of the Cave Access Policy will commence shortly. Potentially, this will involve regionally-based working groups tasked with identifying priority sites, collating relevant information and facilitating dialogue with interested parties. Application of the Policy is not confined to caves within the TWWHA. However, it has been strongly influenced by events within the TWWHA and recognition of a need for better tools to give effect to the ‘protection’ objective of World Heritage management, with particular reference to caves. The Policy can be downloaded from the PWS web site (www.parks.tas.gov.au).



*A spectacular image from Kubla Khan Cave. A portion of this image was used on the cover of ACKMA Journal No. 83
Photo: Ross Anderson*



Tasmanian Wilderness World Heritage Area

Inscribed on the World Heritage List in 1982, extended in 1989, 2010, 2012, 2013.
Total Area = 1,584,459 ha

- | | |
|---|--|
| Tasmanian Wilderness World Heritage Area | Road (major) |
| National Park | Road (minor) |
| Other Protected Area | Track |
| Other World Heritage Areas | Railway |
| | River |



Data Sources : © Commonwealth of Australia, World Heritage Areas.
Projection : Transverse Mercator
Datum : GDA 1994 MGA Zone 55
Date : July 2013

